Experimental Evaluation of an IoT Powered Healthcare Monitoring Scheme Based on Blockchain Technology Assistance

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Abstract: Blockchain technology, which was first made famous by cryptocurrencies, has now attracted a lot of interest from many different sectors, one of which is healthcare. Examining the potential benefits and drawbacks of blockchain technology, this article delves into its experimental uses in the healthcare industry. After providing a brief overview of blockchain technology, this paper explores its potential applications in healthcare, specifically looking at how it can improve data security, interoperability, and patient empowerment. It also tackles some of the challenges associated with blockchain technology, such as regulation, scalability, and privacy. The healthcare business has become more efficient, leading to better patient safety, higher healthcare expenses, and easier access to healthcare services. This study delves into various computing paradigms, data processing techniques, and Internet of Things (IoT) architectures. In order to address its numerous healthcare initiatives and their global advantages, it incorporates a number of communication technologies, often worn sensors, and healthcare monitoring systems. This study also identifies potential future healthcare facility and technology implementation strategies, examines the most prevalent problems with wearable sensory systems that aid in healthcare monitoring, and suggests solutions. This method works well in small towns and rural areas where doctors' offices can keep in touch with larger hospitals about their patients' health issues. Nonetheless, should the patient's health deviate from the expected range, the healthcare monitoring system will promptly alert the attending physician. Healthcare institutions benefit from blockchain technology's increasing use to connect data storage facilities and secure data transfer by addressing the problem of data duplication.

1 INTRODUCTION

One of the most prominent communication paradigms, the Internet of things (IoT) is rapidly expanding across many industries and offers the prospect of centralized data access and fusion. Data access permissions may be defined by user and per authorized staff (e.g., healthcare medics and doctors) (Lokesh Lodha, et al., 2020), (Soubhagya Ranjan Mallick, et al., 2024) and (SoonHyeong Jeong, et al., 2021). Concerns about privacy and confidentiality make this limited access a must in the healthcare industry. The Internet of Things (IoT) enables the interconnection of various devices, such as sensors, cars, homes, and appliances, over the Internet. This enables the sharing of data, information, and resources among users. The result is data fusion, which has the potential to greatly improve application usability, accessibility, and data analysis. Many new trends have emerged as a result of the adaptability of the Internet of Things (IoT), which aims to increase data accessibility, resource efficiency, and data communication across sources in order to boost data integrity performance generally. Recent developments in protocol communication technologies, the prevalence of the Internet, and the ease with which users may access and use the underlying infrastructure have made this a reality. Consequently, people are increasingly looking for ways to save time and effort through centralized data collecting and monitoring. Some significant areas that have been embraced by the Internet of Things (IoT) are smart cities, smart homes, healthcare, and environmental monitoring. One of the most talked-

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about issues recently is healthcare, which has risen to prominence due to factors such as the fast urbanization, industrialization, and aging populations in European countries (Pratima Sharma, et al.,2023), (WAFAA A. N. A. AL-NBHANY, et al., 2024) and (Lokesh Lodha, et al 2024). Wireless body area networks (WBANs) link separate nodes such as sensors and actuators that are embedded in, on, or beneath a person's skin (Simeon Okechukwu Ajakwe, et al., 2024) and (Partha Pratim Ray, et al., 2021). Typically, the network covers the entire human body and is linked by a wireless communication connection between the nodes. The implementation specifies a star or multihop topology for these nodes to be placed in.

Because of a WBAN's limitless range, various exciting new uses have emerged in fields as diverse as medicine, sports, home health care, multimedia, and remote health monitoring. Wearable wireless body area network (BAN) sensors can continuously monitor a patient's vital signs in the medical industry, including temperature, respiration rate, blood pressure, heart rate, electrocardiogram (ECG), and more. Some alternative therapies will enable the patient to leave the hospital and enjoy fresh air inside the room or even outside. It will help the hospital's purse and the patient. The information accumulated by the patients throughout the years in the natural environment will give much more data useful for quick and correct diagnosis (Anichur Rahman, et al., 2024) and (Yazeed Yasin Ghadi, et al., 2024).

