

# IoT dependent Practically feasible Remote System to monitor Diseased Persons

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*Abstract-* The monitoring systems in the health care sector have gained immense attention as the health maintenance has become much essential. The intervention of technologies has increased a lot in the recent years in order to avoid the unanticipated deaths caused due to several ailments that were not treated at the right period. Thus, we construct IoT dependent Practically feasible Remote System to monitor Diseased Persons in order to support the health care professional and avoid the unanticipated deaths that were caused due to unattended diseased persons. This system was developed to support patients both in the hospitals or at home so that the treatment is sought at the right time to avoid any severity or else deaths. We have made use of Raspberry Pi 4, DS18B20 Temperature Sensor, Heartbeat Sensor, Analog to Digital Converting device, Communication Devices, Web server, and Display Device so that the practically feasible and viable health care monitoring system is developed by using Python. We have taken the data of bodily temperature and heartbeat rates to record, assess, and report about any considered patients to the concerned health care professionals who will attend to those persons if they get SMS triggered to them from the communication device. We evaluated and proved the effectiveness of our healthcare monitoring system. By this way, we were able to ensure that the patients get the treatment at the right time without any delay.

**Keywords:** IoT dependent Practically feasible Remote System to monitor Diseased Persons, DS18B20 Temperature Sensor, Heartbeat Sensor, Communication device, Treatment, and Monitoring System.

## 1. Introduction

Due to the increased health related issues and a drastic change in day-to-day's life activities, most of the old aged people are affected with at least one disease or more than that. Considering the patients age in mind, hospitals also face certain difficulties in treating the diseases.

Numerous innovative changes can be observed in information and communication technologies thanks to the IoT (Internet of Things). Huge quantity of data can be

accessed through the IoT technology which permits various devices with different actuators or sensors to transmit critical information within themselves [1]. These sensors, actuators and software are embedded with various physical devices so that they can transmit important data and information through over the air (OTA) or internet. The objects can be controlled and sensed remotely through the internet. [2] These are made possible through the IoT concept which integrates the real physical world into the virtual world of computer

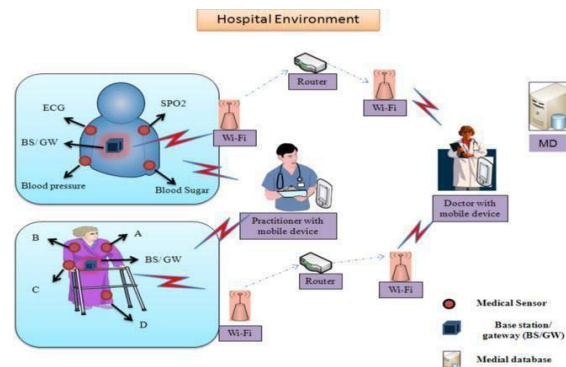
systems. Numerous opportunities are available in this IoT concept. IoT achieves enhanced efficiency along with accuracy and economic benefit with less participation of humans.

[3] IoT concept can be employed in numerous applications. But in the healthcare and medical systems, the hardware and software devices employed here require certain investigations. [4] In 2016, the World Health Organization (WHO) indicated that the elder people who are continuously suffering from chronic diseases need an efficient and effective system for monitoring and treating them. [5] The National Broadband Plan that was devised in 2015 by the FCC (i.e., Federal Communications Commission) predicted that the usage of remote patient monitoring through the IoT technology might save around \$700 billion for the healthcare industry in the next 15-20 years of use.

[6] The barriers existing in the healthcare sector can be overcome through the implementation of a remote patient monitoring model. This remote patient monitoring model is capable of providing professional and quality health services to the rural people through the information technologies. [7] The doctors or the physicians can observe the health conditions of patients remotely at any place and any time through the implementation of a remote patient monitoring system. This is very much helpful in the prevention of certain critical health issues at the earlier stage itself. [8] The remote patient monitoring is capable of monitoring the patients, when they are not in the regular hospital surroundings and are in a different place like home.

[9] In the modern world which is developing everyday in terms of technology,

the health monitoring system is employed across various places like sports, hospital and home car units. This health monitoring system is mostly used for monitoring the patients who are affected with chronic diseases and must visit the hospitals for regular checkups. An example of sensors in an IoT architecture in the hospital environment is depicted in fig. 1.



**Fig. 1 An example of sensors in an IoT architecture in a hospital**

The requirement for treating the old aged patients from their home is keep on increasing. Therefore, it can be achieved by the usage of body sensors which offers a great extent of portability of patients. These sensors facilitate in the treatment and detection of abnormalities occurring in the patient's body. This is very much helpful in reducing the critical conditions by giving the required treatment on stipulated time. Therefore, sensors are fixed on the patient's body which gives information to the doctors and hospitals through wireless networks based on the IoT concept. Various kinds of sensors are utilized for monitoring different kinds of factors like temperature, blood sugar level, blood pressure, heart beat rate, etc.

