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Examination of Machine Learning Algorithms in Diagnosis of Neurological and Mental Diseases

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A B S T R A C T

Mental health conditions, including anxiety, represent major challenges on a global scale. These illnesses encompass a range of conditions that disrupt thought patterns and behavior, often leading to significant discomfort or disability for those affected. the field of data mining has gained prominence in medicine, offering innovative tools to uncover hidden insights and enhance disease classification, particularly in mental health. This analytical method is essential for uncovering valuable patterns in large datasets, enabling better understanding and diagnosis of complex disorders. The purpose of this article is to investigate neurological and mental diseases using machine learning algorithms and to identify the most used algorithm in each disease. The method used in this article is machine learning algorithms and it is the most widely used and most important algorithm in each of the neurological and mental diseases. The results show that the SVM algorithm emerged as the most frequently employed method, followed closely by random forest and decision tree algorithms. These techniques demonstrate the growing importance of machine learning in enhancing diagnostic capabilities and deepening our understanding of mental health disorders. This research focuses on utilizing machine learning techniques to assist in diagnosing neurological and mental health conditions. By analyzing studies conducted between 2005 and 2024, the review evaluates conditions such as schizophrenia, depression, bipolar disorder and Alzheimer. A total of 50 studies were selected based on their relevance to machine learning applications in this domain.

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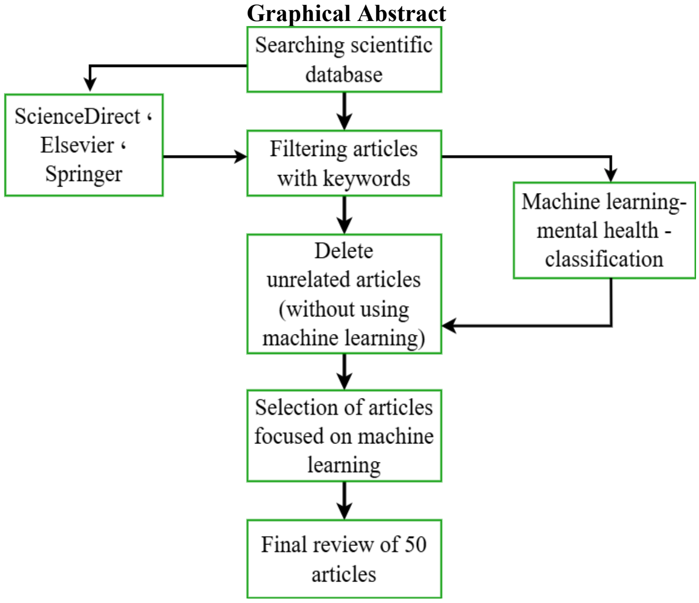
Graphical Abstract



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1. INTRODUCTION

Today, a significant portion of data is stored in databases. Globally, mental illness accounts for 14% of the overall disease burden, with 75% of affected individuals residing in low-income countries. This encompasses a wide range of diagnoses, from common conditions like anxiety and substance abuse to severe disorders such as psychosis (1).

The global cost of mental health treatment is around 2-3 trillion dollars, driven by traditional management methods. However, by enhancing the quality of treatments, these costs could be greatly reduced. One way to improve treatment quality is by incorporating data mining tools and techniques into mental health care (2).

In the last two decades, the use of data mining techniques has been growing steadily across various fields. In medicine, data mining is becoming increasingly important, helping not only with targeted advertising but also offering valuable insights into different types of diseases, particularly in mental health (3).

Data analysis uncovers hidden patterns and insights, enabling valuable knowledge extraction (4).

The mental health of a person is important issue as it shows the overall nature of the person. The cause of mental illness is chemical abnormalities in the brain (5). An important global public health challenge is mental health problems (6).

Most people have stress and some develop depression (7). Mental health refers to an individual's emotional, mental, and social health. It can be impacted by various factors that negatively affect the individual (8).

Artificial Intelligence (AI) and Machine learning (ML) have been expediting rapidly in the medical field since the appearance of modern computers. With advances in computing power and increasing medical intricacy, both AI and medicine have increasingly intersected, fostering collaboration between the two fields with untapped potential. improvement in artificial intelligence and machine learning change Our capability to examine and handle vast volumes of data and anticipate results in medical research and healthcare provision (9). Machine learning is a subset of AI focused on three main tasks: clustering, regression, and classification. It leverages data and algorithms to replicate human learning processes and progressively enhance accuracy in different tasks (8).

ML is the method of automating the detection of shifts in data patterns using a trained algorithm. Data is essential for training effective learning models, as it forms schema that guide the creation of algorithms, which are then used for making future predictions. The distinct characteristics of each dataset create the distinguishing elements of the template formed, which in turn influence the learning algorithm. The data can be split into a training set and a testing set for evaluation purposes. First a ML algorithm is selected and taught with the data of the training set with the specific physiognomy gathered (10).

This study highlights the value of ML in understanding mental health issues, but it also points out that deep learning methods offer even more potential. Deep learning could help not only predict mental health disorders but also diagnose multiple conditions at once. When applied to visual data, deep learning techniques can be particularly useful in identifying mental health problems. The study also emphasizes the effectiveness of using additional methods, like sensors, to assess patients' mental states. However, it is serious to note that different data processing techniques can impact the resolution of these models. Therefore, researchers should explore various ML and DL come closes to find the most accurate solutions.

In 2019, the WHO reported that depression were the most prevalent psychic health disorders, affecting 970 million people globally. The COVID-19 pandemic, starting in 2020, further highlighted the critical need for access to mental health care. Unfortunately, many individuals still lack access to necessary treatment and face challenges such as discrimination, stigma, and human rights violations in the process (11). Data mining includes automated learning algorithms for learning extracting and identifying useful information from big data (12). This organization describe intellectual health as a state of well-being where an exclusive recognizes their ability to cope with life's challenges, work productively, and actively engage in their community. The WHO has determined "mental health" as a singular situation that can manage their stress in life matching to their potency and can yet work normally and constructively (13).

It is very important to identify the early signs of mental health disorders that are indicated by a particular person so that their development can be monitored. In some cases, this can have a remarkable impact even saving a person's life (14).

Mental health problems need to be diagnosed early and addressed. Early diagnosis, stringent distinction and effective therapy can alleviate the pain and enduring of public intercourse with mental health issues. The complications of mental illness can be drastic on dude and their household and throughout society (15).

Bipolar disorder is a mental health estate that motive severe mood vibration. Anxiety is characterized by excessive feelings of stew and horror. Depression is a medical condition that has a wide and negative impact on a person's feelings, thoughts and actions. PTSD is a mental illness that occurs after a traumatic, frightening or dangerous event. Finally, ADHD is a mental illness that affects how people focus and regulate their behavior (6).

The aim of this study is to check machine learning in the diagnosis of mental illnesses that are associated with the diagnosis of diseases such as schizophrenia, depression, Alzheimer's, bipolar disorder, ADHD, PTSD, anorexia nervosa and introduces the best machine learning algorithms for these diseases.

Below, the chapter is organized as pursue: in the second part of this article, a review of the literature is said. In the third part of the paper, the model and methodology were discussed. The fourth part of the article analyzes the graphs. In the fifth section, the discussion is expressed. In Part Six, the conclusion of this article is stated, and in part Seven, future proposals and work are mentioned.

2. LITERATURE REVIEW

2. 1. Data Mining and Machine Learning Data mining emerged in the 1990s, big steps were taken in this branch of knowledge. Data mining is specified as a procedure for discovery patterns and communications in databases along with using information to build predictive models and is also referred to as a process for selecting tracking and building models using stacks of stored data to discover pre-existing samples (16).

A strong implement that is appropriate for fetching formerly unknown patterns and useful information from big data sets (17). The term knowledge discovery in databases is generally used to refer to the general method of useful scholarship intuition of data that data mining is an important scale in this process. Other steps in the process of knowledge demodulation in databases such as data preparation data selection data cleaning and a proper understanding of the data mining process allow the information that is useful to us to be extracted from the data (18).

Knowledge discovery in the database has the following iterative steps:

- Data cleansing: it is a critical step in the KDD process that eliminates noise, errors, and inconsistencies from datasets. It involves removing outliers, handling missing data through techniques like imputation or deletion, and resolving formatting discrepancies to ensure data reliability. This step prepares the dataset for accurate and effective analysis.
- Data integration: merges data from various sources, such as databases and APIs, into a unified dataset by resolving conflicts like differing units or overlaps. This creates a cohesive dataset, enabling more accurate analysis and results (19).
- Data election: data associated with the analysis are resumed from the database.
- Data conversion, or transformation: prepares data for analysis by formatting it appropriately. Key steps include normalization to scale numerical values, encoding to convert categorical data into numerical forms, and aggregation to summarize data at higher levels. These processes ensure compatibility with data mining methods (19).
- Data mining: the main part of the process is that, using specific methods and techniques, knowledge patterns are extracted from the data.
- Pattern evaluation: to determine the correct and desired patterns by measuring criteria (19).

