Lab 3: Installation of IDE and Hello World Example

COEN-4720 Embedded Systems
Cris Ababei
Dept. of Electrical and Computer Engineering, Marquette University

1. Objective

The objective of this lab is to install the STM32CubeIDE Integrated Development Environment (IDE) for STM32 and to create a first project, which will be tested on the Nucleo-64 board. Many of the details of all that is done in this lab are in the textbook used in this course [1].

2. Software Installation

Follow the instructions in Section 2.2 of the textbook to download and install STM32CubeIDE on your machine. In my case, I have downloaded and installed the Windows version, which by default got installed in:
C:\ST\STM32CubeIDE_1.10.1

Continue to follow instructions from the textbook and download and install also the STM32CubeProgrammer. It can be used to upload firmware to MCU; that can be done using either the ST-LINK interface of the Nucleo board or a separate ST-LINK programmer. In my case, I have downloaded and installed the Windows version, which by default got installed in:
C:\Program Files\STMicroelectronics\STM32Cube\STM32CubeProgrammer

At this time, the tool-chain installation is complete. Let us launch the IDE for the 1st time and create a workspace. Follow the instructions from the textbook in Section 2.3 and create a workspace called "work_sandbox".
When you launch the STM32CubeIDE you will be asked to provide a location directory for the workspace. Choose your own location where you store stuff related to this course. In my case, I selected:
M:\MARQUETTE\COEN4720_EmbeddedSystems_V2\work_sandbox

3. Hardware Used in This Course

In this course, we use primarily the STM32 Nucleo-64 development board with STM32L053R8 MCU: NUCLEO-L053R8. The board is shown in Fig.1 below. Its detailed description, manuals, and other resources can be found at the links provided in [4]. Below, there are listed some of the specifications:

MicroController Unit (MCU) features:
- STM32L053R8T6 in LQFP64 package
- ARM®32-bit **Cortex®-M0+** CPU
- 32 MHz max CPU frequency
- VDD from 1.65 V to 3.6 V
- 64 KB Flash

- 8 KB SRAM
- GPIO (51) with external interrupt capability
- 12-bit ADC with 16 channels
- 12-bit DAC with 1 channel
- RTC
- Timers (5)
- I2C (2)
- USART (3)
- SPI (2)
- USB 2.0 full-speed

Nucleo features:
- Two types of extension resources
    - Arduino Uno Revision 3 connectivity
    - STMicroelectronics Morpho extension pin headers for full access to all STM32 I/Os
- On-board ST-LINK/V2-1 debugger/programmer with SWD connector
    - Selection-mode switch to use the kit as a standalone ST-LINK/V2-1
- Flexible board power supply
    - USB VBUS or external source (3.3 V, 5 V, 7 - 12 V)
    - Power management access point
- User LED (LD2)
- Two push buttons: USER and RESET
- USB re-enumeration capability: three different interfaces supported on USB
    - Virtual Com port
    - Mass storage (USB Disk drive) for drag'n'drop programming
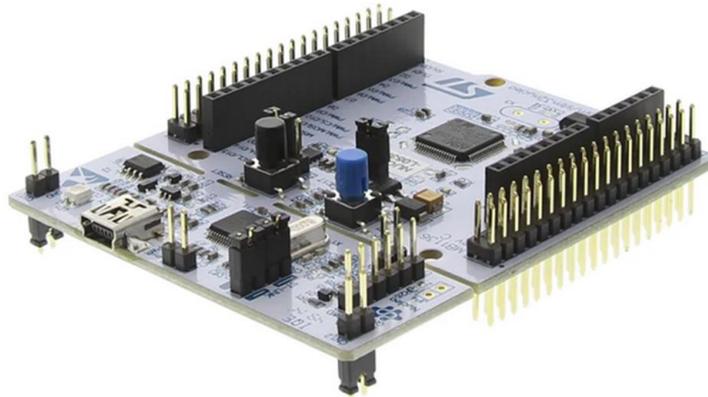   - Debug port

Figure 1: STM32 Nucleo-64 Board.

4. Example 1: Blink the Nucleo-64 Board LED2

Follow the instructions in Section 3.1 from the textbook to create the first hello-world project:

File->New->STM32 Project

When you get the Target Selection window, click on the Board Selector panel and look for the Nucleo-64 board, in the case of this course: NUCLEO-L053R8. Click next and name your empty project as **lab3_ex1**. Then, click Finish.

