

Machine Learning Models based Mental Health Detection

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Abstract—This century will be the fastest ever, putting a heavy burden on future generations, especially students. Future generations will face enormous stress, competition, social issues, and constant pressure. Their lives will become a race. That leaves students with mental health issues that lead to disorders. Five of the most common types of disorders that young people especially face are bipolar disorder (mood disorders), anxiety disorders, depression, eating disorders, and sleep issues. As machine learning plays a vital role in the easiness of human life, this paper also uses Machine Learning (ML) algorithms to screen Mental Health by using a Mental Disorder Questionnaire (MDQ). In this research, there are two types of Questionnaires employed. The first Self Reporting Questionnaire-15 (SRQ-15) has 15 general mental disorder questions with the option of Yes/No. The second Self Reporting Questionnaire-25 (SRQ-25) has 25 questions, five questions for each of the five different mental health disorders mentioned. Within each section, the user fills the questionnaire according to the instructions. We labeled the train data set using Supervised Machine Learning. So we use different algorithms to compare results with manual testing.

Keywords—Mental Health Detection, Mental Health Self-assessment, Machine Learning

I. INTRODUCTION

Community sentiment, hopes, use of social media, and expectations are significant causes of increased high stress recently [1,2,3]. This situation can affect people of all ages; However, as for the students, they are the biggest victim of these high pressures that have led them unstable and unsure about their future in their minds, which in turn will cause mental disorder issues. These will bring psychological and health problems for them. Thus it is urgent to solve these issues for humans, especially for students. During the study, it is tough to identify the minor symptoms of psychological changes that will later become a significant Mental Disorder (MD)[4,5,6,7,8,9].

This study used self-report questionnaires, named Self Reporting Questionnaire-15 (SRQ-15) and Self Reporting Questionnaire-25 (SRQ-25). The SRQ-15 and the SRQ-25 do not give a psychiatric diagnosis but can evaluate general mental health conditions, such as Bipolar, Anxiety, Depression, Eating, and Sleep Issues. Details of all disorders are explained below.

After conducting an online survey using SRQ-15 and SRQ-25, we examined the results manually and used different Machine Learning algorithms to check performance accuracy by comparing them with manual results. Details of results are shown in Section V.

According to recent studies, there are five common mental disorders in students are as follow

Bipolar disorder (BD): Bipolar disorder can cause extreme mood swings, unusual swings in energy and actions.[10] It can affect a student's academic performance and become a hurdle in their life goals and affect their relationships. According to the research, about 3.2% of students have Bipolar Disorder[11,12,13].

- **Symptoms:** The following are a few symptoms of Bipolar disorder[14]:
 1. Unusual upbeat, nervousness.
 2. Increased tasks, energy, or concern.
 3. Making bad decisions.
 4. The most prominent Symptom of BP may include a severe kind of mood. Swings that are different from normal usual mood swings.
- **Complications:** Bipolar disorder can result in problems that can affect life, like:
 1. Suicidal attempts or suicide.
 2. Poor academic or work performance.
 3. Legal problems
 4. Broken relationship.
 5. Use of alcohol or drugs.

Anxiety disorder: Undergo from irregular anxiety is a natural part of life. However, a person suffering from Anxiety Disorder usually has extreme, unnecessary, and unwavering panic, stress, and nervousness about daily affairs.[15] Anxiety Disorder is pervasive in students due to over-stress from studies. According to the research, about 18-20% of students have an Anxiety Disorder.[16,17,18,19,20].

- **Symptoms:** Common Symptoms of Anxiety Disorder includes:
 1. Have a problem with sleeping.
 2. Over Sweating.
 3. Rapidly increased breath.
 4. Nervousness or Anxiousness
 5. Feeling tired.
 6. Increase in heart rate.
- **Complications:** Anxiety Disorder can lead to

other mental or physical conditions, like:

1. Depression
2. Insomnia
3. Performance issues at school or work.
4. Low quality of life.
5. Suicide.

Depression: Depression is also a mood disorder that causes a continuous feeling of sadness and boredom, also known as a depressive disorder. Depression is also common in students. Constant depression can lead to suicidal attempts or suicide [16,17,19,20].

- **Symptoms:** Depression may occur once in a person lifetime; some common symptoms of depression are as follows:
 1. Feeling bored, hopeless, sad.
 2. Loss of interest from ordinary activities.
 3. Disturbances in sleep. (insomnia or oversleep)
 4. Slowed body movement.
 5. Frequent thoughts of death, suicidal attempt, suicide thought, or suicide.
- **Complications:** Depression is a critical disorder that can be troublesome for a person or their family. Difficulties with depression, like:
 1. Alcohol or drug misuse.
 2. Anxiety disorder.
 3. Panic attack.
 4. Relationship hurdles.
 5. School or work issue.

