Project report
on

"NON-CONTACT THERMOMETER USING MLX90614 INFRARED SENSOR"

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Department of Electronics Engineering

Certificate

This is to certify that the project titled "Non Contact Thermometer using MLX90614 Infrared Sensor" has been Successfully completed by the following students under the guidance of Prof. Suresh Balpande in recognition to the partial fulfillment of the requirements for the Electronic Product Design ENP359 course work of Sixth Semester , Electronics Engineering during academic year 2021-2022.

Sourabh Ambade

Guided By

(Prof Suresh Balpande)

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ABSTRACT

Due to the spread of COVID-19 across the world and the increased need for non-contact thermometers to prevent the spread of disease, a new electronic thermometer has been designed and implemented for measuring human body temperature from a distance.[1] This device is currently in use at building entrances to measure the body temperatures of employees, students, and customers. This system is designed using low-cost easy-to-assemble open-source electronic components. The system consists of seven main parts: an Witty Board (ESP8266 12E), an infrared (IR) thermometer for non-contact temperature measurements (GY-906 MLX90614ESF module), for the purpose of contactless initiation of the system, Android/Computer to display results. Continuous body temperature monitoring is the one of the way to detect a corona patient. So many types of thermometers are available in market. The normal thermometer can measure the temperature of a covid patient and also may spread the virus. In this special situation we can use the Non Contact Thermometer. And also known this device as temperature gun. The biggest manufacture of this Temperature Gun China. And this device is costly. But this lock down and Covid-19 threads make the production of this device is more difficult. We can make a Non Contact Thermometer with some commonly available components. The smart thermometer can achieve non-contact measurement, place the thermometer in the forehead for a few seconds to get the body temperature, to alarm once the set value is exceeded. The design temperature range is 0-55°C , and temperature resolution is 0.1 °C [2]

INTRODUCTION

Early methods of measuring body core temperature utilizing contact mercury thermometers are replaced by the safer and more convenient electronic thermometers at the sublingual, armpits, ear canals [2] Many of these surface measurement sites, specifically the temporal and central forehead, reflect lower readings than internal sites. While screening for disease in the ongoing pandemic, rapid temperature measurements of many individuals quickly and safely without allowing the thermometer to be a vector of pathogen transfer are crucial, thus making contact infeasible, ruling out many of the above measurement sites. Non Contact Infrared (IR) thermometers can fulfil this gap by measuring the surface temperature without direct contact, which is through detecting the amount of thermal or the object.[3] Additionally, these thermometers are now commonly used in clinical practices, as well as routinely during the pandemic for self-monitoring and screening at the entrances of public places. To help alleviate the above problems, we describe the design and assembly of a low cost IR thermometer with distance and environmental temperature sensing capabilities to provide more accurate measurements.

Since the COVID-19 situation keeps going on started from 2019. Many solutions are to against the spreading of coronavirus disease. [4]. The nurses have died, and other medical workers are in critical condition from operating in the hospital. It is a deadly virus that kills many humans; urgent solutions have urged the public to be confident about the Government's handling of the 2019-novel Coronavirus. At the same time, everyone has to embrace the new normal lifestyle and social distancing while patiently waiting for scientists and doctors to discover vaccines and treatments to defeat COVID-19. This work proposes an innovation of wireless body temperature that instead of the used manual by medical workers in the hospital. The MLX90614 is an accurate sensor that matches to use for medical promotion. The detected information data from sensor will be sent to the host computer and stored in the cloud internet service.

MOTIVATION

The current COVID-19 scenario needs no introduction. While everyone is giving their best to move forward, it is important to act responsibly and tackle this problem collectively. Today in many public places and in other gatherings, it has become common to screen individuals for body temperature, as a preventive measure to check for fever. The device that is used to do this is called a Non- Contact Infrared Thermometer. As many might have noticed, there is a huge surge in demand for this product, but it is not very hard to build one on your own which could not only serve its purpose but also provide more useful features than the commercial ones.[3]

