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Human body temperature-based Covid-19 Home Quarantined peoples monitoring system for Government front-line Health workers using the Internet of Things (IoT) through a Mobile Application

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Abstract — Smart covid-19 Wearable human body temperature device lets Government front-line Health workers monitor the Home quarantined people's body temperature. It works with a Smart wrist Wearable Device. It contains a temperature sensor, and This System monitors Home quarantined people's body temperature through an Internet of Things (IoT) the device with a mobile application. The home-quarantined person has also tracked their body temperature, and they can see the background of body temperature. If the body temperature is high (>37.5 Celsius), it will automatically send a Government front-line Health workers a warning notification. The front-line health workers will take him to the quarantine ward immediately using the warning notification. The quarantined ward records are entirely paperless. Under the quarantined records has digital records.

Keywords - IoT, Arduino Node MCU-ESP8266, LM35-Temperature sensor, Firebase,Android studio.

I. INTRODUCTION

Coronavirus Infection COVID-19 is now known as a new viral infection. However, most patients who become infected with that type of virus will have mild to moderate respiratory symptoms and heal without special care.

This disease has many signs for diagnosis, and people are uncertain whether or not they are infected with this condition. WHO is in command of the warning signs and, as a result, we can classify the disease Coronavirus affects everyone's life, and also its history is continually evolving.

The World Health Organization (WHO) will hold its annual meeting on December 31, 2019. WHO has been formally informed of a cluster of cases of covid19 in Wuhan City, to eleven million peoples and the economic and cultural hub of Central China By January 5, 59 patients had already had has identified, and nobody had been fatal. Ten days later, the WHO was notified of 282 reported cases, four of which were in Japan, South Korea, and Thailand. There were six deaths in Wuhan, 51 people were seriously ill, and 12 were also in a difficult situation. The virus has isolated on January 7, and its genome has shared on January 12. The cause, including its severe respiratory infection syndrome that became known as COVID-19, also was a novel coronavirus, SARS-CoV-2. The remaining is history, though history is continuously has updated. The most pressing issue is finding those that had has infected with the virus. Although no concrete signs of COVID infection inside the body had has identified, we have left with the only thermal monitoring and evaluation of early symptoms of a viral infection inside the body.

Table 1[1] lists the signs recognized by the World Health Organization. With the rising number of COVID19 cases around the world, approximately 6 lakh people have died. Non-contact thermometers are now commonly used to measure Temperature. However, multiple lawsuits have identified where it has been transmitted to the person when screening the infected.

Table 1. Symptoms have identified to covid19

More AscertainSymptoms	
87.5%	Fever
67.7%	Dry Cough
38.2%	Fatigue
33.4%	Sputum Production
Small AscertainSymptoms	
18.6%	Shortness of Breath
13.8%	Sore Throat
13.6%	Headache
11.4%	Chills

In this paper, we introduce a COVID-19 monitoring framework through Human body temperature. It can have used in various places, including the covid19 containment zone, railway stations, airports, schools, hospitals, colleges, offices, residential properties, and shopping malls. The erratic monitoring of the individual infected with Coronavirus is one reason for the rise in Coronavirus-infected people and death trolls.

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In this paper, we introduce a COVID-19 monitoring framework through Human body temperature. It can have used in various places, including the covid19 containment zone, railway stations, airports, schools, hospitals, colleges, offices, residential properties, and shopping malls. The erratic monitoring of the individual infected with Coronavirus is one reason for the rise in Coronavirus-infected people and death trolls.

To replace this System with clever work with the Internet of Things (IoT) is used. The Internet of Things (IoT) refers to a network of physical devices, or "things," that have sensors and applications and other developments installed inside them to enable them to link to and share data with other computers and systems through the Internet.

The Firebase Real-time Cloud Storage database is being used to store data in the Storage database. The Firebase Real-time Storage database is a cloud-based on NoSQL Storage database that allows users to store and sync data in real-time.

