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Project 2 Report

Introduction

This is the final report for Project 2, the timer project. The report contains

1. Cover Page
2. Introduction
3. Specifications
4. Features
5. Applications
6. Block Diagram
7. Functionality Diagram
8. BOM
9. Schematic
10. Test Plan
11. Results
12. Recommendations for Improvement

These sections should provide a good overview of progress made on the project, and the original specifications the project was built to.

Specifications

- Time is entered as m:ss
- Valid times can go up to 9 min and 59 sec
- User can press A to start the timer
- User can press B to stop/turn off
- User can press D to input the time
- User must use a prompt to enter time
- Every time a value is entered, an LED lights up
- The LCD will display Time Remaining: followed by the current time
- When the specified time is reached the LCD will display Times Up and multiple LEDs will turn on
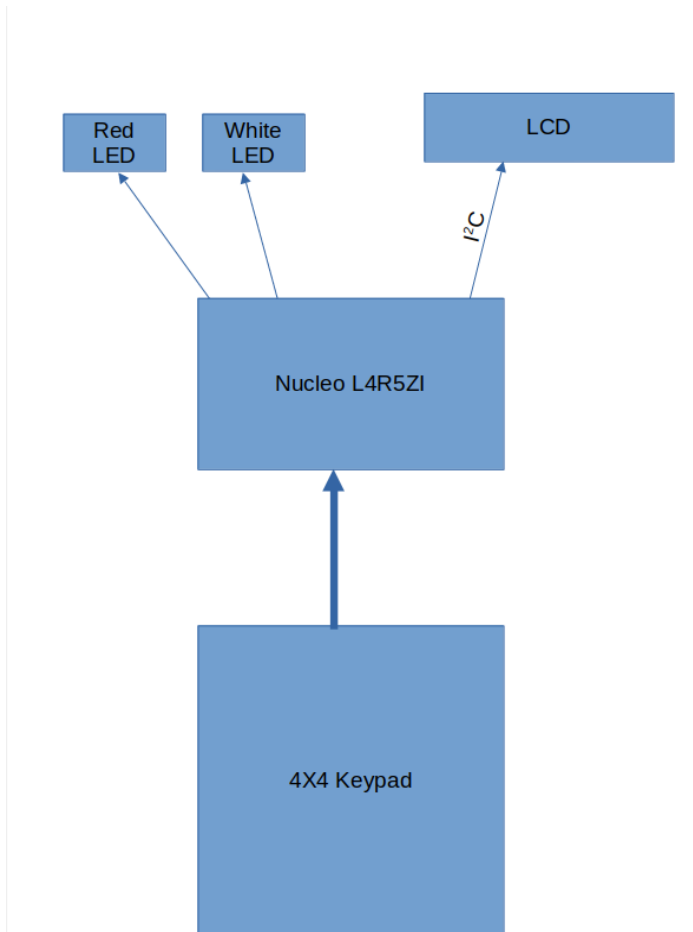- Must run "forever"

