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Smart Healthcare System-To Study its Impact, Future and Challenges in Digitized Medical Era

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Abstract- ***The main emphases of smart healthcare system position its focus on Electronic and Mobile-health services and Electronic health record management for facilitating smarter health services. Smart Healthcare system is architecture by the technology that leads to the better investigative and diagnostic tools, improved management & treatment for patients and devices that recuperates the quality of life for every individual traversing through the system. Most of the pioneers in this area are adopting open source tools and libraries preferably in Hyper Text Markup Language-5 / Javascript, iOS and Python for developing, maintaining and streamlining software. In order to use these standards in real world applications, they strictly compliance with the Healthcare specifications laid down in Health Level-7 (HL7) by American National Standards Institute (ANSI)(accredited Standards Developing Organizations (SDOs) operating in the healthcare arena) which refers to a set of international standards for transfer of clinical and administrative data between software applications used by various healthcare foundations and providers. The prompt expansion of Internet of things (IoT) advocates opportunity for various smart objects to connect together through web technologies and hence, serving more data interoperability procedures for application perseverance. Modern exploration in the area demonstrates further potential applications of IoT in information demanding industrial sectors such as healthcare services. However, the diversity of the entities in IoT leads to heterogeneity problem of the data presentation in various IoT platform(s). In the intervening time, the use of IoT technology in applications has stimulated the increase of real-time data, which makes the information storage and retrieval even more problematic and challenging.***
Keywords: Smart HealthCare System, Standards, Challenges, Future, Stimulated and Computer Aided Diagnosis, Electronic Health Records, Wearable's and Mobile-health apps

I. OBJECTIVES OF THE PAPER

A. To conversant with fundamentals of Smart Health Care devices and technology.
B. To study the impact of Smart Health Care Systems on medical practices.
C. To study the future and challenges in Smart Health Care System.

II. RESEARCH METHODOLOGY

The paper is based upon descriptive, explanatory research methodology. The secondary data mentioned has been collected from online creditable sources, articles, newspaper and already published work in international & national journals reflecting knowledge in the area and research of this study.

III. INTRODUCTION

Since last decade, there is considerable growth in the number of researches those have been conducted using IoT technology to procure data globally, process data and transmit the same over wireless distributed system in the healthcare domain. Ambient Assisted Living (AAL), a blend of concepts, where products, services and technologies come along in social environment to improve quality in all periods of life and is designed to support daily activities of all races of people autonomously as extensive as possible. IoT technology is designed to support medical prescription and consultation among health workers, rural patients, health professionals and urban city specialists with core competencies. The use of IoT technology is not limited to this because it is providing a mentoring environment for the full-fledged growth of Mobile-health concept which is also termed as mobile computing. Medical sensors and communication technologies for healthcare are also attracting more and more investigators applying fourth-generation (4G) mobile communication technology and IoT in smart healthcare products and service [1]. Several advanced technologies rising each day and their usage in smart healthcare bring both prospect and challenges in processing and accessing ubiquitous medical data and services. Further, in acute thirst of efficiency and effective use of smart healthcare product and services, a fully controlled functionalities are designed to coordinate hybrid wireless networks in cloud computing. Latterly, REST (Representational State Transfer) resource concentric prototype has been extended from a kind of software architecture instigated

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from web service research mainly to manage web resource and web service interoperation with an efficient interoperability of medical data.

IV. SMART MEDICAL DEVICES AND INFORMATION TECHNOLOGY

The primary goal is to integrate various sensors into intelligent medical expedients. The attention here is to address pressure sensing technologies to monitor, reduce cost, control or measure vital patient parameters with higher accuracy, reliability and transmit that over a network which is possible due to progressively mushrooming advanced technologies in IT sector. Pressure sensors or the devices comprising sensing techniques are generally used to record and analyze a patient's condition and are installed within respiratory med-care equipment's, or may associate with drug delivery systems, based upon convenience and providing explicitly accurate outcomes. Various pressure applications and pressure sensor technologies below are the few examples of some extraordinary smart equipment(s) [2]:

1) *Blood Pressure sensing devices*
The lion's share of the pressure sensor market is held by the blood pressure sensors. They are available in both of the operative mode– manual (blood pressure cuff) as well as automatic sphygmomanometer and they are used during the surgery to monitor various parameters related with the aspect.

