

A Review on Patient Monitoring System using IOT

Akshay K Sonar¹, Chethana M², Bhavana M³, Preeti G M⁴ and Siddesh G K⁵

¹⁻⁵Electronics and Communication Engineering, Mangalore, India

Email: akshaysonar163@gmail.com, {chethanamohan1516, bmbhavana2003, preetigm22, siddeshgundagatti}@gmail.com

Abstract— With the exponential growth in various technologies today, IoT is one of major domains which has found a broad spectrum of applications. The aim is to increase the quality of healthcare facilities with the help of IoT. The requirement of proper healthcare facilities in remote areas are yet to be covered. The IoT based health monitoring system helps in improving the quality of life of the people in rural areas. Various sensors like ECG sensor, temperature sensors, heartbeat sensors and others collect the data from the patient and store in the cloud, and these data is used for further monitoring. This reduces expenses of long distance travel to seek medications. This implementation not only promotes the growth of the healthcare facility in the country but also utilizes the best of the IoT applications for the welfare of the society.

Index Terms— Internet of Things (IOT), Sensors, Arduino, Database, GPS.

I. INTRODUCTION

The healthcare industry has experienced a significant transformation with the emergence of Internet of Things (IoT) technology. One area that has greatly benefited from this innovation is patient care monitoring. In traditional healthcare systems, data collection and monitoring often rely on manual processes, leading to potential gaps in patient care and delayed interventions.

However, IoT-based patient care monitoring systems have revolutionized the way healthcare providers monitor patients, collect data, and make informed decisions in real-time. This review aims to explore the advancements and benefits of IoT-based patient care monitoring systems, showcasing how they enhance patient safety, optimize resource allocation, and improve healthcare outcomes. By harnessing the power of IoT, healthcare providers can now deliver more efficient and effective care, ultimately transforming the landscape of patient monitoring. The availability of medical professionals in rural and remote areas differs significantly from that in urban areas. Safeguarding our health against harmful diseases is of utmost importance in our daily lives. While it may not be feasible for individuals residing in rural areas to access healthcare services, technology is bridging this gap. The Internet of Things (IoT) has experienced substantial growth in the medical sector, enabling the utilization of various sensors to monitor different parameters of the human body and facilitate efficient treatment. Considering the advancements in health.

II. LITERATURE SURVEY

Kulshrestha et al. [1] In this study, they created and implemented a system that may be used in both patient homes and intensive care units. The suggested system keeps track of the patient's body temperature and pulse, among other critical health indicators. An instant alarm is sent to the doctor in the event that these parameters deviate

from their typical ranges or in the event of an emergency or dangerous circumstance. Temperature and heart rate sensors are part of the system architecture, and a GSM module is used to send the data to the doctor via the Internet of Things. The LM35 temperature sensor, which offers precise temperature measurements over a broad range, is the one in use.

The pulse sensor is a plug-and-play device that uses the blood's absorption of light to determine heart rate. The microprocessor in the system is an Arduino UNO, and communication is handled by a GSM module.

Ravali et al [2] The system proposed is a smart hospital system using IoT. Real-time tracking and monitoring of patient health metrics is its primary goal. The system utilizes a wireless sensor network to collect data from various medical and environmental sensors worn by the patients. This data is then transmitted to a server via a mobile device or PC using the GPRS (General Packet Radio Service) interface. The system architecture consists of several components which includes microcontroller, pulse sensor, electrocardiogram (ECG), temperature Sensor, micro-electromechanical system (MEMS) accelerometer, and RFID reader. The system's central component, the microcontroller, gathers sensor data continually and updates it on a GPRS web page. It also checks for abnormal conditions and triggers an alerting device if any are detected. The system incorporates RFID technology for identification purposes, allowing for the tracking of outpatients and providing their information to doctors. The captured data is delivered to a control system, which can be accessed by doctors and nursing staff. The system also utilizes LCD displays and web pages to display sensor values and captured data.

Kumar et al [3] presented an IoT based model for real-time patient monitoring with the extra feature of drug delivery from the remote location. A vital sign machine with five parameters, including Heart Rate, Non-Invasive Blood Pressure, Blood Saturation, ECG and Body Temperature is attached to the patient. The patient's vital signs are transmitted to a cloud-based server in JSON (JavaScript Object Notation) format. A mobile and desktop application has been created to retrieve patient data from the cloud database. This mobile application allows doctors to view a patient's physiological parameters in real-time and remotely control the infusion pump. An infusion pump with five syringes has been developed for the purpose of administering medication. The accompanying mobile application is capable of retrieving patient data and transmitting doctor's instructions to and from a cloud-based server. A notification is delivered to the doctor's cell phone whenever a patient is transported by ambulance, keeping them updated on the circumstances. The mobile software, which use Java-based Web Tokens (JWT) to guarantee authenticity, allows the doctor to view the patient's vital signs when they have successfully authenticated. The doctor can give the order to inject medication using an infusion pump that is attached to the patient via an IV after examining the patient's vital signs.

