

# IOT-Based Contactless Body Temperature Monitoring Using Raspberry Pi with Camera and Email Alert

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**Abstract** - In this paper we present the development of IOT based contactless body temperature monitoring using raspberry pi with camera and email alert. The proposed system offers the image of the person if the temperature of any particular person exceeds the set value. Experimental results of the suggested prototype show the measuring temperature and sending mail alert with PI.

**Index Terms** - Raspberry pi3, pi camera, MLX90614-IR Temperature sensor, Temperature measurement, Electronic circuits.

## INTRODUCTION

It has become truly challenging to recognize the individuals who are influenced by the infection or not. To tackle this issue, temperature gadgets are regularly used to gauge internal heat level. These gadgets have non-contact IR temperature sensors which can gauge the internal heat level with no actual contact. There are numerous temperature weapons accessible on the lookout, however none of them gives any ready or email warning to higher specialists to make fitting moves when the temperature surpasses a specific cut-off. In this undertaking, we will interface an IR temperature sensor and send the email alarms with the picture of the individual if the temperature of a specific individual surpasses the set is important. The Internet of Things is upsetting our life by fostering various frameworks which can be observed and controlled distantly. IoT can offer generous benefit across the whole life sciences esteem chain, from innovative work digitalization to upgrading the patient experience. This distant innovation dependent on IoT stage is particularly valid in Coronavirus-19 sickness, straightforwardly affecting general wellbeing measures on help clinical in friendly region. This

exploration article proposes the contactless internal heat level checking of the in-patient division (IPD) utilizing the web of clinical advancement. IoT has begun to discover more extensive applications in the field of clinical material the executive's perception. Nodaway's, health monitoring is a global challenge in peoples life time solid condition which affected by natural and careful realities. The estimation of human body fundamental signs is an essential to recognize the wellbeing status. The exhibition of any work or exercise in hot conditions upsets the decent warm homeostasis condition of human body (HB). This equilibrium recognizes the HB about physiological and intellectual execution of body. The typical internal heat level reaches by 36.50C to 37.50C. The situation with wellbeing beneath this cut-off is expressed as hypothermia and the status above is alluded as fever and hyperthermia conditions. The hyperthermia likewise alluded as cancer contingent stage that ranges more than 38.5 0C. The singular body temperature estimation is reliant of various viewpoints for example age, effort, contamination and spot of body at which estimation made. There are a few techniques to gauge the HBT for example oral, rental and axillary through inconsistent and contactless thermometers.

## LITERATURE REVIEW

- 1 It utilizes high LM-35DZ temperature sensor for estimation of human internal heat level. It utilizes GSM innovation and its usefulness for versatile correspondence to communicate the physiological sign data to an approved individual's PDA. This framework has GPS innovation for area recognizable proof. By using this method, we can sense, send, display, and store the physiological parameter such as human body temperature.

- 2 Thermo-vision system is used to detect the overheated spots in electronic PCBs or integrated circuits in a non-destructive, contactless manner, in order to improve their thermal stability and reliability. It offers a low-cost solution for laboratory testing of electronic circuits that has good accuracy and flexibility.
- 3 IOT based health monitoring system using Raspberry Pi, it uses different sensors like Pulse/Heart beat sensor, Body temperature sensor, ECG sensor, Blood pressure sensor and Patient position sensor are attached to the patient and sensor output serially are sent to Raspberry Pi. It will be helpful for students, patients, athletes, gymnastics for their health analysis easily at any place.
- 4 The iRT incorporate a microcontroller with native Wi-Fi support, a Fire Beetle ESP8266 (DFRobot) and the sensor is connected using I2C interface. To make specialized upgrades, including the improvement of significant cautions and notices to inform the client when the temperature meets characterized setpoints. An embedded system using an infrared temperature sensor that works with an IoT-Wi fi controller on the NodeMCU ESP32 board and the detected data will be transferred to users via the internet network, and it will be stored on a cloud internet system. This method is helpful to reduce the contact, proximity between patients and healthcare professionals.
- 5 This system starts with initialization of temperature sensors for collection of real time temperature data in compare to environmental temperature values. The affectability of temperature sensors LM35 (S1) and MLX-90614 (S2) is customized in C++ language and access through Arduino CT-UNO regulator. The daily monitoring of body temperature can prevent the people from threaten of fever, hypothermia and hyperthermia illness.
- 6 A circuit consisting of a microcontroller, Bluetooth, LED, light-dependent resistor (LDR), and MLX 90615 IR temperature sensor has been designed. At the entrance of a building such as a university or a mall, the fever of the visitors can be detected safely, without contacting physically.
- 7 The temperature sensor type (MLX90614ESF) was used similarly as the usage of the beat sensor type (KY039), which related with Arduino Uno

where the results were taken care of and sent by a nRF24L01 development to the far away end and ensuing to tolerating them in the far side are arranged using Arduino Uno. It will show the perusing of the heartbeat sensor and blood heat sensor in BPM (Beats Per Minute) and in Celsius or Fahrenheit.