Eating disorder: Eating disorders are severe disorders related to irregular eating habits that harm a person's life. Students mainly suffer from eating disorders. According to a survey, the National Eating Disorders Association (NEDA) points out that eating disorder generally starts at the age of 18 to 21. During this age, most of the affected people are in school/colleges. The survey indicates that 20% of students are suffering from eating disorders. [17,21,22].

- **Symptoms:** Common symptoms of an eating disorder are as follows:
 1. Skipping meals
 2. Prefer unhealthy food or junk food instead of meals.
 3. Constant worry about being overweight or complain about being overweight and talking about weight loss.
 4. Eating secretly.
 5. Extra focus on a healthy diet.
- **Complications:** An eating disorder can be the cause of death. As well as this, some of the common complications due

to an eating disorder are as follows:

1. Health issues.
2. Anxiety and depression.
3. School or work issue.
4. Death.
5. Growth and body development problems.

Sleep Issues: Sleep issues are conditions that change the way a person sleeps. Sleep issues can affect health and quality of life. Students usually sleep less than they need to sleep. The lack of sleep can disturb student's health, mood, and safety. According to research, about 60% of students have sleep issues, and about 80% have insomnia. [23,24].

- **Symptoms:** Some common symptoms are as follows:
 1. Feeling sleepy at day time and facing hurdles to fall asleep at night.
 2. Falling asleep at an inopportune time, like: during driving.
- **Complications:** Some complications due to sleep issues are as follows:
 1. Health issues.
 2. Quality of life.
 3. School or work issue.

The above five common mental disorders are shown in Table.1.

| Disorders | Yes | No |
|------------------|---------|---------|
| Bipolar disorder | 3.2% | 96.8% |
| Anxiety disorder | 18%-20% | 80%-82% |
| Depression | 20% | 88% |
| Eating disorder | 20% | 80% |
| Sleep issue | 60% | 40% |

Table.1 The suffering percentage of 5 disorders.

We collected the sample data by a public online survey. We conducted our survey in Chinese and English. We then divided our survey into two parts to better understand the disorders, which will increase the accuracy of our designed models.

Firstly, we used the Mental Health Screening Questionnaire (MHSQ) [25] to classify individuals and predict whether an individual has a Mental Health Issue (MHI); we name it SRQ-15. This questionnaire was based on general symptoms of Mental Health. We have considered MHSQ based on typical symptoms related to Mental Health. Based on their answers, we will analyze and, using the particular methodology, predict whether the individual is suffering from any Mental Health issue and inform them to go for further treatment.

Secondly, we have used different Questionnaires to predict Mental disorders; we named it SRQ-25. We have used the Mood Disorder Questionnaire (MDQ) for the prediction of Bipolar Disorder (BP)[26]. We have used General Anxiety Disorder-7 (GDA-7) for the prediction of Anxiety Disorder (AD)[27]. We have used the Patient Health Questionnaire-9 Depressive Disorder (PHQ-9 Depression) to predict depression [28]. We have used Eating Disorder Questionnaire-A (EDE-A) for the prediction of Eating Disorder (ED)[29]. We have used Sleeping Disorder Checklist (SDC) for the prediction of Sleeping Disorder (SD)[30].

A. Purpose and Applications

- Patient Point of View:** Symptoms of mental disorders are hard to understand. Most of the time, people ignore the initial symptoms as regular changes, which can later develop and become the cause of different mental disorders. Notably, at the age of 14 to 26, life is changing fast, and people need to take small and big decisions too quickly; they also need to adapt to quick changes in life[31]. Most people are in school/colleges at this time to be affected by mental disorders. Accepting and embracing new changes can have a profound effect on the present and the future. Mental disorders are hard to identify in the beginning stages; they can sometimes also be hard to locate at dysfunction. Moreover, most of the time, people feel uncomfortable seeing the doctor initially, so this design model can be helpful for the person who is suffering from any mental issue by using a self-assessment prediction using a machine learning approach.
- Medical Point of View:** This paper also brings to light the hurdles that medical specialists face during the diagnosis of Mental Disorder. Because many symptoms are similar to different mental disorders, the actual mental disorder can be misdiagnosed, and the fundamental mental disorder remains undetected, and that person remains undetected for the rest of their lifetime. A better way of reducing the risk is to conduct screening on a large scale regularly. We used several questionnaires approaches to diagnose different mental disorders. This model can be used further at a sizeable commercial range to help humanity.

