ISR Mini-explorer

News

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Warnings

Warning!	The robots available are expensive and belong to a limited series. Therefore, please handle with care and observe the following warnings: ● Watch carefully the robot's movement. ○ In motion above a table, take special care to avoid the robot falling to the ground. ○ Avoid the robot collision with rigid immovable objects. ● Don't lean the robot or the programmer against metallic objects. Both have exposed circuits than can cause a short circuit and damage the robot or the programmer. ● Always hold the robot by the bottom board to prevent that the boards disjoint.

Quick start guide

Mbed account creation (IDE/online compiler)

- To create a *mbed* account go to the signup webpage, click Signup and follow the instructions, filling the form.
- Confirm your *mbed* account following the link sent to your email.

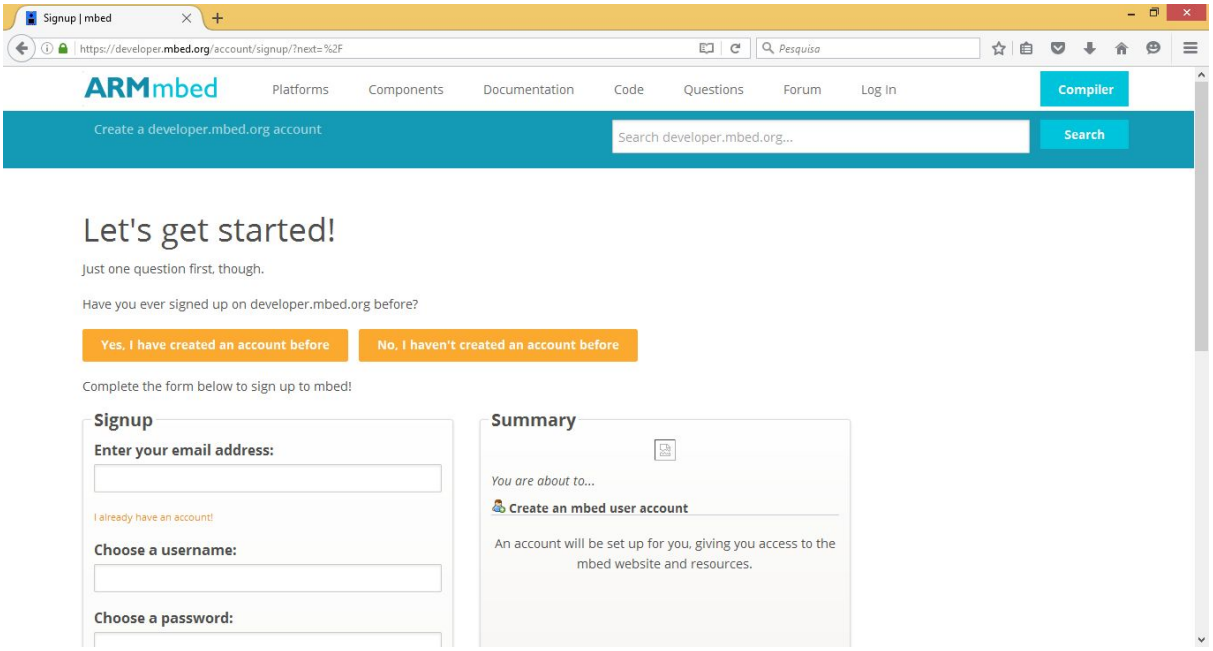


Figure 1. Account creation webpage in mbed platform.

Connections for robot programming

- Connect the computer to the Internet (the Internet connection will allow Windows to get updated drivers if necessary).
- Connect one end of the mini USB cable to the computer.
- Connect the other end to the robot *programmer* as illustrated in the following figure.

Warning! Notice in the figure the correct port for programming.

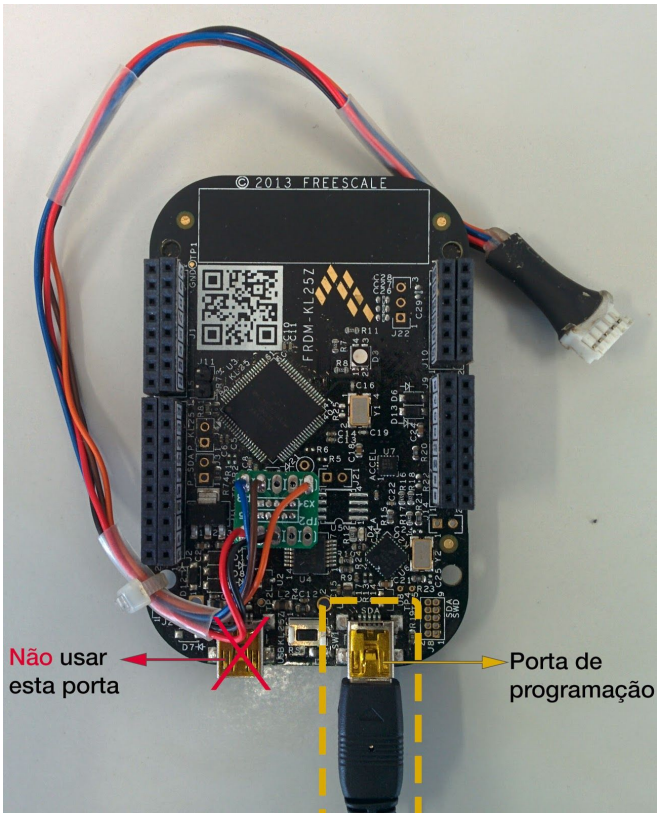


Figure 2. Robot programmer with indication of programming port.

