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DEPRESSION DETECTION USING MACHINE LEARNING ALGORITHMS: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Depression is a common mental health challenge significantly affecting the global health community. Recently, researchers have conducted studies on applying machine learning methods for automated identification of depression symptoms among victims. Depression diagnosis now uses machine learning approaches to identify depression in social media posts. With these machine-learning techniques, researchers improve the detection and prediction of health-related diseases to support government and medical health professionals in their decision-making process. This paper aims to review and assess machine learning methods for the detection of depression. The present prediction systems used by the researchers meticulously found victims of depression using identification, detection, analysis, and prediction. Boolean keywords were used to search several journal databases and filters; the researchers chose and assessed thirty (30) papers, emphasising the application of machine learning methods. The results show that many studies used different models, such as SVM, RF, DT, K-NN, and NB, with various datasets to identify depression in people using clinical or social media information. Datasets utilised in the papers reviewed include those from Twitter, Facebook, Reddit, Survey, and DASS 21. There were few studies on prediction 17%, but most focused on early depression detection. The analysis showed a decline from 2022 to 2024, but the highest rise in machine learning research was in 2019.

Keywords: Detection, Depression, Depression Detection, Deep Learning, Dataset

INTRODUCTION

Depression is a medical ailment and one of the most prevalent mental illnesses, affecting millions of individuals worldwide. Depression is considered a serious condition because it not only affects a person's mental state but also causes bodily harm to a patient (Vandana et al., 2023). It is a serious illness that can harm both physical and mental health (Vasha et al., 2023). It impacts how a person feels, thinks, and acts. Every year, an estimated 300 million people worldwide suffer from depression (Alsagri & Ykhlef, 2020). However, at the early stages of depression, 70% of patients would not consult doctors, which may cause their disease to progress. Depression is characterized by persistent feelings of hopelessness, lack of motivation, mood instability, and disinterest in daily physical, mental, and social activities, resulting in emotional distress and physiological alterations. It particularly impairs cognitive function, induces mood variations, and frequently diminishes work productivity (Vandana et al., 2023). In extreme circumstances, depression results in suicide (He et al., 2021; Alsagri & Ykhlef, 2020a; Kessler et al., 2003). 80% of individuals who attempt suicide experience depression (Vasha et al., 2023; Alsagri & Ykhlef, 2020b).

According to a WHO survey, around 280 million people worldwide suffer from depression, and nearly 800,000 occurrences of suicide related to depression are documented each year (World Health Organisation, 2022). Vasha et al. (2023) state that according to the National Institute of Mental Health survey, 26 people nationwide commit suicide on average each day. The majority of them are female. Compared to men, women are around twice as likely to experience depression. Also, young people today are prone to depression because they spend so much time indoors and are dependent on their phones and video games. According to Reyes-Rodríguez et al. (2013), Alcohol consumption has increased as a result of depression, and their study indicated that higher institution students are significantly more likely to consume alcohol. Mental health conditions account for five of the top ten major disorders that cause disability or incapacity, with depression being the most prevalent (Tejaswisni et al., 2022). Recently, social media has become a tool for identifying individuals with symptoms of depression. The proliferation of social media presents a tremendous potential to strengthen the data available to mental health therapists and researchers, enabling a better-informed and equipped mental health field (Alsagri & Ykhlef, 2020; Gadzama et al., 2024). Identification of depressed and non-depressed individuals from social media is highly significant (Amanat et al., 2022). Social media information, conversation, and posts describe the user's emotional state. Depressed patients on social media frequently utilise terms associated with rejection and negative emotions such as melancholy, tension, demotivation, or discontent (Vandana et al., 2023; Rao et al., 2020).

Leveraging modern computing capabilities, machine learning facilitates a significant paradigm shift in depression identification by examining intricate behavioural and biological data to uncover subtle, frequently concealed patterns indicative of the mental disorder. This method transcends conventional questionnaires, presenting the possibility for objective, scalable, and early screening instruments that can evaluate various factors, including speech patterns, writing styles, and activity logs, thus delivering essential support for clinical evaluation and facilitating equitable access to mental health resources.

Research Questions

i. What are the trends in machine learning research for identifying depression?
ii. What has been the focus of machine learning research on depression detection?
iii. Which machine learning algorithms were mainly applied to analyse depression detection?
iv. Which datasets were employed to train machine-learning models for detecting depression?

MATERIALS AND METHODS

The authors employed a systematic literature review approach to answer the research questions. A systematic literature review (SLR) is a method in which past research publications on a given topic are located, evaluated, and compiled methodically and orderly. The correct and dependable synthesis of current scholarly publications makes this approach suitable (Van Laar et al., 2017). By stressing significant results, trends, gaps, and topics for future study, SLR seeks to provide an objective overview of the current state of knowledge in a particular field. The study followed a structured method to review existing literature, using bibliometric and scientometric evaluations. This method included seven steps suggested by Keathley-Herring et al. (2016). The seven steps in the procedure are problem description, scoping study, search strategy, exclusion criteria, data collection, data analysis, and reporting.

Problem Definition

Despite the rising cases of depression and the limits of subjective diagnostic approaches, the use of machine learning (ML) for its diagnosis is still difficult. A large body of research shows that ML models can be used with various data modalities to identify depressive states, but the field lacks standardisation, algorithmic biases, and clinical translatability. The use of machine learning to identify and detect depression has been the subject of scientific investigation by researchers. When it comes to psychological, mental health, and depression-related research, however, there is a dearth of exhaustive studies that investigate the use of machine learning techniques as a means of directing researchers. One example is the research conducted by Jayanthi et al. (2022) and Kumbhar et al. (2021), which investigated the application of machine learning models in detecting depression. This study aimed to review the use of machine learning algorithms related to depression detection using users' social media posts. This review critically synthesises the existing literature to address a central issue, such as the disparity between the promising accuracy of machine learning models in controlled research environments and their preparedness for reliable, equitable, and effective application in real-world clinical practice. This study thoroughly analyse significant methodological inconsistencies, data restrictions, and ethical issues that impede advancement, with the ultimate goal of identifying approaches to develop robust, generalisable, and clinically applicable machine learning methods for depression identification.

