QRscan2PLC

TUTORIAL

Version 2.1.1

Matteo Moretto

matteomoretto.it Software Solution

05/02/2022

QRscan2PLC - Principle of operation

The application allows you to connect your mobile device (smartphone, tablet) to a PLC device or to an MQTT Broker Server and define interfacing screens with its data, allowing it to be viewed and set up like a classic HMI system.

The interface screens defined are assigned to a QR code (or barcode) with certain characteristics of length or content (presence of a certain string).

Access to the interface screens will be obtained by scanning the corresponding QR code (or barcode) using your mobile device.

Therefore, the operations that the user can carry out will be the following:

a Connect your mobile device (smartphone, tablet) to a PLC device or to an MQTT broker server like MQTT client in the Wifi network.

b Define different types of QR code (or barcode) based on their characteristics of length or content (presence of a specific string).

c Build the interface screens with objects that will allow you to read and write information to the PLC, or in the case of connection to an MQTT server, they will allow you to subscribe data and publish data to other MQTT clients.

d Assign the defined interface screens to a certain type of QR code (or barcode) defined.

e Read the codes. If the code corresponds to one of those defined, the corrisponding interface screen will be displayed in order to consult the desired data and perform the data setting operations on the PLC or on the MQTT broker server. Through the proposed functions it will be possible to obtain data read from the code and set them directly to the PLC in a specific memory area or publish these data to the defined MQTT broker server so that they can be received by other MQTT clients.

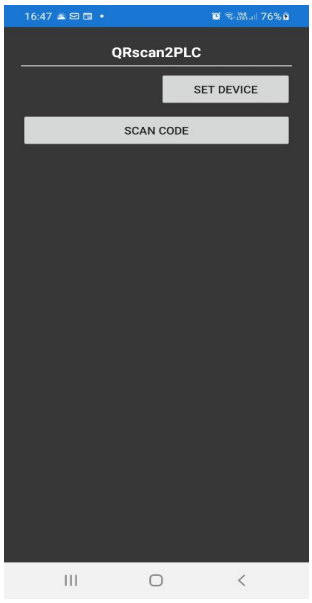
f The code reader used in this application is able to read different types of QR code and barcode.

The application allows you to communicate with PLC Siemens S7-300 / 400, S7-1200 / 1500 PLC models or to any MQTT broker server via TCP connection.

INDEX

1 First start-up of the application

When the application is started, the following screen appears

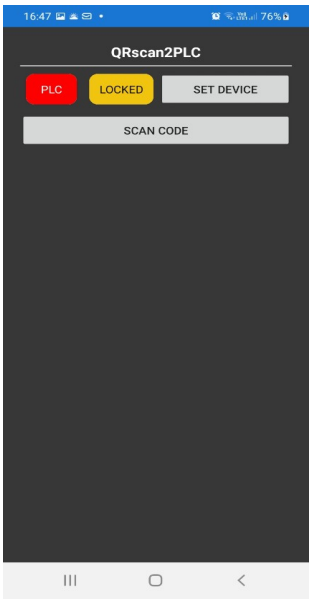


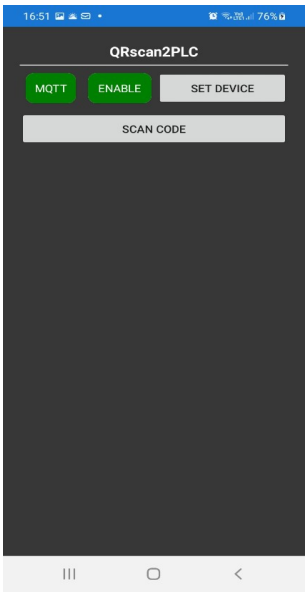
At the first start-up, only the following buttons are displayed:

- **SET DEVICE**: Allows you to access the page for selecting the desired configuration.
- **SCAN CODE**: Allows you to activate the code reader function.

It will therefore be necessary to define and select an interface configuration to the PLC or MQTT broker server by accessing the SET DEVICE page.

Once the desired configuration has been selected, the page will appear as follows





In addition to the SET DEVICE and SCAN CODE buttons, two new information is displayed:

- **PLC/MQTT**: It allows to know the connection status to the PLC or MQTT server. It can be green (Connection OK) or red (Connection Error).
- **ENABLE:** It corresponds to the status relating to the bit reserved for enabling the write functions to the PLC or publish data to MQTT server. If the bit is true, the writing ENABLE will be displayed with a green background and the data writing functions to the PLC/MQTT server will be enabled. If the bit is false, LOCKED will be displayed with a yellow background and the writing functions will be disabled. In the interface screens where data writing elements to the PLC/MQTT server are defined (buttons,  input fields), if writing is disabled, a yellow "padlock" is displayed.

