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Sentimental Analyzer for Depression Using Machine Learning Approaches

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Abstract - Mental stress and depression are prevalent psychological conditions that affect millions of individuals worldwide. Early detection and intervention are crucial for effective management and treatment. With advancements in technology, particularly in the field of computer vision and machine learning, there has been growing interest in utilizing facial input for the detection of mental stress and depression. This abstract presents a concise overview of recent research in this area.

Facial input-based detection methods leverage the analysis of facial expressions, movements, and features to infer an individual's emotional state. Various techniques have been explored, including traditional computer vision algorithms and deep learning approaches. These methods aim to capture subtle changes in facial expressions associated with mental stress and depression, such as sadness, fatigue, and withdrawal.

1. Introduction

Depression is a major global health concern and a leading cause of disability. Despite the availability of validated screening tools, large portions of the population remain undiagnosed due to stigma and lack of access to mental healthcare. With the increase in digital interactions, machine learning (ML) offers new opportunities to analyze behavioural and linguistic patterns to detect markers of depression.

Text-based sentiment analysis has proven effective for uncovering psychological states encoded within written language. Social media platforms such as Twitter, Reddit, and Facebook contain rich emotional data that can be mined using Natural Language Processing (NLP). Parallelly, questionnaire-based clinical data provide structured indicators of depressive tendencies.

This research aims to integrate these two modalities and develop a robust ML model that predicts depression levels reliably. The system is designed to support healthcare providers, organizations, and individuals by enabling early identification of depressive symptoms and enabling timely intervention.

2. Objectives

1. To design a machine learning–based model capable of predicting depression levels using questionnaire responses and text-based inputs.
2. To evaluate the performance of multiple machine learning algorithms and identify the most effective classifier.
3. To build a flexible sentiment analysis pipeline without dependency on proprietary APIs.
4. To provide a deployable framework adaptable for clinical and non-clinical mental health support systems.

3. Problem Identification

Traditional depression diagnosis relies heavily on clinician interpretation and self-reported symptoms, which can be subjective and may fail to capture early warning signs. Digital platforms contain valuable behavioural cues, yet most existing tools are limited to general sentiment classification rather than mental-health-specific indicators. Moreover, many models depend on external libraries with limited customizability.

Thus, there is a need for a scalable, automated system that:

- Integrates structured and unstructured data
- Accurately detects depression-specific cues
- Operates without external black-box frameworks
- Supports real-time self-assessment and clinical decision-making

4. Literature Review

Recent studies emphasize the growing use of artificial intelligence in mental health diagnostics. Research by Resnik (2015) and Shatte et al. (2019) demonstrated that linguistic patterns in social media posts correlate strongly with depressive tendencies. WHO reports also highlight significant increases in depression cases worldwide.

Traditional ML models such as SVM, Logistic Regression, and Naïve Bayes have been extensively applied for sentiment analysis. Recent advancements include transformer-based architectures (BERT, RoBERTa), which provide near-human textual understanding.

However, research gaps still exist:

- Lack of multimodal sentiment systems combining text and structured data
- Limited explainability in deep learning-based depression predictors
- Data imbalance issues in mental health datasets
- Absence of deployable tools for real-world users

This study addresses these gaps by integrating multiple classifiers and constructing a customizable, transparent, and expandable framework.

5. Methodology

The proposed methodology comprises six major phases:

5.1 Data Collection

Two datasets were used:

- Clinical depression dataset (Likert-scale questionnaire responses)
- Twitter sentiment dataset (positive, negative, depressive text posts)

5.2 Data Preprocessing

- Removal of duplicates, URLs, stop words
- Tokenization, lemmatization
- Encoding categorical values
- TF-IDF and word embeddings for feature generation

5.3 Feature Engineering

- Sentiment polarity scores
- Depression-related lexicon frequencies
- Questionnaire score normalization

5.4 Model Development

Classifiers implemented:

- SVM
- Random Forest
- Decision Tree
- Gaussian Naïve Bayes
- KNN

Training/testing split: **80:20**
Cross-validation: **10-fold**

5.5 Evaluation Metrics

- Accuracy
- Precision
- Recall
- F1-score

5.6 Deployment

The final model is designed for deployment as a web-based application enabling:

- Text input analysis
- Questionnaire-based assessment
- Real-time prediction output

6. System Architecture

Workflow:

Data Collection → Preprocessing → Feature Extraction → Model Training → Prediction Engine → Result & Recommendations

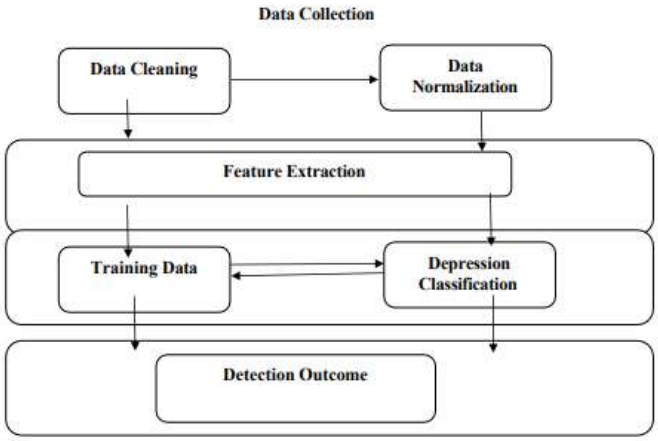

Fig. 1: A system architecture diagram

7. Working Principle

1. User enters text or responds to a questionnaire.
2. Text is cleaned and converted into numerical vectors.
3. The trained ML classifier analyzes the patterns.
4. System predicts depression level:
    - **No Depression**
    - **Mild Depression**
    - **Moderate Depression**
    - **Severe Depression**
5. Recommendations or alerts are provided accordingly.

8. Applications

- Clinical mental health decision-support
- Self-assessment tools
- Corporate wellness monitoring
- Academic institutions
- Social media behaviour analysis
- Mental health research datasets
- Digital therapy and counselling platforms

9. Opportunities

- Integration with facial and voice analysis
- Real-time chatbot integration
- Personalized AI-driven mental health recommendations
- Remote patient monitoring
- Deployment in hospitals and telemedicine systems

10. Challenges

- Data imbalance in depressive text datasets
- Privacy concerns with emotional data
- Ambiguity in natural language
- Need for clinical validation
- Model interpretability limitations

11. Future Scope

- Transformer-based model integration
- Multilingual depression prediction
- IoT and wearable sensor fusion
- Longitudinal emotional trend analysis
- Clinical trials with mental health professionals

12. Conclusion

This research successfully demonstrates a machine learning–based sentimental analysis approach for depression level prediction. By integrating structured questionnaire responses with unstructured social media content, the proposed system provides reliable, scalable, and ethical mental health assessment. The approach holds strong potential for healthcare use, corporate well-being, and AI-powered therapy tools.

13. Acknowledgment

The successful completion of this research has been made possible through persistent effort and a deep commitment to exploring machine learning applications for mental health assessment. This work draws upon insights from existing scientific studies, publicly accessible resources, and advancements in data-driven technologies. The collective contributions of the global research community have played an essential role in shaping the foundations upon which this study is built. This paper is dedicated to furthering research efforts and supporting technological innovation for mental well-being.

14. References

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