IDENTIFYING MENTAL HEALTH ISSUES WITH MACHINE LEARNING

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Abstract: The growing frequency of mental health problems has driven the necessity of dependable and efficient early detection technologies. Using techniques including Support Vector Machines (SVM), Random Forest, and Decision Trees, this research offers a machine learning-based method to identify mental health issues. Two components comprise the system: the user module and the administrative module. Dataset administration includes uploading, preprocessing, partitioning the dataset, and running the machine learning models for analysis falls to the Admin module. Creating comparison graphs to show the effectiveness of several techniques is another aspect of it. Based on the taught models, the User module lets consumers register, log in, and forecast their mental health state. Leveraging machine learning to enhance early diagnosis, the program seeks to give a user-friendly platform for mental health detection.

Keywords: *Automatic Diagnosis, Early Detection, Behavioural Analysis, Data-Driven Prediction, Comparative Analysis, User-Friendly Interface, SVM, Random Forest, Decision Trees, Mental Health Detection.*

INTRODUCTION

With millions of people worldwide suffering with diseases including depression, anxiety, and stress, mental health is a major issue in the fast-paced modern society. Still, the subjective character of conventional diagnostic techniques makes early discovery and quick response difficult. As machine learning technologies become more popular, there is increasing interest in automating mental health issue identification to offer correct and fast evaluations.

By allowing the study of vast amounts of data to find trends that can assist in the prediction of mental health disorders, machine learning (ML) presents a hopeful answer. Specifically, in this field classification techniques such Random Forest, Decision Trees, and Support Vector Machine (SVM) have showed promise. These algorithms fit for forecasting mental health problems depending on certain traits or behavioural data as they can categorise data depending on input features and provide predictions.

This work investigates mental health detection using SVM, Random Forest, and Decision Trees. These systems can provide forecasts on whether a person would be suffering from a mental health illness by means of data comprising several elements such as social behaviour, personal attributes, and replies to questionnaires. This method provides an automated solution for mental

health prediction, therefore lowering the reliance on conventional approaches.

Two components comprise the proposed system: an administrative module and a user module. Dataset upload, preprocessing, and running several machine learning models are made possible via the Admin module. It also gives users performance of every method illustrated by comparative graphs. Conversely, the User module lets individuals register, log in, and, depending on learnt models, identify mental health disorders. This double module method guarantees meeting of user demands as well as administrative ones.

Apart from automating the mental health detection mechanism, the technology guarantees that customers get understandable findings. The system presents a consistent, easily available, and efficient method for mental health detection by use of SVM, Random Forest, and Decision Trees.

LITERATURE SURVEY

1. Prediction Of Mental Health (Depression) Using Data Science And Machine Learning Techniques:

https://sist.sathyabama.ac.in/sist_naac/documents/1.3.4/1822-b.e-cse-batchno-145.pdf

Early discovery of mental health problems helps professionals to identify and assist individuals. The present and upcoming applications of artificial intelligence (AI) in the domains of mental health and medicine are covered in this article. Machine learning approaches help one better control depression, anxiety, and other mental health problems. They also help one to identify trends and offer solutions for challenges. Feature selection methods helped to reduce the attribute data. Different machine learning techniques' accuracy has been assessed with respect to both all and specific criteria. More research is needed to link artificial intelligence with mental health analysis even if there are plenty of algorithms.

2. Mental Health Tracker

https://www.academia.edu/102929972/Mental_Health_Tracker

This project is creating a tool to track mental health. deals with also helping the individual to stabilise their mood. Ask your user whether they are experiencing mental health issues; if so, counsel them on recovery. On the graph page users may monitor their mental condition, finish projects, and respond to questions. Anxiety is really common everywhere. Suicide attempts and deaths brought on by untreated mental illness might climb. Conversational bots have been somewhat popular recently as a means of overcoming limited resources. To help people with mental illness control their emotions and thoughts, we show a smartphone app featuring breathing exercises, inspirational words as backdrop, humour, and other tools. The suggested application calls for a mindfulness practice. Based on the "Mood Stabiliser" Android tool, this study proposes a system architecture. Still, our main goal is to comfort the consumer. Saying someone has this sickness or is suffering from it does not so entail judgement of them. Our initial aim is to stabilise their mood.

