Smart Healthcare and MIOT

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ABSTRACT Internet of Things is widely being used all around us in our day-to-day activities. We shall take a look at the implementation of IoT in the medical and healthcare field, also known as Medical Internet of Things or simply, MIoT. We shall take a look at the technological advancements in the field of MIoT and how it has had an overall impact on the medical industry as a whole, including the effects of MIoT during the Covid-19 period and the future scope of the medical technologies in curing rare and chronic diseases, as well as changing the lifestyle of the people towards a positive side.

KEYWORDS Smart Healthcare, Computational Intelligence, Medical IoT(MIoT)

I. INTRODUCTION

The Internet of Things is the implementation of software, sensors, responsive hardware and their network in day-to-day activities. Using the principles of Internet of Things in the medicine industry and healthcare will have a significant effect on the way hospitals and medical clinics run. MIoT has had a significant increase in its usage during the Covid-19 surge, to match the demand for the rising covid cases. Other than that, it is also used in medical record managing systems, remote patient monitoring, tracking and alerts and remote medical assistance [1]–[3].

Currently, IoT is being used for the efficient management of medical records in hospitals and clinics all over the globe. Instead of the old pen and paper method for managing records, electronic database management has made record handling more time-efficient and easier. Another benefit of electronically managed records is that there is credibility of information and security of data. Due to these reasons, treatment of patients has become much easier, saving lives of numerous people [4], [5], [7]. Remote Patient Monitoring is also one of the most significant uses of IoT in healthcare. It helps in monitoring the health of patients in terms of their dosage, recovery chances, required treatment, precautions needed and so on. This not only helps to provide the best treatment for the patients, but also cuts the unnecessary costs by providing accurate and best methods for treatment. Using past data, future outcomes can be predicted which is helpful in curing rare diseases, saving lives [6], [9], [11].

Nowadays, MIoT has become such an integral part of our daily lives that we may not even notice its existence. One such example is the health monitoring and tracking feature in smart devices. One can get to know their heartbeat rate, blood pressure, water intake and much more. All this data is stored, using which, more personalized healthcare routines can be created. This not only makes a significant change in one's lifestyle, but is also a big step in the prevention of diseases and deficiencies [8], [12]. With constant research and improvement in existing technology, IoT will bring a huge change in the medical sector by incorporating Big Data as well as Edge Computing.

II. USE OF THE INTERNET OF THINGS IN MEDICAL SCIENCE

The use and growth of electronic devices in medical field have increased significantly as a result of information and computing advancements. Additionally, as the Internet of Things (IoT) has developed, the medical IoT has gradually but steadily ingratiated itself into people's daily lives. In order to use the new advancement in the model of modern medicine, the medical Internet of Things has now been defined as a method in which technology has assisted in the embedding of wearable networks in medical equipment [10], [13]. These wireless sensors are combined with the internet and interact with patients, hospitals, and medical equipment [14]–[16], [24]. Some of the key uses of the Internet of Things in health care and medical science include technical development in medical control of pharmaceuticals and equipment, telemedicine and mobile health care, as well as personal medical management and health data management [17].

III. CHALLENGES WITH IOT IN HEALTHCARE

The sensors, communication networks, and centralised servers that are used in IoT-based healthcare services present a number of difficulties. Here, we'll go through some of the biggest problems with IoT healthcare equipment [18], [19], [27].

(i) IoT Security for Medical purposes
    As the number of IoT-connected devices grows daily, security is a critical area where we must make progress.

The Internet of Things is expanding quickly, and it is anticipated that IoT healthcare solutions will be widely used. Applications and devices used in the healthcare industry are expected to handle sensitive personal data like healthcare records. Additionally, these smart gadgets may be linked to international information networks to provide for 24/7 access. It is essential to prevent unauthorised access to the health data that multiple sensors and devices have collected [20], [30]. As a result, strict guidelines including technical security measures should be put in place before sharing health data with approved individuals, entities, and programmes. The most important element is the tradition of secrecy, according to which personal information must be collected for a specific purpose and must never be divulged to a third party unless it is in line with that goal. To stop an attack, a vulnerability, or data loss, a strong system security must be implemented [21], [36].