- **IoT for Healthcare:** Before the advent of the Internet of Things, patients were limited to contacting their doctors via home visitations, via phone, or through text. There was no way a healthcare provider or a clinician could monitor the vital signs of a patient all the time and give advice based on such observations. Devices enabled by the Internet of Things (IoT) have enabled remote monitoring in healthcare, which has the ability to keep patients safe and healthy and gives doctors the ability to provide exceptional care. Because interacting with clinicians is now easier and faster, it has also enhanced patient involvement and happiness. Additionally, re-admissions are reduced and hospital stays are shortened by remote monitoring of patients' health. Improving treatment results and drastically lowering healthcare costs are two other areas where the Internet of Things has a big influence. By re-imagining the role of devices and human interaction in healthcare solution delivery, the Internet of Things (IoT) is undeniably revolutionizing the healthcare business. Everyone from patients and their families to doctors, hospitals, and insurance companies may reap the benefits of the Internet of Things (IoT) in healthcare.
- **IoT for Patients:** Personalization of treatment is made possible by the use of wirelessly linked medical devices such as glucometers, blood pressure monitors, heart rate monitors, etc., in conjunction with wearable fitness bands. A person's calorie intake, exercise routine, appointment scheduling, blood pressure fluctuations, and a whole lot more may be programmed into these gadgets. The ability to continuously monitor health problems is one way in which the Internet of Things has improved people's lives, particularly for the elderly. People who live alone and their families are greatly affected by this. An alert mechanism notifies worried family members and healthcare providers if there is a disruption or change in a person's usual activities.
- **IoT for Physicians:** With the help of wearables and other IoT home monitoring devices, medical practitioners may be able to keep a closer eye on their patients' health. If patients are adhering to their treatment plans or if they need immediate medical attention, they can be tracked by these systems. The Internet of Things has the potential to make healthcare practitioners more watchful by allowing them to proactively engage with patients. Doctors may use the data collected by internet of things devices to help their patients get the best treatment possible.
- **IoT for Hospitals:** Hospitals may greatly benefit from IoT devices in many other ways outside patient health monitoring. Internet of Things (IoT) devices with sensors can track medical equipment including oxygen pumps, defibrillators, nebulizers, and wheelchairs in real time. Additionally, it is also feasible to monitor the deployment of medical workers to different locations in real-time. The spread of illnesses is a reasonable concern for hospitalized patients. Internet of Things (IoT) enabled hygiene monitoring devices help reduce patient infections. In addition to assisting with asset management tasks like pharmaceutical inventory control, IoT devices may monitor

and regulate environmental factors like temperature and humidity.

- **IoT for Health Insurance Companies:** When it comes to intelligent gadgets that are linked to the Internet of Things, health insurers have a lot of chances. Health monitoring gadgets can help insurance firms with underwriting and claims processes by collecting data. They can use this information to spot accusations of fraud and find potential underwriters. With the use of IoT devices, insurers and policyholders may see each other's underwriting, pricing, claims, and risk assessment procedures in action. Customers will be able to see the reasoning behind every decision and the results of every process thanks to data-driven decisions made in all operational processes that are captured by the IoT. To encourage the use and sharing of health data provided by IoT devices, insurers may provide incentives to policyholders. The IoT features a four-stage design that may be thought of as process steps. Data is gathered or processed at one level and then passed on to the next, with a direct correlation between the four processes. The incorporation of values into the process yields intuitive understandings and exciting new opportunities for businesses.
- Deploying a network of linked devices, such as sensors, actuators, monitors, detectors, video systems, etc. Gathered by these gadgets is the data.
- We get data in analog form from sensors and other devices. Then, we need to convert it to digital form so we can process it further.
- After data is gathered and digitized, the third step is to preprocess it, standardize it, and then transfer it to a data center or the Cloud.
- Complete data management and analysis at the desired level. The use of Advanced Analytics to this data yields valuable business insights that can be used to make smart decisions.

2 RELATED WORKS

Increased privacy and security measures are required by the healthcare business to comply with legislation and safeguard sensitive patient information (Sireejaa Uppal, et al.,2023). Blockchain technology allows for the incorporation of both of these aspects into the current systems. A swift solution to the problem of user-friendliness can be achieved by combining blockchain technology with the Internet of Things (IoT). Devices built on the Internet of Things (IoT) get beyond the low processing power of individual smart health monitors. There is a storage capacity constraint for cloud-assisted Internet of Things devices, such as wearable sensors. It should be considered, though, that this method is not without its flaws, which cause it to be inefficient. Data sharing and data privacy are two of these issues. A solution based on the Interplanetary File System (IPFS) is proposed in this study to address these issues. Here, nodes belonging to other users—doctors, pharmacists, insurance firms, hospital administrators, etc are able to access the health data that individuals continuously upload from their IoT devices and include in blockchain transactions. Along with this capability, users may perform transactions on HealthDote's six blockchains using the system-specific cryptocurrency DoteCoins to purchase medical consultations, medicines, insurance authority payments, and hospital supplies.

