

Predicting and Preventing Mental Health Symptoms Using Machine Learning

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Abstract - Mental health issues such as stress, anxiety, and depression have become increasingly common in modern society due to lifestyle changes, work pressure, and social challenges. Early identification of mental health symptoms is important to prevent severe psychological problems and improve overall well-being. Traditional methods for detecting mental health conditions mainly rely on surveys, clinical interviews, and counseling sessions, which are often time-consuming, costly, and dependent on human judgment. These limitations make it difficult to provide timely support for a large number of individuals. This research proposes a machine learning-based system for predicting and preventing mental health symptoms by analyzing lifestyle and behavioral data. The system collects user inputs such as age, sleep hours, stress level, work hours, exercise habits, social interaction level, screen time, and diet quality. The collected data is processed using data preprocessing techniques including cleaning, normalization, and encoding. Multiple machine learning algorithms such as Logistic Regression, Random Forest, and Support Vector Machine (SVM) are used to train prediction models that classify the mental health condition of a user into categories such as healthy, moderate stress, or high stress. The developed system is implemented using Python, machine learning libraries, and a Flask-based web application interface, allowing users to easily input their data and receive predictions in real time. In addition to prediction, the system provides preventive recommendations such as maintaining proper sleep patterns, engaging in regular exercise, practicing mindfulness, and reducing excessive screen time. Visualization tools such as charts are also used to present the prediction results clearly. The proposed system helps in early detection of mental health risks, enabling individuals to take preventive actions before the condition becomes severe. Compared to traditional approaches, the system is faster, cost-effective, scalable, and capable of assisting users in maintaining better mental health and well-being.

Key Words: Machine Learning, Mental Health Prediction, Stress Detection, Preventive Recommendation System, Logistic Regression, Random Forest, Support Vector Machine (SVM), Data Preprocessing, Flask Web Application, Health Analytics.

1.INTRODUCTION

Mental health disorders such as stress, anxiety, and depression have become significant public health concerns worldwide, affecting millions of people and impacting their daily life, productivity, and social relationships. According to reports by the World Health Organization, factors such as increased workload, lack of sleep, social isolation, unhealthy lifestyle habits, and excessive screen time have contributed to the rapid rise in mental health issues. Early detection and prevention of these symptoms are essential to improve individual well-being and reduce long-term societal impact. However, traditional methods used for identifying mental health conditions, including psychological surveys, questionnaires, counseling sessions, and clinical interviews, have several limitations. These methods are often time-consuming, expensive, and dependent on trained professionals, and many individuals avoid seeking help due to social stigma or lack of awareness, leading to delayed diagnosis and treatment.

Recent advancements in artificial intelligence and machine learning have provided new opportunities to address these challenges by enabling efficient analysis of large volumes of data and identification of hidden patterns. Machine learning techniques such as Logistic Regression, Random Forest, and Support Vector Machines are widely used in healthcare for disease prediction, diagnosis support, and patient monitoring due to their ability to learn from historical data and make accurate predictions. In the context of mental health, these models can analyze behavioral and lifestyle factors such as sleep patterns, stress levels, work hours, exercise habits, social interaction, and diet quality to classify individuals into categories such as healthy, moderate stress, or high stress. This predictive capability supports early detection and helps individuals take preventive actions before the condition becomes severe.

The objective of this research is to develop a machine learning-based system that predicts and prevents mental health symptoms using user lifestyle and behavioral data. The system collects input through a web interface, processes the data using preprocessing techniques, and applies machine learning algorithms to determine mental health status. Additionally, it provides preventive recommendations such as improving sleep habits, practicing mindfulness, maintaining a balanced diet, and engaging in

regular physical activity. This approach aims to offer a faster, cost-effective, and accessible solution for supporting mental health awareness and early intervention.

2. PROPOSED SYSTEM

The proposed system is designed to predict and prevent mental health symptoms using machine learning techniques by analyzing user lifestyle and behavioral factors such as age, sleep hours, stress level, work hours, exercise habits, social interaction level, screen time, and diet quality. Based on this data, machine learning models are trained to identify patterns and classify the user's mental health condition into categories such as healthy, moderate stress, or high stress. The primary objective of the system is early detection and prevention of mental health issues, enabling users to take timely action through preventive suggestions such as maintaining a healthy routine, improving sleep patterns, practicing mindfulness, and engaging in regular physical activity. The system is implemented as a web-based application using Flask, which provides an interactive interface for users to input their details and receive real-time prediction results along with graphical visualizations for better understanding.