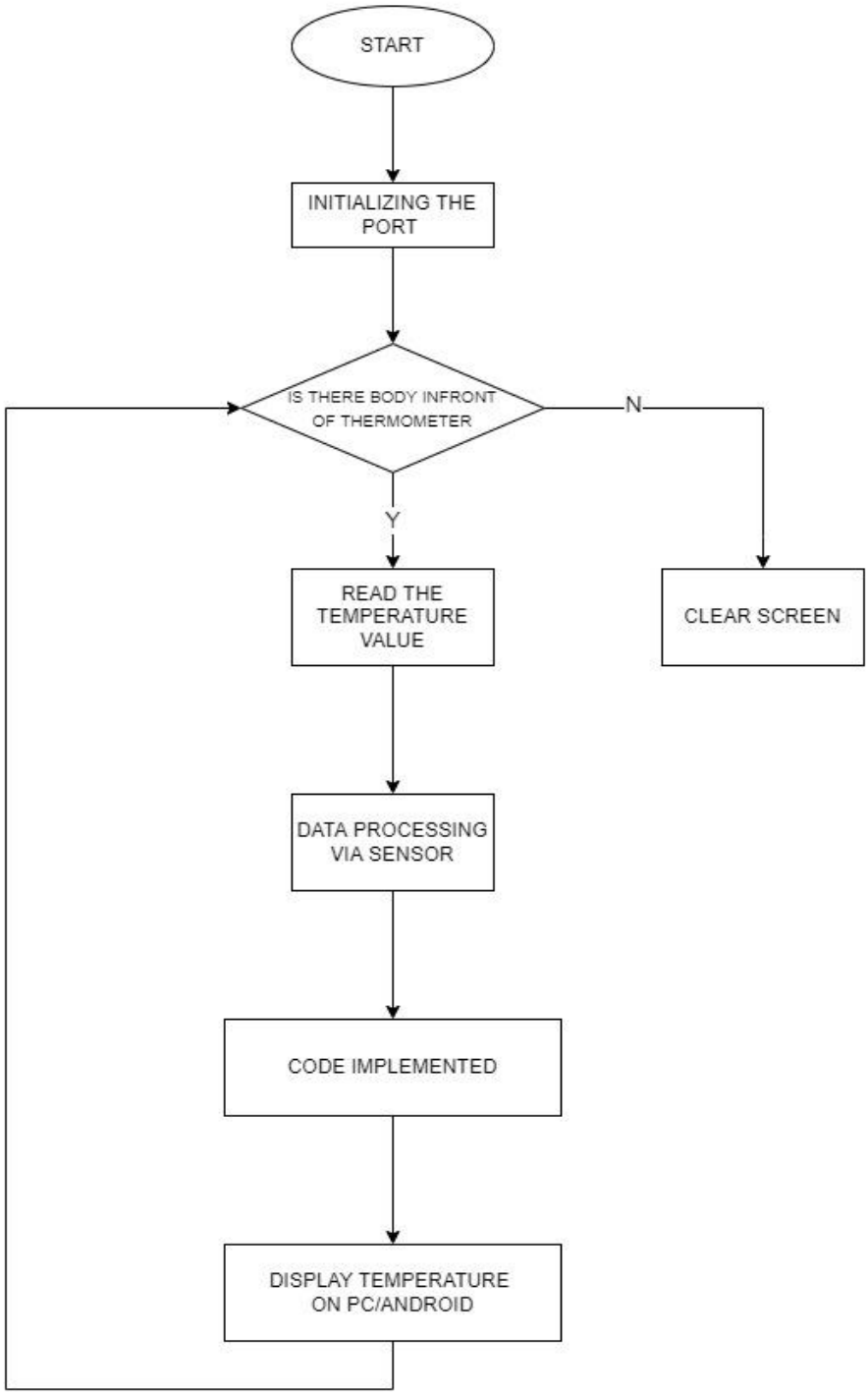
So, the objective of this tutorial is to design a Low cost, Easy to build Contactless Thermometer that can measure body temperature.
By using IoT and MLX90614 sensor we are going to implement the product and help the community from COVID-19 .

By this project we will be able to lower down the case that are spread due to the Physical temperature measurement of individuals who can be employees of a office or the kids playing in the park. This will help and put a positive impact on the society

PROBLEM STATEMENT:

To design a Low cost, Easy to build Non-Contact Thermometer that can measure body temperature.

FLOW CHART



Literature survey

1. **Title:** Design and Development of Digital Proximity Type IR Thermometer Based on Arduino unoR3

   Published In: IJERSET Vol. 5, Issue 2, February 2016

   Technical Analysis: novel design method of digital IR thermometer to achieve temperature display, which uses Arduino unoR3 as the main control device.

2. **Title:** Contactless Body Temperature Monitoring of In-Patient Department (IPD) Using 2.4 GHz Microwave Frequency via the Internet of Things (IoT) Network

   Published In: Wireless Pers Commun (2021).

   Technical Analysis: studied the development of IoT heartbeat and body temperature monitoring systems for community health volunteers.

3. **Title:** Design of Non-Contact Infra-Red Thermometer Based on the Sensor of MLX90614

   Published In: The Open Automation and Control Systems Journal, 2015, Volume 7

   Technical Analysis: Studied the temperature from varying distance of bottles and checked the temperature accuracy and its reliability

Hardware Description & List of Components

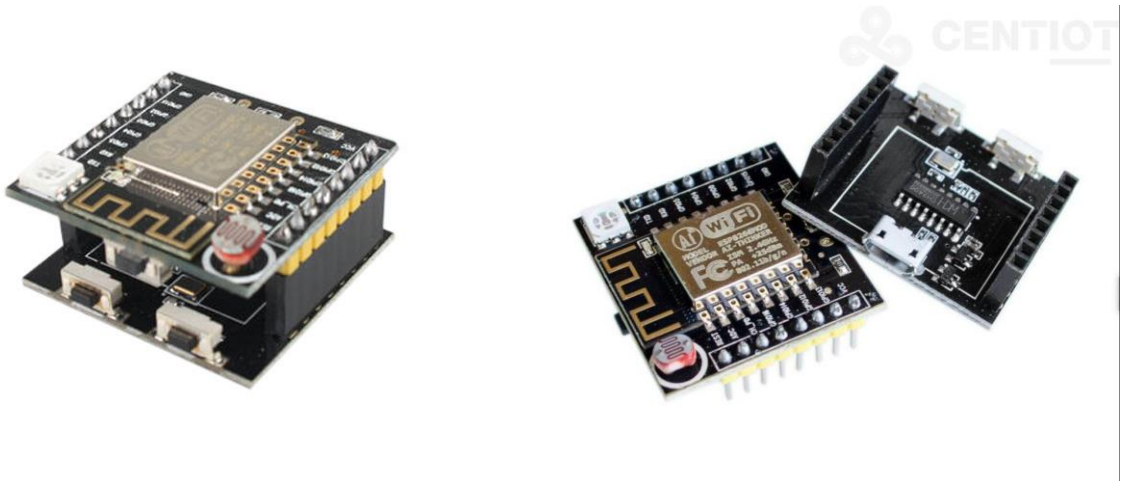


Fig 1 Witty Development Board [8]

1) ESP8266-12E (WITTY DEVELOPMENT BOARD)

- Serial WIFI Witty cloud Development Board Module is a compact ESP8266 board with integrated USB to TTL debug interface, a photoresistor, and/or some useful buttons, all in a white brand board based on ESP-12F.