- **The first time you establish the connection**, Windows will install *programmer* drivers. For that reason, wait the conclusion of drivers installation. You can see the installation progress clicking the icon in the taskbar.

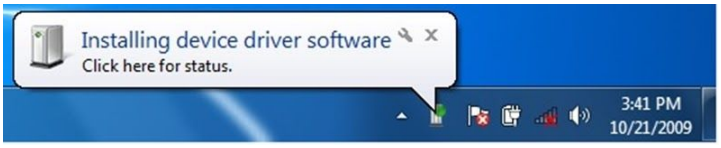


Figure 3. Drivers installation progress icon.

- After drivers installation finish, appears in "This PC"/"My Computer" a disc called MBED as shown in the following figure. If the disk not appears, read the related topic in the troubleshooting section.

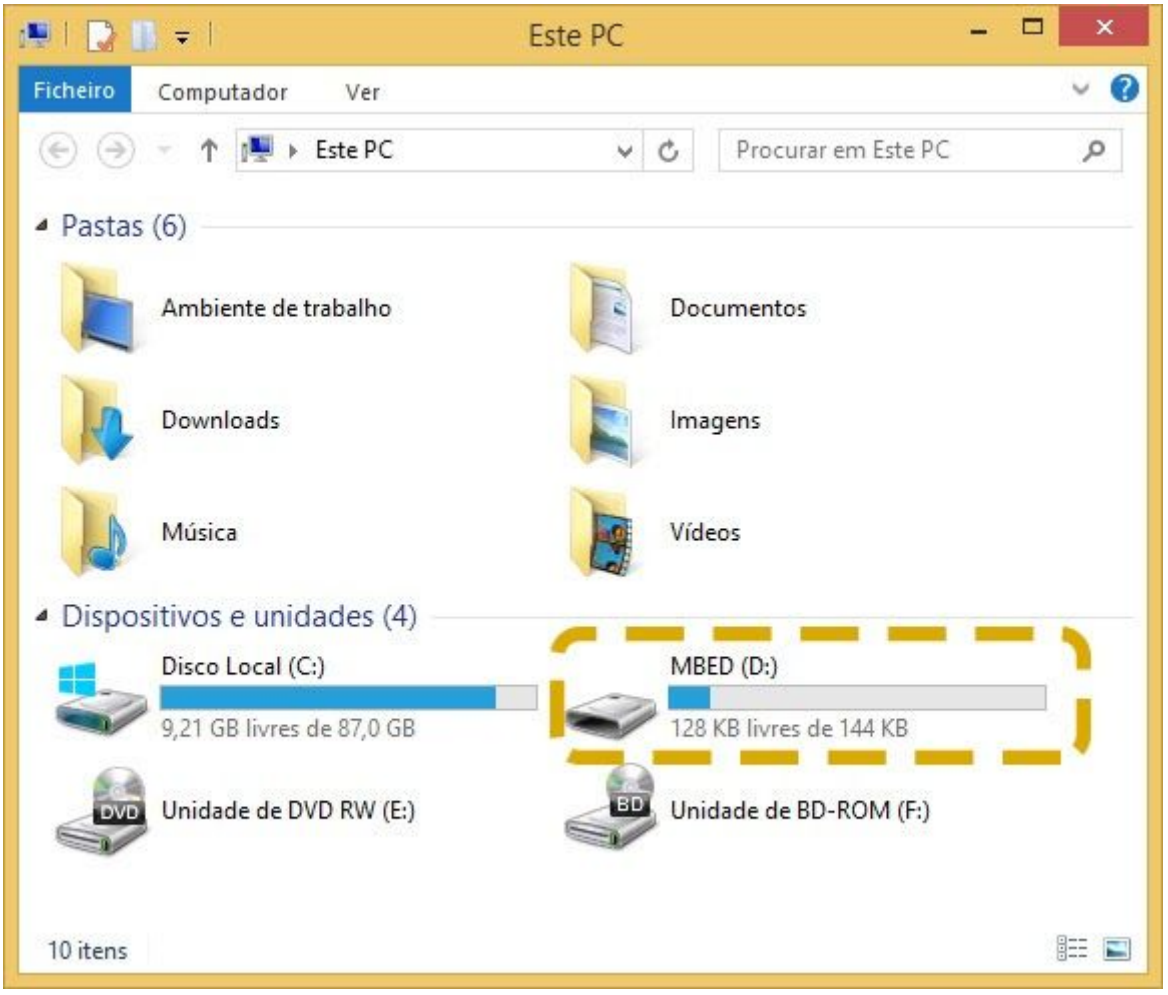


Figure 4. Mbed disk taht appears after connecting the programmer to the computer.

- If you use **Linux** or **Mac OS**, the configuration is also automatic.
- Then, connect the cable identified in the figure to the robot.

