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Design of IoT based Thermometer

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***Abstract* - The demand for contactless temperature measurement devices has increased exponentially as remote health monitoring and hygiene consciousness have increased in importance. In this research, an Internet of Things (IoT) based thermometer is proposed. It can facilitate accurate, safe, and instantaneous body temperature monitoring. The system utilises the MLX90614 infrared temperature sensor for contactless measurement and the ESP8266 Wi-Fi microcontroller for wireless communication. Remote monitoring using smartphones or internet dashboards is facilitated. A comparison of experimental measurements with classical thermometers has an accuracy error of less than ±0.2°C and a reaction time of less than one second. The suggested IoT-based thermometer's modest size, real-time cloud connectivity, and high reliability make it perfect for mounting in public areas like businesses, institutions, hospitals, and public buildings. As a result, the system provides a cost-effective and scalable solution for upcoming smart healthcare monitoring applications.**

Keywords Contactless temperature sensor, Wireless sensor networks, real-time data acquisition, smart healthcare.

1. INTRODUCTION

In recent years, contactless and accurate temperature monitoring has become more and more important for applications pertaining to public health and safety. Although physical-contact thermometers work, they are not suitable for rapid screening and carry a risk of cross-contamination. This restriction was made evident by the COVID-19 pandemic. It encouraged the use of the Internet of Things (IoT). IoT combines wireless modules and smart sensors to offer effective patient healthcare parameter monitoring and control. Since body temperature is still one of the most significant indicators of human health, these developments are focused on it.

The ESP8266 microcontroller, OLED display, MLX90614 infrared sensor, and Blynk cloud platform are used in the proposed design and construction of an Internet of Things (IoT)-enabled contactless thermometer to allow for real-time monitoring and alarm triggering. Due to this proposed design, accuracy is increased, and the existing temperature monitoring system is replaced with a small mobile device. This prototype size, cloud connectivity integration for remote access, and an auto-alarm system for out-of-range readings provide a scalable and based solution for smart healthcare systems.

2. LITERATURE SURVEY

In the paper [1], the author had stated that the infrared sensor was used to measure body temperature before granting access to an autonomous contactless temperature sensor and door access system. By avoiding direct human contact, the method guaranteed safety in pandemic situations. On the basis of the temperature reading, the microcontroller assessed the sensor data and managed the door mechanism. This method demonstrated how temperature monitoring and automation could work together to improve public safety.

In the literature [4], an Internet of Things-based temperature monitoring system that enables users to remotely check the ambient temperature was developed. It had illustrated how remote environmental and health monitoring is made possible by IoT integration.

In the paper [8], the authors developed a noncontact infrared thermometer that provided accurate temperature readings without requiring physical contact using the MLX90614 sensor. The design made use of an Arduino microcontroller to gather and display data. Their research showed that MLX90614 has excellent stability and sensitivity for use in biomedicine. This study provides strong support for the selection of the MLX90614 in contactless temperature-based IoT devices.

This paper[12] developed a NodeMCU ESP8266 and utilised it for medical applications. It was inexpensive, portable, and had the ability to measure and display body temperature. The ESP8266 was integrated to enable wireless data transmission and control through the Internet of Things. The ESP8266 is an appropriate core module for real-time patient monitoring systems, according to this study.

TABLE 1. COMPARISON OF THE PROPOSED SYSTEM WITH THE EXISTING SYSTEM

System Feature	**Digital Contact Thermometer**	**Standard IR Gun**	**Proposed Handheld Thermometer with IoT System**
Contactless Measurement	No	Yes	Yes
Portability / Handheld	Yes (low tech)	Yes	Yes
Real-time IoT Monitoring	No	No	Yes
Historical Data Storage	No	No	Yes (Cloud-based)
Remote Alerting	No	No	Yes (Mobile Push)
Low-Cost Design	Yes	Moderate	Yes

3. MOTIVATION FOR THE NEED OF THIS PROJECT WORK

The motivation behind this project arises from the urgent need for a safe and contactless method of temperature monitoring in public and healthcare sectors. Traditional thermometers involve physical contact, increasing the risk of infection spread. To overcome this challenge, cooperation between IoT technology and sensor systems was introduced to achieve automation and quick real-time monitoring. The integration of the ESP8266 microcontroller and MLX90614 sensor enables an accurate temperature detection without human involvement. and mainly, it is a low-cost comparison of IR gun thermometers. The suggested method is a step in the direction of intelligent, dependable, and sanitary healthcare solutions for the contemporary world.

