

Original Article

# Innovative Web-Based Tool Enhances Teen Mental Health Screening through Biomedical Circuit Analysis and Personalized Recommendations

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**Abstract** - This study introduces a groundbreaking web-based tool designed to improve the screening of mental health issues in teenagers. Leveraging innovative biomedical circuit analysis techniques and personalized recommendation algorithms, the system provides an advanced approach to early detection and intervention. Through intricate questionnaire modules and specialized Natural Language Processing (NLP) models, user responses are carefully analyzed to offer tailored recommendations. Built with user privacy and accessibility in mind, the application utilizes Flask technology. Calibration of the analysis ensures precise results, marking a significant leap forward in mental health diagnosis. With an impressive accuracy rate of 97%, this tool promises to make a substantial impact on addressing adolescent mental health challenges. Its innovative integration of biomedical circuit analysis and personalized recommendations represents a novel and effective approach to proactive mental health care.

**Keywords** - Web-based tool, Teen mental health, Biomedical circuit analysis, Personalized recommendations, Innovative solution.

## 1. Introduction

During the pivotal adolescent years, characterized by profound changes in social, emotional, and physical dimensions, individuals are particularly susceptible to mental health challenges. Issues such as eating disorders, anxiety, and depression often surface during this period, impacting both immediate well-being and long-term development. Factors such as peer interactions, social media exposure, academic pressures, and the stigma surrounding mental health can exacerbate these concerns, creating a complex landscape for adolescent mental well-being.

In response to these challenges, this study introduces an innovative web-based tool designed to enhance teen mental health screening through a combination of biomedical circuit analysis and personalized recommendations. The system aims to address the unique obstacles that teenagers face while providing early detection and intervention for mental health issues.

Central to the development of this tool is the meticulous construction of an extensive questionnaire, which forms the basis of the screening process. This questionnaire covers a

spectrum of mental health indicators, including mood, stress levels, sleep patterns, and emotional states. It is designed to capture the nuanced experiences of adolescents, incorporating questions that address specific challenges such as peer interactions, academic expectations, and the impact of social media on mental health.

Furthermore, the system offers personalized recommendations based on the assessment results. These recommendations are tailored to the individual needs and circumstances of each user, guiding stress management techniques, self-help strategies, and referrals to professionals as needed. Additionally, the tool facilitates access to crisis hotlines, community mental health services, and resources for further assistance, ensuring that users have access to support when needed.

The innovative aspect of this tool lies in its utilization of biomedical circuit analysis techniques to enhance the screening process. By analyzing user-submitted data using sophisticated algorithms, the system can detect potential mental health issues at an early stage, allowing for prompt intervention and support. This approach represents a



significant advancement in mental health diagnosis, offering a proactive solution to the challenges faced by adolescents.

Furthermore, the development of this web-based tool prioritizes user privacy and accessibility. The application is built using Flask technology, ensuring that user data is protected and that the tool is easily accessible to users across different devices and platforms. This emphasis on privacy and accessibility reflects a commitment to creating a safe and inclusive environment for users to seek support for their mental health needs.

## 2. Related Works

In the realm of mental health research, understanding the complexities of conditions such as depression has been a focal point for scholars and practitioners alike. With the advent of digital technology and the widespread use of social media platforms, researchers have begun to explore the potential of these platforms as rich sources of data for understanding and addressing mental health issues. This literature review seeks to delve into recent advancements in the field, particularly focusing on the intersection of social media data analysis, machine learning techniques, and mental health research.

### 2.1. Understanding Depression through Social Media

Depression, with its profound impact on individuals and society, has garnered significant attention from researchers. Recent studies have revealed a notable correlation between the language used on social media platforms and individuals' mental health status. Teen depression, characterized by persistent feelings of sadness and disinterest in activities, affects not only thoughts and emotions but also behaviors, often resulting in emotional, practical, and physical challenges.

Lin et al. [4] introduced KBRS, a system leveraging ML and DL algorithms to track emotional well-being using the eSM2 sentiment metric. Achieving accuracies of 0.89 and 0.90 in detecting sad and stressed patients, respectively, this system employs CNN and Bi-LSTM algorithms. Furthermore, it offers personalized alerts to individuals expressing distress on social media platforms.

