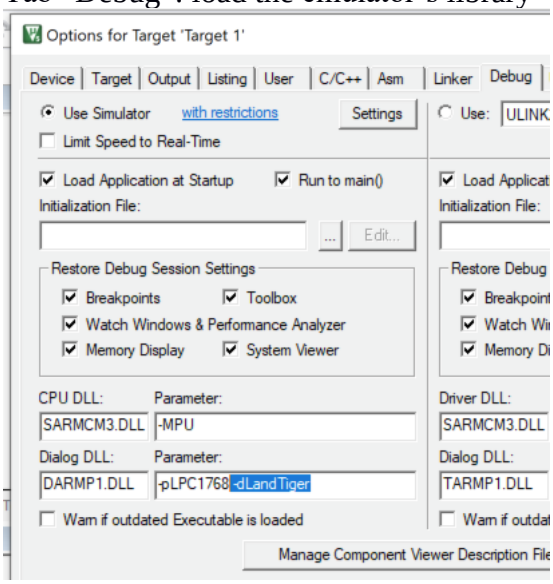
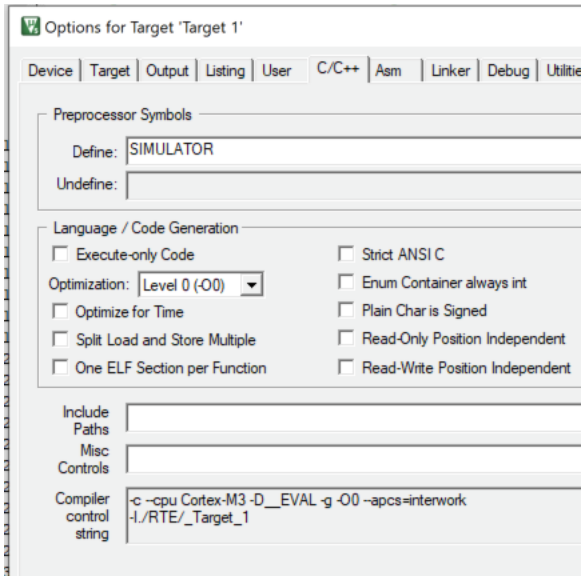
Architetture dei Sistemi di Elaborazione 02GOLOV Laboratory 9	Delivery date: Tuesday 22/12 Expected delivery of lab_09.zip must include: - zipped project folder of the exercise 1 - this lab track completed and converted to pdf format.

Solve the following problems by starting from the *sample_BUTTON_LED* project (open the file project from the uVision menu). Test the problems using the *LandTiger* emulator.
Remember to check if the emulator is enabled in the menu "Options for Target" after installing the emulator.

