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"Virtual Self Care Companion – Detection of mental illness using machine learning and deep learning"

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Abstract-

Smartphones are becoming increasingly ubiquitous. The app market is growing in all the fields, including health and medical consultancy. Although mental health care sector has been slow to adopt technology, the availability and use of health care apps has exponentially grown in recent years. The use of mobile apps to treat mental illness is widespread and growing. The main motive of this paper is to present a survey on the existing chatbot applications as well as study the different techniques applied to understand the behavioral change and mood swings of individuals and detect whether or not they have any kind of mental illness .Based on the in-depth survey conducted across 8 different chatbot applications with regards to the features, accessibility, availability and technical specifications ,the research shows that around 70% users were not satisfied with the services provided. Using multiple categorization models, this paper also seeks to improve the accuracy of predictions (such as Logistic regression, Random Forest classifier, decision tree classifier, Stacking, KNN etc.). This research study is aimed toassist the generality, nature and reasons of mental illness at the primary levels of the conditions and the identification of these disorders. Based on data sources, machine learning techniques, and feature extraction methods, the paper presents a critical assessment analysis on mental health detection.

*Keywords:*Mental health; machine learning; smartphones in mental health care; disorder detection; self-analysis; Mental Health counseling.

I. INTRODUCTION

Mental illness is a rising public health concern across the world, with 1 in 3 individuals between the ages of 18 and 40 and 4 in 10 children between the ages of 12 and 17 experiencing mental health issues each year.Due to missed labour and capital productivity, mental diseases are expected to cost $16 trillion globally between 2011 and 2030.There is a global scarcity of mental health human resources, as well as inadequate funding and mental health illiteracy.This scarcity of resources is particularly noticeable in our country.Mental health services reach 25% and 50% of persons in need in poor and developed nations, respectively, according to the World Health

Organization.In nations such as Japan, 65 percent of working individuals suffer from mental illnesses.

This might be a key reason in the rise in suicide behaviour during the last several decades.As a result, new solutions are required to compensate for resource shortages and promote patient self-care.

The global lack of mental health consultants and therapists has pushed the adoption of technical and artificial intelligence breakthroughs to satisfy the requirements of persons with mental health disorders, such as Chat application and mental health Consultancy over Video conference.Most of these hurdles can be solved through technology-based therapy, such as smartphone applications, which can engage hard-to-reach groups.According to a WHO analysis of 15,000 websites and apps, 30% of them focus on mental health disease diagnosis or therapy.

Mobile applications are one technology that provides a partial answer to the worldwide mental health workforce's capacity shortage.

As the use of technology in healthcare grows, new wireless health monitoring gadgets and mobile applications are being developed, posing a threat to the current standard of care.Patients are the most underused resource in health care, and with thecurrent transition to mobile health, this underutilised resource is seeing an increase in utilisation.

. In primary care sectors, there has been a significant growth in the global acknowledgment and acceptance of prevalent mental disease and disorders as serious socio-public health concerns.This is owing to the fact that these illnesses have a significant influence on the social and personal lives of people who suffer from them, as well as their families, and have implications for both the personal and global economy.

According to research, at least 20% of primary care patients in 72 percent of the working population have a major mental disease, but they go undiagnosed and untreated since most of them are hesitant to seek treatment.

Failure to identify the kind and medicine for a mental condition prevents a person from receive potentially successful therapy in 50–75 percent of instances, and living through such psychological distress has a tremendous influence on one's efficacy and interest in enjoying life.

As a result, early diagnosis of mental problems is critical since it allows for early therapies that decrease long-term social damage.They have the potential to improve mental health care quality and accessibility.Chatbots are projected to make a good contribution to easing the mental health care shortage.

These Applications involve a person's self interest in his treatment and allows them to self monitor rather than following traditional on clinic methods at initial stages remotely. Empowerment is facilitated by giving patients an active, rather than a passive, role in their own healthcare management.By identifying its data analysis methodologies, comparison, problems, and limits, the right way and correctness of mental health detection was also explored. Then the collected data was driven and through different statistics Machine learning algos. And finally, we discuss challenges, observations and outcomes   in using ML algos to improve and precise our

understanding of mental health conditions and also suggest some therapist proven methods and directions in order to improve and ease mental health diagnosis and treatment.