In this proposed system, sensors are utilized for measuring various biological parameters. Raspberry pi is implemented in this system along with various hardware components which are integrated with the

software. The system is also capable of displaying the recorded data to the user where the user possesses the access to control the entire system.

### *1.1 Background*

Normal patients cannot keep track of their body health conditions same as the doctor does. Hence, there are different equipments in the market which assist them to measure their health conditions. But these equipments have certain limitations like maintenance, cost, size and mobility of patients. Therefore, the researchers keep on doing various studies for designing a system as portable device. Different platform like Microcontrollers is used to design the system. This would save patients from the future health problems that might occur due to negligence and improper health management. This would also help patient's concern doctor to take an appropriate action if any emergency occurs.

### *1.2 Our Objectives*

The key objectives of the proposed system are listed below as:

- To successfully make use of sensors to create IoT environment.
- To monitor the temperature prevailing in the human body.
- To monitor the heartbeat rate of human.
- To update the concerned health care professional pertaining to the condition of the diseased person without any interruption.
- To caution the concerned health professional if the abnormalities in the both the measured values.

### *1.3 Outline of the Paper*

The outline of the paper which addresses the remaining portions of the paper is given as follows: Section 2 lists some of the remote patient health monitoring system; Section 3 gives the information about the proposed methodology and the process involved; Section 4 provides the configurations and features of all the hardware components utilized in this research work; Section 5 discusses about the obtained results of the proposed system; and Section 6 summarizes the entire research work with the concluding remarks and the possible future directions of the proposed system.

## **2. Literature Review**

The works related to our proposed system are listed below in the literature review such as:

An Arduino employed PHMS (i.e.,) Patient Health Monitoring System based on the IoT concept was developed in the research work [10]. It gathers the necessary health parameters and analyses the gathered information from the sensor devices. The system is capable of monitoring various health parameters like body temperature, heartbeat and blood pressure level.

[11] An elaborated review of the IoT based healthcare systems were provided in the review paper. Moreover, it also discusses about the challenges and opportunities prevailing in those remote patient health monitoring systems.

Similarly, a systematic review of various IoT based smart systems that were utilized for monitoring the health conditions of patients were given in the investigative survey [12]. The survey concentrates on discussing about the design and overall

outline of the systems utilized for monitoring the patients' health from home.

An intelligent system for monitoring the patients' health was proposed in the research study [13]. The health condition of a patient can be screened automatically through the usage of numerous sensors. The primary motive of the work is to extract the bio signal of ECG through the employment of an ECG sensor. The doctor or nurse or the patient's relative can check the condition of the patient remotely.

[14] A new framework of healthcare was devised based on Mobile-IoT. This framework gathers patient data through various sensors and alerts the patients relatives and doctors through sending an SMS and mail immediately if any issue is diagnosed.

[15] An intelligent health system of BioSenHealth 1.0 was proposed based on IoMT. The system gets data from 50 patients in different hospitals and nursing homes. Vital information like oxygen level, pulse rate, body temperature was recorded and analyzed. The accuracy of the recorded information was calculated and found to be 90% accurate than the existing methodologies.

### **3. Proposed System Methodology**

In this work, we are integrating Raspberry Pi 4, DS18B20 Temperature Sensor, Heartbeat Sensor, Analog to Digital Converting device, Communication Devices, Web server, and Display Device along with the software tools like NOOBS, IP Scanner, VNC Viewer, PYTHON3 IDLE, and Pipenv & Virtual Environments to make our IoT dependent Practically feasible Remote System to monitor Diseased Persons. Using this devised system of ours, we will be

accomplishing the already defined objectives in order to aid the doctors who fancy to treat their patients in remote mode and the patients who fancy to get treated by the doctor in the remote mode. Our system could serve the tough situations like the current COVID pandemic in India.

Our novel IoT dependent Practically feasible Remote System to monitor Diseased Persons will accomplish the below listed actions to establish the effective remote monitoring of the diseased persons by the health professionals.

- Uninterrupted monitoring of the temperature that is prevailing in the human body during the considered period will be measured by using the DS18B20 Temperature Sensor.
- Likewise, the uninterrupted monitoring of the heart beats rates that get maintained during the considered period will be measured by using the heartbeat sensor.
- The measured values be conveniently converted to digital signals from Analog signals before sending to Raspberry Pi 4.
- After conversion of the signal types, Raspberry Pi 4 checks whether those temperature and heart beat rates are within the accepted range.
- After processing from Raspberry Pi 4, the sensor recorded values be uploaded to the simple web server so that the health professionals in the far way hospitals or health care center can access the same to act on it when needed.
- Furthermore, the sensor recorded values will also be displayed in the LCD display by integrating the same with Raspberry Pi 4.

