ECE 342 Final Project

Temperature 2

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1) System Overview

The goal of this final project is to design a non-contact temperature scanner. The system is required to satisfy varying requirements that were given, along with an additional engineer-defined requirement. In order to ensure that the non-contact temperature scanner is working faithfully, the system utilizes the Arduino Uno as the processor. Since the Arduino Uno is the core of the whole system, it also governs the proximity sensor, along with the temperature sensor, an OLED display, a Piezo Buzzer and an SD memory card. Through the designer's programming of the core microprocessor, the system can perform corresponding operations to meet a series of requirements. Once the proximity sensor has been triggered, the temperature sensor will capture the user's body temperature by showcasing the temperature on the OLED display in both Celsius and in Fahrenheit. The temperature sensor has a measurement range of -40C(-40F) to 85C(185F). Simultaneously, the Arduino Uno will compare the user's temperature that was seized with the set temperature (100.4F). If the temperature that was captured from the user ended up being higher than the set temperature, the Piezo Buzzer will issue a beeping sound to indicate a warning that the user may potentially have a fever. Concurrently, the Arduino Uno will document every iota of temperature data from every user that came within the target range needed to activate the proximity sensor for 24 hours. Furthermore, the data of the users' temperature will then be stored.This document will provide the system’s electrical specifications, user guide, design artifacts, PCB information and part information.

2) Electrical Specifications

The Table 1 which can be found down below by showcasing the specifications of all the elements.

Table 1: Electrical Specifications

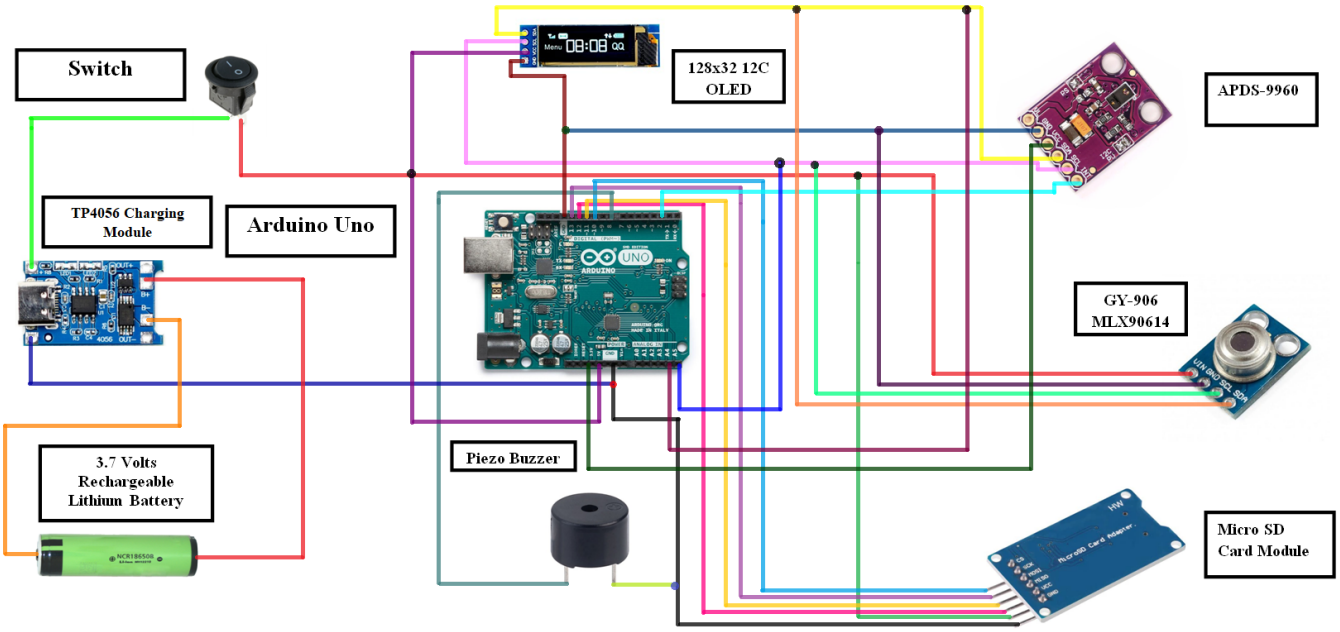
Name	Min Voltage	Max Voltage	Normal Current	Max Current	Operating Temp
Arduino Uno	6V	20V	40mA	50mA	-40F to 185F
APDS-9960	2.4V	3.8V	200uA	250uA	-40F to 185F
GY-906 MLX90614	3V	5.5V	1.5mA	2.5mA	-40F to 185F
128x32 12C OLED	0V	11V	7.3mA	9.1mA	-22F to 158F
Piezo Buzzer	3V	20V	8mA	30mA	14F to 158F
TP4056 Charging	0V	8V	55uA	100uA	-40F to 185F

