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Turn Your Phone Into Ir Contactless Thermometer

Mudimadugula Sai krishna[1], Daram Abhilash[2], Pothula Shiva Reddy[3], Kummari Anil kumar[4] ,Ms.G.Surekha[5]

[1,2,3,4] *B Tech final year students of Electronics & Communication Engineering,*
[5] *Assistant professor, Department of Electronics & Communication Engineering,*
JB Institute of Engineering and Technology (UGC Autonomous),Yenkepally, Hyderabad, 500075, Telangana.

Abstract- *The fast progress of embedded systems and Internet of Things technology has made it possible to create smart healthcare monitoring solutions. One important sign of human health is body temperature. Traditional thermometers need to touch the body, which can cause hygiene problems and infection risks. This project presents a contactless temperature monitoring system that uses an ESP32 microcontroller, an MLX90614 infrared sensor, an SSD1306 OLED display, and a laser module to accurately target the area. The system measures temperature without touching the body by detecting the infrared radiation it gives off. The ESP32 processes the data and shows the real-time readings on the OLED screen. The temperature data is also sent to the ThingSpeak cloud platform so it can be monitored remotely, and alerts are sent through Telegram. This system is easy to carry, doesn't cost too much, and is suitable for modern healthcare needs. It's a great example of how technology can help us take care of our health in a more convenient and safe way. By using this system, we can avoid the risks associated with traditional thermometers and get accurate temperature readings from a distance. This can be especially useful in healthcare settings where infection control is a top priority. Overall, this contactless temperature monitoring system has the potential to make a big impact in the healthcare industry and improve the way we monitor and manage our health.*

Key Words: Contactless Temperature Monitoring, Internet of Things (IoT), ESP32, MLX90614 Sensor, OLED Display, Thing Speak, Telegram, Embedded Systems, Smart Healthcare.

1. INTRODUCTION

The rapid advancement of embedded systems and Internet of Things (IoT) technologies has significantly transformed the healthcare sector by enabling smart, efficient, and real-time monitoring solutions. Among various health parameters, body temperature is one of the most important indicators used to detect infections and monitor overall health conditions. Traditional temperature measurement methods, such as mercury and digital thermometers, require direct physical contact with the human body, which can lead to hygiene issues and increase the risk of cross-contamination, especially in environments where multiple users are involved.

To get around these problems, special systems have been made that can check temperature without touching anything, using a technology that senses infrared. These systems work by finding the infrared radiation that the human body sends out, so they are safe, clean, and fast. When we combine these systems with special tiny computers and the Internet of Things, they get even better, because they can process information in real time, let people monitor things from far away, and send out automatic warnings when something goes wrong.

This project is about creating a smart system that can monitor temperature without touching anything. It uses a special tiny computer called an ESP32, a temperature sensor that can measure heat from a distance, a small screen to show the temperature, and a laser to help aim the sensor. The system shows the temperature in real-time and can also send the data to the internet and notify people, making it a great tool for healthcare.

1.1 Overview of Smart Healthcare Systems

Modern healthcare systems are getting smarter by using advanced technologies like tiny computers, internet-connected devices, and cloud storage. This helps doctors and nurses keep a close eye on patients' health around the clock. These systems can collect and analyze data in real-time and even let medical staff check in on patients from far away. This makes healthcare better and more convenient. Devices that use the internet to connect to

the healthcare system let patients be monitored from anywhere, which means they don't have to go to the hospital as often. It also helps doctors catch health problems early, which can make a big difference.

1.2. Importance of Body Temperature Monitoring

Checking your body temperature is a simple way to figure out if you're sick or not. It's really important to keep an eye on it, especially when there are a lot of people getting sick at the same time. If you can catch something early, you can get treated sooner and feel better faster. So, having good tools to measure temperature is crucial, not just in hospitals, but also in other places where people gather. This way, we can stop sickness from spreading quickly.

2. LITERATURE REVIEW

2.1 Introduction

The field of healthcare monitoring has come a long way, thanks to advances in embedded systems, the Internet of Things, and sensor technologies. When it comes to medical diagnostics, body temperature is a crucial parameter - it can be an early warning sign of infections and other physiological issues. But traditional thermometers that require contact can be a hygiene risk and aren't practical for large-scale or rapid screening. So, researchers have been working on developing systems that can monitor temperature without making contact, using infrared sensing and IoT-based communication technologies. This approach has a lot of potential for improving healthcare monitoring, especially in situations where speed and accuracy are critical. By leveraging these technologies, we can create more effective and efficient ways to track body temperature and respond to potential health issues.

