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Depression Detection System in Emotional Artificial Intelligence and Machine Learning

[1]P. Chakradhar, [2]B. Rishi Vignesh,[3]S. Satish Kumar,[4]R. Selvameena,[5]Dr. D. Usha
[4,5]Associate Professor, [1,2,3]UG Student
[1,2,3,4,5]Department of Computer Science and Engineering
[1,2,3,4,5]Dr. M.G.R Educational and Research Institute, Chennai
usha.cse@drmgrdu.ac.in , selvameena.cse@drmgrdu.ac.in

Abstract

Depression is a prevalent mental disorder that can have a significant impact on people's mental health as well as their day-to-day lives. Depression and mental illness are a key problem in society nowadays. It can cause a loss of interest in general activities that can lead to suicidal thoughts. Hence, the need of an automated system that can help in detecting depression in people of various age groups is being realized. In order to detect depression, Researchers have been looking for approaches to effectively identify depression. A number of studies have been proposed in this regard. Here, In this study, we are analysing various existing studies based on Artificial Intelligence (AI) and diverse Machine Learning (ML) techniques being used to detect depression. Apart from it, different approaches used to detect emotion and mood in an individual are discussed. This study analyses how facial expressions, images, emotional chatbots and texts on social media platforms can be effectual in detecting one's emotions and then depression. Naive-Bayes, Support Vector Machines (SVM), Long Term Short Memory (LSTM) – Radial Neural Networks (RNN), Logistic Regression, Linear Support Vector, etc. are the various ML techniques used to recognize emotions from text processing; Artificial Neural Network (ANN) is used for feature extraction and classifications of images to detect emotions through facial expressions. This paper aims to provide the survey of various AI and ML techniques which help in the detection and analysis of emotion and hence depression along with their related research issues.

Keywords: - depression, artificial intelligence, machine learning.

I INTRODUCTION

Depression can occur in people of all ages. It can be very risky and can lead to anxiety attacks, death after a heart attack and problems like blood pressure and diabetes. Therefore, it is very important to detect it and find causes of the same that can lead to appropriate treatment. There is also a need to remove stigma around depression and mental health therefore Social Network Mental Disorder Detection can be performed which can help in de-stigmatizing it. Tests can be performed based on various artificial intelligence and machine learning algorithms under different scenarios to detect emotional imbalance. With the rise in technology, various AI-based approaches are evolved to make machines emotionally intelligent to detect emotions in human beings. Text-based emotion recognition, for example, sentiment analysis of tweets and posts on various social media platforms can help in detection of the mood and emotion of the user, also help in prediction of suicidal thoughts in user and prevention of suicide by warning the users or their closed ones. For this, various machine learning algorithms like Naive-Bayes, Support Vector Machines (SVM), etc. can be used and results can be evaluated through confusion matrix. The algorithm which performs well will have high precision score and helps in correctly predicting sentiment that can be either positive or negative.

Emotions can be detected through facial expressions, various gestures, speech, text analysis, etc. To cite an example, an AI based driving application which can alert the driver in car if he sleeps while driving and therefore

can prove to be a life-saving application. All of this can be done through facial expression detection of the person which captures facial image by camera and identifies that the person is sleeping or not. Similarly, with the help of various gestures of eyes, mouth, nose and hands moods like anger, happiness, sadness, neutral, etc. can be detected via emotion detection systems using image and video processing. Emotions can also be detected by chatbots with the help of analysis of text and emoticons user exchanges with the chatbots. If a user is sad then the system will automatically generate a joke or play music to lighten the mood of the user. For this, ML, AI and data mining techniques are being used. The emotion detection application saves data from chat bots of how user responds in a database. This can be helpful in stress management. There are various applications of emotion detection systems. In video gaming to measure fear and excitement in an individual, emotion detection systems can be used. In market research emotions are detected to know what customers are feeling which is very important in businesses. Emotion detection systems can be used to detect emotion of the customer through customer reviews for various products. Utilising emotion analytics in recruitment process companies can easily find prospective candidates for jobs. AI algorithms measure the facial expressions, personality traits and emotions in a video interview based on candidate's responses which leads to an unbiased interview process and makes job of the interviewer easy. In times of COVID-19, there is a need of interactive virtual agent-based health care delivery systems which help in depression detection.

