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Opportunities and Challenges in Health Care Using Machine Learning

Madhushree Naigaonkar[1], Ishita Gupta[2], Shruti Raut[3], Abhishek Sonar[4]
Department of Computer Engineering[1,2,3,4]
Guru Gobind Singh College of Engineering and Research Center, Nashik, Maharashtra, India
madhunai2951@gmail.com[1], ishitagupta0203@gmail.com[2], shrutiraut0106@gmail.com[3], abhisonar4121@gmail.com[4]

Abstract: *Healthcare is an ever-evolving industry with a profound impact on all of our lives. However, the incentive behind quality healthcare is that the adoption of technology that allows clinicians to provide superior patient care. With the advancement of technology, the health care industry is also growing rapidly. Nevertheless, there still needs to be deeper research into this integration and determine the best technologies that supports healthcare. One upcoming technological development known as machine learning has great potential when it comes to applications of health care sector. The evolution of machine learning (ML) technology has greatly enriched the services and functionality of healthcare, giving birth to the new field of "smart healthcare." The purpose of this paper is to discuss all of the applications of machine learning in the healthcare sector as well as to provide some insight into the challenges faced by healthcare firms using machine learning technology. As a result of machine learning, many healthcare applications can be developed, such as prognosis, diagnosis, epidemics, and treatments.*

Keywords: Machine Learning, Epidemics, Diagnosis, Potential, Healthcare

I. INTRODUCTION

Healthcare is one of the verticals that can significantly benefit from the increasing amounts of data and its availability. In the past, doctors have been treating patients based on symptoms; however, physicians are beginning to diagnose and treat patients with a concept known as evidence-based medicine. "A patient's primary malignancy was lung cancer. During the course of treatment (she had seen) a pulmonologist for her symptoms. He had performed pulmonary function tests, prescribed inhalers, and told her to return if her symptoms did not improve. She never went back, and the cancer was later found by her family doctor, by which time it was metastatic" [1]. A fundamental issue in the example above and in healthcare system in the past has been that of not developing a good relationship between the health provider and the patient. The way that a modern day physician interacts with their patients determines their satisfaction with the care, their response to medication, and their tendency to schedule follow up appointments. In the status quo, doctors have too many patients to ensure that each patient is in good health, even after the appointment. Additionally, doctors are being urged to see a greater number of patients in a smaller amount of time and with security. As the need to establish relationships with patients increases in tandem with the rising number of patients and need for care, doctors will have to utilize new technology to accomplish their goal of patient-centered care. In the example above, technology could have signalled to both the doctor and the patient that there was an apparent need to schedule a follow-up appointment. Machine learning is a method of data analytics that automates the process of modeling, and thus allows models to be automatically created. With machines learning to utilize certain algorithms, they can find hidden insights from data; it is important to note that in machine learning, we are not telling the machines where to look. Machine learning is an iterative process that allows the machine to adapt its methods and outputs as it is exposed to new data and situations.

Nowadays, it is difficult to envision how machine learning and big data can influence the healthcare industry. Observations have shown that most of the authors who incorporated machine learning and big data analytics in disease diagnosis have not given significant consideration to data privacy and security. A novel design of smart and secure healthcare information system using machine learning and advanced security mechanisms is presented here to handle big data in the medical industry. Integrating optimal storage and data security layers to maintain security and privacy is the

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innovation here. Various techniques are incorporated, including masking encryption, activity monitoring, granular access control, dynamic data encryption, and end point validation. The proposed hybrid four-layer healthcare model appears to be more effective for disease diagnosis.