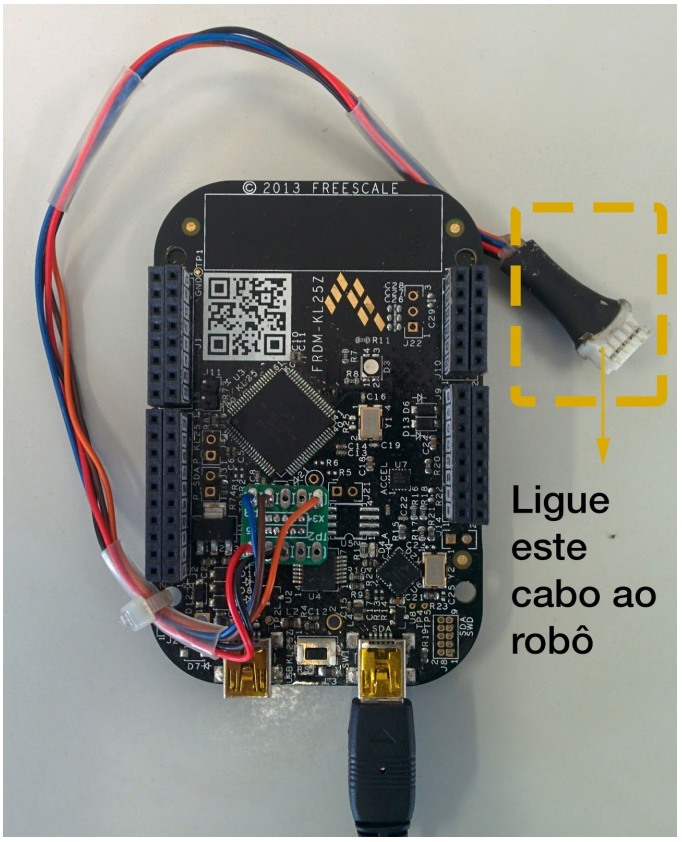


Figure 5. Cable for connection of the robot to the computer.

- Turn the robot on placing the jumper shown in the following figure in ON position (center and right pin as in the figure).

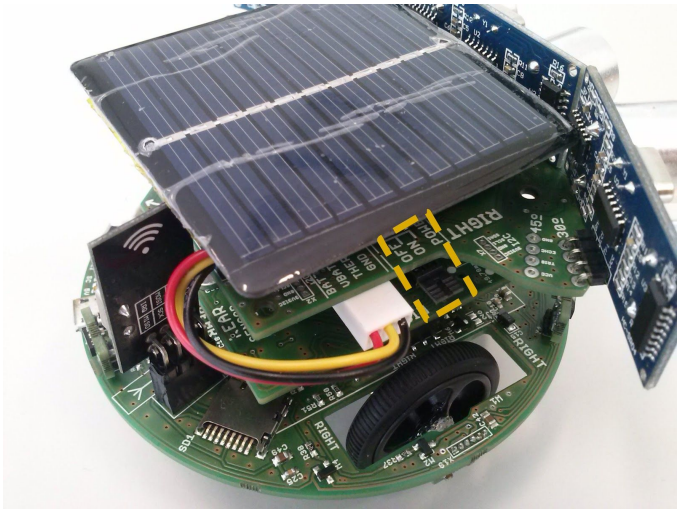


Figure 6. Jumper to turn on/off the robot highlighted on the figure.

Robot programming

- Go to compiler webpage.
- Login. if requested.
- Click on button New.

- **The first time you create a new program** will appear the message "Add Platform" to request to add the platform (see Figure 7). Follow the next procedure (it will be needed **only in the first time**):
    - Click on Add Platform. A browser window will open, showing the available platforms.
    - Select FRDM-KL25Z (see figure 8). A webpage with FRDM-KL25Z platform will appear.
    - Click on Add to your mbed Compiler button (see figure 9). The page will be updated, showing on top a message identifying the platform added.
    - Close the compiler page (previously opened) and re-open it by following this link.
    - Click on New button.

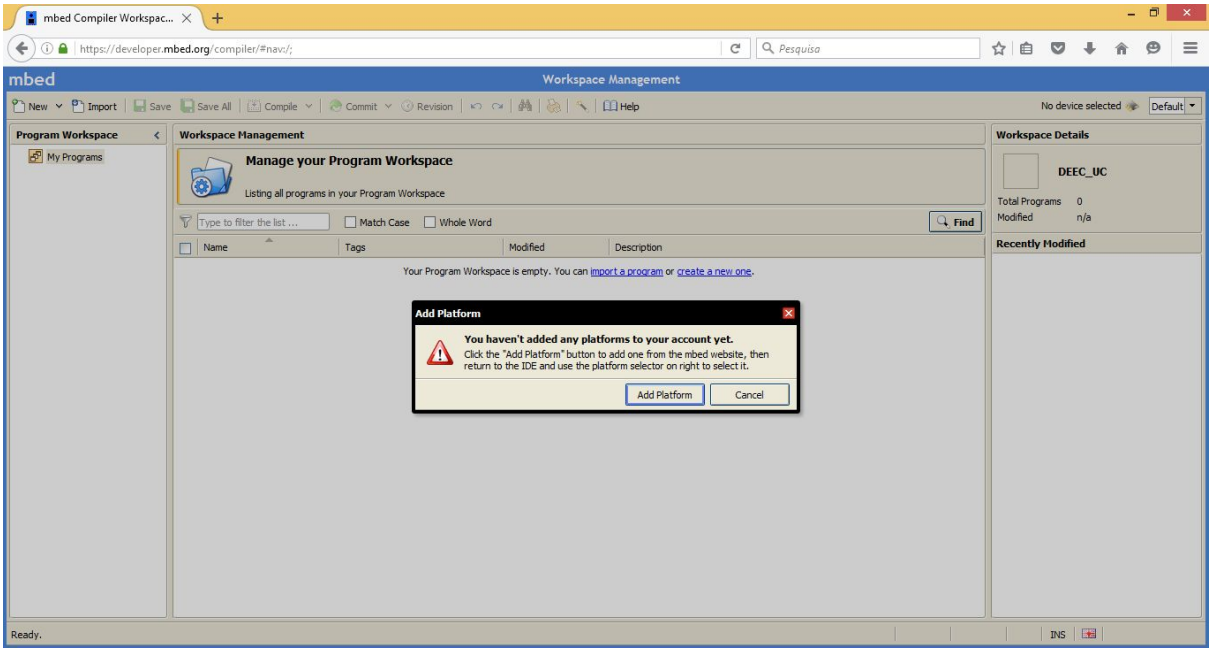


Figure 7. Message asking to add the platform.