The system architecture consists of two main layers: the Web Application Layer and the Machine Learning Layer. In the Web Application Layer, users interact with the system through a user-friendly interface that collects lifestyle and behavioral data, which is then stored in the database for further processing. This layer includes the User Interface, Data Collection Module, and Preventive Recommendation Module. The Machine Learning Layer is responsible for processing and analyzing the data, where the collected input is first cleaned and prepared using the Data Preprocessing Module by handling missing values, normalizing data, and converting categorical values into numerical format. The processed data is then used in the Model Training Module, where algorithms such as Logistic Regression, Random Forest, and Support Vector Machine are applied to learn patterns and relationships within the dataset. After training, the Model Evaluation Module assesses the performance of each algorithm using metrics such as accuracy, precision, and recall, and selects the best performing model. The Prediction Module then uses this trained model to analyze new user inputs and generate prediction results. Finally, the results are sent back to the web application, where the system displays the predicted mental health condition and provides personalized preventive recommendations such as improving sleep habits, engaging in exercise, reducing screen time, and adopting a healthier lifestyle, thereby helping users manage stress and maintain better mental well-being.

3. IMPLEMENTATION DETAILS

The proposed system is implemented using Python along with machine learning and web development libraries, and it is developed as a web-based application using the Flask framework. This allows users to interact with the system

through a browser interface and receive real-time prediction results. The system operates on a local server where user input data is processed and analyzed efficiently. The dataset used in the system consists of various lifestyle and behavioral factors such as age, sleep hours, stress level, work hours, exercise habits, social interaction level, screen time, and diet quality, which are collected through a user-friendly web interface. Before applying machine learning algorithms, the data undergoes preprocessing steps including handling missing values, removing duplicate entries, normalizing numerical values, and encoding categorical data to ensure better model performance.

Multiple machine learning algorithms such as Logistic Regression, Random Forest, and Support Vector Machine (SVM) are implemented using the Scikit-learn library to train the prediction model. These algorithms analyze the relationship between user lifestyle factors and mental health conditions to classify users into categories such as Healthy, Moderate Stress, or High Stress. The performance of these models is evaluated, and the best-performing model is selected for prediction. The web application interface is designed using HTML, CSS, and Bootstrap, providing a simple and responsive user experience. When a user submits their data, the Flask backend processes the input and sends it to the trained model, which generates the prediction result and displays it on the webpage along with preventive suggestions. Additionally, the system includes visualization features such as pie charts to represent the probability distribution of mental health conditions, making the results easier to understand.

Table 1: Key Machine Learning Algorithms Used

Algorithm	Purpose
Logistic Regression	Predicts probability of mental health condition
Random Forest	Improves accuracy using multiple decision trees
Support Vector Machine (SVM)	Classifies complex patterns in data

4. RESULTS AND PERFORMANCE ANALYSIS

4.1 Prediction Results of the System

The proposed machine learning system was tested using various input values representing different lifestyle and behavioral factors such as sleep hours, stress level, work hours, exercise habits, social interaction, screen time, and diet quality. The system successfully processed the user input data and predicted the mental health condition based on the trained machine learning models.

The prediction results classify the user's mental health condition into categories such as Healthy, Moderate Stress, and High Stress. The system provides the result instantly

after the user submits the input form through the web interface. This demonstrates that the proposed system can effectively analyze lifestyle patterns and provide early identification of potential mental health symptoms.

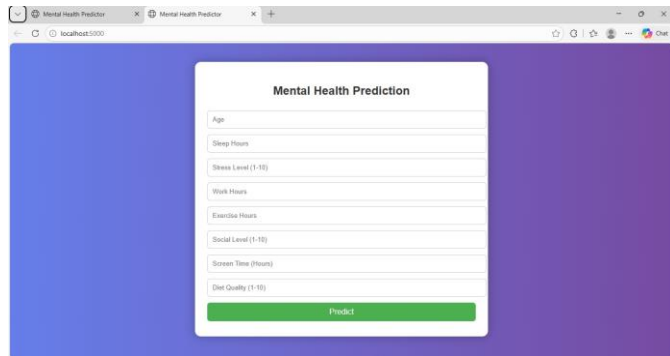


Fig - 1: User Input Interface and Mental Health Prediction Result

The results show that the system is capable of analyzing user-provided data and generating predictions in real time. The simple and interactive web interface makes the system easy to use and accessible to users without technical knowledge.

4.2 Visualization of Mental Health Prediction

To improve user understanding, the system also generates graphical representations of the prediction results. Visualization techniques such as pie charts are used to display the probability distribution of different mental health conditions. This helps users clearly understand the prediction output and the likelihood of each mental health category.

The pie chart visualization represents the predicted probabilities for different mental health conditions, allowing users to easily interpret the results and understand their mental health status. The graphical output improves the overall usability of the system and allows users to quickly interpret the results without needing detailed technical knowledge.