Building a data mining model is a repetitive and dynamic process. If the data was not enough to build the right model, more data will be added. Each step may be repeated several times to make a good model (20).

2. 2. The Main Algorithms of Data Mining The main data mining methods and algorithms fall into two classifications: descriptive (or unsupervised learning) and predictive (or supervised learning) (3).

Descriptive data mining methods: Descriptive data mining relies on unsupervised learning techniques, where data is analyzed without predefined labels. This approach involves identifying patterns or grouping similar items into clusters. Among the various aspects of unsupervised learning, clustering is often the primary focus for researchers due to its widespread applications (21, 22).

Clustering: Data is often untagged. Therefore, the label for each specimen for the clustering algorithm is not specified. The key distinction between supervised and unsupervised learning lies in the presence of labeled data. Clustering, a fundamental aspect of unsupervised learning, involves measuring distances to group similar samples together. Based on these distance calculations, samples are assigned to specific clusters, reflecting their relative similarity (23). Clustering, also called cluster analysis. Unsupervised machine learning techniques focus on identifying relationships and organizing similar data points into groups or clusters without the use of labeled data (24).

Association rules: These types of algorithms are used to analyze a store's shopping cart and look for a connection between features in the dataset. The associative rules technique explores new relationships between variables in a database and focuses on finding frequent patterns among a set of items (4).

Predictive data mining methods: The learning method is supervised. Supervised learning is one of the machine learning approaches in which, a computer algorithm labels input data to obtain a specified result and teaches the model based on them. Supervised learning algorithms operate on datasets where the class attribute values are predefined. This type of data, known as labeled or training data, provides the algorithm with examples to learn from before making predictions (21). Supervised learning can be divided into two general subgroups regression and classification.

Classification: A function of learning the primary data is divided into two datasets, the experimental dataset and the educational dataset. the goal of the classification algorithm is to find the order in different labels based on other characteristics of the samples. In the classification, the class attribute values are discrete. The aim is to decipher patterns or characteristics that can be used to sort data points into different categories or groups based on their attributes (23).

Some examples of classification methods include (23):

- Naïve Bayes (NB)
- Decision Tree (DT)
- Support vector Machine (SVM)
- Nearest neighbors (K-Nearest Neighbor)
- Artificial Neural Networks (ANN)
- Random Forest (RF)

Naïve Bayes:
This algorithm operates under the assumption that all features are independent of each other, which simplifies the computation. Its main strength lies in its simplicity and speed, making it well-suited for applications involving large datasets. Naïve Bayes is particularly effective for text classification tasks such as spam detection and sentiment analysis due to its ability to handle categorical and continuous data. However, the assumption of feature independence can sometimes lead to reduced accuracy when features are highly correlated. Despite this, its ease of implementation and low computational cost make it a popular choice for many machine learning applications (23).

Decision Tree:
Decision trees are constructed using training datasets, where each internal node represents an attribute, and branches signify the possible values that attribute can take. The terminal nodes, or leaves, represent class labels. One of the most significant advantages of decision trees is their interpretability, as the decision process is visually represented. They can handle both categorical and numerical data and are robust to outliers. Additionally, decision trees can perform feature selection implicitly, reducing the need for extensive data preprocessing. However, decision trees are prone to overfitting, particularly with small datasets, and may require pruning or ensemble techniques like random forests to improve generalization (22).

Support Vector Machine:
It is a robust classification algorithm designed to find the optimal hyperplane that separates data points into different classes with the maximum margin. It is particularly effective in handling high-dimensional datasets and can utilize kernel functions to manage nonlinear data separations. The algorithm's strength lies in its theoretical foundation based on structural risk minimization, which reduces the likelihood of overfitting. SVM also adapts dynamically to incorporate new data during training. However, its high computational cost and memory usage can become bottlenecks, especially with large datasets. Despite these challenges, SVM's ability to deliver high accuracy makes it a preferred choice for many applications, including image recognition, bioinformatics, and text classification (23).

Nearest Neighbors (K-Nearest Neighbor):
This algorithm is an instance-based learning method that classifies a data point based on the majority vote of its k nearest neighbors in the feature space. It relies on similarity measures, such as Euclidean or Manhattan distance, to evaluate proximity. KNN is simple to implement and adaptable to various problems, making it ideal for smaller datasets with a clear structure. However, its performance can degrade with large datasets or high-dimensional feature spaces (the curse of dimensionality). It also requires substantial memory for storing training data and is computationally expensive during the prediction phase. Parallel processing can address some of these challenges, further enhancing its scalability (23).

Artificial Neural Networks:
ANNs are inspired by the structure of the human brain, consisting of layers of interconnected neurons. They are highly flexible and can model complex relationships in data, making them suitable for tasks like image and speech recognition. The network architecture typically includes an input layer, one or more hidden layers, and an output layer, with each layer containing multiple neurons. The hidden layers capture intricate patterns and nonlinearities in the data. However, determining the optimal number of neurons and layers often requires experimentation and computational resources. ANNs are prone to overfitting if not carefully regularized and require substantial training data to achieve high performance (25).

Random Forest:
It is an ensemble learning method that combines the outputs of multiple DT to improve prediction accuracy and robustness. Each tree is trained on a random subset of the data, and the final classification is determined by majority voting among the trees. This approach reduces overfitting, which is a common issue in individual decision trees, and enhances generalization. Random Forest is versatile and can handle both classification and regression tasks effectively. It is also robust to noise and missing data. However, the computational cost can be high due to the large number of trees required for optimal performance. RF has been widely adopted in various domains, including finance, healthcare, and environmental modeling (5, 26, 27).

2. 3. Evaluation The performance of data mining algorithms is often measured using a confusing Matrix. The entanglement matrix contains valuable information about the real and predicted classifications by the classification model. Based on the information obtained from this matrix, appropriate comparison indicators are calculated. There are various indicators such as

transparency, sensitivity, accuracy and precision to evaluate classification methods (28, 29).
Positive True (TP): Real positive rate
Negative True (TN): Real negative rate
False Positive (FP): False positive rate
False Negative (FN): False negative rate

$$Accurecy = \frac{TP+TN}{TP+FP+TN+FN} \quad (1)$$

$$Percision = \frac{TP}{TP+FP} \quad (2)$$

$$Sensitivity = \frac{TP}{TP+FN} \quad (3)$$

$$Specificity = \frac{TN}{FP+TN} \quad (4)$$

Table 1 summarized the peer-reviewed articles on the classification of data mining algorithms. Table 1 listed articles whose content is mostly data mining and ML. In this table, the title of the articles along with the name of authors are given. Techniques and tools in each of the articles used are stated and their findings were briefly expressed.

In this section, articles are categorized by type of disease and described in four categories for schizophrenia, bipolar disorder, depression, and anxiety disorders.

TABLE 1. Articles reviewed in the field of classification of data mining algorithm

Authors	Journal	Techniques and tools	Target	Results
Balibo (16)	Idea Group Inc (IGI)	Data mining methods	-	Using data mining methods in knowledge management
Gandecha & Liu (21)	Tutorials in operation research	Data mining methods	-	The impact of data mining methods in social media
Pirouz Nia et al. (12)	Psychiatric Genetics	Bayes networks, support vector machine, random forest, logistic regression, multigene scoring approach	Bipolar Disorder	Bayes networks performed best, but none were significantly better than the multigene scoring approach.
Deziel et al. (27)	Educational Data Mining	Classification and regression algorithms	-	Analysis of mental health Students using classification and regression algorithms
Tomar & Agarwal (17)	International Journal of Bio-Science and Bio-Technology	Data mining and classification methods	-	Examining the concept of data mining and introducing its algorithms
Zafarani (22)	Social Media Mining	Data mining, classification and forecasting methods	-	Using data mining methods and classification algorithms
Atai Mukhtar et al. (18)	Scientific Research Journal of Artificial Intelligence	Data mining, classification and forecasting methods	-	Data analysis to discover patterns and relationships in medical data
Vanaja & Rameshkumar (20)	Journal of Computer Science	Classification methods in medical diagnosis	-	Classification algorithms have a good performance in diagnosing diseases.
Joseph et al. (23)	International journal of computer and technology	Bayes, SVM, DT, KNN	-	Examining the concept of data mining and summarizing weaknesses
Srinivasan et al. (25)	International Journal of Computer Applications	ANN	Parkinson's	Parkinson's disease was diagnosed using ANN
Weise et al. (19)	National congress of innovative research developments in electrical and computer engineering	Fuzzy logic and data mining	-	To show and identify ambiguous patterns in data
Ghorbani & Ghouse	International Journal of Data and Network Science	Supervised and unsupervised algorithms	-	Data mining in healthcare and identifying the most efficient data mining methods used for medical diagnosis purposes
Feczko & Fair (24)	Elsevier Biological psychiatry	Data mining methods	-	Evaluation of challenges and methods of data mining algorithms
Prakash & Kumar (29)	Journal of Information and Communication Technology	Classification algorithms	-	Explanation on how to evaluate the classification method

2. 4. Schizophrenia Schizophrenia is a profound mental condition that affects an individual's ability to accurately perceive reality, causing them to experience distorted thoughts, perceptions, and interpretations of their surroundings. According to a report by WHO, about 1 in 300 people globally are affected by this condition. Additionally, individuals with schizophrenia are at a significantly higher risk of early death. They face to a significantly higher risk of death, with their likelihood of dying being two to three times greater, largely due to their increased vulnerability to conditions such as heart disease and infections (8).