2 Selection and definition of a configuration

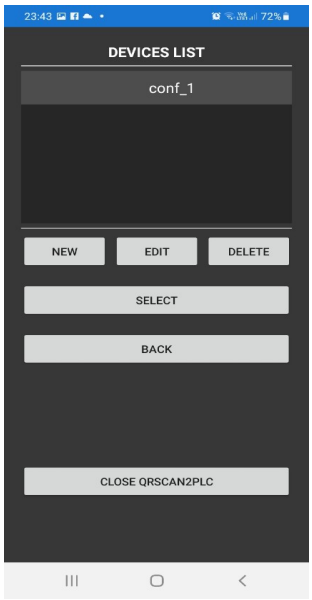
Configuration is the most important part of the application and ensures its operation according to your needs.

In the configuration, the application user defines:

- The information for connecting the mobile device to the PLC or MQTT broker server in Wifi (IP address, etc.).
- The address of the bit (or topic for MQTT) through which, based on its value (True, False), the data writing functions to the PLC/MQTT server will be enabled.
- The different types of code.
- The interface screens with the various elements that will allow you to read and write the information to the PLC or subscribe/publish data to MQTT server.
- The association between the types of code and the interface screens.

2.1 Configuration selection page.

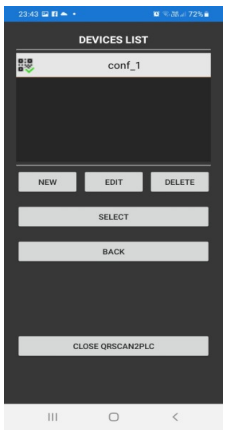
Press the SET DEVICE button from the main page to access the first page of the configuration section.



The defined configurations are displayed in the DEVICES LIST section.
The NEW, EDIT, DELETE buttons allow respectively to create, edit and delete a configuration from the list.
The SELECT button allows you to select the desired configuration for the process.
The BACK button allows you to return to the main page.
The CLOSE QRSCAN2PLC button allows you to close the application.

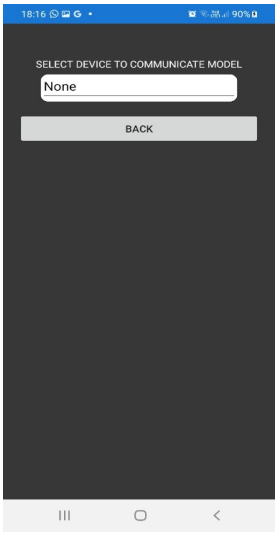
To select a configuration for the process steps, press on the desired configuration in the list and then press the SELECT button.
The following image will be displayed next to the name of the selected configuration

Once the desired configuration has been selected, press the BACK button to return to the main page and the configuration will be immediately active.



2.2 Definition of a new configuration

From the configuration selection page, by pressing the NEW key you access where you will have to select the device to interface with, PLC or MQTT Server.

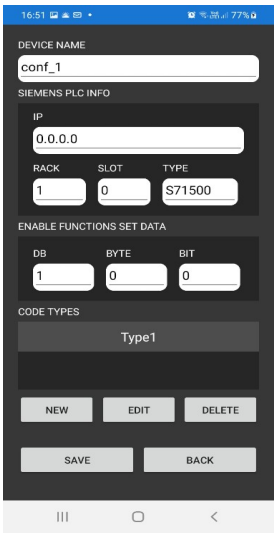


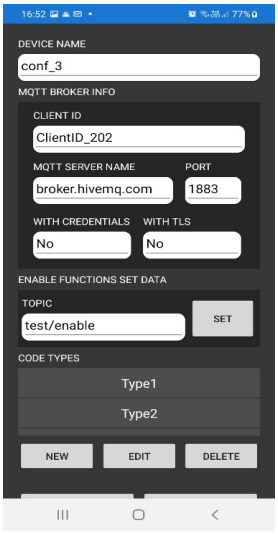
Once the desired device (PLC / MQTT server) has been selected, its configuration page is displayed.
In the section relating to the definition of the data relating to a configuration, the compilation of the information on the following pages will be proposed in succession:

- The page relating to the general data (configuration name) and to the connection data to the PLC or to MQTT broker server and to the desired code types.
- The page relating to the configuration data of the code type (length, substrings present in the code, etc.) and to the list of data to be displayed in the interface screen.
- The page relating to the type of object to be displayed in the interface screen (button, set value, bargraph, etc.) and the corresponding data type (boolean, integer, real, string) with its communication address.

2.2.1 Page for setting the configuration name, connection data and code types

The first screen is the following.