2) *Cardiac Catheters*
As the scenario of cardiovascular diseases are spreading at a fastest pace in all over the world, therefore, patients require prompt diagnoses on cardiovascular diseases. Wedge pressure sensor measures cardiac variations and provide a natural application of pressure sensing and cardiovascular disease diagnosis.

3) *Neonatal Catheters*
Cesarean Sections are the next most concerned area. Caesarean Section Deliveries have approximately risen from 10% to 30% percent in India. An intrauterine catheter is inserted to measure the pressure on the infant's head during contractions and to monitor fetal heartbeat.

4) *Laparoscopic Devices*
Most of the abdominal surgical procedures today are performed using these devices. A small incision is made, the abdomen is extended by filling with pressurized CO_2. After that, surgical cameras, instruments are inserted for the procedures such as appendectomies, gynecologic procedures, gall bladder surgery, hernia repair, tubal ligation, and general exploratory surgery and other procedures.

5) *Endoscopic Procedures*
Endoscopic tools are used to measure pressure in the oesophagus. Technical application covers reflex forces with up to 32 pressure sensors mounted on a tube that is swallowed by patients. Obtained information is useful in the diagnosis of acid reflux and other diseases of the stomach and upper GI tract.

6) *Respiratory*
Pressure sensors are used in applications targeting three major respiratory disorders: asthma, chronic obstructive pulmonary disease and sleep apnea. They are used both in diagnostic equipment (to measure the pressure of air expelled from the lungs) and in therapeutic equipment such as nebulizers, oxygen therapy equipment and ventilators. This market is primarily a non-invasive application of pressure sensing and could be supported by small, low cost devices.

7) *Wearable's and the IoT*
Wearable smart devices could be in the form of wrist or arm bands, bras, contact lenses, and braces. Various corporations like GE Healthcare, IBM, iRobot, solution providers and other healthcare companies are collaborating in joint ventures to create ecosystems for making structured data and unstructured data easily accessible to healthcare expertise. Usually, wearable devices send data related to the Heart rate, Blood glucose levels, Breast tissue health, Skin and cardiovascular health, Chronic pain to the Internet of Things in case of patients with disorders like diabetes, cardiac disease and even those trying to quit smoking.

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8) Other applications

Numerous other applications are reformed to measure effects such as implanted systems that have a reservoir of drugs where dose-delivery is controlled by measuring pressure. Implantable sensors are sealed with bio-compatibility and adaptability to the patient. Sensors are sealed with metal diaphragms or encapsulated with robust coatings. Signals are transmitted through wire interfaces to devices such as pacemakers. Diagnostic sensors transmit signals through wireless networks to external receivers.

V. SIMULATION AND COMPUTER -AIDED DIAGNOSIS

CAD is an interdisciplinary expertise uniting elements of artificial intelligence, information technology with radiological image processing and is generally used for the detection of a tumor.

According to the Food and Drug Administration (FDA) guidance, computer-aided detection (CADe) devices are automated systems proposed to recognize, mark, focus, or in any other fashion devote attention to portions of an image, or aspects of radiology. Radiology provides information that may specify the abnormality during patients examination while relevant data is collected, stored and analyzed [3]. It reveals specific presence or absence of diseases while compiling the patient's images taken during the computer aided diagnosis (CADx) and this also includes evaluation of disease or other conditions in terms of the probability of the existence or nonexistence of disease, and intended to specify the type of disease, harshness, phase, and also endorsed intervention. Computer-aided detection (CADe) systems are usually narrowed to marking noticeable structures and sections. Computer-aided diagnosis (CADx) systems appraise the conspicuous structures.

Computer-aided diagnosis (CAD) is swiftly entering the radiology mainstream and it assists doctors in the interpretation of medical images. Imaging practices such as X-ray, MRI, and ultrasound provides information that is analyzed and evaluated comprehensively by the specialized person(s) quickly. CAD systems assemble digital graphics of typical presence and highlight conspicuous sections, such as possible abnormality or diseases, offering a reassuring input that helps professional to come to the final conclusion. The analytic report generated is used as a "second opinion" in assisting radiologist's image interpretations.

