

IOT Based Patient Health Monitoring System

Ankita Patil¹, Vanashri Yadav², Jyoti Shinde³, Rachana Kumbhar⁴

Students^{1,2,3}, Assistant Professor⁴

Nanasaheb Mahadik College of Engineering, Peth Engineering

Corresponding Authors' Email id: *ankitapatil7799@gmail.com¹, vanashriyadav1623@gmail.com²*

jyotishinde.js30@gmail.com³

Abstract

In the early months of the COVID-19 pandemic with no designated cure or vaccine, the only way to break the infection chain is self-isolation and maintaining the physical distancing. In this paper, a potential application of the Internet of Things (IoT) in healthcare is presented. The proposed framework consists of two parts: a lightweight and low-cost, IoT platform for data analysis and diagnosis. IoT consists of physical devices, such as sensors and monitoring devices for patients (blood pressure, heart rate & activity monitoring, etc) to connect to the internet and transforms information from the physical world into the digital world. The proposed system, with the help of IoT such features, will help to keep the necessary details and reports of a patient organized and available to all actors in the system. IoT devices like low-power sensors will be used to collect data from patients and stored on any personal computer and also on the cloud so that any actor in the system can refer to it. Hence, proposed IoT patient healthcare monitoring system is a significant step towards addressing the requirements for global health.

Keywords: *- Internet of Things, Healthcare Monitoring System, Pulse sensor, Pulse_Oximeter, Temperature sensor, Applications, Technologies, IoT on the platform of things speak*

INTRODUCTION

Today Internet has become one of the important parts of our daily life. It has changed how people live, work, play and

learn. Internet serves for many purposes educations, finance, Business, Industries, Entertainment, Social Networking, Shopping, E-Commerce, etc. The next

new megatrend of the Internet is the Internet of Things (IoT). The entire concept of IoT stands on sensors, gateway, and wireless networks which enable users to communicate and access the application/information. Be that as it may, among all the regions no place does the IoT offer a more prominent guarantee than in the field of health awareness? As a saying goes "Health is wealth" it is exceptionally crucial to make utilization of the innovation for better wellbeing.

Health is always a major concern in every growth the human race is advancing in terms of technology. Like the recent corona virus attack that has ruined the economy of China to an extent is an example how health care has become of major importance. In such areas where the epidemic is spread, it is always a better idea to monitor these patients using remote health monitoring technology. The benefits of healthcare system is reporting and monitoring the patient data, remote medical assistance, faster disease diagnosis. The importance of IoT devices and data can be critical, so security constraints are required to keep IoT data safe from intruders; authentication is one of basic and important means to confirm data privacy and security.

In addition, Doctors play a very important role but the process of the check-up is quite lengthy like first a person needs to register then he/she will get the appointment, and then later on the check-up reports are generated. Due to this lengthy process working people tend to ignore the checkups or postpone them. This modern approach reduces time consumption in the process. Medical scientists are trying in the field of innovation and research for many decades to get better health services and happiness in human lives.

Significance:

Health monitoring is the major problem in today's world. Due to lack of proper health monitoring, patient suffer from serious health issues. There are lots of IOT devices now days to monitor the health of patient over internet. Health experts are also taking advantage of these smart devices to keep an eye on their patients.

So to overcome this gap introduced an IoT based Health Monitoring System which records the patient heart beat rate, oxygen saturation level and body temperature. Pulse rate, oxygen saturation level and body temperature readings are recorded over Thingspeak so that patient health can

be monitored from anywhere in the world over internet.

RELATED WORK

Chandini Unnikrishnan et al. [1] presented a system that is attached to the human body and monitors physiological parameters. In this system, some health sensors are used such as ECG sensors, temperature sensors, pulse monitors, etc. The price of the sensors depends according to their size, adaptability, and correctness. The Raspberry Pi is cheap, adaptable, and fully modified. The system measures a patient's parameter with different available sensors. These sensors group the data i.e. patient's particulars are given to Raspberry Pi and then it is shifted to the server.

