Towards Smart Health Care

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Abstract

The concept of smart healthcare has progressively gained traction as information technology advances. Smart healthcare makes use of a new generation of information technologies, such as the Internet of Things (IoT) and Artificial Intelligence, to completely revolutionize the existing medical system, making it more efficient, easy, and personalized. A hospital setting can be quite stressful, particularly for seniors and children. The traditional patient-doctor appointment has lost its usefulness as the world population grows. As a result, smart healthcare becomes extremely crucial. With the goal of introducing the concept of smart healthcare, the essential technologies were listed that support smart healthcare and discuss the current state of smart healthcare in various key fields in this review. The aim of this paper is to identify some of the challenges that need to be addressed to accelerate the deployment and adoption of smart health technologies for ubiquitous healthcare access. The paper also explores how the key technologies can be combined with smart health to provide better healthcare solutions.

Keywords : Artificial Intelligence, IoT, Mobile Internet, Smart health, Wearables.

1. Introduction

Due to the massive rise in population, traditional healthcare is unable to meet everyone's demands. Medical services are not accessible or inexpensive to everyone, despite having superb infrastructure and cutting-edge technologies. One of the purposes of smart healthcare is to assist consumers by informing them about their medical conditions and keeping them informed about their health. Users with smart healthcare can self-manage some emergency circumstances according to Mohanty et al[1]. It focuses on increasing the user's quality of life and experience. Smart healthcare enables the most efficient use of available resources.

Today's era is one of digitization. Traditional medicine, which has biotechnology at its foundation, has begun to digital and informationize as technology and scientific theory have advanced. In addition, smart healthcare has emerged, embracing a new generation of information technology. According to Liu et al[2018], Smart healthcare is more than just a technological improvement; it is a multi-level transformation. Medical model changes, informatization construction changes, changes in medical management, and changes in the prevention and treatment concept are all examples of this change.