Vippalapalli et al [4] utilizing the BSN (Body Sensor Network), which is composed of a number of implants and health sensors that are located inside or outside the body. A vast number of patients will be maintained and monitored by the suggested system. The Arduino Uno is equipped with a number of health sensors, including blood pressure, temperature, and pulse rate sensors. They produced LabVIEW software in order to gather, handle, and send the data. The patient's body and the Arduino FIO transmitter are connected, and the receiver is USB-attached to the PC. Doctors can view all data using LabVIEW, and patient PCs can also access data.

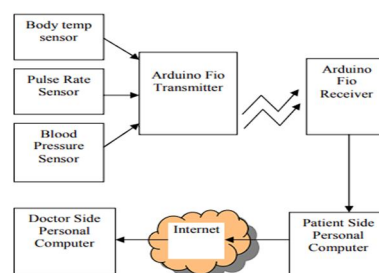


Figure 1. Block Diagram of Model

Shalini [5] has presented a system which guides the patient to take treatment based on their health parameters using Thing Speak. The suggested system is really basic, consisting of an Arduino UNO integrated GPS module, blood pressure sensor, heartbeat sensor, and GSM module. The doctor receives the gathered data. If any problems are discovered, the patient will receive a diagnosis from the doctor along with a copy of the monitored data. The patients who are old who do not care about health and people who care less to their health, The alert messages are sent to such patients so that they can take doctor's consultation when needed.

Singh et al [6] have developed a smart system to monitor the patient's health and smart medicine box. Two controllers are used in the system's design. The first controller gathers data from the patient's body, evaluates it, and stores it on a cloud server. The first part of the hardware system consists of different health sensors which are interfaced with Arduino UNO to collect data and send to doctor for analysis. After the doctor's feed on seeing the patient data, The Smart medicine box will contain all data of patient's medication and schedule of medication. The medicine box consists of LCD display, Buzzer interfaced with Node MCU. When the patient misses any medication or the time is scheduled by a patient this system will display alert message on lcd and turn on buzzer for alarm and the intimation is also provided via SMS. The web page is also setup for displaying patient's data and alert messages.

Kurlekar et al [7] have proposed an electronic Wi-Fi controller based hospital management system using IOT. They developed a hardware model to collect Patient Id and history of the patient's health. A data-based model is created using RFID and web server. The patient's health information is stored in a hospital database. RFID tag is used to maintain patient's name, Id and records of patient health and test reports as it provides secure data exchange and easy access of data. They created a web server using python base. The doctor can easily access all patient's data and data is considered to treat patient and also the current health report will be saved in same database under patient's unique Id. The health sensor hardware model includes the temperature sensor LM35, the pulse oximeter sensor MAX30100, and the RFID RC522 with an integrated WIFI module and Esp32 microcontroller. The doctor will review patient's physical parameters and prescribe a prescription with relevant medicines.

Das et al [8] have over the years produced review papers on patient monitoring systems. In their study, they detail how the system is put into practice, utilizing intelligent biosensors to identify and document human physiological traits, then connecting this data to a computer over wireless protocols so that the system may notify physicians about the patient's health. When these technologies are used together, healthcare will be more effective, less expensive, and less prone to mistakes in diagnosis and treatment. Sensors are used to measure the patient's body temperature and pulse rate. The gathered data is transmitted to the controller, which uses Bluetooth to transform it into a digital signal that is then transferred to the patient's mobile application and the LCD display, where the values are shown. This helps the patients in remote areas to keep in track of their vital signs of their health and in case of any variations they could approach their doctor.

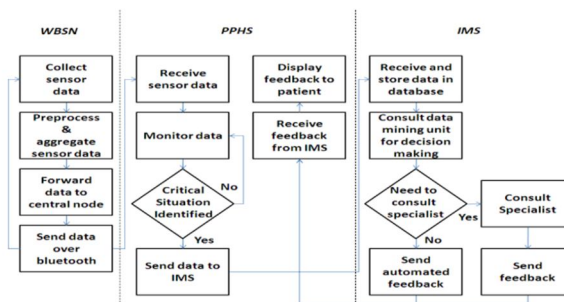


Figure 2. Flowchart of the system

Boikanyo et al [9] in their work presented an IoT-based Patient Health Monitoring System that utilizes sensor technology, microcontrollers, and Wi-Fi connectivity to monitor patients' health. The system was developed to meet the requirements for patients who require constant monitoring, particularly the elderly. The project makes use of sensor technology, including an Arduino Uno microcontroller coupled to temperature and cardiac sensors. For data transfer to a web server, the microcontroller is interfaced with an LCD display and a Wi-Fi module. This enables real-time monitoring of important parameters, such as body temperature and heartbeat, and notifies loved ones and healthcare providers in the event of any irregularities. Through a mobile application, users may also view their health status thanks to the technology. Wireless sensor networks and the Internet of Things make it easier to transmit and collect medical data, allowing for customized healthcare messaging and ongoing monitoring of patients' vital signs.