Schizophrenia is one of the most common severe mental disturbances, but its underlying nature has not yet been clarified, and for this reason it is sometimes called a syndrome. Schizophrenia usually begins before the age of 25, remains stable for the rest of its life, and none of the social classes are immune from it. The prevalence of schizophrenia is equal in men and women but the onset and course of the disease differ in two sexes and schizophrenia in men begins earlier than in women.

One study classified schizophrenia by analyzing free speech, either written or spoken, from psychiatric patients. In this study, researchers compared the performance of surveillance algorithms, specifically the SVM and DT, across a group of schizophrenia patients and control subjects. The SVM achieved 77% accuracy, while the decision tree slightly outperformed it with 78%. However, when patients with mania were added to the group, the models struggled to differentiate between those with schizophrenia and those with mania (30).

The disease is marked by a range of symptoms, including intellectual difficulties, delusions, emotional numbness, hallucinations, changes in willpower, and cognitive impairments (31). The authors analyzed a predictive system for the preventive diagnosis of schizophrenia using ANN, RF, SVM, and Bayes method. Results using random forest, support vector machine and Bayes method showed the highest accuracy of 90.69% (32). In the study, there were 5,968 cases involving patients with schizophrenia (3,002 patients) and 5,916 cases involving individuals with other mental health disorders (3,931 patients). The findings suggest that using the random forest method, the best model achieved an accuracy rate of 72.7% (33).

In a survey, 1,243 articles were retrieved through database search, 15 of which were reviewed based on full-text evaluation. Machine learning techniques were used to foretell schizophrenia. The main algorithms applied were SVM (10 studies), RF (5 studies) and gradient reinforcement (3 studies). Random forest algorithms showed greater accuracy and sensitivity to support vector machine and gradient reinforcement. gradient reinforcement showed a feature significantly higher than the random support vector machine and forest (34). In a study involving 345 participants, the researchers created a clinical prediction model to identify schizophrenia patients at risk of suicide attempts, as well as those who are not. The results revealed that the SVM classifier model and regular logistic regression provided the best performance, with an accuracy of 67% (35).

In another study, an automatic detection method for schizophrenia was developed to help diagnose the condition using objective biological indicators derived from eye movement patterns during reading tasks. The proposed system focuses on abnormal eye movements observed in schizophrenic patients and consists of three main components: extracting valid reading state trajectories, tracking eye movement trajectories, and constructing models based on detected abnormalities. The reading state extraction algorithm divides the reading process into valid and invalid states based on visual perception. Eye movement trajectories are captured using a novel eye center positioning algorithm during the valid reading state. These extracted eye movements are then analyzed across three abnormal aspects: merged eye-head movement, relative eye movement, and overall reading performance.

Using a dataset of 40 participants (20 schizophrenic patients and 20 healthy controls), the models built from these features were tested with classifiers like support vector machine (SVM), random forest, and adaptive boosting. The results indicated that the automatic detection method achieved an impressive accuracy of 96.25%. This high accuracy suggests that the approach has significant potential as a computer-aided diagnostic tool for schizophrenia, offering an innovative and objective method for early detection and clinical support (36).

2. 5. Depression Depression, also known as major depressive disorder, is a prevalent mental health condition that is often diagnosed through a patient's responses to a health questionnaire or clinical assessment. It is marked by ongoing feelings of sadness and a loss of interest in everyday activities, often interfering with a person's ability to manage daily responsibilities and maintain a normal routine (37).

A study revealed that 34% of teenagers aged 10 to 19 are susceptible to experiencing clinical depression, a rate higher than that seen in individuals aged 18 to 25. The research also found that the highest spread of depressive symptoms is in regions like the Middle East, Africa, and Asia (38).

Anxiety and depression are major global health challenges that affect individuals of all ages and backgrounds. These disorders impact children, adults, and the elderly alike, with no distinction between men and women, highlighting their widespread and universal nature (5).

However, it has been reported that teenage girls experience depressive symptoms more frequently than teenage boys. Without proper treatment, depression can escalate, potentially resulting in suicidal thoughts and actions (39).

Predicting anxiety is one of the most challenging aspects of mental health diagnosis, mainly due to its similarities with major depressive disorder within the clinical context (40). In a study, machine learning techniques were applied to predict depression in elderly sick. A total of ten classifiers were evaluated using a selected set of features, with the Random Forest model achieving the highest accuracy of 89% (41).

Stress-related disorders have been on the rise, prompting the need for scalable identification methods. proposed leveraging large language models (LLMs), particularly GPT-3 embeddings, combined with machine learning (ML) algorithms to classify social media posts indicative of stress disorders. Their approach transformed posts into semantic vector representations and trained models, such as support vector machines and neural networks, on a labeled dataset of over 10,000 posts. The best-performing model, a support vector machine, achieved 83% accuracy, showcasing the potential for preliminary screening of stress using online data (42).

At the same time, used the Hospital Depression Scale to predict depression in seafarers. Five machine learning classifiers were evaluated, and Cat Boost outperformed the others, achieving a precision of 84.1%and an accuracy of 82.6%. This outperformed RF model, which achieved an accuracy and precision of 81.2% (43).

In a study, using an artificial neural network based on ten variables, common symptoms of depression such as discomfort, weight loss, insomnia, and so on. They diagnosed the presence or absence of depression with an error of 0.11. The low number of variables for modeling was one of the disadvantages of this method (44).

Figure 1 shows the application of data mining techniques and algorithms; it is also shown that the SVM which is the most used with 45.45%, followed by the biz method with 36.36 %. After Bayes method, RF, DT and logistic regression algorithms are with 27.27 percent [3]. The present study used the classification technique to produce an optimal model and pattern for the diagnosis of depression severity. To produce the model, the data examined were divided into two parts: testing and training. DT, SVM and KNN were used for modeling, and decision tree algorithm with 99.16 accuracy and K nearest neighbor algorithm with 94.16 accuracy have achieved higher accuracy in detecting depression severity compared to the SVM algorithm, so DT algorithm is a suitable model for predicting depression severity (28).

Depression, a severe mental health condition, has been explored in the context of social media, particularly in regions where Roman Urdu is commonly used. addressed the gap in depression prediction by creating a Roman Urdu-English dataset, combining data from Facebook and Kaggle. Using machine learning models

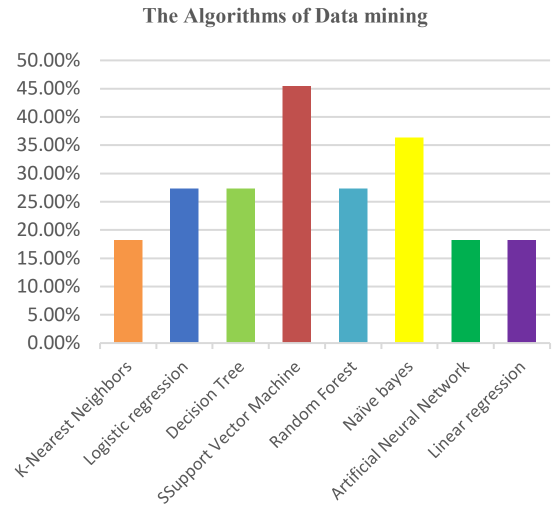

Figure 1. Percentage of algorithms used in articles on depression

such as SVM, SVM-RBF, Random Forest, and BERT, their study classified depression levels into not depressed, moderate, and severe. The SVM model achieved the highest accuracy of 84%, offering a significant advancement in predicting depression in Asian countries (45).

Depression remains a significant global health concern, with growing interest in leveraging artificial intelligence for its detection. reviewed machine learning and deep learning approaches for identifying depressive symptoms, particularly using social media data. The study analyzed various models, including decision trees, random forests, CNNs, and RNNs, applied to datasets like Twitter, Facebook, Reddit, and Kaggle. Findings emphasize the increasing use of deep learning methods for accurate detection and prediction of depression, supporting expert decision-making and highlighting future research opportunities in health-related AI applications (46).

2. 6. Alzheimer's It is a complex condition where the buildup of brain abnormalities causes a gradual decline in cognitive abilities, eventually resulting in dementia (47). As advancements in science, technology, and medicine lead to an increase in the senile population globally, the prevalence of age-related diseases also rises. According to the 2015 Alzheimer's World Report, the number of people living with dementia worldwide reached 44 million in 2013, and this figure is expected to triple, reaching 135 million by 2050 (48).

A computer-based automated detection system to pick up the initial diagnosis of Alzheimer's disease proposed, which operated on the basis of the SVM classification and the selection of visual parameters, achieving an accuracy of 90.38 % (49).