VI. IMPACT AND RISKS OF SMART DEVICES ON MEDICAL PRACTICES

Undoubtedly, healthcare industry has been considerably transformed with the introduction of Internet of Things. Furthermore, the smart devices redefined the medical practices delivering quality healthcare solutions. Following are the prominent impacts of smart health care systems incorporating smart devices over the medical practices [4][5]:

1) *Cost Reduction:* Patient monitoring is done on a real time environment and data transmitted is sufficient for prescription by the physician, which significantly cut down the number of patient-visits, hence eliminating the cost too.
2) *Superior Outcomes of Treatment:* As doctor and patient are connected through health care solutions may be via a cloud computing or other e-system in real time that enables the expertise to make a right decision at the right time based on evidence and hence improve the outcome of treatment.
3) *Enhanced Management of Symptom and Disease***:** As the patients are monitored consistently and expertise are get alerted with the real time vital parameters related to the symptoms, physicians get appropriate time to handle the situation more precisely and effectively.
4) *Increased Accuracy:* Data is collected and computed through automated algorithms those are executed in smart device platforms, which reduces the system cost as well as provide data with minimized error/ tolerance.
5) *Improved Patients Experience:* The primary objective of incorporating smart devices / IoT is to place emphasis on the needs of patient, which ensures preemptive treatment, enhanced accuracy in diagnosis, timely intervention by specialized physicians and improved treatment outcomes which ultimately gain insight confidence in such smart health care systems.
6) *Better Drug Management:* This has become possible because of the IoT that the major area of concern related to cost and management of manufacturing drug and controlling the manufacturing process are managed more effectively and smoothly.

Though the Internet of Things transforms the health care domain, along the roadside it also possesses number of risks [6]:

A. Health related data is sensitive in nature as distributed incongruously; therefore, health information may harm and hamper the treatment practices.
B. Internet of Things require hybrid cloud computing environment (Virtualized infrastructure) to operate, which are critical in guaranteeing the auditing of network acquiescence as well as ensuring real time alert of irregularities.
C. Data Privacy and Transmission hurdles.
D. Inclusion of predictive analysis increases burdens on the data center and demands more sophisticated infrastructure.

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E. Maintaining consistency of data is also another risk factor that is likely to upsurge with intensification in the level of data being distributed and shared.

VII. FUTURE AND CHALLENGES OF SMART HEALTH CARE SYSTEM

In today's rapidly evolving smarter systems in healthcare, healthcare costs are also flattering more unsustainable for many countries. Therefore, its management is crucially important for affordable healthcare services in future. Information Technology has transformed the health care system beyond our expectancies. Above all, another new innovation- blockchain technology is ready to drive the healthcare in future. Blockchain is a continuously blooming record having list of linked transaction (peer to peer transactions) blocks on a digital ledger. This technology may help in future to overcome the constraints related to patient privacy and data security as it amplifies the transparency among different healthcare providers. Moreover, blockchain technology may help in simplifying and cost reduction of benefits administration along with minimizing the maintenance costs [7]. Also, the invention of smart healthcare devices is a boon to medical industry, which may help to increase the efficiency and better treatment outcome with minimal trauma and risk.

Although incorporation of newer technologies have expanded the dimensions of healthcare sector with new opportunities, but on the opposite side, utilizing IoT also raises some challenges which may hinder the way of grasping its potential benefits. Hacking, surveillance concerns, and privacy fears are the ever burning topics. Even though digitalization saves a lot of time, but many technical, legal, new policy implementation and development challenges are also incubating. Apart from privacy, other main challenges impacting IoT in healthcare are security handling of big data, legal issues, inter acceptable standard's issue and data protection [8]. Thus, the Smart Healthcare Systems using IoT raises significant challenges that could stand in the way of grasping its potential benefits.

VIII. CONCLUSION

Smart healthcare system accompanied with the Internet of Things is an embryonic topic of technical, social, and economic connotation. Consumer products, durable goods and chattels, cars and trucks, engineering and utility apparatuses, sensors, and other objects all are being combined through Internet connectivity and commanding data analytic abilities that promise to transform the way of living-hood. Forecasts of the impact of IoT on the Internet and economy are remarkable, with some anticipating as many as 100 billion connected IoT devices and a worldwide economic influence of more than $11 trillion by 2025 [9]. At the end of the day, popularity of Internet of Things is expected to increase ominously, as health care providers hunt for the leverage technologies with the interpretation of enlightening effectiveness. IoT in healthcare is pegged on connectivity; making sure information is accessible to elicit an action. As such, it is set to cultivate in hospitals, even as data sharing continues to be simplified. In order to accomplish set targets to improve healthcare services, it is significantly important to set out strategies in line with government regulations and embracing new technologies. In addition, it is equally essential to recognize the challenges and limitations and making plans to encounter such difficulties successfully so as to build the foundation of healthy community, using the smart healthcare system.