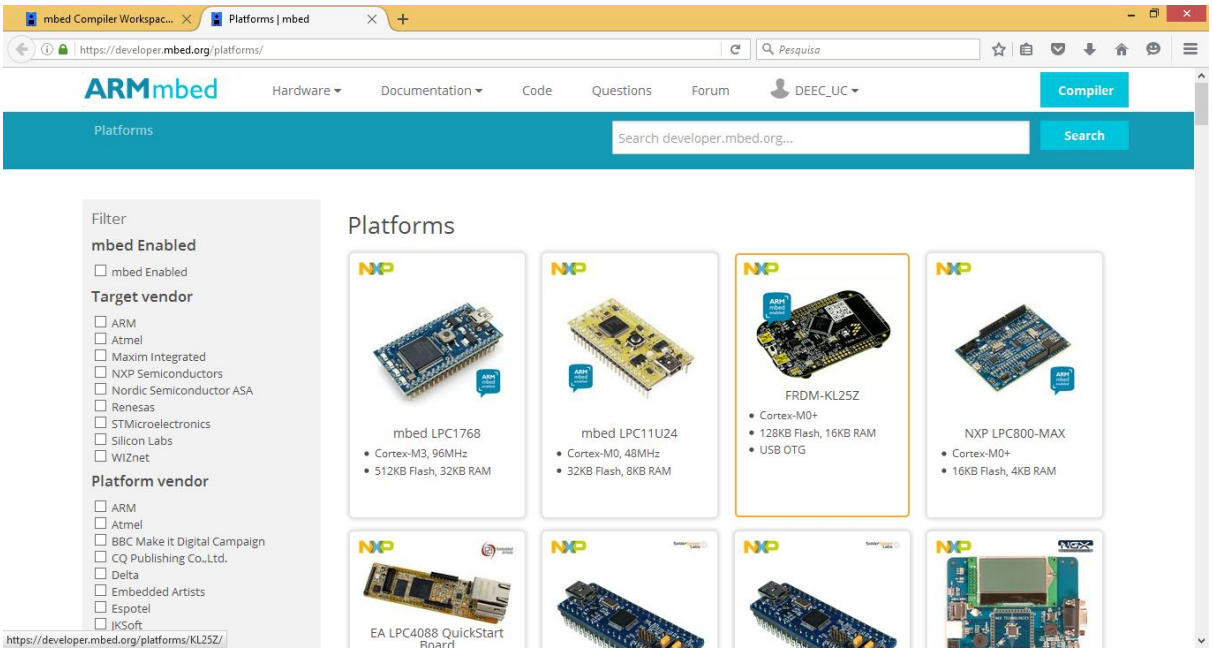


Figure 8. Webpage for selection of the platform to add (FRDM-KL25Z).

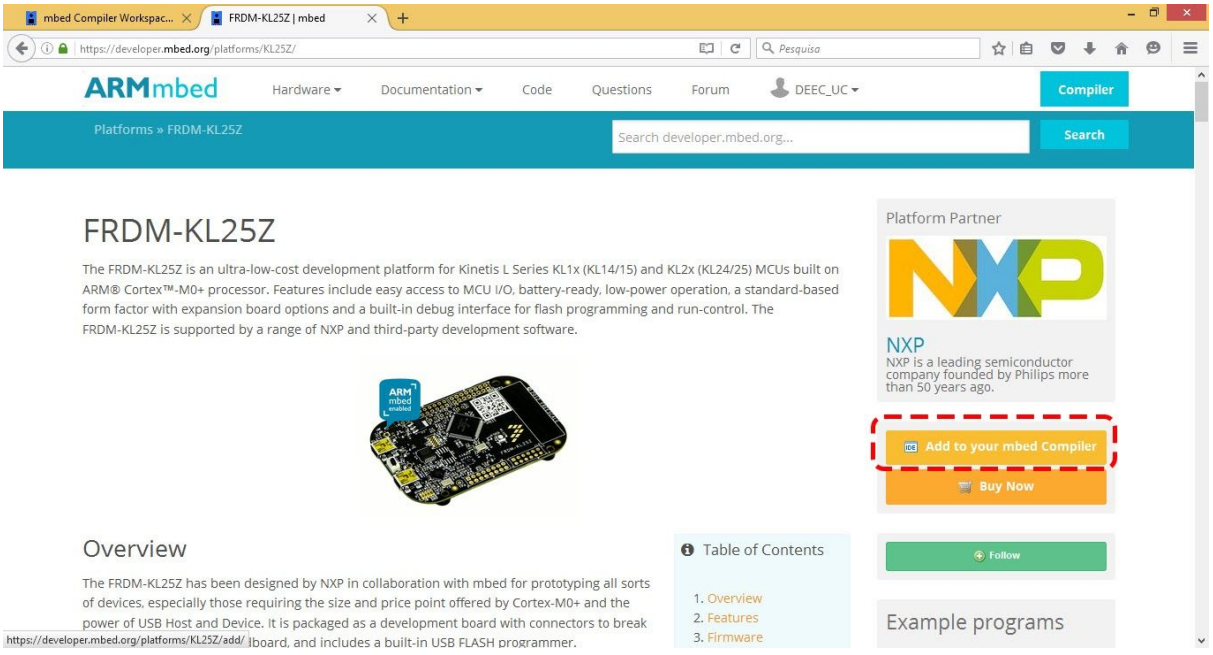


Figure 9. Adding platform webpage with the button to click highlighted.