II. LITERATURE SURVEY

Robust automated ways are essential for a lot of efficient and a lot of correct analysis of multi-modality pictures in clinical observe within the context of early designation, optimum treatment planning, and treatment follow-up. Medical image computing advantages from advances in machine learning to develop data-driven model-based image analysis methods that are less biased by heuristic assumptions regarding the appearance of the objects within the pictures. Supervised learning mistreatment deep convolution neural networks seem promising for numerous applications in medical image analysis.[2]

The adoption of Machine Learning and Deep Learning (ML/DL) techniques has great potential to transform the traditional healthcare applications but it is necessary to ensure that the application is secure, robust and different security as well as privacy challenges should be addressed. However, the magnificent performance of ML/DL, there are still remaining doubts regarding the robustness of ML/DL in healthcare settings (which has traditionally been regarded quite challenging due to the myriad security and privacy issues involved), particularly in light of recent results that have shown that ML/DL are vulnerable to adversarial attacks. The paper carried out the challenges by identifying sources of vulnerabilities in it and by formulating the ML pipeline in healthcare. The potential methods to ensure secure and privacy-preserving ML for healthcare applications were also mentioned. Finally, the current research challenges and promises directions for future research [3].

In this paper, authors reviewed various machine learning algorithms used for developing efficient call support for care applications. This paper helps in reducing the analysis gap for building efficient call support system for medical applications. Machine learning may well be a broad multidisciplinary filed that has its roots in statistics, algebra, processing, and information analytics etc., that produces it robust to come up with a unique definition. ML is a particular method of artificial intelligence it collects info from training data. during this learning, we tend to don't seem to be informing the machines where to seem, and it's at the inspiration of the tree and has a lot of branches and sub-branches. Machine Learning split into four categories i.e., Supervised Learning, Semi-supervised Learning, Unsupervised Learning, Reinforcement Learning. Most of the Americans die each year owing to errors gift within the health care system, and thousands of people deteriorate from nonfatal burns thanks to the constant cause. Health data Technology (IT) Framework Recommended few ways, like collaboration, knowing client choice of clinicians and organizations, and IT adoption. Authors explained the terms like decision support, decision support system in healthcare. Currently, in health-care, an enormous amount of knowledge has become accessible. It contains EMRs that encompass information which can be either unstructured or structured. Structured health data is that the information that's straightforward to analyze during a info and that they can carry a collection of statistics and categories additionally as but not restricted to patient weights, and even generic symptoms like abdomen pain, headache, etc. the majority of medical data is unstructured data inside the variability of diverse completely totally different notes, images, audio and video recording, reports, and discharge summaries. It's really exhausting to quantify and analyze a spoken communication between the provider and also the patient; the spoken communication is unbelievably personalized and would possibly take many various directions. They have stated different techniques used by ML i.e., Support Vector Machine, Naive Bayes Classification, Decision Tree, K-nearest neighbour, Fuzzy Logic etc. It also presents various ML techniques for prediction of assorted diseases like heart disease, carcinoma, diabetic sickness and thyroid sickness. From the sooner study, it's recognized that naive Bayes provides eighty-six of accuracy for the designation of cardiopathy. SVM provides ninety-six.40% of accuracy for the carcinoma diagnosis, and CART provides seventy-nine of accuracy for the detection of diabetic sickness. In future, they tend to try to improve the accuracy of carcinoma prediction by mistreatment different machine learning algorithms [4].

Today, in the healthcare sector, huge data volumes aren't the only concern. Security and privacy of patient information are also vital factors. Generally, authors in their study only concentrates on the interoperability and integration of big data for analyzing informative patterns and hardly concerned with the security. The framework proposed here was designed to integrate and analyze distributed data to provide better treatments for patients and to enable healthcare experts

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to make effective decisions. Big data poses a number of privacy and security concerns. To protect data privacy, it is important to use data appropriately to prevent unauthorized access. First layer deals with heterogeneous data source. Medical records, operational data (flat files, relational data, and ASCII format), genome data, and medical images (X-ray, MRI, CT scan, etc.) form the main data source. This layer is responsible for handling heterogeneous data and transforming it, if necessary, into a homogeneous one. In the second layer, heterogeneous data is stored. Depending on the type of data, it may be stored as data files or as data warehouses. Data can be decomposed and stored in different places using a distributed platform.