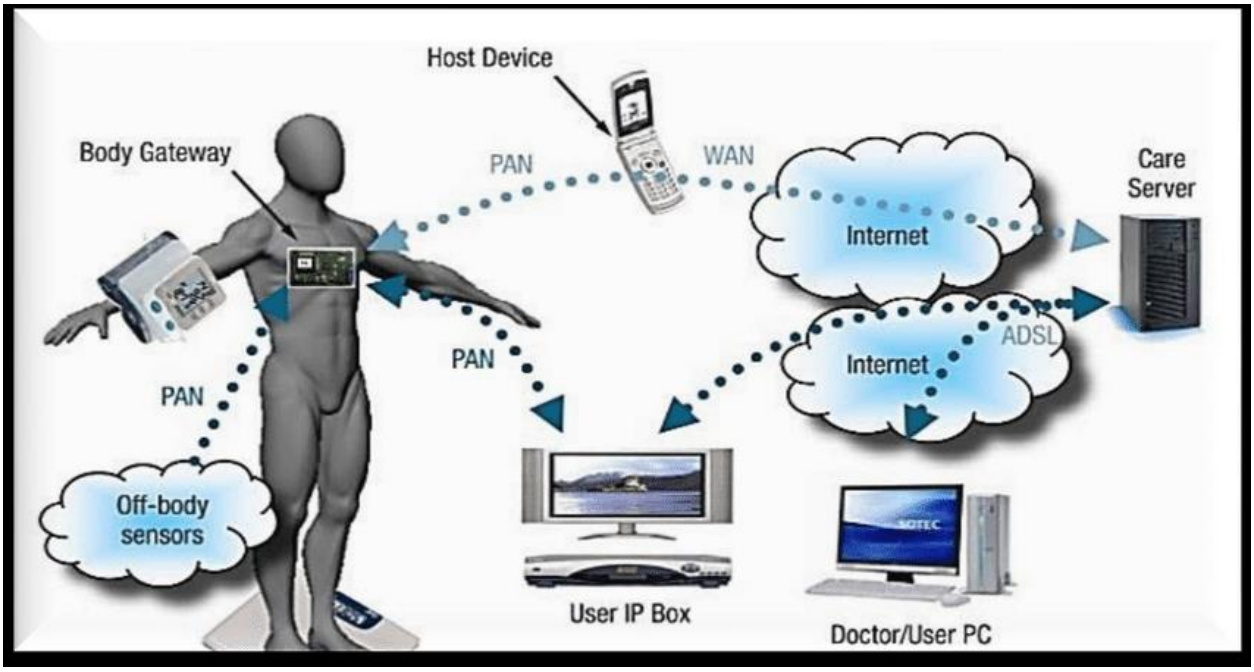

Figure 1. Concept of Smart Healthcare

Smart healthcare is a health-care delivery system that uses wearable devices, the internet of things, and mobile internet to dynamically access information, connect people, materials, and institutions in the healthcare industry, and then controls and responds intelligently to medical ecosystem demands. Smart healthcare can encourage interaction among all participants in the healthcare industry, ensuring that participants receive the services they require, assisting parties in making informed decisions, and facilitating resource allocation. In a result, smart healthcare is a higher level of medical information architecture according to Gong FF et al[2013]. Figure 1 depicts the concept of Smart Healthcare.

These developments are focused on addressing people's specific requirements while increasing the efficiency of medical care, considerably improving the medical and health-care experience, and representing modern medicine's future development trajectory. This review will begin with an introduction to the concept of smart healthcare, followed by a brief overview of the key technologies that support smart healthcare, as well as their Challenges and Opportunities and finally, a discussion of smart healthcare's future prospects.

2. Key Technologies

Multiple participants, such as doctors and patients, hospitals and research organizations, are involved in smart healthcare. It's a multi-dimensional organic whole that includes illness prevention and monitoring, diagnosis and treatment, hospital management, health decision-making and medical research. Smart healthcare is built on the foundation of information technologies such as the Artificial Intelligence, Mobile Internet, Cloud Computing, Internet of Things and wearables. In all facets of smart healthcare, these technologies are frequently used.

Patients can utilize wearable gadgets to keep track of their health at all times, seek medical care through virtual assistants, and use remote houses to implement remote services; doctors can employ a variety of sophisticated clinical decision support systems to assist and improve diagnosis. Doctors can handle medical data using an integrated information platform that incorporates tools like the Laboratory Information Management System, Picture Archiving and Communication Systems (PACS), and the Electronic Medical Record. Surgical robots and mixed reality technology can help with more precise surgery.

2.1 Artificial Intelligence

Artificial Intelligence (AI) has undeniably changed the healthcare industry. There are numerous examples of AI use in healthcare. Deep learning algorithms have changed the way medical practitioners detect and analyze stress today. Micro-expression analysis is a technique for analyzing data from photographs that is considered to be effective. A number of professionals are presently developing AI-based solutions for digital eye scanning. Apart from that, the ubiquity of Chatbots and Virtual Assistants is causing a big upheaval in the healthcare industry. These assistants are being used by healthcare institutions to communicate with patients, create

individualized plans for them, and aid them by addressing some of their most common health-related queries.

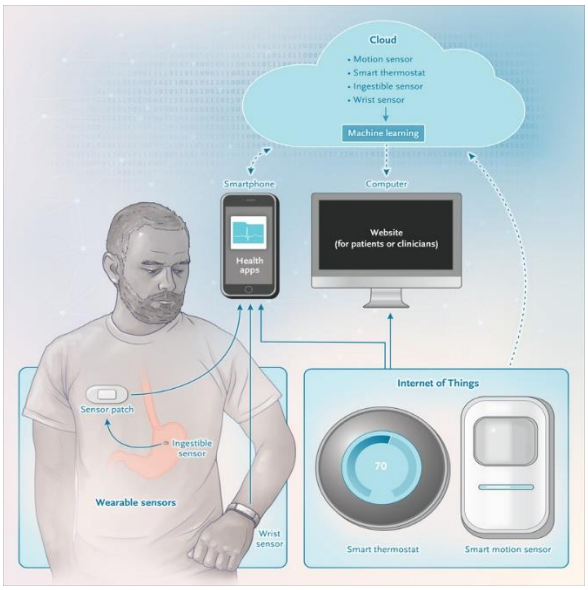

Figure 2: AI in Healthcare **Figure 3: Mobile Internet**

Figure 2 depicts the AI in healthcare. There are various successful AI applications in healthcare, such as Google's Deep mind Health Project or IBM's Watson technology for Oncology. Smart hospitals prioritize improved patient outcomes and increased efficiencies, and AI plays a significant role in both of these areas. AI aids in better decision-making by supporting optimal data management. It aids in the improvement of hospital management by providing real-time visibility into hospital activities. Online consultations powered by AI helpers are not only lowering healthcare expenditures, but they are also improving doctor-patient relationships.