4. PROPOSED SYSTEM MODEL

Figure 1 depicts the block diagram of the Proposed system. It comprises a power module, temperature sensor module, microcontroller module, display module, and cloud connectivity. The system is powered by a 3.7 V Li-ion battery and charged using a TP4056 Type-C charging module. To power the ESP8266 microcontroller safely, MLX90614 infrared temperature sensor, and OLED screen, the battery supplies a 3.3 V regulated voltage. The MLX90614 sensor, without touching the object, reads the ambient and object temperatures. It then sends the readings to the ESP8266 via the I²C interface (SDA and SCL pins). Temperature values are processed by the master controller ESP8266 and displayed on the OLED screen in real time. To enable remote monitoring as well as data logging, it utilizes its onboard Wi-Fi at the same time to send temperature readings to a cloud platform like ThingSpeak, Blynk, or an MQTT broker. To alert on the presence of a possible fever, for instance, the system can also alert when the temperature exceeds set levels.

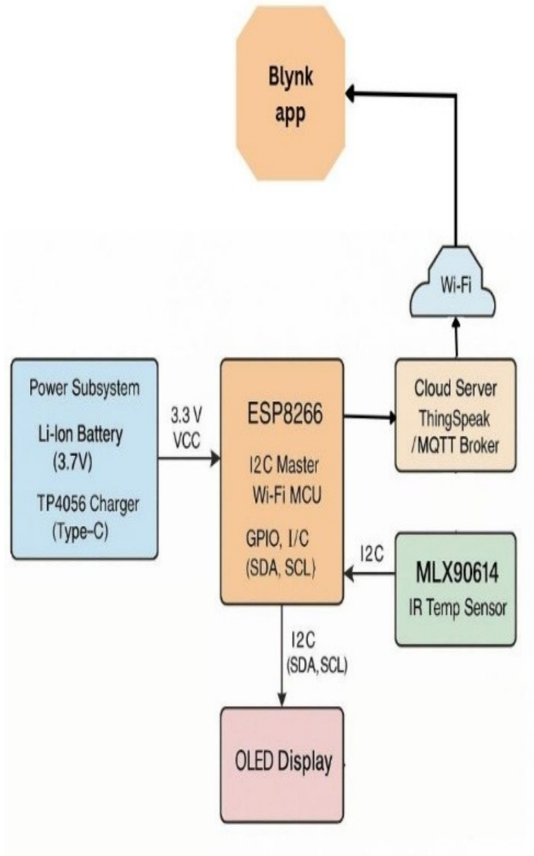

FIGURE 2:BLOCK DIAGRAM OF THE PROPOSED SYSTEM MODEL

4.1. Data Acquisition and Simulation Model:

IoT-based data transfer and contactless, real-time temperature monitoring are at the heart of the suggested solution. The general data flow from capture to cloud visualisation is described as follows:

Sensor Data Acquisition: The infrared temperature sensor continually gauges the target object's surface temperature without making physical contact. After being further digitalised, the sensor converts the infrared light it collects into an electrical signal that a CPU can process.

Microcontroller Processing: The core control unit is the NodeMCU, which utilises the ESP8266 chipset. After calibrating the sensor and collecting digital temperature data via the I²C connection protocol, it converts the data into degrees Celsius for further analysis.

Local Display and Alert Unit: After processing, the temperature data is shown in real time on a tiny OLED panel. If the temperature measurement climbs beyond the preset threshold (for instance, 38°C), the microcontroller activates a buzzer via a digital GPIO signal to offer an immediate local alert message.

Cloud Transmission and Monitoring: The NodeMCU connects to the Blynk IoT platform via Wi-Fi. The temperature data is uploaded to the cloud server via designated virtual pins. Users may monitor real-time measurements via the mobile application interface, ensuring ongoing health monitoring and remote accessibility.

Simulation and Verification: Before hardware deployment, the system was simulated using the Blynk dashboard and the Arduino IDE serial monitor. The simulation's outcomes validated reliable cloud connectivity, consistent sensor data, and consistent functioning under threshold scenarios.

Integration Model: The integration of processing, sensing, alerting, and cloud communication modules ensures efficient data collection and transmission. The system's suitability for portable diagnostic applications, smart healthcare monitoring, and medical screening is confirmed by the model.