B. Applications

This research aims to find the best machine learning approach that can be suitable for the screening of mental disorders. For this purpose, we chose the questionnaire method to predict mental disorders. This system can be improved more in the future for other medical fields. There can be more improvement in the diagnosis of psychological issues in better research related to questionnaires about other disorders. In this research work, we focus on general mental health and five underlying psychiatric disorders. Besides this, it can also be used by doctors for a better understanding of the patient's mental condition from the pre treatment process that can be helpful in later treatment. The remainder of this paper is shown below. Section II presents the purpose

and application of our study model. In section III reviews some literature related to our work. Section IV explains related work to Machine Learning approaches and how their algorithms work. In section V, we explain to our designed models how we implement them. The result of all models and a comparison of the model's results, and the work conclusion is presented in Section VI.

II. LITERATURE REVIEW

In 2019, Ranjana Jadhav et al. [32] proposed a model using a Decision tree classifier to Detect Bipolar Disorder using the questionnaire [33]. That questionnaire is also part of our SRQ-25. The model is well designed only for one mental disorder at one time. The most relevant work with our study [34] is by Paulina Morillo et al. that, in 2019, proposed a web to diagnose mental health using k-NN with TF-IDF by auto-identifying mental disorders suffered by patient symptoms when evaluated by mental health professionals. Kipli et al. [35] use MRI scans to detect depression. In this work, they use four Algorithms to check their performance: SVM, OneR, ReliefF, and Information Gain (IG). They conclude that IG with the combination of Random Tree Classifier and SVM with a combination of Expectation-Maximization (EM) give the highest accuracy.

Marsi RY et al. [36] proposed a system to help psychologists diagnose and treat their patients. The system uses Artificial Intelligence (AI) techniques: fuzzy logic, fuzzy-genetic (fuzzy-GA) algorithm, and rule- based reasoning. D. Razzouk et al. [37] in 2006 purpose decision support system for schizophrenia disorder having an accuracy of 66-82%.

III. RELATED WORK

A. Supervised Learning

Supervised learning will be prepared to respond to a specific series [38]. Use for estimate values of target function then is recognized for desired performance. This approach aims to recognize faults and to make subsequent modifications using the learning algorithm by evaluating the first performance along with the "learned" outcome. Fig.1 demonstrates the supervised learning blueprint.

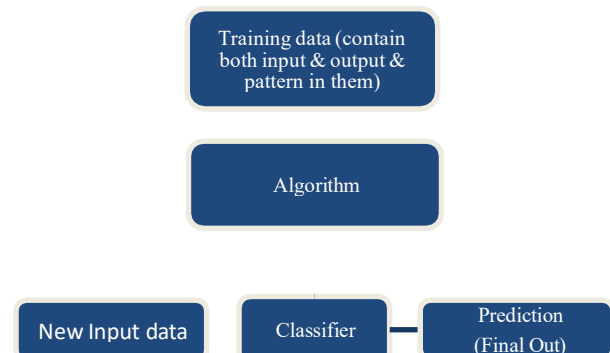


Fig. 1. Supervised Learning

• Logistic Regression

Logistic regression can analyze the dataset and generate a binary result. The data set may consist of more than one or more independent variables. Such factors that are multidimensional decide the outcome. This means that there can only be two findings [39]. It is best used in binary and categorical output forecasting. The logistic regression approach can control the influence of multiple autonomous variables that are imposed simultaneously. Different logistic regression devices are the forecasting trends in the market, success/failure ratio from results, true/false employees' recruitment categories, categorization of images, healthcare, and analysis of the Myocardial Infarction group of people [39], based on their workforce performance in a company.

Support Vector Machine: Support Vector Machine helps to solve linear and nonlinear problems. It constructs a hyper plane. The main objective of building this model is to divide the groups of each entity in a hyper plane with an additional gap from the nearest level of training data; a reasonable separation procedure would be followed. In other words, the rationalization deficiency of the classifier is minimized if the margin value is higher than that. The data range in SVM ranges from [0, 1] [39]. In wide spaces and effective management of power, the key advantage of SVM is memory efficiency. If the characteristics are samples, the probability result could not be obtained; the Support Vector Machine disadvantage is less perfect.

SVM can be used in clinical science, patient diagnosis, statistical time-series, financial review, trend detection, Google page rating.

Decision Tree: Decision Trees help to predict the values. The roots of a tree represent data detected, and leaves reflect values aimed. In analytics, data analysis, and machine learning, this approach may be applied [39]. Decision Trees are implemented based on such restrictions to consider alternative approaches to a problem. The findings are quick and reliable in the decision tree algorithms. Leaves and Nodes define individuals. The output is shown in the sheet, and monitoring of data is shown in nodes.