- 8 To make a classifier that will differentiate between faces with masks and without masks. A Pre-prepared organization called mobileNetV2 which is prepared on the ImageNet dataset with our neural organization model. Various deep learning and computer vision frameworks are used for social distance finding with our proposed system on raspberry pi.
- 9 This system will help to identify people on image/video stream wearing a facemask with the help of Deep Learning and Computer Vision algorithms by using various libraries such as OpenCV, Keras, TensorFlow etc. The images are downloaded from various open-source websites and are differentiated as “mask” and “no mask”. The pictures that we downloaded were of various sizes and various goals. Face Mask and internal heat level recognition can assist us with diminishing the enormous social affair of individuals in a single spot without veils, lessening the danger of getting contaminated.

#### NEED OF TEMPERATURE MONITORING SYSTEM

The variation in human body temperature (HBT) can lead to different disease. It is essential to quantify the range of temperature as shown in body temperature measurement range (Fig1). As expressed by analysts that, while assessing and estimating the wellbeing status extraordinarily HBT, some crucial focuses are essential. Few measurement methods are shown in temperature measurements methods (Fig2), while some aspects are justified in sub-sections diurnal variations (2.1) and emotional status (2.2) respectively and linked are listed in variations in body temperature by age (Table 1).

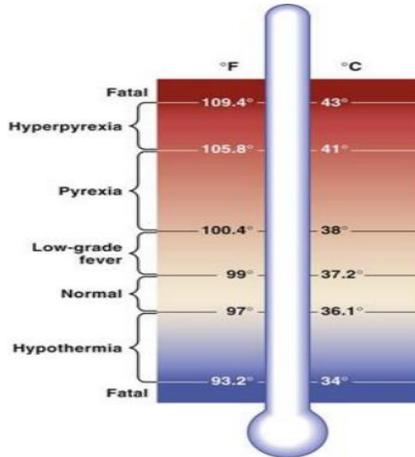


Figure 1. Body temperature measurement range

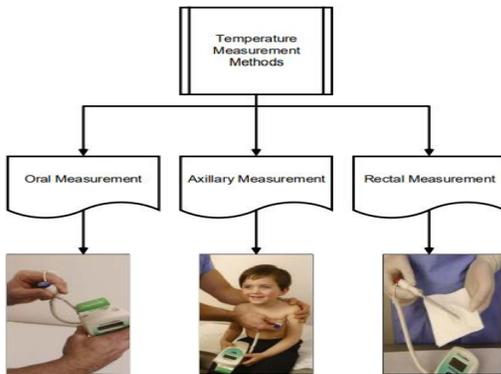


Figure 2. Temperature measurement methods

Table 1

Variations in body temperature by age

Age level	Method	Average temperature
New born	Axillary	36.1C-37.8C
1 year	Oral	37.6C
5 year	Oral	37C
Adult	Oral, rectal, Axillary	37C,37.5,36.4
Over 70 year	Oral	36C

2.1. Diurnal variations - This variety is reliant of human body digestion. During the sleep the metabolism is slower as decrement in contractions of muscles.

2.2. Emotional states- These variations frequently observed with young children during extreme anger and crying state which increase the body temperature.

### COMPONENTS REQUIRED

Raspberry Pi: Raspberry Pi is a credit card size computer that was designed for educational purposes. Due to its price and amazing specifications like onboard Wi-Fi, Bluetooth, and programmable GPIO

header, and the quantity of potential choices to make an application, it was taken on by engineers and gadgets specialists.