Ms. Prachi Patil et al [2] the system aims to design a device in which sensors will sense the heartbeat, blood pressure, glucose level, and oxygen level with a pictorial representation of the human body. After sensing, sensors will send respective data to the ATmega328P. After that ATmega328P will analyze and sent it to the internet or IoT cloud thought to get the way. In the collaborated hospital the patient's data will be sent through the internet.

E. N. Ganes [3] presented a system that comprises a patient's heart rate, blood pressure, and pulse rate. Then using a camera the patient is livelily monitored through the Raspberry kit and this information is sent to the internet and stored in a medical server. The doctor and patient can monitor the patient data from any place of the world through the provided IP server address anytime. The emergency alert is sent to the patient if the sensor value is exceeded the threshold data.

Chowdhary et.al [4] proposed a system with a GSM module connected to a Raspberry Pi in an assembly of different health monitoring sensors. This system focused on the direct transfer of health data in form of direct messages on the phone of the Doctor. They aimed to make it portable and hence to decrease the load in the hospitals for patient monitoring. They obtained the speed of 20 seconds per reading for refreshing the updated value and storing the data in the system.

Laxmi Bhaskar, Prof. Prabhakar Manage [5] discussed designing an IoT based Patient Health Monitoring System using a Raspberry pi3. In this work, the Heart Rate and body of the patient are monitored using Raspberry pi 3 and web server

bigots. The doctor can take simultaneous proper action for the arrived problem.

Sapna Tyagi et al. [6] designed a cloud-IoT framework in which medical information can be safely transferred, with the consent of the patients and other health factors. This paper tries to emphasize an IoT-Cloud enabled healthcare system not only to realize the illustration and traceability of healthcare actors but guarantee improved healthcare services.

Pooja Navdeti, Sumita Parte et al [7] designed a health monitoring system that can be used in hospitals for measuring and monitoring various parameters like temperature, ECG, heartbeat, etc. The results can be recorded using Raspberry Pi displayed on an LCD. Also, the results can be sent to the server using the GSM module. Doctors can log in to a website and view those results.

M. Ryan Fajar Nurdin, Sugondo Hadiyoso & Achmad Rizal [8] presented a prototype that is forced to work only on the transmission of Electrocardiographic signals through Zigbee wirelessly. By attaching a different sensor to different nodes in the body, collected a series of data which is in analog form and made a web application for showing the

respective readings according to the patients. Their application is limited to 20 users only & the data contains different bandwidth issues which cause errors in the proposed result.

Limitations of Project:

1. External power supply and internet connectivity needed.
2. Unauthorized access to centralization.

Aim of Project work:

In this paper, the proposed healthcare monitoring system offers:

1. Low-cost and lightweight IoT server to monitor continuously a person's body temperature, heart rate, and blood oxygen saturation, and periodically monitor data.
2. IoT server that collects sensors data from raspberry pi IoT stores all the data and it easily accessible in doctors, caretaker, patient's family through desktop/computer.

Propose system approach:

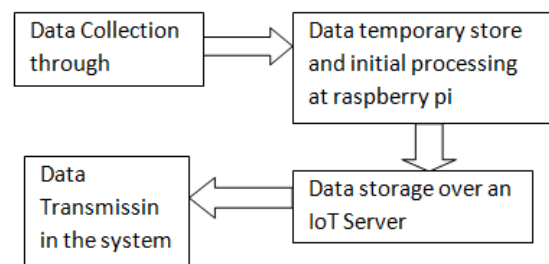


Figure 1 Propose system Approach

As per the workflow first task in the system is to collect data from patients through the sensors. Data here refers to the health parameters of temperature, heartbeat rate, and oxygen level. In this system a low-power sensors are used. They collect data from the patient on a timely basis. With this frequently obtained data the health condition of a particular patient is observed and required prescriptions are recommended required that data is processed and then forwarded to IoT server for storage from where it is accessible to desired clients in the system.

PROBLEM DEFINITION

In today's social insurance framework for patients who stay at home during post-operational days checking is done either via a medical caretaker. Ceaseless observing may not be accomplished by this system, because anything can change in wellbeing parameter inside of part of seconds and amid that time if guardian/attendant is not in the premises causes more noteworthy harm. So with this innovation created period where web administers the world gives a thought to add to another keen health awareness framework where time to time constant checking of the patient is accomplished.

