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CONTACTLESS TEMPERATURE DETECTOR

SY B.Tech. Minor Project Implementation Report

SUBMITTED BY

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GUIDED BY

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SCHOOL OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

MIT ACADEMY OF ENGINEERING, ALANDI (D), PUNE-412105

MAHARASHTRA (INDIA)

June 2023

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

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SY B.Tech. Minor Project Report

submitted in partial fulfilment of the requirements
for the award of the degree

of

Bachelor of Technology

in

Electronics and Telecommunication Engineering

BY

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CERTIFICATE

It is hereby certified that the work which is being presented in the SY B.Tech. Minor Project Implementation Report entitled **"*Contactless Temperature Detector*",** in partial fulfilment of the requirements for the award of the **Bachelor of Technology in Electronics and Telecommunication Engineering** and submitted to the **School of Electronics and Telecommunication Engineering of MIT Academy of Engineering, Alandi(D), Pune, Affiliated to Savitribai Phule Pune University (SPPU), Pune** is an authentic record of work carried out during an Academic Year 2022-2023, under the supervision of **Prof.Vinayak Kulkarni, School of Electronics and Telecommunication.**

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Date:

Signature of Project Advisor	*Signature of Dean*
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School of ENTC Engineering	School of ENTC Engineering
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(STAMP/SEAL)

Signature of Internal examiner/s	*Signature of External examiner/s*
Name……………………………	*Name……………………………*
Affiliation…………………………	*Affiliation…………………………*

CONTENTS

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We want to express our gratitude towards our respected project guide Prof.Vinayak Kulkarni for his constant encouragement and valuable guidance during the completion of this project work. We also want to express our gratitude towards respected School Dean Dr. Dipti Sakhare for her continuous encouragement.

We would be failing in our duty if we do not thank all the other staff and faculty members for their experienced advice and evergreen co-operation.

1. Sakshi Deshmukh
2. Gargi Gundawar
3. Shrawani Chaudhari
4. Gauri Kardekar

ABSTRACT

This project seeks to develop a temperature detector system that is capable of accurately and non-invasively measuring the temperature of human without making physical contact. This system would utilize infrared radiation emitted by the human body to detect its temperature and use signal processing algorithms to calculate the temperature of the object. The system would be made up of an IR sensor based contactless body temperature detection module, signal processor and a control unit. The module would be used to detect the infrared radiation emitted by the human body and the signal processor would be used to process the signals from the sensor and calculate the temperature of the human body. The control unit would be used to display the temperature readings. The system would be implemented to be user-friendly, cost-effective and portable. This project could be used in medical diagnostics and for temperature detection in public places like malls, hospitals and educational institutes.

Chapter-1 Introduction

MOTIVATION FOR THE PROJECT

Fever is a common symptom of many infections e.g. COVID-19 in the pandemic situation, keeping monitoring devices like thermometers in constant demand. Recent technological advancements in thermometers have the infrared (IR) thermometers as the thermometer of choice for screening multiple individuals in a contactless manner. Yet, even so, the measurement accuracy of such thermometers is affected by many factors including the distance from the volunteer's forehead, impurities (such as sweat) and the location measured on the volunteer's forehead. To overcome such factors, we describe the assembly of an Arduino-based digital IR thermometer with distance correction using the MLX90614 IR thermometer. Coupled with some analysis of these factors, we also found ways to program compensation methods with distance correction. The final calibrated assembled digital IR thermometer is thus made to provide more accurate readings and measurements.

PROBLEM STATEMENT

Problem Statement - To design and implement an automatic contactless temperature detector which is in-built in a system (Gate).

OBJECTIVE AND SCOPE

Objectives

1) Detection of temperature using infrared and temperature sensor.
2) Making the device temperature detection system-compatible.
3) Such system can be used in public places like malls, airports and hospital to reduce the spread of the disease.
4) By making the process contactless and automatic, to make temperature detection simpler and safer.

Scope:

• Second year scope for our project – we will make a contactless temperature detector circuit which we will install on the gate.

 FUTURE SCOPE:

1. In many public places like malls, airport and hospital we have walked through metal detector gate similarly we would implementation walked through temperature detector gate.

2. When person would pass through the gate the temperature would be detected and recorded in the database along with the information of the person which would make managing records easier.

EXPECTED RESULTS

Expected result is accurate human body temperature of an individual which would be displayed using a calibrated circuit. The result is the digital display of the temperature of the human body in either Celsius or Fahrenheit.

Chapter-2 Literature Survey

SURVEY OF REFERENCE LITERATURE

1.Title: Implementation of a Contactless Infrared Thermometer
Author: Guangli Long
Publication: International Journal on smart sensing and intelligent System Vol-9
Publication Date: June 1, 2016

Objectives	Methodology	Contribution	Limitations
To detect body temperature of a human being in fast and noncontact manner. To implementation a infrared thermometer for above objective.	The radiation energy density and the temperature of the object are in accordance with the law of radiation $A = \alpha\beta(T_2^4 - T_1^4)$ Hardware – IR, LCD, MCU, Operational amplifier, Voice Module and Buzzer alarm are used	The measurement trouble of the traditional contact thermometer is avoided. It is especially suitable for infants and young children to measure the body temperature, and the measured temperature is displayed by the liquid crystal display module, it is accurate, and it has the function of voice broadcast, it is convenient for the people with poor eyesight.	Even though the temperature measurement is quick and for larger flow of people, the accuracy is hampered sometimes.

2.Title: A Novel Wearable Device for Continuous Temperature Monitoring and Fever Detection
Author Name: Nishant Verma
Publication: IEEE Journal of Translational Engineering in Health and Medicine
Year: 19th July 2021

Objective	Methodology	Contribution	Limitations
Patient self monitoring of temperature and fever incidents suffers from low accuracy and is impractical for extended periods of time. Continuous temperature monitoring by a wearable device (such as Verily Patch) has the potential to overcome these challenges resulting in better patient clinical outcomes and more cost effective care.	In this study, we evaluated the use of a new wearable continuous temperature monitor (Verily Patch) in a high-risk population of cancer patients who have recently undergone high-dose chemotherapy and stem cell transplantation.	This study was conducted to collect data needed to develop the Verily Patch algorithms for body temperature measurement and fever episode detection, and assess its potential in early fever detection.	This study implementation has the limitations of not collecting information on infection diagnosis, antimicrobial administration and its timing, patient hospitalization duration and costs of intervention. This limited our ability to assess direct impact of Verily Patch on patient outcomes and health care costs.

