A

SEMINAR REPORT

ON

"Machine Learning Algorithms for Analysis and Prediction of Depression"

By

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A
Seminar Report
On

"Machine Learning Algorithms for Analysis and Prediction of Depression"

In partial fulfillment of requirements for the degree of

Bachelor of Technology

In

Computer Engineering

Submitted By:

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[2020-21]

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SVKM's Institute of Technology, Dhule - 424001

CERTIFICATE

*This is to certify that the seminar entitled "**Machine Learning Algorithms for Analysis and Prediction of Depression** has been carried out by Ms. Mohini Kilaskar, Ms. Neha Saindane, Mr. Nabeel Ansari, Mr. Dhaval Doshi for Subject **Seminar (BTCOS509)** under the guidance of **Prof. Mayuri Kulkarni** in partial fulfillment of the requirements for the degree of Bachelor of Technology in Computer Engineering of Dr. Babasaheb Ambedkar Technological University, Lonere during the academic year 2020-21(Semester-V).*

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Place: Dhule

Seminar Guide	Department Coordinator	Principal
Prof. Mayuri Kulkarni	Prof. Khalid Alfatmi	Dr. Nilesh Salunke

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Under these responsible and talented personalities. I was efficiently able to complete my seminar in time with success.

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ABSTRACT

Today, depression is one of the critical mental health problems faced by humans of all ages and gender. In this era of increasing technology, it causes a life of less physical work, continuous pressure on one's life, which creates a risk of intellectual disturbance. The work culture, peer pressure, stressful life, emotional imbalance, family disturbances, and social life is resulting in depression. Depression may also sometimes lead to a heart attack. Depression causes adverse effects and becomes a serious medical problem in how individuals feel and act in everyday life. This psychological state causes feelings of sadness, anxiety, loss of interest in things and jobs, and could barely result in suicide. In this paper, the analysis of different Machine Learning Algorithms has been done and compared them by selecting various parameters and then showing which algorithm is more accurate for predicting depression.

Keywords: Machine Learning, Depression, XGBoost, SVM, Logistic Regression, Random Forest

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CHAPTER - 1

INTRODUCTION

Everybody in the world is facing extensive pressure due to work, family, person-al life, etc. It leads the stress in life. Due to this, it affects the individual's medical, personal, professional experience. Affecting medical life leads to emotional im-balance. Some persons easily cope up with such inequality. But some of them do not easily cope up with the situation. Because of this, they move toward mental health disease called depression. This reason makes depression very common around the globe. Worldwide, more than 264 million people of each age have depression [1]. Depression is one of the major contributors to disability to the global burden of disease. The primary and extensive reasons for depression in men and women are as follows:

1. Women are more sensitive in interpersonal relationships, whereas men are more sensitive to their careers and goals.
2. Women tend to contemplate, which may lead to developmental illness. In contrast, Men react to hard times by supporting fishy techniques like an-ger, alcohol, or drug misuse.
3. Women have more emotional quotient in comparison with men, which results in relationship problems.
4. Due to work pressure and household chores, women are less aware of their physical and psychological constraints, due to that she feels more burdened.

From the analysis, it came to know that women get more affected by depression than men, due to this depression the (possible actions) reason why the person thinks of suicide. Depression can result in suicide. Depression is different from regular mood shifts, and emotions that are for a short time will lead to challenges of the standard of living. Specifically, when it lasts for a long time and with medium or high intensity, depression will become a severe psychological health problem. Nearly 8,00,000 people commit suicide each year. Suicide is the second leading cause of death in 15-29 years old [3].

The problem of depression and other psychological state conditions is increasing worldwide. During depression person feels a loss of interest and pleasure, and less energy,

resulting in a decreased workflow for weeks. Many people also suffer from anxiety symptoms, less and disturbed sleep and appetite, and lots of have feelings of low self-worth, guilt, less concentration [1]. Nearly two out of three people suffering from depression do not participate or receive proper treatment [3].

Prior detection of psychological disorder helps to start treatment at an early stage and improves the person's life as well as his/her family. The psychological state handles strain in an individual's life and is very important for making choices in each life stage. The psychological condition is critical in every step of life, whether it's childhood or adultism. An excellent psychological state will support a person to give its full potential in life. It also helps the person to cope up with stress in life. It shall increase the productivity of the people [8].

