IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 10, Issue 5, May 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.165

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005020|

Support Vector Machines (SVMS) Based Advanced Healthcare System Using Machine Learning Techniques

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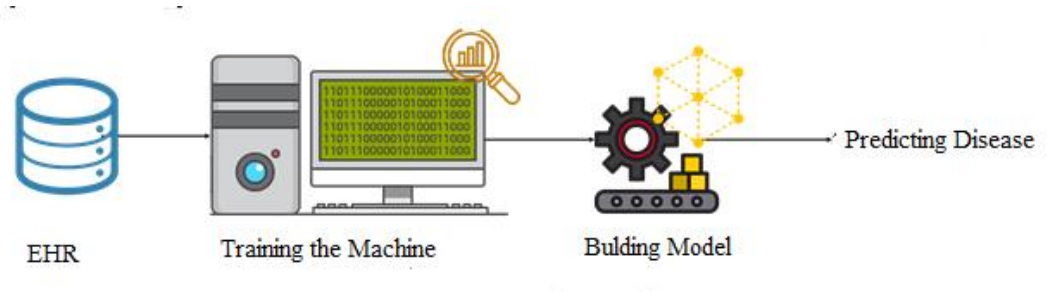
Abstract: Machine learning(ML) is currently a hot topic of conversation. A process known as machine learning is used to discover patterns and make decisions based on data that has been generated by an automated system. Precision medicine is now possible thanks to advances in machine learning technology. ML's contributions to the field of medicine have resulted in significant advancements. The goal of this study is to see if machine learning can be used to improve health care. Machine learning techniques such as support vector machines (SVM) were used in the course of our investigation (Support Vector Machine).

KEYWORDS: Machine Learning, Support Vector Machines (SVM); Healthcare System, Artificial Intelligence

I. INTRODUCTION

The healthcare industry is one of the most delicate, but also one of the most important, sectors of a country's economy[1]. People's lives are inextricably linked to this industry, and they rely on the efficiency of these healthcare organisations to address healthcare concerns and provide improved medical care[2]. The rapid increase of health-related data has created new potential for patients to improve their health[3]. Medicalimage registration, picture segmentation multimodal image fusion, image-guided therapy, computer-aided diagnosis, image annotation, and image database retrieval are all areas where machine learning is becoming increasingly important and where failure could be fatal[4].

ML is currently widely employed in the healthcare sector. In the traditional medical diagnostic procedure, a doctor's judgement is used to create a disease diagnosis. [5] Based on the patient's symptoms and his or her years of expertise, the doctor makes a diagnosis. Although this may lead to subjective judgement mistakes, practitioners can successfully apply machine learning (ML) classification technology to replicate decision-making abilities for illness diagnosis and decision-making. [6]



In many distant and underdeveloped part of the world, medical care facilities and medical assets are limited. Many patients miss out on the greatest chance to treat their condition due to a delay in medical care, resulting in more fatalities[7]. According to data, almost 1.2 billion people live in extreme poverty globally, with more than 2.2 billion people surviving on less than $1.25 per day. [8] Disease-related mortality is widespread in many parts of the world, including Africa and India. ML methods may be utilised to construct high-accuracy, low-cost automatic diagnostic apparatus, give high-quality diagnostic[9] and therapeutic solutions for underserved areas, and successfully tackle prevalent medical issues throughout the world under these conditions[10].