With the growth of the IoT, health monitoring systems have also progressed. This paper focuses on a four-layer health monitoring system that collects patient information and provides input to several medical classifications (Poonam Rani, et al., 2022) as a secure architecture, providing support from IoT. When data are collected for computation from wearable smart sensing devices, the patient ever has to be considered in both respect of privacy and security. A lightweight and secure communication protocol over decentralized IoT networks based on blockchain architecture is developed as the prime focus of this communication. The aim is to categorize these networks into separate classes through transfer learning. For data integrity, we present a system that utilizes transfer learning through various pre-trained models to bind itself with blockchain technology. Energy consumption reduction and network traffic minimization have been achieved through a routing approach that prudently applies node energy, credibility scores, and link reliability in deciding the optimal route for data transmission. Classification accuracy of 92.24% is achieved by the suggested method, according to the findings.

Technology has allowed the eHealth sector to expand rapidly, shifting focus away from traditional hospital settings and toward providing care to patients in the comfort of their own homes (Aya H. Allam, et al., 2024). Remote patient monitoring, simplified electronic medical record (EMR) administration, medication traceability, and efficient disease control are just a few of the ways that blockchain and the IoT are improving healthcare services. This is especially true in times of crisis, like the recent COVID-19 pandemic. Security issues, such as worries about data integrity and device authentication, arise from the increasing use of IoT devices. As a strong option, this study suggests integrating blockchain technology. Building trust among varied IoT devices, blockchain uses its decentralized and tamper-resistant properties to guarantee the integrity of IoT data. The final part of this summarizes the issues posed by and potential solutions offered to the eHealth IoT implementations regarding blockchain technology. With the results of this extensive survey, stakeholders will be better equipped to make decisions that will improve patient care in an ever-changing industry.

In modern domains including smart cities, smart homes, schools, hospitals, transportation, and military operations, the Internet of Things (IoT) plays a pivotal role (Suliman Abdulmalek, et al., 2022). When it comes to healthcare, IoT applications really shine since they allow for safe, real-time remote patient monitoring, which greatly enhances people's lives. This article examines the ways in which healthcare monitoring systems are being impacted by the IoT. In addition to characterizing healthcare monitoring sensors, the article delves into Internet of Things (IoT) monitoring systems that rely on wireless and wearable sensors. We also go into depth on the difficulties and unresolved concerns related to healthcare privacy and security, as well as quality of service. At last, the study concludes with future directions connected to several current technological advances as well as proposals and recommendations for healthcare IoT applications.

A growing number of entities, including healthcare institutions, patients, insurance companies, Internet of Medical Things sensor nodes, and Internet of Things (IoT) wearable medical devices, are becoming integral parts of IoMT systems (Hamed Taherdoost 2023). Because of the need of scalability in blockchain technology, designing a blockchain for such applications is challenging. In light of this insight, we set out to conduct an exhaustive analysis of all English-language blockchain-based IoMT solutions created between 2017 and 2022. Bringing together the theoretical underpinnings of a large corpus of work published in highly regarded academic journals over the past decade, this research aims to standardize evaluation approaches and fully capture the rapidly developing blockchain area. The mentioned findings support the identification of several research gaps and possible future study directions that may benefit both academics and practitioners.

3 METHODOLOGY

Health protection via prevention and prediction is progressively replacing conventional medicine's emphasis on therapy following diagnosis (p2 Health). In response to this trend, it is essential to continuously and comprehensively monitor parameters across all healthcare domains using real-time monitoring and individual data records. The health care internet of things is the focal point of this new age of healthcare, following the successful implementation of e-health and m-health. Internet of Things (IoT) healthcare platforms may integrate and combine (on the server level) important parameters from several domains which could help with healthcare security. The second healthcare-related field is environmental factor monitoring, which encompasses chemical and physical components as well as vital signs and physiological parameters. Using this platform, end-users (approved staff) may alter sampling rates, synchronize, monitor parameters on Wearables and applications, and install additional sensor nodes. The combination of sensor layers at the physical level and data fusion on the cloud allows for ubiquitous and centralized data processing, which is used in healthcare and safety surveillance.

Remote and in-person patient monitoring, diagnosis, and treatment have all been greatly enhanced by the fast integration of technology in the health sector in the past several years. Patients' quality of life and the capacity to track their data are both enhanced by this. Most of the injuries considered focused on chronic illness monitoring as the primary reason for the use of tele-medical electrocardiogram systems and the top objective of remote vital signs monitoring. This is a crucial step in creating an all-inclusive solution for sequential patient monitoring, regardless of the ailment, type of check, or number of units to be managed. Whenever a medical emergency occurs, the doctor is notified by a preexisting wireless patient monitoring system that includes a PIR sensor, temperature, humidity, and smoke detectors that are attached to the patient's body. Patient health monitoring network based on Zigbee wireless sensors. This system is designed to monitor elderly individuals and patients in coma. Among its many sensors are those for measuring heart rate, temperature, saline level, and micro-electromechanical systems (MEMS). These IoT systems, among others, provide great advantages to health and medical care in terms of perception, transfer, and action of data. IoT addressable parts that emulate smart, accessible, and communicative systems, for example, non-limiting is medical equipment, patient information management and medication control, telemedicine, mobile medical care, personal health management, and many more.