As per the prediction of the World Health Organisation (WHO), by 2030, depression will be one of the second leading disabilities [4], [5]. Although very much prepared specialists, clinical and mental medicines are accessible for depression treatment, people or families are hesitant to stand up/arrive at specialists about this problem for different social reasons. Diagnosis of depression disorder includes several visits with patient and patient's family, clinical analysis, questionnaires, which are time-consuming and need to have well-trained specialists. In this present generation of Machine learning, automated depression detection is not complicated and deployed quickly. The automation should use less re-sources, provide accurate results with more reachability [4].

CHAPTER -2

LITERATURE SURVEY

Different ways to analyze depression are as follows:

Anees Ul Hassan, Jamil Hussain, Musarrat Hussain, Muhammad Sadiq, and Sungyoung Lee have proposed that people use social networking sites to express their thoughts, feelings, and many more so. Here Twitter is a social site that al-lows users to tweet statements up to 140 characters. The sentimental analysis helps determine the emotion behind a series of words and teaches Machine Learning techniques to analyze those meanings. Four main components are pre-processing, feature extraction, meta-learning, and training data. In pre-processing, a paragraph gets converted into sentences, and sentences get convert-ed into words, and then from those words, stop words get removed. Stop words are useless words and do not bring enough meaning, for example. And, of, is, from, in, on, over, under, etc. are stop words. The feature detection from text is related to a name or a sequence of words that can be a feature or not [9].

Some of the feature extraction methods are N-grams, Parts of Speech (POS) Tagging, Negation, Sentiment Analyzer. In Meta-Learning, Voting is the easiest way to combine the predictions from multiple machine learning algorithms. Here three classifiers, Support Vector Machine, Naive Bayes, and Maximum Entropy classifiers, are used as learners. Training data includes training datasets, i.e., negative, positive, feature extractor, and word features. There are two datasets included, i.e., the Twitter dataset and 20 newsgroups. Graph 2.1 shows the Machine Learning Algorithms with their accuracy [9].

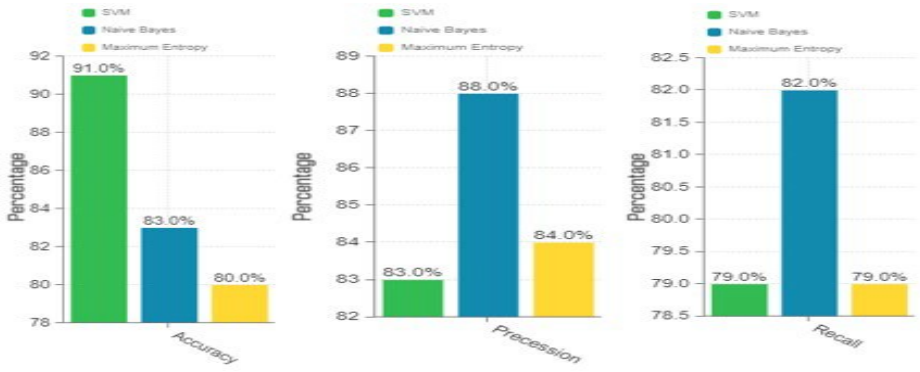

Fig 2.1: - Performance Analysis Graph

"Machine Learning Algorithms for Analysis and Prediction of Depression"

Anna Maridaki, Anastasia Pampouchidou, Kostas Marias and, Manolis Tsiknakis developed a framework based on the dataset provided by AVEC'14 for depression analysis. The proposed work presents two different motion representations: 1) Gabor Motion History Image (GMHI), and 2) Motion History Image (MHI). Various combinations of low-level features get extracted from both representations. These features get further used for training and testing with different ma-chine learning techniques. The proposed approach got an F1 score of 81.93%, both for MHI and GMHI, with Support Vector Machine. The achieved performance is like state-of-the-art approaches, while manages to outperform several others. Except for accomplishing a competitive performance, the proposed work explores various combinations of the investigated motion representations and classifiers [2].

