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Future Prospects Analysis in Healthcare Management Using Machine Learning Algorithms

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Abstract *The healthcare industry is undergoing a rapid transformation fueled by technological advancements and the availability of vast amounts of healthcare data. Machine learning algorithms have emerged as powerful tools in healthcare management, offering the potential to revolutionize various aspects of healthcare delivery. This research paper aims to analyze the future prospects of utilizing machine learning algorithms in healthcare management. Recent improvements in AI and ML technologies have made significant progress in forecasting and identifying health emergencies, disease populations, disease states, and immunological response, among other things. Although there is still skepticism about the practical use and interpretation of results from ML-based techniques in healthcare settings, their use is growing quickly. Here, we give a succinct review of machine learning-based methodologies and teaching techniques, as well as examples of supervised, unsupervised, and reinforcement learning. Second, we go over how ML is being used in a number of medical disciplines, including radiology, genetics, electronic medical records, and neuroimaging. We also make recommendations for future applications and briefly highlight the hazards and difficulties of using machine learning to healthcare, such as system privacy and ethical problems.*

Keywords: *Machine learning, healthcare, support vector machine, genomics, artificial intelligence, EHR.*

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I. Introduction

As healthcare expands into the modern realm of technology, many new breakthroughs appear. The advancement of the profession, including faster, more accurate, and simpler diagnosis, depends on artificial intelligence- and machine learning-based methodologies and applications. This review's objective is to highlight the benefits and drawbacks of machine learning-based methods used in the healthcare sector. We want to give a brief overview of the various methods to machine learning and emphasize the domains where these approaches are largely utilized as the application of new machine learning technology sweeps the healthcare business. We go through their vast application and potential for future advancement in healthcare. We also talk about the hazards and difficulties associated with their application from an ethical and logistical standpoint.

II. Review of other Papers

The first machine that could learn and develop artificial intelligence was hypothesized by Alan Turing in the 1950s, which is when machine learning first saw practical implementation [1]. Machine learning has been employed in a variety of ways since its inception, including face detection for security services [2], enhancing productivity and lowering danger in public transit [3], and more recently in a number of areas of healthcare and biotechnology [4]. Similar changes are expected to occur in healthcare and medicine. Artificial intelligence and machine learning have significantly changed business processes and daily life. Recent developments in this field have demonstrated remarkable progress and opportunities to relieve physicians' workloads and enhance precision, predictability, and treatment quality. The current advances in machine learning in healthcare have mostly supported the ability of a doctor or analyst to carry out their duties, recognize healthcare trends, and create disease prediction models. The organization of electronic health records [5], detection of irregularities in blood samples, organs, and bones [6] using medical imaging and monitoring, as well as robot-assisted surgeries [7] have all benefited from the implementation of machine learning-based approaches in large medical organizations. Recent advancements in machine learning technologies have made it possible to speed up testing and hospital response in the fight against COVID-19. During the pandemic, hospitals have been able to organize, exchange, and track patients, beds, rooms, ventilators, EHRs, and even employees using GE's Clinical Command Centre, a deep learning system. Additionally, SARS-CoV2 genetic sequence discovery, vaccine development, and monitoring have all been done using artificial intelligence [8].

III. MACHINE LEARNING IN HEALTHCARE

Common machine learning advancements have been developing for years in the healthcare industry. The use of AI has the potential to support decision-making [5], improve image scanning and segmentation, enable case triage and diagnoses, forecast illness risk, and in neuroimaging [9]. Here, we give a succinct summary of recent developments in AI applications to several fields of health science. The aforesaid applications meet the inclusion criteria due to their evident implementation of learning approaches with clinical applications and trials, as well as the improved availability of digital data employed in ML-based approaches. In the current review, we concentrated on the use of ML in the disciplines of genetic engineering, medical imaging, and electronic health records in the healthcare industry. These fields also reflect the "BIG" data in healthcare, or the field's structured and unstructured data, and they have shown a lot of promise in terms of therapeutic applications.

3.1 Electronic Health Records

Clinical information systems, also referred to as electronic health records (EHRs), were first launched by Lockheed in the 1960s [10]. The systems have undergone numerous reconstructions since then in order to establish an industry-wide standard system. In an effort to increase the effectiveness and quality of the job, the US federal government began investing billions in supporting EHR deployment in all practices in 2009. By 2015, approximately 87 percent of office-based practices nationally had done so [11]. BIG data collected from EHR systems with structured feature data have been instrumental in deep learning applications, including medication refills and using patient history for predicting diagnoses [5]. This has resulted in significant improvement in data organization, accessibility, and quality of care and has helped physicians with diagnoses and treatments. The standardization of features across datasets has also allowed for increased access to health records for research purposes. Scientists have created deep learning models for the diagnosis and prediction of clinical disorders utilizing EHRs in light of the crucial role that prediction plays in providing therapy. In a recent study, Liu, Zhang, and Razavian created a deep learning algorithm employing CNNs and LSTM networks to predict the start of diseases like heart failure, renal failure, and stroke. This system, in contrast to existing prediction models, combined structured data from the EHR with unstructured data from the progress and diagnosis notes.