Decision trees calculate the sex ratio and estimate the price projection of mortgage loans and population surveys. Decision trees are mainly used when equipped with complex ML algorithms such as Gradient Boosting and Random Forest.

IV. METHODOLOGY

A. Models

• Mental Health Screening (MHS)

Part one, As in MHSQ the user, simply answers with YES/NO about symptoms of mental disorder issues. Below is the equation of our design model.

Model – I (Algorithm)

Step 1: $MD_1, MD_2, \dots, MD_{15}$ in SRQ-15. are mental disorder questions

Step 2: $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_{15}$ are weights of our model

$$\alpha_i \in [0, 1]$$

Step 3: $S_1 = \sum \alpha_i MD_i$

$$i = \{i \in N \mid 1 \leq N \leq 15\}$$

If $S_1 \geq 8$

Mental disorder

Check for mental disorder in Model-II

Else

No mental Issue

End

According to the ratio of YES/NO, the model needs to predict Mental Health using a Machine learning approach. If the ratio of "YES" is higher than "NO," then the person will be considered as "Mental Disorder"; otherwise, they will be considered as "FIT," as shown in Fig 2. We use Logistic Regression for prediction.

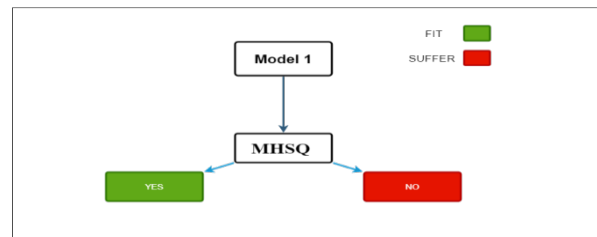


Fig. 2. MHS-Mental Health Screening Questionnaire.

• Multiple Mental Disorder Screening (MMDS)

In the second part, we took five questions, each from five standard mental disorder questionnaires. As shown in Fig 3.

Model – I (Algorithm)

Step 1: $\alpha * BD, \beta * AD, \gamma * D, \delta * ED, \varepsilon * SI$

the output of Algorithms a, b, c, d, e.

Step 2: $\alpha, \beta, \gamma, \delta, \varepsilon \in [0, 1]$

$$S_2 = \alpha * BD + \beta * AD + \gamma * D + \delta * ED + \varepsilon * SI$$

If $S_2 \geq 1$

List Disorder

Else

No Disorder

End

The Bipolar disorder (BD) questionnaire needs to mark their symptoms by scoring from 1 to 5. If the ratio of "1,2" is higher than "4,5," then a person is considered as "FIT"; otherwise, a person will be deemed to have "Bipolar Disorder." If there is a tie between "1,2" and "4,5," then "3"

will go with “4,5,” and the person will be considered as having “Bipolar Disorder.”

Algorithm a:

Step 1: BD_1, BD_2, \dots, BD_5 are five questions of Bipolar disorder in SRQ-25.

Step 2: $\alpha * BD = \alpha * BD_1 + \alpha * BD_2 + \alpha * BD_3 + \alpha * BD_4 + \alpha * BD_5$

$\alpha \in \{i \in N | 1 \leq N \leq 5\}$

if

$$\alpha * BD \geq 16$$

Then

$$\alpha * BD = 1$$

Else

$$\alpha * BD = 0$$

End

For the Anxiety Disorder (AD) questionnaire, the user needs to mark their symptoms for the last two weeks as “Not at All,” “Several Day,” “More than half the day,” and “Nearly every day.” If the ratio of “Not at All” and “Several days” is higher than “More than half the day” and “Nearly every day,” the person will be considered as “Fit”; otherwise, the person will be deemed to have “Anxiety Disorder.”

Algorithm b:

Step 1: AD_1, AD_2, \dots, AD_5 are five questions of Anxiety disorder in SRQ-25.

Step 2: $\beta * AD = \beta * AD_1 + \beta * AD_2 + \beta * AD_3 + \beta * AD_4 + \beta * AD_5$

$\beta \in \{\beta \in N | 1 \leq N \leq 5\}$

if

$$\beta * AD \geq 13$$

Then

$$\beta * AD = 1$$

Else

$$\beta * AD = 0$$

End

For the Depression questionnaire, the user needs to mark their symptoms for the last two weeks as “Not at All,” “Several Day,” “More than half the day,” and “Nearly every day.” If the ratio of “Not at All” and “Several days” is higher than “More than half the day” and “Nearly every day,” the person will be considered as “Fit”; otherwise, the person will be deemed to have “Depression.”