- The board is in two parts – one part has reset/flash buttons, a CH341 UART and female headers; the other half has USB for power only, a button (for input, not reset or flash) and male headers which take up an entire breadboard.

- Uses latest ESP-12E module with 4M flash and integrated antenna.

Specification:

- Uses latest ESP-12F module with 4M flash and integrated antenna
- Includes CH340G USB-to-UART programmer
- Compact design (30mm (w) * 30mm (d) * 15mm (h) approx.)
- Includes LDR (light dependant resistor a.k.a photoresistor) connected to ESP's ADC pin
- RGB LED connected to GPIO 12,13 and 1.
- It has an operating voltage of 3.3V.
- It has an operating current of 100mV ~ that is 12 mV optimal
- Operating temperature range = -40 C to 125 C

2) MLX90614 INFRARED SENSOR

Fig 2 MLX90614 Sensor with the pins to be soldered on left [9]

MLX90614ES is a non-contact infrared thermometer for Arduino, or any microcontroller that can communicate with it through it's I2C interface.

- This sensor comes with a breakout board with all of the components needed foR operation and two types of pins.
- They are unsoldered.
- There are two solder jumpers for the I2C interface that may or may not need to be soldered depending on your application, but will not for most uses.
- This temperature sensor can measure the temperature without touch the object. It has 0.5 degree Celsius over a wide range of temperature.

MLX90614 General Description

The MLX90614 is built from 2 chips developed and manufactured by Melexis:
The Infra Red thermopile detector MLX81101.
The signal conditioning ASSP MLX90302, specially designed to process the output of IR sensor.
The device is available in an industry standard TO-39 package.

Thanks to the low noise amplifier, high resolution 17-bit ADC and powerful DSP unit of MLX90302 high accuracy and resolution of the thermometer is achieved. The calculated object and ambient temperatures are available in RAM of MLX90302 with resolution of 0.01˚C. They are accessible by 2 wire serial SMBus compatible protocol (0.02°C resolution) or via 10-bit PWM (Pulse Width Modulated) output of the device.

Fig 3 MLX90614 Pinout [4]

Pin Name	Function
VSS	Ground. The metal can is also connected to this pin
SCL/Vz	Serial clock input for 2 wire communications protocol. 5.7V Zener is available at this pin for connection of external bipolar transistor to MLX90614A to supply the device from external 8 - 16V source.
PWM/SDA	Digital input / output. In normal mode the measured object temperature is available at this pin Pulse Width Modulated.
VDD	External supply voltage.

Fig 4 Pin Name and its function [4]

MLX90614 Block Diagram

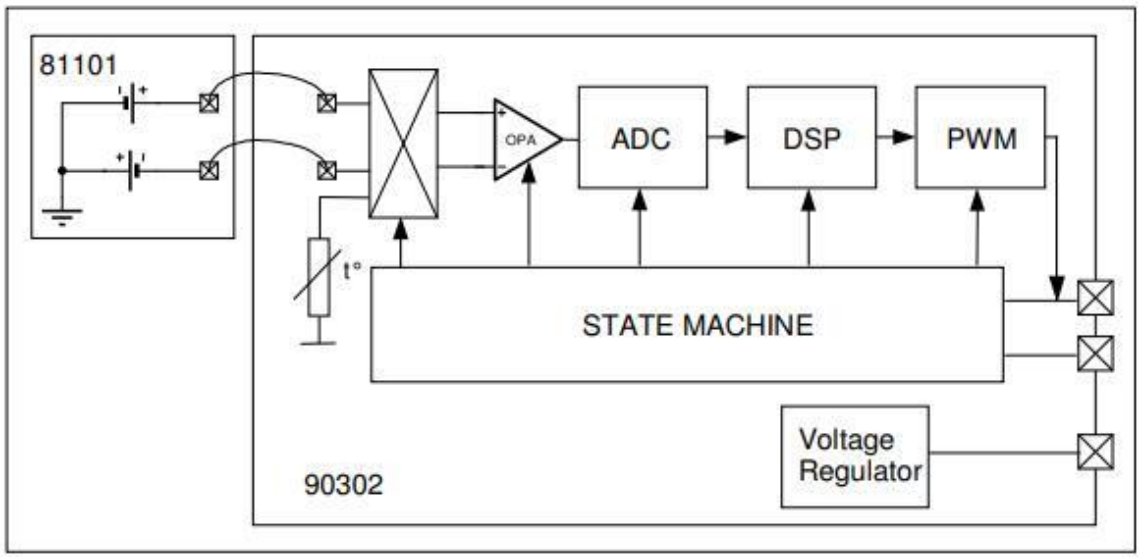


Fig 5 Block Diagram [5]

MLX90614 Specifications

- Operating Voltage: 3.3V to 5V (available in 3V and 5V version)
- Supply Current: 1.5mA
- Object Temperature Range: -70° C to 382.2°C
- Ambient Temperature Range: -40° C to 125°C
- Accuracy: 0.02°C
- Field of View: 80°
- Distance between object and sensor: 2cm-5cm (approx.)

The key feature of the MLX90614 is that it is a high-precision, contactless IR temperature sensor. It can therefore be used in industries to measure the temperature of moving objects, such as a rotating motor shaft. Due to its high accuracy and precision, it is also used in a wide range of commercial, health and household applications such as room temperature monitoring, body temperature measurement, etc.