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II. LITERATURE SURVEY

Machine learning is a subfield of artificial intelligence that enables computers to model the relationship between a set of observables (data input) and a set of variables[11]. It is also abbreviated as "ML," which stands for "machine learning" (data output). This mathematical concept enables computers to automatically recognise patterns in large, complex datasets and generate predictions based on these patterns. This is made possible by the fact that computers can automatically recognise patterns. Pattern recognition software is utilised in order to accomplish this function. Instead of simply estimating and evaluating disease symptoms, machine learning focuses on the construction of automated clinical decision systems for the optimal treatment of infertility [12] and forecasting pregnancy outcomes to assist doctors in making decisions [13]. The production of a more accurate model typically necessitates the use of machine learning algorithms, which in turn call for a sizeable quantity of high-quality training data. The first step in putting machine learning into practise is collecting relevant data and storing it in a format that can be manipulated by the computer [14]. The results of the final analysis will not be convincing if there is insufficient information provided as input. Only between 59 and 68 percent of the time were machine learning models able to accurately predict the outcome of in vitro fertilisation (IVF) [15]. The two studies were carried out in a way that was methodologically sound; however, it is possible that the conclusions were hampered by poor datasets that were devoid of reliable predictors such as data on embryo implantation. This could have been the case. Making logical use of data in this era of big data presents both a challenge and an opportunity, and machine learning is going to become an extremely important instrument for clinical practitioners to have at their disposal. [16]

III. PROPOSED METHOD OF MACHINE LEARNING IN HEALTHCARE

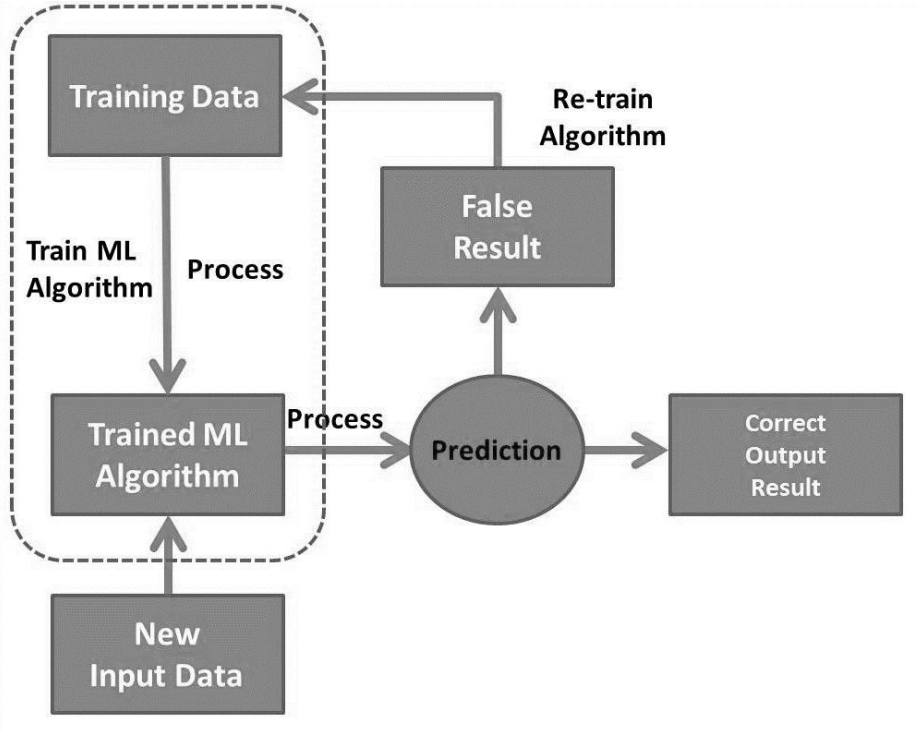

Fig . 1. Flow diagram of Proposed Architecture

Training phaseis the first step of the machine learning. ML structure created for the healthcare sector, or for medical treatments and care, require healthcare training data to be trained[17]. It is also impossible to train the Machine Learning model primarily through supervised machine learning without healthcare training data. Annotated images are also required by computer vision-based models in order to recognise things learned by methods[18]. Actually, finding high-quality medical data sets is difficult due to restricted access to patient data and healthcare data protection restrictions[19]. Most businesses have spent a significant amount of time and money developing data sets in-house or through third-party sources.Obtaining high-quality data sets is also aided by outsourcing training data for machine learning applications[20]. The quality and quantity of our training data have an impact on the accuracy and performance