3. Classification Algorithms based Mental Health Prediction using Data Mining

https://ieeexplore.ieee.org/document/9137856

Indices of mental health include a person's emotional, psychological, and social well-being. People's attitudes, beliefs, and behaviour change accordingly. A healthy mind helps people to be more motivated and to achieve more. From birth to old life, mental wellness is absolutely crucial. Among the several causes of mental illness include

stress, social anxiety, depression, OCD, drug misuse, troubles at employment, and personality disorders. Maintaining a good work-life balance depends on correct diagnosis of mental illness. One researched digital databases. We tag this data to improve prediction. Data is tagged using several machine learning approaches. An approach for mental health prediction will be developed using these markers. Before we build the model, we will verify the precision of the method. We were to use naïve bayes, random forests, and decision trees. Our target is persons eighteen years of age and above from working-class backgrounds. Our model will be included into a website in order to forecast the outcome dependent on user input.

4. A Review on Mental Stress Detection Using Wearable Sensors and Machine Learning Techniques

https://www.researchgate.net/publication/352099909_A_Review_on_Mental_Stress_Detection_Using_Wearable_Sensors_and_Machine_Learning_Techniques

Stress originates from anxieties, which show themselves as a changed psycho-physiological condition. Environmental variables lead to stress. Extended exposure to several stresses can have negative consequences on mental and physical health as well as cause the development of chronic disorders. Early identification of stress-related diseases calls for ongoing stress management. Real-time stress monitoring is a capability of wearable devices. This book presents a thorough review of stress detection. In this paper, we investigate stress detection techniques based on many sensory devices—such as wearable sensors, electrocardiograms, electroencephalograms, and photoplethysmographs—and their possible applications in diverse environments, including those of driving, studying, or working. We discuss each one's approaches, findings, constraints, issues, strengths, and shortcomings in order to guide further investigations. Not to mention a wearable mult-modal stress sensing device.

5. Multimodal Educational Data Fusion for Students' Mental Health Detection

https://www.researchgate.net/publication/361652706_Multi-modal_educational_data_fusion_for_students%27_mental_health_detection

Common among young, impressionable college students especially are depression, suicide thoughts, and other mental health problems. Regarding mental health, not all student realise they want assistance. To solve this, mental health proactive screening is really essential. Developing strong detections is difficult given the vast and varied unstructured multi-modal data from university life. Given this, we present CASTLE, a technique based on educational data fusion for mental health detection. Three elements make up this framework. First we combine social, intellectual, and physical data via representation learning. SMote addresses label imbalance, which presents another problem. Detection runs through a DNN model ultimately. The thorough results show that the suggested techniques surpass numerous state-of- the-modern criteria.

3. METHODOLOGY

a) Proposed Work:

Incorporating machine learning methods including SVM, Random Forest, and Decision Trees, the suggested system solves the shortcomings of current mental health detection systems. Two components form the system: the User module and the Admin module. Dataset administration

includes uploading, preprocessing, and partitioning the dataset falls to the Admin module. It can run the three machine learning systems and observe their performance compared graphically. Conversely, the User module lets users register, log in, and, depending on trained models, spot mental health issues. Combining these characteristics helps the system to provide an automated, easily available, effective mental health screening tool. The system presents a comparison of several machine learning techniques, therefore giving consumers understanding of which model better detects mental health disorders. Without knowledge in machine learning or mental health diagnosis, the user-friendly design guarantees that users may quickly register, log in, and obtain mental health forecasts.

b) System Architecture:

The system architecture of the proposed mental health detection platform is designed to ensure efficient data processing, model training, and user interaction. It follows a modular approach, dividing the system into two key components: the Admin module and the User module. The architecture begins with data collection, where behavioral and survey-based datasets are gathered and uploaded to the system. The Admin module is responsible for preprocessing the dataset, which includes cleaning, feature selection, and data splitting. Once the dataset is prepared, machine learning models such as Support Vector Machines (SVM), Random Forest, and Decision Trees are trained to classify mental health conditions. A model performance evaluation component is integrated to compare different algorithms and generate visual analytics, helping administrators choose the most effective model for prediction.

