A Systematic Review: Towards a Smarter Approach to Healthcare 5.0

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Abstract- The idea of "smart healthcare" has slowly been making its way to the forefront in recent years because of advancements in information technology. Smart healthcare utilizes the latest advancement in information technologies, including the Internet of Medical Things (IoMT), big data, cloud technology, and machine learning, to completely replace the existing healthcare system, therefore improving healthcare to be more effective, extra comfortable, and more customized. In the interest of presenting the idea of "Healthcare 5.0" the purpose of this study is to initially present a listing of the principal techniques that underpin "Healthcare 5.0" and then to present an overview of the current state of intelligent healthcare in a number of significant domains. The next step is for us to elaborate on the issues that are now plaguing smart healthcare and make an effort to suggest potential remedies to these issues. In the concluding part of this article, we take a glance into the horizon and assess the potential of smart healthcare.

Keywords: *Healthcare 5.0, Smart Healthcare, Smart City.*

1. INTRODUCTION:

The information age has here, and it's the one we're living in right now [1]. Conventional medicine, which has biotechnology at its foundation, has progressively started to digital and digitalization in recent years as a result of advances in both technologies and scientific theory [2-4]. In addition, there has been an increase in the implementation of advanced healthcare that makes use of the most recent generation of data technologies. A smart healthcare system is not only an improvement in technology; rather, it is a transformation that takes place on many different fronts simultaneously [5-7]. Modifications in the healthcare framework (moving away from disease-centered treatment toward patient-centered treatment), informatization development improvements (moving away from medical digitalization toward local health informatization), improvements in healthcare administration (moving away from general management toward personalized management), and improvements in the notion of mitigation and diagnosis are all manifestations of this transformation (from concentrating on disease management to concentrating on defensive healthcare) [8]. These alterations place an emphasis on catering to the specific requirements of individuals while simultaneously enhancing the efficacy of basic healthcare. As a result, the experience of receiving medical and health services is significantly improved, and they point to the way in which medical technology is likely to continue its path of evolutionary progression [9]. This review will begin with an explanation of the concept of "smart healthcare," then move on to provide a concise overview of the primary techniques that underpin "smart healthcare," discuss the accomplishments and difficulties associated with "smart healthcare," and finally discuss the possibilities for the development of "smart healthcare" in the coming years [10].

