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Addressing the IoT Schemes for Securing the Modern Healthcare Systems with Block chain Neural Networks

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Abstract-This paper provides a wide-range of literature review of various IOT with AI based enabling wearable technologies and protocols used for medical (IoT) with a taught of examining the present and future smart health care technologies. Despite recent advances in medical systems, biomedical hardware, the growth of IoT in medicine continues to advance in terms of biomedical hardware, monitoring figures like cancer patient data disease indicators, temperature levels, oxygen levels, and glucose levels. In the near future, medical IoT is expected to replace the old traditional healthcare systems to smart Ai-IoT based healthcare systems. In our paper we provided a theoretical approach of the most relevant protocols and wearable technologies used for the IoT health care medical systems. We also provided a proposed smart AI based intelligent IoT frameworks for hospital systems settings.

Keywords: Internet of Things(IoT), biomedical hardware, Artificial Intelligence, wearable technologies, medical systems

I. INTRODUCTION

Health is the foundation of a fulfilling life. In modern times, society faces many problems, such as chronic diseases and organ failure caused by stress and anxiety. Therefore, hospitals must provide adequate resources, facilities, and services, such as timely access to medications, doctors, and nurses [1,2]. The current pandemic and rising incidence of chronic diseases have led to an increased demand for smart healthcare systems. These systems play a crucial role in delivering the effectual healthcare related services to the group of patients and reducing the need for in-person hospital visits [3-5]. Digital (E-healthcare) provides highly-qualitative medical care from the comfort of one's home. Advanced communication technology and the Internet of Things (IoT) have bridged the gap between patients and doctors, providing an effective communication channel. IoT is a solution for the problems in healthcare systems. Patients will be access their related health data and records through mobile application and the available healthcare apps [6].

IoT refers to the interconnectedness of devices, systems, and services through multiway human and machine communication [7,8]. This leads to automation across various fields, including smart cities. IoT has revolutionized modern healthcare by offering various healthcare related apps and emergency services. With the integration of medical oriented devices, such as, the sensors and imaging related devices and also the service providers can provide better care to patients. This results in lower medical costs and improved patient outcomes. IoT-based wireless technologies have enabled the prevention and diagnosis of chronic diseases and provide the monitoring facility. Medical data records are maintained through databases and servers, ensuring patient accessibility at all times. Table.1 lists the advanced technologies integrated with IoT that are valuable in the healthcare sector [9].

Table 1: Technologies Integrated with IoT and Their Advantages in Healthcare

Technology	Description
Big data	Enables quick access to stored data in healthcare systems when needed.
	Facilitates the maintenance of clinical records, bills, and patient medical history.
Cloud computing	Facilitates storage of on-demand data and content access through the internet.
	Helps doctors work more effectively by providing visual access to data resources.
Software	Connects to patients' data, medical tests, and reports, reducing the communication gap between doctors and patients.

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Artificial intelligence	Evaluates, predicts, analyzes, and aids in decision making using algorithms.
	Helps predict and control diseases.
Actuators	Ensures accuracy in calculated parameters and controls the system to act according to requirements.

Figure 1 depicts a comprehensive automatic context for healthcare oriented systems based on IoT technology. The figure showcases the outcomes anticipated through the integration of IoT technologies [10-12].

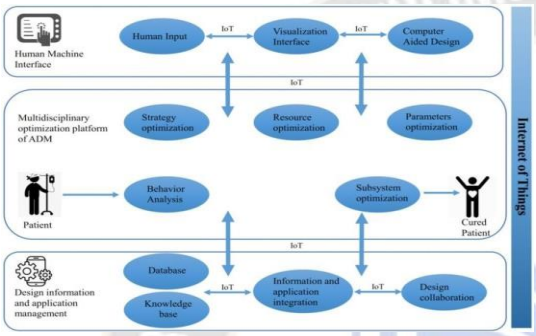

Figure 1: Automated Design Framework Based on IoT

IoT plays a critical role in the healthcare sector, particularly in detecting silent symptoms in patients. Early detection can prevent serious illness and even save lives.