II. LITERATURE SURVEY

1] **Coached mobile app platform**:

Released in 2020 by Graham - A.K. The paper has studies related to curing mental illness via smartphone platform. As adults are obsessed with it becomes much easier for mobile apps to be used for better treatment. All the treatment procedures can be saved and timed via app and no frequent clinic visits are required.

2] **Stability of mental disorder:**

Released in 2018 by Gustavson K the study shows how severe a mental illness grows over a time and its chronic treatments also early detection and symptoms can reduce the risk.DAAS questionnaires to detect the early symptoms.

3]**Self monitoring and emotional well being :**

2018 by Bakker D in this Paper the study was made related to self monitoring real time detection of mood swings is important in order to detect the illness upcoming questionnaires on the daily basis can be useful in the detection of same the apps detects the suspicious response and alerts the user what's going wrong.

4] **Common Mental disorders:**

1980 Steel Z, Marnane C The Paper summarizes what common mental disorders a person faces during a certain age group. The working age group i.e. 24-40 has the highest risk and least relaxation. Where depression, Hypertension,

and Anxiety are very common still large no. of people do not consider it and myth it.the paper explains how the mental disorder can grow Chronic.

5]**Mental Health apps** :

Released in 2016 by Kenny R - Dooley ,the paper Explains the depression symptoms and behaviors during adolescence, In the paper a survey was made where 10k samples from age group of 12-18 were evaluated the CNN meta- algorithms used gave a an accuracy of 92.79% and was later integrated to a mobile application.

6] **Enhancing public mental health:**

2018 by Bakker D The paper was based on the evaluation of three smartphone apps which were evaluated for detaching and consulting for the specific mental illness the paper explains how the apps and the algos. can be modified and used in order to make more efficient and useful health and treatment applications.

7] **User Experience on Mental Health Apps:**

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2016 Anderson K The paper Explains how the individual suffering from depression would ask a virtual companion to user interface and user experience come into handy non depressed person would like to handle a complex application during his treatment the paper shows how the chat application the consulting and other optional interfaces should work by the POV of a Patient.

8] **Virtual Clinics:**

2014 Corrigan P. in this paper the idea of creating virtual clinics was presented. Mental illness treatment is an expensive Service and Setup of virtual clinics would do be both cost effective and time effective. Implementing such of a 1 on 1 meeting for better treatment and Counseling access from anywhere in the world

III.TECHNIQUES

1 SUPPORT VECTOR MACHINE (SVM): Support vector machine (SVMs) is [11] flexible algorithm used for classification and regression. In this, the core idea is to differentiate between two categories using a hyperplaneThe kernel function is used by SVM to tackle the linear indivisibility problem of data. [13]SVM is involved in solving small design, non-linear and pattern recognition. It gives better prediction than neural networks.

2 RANDOM FOREST ALGORITHM (RF): A decision tree algorithm underpins the Random Forest algorithm. In this, the record is divided into small features. It is a simple algorithm and the calculations are very simple. In this, the random data of the stocks are taken and then train the models to achieve better accuracy [10].

3 ARTIFICIAL NEURAL NETWORKS (ANN): ANN is mostly used when the models are non-linear. This algorithm is similar to the human brain. In these, algorithm the input layer, the output layer, and the concealed layer are the three layers.The features data are the model's input, and the output is created by calculating hidden layers in between. This algorithm contains nodes and is calculated by the error backpropagation algorithm which contains various steps like Parameter Initialization, Forward propagation, calculate the total error, and error backpropagation [10].

4 EMPIRICAL MODE DECOMPOSITION (EMD): EMD is used to find the elements that affect the financial time series. It is used to reduce complexity and improve forecasting accuracy. The Fourier transformation is used in this approach to divide the signal into temporal scales.The ARMA technique is a time series approach for identifying regular patterns.Because it decomposes the signal based on local time scale representation without a pre-setting function, EMD is usually employed for non-stationary sequences. [11].