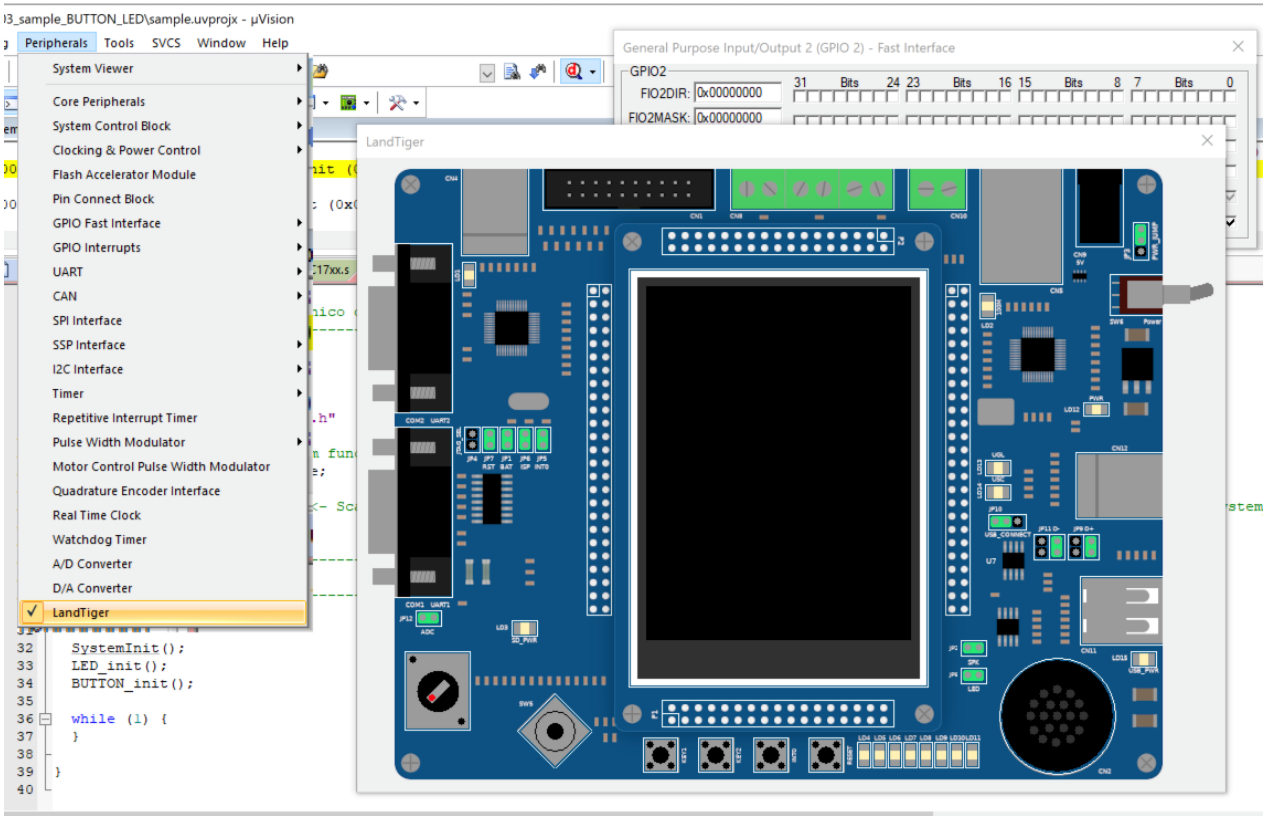
Tab "Debug": load the emulator's library



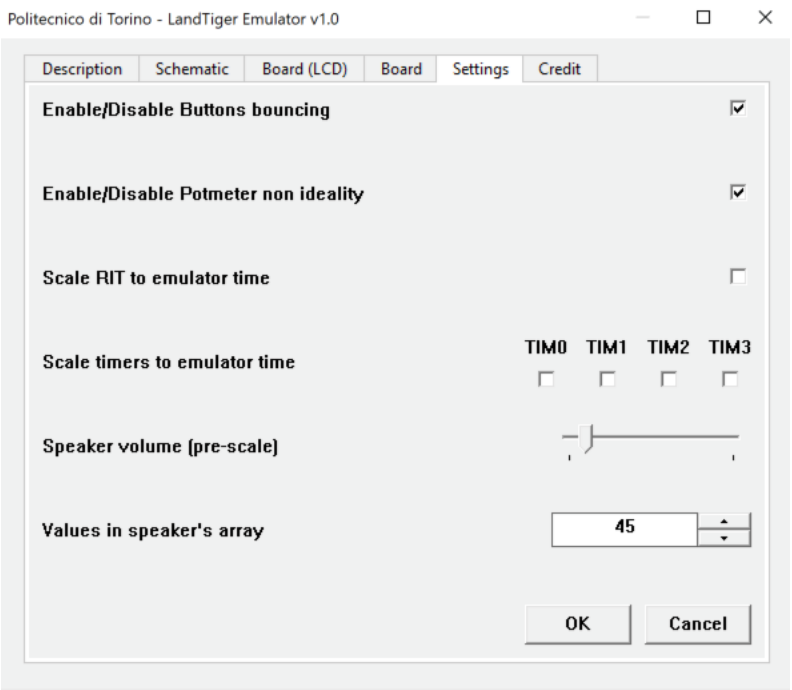
Tab "C/C++": define SIMULATOR



Once you run the debug, if the emulator is correctly installed and added to the debug option, you shall find *LandTiger* under the Peripherals menu.