DESIGN AND DEVELOPMENT

Here, in this system body temperature sensor (DS18B20) and Pulse Oximetry sensor (MAX30102) are used to measures the body temperature and measures the heartbeat sensor as well as the oxygen level of the patient respectively. These sensors' signals are sent to Raspberry pi.

The objectives of the Work:

- To provide technical support to make healthcare systems easier and faster
- To collect accurate physical parameters of a patient.
- To provide availability of necessary data on the internet.
- To provide faster assessment and treatment.

A. List of Healthcare System:

Table.1. List of Healthcare System

	Components used	Parameter Monitor
Patient	DS18B20 Temperature Sensor	Monitor Body Temperature
	MAX30102 Pulse_Oximeter	Monitor Heart beats Monitor Oxygen Level
	Raspberry Pi Zero	Fetching sensor data
	IoT Cloud Server	Store and visualize the sensors data

The table.1 shows which components to be used to implement the Healthcare System and in this Healthcare system which Parameter to be monitor and working of that particular components.

B. System Architecture:

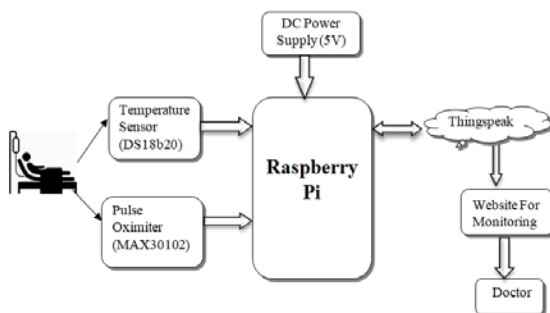


Figure 2 Block Diagram of Proposed Model

Explanation:

This paper proposes a model of Patient Healthcare Monitoring System, with different components like measuring a body temperature, analysis of heart beats and oxygen level saturation. The sensors utilized as a part of this project are Temperature sensor (DS18B20) and Pulse Oximeter (MAX30102). These sensors work autonomously of each other. The measured reading from the sensor is broke down for the patient and is made accessible to the specialist or to any concerned individual in the type of the web or smart phones. The

DS18B20 temperature sensor can monitor a patient's body temperature and MAX30102 pulse_ Oximeter measure a heart beats as well as oxygen level saturation. The Raspberry Pi controller subsystem is responsible for all the storage, processing and transmission of data. The controller is interfaced with all other input, output and peripheral subsystems. The controller also houses built-in WiFi for IoT Communication.

The sensors used in such systems are low power sensors. They collect data from patient on timely basis. With this frequently obtained data the health condition of particular patient is observed and required prescriptions are recommended required that data is processed and then forwarded to IoT server i.e Thingspeak for storage from where it is accessible to desired clients in the system. Then doctors, caretaker and patient's relatives can access the data through IP address.

In this section, the different components and their effectiveness for the project are described. The block diagram show in Figure 2.

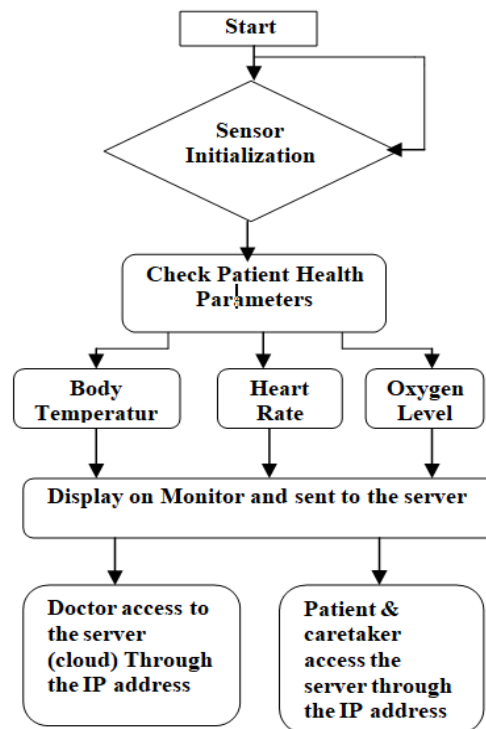


Figure 3 Flow Diagram of Proposed Model

The flow diagram of the project is shown in figure 3, the sensor's values are read and displayed on the monitor and stored in the cloud for future use.