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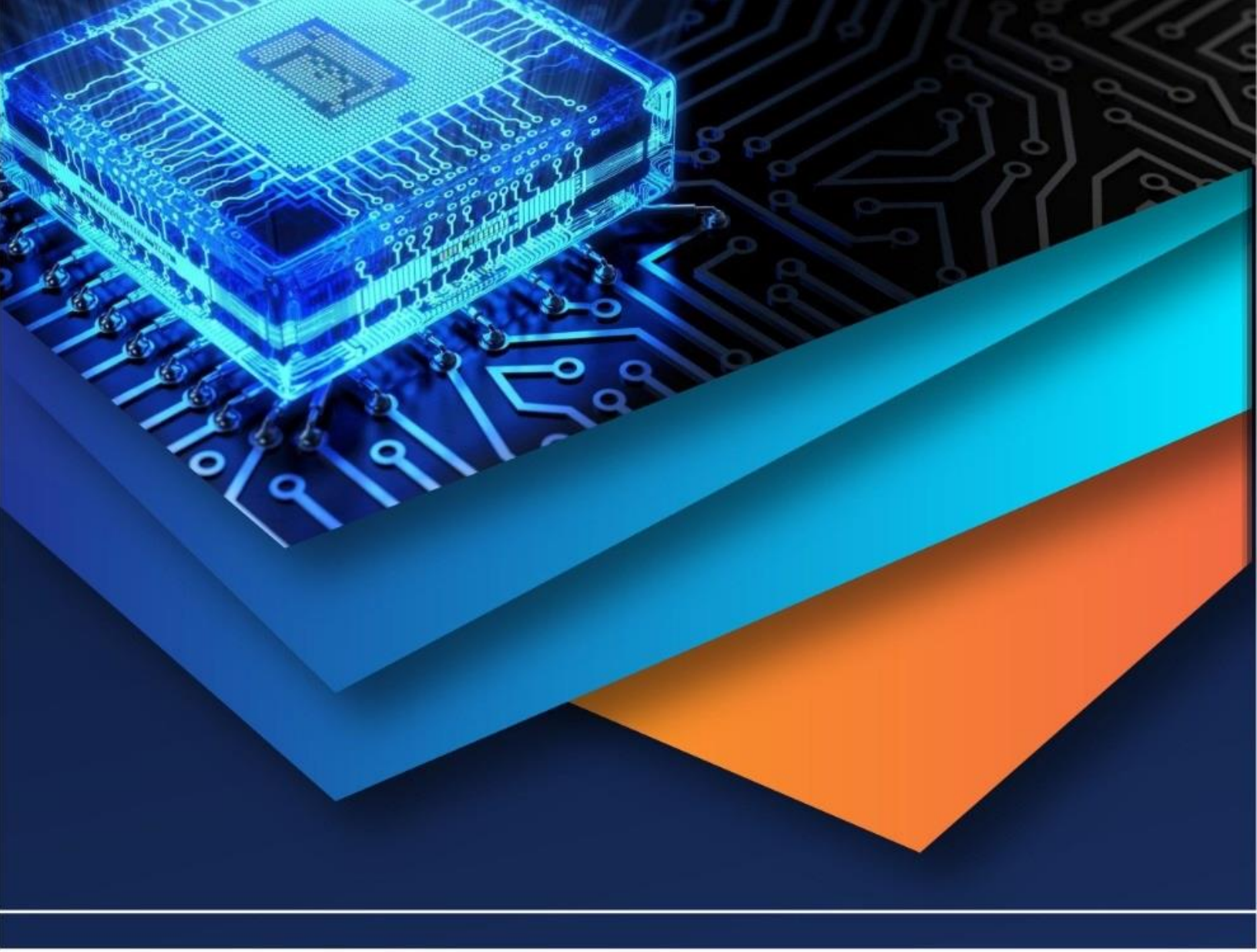

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