It could have been solving by introducing a system that would provide each individual with a unique identification number, offering a mobile application and a smart device. The mobile application has built a database of different users who have access to a smart device.

The wearable smart device can scan the person while the temperature sensor accesses and updates their Temperature in the person's database. The Government front-line Health workers have also accessing the person's body temperature using person QR (Quick Response), Unique code, and access the Fever persons using the Mobile Application. Fever (43.8 % upon admissions and 88.7 % while in the hospital) and Dry cough were the most common symptoms (67.8 %).

Table 2. Different types of body temperature levels and effects

Body Temperature Levels	Effects
Greater than 43 °C	Death is almost definitely going to happen.
Greater than 41 °Cor Less than 43 °C	Dizziness, fainting, extreme headache, delirium, and somnolence can occur. Palpitations and breathlessness may also occur.
Greater than 39 °Cor Less than 41 °C	Deep weeping, flushed and red. Exhaustion, rapid heartbeat, and breathlessness.
Greater than 38 °C	Thirty, uncomfortable, sweating, feeling hungry, feeling chilly, too.
Greater than 35 °Cto Less than 37.5 °C	Normal body temperature.
Less than 35 °C	Shivering, numbness, and grey/bluish Colouring of the skin. Heart irritability may occur.

Table 2 had has exposed body temperature levels. We majorly focused on the greater than 38 °C(> 38 °C), and it has considered has a fever.

The significant symptom for covid 19 is high body temperature. If the body temperature had become more generous than 38°C, the smart wearable device automatically sends the notification to the Government front-line Health workers through the mobile application, as shown in figure 1.

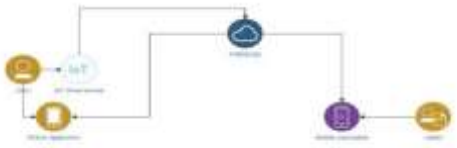

Fig. 1.The workflow of this System

II. RELATED WORK

Many health mitigation strategies have also been observed in recent years to track the health of peoples. We are analyzing some recent research in this area.Works aligned with this field have illustrated as follows.

A. Utsav et al. [1] A device developed uses a sensor to perform thermal scanning of the human body, with the same person's daily record stored in a database. There is a development of QR codes for each User's identification, and This process has a one-time generation process.

T. Mohanraj et al. [2] Health plays an integral part in our daily lives. IoT offers expanded medical care to patients and doctors. This prediction's key reason is a networked patient management system that identifies and analyzes the patient state. It saves details about the patient's illness and helps the doctor to assess it. IoT is commonly used to connect medical services to provide patients with uncomplicated, reliable, and appropriate health care. In this research, they proposed a web-based patient information framework for health care applications. This project's primary goal is to build a health-tracking device that can be made available to readily accessible sensors by tackling different worms.

Tamilselvi et al. [3] It has built a health tracking device that can track the patient's primary symptoms, such as heart rate, blood oxygen percentage, body temperature, and eye movement are all measured. As a result, the machine used sensors such as the Heartbeat, Temperature, SpO2, Eyeblink as capture components, and the Arduino-UNO as a processing unit. It has established a framework, but there is no precise performance measure to implement.

Acharya et al. [4] In the IoT environment, a health screening kit was introduced. The device has designed to regulate specific fundamental human health parameters, such as body temperature, ECG, heartbeat, and breathing. The main hardware components used here are the temperature sensor, pulse sensor, ECG sensor, BP sensor, and raspberry pi sensor.

D. Matsunaga et al. [5] The concept of a thermometer has to be worn during daily tasks to monitor the skin's surface core body temperature (CBT). This sensor computes the CBT by measuring the heat flux of the body using a thermal interface model. The heat flux had typically caused convective ambient conditions (e.g., the air conditioner or posture), influencing the model's accuracy.

M. E. Akbiyik et al. [6] Create a prototype that continually monitors the baby's body temperature using the RGB and thermal camera and provides users with various notification capabilities. The real-time video display had has included in the device with one second of video delay, audio, and audio.The device consists of a real-time camera monitor with a one-second delay for video, audio, and warning functions. The user interface also includes room temperature and humidity info, along with calculated baby body temperature statistics. The device can alert the User when noisy noise has detected in the room.