In a study, it describes the use of ML algorithms to recognize Alzheimer's disease. In this article, various algorithms such as SVM, RF, NB, and DT have been examined. These methods work with huge data collected from disparate sources such as clinical systems. These algorithms have been used to accurately predict results and early detection of Alzheimer's disease. For example, the model of a SVM with a linear kernel in this article has shown the best accuracy compared to other models (50).

Early fall detection is a significant health concern. One study focused on using wearable sensor data and the SisFall dataset to predict falls. It introduced a Conv-LSTM model combined with dynamic sampling to address data imbalance and achieved a sensitivity of over 95% and accuracy of 95% using noise filtering. This model successfully predicted falls 340 ms before the incident, highlighting its utility for early intervention (51).

Finally, another approach to fall detection also employed wearable sensors and the SisFall dataset. This research introduced a hybrid Conv-LSTM model with dynamic sampling, dividing human activity into three classes: normal, alert, and fall. The model achieved sensitivity values of 96.23% to 99.38% and an accuracy rate of 97.83%, showing superior performance over previous models (52).

In a study, it examines and compares different machine learning algorithms to foretell Alzheimer's illness and includes MRI data. The primary aim of this system is to identify the likelihood of dementia in patients by examining a range of distinguishing characteristics. The study used various algorithms such as logistic regression, DT, SVM and RF to predict. Initially, the system is implemented without the benefit of fine-tuning. Subsequently, its performance is compared to that of a fine-tuned model. The results have shown that SVM offers the best accuracy in diagnosing dementia among multiple patients (53).

This research has significantly improved the precision of Alzheimer's disease diagnosis by integrating multiple diagnostic methods. The primary goal of this study was to enhance the accuracy of Alzheimer's disease diagnosis by leveraging the power of combined modeling techniques. In this research, the decision tree algorithm is combined with three types of combined methods, including reinforcement, aggregation and stacking. Experimental results showed that the RF had the highest accuracy of all algorithms with an accuracy of 96.66%, while the DT had the lowest accuracy of 73.33% (54).

Analyses shown in Figure 2 that the decision tree is the most used in the diagnosis of Alzheimer's disease with 24% and is second in the SVM with 20% and the NB method with 16% in third place (3).

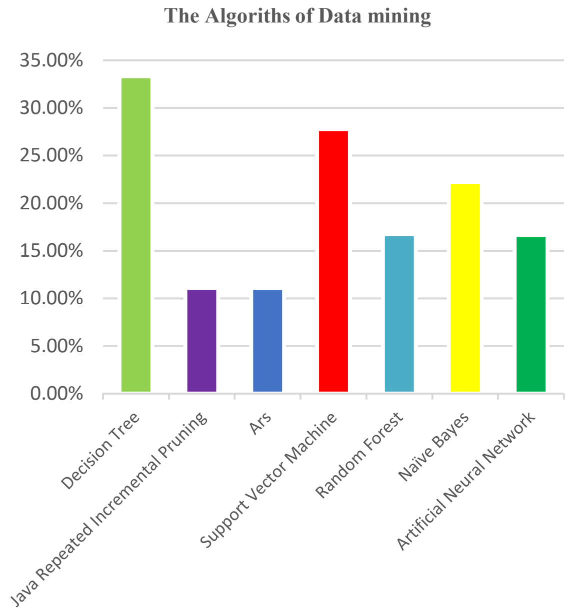

Figure 2. Algorithms used in the field of Alzheimer's disease

In a study, the method proposed in the paper involves the use of a dataset consisting of longitudinal MRI information of about 150 people aged between 60 and 96 years. In the existing method, the SVM algorithm has been used to predict the details of Alzheimer's, but this algorithm only performs the clustering process and isolates people with mainly Alzheimer's. One of the significant drawbacks of this approach is its inability to effectively utilize time. In the proposed method, various algorithms such as linear regression, DT, NB, SVM and RF have been applied to predict accurate results. It deploys supercomputer platforms to exploit the full potential of massive data for Big Data Processing (50).

In another study, researchers tackled the challenges of early Alzheimer's disease (AD) diagnosis, which stem from subtle biomarker changes and the complexity of analyzing high-dimensional data. By leveraging a comprehensive dataset from the National Alzheimer's Coordinating Center, they employed support vector machine (SVM) models to classify and predict AD progression with remarkable accuracy. The models achieved F1 scores of 98.9% for binary classification (distinguishing between normal cognition and AD) and 90.7% for multiclass classification. To improve interpretability, rule-extraction techniques were implemented, identifying critical factors such as MEMORY and JUDGMENT in AD risk evaluation. These rules, validated through SHAP and LIME frameworks, provided insights to assist experts in understanding and managing AD progression effectively (55).

Alzheimer's Disease (AD) is a progressive neurodegenerative disorder that significantly affects cognitive functions, memory, and the ability to perform everyday tasks, particularly in aging populations. With treatments being most effective in the early stages, early detection is paramount. Researchers explored the potential of machine learning and deep learning techniques for early diagnosis by analyzing MRI scans from the OASIS dataset. Models such as Random Forest, Logistic Regression, Extra Trees, and CNN were utilized, with CNN achieving the highest accuracy and AUC, while Extra Trees demonstrated superior precision and recall. These findings underscore the value of advanced computational approaches in detecting early indicators of AD and supporting timely interventions (56).

Early detection of Alzheimer's disease and related cognitive disorders is crucial for timely intervention and management. A recent study introduced a speech-based method for classifying six types of cognitive impairments, including probable and possible Alzheimer's, mild cognitive impairment (MCI), and vascular dementia. Utilizing speech data from the Dementia Bank Pitt Corpus, acoustic features were extracted and analyzed through machine learning models such as KNN, DT, SVM, XGBoost, and RF. Among these, XGBoost delivered the best results, achieving an accuracy of 75.59% in the six-class classification task and demonstrating statistically significant performance over most other models. This innovative approach underscores the promise of speech-based, non-invasive diagnostic tools for identifying cognitive impairments at an early stage (57).

2. 7. Bipolar Disorder Bipolar disorder, once known as manic depression, is a mental health condition marked by dramatic fluctuations in mood, energy, and activity levels. These shifts include manic episodes, characterized by elevated energy and heightened activity, and depressive episodes, defined by low energy, sadness, or feelings of hopelessness. Bipolar disorder may also include less intense mood shifts, known as hypomanic episodes. Globally, it is estimated that around 46 million individuals experience some form of this condition. Unfortunately, people with bipolar disorder are often at a heightened risk of suicidal thoughts or actions (58).

Bipolar disorder often remains undiagnosed for years, delaying effective treatment and increasing the burden on patients. A recent study investigated the potential of machine learning to classify individuals at risk for bipolar disorder by analyzing structural brain features, such as regional cortical thickness. The researchers utilized a linear support vector machine (SVM) on data from 276 help-seeking individuals and achieved a balanced accuracy of 63.1% in predicting risk using the BPSS-P assessment tool. Despite this moderate success, the model faced challenges with other assessment tools, emphasizing both the promise and limitations of applying brain imaging and advanced computational methods to the early detection of bipolar disorder (59).

In a recent study, neural biomarkers for schizophrenia (SZ) and bipolar disorder (BP) were explored through advanced multimodal neuroimaging techniques, including structural MRI, DTI, and resting-state fMRI. The research analyzed data from 113 participants to develop classification models using support vector machines (SVM) and recursive feature elimination. Key findings revealed shared biomarkers, such as increased cortical thickness in the left cuneus and decreased functional connectivity in the left supramarginal gyrus, alongside distinct markers specific to each condition. These results underscore the potential of combining multimodal imaging methods to enhance diagnostic precision and understanding of SZ and BP (60).

Certain major mental health disorders, including chronic conditions like bipolar disorder, often progress gradually. Their symptoms can sometimes be identified early, allowing for better opportunities to manage or even prevent them effectively (5).

According to data in Figure 3 and algorithms, the decision tree is the most used with 37%, followed by the random forest with 27% and the nearest neighbor k with 18% compared to the rest of the algorithms (3).

In a study, various methods of machine learning were examined. The main goal of the research was to compare the performance of five data mining methods including Bayes network, RF, SVM, and logistic regression with a multigene scoring approach in data analysis for bipolar disorder. Two different ways of selecting characteristics were examined: one using all the genome and the other focusing on the genes whose expression is in the brain. Bayes networks performed best among data mining algorithms but none of these algorithms were significantly better than the multigenic scoring approach (12).

In a study, four ML algorithms were used: NB, RF, SVM, and multilayer perceptron. These algorithms were applied to the data set, which consisted of 800 patients. The support vector machine algorithm attempts to find the best separation boundary between different data. The random forest, which contains 100 trees for classification, was one of the top algorithms in the study.