PCA method decreases the feature dimensionality of the data by casting the data into a lower-dimensional space. The smaller feature set gets used as the extracted features for the classification step. The feature extraction step's feature vector is operated by a selected classifier to evaluate the system in the classification step. The machine learning algorithms Naïve Bayes, k-Nearest Neighbors, Random Forest, and Support Vector Machine gets tested. The below graph shows the F1 score results implemented in classifiers for MHI [2].

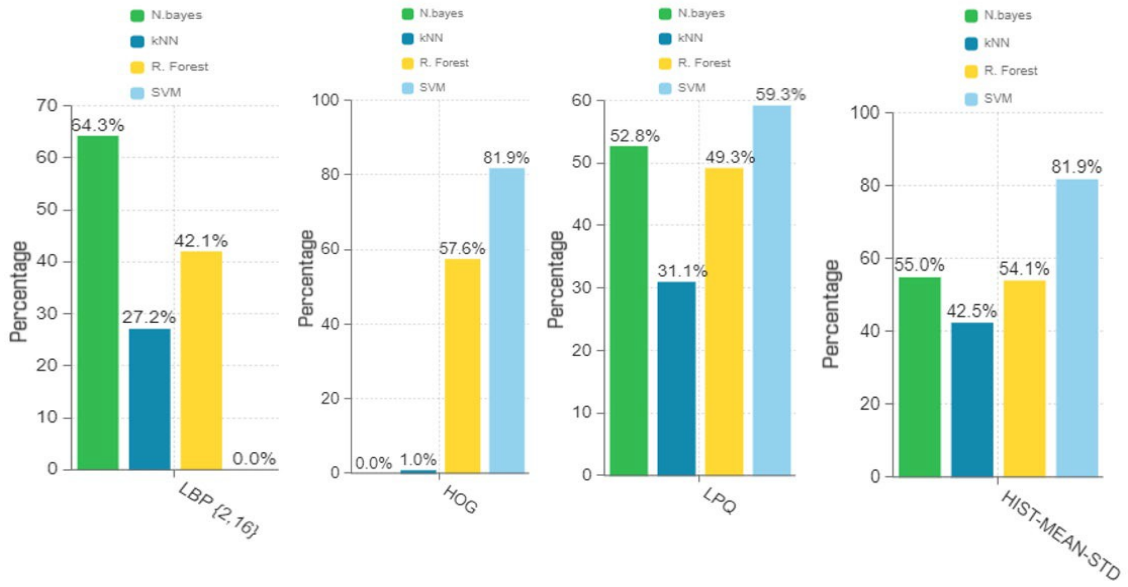

Fig 2.2: Graph for F1 score results implemented in classifiers for MHI

Vanishri Arun, Prajwal V., Murali Krishna, Arun Kumar B. V., Padma S. K, and Shyam V. Proposed a system in which they have validated an utterly unique technique for prediction of depression. They collected clinical information from the on-going MYsore studies of Natal effects on Ageing and Health (MYNAH). The participants completed a complete evaluation for psychological feature func-tion, psychological state, and cardiometabolic disorders in south India. This model developed using the XGBoost Machine learning algorithm. The dataset's training and learning are quicker in the XGBoost Algorithm than other prediction algorithms [7].

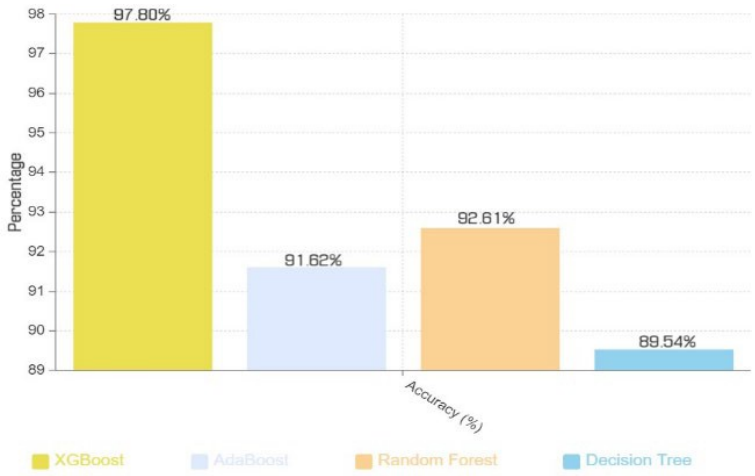

Fig 2.3: Graph of results using MYNAH cohort in various machine learning algorithms

