Comparative Analysis of Mental Health disorder in Higher Education Students using Predictive Algorithms

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***Abstract*—Mental health problem is the biggest problem in the current world. The problem in the case of higher education students is one of the challenging factors. To solve the issue the concern is to collect all the factors then analyses and then implement the methods to find out the cause After getting the full and effective cause, it is also very challenging to implement. But the most effective factor is how the problem can be diagnosed. There are different emerging techniques are developing day to day. But the most effective approaches are to implement machine learning applications or algorithms to detect the solution in an effective manner. This study is based upon the classification tasks. The mental health problems are different types like stress, anxiety or depression etc. The different classification algorithms are implemented over these problems and suitable algorithm is picked as per the performance measurement. The performance evaluation is also done by taking the factors associated with the particular mental health problem. In the study 4 classifications are used as Decision Tree (DT), Logistic Regression (LR), Support Vector Machine (SVM) and Neive Bayes (NB). After successful implementation, different algorithms show different performances. For stress detection Decision Tree algorithm's performance came out as best, while for Anxiety level detection Logistic regression is the out performer. In same way support vector machine works good for depression level calculation. The result shows that machine learning algorithms are best if the input data is trained, tested. Overall, the outcome shows that the methods or machine learning algorithms which are implemented have significant influences. The outcomes can be implemented over the higher education students to detect the mental health problem status. The overall result shows that for stress detection Decision Tree gives 94.4%, Support Vector machine gives result of 91.2% for depression level calculation. For Anxiety level detection, Logistic regression shows 88.76% which is best over all other algorithms.**

Keywords—Mental Health, Decision Tree, SVM, LR, NB, Stress, Depression, Anxiety.

I. INTRODUCTION

The true fact that identifying the mental health problems specially in case of higher education students is tough task. The factors associated with the mental health are also very similar to each one. The factors are influenced by different challenging factors like issues in environment, biology or psychology [1]. It is also very important to identify the real symptoms of the problem otherwise it will lead to misdiagnosis which results to the improper treatment. The implementation of the diagnosis is based upon proper analysis of data. Data analysis with machine learning implementation may give a proper analysis [2]. Machine learning algorithms can be implemented to large volume of data at a time with real time applications to investigate the proper diagnosis method. The algorithm implementation along with treatment can give the best result with a minimum risk factor. But human expertise is the most powerful weapon to control the mental disorder problems. Machine leaning algorithms may give accurate result but it should be integrated or verified before implementation because this problem is very sensitive. These methods are now a days are implemented in non-curable diseases like cancer, diabetes and heart diseases etc. [3-5] Improper treatment may lead to some misshapen to the student. It may lead to unrecoverable conditions. It is an incurable disease. So, it is important to diagnose the problem in its primary stage. Number of methods are used in healthcare systems like fog computing [6], Machine learning approaches and smart technologies [7-8].

Additionally, the main focused must to detect the non-curable diseases in its preliminary stage. For this reason, in higher education system research is now playing a vital role. Government is also giving emphases on research labs to be built in most of the higher education institutes. But the research ecosystem must be built in such a way that the research must be progress with both the collaborations of students and teachers. The main advantage of this collaboration is to give mental strength to students. This activity will provide a solid boost on the mind of the talented students and also students from lower background as compared to financial point of view. The main aim is to make student morally strong such that mental health problem will not be a part of them. In India most of the educational institutes are currently focusing in this research activity such that a greater number of high-quality graduates will come in short period of time.

It is a challenge for each educational institute to create environment where the student will never undergo to mental health problems. So, University has to recognize the mental health of each student. If there is any problem then University must take significant step to correct and maintain a sociolect friendly environment. Also, students in some cases must manage themselves to self-care. They must manage their

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stress to maintain a good mental health to complete the study in the University. They must have to relax their mind and focus on their wellbeing such that they can maintain a good mental health during the entire University years. They can develop this by creating regular habit of self-care, take support from their friends, family and relatives. The main goal of a student must be the time management and utilization the time in effective manner. The time must be utilizing in such a way that their academic activity must come first without any other activities. So, the healthy environment in a higher education is a combined effect of both student and University. But University is responsible to keep the student's mind mentally strong during the academic schedule [9].