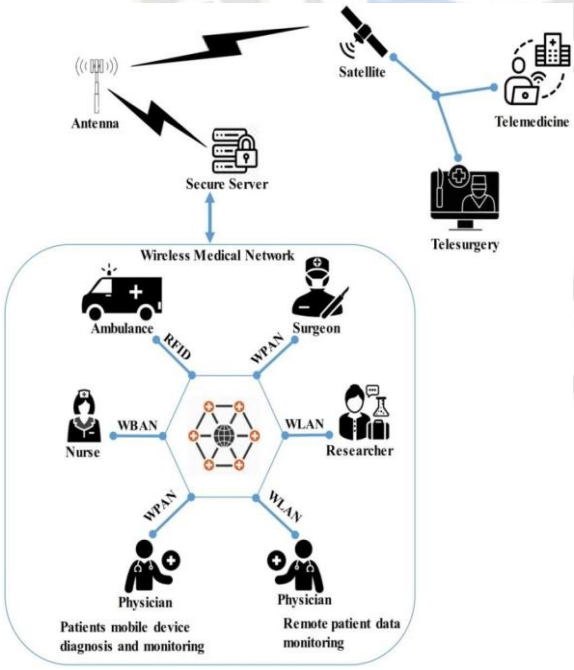

Fig-2: Framework of IoT-oriented Healthcare Applications

The traditional healthcare system posed challenges in diagnosing and treating patients in emergency situations, causing stress, cardiovascular problems, anxiety, and depression for patients and their loved ones. With the introduction of smart healthcare apps and services, a range of online services became accessible from the comfort of people's homes

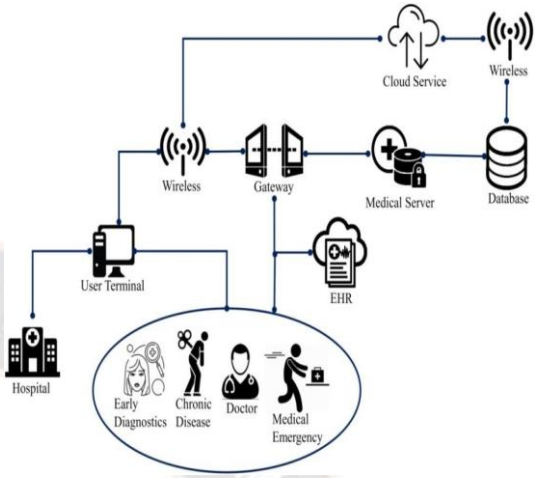

Fig.3 Smart Healthcare oriented Services

Fig.3 illustrates the various secure and convenient smart healthcare services available to individuals, including online doctor appointments, secure storage of medical records, and emergency consultation services [14].

Table 2 displays smart healthcare applications designed to be accessible at all times for people's use. These applications offer a range of health services, enabling individuals to monitor their health parameters daily and make choices about exercise and healthy eating. Without the need for medical consultation, individuals can adopt healthy habits and remedies [9, 15].

Application	**Services**
Health Assistant	Body temperature, fat, weight, BP, glucose level check
Calorie Counter	Calories count from the food eaten
Pedometer	Steps taken and calories burnt
Period Tracker	Record of menstrual cycle in women
Google Fit	Running, cycling and walking activities
WaterYourBody	Water drinking habits and alerts
Heart Rate Monitor	Heart beat
Smart Watch	Number of steps taken, BP, heart rate, calories burnt

The IoT is being employed in healthcare to address various challenges. It has the potential to reduce the strain on the laboratory technician workforce and alleviate the shortage of healthcare professionals. IoT devices can support doctors in treating infections, monitoring patients, and delivering therapies using transdermal medication, electronic gauges, and drug monitoring. Despite these benefits, there are also numerous concerns regarding the security of health information collected and stored by Ai_IoT-embedded devices. Cybersecurity is a major hindrance to the wider

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adoption of Ai_IoT in healthcare. To overcome this barrier, further advancements in the use of IoT devices and networks in healthcare are necessary.