Swati Jain, Suraj Prakash Narayan, Rupesh Kumar Dewang, Utkarsh Bhartiya, Nalini Meena, and Varun Kumar Proposed the suicidal acts system based on the depression level. In this system, they have. By filling of questionnaires, they collect real-time data. Their system uses a questionnaire like PHQ-9, which is an advanced version of it. It covers all characteristics or components and symptoms, leading to depression. Categorizing machine algorithms is used to train and classify it in five stages depending on severity - Minimal or none, mild, moderate, moderately, and severe. Two datasets get chosen, dataset: 1) questionnaires, 2) Twitter tweets. For dataset 1, XGBoost classifier gave the highest accuracy, i.e., 83.87 %, and Logistic Regression gave the lowest, unlike dataset 2 where Logistic regression showed the highest accuracy of 86.45 % because dataset 1 consists of 18 features, which were more than the words on which tweet gets extracted, and model gets trained. Logistic regression starts to falter when there are many features and a good number of lost data. Also, so many categorical variables are a problem for it [6].

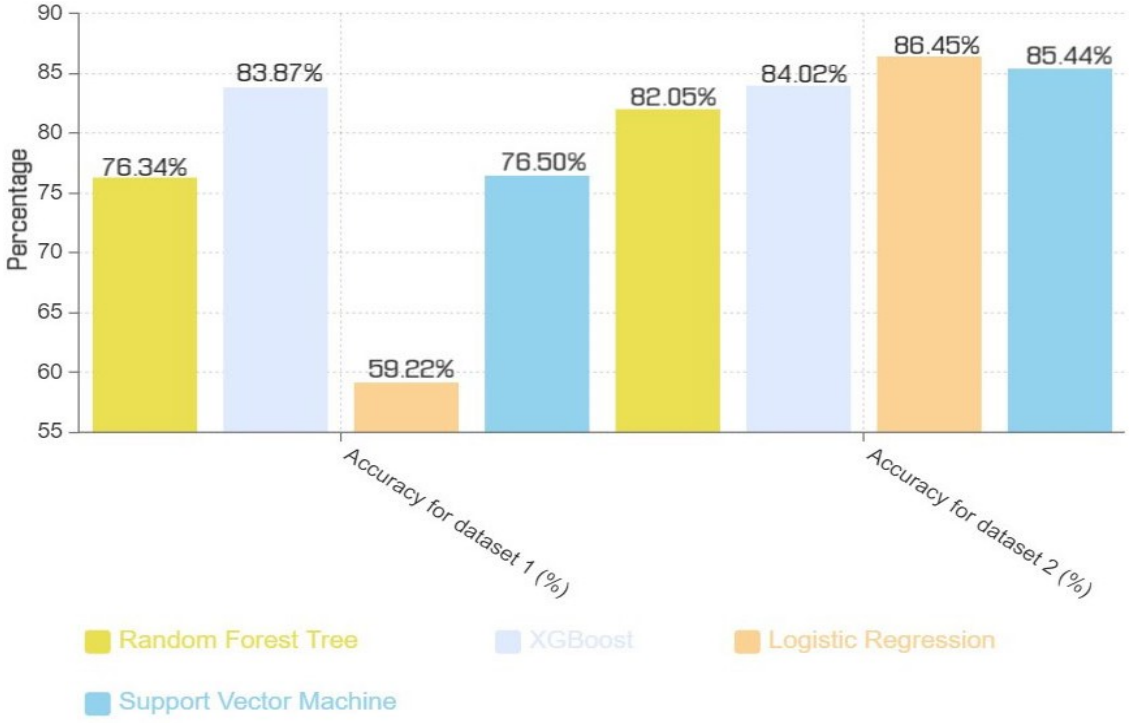

Fig 2.4: Graph for accuracy of algorithms applied to the dataset

Bhanusree Yalamanchili, Nikhil Sai Kota, Maruthi Saketh Abbaraju, Venkata Sai Sathwik Nadella and, Sandeep Varma Alluri have proposed a system in which acoustic feature gets used to training a classification model to categorize a human as Depressed or not-Depressed. DIAC-WOZ database available with the AVEC2016 challenge chosen for training the classifiers. Voice feature gets extracted using the COVAREP tool. SMOTE analysis gets used to overcoming the class imbalance, and 93% accuracy obtained with the support vector machine algorithm, which results in the Depression Classification Model (DCM). An an-droid application cured Deployed on the WAMP server on Amazon Web Service (AWS) cloud is developed to self-assess depression using DCM and PHQ-8 questionnaire. The application was tested on real-time data of 50 persons in the supervision of a qualified psychiatrist, and 90% accuracy got obtained. Three classification techniques, namely Logistic Regression, Random Forest, and SVM, are implemented in the scikit-LEARN toolbox. The evaluation metrics are calculated individually for each classifier-over the DIACWOZ data corpus speech and shown in Fig. 2.5. Finally, the "Depression Classification Model (DCM)" is generated with 93% accuracy on the validation data set