Algorithm c:

Step 1: D_1, D_2, \dots, D_5 are five questions of Anxiety disorder in SRQ-25.

Step 2: $\gamma * D = \gamma * D_1 + \gamma * D_2 + \gamma * D_3 + \gamma * D_4 + \gamma * D_5$

$\gamma \in \{i \in N | 1 \leq N \leq 5\}$

if

$$\gamma * D \geq 13$$

Then

$$\gamma * D = 1$$

Else

$$\gamma * D = 0$$

End

Eating Disorder (ED) questionnaire, the user needs to mark their symptoms for the last two weeks as “Not at All,” “Slightly,” “Moderately,” and “Markedly.” If the ratio of “Not at All” and “Slightly” is higher than “Moderately” and “Markedly” person will be considered as “Fit”; otherwise, the person will be deemed to have “Anxiety Disorder.”

Algorithm d:

Step 1: ED_1, ED_2, \dots, ED_5 are five questions of Eating disorder in SRQ-25.

Step 2: $\delta * ED = \delta * ED_1 + \delta * ED_2 + \delta * ED_3 + \delta * ED_4 + \delta * ED_5$

$\delta \in \{i \in N | 1 \leq N \leq 5\}$

If

$$\delta * ED \geq 13$$

Then

$$\delta * ED = 1$$

Else

$$\delta * ED = 0$$

End

For the Sleep Issues (SI) questionnaire, the user needs to mark their symptoms for the last year as “Never,” “Seldom (1*year),” “Sometimes (1-3*month),” “Often (1-3*week)” and “Frequently (>3*week)”. If the ratio of “Never” and “Seldom (1*year)” is higher than “Sometimes (1-3*month),” “Often (1-3*week)” and “Frequently (>3*week)” the person will be considered as “Fit” otherwise, the person will be deemed to have “Sleep issue.”

Algorithm e:

Step 1: SI_1, SI_2, \dots, SI_5 are five Sleep issues in SRQ-25.

Step 2: $\varepsilon * SI = \varepsilon * SI_1 + \varepsilon * SI_2 + \varepsilon * SI_3 + \varepsilon * SI_4 + \varepsilon * SI_5$

$\varepsilon \in \{i \in N | 1 \leq N \leq 5\}$

if

$$\varepsilon * SI \geq 13$$

Then

$$\varepsilon * SI = 1$$

Else

$$\varepsilon * SI = 0$$

End

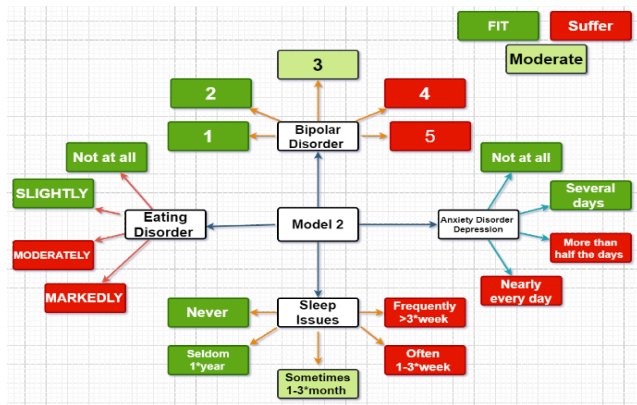


Fig. 3. MMDS-Five Mental Disorder Questionnaire.

All the above problem statements lie under Supervised learning, so we apply different Supervised learning algorithms to find the most accuracy in “Prediction” among all.

V. RESULTS

A. Machine Learning Algorithm

We implement Logistic Regression on MHS. On MMDS, we apply Decision Tree Classifier, SVM (Linear Kernel), SVM (RBF-Radial Basis Function), and Naive Byes for a prediction about mental health through Screening Questionnaires.

- **Data Set**

We were conducting Surveys both in Chinese and English. We got 1253 Samples to test our models and check the accuracy performance of Algorithms to check the validity of our proposed models.

- **Algorithms Analysis**

MHS: For MHS, we use Logistic Regression Algorithms results are shown in Table.2

| MHS | |
|-----------------|---------------------|
| Validation data | Logistic Regression |
| Accuracy | 93.0 |
| Precision | 93.64 |
| Recall – score | 93.00 |
| Fi – score | 92.72 |

Table. 2 Validation Data for MHS.

For MHS, the Accuracy of Logistic Regression was more than 90%. So we select Logistic Regression for testing with sample data.

MMDS: For MMDS, We use 4 Algorithms.