5 LONG SHORT-TERM MEMORY (LSTM): It is the most useful algorithm and is used in many projects of the stock market[10][11]. In this, certain operations are performed and then we train the LSTM model. 1 Support Vector Machine (SVM): A flexible method, support vector machines (SVMs) [11]used for classification and regression. In this, the core idea is to differentiate between two categories using a hyperplane. The kernel function is used by SVM to tackle the

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linear indivisibility problem of data. [13]SVM is involved in solving small design, non-linear and pattern recognition. It gives better prediction than neural networks.

IV. METHODOLOGY

1) **<u>Data cleaning</u>**: The data set collection is an important part. We collected balanced and quality data from Kaggle. The remaining residue duplicate and missing data is sorted in order to create a clean and reliable set on which training validating and testing sets would fit.

2) **<u>Data encoding</u>**: In this process the Modification of data takes place where categorical responses are assigned some weightage. generally, the data is encoded into 1 &0 strings in order to classify later

3) **<u>Feature Scaling</u>**: It is important because the independent features in the dataset are required to be standardized in some fixed scale. if it is not implemented then ML algorithm starts making values dominant and weighting high on the basis of magnitudes, irrespective of Units

4) **<u>Tuning:</u>** Tuning of data is very important as it helps to increase the accuracy of the model without overfitting or creating too much high variance. This is important in order to implement a dependable model.

5) **<u>Decision tree classifier:</u>** The reason using Decision tree is to provide a model flexibility to learn the functions on if - then - else decision rules. it allows learning from training data to the behavior of target variable and for testing what could be the possible classification or predictions
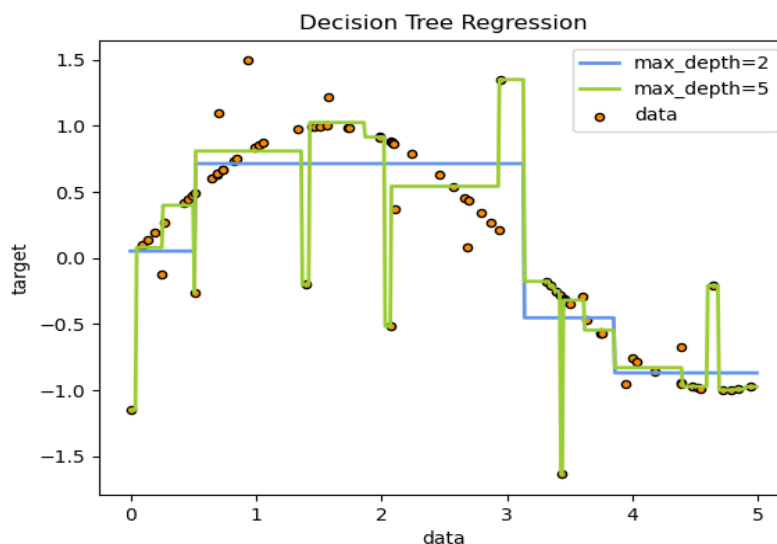

Figure 1: Decision Tree Regression

6) **<u>Random Forest:</u>**

Random forest classifier is most used classifier algorithm because of its ease of use and ability of decision making at various subsets of the dataset it improves the accuracy by taking averages of different compositions . It is an ensemble of many decision tree algorithms.

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7) **Bagging**: Bagging is also a very important machine learning ensemble meta - algorithm with superior ability to identify patterns in the given statistical problem the stability and accuracy of the model makes it useful for making regression and classification predictions.