In the following steps we resume the creation of a new program:

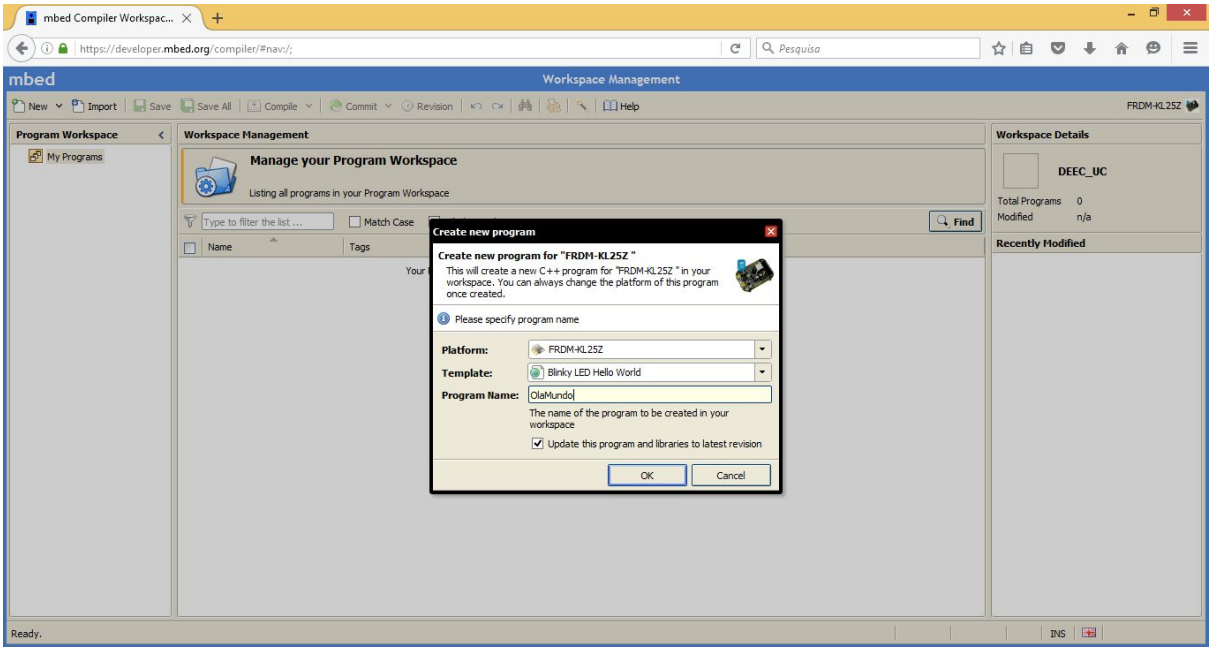


Figure 10. New program creation.

- In Platform, select FRDM-KL25Z.
- In Template, select Blinky LED Hello World.
- In Program Name, write HelloWorld.
- Click on OK button.
- Open main.cpp file and replace the code with the following one:

```
#include "mbed.h"
#include "robot.h" // Initializes the robot. This include should be used in all main.cpp!

int main() {
        initRobot();

        // Turn off all LEDs.
        q_led_red_fro = 1;  //Led Red Front
        q_led_gre_fro = 1;  //Led Green Front
        q_led_blu_fro = 1;  //Led Blue Front
        q_led_red_rea = 1;  //Led Red Rear
        q_led_gre_rea = 1;  //Led Green Rear
        q_led_blu_rea = 1;  //Led Blue Rear

        while(1) {
        q_led_red_fro = 1;
        wait(0.5);
        q_led_red_fro = 0;
        wait(0.5);
        }
}
```

- Click on Import button located on the toolbar.
- Select the Libraries tab and, on search box ("Search criteria ...") write *ISR_Mini-explorer* and click on Search button (see next figure).