Module					
Micro SD Card Module	4.5V	5.5V	80mA	200mA	-40F to 185F
3.7Volts Rechargeable Lithium Battery	3.7V	3.9V	0.2C5A	2.0C5A	32F to 104F

3) User Guide

In Figure 1, that image is exhibiting the instruction of the set up that is being utilized in our project. Additionally, it illustrates the wire connections and the name of each component that was used to make the system operational. In order to make the system operational, the distance between the user and the system has to be within the range of 10-20 cm just to activate the proximity sensor (APDS-9960). The toggle switch acts as a way to make the system become operational. Furthermore, the charge port and 3.7 volts rechargeable lithium battery also acts as another form to make the system operational. Lastly, hooking up the Arduino Uno with a USB cable to a power source like a computer or to an iPhone adapter connected to the wall can generate enough voltage to cause the system to become operational as well.

Figure 1: Wiring Diagram



4) Design Artifacts

In Figure 2, that photo is exhibiting the top level block diagram in a very detail oriented manner to showcase which blocks each team member received, along with how the final engineering

project will be crafted and constructed.The user's temperature displayed on the OLED screen, the warning sound given by the buzzer and the user's temperature data will be the output of the system. When the user is in front of the system, the proximity sensor, along with the temperature sensor will be triggered and the Arduino Uno will display the user's temperature on the OLED display. Additionally, the data will be in the SD card. By comparing the user's temperature with the set temperature, the decision will be made to determine if the Piezo Buzzer will administer a warning. A rechargeable lithium battery is used as the power supply of the system to provide the system with the proper amount of voltage. When the energy of the rechargeable battery is exhausted, the power supply of the system can be charged through the charge card. Likewise, Table 2 is representing the interface definitions that were established which will act as a form of verification to demonstrate that each of the blocks was executed faithfully.

