Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 04, April-2021

# Reviewing Machine Learning Algorithms in the Domain of Healthcare

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***Abstract*:- Machine Learning (ML) is the area of computational science that focuses on analyzing and interpreting patterns and structures in data to enable learning, reasoning, and decision making outside of human interaction. It allows the user to feed a computer algorithm an immense amount of data and have the computer analyze and make data-driven recommendations and decisions based on the input data. If any corrections are identified, the algorithm can incorporate that information to improve its future decision making. Healthcare domain is one of the abundant upcoming areas of research in Machine learning where it plays a vital role in detection, diagnosis and decision making. The voice is part of the personality and character of almost every person. We can also understand diseases using voices because some diseases directly affect human voices.**

***Keywords: Machine learning algorithms, Supervised machine learning algorithm, Unsupervised machine learning algorithm, reinforcement machine learning algorithm, semi-supervised machine learning algorithm., deep learning, voice disorder, SVM, Deep Learning, RNN (Recurrent Neural network), CNN (Convolutional Neural Network)***

## INTRODUCTION

Machine Learning (ML) is the branch of Artificial Intelligence (AI) which is one of the broad areas of learning where machines emulate human abilities. Machine learning systems are trained to learn how to process and make use of data hence the combination of both technologies is also called Machine Intelligence. [1] Machine learning is one of efficient technology which is based on two terms namely testing and training i.e. systems that take training directly from data and experiences. Based on this training, the tests should be applied on different types of data and as per the required algorithm. . It will improve in performance as it gathers more experience by analyzing medical investigation reports of a wider population of patients. [2]

There are several application areas of machine learning which are developed by the many authors like the subsequent:

- Stock marketing
- Online fraud detection
- Traffic prediction
- Image recognition
- Speech recognition
- Self driving cars
- Email spam and malware filtering
- Virtual personal assistant
- Automatic language translation

Human lives are very much important in the world rather than any other things so healthcare is becoming far and wide and is helping patients and clinicians in many different ways. The most common uses of machine learning in the healthcare domain are automating medical billing, clinical decision support and the development of clinical care guidelines [2].In this paper we will focus on machine learning algorithms which are used in voice disorder detection.

## APPLICATIONS OF MACHINE LEARNING IN HEALTHCARE

Healthcare service providers generate a large amount of heterogeneous data and
information daily, making it difficult for the "traditional methods" to analyze and process it. ML/DL methods help to effectively analyze this data for actionable insights. Soon, it will be quite common to find ML-based applications embedded with real-time patient data available from different healthcare systems in multiple countries, thereby increasing the efficacy of new treatment options which were unavailable before. So here we are discussing some applications of machine learning.

1) **Applications of ML in Prognosis**: Prognosis is the process of predicting the expected development of a disease in clinical practice. It also includes identification of symptoms and signs related to a specific disease and whether they will become worse, improve, or remain stable over time and identification of potential associated health problems, complications, ability to perform routine activities, and the likelihood of survival. As in clinical setting, multi-modal patients' data is collected, e.g. phenotypic, genomic, proteomic, pathology tests results, and medical images etc. which can empower the ML models to facilitate disease prognosis, diagnosis and treatment.
[3]

2) **Applications of ML in Diagnosis:**
a) Electronic Health Records (EHRs): Hospitals and other healthcare service providers are producing a large collection of electronic health records (EHRs) on a daily basis and consist of structured and unstructured data that contains a complete medication history of patients. ML-based methods have been utilized for the extraction of clinical features for facilitating the diagnosis process [4]

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Vol. 10 Issue 04, April-2021

b) ML in Medical Image Analysis: In medical image analysis, ML techniques are used for efficient and effective extraction of information from medical images that are required use in different imaging modalities such as magnetic resonance imaging (MRI), computed tomography (CT), ultrasound, and positron emission tomography (PET) etc.

3) **Applications of ML in Clinical Workflows:**
a) Disease Prediction and Diagnosis: The early prediction and diagnosis of diseases from medical data are one of the exciting applications of ML.Various studies have highlighted the potential of using predictive healthcare for the timely treatment of diseases. For instance, the case of cardiovascular risk prediction using different ML algorithms with clinical data is studied in [5] and the study concluded that ML techniques improved the prediction efficacy. A survey of various ML techniques for the detection and diagnosis of different diseases (such as diabetes, dengue, hepatitis, heart, and liver) is presented. [6]

b) ML in Computer-Aided Detection or Diagnosis: The computer-aided detection (CADe) or computer-aided diagnosis (CADx) systems are being developed mainly for the automatic interpretation of medical images that would assist the radiologist in their clinical practice. The system works by utilizing different functionalities including ML/DL, traditional computer vision and image processing techniques and relies heavily on the performance of these techniques. IBM's Watson is a classical example of CADx system developed by integrating various techniques including ML. However, any task in medical image and signal analysis automated by the application of ML/DL models can be deemed as a CADe or CADx systems, e.g. automation detection of fatty liver in ultrasound kurtosis imaging. [7]

c) Clinical Reinforcement Learning: In reinforcement learning, the key objective is to learn a policy function for making precise decisions in an uncertain environment to maximize accumulated reward. In clinical medicine, RL can be used for providing optimal diagnosis and treatment for patients with distinct characteristics. [8] So above are the various applications in healthcare but in this paper we will be focusing on voice disorder application.

## MACHINE LEARNING CLASSIFIERS

In this topic we are discussing some of the
algorithms of machine learning, which are used to diagnose the different diseases.