The configuration name is defined in the DEVICE NAME field. Initially a default name is proposed which can be replaced with the desired name.

Caution(*)

The configuration name must be unique.

In the PLC INFO/MQTT BROKER INFO section, the information for the connection to the PLC device or to MQTT broker server is defined.
In the ENABLE FUNCTIONS SET DATA section, indicate the address of the bit (or the topic for MQTT server) that will have the function of enabling the writing of data to the PLC or MQTT server in the interface screen.
The CODE TYPES section displays the defined code types.

Caution(*)

When defining the types of code it must be kept in mind that at the time of scanning the first type of the list that satisfies the conditions is considered. For example, let's consider that we have defined two types of code. The first must be 10 characters long and the second must have the substring “test” in position two. If at the time of scanning a code 10 characters long and with the substring "test" in position two is detected, the system will display the screen with the interface information corresponding to the first type of code as it will be the first that satisfies the conditions.

The NEW - EDIT - DELETE buttons respectively allow the definition of a new type of code, the editing of an existing type and the deletion of a type. To edit and delete a type, select it from the list and confirm the desired operation.
The SAVE button allows you to save the changes made to the data.
The BACK button allows you to return to the previous page.

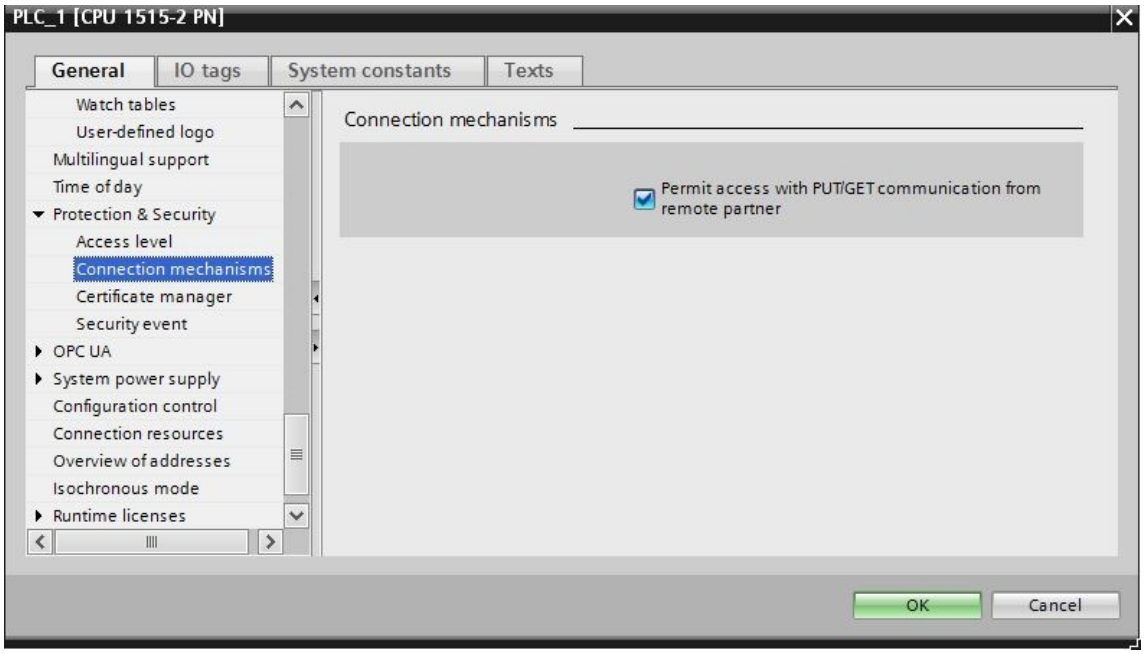
Connection to Siemens PLC

The connection to the siemens PLC requires the definition of the following fields:

- IP : TCP / IP address related to the PLC.
- RACK
- SLOT
- TYPE: It is the type of Siemens PLC. The following types are proposed:
  - S71500
  - S71200
  - S7400
  - S7300

  For PLC types S7 1500 and 1200 indicate RACK 0 - SLOT 1.

In the PLC program, set the connection parameters as shown in the following image.