Figure 2: Top level block diagram

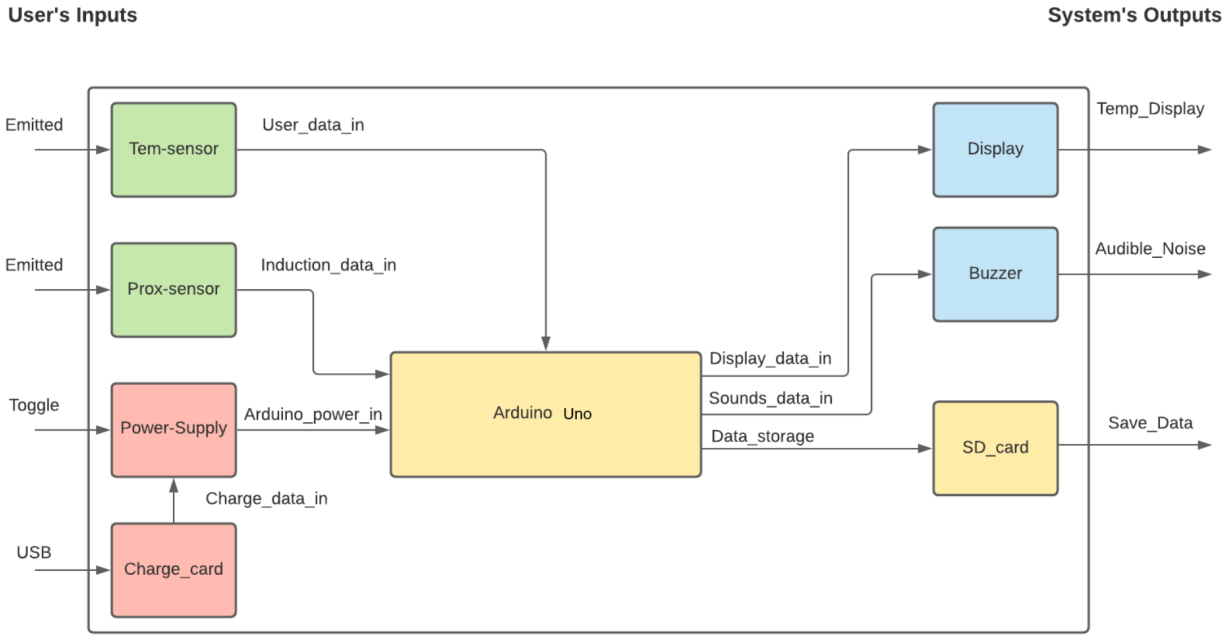


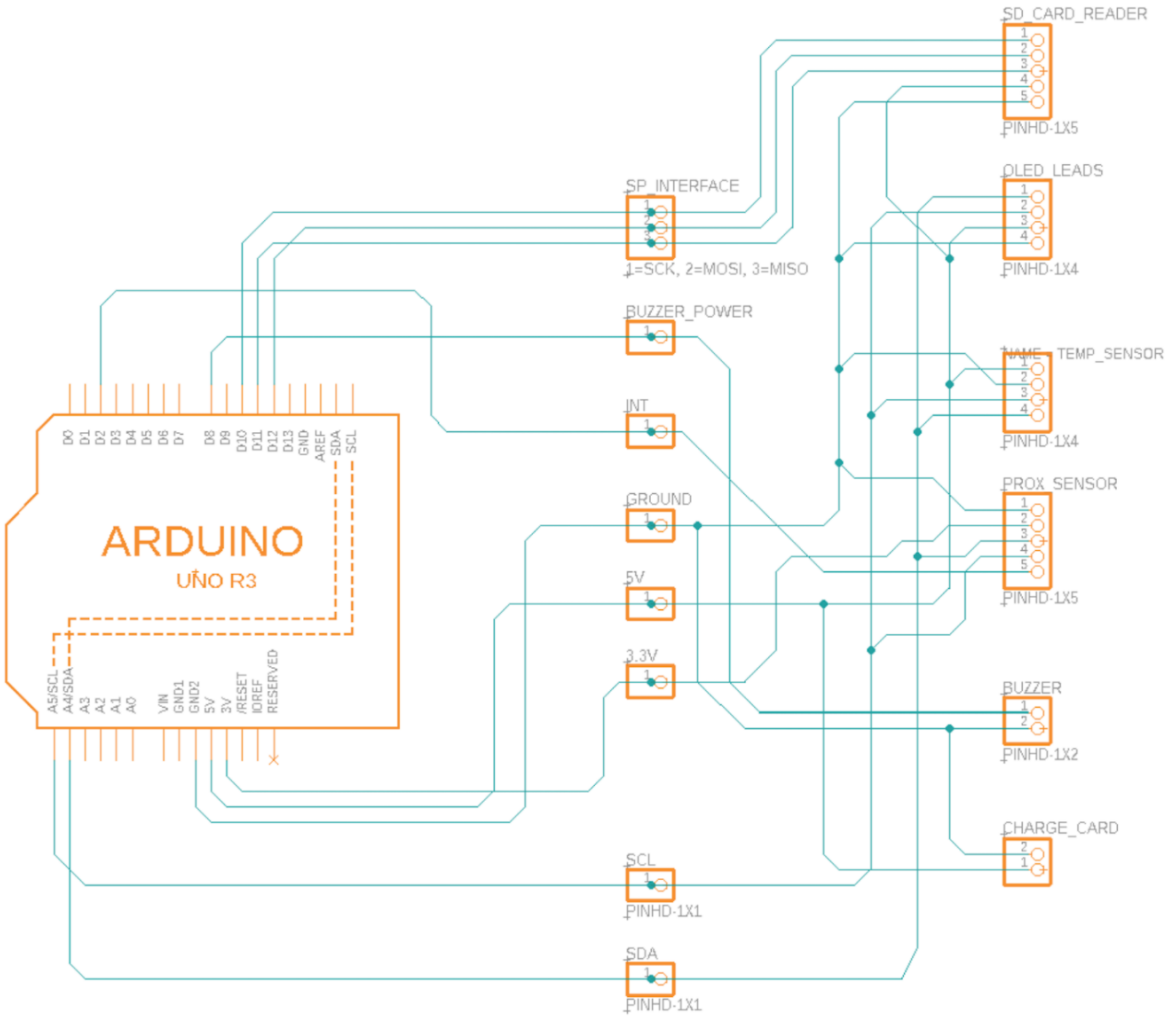
Table 2: Interface definitions

Interface Name	Type	Interface Descriptions
User_data_in	Digital	Voltage: 3.6V~5V standard SPI interface Current: Maximum 2mA Detect the object's temperature from $-40^{\circ}C$($-40^{\circ}F$) to $85^{\circ}C(185^{\circ}F)$.

