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CSE 321 Embedded Systems

11/4/2021

Fall 2021

Programmable Alarm Clock

CSE 321 Embedded Systems

Project 2

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Introduction

This is the report for the second project assigned in the class CSE 321 Embedded systems at the University at Buffalo. The goal of the project was to make a fully programmable alarm clock using a programable board and external peripherals. This report will list the features of the project, the results and how to set the project up

Specifications

The specifications are as follows:

Inputs ports:

- PB_8 and PB_9
 - These are used as the i2c channels for the LCD screen
- PC_8
 - This port will be used as the singular input port that will be connected to the first port of the 4x4 Key pad

Output ports:

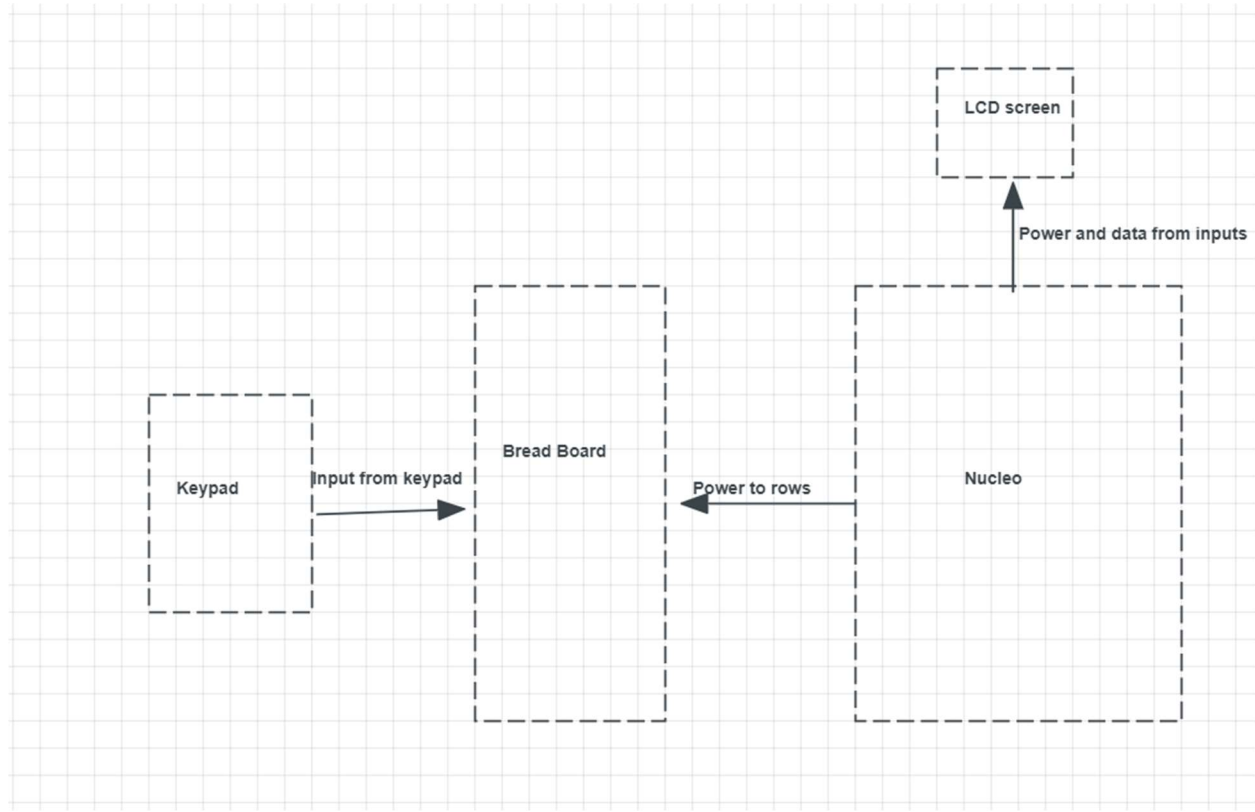
- PC_9
 - This port will power row 1
- PC_10
 - This port will power row 2
- PC_11
 - This port will power row 4

