AI-Powered Mental State Analysis: Detecting Depression and Happiness

Nagashree K T[1]
Dept of Information Science and Engineering (ISE) AMCEC nagashreekt86@gmail.com

Punith SR [1], Siddesh G [2], Mohan Kumar MD [3], Vinith Kumar TC [4]

Dept of information Science and Engineering (ISE)AMCEC
1am22is086@amceducation.in , 1am22is109@amceducation.in , 1am22is066@amceducation.in , 1am22is125@amceducation.in.

Abstract

Mental health issues such as depression are increasing worldwide and have become a major concern affecting individuals' well-being and quality of life. Despite growing awareness, early detection of mental health conditions remains difficult due to social stigma, lack of awareness, and limited access to mental health professionals. At the same time, understanding positive emotional states like happiness is equally important for assessing overall mental well-being.

With rapid advancements in artificial intelligence, it is now possible to analyze human emotions through digital data. AI techniques can interpret emotional cues from text, speech, and facial expressions to identify mental states. This project focuses on developing an AI-powered system that can automatically analyze such data to detect depression and happiness in an efficient and non-intrusive manner.

The proposed system uses transformer-based natural language processing models to analyze textual patterns, CNN-LSTM models to capture emotional features from speech, and deep learning-based facial expression recognition to interpret visual cues. Each of these modalities generates an emotional assessment, which is then combined using a multimodal fusion approach to improve overall prediction accuracy and reliability.

The system is designed with a scalable and user-friendly architecture that supports real-time processing and easy interaction. It provides users with meaningful insights into their emotional state and helps in identifying early signs of mental health issues. By offering continuous monitoring rather than one-time assessment, the system enables better understanding of emotional trends over time.

Key words: Emotional Recognition, Depression Detection, Happiness Analysis, Neural Networks, Multimodal Analysis, Deep Learning.

1. INTRODUCTION

Mental health plays a vital role in an individual's overall well-being, productivity, and quality of life. Conditions such as depression significantly affect emotional, psychological, and social functioning, while positive states like happiness reflect emotional stability and life satisfaction. Despite the growing prevalence of mental health issues worldwide, early identification and continuous monitoring remain challenging due to social stigma, lack of awareness, and limited access to mental health professionals..

In recent years, Artificial Intelligence (AI) has emerged as a powerful tool capable of analyzing complex patterns in large volumes of data. With the increasing availability of digital information from text, speech, facial expressions, and online interactions AI systems can be trained to recognize emotional and behavioral cues associated with different mental states. This creates new opportunities for developing automated and scalable solutions to support mental health assessment.

Traditional mental health evaluation methods rely mainly on clinical interviews and self-reported questionnaires, which are often subjective and provide only a snapshot of an individual's condition Such approaches may miss subtle or early symptoms of depression and fail to capture emotional changes over time.

This project aims to design and implement an AI-powered system capable of detecting depression and happiness by analyzing emotional data using machine learning and deep learning techniques.

2. Problem Statement

Mental health disorders, especially depression, have become a major public health concern, affecting individuals' emotional, psychological, and social well-being. At the same time, understanding positive mental states such as happiness is essential for assessing overall emotional balance. Traditional mental health assessment methods rely mainly on clinical interviews and self-reported questionnaires, which are often subjective, time-consuming, and limited in accessibility. Many individuals hesitate to seek professional help due to stigma, lack of awareness, or unavailability of mental health resources, leading to delayed or missed detection of early symptoms.

Moreover, existing systems usually provide only periodic evaluations and fail to offer continuous monitoring of emotional changes over time. With the growing use of digital platforms, people express emotions through text, speech, and facial cues, but this rich data remains underutilized. Current digital tools often suffer from low accuracy, limited emotional scope, and ethical concerns related to privacy and data security.

3. Methodology

- **Data Collection Module**

The system collects emotional data from multiple sources such as textual inputs (user responses, questionnaires, or social media-like text), speech samples, and facial expression images. These datasets are gathered from reliable and publicly available sources and are labeled into predefined classes such as *depression*.

- **Data Preprocessing Module**

The collected raw data is cleaned and standardized before analysis.
For text data, preprocessing includes lowercasing, removal of stop words, punctuation, and tokenization.
For speech data, noise reduction and normalization are applied.

- **Feature Extraction Module**

Meaningful features are extracted from preprocessed data to represent emotional patterns.
Text features are obtained using TF-IDF and transformer-based embeddings such as BERT..