MLX90614 Working Principle

As mentioned above, the MLX90614 sensor can measure the temperature of an object without any physical contact with it. This is made possible by a law called the Stefan-Boltzmann Law, which states that all objects and living beings emit IR Energy and that the intensity of that emitted IR energy is directly proportional to the temperature of that object or living being. The MLX90614 sensor therefore calculates the temperature of the object by measuring the amount of IR energy emitted from it. [10]

Software Description & Working of Non Contact Thermometer with MLX90614

Blynk App

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, vizualize it and do many other cool things.

There are **three** major components in the platform:

- **Blynk App** - allows to you create amazing interfaces for your projects using various widgets we provide.
- **Blynk Server** - responsible for all the communications between the smartphone and hardware. You can use the Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- **Blynk Libraries** - for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands.[6]

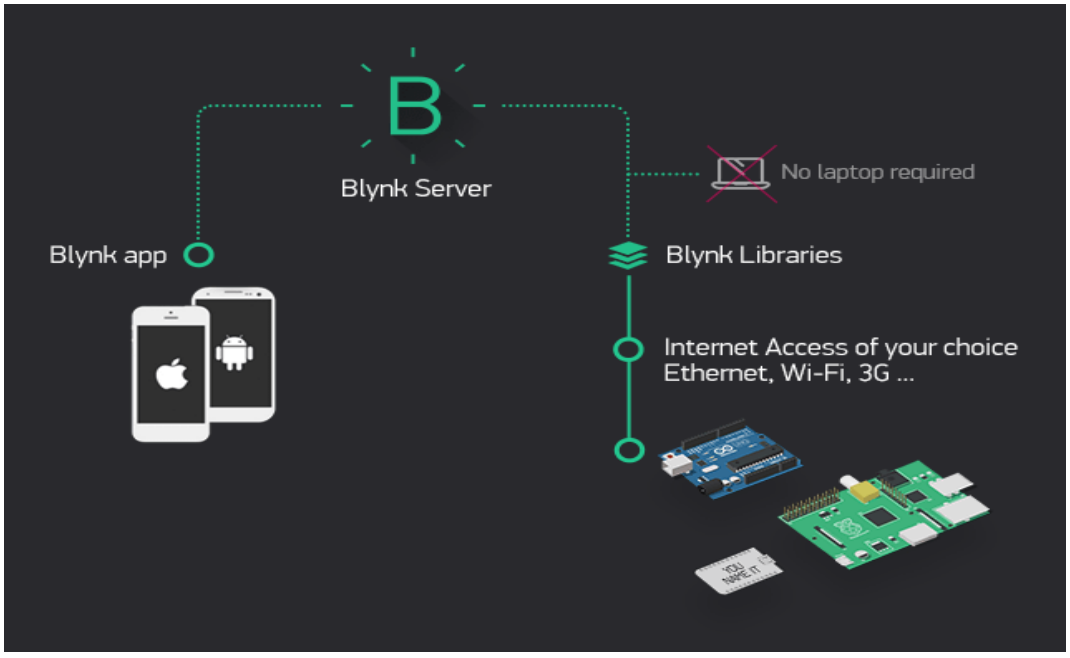


Fig 6 Diagram of Flow for blynk working [6]

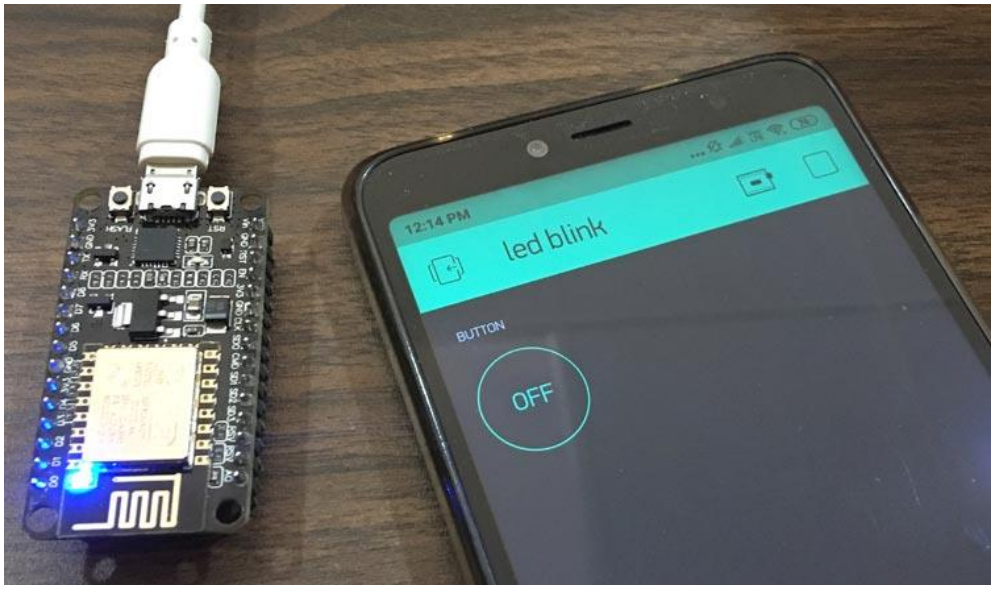


Fig 7 Blynk working [6]

Every time you press a Button in the Blynk app, the message travels to the Blynk Cloud, where it magically finds its way to your hardware. It works the same in the opposite direction and everything happens in a blynk of an eye.

Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. After downloading the Blynk app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen.

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and NodeMCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets[6]

The output from this sensor is connected to ESP8266 board. ESP8266 prints/displays the temperature on smart phone with the help of Blynk App.