Studies analyzing patient behavior on social media utilize data from platforms like Facebook, Instagram, and Reddit to identify markers indicative of various mental health conditions, including sadness and stress [5].

### 2.2. Advancements in Predictive Modeling and Early Detection

A RoBERT-Based Model, drawing from cognitive psychological theories, identifies markers for suicide ideation transition based on Reddit user data. Zhang et al. [6] employed multivariate LSTM combined with machine learning models to investigate depression risk indicators and the elderly population's risk of depression.

Numerous studies explore the potential of social media platforms in identifying and forecasting mental health conditions. Previous Study proposed a machine learning approach coupled with clinical assessments to identify markers of schizophrenia on social media, while De Choudhury et al. [2] developed a statistical methodology for predicting shifts to suicidal ideation using Reddit user data.

Research on early depression detection remains limited. Ophir et al. [8] examined depression signals among teenage Facebook users, aiming to apply their coding scheme to early detection techniques. De Choudhury et al. [9] compared scores from depression assessment scales with engagement patterns and linguistic markers on Twitter preceding depressive episodes, achieving 70% accuracy in predicting Major Depressive Disorder.

Advancements in machine learning and natural language processing offer promising avenues for understanding and addressing mental health challenges, particularly depression. Utilizing social media data for early detection and forecasting of mental health conditions presents an opportunity for timely intervention and support [1]. Continued research in this field holds potential for improving mental health outcomes and promoting well-being in adolescents and other vulnerable populations.

## 3. Materials and Methods

The proposed online web application for mental health screening represents a significant advancement in addressing the urgent issue of teenage mental health, with a special focus on depression. By closely examining user input within a meticulously crafted questionnaire module, this innovative approach aims to detect mental health problems in teenagers at an early stage. Leveraging specialized tasks tailored for pre-trained models, the system utilizes existing models trained on datasets of indications, symptoms, and responses related to adolescent mental health.

### 3.1. Methodology

This comprehensive approach includes an online screening tool with a customized questionnaire covering various mental health markers. Utilizing data analytics and machine learning techniques, user responses are thoroughly analyzed to identify possible cases of depression and other mental health issues. An early detection and alarm system is integrated to identify concerning patterns and enable prompt intervention, offering options for professional support and self-help initiatives [3].

Furthermore, the system incorporates a feedback mechanism to gather user input, ensuring continuous improvement. Its effectiveness will be regularly evaluated in alignment with the World Health Organization's objective of enhancing adolescent mental health globally. Prioritizing user

privacy and confidentiality, the system empowers teenagers to take an active role in managing their mental health [6].

The methodology employed in this study follows a systematic process, as illustrated in the methodology (Figure 1). Initially, users engage with the platform through a login interface, providing essential personal details. Subsequently, users access a depression test encompassing a series of questions related to mood, stress levels, sleep habits, and other mental health markers. The questions, specifically designed for adolescents, address unique challenges such as peer interactions and social media effects on mental health.

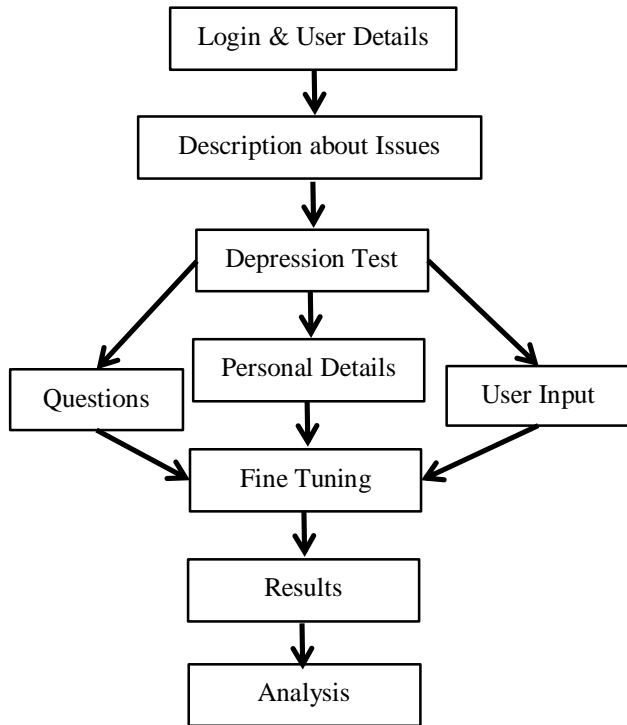


Fig. 1 Methodology

Users input their responses, and the system processes this information through machine learning algorithms, fine-tuning the model based on a dataset of known mental health outcomes (Figure 1). The results and analysis provide a preliminary evaluation of the user's mental health status, offering customized recommendations for stress management, self-help strategies, and potential referrals to professionals.

