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MENTAL MAP NAVIGATING HIDDEN EMOTIONS

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Abstract: Assessment of mental health is challenging in the changing and digitally networked world today. Mental map navigating hidden emotions is a web-based platform that can integrate machine learning models across the three key modalities such as text, speech and behavioral inputs to detect the underlying emotional states and the possible risks. It uses natural language processing methods to process user with journal text converting raw text into labels using Sentence-BERT embeddings and logistic regression classification. The speech module uses audio signal processing drawing the MFCC features from user uploaded and recorded audio sample applying random forest for the emotions detected with associated labels. Behavior inputs having lifestyle activity are tracked through surveys with custom mapping logics and classifier for in depth risk. It supports muti-step process with the user information showing the result as diagnosis, confidence and suggestions.

Keywords: Random forest classifier, Sentence-BERT, MFCC, logistic regression.

1.INTRODUCTION

Many people across the world suffer from stress, anxiety and depression that makes it difficult to live a life, form relationships and function in workplace. even in the recognition individuals face issues because of few resources or absence of customized care. In recent years, changing social norms, more time spent on screens which has affected the globally.

Conventional approaches to mental health evaluation uses self-reporting questionnaires, clinician interview or observations which maybe time consuming. The digital tool and growing use of smartphones and internet access present a strong opportunity to provide scalable, interactive and accessible solutions. New technologies in artificial intelligence and machine learning hold great in the revolutionizing the mental health care.

Th central purpose of the project is to create a easy to use system the processed inputs identify threats and provide recommendation toward the total wellbeing. The integration of natural language processing, speech emotion recognition and behavior data mining hopes to facilitate early invention, minimize stigma, help individual become active in managing mental health.

2. RELATED WORK

With the progress of artificial intelligence and machine learning new methods have arisen to process textual information, speech signals, behavioral data for mental health evaluation. This section contains the overview of the literature, methods and contribution. The study showed:

Rahman et (2020) performed a system review of the use of machine learning techniques in detection of mental health from online social networks .it highlighted sites such as Twitter, Facebook and Weibo which offers large scale text and media data that can act as signs of mental states. Challenges such as imbalance data, overfitting were identified.

Karunakaran (2022) presented a model based on self-reporting questionaries (SRQ-15 and SRQ-25) for the identification of five disorder among students such as bipolar disorder, anxiety, depression, eating disorders and sleep disturbances. survey data were named and analyzed using supervised machine learning algorithms like decision tress, Support vector machine and random forest. The work gave accuracy by making ML outputs against manual diagnosis.

Dayananda (2023) researched on the text-based emotion detection with machine learning on dataset of 7480 labelled texted from Kaggle. SVM, Random Forest were used to recognize emotions such as sad, joy, fear, anger, guilt and shame. The research proved that emotions could be accurate using ML through written language.

Likewise, Midhan (2023) researched classification of emotions in written text using NLP and ML methods. It highlighted on using of preprocessing and compared categorical versus dimensional model of emotion.

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Ahmed (2020) built a supervised learning system for identifying depression and anxiety through psychological measuring scales. Tested algorithms such as Convolutional Neural Networks (CNN), linear Regression showing accuracy 96.8% for depression and 96% for anxiety.

An investigated speech signals with CNNs where speech samples were converted to spectrogram using Short-time Fourier Transform (STFT) and CNNNs were trained to diagnose depression as a type of negative emotion. The findings proved that features like tone and pitch are good predictors of the mental health disorder.

3. METHODOLOGY

The system proposed, Mental Map Navigating Hidden Emotions is a multimodal machine learning system with text, speech, behavioral data to determine mental health state like stress, anxiety, depression and none. The approach has five components: system workflow, data gathering, model development, web application creation and result generation.

System Overview

The workflow is a structured pipeline:

User Registration:

- New user can sign up with name, email and password.
- Name, age, gender and mobile number are asked as for personal details.
- The data is securely stored in SQLite database and associated with analysis reports.

Data Entry:

- Text Input: users write a journal entry using offered web interface an expression of mood, thoughts of day or experience.
- Speech Input: Users may upload .wav or record speech in browser directly.
- Behavior Input: Users provide responses to lifestyle parameters.

Backend ML Models:

- Each modality of data is processed by its trained machine learning model.
- Predictions are made in form of emotional state with confidence score.
- Result Integration and report Generation:
- Results from the all models are integrated into a summary dashboard.
- Customized suggestions are created based on identified condition.
- A printable PDF report is produced, including user information, diagnoses and suggestions.