2.2 Evolution of Contactless Temperature Measurement Systems

Measuring temperature has come a long way, from old-school mercury thermometers to super cool infrared devices that don't even need to touch you. These new thermometers work by picking up the heat signals your body sends out, making them faster and safer to use. Some really smart sensors, like the MLX90614, have made these thermometers way more accurate and reliable, and they can even measure the temperature of objects and the air around them. But, there are still some problems with these systems, like when the environment interferes with the readings or if they're not positioned just right. To make them even better, researchers have been trying out new ways to sense and calibrate the temperature, so we can get the most accurate readings possible. This is pretty important, because temperature measurement is used in all sorts of fields, from medicine to engineering, and having the right tools can make all the difference. By improving these systems, we can get more precise measurements, and that can lead to better decisions and outcomes in all sorts of areas.

2.3. IoT-Based Health Monitoring Technologies

IoT has transformed healthcare by enabling real-time data transmission, remote monitoring, and cloud-based storage. In temperature monitoring systems, microcontrollers such as ESP32 are widely used due to their built-in WiFi capability and efficient data processing.

Cloud platforms like ThingSpeak allow storage, visualization, and analysis of temperature data, enabling users to track trends over time. These systems improve accessibility and reduce the need for manual data recording. However, some implementations require complex configurations or additional hardware, limiting ease of use and scalability.

2.4. Wireless Communication and Alert Systems

In today's healthcare systems, being able to communicate in real time is crucial for keeping a close eye on patients. To make this happen, technologies like WiFi, GSM, and Bluetooth are used to send health information back and forth. More recent systems have started using messaging platforms to send alerts and notifications straight to the people who need them. For example, some systems use Telegram to send updates right away. These systems help people react faster, but they can also have some limitations. For instance, they might not work well if the network is down or if the connection is slow, which can delay the transmission of important data.

2.5. Review of Existing Systems

Several research works have focused on improving contactless temperature monitoring systems. Infrared sensor-based systems provide fast and hygienic measurement, while embedded systems enable real-time processing. IoT integration allows remote monitoring and data analysis. However, many existing systems focus on individual functionalities such as temperature measurement or data transmission rather than providing a fully integrated solution. Some designs lack real-time alert mechanisms, while others require additional components or complex setups. Accuracy issues due to improper alignment and environmental factors are also common limitations.

2.6. Research Gap

Even with all the progress that's been made, most systems still don't have all the features you'd want, like being able to sense things without touching them,

showing what's going on in real-time, storing data in the cloud, and sending notifications to your phone, all in one place. A lot of solutions out there just aren't practical because they're too expensive, not portable, or hard to use.

There are still some issues that need to be fixed, like when the equipment isn't accurate or when there aren't smart alerts to let people know what's going on. Also, we don't use modern ways of communicating as much as we could. So, it's clear that we need a system that brings everything together in one place, is easy to use, and works well. This kind of system would make healthcare monitoring better, more accurate, and more useful. It would be great to have something that combines all the important features into one device, making it easier and more efficient to use.

3. IMPLEMENTATION

3.1. System Architecture

3.1.1 Overall Architecture of the System

The proposed contactless temperature monitoring system is designed as an integrated embedded system that combines sensing, processing, display, and communication functionalities into a single platform. The ESP32 microcontroller acts as the central unit, interfacing with all system components including the MLX90614 infrared temperature sensor, SSD1306 OLED display, and laser module.

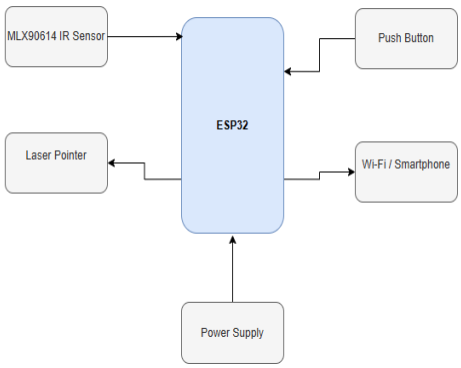

Fig - 3.1: Block Diagram

To start with, all the parts of the hardware are set up and they can all talk to each other. The MLX90614 sensor is always checking the infrared radiation that comes from the human body and it turns this into temperature readings. These readings are then sent to the ESP32 microcontroller using I2C communication. The ESP32 takes the data it gets and shows the temperature on the OLED screen right away, so the user can see what's going on immediately. This way, the user gets instant feedback, which is really useful. The whole process happens in real time, meaning the temperature is updated all the time, so the user can see any changes as they happen.

The ESP32 sets up a WiFi connection to send temperature data to the ThingSpeak cloud platform, where it's stored and visualized. At the same time, it uses Telegram to send temperature readings as real-time notifications to the user's mobile device. To help with alignment, a laser module is included, making sure the sensor and target are properly lined up for accurate measurements. All the components work together to provide real-time monitoring and good performance. This way, the system can give the user instant updates and reliable data.

