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**SIE 370 – Embedded Computer Systems**

**4/24/2023**

**Lab 5**

**Lab Report**

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## **1. Task Prototyping (Tinkercad Simulation)**

Using the references provided in the lab 5 manual for the Monitor and Data Logging System, I successfully modified the Arduino code to meet the specifications of the Tinkercad components. All Acceptance Tests were passed for Task 1, 2, and 3.

### **Guiding Questions**

a) What is the approximate range of distance measurements for our Parallax PING))) sensor?  
According to the Parallax PING))) Ultrasonic Distance Sensor Data Sheet, referenced in the lab manual, the range of distance measurements for the Parallax PING))) sensor is approximately 2 cm to 3 m (0.8 in to 3.3 yd).

b) What is the library you have to use for the LCD display?

The Liquid Crystal library is used for the LCD display. The following code is used to reference this library:

```
#include <LiquidCrystal.h>
```

c) Briefly compare and contrast the TMP36 and DHT11.

TMP36 is a popular precalculated temperature sensor from the TMP series. It is characterized by its low output voltage, linearly proportional to the Celsius temperature. DHT11 is a low-cost temperature/humidity sensor that transforms analog signals from the surrounding environment into digital ones. Figure 1 provides a tabular view of these differences (1).

Indicators	LM35	TMP36	DHT11
Maximum measurement error	0.5° C	2° C	2° C
Operating temperature range	-55 ... +150°C	-40 ... +125°C	0 ... +50°C
Non-linearity	+/-0.18	+/-0.5	+/-1
Maximum electric current intensity, $\mu$ A	60	50	150
Low level heating	+	+	+
Voltage level	4-30 V	2.7-5.5 V	3-55 V
Price	\$1.23	\$1.77	\$1.09

**Figure 1.** LM35, TMP36, and DHT11 Comparative Table

## 2. Task Experiment (Physical Arduino)

After completing the prototyping tasks in Tinkercad, I combined the programs for the LCD, temperature sensor, distance sensor, and piezo buzzer to build the Monitor and Data Logging System references provided in the lab 5 manual for the physical Monitor and Data Logging System. My build was successful, and all Acceptance Tests were passed for Task 4.

### Guiding Questions

4.2. What is the purpose of the potentiometer in this circuit?

The purpose of the potentiometer in this circuit is to adjust the LCD driving voltage. It is also necessary to control screen brightness and screen contrast.

4.3. Explain how the Ultrasonic Range Finder works. You may use the illustration in addition to your own wording from the datasheet with attribution.

The Ultrasonic Range Finder automatically sends eight 40 kHz sound waves and detects the returning pulse waves. If the returning pulse waves is in the high-level frequency, the time of high output IO duration is recorded and used to calculate distance.

4.4. What are the steps you had to take in the Processing Sketch:

Steps taken in the Processing Sketch include the following:

1. Run Task 4 Arduino Sketch
2. Close Serial Monitor
3. Run Processing Sketch
4. Press any key to stop the Processing Sketch
5. Check outputdata.txt serial data output results

4.4.1. To find the correct port number for the Arduino output?

Port: COM4 Serial Port (USB)

4.4.2. Write the output to a file and save it on the host computer (your laptop)?

Serial data saved to outputdata.txt in SIE 370 Lab 5 folder.

## Works Cited

1. "LM35, TMP36 And DHT11 Sensors for ESP32 IOT Project." *Sirin Software*, 22 Mar. 2022, <https://sirinsoftware.com/blog/esp32-iot-project-lm35-tmp36-dht11/>.