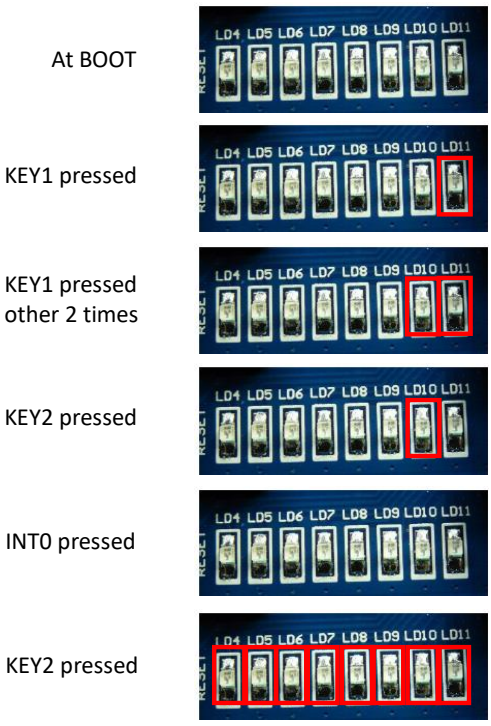
If you right-click on the board, you can access the configuration menu, where you can eventually change some default parameters (tab “Settings”)

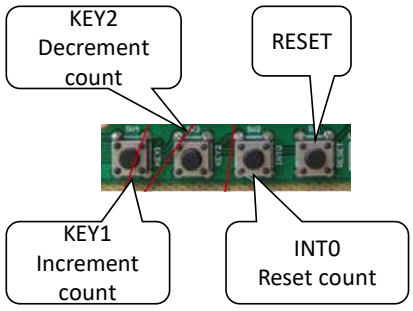


Exercise 1) Implement an 8-bit “signed counter” by using LANDTIGER board; the software permits to use buttons to update a counting value which could be either positive or negative, and the LEDs to show the current value. By first using emulation capabilities, please implement the following functionalities:

- increment a variable every time the button Key1 is pressed,
- decrement when Key2 is pressed (in case, go to negative number)
- reset the count when INT0 is pressed

LEDs are showing the current count in a binary, 2’s complement representation.





HINT: It could be useful to use a global variable in order to keep the information about turned ON LEDs. For example, using a variable called “`char led_value`”, already available in the project.

Q1: By adjusting the emulator settings, you can activate a non-ideal behavior of the buttons called "bouncing". Do you notice any different behaviour on the emulator if you enable such a bouncing setting? Please comment.

Abilitando il bouncing, a causa dei rimbalzi nel valore di tensione misurato, il sistema rileva 2, 3 o 4 pressioni del pulsante invece che 1. Introducendo un sistema di temporizzazione che controlla il valore vero dei pulsanti ogni 50 ms si potrebbe risolvere questo problema.

Q2: What happens if you act on jumpers JP5 and JP8 with respect to the default configuration?

Se JP5 è disabilitato, il pulsante INT0 viene scollegato dal microcontrollore, pertanto nessun click di quel pulsante verrà registrato.
Se JP8 è disabilitato, i LED vengono scollegati dal microcontrollore. I tasti continuano però a funzionare e ad aggiornare la variabile led_value. Riabilitando JP8, infatti, si vede che i LED assumono il valore corretto, corrispondente alla sequenza di tasti premuta.

Using the emulator, check the schematic and fill the following table.

Component	Pull-up resistor name	Pull-up resistor size
LEDs	RN3 e RN2	470 ohm
INT0	R22	10k ohm
KEY1	R25	10k ohm
KEY2	R23	10k ohm