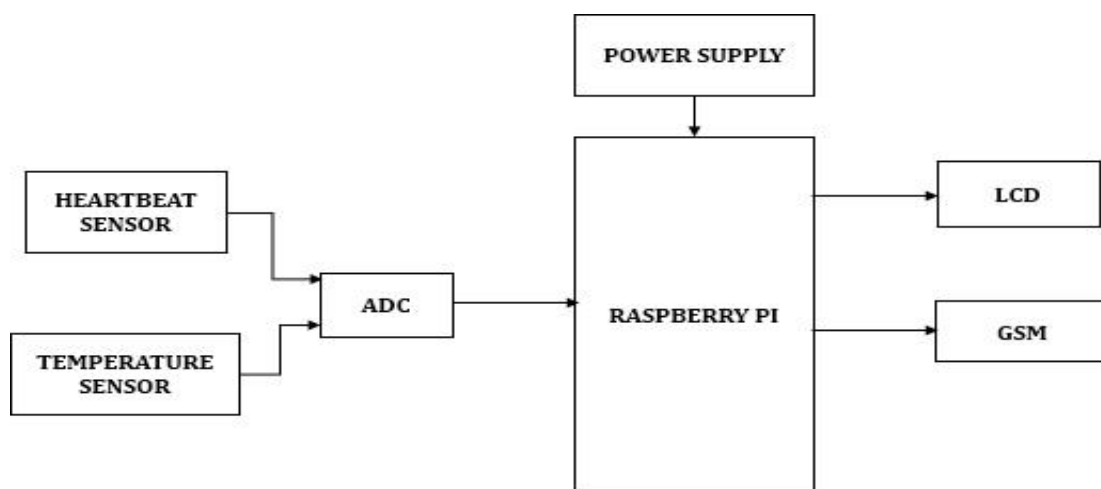
- Finally, whenever the Raspberry Pi 4 senses the temperature related abnormalities in the sensor recorded values, it will also trigger the alert SMS as “Over Temperature detects” to the health professionals who monitors the vital sign of a person. This SMS triggering is done by using the GSM standard communication devices. Thus, it can be beneficially to many diseased persons who suffer from common fever to deadly corona virus infection.

Our novel system of IoT dependent Practically feasible Remote System to monitor Diseased Persons consists of Raspberry Pi 4, which is the major processing element. Using this Raspberry Pi 4, the operational functionalities of several hardware are achieved. Furthermore, those hardware components are also integrated with the above listed software tools. The Raspberry Pi 4 gets its power from a 5 Volts power source. All the implementations of the

current novel work are done by deploying the python programming language. The temperature sensor and heartbeat sensor along with Analog to Digital Converting Device serve as the input units, while the display device (LCD) and GSM communication devices serve as output units. We have made use of the display device to display both the measured bodily temperature and heart beat rates without any interruptions. The temperature is displayed only in Fahrenheit scale as the fever is usually correlated with that scale. Raspberry Pi 4 despite being serving as the processing element in IoT dependent Practically feasible Remote System to monitor Diseased Persons, it also serves as a controlling unit to control various operations taking place.

### 3.1 Block Diagram

The block diagram of our IoT dependent Practically feasible Remote System to monitor Diseased Persons is indicated in the following fig. 2:



**Fig. 2 Block diagram for the proposed IoT dependent Practically feasible Remote System to monitor Diseased Persons**



Every hardware existing in our proposed health care monitoring system have been assigned with a particular purpose. So, we discuss the hardware-wise purposes are discussed in the below pointers.

- **Raspberry Pi 4**
- **Temperature sensor**

### *3.2 Software and Hardware integration for the proposed methodology*

Our IoT dependent Practically feasible Remote System to monitor Diseased Persons records the bodily vital signs like temperature and heartbeat rates for deciding whether a person needs the immediate attention of a health care professional or not. We trained our Raspberry Pi powered monitoring system by using the clinical reference values of both the measured vitals. Then, we verified it by the establishing the successful integration of several hardware and software tools like NOOBS, IP Scanner, VNC Viewer, PYTHON3 IDLE, and Pipenv & Virtual Environments.

