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Machine Learning in Healthcare: A Review

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Abstract

Machine learning a new and very sophisticated technology has been developed as a large trend in the market nowadays. Machine learning is an everywhere phenomenon which is applied in different areas. It's an irreplaceable factor in many sectors such as business, science and security and so on. Implementation of machine learning technology in healthcare is emerging as a crucial trend. The potential presented by the machine learning technologies for the healthcare field is simply stunning. Machine learning technologies are making a huge influence in healthcare. ML, a sort of technology which attempts to enhance the velocity and precision of physicians work. Machine learning algorithms are used to detect hidden patterns in medical data and provides great prediction skills. In this research, we have to examine various methods used to create effective decision assistance for medical applications. This work contributes to minimizing the gap of generating effective decision support systems for healthcare applications.

Keywords: Healthcare, Machine Learning, ubiquitous, medical applications.

I. INTRODUCTION

Machine learning is an artificial intelligence branch that uses latent patterns found in datasets to predict similar data in the future, creating algorithms without explicitly programming them for every task. It allows machines to learn automatically without explicit programming. Machine learning exists in various industries, including finance, retail, and healthcare. Machine learning is increasingly used in healthcare to develop disease diagnosis and treatments. It provides ongoing development for accurate data prediction and categorization in disease analysis. Its approaches can extract relevant data from patient datasets stored in electronic healthcare records. Machine learning algorithms can analyze data from electronic health records to anticipate disease causes. Machine learning has been effective in identifying bodily organs in medical images, classifying interstitial lung illnesses, reconstructing medical images, and segmenting brain tumours.

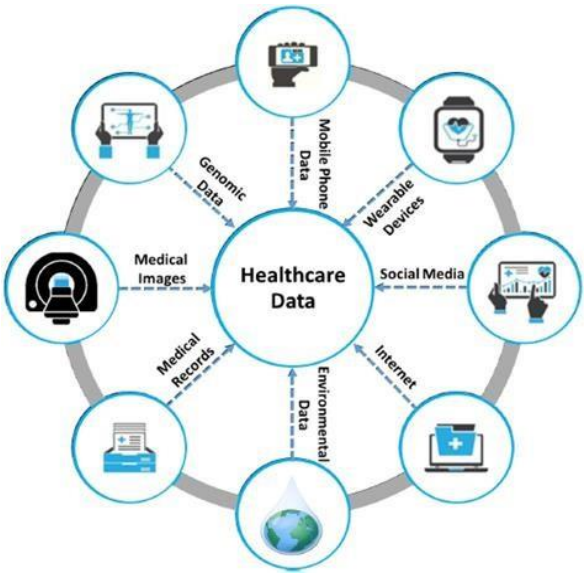

Fig. 1 Records from various sources in generating data used in healthcare [1]

II. MACHINE LEARNING TECHNIQUES

Machine learning is a technique which uses data analytics that guide computers to learn how to work in a similar manner to how human beings and animals do. Machine learning uses various techniques. Some of the techniques are mentioned below in the given diagram.

