Enhanced Depression Detection on Social Media Using AI with Custom Visualizations

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Abstract: **-This study focuses on leveraging deep learning techniques to detect early signs of depression in social media visuals and captions. The system analyzes both visual content and textual data, such as Instagram posts and captions, to identify subtle emotional cues indicative of depression. By integrating natural language processing for textual analysis and emotion detection models for visuals, the project provides a holistic understanding of a user's mental health. The aim is to develop a prototype capable of automatic depression detection, offering a valuable tool for mental health professionals and organizations to monitor public health trends and support timely intervention. This research highlights the transformative potential of AI in advancing mental health care and awareness.**

Keywords - Depression Detection, Deep Learning, Social Media Analysis, Sentiment Analysis, Emotional Recognition.

INTRODUCTION

The intersection of deep learning and mental health offers a transformative opportunity to address the growing concern of depression in modern society. Social media platforms like Instagram, where users regularly share personal moments, thoughts, and visuals, serve as vast repositories of emotional expressions. These digital footprints provide insights into an individual's mental state, enabling novel approaches for early detection of emotional struggles. By leveraging advanced techniques such as natural language processing (NLP) and computer vision, researchers aim to analyze text, images, and interactions to identify patterns indicative of depression. This innovative approach bridges the gap between traditional mental health assessments and the dynamic, real-time nature of social media data.

Despite its promise, the domain poses significant challenges. Variability in linguistic and cultural expressions complicates emotion recognition, while the presence of humor, sarcasm, and implicit messaging adds further complexity. Ethical concerns and privacy regulations, such as GDPR, underscore the importance of handling user data responsibly. Nevertheless, the potential to transform passive social media engagement into proactive mental health care is a driving force behind this research. This endeavor aspires to redefine mental health support, emphasizing prevention and early intervention through AI-driven insights.

By integrating tools like Instaloader for data collection and sentiment analysis models for emotion classification, this project represents a step toward innovative, socially responsible AI applications. It highlights the urgency of addressing mental health in today's digital landscape, offering a proactive solution for fostering well-being in an increasingly interconnected world.

OBJECTIVES

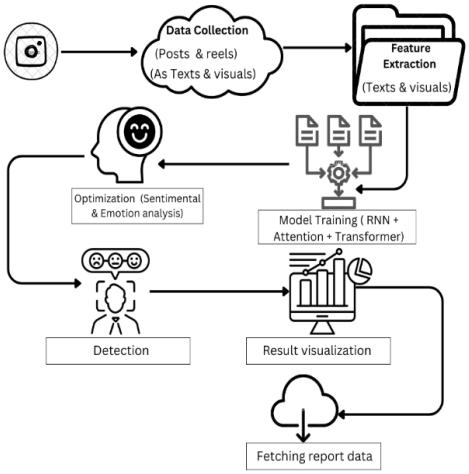
- Analyze social media content to identify early signs of emotional distress, such as depression or anxiety.
- Enable early intervention by detecting mental health concerns before escalation.
- Ensure user data is anonymized and handled ethically under privacy regulations.
- Develop AI models capable of interpreting diverse social media content without bias.
- Combine textual (captions, comments) and visual (images) data for comprehensive emotional analysis.
- Leverage OCR to extract and analyze text from images for emotional cues.

- Generate user-friendly emotion reports for mental health professionals and individuals.

- Extend analysis to other platforms like Facebook to capture broader emotional trends.
- Promote mental health awareness through insights from the analysis.
- Direct users to relevant mental health resources based on detected signs of distress.

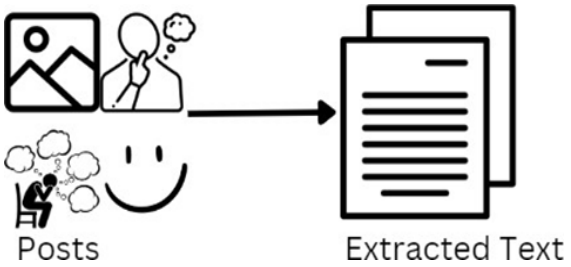
PROPOSED WORK The proposed system enhances depression detection by integrating textual and visual data from social media. Pre-trained models such as RNN, transformers, and NLP techniques process Instagram posts, captions, and images to analyze emotional patterns. OCR extracts text from visuals, while recurrent neural networks with attention mechanisms provide advanced emotional state detection. Optimizations like OGRU improve model accuracy. Privacy and ethical protocols ensure responsible data use. The system aims to support early mental health interventions, offering valuable insights for professionals and organizations while promoting ethical AI practices.