Induction_data_in	Digital	Maximum Voltage: 3.8V Maximum Current: 2mA Detect the user's gesture and perform the tasks specified by the microcontroller.
Arduino_power_in	Electrical	Output Voltage: 5V Maximum Current: 20mA
Charge_data_in	Digital	Input voltage: 5V Charging cut-off voltage: 4.2V
Display_data_in	Digital	Interface Type: IIC interface VCC: Power + (DC 3.3 ~5v)
Sounds_data_in	Electrical/Sound	Input Voltage: 3-5V Max Current : 30mA
Data_storage	Digital/Electrical	Acquiring data from the Arduino Uno by transmitting the data to the SD card(32GB).
Temp_Display	Digital	This is where the temperature readings of Fahrenheit and Celsius will be illustrated. (3.3-5V)
Audible_Noise	Electrical/Audio	~80 dB continuous sound (Frequency: 4kHz)
Save_Data	Coding	This is the .txt file with recorded data.

The schematic illustrated in Figure 3 is displaying the diagram that was drawn in Fusion 360. Since there is no need to add additional electrical components, such as resistors, inductors, and capacitors to the design of the system, the circuit schematic diagram of the system only included the core processor (Arduino Uno) and other modules. The circuit schematic shows how to effectively connect these modules to the processor. The pins A4 and A5 on the Arduino Uno are connected to the SCL and SDA pins of the sensor modules. In order to facilitate the testing of each block of the system, this will be done by vertifying to see if the interface definitions are met. Test points have been added to the electrical schematic diagram as well.

Figure 3: Electrical schematic diagram



To ensure that the system can keep functioning normally, while maintaining stability, the enclosure (Figure 4.1-4.5) of the system is designed in Tinkercad to generate a 3D modeling and it was created by a 3D printing technique. The enclosure of the system is a container box.The prototype and square holes on the lid of the box are used to place proximity sensors and temperature sensors. The holes on the side of the box are used for the SD memory card, charging cable for the system power supply and to prevent switching.