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of our machine learning model. [21] If you utilised training data from 100 transactions, our model's performance would deteriorate in contrast to a model trained on 10,000 transactions. More is usually better when it comes to training data diversity and volume, as long as the data is properly categorized. [21]

1.1. Support Vector Machines (SVMs):

This method is the most widely utilised machine learning technique in the healthcare business. This method is a supervised classifier that has been shown to be quite helpful in tackling a variety of healthcare issues. The goal of SVM training is to discovery a hyperplane that splits the training data into two classes. Support vectors are a (typically limited) subset of vectors from the training set (TT) that specify its position (SVs). [22]Knowing which vectors are chosen as SVs makes the SVM decisions more understandable. Despite the fact that the hyperplane divides the data linearly, SVMs can be used to solve non-linear issues by translating the data into higher-dimensional spaces where they can be separated linearly—this mapping is accomplished using kernel functions.[23]

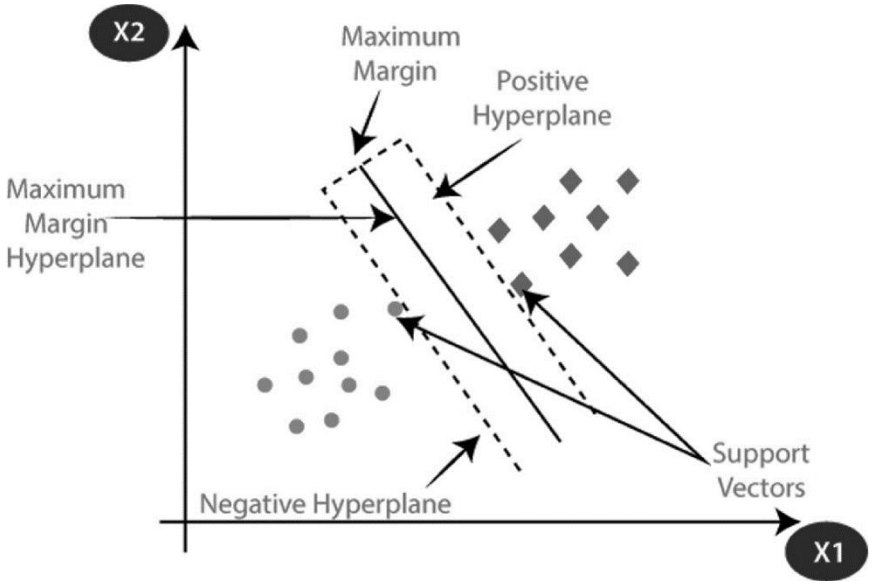

Fig.2. Support Vector graph

In clinical contexts, this technology has lately been utilised to improve procedures for detecting disorders. In bioinformatics, SVM has shown to be quite effective at solving classification difficulties.[24]

- Extracting features and labels from a dataset loaded from a file.
- Normalize the values after splitting a dataset into training and testing sections.
- Create and train a support vector machine.
- Using an SVM to make a medical diagnosis for a new patient.
- Assessing the SVM classifier's accuracy.

SVMs are one of the most well-known optimization-based supervised learning algorithms, having been designed for binary classification issues. The fundamental goal of SVM is to find a decision boundary with the greatest feasible margin between each class's data points.[25] When the data is vast, training nonlinear SVMs might take a long time. When model selection approaches are used, this problem becomes exceedingly sensitive. Humans are required to supply input and required output in supervised learning approaches, as well as provide feedback on the accuracy of the prediction during the training process.[26]

In Training Phase:, The train machine learning algorithm is the next phase. After you've chosen your data, you'll need to put the algorithms into action. Machine Learning in healthcare technology refers to algorithms that employ self-learning neural networks to enhance treatment quality by analysing external data such a patient's condition, CT scans, X-rays, and a variety of screenings and tests. [27]Deep learning is also increasingly being used to detect cancer cells, which is worth highlighting. To "memorise" the appearance of cancer cells, the model is shown a multiplicity of cancer cell pictures. [28]