OVERALL IMPLEMENTATION STRUCTURE OF THE PROPOSED SYSTEM:



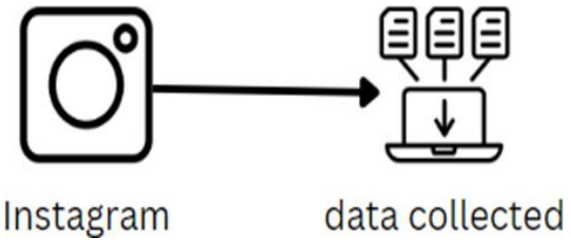
The architecture diagram presented illustrates a deep learning-based approach for detecting depression from social media data, particularly from Instagram posts and reels. It begins with the Data Collection phase, where both text and visual content are gathered. This data undergoes Feature Extraction to identify relevant textual and visual features. The extracted features are then fed into a Model Training phase that uses RNN, Attention, and Transformer layers to process and learn from the data. Next, an Optimization stage applies sentiment and emotion analysis to fine-tune the detection process. Finally, the model outputs the Detection results, identifying signs of depression based on the analysed data. This end-to-end workflow integrates multimodal data to enhance the model's detection accuracy.

MODULE 1: DATA COLLECTION MODULE



The Instaloader Python library is a powerful tool for extracting Instagram data, requiring proper installation and configuration to access profile details. By utilizing user-saved session files, it ensures smooth login and profile exploration, avoiding issues like missing files or connectivity problems. Once set up, it allows for selecting Instagram profiles to explore, including gathering key details like post counts. Posts, including up to five images and their captions, can be downloaded into designated folders, enabling a streamlined data collection process for testing and analysis.

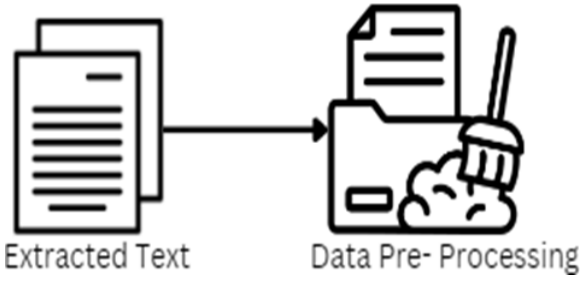
MODULE 2: TEXT EXTRACTION FROM IMAGE & DESCRIPTION



To process text from images and captions, Tesseract OCR is configured on the computer to ensure accurate recognition. The downloaded images are analyzed one by one using pytesseract to extract text, with careful monitoring for potential OCR errors. The extracted text is aggregated and stored systematically. Simultaneously, captions from each post are retrieved using the Instaloader library, ensuring completeness and quality. Both the image text and captions are

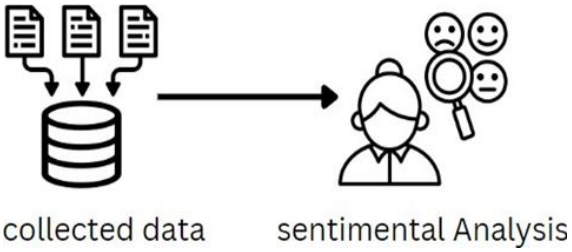
compiled into a consolidated dataset for further analysis.

MODULE 3: DATA PREPROCESSING MODULE



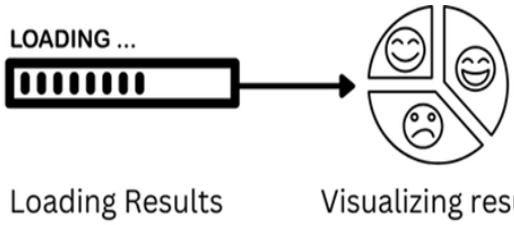
Text preprocessing begins with tokenization, where tools like NLTK are used to break down the collected text into individual words for easier handling. The data is then cleaned by removing unnecessary characters and filtering out irrelevant or redundant words, ensuring clarity and relevance. Finally, the cleaned text from both images and descriptions is merged into a comprehensive dataset, preparing it for detailed analysis.

MODULE 4: SENTIMENTAL AND EMOTION ANALYSIS MODULE



The sentiment analysis process begins by employing the transformers library with a specialized model to determine the emotional tone of textual data. Each text is analyzed to classify its sentiment as positive, negative, or neutral. This analysis is conducted systematically across all collected data. Subsequently, the emotional distribution is aggregated, quantifying each sentiment type and converting these counts into percentages. This comprehensive breakdown provides a clear understanding of the emotional context within the dataset.

