



Mental Health Assistant Using Machine-Learning

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ABSTRACT

Many people suffer from psychological wellness issues like tension and stress. Obtaining proficient help is often hindered by shame and accessibility issues. This paper presents a unique solution: a mobile application based on machine learning for stress and anxiety management. The application uses a simple sign-in and a comprehensive questionnaire developed by experts to assess stress and anxiety levels. It includes ten questions with multiple responses to each question. The AI framework computes a score from 1 to 10, with higher scores indicating more trouble. The app provides personalized solutions based on evidence-based practices, including journaling, reflection, exercises, yoga, positive affirmations, sleep tracking, self-improvement guides, to-do lists, music, and podcast playlists. The frequency and intensity of activities adjust based on the user's levels. The user-friendly interface includes tools for progress monitoring, activity logging, reminders, and content access. The paper discusses the development, assessment, and implementation of the app, emphasizing user perspectives and ethical values. It aims to enhance mental well-being and promote proactive mental healthcare, improving lives and advancing mental health intervention.

I. INTRODUCTION

Mental health has become an important global health issue, with stress and anxiety disorders ranking among the most common and debilitating conditions affecting individuals across the spectrum [3]. According to the World Health Organisation (WHO), mental health disorders contribute to the global burden of disease, with an estimated 264 million people worldwide suffering from anxiety disorders alone. In recent years, technological advances [8] have opened new avenues to address mental health challenges, providing innovative solutions to improve access, affordability, and effectiveness [4]. In particular, mobile health (mHealth) apps have gained attention as promising tools for delivering mental health support and interventions directly to users' fingertips. These apps leverage the ubiquity of smartphones and the flexibility of digital platforms to deliver evidence-based interventions, psychoeducation, self-monitoring tools, and networking peer support, thereby expanding the reach of health services [10]. In this context, the research aims to contribute to the growing digital mental health interventions field by developing and evaluating a machine learning-based mobile application to manage stress and anxiety [11]. Recognizing the complex interactions of biological, psychological, social, and environmental factors in mental health, this approach takes a holistic perspective, integrating insights from the psychology of mental health. The rationale behind the research stems from several key considerations. Firstly, the rising occurrence of stress and anxiety disorders [2] underscores the urgent need for accessible and scalable interventions to attenuate distress and prevent different outcomes such as impaired functioning, reduced quality of life, and co-morbid psychiatric conditions. Secondly, the limitations of traditional mental health care models, including resource constraints, long wait times, and geographical barriers, highlight the potential of technology-enabled solutions to bridge gaps in service delivery and reach underserved populations [12]. Finally, the growing field of machine learning offers unique opportunities to leverage the vast amounts of data generated by digital platforms to improve the accuracy, personalization, and predictive modeling of mental health interventions. The importance of the research lies in its ability to address important gaps in current mental health care models, especially around accessibility, scalability, and

personalization. In the following sections of this article, a detailed overview of the research methodology, including mobile application design and implementation, machine learning algorithm development, performance evaluation, and intervention outcomes is provided. Ultimately, this research is envisioned as a step towards harnessing the transformative potential of technology to promote mental well-being and resilience in an increasingly complex and interconnected world.

II. RELATED WORKS/LITERATURE SURVEY

Mental health disorders, including stress and anxiety, are major public health challenges globally, affecting individual health, productivity, and quality of life. Recognizing the multidimensional nature of mental health, researchers have explored a variety of approaches, including multi-modal data fusion, machine learning diagnostics, and sentiment analysis of network data and help society to understand and address mental health issues as [5] leverages a variety of data sources, including academic performance and behavioural indicators, to determine students at risk of mental health problems.