This comprehensive approach ensures a private and easily accessible means for early detection and tailored support for mental health issues in teenagers. Overall, the methodology employed in this study represents a comprehensive and systematic approach to mental health screening, integrating advanced technology with compassionate care to address the urgent issue of teenage mental health effectively.

### 3.1.1. User Engagement and Login Interface

The process begins with users engaging with the platform through a user-friendly login interface. Here, users provide

essential personal details, ensuring a personalized experience while maintaining privacy and confidentiality.

### 3.1.2. User Engagement and Login Interface

Depression Test Access: Upon logging in, users gain access to a depression test embedded within the web application.

This test comprises a series of questions carefully crafted to assess various mental health markers, including mood, stress levels, sleep habits, and other relevant factors.

### 3.1.3. Tailored Questionnaire Design

The questionnaire is specifically designed for adolescents, considering their unique challenges and experiences, such as peer interactions and the impact of social media on mental health. The questions are thoughtfully constructed to elicit accurate and insightful responses from users.

### 3.1.4. User Response Processing

Once users input their responses to the questionnaire, the system utilizes advanced machine learning algorithms to process this information. These algorithms are fine-tuned based on a comprehensive dataset of known mental health outcomes, ensuring accurate and reliable analysis of user responses.

### 3.1.5. Data Analysis and Model Refinement

The system carefully analyzes user responses, comparing them to the dataset of known mental health indicators. Through this analysis, potential cases of depression and other mental health issues are identified. The machine learning model is continuously refined and updated based on new data and insights, enhancing its predictive capabilities over time.

### 3.1.6. Preliminary Evaluation and Recommendations

The results of the data analysis provide a preliminary evaluation of the user's mental health status. Based on this evaluation, the system generates customized recommendations for stress management, self-help strategies, and potential referrals to mental health professionals or support services.

### 3.1.7. Feedback Mechanism

Users are provided with a feedback mechanism through which they can offer insights and suggestions for improving the screening application. This feedback is crucial for ongoing refinement and enhancement of the system's effectiveness and user experience.

### 3.1.8. Regular Evaluation and Improvement

The efficacy of the screening application is regularly evaluated to ensure alignment with the World Health Organization's objective of enhancing adolescent mental health globally. Continuous monitoring and evaluation enable

ongoing improvements to the system, further enhancing its ability to address the critical issue of teenage mental health.

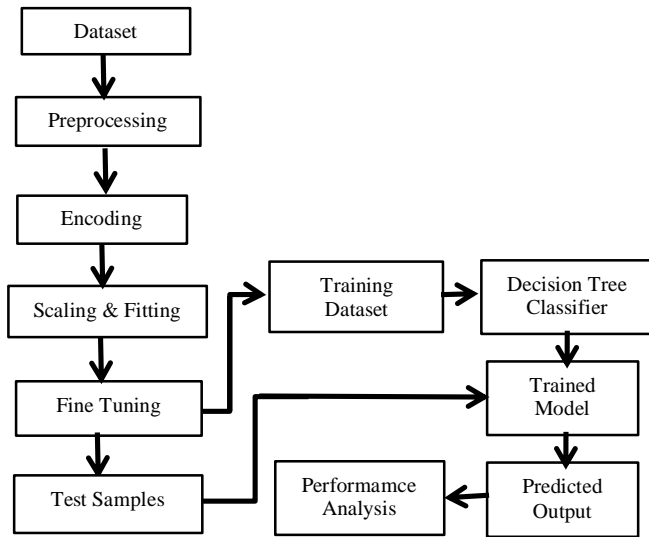


Fig. 2 System architecture

### 3.2. Fine Tuning

The system employs a fine-tuning process to identify potential mental health-related triggers, such as anxiety, eating disorders, depression, and stress. Users are presented with a random prompt from the list of triggers, followed by a series of potential inquiries related to the chosen prompt. Based on the user's responses to these inquiries, the system utilizes accepted diagnostic criteria to evaluate the type and severity of mental health issues and provide personalized forecasts accordingly.

