IoT-Based Health Monitoring System For Forbidden Patients

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***Abstract*— The device is wearable and user-friendly; the patient's health monitoring system may be built using cutting-edge technology like wearable sensors and the IoT. patient's blood pressure, heart rate, temperature, pulse, ECG. The other physiological data may be continually monitored and recorded by the system. The healthcare system may become independent and less dependent on physical intervention by using sensors to analyze and diagnose patient activities in real time. By making the state may be continually checked. Furthermore, the system might be designed to be wireless and cloud-based, connecting several therapeutic devices for patient care and health tracking. To protect patient data, however, security and privacy concerns with implanted medical devices must be addressed.**

Keywords— AD8232, DS18B20, ECG Monitoring, Wearable Sensors, IOT, Oxygen level monitoring, Pulse Monitoring, Temperature monitoring.

I. INTRODUCTION

In recent years, wearable sensors, and the Internet of Things (IoT) have grown increasingly common, contributing to the growing popularity of health monitoring systems. Without the presence of a nurse or other healthcare expert, these devices may be configured to monitor a variety of indicators, including blood pressure, heart rate, temperature, oxygen level, SPO2, and glucose. Further, the system might be designed to be wireless and cloud-based, connecting many therapeutic devices for patient care and health tracking. This system's objective is to offer remote health monitoring to those who, for a variety of reasons such as cultural norms, legal constraints, or other circumstances cannot get medical treatment.

The healthcare system is self-sufficient and does not require physical intervention since the system can continually monitor and record important information, and the sensors can evaluate and diagnose the patient's behaviors in real time. To safeguard patient data, nevertheless, security and privacy issues with implanted medical devices need to be addressed. The result and execution of a health monitoring system that does not require a nurse and is based on variables like oxygen level, temperature, SPO2, and glucose will be covered in this essay. Our proposed work will also talk about the difficulties facing the health system and its many technologies.

With its many advantages for patient monitoring and healthcare delivery, the Internet of Things (IoT) has emerged as a crucial technological advancement in the healthcare sector. IoT-based health monitoring systems can enhance patient outcomes, enable remote care, and supply real-time data. Patients who have certain medical conditions that need constant monitoring, or who are prohibited from engaging in certain activities, may find these systems especially helpful.

The Wearable IoT-cloud-based Health Monitoring System (WISE) is one instance of an Internet of Things (IoT)-based health monitoring system. WISE enables medical personnel to track patients and deliver remote care in an emergency by gathering and displaying patient data via a body sensor network (BSN). Another illustration is the USH-Ubiquitous Sensing for Healthcare system, which monitors ICU patients using wireless sensor networks and analyses data and user behavior. To guarantee prompt and appropriate care, this system can assist in identifying patient disorders and sharing patient information with healthcare providers.

To give a complete picture of a patient's health, IoT-based health monitoring systems can also be used to integrate different kinds of data, including text, photos, and sensor data. Real-time monitoring is supported by these systems, which enables medical personnel to make deft decisions and promptly assist patients. Furthermore, IoT-based systems are accessible from anywhere, giving patients and healthcare professionals worldwide accessibility. IoT-based health monitoring systems can offer significant benefits for patients who require constant monitoring and care. These systems can collect and analyze real-time data, enable remote care, and provide a comprehensive view of a patient's health, ultimately improving patient outcomes and providing timely assistance to healthcare professionals. to get even worse as the population of the world urbanizes and leads to the increment of vehicles.

II. RELATED WORK

In the paper [1] author suggests a remote healthcare system that makes use of cutting-edge communications innovations, remote physiological measuring technologies, and modern information technology. For the aim of detecting blood groups, the suggested system is composed of an Arduino microcontroller, a Node MCU, a temperature, and a heartbeat. The system generates raw data using biosensors, which it then sends to a database server for analysis together with the expert's prior electronic health record. The paper also describes the hardware and software

modules used to design the IoT. There is additional discussion of cloud processing, data transport, and system architecture of physiological data acquisition systems. The suggested method guarantees continuous control over the health metrics, the research finds. In the paper [2] the author suggests the study of "An Intelligent IoT- based Health Monitoring System" describes IoT and WSN. The technology records and monitors various vital signs of patients in medical institutions and is capable of automatically identifying circumstances that are out of the ordinary. The IoT-based health monitoring system's hardware and software elements are described in the article. There is additional discussion of cloud processing, data transport, and system architecture of physiological data acquisition systems. The fuzzy logic-based intelligent method for identifying abnormal circumstances is described together with the outcomes of its experimental testing. The suggested approach, according to the paper's conclusion, guarantees ongoing management of the health metrics.