C. Hardware Description:

1. Raspberry Pi Zero:

The Raspberry Pi is a credit-card-sized small and cheap computer that plugs into a computer monitor or TV and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the

internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

Several generations of Raspberry Pi have been released. The proposed system uses a Raspberry Pi Zero. It can be set up to run like a standard (albeit bare-bones) desktop computer, that isn't the point. Rather, it's intended to be used as an educational tool for those who wish to learn to program. It's also intended to be modified and customized for specific tasks. Data is collected from the sensors which are connected to this raspberry pi board. The temperature sensor and Pulse_Oximeter sensors are used to which are described in

the succeeding sections. The data from these sensors are sent to the Thingspeak IoT server.

2. Temperature Sensor (DS18B20):

The DS18B20 is one type of temperature sensor and it supplies 9-bit to 12-bit readings of temperature. These values show the temperature of a particular device. The communication of this sensor can be done through a one-wire bus protocol which uses one data line to communicate with an inner microprocessor. The Operating voltage of this sensor is 3V to 5V and Temperature Range is from - 55°C to +125°C.

3. Pulse_Oximeter Sensor (MAX30102):

The MAX30102 is integrated pulse oximetry and a heart-rate monitor module. It includes internal LEDs, photo detectors, optical elements, and low-noise electronics with ambient light rejection. The MAX30102 provides a complete system solution to ease the design-in process for mobile and wearable devices. The MAX30102 operates on a single 1.8V power supply and a separate 3.3V power supply for the internal LEDs. Communication is through a standard I2C-compatible interface. The module can be shut down through software with zero

standby current, allowing the power rails to remain powered at all times.

D. Software Description:

1. Win32 disk Imager:

This is a Windows program for saving and restoring images from removable drives (USB drives, SD Memory cards, etc). To write boot images to SD Flash device or USB flash device, making it bootable a Win32 disk imager is used.

2. Raspbian Jessie OS:

Jessie is the official operating system for Raspberry Pi. As compared to Windows 10 IoT, Raspbian Jessie is a full desktop operating system where you can perform lots of tasks just like any PC. Along with these common uses, this OS is used in home automation projects as well.

3. VNC Viewer:

VNC stands for virtual network computing. This is a desktop sharing system that allows to remotely control another computer. A virtual network computing system is a platform dependant. This means that the client working on one type of operating system can't connect to the VNC server that operates on a different type of operating system.

4. Python:

Python is a general-purpose coding language which means that, unlike HTML, CSS, and JavaScript, it can be used for other types of programming and software development besides web development. That includes back end development, software development, data science and writing system scripts among other things.

5. Thingspeak:

Internet of Things (IoT) is defined by many people but in simple words, IoT is nothing but some devices that connect and interact using the internet. In this project, Thingspeak IoT platform is used. Thingspeak is an IoT platform and API for data collection and analytics. It serves as a bridge connecting edge node devices, such as temperature and pressure sensors that collect data and data investigating analysis software that analyzes the data.

E. Hardware Connection Setup:

The kit implementation for Health Monitoring System is shown in figure 4. The Mouse and Keyboard connected to the USB port of Pi. The GPIO pin is connected to the sensors through which the data from the Raspberry Pi is transferred to the server and the patient can monitor the data on the monitor. The controller is interfaced with all other input, output and peripheral subsystems. The controller also houses built-in WiFi for IoT Communication. The remote server based IOT platform known as Thingspeak is a subsystem in the project and is used for remote storage, monitoring and visualization of the received sensor data. The data is displayed in a graphical format by means of a GUI. It also shows Digital Values because the all sensor are digital sensors. Then server can store the data and doctors, caretaker and patient's relatives can access the data through IP address.