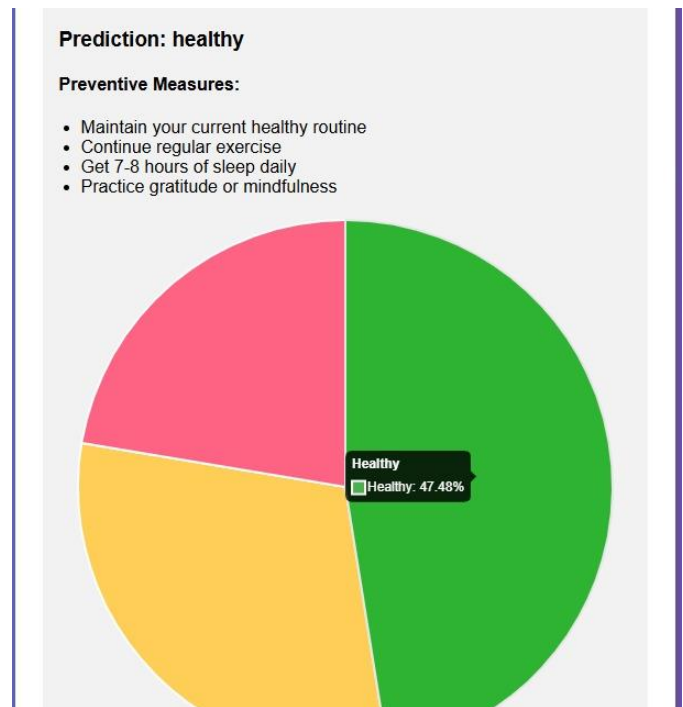


Fig - 2: Pie Chart Visualization of Mental Health Prediction

4.3 Performance Evaluation of Machine Learning Models

The performance of different machine learning algorithms such as Logistic Regression, Random Forest, and Support Vector Machine (SVM) was evaluated using the dataset. The models were trained using the prepared dataset after preprocessing and were tested to measure their classification performance.

Evaluation metrics such as accuracy, precision, and recall were considered for analyzing the model performance. Among the implemented models, ensemble-based methods like Random Forest generally provided higher prediction accuracy due to their ability to handle complex patterns in the dataset.

Table 4: Performance Comparison of Machine Learning Models

Model	Accuracy (%)
Logistic Regression	85%
Support Vector Machine	88%
Random Forest	92%

The results show that the Random Forest algorithm achieved the highest accuracy, making it the most suitable model for predicting mental health symptoms in this system.

5. CONCLUSIONS

Mental health issues such as stress, anxiety, and depression are becoming increasingly common due to modern lifestyle pressures and social challenges. Early detection of these symptoms is essential to prevent serious psychological problems and improve overall well-being. Traditional mental health assessment methods often rely on surveys and clinical evaluations, which can be time-consuming, expensive, and limited in accessibility. In this research, a machine learning-based system for predicting and preventing mental health symptoms was developed. The system analyzes user lifestyle and behavioral factors such as sleep patterns, stress levels, work hours, exercise habits, social interaction, screen time, and diet quality. Machine learning algorithms including Logistic Regression, Random Forest, and Support Vector Machine (SVM) were implemented to classify mental health conditions. The system was integrated into a Flask-based web application, allowing users to easily enter their information and receive prediction results instantly. In addition to predicting mental health status, the system also provides preventive recommendations such as improving sleep habits, practicing mindfulness, engaging in physical activity, and maintaining a balanced lifestyle. The results demonstrate that the proposed system can effectively predict mental health conditions and provide useful preventive guidance. Compared to traditional approaches, the system offers advantages such as faster prediction, improved accessibility, cost-effectiveness, and early detection of mental health risks. Overall, the proposed machine learning-based solution highlights the potential of artificial intelligence in supporting mental health awareness and prevention. The system can serve as a supportive tool to help individuals monitor their mental well-being and take proactive steps toward maintaining a healthy lifestyle.

6. FUTURE WORK

Although the proposed system successfully predicts mental health symptoms using machine learning techniques, there are several opportunities for further improvement and expansion. Future work can focus on enhancing the system's accuracy, scalability, and real-world applicability.

One possible improvement is the use of larger and more diverse datasets collected from different populations and environments. This will help the machine learning models learn more complex patterns and improve prediction accuracy. Incorporating real-time data from wearable devices such as smartwatches or fitness trackers can also provide more reliable information about sleep patterns, physical activity, and heart rate. Another area of future work is the integration of advanced deep learning techniques such as neural networks and natural language processing (NLP). These techniques can analyze text data from user feedback, social media posts, or personal journals to detect emotional patterns and provide more accurate mental health predictions. The system can also be expanded by developing a mobile application that allows users to easily monitor their

mental health anytime and anywhere. A mobile-based system can provide notifications, reminders, and personalized recommendations to encourage healthy lifestyle habits. Additionally, future versions of the system can include direct integration with healthcare professionals or counseling services, allowing users to connect with mental health experts if the system detects a high risk of mental health problems. This would make the system more useful as a supportive healthcare tool.

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