using acoustic features [4].

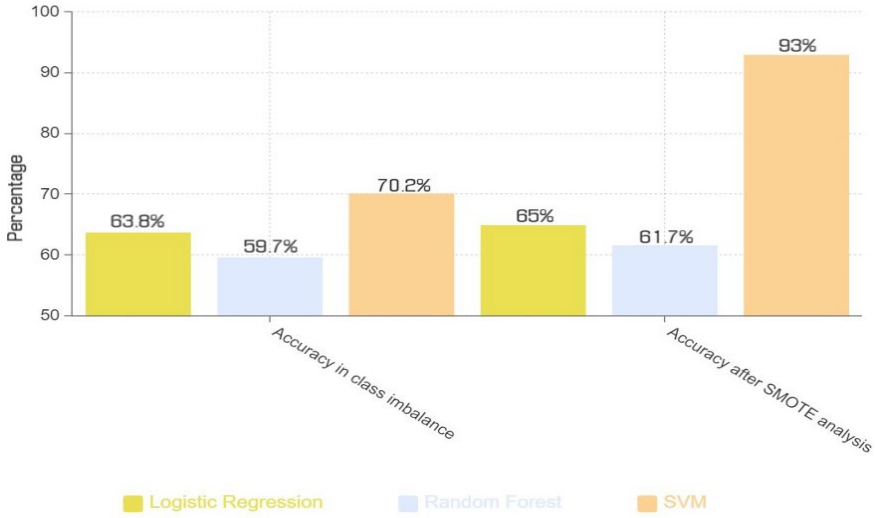

Fig 2.5: Graph for accuracy of classifiers on class imbalance and SMOTE analysis dataset

CHAPTER -3

PROS AND CONS OF PREVIOUS SYSTEM

Title	Author	Pros	Cons
Sentimental analysis of social networking sites (SNS) data using machine learning approach for the measurement of depression [9]	Anees Ul Hassan, Jamil Hussain, Musarrat Hussain, Muhammad Sadiq and, Sungyoung Lee	It uses SVM, Naïve Bayes and Maximum Entropy Classifiers from which SVM showed 91% accuracy which is highest in the twitter dataset	it does not use any other dataset rather than twitter dataset and only predicts depression through twitter and not with other social sites
Machine Learning Techniques for Automatic Depression Assessment [2]	Anna Maridaki, Anastasia Pampouchidou, Kostas Marias and, Manolis Tsiknakis	It shows that with Motion History Image Algorithm combined with SVM had most accurate result i.e., 81.93%	No real-time system is implemented and only through facial expression it can predict depression
A Boosted Machine Learning Approach for Detection of Depression [7]	Vanishri Arun, Prjwal V, Murali Krishna, Arunkumar B. V., Padma S. K. and, Shyam V	It uses dataset collected from MYNAH cohort and tested on XGBoost, SVM, Random Forest and Decision Tree from which XGBoost got highest accuracy i.e., 97.80%	No other dataset is used for prediction of depression and there is no mention of any implemented system that can predict depression automatically
A Machine Learning-based Depression Analysis and Suicidal Ideation Detection System using Questionnaires and Twitter [6]	Swati Jain, Suraj Prakash Narayan, Rupesh Kumar Dewang, Utkarsh Bhartiya, Nalini Meena, and Varun Kumar	For PHQ-9 questionnaires XGBoost gave the highest accurate result i.e., 83.87% and with twitter dataset Logistic Regression 86.45%	For PHQ-9 logistic regression starts to falter because there are many features and a good number of lost data. Also, many categorical variables are a problem for it
Real-time Acoustic based Depression Detection using Machine Learning Technique [4]	Bhanusree Yalamanchili, Nikhil Sai Kota, Maruthi Saketh Abbaraju, Venkata Sai Sathwik Nadella and, Sandeep Varma Alluri	Acoustic based system is implemented where voice features are used and with the help of a psychiatrist depression is detected	The Dataset which is considered for this work is completely based on foreign accent and the model is trained to it