Figure 4.1: Top view of the enclosure

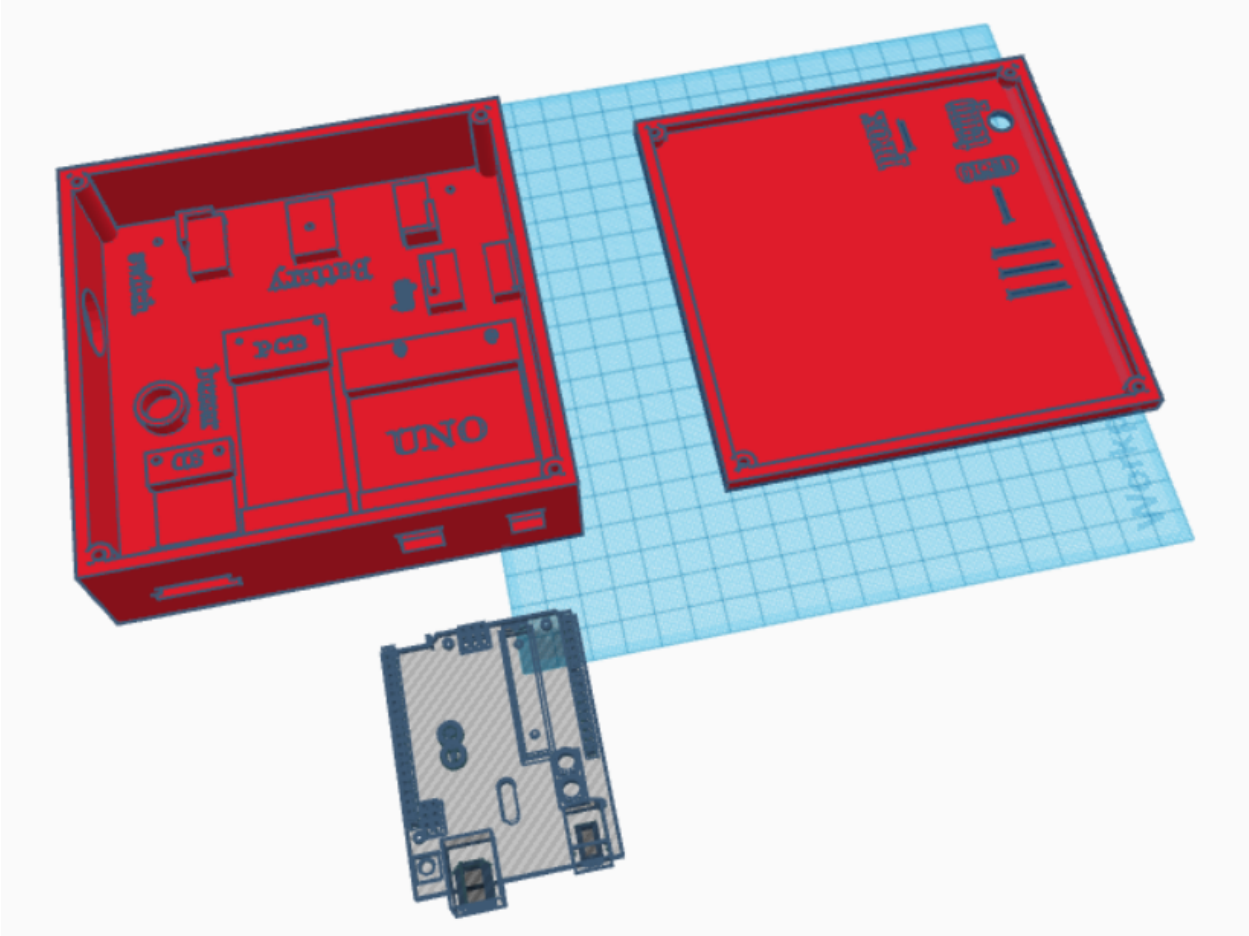


Figure 4.2: Bottom view of the enclosure

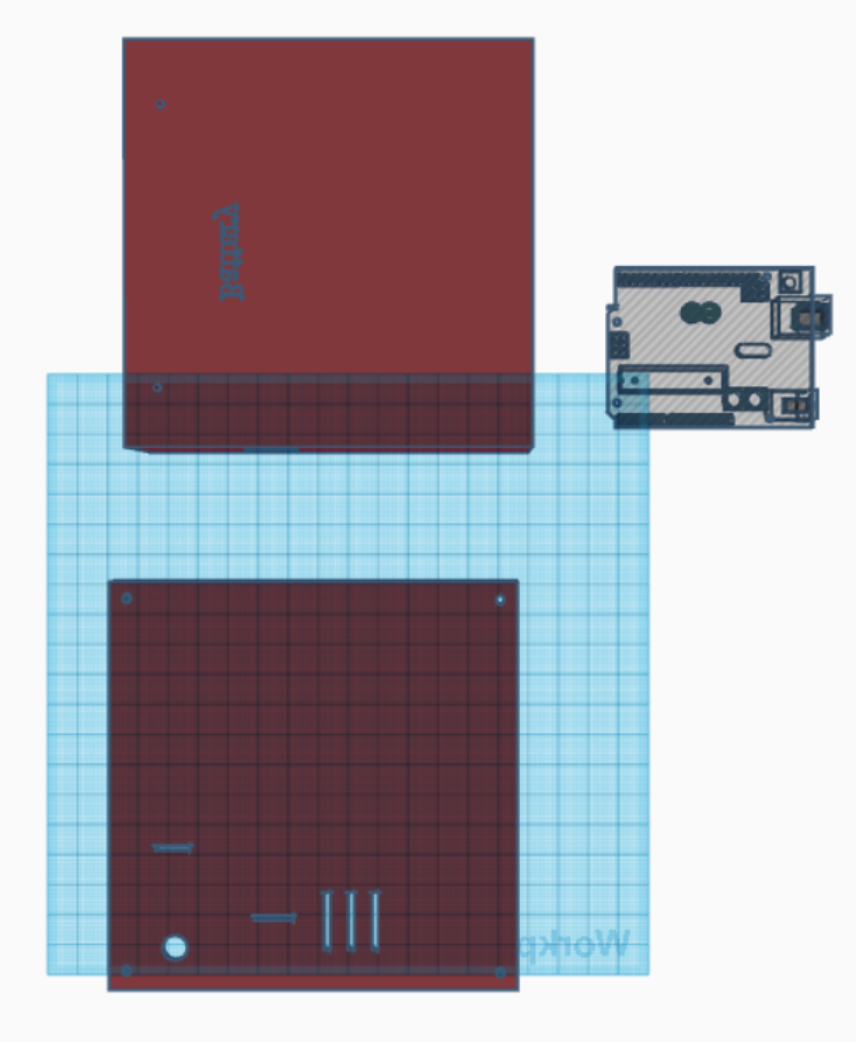


Figure 4.3: Left view of the enclosure

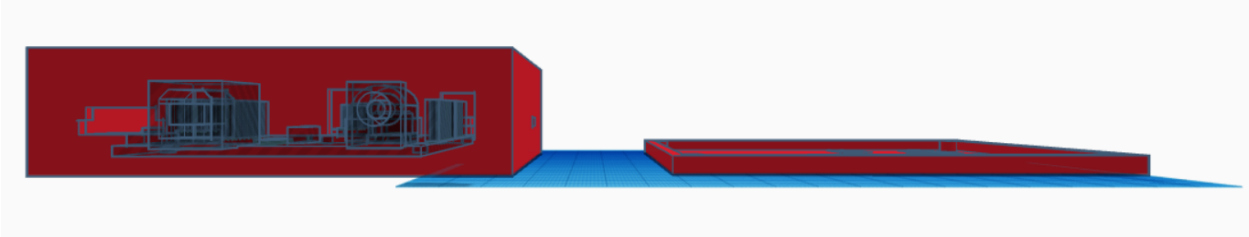


Figure 4.4: Right view of the enclosure

Figure 4.5: A prototype hole on the enclosure

5) PCB Information

A PCB board is designed for the convenience of effectively connecting all of the modules together. The size of the PCB board is 73.66x29.21 inch (as portrayed in Figure 5). In order to improve