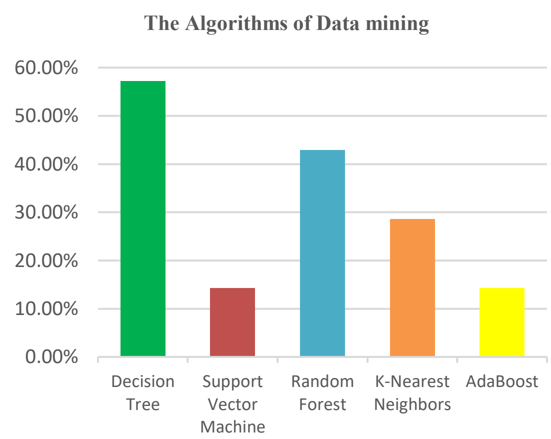

Figure 3. Algorithms used in bipolar and schizophrenic diseases

This algorithm showed high accuracy in prediction by creating a set of Decision Trees. NB works on the theory of Biz probabilities. Multilayer perceptron was set at a learning rate of α = 0.3 and gave acceptable results (61).

The results showed that machine learning algorithms performed significantly in the predictive task, with an average between 61 and 80 percent of the random forest algorithm having the highest average performance. The results suggest that precision medicine approaches, enhanced by machine learning, hold significant potential for treating the condition and reducing the likelihood of future relapses (62).

2. 8. Other Neurological and Mental Illnesses

Flashbacks, nightmares, and intense anxiety are common symptoms of PTSD, along with persistent. To accurately diagnose PTSD, healthcare professionals fulfill physical exams to rule out any underlying medical conditions that may be contributing to these symptoms.

Anorexia nervosa is a serious psychological and physical health condition that can become life-threatening if left untreated and does not have a well-known cause and it can impact individuals of any age, regardless of gender. Statistics show that around 9% of the global population suffers from eating disorders, with approximately 26% of those individuals being at an increased risk of attempting suicide (63). Two prominent developmental mental health conditions are autism spectrum disorder and ADHD. The study revealed that around 9% of children between the ages of 3 and 17 are affected by hyperactivity, while about 4-5% of adults in the United States also experience this condition. In contrast, autism spectrum disorder is less widespread, impacting just 1-2% of people (64).

Another study aimed at early Parkinson's Disease (PD) diagnosis utilized a Bi-LSTM neural network to analyze hand-drawing data. A Fuzzy Inferential Classifier was proposed for the dense layer to handle overlapping data between healthy and PD-affected individuals. The model achieved up to 100% accuracy on spiral drawing tests, outperforming existing methods by at least 2.5%, demonstrating its robustness (65).

Research has explored the impact of sensory experiences on customer behavior, highlighting how detailed data analysis offers valuable insights into emotions and decision-making. Advanced statistical models such as SEM and PLS were employed to examine the complex interplay of variables (66).

The growing amount of medical data necessitates advanced processing techniques like data mining to extract valuable insights for diagnosis and prognosis. Classification algorithms have been widely used in medical research to identify patterns and predict disease outcomes. These approaches can also be leveraged for enhancing diagnostic accuracy in neurological and mental health disorders, providing valuable insights for future research in these fields (67).

Cloud computing plays a crucial role in enhancing data storage and analysis, particularly in healthcare. The utility of cloud technologies can significantly improve machine learning applications in mental health, enabling better processing of large datasets and more accurate diagnostics and predictions (68).

Factors like profitability impact users' attitudes toward mobile marketing, which is vital for improving marketing activities. This concept can be applied to machine learning in mental health to better understand behavior and enhance diagnostic tools (69-72).

For the primary dataset, features such as age, marital status, division unit, gender, and various symptoms were treated as independent variables (Table 2). The dataset includes 29 different diseases, with each considered as a target class. By applying the random forest algorithm, they achieved an accuracy of 0.851, the result of other algorithms such as SVM 0.787, DT 0.723 and KNN 0.756. Because the dataset was small, they calculated accuracy by adding artificial data to ensure an accurate result. Their artificial dataset consisted of 2,600 illness data. For artificial data, the results for the random forest are 0.859 and the result of the support vector machine algorithm was 0.844 and the k nearest neighbor was 0.851 (26).

Table 2 presents the performance results of different algorithms. It compares the outcomes for both the main dataset and the synthetic data. The RF algorithm achieved the highest accuracy, with a score of 0.851 for the main data and 0.859 for the artificial data.

Table 3 lists articles used and reviewed in the field of classification of data mining algorithms in neurological and mental diseases. In the following table (Table 3) lists the titles of the articles along with the author or its authors. the tools and techniques used by each article were also mentioned, and the disease studied and the accuracy of each of the algorithms used in each article was stated. The findings and results of the articles were also mentioned at the end.

3. METHODOLOGY

3. 1. Model Considering the limitations of previous studies, the specific characteristics of each of them, the tools and techniques utilized in past research, and the advantages provided by each of the prior models, we arrived at the model presented in Figure 4 of this study. This model serves as a comprehensive framework outlining the overall approach to this research area.

TABLE 2. Overall performance of various algorithms [26]

RF	KNN	SVM	data
0.851	0.787	0.787	Main (The data set is 466)
0.859	0.851	0.844	Artificial (The data set is 2600)

TABLE 3. Articles reviewed on the classification of data mining algorihms in mental diseases

Authors	Journal	Techniques and tools	Target	Accuracy	Result
Segovia et al. (49)	(Elsevier) Expert Systems with Applications	SVM	Alzheimer	90.38	The use of support vector machine in Alzheimer's diagnosis achieved 90.38 accuracy
Mukherjee et al. (44)	American Journal of Biomedical Sciences	Neural network	Depression	-	This article suggests an approach to deal with the uncertainty aspect using soft computing techniques, taught using real.
Byeon (48)	International Journal of Advanced Computer Science and Applications	RF & MCI	Alzheimer	72.1	The use of random forest in Alzheimer's diagnosis achieved an accuracy of 72.1
Valizadeh & Hamidi (66)	-	-	Neurological diseases	-	Explanation about the types of neurological and mental diseases and explanation about their symptoms and treatment
Dhaka and Johari (2)	IEEE Int. Conf. Electra. Electron. Optima	Genetic algorithm	Mental health	-	Using data mining techniques such as genetic algorithm on the data obtained from global mental health statistics.
Payandeh (47)	IEEE	NB	Mental health	-	The recursive Bayesian framework should be used as a part of the tracking environment in the smart living environment of the elderly
Walker et al. (30)	Biological psychiatry	SVM & DT	Schizophrenia	78	Schizophrenia patients and control subjects, using SVM and DT, support vector machine achieved 77% accuracy while decision tree achieved 78% accuracy.
Hettige et al. (35)	Computer methods and programs in biomedicine (ELSEVIER)	SVM & RF	Schizophrenia	SVM:67 RF:66	All classification models performed similarly. The RF model showed 66% accuracy and the SVM classification model showed 67% accuracy.
Jiang et al. (9)	Stroke and vascular neurology (BMJ)	SVM, neural network and the modern deep learning	Mental health	-	Using machine learning methods for structured data, such as the classical SVM and neural network, as well as NLP for unstructured data
Lin et al. (15)	IEEE	Neural network	Stress	-	A factor graph model integrated with a convolutional neural network is used to analyze tweet content and social interaction data for detecting stress.
Sau & Bhakta (41)	Health Technol. Lett.	SVM & RF	Depression, anxiety	89	Using machine learning methods to predict depression and anxiety with high accuracy
Alonso et al. (3)	Journal of Medical Systems	SVM, RF, DT, NB, KNN, ANN	Schizophrenia, depression, bipolar disorder, Alzheimer's	-	The goal of this study was to investigate data mining techniques and algorithms used in mental health diseases
Khan et al. (26)	International Conference on Innovations in Science, Engineering and Technology (ICISET)	KNN	Mental illnesses	0.859	Prediction of mental illnesses using artificial data
Deoshia et al. (1)	International Journal of Immunology	DT, NB	Mental health	DT:83.3 NB:76.7	Decision Trees can help mental health experts apply algorithm-inferred rules for early diagnosis.
Borges-Junior et al. (60)	IEEE International Conference on Bioinformatics and Biomedicine (BIBM)	SVM, RF, NB, Multilayer perceptron (MLP)	Bipolar disorder	With relapse:68 No recurrence: 74	Machine learning algorithms can be used as a suitable method to support medical decision making in treating BD and preventing future relapses.