Anthony Feliciano

CSE 321 Embedded Systems

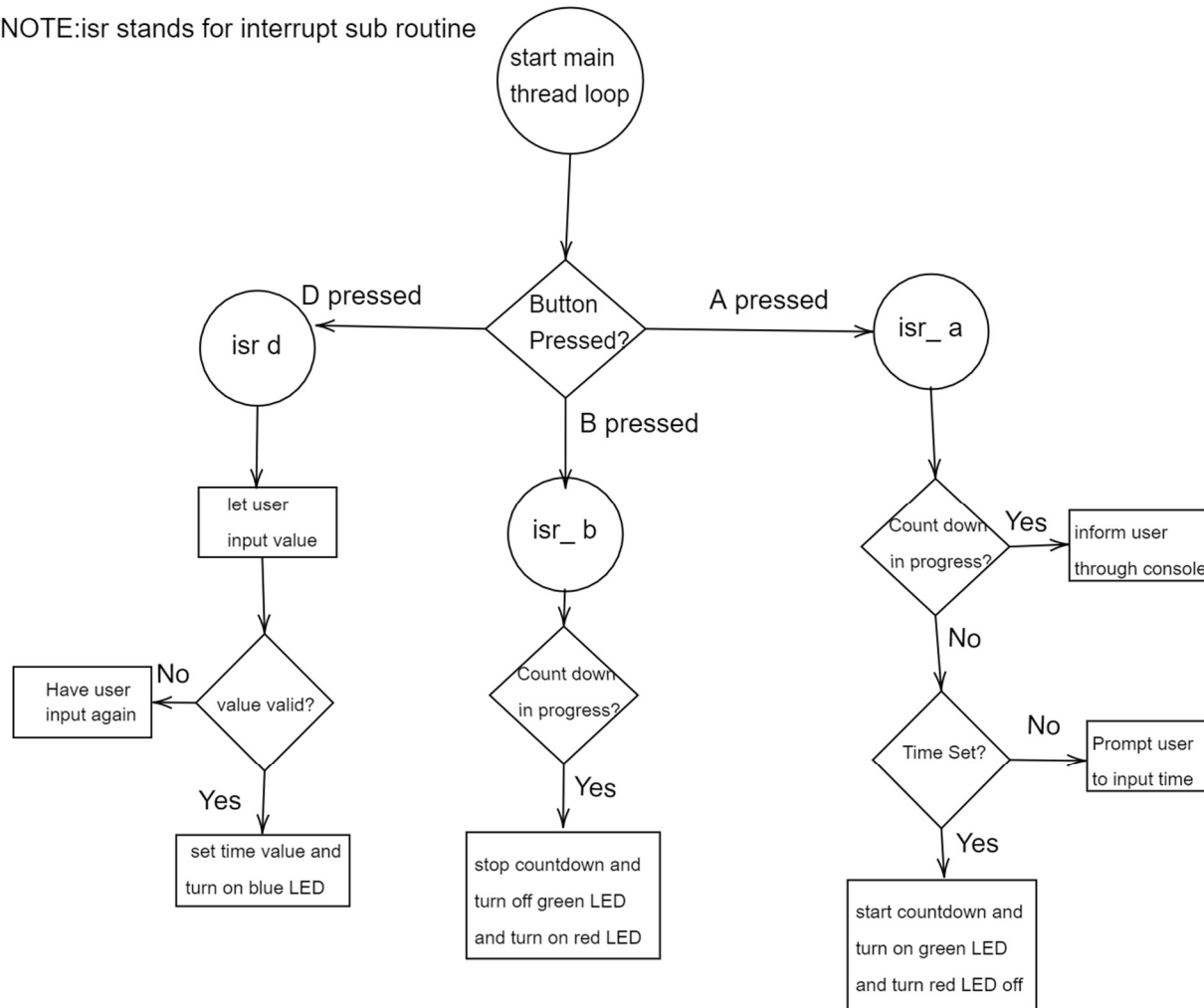
11/4/2021

Diagram



Block Diagram

NOTE: isr stands for interrupt sub routine



Functionality

The project allows for a NUCLEO l45RZI programmable board to be able to interact with external LED lights, a 4x4 matrix keypad and a LCD screen in order to simulate the functionality of a countdown timer.

The functionality is activated primarily through the external 4x4 keypad which interacts with the code in the NUCLEO.

The keypad functionality is as follows:

- Pressing the A button on the keypad will cause the timer will start if the user has inputted in a time and display the current time as it counts down on the external LCD screen

11/4/2021

- If a timer has not been started the user will be prompted to input a time
- Pressing the B button on the keypad will stop the timer if a timer is already in progress
 - If no timer is in progress the user will be prompted that there is no timer in progress
- Pressing the D button will prompt the user through the serial monitor the user will be asked to put in the desired minutes and seconds of the timer separately.
 - If the user puts in a time above 9 minutes and 59 seconds the serial monitor will prompt the user to put in a valid time

The Program also is attached to several LED lights on the breadboard. The LED linked to the input in keypad port 1 will light up anytime an input is inserted into the keypad. There are also LED's that will light up upon the countdown timer reaching zero seconds.