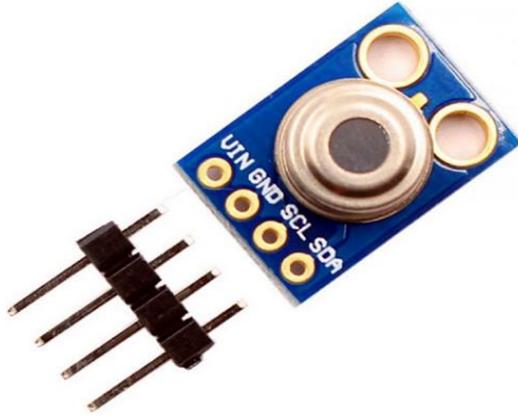


MLX90614 IR Temperature Sensor: There are numerous sensors accessible in the market which can give us temperature and humidity. What makes this sensor unique in relation to any remaining sensors is that it can give us object temperature and different sensors give surrounding temperature. We have used DHT11 Sensor and LM35 extensively for many applications where atmospheric humidity or temperature has to be measured. But here for making a temperature gun which doesn't need physical contact and can measure the object temperature instead of ambient temperature, we use IR based MLX90614. MLX90614 sensor is made by Melexis Microelectronics Integrated frameworks, it chips away at the rule of InfraRed thermopile sensor for temperature estimation. These sensors comprise of two units inserted inside to give the temperature yield. The primary unit is the detecting unit which has an infrared identifier which is trailed constantly unit which plays out the calculation of the information with Digital sign preparing (DSP). This sensor deals with Stefan-Boltzmann law which clarifies power emanated by a dark body as far as its temperature. In straightforward terms, any item radiates IR energy and the power of that will be straightforwardly corresponding to the temperature of that article. MLX90614 sensor changes over the computational worth into 17-bit ADC and that can be gotten to utilizing the I2C correspondence convention. These sensors measure the ambient temperature as well as object temperature with the resolution calibration of 0.02°C. To find out about the elements of the

MLX90614 sensor, allude to the MLX90614 Datasheet.

Features of MLX90614:

- Operating Voltage: 3.6V to 5V.
- Ambient Temperature Range: -40°C to 125°C.
- Object Temperature Range: -70°C to -382.2°C.
- Resolution/Calibration: 0.02°C.
- 17-bit ADC.
- I2C communication.



### METHODOLOGY

Interfacing MLX90614 with raspberry pi

- Step1: - Enabling the I2C from raspberry pi setting.  
 Step2: -Download the package/library of MLX90614 by going to <https://pypi.org/project/PyMLX90614/#files>

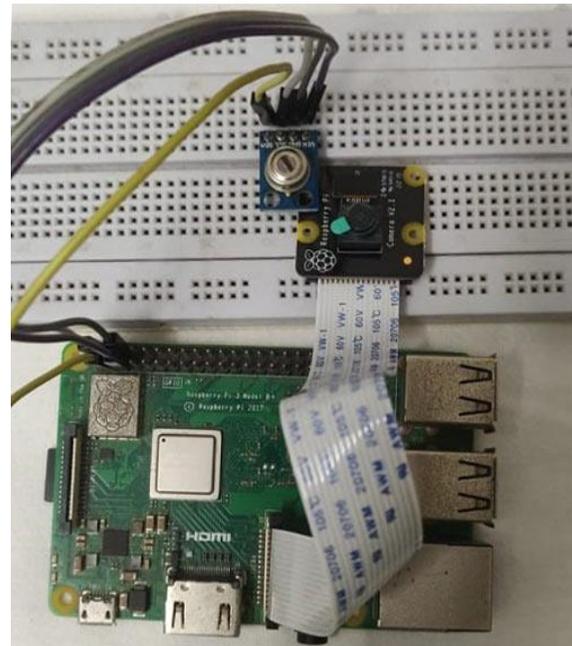
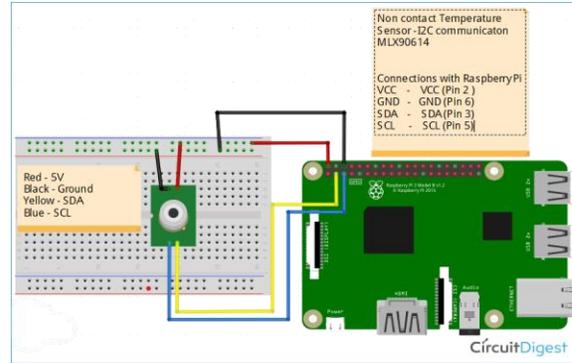
Pi camera interfacing with raspberry pi

- Step1: -Enabling the camera from raspberry pi setting.  
 Step2: -To check if the camera to click a picture with the name image and store that on your desktop.

Setting up SMTP email with raspberry pi

- Step1: -Go to the right corner and click on my manage your google account.  
 Step2: - Click on security and scroll down to “less secure app access”  
 Step3: - Enable the less secure app.  
 Step4: - Repeat with the other email id as well to send/receive the email from the python script.  
 Step5: -Download the required packages.

Step6: - After the establishment of the relative multitude of libraries is done, we need to make changes in the ssmtp.conf document where we need to enter the sender's email subtleties.



### SMTP libraries

Simple Mail Transfer Protocol (SMTP) is a protocol, which handles sending e-mail and routing e-mail between mail servers. Python provides smtp lib module, which defines an SMTP client session object

that can be used to send mail to any Internet machine with an SMTP or ESMTP listener daemon.

