



Yocto-Display-ePaper-C

User's guide

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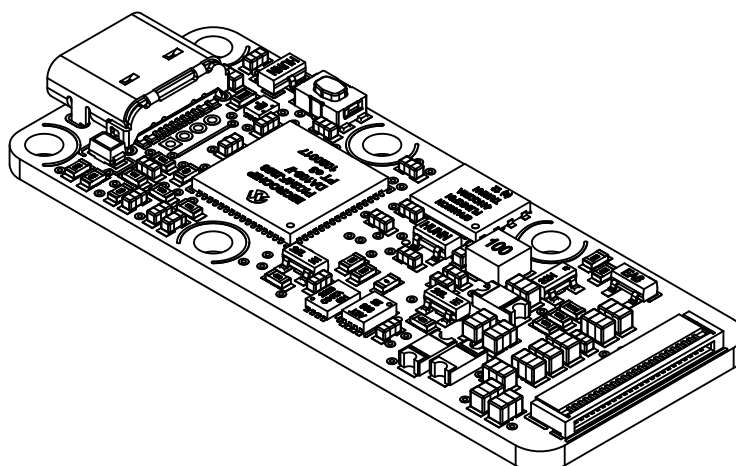
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1. Introduction

The Yocto-Display-ePaper-C is a 50x20mm electronic module which allows you to drive most ePaper displays of the *Pervasive Displays* brand with a maximum diagonal of five inches. This display allows you to easily present some information that is particularly easy to read on a machine that normally does not have a monitor and, most importantly, you can take advantage of the fact that an ePaper display retains its image even when the power is turned off.



The Yocto-Display-ePaper-C module

The Yocto-Display-ePaper-C is not in itself a complete product. It is a component intended to be integrated into a solution used in laboratory equipments, or in industrial process-control equipments, or for similar applications in domestic and commercial environments. In order to use it, you must at least install it in a protective enclosure and connect it to a host computer.

Yoctopuce thanks you for buying this Yocto-Display-ePaper-C and sincerely hopes that you will be satisfied with it. The Yoctopuce engineers have put a large amount of effort to ensure that your Yocto-Display-ePaper-C is easy to install anywhere and easy to drive from a maximum of programming languages. If you are nevertheless disappointed with this module, or if you need additional information, do not hesitate to contact Yoctopuce support:

E-mail address:	support@yoctopuce.com
Web site:	www.yoctopuce.com
Postal address:	Route de Cartigny 33
ZIP code, city:	1236 Cartigny

Country:

Switzerland

1.1. Safety Information

The Yocto-Display-ePaper-C is designed to meet the requirements of IEC 61010-1:2010 safety standard. It does not create any serious hazards to the operator and surrounding area, even in single fault condition, as long as it is integrated and used according to the instructions contained in this documentation, and in this section in particular.

Protective enclosure

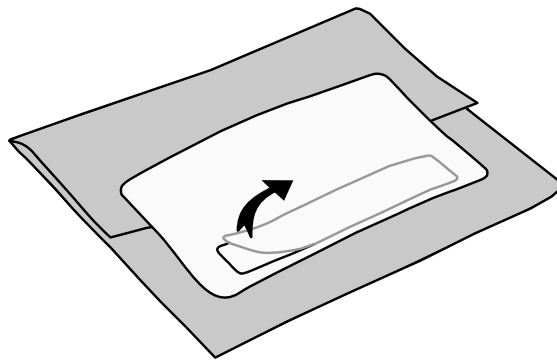
The Yocto-Display-ePaper-C should not be used without a protective enclosure, because of the accessible bare electronic components. For optimal safety, it should be put into a non-metallic, non-flammable enclosure, resistant to a mechanical stress level of 5 J. For instance, use a polycarbonate (e.g. LEXAN) enclosure rated IK08 with a IEC 60695-11-10 flammability rating of V-1 or better. Using a lower quality enclosure may require specific warnings for the operator and/or compromise conformity with the safety standard.

Maintenance

If a damage is observed on the electronic board or on the enclosure, it should be replaced in order to ensure continued safety of the equipment, and to prevent damaging other parts of the system due to overload that a short circuit could cause.

Identification

In order to ease the maintenance and the identification of risks during maintenance, you should stick the water-resistant identification label provided together with the electronic board as close as possible to the device. If the device is put in a dedicated enclosure, the identification label should be affixed on the outside of the enclosure. This label is resistant to humidity and to the usual rubbing that can occur during normal maintenance.



Identification label is integrated in the package label.

Application

The safety standard applied is intended to cover laboratory equipment, industrial process-control equipment, and similar applications in residential or commercial environment. If you intend to use the Yocto-Display-ePaper-C for another kind of application, you should check the safety regulations according to the standard applicable to your application.

In particular, the Yocto-Display-ePaper-C is *not* certified for use in medical environments or for life-support applications.

Environment

The Yocto-Display-ePaper-C is *not* certified for use in hazardous locations, explosive environments, or life-threatening applications. Environmental ratings are provided below.

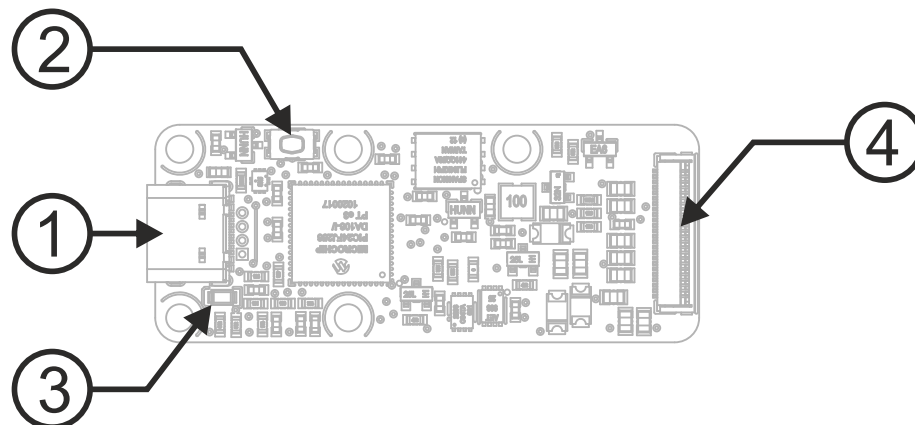
1.2. Environmental conditions

Yoctopuce devices have been designed for indoor use in a standard office or laboratory environment (IEC 60664 *pollution degree 2*): air pollution is expected to be limited and mainly non-conductive. Relative humidity is expected to be between 10% and 90% RH, non condensing. Use in environments with significant solid pollution or conductive pollution requires a protection from such pollution using an IP67 or IP68 enclosure. Yoctopuce's products are designed for use up to altitude 2000m.

All Yoctopuce devices are warranted to perform according to their documentation and technical specifications under normal temperature conditions according to IEC61010-1, i.e. 5°C to 40°C. In addition, most devices can also be used on an extended temperature range, where some limitations may apply from case to case.

The extended operating temperature range for the Yocto-Display-ePaper-C is -40..85°C. This temperature range has been determined based on components manufacturer recommendations, and on controlled environment tests performed during a limited duration (1h). If you plan to use the Yocto-Display-ePaper-C in harsh environments for a long period of time, we strongly advise you to run extensive tests before going to production.

2. Presentation



1: Type-C USB socket 3: Yocto-led
2: Yocto-button 4: ZIF connector

2.1. Common elements

All Yocto-modules share a number of common functionalities.

USB connector

The Yocto-Display-ePaper-C features an USB Type-C socket and uses USB 1.1 protocol which makes it compatible with any USB host port. Alternatively USB wires or a 1.27mm connector can be soldered on the footprint right behind the USB socket.

If, when you plug your Yocto-Display-ePaper-C into a USB-C cable, your module lights up but is not detected by your computer, check that the USB-C plug is fully inserted and that you're using a regular USB cable, not a charging cable with no data lines.

If you plan to use a power source other than a standard USB host port to power the device through the USB connector, that power source must respect the assigned values of USB 2.0 specifications:

- **Voltage min.:** 4.75 V DC
- **Voltage max.:** 5.25 V DC
- **Over-current protection:** 5.0 A max.

A higher voltage is likely to destroy the device. The behaviour with a lower voltage is not specified, but it can result firmware corruption.

Yocto-button

The Yocto-button has two functionalities. First, it can activate the Yocto-beacon mode (see below under Yocto-led). Second, if you plug in a Yocto-module while keeping this button pressed, you can then reprogram its firmware with a new version. Note that there is a simpler UI-based method to update the firmware, but this one works even in case of severely damaged firmware.

Yocto-led

Normally, the Yocto-led is used to indicate that the module is working smoothly. The Yocto-led then emits a low blue light which varies slowly, mimicking breathing. The Yocto-led stops breathing when the module is not communicating any more, as for instance when powered by a USB hub which is disconnected from any active computer.

When you press the Yocto-button, the Yocto-led switches to Yocto-beacon mode. It starts flashing faster with a stronger light, in order to facilitate the localization of a module when you have several identical ones. It is indeed possible to trigger off the Yocto-beacon by software, as it is possible to detect by software that a Yocto-beacon is on.

The Yocto-led has a third functionality, which is less pleasant: when the internal software which controls the module encounters a fatal error, the Yocto-led starts emitting an SOS in morse ¹. If this happens, unplug and re-plug the module. If it happens again, check that the module contains the latest version of the firmware, and, if it is the case, contact Yoctopuce support².

Current sensor

Each Yocto-module is able to measure its own current consumption on the USB bus. Current supply on a USB bus being quite critical, this functionality can be of great help. You can only view the current consumption of a module by software.

Serial number

Each Yocto-module has a unique serial number assigned to it at the factory. For Yocto-Display-ePaper-C modules, this number starts with EPAPER1C. The module can be software driven using this serial number. The serial number cannot be modified.

Logical name

The logical name is similar to the serial number: it is a supposedly unique character string which allows you to reference your module by software. However, in the opposite of the serial number, the logical name can be modified at will. The benefit is to enable you to build several copies of the same project without needing to modify the driving software. You only need to program the same logical name in each copy. Warning: the behavior of a project becomes unpredictable when it contains several modules with the same logical name and when the driving software tries to access one of these modules through its logical name. When leaving the factory, modules do not have an assigned logical name. It is yours to define.

2.2. Specific elements

The ZIF connector

You can use the ZIF (Zero Insertion Force) connector to connect the ribbon cable of your ePaper display. This ribbon cable, usually orange in color, must have 24 pins and have a width of 12.5mm. To open the ZIF connector, lift the tab from the back, as shown below.

2.3. Optional accessories

The accessories below are not necessary to use the Yocto-Display-ePaper-C module but might be useful depending on your project. These are mostly common products that you can buy from your

¹ short-short-short long-long-long short-short-short

² support@yoctopuce.com

favorite DIY store. To save you the tedious job of looking for them, most of them are also available on the Yoctopuce shop.

Screws and spacers

In order to mount the Yocto-Display-ePaper-C module, you can put small screws in the 2.6mm assembly holes, with a screw head no larger than 4.5mm. The best way is to use threaded spacers, which you can then mount wherever you want. You can find more details on this topic in the chapter about assembly and connections.

Micro-USB hub

If you intend to put several Yoctopuce modules in a very small space, you can connect them directly to a micro-USB hub. Yoctopuce builds a multi-TT USB hub particularly small for this purpose (down to 20mmx36mm), on which you can directly solder a USB cable instead of using a USB plug. For more details, see the micro-USB hub information sheet.

YoctoHub-Ethernet, YoctoHub-Wireless and YoctoHub-GSM

You can add network connectivity to your Yocto-Display-ePaper-C, thanks to the YoctoHub-Ethernet, the YoctoHub-Wireless and the YoctoHub-GSM which provides respectively Ethernet, WiFi and GSM connectivity. All of them can drive up to three devices and behave exactly like a regular computer running the VirtualHub application³.

1.27mm (or 1.25mm) connectors

In case you wish to connect your Yocto-Display-ePaper-C to a Micro-hub USB or a YoctoHub without using a bulky USB connector, you can use the four 1.27mm pads just behind the USB connector. There are two options.

You can mount the Yocto-Display-ePaper-C directly on the hub using screw and spacers, and connect it using 1.27mm board-to-board connectors. To prevent shortcuts, it is best to solder the female connector on the hub and the male connector on the Yocto-Display-ePaper-C.

You can also use a small 4-wires cable with a 1.27mm connector. 1.25mm works as well, it does not make a difference for 4 pins. This makes it possible to move the device a few inches away. Don't put it too far away if you use that type of cable, because as the cable is not shielded, it may cause undesirable electromagnetic emissions.

2.4. ePaper displays from Pervasive Displays

The Yocto-Display-ePaper-C module is designed to drive a display, but it does not include a display itself. You must therefore buy one separately. The Yocto-Display-ePaper-C is compatible with most displays of the *Pervasive Displays* brand with a diagonal up to five inches. You can find below the list of displays which have been formally tested, but it is possible that other models, especially older ones and those that are no longer listed by the manufacturer, might work as well.

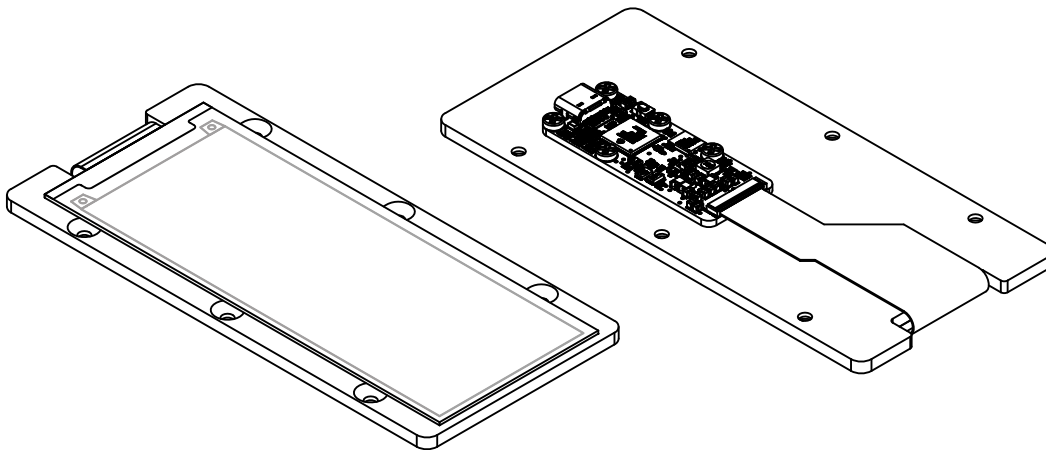
Display model	Size	Resolution	Colors
E2 152 KS 0J1	1"52	200x200	Black & White
E2 152 QS 061	1"52	200x200	Black, White, Red, Yellow
E2 152 QS H61	1"52	200x200	Black, White, Red, Yellow
E2 154 KS 0C2	1"54	152x152	Black & White
E2 154 CS 0C1	1"54	152x152	Black & White
E2 154 QS 0F1	1"54	152x152	Black, White, Red, Yellow
E2 206 KS 0E1	2"06	248x128	Black & White
E2 206 QS 061	2"06	248x128	Black, White, Red, Yellow
E2 213 PS 0E1	2"13	212x104	Black & White
E2 213 KS 0E1	2"13	212x104	Black & White

³ <http://www.yoctopuce.com/EN/virtualhub.php>

E2 266 JS 0C1	2"66	384x168	Black, White, Red
E2 266 KS 0C3	2"66	384x168	Black & White
E2 266 QS 0F1	2"66	296x152	Black, White, Red, Yellow
E2 266 QS 0F9	2"66	296x152	Black, White, Red, Yellow
E2 271 JS 0C1	2"71	264x176	Black, White, Red
E2 271 KS 0C1	2"71	264x176	Black & White
E2 287 PS 091	2"87	296x128	Black & White ⁴
E2 290 KS 0F1	2"90	384x168	Black & White
E2 290 QS 0F2	2"90	384x168	Black, White, Red, Yellow
E2 290 QS DF2	2"90	384x168	Black, White, Red, Yellow
E2 370 JS 0C1	3"70	416x240	Black, White, Red ⁵
E2 370 KS 0C1	3"70	416x240	Black & White
E2 417 KS 0D1	4"17	400x300	Black & White
E2 437 KS 0C1	4"37	480x176	Black & White

List of Pervasive Displays display models which were tested with the Yocto-Display-ePaper-C

The latest models of these displays are generally available from major electronics distributors, including Mouser and DigiKey. Yoctopuce also sells a few models that come with a plastic mounting plate to make installation easier.



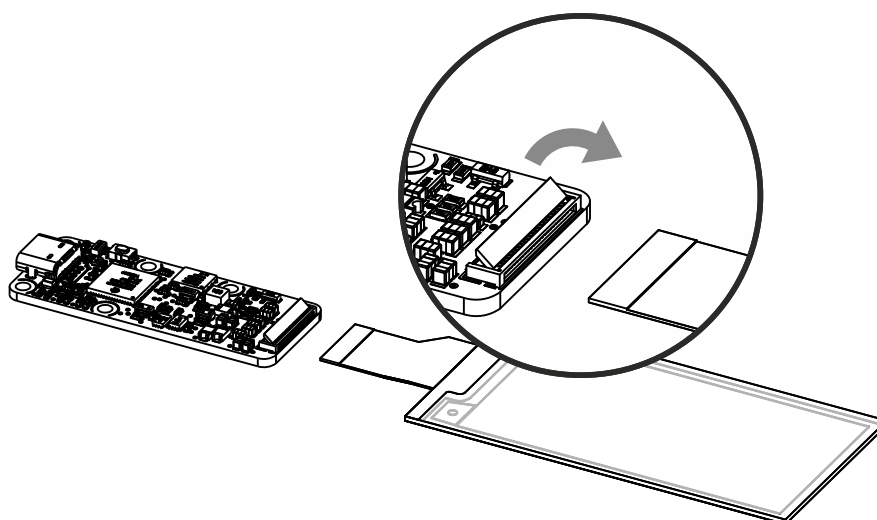
Yoctopuce sells a few models that come with a mounting plate

2.5. Connection

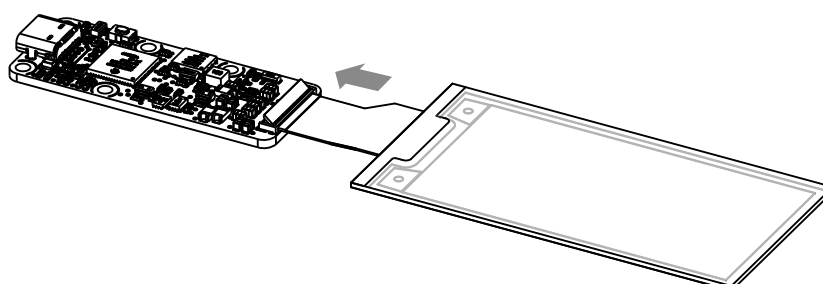
To connect a display to your Yocto-Display-ePaper-C module, check in the configuration of the *Display* function that the output of the module is disabled (OFF), and then proceed as follows:

⁴ Requires a cut in the ribbon cable

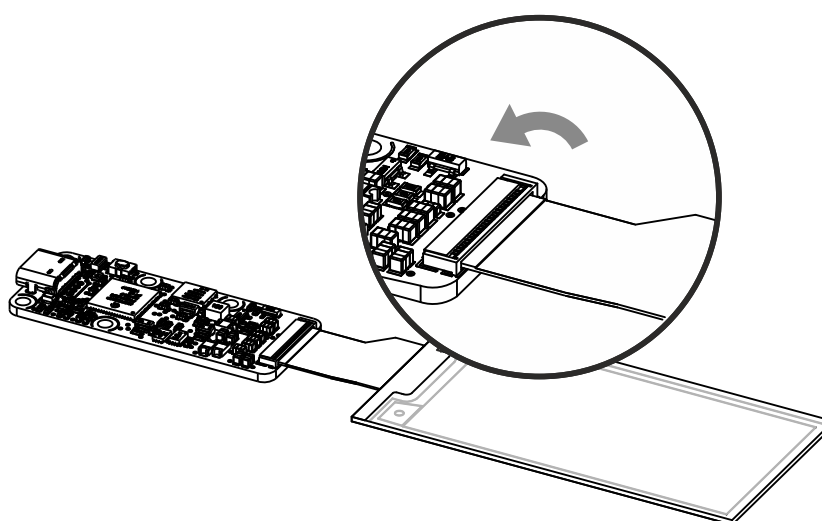
⁵ Define as E2370CS0C1 (Black & White mode)



1- Lift the latch located at the back of the ZIF connector



2- Insert the ribbon cable all the way into the connector, but without forcing it, with the contacts facing down



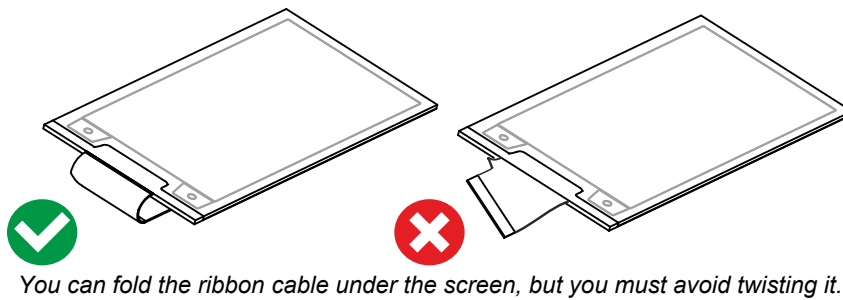
3- Close the latch

You must then configure the *Display* function in accord with the model of the connected display.

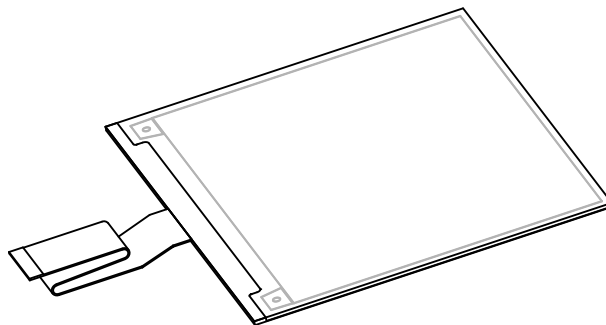
To disconnect the display from the module, follow these steps in reverse order.

Precautions

Caution: The connection between the ribbon cable and the display itself is relatively fragile. You can fold the ribbon cable under the screen, maintaining a minimum radius of 2 mm, but you must avoid twisting it.



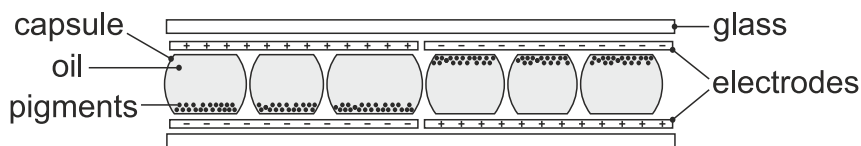
If the ribbon cable is too long for your intended installation, you can "shorten" it by folding it into fairly tight Z-folds, making sure that the folds stay away from the junction between the ribbon cable and the display.



On some models, the junction between the ribbon cable and the display creates a slight increase in thickness, which you need to take into account if you plan to press the screen against a transparent surface.

3. The ePaper technology

The *Pervasive Displays* displays compatible with the Yocto-Display-ePaper-C are electrophoretic displays. They consist of a multitude of microcapsules filled with oil and electrically charged pigments. These microcapsules are sandwiched between two arrays of electrodes.



Simplified diagram of the internal structure of an electrophoretic display

You can cause the pigments inside the microcapsules to migrate by applying a voltage to the electrodes located on either side of the microcapsules. This makes it possible to make pigments visible by bringing them to the surface of the screen or, conversely, to hide them by causing them to sink. By using pigments with different electric charges, it is possible to display multiple colors. When not subjected to an electric field, the pigments tend to remain in place.

You might think that each microcapsule corresponds to a pixel on the display, but it is not the case. The capsules are much smaller than a pixel. They are of variable sizes and are not organized in a regular manner

3.1. Advantages

ePaper displays have a number of advantages over classic displays.

Reflectivity

ePaper displays are reflective: rather than emitting light, they reflect ambient light, which makes them perfectly legible in broad daylight, just like a simple printed piece of paper, hence their name.

Power consumption

Compared to other display methods, ePaper technology is relatively energy-efficient. The Yocto-Display-ePaper-C module consumes approximately 25 mA when idle and approximately 30 mA while refreshing the screen.

Persistence

ePaper displays are bistable; they retain their image when not powered, so it is entirely possible to design systems that remain in sleep mode most of the time but wake up from time to time, perform a few calculations, refresh the display accordingly, and then go back to sleep. As a result, the system's average power consumption remains extremely low.

3.2. Limitations

Although ePaper technology offers significant advantages, it also has limitations that make it unsuitable for some applications.

Reflectivity

The fact that ePaper screens are purely reflective can also be seen as a drawback: they are not readable in the dark, and they cannot be backlit due to their design. However, it is possible to place a flat light guide in front of the screen (Light Guide Plate, aka LGP).

Refresh

Although significant progress has been made recently, ePaper screens are slow, or even very slow, to refresh compared to competing technologies. A standard refresh typically takes a few seconds, and even several tens of seconds for color screens. During this refresh, the image appears to flicker as it forms; this flickering can cause discomfort for some people. This behavior makes interactive applications difficult to implement.

Most recent black-and-white screens also offer a "fast" refresh option, on the order of one second, but this may reveal artifacts from the previous image. These artifacts, which are fairly minor, should not be a deal-breaker, but if you want a perfect image, make sure to perform a full refresh while the user is looking elsewhere.

Working temperature

Even though the Yocto-Display-ePaper-C operates within the -40..85°C temperature range, ePaper displays typically have a fairly narrow operating temperature range. Among *Pervasive Displays* products, the best specifications are offered by the KS family models (black and white), which can be used between -15° C (or even -20°C) and 60°C. However, fast refresh is limited to the 0-50°C range. The Spectra 4-type displays (black, white, red, and yellow) can only be used within the range of 0-40°C.

3.3. Compatible ePaper displays

Yoctopuce managed to make the Yocto-Display-ePaper-C compatible with a maximum of displays from the *Pervasive Displays* brand. However, certain restrictions apply:

- The supported display families are CS (Standard), JS (Spectra), KS (Wide Temperature + Fast Update), PS (Fast Update), and QS (Spectra 4). We recommend using the newer families (KS and QS).
- Due to memory constraints of the Yocto-Display-ePaper-C microprocessor, the maximum supported resolution is limited. For black-and-white displays, the total number of pixels divided by eight must be less than or equal to 16320. For color displays, the total number of pixels divided by four must be less than or equal to 16320.
- The power supplied by the Yocto-Display-ePaper-C is limited to displays with a diagonal of less than 5 inches, which is not really a limiting factor as larger screens have too many pixels anyway.

4. Working principles

4.1. Embedded processor and memory

Like all the Yoctopuce modules, your Yocto-Display-ePaper-C contains an embedded processor allowing it to perform relatively complex operations transparently. Thus, to draw a line, the host computer only needs to send a *draw a line* command to the Yocto-Display-ePaper-C. It does not have to do anything else, everything is managed by the Yocto-Display-ePaper-C processor. For this reason, the Yocto-Display-ePaper-C behaves a little like a graphic accelerator where the graphical tasks are performed by a dedicated processor, letting the main processor perform other tasks.

Your Yocto-Display-ePaper-C contains also a small file system to help you store some graphics, fonts, and other animations.

4.2. Orientation

To facilitate its hardware installation, your Yocto-Display-ePaper-C can work in four distinct orientations. You only need to set a single parameter. When you set the value of this parameter to *left*, *up*, *right*, or *down* to indicate the position of the ribbon cable with regards to the display panel, the screen rotates its content in order for it to appear in the correct orientation.

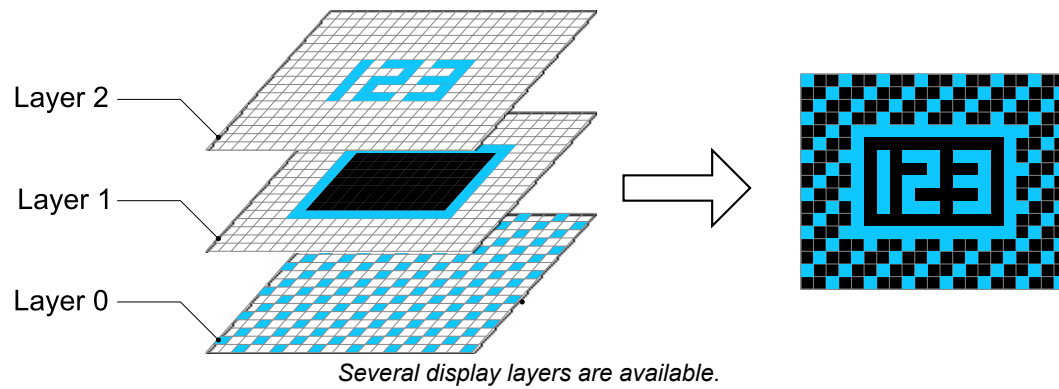


Parameter values LEFT, UP, RIGHT, and DOWN influence the orientation of the display.

This parameter is persistent and can be saved in the flash memory of the Yocto-Display-ePaper-C.

4.3. Layer system

Your Yocto-Display-ePaper-C works according to a principle of superposed and independent layers. You can write and draw independently in each of the layers. This allows you to simplify and optimize your display code.



You can hide or show any layer. You can even laterally move these layers, generating thus a scrolling effect. You can take advantage of this layer system to implement a *double buffering*¹ system.

Each layer has its own graphical context: cursor position, current font, current color, etc. This means that you must set these parameters for each layer with which you work. But this also means that several distinct processes can interact with your Yocto-Display-ePaper-C without risking conflict issues: they only need to write in different layers.

Primitives working directly on display layers include:

- clear
- hide
- unhide
- setLayerPosition
- reset
- swapLayerContent
- copyLayerContent

4.4. Graphic routines

Your Yocto-Display-ePaper-C contains basic graphic routines: lines, rectangles, circles, discs, text display, etc. All these routines support clipping: you can write on top of a layer border, the part located in the zone managed is taken into account, the outside part is ignored.

For more complex graphical operations, or simply if you feel more comfortable with it, you can also use your favorite graphic library running on the host driving the Yocto-Display-ePaper-C to build a bitmap in memory, then render it with a single command on the layer of your choice. The Yoctopuce API is fast enough to make this possible even to make real-time animations.

Basic graphic primitives are:

- moveTo
- lineTo
- drawPixel
- drawRect
- drawBar
- drawCircle
- drawDisc
- drawBitmap
- drawImage
- polygonStart, polygonAdd, polygonEnd

¹ http://en.wikipedia.org/wiki/Multiple_buffering

Colors

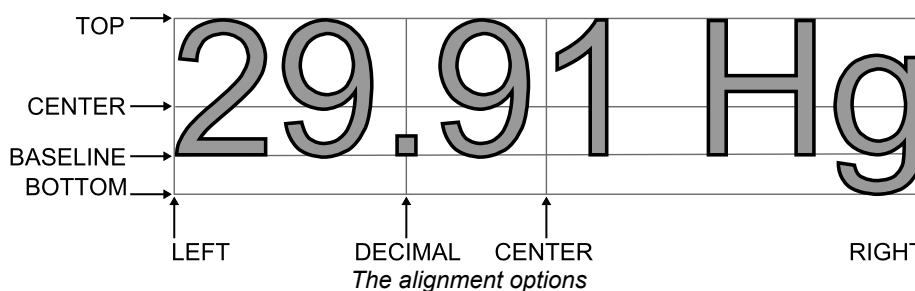
The Yocto-Display-ePaper-C screen is purely monochrome. You cannot, therefore, display grey levels, nor benefit from anti-aliasing. You can draw using three "colors": the screen display color (which we will call "white" in this documentation even if it might be light blue for example), black, or transparent (eraser). When you write using the transparent color, the layer below becomes visible. Note that layer 0 is not transparent. Writing in transparent color on this layer is equivalent to writing in black. This is important when you switch the content of two layers.

Primitives allowing you to change the color of a drawing are:

- `selectGrayPen`
- `selectEraser`
- `selectColorPen`
- `selectFillColor`
- `selectLineColor`

4.5. Text display

You can display any text at an arbitrary location of the screen. The Yocto-Display-ePaper-C contains some embedded fonts, but you can create your own relatively easily. It is not possible to know beforehand the size of a text, but to compensate this, numerous text alignment modes are available. You can align text left, right, and center, from the decimal point, the base line, etc.



Primitives allowing you to display text are:

- `selectFont`
- `drawText`

Fonts built-in into the device firmware are:

- `Small.yfm` (height: 8 pixels)
- `Medium.yfm` (height: 16 pixels)
- `Large.yfm` (height: 32 pixels)
- `8x8.yfm` (monospaced)

Console mode

There is another method to display text on your Yocto-Display-ePaper-C: the console mode. The console is a rectangular area of which you can parameterize the position. Texts displayed in this console are displayed like in a terminal, and line feeds are automatically generated. By default, the console size of each layer is initialized to the size of the screen.

Primitives allowing you to manage the console are:

- `clearConsole`
- `consoleOut`
- `setConsoleMargins`
- `setConsoleBackground`
- `setConsoleWordWrap`

Internationalization and regional characters

The text display functions can render international characters for languages that meet the following criteria:

- 8-bit character set
- left-to-right writing

For character sets requiring more than 8-bit (for instance chinese characters) and for right-to-left (RTL) languages, the only solution is to create a bitmap image on the computer using system built-in functions, and to display it using the `drawBitmap` primitive.

For all other languages, you should simply make sure that you use using the same locale (or *code page*) for the display font and for the text strings to draw. With this, you will be able to display all kind of accented characters and glyphs. Built-in fonts are provided according to the `iso-8859-1` locale (also known as `iso-latin-1` or `Windows-1252`), and support all languages from Western Europe. But you can easily generate equivalent fonts for the locale used by your computer using the small utility provided in the Delphi Library, under *Examples\Display-font-generator*.

In practice, for all languages with native Unicode support (e.g. 16-bit or UTF-8) like Python, C#, VB or Java, you can configure in the API the codepage to use to convert from unicode character strings to 8-bit format. The default value is `iso-8859-1`, corresponding to the built-in fonts.

For other languages like Delphi, C++ or PHP where the codepage is implicitly determined by the encoding of the source file, and where conversions are under the responsibility of the developer, you must simply take care to provide to the API a string that is compatible with the character set used in your display. The most common pitfall is to use an UTF-8 encoded string (because this is the most common format used by editors nowadays) and to forget to convert it into `iso-8859-*` before using it with `drawText` or `consoleOut`. If your display shows two strange letters instead of every accented character, this is the reason.

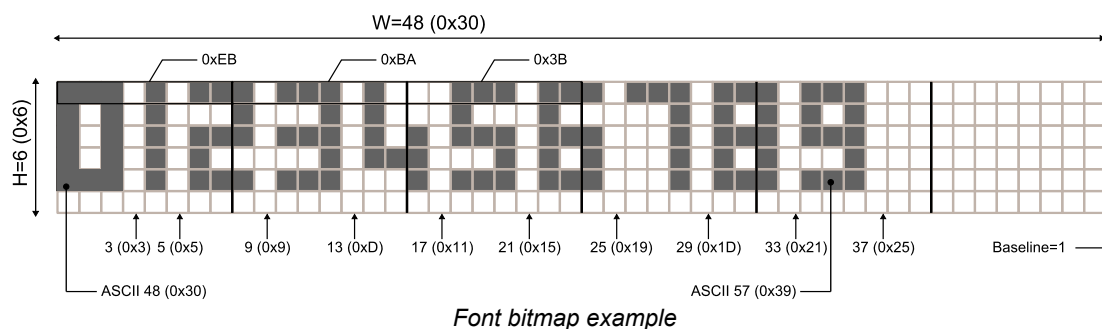
4.6. Font file format

Your Yocto-Display-ePaper-C contains a few embedded fonts, but it is designed so that you could create your own fonts as easily as possible. A font file for your Yocto-Display-ePaper-C is mostly a large bitmap where all the characters are drawn one after the other, in the order of the ASCII code of each character. Besides the bitmap, these files include a header with a some more information, as well as a list of the position of the last column of each character. The format is the following:

offset	type	Size (bytes)	signification
0x00	U16	2	Signature ("YF" 0x4659, little endian)
0x02	U8	1	Version = 1
0x03	U8	1	Bits per pixel =1
0x04	U16	2	<i>W</i> width of the bitmap, little endian, (must be a multiple of 16)
0x06	U8	1	<i>H</i> height of the bitmap
0x07	U8	1	Base line (starting from the bottom)
0x08	U8	1	First defined character
0x09	U8	1	Last defined character
0x0A	U16[]	2*N	Coordinates of the last column of each character (little endian)
0x0A +2*N	U8[]	<i>H</i> * <i>W</i> / 16	Bitmap data

Practical example

Let us imagine that we wish to define a lower case 3x5 pixel font for numbers 0 to 9. The bitmap would be the following:



The font file contains the following data:

Offset	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00000000	59	46	01	01	30	00	06	01	30	39	03	00	05	00	09	00
00000010	0D	00	11	00	15	00	19	00	1D	00	21	00	25	00	EB	BA
00000020	3B	BB	B8	00	A8	8A	22	0A	A8	00	AB	BA	BB	8B	B8	00
00000030	AA	0B	8A	8A	88	00	EB	B8	BB	8B	B8	00	00	00	00	00
00000040	00	00														

Note that the bitmap width must be a multiple of 16 pixels and that the height cannot be above 255 pixels. Moreover, blank spaces between two characters are encoded directly in the image. You do not have to leave a blank space below the characters if you do not intend to use your font in console mode.

You can find in the Delphi library a small Windows tool² enabling you to generate font files from the system fonts.

4.7. Sequences and animations

You can pre-program animations and play them as background tasks. To do so, you must call the *newSequence* method of the *Display* object, then call the available graphical methods. You can insert waiting times with *pauseSequence*. When you are done recording the sequence components, call *saveSequence*. The sequence is then saved in the Yocto-Display-ePaper-C file system. You can play it back at will with *playSequence*. You can create loops by calling *playSequence* within a sequence.

You can find in the libraries a code sample³ illustrating how sequences work. As soon as this example is run, the screen starts playing the sequence indefinitely.

Be aware that sequences change the values of the layer parameters (current point, current color, etc.) with which they work. If you use a sequence as an animation in background task, make sure to work with a different layer than the one used by your sequence.

Startup sequence

When your Yocto-Display-ePaper-C is powered on, it runs the *yocto.seq* sequence which is hard-coded inside the module. But you can configure your module so that it runs a sequence that you have chosen.

4.8. Optimizations

While the Yocto-Display-ePaper-C has its own processor and offers numerous graphical routines, it stays a relatively slow system compared to a classic display system. This slowness is the result of using the HID protocol so that the Yocto-Display-ePaper-C can be driven without drivers. The

² Examples\Display-font-generator

³ Prog-Display-Sequences

transfer rate between the screen and the computer is limited to 64Ko per second. Each request takes up about 3ms. However, there are techniques to optimize display.

Writing in hidden layers

Actions to be performed on visible layers are immediately sent to the screen in order to be executed as soon as possible. On the other hand, actions to be performed on hidden layers are buffered, in order to send several commands at once. It is therefore much more efficient to write in a hidden layer and to make it visible afterwards, which makes double buffering a very interesting technique.

Double buffering

The technique called *double buffering* enables you to display animations without making visible artifacts linked to the creation of the graphics. It consists in working on two layers, one visible, the other one hidden. The images are created in the hidden layer, and once the image is complete, the two layers are switched. In the libraries, you can find an example⁴ using this technique to animate a Von Koch flake.

Using a bitmap

When the graphics become complex, it becomes more efficient to compute a bitmap on the host computer and to send it to the screen. Use the *drawBitmap* to do this. Bitmap data are encoded in a byte array, line by line, starting from the top left corner. In each byte, the most significant bit represents the leftmost pixel. In the libraries, you can find an example⁵ computing a Mandelbrot set based on this principle.

Here is the C code allowing you to draw a pixel at the (x,y) coordinates in the byte array representing a *w x h* bitmap.

```
void putpixel(unsigned char *data, int x, int y)
{
    int bytesPerLine = (w + 7) >> 3;
    data[ (x >> 3) + (y * bytesPerLine) ] |= 128 >> (x & 7);
}
```

⁴ Prog-Display-DoubleBuffering

⁵ Prog-Display-DrawBitmap

5. The embedded file system

Your Yocto-Display-ePaper-C contains a small embedded file system, allowing it to store personalized files for its own use. You can manipulate the file system thanks to the *yocto_files* library.

5.1. Usage

Interactive usage with the VirtualHub

The *VirtualHub* provides a succinct interface to manipulate the content of the file system: simply click the *configuration* button corresponding to your module in the *VirtualHub* interface, then the *manage files* button. The files are listed and you can view them, erase them, or add new ones (downloads).

Because of its small size, the file system does not have an explicit concept of directories. You can nevertheless use the slash sign "/" inside file names to sort them as if they were in directories.

Programmed usage

Use the *yocto_files* library to manage the file system. Basic functions are available:

- *upload* creates a new file on the module, with a content that you provide;
- *get_list* lists the files on the module, including their content size and CRC32;
- *download* retrieves in a variable the content of a file present on the module;
- *remove* erases a file from the module;
- *format* resets the file system to an empty, not fragmented state.

A piece of software using a well designed file system should always start by making sure that all the files necessary for its working are available on the module, and if needed upload them on the module. We can thus transparently manage software updates and application deployment on new modules. To make file versions easier to detect, the *get_list* method returns for each file a 32 bit signature called CRC (Cyclic Redundancy Check) which identifies in a reliable manner the file content. Thus, if the file CRC corresponds, there is less than one chance over 4 billions that the content is not the correct one. You can even compute in advance in your software the CRC of the content you want, and therefore check it without having to download the files. The CRC function used by the Yoctopuce file system is the same as Ethernet, Gzip, PNG, etc. Its characteristic value for the nine character string "123456789" is 0xCBf43926.

HTTP usage

You can access the files that you have downloaded on your Yocto-Display-ePaper-C by HTTP, at the root of the module (at the same level as the REST API). This allows you to load personalized

HTML and Javascript interface pages, for example. You cannot, however, replace the content of a file preloaded on the module, you can only add new ones.

5.2. Limitations

The file system embedded on your Yocto-Display-ePaper-C has some technical limitations:

- Its maximal storage space is 3.5Mo, allocated in blocks enabling to store up to about 800 files.
- Erasing a file does not necessarily immediately free all the space used by the file. The non freed space is completely reused if you create a new file with the same name, but not necessarily if you create files with a distinct name each time. For this reason, it is not recommended to automatically create files with ever changing names.
- You can recover the whole non freed space with the *format* command which frees all the files.
- Each firmware update implicitly provokes a complete reformatting of the file system.
- As all flash memories, the memory used to store the files has a life of about 100'000 erasing cycles. It is enough, but it is not infinite. Make sure that you do not write and erase files uselessly and very quickly in a loop, or you may destroy your module.

6. First steps

By design, all Yoctopuce modules are driven the same way. Therefore, user's guides for all the modules of the range are very similar. If you have already carefully read through the user's guide of another Yoctopuce module, you can jump directly to the description of the module functions.

6.1. Prerequisites

In order to use your Yocto-Display-ePaper-C module, you should have the following items at hand.

A computer

Yoctopuce modules are intended to be driven by a computer (or possibly an embedded microprocessor). You will write the control software yourself, according to your needs, using the information provided in this manual.

Yoctopuce provides software libraries to drive its modules for the following operating systems: **Windows, Linux, macOS, and Android**. Yoctopuce modules do not require the installation of specific drivers, as they use the HID driver¹ standardly supplied in all operating systems.

The general rule regarding supported operating system versions is as follows: Yoctopuce development tools are supported for all versions covered by the operating system vendor's support, including the duration of extended support (*long term support* or LTS). Yoctopuce pays particular attention to long-term support, and whenever possible with reasonable effort, our tools are designed so that they can be used on older systems even several years after the end of the manufacturer's extended support.

Moreover, the programming libraries used to drive our modules being available in source code, you can generally recompile them to run on even older operating systems. To date, our programming library can still be compiled to run on operating systems released in 2008, such as Windows XP SP3 or Linux Debian Squeeze.

The architectures supported by Yoctopuce software libraries are as follows:

- Windows: Intel 64 bits and 32 bits
- Linux: Intel 64 bits and 32 bits, ARM 64 bits and 32 bits, including Raspberry Pi OS.
- macOS: Intel 64 bits and Apple Silicon (ARM)

Under Linux, communication with our USB modules requires the libusb library, version 1.0 or higher, which is available on all common distributions. Libraries and command-line tools should be easy to

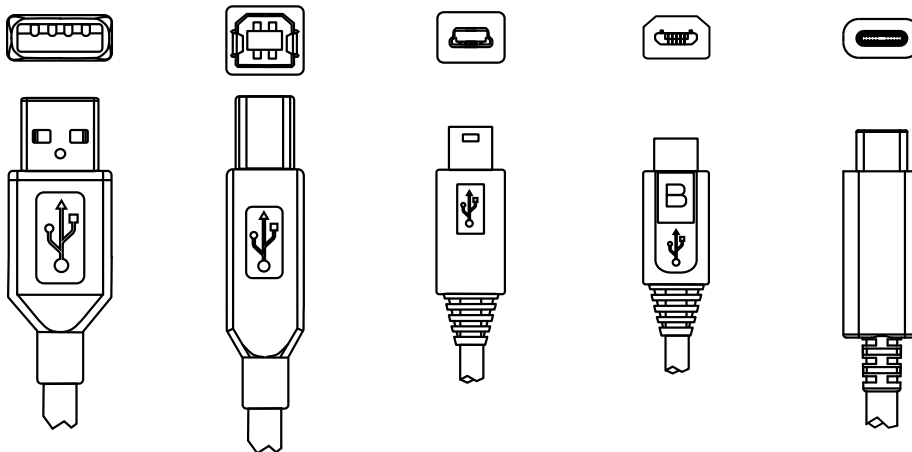
¹ The HID driver is manages peripheral devices such as mouse, keyboard, and so on.

recompile on any UNIX variant (Linux, FreeBSD, ...) from the last fifteen years for which libusb-1.0 is available and functional.

Under Android, the ability to connect a USB module depends on whether the tablet or phone supports the *USB Host mode*.

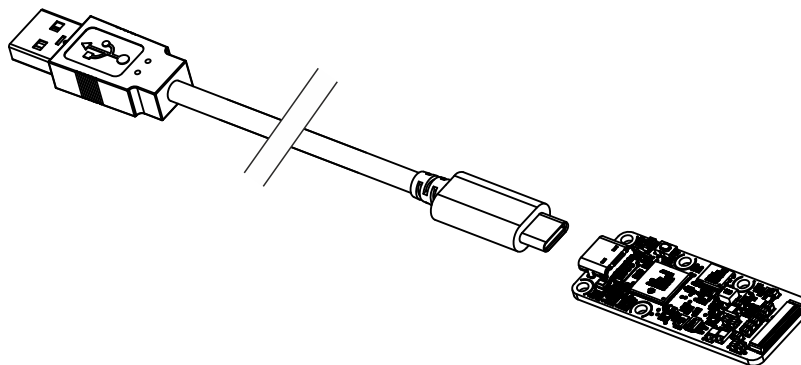
An USB cable, type A - USB-C

USB connectors come in several shapes. The "standard" size is the one you probably use to connect your printer. The "mini" size has more or less disappeared. The "micro" size was the smallest when the first Yoctopuce modules were designed. Over the last few years, USB-C connectors have appeared and are about to replace all other types. That is why, since 2024 Yoctopuce, is progressively migrating its product line to USB-C².



The most common USB 2.0 connectors: A, B, Mini B, Micro B and USB-C.

To connect your Yocto-Display-ePaper-C module to a computer, you need an USB cable of type A-USB-C or type C-USB-C. The price of this cable may vary a lot depending on the source, look for it under the name *USB A to USB-C Data cable*. Make sure not to buy a simple USB charging cable without data connectivity. The correct type of cable is available on the Yoctopuce shop.



You must plug in your Yocto-Display-ePaper-C module with a USB 2.0 cable of type A-USB-C

If you insert a USB hub between the computer and the Yocto-Display-ePaper-C module, make sure to take into account the USB current limits. If you do not, be prepared to face unstable behaviors and unpredictable failures. You can find more details on this topic in the chapter about assembly and connections.

6.2. Testing USB connectivity

At this point, your Yocto-Display-ePaper-C should be connected to your computer, which should have recognized it. It is time to make it work.

² www.yoctopuce.com/EN/article/would-you-like-usb-c-devices

Go to the Yoctopuce web site and download the *VirtualHub* software³. It is available for Windows, Linux, and macOS. Normally, VirtualHub serves as an abstraction layer for languages which cannot access the hardware layers of your computer. However, it also offers a succinct interface to configure your modules and to test their basic functions. You access this interface with a simple web browser⁴. Start VirtualHub in a command line, open your preferred web browser and enter the URL `http://127.0.0.1:4444`. The list of the Yoctopuce modules connected to your computer is displayed.

Serial	Logical Name	Description	Action
VIRTHUB2-3880db7f12		VirtualHub-V2	configure view log file
└ EPAPER1C-2F72C8		Yocto-Display-ePaper-C	configure view log file beacon

Module list as displayed in your web browser

6.3. Localization

You can then physically localize each of the displayed modules by clicking on the **beacon** button. This puts the Yocto-led of the corresponding module in Yocto-beacon mode. It starts flashing, which allows you to easily localize it. The second effect is to display a little blue circle on the screen. You obtain the same behavior when pressing the Yocto-button of the module.

6.4. Test of the module

The first item to check is that your module is working well: click on the serial number corresponding to your module. This displays a window summarizing the properties of your Yocto-Display-ePaper-C.

EPAPER1C-2F72C8



EPAPER1C-2F72C8 is a 66x58mm board featuring a 296 x 152 pixels ePaper display.

Module

Serial #

EPAPER1C-2F72C8

Product name:

Yocto-Display-ePaper-C

Logical name:

Firmware:

73714

Consumption:

26 mA

Beacon:

Inactive

[turn on](#)

Luminosity:

50%

Display

Current state:

OFF

Text to display:

no panel selected

Misc

Open API browser

Get user manual from yoctopuce.com

Close

Properties of the Yocto-Display-ePaper-C module

If the Yocto-Display-ePaper-C is in its factory default settings, the window displays a message indicating that the display type is not configured. To set the display type that you want to use with your Yocto-Display-ePaper-C, open the configuration window.

6.5. Configuration

When, in the module list, you click on the **configure** button corresponding to your module, the configuration window is displayed.

³ www.yoctopuce.com/EN/virtualhub.php

⁴ The interface is tested on Chrome, FireFox, Safari, Edge et IE 11.

Yocto-Display-ePaper-C module configuration

Firmware

The module firmware can easily be updated with the help of the interface. Firmware destined for Yoctopuce modules are available as .byn files and can be downloaded from the Yoctopuce web site.

To update a firmware, simply click on the **upgrade** button on the configuration window and follow the instructions. If the update fails for one reason or another, unplug and re-plug the module and start the update process again. This solves the issue in most cases. If the module was unplugged while it was being reprogrammed, it does probably not work anymore and is not listed in the interface. However, it is always possible to reprogram the module correctly by using VirtualHub⁵ in command line⁶.

Logical name of the module

The logical name is a name that you choose, which allows you to access your module, in the same way a file name allows you to access its content. A logical name has a maximum length of 19 characters. Authorized characters are A..Z, a..z, 0..9, _, and -. If you assign the same logical name to two modules connected to the same computer and you try to access one of them through this logical name, behavior is undetermined: you have no way of knowing which of the two modules answers.

Luminosity

This parameter allows you to act on the maximal intensity of the leds of the module. This enables you, if necessary, to make it a little more discreet, while limiting its power consumption. Note that this parameter acts on all the signposting leds of the module, including the Yocto-led. If you connect a module and no led turns on, it may mean that its luminosity was set to zero.

Logical names of functions

Each Yoctopuce module has a serial number and a logical name. In the same way, each function on each Yoctopuce module has a hardware name and a logical name, the latter can be freely chosen by the user. Using logical names for functions provides a greater flexibility when programming modules.

The functions provided by the Yocto-Display-ePaper-C module are *display*, which corresponds to the display; *temperature*, used internally to control the display; and *files*, which corresponds to the file system.

Configuring the ePaper display model

To select the type of ePaper display that you want to use, click on the "change" button to the right of the "ePaper panel model" field. This opens the display model selection window.

⁵ www.yoctopuce.com/EN/virtualhub.php

⁶ More information available in the VirtualHub documentation

Change ePaper panel

This device supports specific ePaper panels from Pervasive Displays. Not all combinations are supported, but if your panel is not listed, it is definitely not supported and should not be connected: there is a risk of hardware damage !

