

**American University of Sharjah**

**College of Engineering**

**Department of Computer Engineering**

**Embedded Systems (COE 410L)**

**Lab 4,5 Report**

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**Introduction**

**LCD**

The LCD used in this lab is called I2C LCD1602 which is a liquid crystal display (LCD) peripheral. It can display 2 lines of 16 characters each which is in total 32 characters. The LCD can be mounted on a PCF8574 12C chip which helps decrease the required GPIO pins from 7 to just 2. This chip makes it simple to interface with the RPi using the I2C ports to connect to the 0x27 slave address. The LCD along with the I2C chip requires 4 pins:

* SCL of RPi
* SDA of RPi
* VCC (5V)
* Ground

The following commands can be utilized to interact with the LCD:

LCD1602.init(0x27, Background\_light) #1 for backlight on and 0 for backlight off

LCD1602.write(x, y, “XXXXX”) #x is for cursor position and y for line position

LCD1602.clear() #clear the LCD screen

A picture containing text, electronics

Description automatically generated

**Figure 1: LCD front and back connected to PCF8574 I2C Chip**

**Keypad**

The keypad used in this lab is a I6-key keypad containing BCD numbers 0-9, letters A,B,C,D, and special characters ‘\*’ and ‘#’. It is controlled using 8 GPIO pins of which 4 are for input and 4 for output. The working principle behind this keypad lies in quickly applying a LOW voltage on each of the 4 columns of the keypad and scanning which row is forced to LOW, within each column, as a consequence of the applied voltage. For example, if the first column is applied a LOW voltage by a GPIO output pin and the first row becomes LOW as a consequence (detected by a GPIO input pin), then a '1' keypress is detected. Inactive columns are applied with a HIGH voltage.

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Figure 2: Keypad with 16 keys

**System Interface Diagram**

SOUT

Shape

Description automatically generated with medium confidenceShape

Description automatically generated with medium confidence

I2C SCL

I2C SDA

LCD

Keypad

Raspberry Pi

5V vcc

3.3V

33k ohm

22K ohm

RFID Reader

Dr SW

Reverse

SW

Park SW

Ultrasonic

Sensor

PIR

Sensor

PassiveBuzzer

Output signal

PWM Signal

Echo

Trigger

RLED

PLED

DLED

**Code**

**Proteus screenshots**

Diagram

Description automatically generated

When 7 is pressed which is the correct key, LED is on:Diagram

Description automatically generated

When any other button is pressed LED is off:

Diagram

Description automatically generated

Diagram

Description automatically generated

When system is not running (schematic diagram)Diagram, schematic

Description automatically generated

Operating Temperature sensor:Diagram

Description automatically generated

Operating Humidity sensor:Diagram

Description automatically generated

**Conclusion**

Over the course of two labs, we were introduced on how to operate LCD screens using I2C protocol which was implemented in the car control system to show messages. We also familiarized in using a keypad interface which was added to allow the user to input characters directly and the input be used to perform specific coded functions. A feature was added to access the control system using a password through the keypad. We also gained experience further by developing a simulation of LCDs, keypads, buttons, sensors and RPi which was connected together in order for user to type the right key to find if it is the right password and read temperature and humidity sensors by switching buttons connected to each. Overall, we gained valuable knowledge about how to work with LCDs and keypads along with the RPi to develop useful operations.