II. RELATED WORK

Roche has introduced a coagulation device that is equipped with Bluetooth technology. This AI-IoT system allows patients to monitor the speed at which their blood clots, and it is the first platform of its kind specifically designed for anticoagulated patients. By conducting self-tests, patients are less likely to experience bleeding or strokes, as they can stay within their prescribed treatment range. The electronic communication of test results to healthcare practitioners also reduces the need for in-person visits. Roche's device not only enables patients to keep track of their test results, but it also reminds them to re-test and alerts them if their results fall outside of a specific range.

Connected Inhalers for Asthma Management: Asthma is a widespread medical condition that affects many people globally. Inhaler users can improve their treatment and symptom control by using connected inhalers with advanced asthma software. Propeller has developed a sensor that can remotely control an inhaler/spirometer. This sensor alerts asthma and COPD patients with relevant information to aid in making informed decisions about their health. The sensor and software also track medicine usage and allergen presence and predict changes, sending alerts to patients.

IoT-Based Glucose Monitoring for Diabetes Management: Managing glucose levels is a major concern for over 30 million Americans with diabetes. Traditional manual monitoring methods only provide limited information and can be insufficient in detecting sudden changes. IoT-based solutions offer continuous and automated glucose monitoring, reducing the need for manual record keeping. These devices send alerts to patients when their blood glucose levels are irregular.

Implantable Blood Testing Laboratories: The SFIT in Lausanne has developed implantable laboratories that enable independent examination of patients' blood samples. The implant consists of five electrodes with enzyme coatings that provide crucial information. This technology offers a more efficient and convenient way to monitor blood health.

Robotic Surgery: Utilizes miniature Internet-connected robots inside the human body to perform intricate procedures that can't be accomplished by human hands. Small AIoT devices performing the procedure also result in smaller incisions, reducing discomfort for patients and facilitating faster recovery times

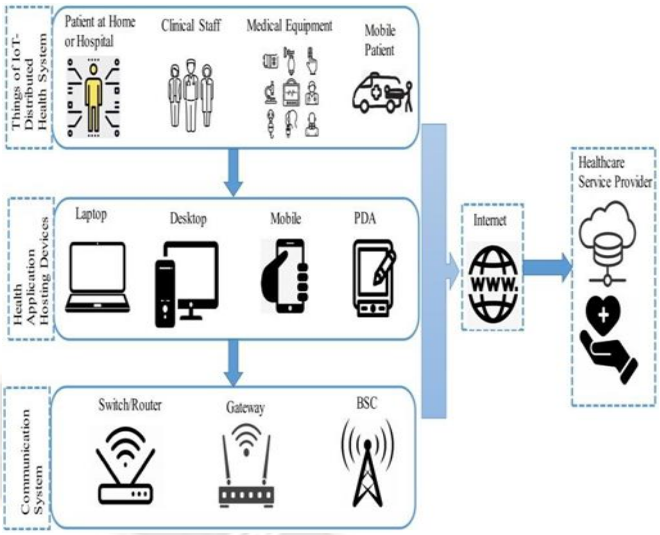

Fig.4: Architecture of Distributed Healthcare System

Artificial Intelligence (AI) in Health Care: Artificial Intelligence (AI) plays a crucial role in healthcare by improving accuracy, efficiency, and accessibility of medical services. AI can analyze vast amounts of data to aid in the early detection of diseases, assist in complex diagnoses, and personalize treatment plans. It can also streamline administrative tasks, reduce human error, and enhance the overall delivery of healthcare services. AI technologies, such as natural language processing and machine learning, are increasingly being used in areas such as medical imaging, drug development, and telemedicine. However, it is important to note that AI should be used as a tool to augment, not replace, human expertise in healthcare.

