International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/IJSRCSEIT

Next Generation IoMT enabled Smart HealthCare using Machine Learning Techniques

S. Sivasankara Rao[*1], E. Madhusudhana Reddy[*2], Shashi Bhushan Tyagi[*3]

[*1] Research Scholar, CSE, Shri JJTUniversity, Associate Professor, Department of CSE, Guru Nanak Institutions Technical Campus, Hyderabad, Telangana, India.

[*2] Professor & Principal, Department of CSE, Bhoj Reddy Engineering College for Women, Hyderabad, Telangana, India.

[*3] Professor , Department of CSE, Shri JJTUniversity, Rajasthan, India.

ARTICLEINFO

Article History:

Accepted: 10 May 2023
Published: 29 May 2023

Publication Issue
Volume 9, Issue 3
May-June-2023

Page Number
279-285

ABSTRACT

AI Enabled Internet of Medical Things (AIEIOMT) are playing a very crucial character in medical industry to increase exactness, productivity, and reliability of the electronics instruments. Recent advances and development in conceptual and design science , Technology and connectivity have led to the emergence of Artificial Intelligence and Internet of Things (IoT) applications in many industries and with an emerging field with great development outlet potential in future years . Nowadays scientists are focusing to establish a digital-physical healthcare system by the interconnections of available medical resources, various healthcare services and digitally smart devices . This paper studies the impart of Technologies such as IoT and AI in healthcare. This analysis further reveals that the application of these technologies in disease diagnosis, forecasting, detection, and treatment, wearables and connectivity, patient care , sensor networks, identified gaps and future research directions related to technical design, acceptance, regulations for data security and privacy and systems efficacy and safety .The relevant impact factors in the blueprint and development of magnified healthcare systems are the related Research fields Artificial intelligence (AI) , Big Data (BD), and Internet of Things (IoT). In the paper the concentration is focused on AI in IoT and healthcare system, which includes utilization and execution of AI methodologies many disciplines of healthcare. This paper work exhibits the principal areas of AI methodology in disease detection, prediction, medicine, robotic surgery, and personalized treatment. Furthermore AIEIOMT addresses numerous heath conditions like diabetes, activated parameters of biophysical supervisions along with subsistence system in decision making. As IoT has various converging domain but our focusing domain is the contribution of IOT in healthcare fields.

The Internet of Medical Things has convergence with several domains but our research contribution correlated to AI and IoT in healthcare, previous contribution, ultra-modern contributions in Covid19 Epidemic, Opportunities, applications and subsequent challenges in terms of medical services in healthcare industry. AI Enabled Internet of Medical Things depute the medically interconnected communication devices and their integration in health network towards patient's health improvement. Even so, due to critical behavior of health-related systems, AIEIOMT still facing various challenges specially in terms of security, safety and reliability.

In this literature we represent the comprehensive scientific research, new contributions in order to improve AIEIOMT by the usage of traditional methodologies furnished by cyber-physical systems. We outline remarkable experimental and realistic applications of standardization of medical devices for patient itself, guardians of patient, doctors, nurses and healthy people too. We also try to recognize Unexposed research oriented direction and trending potentials to solve uncharted research complications.

Keywords : Artificial Intelligence (AI), Internet of Things (IoT), Medical System, Healthcare, Opportunities , Challenges

I. INTRODUCTION

Basically, IoT is termed as permeative and persistent internetworking of electronic devices to enable data transfer and communicate betweem domain specified applications of these devices and the surrounding. Due to this reason internetworkig of IoT has made human life much easier than earlier. It is used in numerous fields like pharmacy, farming, monitoring of indoor quality, pollution management, and many additional usages to enhance lifestyle environment and upgrade well-being. The most pertinent application of IoT can be seen in the medical field where it has led to the creation of up to date paragon known as AI enabled Internet of Medical Things (AIEIOMT). AIEIOMT offers various contingencies such as wearable sensors are commonly being used by people for enhanced health and prosperity intimately correlated with mHealth and eHealth.