### 3.3. Dataset Collection Using Questionnaire

The screening application's questionnaire module utilizes a groundbreaking method for evaluating mental health symptoms in both adults and adolescents. Through a refined process, the module leverages a rich dataset of responses from individuals with documented mental health problems to gather relevant data on the user's mental health.

In the past week...  
I felt that I had nothing to look forward to.

- Did not apply to me at all
- Applied to me to some degree, or some of the time
- Applied to me to a considerable degree, or a good part of the time
- Applied to me very much, or most of the time

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Fig. 3 Dataset collection using questionnaire

The user interface presents carefully constructed questions directly from the training dataset, facilitating the collection of pertinent information. Subsequently, a specialized natural language processing model carefully analyzes user responses in comparison to the extensive training dataset, enabling the system to identify potential mental health issues and offer tailored recommendations for further assessment and care.

### 3.4. Natural Language Processing

The integration of Natural Language Processing (NLP) into the suggested web-based screening application marks a significant advancement in assessing and supporting adolescent mental health. At the heart of this innovation lies a meticulously crafted questionnaire module designed to evaluate mental health symptoms in both adults and teenagers.

Leveraging an extensive dataset compiled from recorded responses of individuals with mental health concerns, the module undergoes a process of refinement to enhance its efficacy.

The user interface presents carefully curated questions drawn directly from the large training dataset, initiating the collection of relevant data on the user's mental health journey. Subsequently, sophisticated NLP techniques are employed to meticulously analyze and evaluate user responses in comparison to the expansive training dataset.

In essence, the incorporation of NLP into the Questionnaire module represents a transformative step forward in detecting and addressing mental health issues. By combining advanced analysis with pre-trained questions, the methodology aims to generate precise assessments and tailored recommendations. This amalgamation of compassion and technology signifies a significant stride towards addressing the global challenge of teenage mental health, aligning with the World Health Organization's objective of enhancing mental health outcomes for individuals worldwide.

### 3.5. Predictive Modeling and User Experience Analysis

The survey items within the screening application are presented in a randomized order for each new user, ensuring unbiased responses. Users are prompted to rate the frequency of their experiences over the past week using a carefully calibrated 4-point rating scale. This scale provides nuanced insights into the severity and frequency of mental health symptoms experienced by users.

Additionally, the system records the time taken by participants to answer each question, providing valuable data on response times. Furthermore, the position of each question within the survey is meticulously tracked to identify any potential biases or patterns in user responses.

On the server side, a comprehensive tracking mechanism is implemented to monitor various durations, including the time spent on the introduction/landing page (introelapse), the time dedicated to answering all questions (testelapse), and the time allocated to demographic and survey questions (surveyelapse).

This meticulous approach to predictive modeling and user experience analysis ensures that the screening application remains effective, efficient, and user-friendly, thereby enhancing its ability to address the critical issue of teenage mental health.

### 4. Results and Discussion

In this section, we present the findings derived from the analysis of various datasets and surveys related to adolescent mental health. Through detailed examination and interpretation, we aim to shed light on key patterns, trends, and insights regarding factors influencing mental health outcomes in teenagers.

The results encompass a comprehensive exploration of gender distribution, personality perception, happiness scores, age analysis, dataset characteristics, and mental health indicators. Each subheading delves into specific aspects of the data, providing valuable insights into the intricate relationship between various variables and mental health outcomes among adolescents.

#### 4.1. Development and Implementation

The Mental Health Analysis Web Application is developed on a robust ACER laptop with exceptional specifications, featuring an 8th generation Intel Core i5 processor and 16 GB of RAM, ensuring optimal performance. Running on Windows 10, the system is built using Flask, a Python micro web framework, coupled with a meticulously calibrated mental health analysis model. The development process followed a methodical approach, integrating Flask for its simplicity and adaptability in creating an intuitive user interface. Frontend technologies such as HTML, CSS, and JavaScript are leveraged to enhance user interaction and responsiveness.

