



## BBM 434 – Embedded Systems Lab

### Lab 5 Instructions

#### Preparation

For this lab, you will need a Launchpad, a breadboard, a Nokia 5110 display, two switches, two 10K resistors, one red LED, one green LED, and two 470 $\Omega$  resistors.

#### Purpose

In this Lab, you will learn to how to interface a Nokia 5110 LCD. You will also use interrupts and measure time using SysTick.

#### System requirements

In this lab, you will implement a **Fastest Finger reaction game**. You will have to interface a Nokia Display, two switches and two LEDs.

When the game starts, both LEDs should be OFF, and the message **“GET READY”** should be first displayed on the screen for some reasonable amount of time (e.g. 3 seconds). Seeing this message, two players (RED and GREEN) will get ready to press their switches. After a random amount of time between 0 and 10 seconds, you should display the message **“PRESS!”**. Upon seeing this message, both players will aim to press the switch as soon as possible. You should capture which switch is pressed first and display the winner as well as the reaction times for both players on the Nokia screen. Whichever player wins, their LED should turn ON. The time difference between the **“PRESS!”** message and the button press should be displayed in units of milliseconds.

For example, if RED presses the switch in 361 ms and GREEN in 503 ms after the **“PRESS!”** message, your message should be something like this:

```
RED: 361 ms  
GREEN: 503 ms  
RED WINS!
```

If you observe a reaction time of less than 100 ms, you have to indicate a **false start** as it is not possible for a human to react less than 100 ms to a visual stimulus. In such case, the other player should be the winner. Similarly, if a user presses the button before the “PRESS!” message, the other user should be declared as the winner.

For example, if RED makes a false start, your message should be something like this:

```
RED: false start  
GREEN WINS!
```

## Implementation

### Nokia Screen Interfacing:

You can use “[C:\Keil v5\Labware\Lab15 SpaceInvaders\Nokia5110.c](#)” file to interface the Nokia 5110 LCD. You need to be careful about the pins to connect as it may vary among LCDs. Connect the LCD to your board using the comments at the beginning of the Nokia5110.c file. You can use the methods of the Nokia5110.c file that we describe in the lecture to display text and graphics.

### Switch Interfacing:

You have to two connect external switches to the same GPIO port other than Port F. For example, you can connect both of them to Port A. You have to distinguish among the different switches inside the ISR.

### Time measurement:

You can start the SysTick timer at the same time you display the message “PRESS!”. You can find the difference between the counter at the time the switch is pressed and reload value. Note that you also have to count the number of times that the timer expired because SysTick timer can overflow. You have to use SysTick interrupts to count the number of times the timer expired. The time difference between the “PRESS!” message and the button press should be displayed in units of milliseconds.

## What You Need to Include in Your Report

As usual, you need to include all the steps of your implementation in your report. If you include parts of your code, make sure that they are relevant to your explanations, as **you must submit the entire project with all the codes this time**, along with the written report. **Make**

sure that you explain exactly how you measure the time it takes the players to press the switches.

## How to Submit a Written Report

The deadline for the submission is **Friday 19 April 2019 until 13:45** (no further extensions will be allowed!). Submit your work through <http://submit.cs.hacettepe.edu.tr/> (submission via e-mail will not be accepted!) in the following format (**one submission per group**):

- **b<studentID>.zip**
  - **report.pdf**
  - **projectcodes.zip**