Features

- Any time up to 9m:59s can be entered through the keypad
- The user can start and stop the time with B and A at will
- The timer can count up to or down from the desired time
- The time is displayed on the LCD
- A message on the LCD and LED indicators are displayed when the desired time is reached
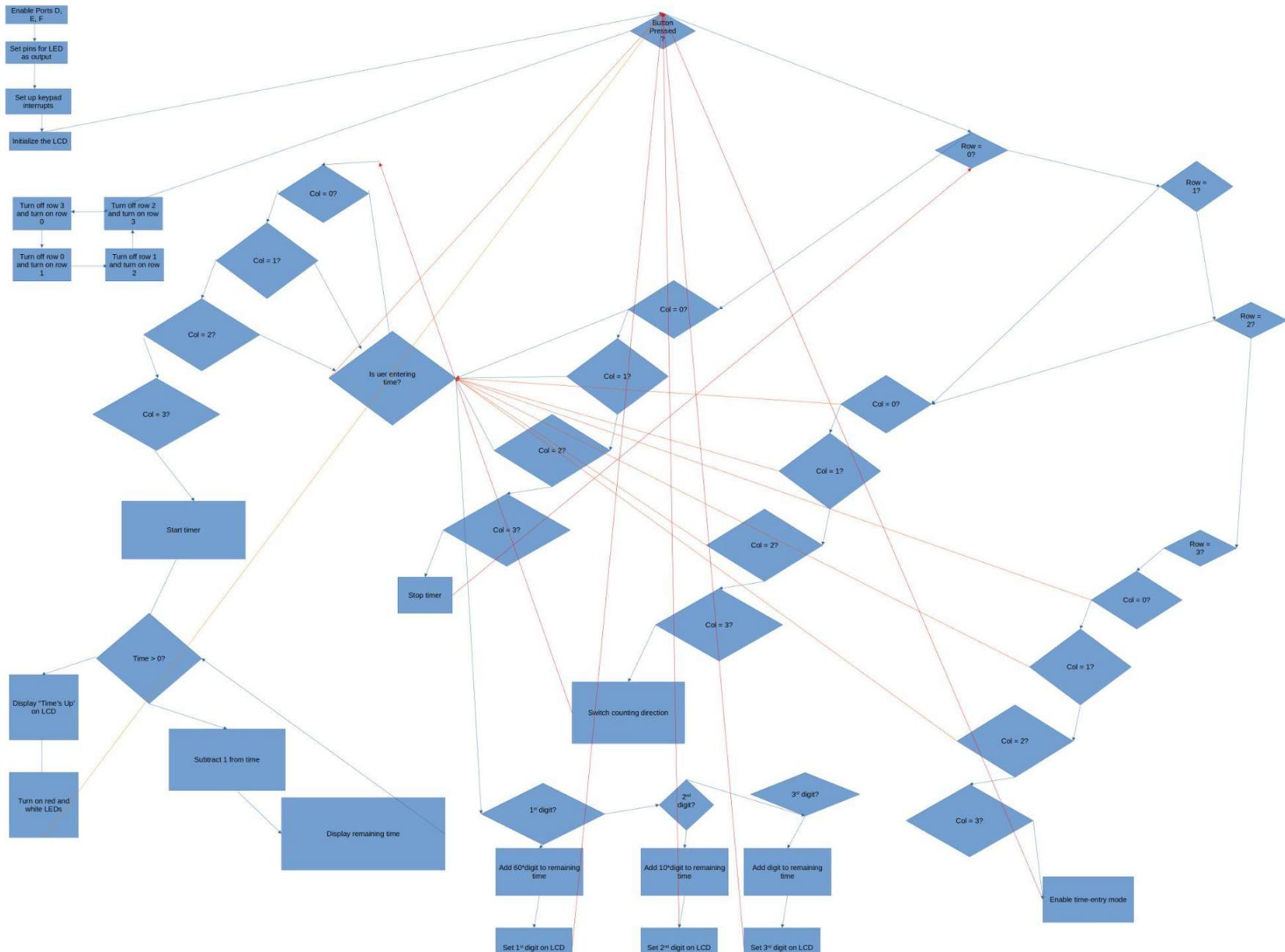- The user can press C at any point to change the counting direction between counting up and down

Applications

- Alarm Clock
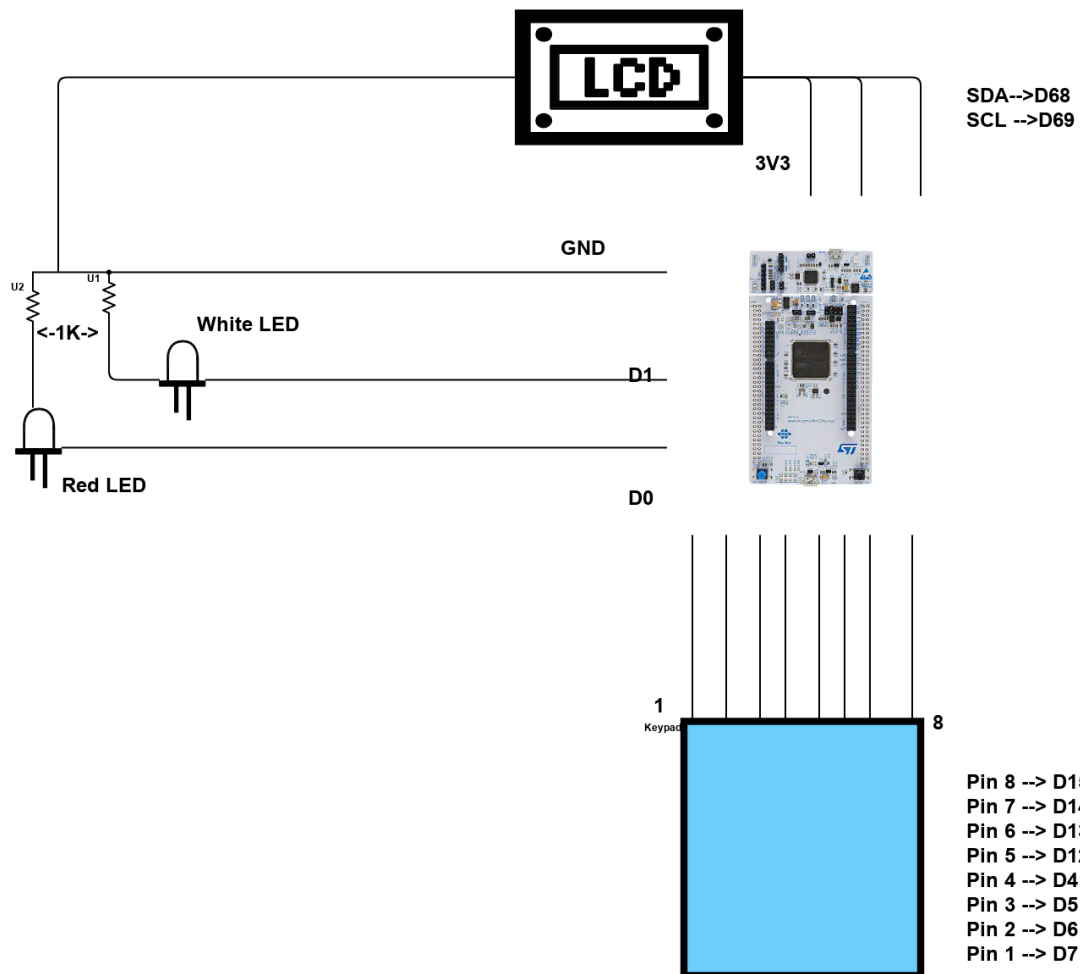- Microwave
- Kitchen timer