Halikar et al [10] have presented an architecture where the doctor can suggest the feedback by considering the patient data via SMS alert if any danger is observed. This method gathers health information from patients in three parts: Transfer the gathered data to the cloud, whereupon the physician can view it remotely and use SMS alerts to provide feedback in the event of an emergency. The ESP32 controller, temperature, pulse, and ECG sensors, LCD display, and GSM module for communication make up the hardware portion. All these sensors and modules are interfaced with microcontroller. The Sensors will collect the patient's physical health data. The patient's temperature, pulse, and heart rate will all be displayed on the LCD. The WIFI module on the server, that provides rapid and simple internet access, is

used to store this data. The doctor receives the stored information so they can continuously monitor the patient's health. If the doctor finds anything, they send an SMS alert via the GSM module.

Jeyaraj et al[11] The creation of an automated physiological signal monitoring system for older, ill patients is the main emphasis of a research paper I worked on called "Smart-Monitor: Patient Monitoring System for IoT-Based Healthcare System Using Deep Learning." The technology is meant to give healthcare providers quick access to data and precise forecasts. To improve the e-healthcare system, the research makes use of deep learning algorithms and Internet of Things (IoT) technologies. An intelligent sensor for signal measurement and a National Instruments myRIO for intelligent data capture make up the suggested system. In prototype testing, the system, named Smart-Monitor, was verified with an average accuracy of 97.2%. It is intended to be a consumer product. The outcomes show how dependable and accurate the automated system can be in terms of monitoring. For healthcare practitioners, the proposed approach might offer dependable support and precise signal prediction. Additionally, the study contrasts the suggested system with current monitoring systems and emphasizes the benefits of utilizing IoT and deep learning algorithms. The study comes to the conclusion that the suggested Smart-Monitor system can be utilized as an integrated solution for precise physiological signal monitoring and prediction in healthcare environments. Both the requirement for patient travel and the quality of service could be enhanced by the system. All things considered, the study provides a thorough analysis of the Smart-Monitor technology and its possible uses in healthcare.

III. PROPOSING SYSTEM

A. Block diagram

Understanding previously created technologies and concepts is the review's primary goal. Through SMS warnings and Alarms, all systems implemented thus far provide patients help from doctors. There isn't a system in place to treat people, particularly those who leave villages and Remote locations. Our proposed system makes use of a variety of sensors and a website to help those living in rural and isolated places. If a video call is required, the system will establish video connection if not, it will recommend medication to address the patient's health issue.

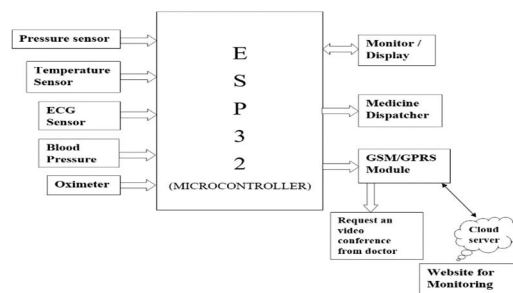


Figure 3. Block Diagram of Proposing Model

IV. RESULTS

All of the sensors in this system will collect data about the patient's health. This sensor is more affordable, quicker, and small. It can be used to take the body temperature, heart rate, and oxygen saturation level. The system continuously monitors the data gathered from the patient's body, and if any problems are identified, it will provide the patients the proper tablets or prescriptions. In situations where a patient needs medical support, the system will initiate a video call so that doctors can provide remote assistance to the patients

← STATUS OF THE PATIENT →	
Temperature	98° F
O2 Level	98%
Blood Pressure	120/80 mm Hg
Pulse	60-100 bpm
CHECK REPORT	

Figure 4. SnapShot showing status of patient In designed website

← REPORT OF THE HEALTH STATUS		
Date: 12/1/24	Name: A	Age:26
Vital Signs of Mr/Ms. A compared to ideal values have resulted as NORMAL, but the temperature value is a bit higher, hence Mr/Ms.A. is suffering from a normal fever. A medication is prescribed, the patient is required to take a single dose of the medicine, after each meal. Mr/Ms.A is required to come test again, in case the fever hasn't settled down.		
MEDICATION: Paracetamol / Piroxicam		
Caution : Medicine prescribed is only for age above 18		
Click here for Appointment	Click here for Video Call	