L. Luo et al. [7] The System consists of an earpiece that measures the ear canal's Temperature every 5 minutes during the night sleep hours and a base station that sends data to a smartphone analysis program.

S. Sudha et al. [10] Temperature is a crucial parameter in assessing a person's health and plays a primary role in diagnosing the problem. Using the Fever Click MAX30205 sensor, a person can quickly determine the Temperature of the body. In situations where the patient is unavailable to communicate with the doctor or needs regular supervision, the body's Temperature could be sent to the doctor at any time via a smartphone application based on the patient's experience.He might give his body temperature to the doctor at any time using a Firebase-based smartphone application. ESP8266 Wi-Fi Module is used to receive the sensor's values and transfer them to Firebase.

T. Wu et al. [12] This machine controls body temperature's critical parameter using a wearable sensor. The information was sent to their parents through a cellular network. The architecture has been expanded to support mobile phone interfaces, allowing for remote control. The system design is made up of a wearable sensor for controlling critical parameters and a sound buzzer. Both modules are equipped with a single micro-controller, the ESPresso Lite V2.0, built on the ESP8266 and has a lithium-ion polymer charger. Furthermore, the System relies exclusively on temperature monitoring.

Raffaele Gravina et al. [14] The device can control the baby's body temperature. It has already worked. However, as well as the equipment scale, The device could not be used consistently for long periods without adding discomfort to the children. A compact, lightweight computer, which constantly tracks. As a consequence, the infant's body temperature and comfort are taken into account. It assists parents by informing them whether their baby's body temperature is higher than average. This System monitors the essential parameter of body temperature.

P. Gope et al. [15] the development of this advanced technology in healthcare applications without considering safety leaves patients' privacy insecure. In this post, we first illustrate the new healthcare system's leading safety standards based on BSN. Subsequently, we suggest a stable IoT-based healthcare framework using BSN, called BSN-Care.

Mehta et al. [20] Designed a hand-held accelerometer sensor used in a smartphone-based speech health tracking app. In the System under test, a miniature accelerometer serves as a speech detector and the mobile to use as a data collection tool.The device to positioned around the patient's neck. Simultaneously, this method used frame-based vocal parameters, raw accelerometer data used for tracking purposes.

The main problem with monitoring the covid19 Home quarantined system does not have to access a centralized device to monitor the human body temperature. Though the significant issues are multiple users cannot access the IoT devices at a time, The System is not to access frequently monitoring the n number of user body temperature. The unique id installed IoT devices do not apply to the users, and the users have the same machine but a different cloud storage database. The Government front-line health workers were hard to monitor the Home quarantined peoples and, The Government front-line health workers have taken the Home quarantined person to the actual quarantined ward is too difficult

III. PROPOSED MODEL

In this paper, we solved the multiple users who have accessed the IoT device a similar cloud storage database at a time, and the users can view their body temperature frequently. This System has a centralized cloud storage database to centralized this System, and the Government front-line health workers were easy to monitor the Home quarantined peoples through the IoT. The Government front-line health workers have taken the Home quarantined person to the actual quarantined ward is too easy.

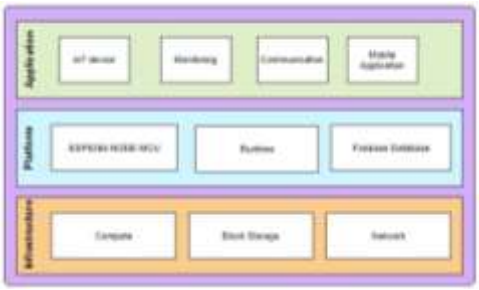

Fig 2 Architecture

In Fig 2, architecture has contain the three levels Application, Platform, and Infrastructure. Application-level has to communication between the IoT device and Mobile Application. Platform-level IoT devices send the data to the firebase database. Infrastructure-level has to create a user's keyspace to interact with platform-level and application-level through a network. We consider this proposed model has three Methodology processes:

1. Work-Flow of Home quarantined Users with an IoT device.
2. IoT device components.
3. Innovative covid19 monitoring Mobile Application.