(ii) Energy Use by Internet of Things Medical Devices
In IoT healthcare settings, there are several devices, and these devices often exhibit heterogeneous sleep, deep sleep, receive, transmit, and composite states, among other characteristics. Each communications layer also has a barrier related to power needs in terms of service availability. Minimizing power consumption in an IoT product can be difficult, regardless of the type of connection used. However, achieving minimal energy and cost usage is equally essential. For IoT goods, radios play a significant role in the energy budget. Low-energy systems can be developed with the use of clever design and component selection in place of WiFi, cellular, or Bluetooth [22], [40].

(iii) Network of Communication
The physical architecture of the IoT-based healthcare network consists of a variety of networks, from short-range networks to long-range networks. Low-energy medical sensor devices and communication protocols can also benefit from the usage of ultra-wideband (UWB), Bluetooth Low Energy (BLE), near field communication (NFC), and RFID technology

IV. INCREASING IOT TECHNOLOGY ADOPTION IN THE CONTEXT OF COVID-19 TO DRIVE DEMAND

The global use of MIoT was valued at roughly USD 70 billion in 2021 and is expected to exceed USD 200 billion by 2028, with a CAGR of 30% between 2022 and 2028

Based on their WHOOP strap, which tracks respiratory rate using resting heart rates (RHR) and Rate Variability (HRV), WHOOP Inc. has developed a COVID-19 identification system (HRV). The WHOOP system receives the data from the WHOOP strap after it has been sent to a mobile application. Their approach detected 20% of COVID-19 positive people two days before symptoms appeared, and 80% of people on the third day of symptoms [28] [29].

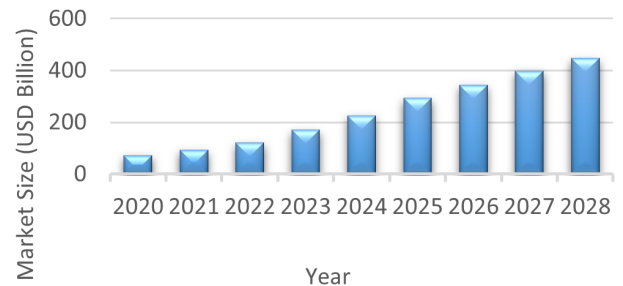**IoT in Healthcare Medical Size, 2020-2028 (USD Billion)**

FIGURE 1: Increasing IOT Technology Adoption in the Context of COVID-19 to Drive Demand

V. LITERATURE REVIEW

Devices and software will be utilised to generate a "health selfie" in the age of sophisticated technology. The Myo, which began as a motion controller for video games, is now utilised in orthopaedics for patients that need to exercise following a fracture. Patients may track their development and doctors can assess the angle of movement using the Myo. This aids in assessing the response of the skeletal muscles and avoiding joint and limb issues [31]. Currently, the majority of MIoT institutions store acquired medical data on the cloud and host their application servers there. The gadgets may then outsource their healthcare functions to the cloud. Through their flexibility and ability to access shared resources and common infrastructure widely and continuously, cloud services provide a viable option for the effective administration of pervasive healthcare data [32]. To create smart clothing systems intelligent, a communication infrastructure including cellphones, mobile apps, cloud computing, and big data analytics is necessary. Despite the fact that multiple research methodologies in the field of health monitoring have been developed and implemented, existing solutions for long-term health monitoring have failed in several respects [33]. IoT and smart health sensors make patients and physicians' lives easier. Where physicians may now electronically and automatically monitor the condition of a patient. Whereas these medical embedded systems provide many new chances to improve the health-care system, they also pose new security vulnerabilities since they are network-connected. More crucially, these devices are severely hardware- and power-constrained, making security more difficult [34] [35] [37].