Select the ePaper panel model to be connected:

E2 (SE2, CE2) for Pervasive Displays

Size 4.37" (480x176)

Film K (Fast update: -15..60°C B/W)

Driver 0C

Revision

E2 ▾

437 ▾

KS ▾

0C ▾

▾

1

2

3

4

5

6

7

8

9

Change display panel, then apply mode

Panel status: OFF

Error message: no panel selected

Debug logs:

```
RCON:00C3
no panel selected
8KB FRAM
```

Apply and test

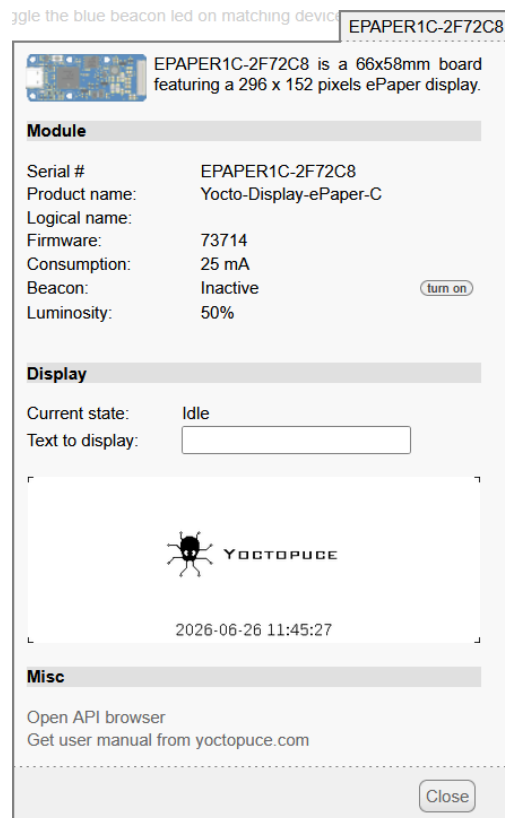
Close

Display model selection window

Select the settings that correspond to your display model; they are printed on a small label on the back of your display. Then click the "Apply and test" button, and after a few seconds, if the display is supported by the Yocto-Display-ePaper-C, a test pattern should appear.

If you then want to select a different display model, click the "turn off" button to change the settings again. As a general rule, make sure the display is turned off before connecting or disconnecting the display's ribbon cable.

Once the screen model has been properly configured, the interface is able to show the display's content.



Once the display has been configured, the interface can show the display's content.

Display orientation

The configuration interface allows you to specify which way you have installed the display, so that the display's coordinate system and the orientation of the characters are set accordingly. The selected orientation value corresponds to the side on which the display's ribbon cable is located:



Effect of the LEFT, UP, RIGHT, and DOWN parameters on the display orientation.

Fast refresh vs. full refresh

For displays that are physically capable of a fast refresh (lasting less than one second and without flickering), you can fine-tune the conditions under which it is used.

- By default, the system normally uses the fast refresh mode and periodically performs a full refresh to restore maximum contrast and prevent display artifacts.
- If the display is refreshed only infrequently or when the user is not present, you can force a full refresh every time, which ensures the best contrast.
- In the few cases where fast refresh rates are not officially supported by Pervasive Displays but still appear to work, you can explicitly instruct the Yocto-Display-ePaper-C to use them.

The ideal frequency for full refreshes depends on the application and the content being displayed. Pervasive Displays recommends a full refresh after 50 or 100 fast refreshes, or when there is a significant change in the displayed image. The Yocto-Display-ePaper-C allows you to set the interval more precisely, either based on the number of refreshes or on an absolute time interval (for example, once a day).

To perform a fast refresh, the display needs to know the content that was previously displayed. The Yocto-Display-ePaper-C can transmit this information even after a cold boot, thanks to an onboard 8KB FRAM memory in which it systematically stores the content of the last displayed image in a compressed format. In the event that the displays content does not fit into the FRAM memory, or if the module loses power before the image is fully saved to flash memory, or before the previous

refresh is complete, the next update is necessarily a full refresh. If this occurs when the module is powered on, you can find information about the specific cause in the modules logs.

Automatically inverting the display content

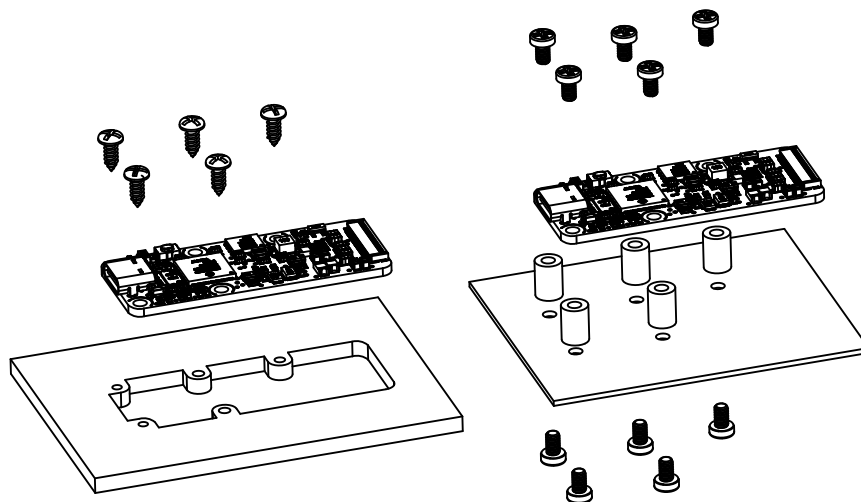
As an alternative to a full refresh, you can enable automatic inversion of the entire display content at a selected interval, such as every half hour. Periodic inversion has a regenerative effect on the e-Paper display similar to a full refresh.

7. Assembly and connections

This chapter provides important information regarding the use of the Yocto-Display-ePaper-C module in real-world situations. Make sure to read it carefully before going too far into your project if you want to avoid pitfalls.

7.1. Fixing

While developing your project, you can simply let the module hang at the end of its cable. Check only that it does not come in contact with any conducting material (such as your tools). When your project is almost at an end, you need to find a way for your modules to stop moving around.



Examples of assembly on supports

The Yocto-Display-ePaper-C module contains 2.5mm assembly holes. You can use these holes for screws. The screw head diameter must not be larger than 4.5mm or they will damage the module circuits. Make sure that the lower surface of the module is not in contact with the support. We recommend using spacers, but other methods are possible. Nothing prevents you from fixing the module with a glue gun; it will not be good-looking, but it will hold.

If you intend to screw your module directly against a conducting part, for example a metallic frame, insert an isolating layer in between. Otherwise you are bound to induce a short circuit: there are naked pads under your module. Simple insulating tape should be enough.

7.2. USB power distribution

Although USB means *Universal Serial BUS*, USB devices are not physically organized as a flat bus but as a tree, using point-to-point connections. This has consequences on power distribution: to make it simple, every USB port must supply power to all devices directly or indirectly connected to it. And USB puts some limits.

In theory, a USB port provides 100mA, and may provide up to 500mA if available and requested by the device. In the case of a hub without external power supply, 100mA are available for the hub itself, and the hub should distribute no more than 100mA to each of its ports. This is it, and this is not much. In particular, it means that in theory, it is not possible to connect USB devices through two cascaded hubs without external power supply. In order to cascade hubs, it is necessary to use self-powered USB hubs, that provide a full 500mA to each subport.

In practice, USB would not have been as successful if it was really so picky about power distribution. As it happens, most USB hub manufacturers have been doing savings by not implementing current limitation on ports: they simply connect the computer power supply to every port, and declare themselves as *self-powered hub* even when they are taking all their power from the USB bus (in order to prevent any power consumption check in the operating system). This looks a bit dirty, but given the fact that computer USB ports are usually well protected by a hardware current limitation around 2000mA, it actually works in every day life, and seldom makes hardware damage.

What you should remember: if you connect Yoctopuce modules through one, or more, USB hub without external power supply, you have no safe-guard and you depend entirely on your computer manufacturer attention to provide as much current as possible on the USB ports, and to detect overloads before they lead to problems or to hardware damages. When modules are not provided enough current, they may work erratically and create unpredictable bugs. If you want to prevent any risk, do not cascade hubs without external power supply, and do not connect peripherals requiring more than 100mA behind a bus-powered hub.

In order to help you controlling and planning overall power consumption for your project, all Yoctopuce modules include a built-in current sensor that indicates (with 5mA precision) the consumption of the module on the USB bus.

Note also that the USB cable itself may also cause power supply issues, in particular when the wires are too thin or when the cable is too long ¹. Good cables are usually made using AWG 26 or AWG 28 wires for data lines and AWG 24 wires for power.

7.3. Electromagnetic compatibility (EMI)

Connection methods to integrate the Yocto-Display-ePaper-C obviously have an impact on the system overall electromagnetic emissions, and therefore also impact the conformity with international standards.

When we perform reference measurements to validate the conformity of our products with IEC CISPR 11, we do not use any enclosure but connect the devices using a shielded USB cable, compliant with USB 2.0 specifications: the cable shield is connected to both connector shells, and the total resistance from shell to shell is under 0.6Ω. The USB cable length is 3m, in order to expose one meter horizontally, one meter vertically and keep the last meter close to the host computer within a ferrite bead.

If you use a non-shielded USB cable, or an improperly shielded cable, your system will work perfectly well but you may not remain in conformity with the emission standard. If you are building a system made of multiple devices connected using 1.27mm pitch connectors, or with a sensor moved away from the device CPU, you can generally recover the conformity by using a metallic enclosure acting as an external shield.

¹ www.yoctopuce.com/EN/article/usb-cables-size-matters

Still on the topic of electromagnetic compatibility, the maximum supported length of the USB cable is 3m. In addition to the voltage drop issue mentioned above, using longer wires would require to run extra tests to assert compatibility with the electromagnetic immunity standards.

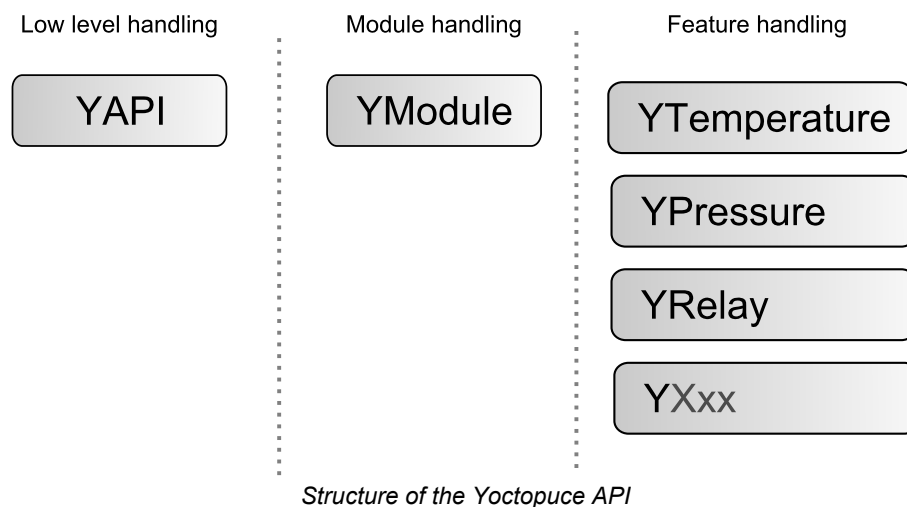
8. Programming, general concepts

The Yoctopuce API was designed to be at the same time simple to use and sufficiently generic for the concepts used to be valid for all the modules in the Yoctopuce range, and this in all the available programming languages. Therefore, when you have understood how to drive your Yocto-Display-ePaper-C with your favorite programming language, learning to use another module, even with a different language, will most likely take you only a minimum of time.

8.1. Programming paradigm

The Yoctopuce API is object oriented. However, for simplicity's sake, only the basics of object programming were used. Even if you are not familiar with object programming, it is unlikely that this will be a hinderance for using Yoctopuce products. Note that you will never need to allocate or deallocate an object linked to the Yoctopuce API: it is automatically managed.

There is one class per Yoctopuce function type. The name of these classes always starts with a Y followed by the name of the function, for example *YTemperature*, *YRelay*, *YPressure*, and so on. There is also a *YModule* class, dedicated to managing the modules themselves, and finally there is the static *YAPI* class, that supervises the global workings of the API and manages low level communications.



The YSensor class

Each Yoctopuce sensor function has its dedicated class: *YTemperature* to measure the temperature, *YVoltage* to measure a voltage, *YRelay* to drive a relay, etc. However there is a special class that can do more: *YSensor*.

The YSensor class is the parent class for all Yoctopuce sensors, and can provide access to any sensor, regardless of its type. It includes methods to access all common functions. This makes it easier to create applications that use many different sensors. Moreover, if you create an application based on YSensor, it will work with all Yoctopuce sensors, even those which do not yet exist.

Programmation

In the Yoctopuce API, priority was put on the ease of access to the module functions by offering the possibility to make abstractions of the modules implementing them. Therefore, it is quite possible to work with a set of functions without ever knowing exactly which module are hosting them at the hardware level. This tremendously simplifies programming projects with a large number of modules.

From the programming stand point, your Yocto-Display-ePaper-C is viewed as a module hosting a given number of functions. In the API, these functions are objects which can be found independently, in several ways.

Access to the functions of a module

Access by logical name

Each function can be assigned an arbitrary and persistent logical name: this logical name is stored in the flash memory of the module, even if this module is disconnected. An object corresponding to an Xxx function to which a logical name has been assigned can then be directly found with this logical name and the *YXxx.FindXxx* method. Note however that a logical name must be unique among all the connected modules.

Access by enumeration

You can enumerate all the functions of the same type on all the connected modules with the help of the classic enumeration functions *FirstXxx* and *nextXxxx* available for each *YXxx* class.

Access by hardware name

Each module function has a hardware name, assigned at the factory and which cannot be modified. The functions of a module can also be found directly with this hardware name and the *YXxx.FindXxx* function of the corresponding class.

Difference between *Find* and *First*

The *YXxx.FindXxxx* and *YXxx.FirstXxxx* methods do not work exactly the same way. If there is no available module, *YXxx.FirstXxxx* returns a null value. On the opposite, even if there is no corresponding module, *YXxx.FindXxxx* returns a valid object, which is not online but which could become so if the corresponding module is later connected.

Function handling

When the object corresponding to a function is found, its methods are available in a classic way. Note that most of these subfunctions require the module hosting the function to be connected in order to be handled. This is generally not guaranteed, as a USB module can be disconnected after the control software has started. The *isOnline* method, available in all the classes, is then very helpful.

Access to the modules

Even if it is perfectly possible to build a complete project while making a total abstraction of which function is hosted on which module, the modules themselves are also accessible from the API. In fact, they can be handled in a way quite similar to the functions. They are assigned a serial number at the factory which allows you to find the corresponding object with *YModule.Find()*. You can also assign arbitrary logical names to the modules to make finding them easier. Finally, the *YModule* class contains the *YModule.FirstModule()* and *nextModule()* enumeration methods allowing you to list the connected modules.

Functions/Module interaction

From the API standpoint, the modules and their functions are strongly uncorrelated by design. Nevertheless, the API provides the possibility to go from one to the other. Thus, the `get_module()` method, available for each function class, allows you to find the object corresponding to the module hosting this function. Inversely, the `YModule` class provides several methods allowing you to enumerate the functions available on a module.

8.2. Make your code Future-proof

If you are writing software that will be sold to customers who will not be able to recompile it, avoid locking your code to a Yoctopuce module name or identifier. It is entirely possible that one day, Yoctopuce will release a new version of the Yocto-Display-ePaper-C. As a matter of principle, Yoctopuce will ensure that this new module is fully compatible with previous versions, but if your code is locked to a specific model name, it won't work with the new versions.

The Python code below is a typical example of what not to do. It is based on a *Yocto-Temperature*, but the logic applies to all other Yoctopuce modules. This code enumerates the available modules to find the temperature sensor sitting on a *Yocto-Temperature*, but it would not work with a *Yocto-Temperature-V2* or a *Yocto-Temperature-C*.

```
# DON'T DO THIS
sensor : YTemperature = None
module : YModule = YModule.FirstModule()
while not (module is None):
    if module.get_productName()=="Yocto-Temperature":
        sensor = YTemperature.FindTemperature(module.get_serialNumber()+".temperature")
        module =module.nextModule()

if sensor is None : sys.exit("No Yocto-Temperature found")
if not sensor.isOnline() : sys.exit("Yocto-Temperature is offline")
print("Temperature = %2.1f %s"%(sensor.get_currentValue(),sensor.get_unit()))
```

The code below is an acceptable fix: it searches for a module whose name begins with *Yocto-Temperature*

```
# Acceptable fix
sensor : YTemperature = None
module : YModule = YModule.FirstModule()
while not (module is None):
    if module.get_productName().startswith("Yocto-Temperature"):
        sensor = YTemperature.FindTemperature(module.get_serialNumber()+".temperature")
        module =module.nextModule()

if sensor is None : sys.exit("No Yocto-Temperature found")
if not sensor.isOnline() : sys.exit("Yocto-Temperature is offline")
print("Temperature = %2.1f %s"%(sensor.get_currentValue(),sensor.get_unit()))
```

However, it is generally recommended to search directly for the function corresponding to the temperature sensor: the following code is compatible with any module that implements a temperature sensor, such as a *Yocto-PT100*. On the other hand, you won't know what will happen if there are multiple temperature sensors in your system.

```
# Better, but not 100% predictable
sensor : YTemperature = YTemperature.FirstTemperature()
if sensor is None : sys.exit("No Yocto-Temperature found")
if not sensor.isOnline() : sys.exit("Temperature sensor is offline")
print("Temperature = %2.1f %s"%(sensor.get_currentValue(),sensor.get_unit()))
```

That is why it is recommended that you first configure the module and assign a logical name to the function *temperature* that you need to interact with, for example *T_ambient*, then you can find it very easily.

```
# Much better: use logical name
sensor : YTemperature = YTemperature.FindTemperature("T_ambient")
```

```
if not sensor.isOnline() : sys.exit("Temperature sensor is offline")
print("Temperature = %2.1f %s"%(sensor.get_currentValue(),sensor.get_unit()))
```

8.3. The Yocto-Display-ePaper-C module

The Yocto-Display-ePaper-C is an ePaper display panel driver.

module : Module

attribute	type	modifiable ?
productName	String	read-only
serialNumber	String	read-only
logicalName	String	modifiable
productId	Hexadecimal number	read-only
productRelease	Hexadecimal number	read-only
firmwareRelease	String	read-only
persistentSettings	Enumerated	modifiable
luminosity	0..100%	modifiable
beacon	On/Off	modifiable
upTime	Time	read-only
usbCurrent	Used current (mA)	read-only
rebootCountdown	Integer	modifiable
userVar	Integer	modifiable

display : Display

attribute	type	modifiable ?
logicalName	String	modifiable
advertisedValue	String	modifiable
enabled	Boolean	modifiable
startupSeq	String	modifiable
brightness	0..100%	modifiable
autoInvertDelay	Integer	modifiable
orientation	Enumerated	modifiable
displayPanel	Serial parameters	modifiable
displayWidth	Integer	read-only
displayHeight	Integer	read-only
displayType	Enumerated	read-only
layerWidth	Integer	read-only
layerHeight	Integer	read-only
layerCount	Integer	read-only
command	String	modifiable

temperature : Temperature

attribute	type	modifiable ?
logicalName	String	modifiable
advertisedValue	String	modifiable
unit	String	modifiable
currentValue	Fixed-point number	read-only
lowestValue	Fixed-point number	modifiable
highestValue	Fixed-point number	modifiable
currentRawValue	Fixed-point number	read-only
logFrequency	Frequency	modifiable
reportFrequency	Frequency	modifiable
advMode	Enumerated	modifiable
calibrationParam	Calibration parameters	modifiable
resolution	Fixed-point number	modifiable

sensorState	Integer	read-only
sensorType	Enumerated	modifiable
signalValue	Fixed-point number	read-only
signalUnit	String	read-only
command	String	modifiable

files : Files

attribute	type	modifiable ?
logicalName	String	modifiable
advertisedValue	String	modifiable
filesCount	Integer	read-only
freeSpace	Integer	read-only

8.4. Module

Global parameters control interface for all Yoctopuce devices

The `YModule` class can be used with all Yoctopuce USB devices. It can be used to control the module global parameters, and to enumerate the functions provided by each module.

productName

Character string containing the commercial name of the module, as set by the factory.

serialNumber

Character string containing the serial number, unique and programmed at the factory. For a Yocto-Display-ePaper-C module, this serial number always starts with EPAPER1C. You can use the serial number to access a given module by software.

logicalName

Character string containing the logical name of the module, initially empty. This attribute can be modified at will by the user. Once initialized to a non-empty value, it can be used to access a given module. If two modules with the same logical name are in the same project, there is no way to determine which one answers when one tries accessing by logical name. The logical name is limited to 19 characters among A..Z, a..z, 0..9, _, and -.

productId

USB device identifier of the module, preprogrammed to 249 at the factory.

productRelease

Release number of the module hardware, preprogrammed at the factory. The original hardware release returns value 1, revision B returns value 2, and so on.

firmwareRelease

Release version of the embedded firmware, changes each time the embedded software is updated.

persistentSettings

State of persistent module settings: loaded from flash memory, modified by the user or saved to flash memory.

luminosity

Lighting strength of the informative leds (e.g. the Yocto-Led) contained in the module. It is an integer value which varies between 0 (LEDs turned off) and 100 (maximum led intensity). The default value is 50. To change the strength of the module LEDs, or to turn them off completely, you only need to change this value.

beacon

Activity of the localization beacon of the module.

upTime

Time elapsed since the last time the module was powered on.

usbCurrent

Current consumed by the module on the USB bus, in milli-amps.

rebootCountdown

Countdown to use for triggering a reboot of the module.

userVar

32bit integer variable available for user storage.

8.5. Display

display control interface, available for instance in the Yocto-Display, the Yocto-MaxiDisplay, the Yocto-MaxiDisplay-G or the Yocto-MiniDisplay

The `YDisplay` class allows to drive Yoctopuce displays. Yoctopuce display interface has been designed to easily show information and images. The device provides built-in multi-layer rendering. Layers can be drawn offline, individually, and freely moved on the display. It can also replay recorded sequences (animations). In order to draw on the screen, you should use the `display.get_displayLayer` method to retrieve the layer(s) on which you want to draw, and then use methods defined in `YDisplayLayer` to draw on the layers.

logicalName

Character string containing the logical name of the display, initially empty. This attribute can be modified at will by the user. Once initialized to a non-empty value, it can be used to access the display directly. If two displays with the same logical name are used in the same project, there is no way to determine which one answers when one tries accessing by logical name. The logical name is limited to 19 characters among `A..Z`, `a..z`, `0..9`, `_`, and `-`.

advertisedValue

Short character string summarizing the current state of the display, that is automatically advertised up to the parent hub. For a display, the advertised value is its power state (ON or OFF).

enabled

Power state of the display. The display can be enabled and disabled at will using this attribute.

startupSeq

Name of the sequence to play when the display is powered on.

brightness

Brightness of the display. It is an integer value which varies between 0 (very dark display) and 100 (very bright display).

autoInvertDelay

Interval between automatic display inversions, measured in seconds.

orientation

Display orientation. The orientation is defined as the side of the screen where the USB connector (for OLED displays) or the ribbon cable (for ePaper panels) is located when the display is up straight.

displayPanel

Exact model of the display panel.

displayWidth

Display width, in pixels.

displayHeight

Display height, in pixels.

displayType

Display type: OLED monochrome (MONO), ePaper black/white (EPAPER_BW), and so on.

layerWidth

Width of the layers to draw on, in pixels.

layerHeight

Height of the layers to draw on, in pixels.

layerCount

Available layers to draw on.

command

Magic attribute used to send content to the display. If a command is not interpreted as expected, check the device logs.

8.6. Temperature

temperature sensor control interface, available for instance in the Yocto-Meteo-V2, the Yocto-PT100, the Yocto-Temperature or the Yocto-Thermocouple

The `YTemperature` class allows you to read and configure Yoctopuce temperature sensors. It inherits from `YSensor` class the core functions to read measurements, to register callback functions, and to access the autonomous datalogger. This class adds the ability to configure some specific parameters for some sensors (connection type, temperature mapping table).

logicalName

Character string containing the logical name of the temperature sensor, initially empty. This attribute can be modified at will by the user. Once initialized to a non-empty value, it can be used to access the temperature sensor directly. If two temperature sensors with the same logical name are used in the same project, there is no way to determine which one answers when one tries accessing by logical name. The logical name is limited to 19 characters among `A..Z`, `a..z`, `0..9`, `_`, and `-`.

advertisedValue

Short character string summarizing the current state of the temperature sensor, that is automatically advertised up to the parent hub. For a temperature sensor, the advertised value is the current value of the temperature.

unit

Short character string representing the measuring unit for the temperature.

currentValue

Current value of the temperature, in Celsius, as a floating point number.

lowestValue

Minimal value of the temperature, in Celsius, as a floating point number.

highestValue

Maximal value of the temperature, in Celsius, as a floating point number.

currentRawValue

Uncalibrated, unrounded raw value returned by the sensor, as a floating point number.

logFrequency

Datalogger recording frequency, or "OFF" when measures should not be stored in the data logger flash memory.

reportFrequency

Timed value notification frequency, or "OFF" when timed value notifications are disabled for this function.

advMode

Measuring mode for the advertised value pushed to the parent hub.

calibrationParam

Extra calibration parameters (for instance to compensate for the effects of an enclosure), as an array of 16 bit words.

resolution

Measure resolution (i.e. precision of the numeric representation, not necessarily of the measure itself).

sensorState

Sensor state (zero when a current measure is available).

sensorType

Thermal sensor type used in the device, this can be a digital sensor, a specific type for a thermocouple, a PT100, a thermistor or a IR sensor

signalValue

Current value of the electrical signal measured by the sensor (except for digital sensors) as a floating point number.

signalUnit

Short character string representing the measuring unit of the electrical signal used by the sensor.

command

Magic attribute used to set up physical sensor parameters.

8.7. Files

filesystem control interface, available for instance in the Yocto-Color-V2, the Yocto-SPI, the YoctoHub-Ethernet or the YoctoHub-GSM-4G

The YFiles class is used to access the filesystem embedded on some Yoctopuce devices. This filesystem makes it possible for instance to design a custom web UI (for networked devices) or to add fonts (on display devices).

logicalName

Character string containing the logical name of the filesystem, initially empty. This attribute can be modified at will by the user. Once initialized to a non-empty value, it can be used to access the filesystem directly. If two filesystems with the same logical name are used in the same project, there is no way to determine which one answers when one tries accessing by logical name. The logical name is limited to 19 characters among A..Z, a..z, 0..9, _, and -.

advertisedValue

Short character string summarizing the current state of the filesystem, that is automatically advertised up to the parent hub. For a filesystem, the advertised value is the number of files loaded in the filesystem.

filesCount

Number of files currently loaded in the filesystem.

freeSpace

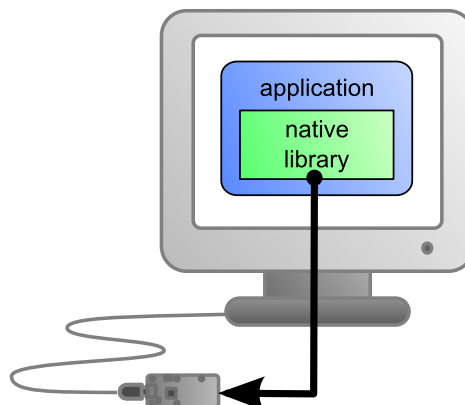
Free space for uploading new files to the filesystem, in bytes.

8.8. What interface: Native, DLL or Service ?

There are several methods to control your Yoctopuce module by software.

Native control

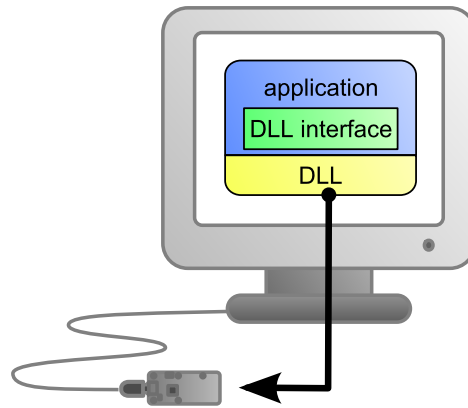
In this case, the software driving your project is compiled directly with a library which provides control of the modules. Objectively, it is the simplest and most elegant solution for the end user. The end user then only needs to plug the USB cable and run your software for everything to work. Unfortunately, this method is not always available or even possible.



The application uses the native library to control the locally connected module

Native control by DLL

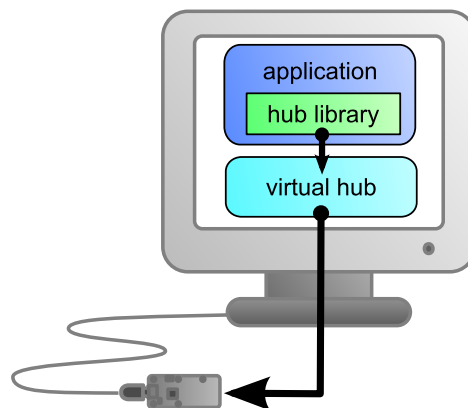
Here, the main part of the code controlling the modules is located in a DLL. The software is compiled with a small library which provides control of the DLL. It is the fastest method to code module support in a given language. Indeed, the "useful" part of the control code is located in the DLL which is the same for all languages: the effort to support a new language is limited to coding the small library which controls the DLL. From the end user stand point, there are few differences: one must simply make sure that the DLL is installed on the end user's computer at the same time as the main software.



The application uses the DLL to natively control the locally connected module

Control by service

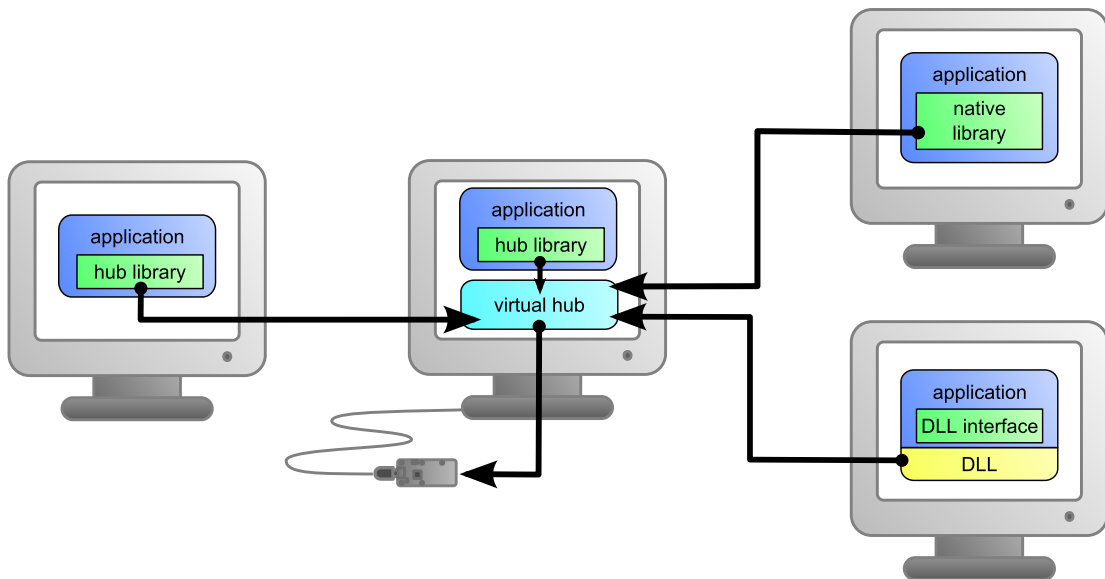
Some languages do simply not allow you to easily gain access to the hardware layers of the machine. It is the case for Javascript, for instance. To deal with this case, Yoctopuce provides a solution in the form of a small piece of software called *VirtualHub*¹. It can access the modules, and your application only needs to use a library which offers all necessary functions to control the modules via this VirtualHub. The end users will have to start VirtualHub before running the project control software itself, unless they decide to install the hub as a service/daemon, in which case VirtualHub starts automatically when the machine starts up.



The application connects itself to VirtualHub to gain access to the module

The service control method comes with a non-negligible advantage: the application does not need to run on the machine on which the modules are connected. The application can very well be located on another machine which connects itself to the service to drive the modules. Moreover, the native libraries and DLL mentioned above are also able to connect themselves remotely to one or several machines running VirtualHub.

¹ www.yoctopuce.com/EN/virtualhub.php



When VirtualHub is used, the control application does not need to reside on the same machine as the module.

Whatever the selected programming language and the control paradigm used, programming itself stays strictly identical. From one language to another, functions bear exactly the same name, and have the same parameters. The only differences are linked to the constraints of the languages themselves.

Language	Native	Native with DLL	VirtualHub
Command line	✓	-	✓
Python	-	✓	✓
C++	✓	✓	✓
C# .Net	-	✓	✓
C# UWP	✓	-	✓
LabVIEW	-	✓	✓
Java	-	✓	✓
Java for Android	✓	-	✓
TypeScript	-	-	✓
JavaScript / ECMAScript	-	-	✓
PHP	-	-	✓
VisualBasic .Net	-	✓	✓
Delphi	-	✓	✓
Objective-C	✓	-	✓

Support methods for different languages

8.9. Accessing modules through a hub

VirtualHub to work around USB access limitation

Only one application at a given time can have native access to Yoctopuce devices. This limitation is related to the fact that two different processes cannot talk to a USB device at the same time. Usually, this kind of problem is solved by a driver that takes care of the police work to prevent multiple processes fighting over the same device. But Yoctopuce products do not use drivers. Therefore, the first process that manages to access the native mode keeps it for itself until `UnregisterHub` or `FreeApi` is called.

If your application tries to communicate in native mode with Yoctopuce devices, but that another application prevents you from accessing them, you receive the following error message:

```
Another process is already using yAPI
```

The solution is to use VirtualHub locally on your machine and to use it as a gateway for your applications. In this way, if all your applications use VirtualHub, you do not have conflicts anymore and you can access all your devices all the time.

With a YoctoHub

A YoctoHub behaves itself exactly like a computer running VirtualHub. The only difference between a program using the Yoctopuce API with modules in native USB and the same program with Yoctopuce modules connected to a YoctoHub is located at the level of the `RegisterHub` function call. To use USB modules connected natively, the `RegisterHub` parameter is `usb`. To use modules connected to a YoctoHub, you must simply replace this parameter by the IP address of the YoctoHub.

So there are three possible modes: native mode, network mode via VirtualHub on your local machine, or via a YoctoHub. To switch from native to network mode on your local machine, you only need to change the parameter when calling `YAPI.RegisterHub`, as shown in the examples below:

```
YAPI.RegisterHub("usb",errmsg); // native USB mode

YAPI.RegisterHub("127.0.0.1",errmsg); // local network mode with VirtualHub

YAPI.RegisterHub("192.168.0.10",errmsg); // YoctoHub mode, with 192.168.0.10 as YoctoHub IP address
```

8.10. Programming, where to start?

At this point of the user's guide, you should know the main theoretical points of your Yocto-Display-ePaper-C. It is now time to practice. You must download the Yoctopuce library for your favorite programming language from the Yoctopuce web site². Then skip directly to the chapter corresponding to the chosen programming language.

All the examples described in this guide are available in the programming libraries. For some languages, the libraries also include some complete graphical applications, with their source code.

When you have mastered the basic programming of your module, you can turn to the chapter on advanced programming that describes some techniques that will help you make the most of your Yocto-Display-ePaper-C.

² <http://www.yoctopuce.com/EN/libraries.php>

9. Using the Yocto-Display-ePaper-C in command line

When you want to perform a punctual operation on your Yocto-Display-ePaper-C, such as reading a value, assigning a logical name, and so on, you can obviously use VirtualHub, but there is a simpler, faster, and more efficient method: the command line API.

The command line API is a set of executables, one by type of functionality offered by the range of Yoctopuce products. These executables are provided pre-compiled for all the Yoctopuce officially supported platforms/OS. Naturally, the executable sources are also provided¹.

9.1. Installing

Download the command line API². You do not need to run any setup, simply copy the executables corresponding to your platform/OS in a directory of your choice. You may add this directory to your PATH variable to be able to access these executables from anywhere. You are all set, you only need to connect your Yocto-Display-ePaper-C, open a shell, and start working by typing for example:

```
C:\>YDisplay any -layer 0 drawText 64 16 CENTER "Hello world!"
```

To use the command line API on Linux, you need either have root privileges or to define an *udev* rule for your system. See the *Troubleshooting* chapter for more details.

9.2. Use: general description

All the command line API executables work on the same principle. They must be called the following way

```
C:\>Executable [options] [target] command [parameter]
```

[options] manage the global workings of the commands, they allow you, for instance, to pilot a module remotely through the network, or to force the module to save its configuration after executing the command.

[target] is the name of the module or of the function to which the command applies. Some very generic commands do not need a target. You can also use the aliases "any" and "all", or a list of names separated by comas without space.

¹ If you want to recompile the command line API, you also need the C++ API.

² <http://www.yoctopuce.com/EN/libraries.php>

`command` is the command you want to run. Almost all the functions available in the classic programming APIs are available as commands. You need to respect neither the case nor the underlined characters in the command name.

[parameters] are logically the parameters needed by the command.

At any time, the command line API executables can provide a rather detailed help. Use for instance:

```
C:\>executable /help
```

to know the list of available commands for a given command line API executable, or even:

```
C:\>executable command /help
```

to obtain a detailed description of the parameters of a command.

9.3. Control of the Display function

To control the Display function of your Yocto-Display-ePaper-C, you need the `YDisplay` executable file.

For instance, you can launch:

```
C:\>YDisplay any -layer 0 drawText 64 16 CENTER "Hello world!"
```

This example uses the *"any"* target to indicate that we want to work on the first Display function found among all those available on the connected Yoctopuce modules when running. This prevents you from having to know the exact names of your function and of your module.

But you can use logical names as well, as long as you have configured them beforehand. Let us imagine a Yocto-Display-ePaper-C module with the *EPAPER1C-123456* serial number which you have called *"MyModule"*, and its display function which you have renamed *"MyFunction"*. The five following calls are strictly equivalent (as long as *MyFunction* is defined only once, to avoid any ambiguity).

```
C:\>YDisplay EPAPER1C-123456.display describe
C:\>YDisplay EPAPER1C-123456.MyFunction describe
C:\>YDisplay MyModule.display describe
C:\>YDisplay MyModule.MyFunction describe
C:\>YDisplay MyFunction describe
```

To work on all the Display functions at the same time, use the *"all"* target.

```
C:\>YDisplay all describe
```

For more details on the possibilities of the `YDisplay` executable, use:

```
C:\>YDisplay /help
```

9.4. Control of the module part

Each module can be controlled in a similar way with the help of the `YModule` executable. For example, to obtain the list of all the connected modules, use:

```
C:\>YModule inventory
```

You can also use the following command to obtain an even more detailed list of the connected modules:

```
C:\>YModule all describe
```

Each `xxx` property of the module can be obtained thanks to a command of the `get_xxxx()` type, and the properties which are not read only can be modified with the `set_xxx()` command. For example:

```
C:\>YModule EPAPER1C-12346 set_logicalName MonPremierModule
C:\>YModule EPAPER1C-12346 get_logicalName
```

Changing the settings of the module

When you want to change the settings of a module, simply use the corresponding `set_xxx` command. However, this change happens only in the module RAM: if the module restarts, the changes are lost. To store them permanently, you must tell the module to save its current configuration in its nonvolatile memory. To do so, use the `saveToFlash` command. Inversely, it is possible to force the module to forget its current settings by using the `revertFromFlash` method. For example:

```
C:\>YModule EPAPER1C-12346 set_logicalName MonPremierModule
C:\>YModule EPAPER1C-12346 saveToFlash
```

Note that you can do the same thing in a single command with the `-s` option.

```
C:\>YModule -s EPAPER1C-12346 set_logicalName MonPremierModule
```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

9.5. Limitations

The command line API has the same limitation than the other APIs: there can be only one application at a given time which can access the modules natively. By default, the command line API works in native mode.

You can easily work around this limitation by using a Virtual Hub: run `VirtualHub3` on the concerned machine, and use the executables of the command line API with the `-r` option. For example, if you use:

```
C:\>YModule inventory
```

you obtain a list of the modules connected by USB, using a native access. If another command which accesses the modules natively is already running, this does not work. But if you run `VirtualHub`, and you give your command in the form:

```
C:\>YModule -r 127.0.0.1 inventory
```

it works because the command is not executed natively anymore, but through `VirtualHub`. Note that `VirtualHub` counts as a native application.

³ <http://www.yoctopuce.com/EN/virtualhub.php>

10. Using the Yocto-Display-ePaper-C with Python

Python is an interpreted object oriented language developed by Guido van Rossum. Among its advantages is the fact that it is free, and the fact that it is available for most platforms, Windows as well as UNIX. It is an ideal language to write small scripts on a napkin. The Yoctopuce library is compatible with Python 2.7 and 3.x up to the latest official versions. It works under Windows, macOS, and Linux, Intel as well as ARM. Python interpreters are available on the Python web site¹.

10.1. Source files

The Yoctopuce library classes² for Python that you will use are provided as source files. Copy all the content of the *Sources* directory in the directory of your choice and add this directory to the *PYTHONPATH* environment variable. If you use an IDE to program in Python, refer to its documentation to configure it so that it automatically finds the API source files.

10.2. Dynamic library

A section of the low-level library is written in C, but you should not need to interact directly with it: it is provided as a DLL under Windows, as a *.so* files under UNIX, and as a *.dylib* file under macOS. Everything was done to ensure the simplest possible interaction from Python: the distinct versions of the dynamic library corresponding to the distinct operating systems and architectures are stored in the *cdll* directory. The API automatically loads the correct file during its initialization. You should not have to worry about it.

If you ever need to recompile the dynamic library, its complete source code is located in the Yoctopuce C++ library.

In order to keep them simple, all the examples provided in this documentation are console applications. Naturally, the libraries function in a strictly identical manner if you integrate them in an application with a graphical interface.

10.3. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a Python code snippet to use the Display function.

¹ <http://www.python.org/download/>

² www.yoctopuce.com/EN/libraries.php

```
[...]
# Enable detection of USB devices
errmsg=YRefParam()
YAPI.RegisterHub("usb",errmsg)
[...]

# Retrieve the object used to interact with the device
display = YDisplay.FindDisplay("EPAPER1C-123456.display")

# Hot-plug is easy: just check that the device is online
if display.isOnline():
    # Use display.get_displayLayer()
    [...]

[...]
```

Let's look at these lines in more details.

YAPI.RegisterHub

The `yAPI.RegisterHub` function initializes the Yoctopuce API and indicates where the modules should be looked for. When used with the parameter "usb", it will use the modules locally connected to the computer running the library. If the initialization does not succeed, this function returns a value different from `YAPI.SUCCESS` and `errmsg` contains the error message.

YDisplay.FindDisplay

The `YDisplay.FindDisplay` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can use logical names as well, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number *EPAPER1C-123456* which you have named "MyModule", and for which you have given the *display* function the name "MyFunction". The following five calls are strictly equivalent, as long as "MyFunction" is defined only once.

```
display = YDisplay.FindDisplay("EPAPER1C-123456.display")
display = YDisplay.FindDisplay("EPAPER1C-123456.MyFunction")
display = YDisplay.FindDisplay("MyModule.display")
display = YDisplay.FindDisplay("MyModule.MyFunction")
display = YDisplay.FindDisplay("MyFunction")
```

`YDisplay.FindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `YDisplay.FindDisplay` allows you to know if the corresponding module is present and in working order.

About python imports

This documentation assumes that you are using the Python library downloaded directly from the Yoctopuce website, but if you are using the library installed with PIP, then you will need to prefix all imports with `yoctopuce..` Meaning all the import examples shown in the documentation, such as:

```
from yocto_api import *
```

need to be converted , when the yoctopuce library was installed by PIP, to:

```
from yoctopuce.yocto_api import *
```

get_displayLayer

The `get_displayLayer()` method of the object returned by `YDisplay.FindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example

Launch Python and open the corresponding sample script provided in the directory **Examples/Doc-GettingStarted-Yocto-Display-ePaper-C** of the Yoctopuce library.

In this example, you will recognize the functions explained above, but this time used with all side materials needed to make it work nicely as a small demo.

```
#!/usr/bin/python
# -*- coding: utf-8 -*-
import os, sys
import random

from yocto_api import YRefParam, YAPI
from yocto_display import YDisplay, YDisplayLayer

def die(msg) -> None:
    YAPI.FreeAPI()
    sys.exit(msg + ' (check USB cable)')

colors = [0xFFFFFF, 0x000000, 0xFF0000, 0xFFFF00 ]

# the API use local USB devices through VirtualHub
errmsg = YRefParam()
if YAPI.RegisterHub("usb", errmsg) != YAPI.SUCCESS:
    sys.exit("RegisterHub failed: " + errmsg.value)

# To use a specific device, invoke the script as
# python helloworld.py [serial_number]
# or
# python helloworld.py [logical_name]
target = 'any'
if len(sys.argv) > 1:
    target = sys.argv[1]

if target == 'any':
    # retrieve any display
    tmp = YDisplay.FirstDisplay()
    if tmp is None:
        die('No module connected')
    target = tmp.get_serialNumber()

# retrieve specified functions
disp = YDisplay.FindDisplay(target + ".display")
if not disp.isOnline():
    die("Yocto-Display '%s' not connected" % target)

# Makes sure the Panel type is set
paneltype = disp.get_displayPanel()
if paneltype=="NOT_SET" :
    print("Use the virtual to Configure the panel first")
    exit()

# retrieve the display size
w = disp.get_displayWidth()
h = disp.get_displayHeight()
middleX = int(w/2)
middleY = int(h/2)
print("Using device %s (panel: %s %dx%d pixels)" % (disp.get_serialNumber(), paneltype, w, h)
)
disp.resetAll()
```

```

# retrieve the first layer
l0 = disp.get_displayLayer(0)
l0.selectFont("medium.yfm")
iterations = 0
animation = True
while animation:
    iterations = iterations + 1
    # prevent refreshing for 2 sec
    disp.postponeRefresh(2000)
    l0.clear()
    ## draw a few circle
    for i in range(15):
        cx = random.randint(0,w)
        cy = random.randint(0,h)
        r = random.randint(int(h/20),int(h/10))
        l0.selectFillColor(colors[random.randint(0,3)])
        l0.drawDisc(cx, cy, r)
        l0.drawCircle(cx,cy,r)
    # draw a rectangle with panel type in it
    l0.selectFillColor(0xffffffff)
    l0.drawBar(middleX-75,middleY-10,middleX+75,middleY+12 )
    l0.drawRect(middleX-75,middleY-10,middleX+75,middleY+12 )
    l0.drawText(middleX,middleY,YDisplayLayer.ALIGN.CENTER,paneltype)
    # forces a full refresh only the 1rst time
    if iterations==1: disp.regenerateDisplay()
    disp.triggerRefresh() # display is allowed to refresh again
    YAPI.Sleep(1000)
    # if no fast refresh available, don't even try to run animations
    if (paneltype.find("KS")<0) : animation=False

YAPI.FreeAPI()

```

10.4. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```

#!/usr/bin/python
# -*- coding: utf-8 -*-
import os, sys

from yocto_api import *

def usage():
    sys.exit("usage: demo <serial or logical name> [ON/OFF]")

errmsg = YRefParam()
if YAPI.RegisterHub("usb", errmsg) != YAPI.SUCCESS:
    sys.exit("RegisterHub error: " + str(errmsg))

if len(sys.argv) < 2:
    usage()

m = YModule.FindModule(sys.argv[1]) # use serial or logical name

if m.isOnline():
    if len(sys.argv) > 2:
        if sys.argv[2].upper() == "ON":
            m.set_beacon(YModule.BEACON_ON)
        if sys.argv[2].upper() == "OFF":
            m.set_beacon(YModule.BEACON_OFF)

    print("serial:      " + m.get_serialNumber())
    print("logical name: " + m.get_logicalName())
    print("luminosity:   " + str(m.get_luminosity()))
    if m.get_beacon() == YModule.BEACON_ON:
        print("beacon:      ON")
    else:
        print("beacon:      OFF")
    print("upTime:      " + str(m.get_upTime() / 1000) + " sec")
    print("USB current: " + str(m.get_usbCurrent()) + " mA")

```

```

    print("logs:\n" + m.get_lastLogs())
else:
    print(sys.argv[1] + " not connected (check identification and USB cable)")
YAPI.FreeAPI()

```

Each property `xxx` of the module can be read thanks to a method of type `YModule.get_xxxx()`, and properties which are not read-only can be modified with the help of the `YModule.set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `YModule.set_xxx()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `YModule.saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `YModule.revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```

#!/usr/bin/python
# -*- coding: utf-8 -*-
import os, sys

from yocto_api import *

def usage():
    sys.exit("usage: demo <serial or logical name> <new logical name>")

if len(sys.argv) != 3:
    usage()

errmsg = YRefParam()
if YAPI.RegisterHub("usb", errmsg) != YAPI.SUCCESS:
    sys.exit("RegisterHub error: " + str(errmsg))

m = YModule.FindModule(sys.argv[1]) # use serial or logical name
if m.isOnline():
    newname = sys.argv[2]
    if not YAPI.CheckLogicalName(newname):
        sys.exit("Invalid name (" + newname + ")")
    m.set_logicalName(newname)
    m.saveToFlash() # do not forget this
    print("Module: serial= " + m.get_serialNumber() + " / name= " + m.get_logicalName())
else:
    sys.exit("not connected (check identification and USB cable)")
YAPI.FreeAPI()

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `YModule.saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `YModule.yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not `null`. Below a short example listing the connected modules.

```

#!/usr/bin/python
# -*- coding: utf-8 -*-
import os, sys

from yocto_api import *

errmsg = YRefParam()

```

```
# Setup the API to use local USB devices
if YAPI.RegisterHub("usb", errmsg) != YAPI.SUCCESS:
    sys.exit("init error" + str(errmsg))

print('Device list')

module = YModule.FirstModule()
while module is not None:
    print(module.get_serialNumber() + ' (' + module.get_productName() + ')')
    module = module.nextModule()
YAPI.FreeAPI()
```

10.5. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software. The only way to prevent this is to implement one of the two error handling techniques described below.

The method recommended by most programming languages for unpredictable error handling is the use of exceptions. By default, it is the behavior of the Yoctopuce library. If an error happens while you try to access a module, the library throws an exception. In this case, there are three possibilities:

- If your code catches the exception and handles it, everything goes well.
- If your program is running in debug mode, you can relatively easily determine where the problem happened and view the explanatory message linked to the exception.
- Otherwise... the exception makes your program crash, bang!

As this latest situation is not the most desirable, the Yoctopuce library offers another possibility for error handling, allowing you to create a robust program without needing to catch exceptions at every line of code. You simply need to call the `YAPI.DisableExceptions()` function to commute the library to a mode where exceptions for all the functions are systematically replaced by specific return values, which can be tested by the caller when necessary. For each function, the name of each return value in case of error is systematically documented in the library reference. The name always follows the same logic: a `get_state()` method returns a `ClassName.STATE_INVALID` value, a `get_currentValue` method returns a `ClassName.CURRENTVALUE_INVALID` value, and so on. In any case, the returned value is of the expected type and is not a null pointer which would risk crashing your program. At worst, if you display the value without testing it, it will be outside the expected bounds for the returned value. In the case of functions which do not normally return information, the return value is `YAPI_SUCCESS` if everything went well, and a different error code in case of failure.

When you work without exceptions, you can obtain an error code and an error message explaining the source of the error. You can request them from the object which returned the error, calling the `errType()` and `errMessage()` methods. Their returned values contain the same information as in the exceptions when they are active.

11. Using Yocto-Display-ePaper-C with C++

C++ is not the simplest language to master. However, if you take care to limit yourself to its essential functionalities, this language can very well be used for short programs quickly coded, and it has the advantage of being easily ported from one operating system to another. Under Windows, C++ is supported with Microsoft Visual Studio 2017 and more recent versions. Under macOS, we support the XCode versions supported by Apple. And under Linux, we support all GCC version published since 2008. Moreover, under Max OS X and under Linux, you can compile the examples using a command line with GCC using the provided `GNUmakefile`. In the same manner under Windows, a `Makefile` allows you to compile examples using a command line, fully knowing the compilation and linking arguments.

Yoctopuce C++ libraries¹ are integrally provided as source files. A section of the low-level library is written in pure C, but you should not need to interact directly with it: everything was done to ensure the simplest possible interaction from C++. The library is naturally also available as binary files, so that you can link it directly if you prefer.

You will soon notice that the C++ API defines many functions which return objects. You do not need to deallocate these objects yourself, the API does it automatically at the end of the application.

In order to keep them simple, all the examples provided in this documentation are console applications. Naturally, the libraries function in a strictly identical manner if you integrate them in an application with a graphical interface. You will find in the last section of this chapter all the information needed to create a wholly new project linked with the Yoctopuce libraries.

11.1. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a C++ code snippet to use the Display function.

```
#include "yocto_api.h"
#include "yocto_display.h"

[...]
// Enable detection of USB devices
String errmsg;
YAPI::RegisterHub("usb", errmsg);
[...]