DIAGRAMS

1) Circuit Diagram of System

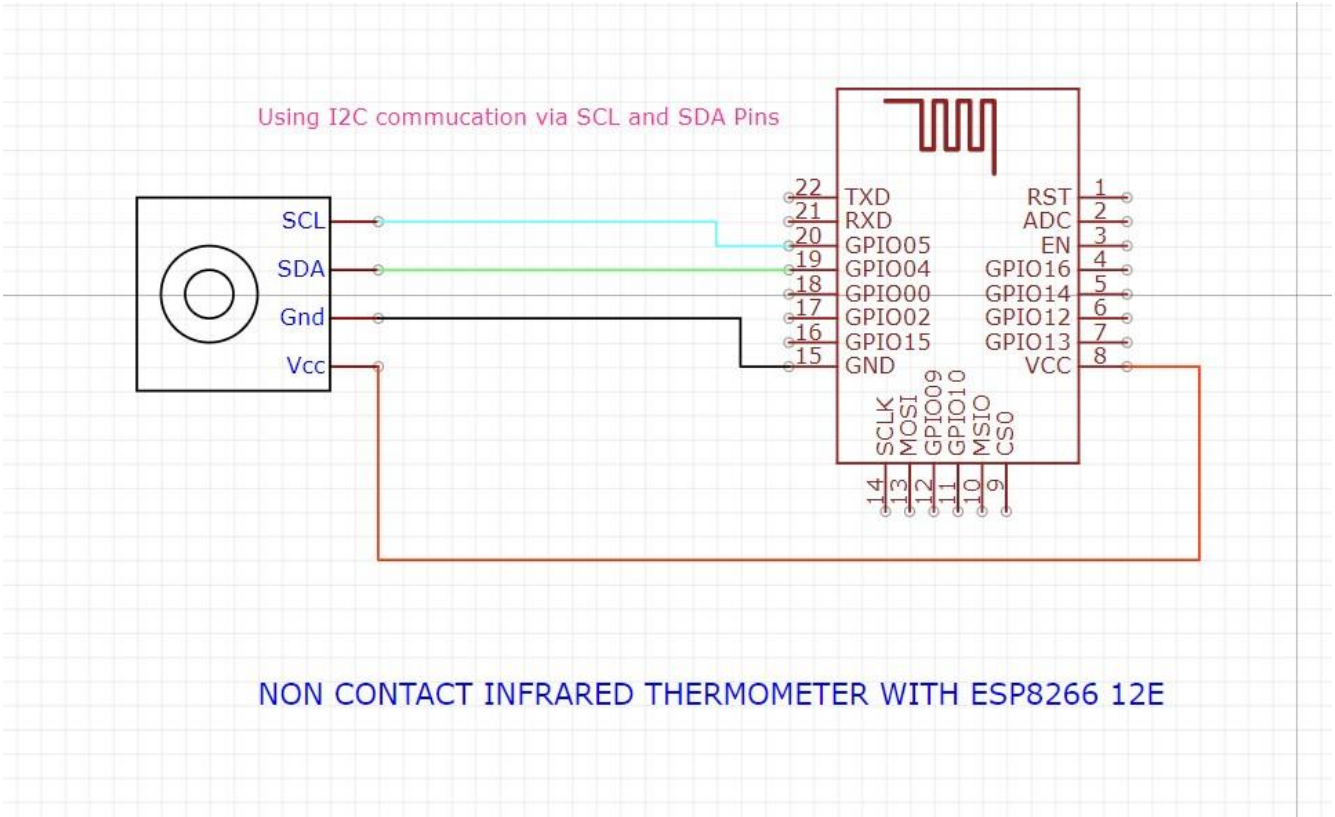


Fig 8 Circuit Diagram Non Contact Infrared Thermometer

Using MLX90614 with Arduino/ESP8266

Wiring.

1. Connect GND to common power/data ground.
2. Connect PWR to the power supply, for the 3V sensor this is about 3.3V. For the 5V version, **use** about 5VDC.
3. Connect the SDA pin to the I2C data SDA pin on ESP8266.
4. Connect the SCL pin to the I2C clock SCL pin on ESP8266.

IR temperature sensors work -

These **sensors work** by focusing the **infrared** energy emitted by an object onto one or more photodetectors. ... Because the emitted **infrared** energy of any object is proportional to its **temperature**, the electrical signal provides an accurate reading of the **temperature** of the object that it is pointed at.

I2C stands for Inter-Integrated Circuit. It is a bus interface connection protocol incorporated into devices for serial communication. It was originally designed by Philips Semiconductor in 1982. Recently, it is a widely used protocol for short-distance communication. It is also known as Two Wired Interface(TWI). [7]

Working of I2C Communication Protocol
It uses only 2 bi-directional open-drain lines for data communication called SDA and SCL. Both these lines are pulled high.

Serial Data (SDA) – Transfer of data takes place through this pin.
Serial Clock (SCL) – It carries the clock signal.

I2C operates in 2 modes –

Master mode
Slave mode
Each data bit transferred on SDA line is synchronized by a high to the low pulse of each clock on the SCL line.