CHAPTER -4

WHAT IS SENTIMENTAL ANALYSIS

Sentimental Analysis is a natural processing technique used to interpret and classify emotions in subjective data. Sentimental analysis is often performed on textual data to detect sentimental details in emails, survey responses, social media data, etc. Sentiment analysis is the process of determining the emotion behind a line of words, used to gain an understanding of the attitudes, opinions, and emotions expressed in a text. It is a way to evaluate written language to determine if the expression is positive, or negative, or neutral. The ability to extract sentiment and emotional insights from social data is a practice that is being adopted by organizations across the globe. Sentimental analysis includes the General questioner, which provides insights toward quantifying patterns in text and, separately, psychological research that examined a person's mental state based on analysis of their verbal behavior.[13]

Sometimes, the structure of sentiments and topics is complex. Also, the problem of sentiment analysis is non-monotonic in respect to sentence and stop-word. In contrast with this issue several rule-based and reasoning-based approaches have been applied to sentiment analysis. Also, there is several tree traversal rules applied to syntactic parse tree to extract the topicality of sentiment in open domain setting.[13]

CHAPTER -5

XGBOOST CLASSIFIER

XGBoost stands for eXtreme Gradient Boosting. XGBoost is a software library that you can download and install on your machine, then access from a variety of interfaces. Specifically, XGBoost supports the following main interfaces:

- Command Line Interface (CLI).
- C++ (the language in which the library is written).
- Python interface as well as a model in scikit-learn.
- R interface as well as a model in the caret package.
- Java and JVM languages like Scala and platforms like Hadoop.[11]

XGBoost Features:

- The library is laser focused on computational speed and model performance, as such there are few frills. Nevertheless, it does offer several advanced features.[11]
- The implementation of the algorithm was engineered for efficiency of compute time and memory resources. A design goal was to make the best use of available resources to train the model. Some key algorithm implementation features include:
    1. Sparse Aware implementation with automatic handling of missing data values.
    2. Block Structure to support the parallelization of tree construction.
    3. Continued Training so that you can further boost an already fitted model on new data.
    4. XGBoost is free open-source software available for use under the permissive Apache-2 license.[11]

Model Features:

The implementation of the model supports the features of the scikit-learn and R implementations, with new additions like regularization. Three main forms of gradient boosting are supported:

- Gradient Boosting algorithm also called gradient boosting machine including the learning rate.
- Stochastic Gradient Boosting with sub-sampling at the row, column, and column per split levels.