// Retrieve the object used to interact with the device
YDisplay *display;
```

¹ www.yoctopuce.com/EN/libraries.php

```
display = YDisplay::FindDisplay("EPAPER1C-123456.display");

// Hot-plug is easy: just check that the device is online
if(display->isOnline())
{
    // Use display->get_displayLayer()
    [...]
}
```

Let's look at these lines in more details.

yocto_api.h et yocto_display.h

These two include files provide access to the functions allowing you to manage Yoctopuce modules. `yocto_api.h` must always be used, `yocto_display.h` is necessary to manage modules containing a display, such as Yocto-Display-ePaper-C.

YAPI::RegisterHub

The `YAPI::RegisterHub` function initializes the Yoctopuce API and indicates where the modules should be looked for. When used with the parameter "usb", it will use the modules locally connected to the computer running the library. If the initialization does not succeed, this function returns a value different from `YAPI_SUCCESS` and `errmsg` contains the error message.

YDisplay::FindDisplay

The `YDisplay::FindDisplay` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can use logical names as well, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number *EPAPER1C-123456* which you have named "MyModule", and for which you have given the *display* function the name "MyFunction". The following five calls are strictly equivalent, as long as "MyFunction" is defined only once.

```
YDisplay *display = YDisplay::FindDisplay("EPAPER1C-123456.display");
YDisplay *display = YDisplay::FindDisplay("EPAPER1C-123456.MyFunction");
YDisplay *display = YDisplay::FindDisplay("MyModule.display");
YDisplay *display = YDisplay::FindDisplay("MyModule.MyFunction");
YDisplay *display = YDisplay::FindDisplay("MyFunction");
```

`YDisplay::FindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `YDisplay::FindDisplay` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YFindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example

Launch your C++ environment and open the corresponding sample project provided in the directory **Examples/Doc-GettingStarted-Yocto-Display-ePaper-C** of the Yoctopuce library. If you prefer to work with your favorite text editor, open the file `main.cpp`, and type `make` to build the example when you are done.

In this example, you will recognize the functions explained above, but this time used with all side materials needed to make it work nicely as a small demo.

```
#include "yocto_api.h"
#include "yocto_display.h"
#include <iostream>
#include <stdio.h>
#include <stdlib.h>

using namespace std;

static void usage(void)
{
    cout << "Wrong command line arguments" << endl;
    cout << "usage: demo <serial_number>" << endl;
    cout << "      demo <logical_name>" << endl;
    cout << "      demo any (use any discovered device)" << endl;
    u64 now = YAPI::GetTickCount();
    while (YAPI::GetTickCount() - now < 3000) {
        // wait 3 sec to show the message
    }
    exit(1);
}

int main(int argc, const char * argv[])
{
    string      errmsg;
    string      target;
    YDisplay    *disp;

    if(argc < 2) usage();

    // Setup the API to use local USB devices
    if (YAPI::RegisterHub("usb", errmsg) != YAPI::SUCCESS) {
        cerr << "RegisterHub error: " << errmsg << endl;
        usage();
        return 1;
    }

    target      = (string) argv[1];
    if (target == "any") {
        disp = YDisplay::FirstDisplay();
        if (disp == NULL) {
            cout << "No module connected (check USB cable)" << endl;
            usage();
            return 1;
        }
    } else {
        disp = YDisplay::FindDisplay(target + ".display");
    }

    if (!disp->isOnline()) {
        cout << "Module is offline (check USB cable)" << endl;
        usage();
        return 1;
    }

    u32 colors[] = { 0xFFFFFF, 0x000000, 0xFF0000, 0xFFFF00 };

    // Makes sure the Panel type is set
    string paneltype = disp->get_displayPanel();
    if (paneltype == "NOT_SET")
    {
        cout << "Use the virtual to Configure the panel first";
        YAPI::Sleep(3000, errmsg);
        exit(1);
    }

    // retrieve the display size
    int w = disp->get_displayWidth();
```

```

int h = disp->get_displayHeight();
int middleX = (int)(w / 2);
int middleY = (int)(h / 2);
cout << "Using device " << disp->get_serialNumber() << " (panel: " << paneltype << " " << w
<< "x" << h << "pixels)\n";
disp->resetAll();

// retrieve the first layer
YDisplayLayer* l0 = disp->get_displayLayer(0);
l0->selectFont("medium.yfm");
int iterations = 0;
bool animation = true;

while (animation)
{
    iterations++;
    // prevent refreshing for 2 sec
    disp->postponeRefresh(2000);
    l0->clear();
    // draw a few circle
    for (int i = 0; i < 15; i++)
    {
        int cx = rand() % w;
        int cy = rand() % h;
        int r = (int)(h / 20) + rand() % (int)(h / 10);
        l0->selectFillColor(colors[rand() % 4]);
        l0->drawDisc(cx, cy, r);
        l0->drawCircle(cx, cy, r);
    }
    // draw a rectangle with panel type in it
    l0->selectFillColor(0xffffffff);
    l0->drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    l0->drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    l0->drawText(middleX, middleY, YDisplayLayer::ALIGN_CENTER, paneltype);
    // forces a full refresh only the 1st time
    if (iterations == 1) disp->regenerateDisplay();
    disp->triggerRefresh(); // display is allowed to refresh again
    YAPI::Sleep(1000, errmsg);
    // if no fast refresh available, don't even try to run animations
    if (paneltype.find("KS") < 0) animation = false;
}

YAPI::FreeAPI();
}

```

11.2. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```

#include <iostream>
#include <stdlib.h>

#include "yocto_api.h"

using namespace std;

static void usage(const char *exe)
{
    cout << "usage: " << exe << " <serial or logical name> [ON/OFF]" << endl;
    exit(1);
}

int main(int argc, const char * argv[])
{
    string      errmsg;

    // Setup the API to use local USB devices
    if(YAPI::RegisterHub("usb", errmsg) != YAPI::SUCCESS) {
        cerr << "RegisterHub error: " << errmsg << endl;
        return 1;
    }
}

```

```

}

if(argc < 2)
    usage(argv[0]);

YModule *module = YModule::FindModule(argv[1]); // use serial or logical name

if (module->isOnline()) {
    if (argc > 2) {
        if (string(argv[2]) == "ON")
            module->set_beacon(Y_BEACON_ON);
        else
            module->set_beacon(Y_BEACON_OFF);
    }
    cout << "serial:      " << module->get_serialNumber() << endl;
    cout << "logical name: " << module->get_logicalName() << endl;
    cout << "luminosity:  " << module->get_luminosity() << endl;
    cout << "beacon:      ";
    if (module->get_beacon() == Y_BEACON_ON)
        cout << "ON" << endl;
    else
        cout << "OFF" << endl;
    cout << "upTime:      " << module->get_upTime() / 1000 << " sec" << endl;
    cout << "USB current: " << module->get_usbCurrent() << " mA" << endl;
    cout << "Logs:" << endl << module->get_lastLogs() << endl;
} else {
    cout << argv[1] << " not connected (check identification and USB cable)"
        << endl;
}
YAPI::FreeAPI();
return 0;
}

```

Each property `xxx` of the module can be read thanks to a method of type `get_xxxx()`, and properties which are not read-only can be modified with the help of the `set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `set_xxx()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```

#include <iostream>
#include <stdlib.h>

#include "yocto_api.h"

using namespace std;

static void usage(const char *exe)
{
    cerr << "usage: " << exe << " <serial> <newLogicalName>" << endl;
    exit(1);
}

int main(int argc, const char * argv[])
{
    string      errmsg;

    // Setup the API to use local USB devices
    if(YAPI::RegisterHub("usb", errmsg) != YAPI::SUCCESS) {
        cerr << "RegisterHub error: " << errmsg << endl;
        return 1;
    }

    if(argc < 2)
        usage(argv[0]);

    YModule *module = YModule::FindModule(argv[1]); // use serial or logical name

```

```

if (module->isOnline()) {
    if (argc >= 3) {
        string newname = argv[2];
        if (!yCheckLogicalName(newname)) {
            cerr << "Invalid name (" << newname << ")" << endl;
            usage(argv[0]);
        }
        module->set_logicalName(newname);
        module->saveToFlash();
    }
    cout << "Current name: " << module->get_logicalName() << endl;
} else {
    cout << argv[1] << " not connected (check identification and USB cable)"
        << endl;
}
YAPI::FreeAPI();
return 0;
}

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not `NULL`. Below a short example listing the connected modules.

```

#include <iostream>

#include "yocto_api.h"

using namespace std;

int main(int argc, const char * argv[])
{
    string      errmsg;

    // Setup the API to use local USB devices
    if(YAPI::RegisterHub("usb", errmsg) != YAPI::SUCCESS) {
        cerr << "RegisterHub error: " << errmsg << endl;
        return 1;
    }

    cout << "Device list: " << endl;

    YModule *module = YModule::FirstModule();
    while (module != NULL) {
        cout << module->get_serialNumber() << " ";
        cout << module->get_productName() << endl;
        module = module->nextModule();
    }
    YAPI::FreeAPI();
    return 0;
}

```

11.3. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software. The only way to prevent this is to implement one of the two error handling techniques described below.

The method recommended by most programming languages for unpredictable error handling is the use of exceptions. By default, it is the behavior of the Yoctopuce library. If an error happens while you try to access a module, the library throws an exception. In this case, there are three possibilities:

- If your code catches the exception and handles it, everything goes well.
- If your program is running in debug mode, you can relatively easily determine where the problem happened and view the explanatory message linked to the exception.
- Otherwise... the exception makes your program crash, bang!

As this latest situation is not the most desirable, the Yoctopuce library offers another possibility for error handling, allowing you to create a robust program without needing to catch exceptions at every line of code. You simply need to call the `YAPI.DisableExceptions()` function to commute the library to a mode where exceptions for all the functions are systematically replaced by specific return values, which can be tested by the caller when necessary. For each function, the name of each return value in case of error is systematically documented in the library reference. The name always follows the same logic: a `get_state()` method returns a `ClassName.STATE_INVALID` value, a `get_currentValue` method returns a `ClassName.CURRENTVALUE_INVALID` value, and so on. In any case, the returned value is of the expected type and is not a null pointer which would risk crashing your program. At worst, if you display the value without testing it, it will be outside the expected bounds for the returned value. In the case of functions which do not normally return information, the return value is `YAPI_SUCCESS` if everything went well, and a different error code in case of failure.

When you work without exceptions, you can obtain an error code and an error message explaining the source of the error. You can request them from the object which returned the error, calling the `errType()` and `errMessage()` methods. Their returned values contain the same information as in the exceptions when they are active.

11.4. Integration variants for the C++ Yoctopuce library

Depending on your needs and on your preferences, you can integrate the library into your projects in several distinct manners. This section explains how to implement the different options.

Integration in source format (recommended)

Integrating all the sources of the library into your projects has several advantages:

- It guarantees the respect of the compilation conventions of your project (32/64 bits, inclusion of debugging symbols, unicode or ASCII characters, etc.);
- It facilitates debugging if you are looking for the cause of a problem linked to the Yoctopuce library;
- It reduces the dependencies on third party components, for example in the case where you would need to recompile this project for another architecture in many years;
- It does not require the installation of a dynamic library specific to Yoctopuce on the final system, everything is in the executable.

To integrate the source code, the easiest way is to simply include the `Sources` directory of your Yoctopuce library into your **IncludePath**, and to add all the files of this directory (including the sub-directory `yapi`) to your project.

For your project to build correctly, you need to link with your project the prerequisite system libraries, that is:

- For Windows: the libraries are added automatically
- For macOS: **IOKit.framework** and **CoreFoundation.framework**
- For Linux: **libm**, **libpthread**, **libusb1.0**, and **libstdc++**

Integration as a static library

With the integration of the Yoctopuce library as a static library, you do not need to install a dynamic library specific to Yoctopuce, everything is in the executable.

To use the static library, you must first compile it using the shell script `build.sh` on UNIX, or `build.bat` on Windows. This script, located in the root directory of the library, detects the OS and recompiles all the corresponding libraries as well as the examples.

Then, to integrate the static Yoctopuce library to your project, you must include the `Sources` directory of the Yoctopuce library into your **IncludePath**, and add the sub-directory `Binaries/...` corresponding to your operating system into your **libPath**.

Finally, for you project to build correctly, you need to link with your project the Yoctopuce library and the prerequisite system libraries:

- For Windows: **yocto-static.lib**
- For macOS: **libyocto-static.a**, **IOKit.framework**, and **CoreFoundation.framework**
- For Linux: **libyocto-static.a**, **libm**, **libpthread**, **libusb1.0**, and **libstdc++**.

Note, under Linux, if you wish to compile in command line with GCC, it is generally advisable to link system libraries as dynamic libraries, rather than as static ones. To mix static and dynamic libraries on the same command line, you must pass the following arguments:

```
gcc (...) -Wl,-Bstatic -lyocto-static -Wl,-Bdynamic -lm -lpthread -lusb-1.0 -lstdc++
```

Integration as a dynamic library

Integration of the Yoctopuce library as a dynamic library allows you to produce an executable smaller than with the two previous methods, and to possibly update this library, if a patch reveals itself necessary, without needing to recompile the source code of the application. On the other hand, it is an integration mode which systematically requires you to copy the dynamic library on the target machine where the application will run (**yocto.dll** for Windows, **libyocto.so.1.0.1** for macOS and Linux).

To use the dynamic library, you must first compile it using the shell script `build.sh` on UNIX, or `build.bat` on Windows. This script, located in the root directory of the library, detects the OS and recompiles all the corresponding libraries as well as the examples.

Then, To integrate the dynamic Yoctopuce library to your project, you must include the `Sources` directory of the Yoctopuce library into your **IncludePath**, and add the sub-directory `Binaries/...` corresponding to your operating system into your **LibPath**.

Finally, for you project to build correctly, you need to link with your project the dynamic Yoctopuce library and the prerequisite system libraries:

- For Windows: **yocto.lib**
- For macOS: **libyocto**, **IOKit.framework**, and **CoreFoundation.framework**
- For Linux: **libyocto**, **libm**, **libpthread**, **libusb1.0**, and **libstdc++**.

With GCC, the command line to compile is simply:

```
gcc (...) -lyocto -lm -lpthread -lusb-1.0 -lstdc++
```

12. Using Yocto-Display-ePaper-C with C#

C# (pronounced C-Sharp) is an object-oriented programming language promoted by Microsoft, it is somewhat similar to Java. Like Visual-Basic and Delphi, it allows you to create Windows applications quite easily. C# is supported under Windows Visual Studio 2017 and its more recent versions.

Our programming library is also compatible with *Mono*, the open source version of C# that also works on Linux and macOS. Under Linux, use Mono version 5.20 or more recent. Under macOS, support is limited to 32bit systems, which makes it virtually useless nowadays. You will find on our web site various articles that describe how to configure Mono to use our library.

12.1. Installation

Download the Visual C# Yoctopuce library from the Yoctopuce web site¹. There is no setup program, simply copy the content of the zip file into the directory of your choice. You mostly need the content of the `Sources` directory. The other directories contain the documentation and a few sample programs. All sample projects are Visual C# 2010, projects, if you are using a previous version, you may have to recreate the projects structure from scratch.

12.2. Using the Yoctopuce API in a Visual C# project

The Visual C#.NET Yoctopuce library is composed of a DLL and of source files in Visual C#. The DLL is not a .NET DLL, but a classic DLL, written in C, which manages the low level communications with the modules². The source files in Visual C# manage the high level part of the API. Therefore, you need both this DLL and the .cs files of the `sources` directory to create a project managing Yoctopuce modules.

Configuring a Visual C# project

The following indications are provided for Visual Studio Express 2010, but the process is similar for other versions. Start by creating your project. Then, on the *Solution Explorer* panel, right click on your project, and select "Add" and then "Add an existing item".

A file selection window opens. Select the `yocto_api.cs` file and the files corresponding to the functions of the Yoctopuce modules that your project is going to manage. If in doubt, select all the files.

¹ www.yoctopuce.com/EN/libraries.php

² The sources of this DLL are available in the C++ API

You then have the choice between simply adding these files to your project, or to add them as links (the **Add** button is in fact a scroll-down menu). In the first case, Visual Studio copies the selected files into your project. In the second case, Visual Studio simply keeps a link on the original files. We recommend you to use links, which makes updates of the library much easier.

Then add in the same manner the `yapi.dll` DLL, located in the `Sources/dll` directory³. Then, from the **Solution Explorer** window, right click on the DLL, select **Properties** and in the **Properties** panel, set the **Copy to output folder** to **always**. You are now ready to use your Yoctopuce modules from Visual Studio.

In order to keep them simple, all the examples provided in this documentation are console applications. Naturally, the libraries function in a strictly identical manner if you integrate them in an application with a graphical interface.

12.3. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a C# code snippet to use the Display function.

```
[...]
// Enable detection of USB devices
string errmsg = "";
YAPI.RegisterHub("usb", errmsg);
[...]

// Retrieve the object used to interact with the device
YDisplay display = YDisplay.FindDisplay("EPAPER1C-123456.display");

// Hot-plug is easy: just check that the device is online
if (display.isOnline())
{
    // Use display.get_displayLayer()
    [...]
}
```

Let's look at these lines in more details.

YAPI.RegisterHub

The `YAPI.RegisterHub` function initializes the Yoctopuce API and indicates where the modules should be looked for. When used with the parameter `"usb"`, it will use the modules locally connected to the computer running the library. If the initialization does not succeed, this function returns a value different from `YAPI.SUCCESS` and `errmsg` contains the error message.

YDisplay.FindDisplay

The `YDisplay.FindDisplay` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can use logical names as well, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number `EPAPER1C-123456` which you have named `"MyModule"`, and for which you have given the `display` function the name `"MyFunction"`. The following five calls are strictly equivalent, as long as `"MyFunction"` is defined only once.

```
display = YDisplay.FindDisplay("EPAPER1C-123456.display");
display = YDisplay.FindDisplay("EPAPER1C-123456.MyFunction");
display = YDisplay.FindDisplay("MyModule.display");
display = YDisplay.FindDisplay("MyModule.MyFunction");
display = YDisplay.FindDisplay("MyFunction");
```

`YDisplay.FindDisplay` returns an object which you can then use at will to control the display.

³ Remember to change the filter of the selection window, otherwise the DLL will not show.

isOnline

The `isOnline()` method of the object returned by `YDisplay.FindDisplay` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YDisplay.FindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example

Launch Microsoft Visual C# and open the corresponding sample project provided in the directory **Examples/Doc-GettingStarted-Yocto-Display-ePaper-C** of the Yoctopuce library.

In this example, you will recognize the functions explained above, but this time used with all side materials needed to make it work nicely as a small demo.

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

namespace ConsoleApplication1
{
    class Program
    {
        static void usage()
        {
            string execname = System.AppDomain.CurrentDomain.FriendlyName;
            Console.WriteLine(execname + " <serial_number> ");
            Console.WriteLine(execname + " <logical_name>");
            Console.WriteLine(execname + " any ");
            System.Threading.Thread.Sleep(2500);
            Environment.Exit(0);
        }

        static void Main(string[] args)
        {
            string errmsg = "";
            string target;
            YDisplay disp;

            if (args.Length < 1) usage();

            target = args[0].ToUpper();

            // API init
            if (YAPI.RegisterHub("usb", ref errmsg) != YAPI.SUCCESS)
            {
                Console.WriteLine("RegisterHub error: " + errmsg);
                Environment.Exit(0);
            }

            // find the display according to command line parameters
            if (target == "ANY")
            {
                disp = YDisplay.FirstDisplay();
                if (disp == null)
                {

```

```

        Console.WriteLine("No module connected (check USB cable) ");
        Environment.Exit(0);
    }
}
else disp = YDisplay.FindDisplay(target + ".display");

if (!disp.isOnline())
{
    Console.WriteLine("Module not connected (check identification and USB cable) ");
    Environment.Exit(0);
}

int[] colors = { 0xFFFFFFFF, 0x000000, 0xFF0000, 0xFFFF00 };

// Makes sure the Panel type is set
string paneltype = disp.get_displayPanel();
if (paneltype == "NOT_SET")
{
    Console.WriteLine("Use the virtual to Configure the panel first");
    YAPI.Sleep(3000, ref errmsg);
    Environment.Exit(0);
}

// retrieve the display size
int w = disp.get_displayWidth();
int h = disp.get_displayHeight();
int middleX = (int)(w / 2);
int middleY = (int)(h / 2);
Console.WriteLine("Using device " + disp.get_serialNumber() + " (panel: " + paneltype
+ " " + w + "x" + h + "pixels)\n");
disp.resetAll();

// retrieve the first layer
YDisplayLayer l0 = disp.get_displayLayer(0);
l0.selectFont("medium.yfm");
int iterations = 0;
bool animation = true;
Random rnd = new Random();

while (animation)
{
    iterations++;
    // prevent refreshing for 2 sec
    disp.postponeRefresh(2000);
    l0.clear();
    // draw a few circle
    for (int i = 0; i < 15; i++)
    {
        int cx = rnd.Next(w);
        int cy = rnd.Next(h);
        int r = rnd.Next((h / 20), (h / 10));
        l0.selectFillColor(colors[rnd.Next(4)]);
        l0.drawDisc(cx, cy, r);
        l0.drawCircle(cx, cy, r);
    }
    // draw a rectangle with panel type in it
    l0.selectFillColor(0xffffffff);
    l0.drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    l0.drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    l0.drawText(middleX, middleY, YDisplayLayer.ALIGN.CENTER, paneltype);
    // forces a full refresh only the 1st time
    if (iterations == 1) disp.regenerateDisplay();
    disp.triggerRefresh(); // display is allowed to refresh again
    YAPI.Sleep(1000, ref errmsg);
    // if no fast refresh available, don't even try to run animations
    if (paneltype.IndexOf("KS") < 0) animation = false;
}

YAPI.FreeAPI();
}
}
}

```

12.4. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

namespace ConsoleApplication1
{
    class Program
    {
        static void usage()
        {
            string execname = System.AppDomain.CurrentDomain.FriendlyName;
            Console.WriteLine("Usage:");
            Console.WriteLine(execname + " <serial or logical name> [ON/OFF]");
            System.Threading.Thread.Sleep(2500);
            Environment.Exit(0);
        }

        static void Main(string[] args)
        {
            YModule m;
            string errmsg = "";

            if (YAPI.RegisterHub("usb", ref errmsg) != YAPI.SUCCESS) {
                Console.WriteLine("RegisterHub error: " + errmsg);
                Environment.Exit(0);
            }

            if (args.Length < 1) usage();

            m = YModule.FindModule(args[0]); // use serial or logical name

            if (m.isOnline()) {
                if (args.Length >= 2) {
                    if (args[1].ToUpper() == "ON") {
                        m.set_beacon(YModule.BEACON_ON);
                    }
                    if (args[1].ToUpper() == "OFF") {
                        m.set_beacon(YModule.BEACON_OFF);
                    }
                }

                Console.WriteLine("serial:          " + m.get_serialNumber());
                Console.WriteLine("logical name:   " + m.get_logicalName());
                Console.WriteLine("luminosity:     " + m.get_luminosity().ToString());
                Console.WriteLine("beacon:         ");
                if (m.get_beacon() == YModule.BEACON_ON)
                    Console.WriteLine("ON");
                else
                    Console.WriteLine("OFF");
                Console.WriteLine("upTime:         " + (m.get_upTime() / 1000 ).ToString() + " sec");
                Console.WriteLine("USB current:    " + m.get_usbCurrent().ToString() + " mA");
                Console.WriteLine("Logs:\r\n" + m.get_lastLogs());
            } else {
                Console.WriteLine(args[0] + " not connected (check identification and USB cable)");
            }
            YAPI.FreeAPI();
        }
    }
}
```

Each property xxx of the module can be read thanks to a method of type `YModule.get_xxxx()`, and properties which are not read-only can be modified with the help of the `YModule.set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `YModule.set_XXX()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `YModule.saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `YModule.revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

namespace ConsoleApplication1
{
    class Program
    {
        static void usage()
        {
            string execname = System.AppDomain.CurrentDomain.FriendlyName;
            Console.WriteLine("Usage:");
            Console.WriteLine("usage: demo <serial or logical name> <new logical name>");
            System.Threading.Thread.Sleep(2500);
            Environment.Exit(0);
        }

        static void Main(string[] args)
        {
            YModule m;
            string errormsg = "";
            string newname;

            if (args.Length != 2) usage();

            if (YAPI.RegisterHub("usb", ref errormsg) != YAPI.SUCCESS) {
                Console.WriteLine("RegisterHub error: " + errormsg);
                Environment.Exit(0);
            }

            m = YModule.FindModule(args[0]); // use serial or logical name

            if (m.isOnline()) {
                newname = args[1];
                if (!YAPI.CheckLogicalName(newname)) {
                    Console.WriteLine("Invalid name (" + newname + ")");
                    Environment.Exit(0);
                }

                m.set_logicalName(newname);
                m.saveToFlash(); // do not forget this

                Console.WriteLine("Module: serial= " + m.get_serialNumber());
                Console.WriteLine(" / name= " + m.get_logicalName());
            } else {
                Console.WriteLine("not connected (check identification and USB cable)");
            }
            YAPI.FreeAPI();
        }
    }
}
```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `YModule.saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `YModule.yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not `null`. Below a short example listing the connected modules.

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;

namespace ConsoleApplication1
{
    class Program
    {
        static void Main(string[] args)
        {
            YModule m;
            string errormsg = "";

            if (YAPI.RegisterHub("usb", ref errormsg) != YAPI.SUCCESS) {
                Console.WriteLine("RegisterHub error: " + errormsg);
                Environment.Exit(0);
            }

            Console.WriteLine("Device list");
            m = YModule.FirstModule();
            while (m != null) {
                Console.WriteLine(m.get_serialNumber() + " (" + m.get_productName() + ")");
                m = m.nextModule();
            }
            YAPI.FreeAPI();
        }
    }
}
```

12.5. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software. The only way to prevent this is to implement one of the two error handling techniques described below.

The method recommended by most programming languages for unpredictable error handling is the use of exceptions. By default, it is the behavior of the Yoctopuce library. If an error happens while you try to access a module, the library throws an exception. In this case, there are three possibilities:

- If your code catches the exception and handles it, everything goes well.
- If your program is running in debug mode, you can relatively easily determine where the problem happened and view the explanatory message linked to the exception.
- Otherwise... the exception makes your program crash, bang!

As this latest situation is not the most desirable, the Yoctopuce library offers another possibility for error handling, allowing you to create a robust program without needing to catch exceptions at every line of code. You simply need to call the `YAPI.DisableExceptions()` function to commute the library to a mode where exceptions for all the functions are systematically replaced by specific return

values, which can be tested by the caller when necessary. For each function, the name of each return value in case of error is systematically documented in the library reference. The name always follows the same logic: a `get_state()` method returns a `ClassName.STATE_INVALID` value, a `get_currentValue` method returns a `ClassName.CURRENTVALUE_INVALID` value, and so on. In any case, the returned value is of the expected type and is not a null pointer which would risk crashing your program. At worst, if you display the value without testing it, it will be outside the expected bounds for the returned value. In the case of functions which do not normally return information, the return value is `YAPI_SUCCESS` if everything went well, and a different error code in case of failure.

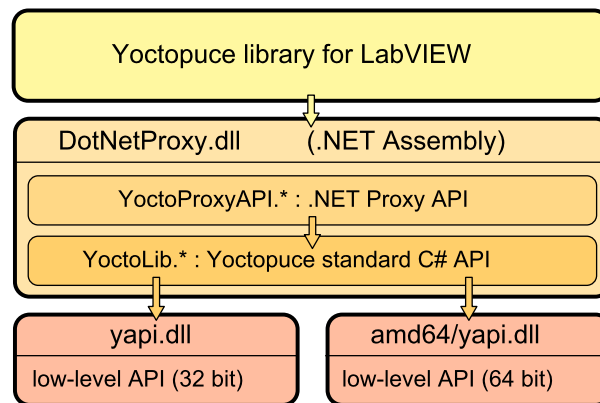
When you work without exceptions, you can obtain an error code and an error message explaining the source of the error. You can request them from the object which returned the error, calling the `errType()` and `errMessage()` methods. Their returned values contain the same information as in the exceptions when they are active.

13. Using the Yocto-Display-ePaper-C with LabVIEW

LabVIEW is edited by National Instruments since 1986. It is a graphic development environment: rather than writing lines of code, the users draw their programs, somewhat like a flow chart. LabVIEW was designed mostly to interface measuring tools, hence the *Virtual Instruments* name for LabVIEW programs. With visual programming, drawing complex algorithms becomes quickly fastidious. The LabVIEW Yoctopuce library was thus designed to make it as easy to use as possible. In other words, LabVIEW being an environment extremely different from other languages supported by Yoctopuce, there are major differences between the LabVIEW API and the other APIs.

13.1. Architecture

The LabVIEW library is based on the Yoctopuce DotNetProxy library contained in the `DotNetProxyLibrary.dll` DLL. In fact, it is this DotNetProxy library which takes care of most of the work by relying on the C# library which, in turn, uses the low level library coded in `yapi.dll` (32bits) and `amd64\yapi.dll` (64bits).



LabVIEW Yoctopuce API architecture

You must therefore imperatively distribute the `DotNetProxyLibrary.dll`, `yapi.dll`, and `amd64\yapi.dll` with your LabVIEW applications using the Yoctopuce API.

If need be, you can find the low level API sources in the C# library and the `DotNetProxyLibrary.dll` sources in the `DotNetProxy` library.

13.2. Compatibility

Firmware

For the LabVIEW Yoctopuce library to work correctly with your Yoctopuce modules, these modules need to have firmware 37120, or higher.

LabVIEW for Linux and MacOS

At the time of writing, the LabVIEW Yoctopuce API has been tested under Windows only. It is therefore most likely that it simply does not work with the Linux and MacOS versions of LabVIEW.

LabVIEW NXG

The LabVIEW Yoctopuce library uses many techniques which are not yet available in the new generation of LabVIEW. The library is therefore absolutely not compatible with LabVIEW NXG.

About DotNetProxyLibrary.dll

In order to be compatible with as many versions of Windows as possible, including Windows XP, the *DotNetProxyLibrary.dll* library is compiled in .NET 3.5, which is available by default on all the Windows versions since XP.

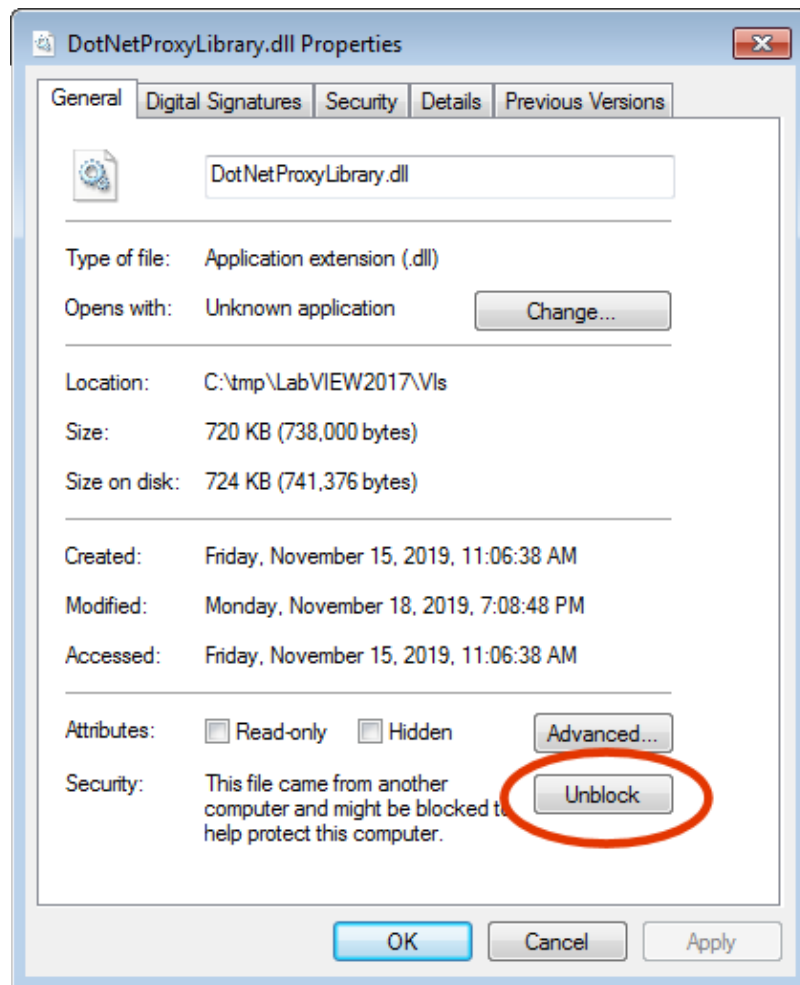
13.3. Installation

Download the LabVIEW library from the Yoctopuce web site¹. It is a ZIP file in which there is a distinct directory for each version of LabVIEW. Each of these directories contains two subdirectories: the first one contains programming examples for each Yoctopuce product; the second one, called *VIs*, contains all the VIs of the API and the required DLLs.

Depending on Windows configuration and the method used to copy the *DotNetProxyLibrary.dll* on your system, Windows may block it because it comes from an other computer. This may happen when the library zip file is uncompressed with Window's file explorer. If the DLL is blocked, LabVIEW will not be able to load it and an error 1386 will occur whenever any of the Yoctopuce VIs is executed.

There are two ways to fix this. The simplest is to unblock the file with the Windows file explorer: *right click / properties* on the *DotNetProxyLibrary.dll* file, and click on the *unblock* button. But this has to be done each time a new version of the DLL is copied on your system.

¹ <http://www.yoctopuce.com/EN/libraries.php>



Unblock the DotNetProxyLibrary DLL.

Alternatively, one can modify the LabVIEW configuration by creating, in the same directory as the labview.exe executable, an XML file called *labview.exe.config* containing the following code:

```
<?xml version="1.0"?>
<configuration>
  <runtime>
    <loadFromRemoteSources enabled="true" />
  </runtime>
</configuration>
```

Make sure to select the correct directory depending on the LabVIEW version you are using (32 bits vs. 64 bits). You can find more information about this file on the National Instruments web site.²

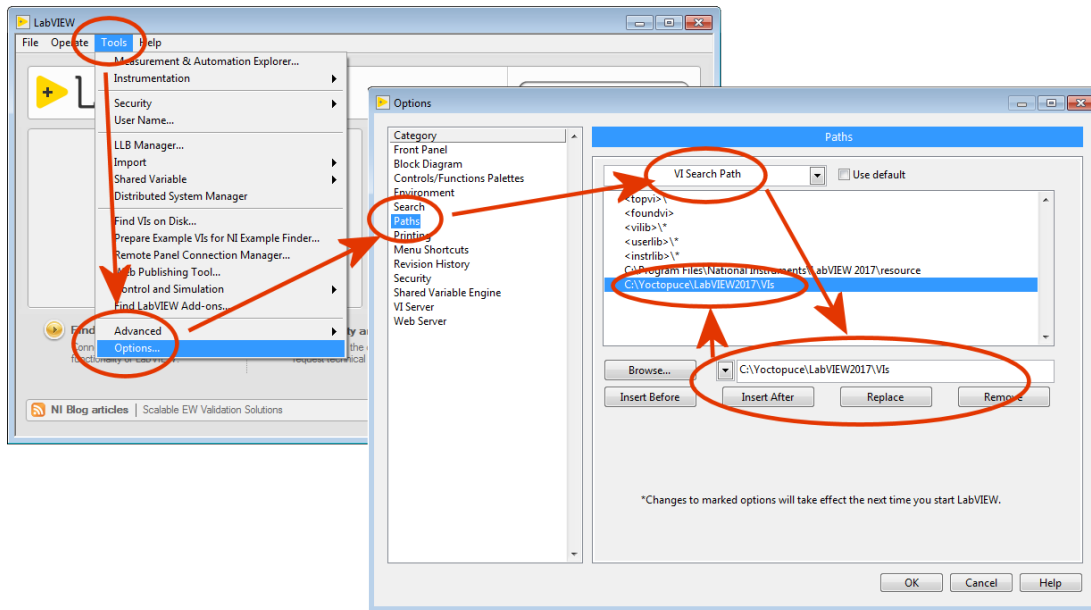
To install the LabVIEW Yoctopuce API, there are several methods.

Method 1 : "Take-out" installation

The simplest way to use the Yoctopuce library is to copy the content of the *VIs* directory wherever you want and to use the VIs in LabVIEW with a simple drag-n-drop operation.

To use the examples provided with the API, it is simpler if you add the directory of Yoctopuce VIs into the list of where LabVIEW must look for VIs that it has not found. You can access this list through the *Tools > Options > Paths > VI Search Path* menu.

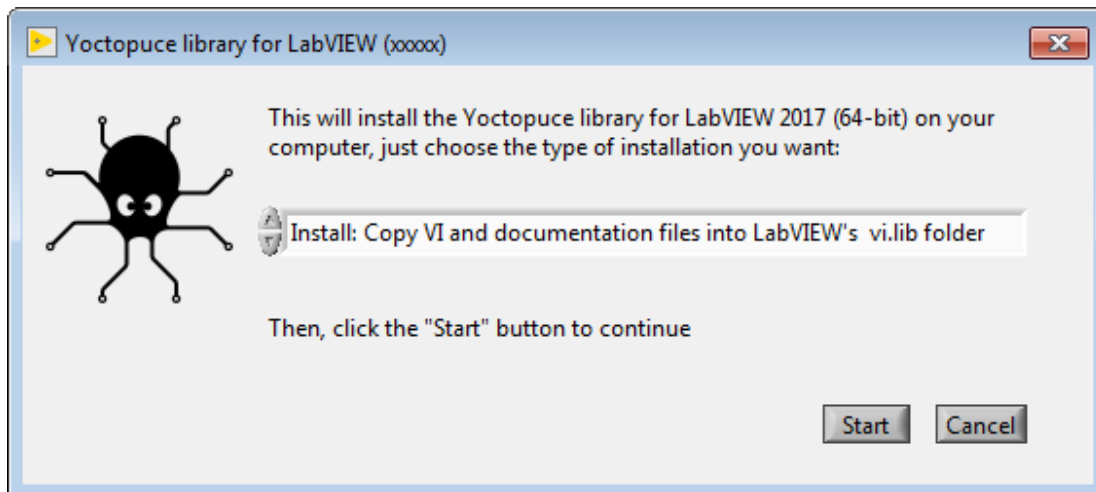
² <https://knowledge.ni.com/KnowledgeArticleDetails?id=kA00Z000000P8XnSAK>



Configuring the "VI Search Path"

Method 2 : Provided installer

In each LabVIEW folder of the Library, you will find a VI named "*Install.vi*", just open the one matching your LabVIEW version.



The provider installer

This installer provide 3 installation options:

Install: Keep VI and documentation files where they are.

With this option, VI files are keep in the place where the library has been unzipped. So you will have to make sure these files are not deleted as long as you need them. Here is what the installer will do if that option is chosen:

- All references to Yoctopuce any library paths will be removed from the *viSearchPath* option in the *labview.ini* file.
- A *dir.mnu* palette file referring to VIs in the install folder will be created in *C:\Program Files xx\National Instruments\LabVIEW 20xx\vi.lib\addons\Yoctopuce*
- A reference to the VIs source install path will inserted into the *viSearchPath* option in the *labview.ini* file.

Install: Copy VI and documentation files into LabVIEW's vi.lib folder

In that case all required files are copied inside the LabVIEW's installation folder, so you will be able to delete the installation folder once the original installation is complete. Note that programming examples won't be copied. Here is the exact behaviour of the installer in that case:

- All references to Yoctopuce library paths will be removed from *viSearchPath* in *labview.ini* file
- All VIs, DLLs, and documentation files will be copied into:
C:\Program Files xx\National Instruments\LabVIEW 20xx\vi.lib\Yoctopuce
- VIs will be patched with the path to copied documentation files
- A dir.mnu palette file referring to copied VIs will be created in
C:\Program Files xx\National Instruments\LabVIEW 20xx\vi.lib\addons\Yoctopuce

Uninstall Yoctopuce Library

this option is meant to remove the LabVIEW library from your LabVIEW installation, here is how it is done:

- All references to Yoctopuce library paths will be removed from *viSearchPath* in *labview.ini* file
- Following folders, if exists, will be removed:
C:\Program Files xx\National Instruments\LabVIEW 20xx\vi.lib\addons\Yoctopuce
C:\Program Files xx\National Instruments\LabVIEW 20xx\vi.lib\Yoctopuce

In any case, if the *labview.ini* file needs to be modified, a backup copy will be made beforehand.

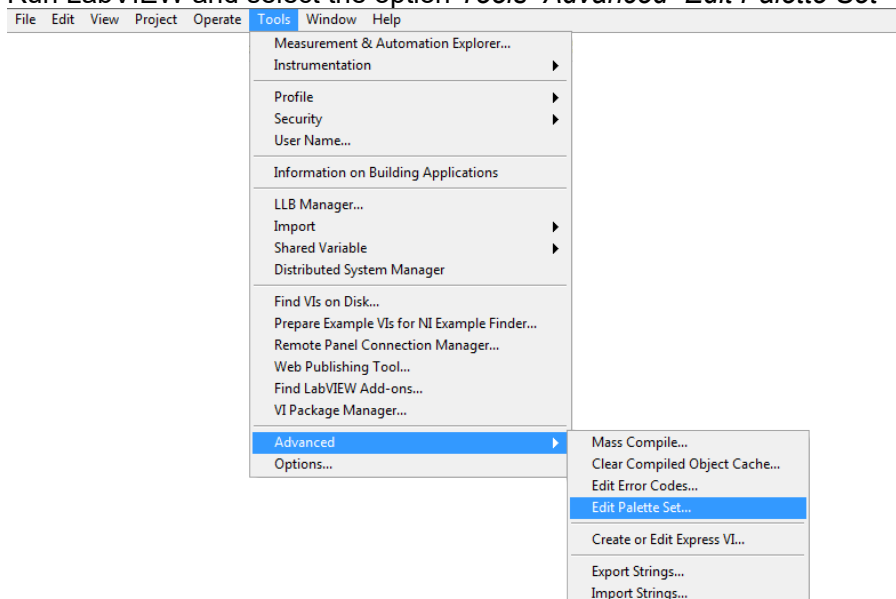
The installer identifies Yoctopuce VIs library folders by checking the presence of the *YRegisterHub.vi* file in said folders.

Once the installation is complete, a Yoctopuce palette will appear in *Functions/Addons* menu.

Method 3 : Installation in a LabVIEW palette (ancillary method)

The steps to manually install the VIs directly in the LabVIEW palette are somewhat more complex. You can find the detailed procedure on the National Instruments web site ³, but here is a summary:

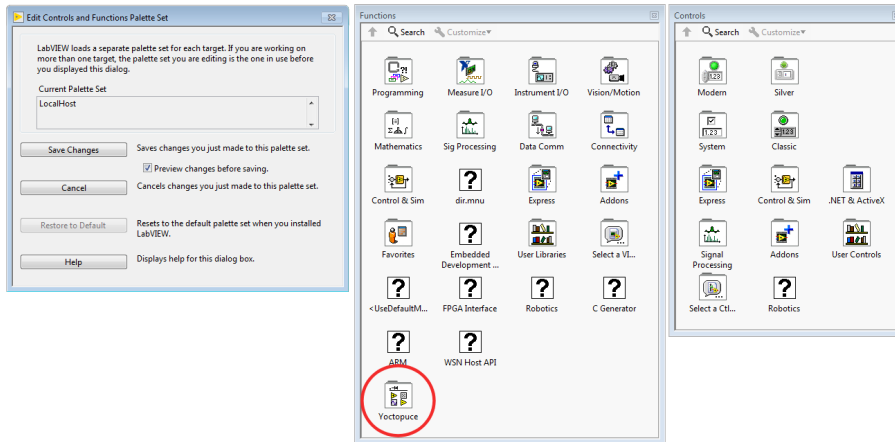
1. Create a *Yoctopuce/API* directory in the *C:\Program Files\National Instruments\LabVIEW xxxx\vi.lib* directory and copy all the VIs and DLLs of the *VIs* directory into it.
2. Create a *Yoctopuce* directory in the *C:\Program Files\National Instruments\LabVIEW xxxx\menus\Categories* directory.
3. Run LabVIEW and select the option *Tools>Advanced>Edit Palette Set*



³ <https://forums.ni.com/t5/Developer-Center-Resources/Creating-a-LabVIEW-Palette/ta-p/3520557>

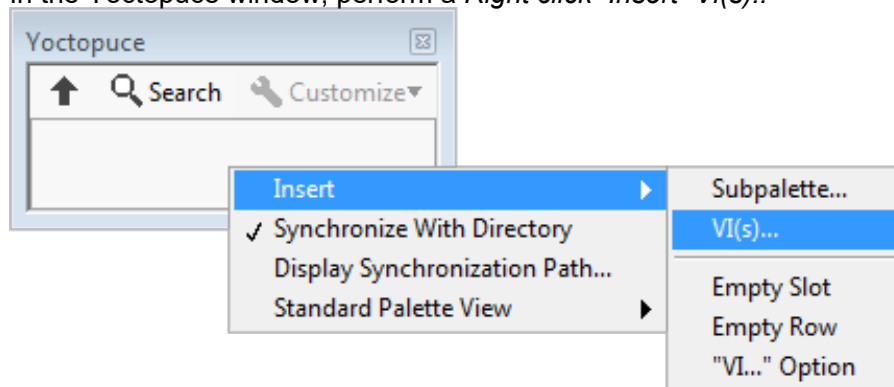
Three windows pop up:

- "Edit Controls and Functions Palette Set"
- "Functions"
- "Controls"

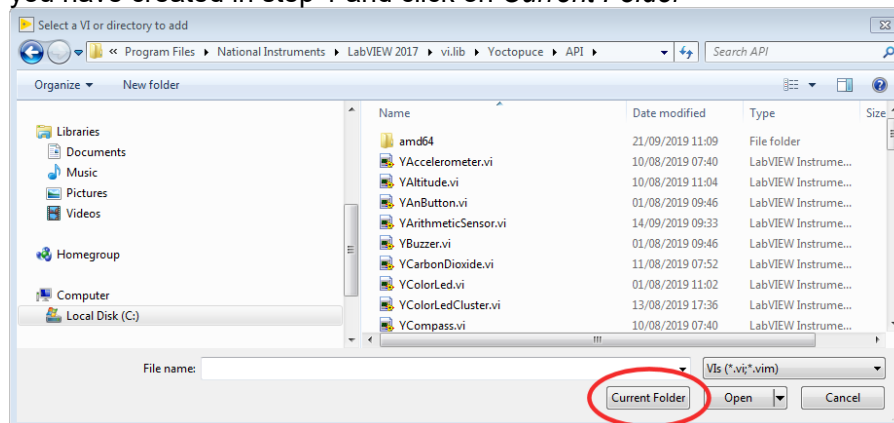


In the *Function* window, there is a *Yoctopuce* icon. Double-click it to create an empty "Yoctopuce" window.

4. In the Yoctopuce window, perform a *Right click>Insert>Vi(s)*..

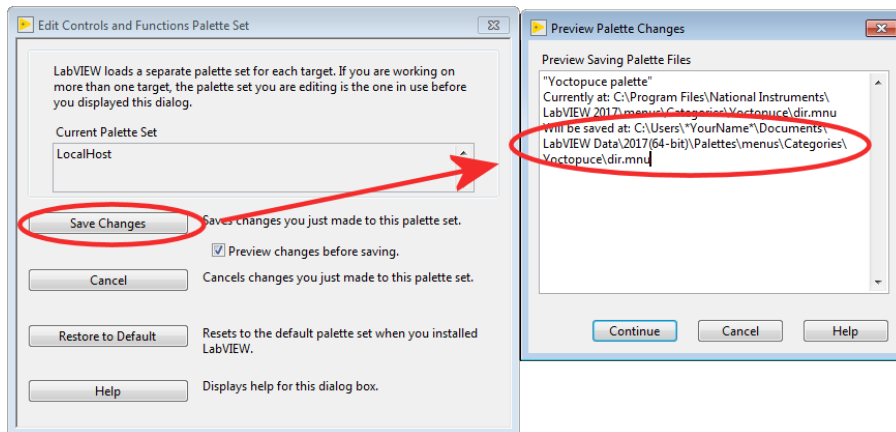


in order to open a file chooser. Put the file chooser in the *vi.lib\Yoctopuce\API* directory that you have created in step 1 and click on *Current Folder*



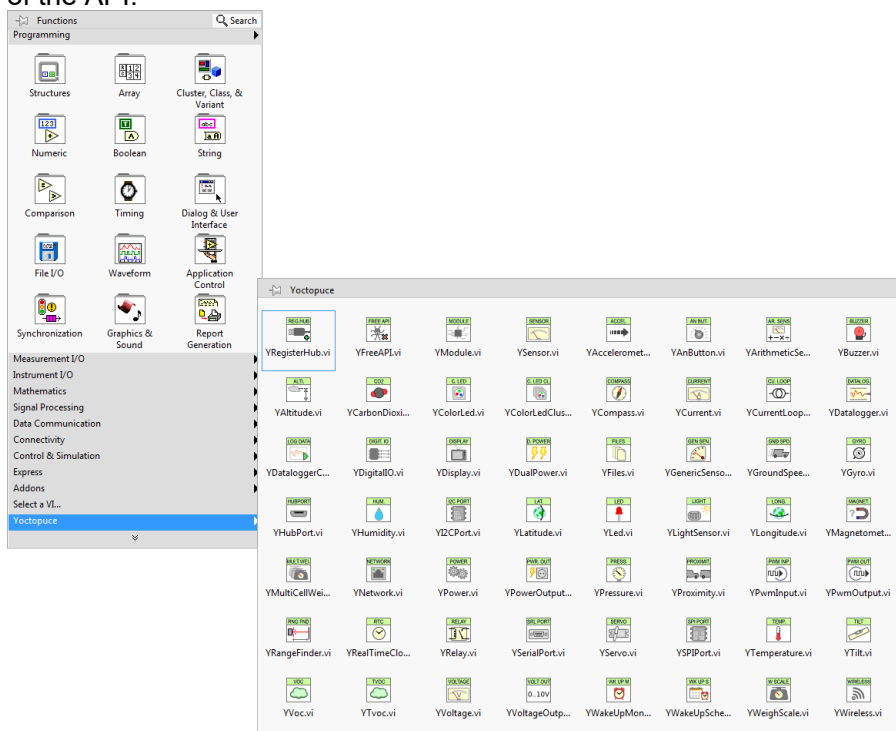
All the Yoctopuce VIs now appear in the Yoctopuce window. By default, they are sorted by alphabetical order, but you can arrange them as you see fit by moving them around with the mouse. For the palette to be easy to use, we recommend to reorganize the icons over 8 columns.

5. In the "Edit Controls and Functions Palette Set" window, click on the "Save Changes" button, the window indicates that it has created a *dir.mnu* file in your *Documents* directory.



Copy this file in the "menus\Categories\Yoctopuce" directory that you have created in step 2.

- Restart LabVIEW, the LabVIEW palette now contains a Yoctopuce sub-palette with all the VIs of the API.

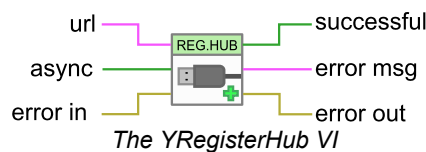


13.4. Presentation of Yoctopuce VIs

The LabVIEW Yoctopuce library contains one VI per class of the Yoctopuce API, as well as a few special VIs. All the VIs have the traditional connectors *Error IN* and *Error Out*.

YRegisterHub

The YRegisterHub VI is used to initialize the API. You must imperatively call this VI once before you do anything in relation with Yoctopuce modules.



The YRegisterHub VI takes a *url* parameter which can be:

- The "usb" character string to indicated that you wish to work with local modules, directly connected by USB
- An IP address to indicate that you wish to work with modules which are available through a network connection. This IP address can be that of a YoctoHub⁴ or even that of a machine on which the VirtualHub⁵ application is running.

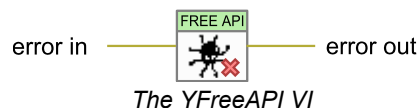
In the case of an IP address, the YRegisterHub VI tries to contact this address and generates an error if it does not succeed, unless the *async* parameter is set to TRUE. If *async* is set to TRUE, no error is generated and Yoctopuce modules corresponding to that IP address become automatically available as soon as the said machine can be reached.

If everything went well, the *successful* output contains the value TRUE. In the opposite case, it contains the value FALSE and the *error msg* output contains a string of characters with a description of the error.

You can use several YRegisterHub VIs with distinct URLs if you so wish. However, on the same machine, there can be only one process accessing local Yoctopuce modules directly by USB (*url* set to "usb"). You can easily work around this limitation by running the VirtualHub software on the local machine and using the "127.0.0.1" url.

YFreeAPI

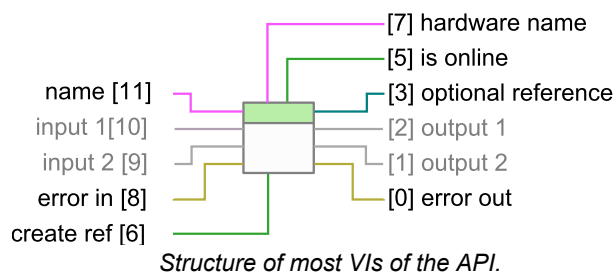
The YFreeAPI VI enables you to free resources allocated by the Yoctopuce API.