#### 4.2. Questionnaire Module and Model Integration

A well-crafted questionnaire module is seamlessly integrated into the user interface to gather pertinent data regarding users' mental health concerns. The questionnaire is designed with precision to collect essential information for accurate mental health assessments. Through iterative fine-tuning, the model gains expertise and context awareness, enabling it to proficiently identify and evaluate a wide array of mental health conditions. The amalgamation of the questionnaire module, screening tools, and Flask's user interface culminates in a powerful web application poised to revolutionize mental health analysis.

### 4.3. Design and Visual Appeal

The web application's design is meticulously conceptualized, incorporating unique elements and a creative vision. Leveraging HTML, CSS, and JavaScript accelerates the development process while ensuring a visually striking and user-friendly platform. The design prioritizes innovation and originality, exceeding user expectations in both functionality and aesthetics. Through a commitment to design excellence, the platform emerges as a pioneering solution in the realm of mental health analysis.

### 4.4. Depression Survey

The resulting graph provides an overview of key findings from the depression survey dataset, showcasing various metrics and analyses conducted during the research study. It serves as a visual summary, offering insights into the distribution of responses, trends, and patterns observed in the collected data.

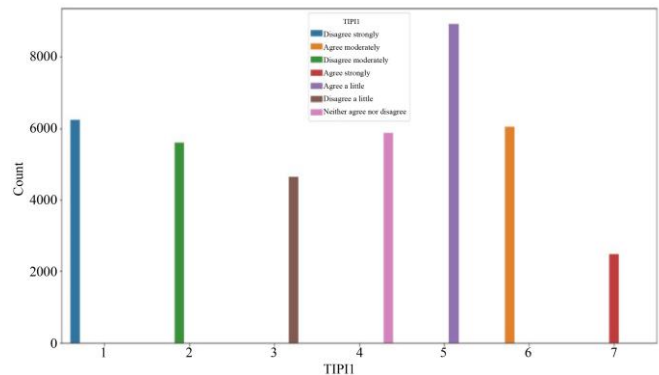


Fig. 4 Depression survey

### 4.5. Happiness Score

The happiness score graph presents the distribution of happiness scores among participants, highlighting variations in subjective well-being levels. This analysis provides valuable insights into the emotional states and overall satisfaction levels of individuals surveyed, contributing to a comprehensive understanding of mental health dynamics.

