

Internet In Biomedical Instrumentation

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Abstract:

IoMT stands for Internet of Medical Things. IoMT is a distinct group of applications of the internet of things and healthcare facilities. In other words, IoMT is the applied knowledge and service of Internet of Things (IoT) in healthcare sector. The American Society of Engineers defines the Internet of Medical Things as: "The Internet of Medical Things (IoMT) is an amalgamation of medical device and applications that can connect to healthcare information technology systems using networking technologies." In this world of technology, Internet of Medical Things (IoMT) is playing a vital role in expanding and retaining the precision, loyalty and productivity of the electronic devices which are utilized in healthcare services. The research contribution of IoT in healthcare domain is reflected in this paper. IoMT envisions a network of medical devices and people, using wireless communication to authorize the exchange of healthcare data. IoMT involves designing of specified health solutions depending on the data collected through medical devices. Across the world, the execution of IoT in healthcare industry has exponentially increased, but still, it has various challenges to be coped up. Design, ethical, legal and technical challenges are also there in front of IoMT. The union of IoT and healthcare can definitely upgrade the caliber of life and can generate more frugal systems - by keeping this vision in mind, the development of IoMT is moving ahead. This paper reflects the rapid development of IoMT and introduction of some healthcare devices through which the IoMT is helping in improving patient outcomes.

Keywords:

Internet of Medical Things, wireless communication, technical challenges, biosensors, intelligent algorithms, chatbots.

Introduction:

The IoMT can be considered as a boon for the healthcare industry. It is providing enormous benefits to the healthcare professionals and patients. IoMT is helping the people in almost every possible situation. In this ongoing COVID-19 pandemic too, the Internet of Medical Things is contributing a lot in treating the patients and also, in preventing the people from the infection. The COVID-19 pandemic has altered the way people procure physician consultation. With the crucial need for social distancing, patients are avoiding face-to-face consultations and favoring the digital media. IoMT's capabilities include more accurate diagnosis, fewer errors, and lower healthcare expenses. The technology, when combined with smartphone apps, allows users to communicate their health information to doctors in order to better monitor diseases and track and avoid chronic sickness. [1]. Industrial production of ventilation tubes, masks, and other medical devices based on IoMT is being carried out to control the health of patients in hospitals or at home as their self-isolation in a secure manner. COVID-19 instances are diagnosed. In this life-threatening worldwide calamity, developing testing kits based on IoMT is a notable undertaking. To combat the pandemic, tasks such as IoMT-based vaccination tracking and distribution, sensor technologies for vaccine cooling,

and secure vaccine distribution are being carried out. The IoMT uses a wide variety of sensors. These include the following sensors:

- Pressure sensor,
- Gyroscope sensor,
- ECG/EEG/EMG sensor,
- Accelerometer sensor,
- Visual sensor,
- Temperature sensor,
- Carbon dioxide sensor,
- Blood oxygen saturation sensor,
- Humidity sensor,
- Respiration sensor,
- Blood pressure sensor.

These sensors are used to continuously watch and monitor the patient's health. The IoMT detects a patient's health state and then transmits clinical data to doctors and care providers using remote cloud data centers. [2,3] During an emergency, this important information from a clinical database is used to prevent and protect the health of the patients. The key problem for IoMT is figuring out how to deal with essential applications, where a high number of linked devices generate a big volume of medical data. [4,5] As a result, there is an increased demand for scalable machine learning and intelligent algorithms. More compatible solutions would result as a result of these changes. Furthermore, this might help to make informed decisions in the burgeoning IoMT space. IoMT aims at dipping the overall healthcare costs but the implementation of the same costs a lot. Equipment costs, constructing an app, storage and maintenance costs require a high primary investment. Hence, these act as a barrier in the swift development of IoMT.

One of the toughest challenges before IoMT is Security. Murali Dhar MS et al. have developed a new policy for delivering security to cloud services based on protected service architecture. A trust-aware policy scheduling technique and an effective and intelligent re-encryption scheme form the basis of the proposed paradigm. This paradigm ensured the scalability, dependability, and security of the e-commerce data and access services that were kept. [6].

Materials and Methods:

Present study is carried out by critical review of the obtained facts. The concept of IoMT is studied from data available on web-based sources, by searching various databases like PubMed and other research articles.

Discussions:

One of the positive outcomes of IoMT is the creation of "Smart Pills," which include microscopic sensors that, once taken, may communicate data to linked devices. Some digital medicine businesses, such as Proteus Discover, have focused their smart pill capabilities on determining the success of pharmacological treatments in order to enhance clinical consequence. Besides healthcare services, a good collection of helpful healthcare devices is also made available by IoMT. IoMT equips the following variety of electronic devices and services:

- Consumer health wearables,

- Clinical grade wearables,
- Personal Emergency Response Systems (PERS),
- Remote Patient Monitoring (RPM),
- Telehealth virtual visits,
- Smart Inhalers,
- AI-powered chatbots,
- Smart Thermometers,
- Blood clot test,
- Anti-Depression App.

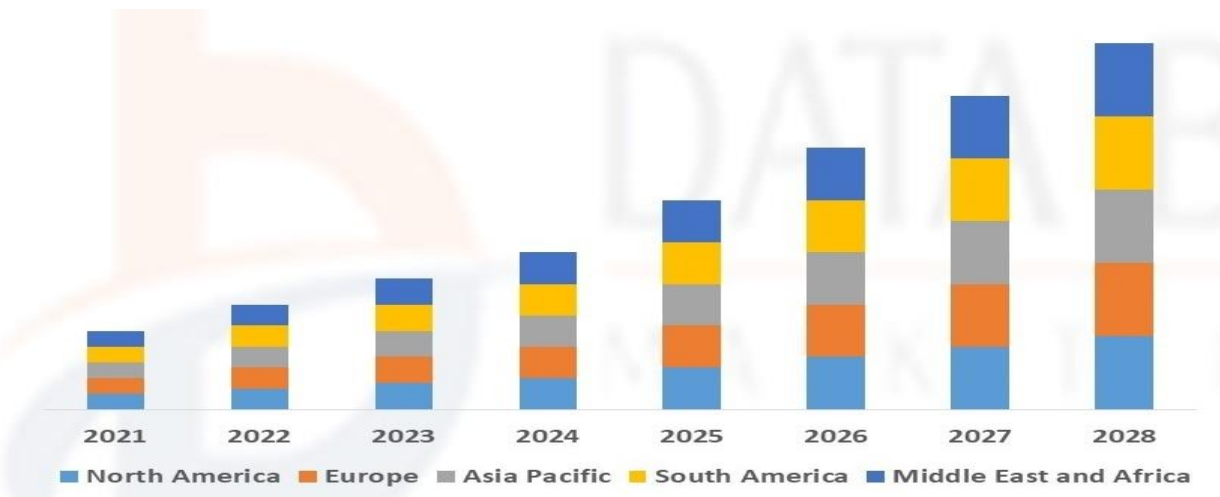
In today's time period, many people like to maintain their personal fitness, especially the young generation. For this purpose, they prefer to use the smart devices and services. Consumer wearables include wristbands, sports watches, and smart clothing, as well as consumer-grade devices for personal fitness. Companies such as Fitbit, Misfit (fossil group) operate in this space. Clinical-grade wearables include Active Protection's smart belt, which detects drops and deploys hip protection for senior wearers, and Neurometrix's Quell, which is a wearable neuromodulation device that taps into sensory neurons to provide chronic pain relief. Personal Emergency Response Systems (PERS) combine a wearable device with a live medical contact center service that allows users to communicate and receive emergency medical help quickly. All home monitoring equipment and sensors used for chronic disease management are included in Remote Patient Monitoring (RPM). This enables continuous physiological parameter monitoring, acute home monitoring for discharged patients surveillance, and medication management to remind users about medication and dosing information. Virtual consultations, such as video consultations and symptom evaluation using video inspection and digital tests, are among the telehealth virtual visits that help patients manage their conditions and obtain prescriptions or treatment plans. [7] Nowadays several respiratory diseases and disorders ranging from the manageable ones like asthma up to the severe ones like lung cancer, emphysema are being experienced by the patients due to the smoke, dust and some other factors. Smart inhalers are being recommended to the patients suffering from asthma and other respiratory conditions for tracking purposes. These inhalers monitor the patients' medication plans and provide visual, audio alerts to remind patients' the time of taking medication and what dose they should take. These inhalers are accompanied by the applications installed on patients' phones. AI-powered chatbots conduct a wide range of serviceable medical tasks like providing advices about treatments, scheduling physical visits to the doctor's clinic. The centers for Disease Control and Prevention hosts an AI-powered chatbot that can assist patients in screening COVID-19. For the people who experience fever alongside other symptoms, the Smart Thermometers connected by apps can be a great help. These thermometers collect the data which is used to check the signs indicating the upsurge of the disease. This data is shared with the doctor and hence, the doctor can provide the additional treatment to the patient and maintain the medical history of the patient. The IoMT provides some devices for keeping watch on the patient's blood clot levels and these devices are connected with the smartphones. These devices provide the data about the patient's blood clot level on the connected smartphones. This facility helps in lowering the risk of stroke and bleeding. Depression affects everyone differently. Deep depression, grief, aloneness, stress - all

these feelings and moods affect greatly to the health of an individual. The Anti-Depression App, developed by Apple, studies and understands the feelings and moods of the patient and provides the required data. With the help of the provided data, the doctors can provide the essential treatment and care to the patient. Due to this App and its services, the patients' lives can be saved as the data provided by the App on proper time can be utilized for the proper treatment and the severe conditions can be avoided.

The IoMT platform is helping in reducing the workload on the medical industry by allowing the remote health monitoring, real-time tracking, rapid diagnosis of the cases, screening and surveillance for prevention and control of the infection. Some challenges to be tackled are present in front of IoMT. To tackle those challenges, IoMT is putting all its efforts. The huge contribution made by IoMT during this COVID-19 pandemic is noteworthy. The increase in demand for actual healthcare solutions and the increasing usage of wearable devices are likely to drive the growth of the Internet of Medical Things (IoMT) market in the forecast future. In this way, a patient can be readily and efficiently assessed using connected devices, lowering the expense of medical specialists' consultations. In the next years, the surge in demand for connected devices in the healthcare industry will present further growth prospects for the Internet of Medical Things (IoMT) market. As we all know that the new variants of old pathogens are developing day by day, hence the number of patients is also rising. Also, the seasonal variations causing temperature fluctuations result in the surge in the number of patients. Improper lifestyle, imbalanced diet, stress are some other factors which are resulting in the increase in the number of patients. IoMT, along with the internet and its devices, is providing a huge help to manage and treat the increasing number of patients.

The Internet of Medical Things (IoMT), provides medical devices and applications that are connected to the healthcare IT systems, are expected to grow at a significantly higher rate, particularly between 2018-2023. According to a wearable tracker report published by IDC, the Indian wearables market saw a huge surge in growth by 144.3%, as compared to 2019, making India the only country in the top three (3) that saw a three-digit growth in 2020. "Wearables are helping us monitor our exercise, our breathing and our heart rates with the use of sensors entrenched in their chips – software algorithms working on the software layer. There are many techniques from which we are able to attain this monitoring such as photoplethysmography for blood pressure to share breathing and heart rates, accelerometer sensing for movement, etc. More often, certain technologies which come under the application of wearables are edge computing, IoT and cloud computing," said Ramneek Kalra, IEEE Member.[8] During the projection period of 2021 to 2028, the IoMT market is expected to increase at a rate of 24.60 percent. [9]

Fig 1: Global internet of medical things(IoMT) market is expected to account for USD XX million by 2028



The above figure shows the future expectations of some geographical areas in IoMT. Because of its rapid technological advancements and well-established healthcare and IT infrastructure, North America dominates the IoMT industry. Because of increased awareness, changing lifestyles, and improved diagnostic facilities, Asia Pacific is expected to see considerable growth in the IoMT market.

The wide adoption of IoMT in hospitals as well as at homes by the users can generate a threat of cybercriminals. The enormous use of the connected devices results in the threat of malicious hackers. The connected devices contain sensitive data including name, nationality, location, of the patient and some other medical records. These connected devices are insecure in nature and therefore, the highly sensitive healthcare data can be easily hacked by the hackers. Due to the risk of data leaking and hacking, many people are avoiding the use of healthcare devices and technologies provided by IoMT. Therefore, there arises a need for the proper security. The developed security will in turn provide good safety to the sensitive data and this will lead to the rapid adoption of the IoMT. ARIA Cybersecurity Solutions, CyberMDX, Cynerio, Sternum, VDOO, Medigate are some cybersecurity solutions. These cybersecurity solutions help the users to keep their sensitive data in a proper secured manner. With the help of these cybersecurity solutions the users feel quite relaxed regarding the data safety concerns.

Conclusion:

The adoption of IoMT among the people is accelerating as it helps a lot in maintaining one's health. Aided living and chronic ill health monitoring are the two areas where IoMT is currently having a great impact. The widespread implementation of IoMT in health-care institutions is assisting in the collection of large amounts of medical and healthcare data, which is then used by medical practitioners to diagnose and identify ailments and provide suitable therapies.. With the fabulous support of IoMT, the disease management is improving day by day. One can observe the betterment in diagnosis and treatment due to the availability of wide range of healthcare devices and applications served by IoMT. This better diagnosis and treatment are improving the patient's outcome. Not only this, but the IoMT is also improving the management of medical records and pharmaceuticals. IoMT is working very hard to improve its performance in providing the electronic devices and services to the users. IoMT promises a better tomorrow to their users all around the world. The arrival of additional and brand new technologies in IoMT will allow

upgraded remote access to the medical care for users all around the world. Day by day, as the technologies are upgrading, the IoMT is introducing the new features in their devices and services. The IoMT will continue to grow and enlarge as the wireless, sensor and cybersecurity technology improve.

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