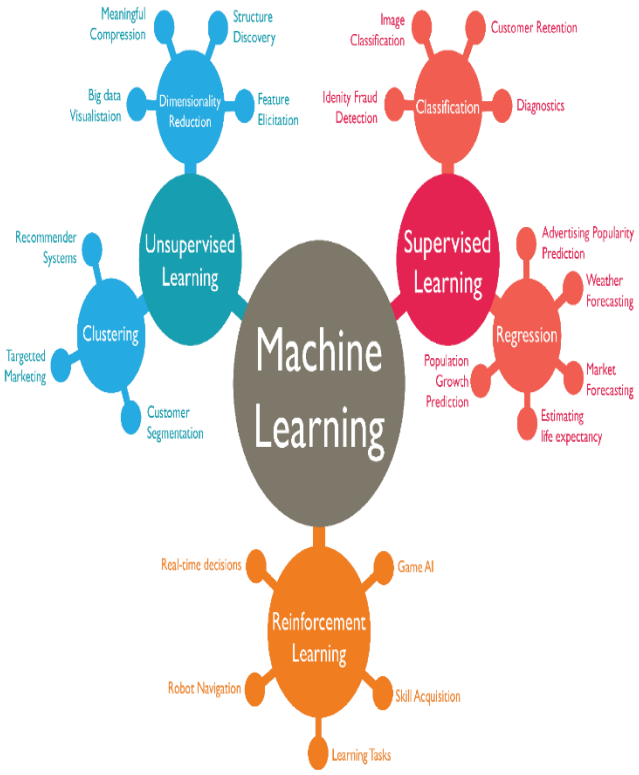

Fig2: Types of machine learning

A. Supervised Machine Learning

We understand supervised learning to be the process of a machine learning algorithm where a label has been placed on the training dataset and then the output is then learned. Currently, the labelled sample is a visualization of the number of inputs that are already differentiated with correct labels. These ML models are utilized when the desired output is given and the data is label according to it. For instance, the desired output could indicate its existence or absence of a condition, such as hypertension or diabetes. There are various algorithms used in supervised learning are as follow:

1) Linear regression: In this algorithm, the value of independent variable and value of dependent variable are dependent on each other. The model successfully forecasts the predicted variable (Y) from the predictor variable (X). Equation (a) represents the relation between predictor and predicted, numeric parameters, real, and continuous.

$$Y = mX + c. \quad (a)$$

where m represents the slope of line and c denotes the intercept. Eq. (a) state the relationship between independent and dependent parameters (X, Y) . This algorithm is used widely for health professionals and it is easy as compared to other ML algorithms.

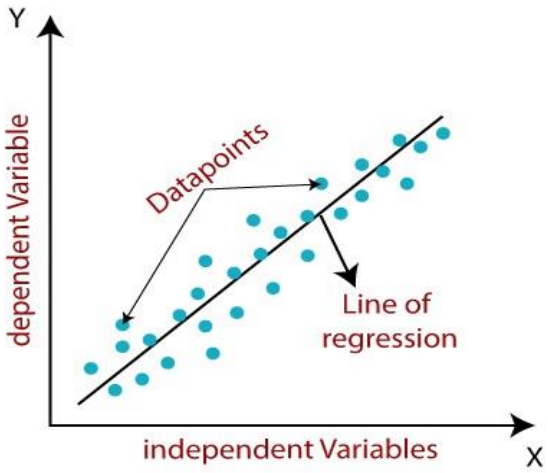

Fig 3: Linear regression

2) Logistic Regression: This algorithm is used to predict class labels. It is used to represent the relationship among various independent variables and categorical dependent variables. There are two possible cases for classification problems of logistic function which categorize labels into binary outcomes 0 and 1.