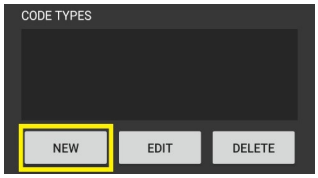
Connection to MQTT broker server

The connection to an MQTT broker server requires the definition of the following parameters:

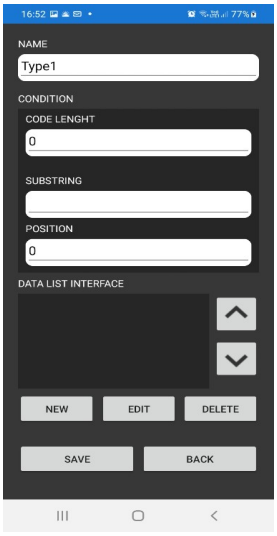
- CLIENT ID : Define an identifier of your mobile device as an MQTT client. By default, the application offers a client ID that can be customized. The important thing is that it is unique in the MQTT network to which your MQTT client will be connected.
- MQTT SERVER NAME: Indicate the name or IP address of the MQTT broker server to connect to.
- PORT: Indicate the port of the TCP connection. By default, port 1883 is proposed.
- WITH CREDENTIALS: Indicate if the connection to the MQTT broker server requires user name and password. If so, it will be proposed to insert them.
- WITH TLS: Indicate whether a secure TCP connection (TLS) is required to connect to the MQTT broker server.

2.2.2 Information page relating to the type of code.

From the first configuration page, in the CODE TYPES section, press the NEW button to create a new type of code



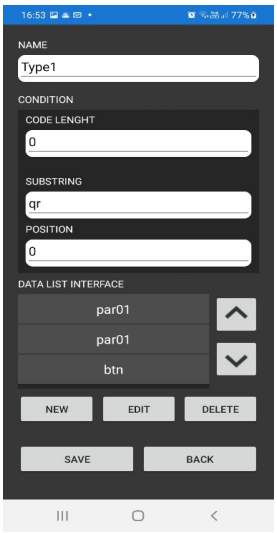
You access the following page



In the NAME field indicate the name of the code type. This will be displayed as the title of the interface data screen.
In the CONDITION section indicate the validity conditions relating to the scanned code which are the following:

- CODE LENGHT: Length of the scanned code string.
- SUBSTRING: Presence of a substring in the scanned code string.
- POSITION: Starting position of the SUBSTRING substring in the scanned code string. If 0 is indicated, the system will check for the presence of the substring without considering its starting position.

It is possible that only one of the two conditions is considered. If you want to consider only the condition relating to the length, it is sufficient not to indicate any substring in the SUBSTRING header. If you want to consider only the presence of the substring SUBSTRING it is sufficient to indicate 0 in the CODE LENGHT head.



The DATA LIST INTERFACE section indicates the list of information corresponding to the interface screen that will be displayed if the code scan satisfies the conditions relating to the type of code. The succession of data in the list will correspond to the display of the information in the interface screen.

The arrow buttons allow you to change the position of the data in the list.

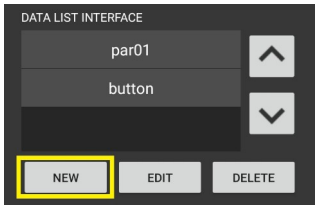
The NEW - EDIT - DELETE buttons allow respectively to create a new element to be displayed on the screen, to edit and delete an element from the list.

Caution(*)

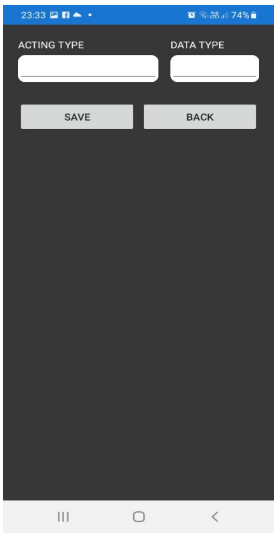
In the data interface screen that appears, if the corresponding code is valid, only the first 5 objects of the DATA LIST INTERFACE list will be displayed.

2.2.3 Information page relating to the elements to be represented in the interface screen.

From the page for defining the parameters relating to the code type, under the DATA LIST INTERFACE section, press the NEW button to define a new data to be represented in the interface screen.



You access the following page



The user is asked to select one of the information from the following lists:

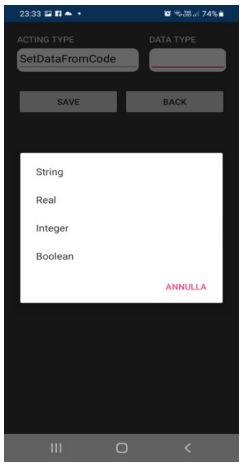
- ACTING TYPE: This is the type of object that will be displayed on the interface screen and that will allow you to perform either a data writing operation to the PLC or MQTT server (button, set value, etc.) or a data reading operation from the PLC or MQTT server (display value, bargraph, etc.).
- DATA TYPE: It is the type of data that will be written to the PLC/MQTT server or read by the PLC/MQTT server based on the ACTING TYPE selected.