Similarly, research on the application of [7] as well as [1] It also understood how social media affects the youth by understanding [6] Additionally, surveying user reviews of mental health apps provides valuable insights into app effectiveness and user preferences. However, while the existing literature provides valuable insights into various aspects of mental health assessment and intervention, the proposed project stands out for its comprehensive approach, Personalized interventions, and integration of machine learning techniques with expert recommendations. Unlike studies that focus solely on diagnostic prediction or sentiment analysis of social media data, the project combines comprehensive questionnaires, expertcurated intervention recommendations, and machine learning algorithms to assess and treat the user's stress and anxiety levels. Additionally, the project's focus on user interaction, tracking, and feedback mechanisms sets it apart from research that focuses solely on app ratings based on user reviews. The project aims to develop a solution that will handle stress and anxiety among individuals in a scalable trend through fusing tested techniques, user-focused design principles, and real-time data analysis. Customized interventions that match their needs and preferences are possible when the group of 18-25 aged people is specifically identified as they undergo several challenges and pressures due to their emergence into adulthood. Through a blend of established research findings and innovative intervention design focusing on user experience, this initiative aims to advance the field of mental health solutions.

The academic study [9] delves, into evaluating health applications by analyzing user reviews using machine learning tools combined with analysis. The goal is to identify recurring themes, user feelings, and features of apps linked to negative user experiences. While the research paper offers insights, into the pros and cons of mental health apps based on user input our project distinguishes itself by addressing various shortcomings highlighted in existing studies. Firstly, the app uses machine learning to analyze user reviews and create personalized recommendations based on their stress and anxiety levels. This allows us to continuously improve our interventions' effectiveness and keep users engaged. In addition to that, the app takes a comprehensive approach to mental health management. The developed application contains a detailed questionnaire, created by experts in the field, that covers different aspects of stress and anxiety. This sets us apart from other apps mentioned in the study that may not have such thorough assessment tools. The application uses machine learning to evaluate user reviews and generate personalized recommendations. It contains a comprehensive questionnaire designed by professionals to assess various dimensions of stress and anxiety. Unlike some apps reviewed in the paper that may lack thorough assessment tools, this application provides users with a robust framework for self-assessment and personalized intervention. Furthermore, unlike most studies that consider the passive analysis of user reviews, the application actively compounds and implements user feedback for further product continuation and perfection. As a result, user-focused design and effort to improve, not only address our users' significant criticisms effectively but also try to make the application more user-friendly and long-lasting. Consequently, although the presented research paper emphasizes considerable difficulties and possible outcomes in the mental health app review, the work stands out as a comprehensive, user-oriented approach that makes use of machine learning, expert advice, and product development to offer a custom-made solution for stress and anxiety management.

III. PROPOSED METHODOLOGY

The proposed methodology is a combination of machine learning algorithms and professional opinions, shaping an integrated manner of achieving a user-centered mental application. Thus, machine learning methods and models are used to analyze user responses and provide tailored suggestions about stress-reducing endeavors. The developed solution is processed over and over, ensuring more optimal outcomes concerning the consumer's feedback regarding the usability, relevance, and efficiency of the application.

A. Ethical Consideration

The mental health application is intended for people aged 18-25 – a population segment particularly prone to vulnerability and stress. Emerging adulthood, spanning from the late teens to the mid-20s, is a critical life phase involving multiple significant life transitions, identity formation, and mental health issues within the

community. In adolescents and young adults, multiple stressors, including but not limited to academic pressure, career indecision, financial stress, relational patterns, social networking, and media culture, cause high levels of stress and anxiety. The target user of the mental health application is the younger population aged 18-25. This age group is characterized by vulnerability and stress. Emerging adulthood, which is in late adolescence through one's mid-20s, is a developmental time of generalized life instability, a condition of tension between past and future life possibilities, and a prolonged period of ambiguity and confusion about one's life choices and life tasks. The primary life transformations during this phase are identified and include early identity exploration followed by premature commitment to occupational tasks and interpersonal relationships, role change in test areas, and concurrence of instability. The questionnaire, developed in collaboration with mental health experts, covers areas relevant to this demographic, such as academic stress, social relationships, self-esteem, and mental health. By soliciting input from experts in the field, the questionnaire ensures validity, reliability, and cultural relevance, while enhancing its utility as a screening tool to assess stress and anxiety levels in young adults.