The University must create the environment of support and acceptance. University must try its best to reduce the mental health problem of a student during the whole academic activities. In each step. University must ensure that it has mental health resources readily available. If there is any problem then University must carry on mental health courses like live chat, create a support group, education campaign etc. Each University must have a support group, which can help students to feel themselves comfortable to express their mental health problem. So overall University must maintain a healthy environment and well-established support group to reduce the mental health problems in higher education systems. So, it must create awareness among students to take the advantage of the creative environment by the well-established support group. So that students can take the advantage of support group and maintain a good mental health.

Apart from the University activity the student must maintain a thinking activity such that there will be never mental health problem. Otherwise, it will disturb the quality of life, disturb the running speed of the life and disturb the social environment. Negativity in mind create a disturbance in creating work balance and to maintain a good friendly environment. It increases depression and increase the anxiety level. It also creates the stress. So that the students can be controlled to do their best in future. The first part of the paper introduces the mental health problems in higher education students. In second part it describes the literature survey of the ongoing problems. The third part comprises with the data collection and methodologies which are implemented. Then in the 4th part it shows the results and outcomes of the applied methods. At last, it concludes with the advantages of implementation of machine learning approaches in these problems of mental health in higher education students.

II. Related Works

Social anxiety disorder is characterized by extreme fear or anxiety about social situations or performance situations, such as public speaking or meeting new people. People with this disorder may experience intense fear of embarrassment, humiliation, or judgement by others, which can significantly impact their social and work life. Treatment for anxiety disorders typically involves a combination of medication and therapy, such as cognitive-behavioral therapy (CBT). CBT helps to control the anxieties in such a way that one can go away from the negative thoughts to search his/her own identity and make his/her strategy to change the lifestyle by of eat healthy foods, doing regular exercises and do the activities like yoga or meditations to reduce the stress. Overall, anxiety disorders can significantly impact a person's daily life and well-being. It is important [9-10].

Stress: Stress is a state of mental or emotional tension or strain caused by demanding or challenging situations, such as work pressure, academic demands, financial difficulties, or relationship issues. Stress is a normal response to daily life events, and it can be beneficial in some situations, such as providing motivation to meet deadlines or perform well in exams. However, excessive stress can have negative effects on physical and mental health, leading to exhaustion, burnout, and creates the cause of more anxieties and depressions. Symptoms of stress include irritability, mood swings, headaches, muscle tension, and difficulty sleeping. One of the most dangerous mental diseases is Schizophrenia. In this disease a person loses ability to think wisely, perform good behavior or unable to feel the expression. Generally, a person does the abnormal behavior, which can make it difficult for a person to communicate and interact with others. People with schizophrenia may experience social withdrawal, lack of motivation, and difficulties with memory and attention. The mystery of this disease is not solved. But it is assumed that the main cause of this disease may be genetic or the environment of the person and the mental chemistry. The treatment is as usual the meditation, yoga, real time therapy and changing the environment.

Financial difficulties can cause a student to feel overwhelmed and unable to cope with the demands of college life, especially if they are struggling to pay tuition fees or meet basic needs like food and housing. This can lead to stress and anxiety, which can further exacerbate mental health problems. Additionally, the learning environment can be a significant stressor for students, particularly when they feel overwhelmed by academic demands, competition, and expectations from lecturers and peers [11]. In case of higher education students' mental health problems starts from irregular sleep, diet, lack of physical activity and the environment of the friend circle. It is essential to note that mental health problems are complex and multifactorial, and they can be caused by a combination of several factors [12]. Therefore, addressing mental health problems requires a comprehensive and integrated approach that considers all the factors involved. Also, the pandemic of COVID-19 impacts on the mental health of students [13-14]. Also, in some cases the organization or institution helps a lot to support higher education students to opt out from the mental health problems [15].

The factors which are discussed can be broadly classified into 7 categories as Peer relationship, Lack Of social Support, Financial Problems, Learning Environment, Being Female and Family Problem shown in Fig1.