In the paper [3] the author suggests an IoT system for remote health monitoring that is cloud-based in the article Cloud-IoT based sensing service for health. The wearable sensor device in the system gathers the patient's physiological data and transmits it to a cloud server for processing and analysis. Because of its scalability, security, and affordability, the system may be used in settings with limited resources. The authors include information on the system's implementation and testing in addition to describing the system's architecture, which includes its hardware and software components. The study's findings demonstrate the effectiveness of the suggested system in remotely monitoring patients' health and its capacity to identify abnormalities and promptly intervene. The portable kit described in the paper "IOT-Based Patient Health Monitoring Portable Kit" may be used to track a number of physiological parameters in patients. The package comes with an electrocardiography sensor to measure brain activity in addition to sensors to measure body temperature and blood pressure. The possibility to obtain the right medication while at home, the avoidance of costly testing and hospital stays, and other advantages are highlighted in the study as advantages of the kit for patients. Care professionals also gain from the kit since it makes patient data easily accessible and permits ongoing monitoring. The final section of the study discusses the potential applications of internet-connected patient health monitoring, which is a rapidly developing field that can be useful in disaster relief rescue camps.

In the paper [4] the author suggests and details the creation of a remote health system that uses AD8232, MAX30100, or MAX30102 sensors to record heart rate, ECG, and SpO2 and uses the IOT to send the data to doctors. Using a smartphone or tablet, the ESP32 module establishes connectivity and shares critical data with medical professionals for real-time study. Hardware and software are communicated using the Blynk IoT cloud platform. r body using a Velcro belt because the developed PCB board is smaller than 60mm by 60 mm and lightweight. The study emphasizes the necessity of a remote health system that can deliver vital information to medical professionals directly from the patient from far away wards or inpatient residence settings without sacrificing any vital data. The suggested system is an effective and affordable remote health monitoring tool that can site and monitor many bodily characteristics and send the data to a healthcare professional. In the paper [5] the author suggests an IoT-based, multi-sensor system with high reliability and efficiency is proposed in this work. A Wi-Fi module and several sensors, including temperature, heart rate, and ECG-Censors, were included in the system's development. Cloud-based storage, such as Think Speak, will house the sensor's collected data. Doctors will periodically review the saved data, and if they see anything unusual, they will send a brief message to the patient's physician and family. Using various machine learning the functionality of the developed health-monitoring system has also been a focus of the research. Included in the survey are articles on machine learning-based patient-monitoring systems, IoT-based, and IoT-based health

In the paper [6] the author suggests the usage of IoT devices in intelligent healthcare monitoring systems is covered in this study. It emphasizes how IoT may help with early health problem identification, lower medical expenditures, and instantaneous health consulting. The article analyses several healthcare devices based on critical factors including temperature, blood pressure, and heart rate, and gives an overview of various (IoT)- based health systems. monitoring systems. The authors stress that future IoT-based healthcare monitoring systems must consider other factors including blood pressure, glucose levels, and oxygen levels. The article highlights the potential of IoT to transform healthcare and save lives overall. a system that varies sensors to track patients' health characteristics and wirelessly communicates to a cloud server. information kept in a database that is accessible via a smartphone application. An automated emergency alert message with the patient's location is sent to the patient's primary contacts and doctor if the patient's health parameters are abnormal in comparison to their past findings in the database. The paper cites several related works, such as research on IoT-based smart security technology for women, fingertip-based heart rate monitoring systems, IoT-based smart healthcare services for underprivileged rural residents, and IoT-based automated predictive systems and health monitoring to combat COVID-19. The scientists recommend additional sensors be added in the future to assess health metrics and that innovations be combined with past findings to further improve the system.