2. SMART HEALTHCARE PARADIGMS:

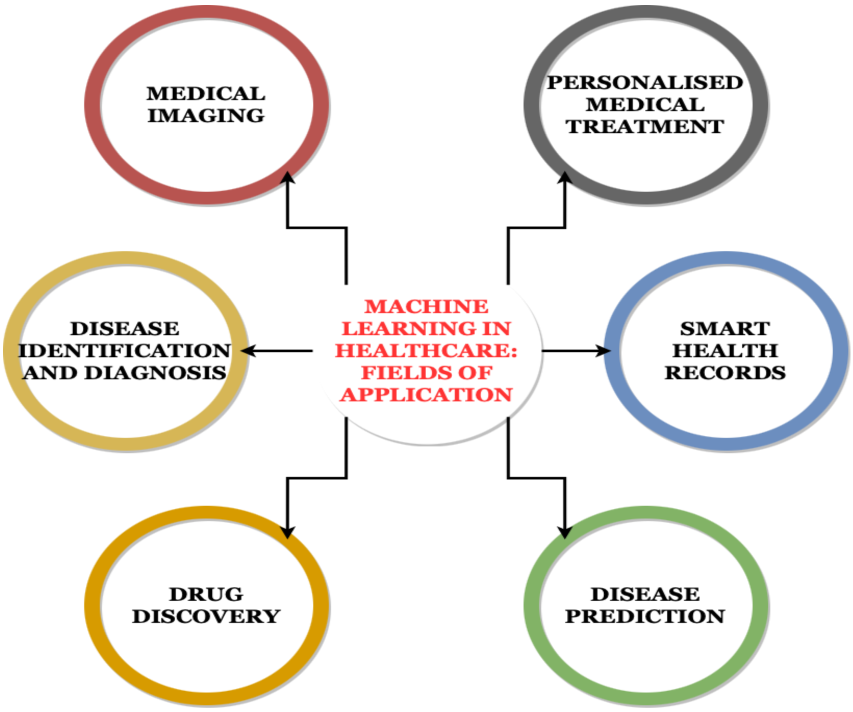

Figure 1: Machine Learning in Healthcare: Fields of Application

Generally said, Smart World is an intelligent architecture that makes use of sensors in order to detect data, sends data via the internet of things (IoT), and investigates the data with the help of powerful computers and cloud technology. It is capable of coordinating and integrating many welfare structures, which enables it to accomplish the continuous and sophisticated administration of modern civilization. A medical service platform that utilizes equipment such as wearable technology, the internet of things (IoT), and internet connectivity to adaptively acquire data, facilitate collaboration, substances, and organizations associated with healthcare, and afterward carry out this work and interact with the requirements of the healthcare ecological system in an intelligent way is referred to as "smart healthcare." Smart healthcare has the potential to encourage engagement among all stakeholders involved in the healthcare sector, guarantee that respondents receive the assistance they require, assist stakeholders in making choices based on accurate information, and make it easier to allocate facilities in an efficient manner. In a nutshell, "smart healthcare" refers to an advanced degree of knowledge building in the realm of medical treatment.

3. HEALTHCARE 5.0 PARADIGM:

Healthcare 5.0 [11-13] is a decentralized system requiring fifth-generation connectivity as the primary network architecture for connecting healthcare devices. The Internet of Things (IoT) will generate data that artificial intelligence (AI) will be able to use. This will help the growth of digital health by concentrating not only on the health and well-being of individual patients but additionally on the quality of life and well-being of individuals located all over the world. The most important challenges in healthcare 4.0 are the flow of information without any errors and with as little information loss as possible. Both automation and artificial intelligence (AI), which are two new technologies that are part of the healthcare 5.0 revolution, have the potential to radically alter every sector of the employment market. The fifth generation of intelligence in the healthcare industry encompasses concepts such as accurate and systematic disease prognosis, online monitoring of patients and surveillance, smart robots, and smart therapy, which may include virtual coaching for patients who suffer from anxiety. The term "artificial intelligence" (AI) refers to an all-encompassing umbrella term that includes all forms of intellectual progress. It is a term that describes the capacity of machine-learning techniques to forecast the outcomes of a process without the participation of humans. The concept of a "smart health system" came into being as a direct result of the rapid development and improvement of technological capabilities within the medical industry.

4. KEY TECHNOLOGIES OF HEALTHCARE 5.0 PARADIGM:

The term "Healthcare 5.0" refers to a system that involves a number of different stakeholders, including patients, medical professionals, hospitals, and academic research institutes. It represents an integrated entity that incorporates numerous aspects, such as the protection and surveillance of diseases, the diagnosis, and therapy of illnesses, the administration of hospitals, the taking of decisions regarding health care, and the conducting of clinical research. Along with contemporary biotechnology, information technologies such as the Internet of Things (IoT), internet Technology, cloud services, big data, 5G, microsystems, and intelligent systems constitute the foundation of healthcare. These innovations are utilized extensively across the board in relation to smart healthcare. When viewed from the point of view of the patient, individuals are willing to utilize portable gadgets to track their well-being in all instances, obtain medical care through automated systems, as well as using virtual residences to enforce cloud service. When viewed from the point of view of the physician, a diversity of smart medical outcome assistance technologies is capable of aiding and enhancing treatment. An integrated data system enables the monitoring of medical data by medical professionals. Components of this system comprise Electronic Health Records, Laboratory Information Management Systems, and Picture Archiving and Communication Systems (PACS), amongst others. Through the use of robotic surgery and 3d virtual technologies, more accurate surgery is now possible. The radiofrequency identification (RFID) technique may be utilized from the standpoint of institutions to control staff resources and the distribution network. Comprehensive management systems can be employed to gather data and aid with strategic planning. The utilization of portable healthcare systems can result in improved outcomes for patients. It is feasible for scientific research institutes to employ methods such as machine learning instead of manually screening people for drugs and to locate suitable subjects by using big data. This is one of the advantages of adopting these methods. Smart healthcare can successfully decrease the expense of medical interventions as well as the associated risks, enhance the utilization efficacy of healthcare infrastructure, encourage transactions and collaboration in various territories, force the advancement of telehealth as well as self-support healthcare services, and eventually make personalized medical facilities pervasive. These benefits can be achieved through the utilization of the aforementioned advancements.

5. THE IMPLEMENTATION STATUS OF HEALTHCARE 5.0:

The applications of healthcare 5.0 may be broken down into the following categories, according to the various requirements.

