Is it possible to Use an Infrared Sensor to Accurately Measure Temperature from a Distance ?

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Prototype Components

Arduino Uno Board - Open-source micro-controller board that can be used for small scale projects. Acts as the brain for this project.

IR Sensor – Measures the temperature within a range.

Ultrasonic Sensor – Contains two pins: Trig and Echo. Two pins work together to measure distance.

LED Screen – Displays the Temperature

Breadboard – Allows extra connections

Buzzer: Makes beeping noise to alert if a fever is found and is the **unique aspect**.



Prototype Assembly

Arduino Board Connections:

- Connect the Arduino Board +5v Connection to Bread board.
- Connect the Arduino Board GND Connection to Bread board.

MLX 90614 Infra-Red (IR) Temperature Sensor Connections:

- Connect GND pin of MLX 90614 IR sensor's to -ve (negative) to Bread board.
- Connect VCC pin of MLX 90614 IR sensor's to +ve (Postive) to Bread board.
- Connect SCL pin of MLX 90614 IR sensor's to A4 pin connection of Arduino on Bread board.
- Connect SDA pin of MLX 90614 IR sensor's to A5 pin connection of Arduino on Bread board. Ultrasonic Sensor HC-SR04 Connections:
- The HC-SR04 Sensor's VCC connect to the Positive Connection +5V on Bread board.
- The HC-SR04 Sensor's GND connect to the GND Connection on Bread board.
- The HC-SR04 Sensor's Trig connect to the Arduino Board Analog I/O A12
- The HC-SR04 Sensor's Echo connect to the Arduino Board Analog I/O A13
- Connect LCD screen to your Arduino board.
- Connect GND pin to -ve (negative) to Bread board.
- Connect VCC pin to +ve (Postive) to Bread board.

Buzzer Connections:

- Connect +5V of buzzer to digital pin 11 of Arduino Uno.
- Connect GND buzzer pin to -ve (negative) to Bread board.

C Programming Code

<pre>#include< Adafruit_MLX90614.h> //Include Adafruit MLX Driver Library</pre>	void setup()			
#include <liquidcrystal_i2c.h> //create LCD display Library</liquidcrystal_i2c.h>	{ pinMode(trigPin, OUTPUT);			
// start of settings for LCD1602 with I2C for 16 chars and 2 line display	pinMode(echoPin, INPUT);			
LiquidCrystal_I2C lcd(0x27, 16, 2);	pinMode(buzz, OUTPUT);			
// Define the MLX90614 sensor function from Library	//Begin serial communication with Arduino IDE (Serial Monitor)			
Adafruit_MLX90614 mlx = Adafruit_MLX90614();	Serial.begin(9600);			
float roomTemp; // ambient or room temperature	//Initialize LCD I2C			
float objectTemp ; // object temperature	lcd.init();			
// buzzer connection to Arduino board	lcd.backlight();			
int buzz = 11;	//Initialize MLX90614			
// Ultrasonic Sensor preparation	mlx.begin(); }			
#define echoPin 8 // Echo Pin				
#define trigPin 9 // Trigger Pin	void play_alert() { // beep when object temperature is >= 99.6 °F			
int maximumRange = 25; // Maximum range needed	tone(buzz, 1000, 200);			
int minimumRange = 8; // Minimum range needed	noTone(buzz);			
long duration, distance; // Duration used to calculate distance	}			

```
if ((distance >= minimumRange) && (distance <= maximumRange)){
void loop()
{ digitalWrite(trigPin, LOW);
                                                                              Icd.print("HOLD ON "); // Hold the Object same place for few seconds
 digitalWrite(trigPin, HIGH);
                                                                                disptemp(); // Call Temp Measurement Function
 digitalWrite(trigPin, LOW);
                                                                             } }
 duration = pulseIn(echoPin, HIGH);
                                                                             // Function to Measure and display the Object Temperature
 //Calculate the distance (in cm) based on the speed of sound.
                                                                             void disptemp()
 distance= duration*0.034/2;
                                                                                 objectTemp = mlx.readObjectTempF();
 // reading object and ambient temperature in degree Fahrenheit
                                                                                if (objectTemp >= 99.6) { // Check Temp, If Temp over 99.6 then
                                                                            Alert
 objectTemp = mlx.readObjectTempF();
                                                                                  play alert(); // Call function to Play Buzzer sound
 roomTemp = mlx.readAmbientTempF(); ;
 // display on OLED screen
                                                                                lcd.clear();
 lcd.setCursor(0, 0);
if (distance > maximumRange) {
                                                                                lcd.setCursor(0,0);
                                                                                lcd.print("Your Body Temp is:");
  lcd.print("GET CLOSER "); // Object is Far over 25 cm, bring object closer
                                                                                lcd.setCursor(0,1);
 if (distance < minimumRange) {
                                                                                lcd.print(String(objectTemp)+ "F ");
  lcd.clear();
                                                                                delay(5000); // Display the Temp for 5 seconds
  lcd.print("TOO CLOSE! "); // Object is very Close, less than 10 cm
                                                                             }
```