In the paper [7] the author suggests the creation of an Internet of Things-based system for keeping an eye on vital patients and facilitating communication via a cloud platform. To enhance patient care and monitoring, this article investigates the creation of a smart healthcare system inside an IoT context. This study looks into a non-invasive way to use pulse data gathered from an Internet of Things device to calculate the number of calories expended during exercise. To provide quick influenza screening, this study suggests a portable, non-contact infrared thermometer. It can be combined with an Internet of Things system to provide real-time monitoring and control. In this study, the deployment of a cloud-based system for usage in healthcare institutions and other settings is discussed. These studies highlight the potential of IoT in healthcare administration and monitoring, offering insightful information and direction for the creation of the suggested IoT-based healthcare monitoring system. The creation of a remote health monitoring system is covered in this study. Given the current state of the epidemic, remote health is essential. The system records and keeps track of a patient's and other vital signs using wearable sensors and cell phones. Authorized medical professionals may access the data, which is kept in the cloud, to aid in diagnosis and provide treatment. In the paper [8] the author examines an IoT-based-integrated-health care that uses sensors to track a number of health indicators, including blood sugar, body temperature, and oxygen saturation. Additionally, the device has an accelerometer to identify muscle movement in paralyzed individuals. Doctors and other authorized users can view the data that the sensors have collected by using a mobile app. Enhancing remote health monitoring and delivering timely alerts and suggestions are the goals of the system. In the Paper [9] the author suggests an Internet of Things (IoT)-based emergency HMS that can track a patient's physiological and pulse rate—constantly. The technology uses a Wi-Fi module to transfer data from sensors placed on the patient's body to a cloud platform. patient's health status can then

be remotely monitored by medical professionals or other authorized personnel. The cost analysis and actual results of utilizing this approach are also included in the paper. In the paper [10] the author suggests a technology that allows soldiers to track their whereabouts and health status by mounting sensors, transmission modules, and wearable physiological equipment on their bodies. A control room receives the information, enabling real-time monitoring and prompt response as necessary.

In the paper [11] the author explains the goal of the suggested system is to offer an allow-cost defense mechanism for troops'lives in combat. Patients may do many medical tests at once thanks to a technology that integrates six separate testing instruments into one gadget. The system has sensors to measure blood sugar, pulse oximetry, heart rate, and ECG in addition to body temperature. An Arduino Mega processes the sensor data and outputs the results onto an OLED screen. Additionally, the gadget features a smartphone that is linked to a server, enabling users and physicians to view the testresults from a distance. The device's prototype underwent testing and comparison with dependable equipment; good findings were obtained. This study examines an IoT-based health monitoring system that uses a patient's phone to monitor their temperature, humidity, andpulse rate. The device gathers data using sensors and a microprocessor, sending it to a smartphone app for in-the-moment monitoring. The report also underlines the necessity of small,reasonably priced devices and stresses the significance of remote health monitoring, particularly in light of the present epidemic.