Fig. 1. Factors associated with changing from good health to problematic mental health

III. METHODS

Data collection is not so easy to carry the research. The data collection is based upon the survey to collect the real time data. In the survey total 3246 data are collected from the different universities by the forms circulated over the different social media and directly contacting through the University Heads where higher education is a part of the University curriculum. Different fields which are taken for the survey are Feel_Positive, Feel_Negative, value_apperance, value_self, value_rel, value_social_supp, value_safety, value_Home_env, Val_outside_env, value_ finance, value_relax, value_religion and value_memory. From the different mental health types, in this study we focused on only 3 types of mental health problems i.e. Stress, Depression and Anxiety. In survey reports we have given

There are different data mining techniques are taken in certain extent by using certain parameters to calculate the which calculate some point values the outcome in 4 levels: Normal, Average, Severe and Upmost state [16-17]. The levels are categorized by the scores. The scores will indicate the patient stage. These level indicators are set by another survey form which took the common values over the 176 doctors from the various hospitals of India. Each level is associated with different feature selections from the total parameters collected from the first survey form.

The patient stage indicator values are shown in Table I.

TABLE I. PATIENT STAGE INDICATOR VALUES

Types	Normal	Average	Severe	Upmost
Stress	0-5	6-14	15-18	>18
Depression	0-3	4-10	11-15	>16
Anxiety	0-7	8-14	15-18	>18

After getting the appropriate Data values, different models are selected as described below. The comparative analysis is summarized at the end to get the conclusion. The detailed procedure is shown in Fig.2. The algorithms which are taken here are Decision Tree (DT), Support vector Machine (SVM), Naive Bayes (NB) and Logistic Regression (LR). The level of mental health types can be calculated as the scores calculated from the survey result along with the feature selection implementation with different ML algorithms.

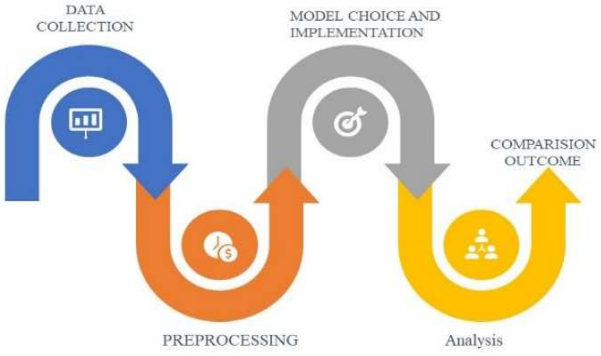

Fig. 2. Data Collection – Comparison – Conclusion

A. *Stress level prediction(Comparative analysis):*

Feature selection for stress detection is based upon 6 attributes i.e., Feel_Positive, Feel_Negative, Value_rel, Value_relax, Value_religion and Value_memory. Target attribute value is Value_stressed or Value_notstressed. The different machine learning algorithms are applied on the feature selection upon the total collected data set. It shows that Decision tree accuracy is best while the Naive Bayes accuracy is worst. As per the result Decision tree accuracy shows a significant result of 94.4% accuracy.

In Table II it shows the comparative algorithms for the stress calculation and Fig 3 shows the performance report

TABLE II. COMPARATIVE ALGORITHMS IN STRESS CALCULATION

Algorithms	Accuracy	Sensitivity	Specificity	Precision
Decision Tree (DT)	94.4	64.9	91.3	80.8
Support Vector Machine (SVM)	85.32	54.71	93.45	67.04
Naive Bayes (NB)	78.71	45.6	87.72	47.8
Logistic Regression (LR)	84.92	53.5	94.3	67.8