Once the ACTING TYPE and DATA TYPE have been correctly selected, the data to be completed relating to the selected options will be displayed on the screen

For all types of ACTING TYPE proposed, the following general information is displayed:
- NAME: The name of the data that will be displayed in the DATA LIST INTERFACE list
- DESCRIPTION: The description that will be displayed on the PLC interface screen.

Depending on the type of ACTING TYPE and DATA TYPE selected, the relevant information will be displayed to be completed in the sections:
- ACTING DATA
- COMMUNICATION ADDRESS

As regards DATA TYPES, four types are proposed:
- BOOLEAN (True, False)
- INTEGER
- REAL
- STRING



Communication address related to the Siemens PLC

To read the data relating to the Siemens PLC it will be necessary to indicate the number of the DB, the number of the byte (DBB) and, depending on whether the type is BOOLEAN or STRING, it will be necessary to indicate the number of the bit (Bit) and the length of the string (Lenght).

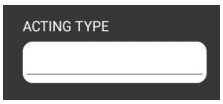
Communication address related to the MQTT broker server

To configure the topic related to reading (subscribing) or writing (publishing) data to the configured MQTT server, the following section is indicated.

You are asked to indicate the topic and confirm the entry of the data with the SET button.

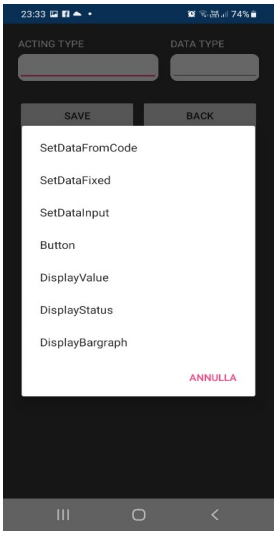
2.2.4 Acting Types for reading and writing information to the PLC/MQTT server

In the page for defining the new data to be represented in the interface screen, you are asked to select an ACTING TYPE, that is the type of object that will allow you to read or write information in the PLC/MQTT server.



You are prompted to select one of the following ACTING TYPE:

- BUTTON: Used to display a button for setting or toggle (set / reset) of a bit.
- DISPLAY VALUE: Used to display a display field of a value read by the PLC/MQTT server.
- DISPLAY STATUS: Used to display a text corresponding to an integer value read by the PLC.
- SET DATA INPUT: Used to display an input field to write a value to the PLC/MQTT server.
- BARGRAPH DISPLAY: Used to display a bargraph relating to a value read by the PLC/MQTT server.
- SET DATA FROM CODE: Allows you to select a portion of the string from the code read and write it to the PLC/MQTT server.
- SET DATA FIXED: Used to write a fixed value to the PLC/MQTT server.



In the following sub-chapters the ACTING TYPE types and the parameters to be defined for their representation will be described in detail.

Button

The Acting Type BUTTON allows you to perform a writing operation of a Boolean value to the PLC/MQTT server.

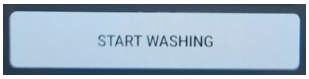
It is possible to select only Boolean as the Data Type for the Acting Type BUTTON.

When the Acting type BUTTON (and the Data Type Boolean) is selected, the following section of parameters is displayed.

In the LABEL field, set the message that will be indicated in the button on the interface screen.
In the MODE field you are asked to select the operating mode of the button which can be:

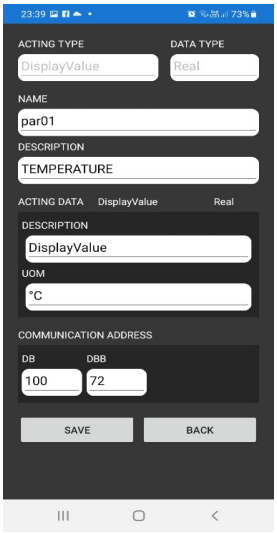
- SetBit: The bit set in the address indicated in the COMMUNICATION ADDRESS area is set to True.
- ToggleBit: The bit set in the address indicated in the COMMUNICATION ADDRESS area is set to TRUE or FALSE based on its current value.

Below is the image of the button as it appears on the interface screen.

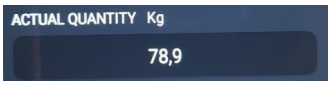


Display value

The acting type DISPLAY VALUE allows you to view a value of any of the proposed types (Boolean, Integer, Real, String) in the interface screen.
When the Acting type DISPLAY VALUE is selected, the following parameter section is displayed.



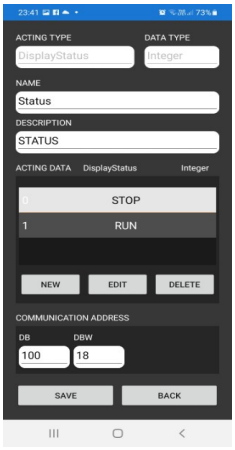
In the DESCRIPTION field indicate the description that will be displayed on the interface screen.
In the UOM field indicate the unit of measurement that will also be displayed on the interface screen.
Both fields can be empty.
Below is the image of the VALUE DISPLAY as it appears in the interface screen.