3.Title: Comparative accuracy testing of contactless infrared thermometers
Author: Scott Adams PhD, Kelly Decker MN
Publication: School of Nursing & Midwifery, Deakin University, Geelong, Australia**.**
Publication Date: 2020-2021

Objectives	**Methodology**	**Contribution**	**Limitations**
Body temperature is a vital sign that is regularly measured to status of a patient's health. The WHO instigated public health measures including body temperature screening for rapid identification of potential Coronavirus cases and infection prevention. One potential method is an indirect estimate of core temperature measurement using Non-Con-tact Infrared Thermometers (NCITs).	A prospective observational study was conducted on a convenience sample of non-infectious inpatients in 2 Australian hospitals. NCIT and TAT devices were used to collect body temperature recordings. Participant characteristics included age, gender, skin colour, highest temperature, and antipyretic medication in last 24 years.	TB conceptualized the project and implementation; TB SK BS and KD were involved in the protocol development; TB BS and RD were involved in data collection and TB SK and RD conducted data analysis. SK, TB,BS, SA, AK and KD were involved in the data interpretation and manuscript writing.	There were several limitations for this study. First, a convenience sampling method was used for recruitment of participants in 2 hospitals. Although this is a simple, cost effective and easy to use method, the sample recruited using this method may not representative of the population. Second, repeated measures where not recorded to check precision of the NCIT. Third, the number of febrile cases (≥37.5°C) were limited to 31(11.7%) cases only.

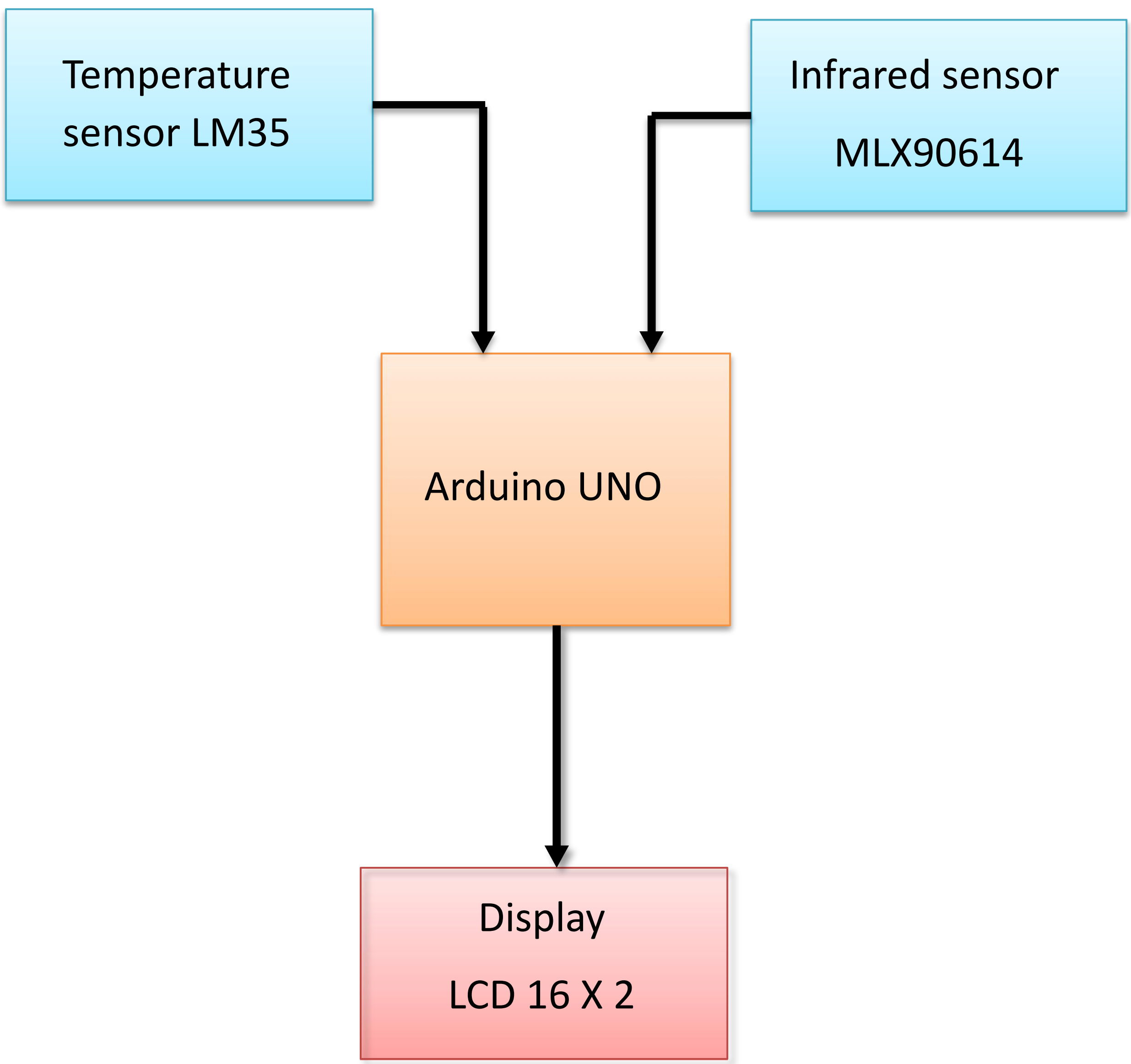
4. Title: Application of Temperature Measurement Contactless with Bidirectional Visitor Counter Using IoT as a Covid-19 Protocol
Author: Wayan Agus Putra
Publication: Advances in Social Science, Education and Humanities Research
Publication Date: 2021

Objectives	Methodology	Contribution	Limitations
To detect the temperature of people To keep the count of people passing through the gate	The system can check the visitor's body temperature The system can count the number of visitors and determine the availability of capacity The system can provide warning information in the form of sound Integrated system with IoT .The system can perform visitor calculations in two directions The system has data storage	The purpose of the MQTT subscription integration is so that Things board can receive data on body temperature and the number of people published by the device to the Hive MQ broker.	Accuracy Range External environmental factor