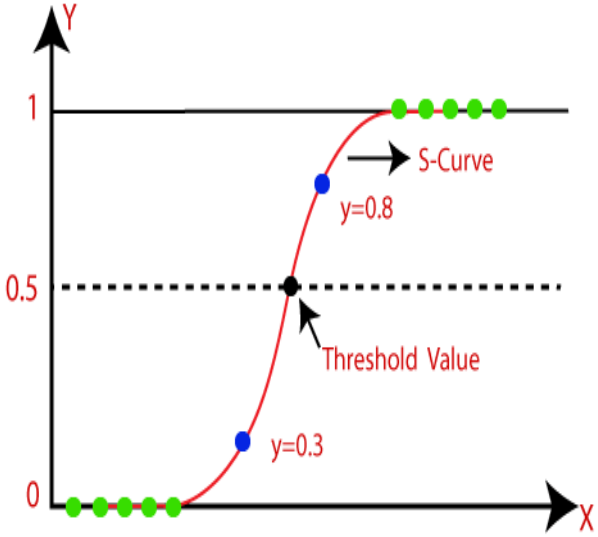

Fig 4: Representation of logistic regression

B. Unsupervised learning

This algorithm is a technique in which machines are made to learn and understand complex problems and patterns by itself without any Supervision. This algorithm is used when there is not any intuition of what to search in data and that data is not labelled. It is used as a human that thinks to learn by their own experiences to predict the output. It can automatically detect unusual outliers and patterns in the data, which may suggest the presence of uncured disorders or rare diseases. Unsupervised learning is categorised into two types: clustering and dimensionality reduction. There are various types of algorithms used in unsupervised learning are

1) K-mean clustering

It is an algorithm of unsupervised learning that deals with clustering problems. In this algorithm, the unlabelled dataset is grouped into different clusters. When a small k is chosen, it results in more compact clusters than hierarchical ones.

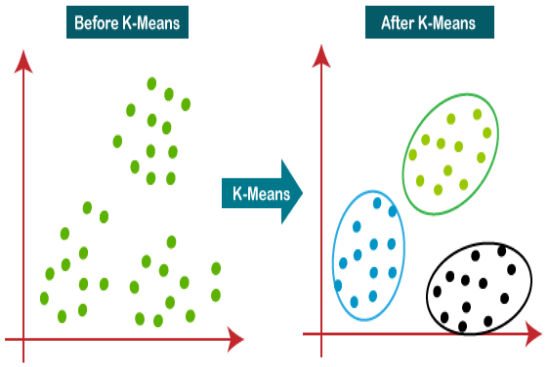

Fig 5: K-means clustering

2) Principle component analysis (PCA)

It is mainly used to decrease dimensions of data before applying classification algorithms. PCA is used to convert 2D data into 1D data. Principle component analysis is a technique of machine learning and dimensionality reduction used to convert a large dataset into smaller dataset and the patterns and trends of dataset remains same.

3) Apriori algorithm

Apriori algorithm was introduced by Agrawal and Srikant. This algorithm aims to depict the filter generation strategy. To efficiently determine item set associations, his technique employs a BFS (Breadth first search) technique and a Hash Tree technique. It is an iterative approach for extracting common item sets from a huge dataset.

C. Reinforcement Machine learning

This algorithm is different from both supervised and unsupervised learning methods. It is strongly tied to an algorithm that takes responsibility for the learning process and achieves a goal. It is a machine learning technique that trains software to make decisions that gives the precised results. There are various types of reinforcement machine learning are as follow:

1) Positive reinforcement

Positive reinforcement is a mechanism which an event that follows a particular behavior enhances

and repeats the behavior. Positive effects are observed in the agent's behavior, leading to a rise in its strength.

2) Negative reinforcement

When a behavior intensifies as a result of ceasing or avoiding an unpleasant condition, it is referred to as negative reinforcement. It may work better than positive reinforcement depending on the situation and behavior, but it only provides reinforcement for the very minimum of effort.

III. APPLICATION OF MACHINE LEARNING IN HEALTHCARE

A. Decision Support in clinical Systems in Healthcare

There are various methods used in ML to formulate a decision support system called CDSS (Clinical Decision Support System). Clinical Decision Support Systems (CDSS) apply machine learning techniques on large datasets to help healthcare practitioners understand test results.

B. Use in public health

Machine learning algorithms can predict healthcare outcomes at the population level using large datasets. Machine Learning algorithms are useful for huge datasets with non-linear relationships between outcomes and independent variables.

C. Identifying diseases and diagnosis

Pneumonia, Breast cancer, heart failure, and Alzheimer's disease are various disease that can be identified by machine learning.

D. Drugs discovery and manufacturing

Machine learning algorithms can anticipate the biological activity of chemicals, allowing scientists to concentrate their efforts on the most promising ones. Furthermore, these algorithms can find prospective medication candidates by examining chemical structures and characteristics.