Display status

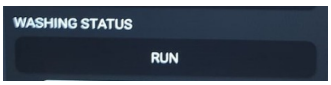
The acting type DISPLAY STATUS allows you to associate a description to an integer value read by the PLC/MQTT server that will be represented in the interface screen.
It is possible to select only Integer as Data Type for the Acting Type DISPLAY STATUS.

When the Acting type DISPLAY STATUS is selected, the following parameter section is displayed.



The list of integer values associated with a description that will appear in the interface screen is displayed.
The NEW - EDIT - DELETE buttons allow respectively to create, edit and delete a description from the list.
When NEW is pressed, the following screen appears

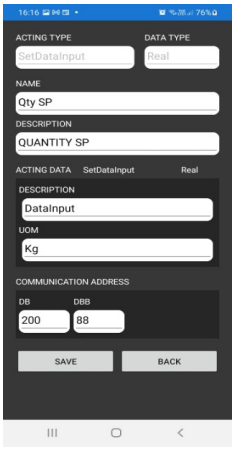
In the VALUE field, indicate the value that will be associated with the description indicated in the DESCRIPTION field. Pressing the CONFIRM button confirms the entry and returns to the previous screen.
Below is the image of the STATUS DISPLAY as it appears on the interface screen.



Set data input

The Acting Type SET DATA INPUT allows you to view a value entry field in the interface screen depending on the type set in the Data Type field.
Boolean cannot be selected as the Data Type.

When the Acting type SET DATA INPUT is selected, the following parameter section is displayed.



In the DESCRIPTION field indicate the description that will be displayed on the interface screen.
In the UOM field indicate the unit of measurement that will also be displayed on the interface screen.
Both fields can be empty.
Below is the image of the SET DATA INPUT as it appears in the interface screen.

When the value to be written in the PLC/MQTT server is set, it is necessary to confirm by pressing the SET key.

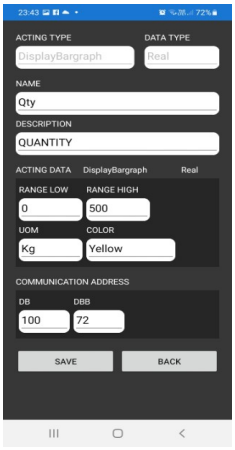
If the writing was successful, the image appears in the object ✔

If the writing was not successful, the image appears in the object ✘

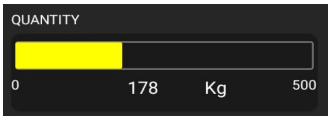
Display Bargraph

The Acting Type DISPLAY BARGRAPH allows you to view a bargraph associated with a REAL type value read by the PLC/MQTT server.
It is possible to select only Real as Data Type for the Acting Type DISPLAY BARGRAPH.

When the Acting type DISPLAY BARGRAPH is selected, the following parameter section is displayed.



In the RANGE LOW and RANGE HIGH fields set the range of the bargraph.
In the UOM field indicate the unit of measurement that will also be displayed on the interface screen. The field is optional.
In the COLOR field, select the color of the bargraph.
Below is the image of the BARGRAPH DISPLAY as it appears in the interface screen.

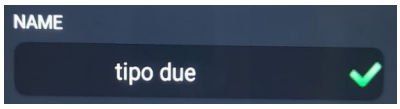


Set data from code

The Acting Type SET DATA FROM CODE allows you to extract a portion of string from the code read, convert it according to the type indicated in the DATA TYPE field and write it in the PLC address or MQTT server topic indicated in the COMMUNICATION ADDRESS section.

When the Acting type SET DATA FROM CODE is selected, the following parameter section is displayed.

In the POSITION field indicate the starting position of the portion of the string to be extracted from the code read. The first position is position 0.
In the LENGHT field indicate the length of the substring to be extracted.
The VISIBLE field allows you to set the display of information or not in the interface screen.
Below is the image of the SET DATA FROM CODE as it appears in the interface screen to the PLC, if the VISIBLE field is set to True.



When the code is scanned and the type of code containing the Acting Type SET DATA FROM CODE is recognized, the value to be written in the PLC/MQTT server is detected by the code read and written directly in the PLC/MQTT server.