VI. CONCLUSION AND FUTURE OF MEDICAL INTERNET OF THINGS

Now that we have discussed the applications of Internet of Things in the current medical scenario, we will take a look at the scope of IoT in the future and its improvements in the upcoming time. Although with the current technology, healthcare has made a drastic improvement as compared to the traditional medical techniques, there is still a lot of scope for the improvement of existing technology and invention of new technologies [38] [39]. Smart Glasses: One of the improvements that can be made in the existing technology is the concept of Smart Glasses. It is a new and improved version of laser guns which are used to measure the temperature of a person. It works on the principle of detection of heat emitted by the body using IR sensors and then creating an image of the IR rays on the glasses, which can be viewed by the person wearing them. The glasses can detect temperatures that are higher than the normal human temperature and can give a warning on this basis. This can become a very good substitute to the laser temperature detectors, firstly because whenever the laser guns are used to measure temperature, there is a rather close distance between the two people involved, which may lead to an airborne infection. On the contrary, smart glasses work at a longer distance, thus greatly reducing the chances of infection [41]. Smart glasses, on the other hand, can record the patient's data and save it in a database, allowing it to be accessed later. The database may be stored on the cloud, which can be accessed remotely. The smart glasses can also be used to track the movements of the potentially infected person by checking their location history through their phones. Despite their benefits, smart glasses have their drawbacks too. First, because of their initial stage of production, these may have unwanted errors or malfunctions. Secondly, these are costly to maintain, since the design is complex and hard to handle. And due to this reason, smart glasses may not even be as much available as the normal thermometers, hence, limiting its usage [42].

REFERENCES

[1] Peñalvo, F. J. G., Sharma, A., Chhabra, A., Singh, S. K., Kumar, S., Arya, V., & Gaurav, A. (2022). Mobile cloud computing and sustainable development: Opportunities, challenges, and future directions. International Journal of Cloud Applications and Computing (IJCAC), 12(1), 1-20.

[2] Zhang, L., Jiang, S., Shen, X., et al. (2021). PWG-IDS: an intrusion detection model for solving class imbalance in IIoT networks using generative adversarial networks. arXiv preprint arXiv:2110.03445.

[3] Singh, S. K., Kumar, A., Gupta, S., & Madan, R. (2011). Architectural performance of WiMAX over WiFi with reliable QoS over wireless communication. International Journal of Advanced Networking and Applications, 3(1), 1017.

[4] Yang, Y., He, D., Vijayakumar, P., et al. (2022). An Efficient Identity-based Aggregate Signcryption Scheme with Blockchain for IoT-enabled Maritime Transportation System. IEEE Transactions on Green Communications and Networking, 6(3), 1520-1531.

[5] A. Dridi, S. Sassi and S. Faiz, "Towards a Semantic Medical Internet of Things," 2017 IEEE/ACS 14th International Conference on Computer Systems and Applications (AICCSA), Hammamet, Tunisia, 2017, pp. 1421-1428, doi: 10.1109/AICCSA.2017.194.

[6] Wang, L., Li, L., Li, J., Li, J., et al. (2018). Compressive sensing of medical images with confidentially homomorphic aggregations. IEEE Internet of Things Journal, 6(2), 1402-1409.

[7] Singh, S. K., Kaur, K., Aggarwal, A., & Verma, D. (2015). Achieving High Performance Distributed System: Using Grid Cluster and Cloud Computing. Int. Journal of Engineering Research and Applications, 5(2), 59-67.

[8] Bhatti, M. H., Khan, J., Khan, M. U. G., Iqbal, R., Aloqaily, M., Jararweh, Y., et al. (2019). Soft computing-based EEG classification by optimal feature selection and neural networks.IEEE Transactions on Industrial Informatics,15(10), 5747-5754.

[9] Jagadeeswari, V., Subramaniyaswamy, V., Logesh, R. et al. A study on medical Internet of Things and Big Data in personalized healthcare system. Health Inf Sci Syst 6, 14 (2018).

[10] Gupta, S., & Gupta, B. B. (2018). XSS-secure as a service for the platforms of online social network-based multimedia web applications in cloud. Multimedia Tools and Applications, 77, 4829-4861.