Applications

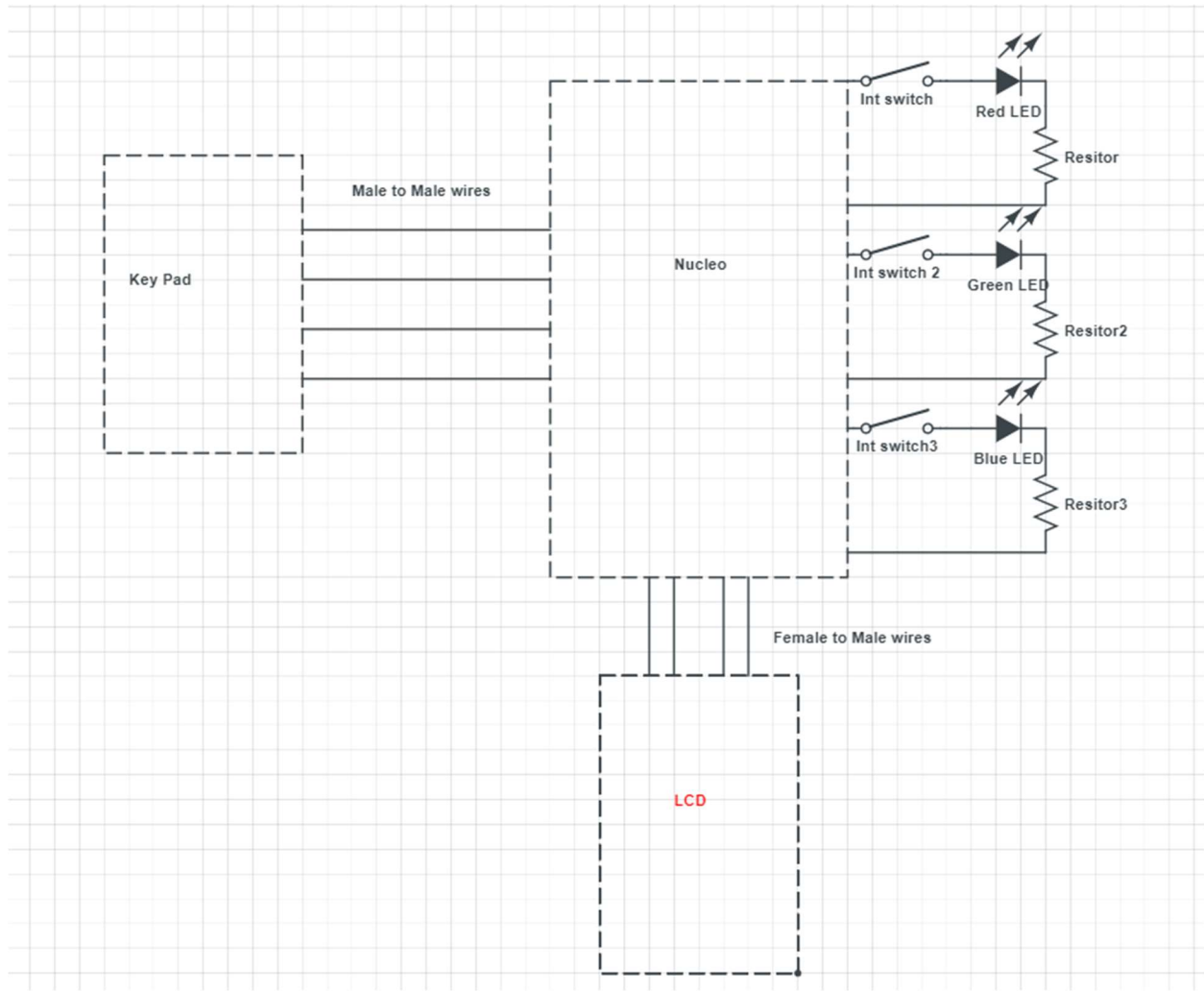
The applications needed are as follows:

- Mbed Studio(IDE)
- mbed.h
- mbed_events.h
- rtos.h
- 1802.cpp and 1820.h

BOM

- Nucleo-L4R5ZI
- USB a to Micro USB B cable
- Breadboard
- Jumpers/Wires
 - Standard male/male(at least 10)
 - at least 4 Male to Female
- LED's at least 6
- Seeed Studio Grove 10402011 LCD screen

Schematic



Test Plan

Testing should be done simply using LED's to test for power.

To ensure the connection of the outputs every single connection to the breadboard should be placed with an LED to test for correct placement of the male to male jumper wires.

The first connection that should be tested is the input PC_8 as this is the connection that will ultimately trigger the interrupt sub routines. Next attach LED's to the connections made to PC_9, PC_10 and PC_11 as these power the rows that will help trigger the sub routines of the programs. On launching the

Anthony Feliciano

CSE 321 Embedded Systems

11/4/2021

program the LED on PC_8 should light up on pressing A,B or D on the Keypad. If not, the connections should be checked

Results

The result of the project was a programmable timer. The user enters time through the serial monitor and is able to see the time remaining through the external LCD screen. Also learning how to professionally document the code and work that was created was also achieved.

Recommendations for improvement

One of the things that can be improved is the way that is way the user inputs the time. Due to a reading error on the part of the developer the user inputs through the serial monitor rather than through the external keypad. Thus only the A, B and D buttons have any functionality at all and depend on the user inputting the numbers through the IDE which is not the intended functionality of the project. However once inputting the information the countdown works as expected.

Another thing that could possibly be improved is the latency and crashing of the program when waiting for the user to input a time. If the user were to press D and wait too long to input the program will crash as the events in the Event Queue will wait too long to execute.