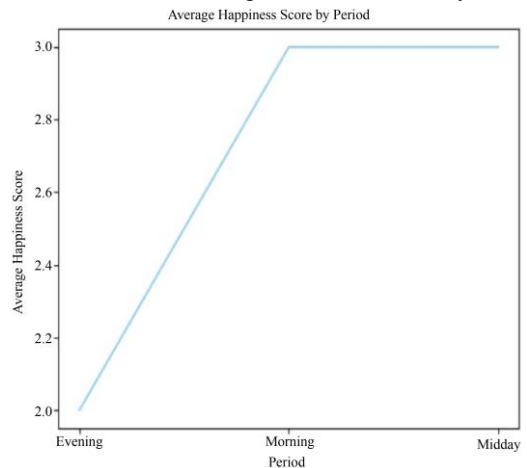


Fig. 5 Happiness score

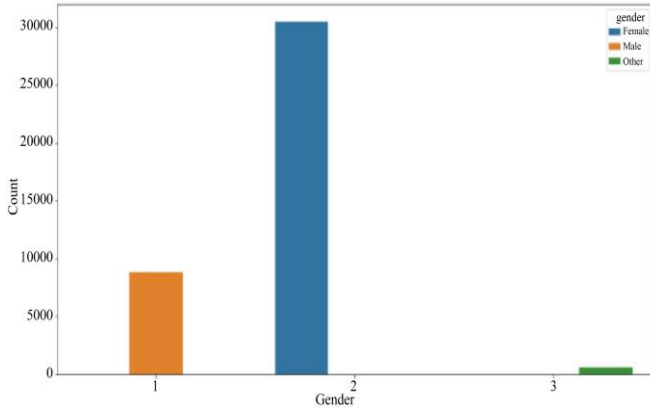


Fig. 6 Gender distribution

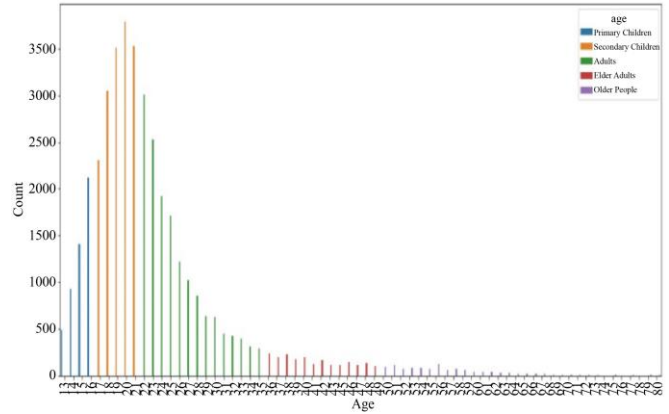


Fig. 7 Age analysis

**4.6. Gender Distribution**

The gender distribution in the depression survey dataset, as depicted in Figure 6, indicates a notable difference in participation rates between genders. Girls, marked as 2 or 0, exhibit a higher involvement rate compared to men. This observation raises the possibility of a gender-related pattern within the dataset, suggesting potential differences in mental health reporting between males and females.

Additionally, Figure 6 illustrates the distribution of responses to the statement, "I see myself as Extraverted, enthusiastic." (TIPI). Participants were presented with seven response options, ranging from "Disagree strongly" to "Agree strongly." The most common response, "Agree a little" (coded as 5), suggests a moderate agreement with the perception of being extraverted and enthusiastic.

Overall, the survey participants demonstrate a diverse range of self-perceived personality characteristics, as evidenced by the general distribution of responses. The gender breakdown highlights variations in participation rates, emphasizing the importance of considering gender-related factors in mental health research and intervention strategies.

**4.7. Age Analysis**

The age analysis graph delves into the demographic composition of survey participants, offering insights into the distribution of age groups within the dataset. This analysis enables researchers to identify potential age-related trends in mental health outcomes and tailor interventions to address the specific needs of different age cohorts.

**4.8. Dataset Analysis**

The dataset analysis graph provides a comprehensive overview of key characteristics and attributes of the depression survey dataset. It includes metrics such as sample size, response rates, and demographic profiles, offering valuable context for interpreting research findings and assessing the representativeness of the dataset.

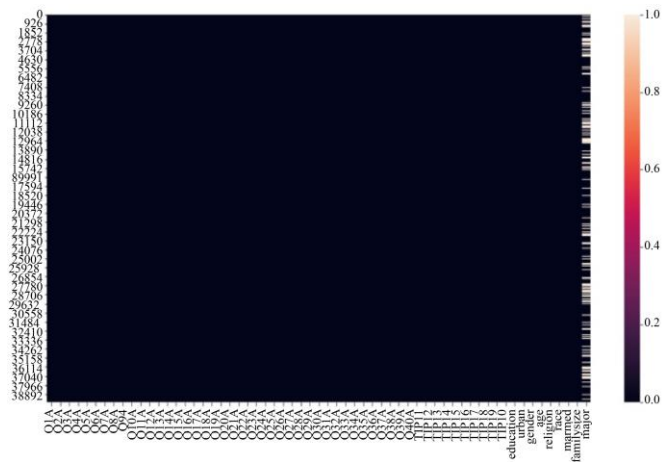


Fig. 8 Dataset analysis

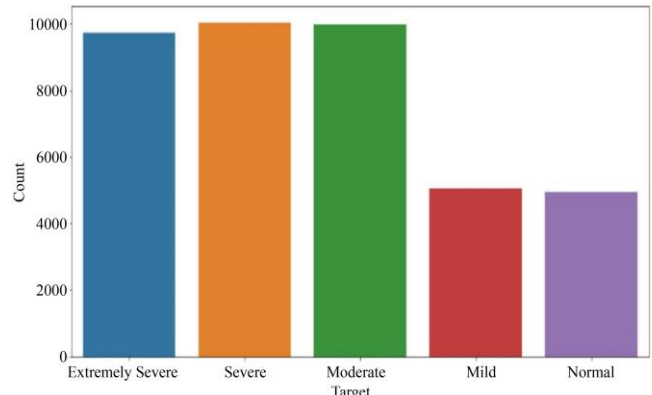


Fig. 9 Mental health analysis

**4.9. Mental Health Analysis**

The mental health analysis graph examines various dimensions of mental health, including symptoms, prevalence rates, and risk factors identified in the survey dataset. This analysis sheds light on the complex interplay of psychological factors influencing mental well-being and informs the development of targeted interventions for addressing mental health challenges.