## I. SUPERVISED LEARNING

Supervised learning can be defined as learning with the proper guide or you can say that Learning in the presence of a teacher .We have a training dataset which acts as the teacher for Prediction on the given dataset. That is for testing a data there is always a training dataset .Supervised learning is based on the "train me" concept. The input dataset is divided into train and test dataset. The train dataset has output variables which need to be predicted or classified.[9]
Supervised learning has following processes:
• Classification
• Random Forest
• Decision tree
To recognize patterns and measure the probability of uninterruptible outcomes is a Phenomenon of regression. Systems have ability to identify numbers, their values and grouping sense of numbers which means width and height etc.

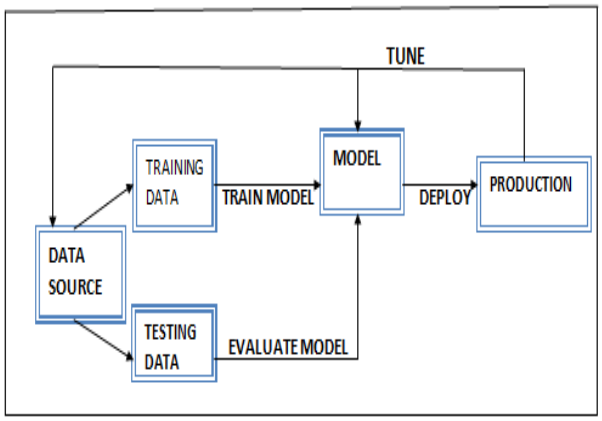


Fig 1: Supervised Learning Workflow

### A. Support Vector Machine:

SVMs use linear and nonlinear separating hyper-planes for data classification. However, since SVMs can only classify fixed length data vectors, this method cannot be readily applied to tasks involving variable length data classification. The variable length data has to be transformed to fixed length vectors before SVMs can be used. It is a generalized linear classifier with maximum-margin fitting functions. This fitting function provides regularization which helps the classifier generalize better. [10]

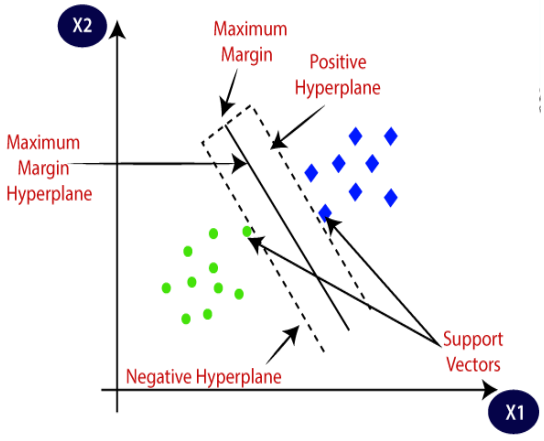


Fig 2: Support Vector Machine

## II. UNSUPERVISED LEARNING

Unsupervised learning can be defined as the learning without guidance. In Unsupervised learning when a dataset is given it automatically works on the dataset and finds the pattern and relationship between them and according to the

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 04, April-2021

created relationships, when new data is given it classifies them and stores them in one of them relations . Unsupervised learning is based on the "self sufficient" concept. [1]

## III. REINFORCEMENT LEARNING

Reinforcement learning is a suitable learning method because its goal is to find the optimum ways or methods to solve problems. After each iteration its knowledge will improve thus producing better problems solving. [9]

## IV. SEMI-SUPERVISED LEARNING

It is the method of identifying the best classifier from each unlabeled and labeled information. By using unlabeled information it transfers high performance of classification. The success of this method totally depends on a few underlying assumptions. [2]

Semi -supervised learning algorithms is a technique which combines the power of both Supervised and unsupervised learning. It can be fruit-full in those areas of machine learning and data mining where the unlabeled data is already present and getting the labeled data is a tedious process. [11]

## V. DEEP LEARNING

Deep learning is basically the intersection point between neural networks, graphical modeling, optimization, artificial intelligence, pattern recognition as well as signal processing there are many different deep learning algorithms, two of these popular algorithms are discussed below: [12]

- **CONVOLUTIONAL NEURAL NETWORKS (CNN)**

These networks are considered a type of discriminative deep architecture in which every model contains a convolutional layer and a pooling layer and are stacked on top of each other. [13] Many weights are shared in the convolutional layer, the pooling layer on the other hand sub-samples the output coming from the convolutional layer and decreases the data rate of the below layer. The weight sharing together with properly chosen pooling schemes, results in variance properties of the CNN. [14]

- **RECURRENT NEURAL NETWORK (RNN)**

Recurrent Neural Networks (RNNs) are considered as a class of deep networks for the use in unsupervised learning in the cases where the depth of the input data sequence can be as large as the length since RNNs allow parameter sharing through the different layers of the network.[15] The RNN is used mainly for the purpose of predicting the future data sequence through the use of previous data samples. The RNN is very prevailing when it comes to modeling sequence data such as speech or text. However, until recently, these networks were not widely used since they are considered hard to train such that it captures the long term dependencies. [16]

## CONCLUSION

The Voice disorder can have a significant unenthusiastic impact on the social and professional life of humans. Although such disorders are frequently underestimated, their early detection and accurate diagnosis are necessary to reduce serious consequences. This paper gives an overview of the various machine learning algorithms, including SVM, CNN etc which are used in voice disorder detection processes. Using these algorithms, users can make correct decisions using proper data. It is claimed by various authors that the deep learning method using CNN for the Voice Pathology Detection system achieves high prediction accuracy results about 90-95%and using SVM they can get even better results in voice disorder detection. The increasingly growing number of applications of machine learning in healthcare allows us to glimpse at a future where data, analysis, and innovation work hand-in-hand to help countless patients without them ever realizing it.

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