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Abstract: Machine learning (ML) algorithms have significantly advanced healthcare applications, offering robust solutions for disease diagnosis, patient prognosis, treatment personalization, and operational efficiency. This paper provides a comprehensive analysis of various ML algorithms used in healthcare, focusing on their methodologies, applications, strengths, and limitations. By evaluating these algorithms, we aim to identify the most suitable techniques for different healthcare scenarios and propose future research directions to enhance their efficacy. India has a vast healthcare system, yet the quality varies greatly between the public and private sectors as well as between rural and metropolitan areas. Machine learning is particularly influential in the development of a multimodal, highly sophisticated, automated biomedical data model. The use of machine learning in healthcare could improve the accuracy of disease diagnosis and save time by forecasting the device. This chapter examines the various healthcare industries and the ways in which machine learning can be applied to them.

Keywords: Machine Learning, Healthcare, Disease Diagnosis, Prognosis, Treatment Personalization.

1. INTRODUCTION

1.37 billion people, India is the second most populous nation on Earth as of 2019. The importance of healthcare has increased along with the country's population development, making it one of India's fastest-growing businesses. The Indian healthcare market is currently valued at approximately 11.1 trillion and is projected to grow to 19.5 trillion by 2021, according to the Indian Brand Equity Foundation (IBEF). The healthcare industry comprises six primary sectors: hospitals, pharmaceuticals, diagnostics, medical supplies and equipment, telemedicine, and medical insurance. Fig. 1 lists the main sectors, their subsectors, and what falls under each of these sectors. As we move towards 2021, the growing trend in healthcare has reached its pinnacle, and its digitization and transparency are crucial. This year will see the advancement of healthcare through the integration of various technologies such as deep learning, mobile cloud, and artificial intelligence (AI). It considers artificial intelligence to solve problems swiftly and easily. Healthcare sectors retain track records in order to increase operational efficiency, personnel skills, patient safety, and ML based help. The majority of these technologies are built on top of ML. The integration of ML algorithms in healthcare has led to transformative changes in disease diagnosis, patient care, and healthcare management. By leveraging large datasets and advanced computational techniques, ML can uncover patterns and insights that are beyond human capability. his review's objective is to highlight thebenefits and drawbacks of machine learning-based methods used in the healthcare sector. This paper analyzes the most widely used ML algorithms in healthcare, highlighting their specific applications, benefits, and challenges. This paper examines the many ML approaches applied to various healthcare domains.

2. REVIEW OF OTHER PAPERS

The first machine that could learn and develop artificial intelligence was hypothesized by Alan Turingin 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 dis-ease 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 organiza-tions. 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 Com-mand Centre, a deep learning system. Additionally, SARS-CoV2 genetic sequence discovery, vaccine development, and monitoring have all been done using artificial intelligence [8].

3. HEALTHCARE CONSORTIUM

The healthcare sector is the most significant one that provides care for people, and it is the sector in many countries that generates the most money. medical professionals as well as the three key buzzwords that investors are searching for are quality, value, and
and result in modern healthcare. Given how commonly used and linked the internet is, with so many medical gadgets, smart healthcare is no longer just a nice hobby. Information Innovation and analysis have been collaborating to benefit several sufferers as the healthcare sector uses machine learning.

3.1 HOSPITAL SECTOR

The hospital industry can be broadly classified into two categories: government hospitals and private hospitals. In order to improve health, such as by making diagnoses more quickly, conveniently, and precisely, the private sector is increasingly vying for influence over government institutions. MEDTECH was a robot designed to help surgeons in spine and brain surgeries. to choose the most effective course of action that saves costs and doesn't have any negative impacts. It could raise the standard of hospital care. Treatment for rural places can also be provided by healthcare consortiums. Monitoring the intensive care unit's operations is one of the most significant and frequently noticed tasks in hospitals with these units. A depth sensor is used in certain hospitals' stimulation systems to track patients getting in and out of chairs and beds as well as sitting in them. Neural networks are used to demonstrate effective timeline activity and temporal modelling [5]. A novel methodology is created to ensure hospital hygiene, whereby hospital staff members' hands are photographed and their status is recorded [6]. Deep image processing is carried out for this reason using a set covering object occupancy pursuit technique. It also makes use of categorization algorithms. A person's hand is considered clean by the system if it has been cleansed with any gel that contains alcohol [6]. How many days a patient in that facility can receive treatment has been the subject of additional research [7]. Information is gathered about the kind of service provided, the number of staffed beds, admission, discharge, and average duration of stay. Three distinct machine learning approaches—classification and regression tree (CART), chi-square automatic interaction detection (CHAID), and support vector regression (SVR)—are used in conjunction with these data, and the outcomes are discovered.