1. Work-Flow of Home quarantined Users with an IoT device.

In-Home quarantined peoples they wrist the IoT device, and every IoT device contains the specific Unique authentication Id (UID) before the device provides to the Home quarantined peoples they must register and get the UID through the mobile application, after the getting the UID the Government front-line health workers contact those persons to identify the correct UID. They implement the UID into the IoT device to provide to that specific person.

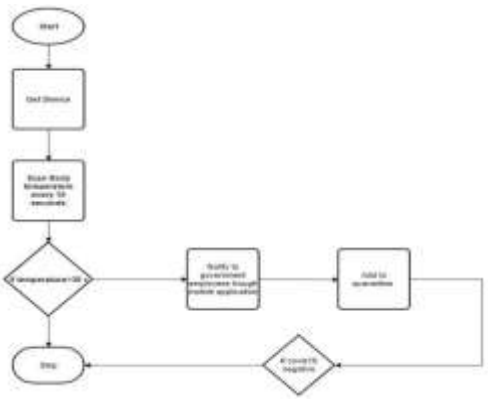

Fig 3 Workflow of Home quarantined Users with an IoT device.

Equipment	Description	Usage
LM35	Contact analog sensor	To monitor the body temperature
ESP8266 NODE MCU	Single motherboard for the device,128 KB RAM, and 4MB of Flash memory to store	To manage the whole monitoring process
lithium polymer battery 3.7v	3.7v capacitor battery	To supply the power entire device

Table 2, Described the usages and description of the components, such as ESP8266 NODE MCU, the motherboard of the IoT device, and this System for manage the whole monitoring process. LM35 is the sensor to contact the analog signal, and it monitors the human body temperature. Lithium polymer battery, it is 3.7v capacitor battery, to supply the power entire device. An entire circuit diagram is shown in fig 4.

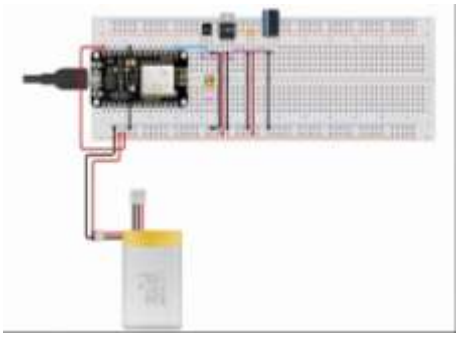

Fig 4 Circuit diagram

2. IoT device components

Circuit Connections for ESP8266 NODE MCU to LM35 sensor as tabulated in Table 3.

Table 3 ESP8266 TO LM35.

ESP8266 NODE MCU	LM35 sensor
3V3	Left
GND	Right
A0	Center

ESP8266 NODE MCU to lithium polymer battery 3.7v as tabulated in Table 4.

ESP8266 NODE MCU	lithium polymer battery 3.7v
3V3	RED
GND	BLACK

3. Innovative covid19 monitoring Mobile Application.

The IoT device has only a physical wrist device. It can serve only wearable purposes only, and We could not view the working process physically for view the working process of IoT the device throughout the Innovative covid19 monitoring Mobile Application. This mobile application has contained two types of users. The first type of users is known as Home-Quarantined persons. Those users have to monitor their body temperature, preview their body temperature history, and view their quarantined status and quarantined released status. The second type of users is known as Government front-line Health workers. The front-line Health workers have to monitor the Home-Quarantined person's body temperature through the IoT device UID. In case, the Home-Quarantined persons have high body temperature, the IoT device automatically notifies the warning message through the mobile application. The front-line health workers have to view the notified person's details through the UID. Moreover, front-line workers have contact with those persons to admit to the quarantine ward. Moreover, it will be noted the quarantined persons in the quarantined record. The quarantined persons have entirely relieved from the covid19-decease the front-lined health worker has noted the quarantine released record, it will altogether a paperless record under the digital records, and the digital record could not get mismatch quarantined the record.