In the paper [12] the author talks about how the cloud receives and stores the sensor data for analysis and storage. In the event of an emergency, doctors may monitor the patient's health state remotely and get notifications. The technologyseeks to lessen the workload for medical personnel by offering an affordable option for ongoing patient monitoring. The system recordspatient vital indicators, including temperature, heart rate, electrocardiogram, and posture, using sensors that are attached to an Arduino board. After that, details are sent to a cloud-storage system so that medical professionals, including assistants, may access and analyze it.The system's goal is to offer a dependable, practical, and quick fix for patient monitoring. It gives medical staff the ability to assess patients' health metrics instantly and gives patient guardians the freedom to make any suggestions they may have. In the paper [13] author suggests the study addresses possible future advancements and emphasizes the difficulties in integrating IoT in health monitoring systems. Applications for real-time healthcare might be revolutionized by the connection with health monitoring systems. To meet the growing number of healthissues, particularly chronic diseases, and the demand for accessible and reasonably priced healthcare solutions, the study highlights the significance of PHMS. In the paper [14] the author investigates the implementation of PHMS using a variety of networks, including PAN, LAN, RC, BAN, WBAN, and M-IoT. The paper also examines the body of research on symptom-based PHMS, wireless technologies, data security in PHMS, wearablehealth monitoring systems, and detection systems. The article's overall message emphasizes how important IoT is to changing healthcare delivery and enhancing patient outcomes. In the paper [15] the author suggests an ultra-low-cost Wi-Fi Based Biomedical Kit for Rural Healthcare" focuseson the development of a low-cost biomedical kit designed specifically for rural healthcare settings. The kit utilizes Wi-Fi technology andincludes the following components: A temperature sensor, and pulseoximeter These components work together to provide a cost-effective solution for monitoring and maintaining the health of individuals in remote or rural areas, where access to traditional healthcare facilities may be limited. In the paper [16] the author suggests an application of deep learning architectures, in particular Convolutional Neural Networks (CNNs), for the classification of skin cancer is covered in "CNN ComparativeAnalysis for Skin Cancer Classification." The study highlights howcrucial it is to identify skin cancer early on and how image-processing and deep learning methods may help with this process. It offers a comparison of several deep learning models, such as MobileNetV2 and a customized CNN architecture, for the categorization of skin lesion photos into seven groups. The study assesses the models' performance using optimizers and accuracy on a dataset of microscopic pictures. The findings show that these deep learning models can accurately classify skin lesions, which might aid in the early diagnosis and treatment of skin Cancer. In the paper [17][18] the author suggests how the impact of online learning on students' physical health during the COVID-19 epidemic is examined in "A Study on the Impact of Online Education on the Physical Health of Students. According to research that polled 111 online learners, most of them spent more than four hours online, which resulted in difficulties with theireyesight, stiffness, numbness, headaches, and obesity. When comparing online to offline classes, 65% of respondents reported feeling physically weary.[19] Additionally, 63% reported having vision problems, 71% reported headaches, and 72% reported feeling stiff and numb throughout their bodies. Some students were able to maintain their physical well-being by engaging in exercises at the gym, yoga, and dance. According to the survey, educational institutions should shorten theduration of their sessions The burden is assigned to pupils to provide them enough time to take care of their physical well-being. Moreover, it emphasizes how crucial it isto strike a balance between online and offline learning to reduce the detrimental effects on students' physical health.

In the paper [20] the author shows how the peasants lacked hospitals, ambulances, and other healthcare facilities; the poster cards session made clear that access to basic healthcare services is a significant barrier for them. The mind map exercise elicited various insights from the village members, emphasizing the necessity for medical care as well as the effects of illnesses on the community. Most ofthe male and elderly inhabitants had diabetes, joint discomfort, and swollen feet, according to the interviews withthe participants, village chiefs, and PHC doctors. Children were more likely to have skin problems. In addition, most of the homes had poor living circumstances, with problems with open defecation, schooling, and money generation. In the paper [21] the author suggests the Role of Amrita Vishwa Vidyapeetham in Integrated Holistic Health Policy Actions of Civil 20 India 2023" talks about Amrita Vishwa Vidyapeetham's involvement in several health-related initiatives as well as the integrated holistic health policy actions. In keeping with the World Health Organization's concept of health, the publication highlights the significance of addressing illness prevention and health promotion at the levels of the mind, body, and environment. It also offers policyproposals, such as establishing a National Mental Health Program, improving primary and community healthcare systems using digital health platforms, and deciding on a One Health strategy to address antibiotic resistance andzoonotic illnesses.

III. METHODOLOGY

Our objective is to introduce a system that can continuously track and record the health indices of patients. The information may be accessed online by the relevant physician and the medical assistant. patient's activity, heart rate, and body temperature are all measured throughout this examination. It is possible to send the data cloud for further analysis and

recording. Putting in place a mechanism that alerts the doctor or medical assistant is an additional choice. Systems for tracking remote health can be developed to collect data that medical experts can later review, making it easier to follow patients remotely over the Internet. To notify individuals who are concerned, an alarm system can also be put in place. The option to send emails or SMS warnings is another recommended approach.

Fig 1. represents the architectural flow of the system and how the patient's health is been monitored with the various sensors. And been continuously monitored and sent to the cloud.