3.1.2 Description of Integrated Modules

The system is made up of several parts that work together to get the job done. One of these parts is the temperature sensing module, which uses a special sensor called the MLX90614 to measure body temperature. This sensor is really good because it can do its job without actually touching the person, which helps keep everything clean and hygienic. Another important part is the processing module, which is based on a tiny computer called the ESP32 microcontroller. This little computer is in charge of collecting data, processing it, and helping all the different components of the system talk to each other.

The system has a display part that uses an OLED screen to show the temperature in real time, so you can see it clearly. It also has a communication part that sends the temperature data to the ThingSpeak cloud, where you can store it, look at it, and check it from far away. Plus, it's connected to Telegram, which sends you messages right away if something's up. There's even a laser part that helps aim exactly, so the measurements are accurate and consistent. All these parts work together, controlled by the ESP32, making sure everything runs smoothly and at the same time.

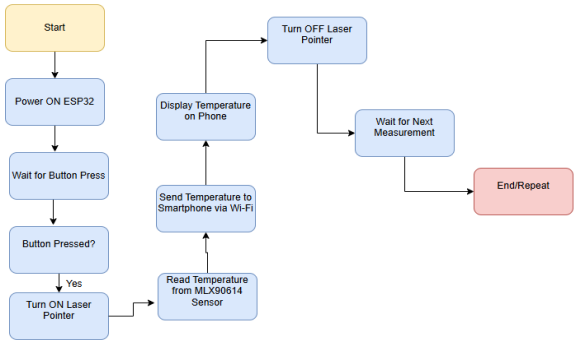

Fig - 3.2: Flowchart

3.2 System Working

The system runs all the time to keep an eye on the temperature in real time. When you turn it on, the ESP32 gets everything ready and starts talking to the sensor, display, and WiFi network. The MLX90614 sensor is always checking the temperature by feeling the infrared radiation coming from the human body. It does this by using the infrared radiation to figure out how hot or cold something is. This way, the system can always know what the temperature is and show it on the display. The WiFi network also helps the system send and receive information, so it can be controlled and monitored from afar.

Here's how the system works: the ESP32 takes the data from the sensors, processes it, and then shows it on the OLED screen so you can see it right away. At the same time, it sends the temperature data to the ThingSpeak cloud platform, where it's stored and can be looked at from anywhere. The system also sends updates on the temperature to the user through Telegram, so they always know what's going on. When the system is taking measurements, it uses a laser module to make sure the sensor is in the right spot. All this happens continuously, which means the system can monitor temperatures efficiently, accurately, and without touching anything.

3.3 Hardware Implementation

The hardware implementation involves interfacing all components with the ESP32 microcontroller. The MLX90614 sensor and OLED display are connected using the I2C communication protocol, which simplifies wiring and ensures reliable data transfer. The laser module is connected to a digital output pin of the ESP32 for control during measurement.

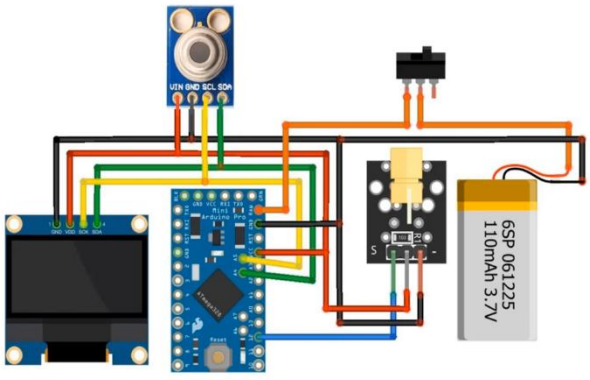

Fig - 3.3: Schematic Layout

To make sure everything works correctly, a steady power supply is given to all parts of the system. This power supply can come from a USB connection or a battery, which makes the system easy to move around and use in different situations. The connections are made carefully and the voltage is controlled to get accurate results and keep the system working consistently. This is important because it helps prevent problems that can happen when the power supply is not stable. By keeping the power supply steady, the system can work well and give reliable results, whether it's being used in a lab, at home, or in some other setting.

3.4. Results and Discussion

The contactless temperature monitoring system that was developed underwent testing to see how well it worked in real-world situations. It was able to successfully measure body temperature using a special sensor called the MLX90614 infrared sensor. This sensor sends the temperature data to the user's mobile device through the Telegram app. If you look at Figure 6.1, you can see that the temperature readings show up on the user's mobile device, along with status messages like "Normal". This gives the user clear and instant feedback, which is really useful. The system is designed to be easy to use and understand, so the user can quickly see if everything is okay or if there's a problem.