2.2 Mobile Internet

Gone are the days when mobile technology was only used in taxis or for food delivery. The healthcare industry has also been streamlined as a result of the introduction of mobile technologies. Smartphones have made life easier; now, reports may be sent via instant messaging to patients or doctors. The operational time is reduced by 26 minutes as a result of this. Several devices feature built-in sensors that can track the patient's health and promote mobility when worn on the chest. There are a number of mobile apps that may be used to maintain track of a patient's health, and any minor issues are immediately communicated to both the patient and the doctor via text

message. Smart hospitals are implementing mobility technologies to help patients live better lives and make better decisions. Figure 3 depicts the Mobile Internet.

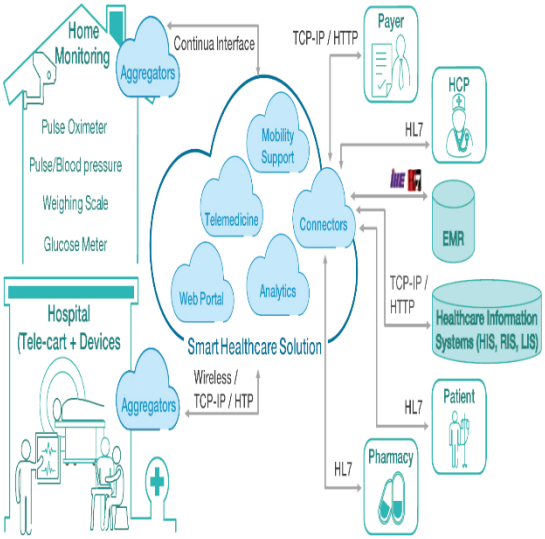

Figure 4. Cloud in Smart Healthcare

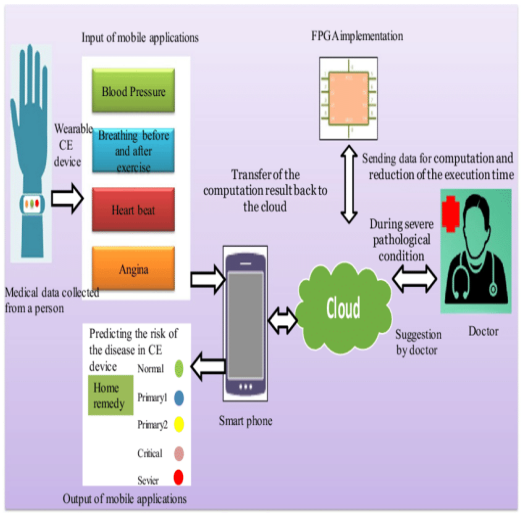

Figure 5. IoT in smart Healthcare

2.3 Cloud

Cloud computing is assisting hospitals in lowering their technology deployment expenses significantly. Cloud facilitates flawless operations for healthcare businesses due to its extensive storage capabilities, extraordinary flexibility, and inexpensive prices. Figure 4 depicts the Cloud in Healthcare systems. With the cloud, data can be accessed by anybody in the healthcare ecosystem at any time and from any device. This aids in the reduction of inefficiencies and the improvement of care quality. Smart hospitals rely on connectivity, and with the cloud, establishing connectivity, exchanging data across numerous devices and systems, swiftly analyzing data, and making insights available for informed decision-making has never been easier.

2.4 IoT

The Internet of Things (IoT) has transformed the healthcare industry. The Internet of Things (IoT) and sensors are the backbones of smart hospitals, allowing for connected healthcare. Smart hospitals can improve the quality of care while lowering the cost of care by connecting systems, processes, and workflows. Remote patient monitoring for management of remote patients with higher health risks, remote asset management for optimal utilization of hospital assets,

ingestible sensors for medication adherence, patient registration and tracking sensors, and many more are some of the most commonly used IoT use cases in smart hospitals.

2.5 Wearables

Wearables are a technology that everyone in the healthcare business is required to pay attention to. Individuals' step-by-step movement, calories burned, and sleep record are all tracked by fitness tracking gadgets like Fitbit or the Apple watch. Medical professionals increasingly urge patients to wear smartwatches in order to effectively monitor their heart rates.