In modern times, a number of portable sensor devices have come up to monitor health, fitness, and levels of activity-a good kind of tech as this technology has started getting attention over the last few years. Besides serving the specialized recreational fitness domain catered by these devices, researchers have investigated possibilities for their clinical applications in tele-health monitoring systems for long-term record-keeping, management, and clinical access to patients' physiological data. Every Internet-connected device in the Internet of Things (IoT) network may communicate with any other device in the network, and each device can be uniquely identified and addressed at any moment. Internet of Things (IoT) based remote health monitoring systems may automatically exchange data with healthcare facilities via the web. The following Figure 1 shows the proposed approach block diagram in clear manner.

- Create an Internet of Things (IoT) based system that can efficiently measure environmental, physiological, and behavioral (partially) variables using a wearable mechanism;
- Integrate, calibrate, and analyze environmental and physiological factors in order to conduct medical research on the interplay between these variables. Also included in this is the ability to see data on the server.
- Launch and refine a modern ambient monitoring prototype.
- The goal is to create an adaptable Internet of Things gateway that can use various commercial devices to measure physiological indicators. Patients and consumers with a variety of product ownership may all benefit from this solution, and the platform is open to all suppliers.

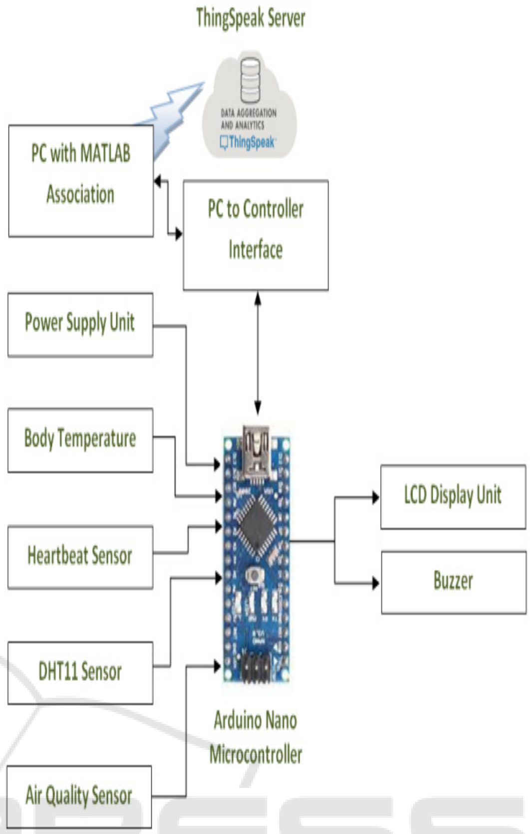

Figure 1: Block Diagram.

- The user and the medics may communicate in real-time from beginning to conclusion, allowing the medics to provide the user with the advice they need.
- Determine a way to make it work for all types of workers. By utilizing the end-to-end connection and adaptable IoT-gateway, medical professionals are granted the ability to personalize each patient's monitoring parameters, including the ability to activate or deactivate certain sensors and parameters.
- **Arduino Nano Microcontroller:** Arduino is a free and open-source software-based platform for making prototypes. Engineers may experiment with developing interactive worlds using this versatile basis. Embedded systems that can control and detect parameters in real-time can be created using them, depending on the application's programming. It is composed of an ATmega328 microcontroller that can be programmed with the Arduino software. An Arduino Uno Boot loader is standard on the Arduino R3/Genuino R3, which is the board's Indian counterpart.

When written with the Arduino IDE, it simulates the behavior of the Arduino board. There are a total of 20 digital inputs and outputs (I/Os), 16 milliseconds (MHz) of crystal oscillation, a USB connector, an ICSP header, a reset button, and 14 digital inputs and outputs (I/Os), 6 of which may function as pulse width modulation (PWM) outputs. The following Figure 2 shows the Arduino nano microcontroller.

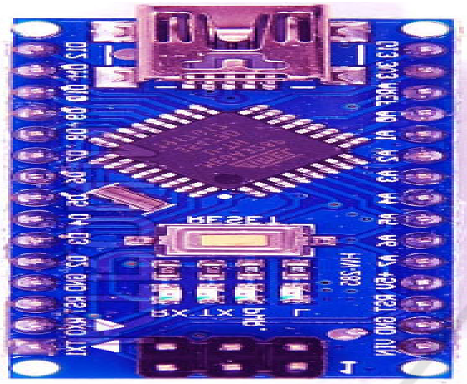

Figure 2: Arduino Nano Microcontroller.