B. Application development

The application has been created with Flutter — a competence in cross-platform application development that excellently aligns with iOS and Android work. Flutter's extremely powered framework is one of the reasons embedding and creating the user interface has been done effortlessly, and the user might not know the difference. Google provided a suite platform, Firebase, that effortlessly authenticates users, and only takes care of data storage and functionality of the back end. With Fire's scalable backend to store user accounts, log every user's entry, and analyze each user's response to questions, safe access and customization have been promised. As one enters the application, the user will be greeted with a range of homepage activities curated to enhance their wellbeing, including guided meditation sessions, serene music playlists, insightful podcasts, quotes, and a lot more. Motivational guides, book recommendations, sleep trackers, exercise tracks, to-do lists, and the Pomodoro technique to increase productivity. The questionnaire section allows the user to get an idea of their stress levels and coping mechanisms with the help of the app's model assesses the responses and then suggests the activities that can be performed for the betterment of the user. The journaling feature allows users to document and gather their feelings, thoughts, and experiences acting as a method of therapy and nurturing mental well-being. The profile page gives access to the settings of the application and account management options, allowing users to personalize their preferences, update their profile information, and safely sign out or delete their accounts if need be. The features of the application are notable, and all-inclusive which makes it very user-centric. Firstly, the application consists of all the features and functions for free, ensuring reachability for multiple users regardless of their financial backgrounds. Additionally, endorsement of all in-app activities, resources, and logging features by mental health professionals makes it more reliable, adds credibility, and assures users, of budding trust in the effectiveness of the capability to support personalized recommendations through the integration of machine learning. Once the responses from the questionnaire are analyzed, the app recommends each individual a bunch of unique activities, thereby improving the effectiveness of the intervention. The app also maintains full anonymity for the user. With a comprehensive set of features, this app stands out as a powerful, user-friendly, and reliable tool for those who wish to give their mental health importance.

C. Questionnaire

The questionnaire in the application stands as a foundation of the user-centric approach, scrupulously crafted by mental health professionals to capture the essence of the multidimensional nature of anxiety and stress that the youth is going through. Every question addresses a distinct aspect of the user's experience, ranging from demographic information and stress levels to the specific causes like behavioural, emotional, cognitive, and social effects of stress. This thorough approach recognizes the interconnectedness of a variety of factors contributing to mental well-being and ensures a panoramic assessment of the user's stress and coping mechanisms. Moreover, the inclusion of multiple-choice options for each question offers users a diversified array of responses, enabling nuanced and personalized feedback. These choices circumscribe a wide range of potential stressors, behavioural and emotional responses, cognitive impairments, social dynamics, and coping strategies, ensuring comprehensive and relevance across a wide range of experiences. By providing users with a strong set of options to choose from, the questionnaire's professional design and validation enhance its efficiency, credibility, and reliability as a broadcast tool for evaluating stress and anxiety levels among young adults. Overall, the questionnaire supplies as the cornerstone component of the application incorporates a commitment to evidence-based practice, user-centric, and tailored intervention for mental well-being.

D. UI

The choice of a minimal, soft, and aesthetic user interface enables the mental health application to assume quality and experience, and to stimulate user engagement. Specifically, the design choice helps set the stage, a tranquil atmosphere but also aligns with stress reduction and mindfulness in design principles. The color scheme, the clean typography, and the scarce layout of the application create an appealing and inviting atmosphere that nudges the user to interact with the application through exploration. In addition, the minimal and soft aesthetic quality of the application implies simplicity and affordance, meaning the mental health

application is very easy and intuitive to use. Clear design elements, such as consistent layouts, recognizable icons, and intuitive gestures, make the application more understandable, thus enabling the user to better navigate the mental health application. The UI empowers users to effectively engage with the app's features and resources, promoting self-reflection and holistic wellbeing.