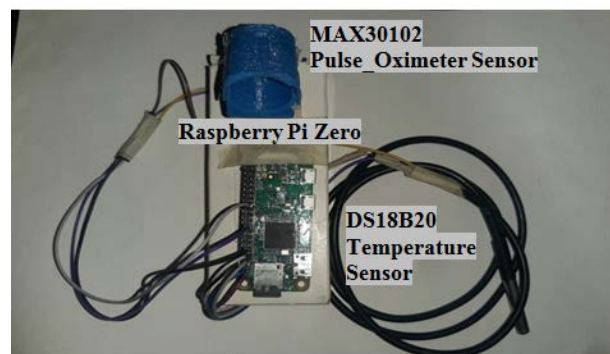


Figure 4 Implementation of Hardware

TESTING

Table.2. Testing of Project

Sr.No	Test case	Description
1	Initialize the sensors	All sensors, microcontroller connected to Dc power supply and attach the sensors to patient body.
2	Check Patient Health Parameters	Checked patient's vital signs i.e. Temperature, Heart Beat and Oxygen level.
3	Display on Monitor and sent to the server	All sensors collected data now send to the cloud i.e. Thingspeak using this observed the patient condition

Table 2 shows the testing of proposed system. Software Testing is a process of executing the application with intent to find any software bugs. It is used to check whether the application met its expectations and all the functionalities of the application is working. The final goal of testing is to check whether the application is behaving in the way it is supposed to under specified conditions. All aspects of the code are examined to check the quality of application. The primary purpose of testing is to detect software failures so that defects may be uncovered and corrected. The test cases are designed in such way that scope of finding the bugs is maximum.

OBSERVATIONS

Table.3. Observation of Project

Parameter	Testing	Observed Value	
		Patient 1	Patient 2
Body Temperature	Sensors Value	32.2°C	32.25°C
	Thermometer Value	32.1°C	32.15°C
Heartbeat	Sensors Value	99 Beats	99 Beats
	Pulse_Oximeter value	100 Beats	110 Beats
Oxygen level	Sensors Value	97%	96%
	Pulse_Oximeter value	97%	96%

Table 3 shows the observed value of two different patients from sensors and original equipment already available in market.

RESULT ANALYSIS

A. Analysis of Heart Beats:

In this figure 5, a 100 Beats heart rate from the patient is obtained. The data can be collected from two mode of patient, one of the modes was relaxing mode and another one was excited mode. So during observation got an 80-90 Beats at the relaxing mode position and above 150 Beats had found at exciting mode, which

was consisting of anxiety, stress. So, the final value from the Pulse Sensor is shown in above figure 5.

B. Analysis of Body Temperature:

The body temperature is one of the most vital parameters of a person's health. Any fluctuations in the body temperature affects the functionality of the blood circulation hence the heart rate. The blood circulates through the body faster when the temperature rises to bring the temperature back to its optimum value.

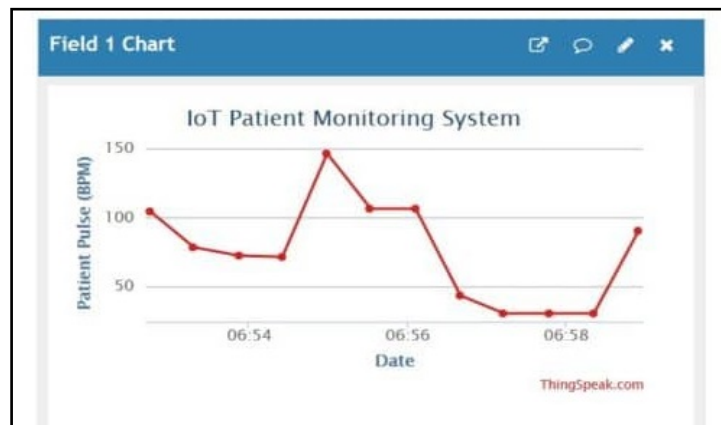


Figure 5 Result of Heart Pulse



Figure 6 Result of body temperature

C. Analysis of Oxygen Level:



Figure 7 Result of Oxygen Level

The figure 7 shows an oxygen saturation level of patient. Blood oxygen levels indicate the oxygen levels present in the blood that flows through the arteries of the body. The normal oxygen levels in a pulse oximetry usually range from 95% to 100%.