[11] Ullah, Kaleem, Munam Ali Shah, and Sijing Zhang. "Effective ways to use Internet of Things in the field of medical and smart health care." 2016 international conference on intelligent systems engineering (ICISE). IEEE, 2016.

[12] Mohammed, Junaid, et al. "Internet of Things: Remote patient monitoring using web services and cloud computing." 2014 IEEE international conference on internet of things (IThings), and IEEE green computing and communications (GreenCom) and IEEE cyber, physical and social computing (CPSCom). IEEE, 2014.

[13] Singh, I., Singh, S. K., Kumar, S., & Aggarwal, K. (2022, July). Dropout-VGG based convolutional neural network for traffic sign categorization. In Congress on Intelligent Systems: Proceedings of CIS 2021, Volume 1 (pp. 247-261). Singapore: Springer Nature Singapore.

[14] Zhao, Wei, Chaowei Wang, and Yorie Nakahira. "Medical application on internet of things." IET international conference on communication technology and application (ICCTA 2011). IET, 2011.

[15] Srivastava, D., Chui, K. T., Arya, V., Peñalvo, F. J. G., Kumar, P., amp; Singh, A. K. (2022). Analysis of Protein Structure for Drug Repurposing Using Computational Intelligence and ML Algorithm.International Journal of Software Science and Computational Intelligence (IJSSCI),14(1), 1-11.

[16] Chopra, M., Singh, S. K., Aggarwal, K., & Gupta, A. (2022). Predicting catastrophic events using machine learning models for natural language processing. In Data mining approaches for big data and sentiment analysis in social media (pp. 223-243). IGI Global.

[17] Kanchan Pradhan, Priyanka Chawla, Medical Internet of things using machine learning algorithms for lung cancer detection, 2020.

[18] Tekeste Habte, T., Saleh, H., Mohammad, B., Ismail, M., Tekeste Habte, T., Saleh, H., ... & Ismail, M. (2019). IoT for healthcare. Ultra Low Power ECG Processing System for IoT Devices, 7-12.

[19] Saini, T., Kumar, S., Vats, T., & Singh, M. (2020). Edge Computing in Cloud Computing Environment: Opportunities and Challenges.

[20] Singh, I., Singh, S. K., Singh, R., & Kumar, S. (2022, May). Efficient loop unrolling factor prediction algorithm using machine learning models. In 2022 3rd International Conference for Emerging Technology (INCET) (pp. 1-8). IEEE.

[21] Elhoseny, M.; Thilakarathne, N.N.; Alghamdi, M.I.; Mahendran, R.K.; Gardezi, A.A.; Weerasinghe, H.; Welhenge, A. Security and Privacy Issues in Medical Internet of Things: Overview, Countermeasures, Challenges and Future Directions. Sustainability 2021, 13, 11645.

[22] Singh, S., Singh, R., & Bhatia, M. (2012). Performance evaluation of hybrid reconfigurable computing architecture over symmetrical FPGAs. International Journal of Embedded Systems and Applications, 2(3), 107-116.

[23] Singh, R., Singh, S. K., Kumar, S., & Gill, S. S. (2022). SDN-Aided Edge Computing-Enabled AI for IoT and Smart Cities. In SDN-Supported Edge-Cloud Interplay for Next Generation Internet of Things (pp. 41-70). Chapman and Hall/CRC.

[24] Shankar, K., Perumal, E., Elhoseny, M., Taher, F., et al. (2021). Synergic deep learning for smart health diagnosis of COVID-19 for

connected living and smart cities. ACM Transactions on Internet Technology (TOIT), 22(3), 1-14.

[25] Gupta, S., Singh, S. K., & Jain, R. (2010). Analysis and optimisation of various transmission issues in video streaming over Bluetooth. International Journal of Computer Applications, 11(7), 44-48.

[26] Market Analysis Report, Internet of Things in Healthcare Market Size, Share & Trends Analysis Report By Component (Service, System & Software), By Connectivity Technology (Satellite, Cellular), By End Use (CRO, Hospital & Clinic), By Application, And Segment Forecasts, 2019 – 2025.

[27] Sarivougioukas, J., & Vagelatos, A. (2022). Fused contextual data with threading technology to accelerate processing in home Ubi-Health. International Journal of Software Science and Computational Intelligence (IJSSCI), 14(1), 1-14.

[28] Chopra, M., Singh, S. K., Gupta, A., Aggarwal, K., Gupta, B. B., & Colace, F. (2022). Analysis & prognosis of sustainable development goals using big data-based approach during COVID-19 pandemic. Sustainable Technology and Entrepreneurship, 1(2), 100012.

[29] Aggarwal, K., Singh, S. K., Chopra, M., & Kumar, S. (2022). Role of social media in the COVID-19 pandemic: A literature review. Data Mining Approaches for Big Data and Sentiment Analysis in Social Media, 91-115.

[30] Nadimikeri, J., Kumar, M. P., Sreenivasulu, G., Prasad, T. L., Lakshmanna, B., Nagalaksmi, K., & Madakka, M. (2022). Mobile phone and base stations Radiation and its effects on Human health and environment: A Review. Sustainable Technology and Entrepreneurship, 100031.

[31] D.V Dimitrov, "Healthcare Informatics Research", 2016.

[32] Wencheng Sun, Zhiping Cai, Yangyang Li, Fang Liu, Shengqun Fang and Guoyan Wang, "Security and Privacy in the Medical Internet of Things: A Review", 2018.

[33] Mostafa Haghi, Kerstin Thurow, Dr. Ing. Habil, Regina Stoll, Dr. Med. Habil, "Wearable Devices in Medical Internet of Things: Scientific Research and Commercially Available Devices", 2017.

[34] N. Sehatbakhsh, M. Alam, A. Nazari, A. Zajic and M. Prvulovic, "Syndrome: Spectral analysis for anomaly detection on medical IoT and embedded devices", 2018.

[35] Singh, S. K., Singh, R. K., & BHATIA, M. S. (2010). System level architectural synthesis & compilation technique in reconfigurable computing system. In ESA 2010: proceedings of the 2010 international conference on embedded systems & applications (Las Vegas NV, July 12-15, 2010) (pp. 109-115).

[36] Xiao, J., Liu, X., Zeng, J., Cao, Y., & Feng, Z. (2022). Recommendation of Healthcare Services Based on an Embedded User Profile Model. International Journal on Semantic Web and Information Systems (IJSWIS), 18(1), 1-21.

[37] Singh, S. K., Singh, R. K., & Bhatia, M. P. S. (2012, December). Design flow of reconfigurable embedded system architecture using LUTs/PLAs. In 2012 2nd IEEE International Conference on Parallel, Distributed and Grid Computing (pp. 385-390). IEEE.

[38] Aggarwal, K., Singh, S. K., Chopra, M., Kumar, S., & Colace, F. (2022). Deep Learning in Robotics for Strengthening Industry 4.0.: Opportunities, Challenges and Future Directions. Robotics and AI for Cybersecurity and Critical Infrastructure in Smart Cities, 1-19.

[39] Singh, S. K., Kaur, K., & Aggrawal, A. (2014). Emerging Trends and Limitations in Technology and System of Ubiquitous Computing. International Journal of Advanced Research in Computer Science, 5(7).

[40] Alamer, S. A., Ilyas, Q. M., Ahmad, M., amp; Irfan, D. (2022). A Metaphoric Design of Electronic Medical Record (EMR) for Periodic Health Examination Reports: An Initiative to Cloud Medical Data Analysis. International Journal of Cloud Applications and Computing (IJCAC), 12(1), 1-18.

[41] Madan, R., Singh, S. K., & Jain, N. (2009). Signal filtering using discrete wavelet transform. International journal of recent trends in engineering, 2(3), 96.

[42] Mohammad Nasajpour, Seyedamin Pouriyeh, Rza M. Parizi, Mohsen Dorodchi, Maria Valero and Hamid R. Arabnia, "Internet of Things for Current COVID-19 and Future Pandemics: an Exploratory Study", 2020.