8) **Boosting**: Basically used as a support algorithm that helps the slow learner algorithms to learn fast and accurately .
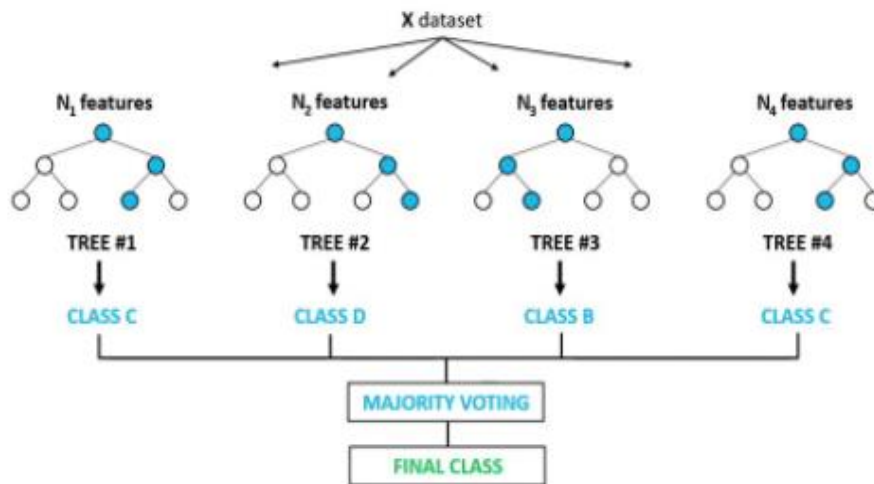

Figure 2: Boosting Algorithm

V. MODEL EVALUATION:

1.Confusion matrix: Sometimes even the best fit classification model may produce some misleading accuracy and to avoid that we use confusion matrix which gives us a detailed report of how the model has done on given datasets
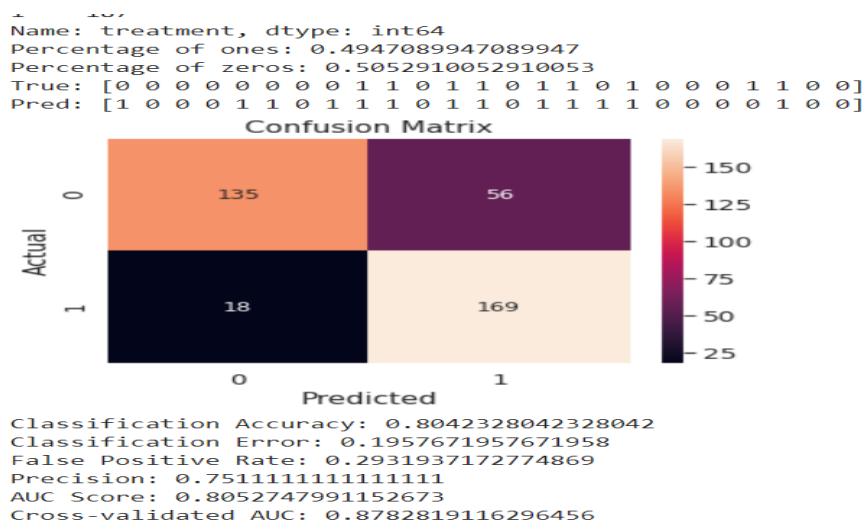

Figure 3: Confusion Matrix

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ROC Curve : Receiver Operating chr.curve shows the accuracy and reliability of the model max value can be 1 that is 100% accuracy area under curve represents accuracy.

VI. RESULTS & OUTCOME:

On successful implementation of the model we took 10 random samples from the testing dataset where we found the accuracy was **87.06%** the accuracy was dependable as we verified it by confusion matrix , classification report and ROC curve.
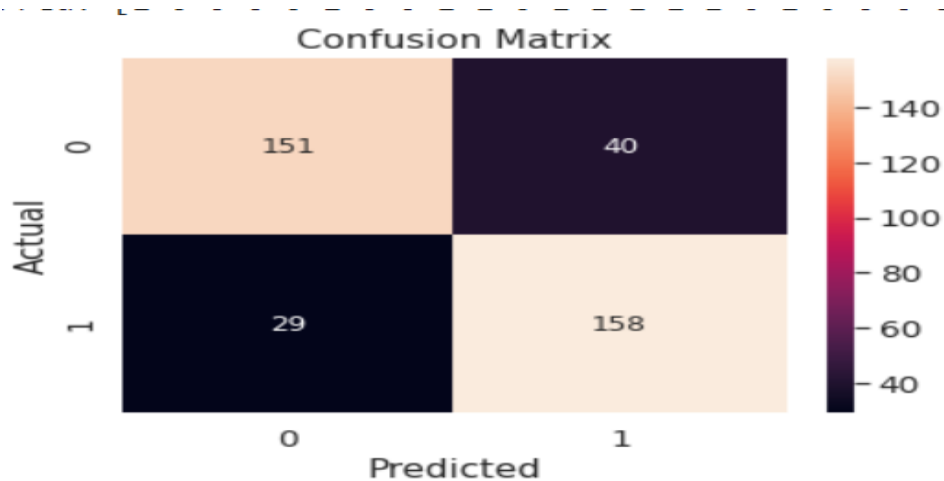