MODULE 5: LOADING & VISUALIZING RESULTS



This module focuses on presenting the analyzed data in a clear and accessible format. Once sentiment analysis and emotion detection are completed, the results are compiled and structured for easy interpretation. Interactive visualizations like pie charts, bar graphs, and line plots are used to display sentiment distribution, providing a comprehensive view of emotional trends. Real-time data display ensures instant feedback, allowing users to observe insights immediately after the analysis. A user-friendly dashboard enhances accessibility, making the system intuitive for both technical and non-technical users, and ensuring a seamless experience when interpreting results.

MODULE 6: RESULT INTERPRETATION AND REPORT GENERATION

This module focuses on generating comprehensive reports based on the sentiment analysis results. After analyzing the collected social media data, including text and visual content, the system compiles the findings into a well-structured format. The sentiment distribution, classified into positive, negative, and neutral categories, is visually represented through interactive charts and graphs. Users can download the final report in a PDF format, providing a detailed overview of emotional trends and analysis outcomes. This report serves as a valuable resource for mental health professionals and researchers, enabling informed decision-making and timely interventions.

METHODOLOGY

A.User Interface Layer

The user interface layer of this application employs Flask API in Python to bridge the interaction between

users and the deep learning backend. Central to this layer is a chatbot equipped with LLM (Large Language Model) capabilities, designed to facilitate mental health conversations. The chatbot is configured to engage users through conversational prompts, capturing relevant details such as symptoms and emotional expressions from Instagram posts. The chatbot continuously learns from user interactions, adapting and improving its responses over time. By guiding the user with open-ended questions, it encourages an expressive and supportive communication channel, fostering a non-judgmental environment.

B. Backend Components

1) Multimodal Depression Detection

The core backend utilizes a deep learning-based framework to process and analyze multimodal data (images and text) from Instagram posts and reels. Text from captions and visual content extracted using Tesseract OCR are preprocessed through advanced natural language processing techniques such as tokenization, cleaning, and stopword removal. This data is then passed through transformer-based models, including RNN and attention layers, to generate meaningful emotional insights. Optimization algorithms like OGRAU and IAO ensure improved detection accuracy while simultaneously reducing false negatives. This combination of features helps create a nuanced and reliable emotional analysis system.

2) Model Training and Data Processing

The training of the detection model utilizes a large dataset from social media, combining emotional, visual, and textual cues for comprehensive analysis. By leveraging a transformer-based architecture, the system is fine-tuned to identify patterns indicative of depressive states. The dataset is preprocessed to remove outliers, and a custom tokenization pipeline ensures uniformity in sequence lengths. Tokenized inputs are converted into PyTorch tensors, leveraging GPU acceleration for efficient processing. This approach enables the model to learn from a diverse set of posts, ensuring robustness and generalization.

3) Sentiment and Emotion Analysis

The sentiment and emotion analysis module integrates pre-trained models such as DistilBERT to classify text as positive, negative, or neutral while identifying emotional states like sadness, anger, or happiness. This analysis aggregates the sentiment scores across posts to understand broader emotional patterns. By combining the visual and textual data streams, the system identifies significant correlations that may indicate underlying depression. The results are logged locally to allow further refinement and validation of the system, ensuring that user privacy and data security are maintained throughout the process.

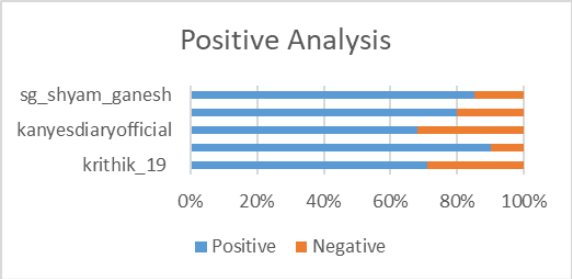
PERFORMANCE ANALYSIS

Positive Analysis Value

The "Positive Analysis" chart compares the percentage of positive and negative sentiment across five Instagram users: sg_shyam_ganesh, som_sekar_03, kanye'sdiaryofficial, vichu_lifts, and krthik_19. Each user displays a predominance of positive sentiment, with varying levels of negative sentiment

Social Media Account	Positive	Negative
krithik_19	71%	29%
vichu_lifts	90%	10%
kanyesdiaryofficial	68%	32%
som_sekar_03	80%	20%
sg_shyam_ganesh	85%	15%

Krthik_19 shows the highest proportion of negative sentiment, while kanye'sdiaryofficial has a more balanced distribution of positive and negative.



Overall, positive sentiment is notably higher than negative across all users, indicating generally positive interactions or content.