E. Dataset Used

To make the mental health app more accurate and reliable, the data stretches to capture the experience of as many real-life patients as possible, whose experiences and struggles are often different. The resulting dataset is, thus, inclusive of patients across all demographics, including age, sex, and socioeconomic status. Our primary aim of spanning the data to as many patients as possible is to simulate the reality of how variable and multidimensional stress and anxiety experiences are across the entire population. Additionally, the collaboration with mental health professionals allowed the development of a comprehensive questionnaire that not only collects data but explores the intricate details of a user's mental stability. The close collaboration with experts ensures the integrity and relevance of the data collection process and improves the performance of our machine-learning models in real-life applications. The processing and analysis of this extensive dataset were processed in a comprehensive and data-rich recount, which opened the door to the creation of refined algorithms capable of adequately tracking and guiding the user to recommendations and stress location offerings. The combination of the app's solid foundation in experimented data and expertise will provide users with a valuable and reliable tool to step through understanding and persuasiveness in their health processes.

F. Resources Used

While gathering content for the application, great care has been given to accumulating all the resources including books, music, and podcasts, carefully selecting the materials that provide genuine value and support to users seeking to manage stress and improve their well-being. Each suggestion has been thoughtfully selected based on how relevant they are, their credibility, and alignment with the help of evidence-based practices. For the reading section, users will locate a mindfully curated library with best-selling and highly acclaimed books for stress management, anxiety, personal development, and resilience building. Similarly, the music and podcasts selected offer a range of genres and topics, serving the diverse preferences and needs of all users. Whether users seek calming tunes for relaxation, motivational or inspirational podcasts, or informative books for self-discovery or self-reflection, the application provides an all-inclusive collection for the users. Furthermore, the content is customized to address specific challenges faced by the users from stress to procrastination, there is something for everyone. This approach underscores the commitment to provide users with mindfully gathered resources to support and help in their mental health journey.

G. Model Used

This section will give an overview of the seven machine learning models that were selected and tested further which the best one was chosen and implemented in the application. Each model will be explained along with a basic idea of the fields in which each model is used.

Random Forest: One of the methods described is random forest, which is an algorithm of an ensemble learning method based on learning multiple decision trees. The predictions of each of them are averaged or taken by voting. The purpose is to increase accuracy and reduce overfitting. Due to the high quality, adaptability, and lower risk of overfitting compared to the stump, random forests are used in many tasks related to classification and regression.

Gradient Boosting: Gradient Boosting is a learning technique that creates a chain of multiple decision trees within which each tree attempts to rectify the error of the preceding trees. The ability of high-dimensional accuracy leads to its broad adoption and application in classification and regression contexts.

Support Vector Regression: Support Vector Regression is a form of regression analysis in which a support vector machine determines the best-fit line or hyperplane for modeling. Support Vector Regression can be used to model non-linear relationships between the dependent and independent variable values and can be used in a range of fields, including financial markets, medical science, and engineering. **Decision Tree:** A Decision Tree is a straightforward yet strong calculation that partitions information into more modest subsets given the upsides of information highlights. It is not difficult to decipher and envision, which grasps basic examples in the information. Choice trees are usually utilized in fields like finance, medical care, and advertising.

K-Nearest Neighbors (KNN): K-Closest Neighbors (KNN) The KNN strategy is an occasion-based, non-parametric learning method that bunches new data of interest as per the greater part class of their nearest neighbors. It is fitting for applications like anomaly discovery, pattern recognition, and recommendation systems since it is direct, simple to utilize, and effective for both regression and characterization undertakings.

Ridge Regression: To avoid overfitting, Ridge Regression is a linear regression methodology that involves supplementing the regular least squares method with a penalty term. When multicollinearity exists in the data, it is very helpful since it can reduce the coefficients to zero and increase model stability. In disciplines including epidemiology, engineering, and economics, ridge regression is frequently utilized.

Neural Network: A model that is an imitation of the human brain in terms of its architecture and operation is known as a Neural Network. It consists of linked layers of neurons that analyze incoming data and develop intricate patterns during training. Because neural networks are quite adaptable and capable of capturing complicated relationships in data, they may be used for various duties.