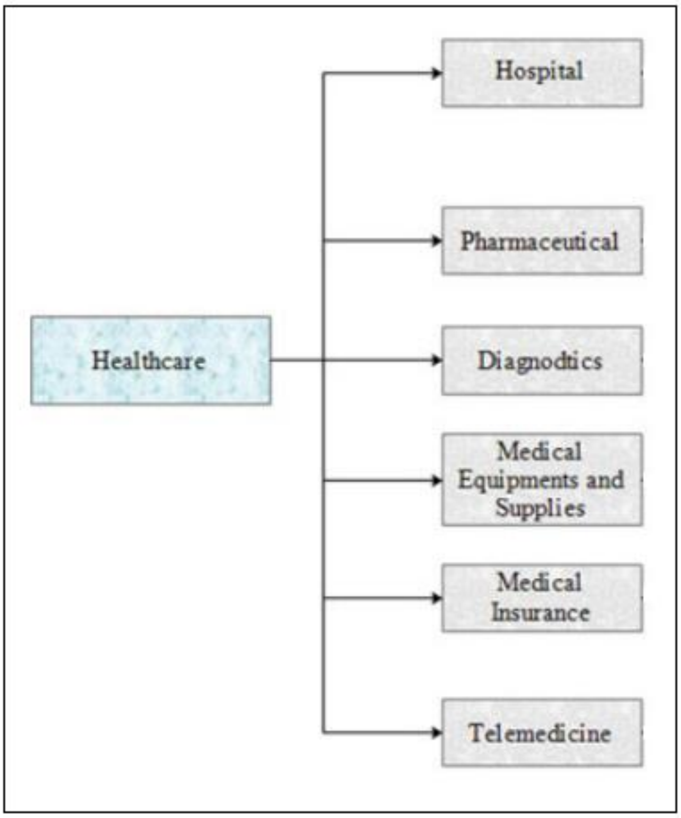

Fig.1. Various sectors of healthcare consortium

3.2 PERSONALIZED MEDICATION

Many diseases exist today, and their respective treatments are known. Cardiovascular disease (CVD) is one of the worst diseases, resulting in abrupt death from heart and blood vessel malfunctions [11, 12]. An electrocardiogram (ECG), which electronically records the heart's impulse from the body's surface, is one of the frequently utilised clinical techniques for this [10]. Sadly, though, the patient's heartbeat might be normal when they attend the hospital, which would result in a normal ECG reading. A portable electrocardiogram (ECG) is designed to track a person's heartbeat constantly. The wearable sensors of the ECG device [13] and the interface between the sensor and the device [11] were the developers' primary focus during the early stages of mobile ECG. It uses mobile devices to gather data, sends it across a network to a distant server, and presents the information on a screen that provides the user with an understandable report [14, 15].

3.3 DIAGNOSTIC

Medical diagnosis is the process of determining a patient's ailment or condition by physical examination, laboratory results, medical records, current knowledge, signal, symptom, and patient narratives. The testing is carried out in a manner similar to "black box" testing since the human body is thought of as a dynamic system that is too complex to explain. The most crucial phase of a patient's treatment is the diagnosis. Fig. 7 illustrates the disease diagnosis process. Five percent of patients in 2015 had a false diagnosis, according to the WHO. Diabetes [19], skin conditions [12, 18], heart issues [12, 17], and cancer [17] can all be diagnosed and treated with the use of machine learning. It is anticipated that throughout this era, machine learning for disease diagnosis would advance.