Chapter-3 System Implementation

BLOCK DIAGRAM OF PROPOSED SYSTEM

Block Diagram



CIRCUIT IMPLEMENTATION

Contact temperature detector

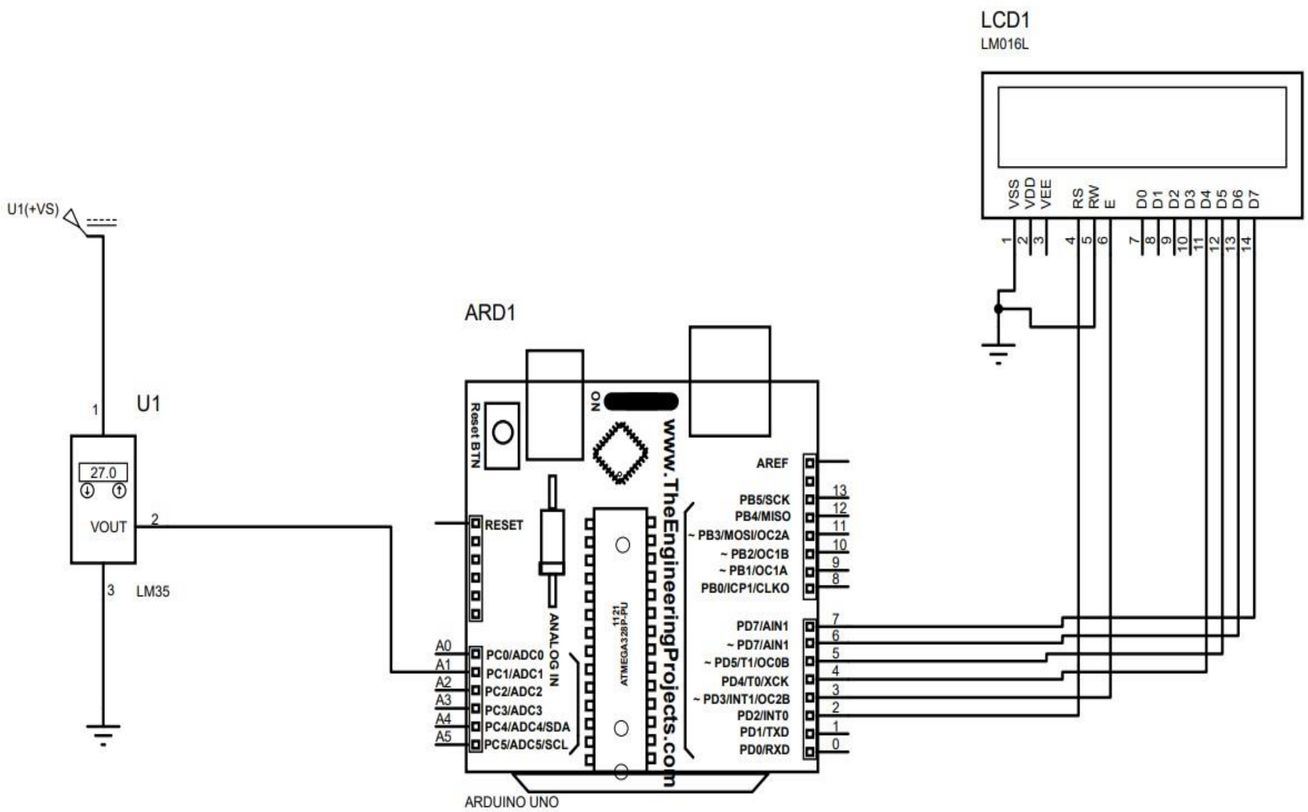


Fig No. 1

Contactless temperature detector

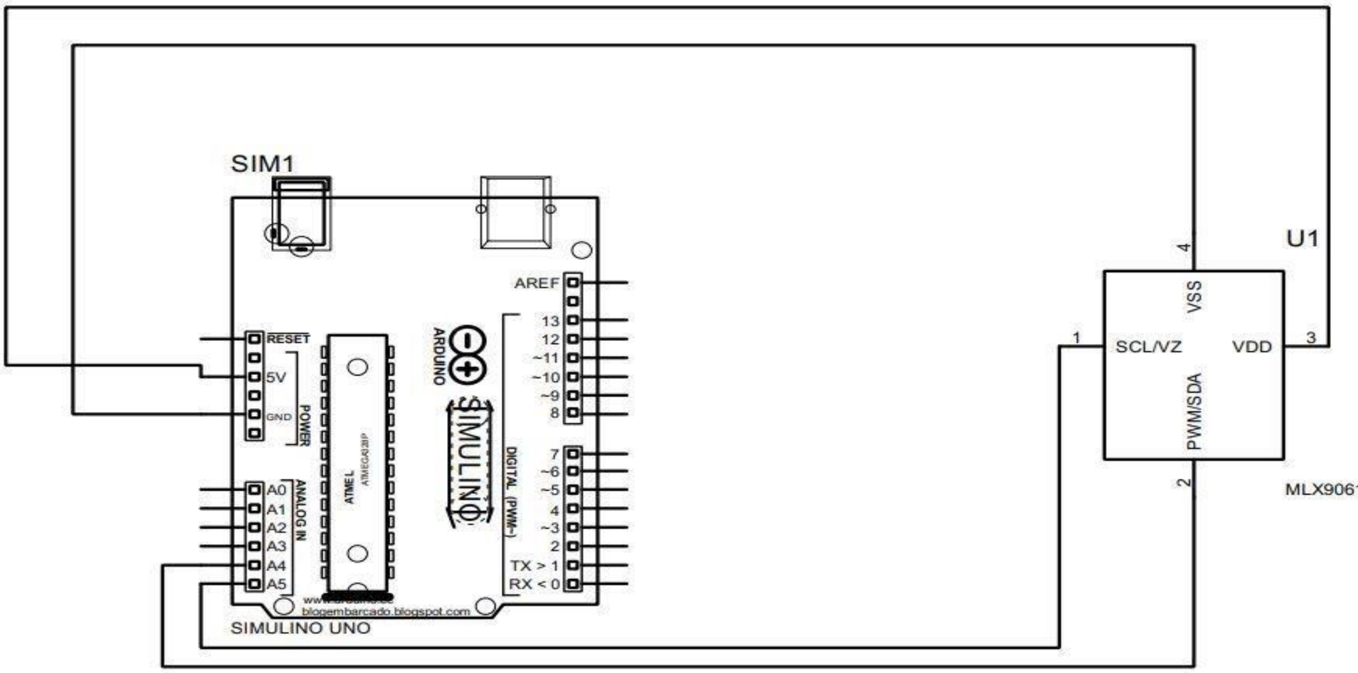


Fig No. 2

MATHEMATICAL ANALYSIS FOR ENTC AND MECHANICAL COMPONENT SELECTION

1) Voltage to Temperature Conversion

$$temperature = \left[\left(vout * \left(\frac{5}{1024}\right) - 0.5\right] * 100$$

$$temperature = [(vout * 0.0048828125) - 0.5] * 100$$

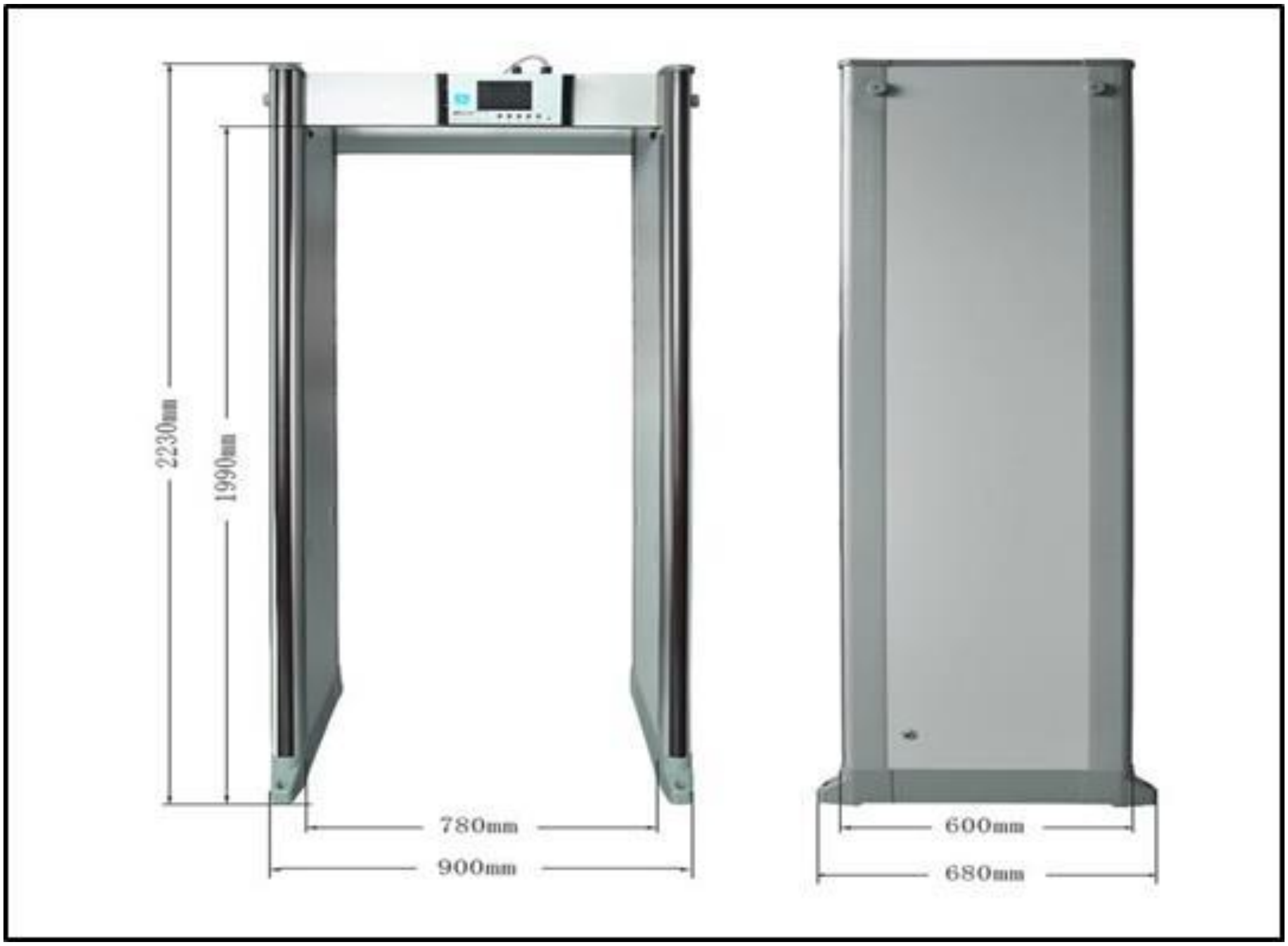
2) Celsius and Fahrenheit Conversion

°C = (5/9)°F-32

°F = (9/5)°C +32

CALCULATION OF SYSTEM PARAMETERS FOR EXPECTED OUTCOME

Specification	Parameters
1. Channel Dimensions	Width: 780 mm Height: 1990 mm
2. External Dimensions	Width: 900 mm Height: 2230 mm
3. Operating Temperature	36.1 C to 37.2 C or more 97 F to 99 F or more



The average height for Indian men is 5.8 feet (177 cm), and that for women is 5.3 feet (162 cm).

The average body temperature is 98.6 F (37 C). But normal body temperature can range between 97 F (36.1 C) and 99 F (37.2 C) or more. So considering this data implementation of walk through is done.

SELECTION OF COMPONENTS AND MECHANISMS FOR IMPLEMENTATIONED PROJECT

1. **Infrared Sensor (MLX90614):** An infrared sensor measures the temperature of an human by detecting the infrared energy emitted from its surface. It can measure temperatures from a few degrees above absolute zero to thousands of degrees Celsius.

2. **Arduino UNO (Microcontroller):** A microcontroller is a small, low-power computer that is often used to control electronic devices. It is implementationed to be embedded in a product, so it can take input from sensors and other components, process that data and produce an output.

3. **Temperature Sensor (LM35):** A temperature sensor is a device that measures the temperature of an object or environment. It can be used to detect the presence of heat, or to measure the temperature of a surface or object.

4. **LCD_I2C Display (16 X 2):** An LCD display is a thin, flat panel that is used to display images, text or other information. It is used in many electronic devices, such as calculators, watches, phones and televisions.

BILL OF MATERIAL

Materials used	Quantity	Cost
MLX90614	1	900
Arduino	1	800
LM35	1	90
Jumper wires	12	60
Cable	1	50
LCD	1	150
Buzzer	1	15
I2C	1	180
Total Cost		**2245**

PROJECT PLAN FOR SEM III AND IV

September (SEM III):

1] Searching for different project ideas.

2] Finalization a topic.

October:

3] Search which components are required for implementation.

4] Made a list of components.

a . Arduino Uno

b. MLX90614

c. LM35

d. LCD

e. Jumper wire

November:

5] Studied deeply about each component, their structure, functions and much more.

December:

6] Make circuit implementation by referring different websites & book.

7] Simulation of circuit on Proteus.

8] Implementation of circuit.

9] Interfacing of Arduino Uno, searching for appropriate code.

March (SEM IV):

1]Cabinet Implementation

April:

2]Interfacing the circuit along with LCD to display the temperature as output in the system

3]Buzzer if the body temperature is high than the normal temperature

May/June: Testing

HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements:

1) Arduino Uno
2) LM35
3) Mlx90614
4) Jumper wires
5) Cable

Software Requirements:

1) Proteus
2) Tinkercad
3) Arduino IDE
4) VS Code
5) Data Streamer

Chapter-4 Implementation Verification with Simulation

FINAL CIRCUIT DIAGRAM

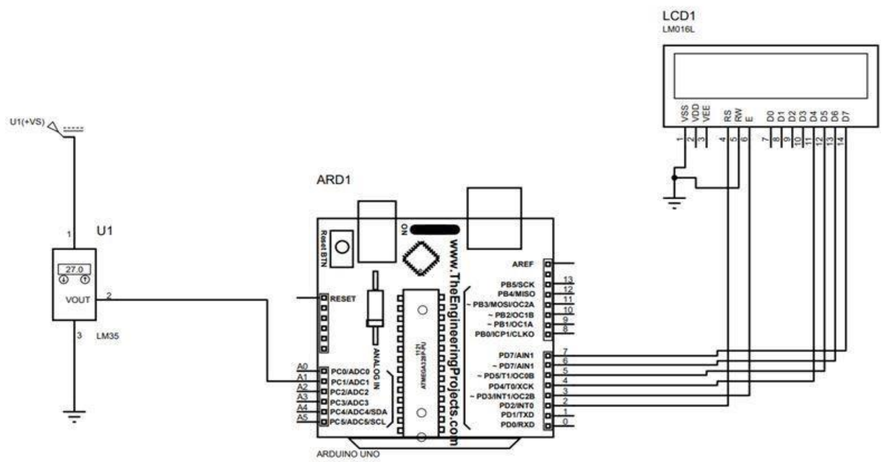


Fig No. 3

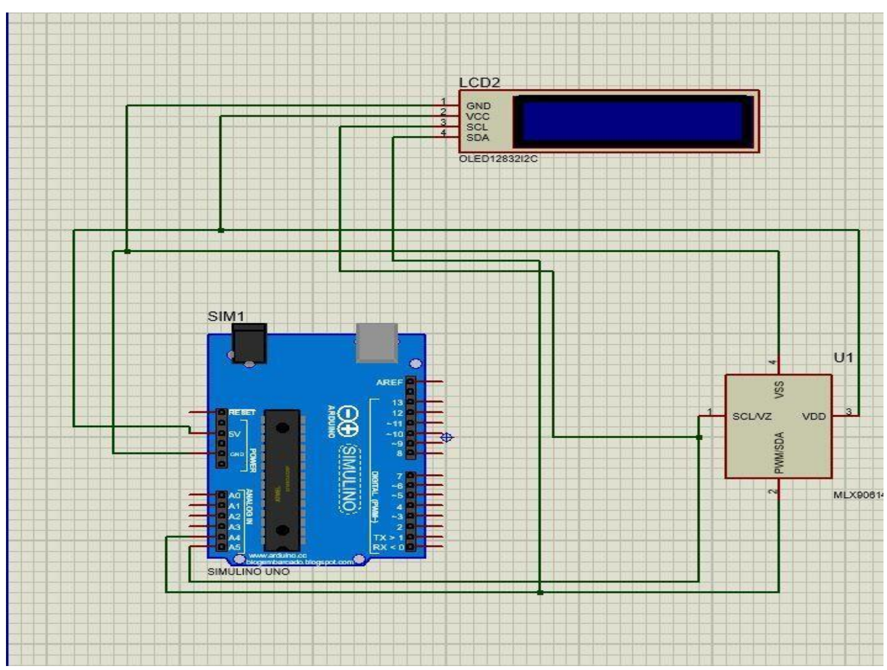


Fig No. 4

ALGORITHM AND FLOWCHART ALGORITHM FOR CONTACT TEMPERATURE DETECTION

Step 1: Start

Step 2: Include Liquid crystal Library of Arduino for interfacing LCD

Step 3: Initialize the variables like rs,en,d4,d5,d6,d7

Step 4: void setup() function

Step 5: Initialize lcd.begin(16,2)

Step 6: Initialize void loop() function

Step 7: Take analog input as voltage variable name – temp from analog pin A1

Step 8: Convert voltage input to temperature in degree Celsius and degree Fahrenheit

Step 9: Display output as temperature

Step 10: End

ALGORITHM FOR CONTACTLESS TEMPERATURE DETECTION

Step 1: Start

Step 2: Include wire.h and AdaFruit.h Library

Step 3: void setup() function

Step 4: mlx.begin() begin the connection pointing to Wire instance

Step 5: void loop() function

Step 6: mlx.readAmbientTempC() reads Ambient temperature in Celsius

Step 7: mlx. readObjectTempC() reads Body temperature in Celsius

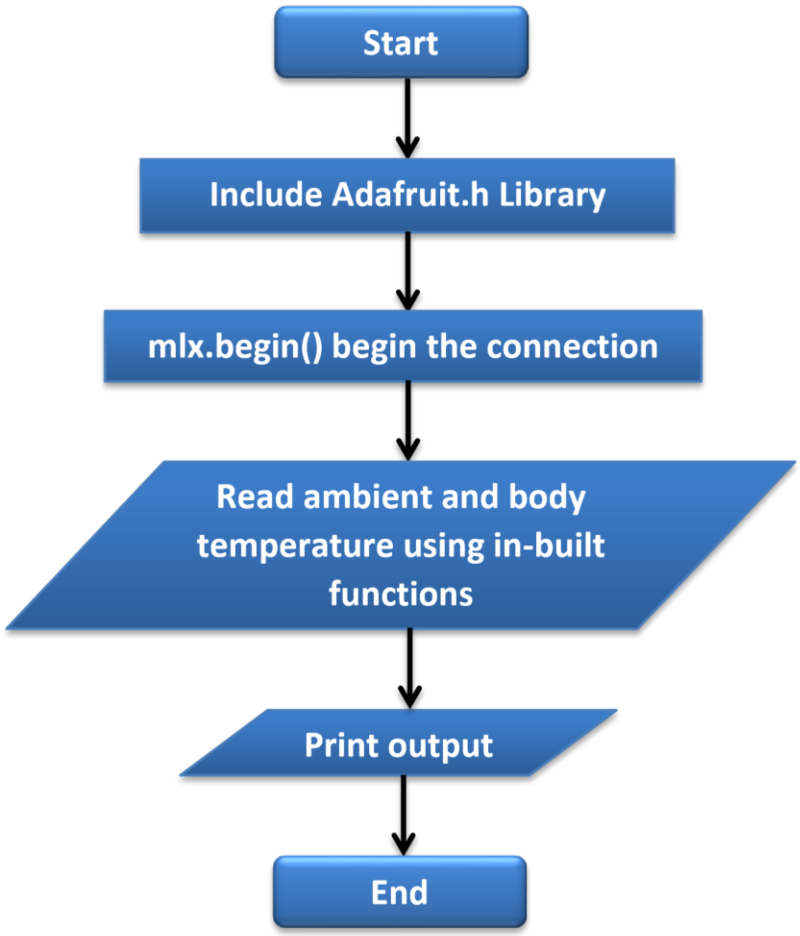
Step 8: mlx. readAmbientTempF() reads Ambient temperature in Fahrenheit

Step 9: mlx. readObjectTempF() reads Body temperature in Fahrenheit

Step 10: Display output

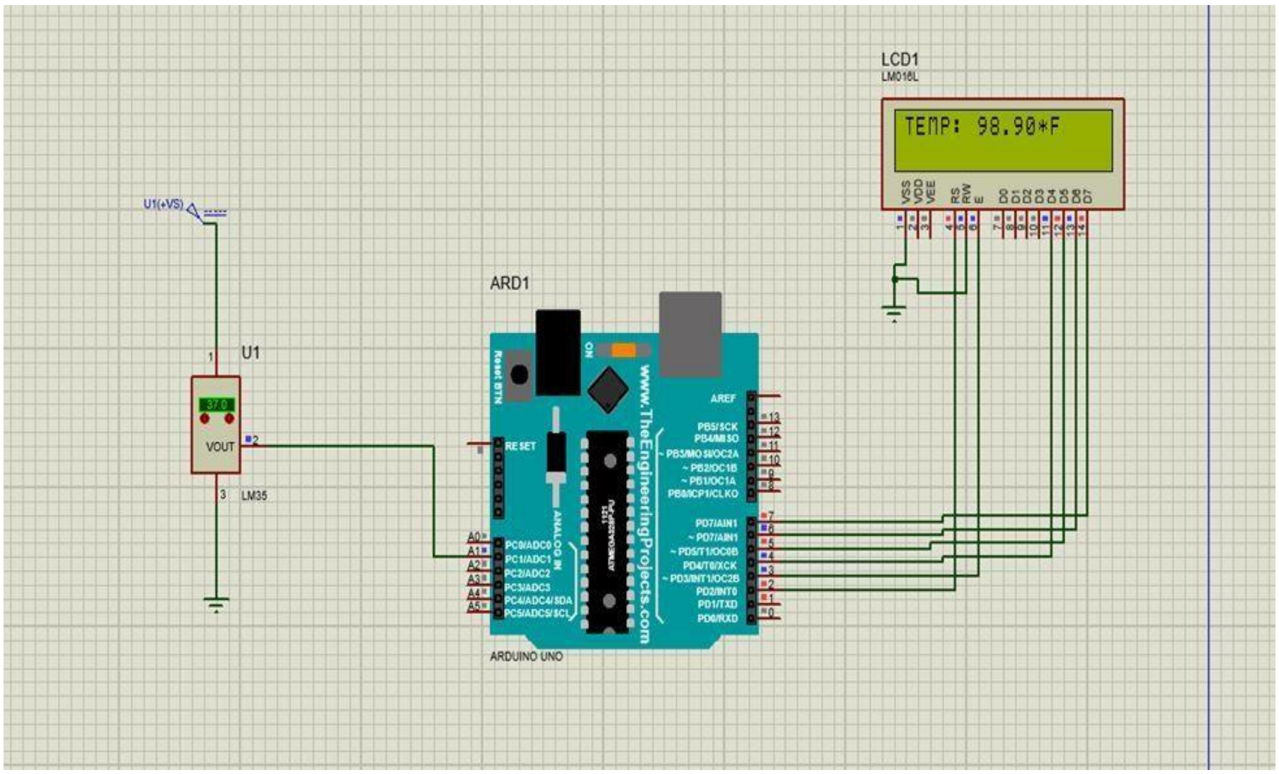
Step 11: End

FLOWCHART FOR CONTACTLESS TEMPERATURE DETECTION

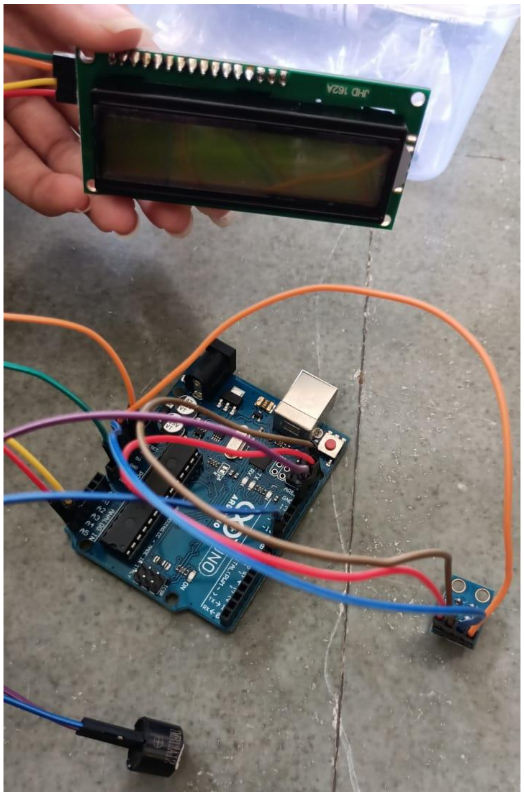


SIMULATION RESULTS

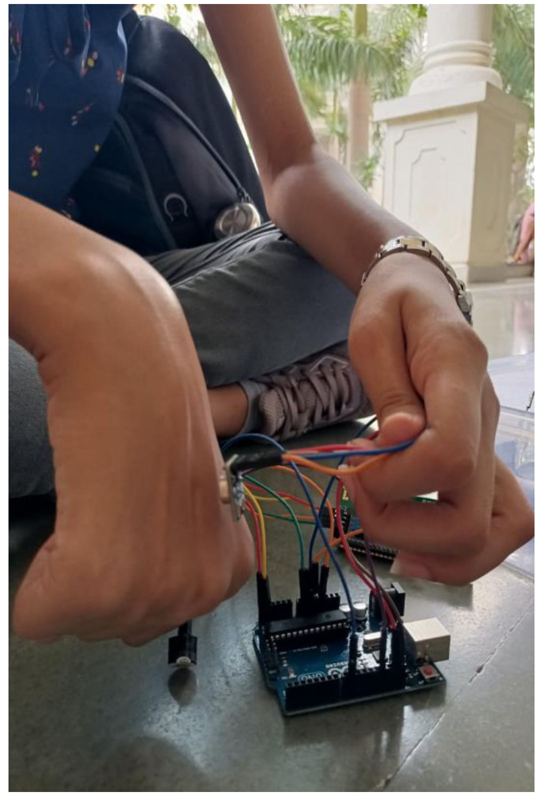
In simulation results, the body temperature is displayed along with the ambient temperature in case of contactless body temperature detection.



1.



2.



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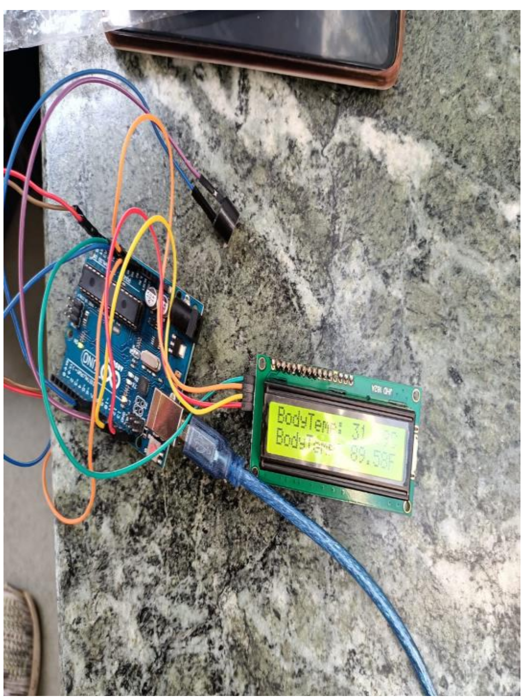

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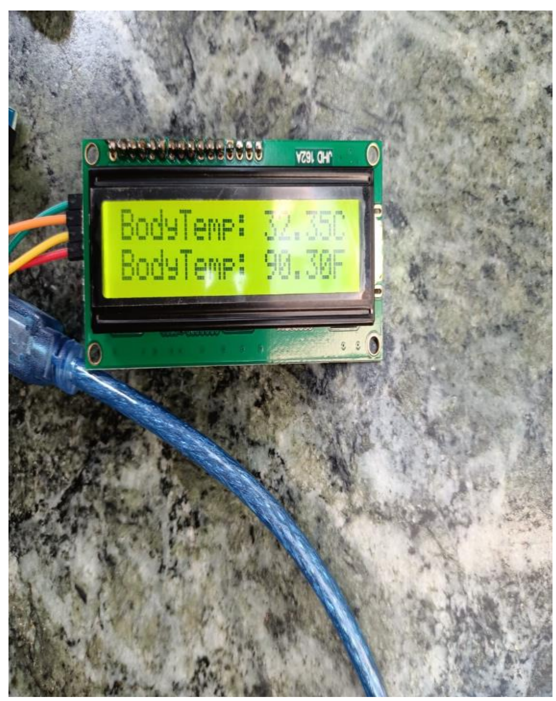


EXPERIMENTAL RESULTS

Testing

- Body temperature reading of people :-

1) 1^{st} person : Date – 23/2/23 Time : 3:25 pm Location : Project lab
   a) Ambient temp. (measured by mercury thermometer) = 35.03°c.
   b) Contactless : 1) From 2cm = 34.63°c.
   2) From 3 cm = 33.99°c.