Among the variety of Machine-Learning models discussed and tested, the Random Forest model turned out to be the best fit for the application. One of the distinctive features of the model lies in the fact that while other single trees are apt to the problem of overfitting, Random Forest uses ensemble learning, and hence, combines their predictions, achieving higher accuracy and reducing the possibility of overfitting. Random Forest displays strength, adaptability, and low tendency for overfitting in comparison to single trees. It is a strong and adequate model for the application that manifests a delicate connection between dependent and independent variables in mental health data.

Mean Squared Error (MSE) and Mean Absolute Error emerged as the primary model testing metrics to evaluate the performance of the models. These two metrics add up as the best evaluation metrics since my application intends to develop a highly accurate and reliable mental health intervention application. Having the selected metrics measured the prediction purpose and error magnitude, ensured continuous and accurate personalized recommendation analysis. MSE evaluates the average squared difference between predicted and actual values, providing a more direct representation of error magnitude.

While assessing the Random Forest model, the MSE came out to be 0.3693 and the MAE was 0.5099. The more the values are closer to 0, the better they perform. By leveraging the powers of Random Forest and employing meticulous evaluation criteria, the aim is to provide users with the best possible result. The aim is to deliver a solution through consistent refinement and optimization, guided by the metrics, empowering everyone to lead healthier and happier lives.

H. Working of the Model

The operation of the model begins when the user answers the questionnaire provided by the application. As users complete the questionnaire, their answers are routed to the app's backend, where they are meticulously stored and updated. These responses are then formatted in JSON (JavaScript Object Notation) format, which serves as a standardized method of data transfer between the application UI and the Application Programming Interface (API) of the model. The model itself resides in the server file of Flask, a microweb framework for Python, where it requests input in JSON format. By evaluating the number of selected answers for each question, the model calculates a weighted cumulative score, which serves as a basis for determining the user's overall stress level. This data driven approach allows for a better understanding of users' mental health, taking into account the different levels of importance assigned to different questions and answer options. Ultimately, the calculated stress level serves as a baseline measure to recommend personalized activities to reduce stress and promote mental health. Through this iterative process of data collection, analysis, and recommendation, the model facilitates a personalized approach to mental health intervention, allowing users to proactively manage their health and have a happier and healthier life.

I. Comparison Table

The following table displays the MSE and MAE values of all the models for comparison. These metrics are commonly used in machine learning to assess the quality of a model's predictions. It is evident from the table that different models exhibit varying degrees of performance, as reflected by their MSE and MAE values. Based on this evaluation, one can identify the most suitable model for the task at hand, taking into account both the complexity of the model and its predictive performance. Here the comparison shows that the models that have values closer to zero are better. Hence, the application consists of Random Forest.

TABLE I COMPARISON OF DIFFERENT MODELS

Sr.No	Model Name	MSE	MAE
1	Random Forest	0.3693	0.5099
2	Gradient Boosting	0.3675	0.5681
3	SVR	0.4592	0.5406
4	Decision Tree	0.3238	0.4875
5	KNN	0.8207	0.8025
6	Ridge Regression	0.3575	0.5508
7	Neural Network	3.8698	1.8447

Fig. 1. represents the performance metrics comparison of the seven models: Random Forest, Gradient Boosting, Support Vector Machine (SVM), Decision Tree, K-Nearest Neighbors (KNN), Ridge Regression, and Neural Network. The comparison is based on 3 metrics: Cross-Validation Mean Squared