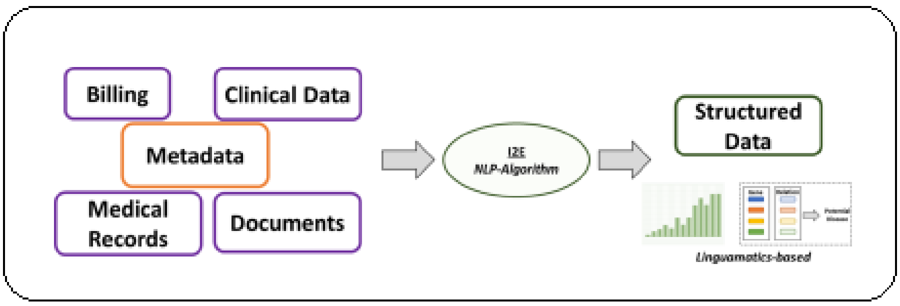

Fig 1 : Schematic representation for the working principle of NLP-based AI system used in massive data retention and analysis in Linguamatics

3.2 Medical Imaging

Medical imaging has made significant advancements with the application of machine learning-based approaches to a number of imaging modalities, including computed tomography (CT), magnetic resonance imaging (MRI), x-ray, positron emission tomography (PET), ultrasound, and more. This is due to the digital nature of data and the existence of structured data formats like DICOM (Digital Imaging and Communications in Medicine). To recognize tumors, lesions, fractures, and rips [12], a number of ML-based models have been created.

In a recent work, McKinney and colleagues used a deep learning system to identify tumors in their early stages of growth using Mammograms. These deep learning-based screen approaches enable for the identification and placement of tumors in earlier stages of breast cancer, allowing for a greater rate of resection in compared to standard screening techniques used to identify tumors. The deep learning-based solution was able to surpass seasoned radiologists in a direct comparison by an AUC score of 11.5% [13]. With varying degrees of effectiveness, a number of other studies have used ML-based strategies for breast cancer detection, including models by Wang and colleagues, Amrane and colleagues, and Ahmad and colleagues [14].

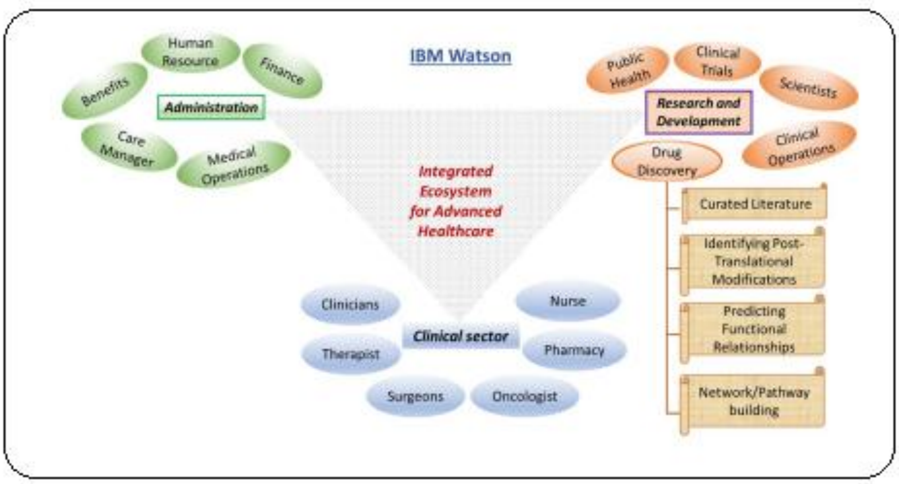

Fig 2 : Schematic representation of the various functional modules in healthcare data analytics IBM Watson's healthcare package.

Tools/Softwares	VTK	ITK	DTI-TK	FSL	SPM	NiftyReg	NiftySeg	NiftSim	NiftRec
MRI		X	X	X	X	X	X	X	X
Ultrasound			X			X	X	X	X
X-ray			X			X	X	X	
fMRI				X	X				
PET			X		X				
CT-Scan					X				X
EEG			X		X				
Mammogram									
GUI	X	X	X	X	X	X	X	X	X
Generic	X	X		X	X		X		
Registration		X			X	X	X		
Segmentation		X			X		X	X	X
Visualization	X		X			X		X	X
Reconstruction	X		X	X	X			X	X
Simulation	X		X	X				X	X
Diffusion	X				X				X