Because this is the 1st time we created a project, the STM32CubeIDE will take a bit longer because it needs to download the corresponding Cube Firmware Package (STM32F4 family) for the specific selected board. The package includes several important components, including:
- Hardware Abstraction Layer (HAL) for the given STM32 family.
- Middleware packages.
- Examples projects for development boards.

NOTE: Before any editing, please configure the IDE so that Tabs are inserted as 2 spaces:
- *Select Window -> Preferences*
- *Select C/C++ -> Code Style -> Formatter*
- *Create a new profile (I called it cristinel), based on the profile you prefer*
- *In the Indentation tab, select Spaces only for Tab policy - and select 2 spaces for both Tab and Indentation*
- *Click Apply and Close*

All right! Now, let's do some coding. In the Project Explorer, expand Core->Src and double-click on main.c to edit it. Inside the main function add the two lines of code as shown below:

```
while (1)
{
  /* USER CODE END WHILE */
  /* USER CODE BEGIN 3 */
  HAL_GPIO_TogglePin(LD2_GPIO_Port, LD2_Pin);
  HAL_Delay(500);
}
```

Now, compile the project: Project->Build Project
If all ok, then you should get in the Output Console finally a message of this sort:
13:51:41 Build Finished. 0 errors, 0 warnings. (took 5s.55ms)

We are now ready to download the executable that the project just built to the microcontroller. But, before doing that, we 1st need to check for latest ST-LINK Firmware and upgrade it to the latest version. Use the USB cable to connect the Nucleo-64 board to your PC. Then, do:
Help->ST-LINK Upgrade
Click in Open in Upgrade Mode, then, click on Upgrade. Upgrade should be successful and you can close that window.

Finally, let's upload the hello-world program firmware to the MCU. Launch the STM32CubeProgrammer; with the Nucleo-64 connected to the PC. ST-LINK board should be identified in the programmer's GUI. Then, click the Connect button.
Then, click Erasing & Programming icon on the left.

Then, click the Browse button and then navigate to where your file is; in my case that is:
M:\MARQUETTE\COEN4720_EmbeddedSystems_V2\work_sandbox\lab3_ex1\Debug\lab3_ex1 .elf
Check the Verify programming and Run after programming flags and click on Start Programming.
If all ok, then in the Log window at the bottom of the screen you should see messages of this sort:

```
…
15:10:00 : Verifying ...
15:10:00 : Read progress:
15:10:00 : Download verified successfully
15:10:00 : RUNNING Program ...
15:10:00 :   Address:      : 0x08000000
15:10:00 : Application is running, Please Hold on...
15:10:00 : Start operation achieved successfully
```

The green LD2 on your Nucleo-64 board should blink at rate of once per second. If that does not happen, then, please go back and debug troubleshoot the project until you get it done correctly.
Cool! You got your hello-world program done successfully! 😊

5. Lab Assignment

Note: this lab report is shorter and it is required to be written in a simpler format and not in the format discussed before (the other lab format discussed in the previous lab shall be used for all other labs, unless explicitly stated like in this case).

Read Chapter 4, "STM32CubeMX Tool", of the textbook. Write a lab report in which you shall present a summary of about 1 page (font size 11, single line spacing) of the chapter. Build your summary around two bulleted lists: one list with main takeaways and a second list with five questions you got while reading the chapter.

6. References and Credits

[1] Textbook:
Carmine Noviello, Mastering STM32 - Second Edition, 2022, Available to purchase online:
https://leanpub.com/mastering-stm32-2nd <--- Buy from
https://github.com/cnoviello/mastering-stm32-2nd <--- Code examples
[2] TM32CubeIDE as Tool-Chain for STM32, Available online: https://www.st.com/en/development-tools/stm32cubeide.html
[3] STM32CubeProgrammer software for all STM32, Available online:
https://www.st.com/en/development-tools/stm32cubeprog.html
[4] STM32 Nucleo-64 development board with STM32L053R8 MCU : NUCLEO-L053R8, Description available online:
https://www.st.com/en/evaluation-tools/nucleo-l053r8.html
https://os.mbed.com/platforms/ST-Nucleo-L053R8/