Allende-Cid et al. (31)	IEEE	NLP	Schizophrenia	-	Use of the proposed computational representations along with machine learning techniques enables a novel and precise strategy to automatically data.
Almutairi et al. (32)	IEEE	SVM, RF, NB, ANN	Schizophrenia	SVM, RF, NB: 90.69 ANN:88.37	The highest accuracy using RF, SVM and NB techniques reached 90.6977%, while the ANN technique reached 88.3721% accuracy.
Sau & Bhakta (43)	Inform. Med. Unlocked	SVM, ANN	Anxiety, depression	84.1	Cat Boost has proven to be the most reliable approach for this purpose, delivering an accuracy of 82.6% and a precision of 84.1%.
Abd Rahman et al. (13)	IEEE Access	ANN, RF, SVM	Mental illnesses	-	(OSNs) hold significant promise as a valuable resource for the early detection of mental health issues. The vast amount of data generated on these platforms plays a crucial role in diagnosing mental health conditions.
Radwan et al. (42)	Indonesian Journal of Electrical Engineering and Informatics (IJEEI)	DT, boosting, summation, RF	Alzheimer	96.66	Improving the accuracy of Alzheimer's diagnosis with hybrid models RF had the best accuracy with 96.66% accuracy
Costantini et al. (37)	Journal of affective disorders (Elsevier)	PHR-9	Depression	74	The two-stage screening system is evaluated by an analysis of a finding performed by care and mental health professionals.
Kaikawaka et al. (7)	ICAST	DT, RF, SVM Label encryption, ANN	Mental health diseases	-	Data was collected from online sources and coding of tags was done. Different machine learning techniques were used.
Parsapour & Peyman, (28)	Journal of Health and Biomedical Informatics	DT, SVM, KNN, NB	Depression	99.16	The decision tree algorithm with 99.16 percent accuracy achieved higher accuracy compared to other algorithms.
Ban Antor et al. (53)	Journal of Healthcare engineering	Machine learning (SVM, neural network, RF)	Alzheimer	92	Dementia prediction using magnetic resonance imaging data The SVM provided the best accuracy
Wilens et al. (63)	Business Ethics Quarterly	-	ADHD	-	Why researchers, policy makers, and social media company managers should consider social media addiction as a serious ethical problem.
Kishore et al. (50)	Materials Today: Proceedings ELSEVIER	SVM, RF, DT, NB	Alzheimer	-	Early diagnosis of Alzheimer's disease using electronic and clinical data SVM with linear kernel had the best accuracy.
de Siqueira Rotenberg et al. (61)	Journal of Affective Disorders ELSEVIER	RF, mood symptom data	Bipolar disorder	-	Using accurate medical models through machine learning can be useful in treating and preventing future relapses.
Shorey et al. (38)	International Journal of Adolescent Medicine and Health	Statistical analysis	Depression	-	Prevalence of depression in teenagers and higher prevalence in teenage girls
Lai et al. (10)	International journal of environmental research and public health	SVM, RF, artificial intelligence, complex and big data	Schizophrenia	-	Studying the progress of using artificial intelligence in schizophrenia and Helping to diagnose and provide suitable options for people with this disease
Aleem et al. (40)	Electronics	DT, SVM, KNN	Anxiety, depression	Support vector machine above 75	Examining the complexities of predicting anxiety and its similarity to major depression

Alonso et al. (33)	Sensors	RF	Schizophrenia	RF:72	Implementation of predictive models to prevent hospitalization of schizophrenic patients
Harmer et al. (39)	Suicidal Ideation	-	Depression	-	Research indicates that teenage girls experience depressive symptoms more frequently than their male counterparts.
Keramati Hatkeposhti et a. (51)	International Journal of Engineering	CNN, LSTM, Conv-LSTM	-	97.83	The model achieved sensitivity values of 96.23 to 99.38 and an accuracy rate of 97.83, showing superior performance over previous models
Vaishnavi et al. (5)	Public Health Journal	Statistical analysis	Anxiety, depression	81.75	Examining public health issues related to anxiety and depression.
Zhang et al. (14)	NPJ Digital Medicine	Natural language processing (NLP)	Mental health	-	Deep learning methods are more popular than traditional machine learning methods and have better performance.
Gaurav et al. (72)	Healthcare (MDPI)	SVM, RF, gradient boosting, deep learning	Mental illnesses	SVM:82.1	Machine learning, on its own, can be a powerful tool in gaining insights into mental health challenges.
Montazeri et al. (34)	Health Science Report	Deep neural networks, SVM, RF and gradient boosting	Schizophrenia, bipolar disorder	SVM:80.48 RF:86.44 Gradient Boost:85.7	Investigating the effectiveness ML algorithms in predicting schizophrenia.
Ahamed et al. (56)	IEEE	Logistic Regression,RF, CNN	Alzheimer	-	with CNN showing the highest accuracy and AUC, while Extra Trees excelled in precision and recall.
Alatrany et al. (55)	Scientific Reports	SVM	Alzheimer	98.9 for binary and 90.7 for multiclass classification	SVM achieved a high F1 score of 98.9 for binary and 90.7 for multiclass classification.
Chen et al. (59)	Journal of Psychiatric Research	SVM	Schizophrenia, bipolar disorder	70.8	SVM with recursive feature elimination (RFE) achieving a classification accuracy of 70.8
Gadzama et al. (46)	*Personalized Medicine in Psychiatry*	DT,RF,KNN,NB,SVM,CNNs, RNNs	Depression	-	Findings emphasize the increasing use of deep learning methods for accurate detection and prediction of depression in health-related AI applications.
Keramati Hatkeposhti et al. (51)	The Computer Journal	CNN and a combination model named Conv_Lstm	Mental health	95	It introduced a Conv-LSTM model combined with dynamic sampling to address data imbalance and achieved a sensitivity of over 95 and accuracy of 95 using noise filtering
Mikolas et al. (58)	Psychological Medicine	SVM	Bipolar disorder	63.1	they achieved moderate performance in predicting risk with a balanced accuracy of 63.1with svm.
Radwan et al. (42)	*International Journal of Web Services Research (IJWSR)*,	LLMs, neural networksSVM	Stress	83	The best-performing model, a svm, achieved 83 accuracy, showcasing the potential for preliminary screening of stress using online data.
Rehmani et al. (45)	Healthcare Technology Letters	SVM, SVM-RBF,RF, and BERT	Depression	84	The SVM model achieved the highest accuracy of 84, offering a significant advancement in predicting depression in Asian countries
Ramzani et al. (64)	International Journal of Imaging Systems and Technology	Fuzzy, LSTM	Parkinson	97 98.5 100	The proposed method has reached 97, 98.5, and 100 accuracy rates for the three mentioned spiral tests with a smoother training loss and accuracy plots.

Sarno and Ghazali (6)	Journal of Information and Communication Technology	ROBERTA multi-level multi-class classification algorithm RF, DT, SVM, NB	Bipolar disorder, depression, ADHD، PTSD	85 & 98	Text analysis to identify mental health disorders and improve classification accuracy The best accuracy algorithm using ROBERTA class band at level 1 and level 2 was 0.98 and 0.85, respectively.
Tripathi & Kumar (57)	*International Journal of Data Science and Analytics*	KNN, DT, SVM, XGBoost, and RF	Alzheimer	75.59	The highest accuracy of 75.59 was achieved in the six-class classification task, with XGBoost.
Yang et al. (36)	Expert Systems with Applications	SVM,RF boosting,	schizophrenia	96.25	. The results indicated that the automatic detection method achieved an impressive accuracy of 96.25

The first step in designing this model was to clearly define the problem statement and research objective. The primary goal of this study is to leverage machine learning (ML) algorithms for the detection and diagnosis of neurological and psychiatric diseases. As previously mentioned, these disorders have gained significant attention in recent years due to their increasing prevalence, affecting a considerable portion of the global population at varying levels of severity.

To develop a reliable and accurate model, it was essential to collect a large volume of data. The required data was gathered from reputable scientific sources and research databases such as IEEE, ScienceDirect, and other well-established repositories. The next crucial phase was data preprocessing, which included tasks such as data cleansing, integration of multiple sources, elimination of invalid records, and normalization. This step was carried out to ensure the accuracy, consistency, and reliability of the dataset by removing any errors, inconsistencies, or outliers, thus making the data suitable for subsequent analysis.

Once the data was properly preprocessed, the next step involved selecting and introducing the most appropriate machine learning algorithms for analysis. In this study, several widely used ML algorithms were employed, including NB, SVM, DT, KNN, and RF. Each of these algorithms possesses unique characteristics and demonstrates varying levels of effectiveness depending on the specific problem domain.

Following the introduction of these ML algorithms, the evaluation phase was conducted to assess their performance and efficiency. This evaluation was based on key performance metrics such as accuracy, precision, and sensitivity, which provide insight into how well each algorithm performs in classification tasks. Through extensive testing and analysis, it was determined that certain algorithms excel in diagnosing specific diseases. For instance, in the case of schizophrenia, SVM emerged as the most effective and widely used models.

The final stage of this study focused on model optimization. To further enhance the efficiency and accuracy of the proposed model, various optimization techniques were explored. These included hybrid modeling approaches and the integration of deep learning techniques, which offer the potential to improve predictive performance and reduce classification errors. By incorporating these advanced methodologies, the model's overall effectiveness was significantly improved.

3. 2. Research Method Flowchart Based on Figure 5, the process of doing the work in this study has been examined by studies conducted during 2005-2024. Articles have been collected by searching scientific databases such as ScienceDirect, Elsevier, Springer and IEEE. The keywords used in this study include Classification, Datamining, Machine Learning, Depression, Mental Health. Studies that used methods other than machine learning were not examined. According to the title, abstract and entire article, unrelated and inappropriate articles were removed. 50 papers were eventually studied and reviewed. Initially, studies were evaluated based on the type of disease followed by machine learning algorithms for each disease.