Steps for sending emails using Python:

1. Set up the SMTP worker and sign into your record.
2. Make the MIME Multipart message article and burden it with suitable headers for From, To, and Subject fields.
3. Add your message body.
4. Send the message utilizing the SMTP worker object.

Python SMTP secure

At the point when you send messages through Python, you should ensure that your SMTP association is encoded, so your message and login accreditations are not effortlessly gotten to by others. SSL (Secure Sockets) Layer) and TLS (Transport Layer Security) are two protocols that can be used to encrypt an SMTP connection.

Steps to Send Mail with attachments using SMTP (smtp lib)

1. Create MIME.
2. Add sender, recipient address into the MIME.
3. Add the mail title into the MIME.
4. Attach the body into the MIME.
5. Start the SMTP meeting with legitimate port number with appropriate security highlights.
6. Login to the system.
7. Send mail and exit.

The Raspberry Pi Foundation explicitly chose Python as the fundamental language due to its force, flexibility, and convenience. Python comes preinstalled on Raspbian, so you'll be prepared to begin consistently. You have various choices for composing Python on the Raspberry Pi..

Raspberry Pi program is, without a doubt, an extremely insignificant beginning. A lot more impressive applications can be composed utilizing the Python programming language. Obviously, on the off chance that you simply need a modest \$35 Linux machine, the Raspberry Pi turns out extraordinary for that to.

Python is generally utilized for creating sites and programming, task computerization, information investigation, and information perception. Since it's

moderately simple to learn, Python has been taken on by numerous non-developers like bookkeepers and researchers, for an assortment of ordinary undertakings, such as getting sorted out accounts.

#### ADVANTAGES

Smart sensors examine ailments, way of life decisions and the climate and suggest deterrent measures, which will diminish the event of sicknesses and intense states. Decrease of medical care costs: IoT lessens expensive visits to specialists and emergency clinic affirmations and makes testing more moderate.

1. Distant observing: Real-time far-off checking through associated IoT gadgets and savvy cautions can analyze ailments, treat infections and save lives in the event of a health-related crisis.
2. Prevention: Smart sensors dissect medical issue, way of life decisions and the climate and suggest protection measures, which will lessen the event of sicknesses and intense states.
3. Reduction of healthcare costs: IoT reduces costly visits to doctors and hospital admissions and makes testing more affordable.
4. Medical data accessibility: Accessibility of electronic medical records allow patients to receive quality care and help healthcare providers make the right medical decisions and prevent complications.
5. Improved treatment management: IoT devices help track the administration of drugs and the response to the treatment and reduce medical error.
6. Improved healthcare management: Utilizing IoT gadgets, medical services specialists can get significant data about hardware and staff adequacy and use it to recommend developments.
7. Research: Since IoT devices are able to collect and analyze a massive amount of data, they have a high potential for medical research purposes.

#### DISADVANTAGES

1. Security and privacy: Security and privacy remain a major concern deterring users from using IoT innovation for clinical purposes, as medical care checking arrangements can possibly be penetrated or hacked. The hole of touchy data about the patient's wellbeing and area and interfering with

sensor information can have grave results, which would counter the advantages of IoT.

2. Risk of failure: Disappointment or bugs in the equipment or even force disappointment can affect the exhibition of sensors and associated gear putting medical services tasks in danger. Likewise, avoiding a planned programming update might be significantly more unsafe than skirting a specialist examination.
3. Integration: There's no agreement with respect to IoT conventions and norms, so gadgets delivered by various makers may not function admirably together. The absence of consistency forestalls full-scale coordination of IoT, thusly restricting its expected viability.
4. Cost: While IoT vows to lessen the expense of medical care in the long haul, the expense of its execution in clinics and staff preparing is very high.

#### APPLICATIONS

1. Symptom-tracking apps that send updates on responses to cancer treatment to the physician and which can avoid hospitalization .
2. Associated clinic gear that advises specialists of their present area, educates the emergency clinic the board regarding the substitution needs and screens staff execution.
3. Distant temperature observing guaranteeing the right transportation and capacity of immunizations.
4. Medical care IT arrangements that remind patients to top off prescription and edible sensors that trigger a notice if the medicine hasn't been taken on schedule.
5. Clinical consideration IT game plans that remind patients to finish off remedy and eatable sensors that trigger a notification if the medication hasn't been taken on time.
6. Smart inhalers associated with an application that help individuals with asthma and aspiratory infection get what causes the manifestations and anticipate allergens.

#### CONCLUSION

When the hardware and software are ready, just run the python code on your pi. it will print the worth of temperature read from the sensor. If the object

temperature, then our python program will take an image from the camera, save it on raspberry pi, and also share it via email.

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