



# **UNT GradInnoHack**

## **MindMate: A Comprehensive Report on Mental Health Detection and Support System**

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## **Abstract**

Mental health challenges, such as depression, anxiety, and suicidal ideation, affect millions globally, often remaining undetected due to stigma, inaccessibility, and the reactive nature of traditional mental health systems. MindMate is an AI-powered application designed to address these issues by providing proactive, real-time mental health detection and support. Utilizing the Sentiment Analysis for Mental Health dataset from Kaggle, the app employs a Logistic Regression model to classify user inputs (text or audio) into mental health states with 76% accuracy. Key features include dual input modes, a crisis alert system via WhatsApp, confidence-driven insights, a personalized chatbot with sentiment analysis, and visual probability charts. Testing demonstrated the app's ability to accurately detect conditions, provide actionable suggestions, and send timely emergency alerts, potentially saving lives. Despite challenges like audio processing limitations and model performance on minority classes, MindMate offers a promising solution for accessible mental health support, paving the way for a future where AI-driven tools normalize mental health conversations and empower users to manage their well-being.

## **Introduction**

Mental health is a critical global issue, with over 280 million people suffering from depression and suicide ranking among the leading causes of death for youth, according to the World Health Organization. Despite the prevalence of mental health challenges, many individuals remain underserved due to stigma, lack of access to professional care, and the high cost of therapy. Traditional mental health systems often respond reactively, addressing issues only after they escalate into crises, leaving a significant gap for early intervention and support. The rise of

artificial intelligence (AI) presents an opportunity to bridge this gap by enabling proactive, accessible, and judgment-free mental health solutions.

MindMate is an innovative AI-powered application designed to detect and support mental health conditions in real-time, empowering users to understand and manage their emotional well-being. Built using the Sentiment Analysis for Mental Health dataset from Kaggle, MindMate leverages machine learning, natural language processing (NLP), and sentiment analysis to identify early signs of mental health conditions such as depression, anxiety, stress, bipolar disorder, personality disorders, and suicidal ideation. The app offers a range of features, including dual input modes (text and audio), a crisis alert system, confidence-driven insights, a personalized chatbot, and visual probability charts, all integrated into a user-friendly Streamlit interface. This report provides a detailed overview of MindMate's development, features, performance, and impact, highlighting its potential to transform mental health care by making it accessible, empathetic, and proactive.

## **1. Problem Statement**

Mental health issues are a global concern, often going unnoticed due to their invisible nature, yet they have profound impacts on individuals and society. According to the World Health Organization, over 280 million people suffer from depression globally, and suicide ranks among the leading causes of death for youth. Many individuals suffer in silence due to stigma, lack of access to mental health resources, or fear of judgment. Additionally, professional mental health care, such as therapy and psychiatric services, is often expensive or inaccessible for a significant portion of the population. Traditional mental health systems are largely reactive, addressing issues only after they escalate into crises. There is a critical need for a proactive, accessible, and

judgment-free solution that can provide immediate mental health insights and support, empowering individuals to understand and manage their emotional well-being in real-time.

MindMate addresses this gap by leveraging artificial intelligence (AI) to offer a proactive mental health detection and support system. It uses machine learning, natural language processing (NLP), and sentiment analysis to identify early signs of mental health conditions such as depression, anxiety, stress, bipolar disorder, personality disorders, and suicidal ideation. The app provides immediate feedback, personalized suggestions, and emergency safeguards, making mental health support accessible 24/7 through text or audio input.

## **2. Dataset Overview**

The MindMate app was developed using the **Sentiment Analysis for Mental Health** dataset from Kaggle

(<https://www.kaggle.com/datasets/engsaiedali/sentiment-analysis-for-mental-health>). This

dataset, named Combined\_Data.csv, contains 53,042 entries and is designed for sentiment analysis and mental health classification tasks. Below is a detailed breakdown of the dataset:

- **Size:** 31.47 MB
- **Columns:**
  - **Label:** A numerical identifier for each entry (0 to 53,041), with a mean of 26,521 and a standard deviation of 15,300. The labels are evenly distributed across 20 bins, each containing approximately 2,652 entries.
  - **Statement:** The text input provided by users, representing their emotional state or thoughts. Out of 53,042 entries, 52,680 are valid (99%), with 362 missing values

(1%). There are 51,074 unique statements, indicating a diverse range of expressions.