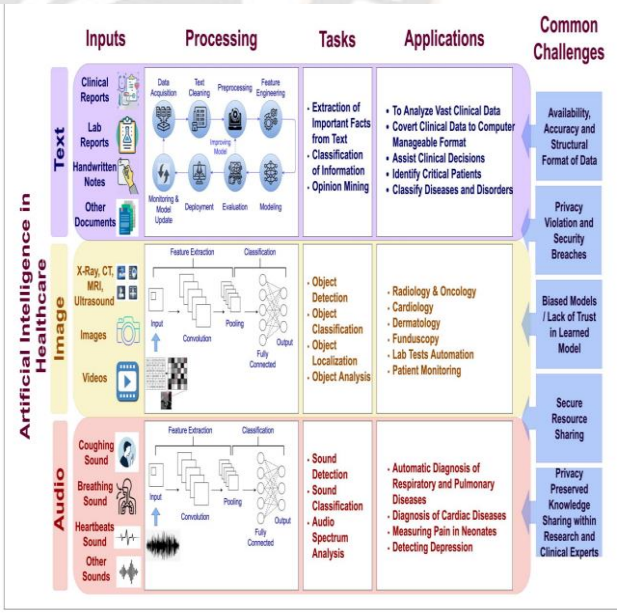

Fig.5 Architecture of Smart Healthcare system using AI

A healthcare system based on Artificial Intelligence (AI) and Natural Language Processing (NLP) would involve the

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integration of these technologies into various aspects of the healthcare industry. For instance, NLP could be utilized for analyzing electronic health records (EHRs) to extract important information and provide insights into patient conditions. This could aid in the diagnosis and treatment of diseases. AI algorithms could be used for medical imaging analysis, such as detecting cancers and other medical conditions through X-rays and MRIs, thus reducing the dependence on human interpretation and reducing the potential for human error.

Moreover, AI-powered chatbots and virtual assistants could be utilized for triaging patients, booking appointments, and providing general health information, making healthcare more accessible and convenient for patients. In drug development, AI algorithms could be used for identifying potential new drug targets, predicting the efficacy and side effects of new drugs, and optimizing clinical trials. Fig.5 provides an outlook of AI based healthcare system.

III. BLOCKCHAIN IN HEALTHCARE

The integration of blockchain technology in healthcare connects patient medical records, healthcare providers, and communities for improved patient care. Blockchain serves as a secure framework for data exchange and management. It operates on a peer-to-peer network, allowing authorized users to access and modify data records. In healthcare, the need for privacy and security of sensitive information is critical, making blockchain a suitable solution. By eliminating the need for a central governing body, blockchain increases trust and transparency through cryptographic and related hash functions.

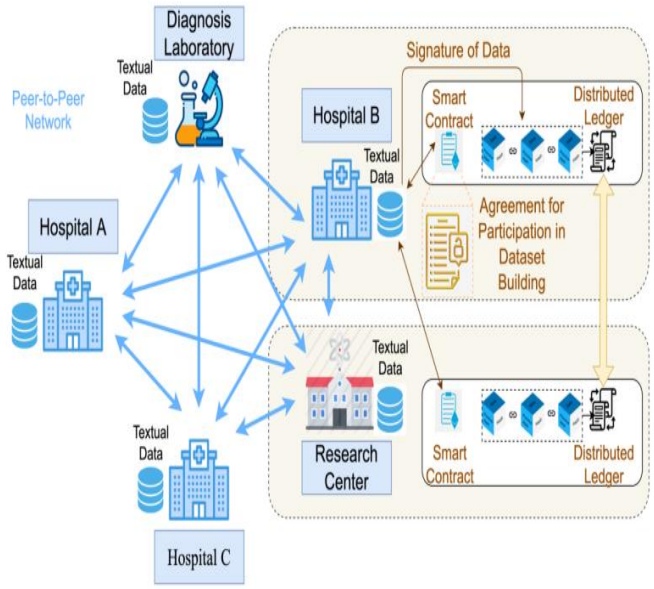

Fig.6 Hospital monitoring Model Architecture

Quantum Blockchain: It is a type of blockchain technology that is built to resist attacks from quantum computers, which can potentially compromise traditional blockchain systems.

Hyperledger: It is an open-source platform for building decentralized applications, also known as blockchains, and the name refers to a collection of projects and tools aimed at improving the performance and scalability of blockchain technology.

Several researchers have proposed the use of blockchain technology to enhance the security of healthcare systems. One proposed solution is to store hash tables for cloud data on blockchain nodes, providing a more secure method of accessing medical records by both patients and doctors. Another proposed model is a multi-workflow system that can manage processes such as clinical trials and complex surgeries. The authors have also introduced a novel platform framework to securely store patients' medical information and efficiently manage personal data.