- Decision Tree Classifier

- SVM Linear
- SVM RBF
- Naive Bayes

Results are shown in Table.3:

| MMDS | | | | |
|-----------------|--------------------------|------------|---------|-------------|
| Validation Data | Decision Tree Classifier | SVM Linear | SVM RBF | Naive Bayes |
| Accuracy | 9.26666 | 78.1333 | 52.6 | 49.3333 |
| Precision | 9.14 | 77.88 | 47.46 | 48.28 |
| Recall score | 9.27 | 78.13 | 52.60 | 49.33 |
| Fi - score | 9.09 | 77.25 | 48.65 | 47.83 |

Table.3 Validation Data for MMDS.

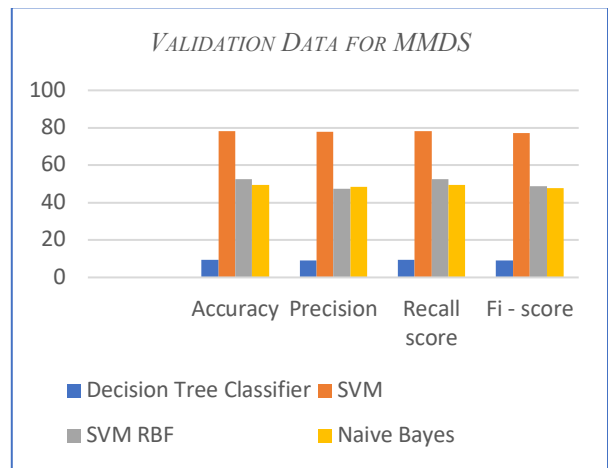


Fig. 4 Validation Data for MMDS.

For MMDS, the Accuracy of SVM linear is highest compared to other algorithms, so we consider the results of SVM linear for testing with sample data.

MHS: As per the MHS questionnaire, out of 1269 samples, we find 1253 valid samples for analysis. We check all those authentic samples by executing our design Logistic regression algorithm; then, we compare our results by the algorithm and manual review of samples to verify the accuracy of our model. So, we conclude that logistic regression is the best option for this questionnaire from supervised machine learning due to the binary answer of the survey. Out of 1253 valid samples, we found that 111 people have general symptoms of mental issues. So, we check these 111 samples in MMDS. The results of MHS are shown in Table.4.

| Disorder | Yes | No | Total |
|-------------------|-----|------|-------|
| General Disorders | 111 | 1142 | 1253 |

Table.4 MHS-Result of Mental Health Screening Questionnaire

MMDS: In MMDS, we have a combination of 5 different disorders. We choose five separate questionnaires to find the

best solution for our best result to check the validity of our proposed model. So when we were analyzing the result, we found out that 57 people have more than one disorder, and Sleeping issues are leading dysfunction among all results as we implement 4 supervised machine learning algorithms to check the validity of our proposed model. We found SVM-Linear having the most accuracy without our manual review of samples. Out of 111 samples positive from Model-1, we found eight people have Bipolar disorder, 19 have Anxiety Disorder, 23 have depression, 29 have Eating Disorder, and 65 have Sleep issues. Seven samples have no disorder from our five listed disorders. The results of MMDS are shown in Table.5.

| Disorders | Yes | No | Total |
|------------------|-----|-----|-------|
| Bipolar disorder | 8 | 103 | 111 |
| Anxiety disorder | 19 | 92 | 111 |
| Depression | 23 | 88 | 111 |
| Eating disorder | 29 | 82 | 111 |
| Sleeping issues | 65 | 46 | 111 |

Table.5 MHS-Result of Mental Health Screening Questionnaire

VI. CONCLUSIONS

Mental Health issues are prevalent among people of all ages. Many Mental Health issues have different symptoms, which are very hard to understand in the beginning. Most symptoms cause various complications later, some of them mentioned above in the paper. So, we propose a model for self-Mental Health Assessment using Machine Learning Approach (Supervised Learning) to screen Mental Health by using a Mental Disorder Questionnaire.

We used two questionnaires to check the validity of our proposed models for Mental Health Detection. In MHS, we used general mental issues questions. In MMDS, we combine five different disorders questions to form one questionnaire.

For testing Models, we focus on students of all levels because they are a soft target of mental health issues. We conclude after testing and validation that our proposed model can be more effective if more work on Symptoms studies and need to be specific for disorders. It can be used on a large commercial scale with the help of the Specialist of Mental Health issues for surveying humanity because the merger of technology and causes mostly gives positive results.