The temperature readings we got were between 35.3°C and 36.9°C, which is pretty much normal for a human body. What's really good is that the system gave us consistent readings every time we measured, so we can trust the sensors are working right. We also got the data sent to us in real time, with hardly any delay, which shows that the WiFi connection is strong and the ESP32 microcontroller is working well with Telegram.

The system also responded quickly to each temperature reading, processing and delivering the information to the user right away, without needing any manual help. Plus, with the IoT-based communication, it's possible to keep an eye on things constantly and easily look back at past data through the messaging interface. This makes it really convenient to stay on top of temperature readings and see how they change over time.

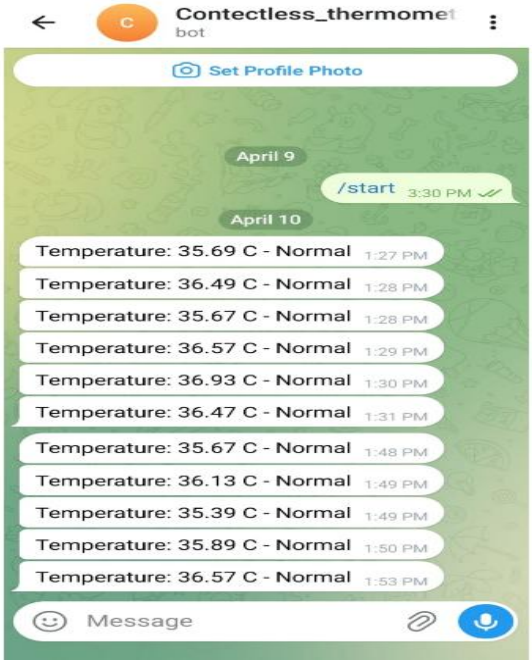

Fig -5.4: Telegram Output Result

Overall, the results indicate that the system provides accurate, fast, and reliable temperature monitoring. The integration of contactless sensing and real-time communication enhances usability and makes the system suitable for healthcare and public monitoring applications.

4. CONCLUSION

The new system is a game-changer for monitoring temperatures without touching anything. It combines infrared sensors, built-in processing, real-time displays, and internet-based communication all in one. This means it can show temperatures right away and send the information to other devices. The best part is that it doesn't need to touch anything, which makes it cleaner and safer for use in hospitals and public places. By not having to make physical contact, it reduces the risk of spreading germs and keeps people healthier.

The system uses a special sensor called MLX90614 to measure temperature. This sensor detects the heat given off by the human body and sends the information to a tiny computer called ESP32. The ESP32 then shows the temperature reading on a small screen in real-time. But that's not all - it also sends the temperature data to a cloud platform called ThingSpeak, where it can be stored and looked at later. And if someone wants to check the temperature from somewhere else, they can get instant updates on Telegram. This way, the system makes it easy to keep track of temperature readings from anywhere, at any time.

The addition of a laser module helps to improve the accuracy of measurements by making sure the sensor is properly aligned with the area being measured. This system works well in real-time and all its parts work together smoothly. It's reliable and efficient, making it a great tool for getting accurate readings quickly.

The system works well despite a few limitations, like being sensitive to its surroundings and needing to be positioned just right. But overall, it's a great solution that's easy on the budget, portable, and simple to use. It makes temperature monitoring more accessible and helps with remote health checks, which is a big step towards creating smart healthcare systems that really work. By using this system, we can keep an eye on health from afar and make sure people get the care they need, which is especially important in today's world.

5. FUTURE SCOPE

The proposed contactless temperature monitoring system can be further enhanced to improve its functionality, accuracy, and applicability in advanced healthcare systems. One of the major improvements is the integration of additional health monitoring sensors such as heart rate, SpO_2 (oxygen saturation), and blood pressure sensors, which would enable the system to monitor multiple vital parameters simultaneously and provide a more comprehensive health analysis.

The system is getting a big upgrade with the addition of artificial intelligence and machine learning. This means it can look at past temperature data on platforms like ThingSpeak and predict when something might go wrong, giving us a heads up so we can take action early. This is really helpful for keeping people healthy. Also, instead of just using Telegram, a special mobile app is being made that will make it easier for users to keep an eye on things, get alerts, and manage data. This app will be more user-friendly and make it simpler for people to use the system. By doing this, the system will be more effective and people will be able to take better care of themselves.

To make the system even better, we can add sensors that measure distance, like ultrasonic sensors, to get accurate positioning when taking temperature readings, which makes it more reliable. We should also use secure ways of sending information and encrypting data to keep it private and safe. This will help prevent any problems with the data and make sure it's handled correctly. By doing this, we can trust the system more and be sure that the information it gives us is accurate and protected.

Future work may also focus on making the system more compact and portable by designing a proper enclosure and integrating rechargeable battery support for continuous operation. The system can be extended to support multi-user data storage and integration with hospital databases and smart healthcare networks for large-scale deployment.

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