Test data is data that has been explicitly identified for use in testing, generally of a computer programme. [20] Some data can be used to verify that a particular set of inputs to a function produces the expected output. [29]

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1.2. **Machine learning's advantages in healthcare**

One of the most important applications of ML in healthcare is its ability to discover and detect illnesses and symptoms that are otherwise difficult to diagnose.[30] This can range from cancers that are difficult to diagnose in their early stages to other inherited diseases. IBM Watson Genomics is only one of the many examples of how combining cognitive computing with a genome-based tumour sequencing may help generate a rapid diagnosis.

a. Medical Imaging Diagnosis [31]

Combining ML and deep learning in health care has resulted in the innovative approach known as Computer Vision. Microsoft's InnerEye project, which focuses on image diagnostic tools for image analysis, has been one of the most passionate sponsors.[40] As machine learning becomes more accessible and their explanatory power develops, expect to see additional data sources from a wide range of medical imaging becoming a part of an AI-driven diagnosis process.

b. Drug Discovery and Manufacturing [32]

One of the most important therapeutic benefits of machine learning in healthcare is the early-stage drug development process. This includes research and development technologies like as next-generation sequencing and precision medicine, which can help in the identification of novel treatment options for difficult disorders. [23] Unsupervised learning, which finds patterns in data without making predictions, has become one of the most useful machine learning approaches. Microsoft's Project Hanover is using Machine Learning-based technologies for a number of projects, including AI-based cancer therapy and personalising drug combinations for Acute Myeloid Leukemia. [24]

c. Personalized Medicine

When integrated with predictive analytics, machine learning in health care assists in the development of tailored treatments that are not only more efficient and effective, but also ripe for further study and improved illness evaluation. Physicians are now limited to a few numbers of diagnoses or even omitting potential risks to the patient based on his clinical history and available genetic data. [26]

However, machine learning in medicine is progressing rapidly, and IBM Watson Oncology is at the forefront of this trend, using the patient's medical history to assist produce multiple therapy alternatives. A variety of biosensors and devices with advanced health monitoring capabilities are expected to join the market in the next years, allowing additional data to be made available for some of the most cutting-edge Machine Learning-based healthcare solutions.[27]

d. Behavioral modification based on machine learning

Since the increasing application of machine learning in healthcare, a host of new enterprises have developed in the sectors of cancer prevention and diagnosis, patient treatment, and so on. Somatix is a B2B2C data analytics company that has produced machine learning-based applications that recognise the motions we use and make in our daily lives, allowing us to better understand our unconscious behaviour and make necessary changes. [28]

e. The Use of Machine Learning in Healthcare

At this time, we can identify at least seven critical areas in healthcare where machine learning technology can make a major difference. In general, the goal is to increase the speed of physicians' work while also improving its accuracy.[29]

1.3. MORE ACCURATE DIAGNOSIS

Many countries are currently dealing with an overburdened healthcare system and a scarcity of experienced physicians. Machine learning comes to the rescue, however it won't be able to completely address the problem. Scientists have been working on machine learning models to predict illness susceptibility or aid in early diagnosis for several years.

For example, MIT's Computer Science and Artificial Intelligence Lab announced in mid-2019 that it has built a novel deep learning-based prediction model that can anticipate the onset of breast cancer up to five years in advance[30]. Advanced prediction models can anticipate which diseases and illnesses a patient is likely to contract based on past data.[31]

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1.4. MEDICAL IMAGING

We wrote a whole post about this machine learning application in healthcare back in 2019. Did you know that the largest data source in the healthcare industry is medical images? Medical photographs, according to IBM, account for at least 90% of all medical data!. The issue is that these images must be taken, stored, and analysed in order to detect cancer cells and other abnormal changes in healthy tissues.