5.1 FACILITATING DIAGNOSIS AND THERAPY:

The identification and treatment of diseases have grown more sophisticated thanks to the deployment of technology such as artificial intelligence, robotic surgery, and wearables. It has been possible to obtain some achievements, including the detection of liver disease, lung disease, and skin cancer, thanks to the use of artificial intelligence in the construction of the system for clinical decision support. The reliability of diagnoses provided by artificial intelligence is superior to that provided by human physicians. In some areas, such as pathology and radiology, technologies based on machine learning can be far more precise than even the most seasoned medical professionals. It is possible for the physician to provide sick people with professional guidance that is centered on methodologies through the utilization of the clinical decision assistance system. This aids in increasing the precision of diagnosis, decreasing the occurrence of overlooked prognosis and misinterpretation, and making it possible for patients to get medical care that is prompt and suitable. The patient's health and illness condition might be more correctly characterized depending on intelligent diagnostics, which assists in the development of a specific medication regimen, and the program has been validated by specialists.

5.2 HEALTH MANAGEMENT:

Acute diseases have steadily gained the top spot in the range of human infections and have developed into a global pandemic since the beginning of the twenty-first century. Persistent diseases have a protracted course of illness, are unable to be cured, and are expensive to treat; as a result, current treatment in the context of persistent illness is of utmost significance. Nevertheless, it would appear that the conventional medical management approach that centers on hospitals and doctors is unable to appropriately address the increasing quantity of patients and disorders. Self-management on the part of patients is given a greater amount of emphasis in the current model for the healthcare system being implemented as part of smart healthcare. It places an emphasis on the real self of patients, instant assessment of health information, and prompt treatment of healthcare behavior. The development of smart gadgets that can be implanted or worn, as well as smart homes and healthcare information systems, all of which are interconnected through the internet of things, offers a remedy to this problem. Wearables and implants of the third generation may intelligently detect and track patients' vital indications in real-time, using a combination of smart wearables, microchips, and wireless components, all while minimizing energy usage, increasing patient satisfaction, and integrating information from many sources. A transition from situation surveillance to constant observation and clinical excellence is required to implement this method. It not only makes it simpler for healthcare centers to evaluate the outlook of the condition, but it also lowers the related dangers that are created by the sickness itself. The proliferation of connected devices, such as smartphones, smartwatches, and so on, has created a new platform upon which this type of surveillance may be carried out. There have been several efforts made to include wearable sensors in mobile devices, specifically smartphones. The mobility of elevated smartphones continues to improve, and they also make it simpler for users to keep tabs on both their surroundings and their bodies.

5.3 PREVENTING DISEASE AND MONITORING RISKS:

Medical authorities traditionally take the lead in disease risk prediction by collecting patient data, analyzing that data in light of established standards, and then making their findings public. This approach is not timely and does not offer them the best guidance. The smart healthcare system incorporates change and individualization into the process of predicting disease risk. Together with their physicians, individuals may now dynamically track their own health threats and implement customized preventative strategies based on those findings. The new illness risk prediction model takes in information from various connected devices and smart applications, transmits it to the cloud over the internet, and then uses big data-based techniques to evaluate the information and provide actual analysis to consumers through text messages. The effectiveness of these methods has been demonstrated.

5.4 VIRTUAL ASSISTANT:

Virtual assistants play a vital role in connecting healthcare providers, patients, and another organizations in the healthcare ecosystem using smart technologies. Medical care is simplified because of them. Through their mobile device, consumers may have the virtual assistant translate normal English into medical terms, allowing them to precisely seek the appropriate medical care. As a result, doctors may spend less time searching for information and more time actually treating patients because the virtual assistant can instantly answer with pertinent information based on basic facts. Using virtual assistants can help medical facilities save time, money, and resources while also meeting the requirements of patients, doctors, and other stakeholders. To further enhance the user experience, nuance technology may be utilized to facilitate conversation between various virtual assistants, particularly among basic assistants and highly specialized assistants. The employment of virtual assistants to enhance people's mental health, for example, has the potential to rectify the shortage of human psychotherapists and promote the spiritual well-being of a larger patient population.