Table 1a : Bioinformatics tools for medical image processing and analysis

Tools/Softwares	ANTS	GIMIAS	elastix	MIA	MITK	Camino	OsiriX	MRIcron	IMOD
MRI	X	X	X			X	X	X	X
Ultrasound		X	X						
X-ray		X	X						
fMRI	X	X	X			X		X	
PET		X	X						
CT-Scan		X	X						
EEG		X	X						
Mammogram		X	X			X			
GUI	X	X	X	X	X	X	X	X	X
Generic	X	X	X			X			
Registration	X	X	X		X	X	X	X	X
Segmentation		X	X	X	X	X	X		
Visualization		X	X		X	X	X	X	X
Reconstruction	X	X	X	X					X
Simulation		X	X	X					
Diffusion		X	X		X	X			

Table 1b : Bioinformatics tools for medical image processing and analysis

IV.RISKS AND CHALLENGES

Although machine learning-based applications in healthcare provide novel and forward-thinking potential, they also bring with them new risks, difficulties, and a fair dose of scepticism. Here, we go over the primary risk considerations, such as the likelihood of prediction mistake and its effects, the privacy and security flaws in the systems, and even the lack of data availability for obtaining verifiable results. The interpretability and practical application of the ideas to bedside settings are some of the problems, along with ethical issues, the loss of the personal part of healthcare. The reliance on the probabilistic distribution and the probability of inaccuracy in diagnosis and prognosis is one of the most significant dangers associated with machine learning-based algorithms. This also encourages a healthy level of skepticism regarding the reliability and accuracy of predictions made using ML-based methods. The consequences of ML-based procedures leading to a human mortality are serious, despite the fact that the probability of error and dependence on probability are deeply ingrained in many facets of health care. One answer is to require strong institutional and legal authorization by many organizations before applying these machine learning-based technologies [15].

The availability of high-quality training and testing data with sufficient sample numbers to guarantee high reliability and reproducibility of the predictions is another concern involved with the application of ML and deep learning algorithms to the healthcare industry. The significance of high-quality data cannot be overstated because ML and deep learning-based techniques 'learn' from data. A limited distribution of the population sample may also be represented by the vast volumes of feature-rich data needed for various learning networks and techniques, which are equally difficult to come by. Additionally, the data that have been collected in a number of healthcare segments are heterogeneous, incomplete, and have a lot more attributes than samples. When creating and analyzing the outcomes of ML-based techniques, these issues need to be handled seriously. The new push for research data sharing and open scientific initiatives may help to overcome these obstacles. When using ML-based methods to healthcare, one should also take into account the privacy risk and ethical ramifications. Several machine learning (ML) based methodologies are created and deployed using cloud-based technologies, with the awareness that these approaches demand large-scale, easily scalable data storage and relatively high processing power. Increased data security and accountability should be one of the first factors to be considered well before model construction, given the sensitive nature of healthcare data and privacy issues.

The interpretation and clinical usefulness of the data is a significant difficulty with ML application to healthcare. It becomes extremely difficult to separate and pinpoint the original characteristics' contribution to the prediction because to the complicated structure of ML-based approaches, particularly deep learning-based techniques. Lack of transparency has significantly hindered the capacity of ML-based approaches in healthcare to be adapted, even though this may not be a major worry in other applications of ML (such as web searches). The solution approach is just as crucial as the actual solution, as is well known in the healthcare industry. Identification and quantification of underlying data aspects that are used for prediction must be done systematically. The creation, implementation, and testing of ML-based techniques with medical experts' input may also increase the acceptance rates. Additionally, despite a healthy dose of skepticism regarding the possibility of a patient's and PCP's personal relationship declining as a result of the greater use of ML-based approaches, these methods offer a special chance to boost involvement. Nearly 25% of Americans lack a primary care physician, according to studies, and the doctor-patient connection is already a vanishing idea [16]. Here, ML can offer special opportunities to boost participation where patients talk about the outcomes of possible diagnosis and boost the effectiveness of outreach initiatives. In discussions with their PCPs, patients may also benefit from early prognosis brought on by ML-based treatments by adopting a healthy lifestyle. Last but not least, a survey of doctors revealed that 56% of them saw patients for little more than 16 minutes, and 56% for no more than 9 minutes. Applying AI techniques to diagnosis and symptom monitoring will reduce stress and offer doctors more one-on-one time with their patients, which will improve patient outcomes and satisfaction.

V. CONCLUSION

Although the overview shows how far machine learning has come, there is still room for significant development in the next years. Many of the recent developments in machine learning in healthcare are intended to support the ability of the doctor or expert to give patients a more effective therapy with increased quality, speed, and precision. By generating and implementing advances in data collecting, storage, and dissemination—or by developing algorithms to process unstructured data—we can address the obstacles of constructing ML algorithms. Future applications may also result in low-cost medical tests and imaging procedures, possibly eradicating health inequities and making services more accessible to people in developing nations and those with lesser incomes. Researchers anticipate progress in three areas: personalized drug response prediction; medication dosage and choice optimization; and the use of genetic modification to address genetic diseases and mutations [17]. By using it, ML can reinvent patient care and support doctors in their work. The existing ML algorithms can offer a great foundation for future developments and applications of ML in healthcare while the dangers and difficulties of the future application are addressed and resolved.

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