RECOMMENDATION ON FUTURE DEVELOPMENT

Day by day, health sector has been improving by using advancement of technology. Researchers have been continuously working on developing the medical appliances. In the further development, numerous sensors can be added to measure the more parameter from patient body such as respiratory sensor, blood pressure sensor and glucose sensor. Also, GSM may be introducing to give the patient condition at the patient guardian. After adding this sensor, this device will

be worked as complete package of health monitoring system.

CONCLUSION

In this paper, main concern was ensuring the uninterrupted health monitoring system for the patients. This project was proposed prototype model. The main goal was to focus on monitoring patient health monitoring with wireless body area network. By using the system, the professional can monitor advice and diagnose their patient and family member before arriving to the emergency. The data are stored and published online. Hence, the professional and family member can monitor their patient from a remote location at any time. Before beginning of the project, every sensor was calibrated individually. Each of the signals is analyzed by taking different data. The entire observed signal was matched by

experimental signal. The final results were transferred to the cloud through Raspberry pi, and the users got the output from the system through a message. This system can use in real life and people will be benefited. This system is user-friendly and cost effective.

REFERENCES

1. Chandini Unnikrishnan, Srishti Pandit "health monitoring system using raspberry pi", International Research Journal of Engineering and Technology (IRJET), Volume: 07 Issue: 04 | Apr 2020.
2. Ms. Prachi Patil, Mr. Swapnil Patil, Mr. Gaurav Parab, "IoT based Patient Health Monitoring System" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, Volume 9, Issue 3 | 2020.
3. N. Ganes, "Health Monitoring System using Raspberry Pi and IoT" Oriental Journal of Computer Science and Technology, ISSN: 0974-6471, Vol. 12, No. (1) 2019, Pg. 08-13 | Feb 2019.
4. K C Chowdary, KL Krishna, KL Prasad, K Thejesh. An Efficient Wireless Health Monitoring System, Proceedings of the Second International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2018) IEEE Xplore Part Number: CFP18OZV-ART; ISBN: 978-1-5386-1442-6.
5. Laxmi Bhaskar, Prof. Prabhakar Manage, "IOT based Patient Health Monitoring System using Raspberry pi 3", International Research Journal of Engineering and Technology (IRJET), Volume: 04 Issue: 07 | July -2017.
6. Sapna Tyagi , Amit Agarwal , Piyush Maheshwari "A Conceptual Framework for IoT Based Healthcare System using Cloud Computing" , 978- 1-4673-8203-8/16/\$31.00_c 2016, IEEE .
7. Pooja Navdeti, Sumita Parte, Prachi Talashilkar , Jagruti Patil , Dr. Vaishali Khairnar "Patient Parameter Monitoring System using Raspberry Pi", International Journal Of Engineering And Computer Science, ISSN:2319-7242 ,Volume – 5, Issue -03

March, 2016 Page No. 16018-16021.

8. M Ryan Fajar Nurdin, S Hadiyoso, A Rizal. A Low-Cost Internet of Things (IoT) System for Multi-Patient ECG's Monitoring, International Conference on Control, Electronics, Renewable Energy and Communications (IEEE- ICCEREC), ISBN:978-1-5090-0744-8/16/2016.
9. I Khan, K Zeb, A Mahmood, W Uddin, MA Khan, SIslam. A Wireless Continuous Patient Monitoring System for Dengue; WiMon, International Conference on Computing, Mathematics and Engineering Technologies – IEEE-iCoMET 2019, ISBN: 978-1-5386-9509-8/19.
10. S Nubenthan, K Ravichelvan. A Wireless Continuous Patient Monitoring System for Dengue; Wi-Mon, IEEE WiSPNET 2017 conference. ISBN: 978-1-5090-4442-9/17.