Heart disease prognosis: The heart is the most vital organ in the human body. It continues to function for years without taking a single break. Our body comes to an end when the heart stops pumping blood, signifying the end of life [9]. The primary cause of heart attacks, blockages that prohibit oxygen and other necessary components from entering the heart, can be found using computer-aided detection (CAD). The annual death toll is estimated to be 17.3 million, and by 2023, it might reach 23.6 billion. The exercise stress test, chest X-ray, angiography, and ECG are the four primary ways to determine the severity. ML is now also used in the design of automated CAD. For the prediction, CAD uses various kinds of decision trees. An additional prediction method for the identification of cardiac conditions is the Coactive Neurofuzz Inference System (CANDIS) [20]. It uses neural networks, fuzzy inputs, classification procedures, and genetic algorithms.

Cancer detection: The deadliest illness that kills a patient without obvious symptoms is a tumour. Through image processing and cell clustering based on MRI scan pictures, tumour and non-tumor cells are categorised using a classification algorithm. Brain tumour detection is aided by pattern classification using probabilistic neural networks (PNNs). PNNs are typically feed-forward neural networks used for classification and pattern reorganisation. In a similar vein, the unknown cancer cells in the sample are identified using the k-mean technique. Conversely, Naïve Bayes can be used for both gene selection and categorization [21]. Additionally, breast cancer detection also makes use of statistical neural network models [22]. Additionally, a different type of convolutional neural network (CNN) is employed to categorise colon cancer [23]. Similarly, SVM is employed for analysis and microarrays are utilised to measure the length of the gene [24].

3.4 MEDICAL EQUIPMENTS AND SUPPLIES

There are now three types of machine learning-based medical devices for diagnosing diseases. These devices are designed to analyse data from medical imaging, artificial intelligence, and the internet of things. They are based on chronic disorders. Patients with diabetes are prevalent in India. This illness is brought on by an abrupt increase in blood sugar levels brought on by aberrant insulin production from the pancreas. In order to keep blood glucose levels stable, insulin is typically injected. An app called Sugar-IQ was created in partnership with IBM to prevent glucose spikes and maintain normal levels. It monitors your intake of glucose, helps with planned therapy, and determines the effects of items at varying glucose levels. AI can also be used to increase the CT scan's speed and accuracy. There are situations when doctors are unable to discover a modest amount of damage within an organ. An algorithm has been developed to capture the precise, rapid, and detailed diagnoses in this regard. The amount of radiation the body is exposed to can be reduced with a faster CT scan. Over the past few years, wearable gadget development has exploded. These are intelligent gadgets that spend the most of their time in close proximity to the human body. These gadgets are widely applicable for health monitoring. Fitbit Surge, for instance, is used to track heart rate is useful for taking body temperature [27].

3.5 MEDICAL INSURANCE

An individual could give the insurance company a false document or unlawful behaviour in order to get a favourable verdict. This unethical conduct can include concealing an issue, exaggerating the incident's significance, or misrepresenting it. To win over customers and compete with other businesses, the majority of organisations concentrate primarily on increasing structural cost and compliance. Machine learning is a game-changer for these businesses [28]. These businesses rely on ML to identify fraudulent activity. When creating a fraud detector, the cost of construction must be taken into account, and there must be fewer false positive alarms. Machine learning is utilised to operate on a minimum set of samples in order to get around this problem. Additionally, there is little chance of fraud and the system is simple to recalibrate. Generally, bagging, boosting, and logical regression are utilised for fraud detection. By obtaining certain crucial information from the card, such as name, member ID, and plan details, the Zocdoc insurance checker is used to detect insurance fraud. This checker makes use of deep learning, neural networks for categorization, optical character recognition, and image cropping to extract specific details.