- Regularized Gradient Boosting with both L1 and L2 regularization.[11]

System Features:

- The library provides a system for use in a range of computing environments, not least:
- Parallelization of tree construction using all your CPU cores during training.
- Distributed Computing for training very large models using a cluster of machines.
- Out-of-Core Computing for very large datasets that do not fit into memory.
- Cache Optimization of data structures and algorithm to make best use of hardware.[11]

How XGBoost Works

- XGBoost is a popular and efficient open-source implementation of the gradient boosted trees algorithm. Gradient boosting is a supervised learning algorithm, which attempts to accurately predict a target variable by combining the estimates of a set of simpler, weaker models.
- When using gradient boosting for regression, the weak learners are regression trees, and each regression tree maps an input data point to one of its leaf's that contains a continuous score. XGBoost minimizes a regularized (L1 and L2) objective function that combines a convex loss function (based on the difference between the predicted and target outputs) and a penalty term for model complexity (in other words, the regression tree functions). The training proceeds iteratively, adding new trees that predict the residuals or errors of prior trees that are then combined with previous trees to make the final prediction. It is called gradient boosting because it uses a gradient descent algorithm to minimize the loss when adding new models.[12]

CHAPTER -6
PROPOSED WORK

As you have seen, many (or every) authors described depression and provided the solution with their end. We have also researched and understood the points written by them. Here we are going to provide our proposed solution to this.

Firstly, we will discuss "XGBoost." XGBoost is an open-source library that provides a gradient boosting framework for Java, Python, R, Perl, and Scala. It works on Linux, Windows, and macOS. The project description aims to provide a "Scalable, Portable, and Distributed Gradient Boosting Library"[10]. It took Input in Tabular format andexplained in detail, but no such application of XGBoost was mentioned in the papers to predict depression.

This paper shows the smart way to predict depression using Social Media Stories, tweets, voice, searches on the browser, etc. The solution we will describe is it can be an Admin app or Add-on in the browser or an IoT device. The module's primary function is to capture data frequently, so it is necessary to refresh after some consecutive limit of time.

The working of our idea shows in the below figure.

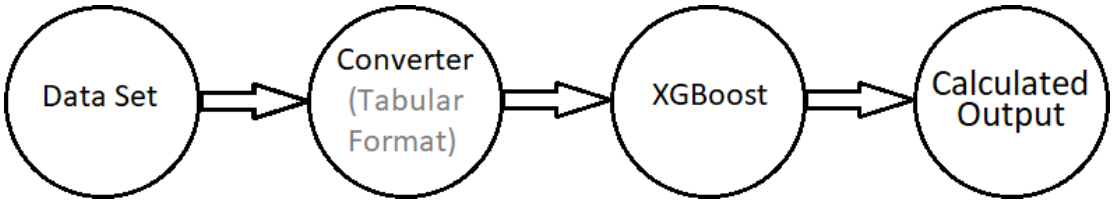

Fig 3.1: Basic Structure of Solution

In the above figure, the Data sets are Social Media Stories, tweets, voice, searches on the browser, etc. The converter is used to calculate the depressive content and convert it into Tabular format (Input can be Images, Texts, and Voices). The last section that is Calculated Output is the part of the solution in which it processes input from XGBoost and reframes it into human-understandable language.

A brief description of the converter is as follows (why how):

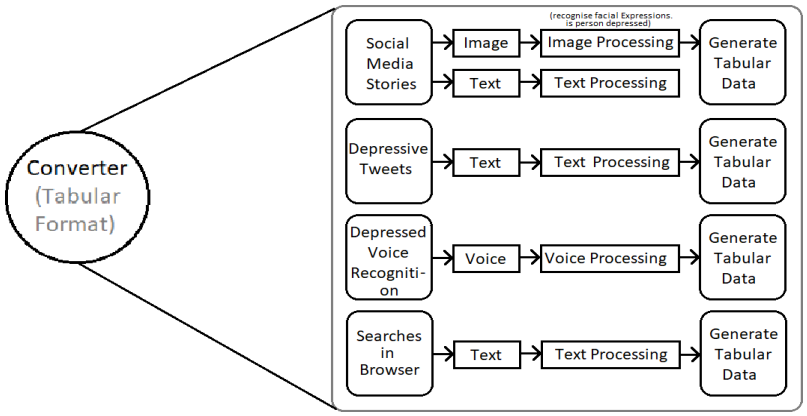

Fig 3.2: Converter Section Functions (Components of Converter)

As the XGBoost is taking input in tabular format so that the dataset's inputs are raw data, we must process it and convert it into a tabular form. Here we need the smart converter. The figure represents the converter's basic structure of converting the raw data into a tabular format. First of all, the Social media stories that have 24 hours are in image format (or a video format, mostly typical depressed person don't put a video on the story), so save it. It is necessary to process and check for depression; now, we use image processing algorithms to identify the facial expressions and check for depression of the person and generate output in tabular format to XGBoost Algorithm. Now the story of social media could also be in text format, so the text would be identified by the text processing algorithm, which checks the depressive words and generates output in tabular form for XGBoost Algorithm as it takes input only in tabular format.