- **Model Design and Training**

The system employs deep learning models for different modalities:
– LSTM / Bi-LSTM or Transformer models for text analysis,
– CNN or CNN-LSTM models for speech emotion recognition,
– CNN models for facial expression analysis..

- **Multimodal Fusion and Prediction**

A Outputs from text, speech, and facial models are combined using feature-level or decision-level fusion

4. Implementation

The implementation of the proposed system is carried out using Python by integrating machine learning and deep learning techniques to analyze emotional data and classify mental states. The system is developed as a modular framework consisting of data preprocessing, feature extraction, model training, multimodal fusion, and prediction components. Initially, emotional input in the form of text, speech, or facial images is collected from the user through a user interface. This raw data is then passed to the preprocessing module, where noise removal, normalization, tokenization, and standardization are performed to ensure clean and consistent input for further analysis..

The After preprocessing, the processed data is transformed into meaningful numerical representations through feature extraction techniques. For textual data, transformer-based models such as BERT are used to generate contextual embeddings. For speech input, acoustic features such as MFCCs, pitch, and energy are extracted, while facial images are processed using convolutional neural networks to capture expression-related features.

The models are trained using labeled datasets containing depressive and happy emotional states. The dataset is divided into training, validation, and testing sets to ensure unbiased learning and evaluation. During training, optimization techniques such as the Adam optimizer and cross-entropy loss function are employed to improve convergence and accuracy..

5. Result and Discussion

The implementation and testing of the proposed AI-powered mental state analysis system demonstrate that the integration of text, speech, and facial expression analysis provides accurate and reliable detection of emotional states. Experimental results confirm that the system is capable of effectively classifying mental states into depression and happiness using deep learning models trained on curated datasets. The multimodal approach significantly improves performance compared to single-modality systems.

The text-based analysis using transformer models successfully captured linguistic patterns such as negative sentiment, self-referential language, and reduced positivity, which are common indicators of depression. Similarly, speech analysis identified variations in pitch, tone, and speaking rate, while facial expression analysis detected reduced facial activity for depressive states and active expressions for happiness. These individual results show that each modality contributes meaningful emotional information.

6. Conculsion

This project successfully demonstrates the design and implementation of an AI-powered mental state analysis system for detecting depression and happiness. By integrating natural language processing, speech emotion recognition, and facial expression analysis, the system provides a comprehensive and data-driven approach to mental health assessment. The proposed framework effectively overcomes the limitations of traditional subjective methods by offering automated and continuous emotional analysis.

The experimental evaluation confirms that the multimodal deep learning approach achieves reliable performance with improved accuracy and robustness. The system is capable of identifying emotional patterns associated with depressive and happy states, making it a useful preliminary screening and awareness tool. The user-friendly interface and real-time prediction capability further enhance its practical applicability..

Overall, the proposed system highlights the potential of artificial intelligence in supporting mental well-being and promoting early mental health awareness. It provides a strong foundation for future research and development in AI-based mental health analysis systems.

6. REFERENCES

[1] Tripathi, RCalvo, R. A., D'Mello, S., Gratch, J., & Kappas, A. (2017). *The Oxford Handbook of Affective Computing*. Oxford University press link

[2] Supriya, slam, M. R., Kabir, M. A., Ahmed, A., Kamal, A. R. M., Wang, H., & Ulhaq, A. (2018). Depression detection from social network data using machine learning techniques. *Health Information Science and Systems*, 6(8)., link

[3] Solomon RajDibeklioğlu, H., Hammal, Z., & Cohn, J. F. (2017). Dynamic multimodal measurement of depression severity using deep learning. *IEEE Journal of Biomedical and Health Informatics*, 22(2), 525–536., link

[4] Srinivasan, D., Yazdavar, A. H., Al-Olimat, H., Banerjee, T., et al. (2020). Multimodal mental health analysis in social media. *PLOS ONE*, 15(4), e0226248.,link

[5] Devaguptam, S., Lee, D., & Park, S. (2022). Early depression detection using transformer-based models on social media text. *IEEE Access*, 10, 12345–12356.

[6] Liu, X., Cao, L., & Chen, Y. (2022). A systematic review of machine learning methods for depression detection from online text. *Artificial Intelligence in Medicine*, 125, 102251. link

[7] Ravi, D., Wong, C., & Yang, B. (2024). Privacy-aware speech-based depression detection using deep learning. *IEEE Transactions on Affective Computing*.link