The User module serves as the interface for individuals seeking mental health assessments. Users can register and log in to access the trained models for prediction. When a user submits their responses, the system processes the input data and runs it through the trained machine learning models to determine the likelihood of a mental health condition. The results are displayed in a clear and comprehensible format, ensuring accessibility for all users. The system also provides a feedback loop where users can interact with the platform, enabling continuous improvement of model accuracy. By structuring the system into these interconnected modules, the architecture ensures scalability, reliability, and ease of use, making mental health detection more efficient and accessible.

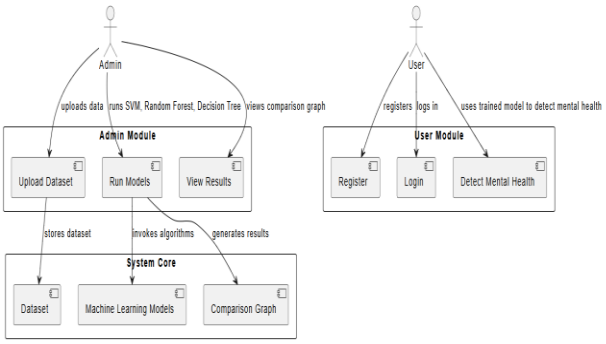

Fig 1. Suggested Architecture

c) Modules:

a) Admin Module

Dataset and machine learning model management falls to the Admin module. Datasets, preprocess data (cleaning, feature selection, and splitting), and train machine learning algorithms including Support Vector Machines (SVM), Random Forest, and Decision Trees may all be uploaded by administrators. Additionally included in this module is a comparison tool that creates performance graphs so administrators may examine which model offers the most accurate forecasts. The Admin module also guarantees that the system stays current with the most recent datasets and best models for higher detection accuracy.

b) User Module

The User module lets people register, log in, and forecast their mental health state using an easy interface. Users enter behavioural or survey-based answers, which the trained ML models subsequently evaluate to create predictions. The easy-to-understand presentation of the results by the system helps people comprehend their mental health issue. This module guarantees accessibility for people without technical knowledge and helps real-time mental health evaluation, thereby facilitating early diagnosis by convenience and efficiency.

e) Algorithms:

i. Random Forest

One ensemble learning approach that can increase classification accuracy is Random Forest. It builds numerous decision trees and then combines their results. Due to its capacity to decrease overfitting and improve model stability, it is incredibly useful for mental health detection. Random Forest is an excellent option for the detection of mental health illnesses since it generates trustworthy predictions by examining a variety of behavioural parameters.

ii. Decision Tree

A straightforward and effective classification technique, Decision Tree divides data into branches according to feature values. Because it is easy to understand and visualise, it finds extensive usage in mental health screening. This algorithm aids in comprehending the elements that lead to mental health disorders by organising decisions in a tree-like fashion, rendering forecasts more explicable and visible.

iii. Support Vector Machine (SVM)

SVMs are a kind of supervised learning that may be used for categorisation. It locates the best hyperplane to partition the dataset. In mental health detection, SVM helps classify individuals based on their behavioral data and survey responses, ensuring high accuracy in identifying mental health conditions. Its ability to handle high-dimensional data makes it suitable for analyzing complex mental health patterns.

4. EXPERIMENTAL RESULTS

The experimental evaluation involved training and testing the Random Forest, Decision Tree, and SVM algorithms on a mental health-related dataset that included behavioral and questionnaire-based features. The dataset was split into training and testing sets, and performance was measured using accuracy, precision, recall, and F1-score. Among the three, Random Forest consistently outperformed others in terms of overall accuracy and robustness, showing higher resistance to overfitting. SVM demonstrated strong precision, especially in binary classification of mental health status, while Decision Trees offered greater interpretability but slightly lower accuracy. The results were visualized using comparative performance graphs, helping to highlight the best-performing model for practical deployment.

