Lab 03
Keypad, Seven Segment, and LCD

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1 Executive Summary

In this lab, the objective is to use the Arduino Mega 2560 to read in analog values from an infrared distance sensor. A program was written to convert the analog values to the distance in centimeters. To determine an equation that will successfully convert the raw analog values to a distance, distance and analog value measurements were taken. The data was plotted into Excel where a line of best fit was determined.

The minimum objectives were:

1. Application must use Sharp GP IR ranger with analog output
2. Must demonstrated a resolution of .5 cm or better
3. Must display measured distance in cm (best) or inches
4. Must have some output that makes use of the range sensor information
5. Implement and demonstrate in a product application
6. Demo to lab assistant, instructor or other person with mechatronics background, document in your report.
7. Test your product on someone outside the class, record their use of your product, discuss outcomes in your report.

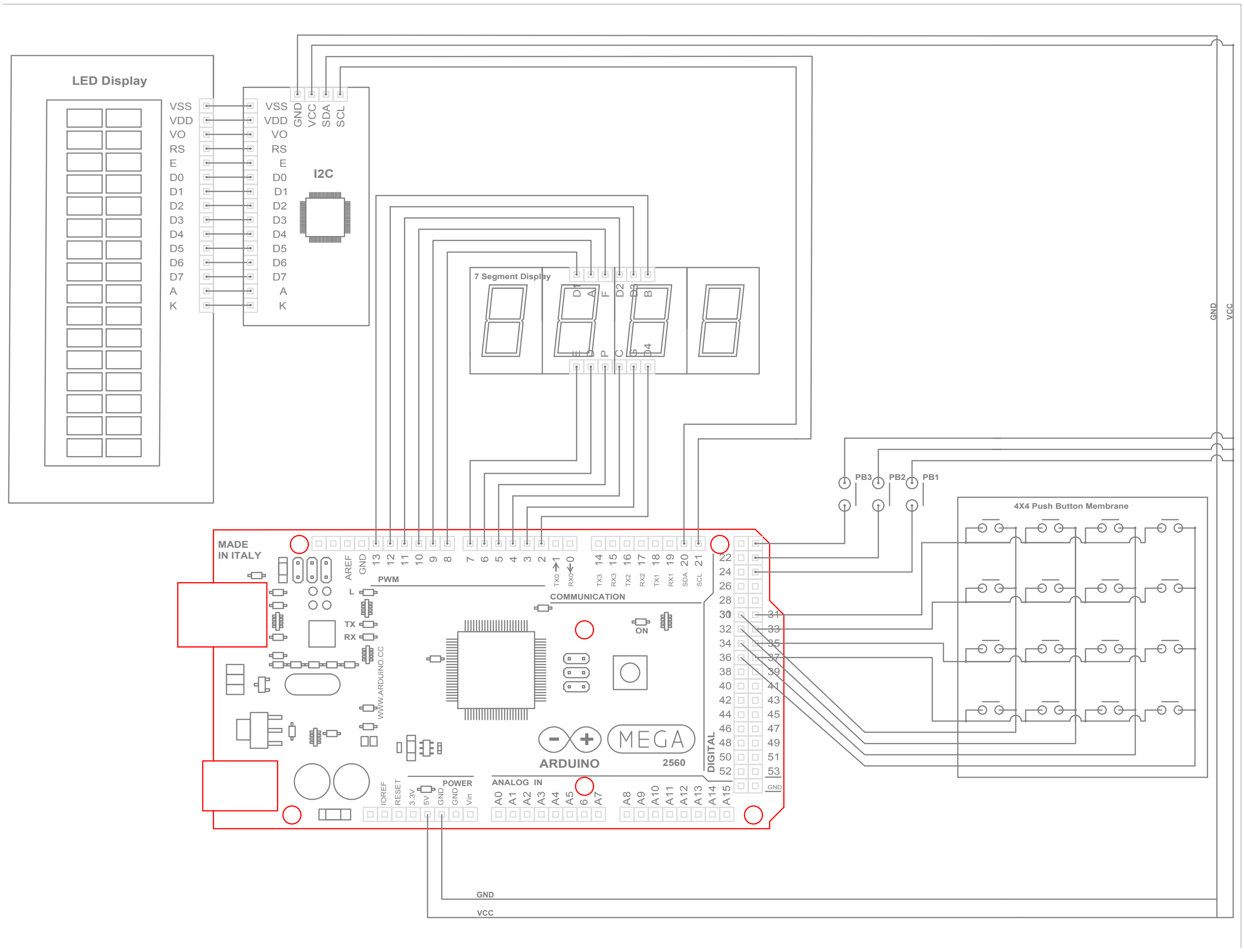

Figure 1: Circuit Diagram

2 Source Code

```
/* AUTHORS: A. LOGAN BARBER; IAN NAIL
 * FILE NAME: Lab04.ino
 * LAST UPDATED: 25 February 2022
 *
 * PURPOSE: THIS IS THE MAIN FILE FOR TAKING AN ANOLOG INPUT FROM A IR DISTANCE SENSOR AND DISPLAYING THE DISTANCE ON THE LCD.
 * The sensor is an SHARP 2Y0A02 F 18
 * Measuring distance: 20 to 150 cm
 * Matlab code for the measurements of IRsensor
 * IRsensor = [1/562 1/456 1/356 1/295 1/248 1/237 1/223 1/206 1/170 1/156 1/138];
 * distance = [21 30 40 50 60 70 80 90 100 110 140];
 * p = polyfit(IRsensor,distance,1)
 * -> p = 20.8833e3 -17.8902
 */
// INCLUDE LIBRARIES
#include <LiquidCrystal_I2C.h>
#include <stdio.h>
#include <math.h>
#define TRUE 0x01