REFERENCES

- [1] JOYCE-BEAULIEU, D., & SULKOWSKI, M. L. The Diagnostic and Statistical Manual of Mental Disorders: Fifth Edition (DSM-5) Model of Impairment. (2016)
- [2] DE GIROLAMO, G., MCGORRY, P. D., & SARTORIUS, N. Age of Onset of Mental Disorders Etiopathogenetic and Treatment Implications. (2019).
- [3] GHAFOR, Y., HUANG, Y.-P., & LIU, S.-I. (2015). An intelligent approach to discovering common symptoms among depressed patients. *Soft Computing : A Fusion of Foundations, Methodologies and Applications*. 19, 819-827.
- [4] Hart, S. R., Jeltova, I., Brock, S. E., & SpringerLink (Online service). (2014). *Identifying, Assessing, and Treating Bipolar Disorder at School*. (Springer eBooks.) Boston, MA: Springer US.
- [5] Macklem, G. L., & SpringerLink (Online service). (2014). *Preventive Mental Health at School: Evidence-Based Services for Students*. (Springer eBooks.) New York, NY: Springer New York.
- [6] Duffy, A., Saunders, K. E. A., Malhi, G. S., Patten, S., Cipriani, A., McNevin, S. H., MacDonald, E., ... Geddes, J. (November 01, 2019). Mental health care for university students: a way forward?. *The Lancet Psychiatry*, 6, 11, 885-887.
- [7] Chiles, C., Stefanovics, E., & Rosenheck, R. (January 01, 2017). Attitudes of Students at a US Medical School Toward Mental Illness and Its Causes. *Academic Psychiatry*, 41, 3, 320-325.
- [8] Shao, R., He, P., Ling, B., Tan, L., Xu, L., Hou, Y., Kong, L., ... Yang, Y. (April 22, 2020). Prevalence of depression and anxiety and correlations between depression, anxiety, family functioning, social support and coping styles among Chinese medical students. *Bmc Psychology*, 8, 1.)
- [9] Azim, S. R., & Baig, M. (June 01, 2019). Frequency and perceived causes of depression, anxiety and stress among medical students of a private medical institute in karachi: A mixed method study. *Journal of the Pakistan Medical Association*, 69, 6, 840-845.
- [10] R. Jadhav, V. Chellwani, S. Deshmukh and H. Sachdev, "Mental Disorder Detection : Bipolar Disorder Scrutinization Using Machine Learning," 2019 9th International Conference on Cloud Computing, Data Science & Engineering (Confluence), Noida, India, 2019, pp. 304-308
- [11] Pedrelli P, Nyer M, Yeung A, et al. "College Students: Mental Health Problems and Treatment Considerations," *Academic Psychiatry*, 2015, 39(5):503-511.
- [12] REILLY-HARRINGTON, N. A., et al. (2016). A tool to predict suicidal ideation and behavior in bipolar disorder: The Concise Health Risk Tracking Self-Report. *Journal of Affective Disorders*. 192, 212-218.
- [13] COOPER, R. (2019). *DIAGNOSING THE DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS: fifth edition*. [S.l.], ROUTLEDGE.
- [14] National Institute of Mental Health (US). (2008). *Bipolar disorder in children and teens*. Bethesda, MD: US Dept. of Health and Human Services, National Institutes of Health, National Institute of Mental Health.
- [15] T. C. Panagiotakopoulos, D. P. Lyras, M. Livaditis, K. N. Sgarbas, G. C. Anastassopoulos and D. K. Lymberopoulos, "A Contextual Data Mining Approach Toward Assisting the Treatment of Anxiety Disorders," in *IEEE Transactions on Information Technology in Biomedicine*, vol. 14, no. 3, pp. 567-581, May 2010.
- [16] Reference Group Executive Summary, American College Health Association National College Health Assessment, Spring 2018.
- [17] COOPER, R. (2019). *DIAGNOSING THE DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS: fifth edition*. [S.l.], ROUTLEDGE.
- [18] Khan, Mussarat Jabeen, Shamim, Farah, & Naeem, Bushra. (2019). *Role of Academic Stress as Predictor of Test Anxiety among University Students*. (Copyright (c) 2019 International Journal of Innovation in Teaching and Learning (IJITL).) International Islamic University Islamabad, Pakistan.
- [19] Shao, R., He, P., Ling, B., Tan, L., Xu, L., Hou, Y., Kong, L., ... Yang, Y. (April 22, 2020). Prevalence of depression and anxiety and correlations between depression, anxiety, family functioning, social support and coping styles among Chinese medical students. *Bmc Psychology*, 8, 1.)
- [20] Azim, S. R., & Baig, M. (June 01, 2019). Frequency and perceived causes of depression, anxiety and stress among medical students of a private medical institute in karachi: A mixed method study. *Journal of the Pakistan Medical Association*, 69, 6, 840-845.
- [21] Eisenberg D, Nicklett E J, Roeder K, et al. "Eating Disorder Symptoms Among College Students: Prevalence, Persistence, Correlates, and Treatment-Seeking," *Journal of American College Health*, 2011, 59(8):700-707.
- [22] YAGER, J. (2006). Practice guideline for the treatment of patients with eating disorders.
- [23] Angelika S, Anja F, Merle C. "Sleep problems in university students – an intervention: *Neuropsychiatric Disease and Treatment*, 2017, Volume 13:1989-2001.