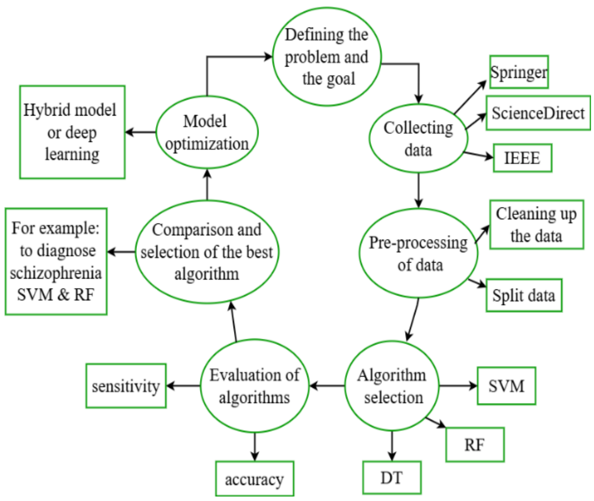

Figure 4. General model of how and stages of research

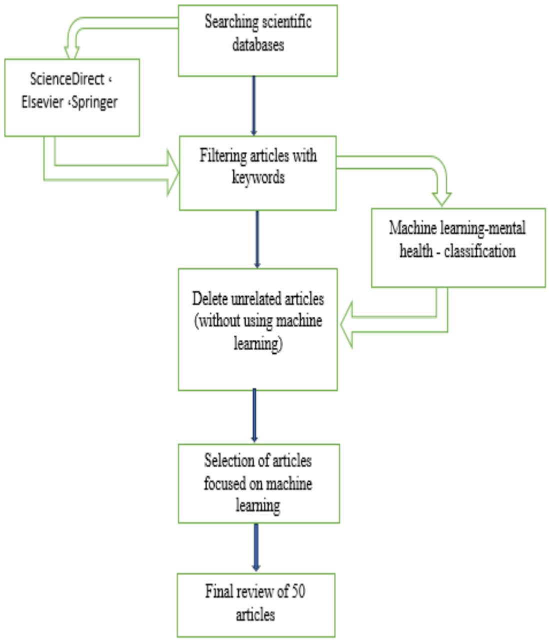

Figure 5. Methodological flowchart

4. GENERAL ANALYSIS AND EVALUATION OF RELATED RESEARCH

The analysis and evaluation that takes place in this section is based on the number of repetitions of algorithms, the frequency of diseases and algorithms used for the most important diseases in the reviewed articles. Therefore, according to the number of repetitions in the articles, the most important categorical algorithms and the most important neurological and psychiatric diseases are characterized.

4. 1. Distribution of Classification Algorithms in Studies Examined Several different classification methods were seen in these studies. SVM, RF, DT, NB, KNN, ANN, CNN and fuzzy system have been classification methods used more than once in studies. The graph of the distribution of categorical algorithms in past studies is shown in Figure 6. As presented in Figure 6, the support vector machine had the highest application rate given the high power in the category, with 35 iterations in studies. After the support vector machine, the forest is random, repeated 25 times in studies. The third algorithm was the decision tree, which has been used 15 times in articles.

After them, the nearest neighbors and the artificial neural network are used with 10 repetitions in articles and the simple method of biz with 9 repetitions in articles. CNN, Gradient enhancement methods, fuzzy system, and regression were other methods used in the papers. According to the studies, the SVM, RF and DT were among the most widely used algorithms in this field.

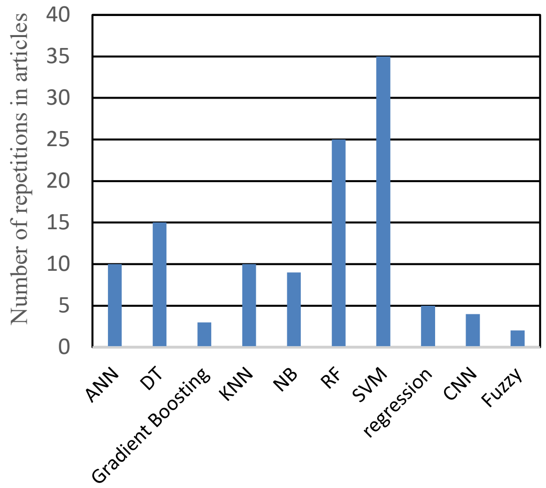

Figure 6. Distribution of classification algorithms in past studies

4. 2. Diseases Examined in Studies In this study, schizophrenia, depression, bipolar disorder and Alzheimer's were the most abundant, according to the articles. After reviewing past studies, the prevalence of neurological and psychiatric diseases is as shown in Figure 7. According to the articles, depressive disease was examined in 18 articles, which had the highest number of repetitions compared to other neurological and psychiatric diseases. After that, it is schizophrenia that has been studied in 15 articles. The third is bipolar disorder, which has been studied and examined in 14 articles. The fourth disease is Alzheimer's, which has been analyzed and reviewed in 10 articles. After that, post-traumatic stress disorder and hyperactivity disorder with 4 repetitions in the diet and anorexia nervosa with 3 repetitions had more than one repetition.

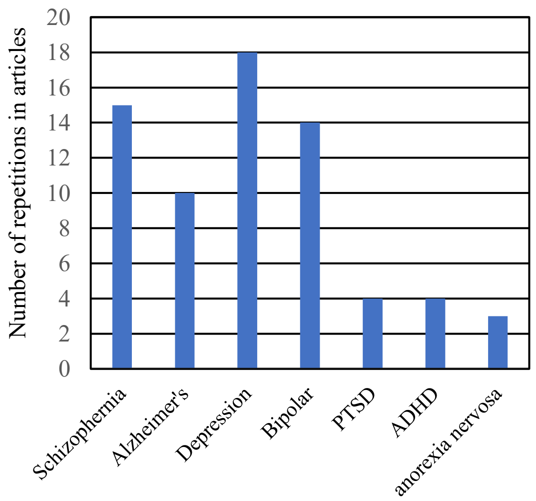

Figure 7. Distribution of diseases examined in past studies

According to studies, depressive diseases, schizophrenia, bipolar disorder, and Alzheimer's had the highest prevalence of diseases among other neurological and psychiatric diseases.

4. 3. Classification Algorithms for the Most Important Neurological and Mental Diseases Now, based on the analysis of the distribution of classification algorithms and the prevalence of neurological and psychiatric diseases based on previous studies. This section examines the distribution of classification algorithms for four diseases, schizophrenia, Alzheimer's, depression and bipolar disorder to show which of the most important classification algorithms for each disease. According to Figure 8, for schizophrenia, SVM has been used in 8 articles that can be expressed as the most widely used category algorithm for schizophrenia. Random forest is the second algorithm that has been repeated the most in articles and has been repeated 7 times. the KNN and regression in 3 studies were the third most abundant algorithms compared to other algorithms. Decision tree, artificial neural network and NB were among the other algorithms in 2 studies that were present in more than one paper.

According to the diagram of Figure 9, for depressive disease, the support vector machine had the most repetitions in the peer-reviewed articles. This algorithm has been used in 12 articles. The second most used algorithm was random forest which had been used in 7 articles. The decision tree was the third most frequently used algorithm in depression and was used 6 times. K-nearest neighbors in 5 studies and Artificial neural network in 4 studies was among the other algorithms that existed in more than one paper. Bayes method and regression were other algorithms used in depression.

According to Figure 10, for Alzheimer's disease, random forest and SVM have been used in 7 articles that can be considered the most widely used classification algorithms for Alzheimer's disease. The DT is the second most widely used algorithm for Alzheimer's disease, used in 5 articles. k the nearest neighbors is employed in 4 articles, simple biz and artificial neural network in 2 articles.

According to Figure 11, for bipolar disorder, the SVM algorithm has the most repetitions in the reviewed articles, and this algorithm has been used 10 times. The second most used algorithm was RF, which was used in 7 articles. NB method in 5 articles, ANN in 3 articles, DT, KNN and regression in 2 articles are algorithms used in bipolar disorder.

For schizophrenia, the SVM and RF were the most important classification algorithms. For Alzheimer's disease, RF and SVM have been most used. For depressive illness, the SVM was the most important classification algorithms. For bipolar disorder, SVM and RF were the most important classification algorithms.