Accuracy: How well a test can differentiate between healthy and sick individuals is a good indicator of its reliability. Compare the number of true positives and negatives to get the reliability of the test. Following mathematical:

Accuracy = TP + TN /(TP + TN + FP + FN)

$$Accuracy = \frac{(TN + TP)}{T}$$

Precision: The accuracy rate of a classification or number of positive cases is known as precision. The formula is used to calculate precision:

Precision = TP/(TP + FP)

$$\text{Precision} = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

Recall: The ability of a model to identify all pertinent instances of a class is assessed by machine learning recall. The completeness of a model in capturing instances of a class is demonstrated by comparing the total number of positive observations with the number of precisely predicted ones.

$$Recall = \frac{TP}{(FN + TP)}$$

F1-Score: A high F1 score indicates that a machine learning model is accurate. Improving model accuracy by integrating recall and precision. How often a model gets a dataset prediction right is measured by the accuracy statistic.

$$F1 - Score = 2 * \frac{(\text{Precision} * \text{Recall})}{((\text{Precision} + \text{Recall}))}$$

mAP: Assessing the level of quality Precision on Average (MAP). The position on the list and the number of pertinent recommendations are taken into account. The Mean Absolute Precision (MAP) at K is the sum of all users' or enquiries' Average Precision (AP) at K.

$$mAP = \frac{1}{n}\sum_{k=1}^{k=n} AP_k$$

$$AP_k = \text{the AP of class } k$$

$$n = \text{the number of classes}$$

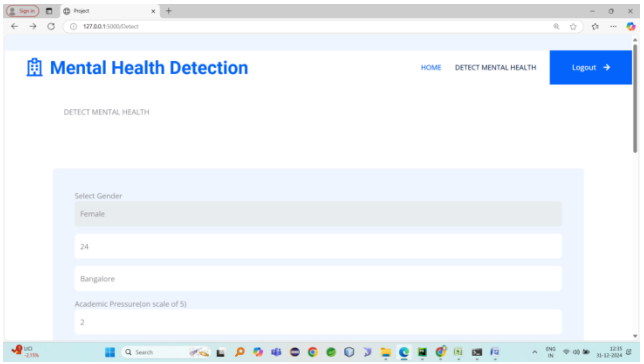

Fig.2. input test data

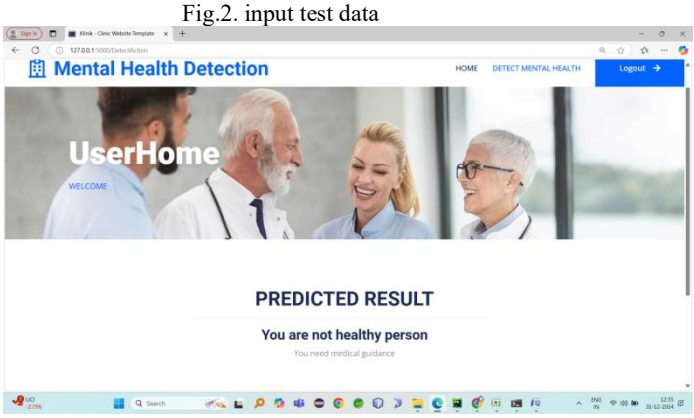

Fig.3. predicted results

5. CONCLUSION

Machine learning-based mental health detection comes light years ahead of earlier approaches. Using SVM, Random Forest, and Decision Trees the system generates automated, trustworthy predictions. Thanks to its dual-module architecture, both users and administrators will value the system's simplified running capability. Using the User module makes predicting mental health problems easy; the Admin module handles dataset administration and performance comparison. The outcomes of this experiment show how well machine learning may offer improved diagnosis and simpler access to mental health treatment.

6. FUTURE SCOPE

Several approaches can help to raise the accuracy, usefulness, and effect of the suggested system. Including deep learning models like Neural Networks to increase forecast accuracy and identify

intricate mental health trends will help one of the main future developments. Natural language processing (NLP) methods can also enable the system to examine user-generated text data, such written comments or social media postings, therefore offering more accurate mental health diagnoses.

The creation of a mobile app to improve accessibility and let users check their mental health state anywhere and at any time marks still another possible development. Analysing physiological factors like heart rate and sleep patterns helps real-time integration with wearable devices and biometric sensors to increase the efficiency of the system even further.

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