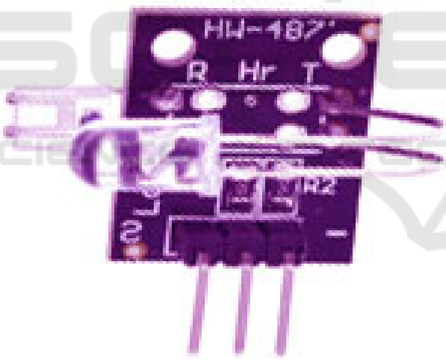

Figure 3: Heartbeat Sensor.

- **Heartbeat Sensor:** Placing a finger on the Heart Beat Sensor causes it to produce an analogue signal that corresponds to the heart rate. Upon activation, the heart detector will begin to flash the topmost LED in response to each heartbeat. In order to measure the heart rate, the output of this sensor may be directly linked to the microcontroller. It works on the premise that light may be modulated by the constant flow of blood via the finger's nerves with each pulse. The analog output mode, which is the module's default, is straightforward. The following Figure 3 shows the heartbeat sensor.

- **Humidity Sensor:** Humidity refers to the amount of water vapor in the air. Many industrial processes are sensitive to the relative humidity of the air, which in turn affects human comfort. Water vapor affects many biological, chemical, and physical processes as well. Because it may have an impact on product costs and worker safety, humidity monitoring is essential in industrial settings. Control systems for industrial operations and human comfort rely heavily on humidity sensing. Many industrial and household applications place a premium on controlling or monitoring humidity. The semiconductor industry is ever so reliant on the measurement and control of relative humidity and moisture in the fabrication of wafers. An example of a medical application of humidity management is pharmaceutical manufacture, the production of biological products, sterilizers, incubators, and respiratory equipment. Some of the most vital activities involving control of humidity include dryers and ovens, chemical purification of gas, humidity control, paper and textile production, food processing, and film drying. In agriculture, there are several reasons for monitoring humidity, including dew prevention in the plantings and soil moisture regulation. Humidity management is essential for residential applications such as building interiors, microwave ovens, and other kitchen appliances. To indicate the relative humidity of a given area, humidity sensors are used in all of these and countless more applications. The following Figure 4 shows the humidity sensor.

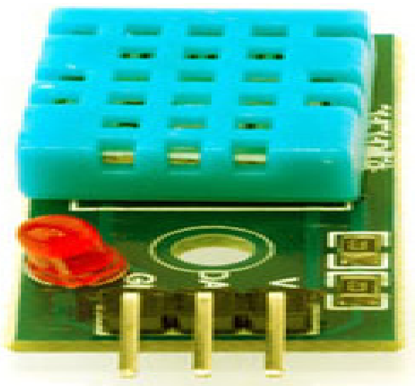

Figure 4: Humidity Sensor.

- **MQ-6 Gas Sensor:** The MQ-6 gas sensor is designed using SnO2, which has relatively low conductivity in clean air, as its sensitive material. With the presence of the target flammable gas, the conductivity of the sensor follows the gas concentration. The change in the conductivity would then be transformed into an output signal by means of a basic electronic circuit in order to determine the concentration. This sensor has extremely high sensitivity for gases such as natural gas, butane, propane, and LPG. The sensor is understood to be a useful product because of its ability to detect various combustible gases, including methane, while being versatile and of low cost. The MQ-6 gas detector is shown in Figure 5.

Figure 5: MQ-6 Gas Sensor.

- **LM35 Temperature Sensor:** The ability to detect when an object is hot or cold is the primary function of a temperature sensor. With a proportional output to the temperature (in °C), the LM35 is a precise integrated circuit temperature sensor. The LM35 is a more precise temperature sensor than a thermistor.

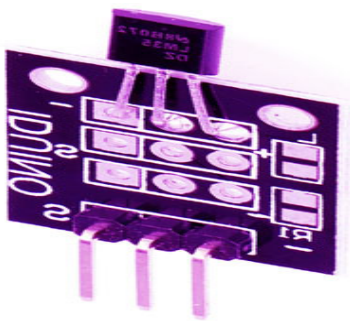

Figure 6: LM35 Temperature Sensor.

Additionally, it has a low coefficient of thermal expansion and raises the temperature of still air by no more than 0.1 °C. The temperature range in which it can function is -55°C to 150°C. Because of its linear output, low output impedance, and accurate intrinsic calibration, the LM35 is ideal for use in control or readout circuits. An output voltage proportional to temperature in Celsius is provided by the LM35. .01V/°C is the scaling factor. The following Figure 6 shows the LM35 temperature sensor.