- [24] Foulkes, L., McMillan, D., & Gregory, A. M. (June 01, 2019). A bad night's sleep on campus: an interview study of first-year university students with poor sleep quality. *Sleep Health*, 5, 3, 280-287.
- [25] The Modified Mini Screen (MMS) Mental Health Screening Tool - LDSS-5009, Mental Health Screening Questionnaire – 2015
- [26] Hirschfeld, R. M. (January 01, 2002). The Mood Disorder Questionnaire: A Simple, Patient-Rated Screening Instrument for Bipolar Disorder. *Primary Care Companion to the Journal of Clinical Psychiatry*, 4, 1, 9-11.
- [27] Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (May 22, 2006). A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. *Archives of Internal Medicine*, 166, 10, 1092.
- [28] Kroenke, K., Spitzer, R. L., & Williams, J. B. (January 01, 2001). The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16, 9, 606-13.
- [29] White, H. J., Haycraft, E., Goodwin, H., & Meyer, C. (January 01, 2014). Eating disorder examination questionnaire: factor structure for adolescent girls and boys. *The International Journal of Eating Disorders*, 47, 1, 99-104.
- [30] J, K. K., R, J. C., & L, P. M. (June 30, 2017). Introducing the Sleep Disorders Symptom Checklist-25: A Primary Care Friendly and Comprehensive Screener for Sleep Disorders. *Sleep Medicine Research*, 8, 1, 17-25.
- [31] Pedrelli, Paola et al. "College Students: Mental Health Problems and Treatment Considerations." *Academic psychiatry : the journal of the American Association of Directors of Psychiatric Residency Training and the Association for Academic Psychiatry* vol. 39,5 (2015): 503-11. doi:10.1007/s40596-014-0205-9
- [32] Jadhav, R., Chellwani, V., Deshmukh, S., & Sachdev, H. (2019). Mental Disorder Detection : Bipolar Disorder Scrutinization Using Machine Learning. 2019 9th International Conference on Cloud Computing, Data Science & Engineering (Confluence),
- [33] Hirschfeld, R. M. (January 01, 2002). The Mood Disorder Questionnaire: A Simple, Patient-Rated Screening Instrument for Bipolar Disorder. *Primary Care Companion to the Journal of Clinical Psychiatry*, 4, 1, 9-11.
- [34] Morillo, P., Ortega, H., Chauca, D., Proaño, J., Vallejo-Huanga, D., & Cazares, M. (2019). Psycho Web: A Machine Learning Platform for the Diagnosis and Classification of Mental Disorders. *Advances in Neuroergonomics and Cognitive Engineering*, 399–410.
- [35] Kipli, K., Kouzani, A. Z., & Hamid, I. R. A. (2013). Investigating Machine Learning Techniques for Detection of Depression Using Structural MRI Volumetric Features. *International Journal of Bioscience, Biochemistry and Bioinformatics*, 444–448. <https://doi.org/10.7763/ijbbb.2013.v3.252>
- [36] R. Y. Masri and H. Mat Jani, "Employing artificial intelligence techniques in Mental Health Diagnostic Expert System," 2012 International Conference on Computer & Information Science (ICCIS), Kuala Lumpur, 2012, pp. 495-499, doi: 10.1109/ICCISci.2012.6297296.
- [37] Razzouk, D., Mari, J. J., Shirakawa, I., Wainer, J., & Sigulem, D. (2006). Decision support system for the diagnosis of schizophrenia disorders. *Brazilian Journal of Medical and Biological Research*, 39(1), 119–128. <https://doi.org/10.1590/s0100-879x2006000100014>
- [38] Sivanandam, S. and Deepa, S., 2013. *Principles Of Soft Computing*. New Delhi: Wiley. Towards Data Science. 2020. *Towards Data Science*. [online] Available at: <http://www.towardsdatascience.com>
- [39] Vapnik, V., 1998. The Support Vector Method of Function Estimation. *Nonlinear Modeling*, pp.55-85
- [40] Kulkarni, M., 2017. Engineering: September 7, 2017 By Mayur Kulkarni | Statistical Classification Theoretical Computer Science.