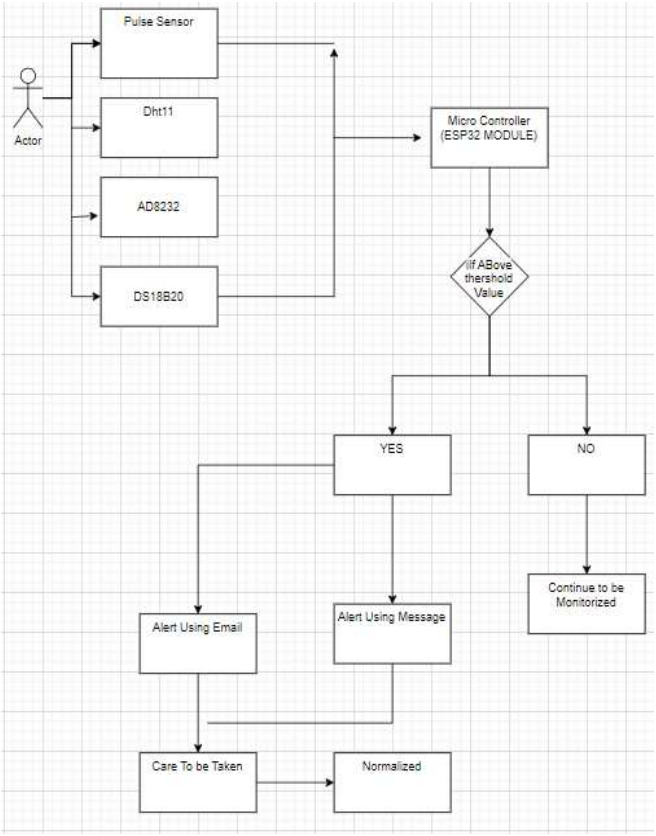

Fig. 1. Architecture Flow Diagram

A thorough approach is required to ensure the correct and efficient gathering and analysis of health-related data when developing (IOT). The process starts with the establishment ofdefined goals and a scope that takes into consideration the targeted users as well as the health measures to be tracked. Stakeholder analysis and methodical literature research assist in determining the most recent developments and user requirements. The design and architecture of the system are then developed, taking security precautions, data connection protocols, and device selection into account. Health data is gathered and sent via the integration of IoT devices and sensors, and actionable insights and warnings are generated via real-time data processing and analytics.

User satisfaction and system dependability are guaranteed via user-friendly interfaces, thorough testing and validation, ongoing feedback, and iteration. Support, training, and deployment come next, all supported by thorough documentation and adherence to pertinent laws. Plans for scalability and user interaction round out the technique, while ongoing maintenance and monitoringassure system operation. IoT health monitoring systems are valuable instruments in healthcare and well-being management since the collected data may be examined forresearch and medical insights.

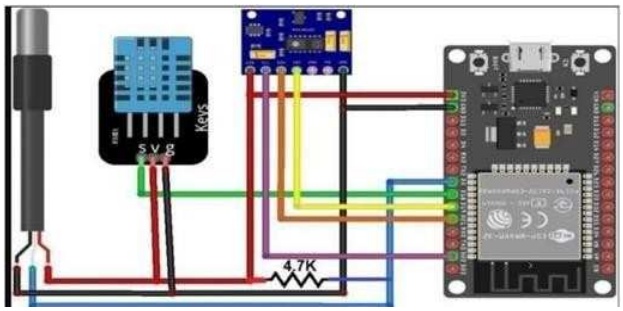

Fig. 2. Block Diagram of Health Care Monitoring System

In the above figure Fig 2. The methodology for developingan IoT-based health monitoring system for forbidden patients using pulse sensors, DS18B20, DHT11, and AD8232 can beoutlined as follows.

IV. IMPLEMENTATION

Sensor Integration: To gather vital sign data, including heart rate, temperature, humidity, and ECG signals, integrate the pulse sensor, temperature sensor (DS18B20), humidity sensor (DHT11), and heart rate sensor (AD8232) into the monitoring system. IoT Device and Cloud Integration: Send sensor data to a cloud server for analysis and storage by using IoT devices. Real-time monitoring and remote access to the patient's vital sign data are made possible by this integration.