2) Front Panel Design

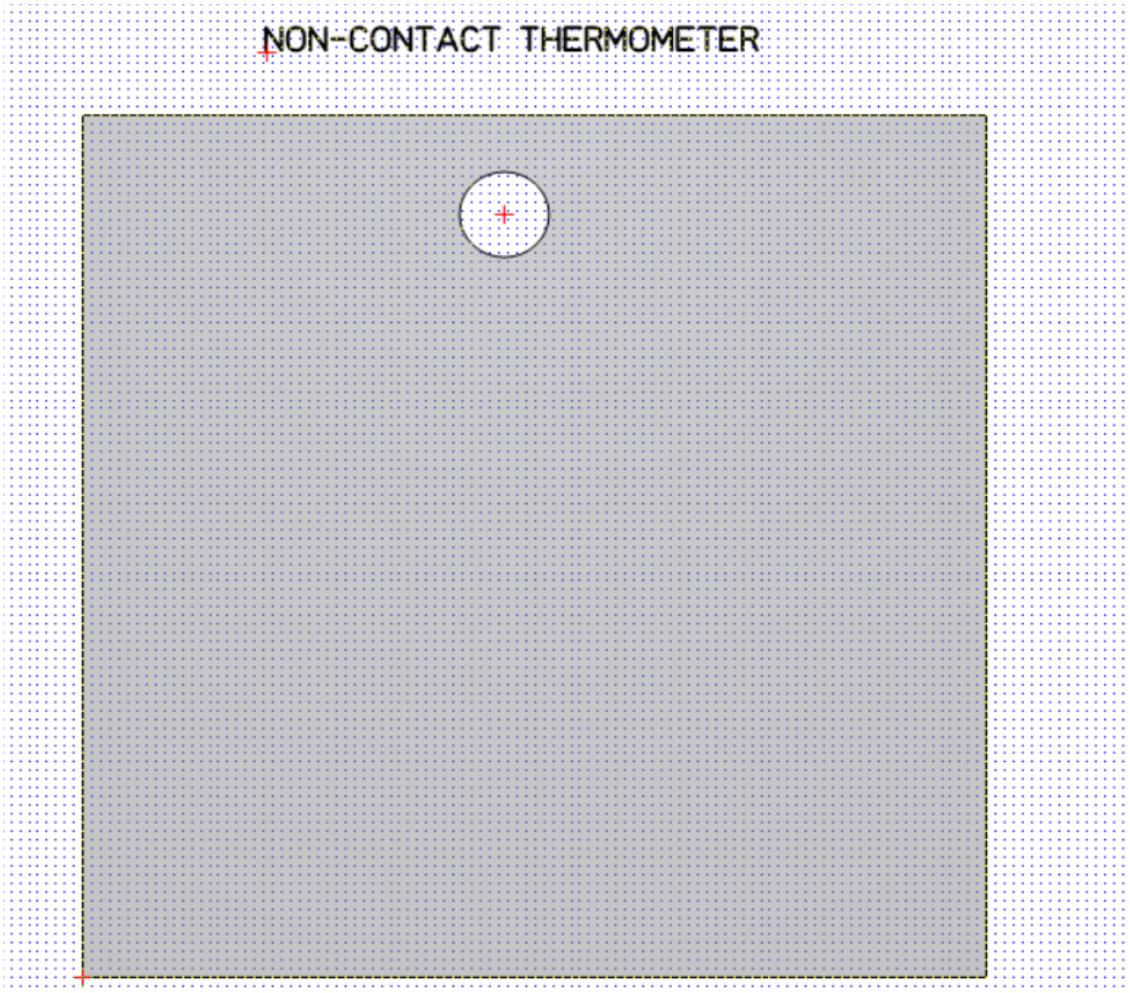


Fig 9 Front Panel Design made by the software

The panel design for this project had to change to accommodate an available enclosure and panel size.

3) Blynk App in Real Time Monitoring

Blynk is an IoT platform that supports both iOS and Android. It can compatibly work with many types of microcontrollers such as Node MCU ESP8266, Arduino, Rasberry Pi, and ESP32 over the Internet. It consists of three major components: 1) the Blynk application, which is used to control a device and display data on widgets; 2) the Blynk server, which is a cloud service responsible for all communications between smartphones and things; and 3) Blynk libraries, which include various widgets such as control buttons, display formats, notifications, and time management that enable a device to send data obtained from a sensor to be displayed on a mobile application in an effective and convenient way [6]

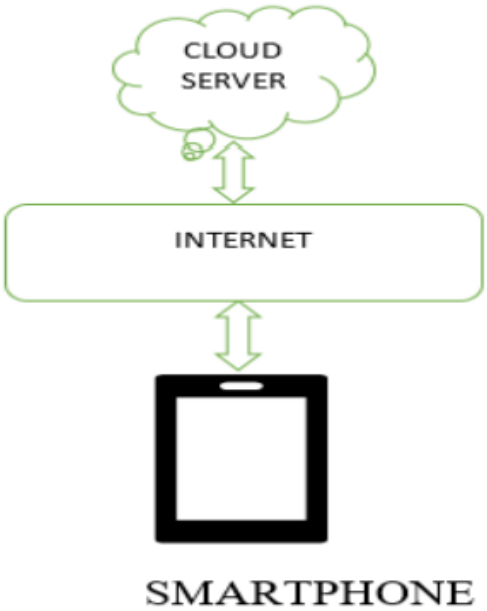


Fig 10 Overall working from Cloud and Smart Phone [6]

Product Cost Analysis

Component	**Price (Rs.)**
ESP 8266 12E	255/-
Infrared Sensor	1000/-
Jumper Wires	30/-
USB Cable	50/-
Total	1335/-

EXPECTED OUTCOME

It will be assured that the output which is temperature of Human Body will be measured accurately with MLX90614 Infrared sensor without the the physical contact and this temperature in Celsius on Display screen of PC (Web Dashboard Blynk) and also monitor the temperature of person via Blynk IoT App over WiFi 2.4 Ghz in realtime on Android/IoS device.