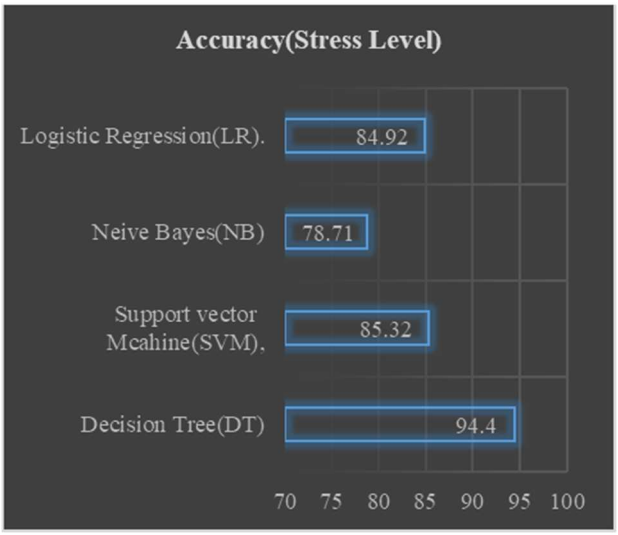

Fig. 3. Accuracy Outcome for the stress detection

B. *Depression level prediction(Comparative analysis):*

Feature selection for depression level detection is based upon 11 attributes i.e., Feel_Positive, Feel_Negative, value_self, value_rel, value_social_supp, value_safety, value_Home_env, Val_outside_env, value_ finance, value_relax, and value_memory. The different machine learning algorithms are applied on the feature selection upon the total collected data set. It shows that Support Vector machine (SVM) accuracy is best while the Naive Bayes accuracy is worst. As per the result Support Vector Machine accuracy shows a significant result of 91.24% accuracy. Table 3 it shows the comparative algorithms for the Depression Level calculation and Fig 4 shows the performance report

TABLE III. COMPARATIVE ALGORITHMS IN DEPRESSION LEVEL CALCULATION

Algorithms	Accuracy	Sensitivity	Specificity	Precision
Decision Tree (DT)	87.8	63.4	93.2	68.2
Support vector Machine (SVM)	91.24	67.67	98.24	83.5
Naive Bayes (NB)	82.56	41.7	92.5	54.7
Logistic Regression (LR).	88.4	63.4	96.5	82.59

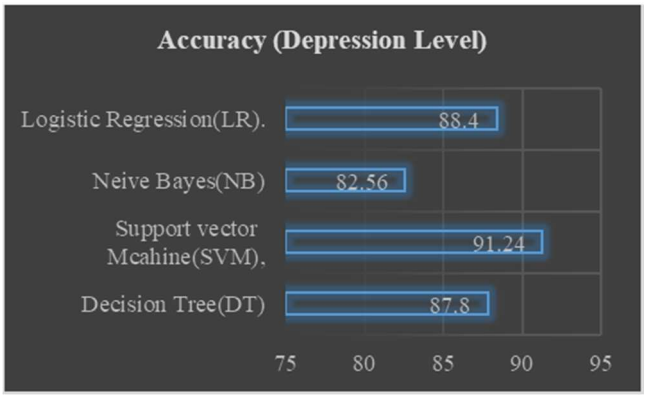

Fig. 4. Accuracy Outcome for the Depression Detection

C. *Anxiety level prediction (Comparative analysis):*

Feature selection for Anxiety level detection is based upon 8 attributes i.e., Feel_Positive, Feel_Negative, value_self, value_rel, value_social_supp, value_safety, value_finance, and value_memory. The different machine learning algorithms are applied on the feature selection upon the total collected data set. It shows that Logistic Regression (LR) accuracy is best while the Naive Bayes accuracy is worst. As per the result Logistic Regression (LR) accuracy shows a significant result of 88.76% accuracy. Table 4 it shows the comparative algorithms for the stress calculation and Fig 5 shows the performance report

TABLE IV. COMPARATIVE ALGORITHMS IN DEPRESSION CALCULATION

Algorithms	Accuracy	Sensitivity	Specificity	Precision
Decision Tree (DT)	75.83	55.43	89.00	72.2
Support vector Machine (SVM)	65.6	48.6	78.6	57.3
Naive Bayes (NB)	65.00	46.45	79.89	60.34
Logistic Regression (LR).	88.76	52.54	93.4	84.5