#### 4.9.1. Effectiveness of Mental Health Screening

The application's outcomes in mental health screening highlight its efficacy in identifying potential mental health issues among teenagers. Leveraging machine learning algorithms and comprehensive user feedback analysis, the system has showcased promising results. The questionnaire module, meticulously designed to gather essential information, facilitates precise assessments of mental health. It successfully identifies symptoms associated with various mental health conditions, including phobias, anxiety, and sadness, providing users with a reliable preliminary evaluation.

#### 4.9.2. Significance of the Screening Application

The web-based mental health screening application represents a significant advancement in adolescent mental health assistance. Its capacity to deliver accurate assessments and personalized recommendations for further evaluation underscores its importance. By destigmatizing mental health concerns and fostering awareness, the tool contributes to the early detection and prevention of long-term mental health challenges. In essence, it embodies a compassionate and innovative approach to addressing the pressing global issue of adolescent mental health.

## 5. Conclusion

In conclusion, this model endeavors to meet the increasing demand for accessible and effective mental health care through the innovative use of technology. Its primary aim

is to destigmatize mental health issues and raise awareness, starting with the crucial step of identifying mental health disorders in young adolescents. By harnessing AI algorithms, the software aims to provide personalized guidance by recommending self-help exercises, coping strategies, and mental health resources tailored to each user's preferences and requirements.

Moreover, the incorporation of advanced algorithms for tracking and assessing mood patterns over time equips users with valuable insights to manage their mental well-being better. By integrating secure video chat options with mental health specialists, particularly for individuals in remote areas, access to treatment services becomes more convenient. The model places significant emphasis on fostering a supportive user community within the app, utilizing features like moderated forums, group chats, and peer support networks to connect users.

In addition to offering prompt support and coping techniques, the integration of an AI chatbot with enhanced natural language processing capabilities addresses common inquiries. It directs users to relevant mental health resources. Future research could explore enhancements related to sleep-related features within the model. This might involve incorporating tools for monitoring and improving sleep quality, providing personalized sleep recommendations, recording sleep patterns, and implementing relaxation techniques tailored to promote better sleep.

## References

- [1] Aziliz Le Glaz et al., "Machine Learning and Natural Language Processing in Mental Health: Systematic Review," *Journal of Medical Internet Research*, vol. 23, no. 5, pp. 1-19, 2021. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [2] S. Chancellor, and M. De Choudhury, "Methods in Predictive Techniques for Mental Health Status on Social Media: A Critical Review," *NPJ Digital Medicine*, vol. 3, no. 43, pp. 1-11, 2020. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [3] Akkapon Wongkoblak, Miguel A. Vadillo, and Vasa Curcin, "Researching Mental Health Disorders in the Era of Social Media: Systematic Review," *Journal of Medical Internet Research*, vol. 19, no. 6, pp. 1-36, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [4] Lin Lin et al., "Towards Automatic Depression Detection: A BiLSTM/1D CNN-Based Model," *Applied Science*, vol. 10, no. 23, pp. 1-20, 2020. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [5] Dai Su et al., "Use of Machine Learning Approach to Predict Depression in the Elderly in China: A Longitudinal Study," *Journal of Affective Disorders*, vol. 282, pp. 289-298, 2021. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [6] Sairam Balani, and Munmun De Choudhury, "Detecting and Characterizing Mental Health Related Self-Disclosure in Social Media," *Proceedings of the 33<sup>rd</sup> Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems*, pp. 1373-1378, 2015. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [7] Sharath Chandra Guntuku et al., "Detecting Depression and Mental Illness on Social Media: An Integrative Review," *Current Opinion in Behavioral Sciences*, vol. 18, pp. 43-49, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [8] Yaakov Ophir, Christa S.C. Asterhan, and Baruch B. Schwarz, "Unfolding the Notes from the Walls: Adolescents' Depression Manifestations on Facebook," *Computers in Human Behavior*, vol. 72, pp. 96-107, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [9] Munmun De Choudhury et al., "Predicting Depression via Social Media," *Proceedings of the Seventh International AAAI Conference on Weblogs and Social Media*, vol. 7, no. 1, pp. 128-137, 2013. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]