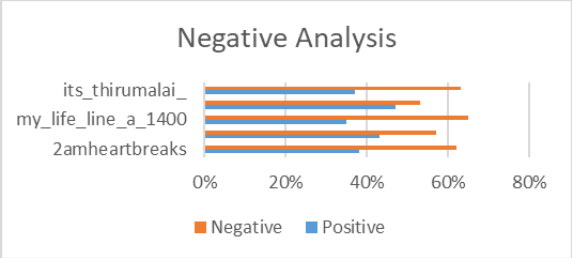
Negative Analysis Value

The "Negative Analysis" chart presents the sentiment distribution for five Instagram users: its_thirumalai_, untold. feeling23, my_life_line_a_1400, ifakesoul, and 2amheartbreaks. Each user exhibits a higher

proportion of negative sentiment compared to positive sentiment.

Social Media Account	Positive	Negative
2amheartbreaks	38%	62%
ifakesoul	43%	57%
my_life_line_a_1400	35%	65%
untold.feeling23	47%	53%
its_thirumalai_	37%	63%

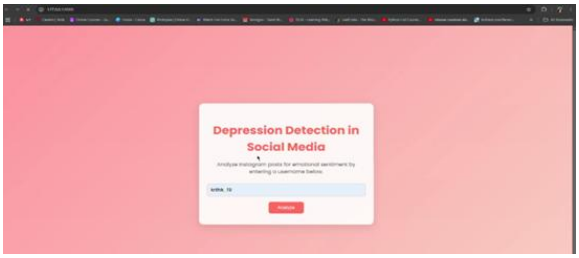
The negative sentiment ranges from approximately 50% to 60%
across these profiles, indicating more negative emotional expression. Positive sentiment is comparatively lower for all users, suggesting these accounts may reflect themes or experiences associated with negative emotions.



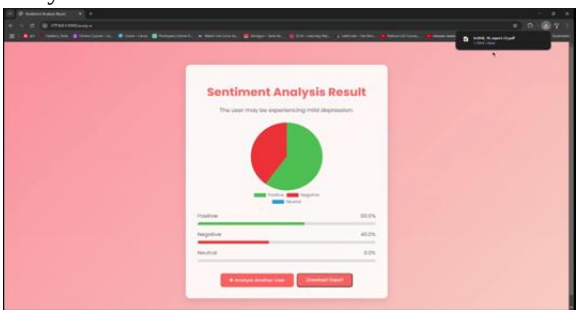
In comparison, the positive sentiment for these profiles remains significantly lower, varying between 35% and 47%. "Untold.feeling23" shows the highest positive sentiment at 47%, whereas "my_life_line_a_1400" has the lowest at 35%. This disparity between positive and negative sentiment reflects an overall inclination toward a more somber or introspective tone within these users' posts, possibly suggesting themes of vulnerability, emotional challenges, or negative experiences. The analysis of this sentiment breakdown provides valuable insight into the emotional dynamics of each account, highlighting a shared tendency toward more negatively skewed content across the sample.

RESULT

The developed system provides a user-friendly interface built using Flask API. This interface integrates deep learning models at the backend for depression detection, ensuring seamless interaction. Upon accessing the application, users can interact with the chatbot, which serves as the primary interface. It allows users to input their social media content, such as images and text captions, for analysis. Below is a screenshot of the user interface showcasing how users interact with the system and upload their Data for depression detection.



After uploading, the system processes the data through multiple stages, including text extraction, sentiment analysis, and multimodal deep learning. The final result is displayed, categorizing the content into positive, negative, or neutral sentiments based on the analysis.



The results also include confidence scores for each sentiment classification, offering users insights into the emotional tone of their social media posts. Below is a screenshot of the final output, highlighting the sentiment categories for individual posts along with corresponding confidence levels.
This implementation not only provides accurate sentiment analysis but also ensures an interactive experience for users, fostering engagement while raising awareness about emotional well-being. The results demonstrate the system's reliability and potential for real-world application in mental health support.

CONCLUSION

The development of an AI-driven system for detecting depression through the analysis of social media posts represents a significant step forward in addressing mental health challenges. By leveraging cutting-edge deep learning techniques, sentiment analysis, and natural language processing, the project aims to provide early detection of depressive states based on users' online activity. This approach not only offers a

valuable tool for mental health professionals butalso contributes to raising awareness and promoting timely intervention. Ensuring privacy and ethical considerations remain central, the project stands asa powerful and responsible innovation in the field of mental health support.

FUTURE SCOPE

The project lies in expanding its capabilities to analyse a broader range ofsocial media platforms and content types, including video and audio. Enhancingthe deep learning models to detect more subtle signs of emotional distress can increase the system's accuracy in identifying early stages of mental health issues. Additionally, integrating with mental healthservices could offer timely interventions. The project's potential can also grow by collaborating with healthcare professionals to refine the models, ensuring that the insights generated lead to meaningful mental health support. Ethical considerations, particularly around privacy, will continue to play a crucial role infuture advancements.

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