the effective use of the PCB board and to reduce the cost of the board, all of the modules will not be directly soldered onto the board, but it will be connected to the board through an external circuit. This design will make moving the module easier when the time comes to combining the system and the enclosure. Lastly, the photo represented by Figure 6 characterizes the physical board that is implemented in the final project.

Figure 5: PCB layout of the system

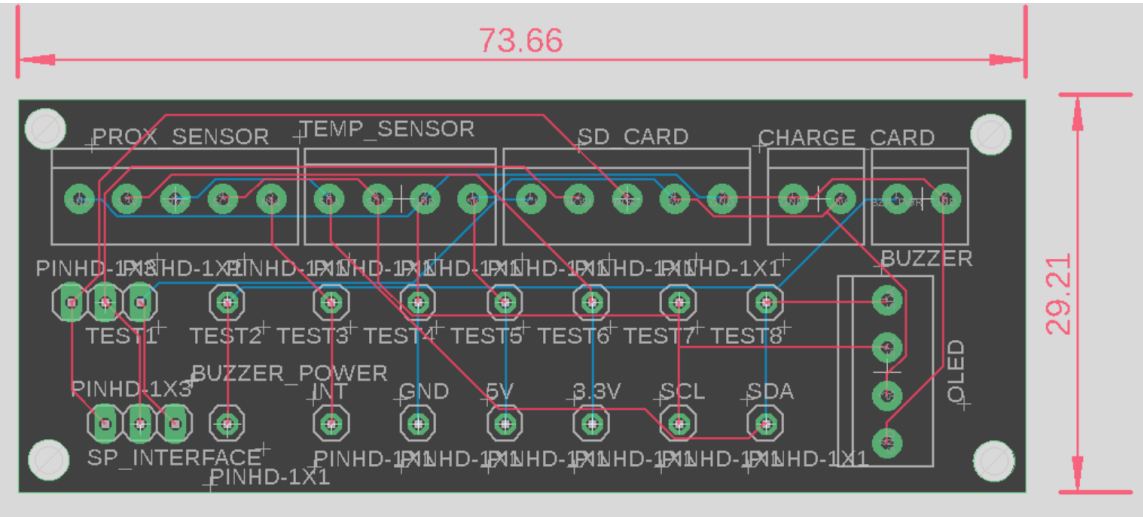
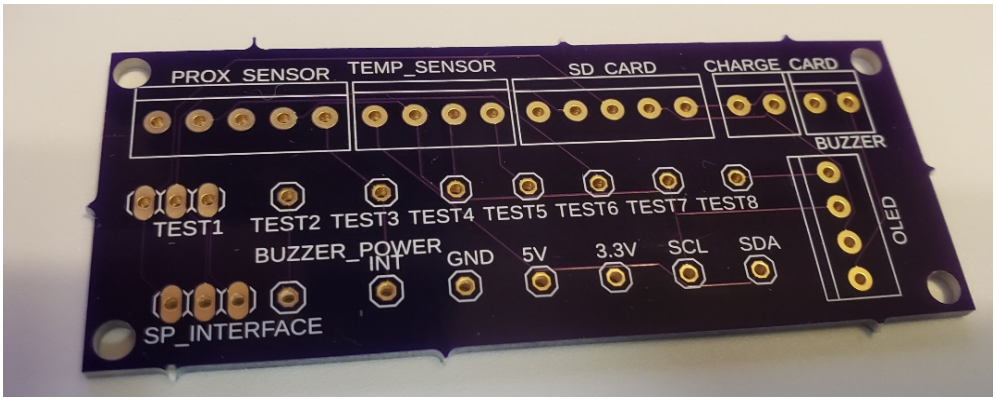