3.1 Process of Mobile application

Home-Quarantined persons have got the IoT device they get UID, as shown in Fig 5

Fig 5 User UID and Dashboard

Home-Quarantined persons also monitor their body temperature and view their body temperature history, as shown in Fig 6.

Fig 6 User monitor their body temperature.

Government front-line health workers monitor the Home-Quarantined person's body temperature using UID, as shown in Fig 7

Fig 7 Front-line health workers monitor the Home-Quarantined Body temperature.

If the Home-Quarantined persons have high body temperature, The IoT Device Send the

Warning notification to the Front-line health workers and take that person into the quarantine ward, and the person ultimately relief from the disease, the front-line health workers have taken him to the quarantine release record as shown in Fig 8.

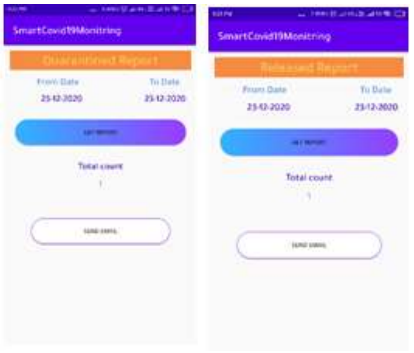

Fig 8 Front-line health workers are handling the digital records.

VI. CONCLUSION

Front-line health workers execute their work securely in Home-Quarantined areas and preserve social distance inside them in this pandemic condition, and they are not afraid of covid19. This technology reduces the risk of health workers coming into direct touch with covid19 cases, and it also allows front-line health workers to deal with the covid19 screening via a mobile application. This unique covid19 project assists us in maintaining a safe distance between affected covid19 individuals and front-line health personnel. Home-Quarantined people can also keep track of their daily body temperature with the use of smart wearable IoT gadgets.

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References	Monitor the Front-line Health workers	Contain the Mobile Application	Wearable IoT device	Multiple users access the System at a Time	Users get Unique Id	Users monitor their body temperature	Total benchmark score of 6
A. Utsav et al. [1]	No	Yes	No	Yes	Yes	Yes	4
T. Mohanraj et al. [2]	Yes	No	Yes	No	No	Yes	3
Tamilselvi V et al. [3]	No	No	Yes	No	No	Yes	2
Acharya AD, Patil SN [4]	Yes	No	Yes	No	No	Yes	3
D. Matsunaga et al. [5]	Yes	No	Yes	No	No	Yes	3
M. E. Akbiyik et al. [6]	Yes	Yes	Yes	No	No	Yes	4
L. Luo et al. [7]	No	No	Yes	No	No	Yes	2
Guan WJ. et al. [8]	Yes	No	No	No	No	Yes	2
AshikurRahaman et al. [9]	No	No	Yes	No	No	Yes	2
S. Sudha. et al. [10]	No	No	Yes	No	No	Yes	2
N. A. Zakaria et al. [11]	Yes	No	No	Yes	No	Yes	3
T. Wu et al. [12]	No	No	Yes	No	No	Yes	2
S. F. Khan [13]	Yes	No	Yes	No	Yes	Yes	4
Raffaele Gravina et al. [14]	No	No	Yes	No	No	Yes	2
P. Gupta. et al. [15]	No	No	Yes	No	No	Yes	2
Archip et al. [16]	Yes	No	Yes	Yes	Yes	No	4
P. Gope, T. Hwang [17]	No	No	Yes	No	No	Yes	2
G. Fortino [19]	No	No	Yes	No	No	Yes	2
Mehta [20]	Yes	Yes	Yes	No	No	Yes	4
J. J. Oresko et al. [21]	Yes	Yes	Yes	No	No	Yes	4
D. Gajalakshmi, R. Mohanraj	Yes	Yes	Yes	Yes	Yes	Yes	6