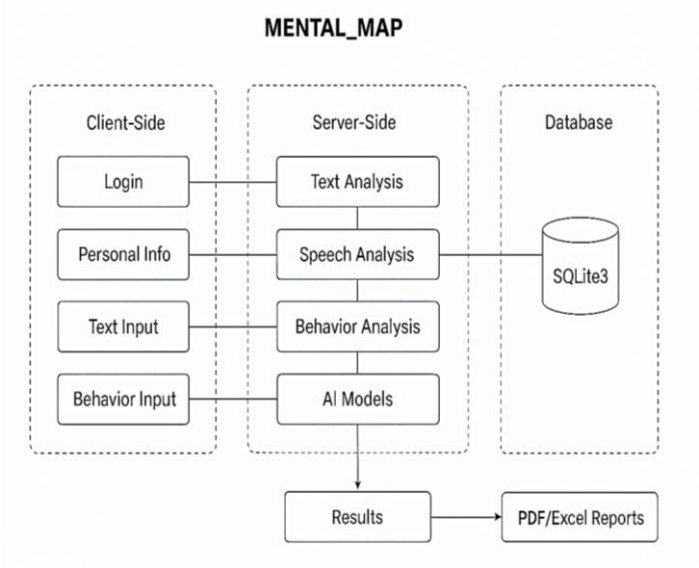

Fig 3.1: System Architecture

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Data Collection

Three kinds of data are utilized to develop relevant models:

1.Text Data

- Source: User-typed journal entries in textbox.
- Written words reflect mood and affective states.
- Data Training: Prelabelled emotions dataset (labels: joy, angry, fear, sad etc.) is mapped to mental health states.

2.Speech Data

- Source: User-uploaded .wav files or in recordings.
- Speech features like tone and pitch are indicators for depression (monotone, low energy) or anxiety (fast Irregular breathing).
- Training Dataset: Toronto Emotional Speech Set (TESS) which has voice recordings with emotions.

3.Behavioral Data

- Source: lifestyle survey done by user.
- Parameter gathered: sleep hours, work hours, exercise, social media usage, diet.
- Training Dataset: Survey-based mental health data like Zenodo Mental Health and Lifestyle dataset.

Model Building

1.Text Model

- Data: Pre-labelled emotional text dataset
- Preprocessing: Text cleaning (punctuation removal, stop words)
- Embedding sentences with sentence-BERT to extract semantic meaning.
- Classification: Logistic Regression model trained on embeddings.

2.Speech model

- Data: Emotional speech audio dataset (TESS)
- Preprocessing and Feature Extraction: Convert audio into .wav format (if not already done). Extract MFCC (Mel Frequency Cepstral Coefficients) features using Librosa.
- Classification: Random Forest classifier trained on MFCC features vectors. Label mapping like text model (stress, depression, anxiety, none).

3.Behavior Model

- Data: Lifestyle survey answers saved in CSV format.
- Model: Random Forest classifier model is based on survey data.

4. EXPERIMENTAL RESULTS

Following the design and training of the three machine learning models, the system was tested using systematic testing to confirm its accuracy reliability and usability.

The comparative study has approaches for detecting using survey, text and speech data. Survey-based models use 84%accuracy while deep learning methods have high accuracy of 96.8% for depression and 96% for anxiety. Text based NLP achieve 85-87% accuracy in emotion. Speech model CNN models based on spectrogram score 90% which has potential for audio.

Model Testing:

For every modality the data was divided between training and test sets in 80-20 ratio. For every model a classification report was created offering metrics including:

- Accuracy: Percentage of accurate predictions.
- Precision: Consistency of positive predictions.
- Recall: Capacity to classify actual cases in the right way.

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- F1-score: Harmonic mean of recall and precision.

Model Accuracy:

The text model, constructed with Sentence-BERT embeddings and a Logistic Regression classifier, had a test set accuracy of 87%. It had high precision and recall for the category's "anxiety" and "depression," showing that the model correctly identified language patterns associated with distress

The speech model, which was trained using MFCC features and a Random Forest classifier, obtained 84% accuracy. It worked best in identifying depression, particularly in speech characterized by a flat or monotonous tone.

The behavior model, with survey data and trained on a Random Forest classifier, was 82% accurate. It consistently distinguished balanced lifestyles (none) from disrupted patterns.

5. CONCLUSION AND FUTURE WORK

The Mental Map Navigating Hidden Emotions shows how the artificial intelligence can increase the availability and scalability. Through the combination of text, speech, and behavioral information, the platform offers an examination of a person's emotional state. It provides a diagnosis with scores of confidences and useful recommendations. The model could even be a multimodal fusion model where outputs from all three modalities are combined together rather than separately to increase predictability.

Several future improvements can be incorporated. The more insightful analytics like tracking trends in emotional state over time. Increased training with bigger and more datasets would enhance generalization across age ranges.

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