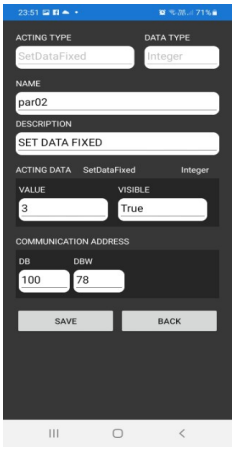
If the writing was successful, the image appears in the object ✔

If the writing was not successful, the image appears in the object ✘

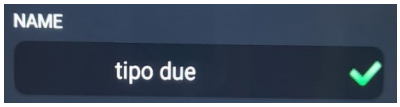
Set data fixed

The SET DATA FIXED Acting Type allows you to directly write a value in the PLC or MQTT server at the address indicated in the COMMUNICATION ADDRESS area.

When the Acting type SET DATA FIXED is selected, the following section of parameters is displayed.



In the VALUE field indicate the value that will be written to the PLC/MQTT server.
The VISIBLE field allows you to set the display of information or not in the interface screen.
Below is the image of the SET DATA FIXED as it appears in the interface screen, if the VISIBLE field is set to True.



When the code is scanned and the type of code containing the Acting Type SET DATA FIXED is recognized, the value indicated in the VALUE field is written directly into the PLC or MQTT server.

If the writing was successful, the image appears in the object ✔

If the writing was not successful, the image appears in the object ✘

2.3 Supported Code Types

The code reader used in this application is able to read most types of QR codes and different types of barcodes.

Some types of supported barcodes are listed below.

CODE 128

CODE-2of5 Interleaved

CODE-39

CODE-93

GS1-128 (UCC/EAN-128)

EAN-8

EAN-13

EAN-14

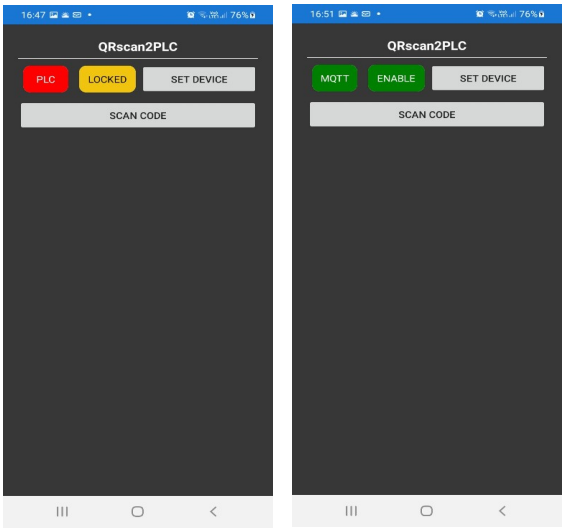
UPC-A

UPC-E

It is possible to see other types of barcodes by consulting the site https://barcode.tec-it.com/it . However, not all types proposed on the site are supported.

3 Scan a code and display the interface screen

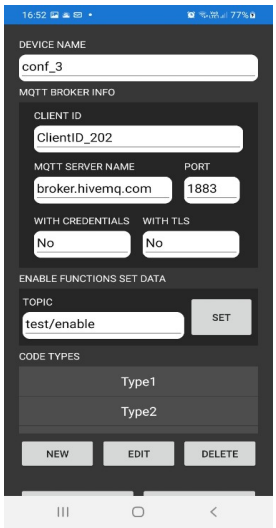
Once a configuration has been defined and selected, the main application screen will appear as follows.



Suggestion(*)

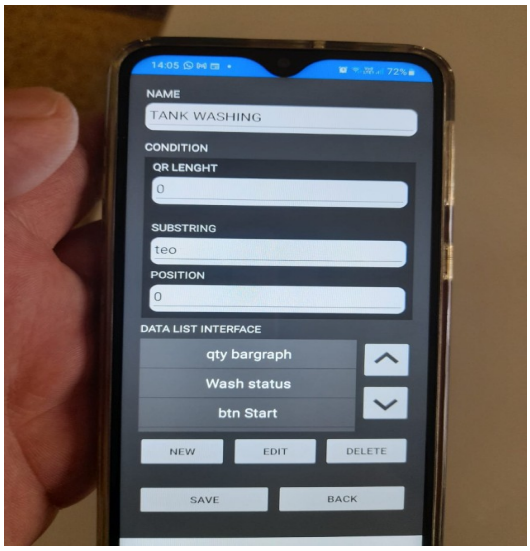
It is possible to test the connection to an MQTT server broker using a free service such as the one offered by https://www.hivemq.com/public-mqtt-broker/.