This will help the medical staff to get the instantaneous status of the Temperature of a person without touching the patient.

This can also be used in corporate offices to monitor the temperature of the people/employees who are entering the office.

As the our MLX90614 and Esp8266 together require less space and are compact they can be fixed on a door and the security personnel can monitor the temperature value on his Phone via the Blynk App deciding whether to permit the person in observation to enter office premise or not.

Results and Discussion

It gives and displays that the internet has been connected to following IP address and is ready to work with the sensor[9]

Now we connect our Sensor with the ESP8266 12E,

This communication will take with I2C or Inter Integrated Communication which will use

MLX90614 Sensor pins to be used

1) VCC (which is 3.3V)
2) GND Pin
3) Serial Clock Pin – SCL
4) Serial Data Pin – SDA

ESP8266 Pins to be used

1) VCC Pin
2) GND Pin
3) GPIO4- connected with SDA of MLX90614 Infra red sensor
4) GPIO5- connected with SCL of MLX90614 Infra red sensor

After the connection of pins with correct manner we use a USB supply to give it 3.3V of voltage to run our Sensor and show temperature results on Blynk IoT App.

After successfully connected our ESP8266 with Blynk app it show us “ONLINE STATUS on website”

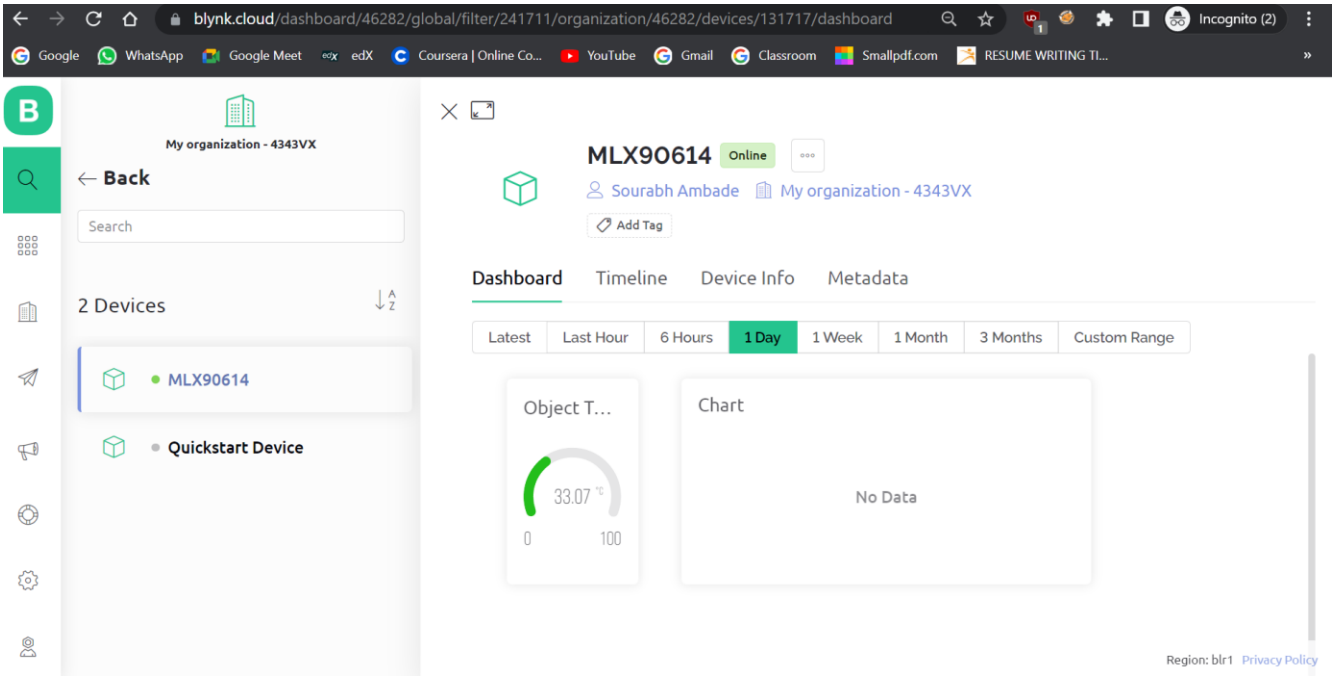


Fig 12 Web Dashboard of Blynk Cloud

Now we can monitor the temperature on both the web dashboard on Blynk IoT Cloud Platform as show in figure