Figure 5: Confusion Matrix

	index	prediction	expected
0	929	0	0
1	901	1	1
2	579	1	1
3	367	1	1
4	615	0	1
5	981	1	1
6	384	1	1
7	200	1	1
8	503	0	0
9	65	1	0

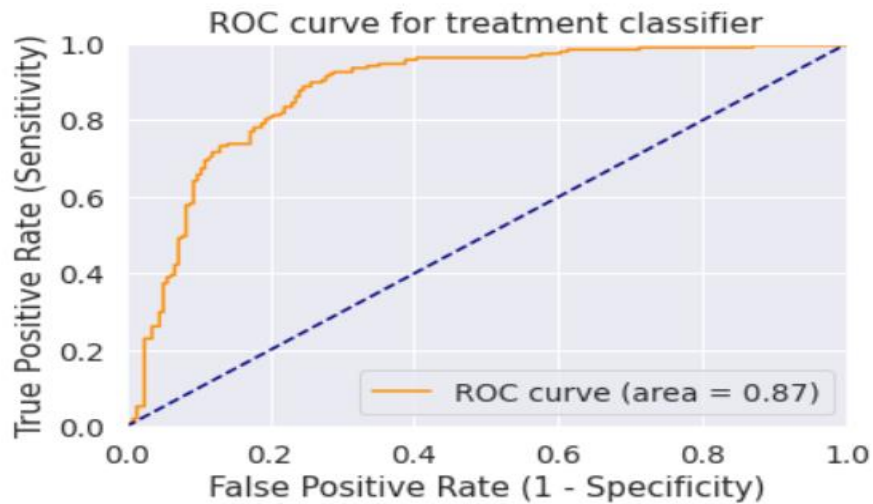**Figure 4: Prediction VS Expected**

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Figure 6: ROC Curve

VII. CHALLENGES:

There are plenty of challenges to this approach Smartphones and Internet are has become an essential part of life these days but even after this almost 36% of global population do not have access to smartphones/phones and 42% of population do not have access to internet using such approach would become a bias to those who are not connected with internet . Illiteracy being another major factor somebody has to always guide the user.

Next challenge is the Personal data. people are conscious about the use of there data, privacy and security are must. Even in the 21st century people are illiterate about Consequences of mental health and no major attention is given to it. With the fear of being taunted by society individuals just take mental illness as a myth and don't get consulted .

Even after making a machine too intelligent, it is still a machine and will not be flexible with the user when it comes to consultancy. Trusting a machine than a human will always be difficult and hence, its difficult to change the traditional clinical platform to AI ML based systems.

CONCLUSION:

Mental Health Detection can be done using machine learning and deep learning algorithms. ML AI based chatbots are making an impact in almost every sector. There are thousands of apps assessing clinicians in managing, directing and interacting with the patients. Also, the market is flooded with personal healthcare apps in order to reshape the health economy. frequent and positive responses from the practitioners and experts have improved the accuracy and reliability of health apps. Chat bot on the other hand can be a great resource to use as a virtual self-care companion in order to have a monitoring on mental health technique like NLP - Neural Networks can be used in order to identify the traces in the data to predict the mental state and emotional state of a person. app-likefeatures give the user a reliability of privacy and asses in the self-monitoring. It also helps in self-awareness like unhealthy lifestyle, mood swing patterns, work

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stress, triggered anxiety, negative thought and behavior filtering much more. The ML based application also give curing methods on the basis of previous history and   a real time detection of dangerous behavior and warnings to consult a doctor. in the real words They can be Virtual companion.

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