IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Development and Evaluation of Contactless Temprature Sensing System using Android Application

JAISHAL SHANDLIYA, KANIKA AGGARWAL, RITIK ATTRI

ECE – 4th Year , ECE – 4th YEAR, ECE – 4th YEAR
ELECTRONICS AND COMMUNICATION ENGINEERING,
RAJ KUMAR GOEL INSTITUTE OF TECHNOLOGY
(GHAZIABAD)

Abstract : With the increasing need for non-invasive temperature measurement techniques, contactless thermometers have gained significant attention. This research paper focuses on the development and evaluation of a contactless thermometer application for Android phones. The objective of this study is to design and assess the performance of an application that utilizes the built-in sensors of Android phones to measure body temperature without the need for physical contact.

The contactless thermometer application utilizes the infrared sensor and ambient temperature sensor present in most modern Android phones. The infrared sensor detects the thermal radiation emitted by the human body, while the ambient temperature sensor measures the surrounding temperature. By combining these measurements, the application calculates the body temperature without requiring direct contact with the person.

Keywords **- Arduino Uno, Temperature sensor, Android application development, Bluetooth Module (HC-05)**

I. INTRODUCTION

In recent times, the need for non-invasive temperature measurement techniques has become increasingly crucial, especially in healthcare and public health settings. Traditional methods of temperature measurement, such as oral, axillary, or tympanic thermometers, require physical contact with the individual, posing potential risks of cross-contamination and discomfort[1-2]. In response to these challenges, contactless thermometers have emerged as a viable alternative, offering the advantages of convenience, hygiene, and ease of use.

The primary objective of this study is to design and evaluate the performance of the contactless thermometer application. The development process involves designing and implementing an algorithm that combines the readings from the infrared and ambient temperature sensors to calculate body temperature accurately. The algorithm takes into account factors such as ambient temperature compensation and calibration to ensure reliable temperature measurements.

To assess the accuracy and reliabilty of the contactless thermometer applicattion, a comparitive analysis is conducted against a standard clinical thermometer. A diverse group of participants is included in the evaluation process, ensuring representation across different demographics. The collected temprature measurements from both the contactless thermometer application and the clinical thermometer are analyzed statistically to determine the level of aggrement between the two methods.

Apart from the technical evaluation, the user experience of the contactless thermometer application is also assessed. Surveys and interviews are conducted to gather feedback from participants regarding the ease of use, comfort, and overall satisfaction with the application[2-3]. This feedback provides valuable insights for further refinement and improvement of the application's design and functionality.

II. SYSTEM ARCHITECTURE AND DESIGN

The system architecture of the contactless thermometer using an Android mobile device includes components for user interface, sensor integration, image processing, temperature calculation, data visualization, calibration, data storage, and connectivity. The design involves capturing temperature data through sensors, processing and analyzing the data, and presenting the results to the user in a user-friendly interface while ensuring accuracy and providing options for data sharing and storage.

A. Overview of the System Architecture

The functional block diagram of proposed system is shown in below Figure 1 . The proposed system starts with initialization of temperature sensors for collection of real time temperature data in compare to environmental temperature values.

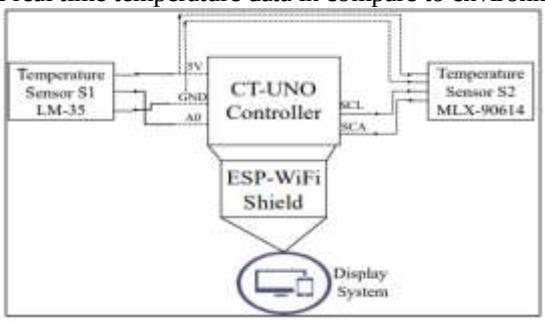

Fig 1.
Block Diagram

A contactless thermometer is a device or system that can measure temperature without physical contact with the object or person being measured. By utilizing an Android mobile device, you aim to develop a thermometer application that utilizes the device's capabilities for temperature measurement.

The main components of this topic include:

1. Non-Contact Temperature Measurement: The focus of your project is to explore non-contact temperature measurement techniques. This typically involves using infrared technology to detect and measure the thermal radiation emitted by objects or individuals.