5. DISCUSSION

Using data mining techniques in psychiatry could lead to new opportunities for research in diagnosing and

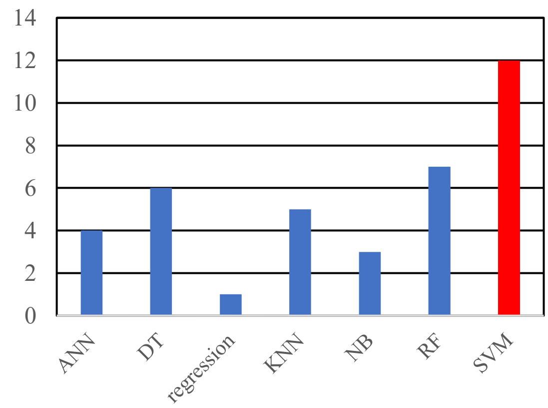

Figure 9. Algorithms used for depression

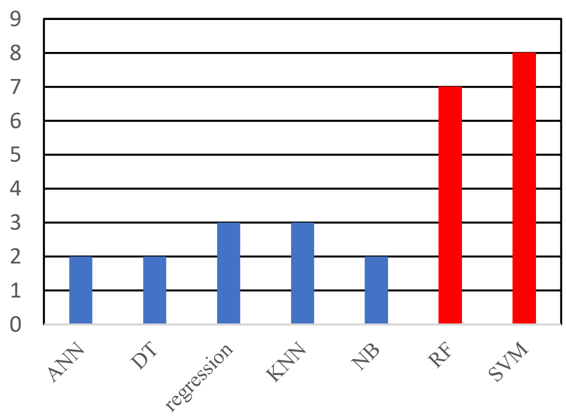

Figure 8. Algorithms used for schizophrenia

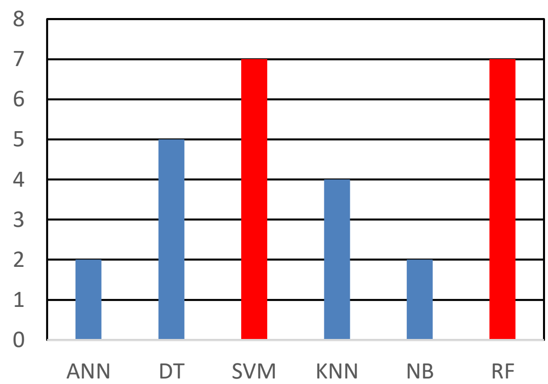

Figure 10. Algorithms used for Alzheimer's

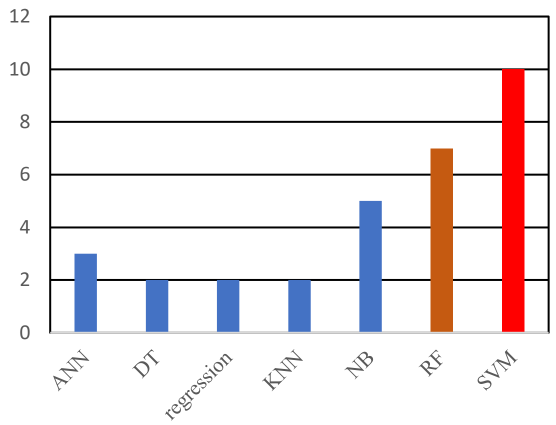

Figure 11. Algorithms used for bipolar disorder

classifying mental health disorders like schizophrenia, Alzheimer's, depression, anxiety, and alcohol abuse. Depression is increasingly common among adolescents, and the rates of suicide linked to depression continue to rise. In recent years, suicide rates have seen a sharp increase globally. This issue is highly complex, involving a mix of biological, psychological, and social factors. The study found that for schizophrenia, SVM was used in 8 articles that could be expressed as the most widely used classification algorithm for schizophrenia. For depressive illness, the support vector machine had the most repetitions in the peer-reviewed articles. This algorithm has been used in 12 articles. For Alzheimer's disease, the SVM and random forest have been used in 7 articles that can be considered the most widely used classification algorithms for Alzheimer's disease, and for bipolar disorder, the SVM algorithm has the most repetitions in the articles reviewed, and this algorithm has been used 10 times.

Support Vector Machine (SVM) stands out as one of the best methods for disease diagnosis due to its capability to identify an optimal decision boundary in high-dimensional feature spaces. By maximizing the margin between classes, SVM effectively handles datasets with overlapping or subtle differences, which are often encountered in medical applications. It is particularly suitable for imbalanced datasets or cases where the number of features exceeds the number of samples, as seen in many healthcare problems. Moreover, the use of kernel functions allows SVM to model nonlinear decision boundaries, further enhancing its adaptability for complex scenarios.

These advantages align with the challenges discussed where the authors addressed the difficulty of distinguishing hand-drawing data from healthy individuals and Parkinson's disease patients. Using Bi-LSTM and a Fuzzy Inferential Classifier, they tackled the issue of overlapping data points, emphasizing the necessity of robust models for precise classification. SVM, with its ability to handle similar challenges, reinforces its position as a highly effective tool for medical data analysis [66].

6. CONCLUSION

In this study, due to the introduction of data mining and the use of its methods in various fields, especially classification as the most important data mining method, in the field of neurological and mental diseases, a review of studies and research carried out in this field has been paid. After reviewing 50 of the studies conducted on the adoption of data mining methods in neurological and mental diseases, it was concluded that the most used classification was in the diagnosis of diseases and the prediction of disease.

After reviewing and studying the articles and analyzing and evaluating them, results were obtained in terms of the number of repetitions of algorithms and the frequency of neurological and mental diseases. These results indicate that the SVM algorithm has the highest frequency among algorithms. Then the random forest and the decision tree had the most repetitions in the articles. Among neurological and psychiatric diseases, schizophrenia, bipolar disorder, depression and Alzheimer's were the most frequent in articles.

The limitations of this article are that articles were reviewed from 2005 to 2024 and articles were collected by searching scientific databases such as ScienceDirect, Elsevier, Springer and IEEE. The keywords used in this study include Classification, Datamining, Machine Learning, Depression, Mental Health. Tools and techniques used in this study, machine learning tools and algorithms such as DT, SVM and ... They were. Studies that used methods other than machine learning were not examined. According to the title, abstract and entire article, unrelated and inappropriate articles were removed. 50 papers were eventually studied and reviewed.

7. SUGGESTIONS AND FUTURE WORK

There are several exciting areas in which machine learning algorithms can help advance the understanding and treatment of neurological and mental illnesses. Here are four of the most promising areas of future research:

Diagnosis and Prediction: Early detection: machine learning algorithms can be used to analyze various data such as brain images and behavioral information to identify early signs of neurological and mental illness.

Disease progression prediction: machine learning algorithms can be used to predict which patients are at risk of developing more severe diseases or relapses.

Personalized Treatments: Treatment selection: machine learning algorithms can be used to analyze patient data and identify the best treatments or therapeutic compounds for each individual .
Treatment monitoring: machine learning algorithms can be used to monitor a patient's response to treatment and adjust treatment plans as needed.
Drug Development: Drug discovery: machine learning algorithms can be used to identify new and potential drugs to treat neurological and mental illnesses
Drug design: machine learning algorithms can be used to design new drugs with specific properties, such as the ability to cross a blood-brain barrier or target specific pathogens.
AI-Based Interventions: Chatbot-based therapies: machine learning-based chatbots can be used to provide supportive or cognitive-behavioral therapies to patients with neurological and mental illnesses.

Therapeutic games: video games and virtual reality programs based on machine learning can be used to provide attractive and effective treatments for various neurological and psychological diseases.

These are just a few examples of several ways that data mining algorithms can be used in the coming years to transform how neurological and mental illness is understood and treated. As research in this area continues to progress, further innovations and significant advances in patient care can be seen in the future.

8. REFERENCES

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Persian Abstract

چکیده

اختلالات روانی، از جمله اضطراب، چالش‌های عمده‌ای را در سطح جهانی ایجاد می‌کنند. این بیماری‌ها شامل مجموعه‌ای از اختلالات هستند که الگوهای فکری و رفتاری را مختل می‌کنند و اغلب منجر به ناراحتی یا ناتوانی قابل توجهی برای افراد مبتلا می‌شوند. حوزه داده‌کاوی در پزشکی به شهرت رسیده است و ابزارهای نوآورانه‌ای را برای کشف بینش‌های پنهان و بهبود طبقه‌بندی بیماری‌ها، به ویژه در زمینه سلامت روان، ارائه می‌دهد. این روش تحلیلی برای کشف الگوهای ارزشمند در داده‌های بزرگ ضروری است و امکان درک و تشخیص بهتر اختلالات پیچیده را فراهم می‌آورد. هدف از این مقاله بررسی بیماری‌های عصبی و روانی با استفاده از الگوریتم‌های یادگیری ماشین و شناسایی مهم‌ترین الگوریتم مورد استفاده در هر بیماری است. روش مورد استفاده در این مقاله الگوریتم‌های یادگیری ماشین است که مهم‌ترین و پرکاربردترین الگوریتم در هر یک از بیماری‌های عصبی و روانی است. نتایج نشان می‌دهند که الگوریتم SVM به‌عنوان رایج‌ترین روش استفاده شده، با فاصله کمی از الگوریتم‌های جنگل تصادفی و درخت تصمیم قرار دارد. این تکنیک‌ها اهمیت روزافزون یادگیری ماشین را در تقویت توانمندی‌های تشخیصی و درک عمیق‌تر اختلالات روانی نشان می‌دهند. این تحقیق بر استفاده از تکنیک‌های یادگیری ماشین برای کمک به تشخیص اختلالات عصبی و روانی متمرکز است. با تحلیل مطالعات انجام شده بین سال‌های ۲۰۰۵ تا ۲۰۲٤، این مرور اختلالاتی مانند اسکیزوفرنی، افسردگی، اختلال دوقطبی و آلزایمر را ارزیابی می‌کند. مجموعاً ۵۰ مطالعه بر اساس ارتباط آن‌ها با کاربردهای یادگیری ماشین در این حوزه انتخاب شدند.