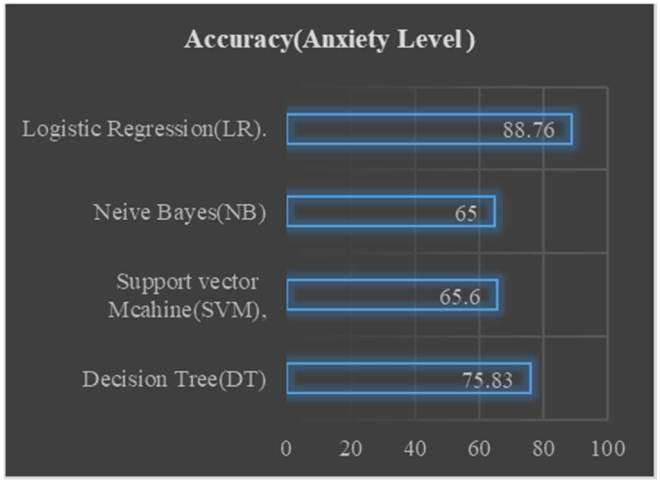

Fig. 5. Accuracy Outcome for the Depression Detection

IV. RESULT AND DISCUSSION

After taking the data values and implementation of various algorithms it is found that the mental health problem can be find out by implementing the Machine Learning algorithm. Overall, the result shows that all the algorithms can be implemented to solve the issue but best part of the implantation is comparative assessment of the different algorithms by taking different features. In the result section after applying different machine learning algorithms with number of features it is found that for Stress detection Decision Tree method gives 94.4%, depression Support Vector Method gives 91.2% and for Anxiety Logistic regression gives 88.76% accuracy with 6,11 and 8 features respectively. The summarize table with the best performance algorithms is given in Table 5 and in Fig 6

TABLE V. RESULT SUMMARIZATION

Mental Health type	No. Of Features	Best Algorithms	Overall Accuracy (%)
Stress	6	DT	94.4
Depression	11	SVM	91.2
Anxiety	8	LR	88.76

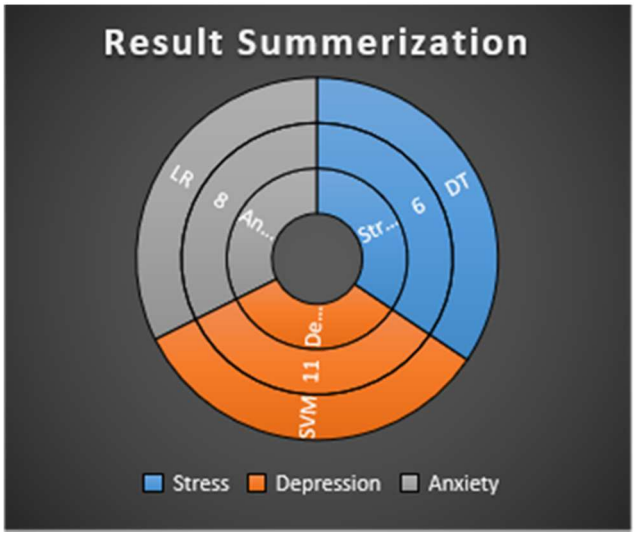

Fig. 6. Summarized Output of all the implementation

V. Conclusion

However, it is important to consider ethical considerations when implementing machine learning algorithms in mental health classification. In the research of this article 4 algorithms are used. But the most important thing is that the machine learning algorithms can give more accurate result but it cannot replace the traditional mental health problem detection and the supportive formulas to cure these problems. It is essential to maintain the privacy and confidentiality during implementation of these algorithms or collection of data to run the algorithms They should instead be seen as complementary tools that can aid in identifying students who may need further assessment and support. It is also essential to ensure that appropriate interventions and support systems are in place to address the mental health needs of students who are identified as requiring further support. In summary, the use of machine learning algorithms in mental health classification among higher education students is a promising approach that can aid in developing effective interventions and support systems. However, it is crucial to ensure that ethical considerations are considered, and that appropriate interventions and support systems are in place to address the mental health needs of students. The overall assessment is based upon 4 algorithms. But this is now a serious problem to the higher education students. So, it can be enhanced by other available algorithms and can be prepare a patented device to measure the stress or anxiety factor in a particular time or situation of a student.

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