2. Android Mobile Device: You plan to leverage the capabilities of Android mobile devices, such as the camera and potential infrared sensors, to enable temperature measurement. This would involve developing a mobile application that utilizes the device's hardware and software to capture and process temperature data.

3. App Development: You will need to familiarize yourself with Android app development, including programming languages like Java or Kotlin and development tools like Android Studio. This will allow you to create a user-friendly interface and implement the necessary features for temperature measurement.

4. Data Processing and Analysis: Once the temperature data is captured by the mobile device, you will need to process and analyze it within your application. This may involve techniques such as calibration, noise reduction, and temperature conversion.

B. Hardware Components Used

Arduino uno : **Arduino Uno** is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Temprature Sensor : The temperature sensor **MLX-90614** (S1) contactless is used in this proposed monitoring system. The MLX-90614 sensor is a precise sensor which directly converts the output voltage into temperature in Celsius. This conversion is programmed into Arduino panel using the [1]. This sensor is better than thermistor due to linear output and low impedance advantages. The range of this sensor is between -55°C to 150°C. [1] This equation normally used for S1 sensor while assembling with Arduino controller and stated numerical value represent the ratio of input value and analog voltage. The linearity of this S1 sensor is 10mV.

Bluetooth Module : HC-05 is a 6 Pin Wireless Serial Bluetooth Module use with any microcontroller. It uses the UART protocol to make it easy to send and receive data wirelessly.

The HC-06 module is a slave only device. This means that it can connect to most phones and computers with Bluetooth but it cannot connect to another slave-only device such as keyboards and other HC-06 modules. The HC-05 module can be operated within 4-6V of power supply. It supports baud rate of 9600, 19200, 38400, 57600, etc.

III. LITERATURE REVIEW

Infrared thermometers work based on a phenomenon called black body radiation. Anything at a temperature above absolute zero has molecules inside it moving around. The higher the temperature, the faster the particles move. The molecules emit infrared radiation as they travel beyond the visible spectrum of light; when they heat up, they release infrared and even visible light. That is why heated metal can glow red or indeed white. Infrared thermometers detect and measure this radiation. The ability to accurately measure the temperature of different materials has always been a challenge for the Instrumentation Engineer. Using the classic contact-type temperature detector such as thermocouples or RTD's (Resistance Temperature Detectors) has not always shown to be the best approach to obtain the standard measurement. When not used carefully in closed environments, thermocouples and RTD's could report the environmental temperature rather than the temperature from the product under examination. They are also temperature limited, and when needed for applications above those limits, costly and low reliable materials are necessary to do the job. The application of non-contact thermometers has become the preferred choice for such tasks.

Recently, research on the application of infrared thermography. Thermometry on human body temperature measurement has been carried out. Rodriguez-Lozano FJ, et al [5] proposed a novel method to segment the human being's forehead region and calculate the mean temperature of this area.

The Coronavirus (COVID-19) has spread globally, and temperature measurement is used to screen people rapidly. Handheld forehead are easy to use, rapid, non-contact, and inexpensive, so they are widely used. These were reported to measure wrist temperature and forehead temperature. However, these devices have unproven reliability [6]. Many studies compare temperature measurements for different parts of the human body using different thermometers.

This project aims to create a mobile application that utilizes infrared sensors, camera sensors, or external attachments to capture temperature data. The system architecture includes components for user interface, sensor integration, image processing, temperature calculation, data visualization, calibration, data storage, and connectivity. By conducting a literature review, one can explore existing research on non-contact temperature measurement, thermography, Android app development, and related areas.

IV. METHODOLOGY

The circuit diagram is depicted with showing the circuit design of the system. In where, MLX90614 temperature sensor and even Android Phone are connected with Arduino analog pin-4 and pin-5. At the same time, MLX90614 temperature sensor SCL is also connected with clock pic and SDA is with data pin simultaneously. To some extent, MLX90614 Infra-Red thermometer is a four pin, SMBus based device produced by Melexis Company [4-6]. It possesses characteristics including simple circuit, smaller size, wider applications and more economical. The on-site temperature is transmitted directly by "bus line" digital mode, which greatly enhances the anti-jamming system. It's suitable for on-site temperature measurement in harsh environments such as: environmental control, equipment or process control, electronic consumables which need proximity type temperature measurement.represents the MLX90614 Schematic and which helps the circuit understanding.