#define FALSE 0x00


// Global Variables
float value_ADC0 = 0;
float Distance_ADC0 = 0;
uint32_t low = 0;
uint32_t high = 0;

// DEFINE MACROS FOR LCD SERIAL
#define ADDRESS 0x27
#define LCDCOLS 16
#define LCDROWS 2
// CREATE LiquidCrystal OBJECT
LiquidCrystal_I2C lcd(ADDRESS, LCDCOLS, LCDROWS);

void setup() {

// Setup ATD:
//Use AVREF as ADC reference , 10 bit reading , Set MUX 4-0 as 0 for ADC pin 0
  ADMUX = 0b01000000;
// Enable ADC
// Don't start conversions yet
// DOn't autrigger , clear flag , Dont enable interrupt
// Prescalers are 100 for divide by 16 prescale
  ADCSRA = 0b10010000;
  ADCSRB = 0b00000000; // for ADC0
//Begin serial and confirmation message
   Serial.begin(9600); // init serial
   Serial.println("Serial Connected");

      // INITIALIZE THE LCD SCREEN
   lcd.begin();
   // turn on the backlight
   lcd.backlight();
}

```

```
void loop() {
 value_ADC0 = average_Distance();
 //Distance_ADC0 = −79.544*log(value_ADC0) + 511.9;

 ///Distance_ADC0 =  2*9462/(value_ADC0 − 8.5);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print(”Distance ”);
  lcd.print(value_ADC0);
  delay(200);
}

/*
 * TYPE: FUNCTION
 * NAME: average_Distance
 * RETURN: uint32_t
 * NUMBER OF PARAMETERS: 0
 * PARAMETER NAMES: void
 * PURPOSE: This function returns the average reading from the IR sensor
 */
uint32_t average_Distance(){
  uint32_t u32_index;
  uint32_t u32_average_distance = 0;
  for(u32_index = 0; u32_index < 15000; u32_index++) {
    ADCSRA |= 0b01000000; // Start ADC Conversion
    while((ADCSRA & 0b00010000)==0); // Stays in while loop while conversion is happening
    low  = ADCL;
    high = ADCH;
    value_ADC0 = (high << 8) | low;
    u32_average_distance = u32_average_distance + value_ADC0;
  }
  u32_average_distance = u32_average_distance/15000;
return u32_average_distance;
}
```

../Lab04.ino