2) 2^{nd} person : Time - 3:28pm
   a) Ambient temperature = 34.9°c.
   b) Contactless : 1) From 2cm = 34.92°c.
   2) From 3 cm = 33.9°c.

3) 3^{rd} person : Time – 3:30pm.
   a) Ambient temperature = 35.5°c
   b) Contatless : 1) From 2cm = 34.9°c.
   2) From 3cm = 34.6°c.

4) 4^{th} person : Time – 3:32pm.
   a) Ambient temperature = 35.2°c.
   b) Contatless : 1) From 2 cm = 35.01°c.
   2) From 3cm = 34.93°c.

5) 5^{th} person : Time - 3:35 pm
   a) Ambient temperature = 34.8°c.
   b) contactless : 1) From 2 cm = 34.9°c.
   2) From 3 cm = 33.94°c.

5) 6th person : Time - 3: 39 pm

a) Ambient temperature = 34·7°C

b) contactless : 1) From 2 cm = 34·43°C.

2) From 3 cm = 33·7°C.

7) 7th person : Time - 3: 41 pm

a) Ambient temperature = 35·0°C.

b) Contactless : 1) From 2 cm = 34·37°C.

2) From 3 cm = 33·33°C.

8) 8th person : Time - 3: 44pm

a) Ambient temperature = 34·5°C

b) Contactless : 1) From 2cm = 33·9°C.

2) From 3 cm = 33·35°C.

9) 9th person : Time :- 3: 47 pm

a) Ambient temperature = 34·4°C.

b) Contactless : 1) From 2 cm = 34·6°C.

2) From 3 cm = 32·6°C.

10) 10th person : Time - 3: 49 pm

a) Ambient temperature = 34·8°C.

b) Contactless : 1) From 2 cm = 33·87°C.

2) From 3 cm = 32·71°C.

- Readings in tabular format:-

Person	Ambient Temp.	Contactless	
		From 2cm	From 3 cm
1st	35.03°C	34.63°C	33.99°C
2nd	34.9°C	34.92°C	33.9°C
3rd	35.5°C	34.9°C	34.6°C
4th	35.2°C	35.01°C	34.93°C
5th	34.8°C	34.9°C	33.94°C
6th	34.7°C	34.43°C	33.7°C
7th	35.0°C	34.37°C	33.33°C
8th	34.5°C	33.9°C	33.35°C
9th	34.4°C	34.6°C	32.6°C
10th	34.8°C	33.87°C	32.71°C

- Percentage error:-

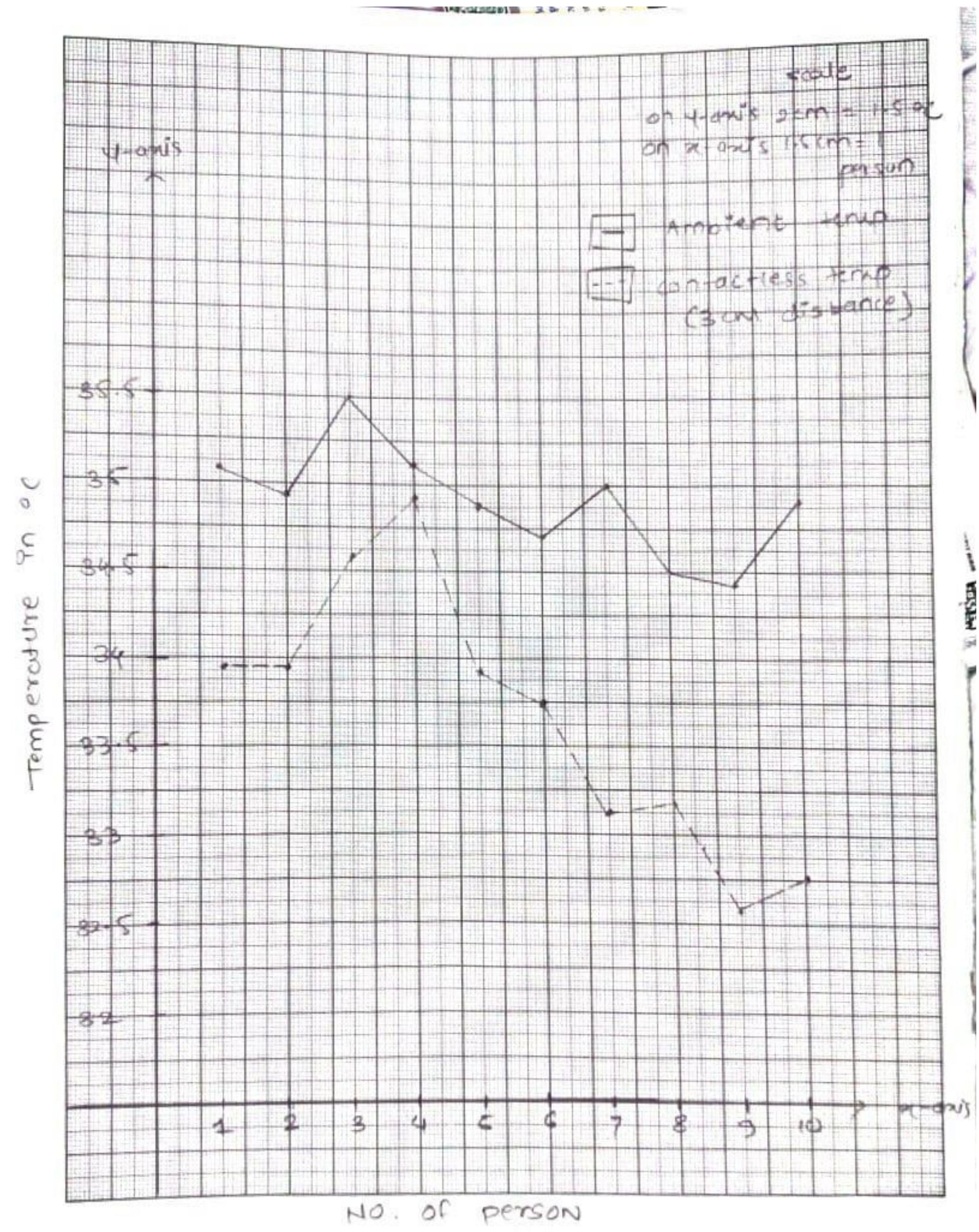
$$\text{Percentage error} = \left(\frac{\text{Ambient temp} - \text{Detected Temp}}{\text{Ambient temp}}\right) \times 100$$