### *3.3 Suitability for the proposed system*

Our proposed monitoring system can be useful for any healthcare professional or diseased persons (patients) who wishes to fulfil their purpose in remote mode. Particularly, in the COVID-19 like pandemic situations, our system can be utilized in the following:

- Used in the hospitals
- Patients at home

primarily in the Linux-based Operating Systems. We are utilizing Raspberry Pi 4, as since it is easier to work with in any type of embedded systems. Raspberry Pi 4 will be

- **Heartbeat Sensor**
- **Analog to Digital Converting device**
- **Communicated Device**
- **Web-ServerDisplay Device**

having a total of 40 pins in it, in which 28 of them will be GPIO pins and rest pins are segregated for power needs. A commonly utilized Raspberry Pi *Analog to Digital Converting Device*

We have used the Analog to Digital converting device intermediary to the two sensory devices and Raspberry Pi 4. This converting device makes the Analog to digital conversion to facilitate easier interpretation of the sensor recorded values of both the temperatures and heartbeat rates.

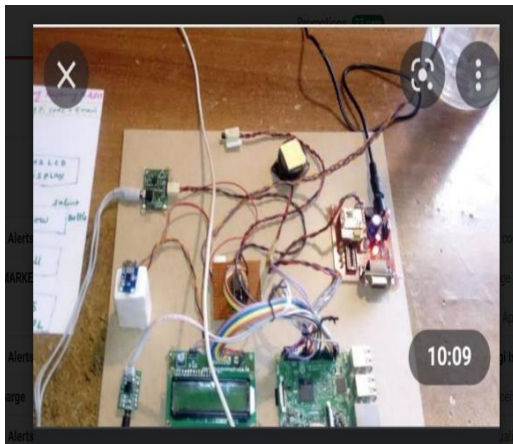
### *3.4 Assembled IoT dependent Practically feasible Remote Diseased Person Monitoring System*

The above listed hardware equipment has been successfully integrated to construct IoT dependent Practically feasible Remote System to monitor Diseased Persons. The assembled view of the same is indicated .

## **4. Results and Discussion**

We are going to evaluate the way in which our proposed system measures and reports the bodily temperature and heartbeat rates without any interruption. The below are the two cases using we assess the performance of IoT dependent Practically feasible Remote System to monitor Diseased Persons.

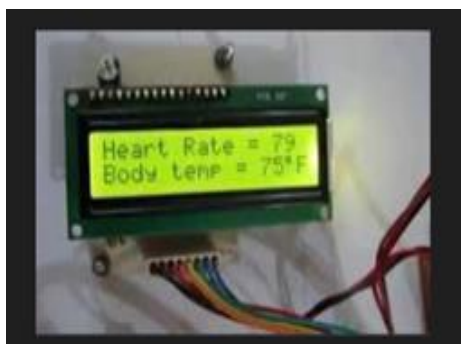
### *Measurement of Body Vitals*



With the successful integration of every hardware and software, we were able to present the body temperature in the Fahrenheit scale and heartbeat rate to the health care professional who continuously monitors the health conditions of the diseased persons. The LCD display outcomes provided by our monitoring system is presented in the following fig. 3

Fig. 2 Assembled View of the Proposed Monitoring System

#### 4.1 Communicating through communication channel

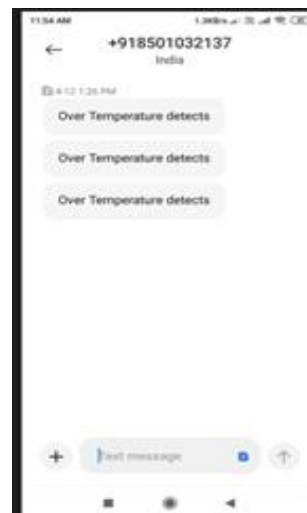


With the help of Raspberry Pi 4, the raised values of temperature were successfully identified in the system and then the system successfully notified the health care professional regarding it as seen in the

below fig. 3 so that the immediate action can be initiated.

### 5 Conclusion and Future Work

In our IoT dependent Practically feasible Remote System to monitor Diseased Persons, we presented with the practical problem-solving solution for the benefit of both the healthcare professionals and diseased persons. This implemented system could be devised in any house or hospital set-up where in the remote health monitoring is primarily needed. This system could also be utilized where the temperature measurement is prioritized as our system was successfully able to provide with the alert message as “Over Temperature detects” whenever the temperature increases above the accepted limits. It is not only the temperature alert that our system was able to provide, but also it successfully maintained the sensor recorded values continuously in the web server so that any abnormalities in heart could be known to avoid any heart ailments.



As a future directive of our system, we would like to deploy from the perspectives of other sector like agriculture so that the robustness of the system is assessed and proved. Furthermore, supplementary sensors like fertility assessing sensors and humidity

sensors will be utilized as per the needs and desired application outcomes.

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