E. Personalized medicine

Because of the outstanding performance of Machine Learning models when dealing with complex big data, the emergence of machine learning applications has resulted in substantial breakthroughs in the adoption of personalized medicine techniques for enhanced health care.

F. Smart health records

A smart health system that established the bridge among sensors that are mounted on the patients' bodies, intelligent houses, smart city infrastructure and devises is the most advanced link that makes it possible for them to send their responses during an emergency situation and alert the doctors, nurses or technicians.

G. Clinical trial and research

Automated technologies provide constant surveillance of patients in real time throughout clinical trials, providing vital information about their medical state and any serious effects. This approach improves patient security and enables rapid action, minimizing risks and optimizing study outcomes.

IV. Risks and Challenges in healthcare

Healthcare applications based on machine learning provide new and exciting prospects, but they also bring with them special risks, difficulties, and a healthy skepticism. Here, we discuss the main risk factors, including the possibility of a prediction error and its ramifications, the systems' security and privacy flaws, and even the lack of data availability required to provide consistent results. Some of the challenges contain ethical concerns, loss of the human touch in healthcare, as well as the techniques' interpretability and usefulness in a bedside context.

The main risk occur in healthcare of machine learning is the probability of error in diagnosis and prediction. This also gives rise to legitimate concerns regarding the reliability and validity of predictions produced by Machine Learning techniques.

The availability of high-quality training and testing data with sufficiently large sample numbers to guarantee high reliability and repeatability of the predictions is another issue connected with the implementation of Machine Learning algorithms to the healthcare industry. Moreover, compared to samples, data gathered from various healthcare segments are far more varied, imperfect, and possess a far higher number of features. When designing ML-based techniques and analyzing their outcomes, these difficulties need to be carefully considered.

Researchers using machine learning (ML) to healthcare may easily learn from the field of genetic engineering, which has seen a great deal of ethical discussion, when it comes to ethical issues.

Sometimes machines in health department are not properly working , due to this problem there will be risk in predicting the accurate disease. This problem may occur lots of problem with patient's health.

V. TECHNOLOGIES USED IN HEALTHCARE

Healthcare technology includes any technology including medical gadgets, blockchain, cloud computing, artificial intelligence (AI), and IT systems that are meant to help healthcare firms. There are many technologies which are used in the healthcare sector are given below

TABLE 1

Technologies	Advantages	Disadvantages
Convolutional neural networks (CNNs)	• CNNs are excellent in picture classification, object identification, and segmentation. • Convolution procedures aid in recognizing • picture pattern. CNN well manage visual noise, This makes them perfect for loud tasks extraction of automatic feature	• Large amount of • labelled data is needed. • Training requires long time. • Time consuming
Long short term memory	• Long-term dependencies are • represented by LSTM networks. It is good for noisy data.	• large dataset requires for train. • LSTM is expensive to train • Not always correct
Recurrent convolutional	• It is used for various tasks.	• Versatile in nature.
neural networks (RCNNs)	• Is used in speech recognition. • It is used in identify patterns	• Need large amount of training data
Support vector machine (SVM)	• It is easy to understand. • Quantity of is dimensions than greater of • quantity for specimens. It is used small	• It is not accepted large datasets • It is expensive • Difficult to find best

	handling datasets.	kernel
Robotic Surgery	• • Mostly precised outstanding • visualization Can perform surgery inside the body	• Cost is high • There is risk of nerve damage

6. CONCLUSION

AI machine learning application in healthcare forecasting may be a game changer regarding traditional healthcare service provision. In the field of health care, machine learning serves different roles including precision diagnostics, efficiency in decision-making processes, and automation of administrative processes. Besides, machine learning in health sector might also be not without problems like data privacy issues, ethical issues and the need of strict validation and regulation. Finally, to fully reap machine learning in medicine, one needs a deep insight into the intricate and shifting healthcare system, partnership of healthcare workers and data scientists and proper ethical and responsible use of machine learning for the sake of the patients.

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