Figure 6a. Wearable Technology in Smart Healthcare

Figure 6b. Wearable Devices in Healthcare

Figure 6a and 6b depicts the Wearable Technology and Wearable devices in Smart Healthcare. Monitoring timely movements of the patient in the hospital is easy. However, once the patient leaves the medical facility, it is hard for doctors to keep track of patients' health. Today, wearables are capable of detecting the abnormal heartbeat and the indication of atrial fibrillation. MYIA labs have developed under-bed sensors and apps to track the respiratory rate and also the heartbeat while the patients are asleep. Diabetes is one such disease that is hitting groups of people across the globe. And it is imperative for the patients to keep a track of their glucose level. Diabetes Sentry is a wearable that traces the temperature of the skin and uses the perspiration level to note a drop in the sugar levels. Patients can now keep track of their diabetes easily and take necessary precaution to prevent the rise of same. Smart hospitals are leveraging the powers of such wearables

to helps the hospital staff and doctors stay connected with their patients and help the patients keep track of their health.

3. Challenges and Opportunities

Patients and providers are expected to be seamlessly connected across various health-care systems using digital health-care systems that utilize electronic health records and use technology such as IoT and big data. These systems are also becoming more and more connected to various types of medical wearable technology that are worn for real-time health-care monitoring over the Internet.

Smart healthcare, although helping to provide better healthcare to everyone around the world, also makes it more vulnerable to dangers. The security needs for smart healthcare systems differ from standard security solutions due to their dynamic nature and smaller form factors according to Zhang et al 2014. Personal information in healthcare networks can be readily tampered with. To keep the design costs down, smart healthcare systems use low-speed CPUs with limited on-device memory, making further security methods impossible to implement according to Zhang et al 2013.

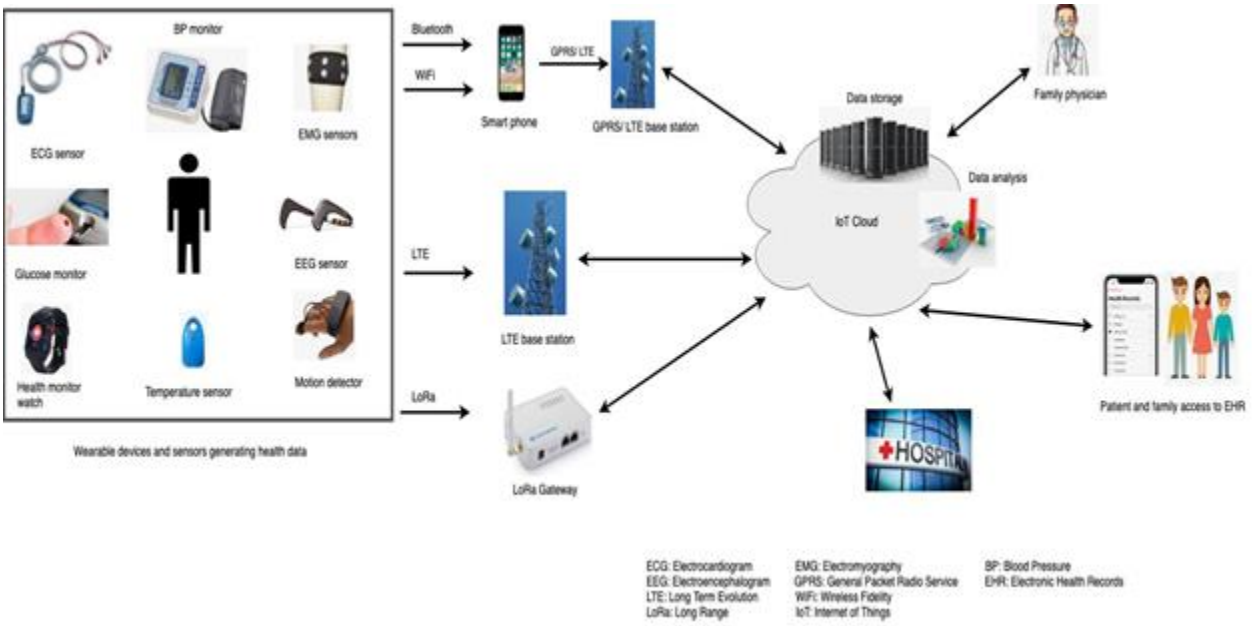

Figure 7: Challenges in Smart Healthcare

3.1 Challenges

The dispersed nature of Sensor-Cloud Infrastructure (S-CI) has revealed a unique set of obstacles for researchers in this emerging field. The following prospective research issues are depicted in this domain snapshot.

3.1.1 Lack of Standard Architecture

S-CI does not have a standard architecture in place to assure patient data privacy and security. Most studies use a hierarchical architecture. As a result, there is a pressing need to develop a common architecture for accessing PPPs in S-CI while preserving patient privacy and security.