You must call the YFreeAPI VI when your code is done with the Yoctopuce API. Otherwise, direct USB access (*url* set to "usb") could stay locked after the execution of your VI, and stay so for as long as LabVIEW is not completely closed.

Structure of the VIs corresponding to a class

The other VIs correspond to each function/class of the Yoctopuce API, they all have the same structure:



- Connector [11]: *name* must contain the hardware name or the logical name of the intended function.
- Connectors [10] and [9]: input parameters depending on the nature of the VI.
- Connectors [8] and [0] : *error in* and *error out*.
- Connector [7] : Unique hardware name of the found function.
- Connector [5] : *is online* contains TRUE if the function is available, FALSE otherwise.
- Connectors [2] and [1]: output values depending on the nature of the VI.
- Connector [6]: If this input is set to TRUE, connector [3] contains a reference to the *Proxy* objects implemented by the VI⁶. This input is initialized to FALSE by default.

⁴ www.yoctopuce.com/EN/products/category/extensions-and-networking

⁵ <http://www.yoctopuce.com/EN/virtualhub.php>

⁶ see section *Using Proxy objects*

- Connector [3]: Reference on the *Proxy* object implemented by the VI if input [6] is TRUE. This object enables you to access additional features.

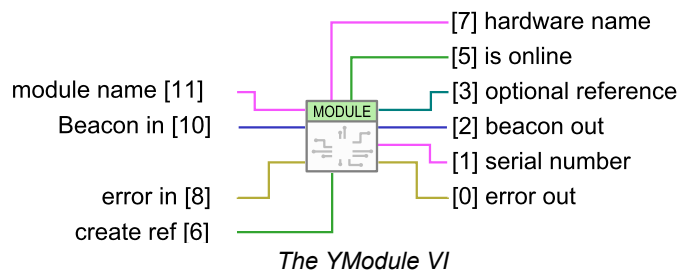
You can find the list of functions available on your Yocto-Display-ePaper-C in chapter *Programming, general concepts*.

If the desired function (parameter *name*) is not available, this does not generate an error, but the *is online* output contains FALSE and all the other outputs contain the value "N/A" whenever possible. If the desired function becomes available later in the life of your program, *is online* switches to TRUE automatically.

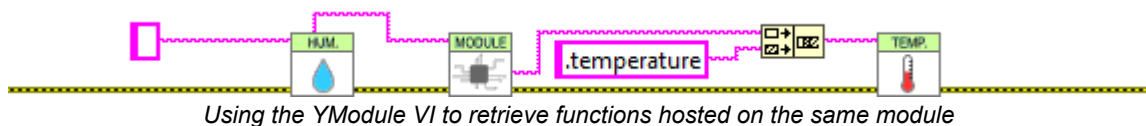
If the *name* parameter contains an empty string, the VI targets the first available function of the same type. If no function is available, *is online* is set to FALSE.

The YModule VI

The YModule VI enables you to interface with the "module" section of each Yoctopuce module. It enables you to drive the module led and to know the serial number of the module.

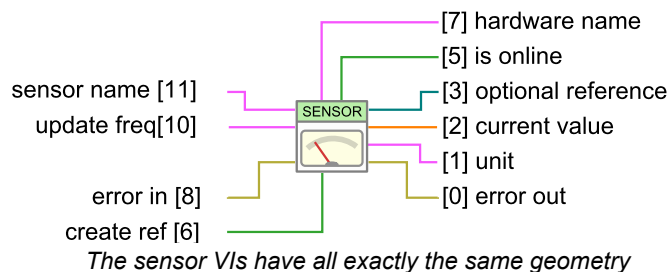


The *name* input works slightly differently from other VIs. If it is called with a *name* parameter corresponding to a function name, the YModule VI finds the *Module* function of the module hosting the function. You can therefore easily find the serial number of the module of any function. This enables you to build the name of other functions which are located on the same module. The following example finds the first available *YHumidity* function and builds the name of the *YTemperature* function located on the same module. The examples provided with the Yoctopuce API make extensive use of this technique.



The sensor VIs

All the VIs corresponding to Yoctopuce sensors have exactly the same geometry. Both outputs enable you to retrieve the value measured by the corresponding sensor as well the unit used.

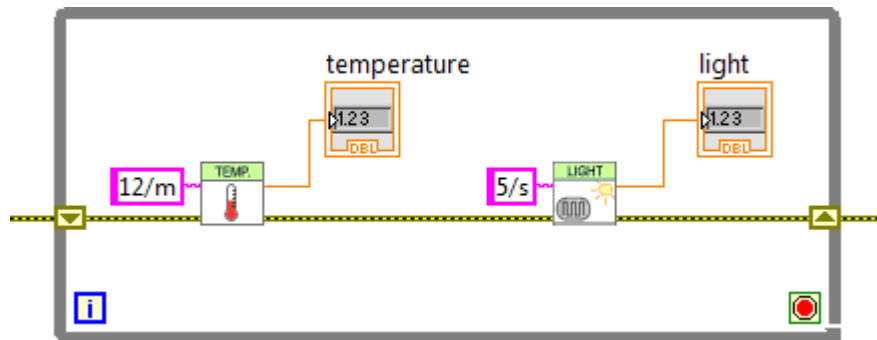


The *update freq* input parameter is a character string enabling you to configure the way in which the output value is updated:

- "auto" : The VI value is updated as soon as the sensor detects a significant modification of the value. It is the default behavior.
- "x/s" : The VI value is updated x times per second with the current value of the sensor.

- "x/m","x/h": The VI value is updated x times per minute (resp. hour) with the average value over the latest period. Note, maximum frequencies are (60/m) and (3600/h), for higher frequencies use the (x/s) syntax.

The update frequency of the VI is a parameter managed by the physical Yoctopuce module. If several VIs try to change the frequency of the same sensor, the valid configuration is that of the latest call. It is however possible to set different update frequencies to different sensors on the same Yoctopuce module.

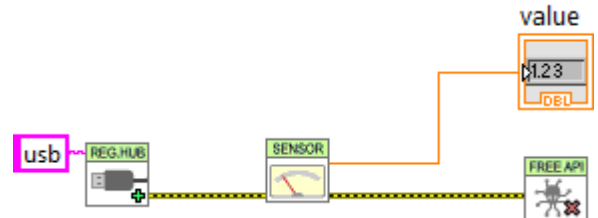


Changing the update frequency of the same module

The update frequency of the VI is completely independent from the sampling frequency of the sensor, which you usually cannot modify. It is useless and counterproductive to define an update frequency higher than the sensor sampling frequency.

13.5. Functioning and use of VIs

Here is one of the simplest example of VIs using the Yoctopuce API.

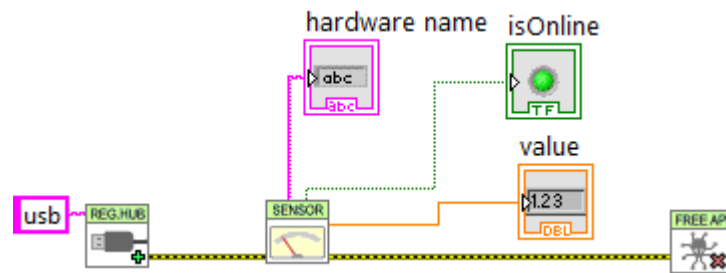


Minimal example of use of the LabVIEW Yoctopuce API

This example is based on the `YSensor` VI which is a generic VI enabling you to interface any sensor function of a Yoctopuce module. You can replace this VI by any other from the Yoctopuce API, they all have the same geometry and work in the same way. This example is limited to three actions:

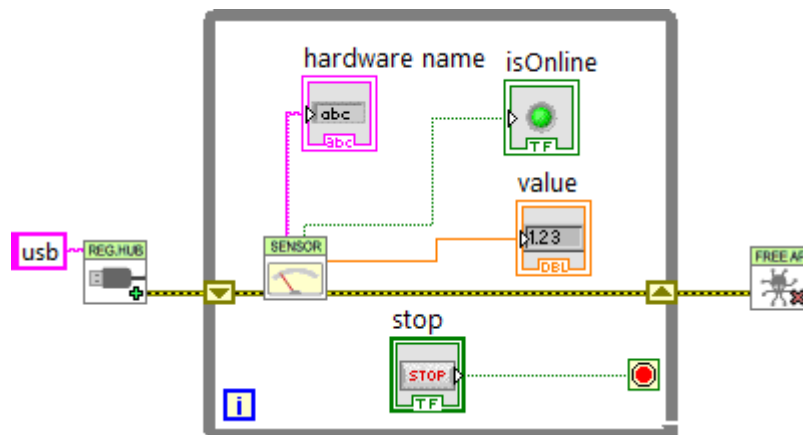
1. It initializes the API in native ("usb") mode with the `YRegisterHub` VI.
2. It displays the value of the first Yoctopuce sensor it finds thanks to the `YSensor` VI.
3. It frees the API thanks to the `YFreeAPI` VI.

This example automatically looks for an available sensor. If there is such a sensor, we can retrieve its name through the *hardware name* output and the *isOnline* output equals TRUE. If there is no available sensor, the VI does not generate an error but emulates a ghost sensor which is "offline". However, if later in the life of the application, a sensor becomes available because it has been connected, *isOnline* switches to TRUE and the *hardware name* contains the name of the sensor. We can therefore easily add a few indicators in the previous example to know how the executions goes.



Use of the hardware name and isOnline outputs

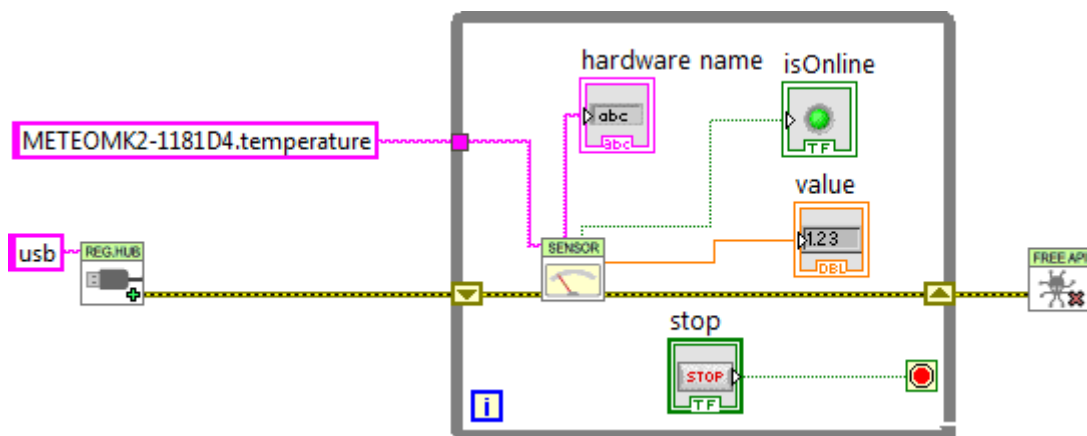
The VIs of the Yoctopuce API are actually an entry door into the library. Internally, this mechanism works independently of the Yoctopuce VIs. Indeed, most communications with electronic modules are managed automatically as background tasks. Therefore, you do not necessarily need to take any specific care to use Yoctopuce VIs, you can for example use them in a non-delayed loop without creating any specific problem for the API.



The Yoctopuce VIs can be used in a non-delayed loop

Note that the YRegisterHub VI is not inside the loop. The YRegisterHub VI is used to initialize the API. Unless you have several URLs that you need to register, it is better to call the YRegisterHub VI only once.

When the *name* parameter is initialized to an empty string, the Yoctopuce VIs automatically look for a function they can work with. This is very handy when you know that there is only one function of the same type available and when you do not want to manage its name. If the *name* parameter contains a hardware name or a logical name, the VI looks for the corresponding function. If it does not find it, it emulates an *offline* function while it waits for the true function to become available.

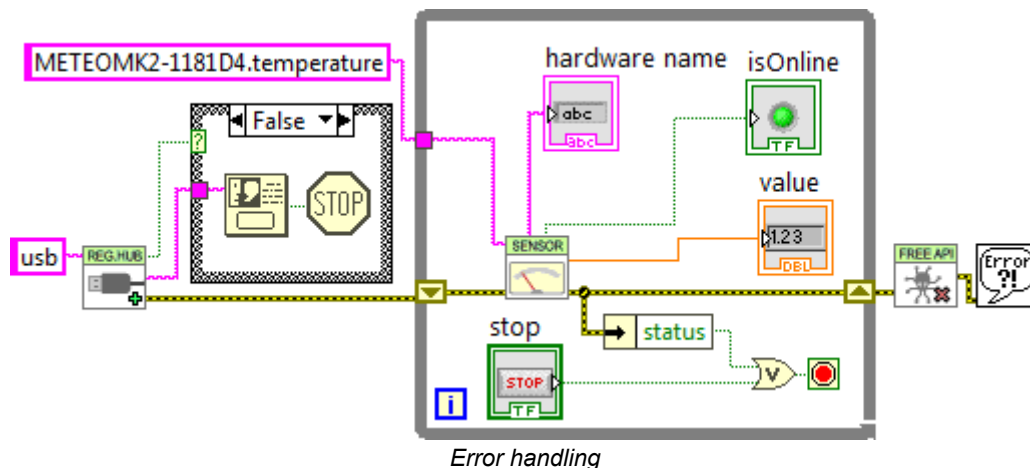


Using names to identify the functions to be used

Error handling

The LabVIEW Yoctopuce API is coded to handle errors as smoothly as possible: for example, if you use a VI to access a function which does not exist, the *isOnline* output is set to FALSE, the other outputs are set to *NaN*, and thus the inputs do not have any impact. Fatal errors are propagated through the traditional *error in*, *error out* channel.

However, the YRegisterHub VI manages connection errors slightly differently. In order to make them easier to manage, connection errors are signaled with *Success* and *error msg* outputs. If there is an issue during a call to the YRegisterHub VI, *Success* contains FALSE and *error msg* contains a description of the error.

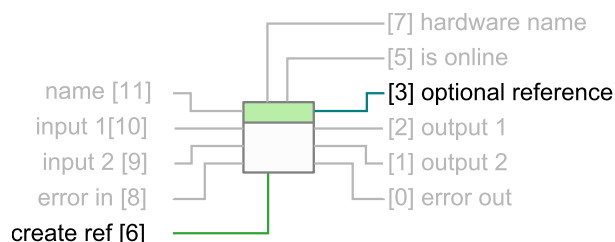


The most common error message is "Another process is already using yAPI". It means that another application, LabVIEW or other, already uses the API in native USB mode. For technical reasons, the native USB API can be used by only one application at the same time on the same machine. You can easily work around this limitation by using the network mode.

13.6. Using Proxy objects

The Yoctopuce API contains hundreds of methods, functions, and properties. It was not possible, or desirable, to create a VI for each of them. Therefore, there is a VI per class that shows the two properties that Yoctopuce deemed the most useful, but this does not mean that the rest is not available.

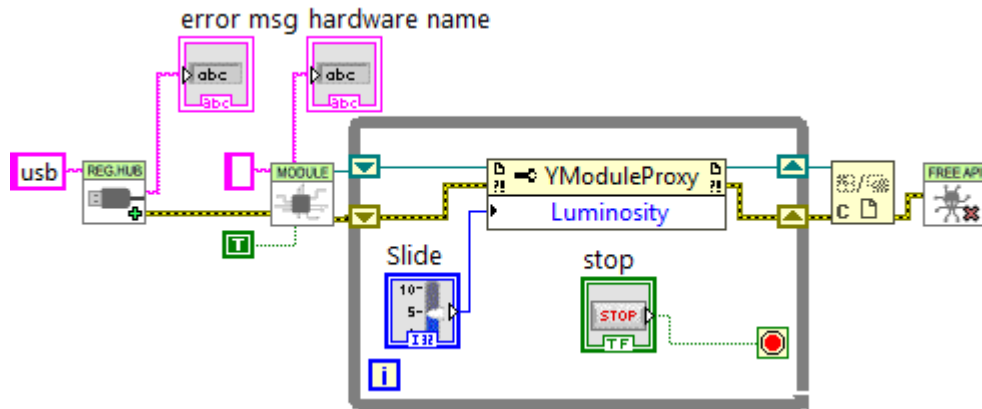
Each VI corresponding to a class has two connectors *create ref* and *optional ref* which enable you to obtain a reference on the Proxy object of the .NET Proxy API on which the LabVIEW library is built.



The connectors to obtain a reference on the Proxy object corresponding to the VI

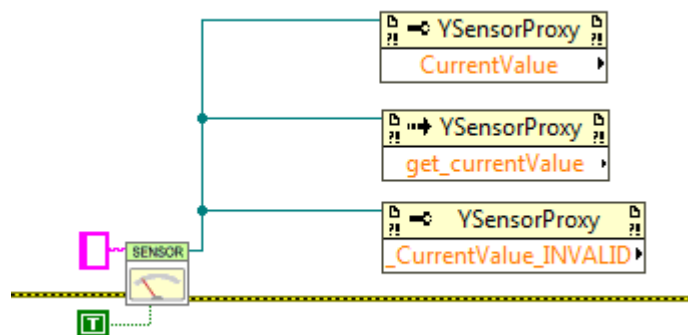
To obtain this reference, you only need to set *optional ref* to TRUE. Note, it is essential to close all references created in this way, otherwise you risk to quickly saturate the computer memory.

Here is an example which uses this technique to change the luminosity of the leds of a Yoctopuce module.



Regulating the luminosity of the leds of a module

Note that each reference allows you to obtain properties (*property nodes*) as well as methods (*invoke nodes*). By convention, properties are optimized to generate a minimum of communication with the modules. Therefore, we recommend to use them rather than the corresponding *get_xxx* and *set_xxx* methods which might seem equivalent but which are not optimized. Properties also enable you to retrieve the various constants of the API, prefixed with the "_" character. For technical reasons, the *get_xxx* and *set_xxx* methods are not all available as properties.

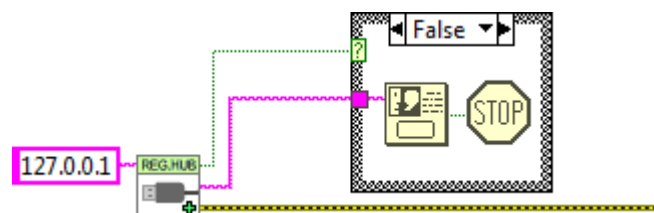


Property and Invoke nodes: Using properties, methods and constants

You can find a description of all the available properties, functions, and methods in the documentation of the *.NET Proxy API*.

Network mode

On a given machine, there can be only one process accessing local Yoctopuce modules directly by USB (url set to "usb"). It is however possible that multiple process connect in parallel to YoctoHubs⁷ or to a machine on which *VirtualHub*⁸ is running, including the local machine. Therefore, if you use the local address of your machine (127.0.0.1) and if a VirtualHub runs on it, you can work around the limitation which prevents using the native USB API in parallel.

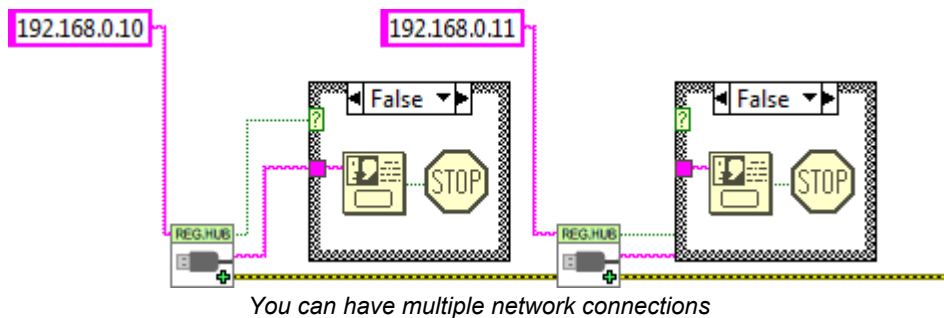


Network mode

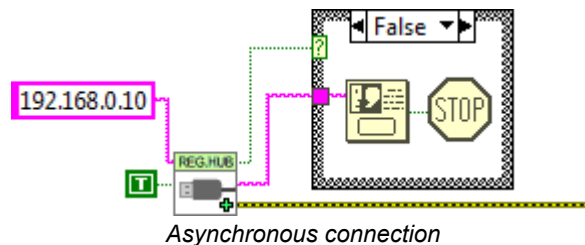
⁷ <https://www.yoctopuce.com/EN/products/category/extensions-and-networking>

⁸ www.yoctopuce.com/EN/virtualhub.php

In the same way, there is no limitation on the number of network interfaces to which the API can connect itself in parallel. This means that it is quite possible to make multiple calls to the YRegisterHub VI. This is the only case where it is useful to call the YRegisterHub VI several times in the life of the application.



By default, the YRegisterHub VI tries to connect itself on the address given as parameter and generates an error (*success=FALSE*) when it cannot do so because nobody answers. But if the *async* parameter is initialized to *TRUE*, no error is generated when the connection does not succeed. If the connection becomes possible later in the life of the application, the corresponding modules are automatically made available.

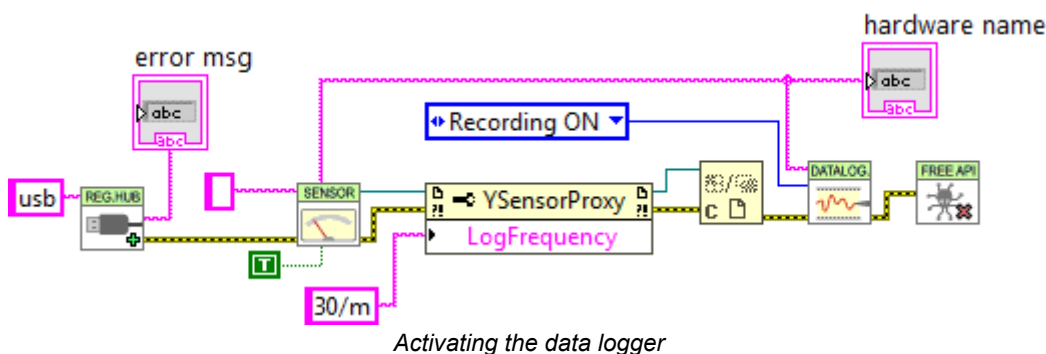


13.7. Managing the data logger

Almost all the Yoctopuce sensors have a data logger which enables you to store the measures of the sensors in the non-volatile memory of the module. You can configure the data logger with the VirtualHub, but also with a little bit of LabVIEW code.

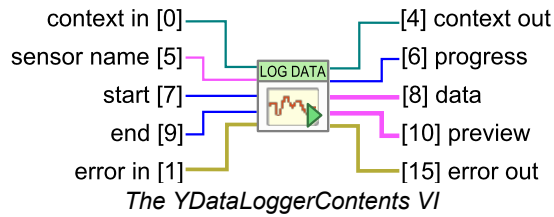
Logging

To do so, you must configure the logging frequency by using the "LogFrequency" property which you can reach with a reference on the *Proxy* object of the sensor you are using. Then, you must turn the data logger on thanks to the YDataLogger VI. Note that, like with the YModule VI, you can obtain the YDataLogger VI corresponding to a module with its own name, but also with the name of any of the functions available on the same module.



Reading

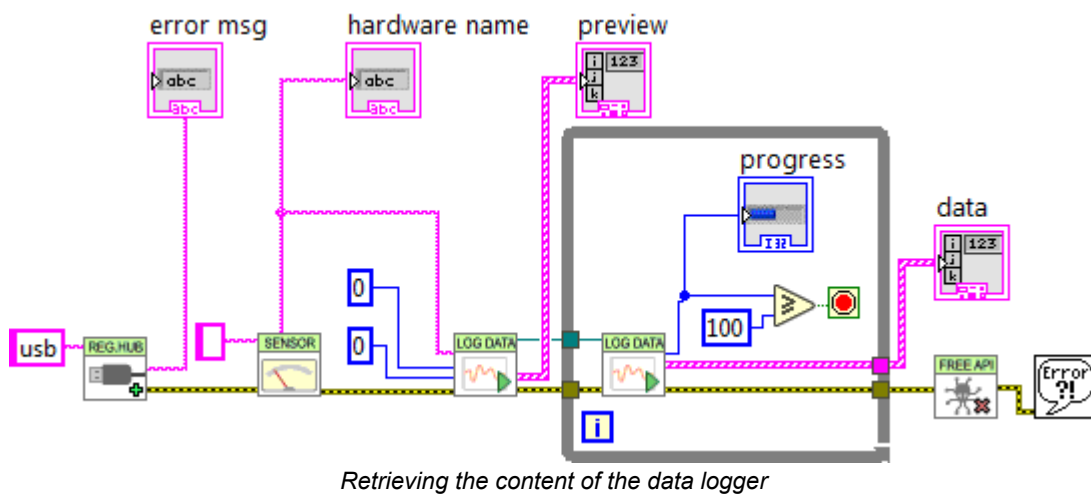
You can retrieve the data in the data logger with the YDataLoggerContents VI.



Retrieving the data from the logger of a Yoctopuce module is a slow process which can take up to several tens of seconds. Therefore, we designed the VI enabling this operation to work iteratively.

As a first step, you must call the VI with a sensor name, a start date, and an end date (UTC UNIX timestamp). The (0,0) pair enables you to obtain the complete content of the data logger. This first call enables you to obtain a summary of the data logger content and a context.

As a second step, you must call the *YDataLoggerContents* VI in a loop with the context parameter, until the *progress* output reaches the 100 value. At this time, the data output represents the content of the data logger.



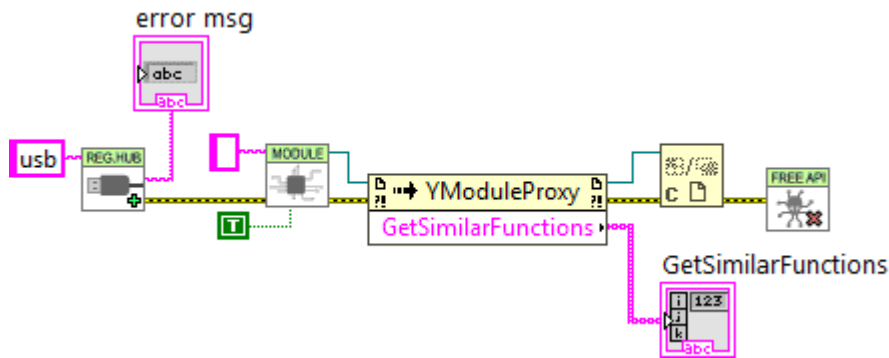
The results and the summary are returned as an array of structures containing the following fields:

- *startTime*: beginning of the measuring period
- *endTime*: end of the measuring period
- *averageValue*: average value for the period
- *minValue*: minimum value over the period
- *maxValue*: maximum value over the period

Note that if the logging frequency is superior to 1Hz, the data logger stores only current values. In this case, *averageValue*, *minValue*, and *maxValue* share the same value.

13.8. Function list

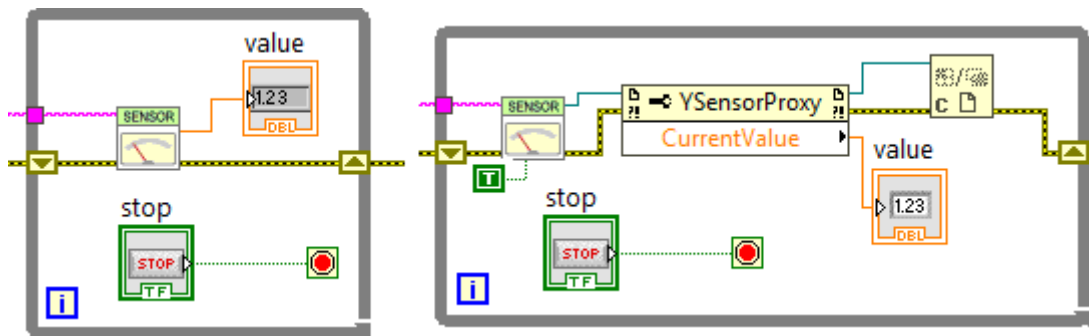
Each VI corresponding to an object of the *Proxy API* enables you to list all the functions of the same class with the *getSimilarFunctions()* method of the corresponding *Proxy* object. Thus, you can easily perform an inventory of all the connected modules, of all the connected sensors, of all the connected relays, and so on.



Retrieving the list of all the modules which are connected

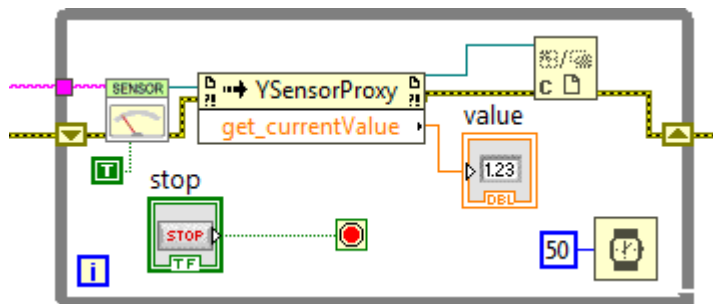
13.9. A word on performances

The LabVIEW Yoctopuce API is optimized so that all the VIs and *.NET Proxy* API object properties generate a minimum of communication with Yoctopuce modules. Thus, you can use them in loops without taking any specific precaution: you *do not have to* slow down the loops with a timer.



These two loops generate little USB communication and do not need to be slowed down

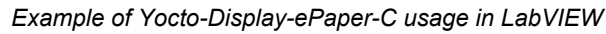
However, almost all the methods of the available Proxy objects initiate a communication with the Yoctopuce modules each time they are called. You should therefore avoid calling them too often without purpose.



This loop, using a method, must be slowed down

13.10. A full example of a LabVIEW program

Here is a very simple example illustrating the use of a Yocto-Display-ePaper-C in LabVIEW. After calling the VI *RegisterHub*, the VI *YDisplay* finds the first available screen. From there, the VI retrieves a reference to *YDisplayProxy* and uses it to initialize the screen and to retrieve its dimensions. Next, it retrieves a reference to layer #0 and uses it to display the contents of the *Text to display* field in the center of the screen whenever the user changes the text and presses the TAB key. Once the application is finished, the Yoctopuce API is released using the *YFreeAPI* VI.



13.11. Differences from other Yoctopuce APIs

These differences were introduced to make the use of modules as easy as possible and requiring a minimum of LabVIEW code.

In the opposite to other languages, you must absolutely free the native API by calling the `YFreeAPI VI` when your code does not need to use the API anymore. If you forget this call, the native API risks to stay locked for the other applications until LabVIEW is completely closed.

In the opposite to classes of the other APIs, classes available in LabVIEW implement *properties*. By convention, these properties are optimized to generate a minimum of communication with the modules while automatically refreshing. By contrast, methods of type *get_xxx* and *set_xxx* systematically generate communications with the Yoctopuce modules and must be called sparingly.

There is no callback in the LabVIEW Yoctopuce API, the VIs automatically refresh: they are based on the properties of the *.NET Proxy* API objects.

14. Using the Yocto-Display-ePaper-C with Java

Java is an object oriented language created by Sun Microsystem. Beside being free, its main strength is its portability. Unfortunately, this portability has an excruciating price. In Java, hardware abstraction is so high that it is almost impossible to work directly with the hardware. Therefore, the Yoctopuce API does not support native mode in regular Java. The Java API needs VirtualHub to communicate with Yoctopuce devices.

14.1. Getting ready

Go to the Yoctopuce web site and download the following items:

- The Java programming library¹
- VirtualHub² for Windows, macOS or Linux, depending on your OS

The library is available as source files as well as a *jar* file. Decompress the library files in a folder of your choice, connect your modules, run VirtualHub, and you are ready to start your first tests. You do not need to install any driver.

In order to keep them simple, all the examples provided in this documentation are console applications. Naturally, the libraries function in a strictly identical manner if you integrate them in an application with a graphical interface.

14.2. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a Java code snippet to use the Display function.

```
[...]
// Get access to your device, through the VirtualHub running locally
YAPI.RegisterHub("127.0.0.1");
[...]

// Retrieve the object used to interact with the device
display = YDisplay.FindDisplay("EPAPER1C-123456.display");

// Hot-plug is easy: just check that the device is online
if (display.isOnline())
{
```

¹ www.yoctopuce.com/EN/libraries.php

² www.yoctopuce.com/EN/virtualhub.php

```
// Use display.get_displayLayer()
[...]
```

Let us look at these lines in more details.

YAPI.RegisterHub

The `yAPI.RegisterHub` function initializes the Yoctopuce API and indicates where the modules should be looked for. The parameter is the address of the Virtual Hub able to see the devices. If the initialization does not succeed, an exception is thrown.

YDisplay.FindDisplay

The `YDisplay.FindDisplay` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can use logical names as well, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number *EPAPER1C-123456* which you have named *"MyModule"*, and for which you have given the *display* function the name *"MyFunction"*. The following five calls are strictly equivalent, as long as *"MyFunction"* is defined only once.

```
display = YDisplay.FindDisplay("EPAPER1C-123456.display")
display = YDisplay.FindDisplay("EPAPER1C-123456.MyFunction")
display = YDisplay.FindDisplay("MyModule.display")
display = YDisplay.FindDisplay("MyModule.MyFunction")
display = YDisplay.FindDisplay("MyFunction")
```

`YDisplay.FindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `YDisplay.FindDisplay` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YDisplay.FindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example

Launch your Java environment and open the corresponding sample project provided in the directory **Examples/Doc-GettingStarted-Yocto-Display-ePaper-C** of the Yoctopuce library.

In this example, you will recognize the functions explained above, but this time used with all the side materials needed to make it work nicely as a small demo.

```
/*
 *
 * $Id: Demo.java 75124 2026-07-06 09:15:16Z seb $
 *
 * An example that shows how to use a Yocto-Display
 */
```

```

* You can find more information on our web site:
* Yocto-Display documentation:
*   https://www.yoctopuce.com/EN/products/yocto-display/doc.html
* JAVA API Reference:
*   https://www.yoctopuce.com/EN/doc/reference/yoctolib-java-EN.html
*/

import java.util.*;

import com.yoctopuce.YoctoAPI.*;

import java.util.logging.Level;
import java.util.logging.Logger;

public class Demo
{

    public static void main(String[] args)
    {

        YDisplay disp;
        int[] colors = {0xFFFFFFFF, 0x000000, 0xFF0000, 0xFFFF00};

        // API init
        try {
            // setup the API to use local VirtualHub
            YAPI.RegisterHub("127.0.0.1");
        } catch (YAPI_Exception ex) {
            System.out.println("Cannot contact VirtualHub on 127.0.0.1 (" +
ex.getLocalizedMessage() + ")");
            System.out.println("Ensure that the VirtualHub application is running");
            System.exit(1);
        }

        if (args.length == 0) {
            disp = YDisplay.FirstDisplay();
            if (disp == null) {
                System.out.println("No module connected (check USB cable)");
                System.exit(1);
            }
        } else {
            disp = YDisplay.FindDisplay(args[0] + ".display");
        }

        try {

            // Makes sure the Panel type is set
            String paneltype = disp.get_displayPanel();
            if (Objects.equals(paneltype, "NOT_SET")) {
                System.out.println("Use the virtual to Configure the panel first");
                YAPI.Sleep(3000);
                System.exit(1);
            }

            // retrieve the display size
            int w = disp.get_displayWidth();
            int h = disp.get_displayHeight();
            int middleX = (int) (w / 2);
            int middleY = (int) (h / 2);
            System.out.printf("Using device %s (panel: %s  %d x %d pixels)\n",
disp.get_serialNumber(), paneltype, w, h);

            // retrieve the first layer
            YDisplayLayer l0 = disp.get_displayLayer(0);
            l0.selectFont("medium.yfm");
            boolean animation = true;
            disp.triggerRefresh(); // make sure next refresh will be a full one
            Random rnd = new Random();

            while (animation) {
                // prevent refreshing for 2 sec
                disp.postponeRefresh(2000);
                l0.clear();
                // draw a few circle
                for (int i = 0; i < 15; i++) {
                    int cx = rnd.nextInt(w);

```

```

        int cy = rnd.nextInt(h);
        int r = (int) (h / 20) + rnd.nextInt((int) (h / 10));
        10.selectFillColor(colors[rnd.nextInt(4)]);
        10.drawDisc(cx, cy, r);
        10.drawCircle(cx, cy, r);
    }
    // draw a rectangle with panel type in it
    10.selectFillColor(0xffffffff);
    10.drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    10.drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    10.drawText(middleX, middleY, YDisplayLayer.ALIGN.CENTER, paneltype);
    disp.triggerRefresh(); // display is allowed to refresh again
    YAPI.Sleep(1000);
    // if no fast refresh available, don't even try to run animations
    if (paneltype.indexOf("KS") < 0) animation = false;
}

} catch (YAPI_Exception ex) {
    System.out.println("Exception durring execution (" + ex.getLocalizedMessage() +
    ")");
    YAPI.FreeAPI();
    System.exit(1);
}

}

}

```

14.3. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```

import com.yoctopuce.YoctoAPI.*;
import java.util.logging.Level;
import java.util.logging.Logger;

public class Demo {

    public static void main(String[] args)
    {
        try {
            // setup the API to use local VirtualHub
            YAPI.RegisterHub("127.0.0.1");
        } catch (YAPI_Exception ex) {
            System.out.println("Cannot contact VirtualHub on 127.0.0.1 (" +
            ex.getLocalizedMessage() + ")");
            System.out.println("Ensure that the VirtualHub application is running");
            System.exit(1);
        }
        System.out.println("usage: demo [serial or logical name] [ON/OFF]");

        YModule module;
        if (args.length == 0) {
            module = YModule.FirstModule();
            if (module == null) {
                System.out.println("No module connected (check USB cable)");
                System.exit(1);
            }
        } else {
            module = YModule.FindModule(args[0]); // use serial or logical name
        }

        try {
            if (args.length > 1) {
                if (args[1].equalsIgnoreCase("ON")) {
                    module.setBeacon(YModule.BEACON_ON);
                } else {
                    module.setBeacon(YModule.BEACON_OFF);
                }
            }
            System.out.println("serial:      " + module.get_serialNumber());
            System.out.println("logical name: " + module.get_logicalName());
        }
    }
}

```

```

        System.out.println("luminosity:  " + module.get_luminosity());
        if (module.get_beacon() == YModule.BEACON_ON) {
            System.out.println("beacon:      ON");
        } else {
            System.out.println("beacon:      OFF");
        }
        System.out.println("upTime:      " + module.get_upTime() / 1000 + " sec");
        System.out.println("USB current:  " + module.get_usbCurrent() + " mA");
        System.out.println("logs:\n" + module.get_lastLogs());
    } catch (YAPI_Exception ex) {
        System.out.println(args[1] + " not connected (check identification and USB
cable)");
    }
    YAPI.FreeAPI();
}
}

```

Each property `xxx` of the module can be read thanks to a method of type `YModule.get_xxxx()`, and properties which are not read-only can be modified with the help of the `YModule.set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `YModule.set_xxx()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `YModule.saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `YModule.revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```

import com.yoctopuce.YoctoAPI.*;

public class Demo {

    public static void main(String[] args)
    {
        try {
            // setup the API to use local VirtualHub
            YAPI.RegisterHub("127.0.0.1");
        } catch (YAPI_Exception ex) {
            System.out.println("Cannot contact VirtualHub on 127.0.0.1 (" +
ex.getLocalizedMessage() + ")");
            System.out.println("Ensure that the VirtualHub application is running");
            System.exit(1);
        }

        if (args.length != 2) {
            System.out.println("usage: demo <serial or logical name> <new logical name>");
            System.exit(1);
        }

        YModule m;
        String newname;

        m = YModule.FindModule(args[0]); // use serial or logical name

        try {
            newname = args[1];
            if (!YAPI.CheckLogicalName(newname))
            {
                System.out.println("Invalid name (" + newname + ")");
                System.exit(1);
            }

            m.set_logicalName(newname);
            m.saveToFlash(); // do not forget this

            System.out.println("Module: serial= " + m.get_serialNumber());
            System.out.println(" / name= " + m.get_logicalName());
        } catch (YAPI_Exception ex) {
            System.out.println("Module " + args[0] + "not connected (check identification
and USB cable)");
            System.out.println(ex.getMessage());
        }
    }
}

```

```

        System.exit(1);
    }

    YAPI.FreeAPI();
}

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `YModule.saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `YModule.yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not null. Below a short example listing the connected modules.

```

import com.yoctopuce.YoctoAPI.*;

public class Demo {

    public static void main(String[] args)
    {
        try {
            // setup the API to use local VirtualHub
            YAPI.RegisterHub("127.0.0.1");
        } catch (YAPI_Exception ex) {
            System.out.println("Cannot contact VirtualHub on 127.0.0.1 (" +
ex.getLocalizedMessage() + ")");
            System.out.println("Ensure that the VirtualHub application is running");
            System.exit(1);
        }

        System.out.println("Device list");
        YModule module = YModule.FirstModule();
        while (module != null) {
            try {
                System.out.println(module.get_serialNumber() + " (" +
module.get_productName() + ")");
            } catch (YAPI_Exception ex) {
                break;
            }
            module = module.nextModule();
        }
        YAPI.FreeAPI();
    }
}

```

14.4. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software.

In the Java API, error handling is implemented with exceptions. Therefore you must catch and handle correctly all exceptions that might be thrown by the API if you do not want your software to crash as soon as you unplug a device.

15. Using the Yocto-Display-ePaper-C with Android

To tell the truth, Android is not a programming language, it is an operating system developed by Google for mobile appliances such as smart phones and tablets. But it so happens that under Android everything is programmed with the same programming language: Java. Nevertheless, the programming paradigms and the possibilities to access the hardware are slightly different from classical Java, and this justifies a separate chapter on Android programming.

15.1. Native access and VirtualHub

In the opposite to the classical Java API, the Java for Android API can access USB modules natively. However, as there is no VirtualHub running under Android, it is not possible to remotely control Yoctopuce modules connected to a machine under Android. Naturally, the Java for Android API remains perfectly able to connect itself to VirtualHub running on another OS.

15.2. Getting ready

Go to the Yoctopuce web site and download the Java for Android programming library¹. The library is available as source files, and also as a jar file. Connect your modules, decompress the library files in the directory of your choice, and configure your Android programming environment so that it can find them.

To keep them simple, all the examples provided in this documentation are snippets of Android applications. You must integrate them in your own Android applications to make them work. However, you can find complete applications in the examples provided with the Java for Android library.

15.3. Compatibility

In an ideal world, you would only need to have a smart phone running under Android to be able to make Yoctopuce modules work. Unfortunately, it is not quite so in the real world. A machine running under Android must fulfil to a few requirements to be able to manage Yoctopuce USB modules natively.

Android version

Our library can be compiled to work with older versions, as long as the Android tools allow us to support them, i.e. approximately versions of the last ten years.

¹ www.yoctopuce.com/EN/libraries.php

USB host support

Naturally, not only must your machine have a USB port, this port must also be able to run in *host* mode. In *host* mode, the machine literally takes control of the devices which are connected to it. The USB ports of a desktop computer, for example, work in *host* mode. The opposite of the *host* mode is the *device* mode. USB keys, for instance, work in *device* mode: they must be controlled by a *host*. Some USB ports are able to work in both modes, they are *OTG (On The Go)* ports. It so happens that many mobile devices can only work in *device* mode: they are designed to be connected to a charger or a desktop computer, and nothing else. It is therefore highly recommended to pay careful attention to the technical specifications of a product working under Android before hoping to make Yoctopuce modules work with it.

Unfortunately, having a correct version of Android and USB ports working in *host* mode is not enough to guaranty that Yoctopuce modules will work well under Android. Indeed, some manufacturers configure their Android image so that devices other than keyboard and mass storage are ignored, and this configuration is hard to detect. As things currently stand, the best way to know if a given Android machine works with Yoctopuce modules consists in trying.

15.4. Activating the USB port under Android

By default, Android does not allow an application to access the devices connected to the USB port. To enable your application to interact with a Yoctopuce module directly connected on your tablet on a USB port, a few additional steps are required. If you intend to interact only with modules connected on another machine through the network, you can ignore this section.

In your `AndroidManifest.xml`, you must declare using the "USB Host" functionality by adding the `<uses-feature android:name="android.hardware.usb.host" />` tag in the `manifest` section.

```
<manifest ...>
  ...
  <uses-feature android:name="android.hardware.usb.host" />
  ...
</manifest>
```

When first accessing a Yoctopuce module, Android opens a window to inform the user that the application is going to access the connected module. The user can deny or authorize access to the device. If the user authorizes the access, the application can access the connected device as long as it stays connected. To enable the Yoctopuce library to correctly manage these authorizations, your must provide a pointer on the application context by calling the `EnableUSBHost` method of the `YAPI` class before the first USB access. This function takes as arguments an object of the `android.content.Context` class (or of a subclass). As the `Activity` class is a subclass of `Context`, it is simpler to call `YAPI.EnableUSBHost(this)` ; in the method `onCreate` of your application. If the object passed as parameter is not of the correct type, a `YAPI_Exception` exception is generated.

```
...
@Override
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    try {
        // Pass the application Context to the Yoctopuce Library
        YAPI.EnableUSBHost(this);
    } catch (YAPI_Exception e) {
        Log.e("Yocto", e.getLocalizedMessage());
    }
}
...
```

Autorun

It is possible to register your application as a default application for a USB module. In this case, as soon as a module is connected to the system, the application is automatically launched. You must

add `<action android:name="android.hardware.usb.action.USB_DEVICE_ATTACHED"/>` in the section `<intent-filter>` of the main activity. The section `<activity>` must have a pointer to an XML file containing the list of USB modules which can run the application.

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
...
<uses-feature android:name="android.hardware.usb.host" />
...
<application ... >
    <activity
        android:name=".MainActivity" >
        <intent-filter>
            <action android:name="android.intent.action.MAIN" />
            <action android:name="android.hardware.usb.action.USB_DEVICE_ATTACHED" />
            <category android:name="android.intent.category.LAUNCHER" />
        </intent-filter>

        <meta-data
            android:name="android.hardware.usb.action.USB_DEVICE_ATTACHED"
            android:resource="@xml/device_filter" />
        </activity>
    </application>
</manifest>
```

The XML file containing the list of modules allowed to run the application must be saved in the `res/xml` directory. This file contains a list of USB *vendorId* and *deviceId* in decimal. The following example runs the application as soon as a Yocto-Relay or a YoctoPowerRelay is connected. You can find the vendorID and the deviceId of Yoctopuce modules in the characteristics section of the documentation.

```
<?xml version="1.0" encoding="utf-8"?>

<resources>
    <usb-device vendor-id="9440" product-id="12" />
    <usb-device vendor-id="9440" product-id="13" />
</resources>
```

15.5. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a Java code snippet to use the Display function.

```
[...]
// Enable detection of USB devices
YAPI.EnableUSBHost(this);
YAPI.RegisterHub("usb");
[...]
// Retrieve the object used to interact with the device
display = YDisplay.FindDisplay("EPAPER1C-123456.display");

// Hot-plug is easy: just check that the device is online
if (display.isOnline()) {
    // Use display.get_displayLayer()
    [...]
}
[...]
```

Let us look at these lines in more details.

YAPI.EnableUSBHost

The `YAPI.EnableUSBHost` function initializes the API with the Context of the current application. This function takes as argument an object of the `android.content.Context` class (or of a subclass). If you intend to connect your application only to other machines through the network, this function is facultative.

YAPI.RegisterHub

The `yAPI.RegisterHub` function initializes the Yoctopuce API and indicates where the modules should be looked for. The parameter is the address of the virtual hub able to see the devices. If the string "usb" is passed as parameter, the API works with modules locally connected to the machine. If the initialization does not succeed, an exception is thrown.

YDisplay.FindDisplay

The `YDisplay.FindDisplay` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can use logical names as well, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number *EPAPER1C-123456* which you have named "MyModule", and for which you have given the *display* function the name "MyFunction". The following five calls are strictly equivalent, as long as "MyFunction" is defined only once.

```
display = YDisplay.FindDisplay("EPAPER1C-123456.display")
display = YDisplay.FindDisplay("EPAPER1C-123456.MyFunction")
display = YDisplay.FindDisplay("MyModule.display")
display = YDisplay.FindDisplay("MyModule.MyFunction")
display = YDisplay.FindDisplay("MyFunction")
```

`YDisplay.FindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `YDisplay.FindDisplay` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YDisplay.FindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example

Launch your Java environment and open the corresponding sample project provided in the directory **Examples//Doc-Examples** of the Yoctopuce library.