Experiment Outcomes

- Prototype developed met the engineering goal of this project
- Three things tested & measured:
 - Temperature of hot water (Prototype vs. Generic Thermometer)
 - Body Temperature (Prototype vs. Generic Thermometer)
 - Room Temperature (Prototype vs. Home Thermostat)
- 5 Trials conducted for each experiment; for each --- the prototype was able to accurately measure the temperature (95% Confidence Interval; Error was less than 5%)
 - Temperature of hot water (Percent Error range between 0.02% to 0.4%)
 - Body Temperature (Percent Error range between 0.06% to 0.11%)
 - Room Temperature (Percent Error range between 0.05% to 0.11%)

Graphs and Tables

נ	Temperatur	e Measurem	ent in (In ^o l	5)	
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
		Hot water			
Regular Digital Thermometer	101.6	101.5	103.2	99.9	98.6
MLX-90614 IR Sensor	101.62	101.6	103.41	99.99	98.98
Percent Error	0.02%	0.10%	0.20%	0.09%	0.39%
	Во	dy Temperat	ture		
Regular Digital Thermometer	98.4	98.5	98.1	98.2	98.8
MLX-90614 IR Sensor	98.46	98.61	98.01	98.27	98.9
Percent Error	0.06%	0.11%	0.09%	0.07%	0.10%
	Roc	om Tempera	ture		
Regular Digital Thermometer	73	73	73	73	73
MLX-90614 IR Sensor	73.07	73.04	72.96	72.92	73.06
Percent Error	0.10%	0.05%	0.05%	0.11%	0.08%









Results Analysis

- The reason for difference in temperatures: contact vs. no contact
- For the thermostat and my device, the temperatures could be different due to environmentally impacted variations.
- For real world applications, a more robust and powerful IR sensor than MLX90614
- Temperature sensor can be affected by humidity, wind speed in the building (high-speed airwaves), extreme temperatures, and any contact with an outside substance
- HC-Sr04 ultrasonic sensor is a good sensor for measuring or detecting objects with automation at an economical price

Why Should I Be Funded?

- If I can make a prototype that can detect the temperature of people and warn people when the temperature is classified as a fever, then this type of detection can be used to possibly prevent or reduce the spread of COVID-19 and make temperature sensing easier and more efficient. With this project, I was able to make such a prototype that did in fact work.
- Temperature sensor can be used for:
 - o An aquarium and making sure it's safe for the animals inside,
 - o Incubators and make sure it is warm enough for the premature animal or egg
 - o Manufacturing industry which can safely measure the temperature which may be too hot or cold for any contact.
 - o For my case, it can quickly and efficiently measure the temperature of people when they are doing an inperson activity or event during the COVID-19 pandemic time period.

With the Money I Get; I Will Be Able to:

- Apply for a patent
- Print Circuit Board
- Buy more powerful sensors

References

- https://www.arduino.cc/
- <u>Read Temperatures using I2C, HC-SR04 sensors and Arduino</u> (electroschematics.com)
- Arduino Thermometer using the IR temperature sensor (icstation.com)
- Arduino IR thermometer (educ8s.tv)
- Udemy, how to use Arduino uno board (robojax.com/L/?id=62)
- Contactless Temperature measurement (alselectro.com)
- Arduino Based Digital Thermometer (electronicshub.org)