4.1.1.Pseudocode of Proposed System:

Step1:
Initialise all hardware devices — power on the device, initiate serial communication, and initialise the infrared temperature sensor, OLED screen, and Wi-Fi interface. Connect the module to the Blynk cloud server using the given authentication token.

Step2:
Read the object temperature value from the infrared sensor continuously through the I²C interface and save the measured temperature in a variable.

Step3:
Show the real-time current temperature reading on the OLED display for local viewing and confirmation.

Step4:
Compare the sensed temperature with the set threshold value.

If the temperature goes beyond the limit, drive the buzzer for warning indication; else, keep the buzzer in the off state.

Step5:
Display the sensed temperature and warning status to the Blynk cloud through virtual pins (V10 and V11) for far-end visualisation. Continue the same indefinitely for real-time monitoring.

5. RESULTS & DISCUSSIONS

In this section, the hardware implementation of the proposed system is explained.

5.1 Hardware Implementation:

Figure 3 shows the hardware implementation of the proposed system..For precise temperature monitoring, the concept combines a non-contact thermal sensor with a microprocessor that can connect to Wi-Fi. The user may see the measured data instantaneously on a small OLED display. A buzzer is included when readings are deemed abnormal. The entire gadget is powered by a 3.7V rechargeable battery, ensuring portability and continuous operation. Every part is safely housed in a portable 3D-printed model, demonstrating functionality and practical application for both personal and medical uses.

FIGURE 3:HARDWARE IMPLEMENTATION OF THE PROPOSED SYSTEM

TABLE 2: INPUT PARAMETERS

SI.No	Temperature (Input Parameters)	Unit
1.	35.6	°C
2.	36.2	°C
3.	36.8	°C
4.	37.1	°C
5.	37.5	°C

From **Table 2**, it is observed that the input parameters of the system are the temperature values measured by the MLX90614 infrared sensor. These values are in degrees Celsius and represent the body or object temperature. The system collects multiple readings from different patients or locations. The inputs are continuously monitored for real-time processing.

TABLE 3: BODY TEMPERATURE STATUS

SI.No	Temperature Status	Buzzer Indication
1.	Normal	OFF
2.	Normal	OFF
3.	Normal	OFF
4.	Slightly elevated	OFF
5.	Mild fever	ON(Beep Once)

From **Table 3**, the output parameters include the temperature status, such as normal, mild fever, or high fever, based on threshold values. The system activates a buzzer and LED alerts for abnormal temperatures. It also stores the readings for logging and historical analysis. Remote monitoring through cloud dashboards is available as an output feature. The outputs enable timely intervention and ensure patient safety.

TABLE 4: COMPARISON OF THE PROPOSED SYSTEM AND THE CONVENTIONAL SYSTEM WITH THRESHOLD STATUS

Patient ID	Proposed System (°C)	Conventional System (°C)	Threshold Status
P001	35.6	35.8	Normal
P002	36.2	36.4	Normal
P003	36.8	37.0	Normal
P004	37.1	37.2	Slightly Elevated
P005	37.5	37.6	Mild Fever
P006	38.0	38.1	Moderate Fever
P007	38.4	38.3	High Fever
P008	39.0	39.1	High Fever
P009	39.5	39.6	Very High Fever
P010	40.0	39.9	Critical Temperature

Table 4, the comparison of the proposed system and the conventional system with threshold status. From the table, it can be seen that with only a ±0.1°C difference, the comparison demonstrates how well the suggested approach matches the traditional system. Hence, The Proposed contactless temperature monitoring system for real-time patient evaluation has a high degree of accuracy and reliability.

6. CONCLUSION

The proposed IoT-based system of a contactless body temperature scanner is a portable, safe, and amiable real-time health screening device. Without making physical contact, the gadget can precisely monitor body temperature thanks to the ESP8266 Wi-Fi module and the MLX90614 infrared sensor. The output is subsequently transmitted to the Blynk IoT cloud for real-time consumption. The buzzer signal and integrated OLED display improve user involvement and safety by providing instantaneous feedback. Connecting IoT technology to healthcare in this way is economical, effective, and hygienic. We find that it can provide accurate, consistent, and reliable temperature monitoring in public areas like workplaces, educational institutions, railway stations, and airports.

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