3.1.2 Lack of Standard Dataset

Many studies have been discovered to provide cures without employing a well defined dataset. The majority of studies, according to Sajid et al [2017], employed common PPPs as their dataset, such as ECG, EGG, blood pressure, and pulse rate. Others just term it medical data or medical images, according to Shunu[2017], without identifying any specific PPPs. As a result, a standard or "golden" dataset is urgently needed.

3.1.3 Lack of Handling of Patient Behaviour and Intentions

According to Zhou et al [2015], how patient behavior and intentions are handled to drive collaboration in social networks is completely neglected. To tackle this issue, appropriate solutions and a trust model should be suggested.

3.1.4 Lack of Emergency Management

Another crucial feature of S-CI for PPPs real-time monitoring and access, emergency management, is overlooked when dealing with patient data privacy and security. Only a few studies address emergencies in their solutions according to J-X.Hu et al[2017]. There is a pressing need to deal with emergency management using realistic access scenarios.

3.1.5 Lack of Data Management in Multiple Accesses

For S-CI patient data monitoring and access, the investigations use standard and established encryption approaches. According to Lounis et al [2016], there is a tremendous need to create

novel data management scenarios for the distributed environment and numerous access to PPPs among various medical entities.

3.1.6 Lack of Search Encrypted Medical Terms and Similarity Semantics

No single study has disclosed any mechanism in S-CI to search for encrypted key words of medical phrases, as indicated by Barua [2011], and to support key word similarity semantics. As a result, a search mechanism for encrypted and similarity semantics of key words in S-CI is critical.

3.1.7 Non-User-Friendly Applications

From the patient's perspective, S-CI procedures and processes should be user-friendly, especially for elderly or paralyzed patients, to make the process straightforward to follow.

3.1.8 Real-Time Implementation and Integration

In this research area, it has been noticed that procedures are simulated in an artificial environment for experimentation. As a result, Waqar's [2013] methodologies should be applied and incorporated in real time in the UEC–Eucalyptus platform to aid future advancement.

3.2 Opportunities

In smart healthcare, confidentiality is a critical security requirement. Only authorized users should have access to data that contains personal information about the user. The services or resources should only be accessible to authorized nodes and users. To confirm the peer's authenticity, at least two-level authentication must be established. The healthcare network's integrity must be maintained, assuring users that the data being transmitted and received is not tampered with or corrupted. If an interconnected device is hacked, the security system should prevent an assault on the healthcare network's information or devices. The networked devices must be self-healing to some extent, ensuring that if one fails, the impact on the healthcare network is minimal.

4. Discussion

The complexity and expense of installation are determined by the precision required of individual devices, as well as the functions and sophistication of the application for which they are utilized. VLSI, embedded systems, big data, machine learning, cloud computing, and Artificial

Intelligence are all vertical areas that smart healthcare falls under. The importance, requirements, and uses of smart healthcare, as well as current industry trends and products, are discussed in this article. It provides a clearer understanding of the various platforms on which future study in this dynamic topic may be conducted.

Through interaction with top discovery engines, ensuring total IoT device visibility and risk analysis helps find and classify IoT devices on a particular network, exposing risks such as weak passwords, obsolete firmware, and known vulnerabilities. Even IoT devices with unpatched firmware or legacy operating systems should be ‘virtually patched' to fix security concerns. To avoid IoT-targeted malware assaults, it's critical to detect and stop unwanted access and traffic to and from devices and servers.

5. Conclusion and Future enhancement

This article identified some of the difficulties and opportunities in smart healthcare. The paper also explored how the key technologies can be combined with smart health to provide better healthcare solutions. Healthcare solutions that are needle-free and cost-effective have always been in high demand. The shift to smart healthcare services is taking place slowly and steadily. This is mostly due to the fact that healthcare workers must be continually taught and motivated to adapt to the digital world. Finally, medical devices aren't the only targets; smart office and building management systems (BMS) assets are also great targets, whether as a gateway into the hospital network or as a target for manipulation and takeover. Though IoT-enabled smart healthcare systems can boost income and improve quality of life, the advantages can be easily outweighed if security is compromised. At both the client and developer sides, more precautions must be taken to deal with attacks and secure potentially sensitive information. While the health-care sector is increasingly interested in leveraging IoT and big data technologies to become more efficient, there are several challenges that need to be addressed before digital health care can become a widespread reality.

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