- **Status:** The mental health classification label for each statement, categorized into seven classes:

- Normal: 31% (16,439 entries)
- Depression: 29% (15,389 entries)
- Suicidal: 20% (10,655 entries)
- Anxiety: 7% (3,840 entries)
- Stress: 5% (2,585 entries)
- Bipolar: 5% (2,780 entries)
- Personality Disorder: 2% (1,075 entries)

- **Data Quality:**

- No mismatched values.
- 1% missing values in the Statement column, which were handled during preprocessing.
- The dataset is well-balanced across the Label column but shows some imbalance in the Status column, with "Normal" and "Depression" being the most common classes.

This dataset was used to train a Logistic Regression model (LogisticRegression\_model.pkl), which powers the MindMate app's mental health prediction capabilities. The dataset's diversity and size make it suitable for training a model to detect various mental health conditions based on user input.

### **3. Methodology**

The development of MindMate involved several key steps, from data preprocessing and model training to app implementation and testing.

#### **3.1 Data Preprocessing**

- **Handling Missing Values:** The 362 missing values in the Statement column were either imputed or removed to ensure the dataset was complete for training.
- **Text Preprocessing:** The Statement column was processed using NLP techniques, including:
  - Tokenization and lowercasing.
  - Removal of stopwords using NLTK's stopwords list.
  - Lemmatization using NLTK's WordNetLemmatizer to reduce words to their base form.
  - Vectorization using TF-IDF (Term Frequency-Inverse Document Frequency) to convert text into numerical features for model training.

#### **3.2 Model Training**

Multiple machine learning models were trained and evaluated on the dataset to select the best-performing model for deployment. The training script (train\_model.py) evaluated the following models:

- Logistic Regression
- Random Forest
- Multinomial Naive Bayes

- Linear SVC
- Ridge Classifier
- Gradient Boosting
- Decision Tree
- K-Nearest Neighbors (KNN)

The evaluation metrics included precision, recall, F1-score, and overall accuracy. The results are summarized below:

- **Logistic Regression:**
  - Accuracy: 76%
  - Macro F1-Score: 0.73
  - Best performance for "Normal" (F1: 0.89) and "Anxiety" (F1: 0.81).
  - Selected for deployment due to its balanced performance across all classes.
- **Linear SVC and Ridge Classifier:**
  - Both achieved an accuracy of 77%, slightly higher than Logistic Regression.
  - However, Logistic Regression was chosen for its interpretability and computational efficiency in a real-time app setting.
- **Random Forest:**
  - Accuracy: 67%
  - Struggled with imbalanced classes like "Stress" (F1: 0.32) and "Personality Disorder" (F1: 0.44).
- **Multinomial Naive Bayes and KNN:**
  - Poor performance with accuracies of 45% and 32%, respectively, due to their inability to handle the complexity of the dataset.



- **Gradient Boosting and Decision Tree:**
  - Accuracies of 74% and 61%, respectively, but underperformed compared to Logistic Regression.

The trained Logistic Regression model was saved as `LogisticRegression_model.pkl` and integrated into the MindMate app for real-time predictions.

### **3.3 App Development**

MindMate was built using Streamlit, a Python framework for creating interactive web applications. The app integrates several libraries:

- **Machine Learning:** Scikit-learn for model training and prediction.
- **NLP:** NLTK for sentiment analysis and text preprocessing.
- **Speech Recognition:** `speech_recognition` for audio input processing.
- **Visualization:** Altair for interactive probability charts.
- **APIs:** Twilio for WhatsApp alerts, YouTube Data API for guided meditation links.

The app is structured into three main pages:

1. **Home Page:** Introduces the app with a welcoming image and brief description.
2. **Monitor Page:** Allows users to input text or audio to analyze their mental health.
3. **About Page:** Provides detailed information about the app's purpose, features, and target audience.

## **4. Features and Functions**

MindMate offers a range of features designed to provide comprehensive mental health support. Below is a detailed explanation of each feature, its functionality, and its implementation.

#### **4.1 Real-Time Mental Health Prediction**

- **Functionality:** Users can input their emotions via text or audio, and the app predicts their mental health status (e.g., Depression, Anxiety, Suicidal) using the trained Logistic Regression model.
- **Implementation:**
  - **Text Input:** Users type their feelings in a text area, and the `predict_mhealth` function processes the input to return a prediction.
  - **Audio Input:** Users record their voice, which is transcribed using Google's Speech Recognition API (`speech_recognition`). The transcribed text is then analyzed similarly to text input.
- **Results:** The model achieved an accuracy of 76% on the test set, with strong performance across all classes (e.g., F1-score of 0.89 for "Normal" and 0.81 for "Anxiety").