Figure 5. Snapshot of website showing report in website

TABLE I. COMPARISON OF PREVIOUS SYSTEMS WITH PROPOSED SYSTEM

	year	Advantages	Disadvantages
[1]	2021	Alert message is sent to doctor in case of change in nominal values and Cost effective	Device is too small And can only be used for monitoring .
[2]	2021	Continuously monitors the patient's health and send the data to doctor/ nurse through website	No interaction of doctor with patient remotely. Patient should visit hospital for medications
[3]	2021	An android based mobile application through which patient data can be monitored very easily and Drug delivery through infusion pipe	This system is only used for patients in admitted in hospitals and patient in ambulance.
[6]	2023	Includes mobile application for patient for personalized alerts and schedules.	Interaction of patient with doctor, feature is not included and video conferencing is not included
[11]	2022	Low cost, Highly accurate, Uses deep learning algorithm for signal monitoring and analysis.	Only proposed for keeping track of health of a patient, No video conferencing with doctor.
Proposing System	2024	Cost effective, less complex system, Website is provided for patient interaction. Medication is recommended for general issues and for complex issues video conference is provided with doctor remotely.	No Treatment for complex diseases and a paramedic is required, as this system is mainly built to be included in villages.

III. CONCLUSIONS

The integration of iot in health care and patient monitoring systems has proven to be revolutionary advancement in the health sector. This study has helped us to explore various facts of patient monitoring systems, focus on pivotal role played by IoT technologies in amplifying efficiency ,patient care and overall operational effectiveness of the smart hospital system. The implementation of iot has facilitated real-time monitoring of medical appliances, patients vital conditions and other critical data , enabling professionals to make decisions properly. The advancements taken up till now in this system have resulted in seamless workflows, reduced errors and improved patient outcomes. Additionally, the security and privacy concerns associated with iot through robust protocols and encryption mechanism, ensures the confidentiality of patient information. As we move towards the era of digital transformation in healthcare powered by IoT will continue to evolve, bringing out even more sophisticated results. the ongoing advancements in artificial intelligence , sensor technologies ultimately contribute to a more efficient and sustainable healthcare system.

REFERENCES

- [1] Prateek Kulshrestha, Preksha Joshi, Piyush Sharma, Dinesh Verma , “Wireless Patient Monitoring System Using IOT”, in 2021 International Journal of Electrical, Electronics and Computers Vol-6, Issue-3.
- [2] S.Ravali and Dr.R.Lakshmi Priya, “Design and Implementation of Smart Hospital using IOT,” in 2021 Proceedings of the Fifth International Conference on Computing Methodologies and Communication (ICCMC 2021) IEEE Xplore Part Number:CFP21K25-ART.
- [3] Naveen Kumar, Rajesh Kumar Kaushal and Surya Narayan Panda ” IoT Based Smart and Portable System for Remote Patient Monitoring and Drug Delivery”, et al 2021 J. Phys.: Conf. Ser. 1950 012017.
- [4] Vikas Vipplapalli and Snigdha Ananthula, “Internet of Things (IOT) based Smart Health Care System”, International conference on Signal Processing, Communication, Power and Embedded System (SCOPE)-2016.
- [5] V. Baby Shalini, “Smart Health Care Monitoring System based on Internet of Things (IOT)”, Proceedings of the International Conference on Artificial Intelligence and Smart Systems (ICAIS-2021) IEEE Xplore Part Number: CFP21OAB-ART; ISBN: 978-1-7281-9537-7
- [6] Aditya Singh, Ankit Kumar, Mansi Gupta and Nihir Guptha, “Design and Development of IoT Based Patient Monitoring System with Smart Medicine Box”, May 29 2023.
- [7] Supriya P Kurlekar, Darshana D Wani, Rutuja M Kulkarni and Ruchita R Kamble, “IoT Based Smart Hospital Management System”, 2022 JETIR January 2022, Volume 9, Issue 1.
- [8] Priyanka Das, Rashmita Deka, Suneina Sengyung, Bintu Kr. Nath and Hemahsree Bordoloi, “A Review Paper On Patient Monitoring System” Dept. of Electronics and Communication, School of Technology, Assam Don Bosco University, Guwahati 781017 .

- [9] Kegomoditswe Boikanyo, Adamu Murtala Zungeru, Boyce Sigweni, Abid Yahya, Caspar Lebekwe, "Remote patient monitoring systems: Applications, architecture, and challenges"
- [10] Vikrant Halikar , Pranav Jadhav , Sanket More , S.D.Patil, "Patient Health Monitoring System Using IOT Devices", INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY, IJIRT 154527, Volume 8 Issue 11 April 2022.
- [11] Pandia Rajan Jeyaraj & Edward Rajan Samuel Nadar IETE Journal of Research, Volume 68, 2022 "Smart-Monitor: Patient Monitoring System for IoT-Based Healthcare System Using Deep Learning".