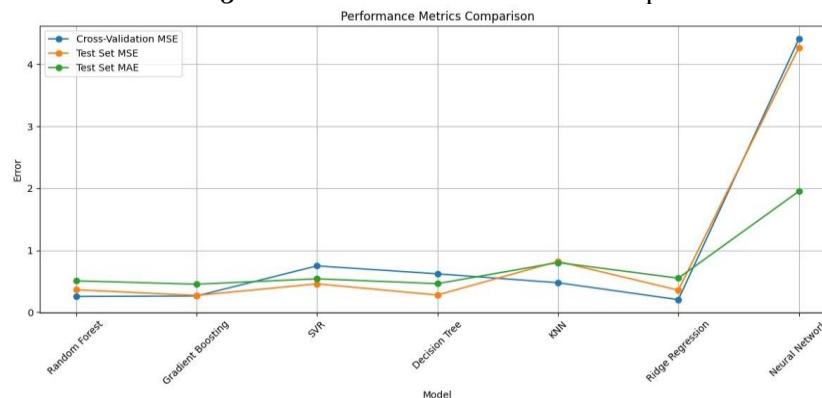


Fig. 1. Performance Metrics Comparison

Error (MSE), Test Set MSE, and Test Set Mean Absolute Error (MAE).

The graph clearly shows that Random Forest and Gradient Boosting have the lowest error scores across all three metrics which indicates that their accuracy in predicting the stress levels among students is the best. They are followed by Support Vector Machine and Decision Tree, which also have relatively lower error scores but fail in comparison to the top performers.

On the contrary, Ridge Regression and Neural Networks show higher error scores particularly in Test Set MSE and MAE which indicates that they were unable to capture the underlying patterns in the data.

To conclude, Random Forest and Gradient Boosting with their error values near to zero show their robustness and reliability in this scenario. The findings from the graph suggest that using these models for predicting the stress levels of the students will cater in recommending better solutions for the students.

IV. RESULTS

To test the application, seven students of varying ages were considered. These students were asked to register for the application and their identity would be anonymous. These students filled out the questionnaire and based on that, out of 10 their stress level was calculated, and depending upon these values the students were recommended a certain set of activities.

TABLE II RESULTS OBTAINED

Student	Age	Calculated Stress Level
A	19	2.3
B	21	0.8
C	18	3.6
D	22	7.1
E	23	5.2
F	20	2.6
G	21	4.3

Table II represents the seven students and their calculated stress levels. The activities recommended for each student are: For Student A:

Journaling every day, reading at least 15 pages a day, maintaining to-do lists, try learning a new hobby, speaking out positive affirmations, working out for at least 20-25 minutes, and tracking your sleep.

For Student B:

Journaling every day, working out for at least 15 minutes, reading a minimum of 5 pages daily, listening to soothing music, and tracking your sleep.

For Student C:

Meditation or Yoga for 25 minutes daily, Learning new hobbies, Breathing and concentration exercises, speaking out positive affirmations, and tracking your sleep.

For Student D:

Working out for a minimum of 40 minutes, Breathing and concentration exercises, listening to Podcasts or some soothing music, reading at least 10 pages daily, and journaling every day.

For Student E:

Breathing and concentration exercises, Working out for a minimum of 30 minutes, listening to Podcasts or some soothing music, reading at least 15 pages daily, and journaling every day.

For Student F:

Journaling every day, reading at least 15 pages a day, maintaining to-do lists, try learning a new hobby, speaking out positive affirmations, working out for at least 20-25 minutes, and tracking your sleep.

For Student G:

Minimum 35 minutes of meditation, Yoga for at least 30 minutes daily, tracking your sleep, listening to Podcast or music, and journaling every day.

V. CONCLUSION

In conclusion, developing this mental well-being application represents a significant step toward promoting and enhancing users' mental health. Through a comprehensive range of features including meditation, relaxation techniques, journaling, personalized recommendations, and more, the application aims to provide users with accessible tools to manage stress, improve mood, and foster emotional well-being.

The user-centric design coupled with professional input ensures that the app meets the highest standards of effectiveness and credibility. By leveraging technologies such as Flutter for cross-platform development, Firebase for backend functionality, and machine learning for personalized recommendations, the application offers a seamless and intuitive user experience.

The testing phase has received positive feedback, emphasizing this app's potential impact in addressing individual's mental health issues. This application, with more fine-tuning and the incorporation of user feedback, is positioned to be a must-have tool for promoting mental wellness in today's fast paced world.

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