In this example, you can recognize the functions explained above, but this time used with all the side materials needed to make it work nicely as a small demo.

```
package com.yoctopuce.doc_examples;

import android.app.Activity;
import android.os.Bundle;
import android.view.View;
import android.widget.AdapterView;
import android.widget.AdapterView.OnItemClickListener;
import android.widget.ArrayAdapter;
import android.widget.EditText;
import android.widget.Spinner;

import com.yoctopuce.YoctoAPI.YAPI;
import com.yoctopuce.YoctoAPI.YAPI_Exception;
```

```

import com.yoctopuce.YoctoAPI.YDisplay;
import com.yoctopuce.YoctoAPI.YDisplayLayer;

import java.util.Random;

public class GettingStarted_Yocto_Display_ePaper extends Activity implements
OnItemSelectedListener {

    private YDisplay display = null;
    private ArrayAdapter<String> aa;

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.gettingstarted_yocto_display_epaper);
        Spinner my_spin = (Spinner) findViewById(R.id.spinner1);
        my_spin.setOnItemSelectedListener(this);
        aa = new ArrayAdapter<String>(this, android.R.layout.simple_spinner_item);
        aa.setDropDownViewResource(android.R.layout.simple_spinner_dropdown_item);
        my_spin.setAdapter(aa);
    }

    @Override
    protected void onStart() {
        super.onStart();
        aa.clear();
        try {
            YAPI.EnableUSBHost(this);
            YAPI.RegisterHub("usb");
            YDisplay d = YDisplay.FirstDisplay();
            while (d != null) {
                String hwid = d.get_hardwareId();
                aa.add(hwid);
                d = d.nextDisplay();
            }
        } catch (YAPI_Exception e) {
            e.printStackTrace();
        }
        aa.notifyDataSetChanged();
    }

    @Override
    protected void onStop() {
        super.onStop();
        YAPI.FreeAPI();
    }

    @Override
    public void onItemSelected(AdapterView<?> parent, View view, int pos, long id) {
        String hwid = parent.getItemAtPosition(pos).toString();
        display = YDisplay.FindDisplay(hwid);
        updateDisplay(null);
    }

    @Override
    public void onNothingSelected(AdapterView<?> arg0) {
    }

    public void updateDisplay(View view) {
        if (display == null)
            return;

        EditText message = (EditText) findViewById(R.id.editText1);
        // clean up
        try {
            int[] colors = {0xFFFFFF, 0x000000, 0xFF0000, 0xFFFF00};
            String paneltype = display.get_displayPanel();
            if (paneltype.equals("NOT_SET")) {
                System.out.println("Use the virtual to Configure the panel first");
                YAPI.Sleep(3000);
                System.exit(1);
            }

            // retrieve the display size
            int w = display.get_displayWidth();
            int h = display.get_displayHeight();
            int middleX = (int) (w / 2);

```

```

        int middleY = (int) (h / 2);
        System.out.printf("Using device %s (panel: %s %d x %d pixels)\n",
display.get_serialNumber(), paneltype, w, h);

        // retrieve the first layer
YDisplayLayer l0 = display.get_displayLayer(0);
l0.selectFont("medium.yfm");
display.triggerRefresh(); // make sure next refresh will be a full one
Random rnd = new Random();
// prevent refreshing for 2 sec
display.postponeRefresh(2000);
l0.clear();
// draw a few circle
for (int i = 0; i < 15; i++) {
    int cx = rnd.nextInt(w);
    int cy = rnd.nextInt(h);
    int r = (int) (h / 20) + rnd.nextInt((int) (h / 10));
    l0.selectFillColor(colors[rnd.nextInt(4)]);
    l0.drawDisc(cx, cy, r);
    l0.drawCircle(cx, cy, r);
}
// draw a rectangle with panel type in it
l0.selectFillColor(0xffffffff);
l0.drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
l0.drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
l0.drawText(middleX, middleY, YDisplayLayer.ALIGN.CENTER, paneltype);
display.triggerRefresh(); // display is allowed to refresh again
YAPI.Sleep(1000);
} catch (YAPI_Exception e) {
    e.printStackTrace();
}

}

}

```

15.6. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```

package com.yoctopuce.doc_examples;

import android.app.Activity;
import android.os.Bundle;
import android.view.View;
import android.widget.AdapterView;
import android.widget.AdapterView.OnItemClickListener;
import android.widget.ArrayAdapter;
import android.widget.Spinner;
import android.widget.Switch;
import android.widget.TextView;

import com.yoctopuce.YoctoAPI.YAPI;
import com.yoctopuce.YoctoAPI.YAPI_Exception;
import com.yoctopuce.YoctoAPI.YModule;

public class ModuleControl extends Activity implements OnItemClickListener
{
    private ArrayAdapter<String> aa;
    private YModule module = null;

    @Override
    public void onCreate(Bundle savedInstanceState)
    {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.modulecontrol);
        Spinner my_spin = (Spinner) findViewById(R.id.spinner1);
        my_spin.setOnItemClickListener(this);
        aa = new ArrayAdapter<String>(this, android.R.layout.simple_spinner_item);
        aa.setDropDownViewResource(android.R.layout.simple_spinner_dropdown_item);
    }
}

```

```

        my_spin.setAdapter(aa);
    }

    @Override
    protected void onStart()
    {
        super.onStart();

        try {
            aa.clear();
            YAPI.EnableUSBHost(this);
            YAPI.RegisterHub("usb");
            YModule r = YModule.FirstModule();
            while (r != null) {
                String hwid = r.get_hardwareId();
                aa.add(hwid);
                r = r.nextModule();
            }
        } catch (YAPI_Exception e) {
            e.printStackTrace();
        }
        // refresh Spinner with detected relay
        aa.notifyDataSetChanged();
    }

    @Override
    protected void onStop()
    {
        super.onStop();
        YAPI.FreeAPI();
    }

    private void DisplayModuleInfo()
    {
        TextView field;
        if (module == null)
            return;
        try {
            field = (TextView) findViewById(R.id.serialfield);
            field.setText(module.getSerialNumber());
            field = (TextView) findViewById(R.id.logicalnamefield);
            field.setText(module.getLogicalName());
            field = (TextView) findViewById(R.id.luminosityfield);
            field.setText(String.format("%d%", module.getLuminosity()));
            field = (TextView) findViewById(R.id.uptimefield);
            field.setText(module.getUpTime() / 1000 + " sec");
            field = (TextView) findViewById(R.id.usbcurrentfield);
            field.setText(module.getUsbCurrent() + " mA");
            Switch sw = (Switch) findViewById(R.id.beaconswitch);
            sw.setChecked(module.getBeacon() == YModule.BEACON_ON);
            field = (TextView) findViewById(R.id.logs);
            field.setText(module.get_lastLogs());

        } catch (YAPI_Exception e) {
            e.printStackTrace();
        }
    }

    @Override
    public void onItemSelected(AdapterView<?> parent, View view, int pos, long id)
    {
        String hwid = parent.getItemAtPosition(pos).toString();
        module = YModule.FindModule(hwid);
        DisplayModuleInfo();
    }

    @Override
    public void onNothingSelected(AdapterView<?> arg0)
    {
    }

    public void refreshInfo(View view)
    {
        DisplayModuleInfo();
    }

    public void toggleBeacon(View view)
    {

```

```

        if (module == null)
            return;
        boolean on = ((Switch) view).isChecked();

        try {
            if (on) {
                module.setBeacon(YModule.BEACON_ON);
            } else {
                module.setBeacon(YModule.BEACON_OFF);
            }
        } catch (YAPI_Exception e) {
            e.printStackTrace();
        }
    }
}

```

Each property `xxx` of the module can be read thanks to a method of type `YModule.get_xxxx()`, and properties which are not read-only can be modified with the help of the `YModule.set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `YModule.set_xxx()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `YModule.saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `YModule.revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```

package com.yoctopuce.doc_examples;

import android.app.Activity;
import android.os.Bundle;
import android.view.View;
import android.widget.AdapterView;
import android.widget.AdapterView.OnItemClickListener;
import android.widget.ArrayAdapter;
import android.widget.EditText;
import android.widget.Spinner;
import android.widget.TextView;
import android.widget.Toast;

import com.yoctopuce.YoctoAPI.YAPI;
import com.yoctopuce.YoctoAPI.YAPI_Exception;
import com.yoctopuce.YoctoAPI.YModule;

public class SaveSettings extends Activity implements OnItemClickListener
{
    private ArrayAdapter<String> aa;
    private YModule module = null;

    @Override
    public void onCreate(Bundle savedInstanceState)
    {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.savesettings);
        Spinner my_spin = (Spinner) findViewById(R.id.spinner1);
        my_spin.setOnItemClickListener(this);
        aa = new ArrayAdapter<String>(this, android.R.layout.simple_spinner_item);
        aa.setDropDownViewResource(android.R.layout.simple_spinner_dropdown_item);
        my_spin.setAdapter(aa);
    }

    @Override
    protected void onStart()
    {
        super.onStart();

        try {
            aa.clear();
            YAPI.EnableUSBHost(this);
            YAPI.RegisterHub("usb");

```

```

        YModule r = YModule.FirstModule();
        while (r != null) {
            String hwid = r.get_hardwareId();
            aa.add(hwid);
            r = r.nextModule();
        }
    } catch (YAPI_Exception e) {
        e.printStackTrace();
    }
    // refresh Spinner with detected relay
    aa.notifyDataSetChanged();
}

@Override
protected void onStop()
{
    super.onStop();
    YAPI.FreeAPI();
}

private void DisplayModuleInfo()
{
    TextView field;
    if (module == null)
        return;
    try {
        YAPI.UpdateDeviceList(); // fixme
        field = (TextView) findViewById(R.id.logicalnamefield);
        field.setText(module.getLogicalName());
    } catch (YAPI_Exception e) {
        e.printStackTrace();
    }
}

@Override
public void onItemSelected(AdapterView<?> parent, View view, int pos, long id)
{
    String hwid = parent.getItemAtPosition(pos).toString();
    module = YModule.FindModule(hwid);
    DisplayModuleInfo();
}

@Override
public void onNothingSelected(AdapterView<?> arg0)
{
}

public void saveName(View view)
{
    if (module == null)
        return;

    EditText edit = (EditText) findViewById(R.id.newname);
    String newname = edit.getText().toString();
    try {
        if (!YAPI.CheckLogicalName(newname)) {
            Toast.makeText(getApplicationContext(), "Invalid name (" + newname + ")",
                Toast.LENGTH_LONG).show();
            return;
        }
        module.set_logicalName(newname);
        module.saveToFlash(); // do not forget this
        edit.setText("");
    } catch (YAPI_Exception ex) {
        ex.printStackTrace();
    }
    DisplayModuleInfo();
}
}

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short,

you can use the `YModule.saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `YModule.yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not `null`. Below a short example listing the connected modules.

```
package com.yoctopuce.doc_examples;

import android.app.Activity;
import android.os.Bundle;
import android.util.TypedValue;
import android.view.View;
import android.widget.LinearLayout;
import android.widget.TextView;

import com.yoctopuce.YoctoAPI.YAPI;
import com.yoctopuce.YoctoAPI.YAPI_Exception;
import com.yoctopuce.YoctoAPI.YModule;

public class Inventory extends Activity
{
    @Override
    public void onCreate(Bundle savedInstanceState)
    {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.inventory);
    }

    public void refreshInventory(View view)
    {
        LinearLayout layout = (LinearLayout) findViewById(R.id.inventoryList);
        layout.removeAllViews();

        try {
            YAPI.UpdateDeviceList();
            YModule module = YModule.FirstModule();
            while (module != null) {
                String line = module.get_serialNumber() + " (" + module.get_productName() +
                ")";

                TextView tx = new TextView(this);
                tx.setText(line);
                tx.setTextSize(TypedValue.COMPLEX_UNIT_SP, 20);
                layout.addView(tx);
                module = module.nextModule();
            }
        } catch (YAPI_Exception e) {
            e.printStackTrace();
        }
    }

    @Override
    protected void onStart()
    {
        super.onStart();
        try {
            YAPI.EnableUSBHost(this);
            YAPI.RegisterHub("usb");
        } catch (YAPI_Exception e) {
            e.printStackTrace();
        }
        refreshInventory(null);
    }

    @Override
    protected void onStop()
    {
        super.onStop();
        YAPI.FreeAPI();
    }
}
```

```
}
```

15.7. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software.

In the Java API for Android, error handling is implemented with exceptions. Therefore you must catch and handle correctly all exceptions that might be thrown by the API if you do not want your software to crash soon as you unplug a device.

16. Using Yocto-Display-ePaper-C with TypeScript

TypeScript is an enhanced version of the JavaScript programming language. It is a syntactic superset with strong typing, therefore increasing the code reliability, but transpiled - aka compiled - into JavaScript for execution in any standard Web browser or Node.js environment.

This Yoctopuce library therefore makes it possible to implement JavaScript applications using strong typing. Similarly to our EcmaScript library, it uses the new asynchronous features introduced in ECMAScript 2017, which are now available in all modern JavaScript environments. Note however that at the time of writing, Web browsers and Node.JS cannot use TypeScript code directly, so you must first compile your TypeScript into JavaScript before running it.

The library works both in a Web browser and in Node.js. In order to allow for a static resolution of dependencies, and to avoid ambiguities that can arise when using hybrid environments such as Electron, the choice of the runtime environment must be done explicitly upon import of the library, by referencing in the project either `yocto_api_nodejs.js` or `yocto_api_html.js`.

The library can be integrated in your projects in multiple ways, depending on what best fits your requirements:

- by directly copying the TypeScript library source files into your project, and by adding them to your build script. Only a few files are usually needed to handle most use-cases. You will find TypeScript source files in the `src` subdirectory of our library.
- by using CommonJS module resolution, natively supported by TypeScript, with a package manager such as `npm`. You will find a version of the library transpiled according to CommonJS module standard in the `dist/cjs` subdirectory, including all type definition files (with extension `.d.ts`) and source maps (with extension `.js.map`) enabling source-level error reporting and debugging. We have also published these files on `npmjs` under the name `yoctolib-cjs`.
- by using ECMAScript standard module resolution, also supported by TypeScript, usually referenced by relative path. You will find a version of the library transpiled as an ECMAScript 2015 module in the `dist/esm` subdirectory, including all type definition files (with extension `.d.ts`) and source maps (with extension `.js.map`) enabling source-level error reporting and debugging. We have also published these files on `npmjs` under the name `yoctolib-esm`.

16.1. Using the Yoctopuce library for TypeScript

1. Start by installing TypeScript on your machine if this is not yet done. In order to do so:

- Install on your development machine the official version of Node.js (version 10 or more recent). You can download it for free from the official web site: <http://nodejs.org>. Make sure to install it fully, including `npm`, and add it to the system path.
- Then install TypeScript on your machine using the command line:

```
npm install -g typescript
```

2. Go to the Yoctopuce web site and download the following items:

- The TypeScript programming library¹
- The VirtualHub software² for Windows, macOS, or Linux, depending on your OS. TypeScript and JavaScript are part of those languages which do not generally allow you to directly access to USB peripherals. Therefore the library can only be used to access network-enabled devices (connected through a YoctoHub), or USB devices accessible through Yoctopuce TCP/IP to USB gateway, named *VirtualHub*. No extra driver will be needed, though.

3. Extract the library files in a folder of your choice, and open a command window in the directory where you have installed it. In order to install the few dependencies which are necessary to start the examples, run this command:

```
npm install
```

When the command has run without error, you are ready to explore the examples. They are available in two different trees, depending on the environment that you need to use: `example_html` for running the Yoctopuce library within a Web browser, or `example_nodejs` if you plan to use the library in a Node.js environment.

The method to use for launching the examples depends on the environment. You will find more about it below.

16.2. Refresher on asynchronous I/O in JavaScript

JavaScript is single-threaded by design. In order to handle time-consuming I/O operations, JavaScript relies on asynchronous operations: the I/O call is only triggered but then the code execution flow is suspended. The JavaScript engine is therefore free to handle other pending tasks, such as user interface. Whenever the pending I/O call is completed, the system invokes a callback function with the result of the I/O call to resume execution of the original execution flow.

When used with plain callback functions, as pervasive in Node.js libraries, asynchronous I/O tend to produce code with poor readability, as the execution flow is broken into many disconnected callback functions. Fortunately, the ECMAScript 2015 standard came in with *Promise* objects and a new `async / await` syntax to abstract calls to asynchronous calls:

- a function declared *async* automatically encapsulates its result as a Promise
- within an *async* function, any function call prefixed with *await* chains the Promise returned by the function with a promise to resume execution of the caller
- any exception during the execution of an *async* function automatically invokes the Promise failure continuation

To make a long story short, *async* and *await* make it possible to write TypeScript code with all the benefits of asynchronous I/O, but without breaking the code flow. It is almost like multi-threaded

¹ www.yoctopuce.com/EN/libraries.php

² www.yoctopuce.com/EN/virtualhub.php

execution, except that control switch between pending tasks only happens at places where the *await* keyword appears.

This TypeScript library uses the *Promise* objects and *async* methods, to allow you to use the *await* syntax. To keep it easy to remember, all public methods of the TypeScript library are *async*, i.e. return a Promise object, except:

- `GetTickCount()`, because returning a time stamp asynchronously does not make sense...
- `FindModule()`, `FirstModule()`, `nextModule()`, ... because device detection and enumeration always works on internal device lists handled in background, and does not require immediate asynchronous I/O.

In most cases, TypeScript strong typing will remind you to use *await* when calling an asynchronous method.

16.3. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a TypeScript code snippet to use the Display function.

```
// For Node.js, the library is referenced through the NPM package
// For HTML, we would use instead a relative path (depending on the build environment)
import { YAPI, YErrorMsg, YModule } from 'yoctolib-cjs/yocto_api_nodejs.js';
import { YDisplay } from 'yoctolib-cjs/yocto_display.js';

[...]
```

```
// Get access to your device, through the VirtualHub running locally
await YAPI.RegisterHub('127.0.0.1');
[...]
```

```
// Retrieve the object used to interact with the device
var display: YDisplay = YDisplay.FindDisplay("EPAPER1C-123456.display");

// Check that the module is online to handle hot-plug
if(await display.isOnline())
{
    // Use display.get_displayLayer()
    [...]
```

Let us look at these lines in more details.

yocto_api and yocto_display import

These two imports provide access to functions allowing you to manage Yoctopuce modules. `yocto_api` is always needed, `yocto_display` is necessary to manage modules containing a display, such as Yocto-Display-ePaper-C. Other imports can be useful in other cases, such as `YModule` which can let you enumerate any type of Yoctopuce device.

In order to properly bind `yocto_api` to the proper network libraries (provided either by Node.js or by the web browser for an HTML application), you must import at least once in your project one of the two variants `yocto_api_nodejs.js` or `yocto_api_html.js`.

Note that this example imports the Yoctopuce library as a CommonJS module, which is the most frequently used with Node.JS, but if your project is designed around EcmaScript native modules, you can also replace in the import directive the prefix `yoctolib-cjs` by `yoctolib-esm`.

YAPI.RegisterHub

The `RegisterHub` method allows you to indicate on which machine the Yoctopuce modules are located, more precisely on which machine the VirtualHub software is running. In our case, the `127.0.0.1:4444` address indicates the local machine, port 4444 (the standard port used by Yoctopuce). You can very well modify this address, and enter the address of another machine on which the VirtualHub software is running, or of a YoctoHub. If the host cannot be reached, this function will trigger an exception.

As explained above, using `RegisterHub("usb")` is not supported in TypeScript, because the JavaScript engine has no direct access to USB devices. It needs to go through the VirtualHub via a localhost connection.

YDisplay.FindDisplay

The `FindDisplay` method allows you to find a display from the serial number of the module on which it resides and from its function name. You can also use logical names, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number *EPAPER1C-123456* which you have named *"MyModule"*, and for which you have given the *display* function the name *"MyFunction"*. The following five calls are strictly equivalent, as long as *"MyFunction"* is defined only once.

```
display = YDisplay.FindDisplay("EPAPER1C-123456.display")
display = YDisplay.FindDisplay("EPAPER1C-123456.MaFonction")
display = YDisplay.FindDisplay("MonModule.display")
display = YDisplay.FindDisplay("MonModule.MaFonction")
display = YDisplay.FindDisplay("MaFonction")
```

`YDisplay.FindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `FindDisplay` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YDisplay.FindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example, for Node.js

Open a command window (a terminal, a shell...) and go into the directory **example_nodejs/Doc-GettingStarted-Yocto-Display-ePaper-C** within Yoctopuce library for TypeScript. In there, you will find a file named `demo.ts` with the sample code below, which uses the functions explained above, but this time used with all side materials needed to make it work nicely as a small demo.

If your Yocto-Display-ePaper-C is not connected on the host running the browser, replace in the example the address `127.0.0.1` by the IP address of the host on which the Yocto-Display-ePaper-C is connected and where you run the VirtualHub.

```
import { YAPI, YErrorMsg, YModule } from 'yoctolib-cjs/yocto_api_nodejs.js';
import { YDisplay, YDisplayLayer } from 'yoctolib-cjs/yocto_display.js'

let disp: YDisplay;
let l0: YDisplayLayer;
let h: number;
let w: number;
let middleX: number;
let middleY: number;
let paneltype :string

async function startDemo(): Promise<void>
{
```

```

await YAPI.LogUnhandledPromiseRejections();

// Setup the API to use the VirtualHub on local machine
let errmsg: YErrorMsg = new YErrorMsg();
if(await YAPI.RegisterHub('127.0.0.1', errmsg) !== YAPI.SUCCESS) {
    console.log('Cannot contact VirtualHub on 127.0.0.1: '+errmsg.msg);
    return;
}

// Select specified device, or use first available one
let serial: string = process.argv[process.argv.length-1];
if (serial[8] !== '-') {
    let anydisplay = YDisplay.FirstDisplay();
    if (anydisplay) {
        let module: YModule = await anydisplay.get_module();
        serial = await module.get_serialNumber();
    } else {
        console.log('No matching device connected, check cable !');
        await YAPI.FreeAPI();
        return;
    }
}

disp = YDisplay.FindDisplay(serial + ".display");

//clean up
await disp.resetAll();

// Makes sure the Panel type is set
paneltype = await disp.get_displayPanel();
if (paneltype === "NOT_SET")
{
    console.log( "Use the virtual hub application to configure the panel first");
    return;
}

// retrieve the display size
w = await disp.get_displayWidth();
h = await disp.get_displayHeight();
middleX = Math.floor(w / 2);
middleY = Math.floor(h / 2);
console.log("Using:"+await disp.get_serialNumber() +(Panel: " + paneltype + " " + w +
"x" + h+ "pixels)");

//clean up
await disp.resetAll();
await disp.regenerateDisplay(); // makes sure the next refresh will be a full one

// retrieve the first layer
l0 = await disp.get_displayLayer(0) as YDisplayLayer;
await l0.selectFont("medium.yfm");

refresh();
}

async function refresh(): Promise<void>
{
    let errmsg = new YErrorMsg();
    const colors = [0xFFFFFFFF, 0x000000, 0xFF0000, 0xFFFF00 ];
    if (disp && l0 && await disp.isOnline())
    { // prevent refreshing for max 2 sec
        await disp.postponeRefresh(2000);
        await l0.clear();
        // draw a few circles
        for (var i = 0; i < 15; i++)
        {
            let cx = Math.floor(Math.random()* w);
            let cy = Math.floor(Math.random()* h);
            let r = Math.floor((h / 20) + Math.random()* (h / 10));
            await l0.selectFillColor(colors[Math.floor(Math.random()* 4)]);
            await l0.drawDisc(cx, cy, r);
            await l0.drawCircle(cx, cy, r);
        }
        // draw a rectangle with panel type in it
        await l0.selectFillColor(0xffffffff);
        await l0.drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
        await l0.drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    }
}

```

```

    await l0.drawText(middleX, middleY, YDisplayLayer.ALIGN_CENTER, paneltype);
    // forces a full refresh only the 1st time

    await disp.triggerRefresh(); // display is allowed to refresh again
    await YAPI.Sleep(1000, errmsg);
    // if no fast refresh available, don't even try to run animations
    if (paneltype.indexOf("KS") >= 0) setTimeout(refresh, 5);

  }
}

startDemo();

```

As explained at the beginning of this chapter, you need to have installed the TypeScript compiler on your machine to test these examples, and to install the typescript library dependencies. If you have done that, you can now type the following two commands in the example directory, to finalize the resolution of the example-specific dependencies:

```
npm install
```

You are now ready to start the sample code with Node.js. The easiest way to do it is to use the following command, replacing the [...] by the arguments that you want to pass to the demo code:

```
npm run demo [...]
```

This command, defined in `package.json`, will first start the TypeScript compiler using the simple `tsc` command, then run the transpiled code in Node.js.

The compilation uses the parameters specified in the file `tsconfig.json`, and produces

- a JavaScript file named `demo.js`, that Node.js can run
- a debug file named `demo.js.map`, that will help Node.js to locate the source of errors in the original TypeScript source file rather than reporting them in the JavaScript compiled file.

Note that the `package.json` file in our examples uses a relative reference to the local copy of the library, to avoid duplicating the library in each example. But of course, for your application, you can refer to the package directly in npm repository, by adding it to your project using the command:

```
npm install yoctolib-cjs
```

Same example, but this time running in a browser

If you want to see how to use the library within a browser rather than with Node.js, switch to the directory **example_html/Doc-GettingStarted-Yocto-Display-ePaper-C**. You will find there an HTML file named `app.html`, and a TypeScript file `app.ts` similar to the code above, but with a few changes since it has to interact through an HTML page rather than through the JavaScript console.

No installation is needed to run this example, as the TypeScript library is referenced using a relative path. However, in order to allow the browser to run the code, the HTML page must be served by a Web server. We therefore provide a simple test server for this purpose, that you can start with the command:

```
npm run app-server
```

This command will compile the TypeScript sample code, make it available via an HTTP server on port 3000 and open a Web browser on this example. If you change the example source code, the TypeScript compiler will automatically be triggered to update the transpiled code and a simple page reload on the browser will make it possible to test the change.

As for the Node.js example, the compilation process will create a source map file which makes it possible to debug the example code in TypeScript source form within the browser debugger. Note

that as of the writing of this document, this works on Chromium-based browsers but not yet in Firefox.

16.4. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```
import { YAPI, YErrorMsg, YModule } from 'yoctolib-cjs/yocto_api_nodejs.js';

async function startDemo(args: string[]): Promise<void>
{
    await YAPI.LogUnhandledPromiseRejections();

    // Setup the API to use the VirtualHub on local machine
    let errmsg: YErrorMsg = new YErrorMsg();
    if (await YAPI.RegisterHub('127.0.0.1', errmsg) !== YAPI.SUCCESS) {
        console.log('Cannot contact VirtualHub on 127.0.0.1: '+errmsg.msg);
        return;
    }

    // Select the device to use
    let module: YModule = YModule.FindModule(args[0]);
    if(await module.isOnline()) {
        if(args.length > 1) {
            if(args[1] == 'ON') {
                await module.set_beacon(YModule.BEACON_ON);
            } else {
                await module.set_beacon(YModule.BEACON_OFF);
            }
        }
        console.log('serial:      '+await module.get_serialNumber());
        console.log('logical name: '+await module.get_logicalName());
        console.log('luminosity:  '+await module.get_luminosity()+'%');
        console.log('beacon:      '+
            (await module.get_beacon() == YModule.BEACON_ON ? 'ON' : 'OFF'));
        console.log('upTime:      '+
            ((await module.get_upTime()/1000)>>0) + ' sec');
        console.log('USB current: '+await module.get_usbCurrent()+ ' mA');
        console.log('logs:');
        console.log(await module.get_lastLogs());
    } else {
        console.log("Module not connected (check identification and USB cable)\n");
    }
    await YAPI.FreeAPI();
}

if(process.argv.length < 3) {
    console.log("usage: npm run demo <serial or logicalname> [ ON | OFF ]");
} else {
    startDemo(process.argv.slice(2));
}
```

Each property `xxx` of the module can be read thanks to a method of type `get_xxxx()`, and properties which are not read-only can be modified with the help of the `set_xxx()` method. For more details regarding the used methods, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `set_xxx()` method. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```
import { YAPI, YErrorMsg, YModule } from 'yoctolib-cjs/yocto_api_nodejs.js';

async function startDemo(args: string[]): Promise<void>
{
```

```

await YAPI.LogUnhandledPromiseRejections();

// Setup the API to use the VirtualHub on local machine
let errmsg: YErrorMsg = new YErrorMsg();
if (await YAPI.RegisterHub('127.0.0.1', errmsg) !== YAPI.SUCCESS) {
    console.log('Cannot contact VirtualHub on 127.0.0.1: ' + errmsg.msg);
    return;
}

// Select the device to use
let module: YModule = YModule.FindModule(args[0]);
if(await module.isOnline()) {
    if(args.length > 1) {
        let newname: string = args[1];
        if (!await YAPI.CheckLogicalName(newname)) {
            console.log("Invalid name (" + newname + ")");
            process.exit(1);
        }
        await module.set_logicalName(newname);
        await module.saveToFlash();
    }
    console.log('Current name: ' + await module.get_logicalName());
} else {
    console.log("Module not connected (check identification and USB cable)\n");
}
await YAPI.FreeAPI();
}

if(process.argv.length < 3) {
    console.log("usage: npm run demo <serial> [newLogicalName]");
} else {
    startDemo(process.argv.slice(2));
}

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `saveToFlash()` method only 100000 times in the life of the module. Make sure you do not call this method within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `YModule.FirstModule()` method which returns the first module found. Then, you only need to call the `nextModule()` method of this object to find the following modules, and this as long as the returned value is not null. Below a short example listing the connected modules.

```

import { YAPI, YErrorMsg, YModule } from 'yoctolib-cjs/yocto_api_nodejs.js';

async function startDemo(): Promise<void>
{
    await YAPI.LogUnhandledPromiseRejections();

    // Setup the API to use the VirtualHub on local machine
    let errmsg = new YErrorMsg();
    if (await YAPI.RegisterHub('127.0.0.1', errmsg) !== YAPI.SUCCESS) {
        console.log('Cannot contact VirtualHub on 127.0.0.1');
        return;
    }
    refresh();
}

async function refresh(): Promise<void>
{
    try {
        let errmsg: YErrorMsg = new YErrorMsg();
        await YAPI.UpdateDeviceList(errmsg);

        let module = YModule.FirstModule();
        while(module) {
            let line: string = await module.get_serialNumber();
            line += '(' + (await module.get_productName()) + ')';
            console.log(line);
            module = module.nextModule();
        }
    }
}

```

```

    }
    setTimeout(refresh, 500);
  } catch(e) {
    console.log(e);
  }
}

startDemo();

```

16.5. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software. The only way to prevent this is to implement one of the two error handling techniques described below.

The method recommended by most programming languages for unpredictable error handling is the use of exceptions. By default, it is the behavior of the Yoctopuce library. If an error happens while you try to access a module, the library throws an exception. In this case, there are three possibilities:

- If your code catches the exception and handles it, everything goes well.
- If your program is running in debug mode, you can relatively easily determine where the problem happened and view the explanatory message linked to the exception.
- Otherwise... the exception makes your program crash, bang!

As this latest situation is not the most desirable, the Yoctopuce library offers another possibility for error handling, allowing you to create a robust program without needing to catch exceptions at every line of code. You simply need to call the `YAPI.DisableExceptions()` function to commute the library to a mode where exceptions for all the functions are systematically replaced by specific return values, which can be tested by the caller when necessary. For each function, the name of each return value in case of error is systematically documented in the library reference. The name always follows the same logic: a `get_state()` method returns a `ClassName.STATE_INVALID` value, a `get_currentValue` method returns a `ClassName.CURRENTVALUE_INVALID` value, and so on. In any case, the returned value is of the expected type and is not a null pointer which would risk crashing your program. At worst, if you display the value without testing it, it will be outside the expected bounds for the returned value. In the case of functions which do not normally return information, the return value is `YAPI_SUCCESS` if everything went well, and a different error code in case of failure.

When you work without exceptions, you can obtain an error code and an error message explaining the source of the error. You can request them from the object which returned the error, calling the `errType()` and `errMessage()` methods. Their returned values contain the same information as in the exceptions when they are active.

17. Using Yocto-Display-ePaper-C with JavaScript / EcmaScript

EcmaScript is the official name of the standardized version of the web-oriented programming language commonly referred to as *JavaScript*. This Yoctopuce library take advantages of advanced features introduced in EcmaScript 2017. It has therefore been named *Library for JavaScript / EcmaScript 2017* to differentiate it from the previous *Library for JavaScript*, now deprecated in favor of this new version.

This library provides access to Yoctopuce devices for modern JavaScript engines. It can be used within a browser as well as with Node.js. The library will automatically detect upon initialization whether the runtime environment is a browser or a Node.js virtual machine, and use the most appropriate system libraries accordingly.

Asynchronous communication with the devices is handled across the whole library using Promise objects, leveraging the new EcmaScript 2017 `async / await` non-blocking syntax for asynchronous I/O (see below). This syntax is now available out-of-the-box in most Javascript engines. No transpilation is needed: no Babel, no jspm, just plain Javascript. Here is your favorite engines minimum version needed to run this code. All of them are officially released at the time we write this document.

- Node.js v7.6 and later
- Firefox 52
- Opera 42 (incl. Android version)
- Chrome 55 (incl. Android version)
- Safari 10.1 (incl. iOS version)
- Android WebView 55
- Google V8 Javascript engine v5.5

If you need backward-compatibility with older releases, you can always run Babel to transpile your code and the library to older standards, as described a few paragraphs below.

We don't suggest using `jspm` anymore now that `async / await` are part of the standard.

17.1. Blocking I/O versus Asynchronous I/O in JavaScript

JavaScript is single-threaded by design. That means, if a program is actively waiting for the result of a network-based operation such as reading from a sensor, the whole program is blocked. In browser environments, this can even completely freeze the user interface. For this reason, the use of blocking I/O in JavaScript is strongly discouraged nowadays, and blocking network APIs are getting deprecated everywhere.

Instead of using parallel threads, JavaScript relies on asynchronous I/O to handle operations with a possible long timeout: whenever a long I/O call needs to be performed, it is only triggered and but then the code execution flow is terminated. The JavaScript engine is therefore free to handle other pending tasks, such as UI. Whenever the pending I/O call is completed, the system invokes a callback function with the result of the I/O call to resume execution of the original execution flow.

When used with plain callback functions, as pervasive in Node.js libraries, asynchronous I/O tend to produce code with poor readability, as the execution flow is broken into many disconnected callback functions. Fortunately, new methods have emerged recently to improve that situation. In particular, the use of *Promise* objects to abstract and work with asynchronous tasks helps a lot. Any function that makes a long I/O operation can return a *Promise*, which can be used by the caller to chain subsequent operations in the same flow. Promises are part of EcmaScript 2015 standard.

Promise objects are good, but what makes them even better is the new `async / await` keywords to handle asynchronous I/O:

- a function declared `async` will automatically encapsulate its result as a Promise
- within an `async` function, any function call prefixed with by `await` will chain the Promise returned by the function with a promise to resume execution of the caller
- any exception during the execution of an `async` function will automatically invoke the Promise failure continuation

Long story made short, `async` and `await` make it possible to write EcmaScript code with all benefits of asynchronous I/O, but without breaking the code flow. It is almost like multi-threaded execution, except that control switch between pending tasks only happens at places where the `await` keyword appears.

We have therefore chosen to write our new EcmaScript library using Promises and `async` functions, so that you can use the friendly `await` syntax. To keep it easy to remember, **all public methods** of the EcmaScript library **are `async`**, i.e. return a Promise object, **except**:

- `GetTickCount()`, because returning a time stamp asynchronously does not make sense...
- `FindModule()`, `FirstModule()`, `nextModule()`, ... because device detection and enumeration always work on internal device lists handled in background, and does not require immediate asynchronous I/O.

17.2. Using Yoctopuce library for JavaScript / EcmaScript 2017

JavaScript is one of those languages which do not generally allow you to directly access the hardware layers of your computer. Therefore the library can only be used to access network-enabled devices (connected through a YoctoHub), or USB devices accessible through Yoctopuce TCP/IP to USB gateway, named *VirtualHub*.

Go to the Yoctopuce web site and download the following items:

- The Javascript / EcmaScript 2017 programming library¹
- VirtualHub² for Windows, macOS or Linux, depending on your OS

Extract the library files in a folder of your choice, you will find many of examples in it. Connect your modules and start the VirtualHub software. You do not need to install any driver.

Using the official Yoctopuce library for node.js

Start by installing the latest Node.js version (v7.6 or later) on your system. It is very easy. You can download it from the official web site: <http://nodejs.org>. Make sure to install it fully, including npm, and add it to the system path.

¹ www.yoctopuce.com/EN/libraries.php

² www.yoctopuce.com/EN/virtualhub.php

To give it a try, go into one of the example directory (for instance `example_nodejs/Doc-Inventory`). You will see that it include an application description file (`package.json`) and a source file (`demo.js`). To download and setup the libraries needed by this example, just run:

```
npm install
```

Once done, you can start the example file using:

```
node demo.js
```

Using a local copy of the Yoctopuce library with node.js

If for some reason you need to make changes to the Yoctopuce library, you can easily configure your project to use the local copy in the `lib/` subdirectory rather than the official npm package. In order to do so, simply type the following command in your project directory:

```
npm link ../../lib
```

Using the Yoctopuce library within a browser (HTML)

For HTML examples, it is even simpler: there is nothing to install. Each example is a single HTML file that you can open in a browser to try it. In this context, loading the Yoctopuce library is no different from any standard HTML script include tag.

Using the Yoctopuce library on older JavaScript engines

If you need to run this library on older JavaScript engines, you can use Babel³ to transpile your code and the library into older JavaScript standards. To install Babel with typical settings, simply use:

```
npm instal -g babel-cli
npm instal babel-preset-env
```

You would typically ask Babel to put the transpiled files in another directory, named `compat` for instance. Your files and all files of the Yoctopuce library should be transpiled, as follow:

```
babel --presets env demo.js --out-dir compat/
babel --presets env ../../lib --out-dir compat/
```

Although this approach is based on node.js toolchain, it actually works as well for transpiling JavaScript files for use in a browser. The only thing that you cannot do so easily is transpiling JavaScript code embedded directly in an HTML page. You have to use an external script file for using EcmaScript 2017 syntax with Babel.

Babel has many smart features, such as a watch mode that will automatically refresh transpiled files whenever the source file is changed, but this is beyond the scope of this note. You will find more in Babel documentation.

Backward-compatibility with the old JavaScript library

This new library is not fully backward-compatible with the old JavaScript library, because there is no way to transparently map the old blocking API to the new asynchronous API. The method names however are the same, and old synchronous code can easily be made asynchronous just by adding the proper `await` keywords before the method calls. For instance, simply replace:

```
beaconState = module.get_beacon();
```

by

³ <http://babeljs.io>

```
beaconState = await module.get_beacon();
```

Apart from a few exceptions, most XXX_async redundant methods have been removed as well, as they would have introduced confusion on the proper way of handling asynchronous behaviors. It is however very simple to get an *async* method to invoke a callback upon completion, using the returned Promise object. For instance, you can replace:

```
module.get_beacon_async(callback, myContext);
```

by

```
module.get_beacon().then(function(res) { callback(myContext, module, res); });
```

In some cases, it might be desirable to get a sensor value using a method identical to the old synchronous methods (without using Promises), even if it returns a slightly outdated cached value since I/O is not possible. For this purpose, the EcmaScript library introduce new classes called *synchronous proxies*. A synchronous proxy is an object that mirrors the most recent state of the connected class, but can be read using regular synchronous function calls. For instance, instead of writing:

```
async function logInfo(module)
{
  console.log('Name: '+await module.get_logicalName());
  console.log('Beacon: '+await module.get_beacon());
}

...
logInfo(myModule);
...
```

you can use:

```
function logInfoProxy(moduleSyncProxy)
{
  console.log('Name: '+moduleProxy.get_logicalName());
  console.log('Beacon: '+moduleProxy.get_beacon());
}

logInfoSync(await myModule.get_syncProxy());
```

You can also rewrite this last asynchronous call as:

```
myModule.get_syncProxy().then(logInfoProxy);
```

17.3. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a JavaScript code snippet to use the Display function.

```
// For Node.js, we use function require()
// For HTML, we would use <script src="...">
require('yoctolib-es2017/yocto_api.js');
require('yoctolib-es2017/yocto_display.js');

[...]
// Get access to your device, through the VirtualHub running locally
await YAPI.RegisterHub('127.0.0.1');
[...]

// Retrieve the object used to interact with the device
var display = YDisplay.FindDisplay("EPAPER1C-123456.display");

// Check that the module is online to handle hot-plug
```

```

if(await display.isOnline())
{
    // Use display.get_displayLayer()
    [...]
}

```

Let us look at these lines in more details.

yocto_api and yocto_display import

These two import provide access to functions allowing you to manage Yoctopuce modules. `yocto_api` is always needed, `yocto_display` is necessary to manage modules containing a display, such as Yocto-Display-ePaper-C. Other imports can be useful in other cases, such as `YModule` which can let you enumerate any type of Yoctopuce device.

YAPI.RegisterHub

The `RegisterHub` method allows you to indicate on which machine the Yoctopuce modules are located, more precisely on which machine the VirtualHub software is running. In our case, the `127.0.0.1:4444` address indicates the local machine, port `4444` (the standard port used by Yoctopuce). You can very well modify this address, and enter the address of another machine on which the VirtualHub software is running, or of a YoctoHub. If the host cannot be reached, this function will trigger an exception.

YDisplay.FindDisplay

The `FindDisplay` method allows you to find a display from the serial number of the module on which it resides and from its function name. You can also use logical names, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number `EPAPER1C-123456` which you have named `"MyModule"`, and for which you have given the `display` function the name `"MyFunction"`. The following five calls are strictly equivalent, as long as `"MyFunction"` is defined only once.

```

display = YDisplay.FindDisplay("EPAPER1C-123456.display")
display = YDisplay.FindDisplay("EPAPER1C-123456.MaFonction")
display = YDisplay.FindDisplay("MonModule.display")
display = YDisplay.FindDisplay("MonModule.MaFonction")
display = YDisplay.FindDisplay("MaFonction")

```

`YDisplay.FindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `FindDisplay` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YDisplay.FindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example, for Node.js

Open a command window (a terminal, a shell...) and go into the directory **example_nodejs/Doc-GettingStarted-Yocto-Display-ePaper-C** within Yoctopuce library for JavaScript / EcmaScript 2017. In there, you will find a file named `demo.js` with the sample code below, which uses the functions explained above, but this time used with all side materials needed to make it work nicely as a small demo.

If your Yocto-Display-ePaper-C is not connected on the host running the browser, replace in the example the address `127.0.0.1` with the IP address of the host on which the Yocto-Display-ePaper-C is connected and where you run the VirtualHub.

```
"use strict";

require('yoctolib-es2017/yocto_api.js');
require('yoctolib-es2017/yocto_display.js');

let disp, l0;
let w, h, middleX, middleY, paneltype;
const colors = [0xFFFFFF, 0x000000, 0xFF0000, 0xFFFF00 ];

async function startDemo() {
  await YAPI.LogUnhandledPromiseRejections();
  await YAPI.DisableExceptions();

  // Setup the API to use the VirtualHub on local machine
  let errmsg = new YErrorMsg();
  if (await YAPI.RegisterHub('127.0.0.1', errmsg) !== YAPI.SUCCESS) {
    console.log('Cannot contact VirtualHub on 127.0.0.1: ' + errmsg.msg);
    return;
  }

  // Select specified device, or use first available one
  let serial = process.argv[process.argv.length - 1];
  if (serial[8] !== '-') {
    // by default use any connected module suitable for the demo
    let anysensor = YDisplay.FirstDisplay();
    if (anysensor) {
      let module = await anysensor.module();
      serial = await module.get_serialNumber();
    } else {
      console.log('No matching sensor connected, check cable !');
      return;
    }
  }
  console.log('Using device ' + serial);
  disp = YDisplay.FindDisplay(serial + ".display");

  //clean up
  await disp.resetAll();

  // Makes sure the Panel type is set
  paneltype = await disp.get_displayPanel();
  if (paneltype === "NOT_SET") {
    { alert( "Use the virtual to configure the panel first");
      return;
    }
  }

  // retrieve the display size
  w = await disp.get_displayWidth();
  h = await disp.get_displayHeight();
  middleX = parseInt(w / 2);
  middleY = parseInt(h / 2);
  console.log("Using:" + await disp.get_serialNumber() + "(Panel: " + paneltype + " " + w +
    "x" + h + "pixels)");

  //clean up
  await disp.resetAll();
  await disp.regenerateDisplay(); // makes sure the next refresh will be a full one

  // retrieve the first layer
  l0 = await disp.get_displayLayer(0);
  await l0.selectFont("medium.yfm");
  refresh()
}
```

```

    }

    async function refresh()
    {
        let errormsg = new YErrorMsg();
        const colors = [0xFFFFFF, 0x000000, 0xFF0000, 0xFFFF00 ];
        if (await disp.isOnline())
        { // prevent refreshing for max 2 sec
            await disp.postponeRefresh(2000);
            await l0.clear();
            // draw a few circles
            for (var i = 0; i < 15; i++)
            {
                let cx = Math.floor(Math.random()* w);
                let cy = Math.floor(Math.random()* h);
                let r = Math.floor((h / 20) + Math.random()* (h / 10));
                await l0.selectFillColor(colors[Math.floor(Math.random()* 4)]);
                await l0.drawDisc(cx, cy, r);
                await l0.drawCircle(cx, cy, r);
            }
            // draw a rectangle with panel type in it
            await l0.selectFillColor(0xffffffff);
            await l0.drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
            await l0.drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
            await l0.drawText(middleX, middleY, YDisplayLayer.ALIGN_CENTER, paneltype);
            // forces a full refresh only the first time

            await disp.triggerRefresh(); // display is allowed to refresh again
            await YAPI.Sleep(1000, errormsg);
            // if no fast refresh available, don't even try to run animations
            if (paneltype.indexOf("KS") >= 0) setTimeout(refresh, 5);
            } else document.getElementById('msg').innerText = 'Module not connected';
        }

        startDemo();
    }

```

As explained at the beginning of this chapter, you need to have Node.js v7.6 or later installed to try this example. When done, you can type the following two commands to automatically download and install the dependencies for building this example:

```
npm install
```

You can then start the sample code within Node.js using the following command, replacing the [...] by the arguments that you want to pass to the demo code:

```
node demo.js [...]
```

Same example, but this time running in a browser

If you want to see how to use the library within a browser rather than with Node.js, switch to the directory **example_html/Doc-GettingStarted-Yocto-Display-ePaper-C**. You will find there a single HTML file, with a JavaScript section similar to the code above, but with a few changes since it has to interact through an HTML page rather than through the JavaScript console.

```

<!DOCTYPE html>
<html>
<head>
  <meta charset="UTF-8">
  <title>Hello World</title>
  <script src="../../lib/yocto_api.js"></script>
  <script src="../../lib/yocto_display.js"></script>
  <script>
    var disp,l0;
    var w,h, middleX,middleY,paneltype;

    async function startDemo()
    {
        await YAPI.LogUnhandledPromiseRejections();
        await YAPI.DisableExceptions();

        // Setup the API to use the VirtualHub on local machine
    }
  </script>

```

```

let errmsg = new YErrorMsg();
if (await YAPI.RegisterHub('127.0.0.1', errmsg) !== YAPI.SUCCESS) {
    alert('Cannot contact VirtualHub on 127.0.0.1: ' + errmsg.msg);
    return
}

// Select specified device, or use first available one
let serial = document.getElementById('serial').value;
if (serial == '') {
    // by default use any connected module suitable for the demo
    let anydiplay = YDisplay.FirstDisplay();
    if (anydiplay) {
        let module = await anydiplay.module();
        serial = await module.get_serialNumber();
        document.getElementById('serial').value = serial;
    }
}
disp = YDisplay.FindDisplay(serial + ".display");

// Makes sure the Panel type is set
paneltype = await disp.get_displayPanel();
if (paneltype == "NOT_SET")
{ alert("Use the virtual to configure the panel first");
  return;
}

// retrieve the display size
w = await disp.get_displayWidth();
h = await disp.get_displayHeight();
middleX = parseInt(w / 2);
middleY = parseInt(h / 2);
document.getElementById('msg').innerHTML = "Panel: " + paneltype + " " + w + "x" + h +
"pixels";

//clean up
await disp.resetAll();
await disp.regenerateDisplay(); // makes sure the next refresh will be a full one

// retrieve the first layer
l0 = await disp.get_displayLayer(0);
await l0.selectFont("medium.yfm");
refresh();
}

async function refresh()
{
    let errmsg = new YErrorMsg();
    const colors = [0xFFFFFF, 0x000000, 0xFF0000, 0xFFFF00 ];
    if (await disp.isOnline())
    { // prevent refreshing for max 2 sec
        await disp.postponeRefresh(2000);
        await l0.clear();
        // draw a few circles
        for (var i = 0; i < 15; i++)
        {
            let cx = Math.floor(Math.random()* w);
            let cy = Math.floor(Math.random()* h);
            let r = Math.floor((h / 20) + Math.random()* (h / 10));
            await l0.selectFillColor(colors[Math.floor(Math.random()* 4)]);
            await l0.drawDisc(cx, cy, r);
            await l0.drawCircle(cx, cy, r);
        }
        // draw a rectangle with panel type in it
        await l0.selectFillColor(0xffffffff);
        await l0.drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
        await l0.drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
        await l0.drawText(middleX, middleY, YDisplayLayer.ALIGN_CENTER, paneltype);
        // forces a full refresh only the 1st time

        await disp.triggerRefresh(); // display is allowed to refresh again
        await YAPI.Sleep(1000, errmsg);
        // if no fast refresh available, don't even try to run animations
        if (paneltype.indexOf("KS") >= 0) setTimeout(refresh, 5);
    } else document.getElementById('msg').innerHTML = 'Module not connected';
}

startDemo();
</script>

```

```

</head>
<body>

Module to use:      <input id='serial'><br>
<span id='msg'></span><br>
</body>
</html>

```

No installation is needed to run this example, all you have to do is open the HTML file using a web browser,

17.4. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```

"use strict";

require('yoctolib-es2017/yocto_api.js');

async function startDemo(args)
{
    await YAPI.LogUnhandledPromiseRejections();

    // Setup the API to use the VirtualHub on local machine
    let errmsg = new YErrorMsg();
    if(await YAPI.RegisterHub('127.0.0.1', errmsg) !== YAPI.SUCCESS) {
        console.log('Cannot contact VirtualHub on 127.0.0.1: '+errmsg.msg);
        return;
    }

    // Select the relay to use
    let module = YModule.FindModule(args[0]);
    if(await module.isOnline()) {
        if(args.length > 1) {
            if(args[1] == 'ON') {
                await module.set_beacon(YModule.BEACON_ON);
            } else {
                await module.set_beacon(YModule.BEACON_OFF);
            }
        }
        console.log('serial:      '+await module.get_serialNumber());
        console.log('logical name: '+await module.get_logicalName());
        console.log('luminosity:   '+await module.get_luminosity()+'%');
        console.log('beacon:      '+((await module.get_beacon()===YModule.BEACON_ON
        ?'ON':'OFF')));
        console.log('upTime:      '+parseInt(await module.get_upTime()/1000)+' sec');
        console.log('USB current: '+await module.get_usbCurrent()+' mA');
        console.log('logs:');
        console.log(await module.get_lastLogs());
    } else {
        console.log("Module not connected (check identification and USB cable)\n");
    }
    await YAPI.FreeAPI();
}

if(process.argv.length < 2) {
    console.log("usage: node demo.js <serial or logicalname> [ ON | OFF ]");
} else {
    startDemo(process.argv.slice(2));
}

```

Each property `xxx` of the module can be read thanks to a method of type `get_xxxx()`, and properties which are not read-only can be modified with the help of the `set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `set_xxx()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them

persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```
"use strict";

require('yoctolib-es2017/yocto_api.js');

async function startDemo(args)
{
    await YAPI.LogUnhandledPromiseRejections();

    // Setup the API to use the VirtualHub on local machine
    let errmsg = new YErrorMsg();
    if(await YAPI.RegisterHub('127.0.0.1', errmsg) !== YAPI.SUCCESS) {
        console.log('Cannot contact VirtualHub on 127.0.0.1: '+errmsg.msg);
        return;
    }

    // Select the relay to use
    let module = YModule.FindModule(args[0]);
    if(await module.isOnline()) {
        if(args.length > 1) {
            let newname = args[1];
            if (!await YAPI.CheckLogicalName(newname)) {
                console.log("Invalid name (" + newname + ")");
                process.exit(1);
            }
            await module.set_logicalName(newname);
            await module.saveToFlash();
        }
        console.log('Current name: '+await module.get_logicalName());
    } else {
        console.log("Module not connected (check identification and USB cable)\n");
    }
    await YAPI.FreeAPI();
}

if(process.argv.length < 2) {
    console.log("usage: node demo.js <serial> [newLogicalName]");
} else {
    startDemo(process.argv.slice(2));
}
```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `YModule.FirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not null. Below a short example listing the connected modules.

```
"use strict";

require('yoctolib-es2017/yocto_api.js');

async function startDemo()
{
    await YAPI.LogUnhandledPromiseRejections();
    await YAPI.DisableExceptions();

    // Setup the API to use the VirtualHub on local machine
    let errmsg = new YErrorMsg();
    if (await YAPI.RegisterHub('127.0.0.1', errmsg) !== YAPI.SUCCESS) {
        console.log('Cannot contact VirtualHub on 127.0.0.1');
        return;
    }
}
```

```

refresh();
}

async function refresh()
{
    try {
        let errormsg = new YErrorMsg();
        await YAPI.UpdateDeviceList(errormsg);

        let module = YModule.FirstModule();
        while(module) {
            let line = await module.get_serialNumber();
            line += '(' + (await module.get_productName()) + ')';
            console.log(line);
            module = module.nextModule();
        }
        setTimeout(refresh, 500);
    } catch(e) {
        console.log(e);
    }
}

try {
    startDemo();
} catch(e) {
    console.log(e);
}

```

17.5. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software. The only way to prevent this is to implement one of the two error handling techniques described below.

The method recommended by most programming languages for unpredictable error handling is the use of exceptions. By default, it is the behavior of the Yoctopuce library. If an error happens while you try to access a module, the library throws an exception. In this case, there are three possibilities:

- If your code catches the exception and handles it, everything goes well.
- If your program is running in debug mode, you can relatively easily determine where the problem happened and view the explanatory message linked to the exception.
- Otherwise... the exception makes your program crash, bang!

As this latest situation is not the most desirable, the Yoctopuce library offers another possibility for error handling, allowing you to create a robust program without needing to catch exceptions at every line of code. You simply need to call the `YAPI.DisableExceptions()` function to commute the library to a mode where exceptions for all the functions are systematically replaced by specific return values, which can be tested by the caller when necessary. For each function, the name of each return value in case of error is systematically documented in the library reference. The name always follows the same logic: a `get_state()` method returns a `ClassName.STATE_INVALID` value, a `get_currentValue` method returns a `ClassName.CURRENTVALUE_INVALID` value, and so on. In any case, the returned value is of the expected type and is not a null pointer which would risk crashing your program. At worst, if you display the value without testing it, it will be outside the expected bounds for the returned value. In the case of functions which do not normally return

information, the return value is `YAPI_SUCCESS` if everything went well, and a different error code in case of failure.

When you work without exceptions, you can obtain an error code and an error message explaining the source of the error. You can request them from the object which returned the error, calling the `errType()` and `errMessage()` methods. Their returned values contain the same information as in the exceptions when they are active.

18. Using Yocto-Display-ePaper-C with PHP

PHP is, like Javascript, an atypical language when interfacing with hardware is at stakes. Nevertheless, using PHP with Yoctopuce modules provides you with the opportunity to very easily create web sites which are able to interact with their physical environment, and this is not available to every web server. This technique has a direct application in home automation: a few Yoctopuce modules, a PHP server, and you can interact with your home from anywhere on the planet, as long as you have an internet connection.

PHP is one of those languages which do not allow you to directly access the hardware layers of your computer. Therefore you need to run VirtualHub on the machine on which your modules are connected.

To start your tests with PHP, you need a PHP 7.1 (or more recent) server¹, preferably locally on you machine. If you wish to use the PHP server of your internet provider, it is possible, but you will probably need to configure your ADSL router for it to accept and forward TCP request on the 4444 port.

18.1. Getting ready

Go to the Yoctopuce web site and download the following items:

- The PHP programming library²
- VirtualHub³ for Windows, macOS, or Linux, depending on your OS

Our PHP library is based on PHP 8.x. In other words, our library works perfectly with any version of PHP currently still supported. However, in order not to abandon our customers with older installations, we maintain a version compatible with PHP 7.1. which dates back to 2016.

We also offer a version of the library that follows PSR's recommendations. For simplicity's sake, this version uses the same code as the php8 version, but each class is stored in a separate file. In addition, this version uses a `Yoctopuce\YoctoAPI` namespace. These changes make our library much easier to use with autoload installations.

Note that the examples in the documentation do not use the PSR version.

¹ A couple of free PHP servers: easyPHP for Windows, MAMP for macOS.

² www.yoctopuce.com/EN/libraries.php

³ www.yoctopuce.com/EN/virtualhub.php

In the library archive, there are thus three subdirectories:

- php7
- php8
- phpPSR

Choose the right directory according to the version of the library you wish to use, unzip the files of this directory into a directory of your choice accessible to your web server, plug in your modules, launch VirtualHub, and you are ready to start testing. You do not need to install any driver.