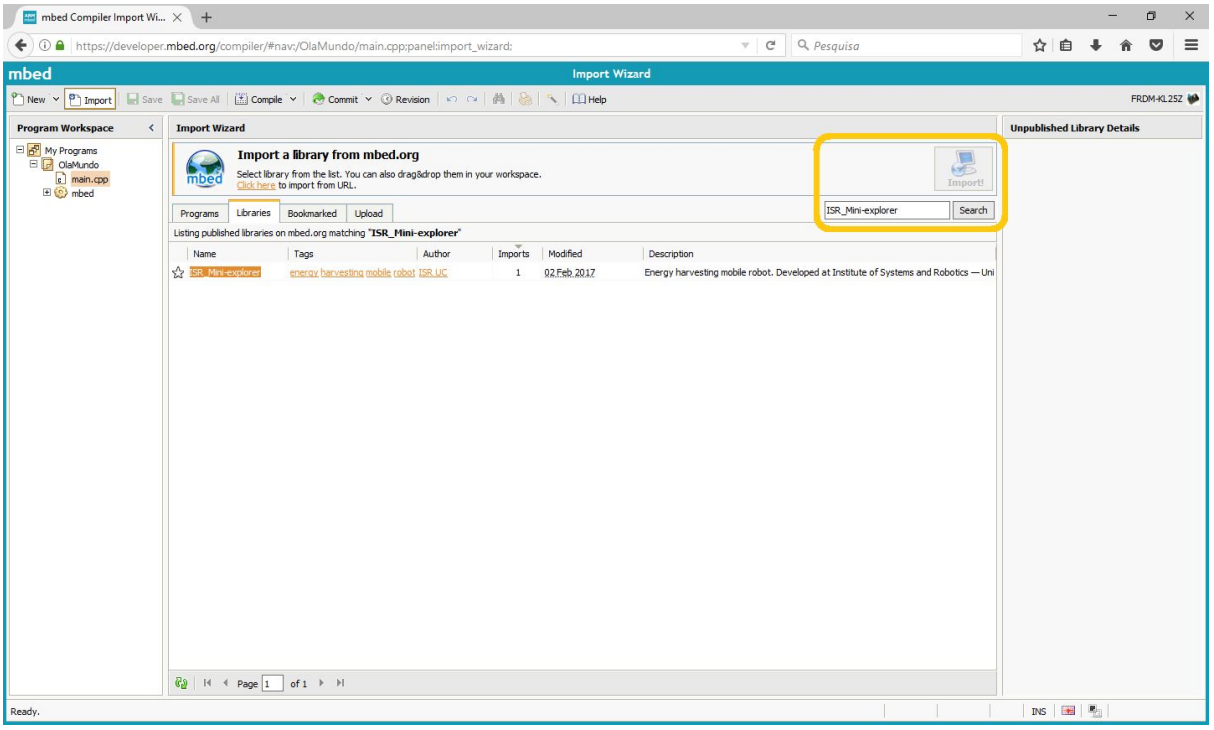


Figure 11. Robot library importation.

- Click on Import! button (see figure 11). It will show a window for **library importation**. Select Import As: Library and click on Import button.
- If you didn't turned on the robot on the jumper, turn it on following the instructions above.
- On toolbar, click on Compile button. A download will start.
- Copy the downloaded file to the MBED disk that appears in "This PC"/"My Computer" (see next figure).

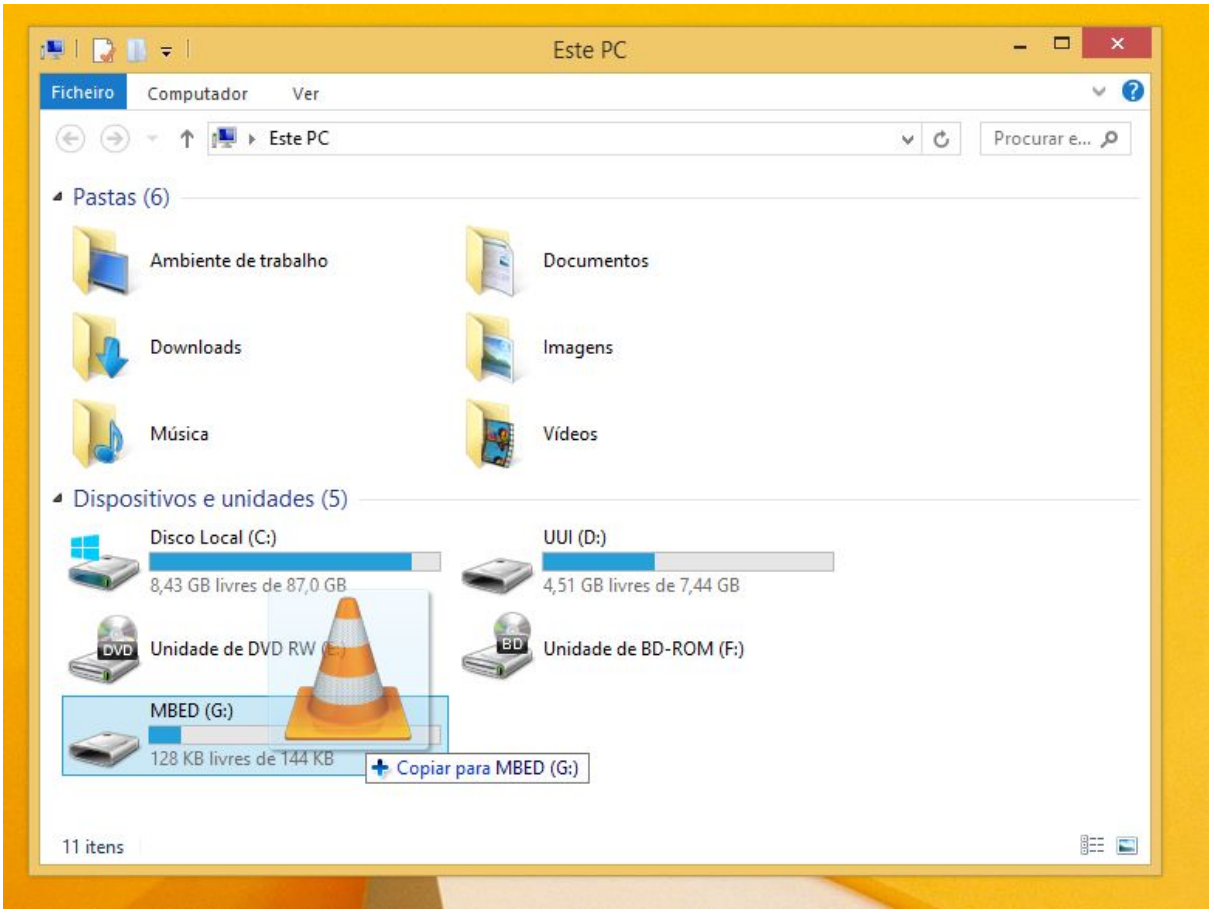


Figure 12. Robot programming through firmware copy to the MBED disk.