Its availability, low cost, and accessibility is the prime reason for rise in the acquisition of the mobile sensors. Furthermore, their use as a health monitoring system helps collect relevant biophysical data which is used to make ameliorate diagnostics and medical resolution.

AI, Big data and IoT are interrelated research domain which affect and help improve modelling and advancement of amplified personal heathcare systems. Wearable medical systems integrated with Big data can be used to supply steady monitoring characteristics that will aide in the collection of high amounts of medical data, based upon which doctor, nurse can more accurately forecast patient's future condition.

The knowledge extraction and data analysis involved is a complex operation that requires upgraded security method [1] AI and Big data extend multiple opportunities for IoT based heathcare systems. Big data developing innovatives centered on AI can drastically build on worldwide community health. AIEIOMT technology reduces overall cost for chronic illnesses

prevention a reality. The instantaneous health inputs gathered by such systems make assistance to the patents during self managing therapies. Mobile device applications are frequently applied and combined with mHealth and teletherapy via AIEIOMT.

The outcomes of telemedicine data analytics from these states enhance the materiality of data interpretations and reduce the time taken in data output analysis.[2] Moreover, a novel system "Personalized Preventative Health Coaches" is established that keeps experience and are utilized in describing comprehend safety and well-being data. Sensor networks facilitate in the observation of individuals who do not have approach to an systematic healthcare monitoring system. Moreover integrating wireless communication with machine learning (ML) makes it possible to evaluate medicinal figures that assists doctor to construct apt exhortations. The manuscript presents an inclusive learning and broad applications of AIEIOMT in the medical fields. It examines which type of AIEIOMT systems were used in various areas of therapy and the methods that were utilized in compilation of clinical details in order to assist, inspect and analyse. The other objective of this paper is to construct a recent advancement of AIEIOMT technologies in healthcare.[3]

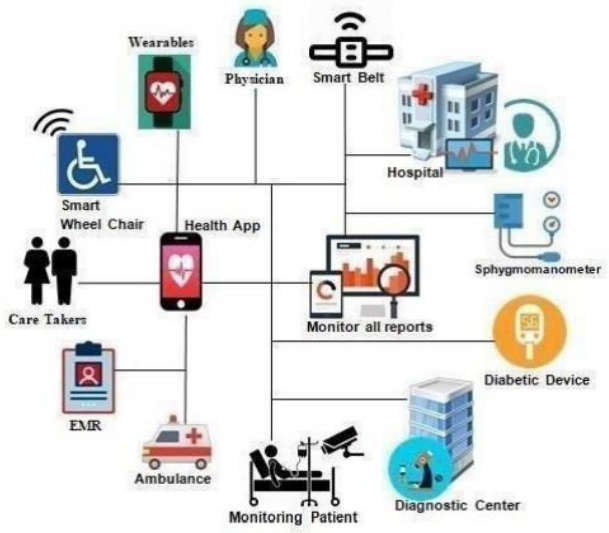

Fig.1- AI Enabled Internet of Medical Things

II. RELATED WORK

Yang et al. [1] used IoMT in the context of home physical therapy. IoMT was examined in the context of mobile edge computing in [4]. An overview of IoMT sensors in the context of patient monitoring was studied in [5]. A comprehensive health IoT survey based on the effect of the Internet of Nano Things and 5G Touch Internet on health service quality has been described [8]. The convergence of IoT and cloud was used by Alhussein et al. [7] to monitor the patient's health status in an IoT Cognitive Health Care (CHIoT) system. A review of the IoMT for pandemic management, such as COVID-19, was presented in [8]. Ahmed et al. [9] designed a framework capable of tracking social distancing and generating alerts in the event of a violation of social distancing. The use of IoMT was investigated by Singh et al. [2]. In the collection of emotions of users who use IoMT was presented by using machine learning with IoT integrity. To help people with obesity manage their health, DL sentiment analysis system capable of understanding the patient's emotional state. Hossain and Ghulam described a system in which emotion is recognized by the Extreme Learning Machine (ELM) classifier. The system presented in the DL used to classify the activities of daily life was used.