6. IMPLEMENTATIONS OF MACHINE LEARNING AND AI IN HEALTHCARE:

IoT-enabled Systems that incorporate artificial intelligence and machine learning have great promise in the healthcare industry, particularly in the areas of disease management, early identification, and appropriate treatment selection. Health care in the future will be more advanced and individualized [16-20]. To put it simply, machine learning is one of the most important technologies in AI [21-24]. It necessitates the collection of a significant quantity of data samples, on the foundation of which specialized algorithms construct models through the use of pattern classification [14-17].
In recent years, there has been a rise in the use of smartphone applications and wearables for patients to keep track of their own health data. Applying an AI system to this information can have significant positive outcomes [18-20]. Data science is aiding researchers and doctors in their pursuit of a cure for cancer, a cure for rare genetic disorders, and the discovery of novel medical ailments. Complex data analysis is frequently necessary before new diagnostic approaches can be developed for individualized therapy. Algorithms developed by artificial intelligence (AI) are already being put to use in the medical field to improve medical diagnostic methods. These methods can be employed by doctors and other medical professionals to improve the accuracy, speed, and reliability with which they analyze images obtained from x-rays, nuclear medications practices, radiofrequency topographies, and ultrasounds of various organ systems. Patient autonomy can be improved with the use of AI-based technologies. Wearables empower people to determine their own health priorities, track their progress toward those goals, and utilize that information to make better choices in their day-to-day lives. By having access to their own data, patients have a better chance of being able to make an informed

decision about their treatment. Artificial intelligence (AI) has the potential to quickly and accurately assess massive datasets, and generate new datasets and insights [21-22].

Artificial intelligence algorithms don't just give you a yes or no answer; they figure out the odds of anything happening based on their description of reality [23-24]. Even well-trained models have limitations in their ability to portray reality. This rule out the possibility of a self-directed AI program [25-29]. What it really means is that doctors and nurses need to take appropriate action in response to the findings. Whether you're healthy or a member of a specific patient population, the following scenarios highlight AI's advantages. As such, it is difficult to draw distinct lines between the various groups. It is not uncommon for a patient to fall into more than one category; for instance, a stroke is considered an acute disease, although it is often preceded by chronic symptoms. Artificial intelligence has the ability to aid in the early diagnosis of illnesses, decreasing the severity of their effects on the patient. Data from the health industry may provide surprising results from machine learning. Artificial intelligence can analyze data and spot patterns by itself. Once the database develops, so does the amount of information that can be used in an ML algorithm. It might help patients determine whether or not their current health habits are contributing to their future disease risk.

In table 1, some of the previous smart healthcare applications [30-42] are highlighted with statistical approaches and key issues examined.

Table 1: Review of camera-based smart healthcare applications

Authors	Camera type	Statistical approach	Key issues examined
Helfrick et.al 2010	Stereo camera pair	Digital image correlation	Curvature method for damage detection
Eshlaghy A et al. 2013	Breast cancer	SVM	Age at diagnosis, age at menarche
Chen Y-C et al. 2014	Lung cancer	ANN	Sex, age, T_ stage, N_ stage LCK and ERBB2 genes
Park K et al. 2013	Breast cancer	Graph-based SSL algorithm	Tumor size, age at diagnosis, number of nodes

Chang S-W et al. 2013	Oral cancer	VM	Drink, invasion, p63 gene
Ayer et. Al 2010	Brest cancer	ANN	Brest cancer risk prediction
Waddell M et. Al 2005	Multiple myeloma	SVM	Cancer susceptibility prediction using single nucleotide polymorphism data
Lisgarten et.al 2004	Brest cancer	SVM	Predictive brest cancer susceptibility from multiple single nucleotide polymorphisms
Stajadinovic et. Al 2011	Colon carcinomatosis	BN	Personalized prognostic risk assessment in colon carcinomatosis using a Bayesian belief
Exarchos K et. Al 2012	Oral cancer	BN	Prediction of oral cancer reoccurrence using the multiparametric decision support system
Kim W et. Al 2012	Brest cancer	SVM,	Prediction of brest cancer recurrence using support vector machine
Park C et.al 2014	Colon and brest cancer	Graph based SS Algorithm	Analyze Cancer Recurrence Integrative Gene Network Construction to Using Semi-Supervised Learning.
Tseng C-J et.al 2014	Cervical cancer	SVM	Prediction the recurrence-proneness of cervical cancer using machine learning to

4 CONCLUSIONS:

In conclusion, the future of intelligent healthcare is bright. Healthcare 5.0 systems allow individuals to take greater control of their own medical decisions. Medical treatment will be easier to get when required, and it will be better tailored to the individual receiving it. Healthcare 5.0 has several benefits for healthcare facilities, including lowering costs, relieving staff strain, achieving integrated resource and data management, and enhancing patient satisfaction. Smart healthcare has the potential to save costs, shorten timelines, and increase productivity in research facilities. Smart healthcare has the potential to ameliorate the current state of medical resource disparity, advance the progress of the healthcare revolution, encourage the adoption of preventative techniques, and cut down on societal medical expenditures with regard to global decision-making. 42 But several issues remain in the development procedure. It will need the combined efforts of patients, physicians, hospitals, and IT businesses to find a permanent solution to these issues.

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