- **LCD Display:** The liquid crystal display (LCD) screen is an electrical display module that has several functions. Many different kinds of gadgets and circuits make use of the same basic module: a 16x2 LCD display. This LCD is called a 16x2 because it has two lines of sixteen characters each. A 5x7 pixel matrix displays each character in this LCD. Command and Data are the names of the two registers on this LCD. Figure 7 Shows the LCD Display.

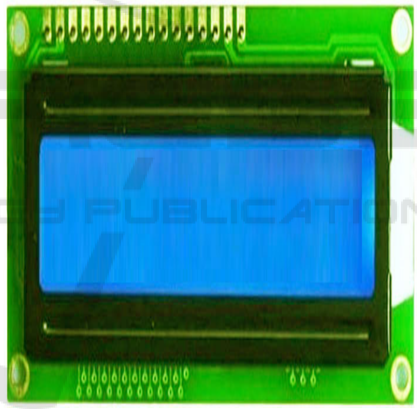

Figure 7: LCD Display.

- **BlockChain and IoT Interfacing:** Blockchain technology is enhancing security, privacy, and efficiency, skidding giant wheels in revolutionizing healthcare monitoring. It provides a decentralized and impossible to penetrate system for conducting medical data managements, integrity of data, and functioning for real-time patient monitoring. However, some challenges persist, including privacy, interoperability, and security of data. Blockchain technology, by providing smart decentralized immutable frameworks, solves all these problems in terms of IoT health monitoring concerning its efficiency, privacy, and security concerning real-time patient data.

With continuous health data stream from IoT devices such as smart sensors, medical implants, and wearables to be stored in the blockchain, integrity is restored and minimized access to the information outside authorized parties. This integration creates better interoperability, promotes data-sharing among healthcare providers, and reduces the chance of central data breaches. Not only does blockchain technology allow early detection of diseases and preventive health measures, but also real-time health monitoring. While blockchain-based IoT healthcare solutions promise a safer, more transparent and efficient digital healthcare ecosystem, they are also faced with the immense cost of installation, limited scalability, and regulatory compliance.

4 RESULTS AND DISCUSSION

Recent developments in healthcare monitoring technology make it possible for medical equipment to do real-time assessments hitherto unthinkable for doctors to execute. It has also enabled healthcare institutions to operate the lowest cost and simultaneously service a bigger population. Big data and cloud computing have also helped to increase consistency and simplicity of doctor-patient communication. This resulted in a decreased financial burden for the patient and more patient participation in the treatment process. Management has evolved healthcare monitoring system applications including personal care for children, old patients and illness detection. Recent years' notable Internet of Things effect helps to keep track of chronic illnesses and enhance health and fitness by means of monitoring. By tackling a broad spectrum of medical problems, ideas and service have distorted the healthcare industry. Growing health-care requirements and technological developments drive daily service provision from additional angles. An electronic healthcare network depends on data interchange between several medical devices and healthcare service providers. Block chain technology is one of the main issues with safe data also promoting cooperation, sharing, and data fragmentation nevertheless. Data fragmentation might cause a knowledge gap between doctors linked to the same patient. Lack of proper information might hinder the course of therapy. Block chain technology not only solves data fragmentation but also helps healthcare institutions to link the data repositories found in the network study.

Artificial Intelligence (AI), which interacts with the Internet of Things, offers age-related support in expert capacity. The main objective of the suggested artificial intelligence-based solution is to let elderly people live comfortably and safely at home. In the event of a medical calamity, this system offers a means for closely monitoring patients in real-time and guarantees that they get help on par with those of human services. Sophisticated artificial intelligence techniques, large data analysis, machine learning, and healthcare sector application help to make this achievable. Several software tools, like MATLAB and Arduino IDE, help to empirically evaluate the suggested method. This MATLAB program is used to link the whole hardware to PC and obtain the necessary health data from patients via sensors thereby enabling the Internet of Things (IoT) help. MATLAB analyzes and handles the gathered data; the results are shown to users appropriately. After that, IoT technology passes the resultant specifics to a distant server. Figure 8 displays the hardware design result of the suggested solution, in which the web application output pages are clearly shown on further figures.

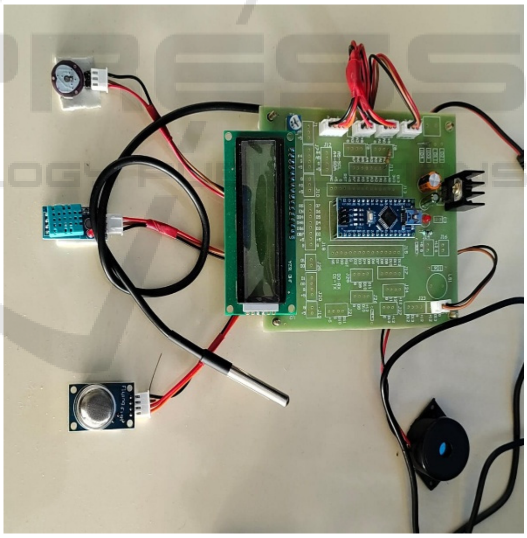

Figure 8: Hardware Design.