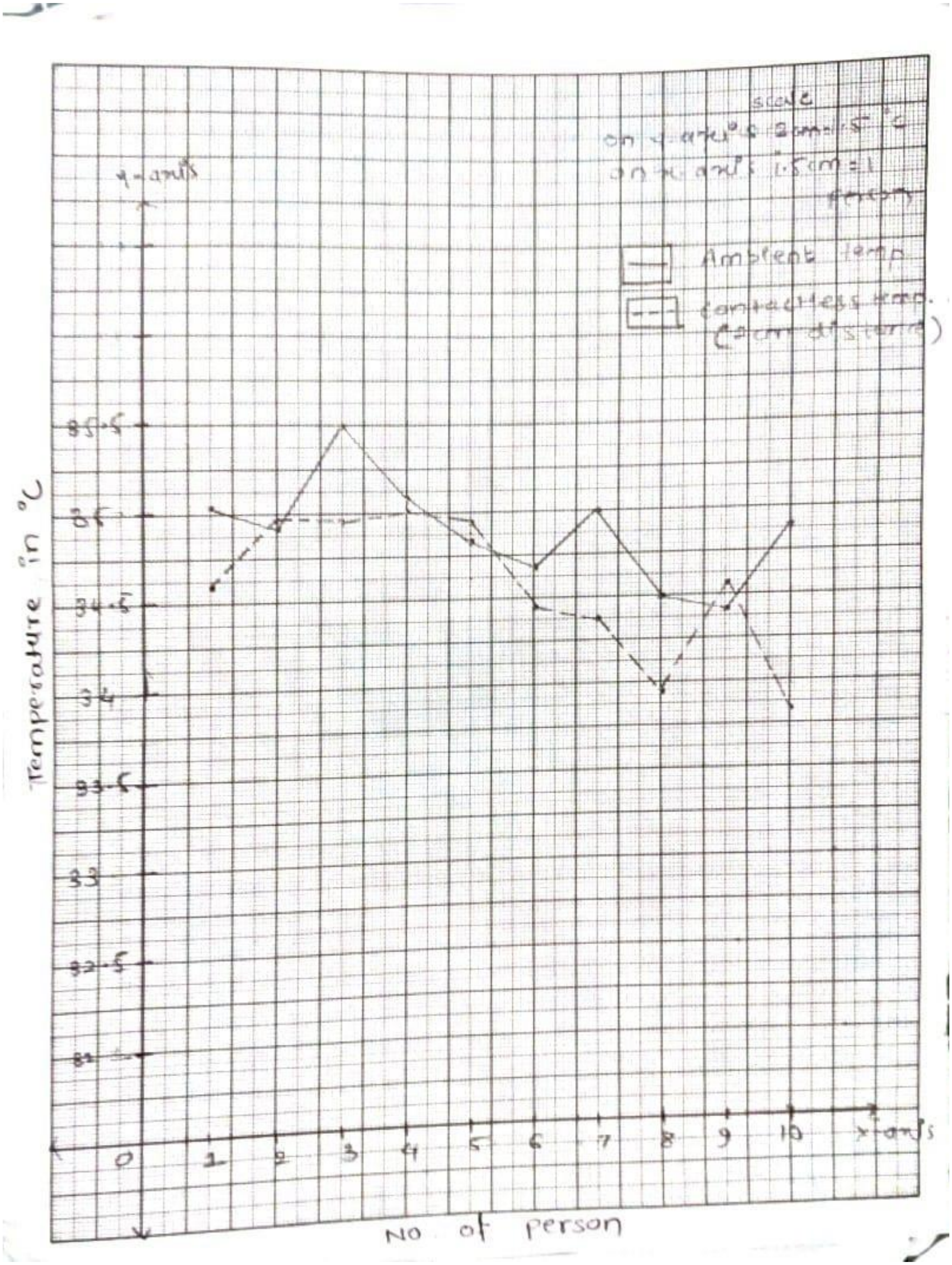
I) 1st person :

Ambient temp = 35.03°C, Detected temp : From 2cm = 34.63, 3cm = 33.99

I) From 2cm ⇒ % error = $\left(\frac{35.03°C - 34.63°C}{35.03°C}\right) \times 100 = \boxed{1.14\%}$

2) From 3cm ⇒ % error = $\left(\frac{35.03°C - 33.99°C}{35.03°C}\right) \times 100 = \boxed{2.96\%}$


scale
on y-axis 2cm = 1.5 °C
on x-axis 1.5cm = 1 person
Ambient temp
contactless temp
(3cm distance)
y-axis
35.5
35
34.5
34
33.5
33
32.5
32
Temperature in °C
1
2
3
4
5
6
7
8
9
10
x-axis
No. of person


scale
Ambient temp
y-axis
35.5
35
34.5
34
33.5
33
32.5
0
1
2
3
4
5
6
7
8
9
10
x-axis
Temperature in °C
No of person

DISCUSSION ON IMPLEMENTATION IMPROVEMENT

1. Improving mechanical implementation: The mechanical implementation of the detector could be improved to make it easier to use. This could include making it more lightweight, adding a handle or grip, or making it more compact.

2. Improving accuracy: The accuracy of the temperature detection could be improved by adding a more sensitive sensor or a better calibration system.

3. Improving durability: The durability of the device could be improved by using stronger materials and better construction techniques.

4. Adding a warning system: Adding a warning system can alert users when the temperature exceeds a certain threshold. This can be useful in applications where temperature needs to be kept within a predetermined range.

5. Adding a display screen: Adding a display screen to the temperature detector will allow users to more easily monitor the temperature readings in real time.

Chapter-5 References

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Pseudo Code

PSEUDO-CODE FOR CONTACTLESS TEMPERATURE DETECTOR

This program detects the human body temperature using in-built methods of MLX90614 module in Celsius as well as Fahrenheit

Include Wire.h library
Include LiquidCrystal_I2C.h library
Include Adafruit_MLX90614.h
Initialize the LiquidCrystal_I2C with address 0x27 which is commonly used for 16x2 LCD modules

In the setup() function{

Intialize the LCD

Turn on the backlight

Intialize the MLX90614 sensor

End

}

In the loop() function{

Declare the float objTemp and read Object temp in Celsius(in-built function)

Set lcd Cursor to 1st column and 1st row

Print the objTemp with 2 decimals

Declare the float objTemp1 and read Object temp in Fahrenheit (in-built function)

Set lcd Cursor to 1st column and 2nd row

Print the objTemp1 with 2 decimals

Print the temperature on Serial Monitor

End

}