Figure 6: Physical PCB board



6) Part Information

The Table 3 portrayed down below is outlining the bill of materials, which comprises all of the components that were utilized to assemble the non-contact temperature scanner. The quantity and prices of each required part of the system are listed. The total price of the system is concluded to be $109.6.

Table 3: Bill of materials(BOM)

Name	Price	Part Description	Quantity	Dimensions
Arduino Uno	$20.12	A microcontroller	1	2.7 inches by 2.1 inches

		board that is based on the ATmega328. It is a board that can be programmed with a multitude of applications.		
APDS-9960	$9.39 2PCS	It's a gesture sensor that can detect ambient light. Likewise it is a touch-less device that can also be used as a proximity sensor that can detect movement that is within a 4-8 inches range.	1	3.94×2.36×1.35 mm
GY-906 MLX90614	$14.99	This component is an infrared thermometer which is used to obtain temperature measurements in a non-contact fashion.	1	17 x 11mm (0.67 x 0.43")
128x32 12C OLED	$12.99	Organic Light-Emitting Diode (OLED) is a device that harnesses LEDS in which the light is generated by organic molecules. The OLEDs permit the ability to	1	PCB: 20mm x 35mm (0.8" x 1.4") Display area: 7mm x 25mm Thickness: 4mm Resolution Ratio: 128x32

		power to radiate the display by having the pixels individually controlled and discharge its own light.		
Piezo Buzzer	$5.99 2PCS	A device designed to provide an alarm sound.	1	11.7 x 8.8mm/0.46" x 0.35"(D*H);Pin Spacing: 7.6mm/0.35"
SD Card (SanDisk 32GB SDHC)	$7.85	A memory card utilized in various portable devices. It is designed for high-capacity memory	1	5 x 2.99 x 0.23 inches
TP4056 Charging Module	$6.69	A finished constant-voltage and constant current linear charger for lithium-ion batteries that are single cell.	1	Length: 28mm Diameter: 17mm
AiTrip 3PCS Micro SD Card Module with chip level Conversion for Arduino, SDHC Card TF Card Adapter Reader	$5.59	A Serial Peripheral Interface (SPI) Reader mini SD Memory Card TF Memory Card for the Arduino. The purpose of an SPI is predominantly for communication	1	Dimension:42mm x24mm x 12mm/1.65” x 0.94” x 0.47”(L x W x H)

		that involves memory cards, sensors, displays, etc.		
PCB Board	$16 for 3PCBs	A printed circuit board (PCB) main purpose is to electrically connect and mechanically support the parts in a conductive manner from the copper sheets that are laminated to a non-conductive substance.	1	Dimension: 73.02 mm x 27.68 mm x 1.62 mm
3.7 Volts Rechargeable Lithium Battery	$9.99	It's a lithium ion battery that is rechargeable, which has a cell voltage of 3.7 volts. Additionally, it has a current of 500mAh (milliamp per hour)	1	25.5 x 36 x 4.3mm/1"x1.41" x0.17" (WxLxH)