TABLE I. THE COMPONENTS USED FOR THE IOT-BASED HEALTH MONITORING SYSTEM.

S.NO	Products Name	Specification
1	ESP32-Wifi Module	3.3V-32 Pin Wi-fi Module,power amplifier
2	DS18b20(Body temperature)	5V- 3 Pin Module, -10[°C] to +85 [°C].
3	DHT11(Room Humidity Sensor)	3.3V- 4 Pin Module, ultra low-cost digital temperature and humidity sensor
4	Pulse Sensor	3.3V- 3 Pin Module, a the detector that monitors the volume change
5	AD8232(Ecg Sensor)	3.3V- 5 Pin Module, to extract, amplify, and filter small biopotential signals in the presence of noisy conditions.

Blockchain Structure: Table I represents the components and specifications used to guarantee the security and legitimacy of the transferred data and put in place a blockchain structure. This action is essential to preserving the accuracy of the patient's medical records.

Pre-processing and Analysisof the Data: Create clever techniques to identify any anomalies or important events in the time-series sensor data. Thanks to this analysis, the system will be able to deliver alerts on time and help when needed. Testing of the Prototype: After the system is developed, thoroughly test it tomake sure it is accurate, dependable, and efficient in tracking and documenting the medical information of patients who arenot allowed.

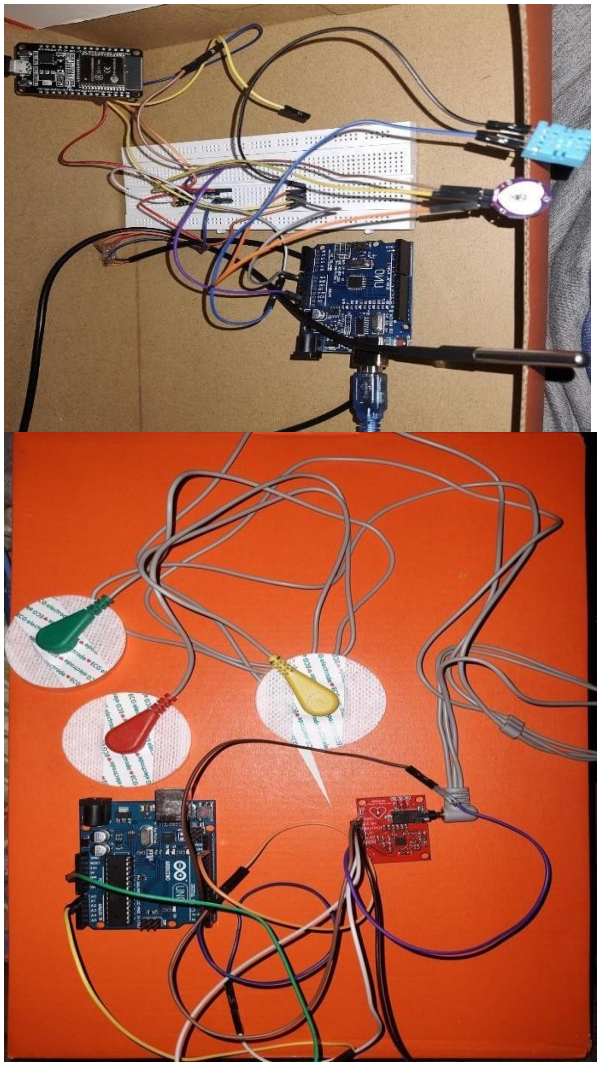

Fig 3. Circuit Connections

In Fig 3. This shows the connections of module ESP32, linked with the other sensors given Namely, DHT11, Pulse Sensor, and DS18b20. The other part of the picture represents the linkageof Arduino with the ECG Module.

V. RESULTS AND DISCUSSION

The results of experiments utilizing the ESP32, Arduino, and a variety of health monitoring sensors, such as the DHT11, DS18B20, AD8232, and Pulse Sensor, showed that it was possible to successfully acquire and display important health parameters in real-time. By using the ESP32 for wireless communication, the system successfully transmitted data to a central monitoring system.