Finally, this layer optimizes storage for optimal use of memory resources. Security is the most important concern in the healthcare sector. In this model, different types of encrypted techniques have been incorporated in security and privacy layer to ensure patients' data is secure, including dynamic encryption, granular access control, and activity monitoring. The machine learning-based application layer is another important aspect of the proposed framework. It consists of five submodules: early diagnosis, drug discovery, epidemic outbreak forecasting, data analytics, and visualization. These sub-modules can be addressed by different machine learning methods, such as the naive bayes, the support vector machine, the decision tree, genetic algorithms, etc. Depending on performance and accuracy, machine learning techniques may be combined with other soft computing techniques to achieve better results. In Layer4, big data methods are utilized to develop predictive models to assist in decision-making and to obtain insights from data. This layer encapsulates all the applications and services that relate to healthcare. In the final step, the generated information can be presented using machine learning, SQL queries, and medical imaging analytics [5].

III. Applications Of ML In Healthcare

Machine learning in healthcare is becoming more widely used and is helping patients and doctors in many different ways. The common healthcare use cases for machine learning are automation of medical billing, clinical decision support and the development of healthcare guidelines. The four major applications of healthcare using Machine Learning are prognosis, diagnosis, treatment, epidemic control which is discussed further.

3.1. Machine Learning in Prognosis

Prognosis is the process of predicting the development of a disease in medical practice. It includes identification of symptoms of a specific disease and also identifying the state (worse, improve, stable). It also helps in identification of possible health problems, complications, ability to perform daily activities, and the probability of survival. Machine learning models have been developed for identification of disease not only in humans but also in plants and animals. For example: Machine learning models are widely developed for identification of cancer in humans and also the classification of different types of cancers like brain tumour, lung cancer, etc. In plants machine learning model is used to identification of disease that results in loss of crop yield.

3.2 Machine Learning in Diagnosis

Machine learning can help in diagnosis with the help of electronic health records which are generated by hospitals and healthcare providers on daily basis. The data contains different information of patient in different format. It may contain the complete medication history of patient, different medical image documents, etc. Machine learning models are used to extract the medical features for facilitating the diagnosis process. Machine learning models can be used to diagnose diseases like diabetes by using the previous historical medical documents and also by checking the present test reports. Moreover, some models of machine learning facilitate the diagnosis process with the help of images (x-ray, CT scan, MRI, etc). These ML models are used for effective and efficient extraction of information from medical images.

3.3 Machine Learning in Treatment

Machine learning is helping in treatment with the help of image interpretation and real time health monitoring. Medical images are widely used in routine medical checkups and diagnosis. Images are further processed by expert physicians and radiologists and generate a report in textual format which describes the finding from the captured images. This task becomes tedious and time consuming for the experts. Hence, we can use different machine learning and natural language

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processing methods wherein it will annotate clinical radiology report. Real time health monitoring is very important when it comes to the patients who are at critical stage and continuous monitoring is essential factor for treatment process. Real time health monitoring can be achieved with the help of IOT devices. The data will be collected by IOT devices and then transmitted to cloud for further analysis. In order to analyze the data efficiently and effectively we can make use of Machine learning and deep learning.

3.4. Machine Learning in Epidemic Control

Machine learning plays a key role in epidemic analysis and furcating. As discussed above, the data which is collected at the time of diagnosis, treatment, monitoring can be used further to predict the severity of certain disease. With the help of historical epidemic data, we can easily predict the occurrence, its spread and its severity. With the help of machine learning, we can find the epidemic patterns so that the early precautions can be practiced to stop its spread.

IV. Challenges Involved In Existing System And Relevent Solution

A large amount of data is obtained everyday by different healthcare services, which makes it difficult to handle, analyze and process the data by using traditional methods. Moreover, there are different sources of data that can increase the existing healthcare data such as genomics, medical data, data from social media, and environmental data, etc. Machine Learning methods can help to analyze the data very effectively. But there are various challenges associated ranging from privacy, security, robustness, data integrity and volume of data. Following are several challenges of ML in healthcare:

1. **Privacy:** It is one of the major challenges to data driven health care related to the use of user data by ML or DL systems in making predictions. Users (i.e. patients) expect service providers should follow the safety precautions required to protect their natural right to privacy of their confidential information, e.g., age, gender, date of birth, and other health data Possible privacy threats can be of two types, namely, disclosure confidential information and malicious use of data (possible by unauthorized agents).
2. **Ethical challenge:** In ML user-focused applications like health care, it is important to ensure proper use of data. Clear steps must be taken to be understood the number of target users and their social features previously collect data for building ML models. In addition, understanding how data collection can harm a patient's well-being as well dignity is an important consideration in this regard. If the code of conduct concerns is ignored then the use of ML in the actual settings there will be negative consequences.
3. **Injuries and errors:** The most obvious risk is that ML systems can typically be wrong, such as patient injury or different health-care issues. If associate in Nursing ML system recommends the incorrect drug for a patient, fails to note a neoplasm on an imaging scan, or allocates a single bed to 1 patient over another as a result of it foretold incorrectly that patient would profit additional, the patient may well be contused. Of course, several injuries occur because of medical error within the health-care system these days, even while not the involvement of ML. The errors are doubtless totally different for a minimum of 2 reasons. First, patients and suppliers could react otherwise to injuries ensuing from software systems than from human error. Second, if ML systems become widespread, Associate in Nursing underlying downside in one ML system would possibly end in injuries to thousands of patients—rather than the restricted range of patients contused by any single provider's error.
4. **Security:** It is that the most significant issue within the application of ML to the medical trade, and it conjointly needs the foremost rigorous review.
    a. **Hardware security:** All ML merchandise presently require a series of electronic merchandise to perform their functions, like computers, mobile phones, and bracelets. Three key issues concerning the protection of such hardware should be noted. First, even the most effective physically unclonable functions are going to be affected by factors like price, temperature variations, and magnetism interference.
5. **Software security:** Even formula programs with powerful functions are terribly vulnerable under style attacks. The performance of the system is usually disappointing in a very targeted style confrontation despite its performance being glorious within the initial design review. In fact, all stages of the ML formula formation method are attacked, assumptive that the assailant knows everything associated with the trained neural network

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model (training knowledge, model design, hyperparameters, number of layers, activation operate, and model weights).

6. **Safety:** Excellent performance in a controlled lab environment (which is typical ML community practice) is not proof of safety. ML / DL security is this determining how safe the ML / DL system is for patients. There should be an ongoing sense of security throughout the ML / DL life cycle.
7. **Availability of Good Quality Data:** Availability of representative, diverse and high-quality data is one of major challenges to health care. For example, the number of the information available in the research community is very limited in size and limited space compared to the various collections of patient data of many types produced daily in different sizes small and large health facilities. However, a good development quality data similar to actual clinical settings is another is very challenging and requires management resources and maintenance. The availability of high quality data can be successfully achieving the intended purpose of predicting diseases and making treatment planning decisions. Data collected in performance suffers from a variety of problems such as humility, reciprocity, and bias. As ML / DL models make assumptions by reading only the hidden features of data trained with, therefore, the result of data generated by unpleasant past practices in hospitals will be displayed in algorithm results. Availability of representative, diverse and high-quality data is one of major challenges to health care. For example, the number of the information available in the research community is very limited in size and limited space compared to the various collections of patient data of many types produced daily in different sizes small and large health facilities. However, a good development quality data similar to actual clinical settings is another is very challenging and requires management resources and maintenance. The availability of high quality data can be successfully achieving the intended purpose of predicting diseases and making treatment planning decisions. Data collected in performance suffers from a variety of problems such as humility, reciprocity, and bias. As ML / DL models make assumptions by reading only the hidden features of data trained with, therefore, the result of data generated by unpleasant past practices in hospitals will be displayed in algorithm results.

V. CONCLUSION

Machine learning (ML) models for healthcare applications hold the potential to completely transform traditional healthcare domains. The use of Machine Learning methods can greatly enhance the analysis of data. Throughout this paper, we have explored various challenges and methods of ML in healthcare sectors and tried to come up with practical solutions. Furthermore, we discussed possible solutions for providing secure and privacy-preserving machine learning for healthcare and other security-critical applications.

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