A 5G-based edge learning framework for monitoring COVID-19 patients was presented in [1], where IoMT was used to monitor symptoms. To reduce the latency of IoMT inference and add privacy and security to IoMT data, the authors suggested edge inference. To avoid delays in bringing home critical patient health data, Hossain [5] proposed a cloud-based health monitoring system. Meanwhile, federated learning has been proposed to support edge learning in [3]. In another endeavor, edge-AI [6] was designed to support edge computing and mobile learning. Rahman et al. [9] proposed an edge computing framework to provide safe medical therapy.

III. PROPOSED SYSTEM

The proposed IoMT-based health monitoring system (Fig 1) was of the project. Arduino collects real-time health data from a pulse oximeter sensor which measures your heart rate in minutes or BPM (beats per minute), oxygen level. An Arduino digital temperature sensor measures the patient's body temperature. A temperature sensor is connected to Arduino to measure the ambient temperature so that we can adjust the room temperature according to our health and body temperature; Accelerometer used for fall detection is connected with arduinouno and NodeMc. For edge computing, use laptop having NVIDIA Graphics card which serially connect with arduino and NodeMC for intruder face detection. The buzzer emits beeps that are audible when the face is detected. Uncommon heartbeat can be detected by hearing only the beeps. The standard ESP32IoT module connects to Arduino via UART, is responsible for connecting the machine to the Internet and sending health data to the IoT (Thing speak) Server for archiving and monitoring. Monitoring patient's information through Blynk mobile app. This is useful for healthcare professionals who actively monitor the patient on site.

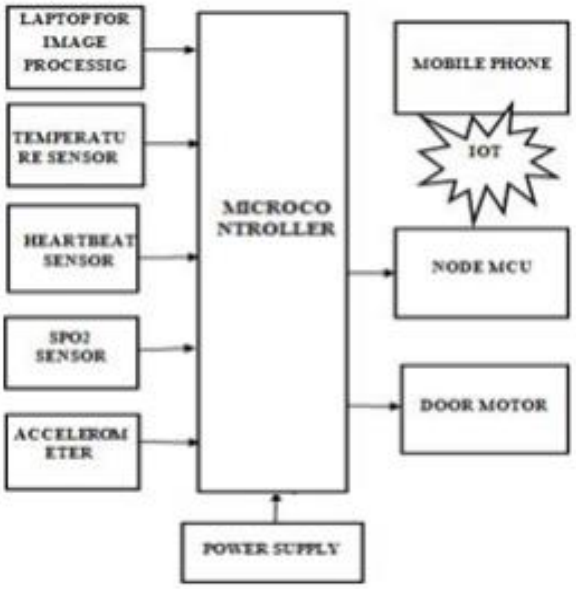

Figure 2 : System block diagram

The laptop connected in series to the microcontroller Build deep learning applications for patient safety, such as intruder face detection. Machine learning with live video. All information collected from patients by the microcontroller is sent via the IoT device to the receiver side. Using the Blink app, all information can be monitored by doctors, healthcare professionals, relatives. Includes physiological information and safety information's.

IV. IOMT FOR SMART HEALTHCARE

The medical ecosystem has evolved significantly with the rapid advancements in science, technology, and medicine, and the proliferation of smart medical devices. In addition, the advancement of communication technologies has turned various medical services into accessible virtual systems and remote distance applications.[6]

Implementations of the IoT into medical systems have had a tremendous impact on public life and in the healthcare industry. Researchers and industries are moving towards IoMT applications in order to provide better, cheaper, and accessible healthcare. In addition to these, IoMT medical ecosystem includes cloud data, applications (online, mobile, real-time, and non-real-time), Wearable sensor devices, and security. Below figure compares a traditional medical ecosystem with a more advanced IoMT-based ecosystem.[8] One of the recent such advancements in this field is Apple Smart Watch. It has various features as compared to other devices. But what makes it a technological marvel is that it has certain features like Crass/Fall detection, ECG, Spo2, Period tracker and many more. Crass/Fall detection has helped numerous people when they have faced with some kind of accident or fall, it has contacted the emergency services and informed the emergency contacts as well.