Fig. 7 Architecture of Embedded Hardware for Ai-IoT Healthcare Systems

IV. RESULT ANALYSIS

The focus of this section is the outcome of the proposed model evaluation. The evaluation was performed based on transaction time, throughput, and latency. A total of 5 nodes were deployed, including 4 IoT devices for data sensing and one hospital node. The Ethereum platform was used to deploy the blockchain for secure distribution of medical records on the hospital node. The deployment of the proposed model was achieved through the use of an AI-supported smart contract. The results of the deployed IoT devices, including the transaction processing time and average delay, are presented in Table 4 and Table 5, respectively.

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Table-4. Transaction based Processing Time for IoT-based Medical Devices

Number of Transactions	Processing Time (Seconds)			
	Device 1	Device 2	Device 3	Device 4
50	20	22	18	23
100	31	41	37	45
150	55	62	58	67
200	82	84	73	91

Table-5. Average Delay in Transaction Processing for IoT-based Medical Nodes

Number of Transactions	Average Delay (Seconds)			
	Device 1	Device 2	Device 3	Device 4
50	0.8	0.9	0.7	0.8
100	2.1	2	1.9	1.7
150	2.4	1.8	2.6	2.1
200	3.6	3.2	3.3	3

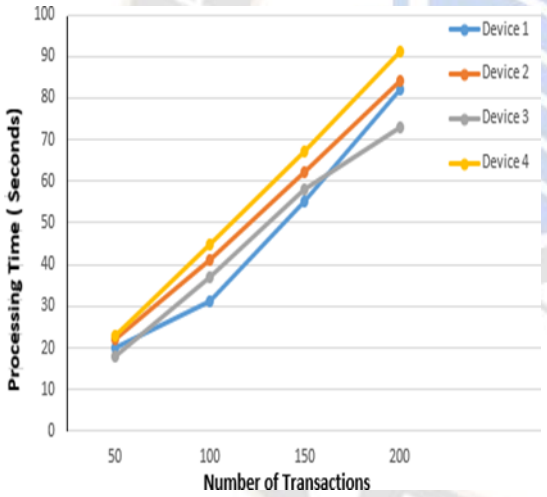

Fig:8 Transaction Processing Time (TPT): Medical IoT Nodes

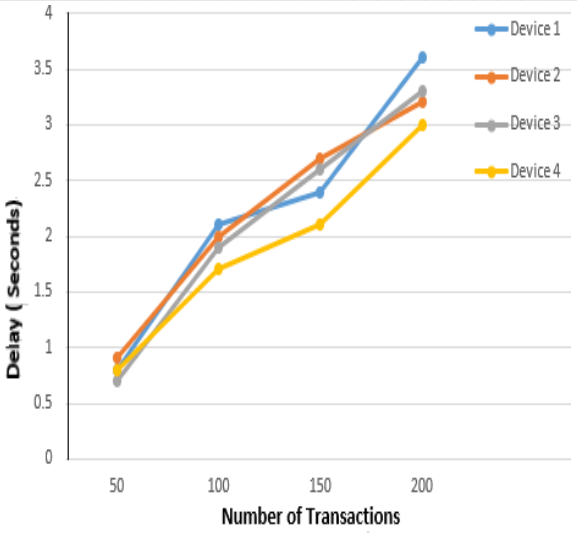

Fig: 9 Average Delay (AD): Medical IoT Nodes

V. CONCLUSION

The use of smart distributed healthcare systems is gaining widespread popularity, providing medical services in a transparent, secure, and convenient manner. The proposed blockchain model incorporates AI-oriented smart contract technology deployed in the layer level at the hospital desk layer, making the healthcare system resistant to a single point of failure. Patient medical records are stored in decentralized databases. The effectively proposed framework has been tested in the real-world conditions for TPT (transaction processing time) and average delay, two critical parameters. The system can be further optimized by integrating more advanced AI algorithms to reduce processing time and minimize average delays within the blockchain network.

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