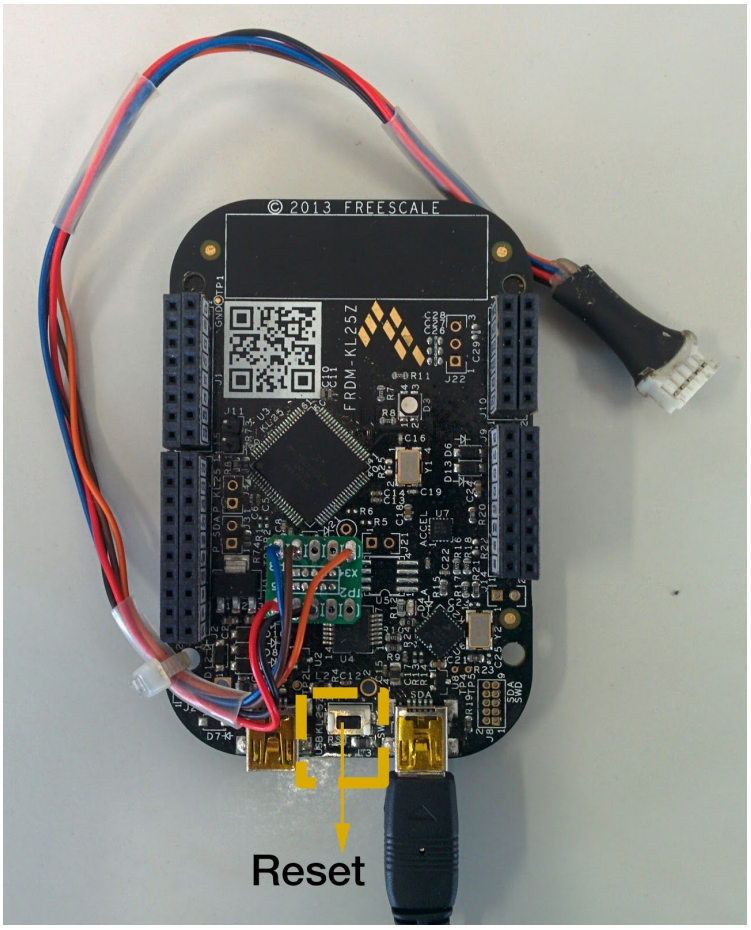
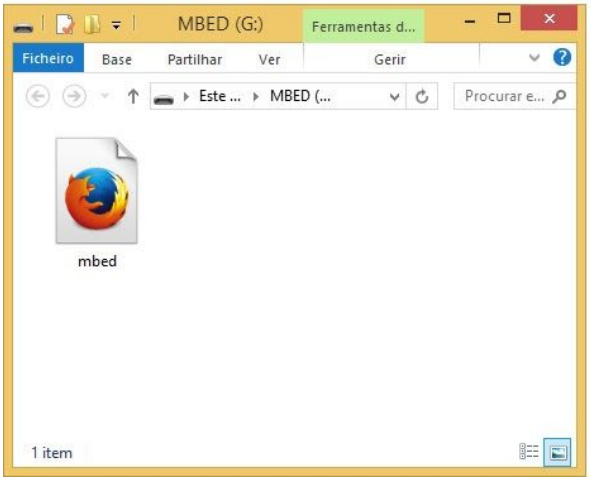


Figure 13. Programmer Reset button.

- MBED disk window will close and re-open automatically. If programming fails, it will appear on the MBED disk a text file named fail.txt (see Figure 14).
- The LED next to programmer USB port will flash while the computer uploads the program to the robot. When the LED stop flashing, press the Reset button on the programmer to load the program on the robot (see Figure 13 to locate the Reset button).

Programação bem sucedida:



Programação falhada:

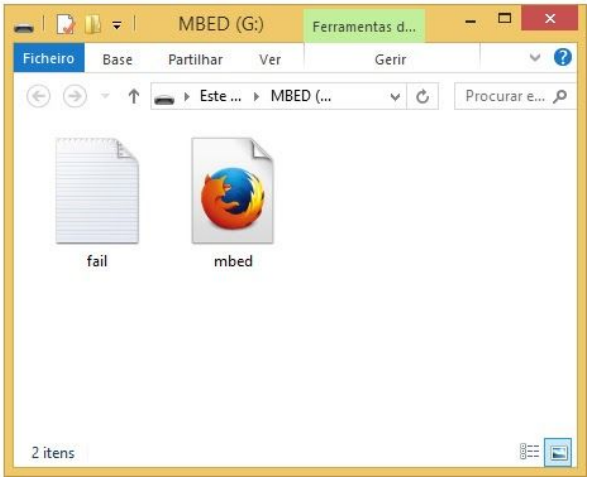


Figure 14. MBED window on programming fail and programming success situations.

If successful, the front LED on robot base board will flash in red.
Next, it is suggested to explore the support library to use the motors and the encoders:

- Robot library functions reference (developed by Fernando Pais).
- Library manual (by Fernando Pais)

Battery charging

To charge the robot's battery plug one end of the mini USB cable directly to the robot and the other end to the computer. Thus, you can use the robot powered directly from the PC and charge the battery simultaneously.

Troubleshooting

Refer to section *K.3 Questões Frequentes* (page 162) of Pedro Santos' master's thesis.

References

To learn more about the robot, software library or mbed platform read the following references.