#### **4.2 Confidence-Driven Insights**

- **Functionality:** Each prediction is accompanied by a confidence score (0–1), which is categorized into:
  - Low Confidence ( $< 0.6$ ): No alert, avoids false positives.
  - Moderate Confidence (0.6–0.85): Suggests monitoring.
  - High Confidence ( $\geq 0.85$ ): Indicates serious attention is needed.

- **Implementation:** The `get_predictions_proba` function returns the probability distribution across all classes, and the maximum probability is used as the confidence score. The `get_confidence_label` function labels the confidence level for user understanding.
- **Results:** For a test input like "I feel so sad and hopeless every day," the app predicted "Depression" with a confidence of 0.92 (High Confidence), ensuring reliable detection.

### **4.3 Crisis Alert System**

- **Functionality:** If the app detects a "Suicidal" state with a confidence  $\geq 0.50$  and the user has opted in for emergency alerts, it sends a WhatsApp message to a designated emergency contact.
- **Implementation:** The `send_alert_message` function uses the Twilio API to send a message: "Urgent: A high suicide risk score has been detected. Please reach out to your loved one and provide support during this time."
- **Results:** During testing, a user input of "I don't want to live anymore" resulted in a "Suicidal" prediction with a confidence of 0.87. The app successfully sent a WhatsApp message to the emergency contact, with the message SID logged in the console for verification.

### **4.4 Personalized Chatbot with Sentiment Understanding**

- **Functionality:** The app provides empathetic, context-aware responses based on the predicted mental health state. It also suggests guided meditation videos tailored to the user's condition.
- **Implementation:**

- The `generate_response` function crafts responses based on the prediction (e.g., for "Depression": "I'm really sorry you're feeling this way... Try talking to a trusted friend").
- Sentiment analysis is performed using NLTK's `SentimentIntensityAnalyzer` to classify the input as positive, negative, or neutral.
- The `get_youtube_video` function fetches a guided meditation video link using the YouTube Data API.
- **Results:** For an input like "I'm constantly worried about everything," the app predicted "Anxiety" and responded with: "I can sense your anxiety, and I'm here for you... Take a moment to breathe deeply." It also provided a link to a guided meditation video for anxiety.

#### **4.5 Visual Prediction Probability**

- **Functionality:** The app displays an interactive bar chart showing the probability distribution across all mental health classes, enhancing transparency.
- **Implementation:** The `get_predictions_proba` function returns probabilities, which are converted into a `DataFrame` and visualized using Altair's `mark_bar` chart.
- **Results:** For the input "I feel so sad and hopeless," the chart showed a 92% probability for "Depression," with lower probabilities for other classes, helping users understand the model's decision-making process.

#### **4.6 Tailored Suggestions**

- **Functionality:** Based on the prediction and confidence level, the app provides practical suggestions to help users manage their emotions.

- **Implementation:** The `get_risk_level` function returns a risk assessment and suggestion (e.g., for "Depression" with high confidence: "Call a helpline or talk to someone you trust").
- **Results:** For a "Stress" prediction with a confidence of 0.70, the app suggested: "Take a short walk or practice yoga," providing actionable advice to alleviate stress.

#### **4.7 User-Friendly Interface**

- **Functionality:** The app features an intuitive layout with a compact sidebar, minimal scrolling, and a professional tone.
- **Implementation:**
  - Streamlit's `set_page_config` and tabs are used to create a wide layout with Home, Monitor, and About pages.
  - The sidebar includes navigation buttons and an emergency alert opt-in form.
  - Image sizes are adjusted to fit without excessive scrolling, and a "Clear" button allows users to reset inputs.
- **Results:** Users reported a seamless experience, with the sidebar requiring minimal scrolling and the interface maintaining a professional tone (e.g., no emojis in the About section).

#### **5. Unique Features**

MindMate stands out due to several unique features that differentiate it from other mental health apps:

##### **1. Dual Input Modes (Text and Audio):**

- Unlike many mental health apps that rely solely on text input, MindMate supports both text and audio inputs, catering to users who may find it easier to express their emotions verbally.
- The audio input feature uses speech recognition to transcribe user speech, making the app more accessible and inclusive.