In the proposed layout, the pages that are represented by the following figures are the Homepage, New User Registration, and New Doctor Registration. These figures are organized 9 through 11 respectively.

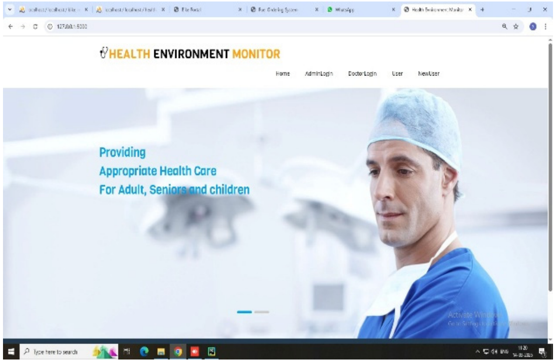

Figure 9: Homepage.

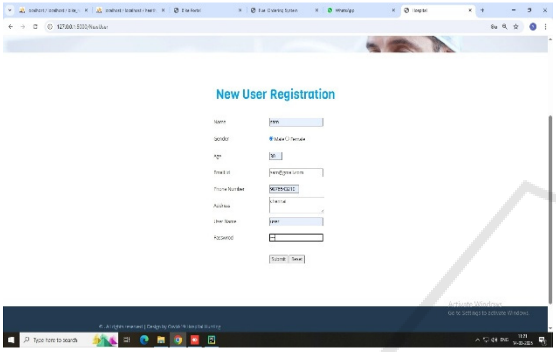

Figure 10: New User Registration.

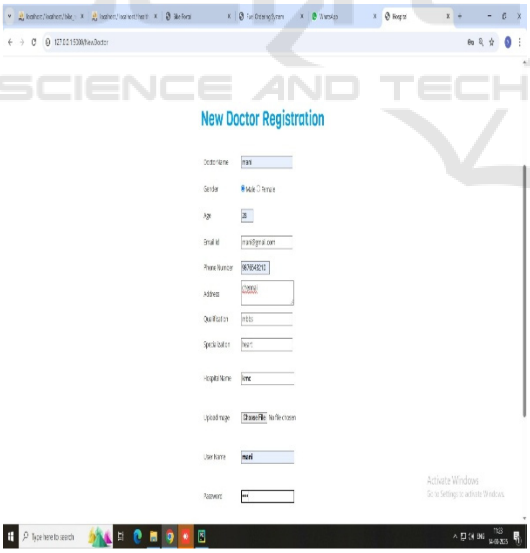

Figure 11: New Doctor Registration.

The outputs of the suggested system are depicted in the following Figure 12 These figures reflect the User Login, Administrator Login, and Doctor Login results, respectively.

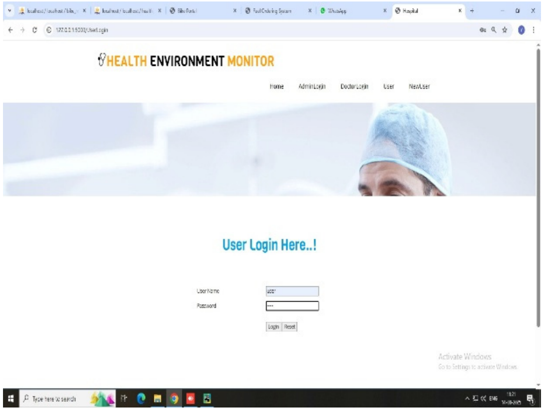

Figure 12: Login User, Administrator and Doctor.

The Matlab output summary of the health information obtained from sensors such as body temperature, heartbeat rate, environment temperature, environment humidity, and air quality ratio is represented by the following figures, Fig-15 (a), (b), (c), (d), and (e). These figures are described in more depth below.