This is where artificial intelligence (AI) comes into play. After initial training (in which you must teach the ML algorithm which tissues are healthy and which are diseased), machine learning algorithms may detect diseased tissues at a rate unattainable by humans. Like an expert physician, machine learning algorithms can evaluate imaging data. They are capable of detecting abnormal skin patches, lesions, cancers, and brain bleeding.They never get weary, they don't need to go to the doctor, and they can work all year round. As a result, ML-powered medical imaging is a huge step forward in healthcare. Physicians don't have to spend hundreds of hours analysing medical photos using this solution. They don't have to do anything since the algorithms do it for them.Someone could wonder why it isn't a typical solution all around the world at this time. To learn more, we recommend reading our page on medical imaging. We can only conclude that healthcare data remains exceedingly varied and incomplete at this time. It's difficult to train a good machine learning model with such a diverse dataset.PathAI is a Massachusetts-based startup. Their technology uses machine learning to assist pathologists in making more accurate diagnosis and identifying individuals who might benefit from new treatments or therapies.Stanford University has developed a skin cancer diagnostic system. They built a library of approximately 130,000 photos of skin diseases and used it to train their algorithm to detect cancer. Their algorithm matched the dermatologists' performance.[32]

IV. HEALTHCARE PATIENT DATABASE MANAGEMENT

We discussed the topic of healthcare data quality in the medical imaging section. It's a serious issue that's preventing this field from progressing. To get beyond this stumbling block, we'll need to build a centralised, high-quality patient database. Only then could a machine learning system capable of analysing patient data on a worldwide scale be developed, resulting in more accurate results and diagnoses.

What we require is an AI-enabled patient data platform that can link to and analyse data from a variety of patient databases. It would be a watershed moment for the healthcare business. Unfortunately, it has yet to arrive.Many firms are working on ML-aided patient databases, including Quotient Health in Denver, Colorado. Quotient Health develops a solution that can optimise and standardise the way EMRs (Electronic Medical Records) are constructed using deep learning.[33]

4.1. PERSONALIZED MEDICINE WITH MACHINE LEARNING

To achieve completely individualised therapy, massive volumes of data on each patient are required. We are making progress in this direction. Collecting patient data is now considerably more efficient thanks to healthcare electronic data records. It's a lot easier to locate the optimal treatment for a patient with such information. Machine learning (aided by big data) aids in the collection of demographic and medical data about each patient, including:

- ✓ Lab tests and clinical data
- ✓ Genetic data
- ✓ Lifestyle data
- ✓ Past diagnoses
- ✓ Medical conditions
- ✓ Treatment history
- ✓ Clinical data of family members, and so on.

Furthermore, machine learning can aid in the forecast of illness occurrences or the detection of patterns that lead to improved societal health and lifestyles.[34]Clinicians can use IBM Watson Oncology to assist them think about personalised cancer therapy choices for their patients. IBM's technology analyses data from each patient's medical record and offers treatment alternatives rated by confidence level.[35]One of the companies that has partnered with IBM is Pfizer. Pfizer employs machine learning for immuno-oncology studies regarding how the body's immune system can fight cancer with the help of IBM's Watson AI platform.[36]

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V. CONCLUSION

Machine learning is becoming one of the quickest-growing technologies. It has a variety of applications in our daily lives. This research teaches us about the foundations of machine learning, its methodology, and machine learning applications in the medical field. Healthcare is an area where most of the aspects of machine learning can be employed because they are so closely related.In this work, researchers looked at research papers on machine learning algorithms utilised in healthcare applications. In their healthcare prediction study, the majority of researchers use Support Vector Machine as machine learning classification algorithms, and they are the most accurate algorithms. Machine learning has practically infinite applications in the healthcare and medical areas. Machine learning is assisting in the mapping and treatment of diseases by assisting in the speeding up administrative activities, diagnosing diseases, prognosticating diseases, creating treatment schedules, and customising medical treatments in healthcare. In the future, more advanced Machine Learning algorithms concentrating on early disease detection, diagnosis, and prognosis may be created.

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|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005020|

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| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

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INNO SPACE
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