**2. Crisis Alert System:**

- The automated WhatsApp alert system for high suicide risk is a life-saving feature not commonly found in similar apps. It ensures that emergency contacts are notified promptly when a user is at risk, facilitating timely intervention.

**3. Confidence-Driven Insights:**

- The app's use of confidence scores and clear labeling (Low, Moderate, High) provides transparency and helps users understand the reliability of predictions, a feature that enhances trust in the system.

**4. Integrated Sentiment Analysis:**

- By incorporating NLTK's SentimentIntensityAnalyzer, MindMate adds an additional layer of emotional understanding, allowing for more nuanced responses that align with the user's sentiment (positive, negative, or neutral).

**5. Visual Transparency:**

- The interactive probability chart is a unique feature that visually explains the model's predictions, making the app more educational and trustworthy for users.

**6. Results and Performance**

The MindMate app was rigorously tested using a variety of inputs to evaluate its performance across different scenarios. Below are some key results:

- **Prediction Accuracy:**

- The Logistic Regression model achieved an accuracy of 76% on the test set, with F1-scores ranging from 0.59 (Stress) to 0.89 (Normal). This indicates reliable performance across all mental health classes.
- During live testing, the app correctly identified "Depression" for inputs like "I feel so sad and hopeless" (confidence: 0.92) and "Suicidal" for inputs like "I don't want to live anymore" (confidence: 0.87).

- **Crisis Alert Functionality:**

- The WhatsApp alert system was tested with a high-risk suicidal input ("I don't want to live anymore"). The app successfully sent a message to the emergency contact, with the message SID logged for verification.

- **User Experience:**

- The app's interface was tested on various screen sizes (desktop, tablet, mobile), and the layout remained functional with minimal scrolling. The "Clear" button worked as expected, resetting inputs seamlessly.
- Users appreciated the empathetic chatbot responses and found the guided meditation links helpful for managing their emotions.

- **Audio Input:**

- The audio input feature successfully transcribed clear speech (e.g., "I feel really sad") and provided accurate predictions. However, it struggled with background noise, returning errors like "Sorry, I couldn't understand the audio."

## 7. Challenges and Limitations

While MindMate is a robust tool, it faces some challenges and limitations:

**1. Audio Processing:**

- The current speech recognition system (speech\_recognition with Google's API) requires an internet connection and can be slow due to network latency.  
Background noise also affects transcription accuracy.
- **Solution:** Switching to a local model like OpenAI's Whisper would enable offline functionality and improve speed.

**2. Crisis Alert Threshold:**

- The threshold for sending WhatsApp alerts (confidence  $\geq 0.50$  for suicidal ideation) may lead to false positives, potentially causing unnecessary alarm.
- **Solution:** Increase the threshold to  $\geq 0.85$  to align with other high-risk classifications and reduce false positives.

**3. Model Performance:**

- The model struggles with less-represented classes like "Stress" (F1: 0.59) and "Personality Disorder" (F1: 0.63), likely due to class imbalance in the dataset.
- **Solution:** Use techniques like oversampling or class weighting to improve performance on minority classes.

**4. Accessibility:**

- The app currently lacks features for visually impaired users (e.g., text-to-speech) and support for multiple languages.
- **Solution:** Add text-to-speech functionality and multilingual support to enhance accessibility.



**8. Conclusion**

MindMate is a pioneering AI-powered mental health detection and support system that addresses the critical need for accessible, proactive mental health care. By leveraging the Sentiment Analysis for Mental Health dataset, the app achieves reliable predictions with a 76% accuracy, identifying conditions such as depression, anxiety, and suicidal ideation. Its unique features, including dual input modes (text and audio), a crisis alert system, confidence-driven insights, and a personalized chatbot, make it a valuable tool for individuals seeking to understand and manage their emotional well-being.

The app's performance during testing demonstrated its ability to provide accurate predictions, actionable suggestions, and timely emergency alerts, potentially saving lives through early intervention. Despite some limitations, such as audio processing challenges and the need for improved model performance on minority classes, MindMate represents a significant step forward in making mental health support accessible to all. Future enhancements, such as offline audio processing, a higher crisis alert threshold, and improved accessibility, will further strengthen its impact.

MindMate aligns with its vision of a future where mental health care is integrated into daily life, driven by empathy, and powered by AI. It serves as a lifeline for students, remote workers, the elderly, and anyone battling emotional challenges, helping to remove stigma, normalize conversations, and save lives through early detection and supportive action.