Android App Development : To make an app, you can use app creators such as MIT App Inventor, Kodular, Android studio, Eclipse, and others. For this project, Kodular has been used to create the app.

Sign up and create a new project: Go to the Kodular website (https://www.kodular.io/) and sign up for an account. Create a new project and give it a suitable name.

Design the user interface: Use Kodular's drag-and-drop interface builder to design the user interface for your app. Add necessary components like buttons

Then, create a new app by clicking the 'Create project' option. Name the project as per your choice. Here, the project name is 'Contactless IR thermometer.' Next, make the app layout and add the following components to the layout:

- Bluetooth client
- File
- Listpicker
- Clock
- Image

Fig 2.
Android Application Layout

There are three sections in the Kodular platform: Assets, Designer, and Blocks. The app layout in the Designer section is shown in Fig 3. Open the Blocks section and start the coding by joining various blocks, as shown in Fig. Next, export the project as IRThermo.apk file and install it on your Android phone.

Fig 3.
Coding Section in Kodular

Testing : After making the connections and installation of the app on your phone, enclose the hardware along with a 9V battery in a suitable plastic box with MLX90614 sensor fitted on the front panel. But first, you need to upload the Arduino code (IRThermo.ino) to the Arduino board.

Turn on the Bluetooth on your phone, open the app, and click on the 'Tap to Connect' button. Select HC-05 to connect it. After a successful connection, you can see the temperature readings on the application.

Fig 4.
Testing Application

USB based contactless IR thermometer : We made the project by omitting the Bluetooth HC-05 module. With the same code in the Arduino board, connecting the circuit with the phone using a USB cable and an OTG (on-the-go) connector,

Fig 5.
Circuit Connected to Mobile

We need to install a serial monitor app such as Serial USB Terminal (by Kai Morich) on our phone. After connecting the circuit with the mobile phone, We can see the object and surrounding temperatures on the phone.

V. RESULT

After completing our project it is the output. Here we can see the desired contactless thermometer which is used for measuring temperature without any contact. Below Figure is shown in room temperature. In this system we make a target for measuring temperature which would be someone's body or object. Moreover, the temperature will show in the Mobile display. Here we can see MLX90614 temperature sensor and a LED/IR light for accurate target of desired object or body. Besides, the last is provided with the side view of the contactless thermometer. At this time, the system considers a switch where if the switch is pushed down the Arduino gets power and the MLX90614 sensor reads temperature.

Fig 6.
Result of Application

VI. CONCLUSIONS

The system depicts the development of a contactless thermometer. Where we are fighting against unseen viruses which increase day by day contacting by person to person. So we need to maintain social distancing and need to measure body temperature without any contact. This system will help for making any contactless thermometer and measuring temperature without contact. In addition, the contactless thermometer is more advantageous in the application especially in the medical field. The system is successfully implemented and evaluated using highly advanced ICs and with the help of growing technology.

VII. REFERENCES

[1]A. Sohail, et al., "A review on hyperthermia via nanoparticle- mediated therapy," Bulletin du Cancer, vol. 104, no. 5, pp. 452-461, 2018.
[2] N. A. A. Rahman and A. B. Jambek, "Biomedical health monitoring system design and analysis," Indonesian Journal of Electrical Engineering and Computer Science, vol. 13, no. 1, pp. 1056-1064, 2020.

[3] M. Hyland, et al., "Wearable thermoelectric generators for human body heat harvesting," Applied Energy, vol. 182, pp. 518-524, 2020.
[4] A. Almazroa, et al., "Easy Clinic : Smart Sensing Application in Healthcare," in 2019 2nd International Conference on Computer Applications & Information Security (ICCAIS), pp. 1-5, 2019.
[5] G. C. van Rhoon, et al., "Hyperthermia and the need to monitor temperature," in International Conference on Electromagnetics in Advanced Applications (ICEAA), pp. 1181-1185, 2020.
[6] T. Drizdal, et al., "Prediction of Temperature Distribution for Superficial Hyperthermia Treatment : Accuracy of Temperature Dependent Blood Perfusion Model," in 44th European Microwave Conference, pp. 782-785, 2019.