- Robot
  - Drawing with sonars positioning on robot. **[NEW]**
  - Master's thesis of Pedro Santos (portuguese version) – low resolution version (5 MB) | high resolution version (28 MB)
  - Pedro Santos' thesis summary (english version)
- Software library
  - Software library manual developed (by Fernando Pais).
  - Software library functions reference (by Fernando Pais).
- mbed
  - mbed compiler presentation.
  - Serial port programming and communication instructions for FRDM-KL25Z bord on Windows, Linux and Mac OS. It is suggested the reading of documents related with *links* on the mentioned webpage. **Note:** FRDM-KL25Z board (named on this document "programmer") is demonstration board for MKL25Z128VLK4 microcontroller. This microcontroller is present in the "programmer" and in the robot too.
- **Outdated** files/links (this versions are **outdated** and is advised to import the software library through mbed):
  - Software library developed by Fernando Pais
  - Software library with extra functions for radio communication and for infrared proximity sensors.

Annex I - Robot microcontroller pin connections list

For more information refer to Master's thesis of Pedro Santos.

Tabela H.1: Lista de entradas digitais do microcontrolador;

Function	Pin	Note	Module
Encoder Right Direction	PTB8	Normal Input	Base
Encoder Left Direction	PTB9	Normal Input	Base
Interrupt MPU9250	PTA15	External Interrupt	Sensor
MICRO SD Card Detect	PTC16	Normal Input	Base
Interrupt ISL29125 Color S.	PTA16	External Interrupt	Base
Fail MPPT Signal	PTE5	Normal Input	Solar
USB Voltage detect	PTB10	Normal Input	Base
Supercap State Charger	PTB19	Normal Input	Base
Li-ion State Charger	PTB18	Normal Input	Base
Interrupt Comp Micro F L	PTD7	External Interrupt	Sensor
Interrupt Comp Micro F R	PTD6	External Interrupt	Sensor
Interrupt Comp Micro R C	PTD5	External Interrupt	Sensor

Tabela H.2: Lista de saídas digitais do microcontrolador;

Function	Pin	Note	Module
PWM Enable Motor Right	PTE20	Pwm	Base
Phase Motor Right	PTE4	Normal Output	Base
Nano Sleep Motor Right	PTE3	Normal Output	Base
PWM Enable Motor Left	PTE31	Pwm	Base
Phase Motor Left	PTA17	Normal Output	Base
Nano Sleep Motor Left	PTB11	Normal Output	Base
Power Enable i2c FET P	PTE2	Normal Output	Base
Power enable Micro	PTA14	Normal Output	Sensor
Led Red Front	PTA4	Normal Output	Base
Led Green Front	PTA5	Normal Output	Base
Led Blue Front	PTA12	Normal Output	Base
Led Red Rear	PTD4	Normal Output	Base
Led Green Rear	PTA1	Normal Output	Base
Led Blue Rear	PTA2	Normal Output	Base
Power LMC555 IR COM	PTD0	Normal Output	Base
Buzzer PWM	PTE21	Pwm	Base
AS5600 Power MOSFET N	PTC6	Normal Output	Base
AS5600 Power MOSFET P	PTC5	Normal Output	Base
SPI Power MOSFET P	PTC4	Normal Output	Base
Enable MPPT Control	PTC0	Normal Output	Harvester
Boost Power Save	PTC7	Normal Output	Harvester
Reset TCA9548	PTC3	Normal Output	Base
Led white pwm	PTE29	Pwm	Base

Tabela H.3: Lista de sinais analógicos do microcontrolador;

Function	Pin	Note	Module
Encoder Left Output_AS_MR	PTC2	Analog Input 16bits	Base
Encoder Right Output_AS_ML	PTC1	Analog Input 16bits	Base
Analog microphone F L	PTB0	Analog Input 16bits	Sensor
Analog microphone F R	PTB1	Analog Input 16bits	Sensor
Analog microphone R C	PTB2	Analog Input 16bits	Sensor
Temperature Battery	PTB3	Analog Input 16bits	Harvester
Dac_Comparator MIC	PTE30	Analog output 16bits	Sensor

Tabela H.4: Lista de sinais de comunicação do microcontrolador;

Function	Pin	Note	Module
SDA0 - BUS I2C0	PTC9	I2C0 BUS	Base
SCL0 - BUS I2C1	PTC8	I2C0 BUS	Base
SDA1 - BUS I2C1	PTC11	I2C1 BUS	All
SCL1 - BUS I2C1	PTC10	I2C1 BUS	All
MISO - BUS SPI	PTD3	SPI0 BUS	Base
MOSI - BUS SPI	PTD2	SPI0 BUS	Base
SCK - BUS SPI	PTD1	SPI0 BUS	Base
CE_NRF24L01	PTC12	CE_Spi	Base
CSN_NRF24L01	PTC13	Chip Select Spi	Base
IRQ_RF_NRF24L01	PTA13	External Interrupt	Base
CSN_MICRO_SD	PTC17	Chip Select Spi	Base
TX_UART_IR	PTE22	Uart2 Comm tx	Sensor
RX_UART_IR	PTE23	Uart2 Comm rx	Sensor
TX_UART_PC	PTE1	Uart1 Comm Rx	Base
RX_UART_PC	PTE0	Uart1 Comm Tx	Base

Tabela H.5: Lista de sinais para programação do microcontrolador;

Function	Pin	Note	Module
KL25_SWD_CLK	PTA0	Clock	Base
SWD_DIO_TGTMCU	PTA3	D_I/o	Base
RST_TGTMCU	RESET_B	Reset	Base