The next one is depressive tweets. Tweets are always in the text format so that input is already in the text format, so check the depressive words in the tweet make it in tabular form so the XGBoost could recognize the data.

Next is Depressed Voice Recognition, Here the inputs are of voice captured by phone microphone is any accessible microphone if possible, call recordings, so the algorithm for detecting depressive voice gets used. It will check the depressive voices in the recorded conversation and convert it to tabular format so that XGBoost Algorithm can recognize it.

The last one is the "Searches in Browser." It mostly happens that the depressive person searches the suicidal contents on the Internet so that the system will capture and process it in an algorithm, check depressive words, and generate output, which will be understandable to the XGBoost(tabular).

CHAPTER-7

FUTURE SCOPE

As the system will be an Admin Application (so it needs to monitor the camera, stories, voice, etc., of the user), it is necessary to gain user trust. Hence tying-up with the trusted IT companies (i.e., Google, Amazon, etc.) is the best solution.

Cloud-based data are memorizing for faster access from anywhere.

Cloud-based parental control will also be the best part for parents to monitor their children smartly.

Video calling depression detection, detection of suicidal activities.

Monitoring financial loss in business, less account balance of well-earning employees, fewer marks obtained by the genius student, etc.

CONCLUSION

The Paper reports machine learning algorithms for analysis and prediction of depression. The algorithm is implemented based on the user's social media data. This paper studied various machine learning algorithms implemented in past years in the depression prediction combined with the machine learning algorithms and learned how they outshined. Future research will get conducted towards upgrading the performance of the system.

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PUBLICATION DETAILS

10.1 PROCEEDING PAPER

Not yet published.

10.2 CERTIFICATE

Estd. in 2001

Conferred Autonomous Status by University Grants Commission (UGC) for 10 years w.e.f. AY 2019-20

ISO 9001:2015 Certified Institute	NBA Accredited Programs	NAAC Accredited Institute with 'A' Grade	AICTE-CII Survey rating in Platinum category for Industry linkages	Among Top 250 Colleges in NIRF Ranking	68th & 78th in All India Rank by Outlook survey published in June 2019 & May 2018 respectively

E- Conference on AI & ML
(Artificial Intelligence and Machine Learning)

(Organised by Department of Information Technology)

EC-AIML-2020

Certificate

This is to certify that Dr./Mr./Ms. Mohini Kilaskar has presented/published a FLP length paper with the title Machine Learning Algorithms for Analysis and Prediction of Depression in the E- Conference on Artificial Intelligence and Machine Learning (EC-AIML 2020) organized during November 27th & 28th, 2020 at Thakur College of Engineering and Technology, Kandivali (E), Mumbai.

Dr. Bijith Marakarkandy
Convenor

Dr. Deven Shah
Program Co-Chair

Dr. B.K. Mishra
Program Chair

10.3 REVIEW RECEIVED FROM JOURNAL/CONFERENCE

---------- COMMENT ----------

SUBMISSION: 3

TITLE: Machine Learning Algorithms for Analysis and Prediction of Depression

AUTHORS: Mohini Kilaskar, Neha Saindane, Nabeel Ansari, Dhaval Doshi and Mayuri Kulkarni

PC MEMBER: Sangeeta Vhatkar

1. English and grammar mistakes need to be corrected. There are lot of mistakes in the paper.
2. All figures/Graphs need to be properly cited with references if its not owned by you.
3. Figure No. and Table no. shall be marked in the paper.
4. Future scope must be written in the paper.

10.4 PLAGIARISM REPORT

Machine Learning Algorithms for Analysis and Prediction of Depression

ORIGINALITY REPORT

27%	5%	25%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS