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IOT- Revolutionizing Healthcare Unprecedently

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Abstract

Integration of technology with healthcare has always worked wonders. With the recent technological advancements and integration of internet of things (IOT) in healthcare, healthcare has reached to a different height. IOT has been beneficial in simple yet tedious work of patient registration and record maintenance to complex and skillful surgical procedures. Its influence in the field of diagnostics, both pathology & radiology is obvious. This paper reviews the usefulness of IOT in various fields of healthcare and looks into challenges in developing and implementing the same.

Keywords. IOT, healthcare

Introduction.

Last century has seen exponential growth in computer science technology, with technology seeping into our day to day life and becoming an indispensable part of it[1]. By making so many things available on fingertips, it has made life easier and more accommodative. We are surrounded by cybernated devices smart enough to perform directed tasks for us, making a web of connected things. This web of smart devices is better known as Internet of things[2]. These smart devices have percolated in all spheres of our life, healthcare being no exception. With its many advantages, IOT has given a good boost to healthcare. From preventive to curative aspect of patient management to hospital management and administration IOT has proved to be a blessing[3].

IOT and Healthcare

IOT has left no aspect of healthcare untouched. Especially after the recent COVID 19 pandemic, usage of IOT has gained momentum[4]. These connected devices not only measure, calculate, collect and store data but are able to transmit and analyze this data, and give suggestions on the analyzed data. Hence, a new term Internet of Medical Things (IoMT) has come in vogue[5].

1) APPLICATION OF IOT IN PATIENT CONSULTATION
   The recent COVID-19 pandemic caused a surge in remote consultation by medical practitioners[6]. In view of the pandemic, Centre for Disease Control and Prevention(CDC) recognized the need

of remote consultation and issued advisory guidelines for the same[7]. Telemedicine has other advantages of decreasing the burden of in-person consultation, assessing geographically remote areas, providing home consultation to geriatric patients and making consultations more effective and efficient[3].

2) APPLICATION OF IOT IN HOSPITAL MANAGEMENT AND ADMINISTRATION

IOT has simplified many tedious tasks involved in hospital management and administration such as inventory management (of drugs as well as consumables), staff flow, attendance and availability, bed availability and turn over[8].

3) WEARABLES

Many wearable devices are now available which monitor patient's physiological parameters such as pulse, heart rate and rhythm, daily activity, calories consumed and utilized, sleep duration and pattern, oxygen saturation etc. These devices are helpful in early intervention by detection of any changes in physiological parameters. Fitbit™, Apple Inc., and AliveCor™ are few who are into manufacturing of such devices[3,9]. However, these devices generally have a short lasting battery supply and needs to be charged frequently, which may require nursing assistance in some cases[10].

Machine learning algorithm for early detection of heart disease proposed by Kumar and Gandhi and executed by Apache HBase and Apache Mahout uses sensor on a wearable device for collecting and transmitting data to be stored in cloud[11].

4) IOT AND RADIOlOGY

IOT and digitalization has a pivotal role in bringing Diagnostic as well as interventional radiology to the zenith of success it is experiencing today. With devices capable of generating and transmitting high resolution images patient management has dramatically changed by allowing faster clinical decision making, even at odd hours[12].

5) IOT AND PATHOLOGY

The advent of LIS has bought a revolutionary change in pathology services. It has enabled labs to handle large volumes of workload with ease and minimalized errors. Rapid transfer of patient's parameters to the managing team has considerably improved clinical management of patients[13]. Digitalized slides have given a leap to pathology reporting by allowing a single pathologist to report large number of cases efficiently. Rapid sharing of these images has made it easy to discuss grey zone cases with colleagues[14,15].

6) IOT AND OPERATION THEATERS

IOT is gaining rapid access to operation theatres, improving surgical outcomes. Visualization of instrument usage in a specific procedure has led to optimal usage of instruments and helped standardize surgical procedures[16]. It also gives information if the surgical path will have a negative after effect on patient's body[17]. Radio frequency identification(RFID) has made it easier to monitor instrument and sponges used in surgeries, thereby, helping to avoid many dreaded

complications[18]. Robotic arms has assisted to increase efficiency and minimize complications especially in minimally invasive surgeries[19].

7) RESEARCH
Since a large volume of information is collected and stored in clouds in the form of data, which is easy to analyze, it could be utilized fruitfully for research purpose[20].

8) TEACHING
There is an unquestionable role of IOT as a teaching modality, especially in current COVID scenario where teaching programs are being conducted on platforms like zoom and google meet[21]. The digitalization of images from so many equipment used in healthcare has allowed utilization of these images for discussion and learning[12,14]. Live broadcast of surgical procedures has given opportunity to many enthusiastic learners to learn from celebrated experts in the field[22].

9) ELECTRONIC HEALTH RECORDS(EHR)
Maintaining electronic health records has many advantages- it allows fast retrieval of information when managing physician change due to intra or inter health care shifting of patent, it also provides information when patient is minor or unable to speak, it does not allow patient to hide information and mislead treating physician[23].

Challenges and Drawbacks

1) Privacy, Security and Ownership. There is a possibility of breach in integrity during transmission from sensors to cloud, especially from low resource devices. The ownership of data, weather it belongs to government or patient and whether a patient has right to modify the data are questions which needs to be settled. National Digital Health mission has given a blueprint and is working towards guiding and implementing rightful usage of the data[24].
2) Cost and Funding. The high cost of these advanced technologies makes it difficult to rapidly integrate these technologies in healthcare. The cost of advanced machinery and equipment is generally very high. Cloud data center consumes a very high energy, thereby increasing cost[25].
3) Interoperability. The ability of medical devices to share information and utilize shared information is of utmost importance for optimal use of these devices. Since these devices are developed by unrelated companies, there can be issues with compatibilities and interoperability[26].
4) Digital Capability. With increasing use of IOTs, it has become imperative for health professionals to have knowledge about working with and working of these technologies. Also since majority of India's population is rural and illiterate, it is a challenge to make them use IOTs for healthcare provision[3].
5) Failure of Technology. A failure of technology can create chaos and needs continuous vigilance and knowledge. A minor defect in a sensor can give bad results and transmit misleading information[27].

Conclusion.

To conclude IOT is a portentous part of health care system and its application can be seen in all areas of healthcare system. Barring the few overcomable drawbacks, its usefulness is far much. With advances in technology and increased affordability, in the coming years it will definitely help in furtherance of healthcare services.

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