18.2. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a PHP code snippet to use the Display function.

```
include('yocto_api.php');
include('yocto_display.php');

[...]
// Get access to your device, through the VirtualHub running locally
YAPI::RegisterHub('http://127.0.0.1:4444/', $errmsg);
[...]

// Retrieve the object used to interact with the device
$display = YDisplay::FindDisplay("EPAPER1C-123456.display");

// Check that the module is online to handle hot-plug
if($display->isOnline())
{
    // Use $display->get_displayLayer()
    [...]
}
```

Let's look at these lines in more details.

yocto_api.php and yocto_display.php

These two PHP includes provides access to the functions allowing you to manage Yoctopuce modules. `yocto_api.php` must always be included, `yocto_display.php` is necessary to manage modules containing a display, such as Yocto-Display-ePaper-C.

YAPI::RegisterHub

The `YAPI::RegisterHub` function allows you to indicate on which machine the Yoctopuce modules are located, more precisely on which machine the VirtualHub software is running. In our case, the `127.0.0.1:4444` address indicates the local machine, port 4444 (the standard port used by Yoctopuce). You can very well modify this address, and enter the address of another machine on which the VirtualHub software is running.

YDisplay::FindDisplay

The `YDisplay::FindDisplay` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can use logical names as well, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number `EPAPER1C-123456` which you have named `"MyModule"`, and for which you have given the `display` function the name `"MyFunction"`. The following five calls are strictly equivalent, as long as `"MyFunction"` is defined only once.

```
$display = YDisplay::FindDisplay("EPAPER1C-123456.display");
$display = YDisplay::FindDisplay("EPAPER1C-123456.MyFunction");
$display = YDisplay::FindDisplay("MyModule.display");
$display = YDisplay::FindDisplay("MyModule.MyFunction");
$display = YDisplay::FindDisplay("MyFunction");
```

`YDisplay::FindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `YDisplay::FindDisplay` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YFindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example

Open your preferred text editor⁴, copy the code sample below, save it with the Yoctopuce library files in a location which is accessible to your web server, then use your preferred web browser to access this page. The code is also provided in the directory **Examples/Doc-GettingStarted-Yocto-Display-ePaper-C** of the Yoctopuce library.

In this example, you will recognize the functions explained above, but this time used with all side materials needed to make it work nicely as a small demo.

```
<HTML>
<HEAD>
  <TITLE>Hello World</TITLE>
</HEAD>
<BODY>
  <FORM method='get'>
    <?php
      include('../php8/yocto_api.php');
      include('../php8/yocto_display.php');

      // Use explicit error handling rather than exceptions
      YAPI::DisableExceptions();
      $errmsg = "";
      // Setup the API to use the VirtualHub on local machine
      if(YAPI::RegisterHub('http://127.0.0.1:4444/', $errmsg) != YAPI::SUCCESS) {
        die("Cannot contact VirtualHub on 127.0.0.1");
      }

      @$serial = $_GET['serial'];
      if ($serial != '') {
        // Check if a specified module is available online
        $disp = YDisplay::FindDisplay("$serial.display");
        if (!$disp->isOnline()) {
          die("Module not connected (check serial and USB cable)");
        }
      } else {
        // or use any connected module suitable for the demo
        $disp = YDisplay::FirstDisplay();
        if(is_null($disp)) {
          die("No module connected (check USB cable)");
        }
      }
      $serial = $disp->get_module()->get_serialNumber();
      Print("Module to use: <input name='serial' value='$serial'><br>");

      $colors = [ 0xFFFFFF, 0x000000, 0xFF0000, 0xFFFF00 ];
```

⁴ If you do not have a text editor, use Notepad rather than Microsoft Word.

```
// Makes sure the Panel type is set
$paneltype = $disp->get_displayPanel();
if ($paneltype== "NOT_SET")
{ die(" Use the virtual to configure the panel first");
}
// retrieve the display size
$w = $disp->get_displayWidth();
$h = $disp->get_displayHeight();
$midx = (int)($w / 2);
$midy = (int)($h / 2);
Print(" Using device {$disp->get_serialNumber()} (panel: $paneltype $w x $h pixels)");
$disp->resetAll();

// retrieve the first layer
$l0 = $disp->get_displayLayer(0);
$l0->selectFont("medium.yfm");
$disp->regenerateDisplay(); // kaes sure next refres will be a full one
// prevent refreshing for 2 sec
$disp->postponeRefresh(2000);
$l0->clear();
// draw a few circles
for ($i = 0; $i < 15; $i++)
{
    $cx = rand(0,$w) ;
    $cy = rand(0,$h) ;
    $r = rand( ($h / 20) , ($h / 10) );
    $l0->selectFillColor($colors[rand() % 4]);
    $l0->drawDisc($cx, $cy, $r);
    $l0->drawCircle($cx, $cy, $r);
}
// draw a rectangle with panel type in it
$l0->selectFillColor(0xffffff);
$l0->drawBar($midx - 75, $midy - 10, $midx + 75, $midy + 12);
$l0->drawRect($midx - 75, $midy - 10, $midx + 75, $midy + 12);
$l0->drawText($midx, $midy, YDisplayLayer::ALIGN_CENTER, $paneltype);
// forces a full refresh only the 1rst time
$disp->triggerRefresh(); // display is allowed to refresh again
YAPI::FreeAPI();

?>
<br><input type='submit' value="Refresh">
</FORM>
</BODY>
</HTML>
```

18.3. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```
<HTML>
<HEAD>
<TITLE>Module Control</TITLE>
</HEAD>
<BODY>
<FORM method='get'>
<?php
include('../php8/yocto_api.php');

// Use explicit error handling rather than exceptions
YAPI::DisableExceptions();

// Setup the API to use the VirtualHub on local machine
if(YAPI::RegisterHub('http://127.0.0.1:4444/', $errmsg) != YAPI::SUCCESS) {
    die("Cannot contact VirtualHub on 127.0.0.1 : ".$errmsg);
}

@$serial = $_GET['serial'];
if ($serial != '') {
    // Check if a specified module is available online
    $module = YModule::FindModule("$serial");
    if (!$module->isOnline()) {
```

```

        die("Module not connected (check serial and USB cable)");
    }
} else {
    // or use any connected module suitable for the demo
    $module = YModule::FirstModule();
    if($module) { // skip VirtualHub
        $module = $module->nextModule();
    }
    if(is_null($module)) {
        die("No module connected (check USB cable)");
    } else {
        $serial = $module->get_serialnumber();
    }
}
Print("Module to use: <input name='serial' value='$serial'><br>");

if (isset($_GET['beacon'])) {
    if ($_GET['beacon']=='ON')
        $module->set_beacon(Y_BEACON_ON);
    else
        $module->set_beacon(Y_BEACON_OFF);
}
printf('serial: %s<br>', $module->get_serialNumber());
printf('logical name: %s<br>', $module->get_logicalName());
printf('luminosity: %s<br>', $module->get_luminosity());
print('beacon: ');
if($module->get_beacon() == Y_BEACON_ON) {
    printf("<input type='radio' name='beacon' value='ON' checked>ON ");
    printf("<input type='radio' name='beacon' value='OFF'>OFF<br>");
} else {
    printf("<input type='radio' name='beacon' value='ON'>ON ");
    printf("<input type='radio' name='beacon' value='OFF' checked>OFF<br>");
}
printf('upTime: %s sec<br>',intVal($module->get_upTime()/1000));
printf('USB current: %sA<br>', $module->get_usbCurrent());
printf('logs:<br><pre>%s</pre>', $module->get_lastLogs());
YAPI::FreeAPI();
?>
<input type='submit' value='refresh'>
</FORM>
</BODY>
</HTML>

```

Each property `xxx` of the module can be read thanks to a method of type `get_xxxx()`, and properties which are not read-only can be modified with the help of the `set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `set_xxx()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```

<HTML>
<HEAD>
  <TITLE>save settings</TITLE>
<BODY>
  <FORM method='get'>
  <?php
    include('../..//php8/yocto_api.php');

    // Use explicit error handling rather than exceptions
    YAPI::DisableExceptions();

    // Setup the API to use the VirtualHub on local machine
    if(YAPI::RegisterHub('http://127.0.0.1:4444/', $errmsg) != YAPI::SUCCESS) {
        die("Cannot contact VirtualHub on 127.0.0.1");
    }

    @$serial = $_GET['serial'];

```

```

if ($serial != '') {
    // Check if a specified module is available online
    $module = YModule::FindModule("$serial");
    if (!$module->isOnline()) {
        die("Module not connected (check serial and USB cable)");
    }
} else {
    // or use any connected module suitable for the demo
    $module = YModule::FirstModule();
    if($module) { // skip VirtualHub
        $module = $module->nextModule();
    }
    if(is_null($module)) {
        die("No module connected (check USB cable)");
    } else {
        $serial = $module->get_serialnumber();
    }
}
Print("Module to use: <input name='serial' value='$serial'><br>");

if (isset($_GET['newname'])){
    $newname = $_GET['newname'];
    if (!yCheckLogicalName($newname))
        die('Invalid name');
    $module->set_logicalName($newname);
    $module->saveToFlash();
}
printf("Current name: %s<br>", $module->get_logicalName());
print("New name: <input name='newname' value='' maxlength=19><br>");
YAPI::FreeAPI();
?>
<input type='submit'>
</FORM>
</BODY>
</HTML>

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not `NULL`. Below a short example listing the connected modules.

```

<HTML>
<HEAD>
    <TITLE>inventory</TITLE>
</HEAD>
<BODY>
<H1>Device list</H1>
<TT>
    <?php
        include('../php8/yocto_api.php');
        YAPI::RegisterHub("http://127.0.0.1:4444/");
        $module = YModule::FirstModule();
        while (!is_null($module)) {
            printf("%s (%s)<br>\n", $module->get_serialNumber(),
                $module->get_productName());
            $module=$module->nextModule();
        }
        YAPI::FreeAPI();
    ?>
</TT>
</BODY>
</HTML>

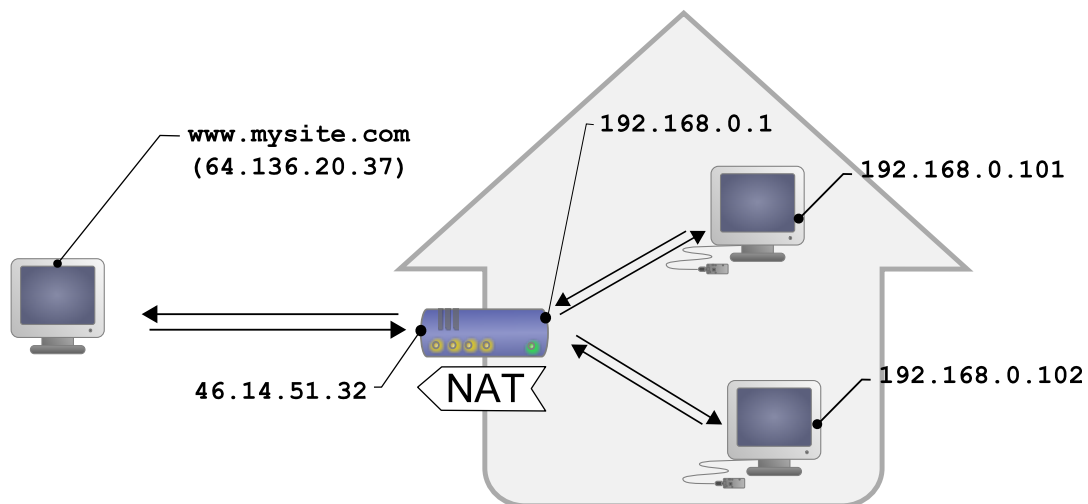
```

18.4. HTTP callback API and NAT filters

The PHP library is able to work in a specific mode called *HTTP callback Yocto-API*. With this mode, you can control Yoctopuce devices installed behind a NAT filter, such as a DSL router for example, and this without needing to open a port. The typical application is to control Yoctopuce devices, located on a private network, from a public web site.

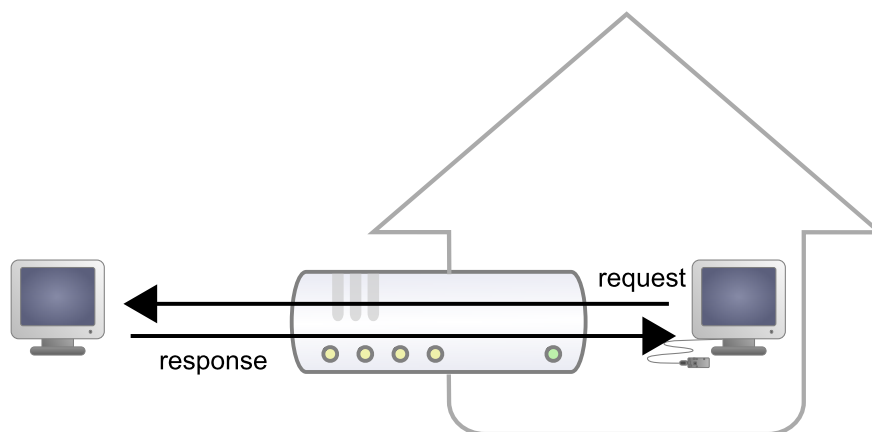
The NAT filter: advantages and disadvantages

A DSL router which translates network addresses (NAT) works somewhat like a private phone switchboard (a PBX): internal extensions can call each other and call the outside; but seen from the outside, there is only one official phone number, that of the switchboard itself. You cannot reach the internal extensions from the outside.

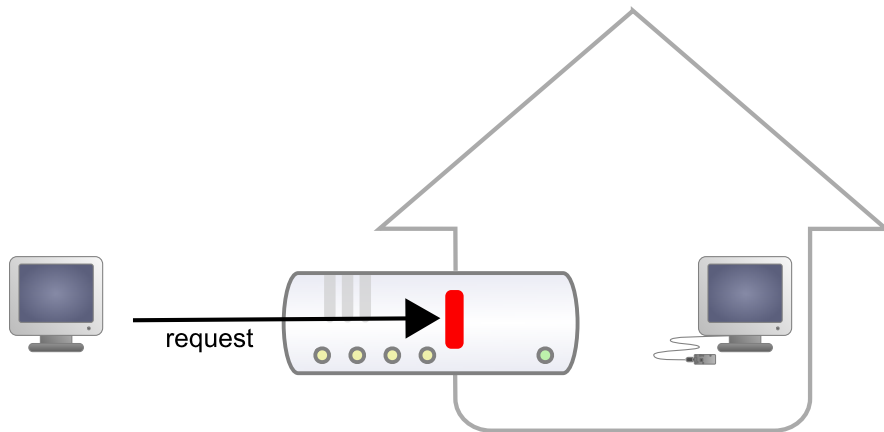


Typical DSL configuration: LAN machines are isolated from the outside by the DSL router

Transposed to the network, we have the following: appliances connected to your home automation network can communicate with one another using a local IP address (of the 192.168.xxx.yyy type), and contact Internet servers through their public address. However, seen from the outside, you have only one official IP address, assigned to the DSL router only, and you cannot reach your network appliances directly from the outside. It is rather restrictive, but it is a relatively efficient protection against intrusions.



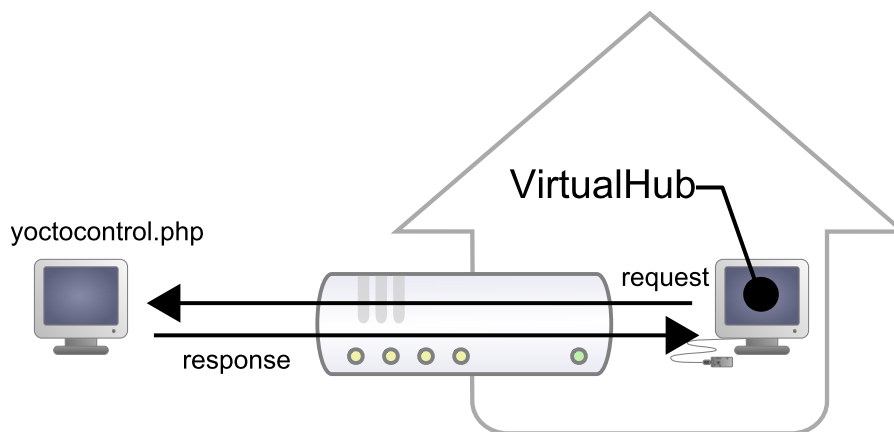
Responses from request from LAN machines are routed.



But requests from the outside are blocked.

Seeing Internet without being seen provides an enormous security advantage. However, this signifies that you cannot, a priori, set up your own web server at home to control a home automation installation from the outside. A solution to this problem, advised by numerous home automation system dealers, consists in providing outside visibility to your home automation server itself, by adding a routing rule in the NAT configuration of the DSL router. The issue of this solution is that it exposes the home automation server to external attacks.

The HTTP callback API solves this issue without having to modify the DSL router configuration. The module control script is located on an external site, and it is the *VirtualHub* which is in charge of calling it a regular intervals.



The HTTP callback API uses the *VirtualHub* which initiates the requests.

Configuration

The callback API thus uses the *VirtualHub* as a gateway. All the communications are initiated by the *VirtualHub*. They are thus outgoing communications and therefore perfectly authorized by the DSL router.

You must configure the *VirtualHub* so that it calls the PHP script on a regular basis. To do so:

1. Launch a *VirtualHub*
2. Access its interface, usually 127.0.0.1:4444
3. Click on the **configure** button of the line corresponding to the *VirtualHub* itself
4. Click on the **edit** button of the **Outgoing callbacks** section

Serial	Logical Name	Description	Action
VIRTHUB0-7d1a86fb0		VirtualHub	configure view log file
RELAYH11-00055		Yocto-PowerRelay	configure view log file beacon
TMPSENS1-05E7F		Yocto-Temperature	configure view log file beacon

Click on the "configure" button on the first line

Edit parameters for VIRTHUB0-7d1a86fb09, and click on the **Save** button.

Serial #: VIRTHUB0-7d1a86fb09
 Product name: VirtualHub
 Software version: 10789
 Logical name:

Incoming connections

Authentication to read information from the devices: NO
 Authentication to make changes to the devices: NO

Outgoing callbacks

Callback URL: octoHub
 Delay between callbacks: min: 3 [s] max: 600 [s]

Click on the "edit" button of the "Outgoing callbacks" section

Edit callback

This VirtualHub can post the advertised values of all devices on a specific URL on a regular basis. If you wish to use this feature, choose the callback type follow the steps below carefully.

1. Specify the Type of callback you want to use: **Yocto-API callback**

Yoctopuce devices can be controled through remote PHP scripts. That Yocto-API callback protocol is designed so it can pass trough NAT filters without opening ports. See your device user manual, *PHP programming* section for more details.

2. Specify the URL to use for reporting values. *HTTPS protocol is not yet supported.*
 Callback URL:

3. If your callback requires authentication, enter credentials here. Digest authentication is recommended, but Basic authentication works as well.
 Username:
 Password:

4. Setup the desired frequency of notifications:
 No less than seconds between two notification
 But notify after seconds in any case

5. Press on the **Test** button to check your parameters.
 6. When everything works, press on the **OK** button.

And select "Yocto-API callback".

You then only need to define the URL of the PHP script and, if need be, the user name and password to access this URL. Supported authentication methods are *basic* and *digest*. The second method is safer than the first one because it does not allow transfer of the password on the network.

Usage

From the programmer standpoint, the only difference is at the level of the `yRegisterHub` function call. Instead of using an IP address, you must use the *callback* string (or `http://callback` which is equivalent).

```
include("yocto_api.php");
yRegisterHub("callback");
```

The remainder of the code stays strictly identical. On the *VirtualHub* interface, at the bottom of the configuration window for the HTTP callback API, there is a button allowing you to test the call to the PHP script.

Be aware that the PHP script controlling the modules remotely through the HTTP callback API can be called only by the *VirtualHub*. Indeed, it requires the information posted by the *VirtualHub* to function. To code a web site which controls Yoctopuce modules interactively, you must create a user interface which stores in a file or in a database the actions to be performed on the Yoctopuce modules. These actions are then read and run by the control script.

Common issues

For the HTTP callback API to work, the PHP option `allow_url_fopen` must be set. Some web site hosts do not set it by default. The problem then manifests itself with the following error:

```
error: URL file-access is disabled in the server configuration
```

To set this option, you must create, in the repertory where the control PHP script is located, an `.htaccess` file containing the following line:

```
php_flag "allow_url_fopen" "On"
```

Depending on the security policies of the host, it is sometimes impossible to authorize this option at the root of the web site, or even to install PHP scripts receiving data from a POST HTTP. In this case, place the PHP script in a subdirectory.

Limitations

This method that allows you to go through NAT filters cheaply has nevertheless a price. Communications being initiated by the *VirtualHub* at a more or less regular interval, reaction time to an event is clearly longer than if the Yoctopuce modules were driven directly. You can configure the reaction time in the specific window of the *VirtualHub*, but it is at least of a few seconds in the best case.

The *HTTP callback Yocto-API* mode is currently available in PHP, EcmaScript (Node.JS) and Java only.

18.5. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software. The only way to prevent this is to implement one of the two error handling techniques described below.

The method recommended by most programming languages for unpredictable error handling is the use of exceptions. By default, it is the behavior of the Yoctopuce library. If an error happens while you try to access a module, the library throws an exception. In this case, there are three possibilities:

- If your code catches the exception and handles it, everything goes well.
- If your program is running in debug mode, you can relatively easily determine where the problem happened and view the explanatory message linked to the exception.
- Otherwise... the exception makes your program crash, bang!

As this latest situation is not the most desirable, the Yoctopuce library offers another possibility for error handling, allowing you to create a robust program without needing to catch exceptions at every line of code. You simply need to call the `YAPI.DisableExceptions()` function to commute the library to a mode where exceptions for all the functions are systematically replaced by specific return values, which can be tested by the caller when necessary. For each function, the name of each return value in case of error is systematically documented in the library reference. The name always follows the same logic: a `get_state()` method returns a `ClassName.STATE_INVALID` value, a `get_currentValue` method returns a `ClassName.CURRENTVALUE_INVALID` value, and so on. In any case, the returned value is of the expected type and is not a null pointer which would

risk crashing your program. At worst, if you display the value without testing it, it will be outside the expected bounds for the returned value. In the case of functions which do not normally return information, the return value is `YAPI_SUCCESS` if everything went well, and a different error code in case of failure.

When you work without exceptions, you can obtain an error code and an error message explaining the source of the error. You can request them from the object which returned the error, calling the `errType()` and `errMessage()` methods. Their returned values contain the same information as in the exceptions when they are active.

19. Using Yocto-Display-ePaper-C with Visual Basic .NET

VisualBasic has long been the most favored entrance path to the Microsoft world. Therefore, we had to provide our library for this language, even if the new trend is shifting to C#. We support Visual Studio 2017 and its more recent versions.

19.1. Installation

Download the Visual Basic Yoctopuce library from the Yoctopuce web site¹. There is no setup program, simply copy the content of the zip file into the directory of your choice. You mostly need the content of the `Sources` directory. The other directories contain the documentation and a few sample programs. All sample projects are Visual Basic 2010, projects, if you are using a previous version, you may have to recreate the projects structure from scratch.

19.2. Using the Yoctopuce API in a Visual Basic project

The Visual Basic.NET Yoctopuce library is composed of a DLL and of source files in Visual Basic. The DLL is not a .NET DLL, but a classic DLL, written in C, which manages the low level communications with the modules². The source files in Visual Basic manage the high level part of the API. Therefore, you need both this DLL and the .vb files of the `sources` directory to create a project managing Yoctopuce modules.

Configuring a Visual Basic project

The following indications are provided for Visual Studio Express 2010, but the process is similar for other versions. Start by creating your project. Then, on the *Solution Explorer* panel, right click on your project, and select "Add" and then "Add an existing item".

A file selection window opens. Select the `yocto_api.vb` file and the files corresponding to the functions of the Yoctopuce modules that your project is going to manage. If in doubt, select all the files.

You then have the choice between simply adding these files to your project, or to add them as links (the **Add** button is in fact a scroll-down menu). In the first case, Visual Studio copies the selected files into your project. In the second case, Visual Studio simply keeps a link on the original files. We recommend you to use links, which makes updates of the library much easier.

¹ www.yoctopuce.com/EN/libraries.php

² The sources of this DLL are available in the C++ API

Then add in the same manner the `yapi.dll` DLL, located in the `Sources/dll` directory³. Then, from the **Solution Explorer** window, right click on the DLL, select **Properties** and in the **Properties** panel, set the **Copy to output folder** to **always**. You are now ready to use your Yoctopuce modules from Visual Studio.

In order to keep them simple, all the examples provided in this documentation are console applications. Naturally, the libraries function in a strictly identical manner if you integrate them in an application with a graphical interface.

19.3. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a Visual Basic code snippet to use the Display function.

```
[...]
' Enable detection of USB devices
Dim errmsg As String
YAPI.RegisterHub("usb", errmsg)
[...]

' Retrieve the object used to interact with the device
Dim display As YDisplay
display = YDisplay.FindDisplay("EPAPER1C-123456.display")

' Hot-plug is easy: just check that the device is online
If (display.isOnline()) Then
    ' Use display.get_displayLayer()
    [...]
End If

[...]
```

Let's look at these lines in more details.

YAPI.RegisterHub

The `YAPI.RegisterHub` function initializes the Yoctopuce API and indicates where the modules should be looked for. When used with the parameter `"usb"`, it will use the modules locally connected to the computer running the library. If the initialization does not succeed, this function returns a value different from `YAPI_SUCCESS` and `errmsg` contains the error message.

YDisplay.FindDisplay

The `YDisplay.FindDisplay` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can use logical names as well, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number `EPAPER1C-123456` which you have named `"MyModule"`, and for which you have given the `display` function the name `"MyFunction"`. The following five calls are strictly equivalent, as long as `"MyFunction"` is defined only once.

```
display = YDisplay.FindDisplay("EPAPER1C-123456.display")
display = YDisplay.FindDisplay("EPAPER1C-123456.MyFunction")
display = YDisplay.FindDisplay("MyModule.display")
display = YDisplay.FindDisplay("MyModule.MyFunction")
display = YDisplay.FindDisplay("MyFunction")
```

`YDisplay.FindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `YDisplay.FindDisplay` allows you to know if the corresponding module is present and in working order.

³ Remember to change the filter of the selection window, otherwise the DLL will not show.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YFindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example

Launch Microsoft VisualBasic and open the corresponding sample project provided in the directory **Examples/Doc-GettingStarted-Yocto-Display-ePaper-C** of the Yoctopuce library.

In this example, you will recognize the functions explained above, but this time used with all side materials needed to make it work nicely as a small demo.

```
Module Module1

    Private Sub Usage()
        Dim execname = System.AppDomain.CurrentDomain.FriendlyName
        Console.WriteLine("Usage:")
        Console.WriteLine(execname + " <serial_number>")
        Console.WriteLine(execname + " <logical_name> ")
        Console.WriteLine(execname + " any")
        System.Threading.Thread.Sleep(2500)
    End Sub

    Sub Main()
        Dim argv() As String = System.Environment.GetCommandLineArgs()
        Dim errmsg As String = ""
        Dim target As String
        Dim disp As YDisplay

        If argv.Length <= 1 Then Usage()

        target = argv(1)

        REM Setup the API to use local USB devices
        If (YAPI.RegisterHub("usb", errmsg) <> YAPI_SUCCESS) Then
            Console.WriteLine("RegisterHub error: " + errmsg)
            System.Threading.Thread.Sleep(2500)
        End If

        If target = "any" Then
            disp = YDisplay.FirstDisplay()
            If disp Is Nothing Then
                Console.WriteLine("No module connected (check USB cable) ")
            End If
        End If

        Else
            disp = YDisplay.FindDisplay(target + ".display")
        End If

        If Not (disp.IsOnline()) Then
            Console.WriteLine("Module not connected (check identification and USB cable)")
        End If

        Dim colors() As Integer = {&HFFFFFF, &H0, &HFF0000, &HFFFF00}
```

```

REM Makes sure the Panel type Is set
Dim paneltype As String = disp.get_displayPanel()
If paneltype = "NOT_SET" Then
    Console.WriteLine("Use the virtual to Configure the panel first")
    YAPI.Sleep(3000, errmsg)
    Environment.Exit(0)
End If

REM retrieve the display size
Dim w As Integer = disp.get_displayWidth()
Dim h As Integer = disp.get_displayHeight()
Dim middleX As Integer = CInt(w / 2)
Dim middleY As Integer = CInt(h / 2)

Console.WriteLine("Using device " + disp.get_serialNumber() + " (panel: " + paneltype +
" " + w.ToString() + "x" + h.ToString() + "pixels)")
disp.resetAll()

REM forces a full the next refresh only the 1rst time
disp.regenerateDisplay()

REM retrieve the first layer
Dim l0 As YDisplayLayer = disp.get_displayLayer(0)
l0.selectFont("medium.yfm")
Dim animation As Boolean = True

While animation
    REM prevent refreshing for 2 sec
    disp.postponeRefresh(2000)
    l0.clear()
    REM draw a few circle
    For i As Integer = 1 To 15
        Dim cx As Integer = CInt(w * Rnd())
        Dim cy As Integer = CInt(h * Rnd())
        Dim r As Integer = CInt(h / 20) + CInt(Rnd() * h / 10)
        Dim c As Integer = CInt(3 * Rnd())
        l0.selectFillColor(colors(c))
        l0.drawDisc(cx, cy, r)
        l0.drawCircle(cx, cy, r)
    Next i
    REM draw a rectangle with panel type in it
    l0.selectFillColor(&HFFFFFF)
    l0.drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12)
    l0.drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12)
    l0.drawText(middleX, middleY, Y_ALIGN.CENTER, paneltype)
    disp.triggerRefresh() REM display is allowed To refresh again
    YAPI.Sleep(1000, errmsg)
    REM if no fast refresh available, don't even try to run animations
    If paneltype.IndexOf("KS") < 0 Then animation = False
End While
YAPI.FreeAPI()

End Sub

End Module

```

19.4. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```

Imports System.IO
Imports System.Environment

Module Module1

    Sub usage()
        Console.WriteLine("usage: demo <serial or logical name> [ON/OFF]")
    End Sub

End Sub

```

```

Sub Main()
    Dim argv() As String = System.Environment.GetCommandLineArgs()
    Dim errmsg As String = ""
    Dim m As YModule

    If (YAPI.RegisterHub("usb", errmsg) <> YAPI_SUCCESS) Then
        Console.WriteLine("RegisterHub error:" + errmsg)
    End If

    If argv.Length < 2 Then usage()

    m = YModule.FindModule(argv(1)) REM use serial or logical name
    If (m.isOnline()) Then
        If argv.Length > 2 Then
            If argv(2) = "ON" Then m.set_beacon(Y_BEACON_ON)
            If argv(2) = "OFF" Then m.set_beacon(Y_BEACON_OFF)
        End If
        Console.WriteLine("serial:      " + m.get_serialNumber())
        Console.WriteLine("logical name: " + m.get_logicalName())
        Console.WriteLine("luminosity:   " + Str(m.get_luminosity()))
        Console.WriteLine("beacon:      ")
        If (m.get_beacon() = Y_BEACON_ON) Then
            Console.WriteLine("ON")
        Else
            Console.WriteLine("OFF")
        End If
        Console.WriteLine("upTime:      " + Str(m.get_upTime() / 1000) + " sec")
        Console.WriteLine("USB current:  " + Str(m.get_usbCurrent()) + " mA")
        Console.WriteLine("Logs:")
        Console.WriteLine(m.get_lastLogs())
    Else
        Console.WriteLine(argv(1) + " not connected (check identification and USB cable)")
    End If
    YAPI.FreeAPI()
End Sub

End Module

```

Each property xxx of the module can be read thanks to a method of type `get_xxxx()`, and properties which are not read-only can be modified with the help of the `set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `set_xxx()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```

Module Module1

    Sub usage()

        Console.WriteLine("usage: demo <serial or logical name> <new logical name>")
    End Sub

    Sub Main()
        Dim argv() As String = System.Environment.GetCommandLineArgs()
        Dim errmsg As String = ""
        Dim newname As String
        Dim m As YModule

        If (argv.Length <> 3) Then usage()

        REM Setup the API to use local USB devices
        If YAPI.RegisterHub("usb", errmsg) <> YAPI_SUCCESS Then
            Console.WriteLine("RegisterHub error: " + errmsg)
        End If
    End Sub

End Module

```

```

End If

m = YModule.FindModule(argv(1)) REM use serial or logical name
If m.isOnline() Then
    newname = argv(2)
    If (Not YAPI.CheckLogicalName(newname)) Then
        Console.WriteLine("Invalid name (" + newname + ")")
    End If
    End If
    m.set_logicalName(newname)
    m.saveToFlash() REM do not forget this
    Console.Write("Module: serial= " + m.get_serialNumber)
    Console.Write(" / name= " + m.get_logicalName())
Else
    Console.Write("not connected (check identification and USB cable)")
End If
YAPI.FreeAPI()

End Sub

End Module

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not `Nothing`. Below a short example listing the connected modules.

```

Module Module1

Sub Main()
    Dim M As ymodule
    Dim errmsg As String = ""

    REM Setup the API to use local USB devices
    If YAPI.RegisterHub("usb", errmsg) <> YAPI.SUCCESS Then
        Console.WriteLine("RegisterHub error: " + errmsg)
    End If
End If

Console.WriteLine("Device list")
M = YModule.FirstModule()
While M IsNot Nothing
    Console.WriteLine(M.get_serialNumber() + " (" + M.get_productName() + ")")
    M = M.nextModule()
End While
YAPI.FreeAPI()
End Sub

End Module

```

19.5. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then

hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software. The only way to prevent this is to implement one of the two error handling techniques described below.

The method recommended by most programming languages for unpredictable error handling is the use of exceptions. By default, it is the behavior of the Yoctopuce library. If an error happens while you try to access a module, the library throws an exception. In this case, there are three possibilities:

- If your code catches the exception and handles it, everything goes well.
- If your program is running in debug mode, you can relatively easily determine where the problem happened and view the explanatory message linked to the exception.
- Otherwise... the exception makes your program crash, bang!

As this latest situation is not the most desirable, the Yoctopuce library offers another possibility for error handling, allowing you to create a robust program without needing to catch exceptions at every line of code. You simply need to call the `YAPI.DisableExceptions()` function to commute the library to a mode where exceptions for all the functions are systematically replaced by specific return values, which can be tested by the caller when necessary. For each function, the name of each return value in case of error is systematically documented in the library reference. The name always follows the same logic: a `get_state()` method returns a `ClassName.STATE_INVALID` value, a `get_currentValue` method returns a `ClassName.CURRENTVALUE_INVALID` value, and so on. In any case, the returned value is of the expected type and is not a null pointer which would risk crashing your program. At worst, if you display the value without testing it, it will be outside the expected bounds for the returned value. In the case of functions which do not normally return information, the return value is `YAPI_SUCCESS` if everything went well, and a different error code in case of failure.

When you work without exceptions, you can obtain an error code and an error message explaining the source of the error. You can request them from the object which returned the error, calling the `errType()` and `errMessage()` methods. Their returned values contain the same information as in the exceptions when they are active.

20. Using Yocto-Display-ePaper-C with Delphi or Lazarus

Delphi is a descendent of Turbo-Pascal. Originally, Delphi was produced by Borland, Embarcadero now edits it. The strength of this language resides in its ease of use, as anyone with some notions of the Pascal language can develop a Windows application in next to no time. Its only disadvantage is to cost something¹.

Lazarus² is a free IDE based on Free-Pascal, it has nothing to envy to Delphi and is available for both Windows and Linux. The Yoctopuce Delphi library is compatible with both Windows and Linux versions of Lazarus

Delphi libraries are provided not as VCL components, but directly as source files. These files are compatible with most Delphi and Lazarus versions.³

20.1. Preparation

Go to the Yoctopuce web site and download the Yoctopuce Delphi libraries⁴. Uncompress everything in a directory of your choice.

- With Delphi, add the subdirectory *sources* in the list of directories of Delphi libraries.⁵
- With Lazarus, open your project options and add the *sources* folder to your "other unit files" path.⁶

Windows

With Windows, the Yoctopuce Delphi / Lazarus library uses two dlls *yapi.dll* (32-bit version) and *yapi64.dll* (64-bit version). All the applications that you create with Delphi or Lazarus must have access to these DLL. The simplest way to ensure this is to make sure that they are located in the same directory as the executable file of your application. You can find these dlls in the *sources/dll* folder.

¹ Actually, Borland provided free versions (for personal use) of Delphi 2006 and 2007. Look for them on the Internet, you may still be able to download them.

² www.lazarus-ide.org

³ Delphi libraries are regularly tested with Delphi 5, Delphi XE2, and the latest version of Lazarus.

⁴ www.yoctopuce.com/EN/libraries.php

⁵ Use the **Tools / Environment options** menu.

⁶ Use the Menu **Project / Project options/ Compiler options / Paths**

Linux

Under Linux, the Delphi / Lazarus library uses the following lib files:

- *libyapi-i386.so* for Intel 32-bit systems
- *libyapi-amd64.so* for Intel 64-bit systems
- *libyapi-armhf.so* for ARM 32-bit systems
- *libyapi-aarch64.so* for ARM 64-bit systems

You will find these lib files in the *sources/dll* folder. You have to make sure that

- Lazarus can find the right .so file at compilation time.
- The executable can find it at execution time.

The simplest way to ensure this is to copy all four .so files into the */usr/lib* folder. Alternatively, you can copy them next to your main source file and adjust your *LD_LIBRARY_PATH* environment variable accordingly.

20.2. About examples

To keep them simple, all the examples provided in this documentation are console applications. Obviously, the libraries work in a strictly identical way with VCL applications.

Note that most of these examples use command line parameters ⁷.

You will soon notice that the Delphi API defines many functions which return objects. You do not need to deallocate these objects yourself, the API does it automatically at the end of the application.

20.3. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a Delphi code snippet to use the Display function.

```
uses yocto_api, yocto_display;

var errmsg: string;
    display: TYDisplay;

[...]
// Enable detection of USB devices
yRegisterHub('usb', errmsg)
[...]

// Retrieve the object used to interact with the device
display = yFindDisplay("EPAPER1C-123456.display")

// Hot-plug is easy: just check that the device is online
if display.isOnline() then
begin
    // Use display.get_displayLayer()
    [...]
end;
[...]
```

Let's look at these lines in more details.

yocto_api and yocto_display

These two units provide access to the functions allowing you to manage Yoctopuce modules. *yocto_api* must always be used, *yocto_display* is necessary to manage modules containing a display, such as Yocto-Display-ePaper-C.

⁷ See <https://www.yoctopuce.com/EN/article/about-programming-examples>

yRegisterHub

The `yRegisterHub` function initializes the Yoctopuce API and specifies where the modules should be looked for. When used with the parameter `'usb'`, it will use the modules locally connected to the computer running the library. If the initialization does not succeed, this function returns a value different from `YAPI_SUCCESS` and `errmsg` contains the error message.

yFindDisplay

The `yFindDisplay` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can also use logical names, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number `EPAPER1C-123456` which you have named `"MyModule"`, and for which you have given the `display` function the name `"MyFunction"`. The following five calls are strictly equivalent, as long as `"MyFunction"` is defined only once.

```
display := yFindDisplay("EPAPER1C-123456.display");
display := yFindDisplay("EPAPER1C-123456.MyFunction");
display := yFindDisplay("MyModule.display");
display := yFindDisplay("MyModule.MyFunction");
display := yFindDisplay("MyFunction");
```

`yFindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `yFindDisplay` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `yFindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example

Launch your Delphi environment, copy the `yapi.dll` DLL in a directory, create a new console application in the same directory, and copy-paste the piece of code below:

In this example, you will recognize the functions explained above, but this time used with all side materials needed to make it work nicely as a small demo.

```
program helloworld;
{$APPTYPE CONSOLE}
uses
  SysUtils,
  {$IFDEF UNIX}
  windows,
  {$ENDIF UNIX}
  yocto_api,
  yocto_display;

Procedure Usage();
var
  exe : string;
```

```

begin
  exe:= ExtractFileName(paramstr(0));
  WriteLn(exe+' <serial_number>');
  WriteLn(exe+' <logical_name>');
  WriteLn(exe+' any');
  sleep(3000);
  halt;
End;

var
  disp          : TYDisplay;
  l0            : TYDisplayLayer;
  errmsg        : string;
  w,h           : integer;
  paneltype     : string;
  middleX,middleY : integer;
  iterations    : integer;
  animation     : boolean;
  cx,cy,r,i     : integer;

const
  colors: array[0..3] of integer =( $FFFFFF, $000000, $FF0000, $FFFF00 );

begin
  errmsg:='';
  if (paramcount<1) then usage();

  // Setup the API to use local USB devices
  if yRegisterHub('usb', errmsg)<>YAPI_SUCCESS then
  begin
    Write('RegisterHub error: '+errmsg);
    sleep(3000);
    exit;
  end;

  // first one of the two RGB leds
  if paramstr(1)='any' then
  begin
    disp := yFirstDisplay();
    if disp=nil then
      begin
        writeln('No module connected (check USB cable)');
        sleep(3000);
        halt;
      end
    end
  else
    disp:= YFindDisplay(paramstr(1)+'.display');

  // make sure it is online
  if not(disp.isOnline()) then
  begin
    writeln('No module connected (check USB cable)');
    sleep(3000);
    halt;
  end;

  // Makes sure the Panel type is set
  paneltype := disp.get_displayPanel();
  if (paneltype = 'NOT_SET') then
  begin
    Writeln('Use the virtual to Configure the panel first');
    ySleep(3000, errmsg);
    halt;
  end;

  // retrieve the display size
  w := disp.get_displayWidth();
  h := disp.get_displayHeight();
  middleX := w div 2;
  middleY := h div 2;
  writeln( 'Using device ' +disp.get_serialNumber() + ' (panel: ' + paneltype + ' ' +
  IntToStr(w) + 'x' + IntToStr(h) + 'pixels)');
  disp.resetAll();

  // retrieve the first layer
  l0 := disp.get_displayLayer(0);

```

```

10.selectFont('medium.yfm');
iterations := 0;
animation := true;

while (animation) do
begin
    iterations:=iterations+1;
    // prevent refreshing for 2 sec
    disp.postponeRefresh(2000);
    10.clear();
    // draw a few circle
    for i := 1 to 15 do
    begin
        cx := trunc(Random * w);
        cy := trunc(Random * h);
        r := trunc(h / 20) + trunc(Random * h / 10);
        10.selectFillColor(colors[trunc(4*Random)]);
        10.drawDisc(cx, cy, r);
        10.drawCircle(cx, cy, r);
    end;
    // draw a rectangle with panel type in it
    10.selectFillColor($ffffff);
    10.drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    10.drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    10.drawText(middleX, middleY, Y_ALIGN_CENTER, paneltype);
    // forces a full refresh only the 1rst time
    if (iterations = 1) then disp.regenerateDisplay();
    disp.triggerRefresh(); // display is allowed to refresh again
    ySleep(1000, errmsg);
    // if no fast refresh available, don't even try to run animations
    if (pos('KS',paneltype)<=0) then animation := false;
end;
yFreeAPI();
end.

```

20.4. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```

program modulecontrol;
{$APPTYPE CONSOLE}
uses
    SysUtils,
    yocto_api;

const
    serial = 'EPAPER1C-123456'; // use serial number or logical name

procedure refresh(module:Tymodule) ;
begin
    if (module.isOnline()) then
    begin
        Writeln('');
        Writeln('Serial      : ' + module.get_serialNumber());
        Writeln('Logical name : ' + module.get_logicalName());
        Writeln('Luminosity   : ' + intToStr(module.get_luminosity()));
        Write('Beacon     :');
        if (module.get_beacon()=Y_BEACON_ON) then Writeln('on')
            else Writeln('off');
        Writeln('uptime      : ' + intToStr(module.get_upTime() div 1000)+'s');
        Writeln('USB current : ' + intToStr(module.get_usbCurrent())+'mA');
        Writeln('Logs        : ');
        Writeln(module.get_lastlogs());
        Writeln('');
        Writeln('r : refresh / b:beacon ON / space : beacon off');
    end
    else Writeln('Module not connected (check identification and USB cable)');
end;

procedure beacon(module:Tymodule;state:integer);
begin

```

```

    module.set_beacon(state);
    refresh(module);
end;

var
    module : TYModule;
    c      : char;
    errmsg : string;

begin
    // Setup the API to use local USB devices
    if yRegisterHub('usb', errmsg) <> YAPI_SUCCESS then
    begin
        Write('RegisterHub error: '+errmsg);
        exit;
    end;

    module := yFindModule(serial);
    refresh(module);

    repeat
        read(c);
        case c of
            'r': refresh(module);
            'b': beacon(module, Y_BEACON_ON);
            ' ': beacon(module, Y_BEACON_OFF);
        end;
    until c = 'x';
    yFreeAPI();
end.

```

Each property `xxx` of the module can be read thanks to a method of type `get_xxxx()`, and properties which are not read-only can be modified with the help of the `set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `set_xxx()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```

program savesettings;
{$APPTYPE CONSOLE}
uses
    SysUtils,
    yocto_api;

const
    serial = 'EPAPER1C-123456'; // use serial number or logical name

var
    module : TYModule;
    errmsg : string;
    newname : string;

begin
    // Setup the API to use local USB devices
    if yRegisterHub('usb', errmsg) <> YAPI_SUCCESS then
    begin
        Write('RegisterHub error: '+errmsg);
        exit;
    end;

    module := yFindModule(serial);
    if (not(module.isOnline)) then
    begin
        writeln('Module not connected (check identification and USB cable)');
        exit;
    end;

    Writeln('Current logical name : '+module.get_logicalName());

```

```

Write('Enter new name : ');
Readln(newname);
if (not(yCheckLogicalName(newname))) then
begin
    Writeln('invalid logical name');
    exit;
end;
module.set_logicalName(newname);
module.saveToFlash();
yFreeAPI();
Writeln('logical name is now : '+module.get_logicalName());
end.

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not `nil`. Below a short example listing the connected modules.

```

program inventory;
{$APPTYPE CONSOLE}
uses
    SysUtils,
    yocto_api;

var
    module : TYModule;
    errmsg : string;

begin
    // Setup the API to use local USB devices
    if yRegisterHub('usb', errmsg) <> YAPI_SUCCESS then
    begin
        Write('RegisterHub error: '+errmsg);
        exit;
    end;

    Writeln('Device list');

    module := yFirstModule();
    while module <> nil do
    begin
        Writeln( module.get_serialNumber()+' ('+module.get_productName()+')');
        module := module.nextModule();
    end;
    yFreeAPI();
end.

```

20.5. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that

you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software. The only way to prevent this is to implement one of the two error handling techniques described below.

The method recommended by most programming languages for unpredictable error handling is the use of exceptions. By default, it is the behavior of the Yoctopuce library. If an error happens while you try to access a module, the library throws an exception. In this case, there are three possibilities:

- If your code catches the exception and handles it, everything goes well.
- If your program is running in debug mode, you can relatively easily determine where the problem happened and view the explanatory message linked to the exception.
- Otherwise... the exception makes your program crash, bang!

As this latest situation is not the most desirable, the Yoctopuce library offers another possibility for error handling, allowing you to create a robust program without needing to catch exceptions at every line of code. You simply need to call the `YAPI.DisableExceptions()` function to commute the library to a mode where exceptions for all the functions are systematically replaced by specific return values, which can be tested by the caller when necessary. For each function, the name of each return value in case of error is systematically documented in the library reference. The name always follows the same logic: a `get_state()` method returns a `ClassName.STATE_INVALID` value, a `get_currentValue` method returns a `ClassName.CURRENTVALUE_INVALID` value, and so on. In any case, the returned value is of the expected type and is not a null pointer which would risk crashing your program. At worst, if you display the value without testing it, it will be outside the expected bounds for the returned value. In the case of functions which do not normally return information, the return value is `YAPI_SUCCESS` if everything went well, and a different error code in case of failure.

When you work without exceptions, you can obtain an error code and an error message explaining the source of the error. You can request them from the object which returned the error, calling the `errType()` and `errMessage()` methods. Their returned values contain the same information as in the exceptions when they are active.

21. Using the Yocto-Display-ePaper-C with Universal Windows Platform

Universal Windows Platform (UWP) is not a language per say, but a software platform created by Microsoft. This platform allows you to run a new type of applications: the universal Windows applications. These applications can work on all machines running under Windows 10. This includes computers, tablets, smart phones, XBox One, and also Windows IoT Core.

The Yoctopuce UWP library allows you to use Yoctopuce modules in a universal Windows application and is written in C# in its entirety. You can add it to a Visual Studio 2017¹ project.

21.1. Blocking and asynchronous functions

The Universal Windows Platform does not use the Win32 API but only the Windows Runtime API which is available on all the versions of Windows 10 and for any architecture. Thanks to this library, you can use UWP on all the Windows 10 versions, including Windows 10 IoT Core.

However, using the new UWP API has some consequences: the Windows Runtime API to access the USB ports is asynchronous, and therefore the Yoctopuce library must be asynchronous as well. Concretely, the asynchronous methods do not return a result directly but a `Task` or `Task<>` object and the result can be obtained later. Fortunately, the C# language, version 6, supports the `async` and `await` keywords, which simplifies using these functions enormously. You can thus use asynchronous functions in the same way as traditional functions as long as you respect the following two rules:

- The method is declared as asynchronous with the `async` keyword
- The `await` keyword is added when calling an asynchronous function

Example:

```
async Task<int> MyFunction(int val)
{
    // do some long computation
    ...

    return result;
}

int res = await MyFunction(1234);
```

¹ <https://www.visualstudio.com/vs/cordova/vs/>

Our library follows these two rules and can therefore use the `await` notation.

For you not to have to wonder whether a function is asynchronous or not, there is the following convention: **all the public methods** of the UWP library **are asynchronous**, that is that you must call them with the `await` keyword, **except**:

- `GetTickCount()`, because measuring time in an asynchronous manner does not make a lot of sense...
- `FindModule()`, `FirstModule()`, `nextModule()`,... because detecting and enumerating modules is performed as a background task on internal structures which are managed transparently. It is therefore not necessary to use blocking functions while going through the lists of modules.

21.2. Installation

Download the Yoctopuce library for Universal Windows Platform from the Yoctopuce web site². There is no installation software, simply copy the content of the zip file in a directory of your choice. You essentially need the content of the `Sources` directory. The other directories contain documentation and a few sample programs. Sample projects are Visual Studio 2017 projects. Visual Studio 2017 is available on the Microsoft web site³.

21.3. Using the Yoctopuce API in a Visual Studio project

Start by creating your project. Then, from the **Solution Explorer** panel right click on your project and select **Add** then **Existing element**.

A file chooser opens: select all the files in the library `Sources` directory.

You then have the choice between simply adding the files to your project or adding them as a link (the **Add** button is actually a drop-down menu). In the first case, Visual Studio copies the selected files into your project. In the second case, Visual Studio simply creates a link to the original files. We recommend to use links, as a potential library update is thus much easier.

The Package.appxmanifest file

By default a Universal Windows application doesn't have access rights to the USB ports. If you want to access USB devices, you must imperatively declare it in the `Package.appxmanifest` file.

Unfortunately, the edition window of this file doesn't allow this operation and you must modify the `Package.appxmanifest` file by hand. In the "Solution Explorer" panel, right click on the `Package.appxmanifest` and select "View Code".

In this XML file, we must add a `DeviceCapability` node in the `Capabilities` node. This node must have a "Name" attribute with a "humaninterfacedevice" value.

Inside this node, you must declare all the modules that can be used. Concretely, for each module, you must add a "Device" node with an "Id" attribute, which has for value a character string "vidpid:USB_VENDORID USB_DEVICE_ID". The Yoctopuce USB_VENDORID is 24e0 and you can find the USB_DEVICE_ID of each Yoctopuce device in the documentation in the "Characteristics" section. Finally, the "Device" node must contain a "Function" node with the "Type" attribute with a value of "usage:ff00 0001".

For the Yocto-Display-ePaper-C, here is what you must add in the "Capabilities" node:

```
<DeviceCapability Name="humaninterfacedevice">
  <!-- Yocto-Display-ePaper-C -->
  <Device Id="vidpid:24e0 00F9">
    <Function Type="usage:ff00 0001" />
  </Device>
</DeviceCapability>
```

² www.yoctopuce.com/EN/libraries.php

³ <https://www.visualstudio.com/downloads/>

```
</Device>
</DeviceCapability>
```

Unfortunately, it's not possible to write a rule authorizing all Yoctopuce modules. Therefore, you must imperatively add each module that you want to use.

21.4. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a C# code snippet to use the Display function.

```
[...]
// Enable detection of USB devices
await YAPI.RegisterHub("usb");
[...]

// Retrieve the object used to interact with the device
YDisplay display = YDisplay.FindDisplay("EPAPER1C-123456.display");

// Hot-plug is easy: just check that the device is online
if (await display.isOnline())
{
    // Use display.get_displayLayer()
    [...]
}

[...]
```

Let us look at these lines in more details.

YAPI.RegisterHub

The `YAPI.RegisterHub` function initializes the Yoctopuce API and indicates where the modules should be looked for. The parameter is the address of the virtual hub able to see the devices. If the string "usb" is passed as parameter, the API works with modules locally connected to the machine. If the initialization does not succeed, an exception is thrown.

YDisplay.FindDisplay

The `YDisplay.FindDisplay` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can use logical names as well, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number *EPAPER1C-123456* which you have named "*MyModule*", and for which you have given the *display* function the name "*MyFunction*". The following five calls are strictly equivalent, as long as "*MyFunction*" is defined only once.