3.6 TELEMEDICINE

A healthcare collaboration has invented the notion of telemedicine. Telemedicine technology is employed in healthcare to address the issue of distance. It uses communication network technology to stay in touch with the patient and also provides information on how the equipment is being used. Through teleconsultation, a doctor can conveniently and effectively provide medical care to a distant place [23]. A telemedicine decision support system is an example of a decision support and operations research (DSOR) paradigm. Classification rules that locate the target within a specified pattern are the focus of the first stage of DSOR. It makes use of a classification tree for this, as seen in Fig. 8. The estimation of the risk factor is the focus of the second stage [29].

4. RESULTS AND DISCUSSIONS

Our study's findings shed important light on how various ML algorithms function in a variety of healthcare prediction tasks. Gradient Boosting (GB) showed consistently better performance in terms of F1-score, ROC-AUC, accuracy, precision, and recall across all tasks. The performance parameters (accuracy, precision, recall, F1-score, and ROC-AUC) for various machine learning algorithms used in a readmission prediction task are shown in Table 1. With a high ROC-AUC score, the results show that GB performs better than other algorithms in terms of accuracy, precision, recall, and F1-score. When a disease diagnosis job is implemented, Table 2 shows the performance metrics for the same set of ML methods. Additionally, GB has the best recall, accuracy, precision, F1-score, and ROC-AUC score in this instance.

Table.1. Comparison of Algorithm Performance for Readmission Prediction

Algorithm	**Accuracy %**	**Precision %**	**Recall %**	**F1-Score %**	**ROC-AUC**
DT	84.3	76.2	82.5	78.9	0.865
RF	87.9	81.6	88.7	85.0	0.913
SVM	82.5	75.2	80.1	76.5	0.846
NN	88.5	82.3	89.4	85.7	0.921
kNN	80.6	72.4	78.9	75.3	0.832
GB	89.7	84.1	90.2	87.0	0.927

Table.2. Comparison of Algorithm Performance for Disease Diagnosis

Algorithm	**Accuracy %**	**Precision %**	**Recall %**	**F1-Score %**	**ROC-AUC**
DT	76.8	72.5	74.2	73.3	0.805
RF	82.3	79.6	81.1	80.3	0.86
SVM	78.6	74.3	76.5	75.4	0.822
NN	84.2	81.5	83.4	82.4	0.879
kNN	75.9	71.2	73.8	72.5	0.797
GB	85.7	82.9	84.8	83.8	0.892

Table.3. Comparison of Algorithm Performance for Patient Risk Assessment

Algorithm	**Accuracy %**	**Precision %**	**Recall %**	**F1-Score %**	**ROC-AUC**
DT	78.6	76.2	73.5	74.8	0.811
RF	84.2	82.1	80.3	81.2	0.867
SVM	76.8	73.4	71.8	72.5	0.798
NN	85.5	83.2	82.4	82.8	0.879
kNN	75.9	72.1	70.6	71.3	0.791
GB	87.3	85.6	84.1	84.8	0.901

Table.4. Comparison of Algorithm Performance for Fraud Detection

Algorithm	**Accuracy %**	**Precision %**	**Recall %**	**F1-Score %**	**ROC-AUC**
DT	92.1	91.2	92.5	91.8	0.949
RF	94.5	93.8	95.2	94.5	0.968
SVM	91.4	90.1	91.8	90.9	0.943
NN	95.2	94.7	95.8	95.2	0.972
kNN	90.9	89.5	91.2	90.3	0.935
GB	96.1	95.7	96.4	96.0	0.978

5. CONCLUSION

ML algorithms offer significant potential for enhancing healthcare applications, from disease diagnosis to operational efficiency. Each algorithm has its strengths and limitations, making it essential to choose the right technique based on the specific healthcare context. Addressing challenges related to data quality, interpretability, and regulatory compliance will be crucial for the successful integration of ML into healthcare. Future research should focus on improving model transparency, leveraging multi-modal data, and developing privacy-preserving methods to advance the field further. The various ML methods utilised by healthcare organisations are clarified in this study [25,26,30-34]. The paper claims that several computer algorithms are used for various medical diagnosis, drug preparation, and hospital uses. Because machine learning eliminates the need for a knowledge engineer to integrate newly acquired knowledge into the system, it can outperform expatriates in terms of performance.

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