Similarly, its other features like Period cycle tracker has helped women keep track of their menstrual cycle and personal well-being, Spo2 has helped many people in keeping track of their blood-oxygen levels during

the recent covid-19 pandemic and ECG has helped many people from heart related ailments by notifying them proactively about their irregular heart rhythms and possible heart attacks and other medical complications.[8]

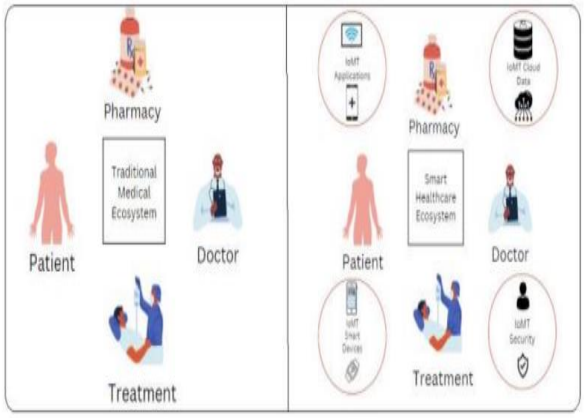

Fig. 3 Traditional vs Smart Healthcare System

Smart healthcare depends on various short range and longrange communication technologies to transport data between devices and servers. Most of the short-range wireless technologies are Wi-Fi, Zig-Bee, Bluetooth, and Wireless Metropolitan Area Network (WiMAX) which are primarily used for short communication in smart healthcare such as BAN (Body Area Network).

The 5G is already capable enough to fulfill some of the requirements of smart healthcare and it is going to further enhance its capabilities to strengthen the smart healthcare infrastructure. The 5G network can minimize latency up to 1 ms, which can lead to new telesurgery applications with strict latency requirements. In future, modern solutions might be possible in the healthcare environment. For example, surgeons can perform operations with robots virtually from anywhere in the world.

A key feature of the 5G network is to support higher frequencies (including above than 10 GHz frequencies). More spectrum is available by using these frequencies, which leads to very high transmission rates (on the order of Gbps). Physicians can see high-resolution pictures remotely and deployed healthcare solution with ultrahigh definition (UHD) content through the high-speed 5G network.

To connect large numbers of sensors and biomedical equipment's, low-cost devices with high battery life is important. For continuous remote monitoring, the aim is to connect self-sustainable devices in the network for the full duration of medical operation. In 5G, low-power sensors are intended to work on the same battery for 10 years. Therefore, the network lifetime must be improved.[8]

V. RESULTS AND CHALLENGES

Along with numerous benefits of these technologies, there are numerous challenges and open research issues in adopting 5G and IoMT for smart healthcare. A smart healthcare network consists of billions of devices. Smart healthcare concept can succeed only if it can provide connectivity to every device present in the network with the capabilities of sensing to produce important information. However, guaranteeing connectivity in smart healthcare postures many challenges, such as:

• Guaranteeing connectivity to huge devices deployed in the network in wide range.

• Providing connectivity to high mobility (i.e., highspeed ambulance, carrying patients) devices in the network.

Big data analytics is a key research direction in smart healthcare. In smart healthcare, billions of devices are connected, which can produce a huge amount of data and information for analysis. This data can consist of information about user private data (i.e., Patient Data) and from the surrounding environment (i.e., ECG, Heart Rate monitoring). For example, data produced by locally connected devices can be analyzed efficiently by adopting deep learning algorithms. The key issues that must be addressed are:

• During data analysis, user privacy must be protected.

• Data secrecy must be provided for sensitive data.