```
display = YDisplay.FindDisplay("EPAPER1C-123456.display");
display = YDisplay.FindDisplay("EPAPER1C-123456.MaFonction");
display = YDisplay.FindDisplay("MonModule.display");
display = YDisplay.FindDisplay("MonModule.MaFonction");
display = YDisplay.FindDisplay("MaFonction");
```

`YDisplay.FindDisplay` returns an object which you can then use at will to control the display.

isOnline

The `isOnline()` method of the object returned by `YDisplay.FindDisplay` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YDisplay.FindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

21.5. A real example

Launch Visual Studio and open the corresponding project provided in the directory **Examples/Doc-GettingStarted-Yocto-Display-ePaper-C** of the Yoctopuce library.

Visual Studio projects contain numerous files, and most of them are not linked to the use of the Yoctopuce library. To simplify reading the code, we regrouped all the code that uses the library in the `Demo` class, located in the `demo.cs` file. Properties of this class correspond to the different fields displayed on the screen, and the `Run()` method contains the code which is run when the "Start" button is pushed.

In this example, you can recognize the functions explained above, but this time used with all the side materials needed to make it work nicely as a small demo.

```
using System;
using System.Diagnostics;
using System.Threading.Tasks;
using Windows.UI.Xaml.Controls;
using com.yoctopuce.YoctoAPI;

namespace Demo
{
    public class Demo : DemoBase
    {
        public string HubURL { get; set; }
        public string Target { get; set; }
        public string Message { get; set; }

        public override async Task<int> Run()
        {
            try {
                YDisplay disp;

                await YAPI.RegisterHub(HubURL);

                // find the display according to command line parameters
                if (Target.ToLower() == "any") {
                    disp = YDisplay.FirstDisplay();
                    if (disp == null) {
                        WriteLine("No module connected (check USB cable) ");
                        return -1;
                    }
                } else {
                    disp = YDisplay.FindDisplay(Target + ".display");
                }

                if (!await disp.isOnline()) {
                    WriteLine("Module not connected (check identification and USB cable) ");
                    return -1;
                }

                int[] colors = { 0xFFFFFF, 0x000000, 0xFF0000, 0xFFFF00 };

                // Makes sure the Panel type is set
                string paneltype = await disp.get_displayPanel();
                if (paneltype == "NOT_SET") {
                    WriteLine("Use the virtual to Configure the panel first");
                    await YAPI.Sleep(3000);
                    Environment.Exit(0);
                }
            }
        }
    }
}
```

```

// retrieve the display size
int w = await disp.get_displayWidth();
int h = await disp.get_displayHeight();
int middleX = (int)(w / 2);
int middleY = (int)(h / 2);
WriteLine("Using device " + disp.get_serialNumber() + " (panel: " + paneltype + " "
+ w + "x" + h + "pixels)\n");
await disp.resetAll();

// retrieve the first layer
YDisplayLayer l0 = await disp.get_displayLayer(0);
await l0.selectFont("medium.yfm");
int iterations = 0;
bool animation = true;
Random rnd = new Random();

while (animation) {
    iterations++;
    // prevent refreshing for 2 sec
    await disp.postponeRefresh(2000);
    await l0.clear();
    // draw a few circle
    for (int i = 0; i < 15; i++) {
        int cx = rnd.Next(w);
        int cy = rnd.Next(h);
        int r = rnd.Next((h / 20), (h / 10));
        await l0.selectFillColor(colors[rnd.Next(4)]);
        await l0.drawDisc(cx, cy, r);
        await l0.drawCircle(cx, cy, r);
    }
    // draw a rectangle with panel type in it
    await l0.selectFillColor(0xffffffff);
    await l0.drawBar(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    await l0.drawRect(middleX - 75, middleY - 10, middleX + 75, middleY + 12);
    await l0.drawText(middleX, middleY, YDisplayLayer.ALIGN.CENTER, paneltype);
    // forces a full refresh only the 1st time
    if (iterations == 1) await disp.regenerateDisplay();
    await disp.triggerRefresh(); // display is allowed to refresh again
    await YAPI.Sleep(1000);
    // if no fast refresh available, don't even try to run animations
    if (paneltype.IndexOf("KS") < 0) animation = false;
}
} catch (YAPI_Exception ex) {
    WriteLine("error: " + ex.Message);
}

await YAPI.FreeAPI();

return 0;
}
}

```

21.6. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```

using System;
using System.Diagnostics;
using System.Threading.Tasks;
using Windows.UI.Xaml.Controls;
using com.yoctopuce.YoctoAPI;

namespace Demo
{
    public class Demo : DemoBase
    {
        public string HubURL { get; set; }
        public string Target { get; set; }
        public bool Beacon { get; set; }
    }
}

```

```

public override async Task<int> Run()
{
    YModule m;
    string errmsg = "";

    if (await YAPI.RegisterHub(HubURL) != YAPI.SUCCESS) {
        WriteLine("RegisterHub error: " + errmsg);
        return -1;
    }
    m = YModule.FindModule(Target + ".module"); // use serial or logical name
    if (await m.IsOnline()) {
        if (Beacon) {
            await m.set_beacon(YModule.BEACON_ON);
        } else {
            await m.set_beacon(YModule.BEACON_OFF);
        }

        WriteLine("serial: " + await m.get_serialNumber());
        WriteLine("logical name: " + await m.get_logicalName());
        WriteLine("luminosity: " + await m.get_luminosity());
        Write("beacon: ");
        if (await m.get_beacon() == YModule.BEACON_ON)
            WriteLine("ON");
        else
            WriteLine("OFF");
        WriteLine("upTime: " + (await m.get_upTime() / 1000) + " sec");
        WriteLine("USB current: " + await m.get_usbCurrent() + " mA");
        WriteLine("Logs:\r\n" + await m.get_lastLogs());
    } else {
        WriteLine(Target + " not connected on" + HubURL +
            "(check identification and USB cable)");
    }
    await YAPI.FreeAPI();
    return 0;
}
}

```

Each property `xxx` of the module can be read thanks to a method of type `YModule.get_xxxx()`, and properties which are not read-only can be modified with the help of the `YModule.set_xxx()` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `YModule.set_xxx()` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `YModule.saveToFlash()` method. Inversely, it is possible to force the module to forget its current settings by using the `YModule.revertFromFlash()` method. The short example below allows you to modify the logical name of a module.

```

using System;
using System.Diagnostics;
using System.Threading.Tasks;
using Windows.UI.Xaml.Controls;
using com.yoctopuce.YoctoAPI;

namespace Demo
{
    public class Demo : DemoBase
    {
        public string HubURL { get; set; }
        public string Target { get; set; }
        public string LogicalName { get; set; }

        public override async Task<int> Run()
        {
            try {
                YModule m;

                await YAPI.RegisterHub(HubURL);

                m = YModule.FindModule(Target); // use serial or logical name
            }
        }
    }
}

```

```

        if (await m.isOnline()) {
            if (!YAPI.CheckLogicalName(LogicalName)) {
                WriteLine("Invalid name (" + LogicalName + ")");
                return -1;
            }

            await m.set_logicalName(LogicalName);
            await m.saveToFlash(); // do not forget this
            Write("Module: serial= " + await m.get_serialNumber());
            WriteLine(" / name= " + await m.get_logicalName());
        } else {
            Write("not connected (check identification and USB cable)");
        }
    } catch (YAPI_Exception ex) {
        WriteLine("RegisterHub error: " + ex.Message);
    }
    await YAPI.FreeAPI();
    return 0;
}
}
}

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short, you can use the `YModule.saveToFlash()` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `YModule.yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not null. Below a short example listing the connected modules.

```

using System;
using System.Diagnostics;
using System.Threading.Tasks;
using Windows.UI.Xaml.Controls;
using com.yoctopuce.YoctoAPI;

namespace Demo
{
    public class Demo : DemoBase
    {
        public string HubURL { get; set; }

        public override async Task<int> Run()
        {
            YModule m;
            try {
                await YAPI.RegisterHub(HubURL);

                WriteLine("Device list");
                m = YModule.FirstModule();
                while (m != null) {
                    WriteLine(await m.get_serialNumber()
                        + " (" + await m.get_productName() + ")");
                    m = m.nextModule();
                }
            } catch (YAPI_Exception ex) {
                WriteLine("Error:" + ex.Message);
            }
            await YAPI.FreeAPI();
            return 0;
        }
    }
}

```

21.7. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software.

In the Universal Windows Platform library, error handling is implemented with exceptions. You must therefore intercept and correctly handle these exceptions if you want to have a reliable project which does not crash as soon as you disconnect a module.

Library thrown exceptions are always of the `YAPI_Exception` type, so you can easily separate them from other exceptions in a `try{...} catch{...}` block.

Example:

```
try {
    ....
} catch (YAPI_Exception ex) {
    Debug.WriteLine("Exception from Yoctopuce lib:" + ex.Message);
} catch (Exception ex) {
    Debug.WriteLine("Other exceptions :" + ex.Message);
}
```

22. Using Yocto-Display-ePaper-C with Objective-C

Objective-C is language of choice for programming on macOS, due to its integration with the Cocoa framework. Yoctopuce supports the XCode versions supported by Apple. The Yoctopuce library is ARC compatible. You can therefore implement your projects either using the traditional *retain / release* method, or using the *Automatic Reference Counting*.

Yoctopuce Objective-C libraries¹ are integrally provided as source files. A section of the low-level library is written in pure C, but you should not need to interact directly with it: everything was done to ensure the simplest possible interaction from Objective-C.

You will soon notice that the Objective-C API defines many functions which return objects. You do not need to deallocate these objects yourself, the API does it automatically at the end of the application.

In order to keep them simple, all the examples provided in this documentation are console applications. Naturally, the libraries function in a strictly identical manner if you integrate them in an application with a graphical interface. You can find on Yoctopuce blog a detailed example² with video shots showing how to integrate the library into your projects.

22.1. Control of the Display function

A few lines of code are enough to use a Yocto-Display-ePaper-C. Here is the skeleton of a Objective-C code snippet to use the Display function.

```
#import "yocto_api.h"
#import "yocto_display.h"

...
NSError *error;
[YAPI RegisterHub:@"usb": &error]
...
// On récupère l'objet représentant le module (ici connecté en local sur USB)
display = [YDisplay FindDisplay:@"EPAPER1C-123456.display"];

// Pour gérer le hot-plug, on vérifie que le module est là
if([display isOnline])
{
    // Utiliser [display get_displayLayer]
    ...
}
```

¹ www.yoctopuce.com/EN/libraries.php

² www.yoctopuce.com/EN/article/new-objective-c-library-for-mac-os-x

Let's look at these lines in more details.

yocto_api.h and yocto_display.h

These two import files provide access to the functions allowing you to manage Yoctopuce modules. `yocto_api.h` must always be used, `yocto_display.h` is necessary to manage modules containing a display, such as Yocto-Display-ePaper-C.

[YAPI RegisterHub]

The `[YAPI RegisterHub]` function initializes the Yoctopuce API and indicates where the modules should be looked for. When used with the parameter `@"usb"`, it will use the modules locally connected to the computer running the library. If the initialization does not succeed, this function returns a value different from `YAPI_SUCCESS` and `errmsg` contains the error message.

[Display FindDisplay]

The `[Display FindDisplay]` function allows you to find a display from the serial number of the module on which it resides and from its function name. You can use logical names as well, as long as you have initialized them. Let us imagine a Yocto-Display-ePaper-C module with serial number *EPAPER1C-123456* which you have named "MyModule", and for which you have given the *display* function the name "MyFunction". The following five calls are strictly equivalent, as long as "MyFunction" is defined only once.

```
YDisplay *display = [Display FindDisplay:@"EPAPER1C-123456.display"];
YDisplay *display = [Display FindDisplay:@"EPAPER1C-123456.MyFunction"];
YDisplay *display = [Display FindDisplay:@"MyModule.display"];
YDisplay *display = [Display FindDisplay:@"MyModule.MyFunction"];
YDisplay *display = [Display FindDisplay:@"MyFunction"];
```

`[Display FindDisplay]` returns an object which you can then use at will to control the display.

isOnline

The `isOnline` method of the object returned by `[Display FindDisplay]` allows you to know if the corresponding module is present and in working order.

get_displayLayer

The `get_displayLayer()` method of the object returned by `YDisplay.FindDisplay` allows you to retrieve the object corresponding to one of the screen layers. This object implements all the graphical routines.

postponeRefresh

The `postponeRefresh()` method of `YDisplay` allows you to temporarily disable screen updates while building the next frame to be displayed; the `triggerRefresh` method reverses this effect. This is a way to implement *double buffering* on screens that can only have a single layer.

regenerateDisplay

The `postponeRefresh` method of `YDisplay` ensures that the next screen update will be a full refresh, regardless of the Yocto-Display-ePaper-C configuration.

A real example

Launch Xcode 4.2 and open the corresponding sample project provided in the directory **Examples/Doc-GettingStarted-Yocto-Display-ePaper-C** of the Yoctopuce library.

In this example, you will recognize the functions explained above, but this time used with all side materials needed to make it work nicely as a small demo.

```
#import <Foundation/Foundation.h>
#import <stdlib.h>
#import "yocto_api.h"
#import "yocto_display.h"
```

```

int colors[4] = { 0xFFFFFF,0x000000, 0xFF0000, 0xFFFF00 };

static void usage(void)
{
    NSLog(@"usage: demo <serial_number> ");
    NSLog(@"      demo <logical_name>");
    NSLog(@"      demo any          (use any discovered device)");
    exit(1);
}

int main(int argc, const char * argv[])
{
    NSError *error;
    YDisplay *disp;
    YDisplayLayer *l0;

    @autoreleasepool {

        // Setup the API to use local USB devices
        if([YAPI RegisterHub:@"usb": &error] != YAPI_SUCCESS) {
            NSLog(@"RegisterHub error: %@", [error localizedDescription]);
            usage();
            return 1;
        }
        if(argc < 2) {
            disp = [YDisplay FirstDisplay];
            if(disp == nil) {
                NSLog(@"No module connected (check USB cable)");
                usage();
                return 1;
            }
        } else {
            NSString *target = [NSString stringWithUTF8String:argv[1]];

            disp = [YDisplay FindDisplay:target];
            if(![disp isOnline]) {
                NSLog(@"Module not connected (check identification and USB cable)");
                usage();
                return 1;
            }
        }

        // Makes sure the Panel type is set
        NSString* paneltype = [disp get_displayPanel];
        if([paneltype isEqual: @"NOT_SET"]) {
            NSLog(@"Use the virtual to Configure the panel first");
            return 1;
        }

        // clear screen (and all layers)
        [disp resetAll];

        // retrieve the display size
        int w = [disp get_displayWidth];
        int h = [disp get_displayHeight];
        int middleX = w/2;
        int middleY = h/2;
        NSLog(@"Using device %@ (panel: %@ %dx%d pixels)",
              [disp get_serialNumber], paneltype, w, h);

        // retrieve the first layer
        l0 = [disp get_displayLayer:0];

        // if no fast refresh available, don't even try to run animations
        bool animation = ([paneltype rangeOfString:@"KS"].location != NSNotFound);
        int iterations = 0;
        do {
            // prevent refreshing for 2 sec
            [disp postponeRefresh: 2000];
            [l0 clear];

            // draw a few circle
            for(int i = 0; i < 15; i++) {
                int cx = arc4random_uniform(w);
                int cy = arc4random_uniform(h);
                int r = arc4random_uniform(h/20)+(h/20);
                [l0 selectFillColor: colors[arc4random_uniform(3)]];
            }
        } while(animation);
    }
}

```

```

        [l0 drawDisc: cx :cy :r];
        [l0 drawCircle: cx :cy :r];
    }

    // draw a rectangle with panel type in it
    [l0 selectFillColor: 0xffffffff];
    [l0 drawBar: middleX-75 :middleY-10 :middleX+75 :middleY+12];
    [l0 drawRect: middleX-75 :middleY-10 :middleX+75 :middleY+12];
    [l0 drawText: middleX :middleY :Y_ALIGN_CENTER :paneltype];
    // forces a full refresh only the 1st time
    if(++iterations == 1) {
        [disp regenerateDisplay];
    }
    [disp triggerRefresh]; // display is allowed to refresh again
    [YAPI Sleep:1000 :&error];
} while(animation);
}

return 0;
}

```

22.2. Control of the module part

Each module can be controlled in a similar manner, you can find below a simple sample program displaying the main parameters of the module and enabling you to activate the localization beacon.

```

#import <Foundation/Foundation.h>
#import "yocto_api.h"

static void usage(const char *exe)
{
    NSLog(@"usage: %s <serial or logical name> [ON/OFF]\n", exe);
    exit(1);
}

int main (int argc, const char * argv[])
{
    NSError *error;

    @autoreleasepool {
        // Setup the API to use local USB devices
        if([YAPI RegisterHub:@"usb": &error] != YAPI_SUCCESS) {
            NSLog(@"RegisterHub error: %@", [error localizedDescription]);
            return 1;
        }
        if(argc < 2)
            usage(argv[0]);
        NSString *serial_or_name = [NSString stringWithUTF8String:argv[1]];
        // use serial or logical name
        YModule *module = [YModule FindModule:serial_or_name];
        if ([module isOnline]) {
            if (argc > 2) {
                if (strcmp(argv[2], "ON") == 0)
                    [module setBeacon:Y_BEACON_ON];
                else
                    [module setBeacon:Y_BEACON_OFF];
            }
            NSLog(@"serial:      %@\n", [module serialNumber]);
            NSLog(@"logical name: %@\n", [module logicalName]);
            NSLog(@"luminosity:   %d\n", [module luminosity]);
            NSLog(@"beacon:      ");
            if ([module beacon] == Y_BEACON_ON)
                NSLog(@"ON\n");
            else
                NSLog(@"OFF\n");
            NSLog(@"upTime:      %ld sec\n", [module upTime] / 1000);
            NSLog(@"USB current:  %d mA\n", [module usbCurrent]);
            NSLog(@"logs:       %@\n", [module get_lastLogs]);
        } else {
            NSLog(@"%@ not connected (check identification and USB cable)\n",
                serial_or_name);
        }
    }
}

```

```

[YAPI FreeAPI];
}
return 0;
}

```

Each property `xxx` of the module can be read thanks to a method of type `get_xxxx`, and properties which are not read-only can be modified with the help of the `set_xxx` method. For more details regarding the used functions, refer to the API chapters.

Changing the module settings

When you want to modify the settings of a module, you only need to call the corresponding `set_xxx` function. However, this modification is performed only in the random access memory (RAM) of the module: if the module is restarted, the modifications are lost. To memorize them persistently, it is necessary to ask the module to save its current configuration in its permanent memory. To do so, use the `saveToFlash` method. Inversely, it is possible to force the module to forget its current settings by using the `revertFromFlash` method. The short example below allows you to modify the logical name of a module.

```

#import <Foundation/Foundation.h>
#import "yocto_api.h"

static void usage(const char *exe)
{
    NSLog(@"usage: %s <serial> <newLogicalName>\n", exe);
    exit(1);
}

int main (int argc, const char * argv[])
{
    NSError *error;

    @autoreleasepool {
        // Setup the API to use local USB devices
        if([YAPI RegisterHub:@"usb" :&error] != YAPI_SUCCESS) {
            NSLog(@"RegisterHub error: %@", [error localizedDescription]);
            return 1;
        }

        if(argc < 2)
            usage(argv[0]);

        NSString *serial_or_name = [NSString stringWithUTF8String:argv[1]];
        // use serial or logical name
        YModule *module = [YModule FindModule:serial_or_name];

        if (module.isOnline) {
            if (argc >= 3) {
                NSString *newname = [NSString stringWithUTF8String:argv[2]];
                if (![YAPI CheckLogicalName:newname]) {
                    NSLog(@"Invalid name (%@)\n", newname);
                    usage(argv[0]);
                }
                module.logicalName = newname;
                [module saveToFlash];
            }
            NSLog(@"Current name: %@\n", module.logicalName);
        } else {
            NSLog(@"%@ not connected (check identification and USB cable)\n",
                serial_or_name);
        }
        [YAPI FreeAPI];
    }
    return 0;
}

```

Warning: the number of write cycles of the nonvolatile memory of the module is limited. When this limit is reached, nothing guaranties that the saving process is performed correctly. This limit, linked to the technology employed by the module micro-processor, is located at about 100000 cycles. In short,

you can use the `saveToFlash` function only 100000 times in the life of the module. Make sure you do not call this function within a loop.

Listing the modules

Obtaining the list of the connected modules is performed with the `yFirstModule()` function which returns the first module found. Then, you only need to call the `nextModule()` function of this object to find the following modules, and this as long as the returned value is not `NULL`. Below a short example listing the connected modules.

```
#import <Foundation/Foundation.h>
#import "yocto_api.h"

int main (int argc, const char * argv[])
{
    NSError *error;

    @autoreleasepool {
        // Setup the API to use local USB devices
        if([YAPI RegisterHub:@"usb" :&error] != YAPI_SUCCESS) {
            NSLog(@"RegisterHub error: %@\n", [error localizedDescription]);
            return 1;
        }

        NSLog(@"Device list:\n");

        YModule *module = [YModule FirstModule];
        while (module != nil) {
            NSLog(@"%@ %@", module.serialNumber, module.productName);
            module = [module nextModule];
        }
        [YAPI FreeAPI];
    }
    return 0;
}
```

22.3. Error handling

When you implement a program which must interact with USB modules, you cannot disregard error handling. Inevitably, there will be a time when a user will have unplugged the device, either before running the software, or even while the software is running. The Yoctopuce library is designed to help you support this kind of behavior, but your code must nevertheless be conceived to interpret in the best possible way the errors indicated by the library.

The simplest way to work around the problem is the one used in the short examples provided in this chapter: before accessing a module, check that it is online with the `isOnline` function, and then hope that it will stay so during the fraction of a second necessary for the following code lines to run. This method is not perfect, but it can be sufficient in some cases. You must however be aware that you cannot completely exclude an error which would occur after the call to `isOnline` and which could crash the software. The only way to prevent this is to implement one of the two error handling techniques described below.

The method recommended by most programming languages for unpredictable error handling is the use of exceptions. By default, it is the behavior of the Yoctopuce library. If an error happens while you try to access a module, the library throws an exception. In this case, there are three possibilities:

- If your code catches the exception and handles it, everything goes well.
- If your program is running in debug mode, you can relatively easily determine where the problem happened and view the explanatory message linked to the exception.
- Otherwise... the exception makes your program crash, bang!

As this latest situation is not the most desirable, the Yoctopuce library offers another possibility for error handling, allowing you to create a robust program without needing to catch exceptions at every line of code. You simply need to call the `YAPI.DisableExceptions()` function to commute the library to a mode where exceptions for all the functions are systematically replaced by specific return

values, which can be tested by the caller when necessary. For each function, the name of each return value in case of error is systematically documented in the library reference. The name always follows the same logic: a `get_state()` method returns a `ClassName.STATE_INVALID` value, a `get_currentValue` method returns a `ClassName.CURRENTVALUE_INVALID` value, and so on. In any case, the returned value is of the expected type and is not a null pointer which would risk crashing your program. At worst, if you display the value without testing it, it will be outside the expected bounds for the returned value. In the case of functions which do not normally return information, the return value is `YAPI_SUCCESS` if everything went well, and a different error code in case of failure.

When you work without exceptions, you can obtain an error code and an error message explaining the source of the error. You can request them from the object which returned the error, calling the `errType()` and `errMessage()` methods. Their returned values contain the same information as in the exceptions when they are active.

23. Using with unsupported languages

Yoctopuce modules can be driven from most common programming languages. New languages are regularly added, depending on the interest expressed by Yoctopuce product users. Nevertheless, some languages are not, and will never be, supported by Yoctopuce. There can be several reasons for this: compilers which are not available anymore, unadapted environments, and so on.

However, there are alternative methods to access Yoctopuce modules from an unsupported programming language.

23.1. Command line

The easiest method to drive Yoctopuce modules from an unsupported programming language is to use the command line API through system calls. The command line API is in fact made of a group of small executables which are easy to call. Their output is also easy to analyze. As most programming languages allow you to make system calls, the issue is solved with a few lines of code.

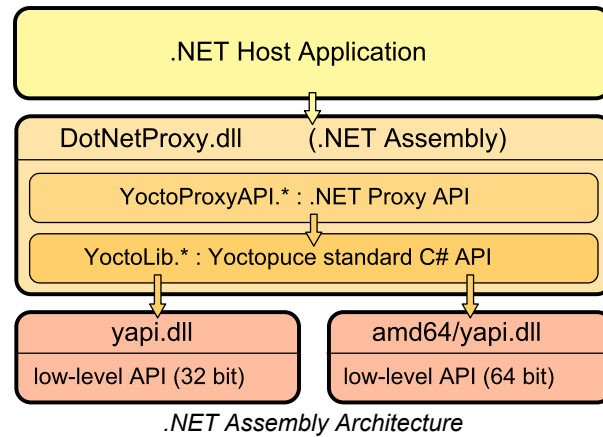
However, if the command line API is the easiest solution, it is neither the fastest nor the most efficient. For each call, the executable must initialize its own API and make an inventory of USB connected modules. This requires about one second per call.

23.2. .NET Assembly

A .NET Assembly enables you to share a set of pre-compiled classes to offer a service, by stating entry points which can be used by third-party applications. In our case, it's the whole Yoctopuce library which is available in the .NET Assembly, so that it can be used in any environment which supports .NET Assembly dynamic loading.

The Yoctopuce library as a .NET Assembly does not contain only the standard C# Yoctopuce library, as this would not have allowed an optimal use in all environments. Indeed, we cannot expect host applications to necessarily offer a thread system or a callback system, although they are very useful to manage plug-and-play events and sensors with a high refresh rate. Likewise, we cannot expect from external applications a transparent behavior in cases where a function call in Assembly creates a delay because of network communications.

Therefore, we added to it an additional layer, called *.NET Proxy* library. This additional layer offers an interface very similar to the standard library but somewhat simplified, as it internally manages all the callback mechanisms. Instead, this library offers mirror objects, called *Proxys*, which publish through *Properties* the main attributes of the Yoctopuce functions such as the current measure, configuration parameters, the state, and so on.



The callback mechanism automatically updates the properties of the *Proxys* objects, without the host application needing to care for it. The later can thus, at any time and without any risk of latency, display the value of all properties of Yoctopuce Proxy objects.

Pay attention to the fact that the `yapi.dll` low-level communication library is **not** included in the .NET Assembly. You must therefore keep it together with `DotNetProxyLibrary.dll`. The 32 bit version must be located in the same directory as `DotNetProxyLibrary.dll`, while the 64 bit version must be in a subdirectory `amd64`.

Example of use with MATLAB

Here is how to load our Proxy .NET Assembly in MATLAB and how to read the value of the first sensor connected by USB found on the machine:

```

NET.addAssembly("C:/Yoctopuce/DotNetProxyLibrary.dll");
import YctoProxyAPI.*

errmsg = YAPIProxy.RegisterHub("usb");
sensor = YSensorProxy.FindSensor("");
measure = sprintf('%0.3f %s', sensor.CurrentValue, sensor.Unit);
  
```

Example of use in PowerShell

PowerShell commands are a little stranger, but we can recognize the same structure:

```

Add-Type -Path "C:/Yoctopuce/DotNetProxyLibrary.dll"

$errmsg = [YctoProxyAPI.YAPIProxy]::RegisterHub("usb")
$sensor = [YctoProxyAPI.YSensorProxy]::FindSensor("")
$measure = "{0:n3} {1}" -f $sensor.CurrentValue, $sensor.Unit
  
```

Specificities of the .NET Proxy library

With regards to classic Yoctopuce libraries, the following differences in particular should be noted:

No FirstModule/nextModule method

To obtain an object referring to the first found module, we call `YModuleProxy.FindModule("")`. If there is no connected module, this method returns an object with its `module.IsOnline` property set to `False`. As soon as a module is connected, the property changes to `True` and the module hardware identifier is updated.

To list modules, you can call the `module.GetSimilarFunctions()` method which returns an array of character strings containing the identifiers of all the modules which were found.

No callback function

Callback functions are implemented internally and they update the object properties. You can therefore simply poll the properties, without significant performance penalties. Be aware that if you

use one of the function that disables callbacks, the automatic refresh of object properties may not work anymore.

A new method `YAPIProxy.GetLog` makes it possible to retrieve low-level debug logs without using callbacks.

Enumerated types

In order to maximize compatibility with host applications, the .NET Proxy library does not use true .NET enumerated types, but simple integers. For each enumerated type, the library includes public constants named according to the possible values. Contrarily to standard Yoctopuce libraries, numeric values always start from 1, as the value 0 is reserved to return an invalid value, for instance when the device is disconnected.

Invalid numeric results

For all numeric results, rather than using an arbitrary constant, the invalid value returned in case of error is *NaN*. You should therefore use function *isNaN()* to detect this value.

Using .NET Assembly without the Proxy library

If for a reason or another you do not want to use the Proxy library, and if your environment allows it, you can use the standard C# API as it is located in the Assembly, under the `YoctoLib` namespace. Beware however not to mix both types of use: either you go through the Proxy library, or you use the `YoctoLib` version directly, but not both!

Compatibility

For the LabVIEW Yoctopuce library to work correctly with your Yoctopuce modules, these modules need to have firmware 37120, or higher.

In order to be compatible with as many versions of Windows as possible, including Windows XP, the *DotNetProxyLibrary.dll* library is compiled in .NET 3.5, which is available by default on all the Windows versions since XP. As of today, we have never met any non-Windows environment able to load a .NET Assembly, so we only ship the low-level communication dll for Windows together with the assembly.

23.3. VirtualHub and HTTP GET

VirtualHub is available on almost all current platforms. It is generally used as a gateway to provide access to Yoctopuce modules from languages which prevent direct access to hardware layers of a computer (JavaScript, PHP, Java, ...).

In fact, VirtualHub is a small web server able to route HTTP requests to Yoctopuce modules. This means that if you can make an HTTP request from your programming language, you can drive Yoctopuce modules, even if this language is not officially supported.

REST interface

At a low level, the modules are driven through a REST API. Thus, to control a module, you only need to perform appropriate requests on the *VirtualHub*. By default, the VirtualHub HTTP port is 4444.

An important advantage of this technique is that preliminary tests are very easy to implement. You only need a VirtualHub and a simple web browser. If you copy the following URL in your preferred browser, while VirtualHub is running, you obtain the list of the connected modules.

```
http://127.0.0.1:4444/api/services/whitePages.txt
```

Note that the result is displayed as text, but if you request *whitePages.xml*, you obtain an XML result. Likewise, *whitePages.json* allows you to obtain a JSON result. The *html* extension even allows you to display a rough interface where you can modify values in real time. The whole REST API is available in these different formats.

Driving a module through the REST interface

Each Yoctopuce module has its own REST interface, available in several variants. Let us imagine a Yocto-Display-ePaper-C with the *EPAPER1C-12345* serial number and the *myModule* logical name. The following URL allows you to know the state of the module.

```
http://127.0.0.1:4444/bySerial/EPAPER1C-12345/api/module.txt
```

You can naturally also use the module logical name rather than its serial number.

```
http://127.0.0.1:4444/byName/myModule/api/module.txt
```

To retrieve the value of a module property, simply add the name of the property below *module*. For example, if you want to know the signposting led luminosity, send the following request:

```
http://127.0.0.1:4444/bySerial/EPAPER1C-12345/api/module/luminosity
```

To change the value of a property, modify the corresponding attribute. Thus, to modify the luminosity, send the following request:

```
http://127.0.0.1:4444/bySerial/EPAPER1C-12345/api/module?luminosity=100
```

Driving the module functions through the REST interface

The module functions can be manipulated in the same way. To know the state of the display function, build the following URL:

```
http://127.0.0.1:4444/bySerial/EPAPER1C-12345/api/display.txt
```

Note that if you can use logical names for the modules instead of their serial number, you cannot use logical names for functions. Only hardware names are authorized to access functions.

You can retrieve a module function attribute in a way rather similar to that used with the modules. For example:

```
http://127.0.0.1:4444/bySerial/EPAPER1C-12345/api/display/logicalName
```

Rather logically, attributes can be modified in the same manner.

```
http://127.0.0.1:4444/bySerial/EPAPER1C-12345/api/display?logicalName=myFunction
```

You can find the list of available attributes for your Yocto-Display-ePaper-C at the beginning of the *Programming* chapter.

Accessing Yoctopuce data logger through the REST interface

This section only applies to devices with a built-in data logger.

The preview of all recorded data streams can be retrieved in JSON format using the following URL:

```
http://127.0.0.1:4444/bySerial/EPAPER1C-12345/dataLogger.json
```

Individual measures for any given stream can be obtained by appending the desired function identifier as well as start time of the stream:

```
http://127.0.0.1:4444/bySerial/EPAPER1C-12345/dataLogger.json?id=display&utc=1389801080
```

23.4. Using dynamic libraries

The low level Yoctopuce API is available under several formats of dynamic libraries written in C. The sources are available with the C++ API. If you use one of these low level libraries, you do not need VirtualHub anymore.

Filename	Platform
libyapi.dylib	Max OS X
libyapi-amd64.so	Linux Intel (64 bits)
libyapi-armel.so	Linux ARM EL (32 bits)
libyapi-armhf.so	Linux ARM HL (32 bits)
libyapi-aarch64.so	Linux ARM (64 bits)
libyapi-i386.so	Linux Intel (32 bits)
yapi64.dll	Windows (64 bits)
yapi.dll	Windows (32 bits)

These dynamic libraries contain all the functions necessary to completely rebuild the whole high level API in any language able to integrate these libraries. This chapter nevertheless restrains itself to describing basic use of the modules.

Driving a module

The three essential functions of the low level API are the following:

```
int yapiInitAPI(int connection_type, char *errmsg);
int yapiUpdateDeviceList(int forceupdate, char *errmsg);
int yapiHTTPRequest(char *device, char *request, char* buffer, int buffsize, int *fullsize,
char *errmsg);
```

The *yapiInitAPI* function initializes the API and must be called once at the beginning of the program. For a USB type connection, the *connection_type* parameter takes value 1. The *errmsg* parameter must point to a 255 character buffer to retrieve a potential error message. This pointer can also point to *null*. The function returns a negative integer in case of error, zero otherwise.

The *yapiUpdateDeviceList* manages the inventory of connected Yoctopuce modules. It must be called at least once. To manage hot plug and detect potential newly connected modules, this function must be called at regular intervals. The *forceupdate* parameter must take value 1 to force a hardware scan. The *errmsg* parameter must point to a 255 character buffer to retrieve a potential error message. This pointer can also point to *null*. The function returns a negative integer in case of error, zero otherwise.

Finally, the *yapiHTTPRequest* function sends HTTP requests to the module REST API. The *device* parameter contains the serial number or the logical name of the module which you want to reach. The *request* parameter contains the full HTTP request (including terminal line breaks). *buffer* points to a character buffer long enough to contain the answer. *buffsize* is the size of the buffer. *fullsize* is a pointer to an integer to which will be assigned the actual size of the answer. The *errmsg* parameter must point to a 255 character buffer to retrieve a potential error message. This pointer can also point to *null*. The function returns a negative integer in case of error, zero otherwise.

The format of the requests is the same as the one described in the *VirtualHub et HTTP GET* section. All the character strings used by the API are strings made of 8-bit characters: Unicode and UTF8 are not supported.

The result returned in the buffer variable respects the HTTP protocol. It therefore includes an HTTP header. This header ends with two empty lines, that is a sequence of four ASCII characters 13, 10, 13, 10.

Here is a sample program written in pascal using the *yapi.dll* DLL to read and then update the luminosity of a module.

```
// Dll functions import
function yapiInitAPI(mode:integer;
```

```

errmsg : pansichar):integer;cdecl;
external 'yapi.dll' name 'yapiInitAPI';
function yapiUpdateDeviceList(force:integer;errmsg : pansichar):integer;cdecl;
external 'yapi.dll' name 'yapiUpdateDeviceList';
function yapiHTTPRequest(device:pansichar;url:pansichar; buffer:pansichar;
buffsize:integer;var fullsize:integer;
errmsg : pansichar):integer;cdecl;
external 'yapi.dll' name 'yapiHTTPRequest';

var
errmsgBuffer : array [0..256] of ansichar;
dataBuffer : array [0..1024] of ansichar;
errmsg,data : pansichar;
fullsize,p : integer;

const
serial = 'EPAPER1C-12345';
getValue = 'GET /api/module/luminosity HTTP/1.1'#13#10#13#10;
setValue = 'GET /api/module?luminosity=100 HTTP/1.1'#13#10#13#10;

begin
errmsg := @errmsgBuffer;
data := @dataBuffer;
// API initialization
if(yapiInitAPI(1,errmsg)<0) then
begin
writeln(errmsg);
halt;
end;

// forces a device inventory
if( yapiUpdateDeviceList(1,errmsg)<0) then
begin
writeln(errmsg);
halt;
end;

// requests the module luminosity
if (yapiHTTPRequest(serial,getValue,data,sizeof(dataBuffer),fullsize,errmsg)<0) then
begin
writeln(errmsg);
halt;
end;

// searches for the HTTP header end
p := pos(#13#10#13#10,data);

// displays the response minus the HTTP header
writeln(copy(data,p+4,length(data)-p-3));

// changes the luminosity
if (yapiHTTPRequest(serial,setValue,data,sizeof(dataBuffer),fullsize,errmsg)<0) then
begin
writeln(errmsg);
halt;
end;

end.

```

Module inventory

To perform an inventory of Yoctopuce modules, you need two functions from the dynamic library:

```

int yapiGetAllDevices(int *buffer,int maxsize,int *neededsize,char *errmsg);
int yapiGetDeviceInfo(int devdesc,yDeviceSt *infos, char *errmsg);

```

The *yapiGetAllDevices* function retrieves the list of all connected modules as a list of handles. *buffer* points to a 32-bit integer array which contains the returned handles. *maxsize* is the size in bytes of the buffer. To *neededsize* is assigned the necessary size to store all the handles. From this, you can deduce either the number of connected modules or that the input buffer is too small. The *errmsg* parameter must point to a 255 character buffer to retrieve a potential error message. This pointer can also point to *null*. The function returns a negative integer in case of error, zero otherwise.

The *yapiGetDeviceInfo* function retrieves the information related to a module from its handle. *devdesc* is a 32-bit integer representing the module and which was obtained through *yapiGetAllDevices*. *infos* points to a data structure in which the result is stored. This data structure has the following format:

Name	Type	Size (bytes)	Description
vendorid	int	4	Yoctopuce USB ID
deviceid	int	4	Module USB ID
devrelease	int	4	Module version
nbinbterfaces	int	4	Number of USB interfaces used by the module
manufacturer	char[]	20	Yoctopuce (null terminated)
productname	char[]	28	Model (null terminated)
serial	char[]	20	Serial number (null terminated)
logicalname	char[]	20	Logical name (null terminated)
firmware	char[]	22	Firmware version (null terminated)
beacon	byte	1	Beacon state (0/1)

The *errmsg* parameter must point to a 255 character buffer to retrieve a potential error message.

Here is a sample program written in pascal using the *yapi.dll* DLL to list the connected modules.

```
// device description structure
type yDeviceSt = packed record
  vendorid      : word;
  deviceid      : word;
  devrelease    : word;
  nbinbterfaces : word;
  manufacturer  : array [0..19] of ansichar;
  productname   : array [0..27] of ansichar;
  serial        : array [0..19] of ansichar;
  logicalname   : array [0..19] of ansichar;
  firmware      : array [0..21] of ansichar;
  beacon        : byte;
end;

// Dll function import
function yapiInitAPI(mode:integer;
  errmsg : pansichar):integer;cdecl;
  external 'yapi.dll' name 'yapiInitAPI';

function yapiUpdateDeviceList(force:integer;errmsg : pansichar):integer;cdecl;
  external 'yapi.dll' name 'yapiUpdateDeviceList';

function yapiGetAllDevices( buffer:pointer;
  maxsize:integer;
  var neededsize:integer;
  errmsg : pansichar):integer; cdecl;
  external 'yapi.dll' name 'yapiGetAllDevices';

function apiGetDeviceInfo(d:integer; var infos:yDeviceSt;
  errmsg : pansichar):integer; cdecl;
  external 'yapi.dll' name 'yapiGetDeviceInfo';

var
  errmsgBuffer : array [0..256] of ansichar;
  dataBuffer    : array [0..127] of integer; // max of 128 USB devices
  errmsg,data   : pansichar;
  neededsize,i  : integer;
  devinfos      : yDeviceSt;

begin
  errmsg := @errmsgBuffer;

  // API initialization
  if(yapiInitAPI(1,errmsg)<0) then
  begin
    writeln(errmsg);
    halt;
  end;
```

```
// forces a device inventory
if( yapiUpdateDeviceList(1,errmsg)<0) then
begin
    writeln(errmsg);
    halt;
end;

// loads all device handles into dataBuffer
if yapiGetAllDevices(@dataBuffer,sizeof(dataBuffer),neededsize,errmsg)<0 then
begin
    writeln(errmsg);
    halt;
end;

// gets device info from each handle
for i:=0 to neededsize div sizeof(integer)-1 do
begin
    if (apiGetDeviceInfo(dataBuffer[i], devinfos, errmsg)<0) then
    begin
        writeln(errmsg);
        halt;
    end;
    writeln(pansichar(@devinfos.serial)+' ('+pansichar(@devinfos.productname)+' ');
end;

end.
```

VB6 and yapi.dll

Each entry point from the yapi.dll is duplicated. You will find one regular C-decl version and one Visual Basic 6 compatible version, prefixed with *vb6_*.

23.5. Porting the high level library

As all the sources of the Yoctopuce API are fully provided, you can very well port the whole API in the language of your choice. Note, however, that a large portion of the API source code is automatically generated.

Therefore, it is not necessary for you to port the complete API. You only need to port the *yocto_api* file and one file corresponding to a function, for example *yocto_relay*. After a little additional work, Yoctopuce is then able to generate all other files. Therefore, we highly recommend that you contact Yoctopuce support before undertaking to port the Yoctopuce library in another language. Collaborative work is advantageous to both parties.

24. Advanced programming

The preceding chapters have introduced, in each available language, the basic programming functions which can be used with your Yocto-Display-ePaper-C module. This chapter presents in a more generic manner a more advanced use of your module. Examples are provided in the language which is the most popular among Yoctopuce customers, that is C#. Nevertheless, you can find complete examples illustrating the concepts presented here in the programming libraries of each language.

To remain as concise as possible, examples provided in this chapter do not perform any error handling. Do not copy them "as is" in a production application.

24.1. Event programming

The methods to manage Yoctopuce modules which we presented to you in preceding chapters were polling functions, consisting in permanently asking the API if something had changed. While easy to understand, this programming technique is not the most efficient, nor the most reactive. Therefore, the Yoctopuce programming API also provides an event programming model. This technique consists in asking the API to signal by itself the important changes as soon as they are detected. Each time a key parameter is modified, the API calls a callback function which you have defined in advance.

Detecting module arrival and departure

Hot-plug management is important when you work with USB modules because, sooner or later, you will have to connect or disconnect a module when your application is running. The API is designed to manage module unexpected arrival or departure in a transparent way. But your application must take this into account if it wants to avoid pretending to use a disconnected module.

Event programming is particularly useful to detect module connection/disconnection. Indeed, it is simpler to be told of new connections rather than to have to permanently list the connected modules to deduce which ones just arrived and which ones left. To be warned as soon as a module is connected, you need three pieces of code.

The callback

The callback is the function which is called each time a new Yoctopuce module is connected. It takes as parameter the relevant module.

```
static void deviceArrival(YModule m)
{
    Console.WriteLine("New module : " + m.get_serialNumber());
}
```

Initialization

You must then tell the API that it must call the callback when a new module is connected.

```
YAPI.RegisterDeviceArrivalCallback(deviceArrival);
```

Note that if modules are already connected when the callback is registered, the callback is called for each of the already connected modules.

Triggering callbacks

A classis issue of callback programming is that these callbacks can be triggered at any time, including at times when the main program is not ready to receive them. This can have undesired side effects, such as dead-locks and other race conditions. Therefore, in the Yoctopuce API, module arrival/departure callbacks are called only when the `UpdateDeviceList()` function is running. You only need to call `UpdateDeviceList()` at regular intervals from a timer or from a specific thread to precisely control when the calls to these callbacks happen:

```
// waiting loop managing callbacks
while (true)
{
    // module arrival / departure callback
    YAPI.UpdateDeviceList(ref errmsg);
    // non active waiting time managing other callbacks
    YAPI.Sleep(500, ref errmsg);
}
```

In a similar way, it is possible to have a callback when a module is disconnected. You can find a complete example implemented in your favorite programming language in the *Examples/Prog-EventBased* directory of the corresponding library.

Be aware that in most programming languages, callbacks must be global procedures, and not methods. If you wish for the callback to call the method of an object, define your callback as a global procedure which then calls your method.

25. High-level API Reference

This chapter summarizes the high-level API functions to drive your Yocto-Display-ePaper-C. Syntax and exact type names may vary from one language to another, but, unless otherwise stated, all the functions are available in every language. For detailed information regarding the types of arguments and return values for a given language, refer to the definition file for this language (`yocto_api.*` as well as the other `yocto_*` files that define the function interfaces).

For languages which support exceptions, all of these functions throw exceptions in case of error by default, rather than returning the documented error value for each function. This is by design, to facilitate debugging. It is however possible to disable the use of exceptions using the `yDisableExceptions()` function, in case you prefer to work with functions that return error values.

This chapter does not repeat the programming concepts described earlier, in order to stay as concise as possible. In case of doubt, do not hesitate to go back to the chapter describing in details all configurable attributes.

25.1. Class YAPI

General functions

These general functions should be used to initialize and configure the Yoctopuce library. In most cases, a simple call to function `yRegisterHub()` should be enough. The module-specific functions `yFind...()` or `yFirst...()` should then be used to retrieve an object that provides interaction with the module.

In order to use the functions described here, you should include:

java	<code>import com.yoctopuce.YoctoAPI.YAPI;</code>
dnp	<code>import YoctoProxyAPI.YAPIProxy</code>
cp	<code>#include "yocto_api_proxy.h"</code>
m1	<code>import YoctoProxyAPI.YAPIProxy"</code>
cpp	<code>#include "yocto_api.h"</code>
vb	<code>yocto_api.vb</code>
cs	<code>yocto_api.cs</code>
py	<code>from yocto_api import *</code>
php	<code>require_once('yocto_api.php');</code>
ts	<code>import { YAPI, YErrorMsg, YModule, YSensor } from '../dist/esm/yocto_api_html.js'; // in HTML</code> <code>import { YAPI, YErrorMsg, YModule, YSensor } from 'yoctolib-cjs/yocto_api_nodejs.js'; // in Node.js</code>
tpy	<code>from yoctolib.yocto_api import * # std API</code> <code>from yoctolib.yocto_api_aio import * # async API</code>
vi	<code>YModule.vi</code>
pas	<code>uses yocto_api;</code>
es	<code><script src="../../lib/yocto_api.js"></script> // in HTML</code> <code>require('yoctolib-es2017/yocto_api.js'); // in node.js</code>

Global functions

YAPI.AddTrustedCertificates(**certificate**)

Adds a TLS/SSL certificate to the list of trusted certificates.

cpp vb cs java py php ts tpy pas es

YAPI.AddUdevRule(**force**)

Adds a UDEV rule which authorizes all users to access Yoctopuce modules connected to the USB ports.

cpp vb cs java py php ts pas es

YAPI.CheckLogicalName(**name**)

Checks if a given string is valid as logical name for a module or a function.

cpp vb cs java py php ts tpy pas es

YAPI.ClearHTTPCallbackCacheDir(**removeFiles**)

Disables the HTTP callback cache.

java php

YAPI.DisableExceptions()

Disables the use of exceptions to report runtime errors.

cpp vb cs py php ts tpy pas es

YAPI.DownloadHostCertificate(**url**, **mstimeout**)

Download the TLS/SSL certificate from the hub.

cpp vb cs java py php ts tpy pas es

YAPI.EnableExceptions()

Re-enables the use of exceptions for runtime error handling.

cpp vb cs py php ts tpy pas es

YAPI.EnableUSBHost(osContext)

This function is used only on Android.

java

YAPI.FreeAPI()

Waits for all pending communications with Yoctopuce devices to be completed then frees dynamically allocated resources used by the Yoctopuce library.

cpp vb cs java py php ts dnp tpy pas es

YAPI.GetAPIVersion()

Returns the version identifier for the Yoctopuce library in use.

cpp vb cs java py php ts dnp tpy pas es

YAPI.GetCacheValidity()

Returns the validity period of the data loaded by the library.

cpp vb cs java py php ts tpy pas es

YAPI.GetDeviceListValidity()

Returns the delay between each forced enumeration of the used YoctoHubs.

cpp vb cs java py php ts tpy pas es

YAPI.GetDllArchitecture()

Returns the system architecture for the Yoctopuce communication library in use.

dnp

YAPI.GetDllPath()

Returns the paths of the DLLs for the Yoctopuce library in use.

dnp

YAPI.GetLog(lastLogLine)

Retrieves Yoctopuce low-level library diagnostic logs.

dnp

YAPI.GetNetworkTimeout()

Returns the network connection delay for `yRegisterHub()` and `yUpdateDeviceList()`.

cpp vb cs java py php ts dnp tpy pas es

YAPI.GetTickCount()

Returns the current value of a monotone millisecond-based time counter.

cpp vb cs java py php ts tpy pas es

YAPI.GetYAPISharedLibraryPath()

Returns the path to the dynamic YAPI library.

cpp vb cs java py php ts pas es

YAPI.HandleEvents(errmsg)

Maintains the device-to-library communication channel.

cpp vb cs java py php ts tpy pas es

YAPI.InitAPI(mode, errmsg)

Initializes the Yoctopuce programming library explicitly.

cpp vb cs java py php ts tpy pas es

YAPI.PreregisterHub(url, errmsg)

Fault-tolerant alternative to `yRegisterHub()`.

cpp vb cs java py php ts dnp tpy pas es

YAPI.RegisterDeviceArrivalCallback(arrivalCallback)

Register a callback function, to be called each time a device is plugged.

cpp vb cs java py php ts tpy pas es

YAPI.RegisterDeviceRemovalCallback(removalCallback)

Register a callback function, to be called each time a device is unplugged.

cpp vb cs java py php ts tpy pas es

YAPI.RegisterHub(url, errmsg)

Set up the Yoctopuce library to use modules connected on a given machine.

cpp vb cs java py php ts dnp tpy pas es

YAPI.RegisterHubDiscoveryCallback(hubDiscoveryCallback)

Register a callback function, to be called each time an Network Hub send an SSDP message.

cpp vb cs java py ts tpy pas es

YAPI.RegisterHubWebsocketCallback(ws, errmsg, authpwd)

Variant to `yRegisterHub()` used to initialize Yoctopuce API on an existing Websocket session, as happens for incoming WebSocket callbacks.

YAPI.RegisterLogFunction(logfun)

Registers a log callback function.

cpp vb cs java py ts tpy pas es

YAPI.SelectArchitecture(arch)

Select the architecture or the library to be loaded to access to USB.

py

YAPI.SetCacheValidity(cacheValidityMs)

Change the validity period of the data loaded by the library.

cpp vb cs java py php ts tpy pas es

YAPI.SetDelegate(object)

(Objective-C only) Register an object that must follow the protocol `YDeviceHotPlug`.

YAPI.SetDeviceListValidity(deviceListValidity)

Modifies the delay between each forced enumeration of the used YoctoHubs.

cpp vb cs java py php ts tpy pas es

YAPI.SetHTTPCallbackCacheDir(directory)

Enables the HTTP callback cache.

java php

YAPI.SetNetworkSecurityOptions(opts)

Enables or disables certain TLS/SSL certificate checks.

cpp vb cs java py php ts tpy pas es

YAPI.SetNetworkTimeout(networkMsTimeout)

Modifies the network connection delay for yRegisterHub() and yUpdateDeviceList().

cpp vb cs java py php ts dnp tpy pas es

YAPI.SetTimeout(callback, ms_timeout, args)

Invoke the specified callback function after a given timeout.

ts es

YAPI.SetTrustedCertificatesList(certificatePath)

Set the path of Certificate Authority file on local filesystem.

cpp vb cs java py php ts tpy pas es

YAPI.SetUSBPacketAckMs(pktAckDelay)

Enables the acknowledge of every USB packet received by the Yoctopuce library.

java

YAPI.Sleep(ms_duration, errmsg)

Pauses the execution flow for a specified duration.

cpp vb cs java py php ts tpy pas es

YAPI.TestHub(url, mstimeout, errmsg)

Test if the hub is reachable.

cpp vb cs java py php ts dnp tpy pas es

YAPI.TriggerHubDiscovery(errmsg)

Force a hub discovery, if a callback as been registered with yRegisterHubDiscoveryCallback it will be called for each net work hub that will respond to the discovery.

cpp vb cs java py ts tpy pas es

YAPI.UnregisterHub(url)

Set up the Yoctopuce library to no more use modules connected on a previously registered machine with RegisterHub.

cpp vb cs java py php ts tpy pas es

YAPI.UpdateDeviceList(errmsg)

Triggers a (re)detection of connected Yoctopuce modules.

cpp vb cs java py php ts tpy pas es

YAPI.UpdateDeviceList_async(callback, context)

Triggers a (re)detection of connected Yoctopuce modules.

25.2. Class YModule

Global parameters control interface for all Yoctopuce devices

The YModule class can be used with all Yoctopuce USB devices. It can be used to control the module global parameters, and to enumerate the functions provided by each module.

In order to use the functions described here, you should include:

cpp	<code>#include "yocto_api.h"</code>
vb	<code>yocto_api.vb</code>
cs	<code>yocto_api.cs</code>
java	<code>import com.yoctopuce.YoctoAPI.YModule;</code>
py	<code>from yocto_api import *</code>
php	<code>require_once('yocto_api.php');</code>
ts	<code>import { YAPI, YErrorMsg, YModule, YSensor } from '../dist/esm/yocto_api_html.js'; // in HTML</code> <code>import { YAPI, YErrorMsg, YModule, YSensor } from 'yoctolib-cjs/yocto_api_nodejs.js'; // in Node.js</code>
dnp	<code>import YoctoProxyAPI.YModuleProxy</code>
cp	<code>#include "yocto_module_proxy.h"</code>
tpy	<code>from yoctolib.yocto_api import * # std API</code> <code>from yoctolib.yocto_api_aio import * # async API</code>
vi	<code>YModule.vi</code>
ml	<code>import YoctoProxyAPI.YModuleProxy"</code>
pas	<code>uses yocto_api;</code>
es	<code><script src='../lib/yocto_api.js'></script> // in HTML</code> <code>require('yoctolib-es2017/yocto_api.js'); // in node.js</code>

Global functions

YModule.FindModule(func)

Allows you to find a module from its serial number or from its logical name.

cpp vb cs java py php ts dnp tpy pas es

YModule.FindModuleInContext(yctx, func)

Retrieves a module for a given identifier in a YAPI context.

java ts tpy es

YModule.FirstModule()

Starts the enumeration of modules currently accessible.

cpp vb cs java py php ts tpy pas es

YModule properties

module→Beacon [writable]

State of the localization beacon.

dnp

module→FirmwareRelease [read-only]

Version of the firmware embedded in the module.

dnp

module→FunctionId [read-only]

Retrieves the hardware identifier of the *n*th function on the module.

dnp

module→HardwareId [read-only]

Unique hardware identifier of the module.

dnp

module→IsOnline [read-only]

Checks if the module is currently reachable.

dnp

module→LogicalName [writable]

Logical name of the module.

dnp

module→Luminosity [writable]

Luminosity of the module informative LEDs (from 0 to 100).

dnp

module→ProductId [read-only]

USB device identifier of the module.

dnp

module→ProductName [read-only]

Commercial name of the module, as set by the factory.

dnp

module→ProductRelease [read-only]

Release number of the module hardware, preprogrammed at the factory.

dnp

module→SerialNumber [read-only]

Serial number of the module, as set by the factory.

dnp

YModule methods**module→addFileToHTTPCallback(filename)**

Adds a file to the uploaded data at the next HTTP callback.

cmd cpp vb cs java py php ts dnp pas es

module→checkFirmware(path, onlynew)

Tests whether the byn file is valid for this module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→clearCache()

Invalidates the cache.

cpp vb cs java py php ts tpy pas es

module→describe()

Returns a descriptive text that identifies the module.

cpp vb cs java py php ts tpy pas es

module→download(pathname)

Downloads the specified built-in file and returns a binary buffer with its content.

cmd cpp vb cs java py php ts dnp tpy pas es

module→**functionBaseType**(**functionIndex**)

Retrieves the base type of the *n*th function on the module.

cpp vb cs java py php ts tpy pas es

module→**functionCount**()

Returns the number of functions (beside the "module" interface) available on the module.

cpp vb cs java py php ts tpy pas es

module→**functionId**(**functionIndex**)

Retrieves the hardware identifier of the *n*th function on the module.

cpp vb cs java py php ts tpy pas es

module→**functionName**(**functionIndex**)

Retrieves the logical name of the *n*th function on the module.

cpp vb cs java py php ts tpy pas es

module→**functionType**(**functionIndex**)

Retrieves the type of the *n*th function on the module.

cpp vb cs java py php ts tpy pas es

module→**functionValue**(**functionIndex**)

Retrieves the advertised value of the *n*th function on the module.

cpp vb cs java py php ts tpy pas es

module→**get_allSettings**()

Returns all the settings and uploaded files of the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→**get_beacon**()

Returns the state of the localization beacon.

cmd cpp vb cs java py php ts dnp tpy pas es

module→**get_errorMessage**()

Returns the error message of the latest error with this module object.

cpp vb cs java py php ts tpy pas es

module→**get_errorType**()

Returns the numerical error code of the latest error with this module object.

cpp vb cs java py php ts tpy pas es

module→**get_firmwareRelease**()

Returns the version of the firmware embedded in the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→**get_functionIds**(**funType**)

Retrieve all hardware identifier that match the type passed in argument.

cmd cpp vb cs java py php ts dnp pas es

module→**get_hardwareId**()

Returns the unique hardware identifier of the module.

cpp vb cs java py php ts dnp tpy es cmd pas

module→**get_icon2d**()

Returns the icon of the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_lastLogs()

Returns a string with last logs of the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_logicalName()

Returns the logical name of the module.

cpp vb cs java py php ts dnp tpy pas es cmd

module→get_luminosity()

Returns the luminosity of the module informative LEDs (from 0 to 100).

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_parentHub()

Returns the serial number of the YoctoHub on which this module is connected.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_persistentSettings()

Returns the current state of persistent module settings.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_productId()

Returns the USB device identifier of the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_productName()

Returns the commercial name of the module, as set by the factory.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_productRelease()

Returns the release number of the module hardware, preprogrammed at the factory.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_rebootCountdown()

Returns the remaining number of seconds before the module restarts, or zero when no reboot has been scheduled.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_serialNumber()

Returns the serial number of the module, as set by the factory.

cpp vb cs java py php ts dnp tpy pas es cmd

module→get_subDevices()

Returns a list of all the modules that are plugged into the current module.

cmd cpp vb cs java py php ts dnp pas es

module→get_upTime()

Returns the number of milliseconds spent since the module was powered on.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_url()

Returns the URL used to access the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_usbCurrent()

Returns the current consumed by the module on the USB bus, in milli-amps.

cmd cpp vb cs java py php ts dnp tpy pas es

module→get_userData()

Returns the value of the userData attribute, as previously stored using method `set_userData`.

cpp vb cs java py php ts tpy pas es

module→get_userVar()

Returns the value previously stored in this attribute.

cmd cpp vb cs java py php ts dnp tpy pas es

module→hasFunction(funcId)

Tests if the device includes a specific function.

cmd cpp vb cs java py php ts dnp tpy pas es

module→isOnline()

Checks if the module is currently reachable, without raising any error.

cpp vb cs java py php ts dnp tpy pas es

module→isOnline_async(callback, context)

Checks if the module is currently reachable, without raising any error.

module→isReadOnly()

Indicates whether changes to the module are prohibited or allowed.

cpp vb cs java py php ts dnp tpy pas es cmd

module→load(msValidity)

Preloads the module cache with a specified validity duration.

cpp vb cs java py php ts tpy pas es

module→load_async(msValidity, callback, context)

Preloads the module cache with a specified validity duration (asynchronous version).

module→log(text)

Adds a text message to the device logs.

cmd cpp vb cs java py php ts dnp tpy pas es

module→nextModule()

Continues the module enumeration started using `yFirstModule()`.

cpp vb cs java py php ts tpy pas es

module→reboot(secBeforeReboot)

Schedules a simple module reboot after the given number of seconds.

cmd cpp vb cs java py php ts dnp tpy pas es

module→registerBeaconCallback(callback)

Register a callback function, to be called when the localization beacon of the module has been changed.

cpp vb cs java py php ts tpy pas es

module→registerConfigChangeCallback(callback)

Register a callback function, to be called when a persistent settings in a device configuration has been changed (e.g.

cpp vb cs java py php ts tpy pas es

module→registerLogCallback(callback)

Registers a device log callback function.

cpp vb cs java py php ts tpy pas es

module→revertFromFlash()

Reloads the settings stored in the nonvolatile memory, as when the module is powered on.

cmd cpp vb cs java py php ts dnp tpy pas es

module→saveToFlash()

Saves current settings in the nonvolatile memory of the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→set_allSettings(settings)

Restores all the settings of the device.

cmd cpp vb cs java py php ts dnp tpy pas es

module→set_allSettingsAndFiles(settings)

Restores all the settings and uploaded files to the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→set_beacon(newval)

Turns on or off the module localization beacon.

cmd cpp vb cs java py php ts dnp tpy pas es

module→set_logicalName(newval)

Changes the logical name of the module.

cpp vb cs java py php ts dnp tpy pas es cmd

module→set_luminosity(newval)

Changes the luminosity of the module informative leds.

cmd cpp vb cs java py php ts dnp tpy pas es

module→set_userData(data)

Stores a user context provided as argument in the userData attribute of the function.

cpp vb cs java py php ts tpy pas es

module→set_userVar(newval)

Stores a 32 bit value in the device RAM.

cmd cpp vb cs java py php ts dnp tpy pas es

module→triggerConfigChangeCallback()

Triggers a configuration change callback, to check if they are supported or not.

cmd cpp vb cs java py php ts dnp tpy pas es

module→triggerFirmwareUpdate(secBeforeReboot)

Schedules a module reboot into special firmware update mode.

cmd cpp vb cs java py php ts dnp tpy pas es

module→updateFirmware(path)

Prepares a firmware update of the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→updateFirmwareEx(path, force)

Prepares a firmware update of the module.

cmd cpp vb cs java py php ts dnp tpy pas es

module→**wait_async(callback, context)**

Waits for all pending asynchronous commands on the module to complete, and invoke the user-provided callback function.

ts es

25.3. Class YDisplay

Display control interface, available for instance in the Yocto-Display, the Yocto-MaxiDisplay, the Yocto-MaxiDisplay-G or the Yocto-MiniDisplay

The YDisplay class allows to drive Yoctopuce displays. Yoctopuce display interface has been designed to easily show information and images. The device provides built-in multi-layer rendering. Layers can be drawn offline, individually, and freely moved on the display. It can also replay recorded sequences (animations).

In order to draw on the screen, you should use the `display.get_displayLayer` method to retrieve the layer(s) on which you want to draw, and then use methods defined in YDisplayLayer to draw on the layers.

In order to use the functions described here, you should include:

cpp	<code>#include "yocto_display.h"</code>
vb	<code>yocto_display.vb</code>
cs	<code>yocto_display.cs</code>
java	<code>import com.yoctopuce.YoctoAPI.YDisplay;</code>
py	<code>from yocto_display import *</code>
php	<code>require_once('yocto_display.php');</code>
ts	<code>import { YDisplay } from '../dist/esm/yocto_display.js'; // in HTML</code> <code>import { YDisplay } from 'yoctolib-cjs/yocto_display.js'; // in Node.js</code>
dnf	<code>import YoctoProxyAPI.YDisplayProxy</code>
cp	<code>#include "yocto_display_proxy.h"</code>
tpy	<code>from yoctolib.yocto_display import YDisplay # std API</code> <code>from yoctolib.yocto_display_aio import YDisplay # async API</code>
vi	<code>YDisplay.vi</code>
ml	<code>import YoctoProxyAPI.YDisplayProxy</code>
pas	<code>uses yocto_display;</code>
es	<code><script src="../../lib/yocto_display.js"></script> // in HTML</code> <code>require('yoctolib-es2017/yocto_display.js'); // in node.js</code>

Global functions

YDisplay.FindDisplay(func)

Retrieves a display for a given identifier.

cpp vb cs java py php ts dnf tpy pas es

YDisplay.FindDisplayInContext(yctx, func)

Retrieves a display for a given identifier in a YAPI context.

java ts tpy es

YDisplay.FirstDisplay()

Starts the enumeration of displays currently accessible.

cpp vb cs java py php ts tpy pas es

YDisplay.FirstDisplayInContext(yctx)

Starts the enumeration of displays currently accessible.

java ts tpy es

YDisplay.GetSimilarFunctions()

Enumerates all functions of type Display available on the devices currently reachable by the library, and returns their unique hardware ID.

dnf

YDisplay properties

display→AdvertisedValue [read-only]

Short string representing the current state of the function.

dnf

display→AutoInvertDelay [writable]

Interval between automatic display inversions, or 0 if automatic inversion is disabled.

dnf

display→Brightness [writable]

Luminosity of the module informative LEDs (from 0 to 100).

dnf

display→DisplayHeight [read-only]

Display height, in pixels.

dnf

display→DisplayPanel [writable]

Exact model of the display panel.

dnf

display→DisplayType [read-only]

Display type: monochrome OLED, black and white ePaper, color ePaper, and so on.

dnf

display→DisplayWidth [read-only]

Display width, in pixels.

dnf

display→FriendlyName [read-only]

Global identifier of the function in the format `MODULE_NAME . FUNCTION_NAME`.

dnf

display→FunctionId [read-only]

Hardware identifier of the display, without reference to the module.

dnf

display→HardwareId [read-only]

Unique hardware identifier of the function in the form `SERIAL . FUNCTIONID`.

dnf

display→IsOnline [read-only]

Checks if the function is currently reachable.

dnf

display→LayerCount [read-only]

Number of available layers to draw on.

dnf

display→LayerHeight [read-only]

Height of the layers to draw on, in pixels.

dnf

display→LayerWidth [read-only]

Width of the layers to draw on, in pixels.

dnf

display→LogicalName [writable]

Logical name of the function.

dnf

display→Orientation [writable]

Currently selected display orientation.

dnf

display→SerialNumber [read-only]

Serial number of the module, as set by the factory.

dnf

display→StartupSeq [writable]

Name of the sequence to play when the displayed is powered on.

dnf

YDisplay methods

display→clearCache()

Invalidates the cache.

cpp vb cs java py php ts tpy pas es

display→copyLayerContent(srcLayerId, dstLayerId)

Copies the whole content of a layer to another layer.

cmd cpp vb cs java py php ts dnf tpy pas es

display→describe()

Returns a short text that describes unambiguously the instance of the display in the form TYPE(NAME)=SERIAL.FUNCTIONID.

cpp vb cs java py php ts tpy pas es

display→fade(brightness, duration)

Smoothly changes the brightness of the screen to produce a fade-in or fade-out effect.

cmd cpp vb cs java py php ts dnf tpy pas es

display→get_advertisedValue()

Returns the current value of the display (no more than 6 characters).

cpp vb cs java py php ts dnf tpy pas es cmd

display→get_autoInvertDelay()

Returns the interval between automatic display inversions, or 0 if automatic inversion is disabled.

cmd cpp vb cs java py php ts dnf tpy pas es

display→get_brightness()

Returns the luminosity of the module informative LEDs (from 0 to 100).

cmd cpp vb cs java py php ts dnf tpy pas es

display→get_displayHeight()

Returns the display height, in pixels.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_displayLayer(layerId)

Returns a YDisplayLayer object that can be used to draw on the specified layer.

cpp vb cs java py php ts dnp tpy pas es

display→get_displayPanel()

Returns the exact model of the display panel.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_displayType()

Returns the display type: monochrome OLED, black and white ePaper, color ePaper, and so on.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_displayWidth()

Returns the display width, in pixels.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_ePaperState(errmsg)

Returns the current state of an ePaper display, specifically to determine whether an update is in progress or whether a configuration issue has been detected.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_enabled()

Returns true if the screen is powered, false otherwise.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_errorMessage()

Returns the error message of the latest error with the display.

cpp vb cs java py php ts tpy pas es

display→get_errorType()

Returns the numerical error code of the latest error with the display.

cpp vb cs java py php ts tpy pas es

display→get_fastRefreshPolicy()

Returns the fast refresh usage policy in use (ePaper displays only).

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_friendlyName()

Returns a global identifier of the display in the format **MODULE_NAME . FUNCTION_NAME**.

cpp cs java py php ts dnp tpy es

display→get_functionDescriptor()

Returns a unique identifier of type YFUN_DESCR corresponding to the function.

cpp vb cs java py php ts pas es

display→get_functionId()

Returns the hardware identifier of the display, without reference to the module.

cpp vb cs java py php ts dnp tpy es

display→get_hardwareId()

Returns the unique hardware identifier of the display in the form **SERIAL . FUNCTIONID**.

cpp vb cs java py php ts dnp tpy es

display→get_layerCount()

Returns the number of available layers to draw on.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_layerHeight()

Returns the height of the layers to draw on, in pixels.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_layerWidth()

Returns the width of the layers to draw on, in pixels.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_logicalName()

Returns the logical name of the display.

cpp vb cs java py php ts dnp tpy pas es cmd

display→get_module()

Gets the YModule object for the device on which the function is located.

cpp vb cs java py php ts dnp tpy pas es

display→get_module_async(callback, context)

Gets the YModule object for the device on which the function is located (asynchronous version).

display→get_orientation()

Returns the currently selected display orientation.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_regeneratePolicy()

Returns the display regeneration minimal frequency (ePaper displays only).

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_serialNumber()

Returns the serial number of the module, as set by the factory.

cpp vb cs java py php ts dnp tpy pas es cmd

display→get_startupSeq()

Returns the name of the sequence to play when the displayed is powered on.

cmd cpp vb cs java py php ts dnp tpy pas es

display→get_userData()

Returns the value of the userData attribute, as previously stored using method set_userData.

cpp vb cs java py php ts tpy pas es

display→isOnline()

Checks if the display is currently reachable, without raising any error.

cpp vb cs java py php ts dnp tpy pas es

display→isOnline_async(callback, context)

Checks if the display is currently reachable, without raising any error (asynchronous version).

display→isReadOnly()

Indicates whether changes to the function are prohibited or allowed.

cpp vb cs java py php ts dnp tpy pas es cmd

display→load(msValidity)

Preloads the display cache with a specified validity duration.

cpp vb cs java py php ts tpy pas es

display→loadAttribute(attrName)

Returns the current value of a single function attribute, as a text string, as quickly as possible but without using the cached value.

cpp vb cs java py php ts dnp tpy pas es

display→load_async(msValidity, callback, context)

Preloads the display cache with a specified validity duration (asynchronous version).

display→muteValueCallbacks()

Disables the propagation of every new advertised value to the parent hub.

cpp vb cs java py php ts dnp tpy pas es cmd

display→newSequence()

Starts to record all display commands into a sequence, for later replay.

cmd cpp vb cs java py php ts dnp tpy pas es

display→nextDisplay()

Continues the enumeration of displays started using `yFirstDisplay()`.

cpp vb cs java py php ts tpy pas es

display→pauseSequence(delay_ms)

Waits for a specified delay (in milliseconds) before playing next commands in current sequence.

cmd cpp vb cs java py php ts dnp tpy pas es

display→playSequence(sequenceName)

Replays a display sequence previously recorded using `newSequence()` and `saveSequence()`.

cmd cpp vb cs java py php ts dnp tpy pas es

display→postponeRefresh(duration)

Disables screen refresh for a short period of time.

cmd cpp vb cs java py php ts dnp tpy pas es

display→readDisplay(palette)

Returns a color image with the current content of the display.

cmd cpp vb cs java py php ts dnp tpy pas es

display→regenerateDisplay()

Forces an ePaper screen to perform a regenerative update using the slow update method.

cmd cpp vb cs java py php ts dnp tpy pas es

display→registerValueCallback(callback)

Registers the callback function that is invoked on every change of advertised value.

cpp vb cs java py php ts tpy pas es

display→resetAll()

Clears the display screen and resets all display layers to their default state.

cmd cpp vb cs java py php ts dnp tpy pas es

display→saveSequence(sequenceName)

Stops recording display commands and saves the sequence into the specified file on the display internal memory.

cmd cpp vb cs java py php ts dnp tpy pas es

display→set_autoInvertDelay(newval)

Changes the interval between automatic display inversions.

cmd cpp vb cs java py php ts dnp tpy pas es

display→set_brightness(newval)

Changes the brightness of the display.

cmd cpp vb cs java py php ts dnp tpy pas es

display→set_displayPanel(newval)

Changes the model of display to match the connected display panel.

cmd cpp vb cs java py php ts dnp tpy pas es

display→set_enabled(newval)

Changes the power state of the display.

cmd cpp vb cs java py php ts dnp tpy pas es

display→set_logicalName(newval)

Changes the logical name of the display.

cpp vb cs java py php ts dnp tpy pas es cmd

display→set_orientation(newval)

Changes the display orientation.

cmd cpp vb cs java py php ts dnp tpy pas es

display→set_startupSeq(newval)

Changes the name of the sequence to play when the display is powered on.

cmd cpp vb cs java py php ts dnp tpy pas es

display→set_userData(data)

Stores a user context provided as argument in the userData attribute of the function.

cpp vb cs java py php ts tpy pas es

display→stopSequence()

Stops immediately any ongoing sequence replay.

cmd cpp vb cs java py php ts dnp tpy pas es

display→swapLayerContent(layerIdA, layerIdB)

Swaps the whole content of two layers.

cmd cpp vb cs java py php ts dnp tpy pas es

display→triggerRefresh()

Triggers an immediate screen refresh.

cmd cpp vb cs java py php ts dnp tpy pas es

display→unmuteValueCallbacks()

Re-enables the propagation of every new advertised value to the parent hub.

cpp vb cs java py php ts dnp tpy pas es cmd

display→upload(pathname, content)

Uploads an arbitrary file (for instance a GIF file) to the display, to the specified full path name.

cmd

cpp

vb

cs

java

py

php

ts

dnp

tpy

pas

es

display→wait_async(callback, context)

Waits for all pending asynchronous commands on the module to complete, and invoke the user-provided callback function.

ts

es

display→set_fastRefreshPolicy(fastRefresh, regenerate)

Changes the fast refresh usage policy and display regeneration minimal frequency (ePaper displays only).

25.4. Class YDisplayLayer

Interface for drawing into display layers, obtained by calling `display.get_displayLayer`.

Each `DisplayLayer` represents an image layer containing objects to display (bitmaps, text, etc.). The content is displayed only when the layer is active on the screen (and not masked by other overlapping layers).

In order to use the functions described here, you should include:

cpp	<code>#include "yocto_display.h"</code>
vb	<code>yocto_display.vb</code>
cs	<code>yocto_display.cs</code>
java	<code>import com.yoctopuce.YoctoAPI.YDisplayLayer;</code>
py	<code>from yocto_display import *</code>
php	<code>require_once('yocto_display.php');</code>
ts	<code>import { YDisplayLayer } from '../dist/esm/yocto_display.js'; // in HTML import { YDisplayLayer } from 'yoctolib-cjs/yocto_display.js'; // in Node.js</code>
dnp	<code>import YoctoProxyAPI.YDisplayLayerProxy</code>
cp	<code>#include "yocto_display_proxy.h"</code>
tpy	<code>from yoctolib.yocto_display import YDisplayLayer # std API from yoctolib.yocto_display_aio import YDisplayLayer # async API</code>
ml	<code>import YoctoProxyAPI.YDisplayLayerProxy</code>
pas	<code>uses yocto_display;</code>
es	<code><script src="../../lib/yocto_display.js"></script> // in HTML require('yoctolib-es2017/yocto_display.js'); // in node.js</code>

YDisplayLayer methods

`displaylayer→clear()`

Erases the whole content of the layer (makes it fully transparent).

cmd cpp vb cs java py php ts dnp tpy pas es

`displaylayer→clearConsole()`

Blanks the console area within console margins, and resets the console pointer to the upper left corner of the console.

cmd cpp vb cs java py php ts dnp tpy pas es

`displaylayer→consoleOut(text)`

Outputs a message in the console area, and advances the console pointer accordingly.

cmd cpp vb cs java py php ts dnp tpy pas es

`displaylayer→drawBar(x1, y1, x2, y2)`

Draws a filled rectangular bar at a specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

`displaylayer→drawBitmap(x, y, w, bitmap, bgcolor)`

Draws a bitmap at the specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

`displaylayer→drawCircle(x, y, r)`

Draws an empty circle at a specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→drawDisc(x, y, r)

Draws a filled disc at a given position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→drawGIF(x, y, gifimage)

Draws a GIF image provided as a binary buffer at the specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→drawImage(x, y, imagename)

Draws an image previously uploaded to the device filesystem, at the specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→drawPixel(x, y)

Draws a single pixel at the specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→drawRect(x1, y1, x2, y2)

Draws an empty rectangle at a specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→drawText(x, y, anchor, text)

Draws a text string at the specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→get_display()

Gets parent YDisplay.

cpp vb cs java py php ts dnp tpy pas es

displaylayer→get_displayHeight()

Returns the display height, in pixels.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→get_displayWidth()

Returns the display width, in pixels.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→get_layerHeight()

Returns the height of the layers to draw on, in pixels.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→get_layerWidth()

Returns the width of the layers to draw on, in pixels.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→hide()

Hides the layer.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→lineTo(x, y)

Draws a line from current drawing pointer position to the specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→moveTo(x, y)

Moves the drawing pointer of this layer to the specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→polygonAdd(x, y)

Adds a point to the currently open polygon, previously opened using `polygonStart`.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→polygonEnd()

Closes the currently open polygon, fill its content the fill color currently selected for the layer, and draw its outline using the selected line color.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→polygonStart(x, y)

Starts drawing a polygon with the first corner at the specified position.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→reset()

Reverts the layer to its initial state (fully transparent, default settings).

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→selectColorPen(color)

Selects the color to be used for all subsequent drawing functions, for filling as well as for line and text drawing.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→selectEraser()

Selects an eraser instead of a pen for all subsequent drawing functions, except for bitmap copy functions.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→selectFillColor(color)

Selects the color to be used for filling rectangular bars, discs and polygons.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→selectFont(fontname)

Selects a font to use for the next text drawing functions, by providing the name of the font file.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→selectGrayPen(graylevel)

Selects the pen gray level for all subsequent drawing functions, for filling as well as for line and text drawing.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→selectLineColor(color)

Selects the color to be used for drawing the outline of rectangular bars, discs and polygons, as well as for drawing lines and text.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→selectLineWidth(width)

Selects the line width for drawing the outline of rectangular bars, discs and polygons, as well as for drawing lines.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→setConsoleBackground(bgcol)

Sets up the background color used by the `clearConsole` function and by the console scrolling feature.

cmd cpp vb cs java py php ts dnp tpy pas es

displaylayer→setConsoleMargins(x1, y1, x2, y2)

Sets up display margins for the `consoleOut` function.

`cmd` `cpp` `vb` `cs` `java` `py` `php` `ts` `dnp` `tpy` `pas` `es`

`displaylayer→setConsoleWordWrap(wordwrap)`

Sets up the wrapping behavior used by the `consoleOut` function.

`cmd` `cpp` `vb` `cs` `java` `py` `php` `ts` `dnp` `tpy` `pas` `es`

`displaylayer→setLayerPosition(x, y, scrollTime)`

Sets the position of the layer relative to the display upper left corner.

`cmd` `cpp` `vb` `cs` `java` `py` `php` `ts` `dnp` `tpy` `pas` `es`

`displaylayer→unhide()`

Shows the layer.

`cmd` `cpp` `vb` `cs` `java` `py` `php` `ts` `dnp` `tpy` `pas` `es`

25.5. Class YTemperature

Temperature sensor control interface, available for instance in the Yocto-Meteo-V2, the Yocto-PT100, the Yocto-Temperature or the Yocto-Thermocouple

The YTemperature class allows you to read and configure Yoctopuce temperature sensors. It inherits from YSensor class the core functions to read measurements, to register callback functions, and to access the autonomous datalogger. This class adds the ability to configure some specific parameters for some sensors (connection type, temperature mapping table).

In order to use the functions described here, you should include:

cpp	<code>#include "yocto_temperature.h"</code>
vb	<code>yocto_temperature.vb</code>
cs	<code>yocto_temperature.cs</code>
java	<code>import com.yoctopuce.YoctoAPI.YTemperature;</code>
py	<code>from yocto_temperature import *</code>
php	<code>require_once('yocto_temperature.php');</code>
ts	<code>import { YTemperature } from '../dist/esm/yocto_temperature.js'; // in HTML import { YTemperature } from 'yoctolib-cjs/yocto_temperature.js'; // in Node.js</code>
dnp	<code>import YoctoProxyAPI.YTemperatureProxy</code>
cp	<code>#include "yocto_temperature_proxy.h"</code>
tpy	<code>from yoctolib.yocto_temperature import YTemperature # std API from yoctolib.yocto_temperature_aio import YTemperature # async API</code>
vi	<code>YTemperature.vi</code>
ml	<code>import YoctoProxyAPI.YTemperatureProxy</code>
pas	<code>uses yocto_temperature;</code>
es	<code><script src="../../lib/yocto_temperature.js"></script> // in HTML require('yoctolib-es2017/yocto_temperature.js'); // in node.js</code>

Global functions

YTemperature.FindTemperature(func)

Retrieves a temperature sensor for a given identifier.

cpp vb cs java py php ts dnp tpy pas es

YTemperature.FindTemperatureInContext(yctx, func)

Retrieves a temperature sensor for a given identifier in a YAPI context.

java ts tpy es

YTemperature.FirstTemperature()

Starts the enumeration of temperature sensors currently accessible.

cpp vb cs java py php ts tpy pas es

YTemperature.FirstTemperatureInContext(yctx)

Starts the enumeration of temperature sensors currently accessible.

java ts tpy es

YTemperature.GetSimilarFunctions()

Enumerates all functions of type Temperature available on the devices currently reachable by the library, and returns their unique hardware ID.

dnp

YTemperature properties	
temperature→AdvMode <i>[writable]</i>	
Measuring mode used for the advertised value pushed to the parent hub.	dnf
temperature→AdvertisedValue <i>[read-only]</i>	
Short string representing the current state of the function.	dnf
temperature→FriendlyName <i>[read-only]</i>	
Global identifier of the function in the format MODULE_NAME . FUNCTION_NAME.	dnf
temperature→FunctionId <i>[read-only]</i>	
Hardware identifier of the sensor, without reference to the module.	dnf
temperature→HardwareId <i>[read-only]</i>	
Unique hardware identifier of the function in the form SERIAL . FUNCTIONID.	dnf
temperature→IsOnline <i>[read-only]</i>	
Checks if the function is currently reachable.	dnf
temperature→LogFrequency <i>[writable]</i>	
Datalogger recording frequency for this function, or "OFF" when measures are not stored in the data logger flash memory.	dnf
temperature→LogicalName <i>[writable]</i>	
Logical name of the function.	dnf
temperature→ReportFrequency <i>[writable]</i>	
Timed value notification frequency, or "OFF" if timed value notifications are disabled for this function.	dnf
temperature→Resolution <i>[writable]</i>	
Resolution of the measured values.	dnf
temperature→SensorType <i>[writable]</i>	
Temperature sensor type.	dnf
temperature→SerialNumber <i>[read-only]</i>	
Serial number of the module, as set by the factory.	dnf
temperature→SignalUnit <i>[read-only]</i>	
Measuring unit of the electrical signal used by the sensor.	dnf

YTemperature methods

temperature→calibrateFromPoints(rawValues, refValues)

Configures error correction data points, in particular to compensate for a possible perturbation of the measure caused by an enclosure.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→clearCache()

Invalidates the cache.

cpp vb cs java py php ts tpy pas es

temperature→describe()

Returns a short text that describes unambiguously the instance of the temperature sensor in the form TYPE(NAME)=SERIAL.FUNCTIONID.

cpp vb cs java py php ts tpy pas es

temperature→get_advMode()

Returns the measuring mode used for the advertised value pushed to the parent hub.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_advertisedValue()

Returns the current value of the temperature sensor (no more than 6 characters).

cpp vb cs java py php ts dnp tpy pas es cmd

temperature→get_currentRawValue()

Returns the uncalibrated, unrounded raw value returned by the sensor, in Celsius, as a floating point number.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_currentValue()

Returns the current value of the temperature, in Celsius, as a floating point number.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_dataLogger()

Returns the YDataLogger object of the device hosting the sensor.

cpp vb cs java py php ts dnp tpy pas es

temperature→get_errorMessage()

Returns the error message of the latest error with the temperature sensor.

cpp vb cs java py php ts tpy pas es

temperature→get_errorType()

Returns the numerical error code of the latest error with the temperature sensor.

cpp vb cs java py php ts tpy pas es

temperature→get_friendlyName()

Returns a global identifier of the temperature sensor in the format MODULE_NAME.FUNCTION_NAME.

cpp cs java py php ts dnp tpy es

temperature→get_functionDescriptor()

Returns a unique identifier of type YFUN_DESCR corresponding to the function.

cpp vb cs java py php ts pas es

temperature→get_functionId()

Returns the hardware identifier of the temperature sensor, without reference to the module.

cpp vb cs java py php ts dnp tpy es

temperature→get_hardwareId()

Returns the unique hardware identifier of the temperature sensor in the form **SERIAL . FUNCTIONID**.

cpp vb cs java py php ts dnp tpy es

temperature→get_highestValue()

Returns the maximal value observed for the temperature since the device was started.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_logFrequency()

Returns the datalogger recording frequency for this function, or "OFF" when measures are not stored in the data logger flash memory.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_logicalName()

Returns the logical name of the temperature sensor.

cpp vb cs java py php ts dnp tpy pas es cmd

temperature→get_lowestValue()

Returns the minimal value observed for the temperature since the device was started.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_module()

Gets the YModule object for the device on which the function is located.

cpp vb cs java py php ts dnp tpy pas es

temperature→get_module_async(callback, context)

Gets the YModule object for the device on which the function is located (asynchronous version).

temperature→get_recordedData(startTime, endTime)

Retrieves a YDataSet object holding historical data for this sensor, for a specified time interval.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_reportFrequency()

Returns the timed value notification frequency, or "OFF" if timed value notifications are disabled for this function.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_resolution()

Returns the resolution of the measured values.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_sensorState()

Returns the sensor state code, which is zero when there is an up-to-date measure available or a positive code if the sensor is not able to provide a measure right now.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_sensorType()

Returns the temperature sensor type.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_serialNumber()

Returns the serial number of the module, as set by the factory.

cpp vb cs java py php ts dnp tpy pas es cmd

temperature→get_signalUnit()

Returns the measuring unit of the electrical signal used by the sensor.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_signalValue()

Returns the current value of the electrical signal measured by the sensor.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_unit()

Returns the measuring unit for the temperature.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→get_userData()

Returns the value of the userData attribute, as previously stored using method set_userData.

cpp vb cs java py php ts tpy pas es

temperature→isOnline()

Checks if the temperature sensor is currently reachable, without raising any error.

cpp vb cs java py php ts dnp tpy pas es

temperature→isOnline_async(callback, context)

Checks if the temperature sensor is currently reachable, without raising any error (asynchronous version).

temperature→isReadOnly()

Indicates whether changes to the function are prohibited or allowed.

cpp vb cs java py php ts dnp tpy pas es cmd

temperature→isSensorReady()

Checks if the sensor is currently able to provide an up-to-date measure.

cmd

temperature→load(msValidity)

Preloads the temperature sensor cache with a specified validity duration.

cpp vb cs java py php ts tpy pas es

temperature→loadAttribute(attrName)

Returns the current value of a single function attribute, as a text string, as quickly as possible but without using the cached value.

cpp vb cs java py php ts dnp tpy pas es

temperature→loadCalibrationPoints(rawValues, refValues)

Retrieves error correction data points previously entered using the method calibrateFromPoints.

cmd cpp vb cs java py php ts tpy pas es

temperature→loadThermistorResponseTable(tempValues, resValues)

Retrieves the thermistor response table previously configured using the set_thermistorResponseTable function.

cmd cpp vb cs java py php ts tpy pas es

temperature→load_async(msValidity, callback, context)

Preloads the temperature sensor cache with a specified validity duration (asynchronous version).

temperature→muteValueCallbacks()

Disables the propagation of every new advertised value to the parent hub.

cpp vb cs java py php ts dnp tpy pas es cmd

temperature→nextTemperature()

Continues the enumeration of temperature sensors started using `yFirstTemperature()`.

cpp vb cs java py php ts tpy pas es

temperature→registerTimedReportCallback(callback)

Registers the callback function that is invoked on every periodic timed notification.

cpp vb cs java py php ts tpy pas es

temperature→registerValueCallback(callback)

Registers the callback function that is invoked on every change of advertised value.

cpp vb cs java py php ts tpy pas es

temperature→set_advMode(newval)

Changes the measuring mode used for the advertised value pushed to the parent hub.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_highestValue(newval)

Changes the recorded maximal value observed.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_logFrequency(newval)

Changes the datalogger recording frequency for this function.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_logicalName(newval)

Changes the logical name of the temperature sensor.

cpp vb cs java py php ts dnp tpy pas es cmd

temperature→set_lowestValue(newval)

Changes the recorded minimal value observed.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_ntcParameters(res25, beta)

Configures NTC thermistor parameters in order to properly compute the temperature from the measured resistance.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_reportFrequency(newval)

Changes the timed value notification frequency for this function.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_resolution(newval)

Changes the resolution of the measured physical values.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_sensorType(newval)

Changes the temperature sensor type.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_thermistorResponseTable(tempValues, resValues)

Records a thermistor response table, in order to interpolate the temperature from the measured resistance.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_unit(newval)

Changes the measuring unit for the measured temperature.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→set_userdata(data)

Stores a user context provided as argument in the userData attribute of the function.

cpp vb cs java py php ts tpy pas es

temperature→startDataLogger()

Starts the data logger on the device.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→stopDataLogger()

Stops the datalogger on the device.

cmd cpp vb cs java py php ts dnp tpy pas es

temperature→unmuteValueCallbacks()

Re-enables the propagation of every new advertised value to the parent hub.

cpp vb cs java py php ts dnp tpy pas es cmd

temperature→wait_async(callback, context)

Waits for all pending asynchronous commands on the module to complete, and invoke the user-provided callback function.

ts es

25.6. Class YFiles

Filesystem control interface, available for instance in the Yocto-Color-V2, the Yocto-SPI, the YoctoHub-Ethernet or the YoctoHub-GSM-4G

The YFiles class is used to access the filesystem embedded on some Yoctopuce devices. This filesystem makes it possible for instance to design a custom web UI (for networked devices) or to add fonts (on display devices).

In order to use the functions described here, you should include:

cpp	<code>#include "yocto_files.h"</code>
vb	<code>yocto_files.vb</code>
cs	<code>yocto_files.cs</code>
java	<code>import com.yoctopuce.YoctoAPI.YFiles;</code>
py	<code>from yocto_files import *</code>
php	<code>require_once('yocto_files.php');</code>
ts	<code>import { YFiles } from '../dist/esm/yocto_files.js'; // in HTML</code> <code>import { YFiles } from 'yoctolib-cjs/yocto_files.js'; // in Node.js</code>
dnp	<code>import YoctoProxyAPI.YFilesProxy</code>
cp	<code>#include "yocto_files_proxy.h"</code>
tpy	<code>from yoctolib.yocto_files import YFiles # std API</code> <code>from yoctolib.yocto_files_aio import YFiles # async API</code>
vi	<code>YFiles.vi</code>
ml	<code>import YoctoProxyAPI.YFilesProxy</code>
pas	<code>uses yocto_files;</code>
es	<code><script src="../../lib/yocto_files.js"></script> // in HTML</code> <code>require('yoctolib-es2017/yocto_files.js'); // in node.js</code>

Global functions

YFiles.FindFiles(func)

Retrieves a filesystem for a given identifier.

cpp vb cs java py php ts dnp tpy pas es

YFiles.FindFilesInContext(yctx, func)

Retrieves a filesystem for a given identifier in a YAPI context.

java ts tpy es

YFiles.FirstFiles()

Starts the enumeration of filesystems currently accessible.

cpp vb cs java py php ts tpy pas es

YFiles.FirstFilesInContext(yctx)

Starts the enumeration of filesystems currently accessible.

java ts tpy es

YFiles.GetSimilarFunctions()

Enumerates all functions of type Files available on the devices currently reachable by the library, and returns their unique hardware ID.

dnp

YFiles properties

files→AdvertisedValue *[read-only]*

Short string representing the current state of the function.

dnf

files→FilesCount *[read-only]*

Number of files currently loaded in the filesystem.

dnf

files→FriendlyName *[read-only]*

Global identifier of the function in the format `MODULE_NAME . FUNCTION_NAME`.

dnf

files→FunctionId *[read-only]*

Hardware identifier of the filesystem, without reference to the module.

dnf

files→HardwareId *[read-only]*

Unique hardware identifier of the function in the form `SERIAL . FUNCTIONID`.

dnf

files→IsOnline *[read-only]*

Checks if the function is currently reachable.

dnf

files→LogicalName *[writable]*

Logical name of the function.

dnf

files→SerialNumber *[read-only]*

Serial number of the module, as set by the factory.

dnf

YFiles methods

files→clearCache()

Invalidates the cache.

cpp vb cs java py php ts tpy pas es

files→describe()

Returns a short text that describes unambiguously the instance of the filesystem in the form `TYPE (NAME)=SERIAL . FUNCTIONID`.

cpp vb cs java py php ts tpy pas es

files→download(pathname)

Downloads the requested file and returns a binary buffer with its content.

cmd cpp vb cs java py php ts dnf tpy pas es

files→download_async(pathname, callback, context)

Downloads the requested file and returns a binary buffer with its content.

files→fileExist(filename)

Tests if a file exists on the filesystem of the module.

cmd cpp vb cs java py php ts dnf tpy pas es

files→format_fs()

Reinitialize the filesystem to its clean, unfragmented, empty state.

cmd cpp vb cs java py php ts dnp tpy pas es

files→get_advertisedValue()

Returns the current value of the filesystem (no more than 6 characters).

cpp vb cs java py php ts dnp tpy pas es cmd

files→get_content_crc(content)

Returns the expected file CRC for a given content.

cmd cpp vb cs java py php ts dnp tpy pas es

files→get_errorMessage()

Returns the error message of the latest error with the filesystem.

cpp vb cs java py php ts tpy pas es

files→get_errorType()

Returns the numerical error code of the latest error with the filesystem.

cpp vb cs java py php ts tpy pas es

files→get_filesCount()

Returns the number of files currently loaded in the filesystem.

cmd cpp vb cs java py php ts dnp tpy pas es

files→get_freeSpace()

Returns the free space for uploading new files to the filesystem, in bytes.

cmd cpp vb cs java py php ts dnp tpy pas es

files→get_friendlyName()

Returns a global identifier of the filesystem in the format **MODULE_NAME . FUNCTION_NAME**.

cpp cs java py php ts dnp tpy es

files→get_functionDescriptor()

Returns a unique identifier of type YFUN_DESCR corresponding to the function.

cpp vb cs java py php ts pas es

files→get_functionId()

Returns the hardware identifier of the filesystem, without reference to the module.

cpp vb cs java py php ts dnp tpy es

files→get_hardwareId()

Returns the unique hardware identifier of the filesystem in the form **SERIAL . FUNCTIONID**.

cpp vb cs java py php ts dnp tpy es

files→get_list(pattern)

Returns a list of YFileRecord objects that describe files currently loaded in the filesystem.

cmd cpp vb cs java py php ts dnp pas es

files→get_logicalName()

Returns the logical name of the filesystem.

cpp vb cs java py php ts dnp tpy pas es cmd

files→get_module()

Gets the YModule object for the device on which the function is located.

cpp vb cs java py php ts dnp tpy pas es

files→get_module_async(callback, context)

Gets the YModule object for the device on which the function is located (asynchronous version).

files→get_serialNumber()

Returns the serial number of the module, as set by the factory.

cpp vb cs java py php ts dnp tpy pas es cmd

files→get_userData()

Returns the value of the userData attribute, as previously stored using method set_userData.

cpp vb cs java py php ts tpy pas es

files→isOnline()

Checks if the filesystem is currently reachable, without raising any error.

cpp vb cs java py php ts dnp tpy pas es

files→isOnline_async(callback, context)

Checks if the filesystem is currently reachable, without raising any error (asynchronous version).

files→isReadOnly()

Indicates whether changes to the function are prohibited or allowed.

cpp vb cs java py php ts dnp tpy pas es cmd

files→load(msValidity)

Preloads the filesystem cache with a specified validity duration.

cpp vb cs java py php ts tpy pas es

files→loadAttribute(attrName)

Returns the current value of a single function attribute, as a text string, as quickly as possible but without using the cached value.

cpp vb cs java py php ts dnp tpy pas es

files→load_async(msValidity, callback, context)

Preloads the filesystem cache with a specified validity duration (asynchronous version).

files→muteValueCallbacks()

Disables the propagation of every new advertised value to the parent hub.

cpp vb cs java py php ts dnp tpy pas es cmd

files→nextFiles()

Continues the enumeration of filesystems started using yFirstFiles().

cpp vb cs java py php ts tpy pas es

files→registerValueCallback(callback)

Registers the callback function that is invoked on every change of advertised value.

cpp vb cs java py php ts tpy pas es

files→remove(pathname)

Deletes a file, given by its full path name, from the filesystem.

cmd cpp vb cs java py php ts dnp tpy pas es

files→set_logicalName(newval)

Changes the logical name of the filesystem.

cpp vb cs java py php ts dnp tpy pas es cmd

files→set_userdata(data)

Stores a user context provided as argument in the userData attribute of the function.

cpp vb cs java py php ts tpy pas es

files→unmuteValueCallbacks()

Re-enables the propagation of every new advertised value to the parent hub.

cpp vb cs java py php ts dnp tpy pas es cmd

files→upload(pathname, content)

Uploads a file to the filesystem, to the specified full path name.

cmd cpp vb cs java py php ts dnp tpy pas es

files→wait_async(callback, context)

Waits for all pending asynchronous commands on the module to complete, and invoke the user-provided callback function.

ts es

26. Troubleshooting

26.1. Where to start?

If it is the first time that you use a Yoctopuce module and you do not really know where to start, have a look at the Yoctopuce blog. There is a section dedicated to beginners ¹.

26.2. Programming examples don't seem to work

Most of Yoctopuce API programming examples are command line programs and require some parameters to work properly. You have to start them from your operating system command prompt, or configure your IDE to run them with the proper parameters. ².

26.3. Linux and USB

To work correctly under Linux, the library needs to have write access to all the Yoctopuce USB peripherals. However, by default under Linux, USB privileges of the non-root users are limited to read access. To avoid having to run the library as root, you need to create a new *udev* rule to authorize one or several users to have write access to the Yoctopuce peripherals.

To add a new *udev* rule to your installation, you must add a file with a name following the "`##-arbitraryName.rules`" format, in the `/etc/udev/rules.d` directory. When the system is starting, *udev* reads all the files with a `.rules` extension in this directory, respecting the alphabetical order (for example, the `51-custom.rules` file is interpreted AFTER the `50-udev-default.rules` file).

The `50-udev-default` file contains the system default *udev* rules. To modify the default behavior, you therefore need to create a file with a name that starts with a number larger than 50, that will override the system default rules. Note that to add a rule, you need a root access on the system.

In the `udev_conf` directory of the VirtualHub for Linux³ archive, there are two rule examples which you can use as a basis.

¹ see: http://www.yoctopuce.com/EN/blog_by_categories/for-the-beginners

² see: <http://www.yoctopuce.com/EN/article/about-programming-examples>

³ <http://www.yoctopuce.com/EN/virtualhub.php>

Example 1: 51-yoctopuce.rules

This rule provides all the users with read and write access to the Yoctopuce USB devices. Access rights for all other devices are not modified. If this scenario suits you, you only need to copy the "51-yoctopuce_all.rules" file into the "/etc/udev/rules.d" directory and to restart your system.

```
# udev rules to allow write access to all users
# for Yoctopuce USB devices
SUBSYSTEM=="usb", ATTR{idVendor}=="24e0", MODE="0666"
```

Example 2: 51-yoctopuce_group.rules

This rule authorizes the "yoctogroup" group to have read and write access to Yoctopuce USB peripherals. Access rights for all other peripherals are not modified. If this scenario suits you, you only need to copy the "51-yoctopuce_group.rules" file into the "/etc/udev/rules.d" directory and restart your system.

```
# udev rules to allow write access to all users of "yoctogroup"
# for Yoctopuce USB devices
SUBSYSTEM=="usb", ATTR{idVendor}=="24e0", MODE="0664", GROUP="yoctogroup"
```

26.4. ARM Platforms: HF and EL

There are two main flavors of executable on ARM: HF (Hard Float) binaries, and EL (EABI Little Endian) binaries. These two families are not compatible at all. The compatibility of a given ARM platform with one of these two families depends on the hardware and on the OS build. ArmHL and ArmEL compatibility problems are quite difficult to detect. Most of the time, the OS itself is unable to make a difference between an HF and an EL executable and will return meaningless messages when you try to use the wrong type of binary.

All pre-compiled Yoctopuce binaries are provided in both formats, as two separate ArmHF et ArmEL executables. If you do not know what family your ARM platform belongs to, just try one executable from each family.

26.5. Powered module but invisible for the OS

If your Yocto-Display-ePaper-C is connected by USB, if its blue led is on, but if the operating system cannot see the module, check that you are using a true USB cable with data wires, and not a charging cable. Charging cables have only power wires.

26.6. Another process named xxx is already using yAPI

If when initializing the Yoctopuce API, you obtain the *"Another process named xxx is already using yAPI"* error message, it means that another application is already using Yoctopuce USB modules. On a single machine only one process can access Yoctopuce modules by USB at a time. You can easily work around this limitation by using VirtualHub and the network mode ⁴.

26.7. Disconnections, erratic behavior

If your Yocto-Display-ePaper-C behaves erratically and/or disconnects itself from the USB bus without apparent reason, check that it is correctly powered. Avoid cables with a length above 2 meters. If needed, insert a powered USB hub ^{5 6}.

⁴ see: <http://www.yoctopuce.com/EN/article/error-message-another-process-is-already-using-yapi>

⁵ see: <http://www.yoctopuce.com/EN/article/usb-cables-size-matters>

⁶ see: <http://www.yoctopuce.com/EN/article/how-many-usb-devices-can-you-connect>

26.8. After a failed firmware update, the device stopped working

If a firmware update of your Yocto-Display-ePaper-C fails, it is possible that the module is no longer working. If this is the case, plug in your module while holding down the Yocto-Button. The Yocto-LED should light up brightly and remain steady. Release the button. Your Yocto-Display-ePaper-C should then appear at the bottom of the VirtualHub user interface as a module waiting to be flashed. This operation also reverts the module to its factory configuration.

26.9. The web interface shows errors after a firmware update

After an update, the windows corresponding to Yocto-Display-ePaper-C in the VirtualHub user interface report errors. This might be a bug, but it is more likely that your web browser has cached part of the interface code from the previous firmware. Perform a *shift-reload* or clear your browser cache and everything should be back to normal.

26.10. Registering VirtualHub disconnects another instance

If, when performing a call to `RegisterHub()` with a VirtualHub address, another previously registered VirtualHub disconnects, make sure the machine running these VirtualHubs do not have the same *Hostname*. Same *Hostname* can happen very easily when the operating system is installed from a monolithic image, Raspberry Pi are the best example. The Yoctopuce API uses serial numbers to communicate with devices and VirtualHub serial numbers are created on the fly based the *hostname* of the machine running VirtualHub.

26.11. Dropped commands

If, after sending a bunch of commands to a Yoctopuce device, you are under the impression that the last ones have been ignored, a typical example is a quick and dirty program meant to configure a device, make sure you used a `YAPI.FreeAPI()` at the end of the program. Commands are sent to Yoctopuce modules asynchronously thanks to a background thread. When the main program terminates, that thread is killed no matter if some command are left to be sent. However `API.FreeAPI()` waits until there is no more command to send before freeing the API resources and returning.

26.12. Damaged device

Yoctopuce strives to reduce the production of electronic waste. If you believe that your Yocto-Display-ePaper-C is not working anymore, start by contacting Yoctopuce support by e-mail to diagnose the failure. Even if you know that the device was damaged by mistake, Yoctopuce engineers might be able to repair it, and thus avoid creating electronic waste.



Waste Electrical and Electronic Equipment (WEEE) If you really want to get rid of your Yocto-Display-ePaper-C, do not throw it away in a trash bin but bring it to your local WEEE recycling point. In this way, it will be disposed properly by a specialized WEEE recycling center.



27. Characteristics

You can find below a summary of the main technical characteristics of your Yocto-Display-ePaper-C module.

Product ID	EPAPER1C
Hardware release [†]	
USB connector	USB-C
Width	20 mm
Length	50 mm
Weight	5 g
Protection class, according to IEC 61140	class III
Normal operating temperature	5...40 °C
Extended operating temperature [‡]	-40..85 °C
RoHS compliance	RoHS III (2011/65/UE+2015/863)
USB Vendor ID	0x24E0
USB Device ID	0x00F9
Suggested enclosure	N/A
Harmonized tariff code	9032.9000
Made in	Switzerland

[†] These specifications are for the current hardware revision. Specifications for earlier revisions may differ.

[‡] The extended temperature range is defined based on components specifications and has been tested during a limited duration (1h). When using the device in harsh environments for a long period of time, we strongly advise to run extensive tests before going to production.



A4

Scale
2:1
Echelle