Block Diagram

Red
LED

White
LED

LCD

I²C

Nucleo L4R5ZI

4X4 Keypad

Functionality Diagram

Enable Ports D, E, F

Set pins for LED as output

Set up keypad interrupts

Initialize the LCD

Button Pressed?

Row = 0?

Row = 1?

Row = 2?

Row = 3?

Turn off row 3 and turn on row 0

Turn off row 2 and turn on row 3

Turn off row 0 and turn on row 1

Turn off row 1 and turn on row 2

Col = 0?

Col = 1?

Col = 2?

Col = 3?

Is uer entering time?

Col = 0?

Col = 1?

Col = 2?

Col = 3?

Col = 0?

Col = 1?

Col = 2?

Col = 3?

Col = 0?

Col = 1?

Col = 2?

Col = 3?

Start timer

Stop timer

Switch counting direction

Time > 0?

Display 'Time's Up' on LCD

Turn on red and white LEDs

Subtract 1 from time

Display remaining time

1st digit?

2nd digit?

3rd digit?

Add 60*digit to remaining time

Add 10*digit to remaining time

Add digit to remaining time

Enable time-entry mode

Set 1st digit on LCD

Set 2nd digit on LCD

Set 3rd digit on LCD

Bill Of Materials
- 1 Red LED
- 1 White LED
- 1 4X4 matrix keypad
- 1 I²C LCD
- 2 1KΩ Resistor
- 1 Breadboard
- 15 Jumpers

Schematic

SDA-->D68
SCL -->D69

3V3

GND

White LED

U2 U1

<-1K->

D1

Red LED

D0

1
Keypad

8

Pin 8 --> D15
Pin 7 --> D14
Pin 6 --> D13
Pin 5 --> D12
Pin 4 --> D4
Pin 3 --> D5
Pin 2 --> D6
Pin 1 --> D7

Test Plan
1. Test a time under 9:59 but over 0:59

2. Test a time between 0:00 and 0:59
3. Test a time using only row 0
4. Test a time using only row 1
5. Test a time using all 4 rows
6. Test a time over 9:59
7. Test a 0:60
8. Start timer before entering a time
9. Stop timer before 0:00
10. Hit "D" while timer is running
11. Hit numbers while time is running
12. Hit "D" after 0:00, repeatedly

Results
1. Time enters successfully, counts down, and LEDs indicate end, plus LCD message (1:30)
2. Time enters successfully, counts down, and LEDs indicate end, plus LCD message (0:30)
3. Time enters successfully, counts down, and LEDs indicate end, plus LCD message (1:31)
4. No keys working (4:56)
5. Row 1 inoperative (1:59)
6. Timer won't allow ten-seconds place greater than 5, so cannot enter time over 9:59
7. Same result as 6
8. Immediately displays "Time's up" and LEDs light
9. Timer stops and LDC returns to "Enter Time"
10. No effect
11. Returns to "Enter time" indefinitely

Recommendations for Improvement
1. Fix the second row issue, allowing for more times to be entered
2. Allow for times greater than 9m:59s
3. Add some other notification method, like a sound
4. Address bounce in a more efficient way, so that the user is not waiting as long between button presses