• Infrastructure must be provided to collect, analyze, and store a massive amount of data.[3][9]

Implementing security on IoMT devices is a challenging task due to the constrained-device criteria

and distributed architecture of IoMT ecosystem. Additionally, these devices are located at the edge of a network and, in some cases, are remote or located within the body, etc. and not easily accessible. Moreover, data protection and safe communication that adhere to security requirements are required to make IoMT systems secure. Many IoT systems suffer from lack or weak authentication as a result of constraints in hardware, energy consumption, and other computing resources. Unfortunately, this has presented opportunities for cyber attacks.[9]

VI. CONCLUSION

This paper presents an overview of recent advancements and use cases along with existing and future opportunities on the aspect of 5G and IoMT for smart healthcare solutions. Health systems currently face challenges related to shortages of critical medical professionals, long waiting times, rising demand for services, and financial constraints. 5G and IoMT could help in easing some constraints by shortening the time healthcare experts invest in repetitive activities (using AI methods and IoT devices), thus allowing them to focus on other activities, such as seeing more patients and indulging in more R&D for new methods and techniques in healthcare. [13]

Moreover, these recent trends show that people are taking their health more seriously and taking proactive steps to prevent them from getting sick or facing any critical conditions by actively focusing on mental health, physical health and safeguarding themselves from any unknown diseases by investing in sound healthcare practices. And this trend will certainly grow in terms of growing population, changing demographic and rapid growth of economy of the entire world post these pandemic times.

VII. FUTURE WORK

Most relevant trending applications have been identified and Many research opportunities are recognized, which can be emerging research area in near future.

VIII. REFERENCES

[1]. Internet of Things (IoT): number of connected devices worldwide from 2012 to 2020 (in billions). https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/

[2]. Institute of health metrics and evaluation, 2015 http://www.healthdata.org/pakistan

[3]. Kaur, P., Kumar, R., Kumar, M.: A healthcare monitoring system using random forest and internet of things (IoT). Multimed Tools Appl. 78, 19905–19916 (2019). https://doi.org/10.1007/s110420197327-8

[4]. Manogaran, G., Chilamkurti, N., Hsu, C.-H.: Emerging trends, issues, and challenges in internet of medical things and wireless networks. Pers. Ubiquit. Comput. (2018). https://doi.org/10 1007/s00779018-1178-637. Kaur, P., Sharma, N., Singh

[5]. Cielen, D., Meysman, A., Ali, M.: Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools. Manning Publications, Shelter Island, NY (2016)

[6]. Attia, Z.I., Kapa, S., Lopez-Jimenez, F., McKie, P.M., Ladewig, D.J., Satam, G., Pellikka,P.A., EnriquezSarano, M., Noseworthy, P.A., Munger, T.M., Asirvatham, S.J., Scott, C.G., Carter, R.E., Friedman, P.A.: Screening for cardiac contractile dysfunction using an artificial intelligence–enabled electrocardiogram. Nat. Med. 25, 70–74 (2019). https://doi.org/10.1038/s415910180240-2

[7]. Allouzi, M.A., Khan, J.I.: Soter: trust discovery framework for internet of medical things (IoMT). In: 2019 IEEE 20th International Symposium on "A World of Wireless, Mobile and Multimedia Networks" (WoWMoM), pp. 1–9. IEEE, Washington, DC, USA (2019).

https://doi.org/10.1109/WoWMoM.2019.8792971

[8]. Yanambaka, V.P., Mohanty, S.P., Kougianos, E., Puthal, D.: PMsec: physical unclonable functionbased robust and lightweight authentication in the internet of medical things. IEEE Trans. Consumer Electron. 65, 388–397 (2019). https://doi.org/10.1109/TCE.2019.2926192

[9]. Manogaran, G., Varatharajan, R., Priyan, M.K.: Hybrid recommendation system for heart disease diagnosisbased on multiple kernel learning with adaptive neuro-fuzzy inference system. Multimed Tools Appl. 77, 4379–4399 (2018). https://doi.org/10.1007/s11042-017-5515-y

[10]. Jin, Y., Yu, H., Zhang, Y., Pan, N., Guizani, M.: Predictive analysis in outpatients assisted by the internet of medical things. Future Gener. Comput. Syst. 98, 219–226 (2019). https://doi.org/10.1016/j.future.2019.01.019

Cite this article as :

S. Sivasankara Rao, E. Madhusudhana Reddy, Shashi Bhushan Tyagi, "Next Generation IoMT enabled Smart HealthCare using Machine Learning Techniques", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 9, Issue 3, pp.279-285, May-June-2023.