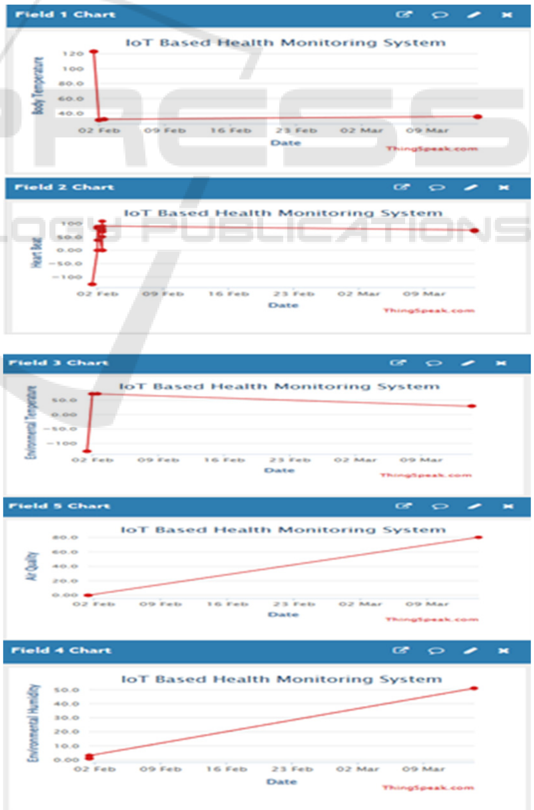

Figure 13: Health Records Analysis, Body Temperature, Heartbeat Rate, Environment Temperature, Environment Humidity and Air Quality.

5 CONCLUSION AND FUTURE SCOPE

The creative health monitoring system that has been proposed enables physicians to easily identify the information of each patient on the display monitor located at their location. Doctors can differentiate between the data of a specific patient with respect to their previous values and their current values. In addition to data recording on the cloud, the Internet of Things offers the potential to incorporate additional biomedical sensors and more advanced features or advantages into this system. Consequently, the capabilities of IoT technology render this monitoring system more adaptable and upgradable in the future. A low-cost, user-friendly monitoring system for signature signs of highly sensitive patients is proposed. Vital signs are accurately sensed, converted into clinical indicators, and displayed on a central screen and web server, in a manner that communicates wirelessly with Wi-Fi-enabled networks or specially-constructed wireless IoT devices. In summary, blockchain technology has the capacity to transform healthcare delivery and outcomes by improving patients' empowerment, interoperability, transparency, and data security. Although challenges and constraints persist, ongoing research and collaboration will foster innovation and establish a future in which blockchain-enabled healthcare systems enhance the quality, accessibility, and equity of care for all. Additionally, this work can be improved by incorporating certain deep learning concepts to instantaneously determine the healthcare status and provide users with the corresponding information.

REFERENCES

Lokesh Lodha, et al., "Blockchain-Based Secured System Using the Internet of Medical Things (IOMT) Network for E-Healthcare Monitoring", *International Conference on Computer Science, Engineering and Applications*, 2020.

Soubhagya Ranjan Mallick, et al., "Blockchain-enhanced IoT ecosystem for healthcare: Transformative potentials, applications, challenges, solutions, and future perspectives", Computers & Industrial Engineering, 2024.

SoonHyeong Jeong, et al., "A Study on Smart Healthcare Monitoring Using IoT Based on Blockchain", Wireless Communications and Mobile Computing, 2021

Pratima Sharma, et al., "Blockchain-Based Privacy Preservation for IoT-Enabled Healthcare System", ACM Transactions on Sensor Networks, 2023.

WAFAA A. N. A. AL-NBHANY, et al., *"Blockchain-IoT Healthcare Applications and Trends: A Review*", IEEE Access, 2024.

Lokesh Lodha, et al., "A blockchain-based secured system using the Internet of Medical Things (IOMT) network for e-healthcare monitoring", Measurement: Sensors, 2023.

Simeon Okechukwu Ajakwe, et al., "Medical IoT Record Security and Blockchain: Systematic Review of Milieu, Milestones, and Momentum", Big Data Cogn. Comput., 2024.

Partha Pratim Ray, et al., "BIoTHR: Electronic Health Record Servicing Scheme in IoT-Blockchain Ecosystem", IEEE Internet of Things Journal, 2021.

Anichur Rahman, et al., "Internet of medical things and blockchain-enabled patient-centric agent through SDN for remote patient monitoring in 5G network", Scientific Reports, 2024.

Yazeed Yasin Ghadi, et al., "The role of blockchain to secure internet of medical things", Scientific Reports, 2024.

Sireejaa Uppal, et al., "HealthDote: A blockchain-based model for continuous health monitoring using interplanetary file system", Healthcare Analytics, 2023.

Poonam Rani, et al., "Blockchain-based IoT enabled health monitoring system", *The Journal of Supercomputing*, 2022.

Aya H. Allam, et al., "IoT-based eHealth using blockchain technology: a survey", Cluster Comput, 2024.

Suliman Abdulmalek, et al., "IoT-Based Healthcare-Monitoring System towards Improving Quality of Life: A Review", Healthcare, 2022.

Hamed Taherdoost, *"Blockchain-Based Internet of Medical Things"*, Appl. Sci., 2023.