Fig. 4. Blynk Readings of the Health Monitoring System

In above Figure 4 shows that the data is been sent to the cloud and monitored continually Under a variety of circumstances, the accuracy and dependability of sensor readings from the Pulse Sensor, DHT11, AD8232 (for ECG data), and DS18B20 were assessed, with an emphasis on making sure the data was collected coherently and synchronously.

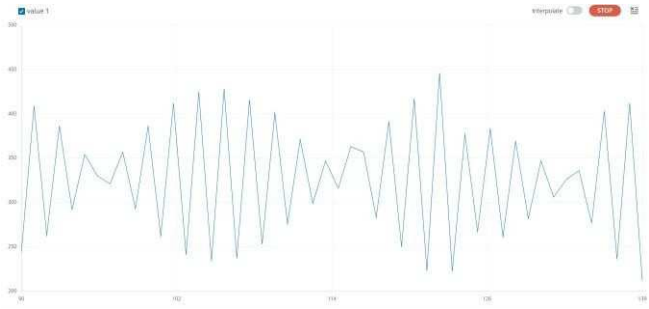

Fig. 5. ECG Readings of the Health Monitoring System.

TABLE II. THE METRICS OBTAINED FOR THE FIVE READINGS OF THE NORMAL HUMAN BODY-I

Session	Pulse (per second)	Room Temperature (in Celsius)	Body Temperature (in Celsius)	Room humidity (in Percentage)
Session 1	68	24	29	69
Session 2	65	27	27	65
Session 3	69	24	25	66
Session 4	64	27	25	67
Session 5	66	24	27	65

Similarly, Table II and Table III represent the values that may differ for different perspectives of the body.

TABLE III. THE METRICS OBTAINED FOR THE FIVE READINGS OF THE NORMAL HUMAN BODY-2

Session	Pulse (per second)	Room Temperature (in C^O)	Body-Temp	Room -hum
Session 1	69	27	28	69
Session 2	66	25	27	68
Session 3	64	24	27	66
Session 4	69	28	26	67
Session 5	66	24	26	65
Session 2	67	26	26	68

Figure 5 shows that the Readings of the ECG have been Shown And been continuously monitored.Figure 5 represents the circuit diagram and the connection has been done for the patient health monitoring system. It was confirmed that the DS18B20 and DHT11 sensors' temperature readings were accurate in a variety of environmental settings. Sensitive health data was evaluated for protection during wireless transmission using security measures.

Comprehensive insights into the functionality, dependability, and viability of the IoT-based health monitoring solution utilizing the designated components were obtained by considering the user interface and experience, as well as the scalability and cost-efficiency of the prototyped system.

VI. Conclusion

In conclusion, a variety of sensors, including pulse sensors, DS18B20, DHT11, and AD8232, can be used to create an Internet ofThings-based health monitoring system for patients who are prohibited. Real-time data on the patient's vital signs, such as bloodpressure, temperature, and heart rate, can be gathered by thesesensors. IoT devices can be used to send the gathered data to a cloud server. IoT-based health monitoring systems can give patients a complete picture of their health, enhance patient outcomes, and enable remote care. Although the application of IoT in healthcare is still in its infancy, its importance and advantages cannot be overlooked, and it is anticipated to play a major role in the field going forward.

This study presents the design and implementation of an Internet of Things-based health monitoring system. Users can use this Internetof Things (IoT) device to find out their health parameters, which may help them manage their health over time. Patients may eventually seek medical attention if necessary. They could quickly and easily share with the doctor their health parameter data through a single application. As far as we are aware, one of the most sought-after options for health monitoring is the Internet of Things. The most crucial feature is that any doctor can remotely monitor a patient's health because it ensures that the parameter data is safe on the cloud.

The developed Arduino-based Internet of Things health monitoring system is the subject of this paper. The device will use Bluetooth to transfer the patient's blood SpO2 levels, heart rate, and body temperature readings to an app. The LCD panel receives this information as well, giving the patient rapid access to their current health status. With the aid of the system we created, patients who arediabetic, elderly, have asthma, COPD, or other chronic illnesses, or who have COVID-19 will be able to manage their health over time.

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