On the configuration page relating to the connection to the MQTT broker server, indicate the settings as shown in the following figure



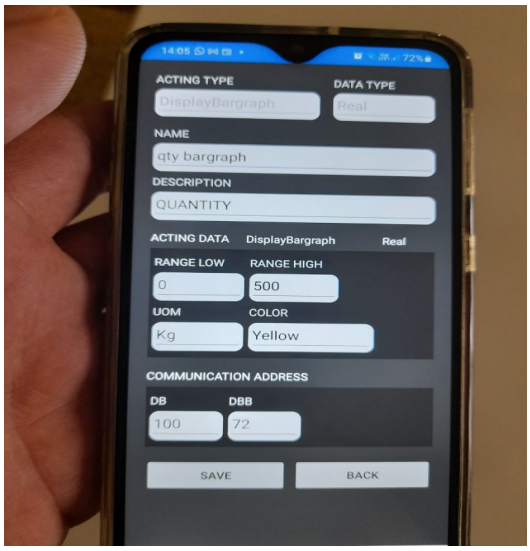
At this point you are ready to scan the QR Code and display the relative interface screen.
Let's try to generate a QR code that contains a certain substring, for example "teo".
To generate a QR code you can use the following service https://it.qr-code-generator.com for example.
Let's create a QR Code like this

In the configuration section we define a QR Code type that contains the substring "teo" and we call it for example TANK WASHING (the name is indifferent).

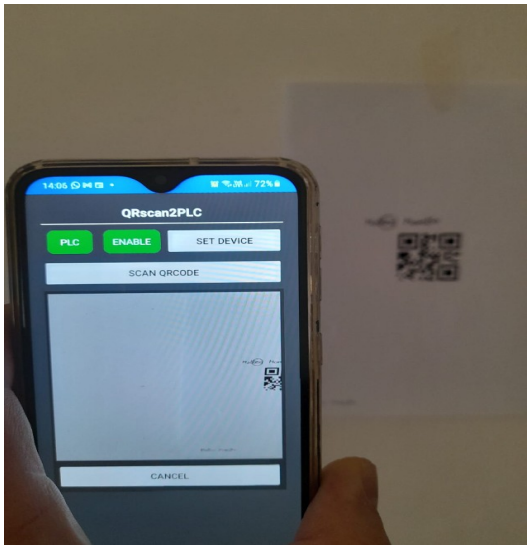


In the DATA LIST INTERFACE we create four Actings. In this case, the following are created:

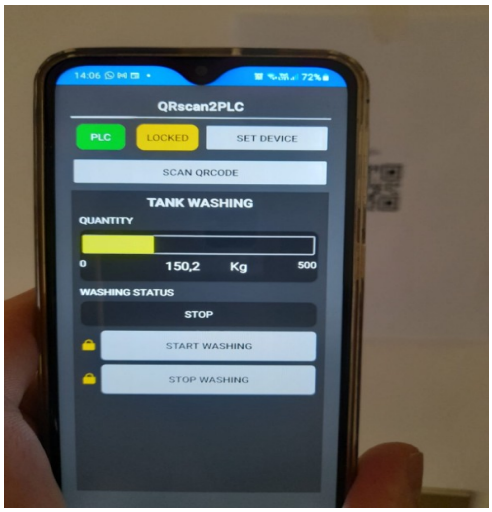
- A BARGRAPH DISPLAY
- A STATUS DISPLAY
- Two BUTTONS (START WASHING, STOP WASHING)

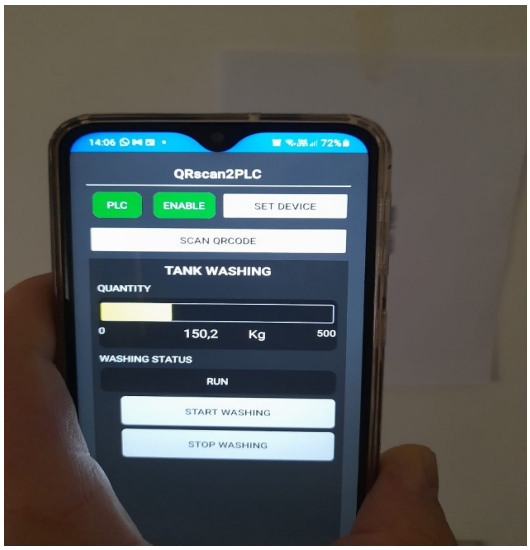


Let's save and go back to the main screen.
At this point, press the SCAN CODE button and try to scan the generated QR Code as shown in the image.



If the QR Code containing the substring "teo" is recognized, the interface screen will be displayed with the desired data in the order indicated in the DATA LIST INTERFACE list.





As we can see, the padlock appears next to the buttons indicating that the write operation cannot be performed because the Enable bit is False (LOCKED). By forcing the Enable bit to TRUE from the PLC or subscribe topic for MQTT server, the padlock disappears and the information can be written to the PLC/MQTT server.