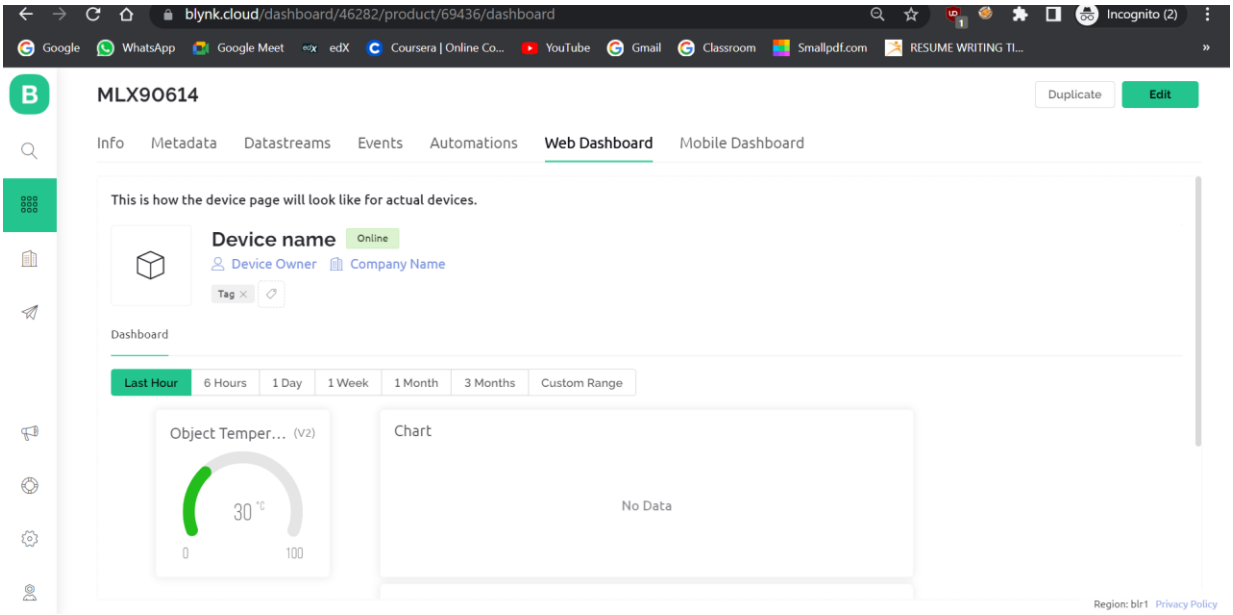


Fig 13 Web Dashboard of Blynk Cloud

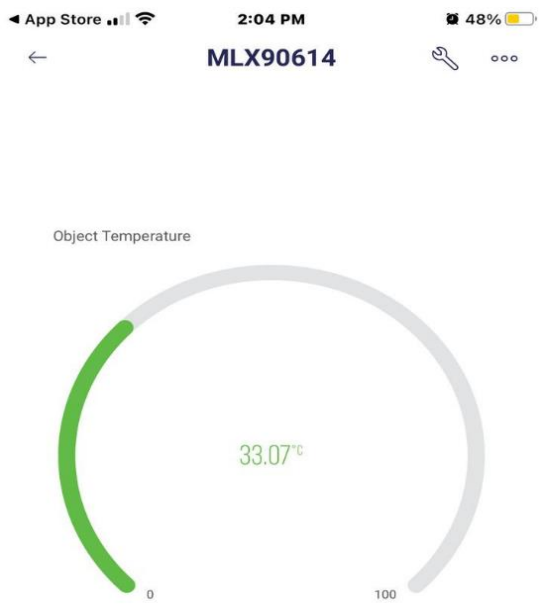


Fig 14 Web Dashboard of Blynk Cloud

The values of temperature change in realtime with the given delay of 1 sec as per code**.**

We can monitor the values of temperature of the object or body by Non Contact Thermometer using MLX90614 which has Infrared sensor which means we will have no physical contact with the body whose temperature is to be measured but still monitor and check the temperature of person on our phone via the Blynk IoT app directly. This is breakthrough technology in field of IOT and countries from all over the world started innovating new method for measuring the temperature without physical contact and came up with excellent results such as ours project made and described in this report.

Conclusion & Future Scope

Conclusion:

We were successful in Figuring out the parameters of temperatures under which we would permit the person in observation to enter the premise or not [6] Furthermore the proposed model was able to display the effectiveness visually on a numerically displaying the concerned values both on the PC and also on the android and ios smartphone. The present project focused on applying the IoT technology to monitor the temperature of objects or human body in office premise or in public places using MLX90614 IR Sensor. According to the project results, the Blynk mobile application could work well on Android and iOS. Blynk users can use basic widgets for free. However, an additional payment is required in case they want to use a other widgets. Alternative for displaying data over net would be great to use its potential to full capacity. In the present project, it costed about Rs 1335 to create the hardware. The results suggested that the Blynk server could systematically store the temperature data sent by the sensor installed on phone app but it had difficulty in sensing the accurate values for a distance above 5cm.The accuracy and range of the Non Contact Thermometer shall be increased for further usecase in different places of premise like that of industry to on a large scale. The object temperature was affected by the room conditions which were a little extreme than the normal, the results deviated for such condition. The Blynk application was able to effectively display all of the related data.

Future Scope

Future scope of this product finds Non Contact Thermometer using MLX90614 in every medical facility nationwide. Hospitals, dentals clinics, camps etc, and all the public place where the monitoring the temperature of people is crucial for taking decision on the safety of society so as to not hamper the peace and keep everyone protected from various diseases like Corona this product can be made as a compulsory standard for these medical facilities to follow, to ensure effective and safe use of measuring the temperature without being in contact with body to measure the temperature. [7]

References:

1)https://create.arduino.cc/projecthub/akshayjoseph666/covid-19-noncontact-thermometer-ad448a?ref=platform&ref_id=424_trending___&offset=241

2)Development of a Non-contact Infrared Thermometer by Jing Zhang. https://www.atlantis-press.com/proceedings/aetr-17/25892853

3) https://www.sciencedirect.com/science/article/pii/S2468067221000122

4) https://www.apogeeweb.net/circuitry/MLX90614-temperature-sensor.html

5) https://link.springer.com/article/10.1007/s11277-021-09438-4

6) Blynk Documentation : https://docs.blynk.io/en/

7) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8198193/

8) https://www.amazon.in/ESP8266-ESP-12F-Serial-Development-NODEMCU/dp/B01MF7IJA0

9) https://projectiot123.com/product/infrared-temperature-sensor-module-mlx90614-in-pakistan/

Datasheet References:

MLX90614 IR Sensor:

10)https://www.melexis.com/en/documents/documentation/datasheets/data sheet-mlx9061