Scoping Study

The study queries Google Scholars, the Institute of Electrical and Electronics Engineers (IEEE) Library, Elsevier, Springer, the Multidisciplinary Digital Publishing Institute (MDPI) Library, the Association of Computing Machinery (ACM) Digital Library, Social Science Research Network (SSRN) Library, The Institute of Electronics, Information and Communication Engineers (IEICE) Digital Library, Social Science Research Network (SSRN) open access eLibrary, Research Gate, and Academia databases. The researchers conducted a web search by inputting keywords such as "depression detection," "depression detection using machine learning," and "depression detection using machine learning on social media" to find pertinent papers. This study examined English-language research publications, peer-reviewed papers, and conference proceedings. The objective was to assess the existing literature on using machine learning to diagnose depression. The study curated and organised the relevant journals and conference articles based on the date of presentation and publication. The findings imply that reviewing recent papers could produce vital information to aid future research progress in detecting depression.

Search Strategy

The authors use several academic databases to search and download articles. The search covers Google Scholar, IEEE Library, Elsevier, Springer, the MDPI Library, the ACM Digital Library, SSRN Library, the IEICE Digital Library, SSRN open access eLibrary, Research Gate, and Academia. Machine learning, depression detection, machine learning in depression identification, and a mix of these terms are the first search criteria applied to identify papers. This review sought to retrieve peer-reviewed scholarly papers and conference proceedings in English using Boolean operators such as "and" and "or." The authors tested and changed Boolean phrases and associated subjects, including ML, detection, prediction, and depression, to increase their sensitivity in the searches. The authors checked each article's full-text availability and closely examined its abstract to see how carefully it matched the aim of the research.

The initial search terms employed to source articles include: depression detection, depression detection and machine learning, depression detection using machine learning, depression detection using machine learning techniques, depression detection via social media, depression detection using social media data, depression detection employing social media, depression detection using Twitter data, depression detection with machine learning algorithms, depression detection using Reddit with machine learning algorithms, depression detection using Facebook with machine learning algorithms, and hybrid machine learning algoriths using social media. The resulting papers from one of the searches are Rehmani et al., (2024) Depression Detection with Machine Learning of Structural and Non-Structural Dual Languages and Kumbhar et al., (2021) Depression Detection Using Machine Learning.

Exclusion Criteria

The study does not include journals or conference proceedings that do not have a connection to machine learning in depression detection. The study also excludes articles in academic peer-reviewed journals not written in English. Moreover, the analysis omitted papers without machine learning techniques. The analysis rejected articles with just an abstract shown on the Internet since they lacked any results or suggested studies. After employing the exclusion criteria, a total of 30 articles remain.

Data Collection

The data collected were publications on using machine learning approaches for depression detection on social media. After removing abstract-only and duplicate publications, the search yielded thirty (30) machine learning-related papers within the study years. The publications were divided into the following categories: IEICE Digital Library = 1, ACM Digital Library = 1, SSRN eLibrary = 1, Google Scholar = 12, IEEE = 8, Elsevier = 4, and Springer = 3. The study also evaluated the papers' titles, abstracts, and keywords. The study links fifteen articles to the field of machine learning. Figure 1 depicts a bar chart emphasising research trends in deep learning publications throughout the years under consideration.

Review of Machine Learning Approaches for Depression Detection

Adarsh et al. (2023) studied social media posts to find people with depression in "Fair and Explainable Depression Detection in Social Media." The study aimed to find and assess those prone to mental illness and to look for early signs of suicidal thoughts and actions. Reddit's API was used to get the study data. Following data collection and text preprocessing, the study used a primitive neural machine translator (NMT) to reduce noise from the acquired data. The researchers analysed the data for class imbalances after data purification. The one-shot choice technique equalises engagement differential across age and demographic groupings. After filtering, the data is clustered using a Gaussian mixture model, which includes K-means clustering. The program divides the data into two groups: those with suicidal thoughts and those without. Participation dynamics are used to analyse the two clustered groups and verify the degrees of participation displayed by the groups in the source data. The research uses a new ensemble model that combines SVM and KNN algorithms, with built-in interpretability. The paper also includes approaches for fixing noisy labels. This method is a new way to tell apart despair and suicidal thoughts. The study's final categorisation accuracy was 98.05%. The suggested ensemble model ensured impartial data classification.

Vasha et al. (2023) used machine learning to identify depression in social media comments. A dataset of 10,000 unique data points on depression and non-depression was compiled from Facebook text, comments, and single-line messages received in Bangla. The study rated depression as 0 (absent) or 1 (present). All excess was cut. The dataset had about 300 duplicate records. The researchers split the material into two groups. Data training is vital in machine learning. Data mining algorithms were used to assess the information and its depressing nature. Another classification is the test results. 80% of the data was used for training and 20% for testing. The methodology methodically addresses sequential stages of data preparation, data extraction, text processing, and application of classification models.

The data was labelled for machine learning (ML) using a vectoriser to compute inverse document frequency (IDF) and term frequency (TF). The researcher also employed Random Forest (RF), Logistic Regression (LR), Decision Tree (DT), Support Vector Machine (SVM), K-nearest neighbours (KNN), and Multinomial Naive Bayes (NB) to predict melancholy remarks. The TF-IDF feature combination yields the best classification results. The SVM model has the best F1 scores and precision rates, at 0.77 and 0.78. The study efficiently detected depression using classifiers on a dataset of 10,000 unique data points from posts and comments on profiles of people from various groups. The researchers chose not to use larger datasets, even though it would have made the study more efficient. Machine learning may have predicted depression better than deep learning in the investigation.

Angskun et al. (2022) claimed that the number of depressed people rose during COVID-19. Many depressed people find social media a place to share their true sentiments. So, big data analytics on social media is recommended for quickly finding depression instances. This study measured depression using demographic data and opinions expressed by Twitter users over two months after completing the PHQ-9. The detection model was made via machine learning. This study examines five machine learning methods: SVM, DT, RF, naive Bayes (NB), and deep learning (DL). According to the research, the Random Forest method was more accurate than other methods in detecting depression. This study contributes to the existing literature by proposing a new model that includes Twitter users' text sentiment and demographics. The model may accurately portray the gloomy feelings of depressed people. This study is a big step towards reducing suicide rates linked to depression.

Gupta et al. (2022) studied social media's psychological effects to find signs of depression. The study found that the Internet's growth has led to the widespread usage of social networks like Twitter, Facebook, Telegram, and Instagram as forums for people to communicate their ideas, psychological tendencies, and sentiments. Psychological analysis systematically examines text to find and extract factual data, distinguishing qualities, and relevant information from user opinions. Social networks provide helpful information about a person's cognition at the start of depression, according to the study. These insights include reduced social connections, medical treatment, increased self-focus, and more activities during the day and night. Five machine learning classifiers—DT, KNN, SVM, LR, and LSTM—were used to find tweets with depression. The dataset is balanced and imbalanced, focusing on technical oversampling procedures. The LSTM classification model outperformed other baseline models in detecting depression in healthcare, independent of data balance.

Jayanthi et al. (2022) utilised machine learning techniques, including chatbots, logistic regression (LR), naive Bayes (NB), decision trees (DT), random forests (RF), support vector machines (SVM), and k-nearest neighbours (KNN), to predict depression in individuals. The research aimed to determine the predominant factors contributing to depression. A dataset was created to screen for depression, encompassing 23 sociodemographic and psychological characteristics of 1,429 adults. Multiple feature selection strategies have been employed to identify the critical demographic and psychosocial factors that influence the onset of depression. Utilising five distinct machine learning classifiers. The random forest classifier demonstrates high efficacy in predicting depression among participants. The accuracy is 84%. Advanced feature selection models enhance accuracy. This study characterised depression through an expanded set of attributes and factors.

Chatterjee et al. (2021) used the multinomial naive theorem to find signs of depression in social media posts. The study's findings necessitate swift action on depression by identifying risk factors and using social media. The study aimed to find people with depression on the Internet so that those who need help but are hindered by the aforementioned issues can be identified and treated. The study examined data from tweets and Facebook comments. The study merged the datasets to form a training and testing set. Data is derived via analysing emotional, linguistic, and temporal characteristics. The latter processing is done individually and has numerous features. The dataset was analysed with an NB classifier. Their simplicity and remarkable efficiency as linear classifiers help to explain this. The Bayes theorem is vital to creating the probabilistic model for NB classifiers. Independent datasets give one the label "naive." According to the research, the NB approach provides a precision value of 0.86, a recall value of 0.31, an F-score value of 0.459, and an accuracy value of 0.766.

Chiong et al. (2021) employed a text-based feature technique with machine learning classifiers and social media texts to predict depression. The study looked at various ways to extract and preprocess text data. It also examined various individual and ensemble machine learning classifiers to create a complete model for detecting depression from social media posts. This work trains and assesses machine learning models

using two free Twitter datasets. Three non-Twitter datasets—Facebook, Reddit, and an electronic diary—are also utilised to evaluate the trained models' efficacy in analysing depression-related content on various social media platforms. The empirical results reveal that, even in circumstances when the training datasets do not include explicit terms such as "depression" and "diagnosis" and when unrelated datasets are used for testing purposes, the proposed model can recognise indications of depression within social media texts.

With a consistent rise in the number of people afflicted by this mental health issue, Govindasamy and Palanichamy (2021) claim that the frequency of depression has become a significant cause of worry for modern society. Using Naive Bayes and NBTree machine learning approaches, the paper investigated the identification of depression using Twitter data. This study aimed to find depression indicators among people using information they post on social media sites. Twitter scraper tools helped to gather the data utilised in this study, which was kept in the CSV file format. The starting dataset was cleaned and preprocessed. The data went tokenised, stemmed, and lemmatised as part of the normalising process. Sentiment analysis was then used to examine the data and generate a word score. Two different classifiers—NBTree and NB—have the data entered into them. A comparative analysis was done to determine the best approach for spotting depression; the results were assessed according to the best accuracy metric. The results show that the Nave Bayes and NBTree algorithms have similar performance and produce the same accuracy rate, 97.31%.

Haque et al. (2021) suggested an RF model to predict child and teen depression. The authors think their model is more insightful and accurate than others. The model excels in execution time and the confusion matrix's four criteria. The work's objective was to employ machine learning to discover child depression. Few studies using machine learning (ML) methods have been shown to detect depression in kids and teens aged 4 to 17. Few studies employ a well-chosen high-prediction dataset like Young Minds Matter (YMM). To decrease long-term impacts, early and correct identification of mental diseases, including depression, in children and teens depends on recognising warning indicators. This study incorporates data from the second Australian Child and Adolescent Survey of Mental Health and Wellbeing (2013–2014). The study excluded variables with a binary value and a weak connection to the target variable, the depressed state. The Boruta approach and an RF classifier were used to determine the most important features to predict sadness in a dataset, including tightly correlated variables. Supervised learning models were chosen using the Tree-based Pipeline Optimisation Tool (TPOTclassifier). The study revealed 11 critical characteristics that can diagnose depression in children and teens. Sadness, annoyance, poor interest, weight and sleep changes, psychomotor changes, exhaustion, cognitive or decision-making challenges, suicidal thoughts or acts, and any of the five symptoms are included. The Random Forest technique has beaten past algorithms in accurately predicting depressed classes, with a 99% success rate. A 95% precision rate and 315 ms processing time validated this forecast accuracy. The model's processing time performance varied little, which is significant.

Kumbhar et al. (2021) reported on machine learning for depression identification at the International Conference on Smart Data Intelligence (ICSMDI 2021). Their paper sought to compile the surprising but maybe helpful aspects of depression symptoms manifested utilising social media data. They analysed tweets from Twitter. Logging onto a Twitter account and using the API to get the Twitter database allowed one to compile the tweets dataset. The API transfers database data to a text file. Attitudes and assigned values of 1 for positive, 0 for neutral, and -1 for negative are matched with tweet words. The remaining data was utilised to evaluate the models and project the outcomes after the models underwent training. Once the models have been assessed, the accuracy is computed after building the confusion matrix. Following 3.40 seconds of processing time, the Decision Tree boasts the best accuracy, 98.55%.

Alsagri and Ykhlef (2020) used machine learning to identify depression on Twitter. Predictions are based on tweets and online activity. SVM, NB, and linear kernel DT are machine learning methods. The sadness data from Twitter was examined. A common way to diagnose depression on Twitter is by gathering personal stories from users. The real-time Twitter Search API fetches recent tweets checked by hand. Twitter accounts for both depressed and non-depressed users share information about their accounts and activities. Posts, times, comments, and retweets. Merging tweets into a single text. They built and tested depression-detecting network activity and tweet classifiers. Annotators confirm that these tweets are about the person's sadness, not that of friends or family. You use R version 3.3 for data preparation, extracting features, and classification. Reduce overfitting with 10-fold cross-validated classifiers. Models are tested using a separate set of data. The automated prediction was checked for accuracy using accuracy, precision, memory, F1 scores, confusion matrix, and ROC curves. Studies show that SVM-L has an accuracy of 82% and NB has an accuracy of 80%. A 0.79 SVM-L F measure. SVM had the highest accuracy. Machine learning models that avoid overfitting and other ways to analyse how the 13 traits affect the results were not included.

Priya et al. (2020) presented their research at the International Conference on Computational Intelligence and Data Science (ICCIDS 2019). The study examined the use of machine learning algorithms to predict anxiety, depression, and stress levels in modern society. The researchers analyse relevant literature regarding anxiety, depression, and stress, along with the methodologies and approaches utilised in prior studies. Machine learning algorithms were utilised to determine five specific levels of severity for anxiety, depression, and stress. The researchers employed a standardised questionnaire, namely the Depression Anxiety Stress Scales-21 (DASS-21), to collect data on the prevalent symptoms of anxiety, depression, and stress. Three hundred forty-eight individuals were surveyed via Google Forms to obtain the required data. A total of five distinct classification techniques were employed: Decision Trees (DT), Random Forest Trees (RFT), Naive Bayes (NB), Support Vector Machines (SVM), and K-Nearest Neighbours (KNN). Although Random Forest was identified as the optimal model, Naive Bayes demonstrated the highest accuracy level. The optimal model selection was based on the F1 score, a metric frequently used in contexts with imbalanced classes.

Skaik and Inkpen (2020) studied the difficulty of spotting signs of depression in tweets, as these social media posts often give people a forum to freely express their emotions, ideas, hobbies, and points of view. The researchers developed a model capable of predicting depression among a sample of Twitter users that closely aligns with the demographics of the Canadian population, utilising personal narratives from individuals who self-identified as experiencing depression. There are 1,402 total members of the training sample who freely shared their 2016 depression experience. Using conventional machine learning techniques—Support SVM, LR, RF, Gradient Boosting Decision Trees (GBDT), and

Extreme Gradient Boosting (XGBoost)—in concert with 10-fold cross-validation, the F1-score of 0.961 was produced. This work used the CLPsych 2015 dataset as the test set. With an F1-score of 0.898, the deep learning models used in the investigation produced quite remarkable results. The researchers then used the same methodology on a representative population sample to produce results consistent with the depression numbers published by Statistics Canada for 2015.

Asad et al. (2019) examined depression detection using social media user-generated content. This paper presents a data-analytic paradigm for depression detection. This study uses Twitter and Facebook user-generated content. Users' social media posts were analysed to determine depression severity. NLP, SVM, and NB recognised depression. Depression is linked to serious psychiatric problems, including suicide, according to studies. These studies demonstrate the efficiency of machine learning to detect depression on social media. The study uses a user's account name to assess depression risk by analysing social media comments. The model scored 74% accurate and 100% precise, according to the researchers. It may help depressed people by informing friends and family about their mental health, allowing for appropriate responses.

Arora and Arora (2019) examined health tweets on depression and anxiety. The researchers classified tweets using multinomial naive Bayes (MNB) and support vector regression (SVR) methods. The dataset was compiled from Twitter's streaming service, containing all tweets. The researchers classified tweets expressing despair, anxiety, and mental illness. MNB and SVR classifiers classify health-related tweets from a database, including depression and anxiety tweets. Multinomial Naive Bayes (MNB) classified depression-related health tweets with 78% accuracy, and Support Vector Regression with 79.7%. This study introduces a novel method for effectively recognising tweets related to depression and anxiety from a broad set of tweets, helping people assess their mental health in real life. This new platform encourages patient participation in decision-making to improve healthcare treatment outcomes.

A depression diagnosis and prevention system by Chavan et al. (2019) could identify depression-related terms and phrases in tweets and assess the type of depression. The technology aims to recognise sad tweets. Additionally, it can identify a certain depression type. The system correctly identifies negative and positive posts. The study classifies the tweets using SVM and NB while accounting for emoticons, then produces a graph of the classified tweets with time. This approach helps diagnose and prevent depression. An NB-based SVM classifier with 85% sentiment analysis classification accuracy was found in the study. This hybrid method works well with short and extended extracts.

Gui et al. (2019) identified two barriers to early depression identification among social media users. First, valid depression findings require textual and visual evidence. The second issue is that users' diverse material makes it hard to extract relevant indicator phrases and images. The researcher suggested a novel cooperative multi-agent paradigm to address these difficulties. The suggested method automatically selects related indication phrases and photographs from users' past posts. Experimental results reveal that the proposed strategy reduces errors by 30% compared to state-of-the-art methods. In multiple trials, the study shows that the chosen postings may accurately communicate user despair and that the model can function well in real life.

Kumar et al. (2019) created a supervised learning-based anxious depression disorder prediction model. The model uses linguistic, semantic, and activity factors to assess India student forum tweets from the first 100 followers. The authors classified anxiety-related words as a linguistic indicator and negative tweet quantity and polarity differentiation as semantic indicators. This study analyses tweet temporal and frequency patterns to find anomalies. This study used multinomial naive Bayes, gradient boosting, and random forest classifiers. The final prediction is made via a majority-voting ensemble vote classifier. The suggested Alzheimer's disease (AD) prediction model classifies AD cases with 85.09% accuracy. The model's F-score of 79.68% shows its AD prediction precision and recall balance. The model predicts favourable outcomes for anxious depressive disorder patients.

Li et al. (2019) introduced a model designed to automate the prediction of clinical outcomes for individuals diagnosed with depression. The employed method is crucial for improving the accuracy of depression identification and treatment. Employing machine learning techniques alongside the manipulation of electroencephalogram (EEG) features improves the precision of depression detection. As a result of implementing the ensemble model and employing power spectral density, the highest accuracy achieved was 89.02%. The deep learning algorithm attained a maximum accuracy of 84.75% based on the conducted activity. The experimental results in this study provide evidence for the efficiency of the proposed techniques. These findings suggest that electroencephalography (EEG) may be a reliable measure for identifying individuals with depression. This study facilitates the future development of portable EEG-based systems for depression recognition.

Tadesse et al. (2019) examined the identification of posts concerning depression within a Reddit social media forum. This study aimed to analyse Reddit posts to identify variables indicative of depressive attitudes within the online community. The researchers employ natural language processing (NLP) methodologies and machine learning algorithms to train the dataset and evaluate the effectiveness of the proposed approach in achieving these objectives. The application of the SVM classifier alongside the Bigram feature demonstrates significant efficacy in depression identification, achieving an accuracy rate of 80% and F1-scores of 0.80. The optimal performance achieved in diagnosing depression resulted in an accuracy rate of 91% and F1-scores of 0.93. The research findings indicate that careful feature selection and the investigation of various combinations of these features can lead to substantial improvements in performance.

An automated depression diagnosis system by Alhanai et al. (2018) replicates an interview between a subject and an agent, learning from questions and responses. The study modelled audio and text sequences from a human-virtual agent interaction to diagnose depression. Considering the potential benefits of these methodologies, the authors felt forced to perform data-driven modelling without supposing that a topic was settled. Audio and text transcriptions from 142 depression screenings by a human-operated virtual agent were used. The dataset was divided into training (57%, 107 subjects), development (19%, 35 subjects), and testing (25%, 47 subjects). The DAIC public release lacked test set annotations, hence all models were assessed using the development set. For depression detection, the authors used an LSTM neural network model to assess audio-text interactions. Sequential modelling of interactions, with minimum awareness of the interview structure, revealed melancholy, comparable to methodologies that clearly described the contents of the enquiries and responses.

The study by Islam, Kamal, et al. (2018) examined the utilisation of social network data for the application of machine learning techniques in the detection of depression. The use of social network data to investigate the history of depression has gained significant recognition; however, there are still aspects that have not been explored. This study aimed to investigate the phenomenon of depression through the analysis of Facebook data sourced from a publicly available online platform. The analysis utilised MATLAB 2016b. The research utilised four main classifiers: SVM, KNN, DT, and Ensemble. The results indicate that the Decision Tree algorithm demonstrates greater accuracy in numerous tests compared to other machine learning methods for identifying disorders associated with depression. Machine learning technologies have demonstrated effectiveness in providing solutions for mental health issues among Facebook users.

Islam, Kabir, et al. (2018) investigated the prevalence of depression among various Facebook users. Despite the exploration and implementation of various strategies for identifying depression, Islam, Kamal, et al. (2018) argue that accurate detection through social network data remains essential. This study investigates the potential utilization of Facebook data alongside KNN classification methods for identifying depressive feelings. The study employed various KNN classifiers, including Fine KNN, Medium KNN, Coarse KNN, Cosine KNN, Cubic KNN, and Weighted KNN. This study examined the efficacy of employing Facebook data for the detection of depression through various KNN algorithms. The results indicate that the performance of different KNN techniques and the ground truth dataset differs by 60% to 70% across various metric levels. The researchers anticipate that their study and methodology may enhance users' awareness in online social networks.

Katchapakirin et al. (2018) report that approximately 1.5% of Thai individuals experience depression, a figure that is rapidly increasing. The study reports that fewer than 50% of individuals experiencing this emotional difficulty have access to mental health services, despite its significance as a psychological issue. The objective of the research was to develop a detection algorithm as an innovative psychiatric instrument. This study examined the efficacy of the proposed algorithm in determining an individual's depressive state based on their Facebook posts. The evaluation's findings indicate that the accuracy of the SVM model was slightly higher than that of the majority vote, which acted as the benchmark for the evaluation. The model suggests that individuals who frequently post neutral microblogs on Mondays may encounter feelings of despair.

Aldarwish and Ahmad (2017) investigated the efficacy of social media posts in predicting depression levels. The researchers aimed to determine the feasibility of using posts from social networking site (SNS) users to classify their mental health levels. This paper presents a model that employs two SVM classifiers and one NB classifier to classify user-generated content (UGC). This study proposes the creation of a web-based application designed to classify social networking service users into four distinct levels of depression. This online application may be utilised by psychiatrists, as well as by the patient's family and acquaintances. The web application collects user-generated content from patients' social media accounts, specifically Facebook and/or Twitter. The proposed method demonstrated adequate precision; however, it showed deficiencies in accuracy and recall.

Deshpande (2017) conducts research utilising emotion-based artificial intelligence on Twitter to diagnose depression. This study analyses emotions in Twitter feeds, specifically focusing on depression, through the application of natural language processing techniques. SVM and NB classifiers have been utilized. By employing a meticulously selected vocabulary to identify signs of depression, each tweet is classified into one of two categories: neutral or negative. The results demonstrate that multinomial Naive Bayes attained the highest performance in the classification task, with an F1-score of 83.29. Conversely, SVM produced a lower F1-score of 79.73. The performance of SVM is inferior to that of multinomial naive Bayes regarding precision and recall.

Grover and Verma (2016) investigate the utility of social media for the early detection of major depressive disorder (MDD) in individuals' online identities before its clear manifestation. This study utilizes a crowdsourced method to compile a list of Twitter users who report their experiences with depression diagnoses. The classification of 2.5 million tweets in the study achieved an accuracy rate of 81% and a precision score of 86%. The research findings indicate that this method shows potential effectiveness in developing predictive tools for evaluating an individual's vulnerability to depression. These tools can be utilized by medical professionals, individuals with concerns, and healthcare institutions to aid in the diagnosis of the condition.

Nadeem et al. (2016) categorized attitudes towards social media use into three distinct groups: positive, negative, and neutral. Their research developed a text-mining tool to identify six emotions expressed by Twitter users: happiness, sorrow, anger, contempt, fear, and surprise. The study demonstrated that the program achieved an accuracy of 83% across 105 tweets. An improved model in the training data is essential for achieving higher accuracy. The Twitter API enables the text mining application to effectively extract data from the platform. The test results indicate that particular phrases and an increased volume of training data enhance accuracy in emotion identification, as they more effectively encapsulate the emotional events encountered in daily life.

This review examines machine learning-based depression detection methods. This study identified early-stage depressive symptoms on social media. Textual data study on depressive symptoms is promising, but difficult to acquire. Most researchers used one machine-learning method, although some hybridized two or more.

Table 1: Summary of related literature

Authors/Year	Techniques	Dataset	Outcome	Limitation/Weakness
Rehmani et al., 2024)	SVM, SVM-RBF, RF & B ERT	Facebook and Twitter	The experimental result of the study shows that the SVM outperformed other models with an accuracy of 0.84%.	The researchers manually created a dataset of Roman Urdu for non-structural language for the study.
Khan & Alqahtani, 2024	LR & SVM	Twitter tweets.	The findings demonstrate that the suggested models accurately identified depressive symptoms.	There is an absence of a control group to compare the performance of the suggested models, and the usage of only one dataset.

Authors/Year	Techniques	Dataset	Outcome	Limitation/Weakness
Adarsh et al., 2023	KNN & SVM	Reddit	The presented ensemble approach ensures that the data classification is not skewed, leading to the study's ultimate classification accuracy of 98.05%.	Men from the United States between the ages of 18 and 49 make up the majority of Reddit users.
Vasha et al., 2023	DT, K-NN, LR, RF, SVM, & MNB classifiers	Facebook posts and comments in the Bangla language	The result found that SVM is the best machine learning (ML) algorithm with accuracy.	The study was limited to data from comments and posts on Facebook in the Bangla language.
Angskun et al., 2022	DL, DT, NB, RF & SVM	Twitter	The experimental findings revealed that the RF approach was more accurate than other ML techniques at detecting depression.	The model cannot retrieve private information like direct messages or information users don't wish to publish.
Gupta et al., 2022	DT, K-NN, LSTM, MLR & SVM	Tweets	The LSTM classification model performs better than the other baseline models for balanced and unbalanced data.	Many people do not use social media, and because of that, they remain undiagnosed.
Jayanthi et al., 2022	Chatbots, LR, NB, DT, RF, SVMs & KNNs	Survey	The analysis showed that Random Forest achieved its highest accuracy of 84% in predicting depression.	The dataset was insufficient to provide efficiency and effectiveness for the models tested.
Chatterjee et al., 2021	NB	Facebook	The research's conclusion led to the classification of the degree and severity using NB.	The study focused on the classification of the level and degree of depressed Facebook posts.
Chiong et al., 2021	LR, LSVM, MLP & DT	Twitter, Reddit & Victoria's Diary	The findings show that the suggested method may accurately identify depression in texts using social media.	The strategy is restricted to training the classifiers using annotated datasets.
Govindasamy & Palanichamy, 2021	NB	Twitter	The NB Tree identifier correctly distinguishes between depression and non-depressive tweets with a 97.31% accuracy rate.	The study's outcome is limited to the text only and does not target specific tweets.
Haque et al., 2021	RF, XGB, DT & Gaussian NB	The second Australian Child and Adolescent Survey of Mental Health and Wellbeing 2013–2014	Regarding predicting pediatric and teenage depression, the RF-based prediction model is more reliable and instructive.	The study was limited to detecting depression in children and young people between the ages of 4 and 17 years.
Kumbhar et al., 2021	SVM, RF, DT, K-NN & NB	Tweets	The findings indicate that DT has 98.55% accuracy after a processing time of 3.40 seconds.	The use of more datasets will provide more efficiency and effectiveness.
Alsagri & Ykhlef, 2020	LSVM, DT & NB	Twitter	The best outcomes are provided by SVM-linear, with an accuracy of 82.5% and an F-measure of 0.79.	The study did not use unusual ML models to overfit the data and establish a more reliable approach to measure feature influence.
Priya et al., 2020	DT, RFT, NB SVM & K-NN	DASS 21 via Google forms	RF was found to have a better model, whereas NB was shown to have the highest accuracy.	The study used a limited dataset of 348 participants to test the models.

Authors/Year	Techniques	Dataset	Outcome	Limitation/Weakness
Skaik & Inkpen, 2020	GBDT, LR, RF, SVM, & XGBoost	Twitter	XGBoost delivers the highest accuracy and precision of 96.4% and 0.956, respectively.	The study objective was limited to detecting depression in the Canadian population.
Al Asad et al., 2019	NB & SVM	Twitter & Facebook	The model has an accuracy of 74% and a precision of 100%.	The algorithm necessitates a user's username and analyses their posts to forecast their degree of despair.
Arora & Arora, 2019	Multinomial NB & SVR	Tweets	The study's findings indicate that when it comes to identifying health tweets for depression, multinomial NB has an accuracy of 78% and SVR has a greater accuracy of 79.7%.	The accuracy of MNB and SVR classifiers was assessed using two class labels, such as positive and negative tweets. .
Chavan et al., 2019	NB & SVM	Twitter	Naive Bayes and Support Vector Machine classifiers achieve 85% accuracy in sentiment analysis categorisation tasks.	The analytical dataset was small. A huge dataset improves analytical efficiency.
Gui et al., 2019	CNN & GRU	Twitter	The experiment's findings demonstrate that the recommended approach performed significantly better than the current approaches (error reduction of more than 30%).	The study focused on the process of identifying sadness using text- and graphic-rich tweets.
Kumar et al., 2019	Multinomial NB, RF, Gradient Boosting, Ensemble Vote Classifier	Twitter	This finding suggests a supervised learning-based prediction model.	Just 100 chosen users' tweets from a single month were used to test the algorithm.
Li et al., 2019	RF, K-NN, SVM & CNN	HCGSN & MINI	The outcomes show that EEG is a reliable indicator for diagnosing depression and show how successful the recommended methods are.	The study used a small dataset. Only 28 persons participated, 14 of whom had depression and 14 without.
Tadesse et al., 2019	Ada boost, LR, MLP, RF & SVM	Reddit	The MLP classifier is the best at diagnosing depression on Reddit, with 91% accuracy and 0.93 F1 score.	The investigation focused solely on information derived from Reddit posts.
Alhanai et al., 2018	LSTM	Interview, i.e., Audio and Text-based	The analysis indicates that the F1 score is 0.44 and the precision is 0.59%.	The study concentrated on the modelling of audio and textual interviews.
Islam, Kabir, et al., 2018	DT, SVM, Ensemble & KNN	Facebook	Decision Trees are more efficacious in detecting depression.	The researcher concentrates exclusively on Facebook posts.
Islam, Kamal, et al., 2018	KNN	Facebook	Different KNN algorithms and the ground truth dataset yield 60–70% different results depending on the metric level.	The researchers exclusively employed KNN classification.
Katchapakirin et al., 2018	DL, RF & SVM	Facebook	The study found that RF and DL performed better, with an accuracy of 84.6% and 85%, respectively.	The sample size for this study is tiny due to Facebook constraints, and obtaining the dataset has become challenging.

Authors/Year	Techniques	Dataset	Outcome	Limitation/Weakness
Aldarwish & Ahmad, 2017	Rapidminer, SVM & NB	Twitter and Facebook	The study exhibited minimal accuracy despite attaining commendable precision.	The researcher examines sentiment analysis, SVM, and Naive Bayes results.
Deshpande, 2017	NB & SVM	Twitter	The study found that multinomial NB had the highest F1 score, 83.29, while SVM scored 79.73.	Supervised learning classification cannot match human accuracy with text data.
Grover & Verma, 2016	Rule-based engine, SVM & NB	Punjabi Textual	The proposed approach accurately detects Punjabi language emotions.	The research focuses exclusively on small-scale regional texts in the Punjabi language.
Nadeem et al., 2016	DT, SVM, NB & LGR	Tweets	In comparison to alternative procedures, NB and LGR yield more favourable results.	Twitter was utilised solely for the assessment and prediction of major depressive disorders in individuals.

Data Analysis and Reporting

This section uses graphs and charts to present the analysis findings and address the research questions. Based on the aforementioned study questions, the analysis of data and reporting are as discussed below.

Question 1: What are the trends in ML research for identifying depression?

Figure 1 below depicts the research trends of Machine learning models in detecting depression.

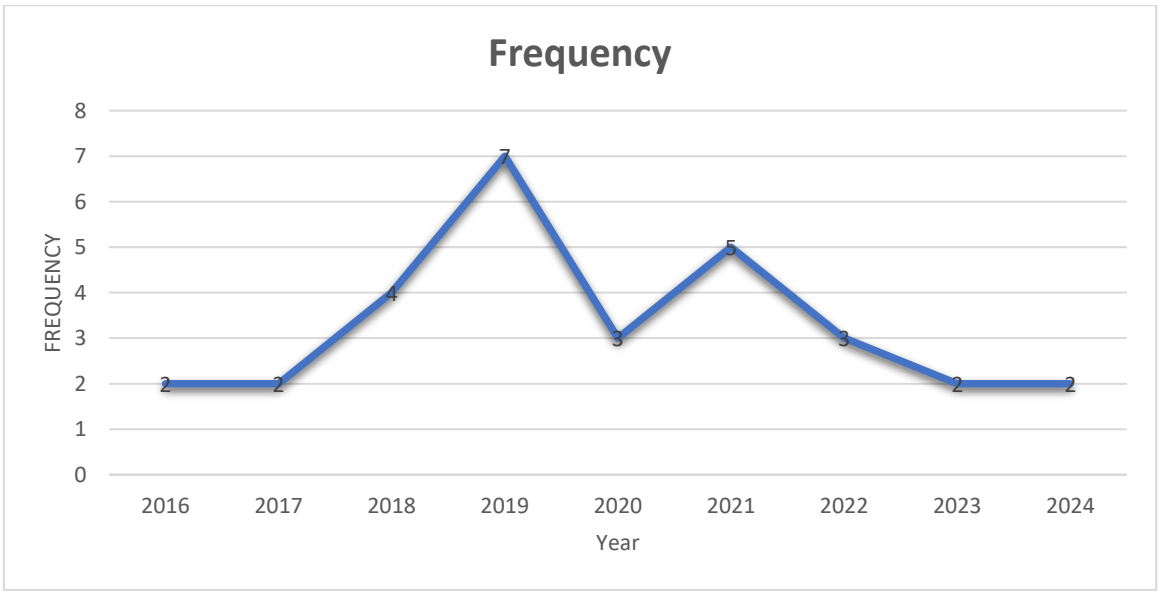

Figure 1: Research Trends in ML

Figure 1 shows that the use of machine learning approaches in depression detection has increased from 2017 to 2019. There is a decrease between 2019 and 2020. There was also a slight increase between 2020 and 2021. However, there was a slight decrease in machine learning research from 2021 to 2023. There is the same amount of research on depression detection in 2023 and 2024. The highest number of publications in machine learning was in 2019, which was 7 publications. The recent development of AI technologies, such as deep learning to predict depression and related mental disorders using large datasets, has contributed to the decrease in research interest in machine learning applications in depression detection. Figure 1 depicts the research trends during the study periods.

Question 2: What has been the focus of machine learning research on depression detection?

Figure 2 below presents the focus of machine learning research related to depression detection, prediction, classification and analysis in percentage.

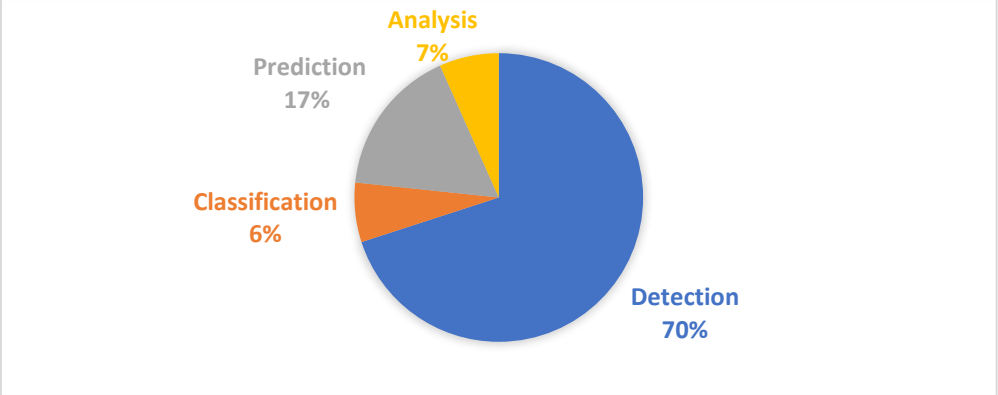

Figure 2: Research Focus in DL

Figure 2 illustrates that considerable machine learning research focuses on depression detection; 70% of the studies feature an early depression detection component. Early detection can provide information on individuals with depression, which will help provide medical attention and prevention. Additionally, identifying depressed individuals might provide insight into other connected mental illnesses and conditions that are linked to severe mental health issues and fatalities. Using machine learning to predict depression accounted for 17% of the study. The percentages for depression analysis and classification are 7% and 6%, respectively. According to this study, most research focuses on early depression detection, whereas few studies focus on the prediction level.

Question 3: Which machine learning algorithms were mainly applied to analyse depression detection?
Figure 3 below shows the percentage of how machine learning algorithms were frequently used in depression detection.

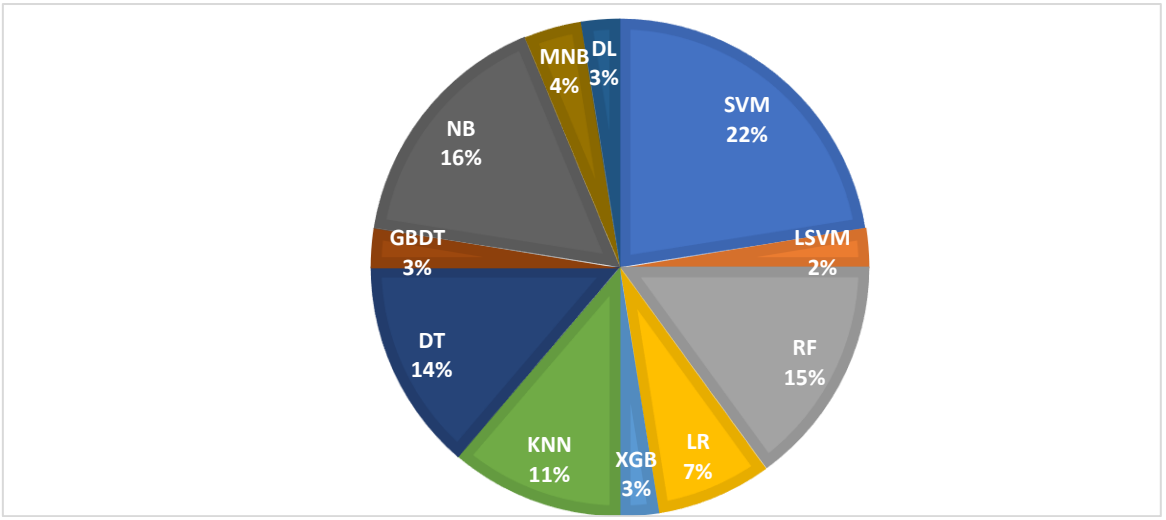

Figure 3: Machine Learning Techniques

Figure 3 depicts researchers' use of machine learning approaches for depression detection. It displays the most popular machine learning algorithms used recently to study depression detection. The most significant percentage of researchers, 22%, use Support Vector Machines, while 16% Naïve Bayes, 15% employ Random Forest, and 14% Decision Tree approaches. Additionally, the data showed that 7% of the study employed Logistic Regression and 11% used K-Nearest Neighbors. The XGBoost, Gradient Boosted Decision Trees, and Random Forest have 3% each, respectively. Multinomial Naive Bayes, 4% and Linear Support Vector Machine methods have 2%. Most research included two or more machine learning models for their evaluation. SVM, NB, RF, D, and KNN are the most commonly used models in the studies. These models were used to identify, predict, analyse, and classify depression using surveys, social media, or the DASS-21 datasets.

Question 4: Which datasets were employed to train machine-learning models for detecting depression?
Figure 4 below presents the percentage of datasets used by researchers in identifying the presence of depression among victims.

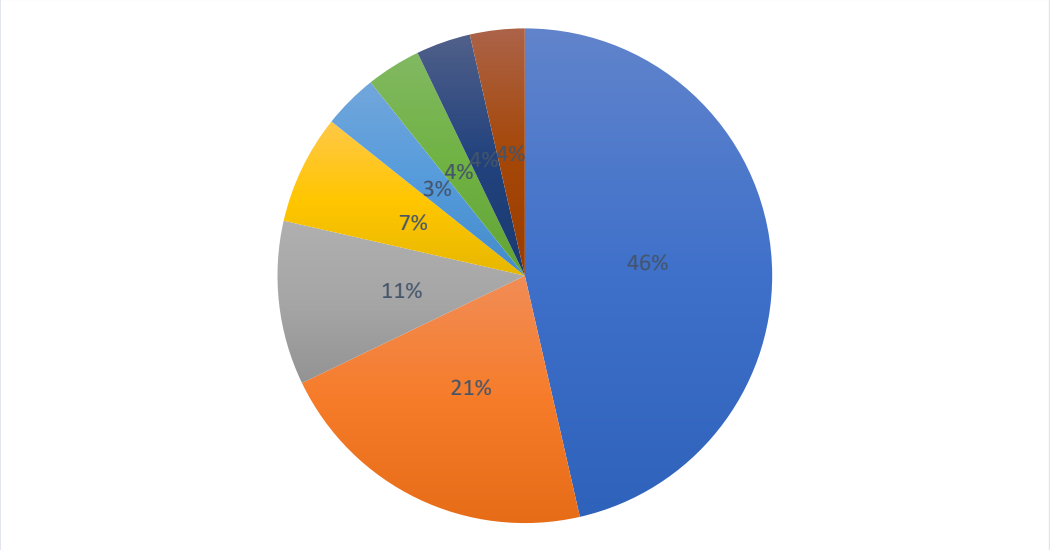

Figure 4: Data Source of DL

Figure 4 shows the source of the data set utilized to identify, predict, analyse, and evaluate the effectiveness of using machine learning for depression detection. Social media accounted for the majority of the data sources. According to the chart, Twitter tweets accounted for 46% of the data source. Facebook 21%, Reddit 11%, and a survey accounted for 7% of the data. HCGSN & MINI, Interview, and Punjabi text have 4% each. DASS 21 uses Google Forms to account for 3% of the total. This finding indicates that Twitter provided most of the data to detect depression. The result demonstrates that using Twitter to obtain massive datasets for free is easier. Model testing requires large datasets to provide a high degree of accuracy. Due to the challenges of data accessibility, the researcher often used data from free sources.

RESULTS AND DISCUSSION

Depression detection using machine learning algorithms has been. The cases of depression and related mental health illnesses have been on the rise globally. Researchers have used combinations of multiple ML models to detect, identify, predict, analyse and categorize depression. Figure 2 shows that most machine learning research focuses on depression detection; 70% of the studies feature an early depression detection component. SVM, NB, RF, D, and KNN are the most commonly used machine learning models, often used as single or hybrid models to assess their strengths and weaknesses. Figure 3 shows that researchers use SVM as the most significant model with 22%. The most common datasets from the journals reviewed are Twitter, Facebook, Reddit and surveys. Figure 4 shows that 46% of the datasets used for depression detection were from Twitter, 21% from Facebook, 11% from Reddit, and 7% data from a survey. Figure 1 indicates that the highest number of research related to ML on depression detection was in 2019. This study will assist medical professionals, psychologists, the government, and policymakers in identifying victims of depression. Future researchers can use the findings of this review to determine research gaps and future research directions.

CONCLUSION

The use of machine learning approaches to detect depression by many researchers has been demonstrated to be efficient in the identification of victims of depression. A comprehensive literature review on using machine learning algorithms for depression detection has described the prevailing detection algorithms used to detect and predict depressive states in individuals. The findings reveal that most studies employed diverse models, including SVM, NB, RF, D, and KNN. The various datasets used to detect depression are social media data, surveys, DASS-21, HCGSN & MINI, interviews, and Punjabi text. Further reviews are necessary to discover the specific domains where machine learning in depression detection necessitates further study. Researchers should focus on implementing a range of models and combinations of two or more models that will produce enhanced results in identifying individuals with symptoms of depression. This will aid researchers, governmental bodies, and healthcare professionals in the detection and treatment of depressed individuals.

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