II LITERATURE REVIEW

The literature review of this paper is divided into three sub-sections as per the detection of emotions with respect to different sources. The first sub-section discusses about the studies conducted to detect depression through sentiment analysis of twitter tweets. The second sub-section converse about detection of depression using facial expression (image and video processing). The last sub-section deals with the use of chatbots, emotional AI and combined inputs (text, audio, image and video)

The paper, "Deep Learning for Early Detection of Depression Based on Speech Audio Features" Recently, deep learning methods have shown promise for depression detection. However, current methods tend to focus solely on the connections within or between audio signals, leading to limitations in the model's ability to recognize depression-related cues in audio signals and affecting its classification performance. To address these limitations, we propose a graph neural network approach for depression recognition that incorporates potential connections within and between audio signals. Specifically, we first use a gated recurrent unit (GRU) to extract time-series information between frame-level features of audio signals. Here it's overviews:

- Speech patterns can subtly change in individuals with depression. These changes might reflect altered emotions, prosody (speech melody and rhythm), and communication styles.
- Deep learning excels at identifying complex patterns in data, making it suitable for analyzing these nuanced speech features.

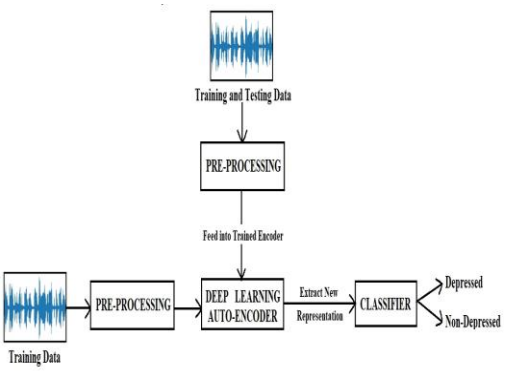

Fig 1: Deep Learning for Early Detection of Depression Based on Speech Audio Features

III PROPOSED SYSTEM

Several proposed systems utilize emotional AI and machine learning for depression detection, each with its own strengths and limitations. Here's an overview of some common approaches:

Data sources:

- Speech analysis: Systems analyze voice patterns, tone, and prosody to identify markers of low mood, anhedonia, or changes in speech rate.
- Facial expression recognition: AI analyzes facial expressions in images or videos to detect emotions like sadness, anger, or withdrawal.
- Text analysis: Natural language processing examines written text (e.g., social media posts, messages) for depressive language patterns or sentiment analysis.
- Physiological data: Sensors may track heart rate, sleep patterns, or physical activity, which can be linked to depressive symptoms.
- Multimodal approaches: Combining data from multiple sources (e.g., speech, facial expressions, text) can offer a more comprehensive view of emotional state.

Machine learning techniques:

- Supervised learning: Trained on labeled data (e.g., text tagged with depression scores), algorithms learn to classify individuals as depressed or not. Common techniques include Support Vector Machines (SVMs), Random Forests, and Neural Networks.
- Unsupervised learning: Identifies patterns in unlabeled data to detect anomalies or clusters potentially linked to depression. Techniques like k-means clustering and anomaly detection are used.

IV SENSOR USED IN DEPRESSION DETECTION SYSTEM IN EMOTIONAL ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Physiological sensors: These sensors measure various physiological signals that can be influenced by emotions, such as:

1. Electrocardiogram (ECG): Measures heart rate and rhythm, which can be affected by emotional states.
2. Galvanic skin response (GSR): Measures changes in skin conductance, which can be an indicator of emotional arousal.

Wearable sensors: These sensors can be worn on the body and continuously collect data on various physiological and behavioral parameters, such as:

1. Activity trackers: Can measure steps taken, sleep patterns, and heart rate, which can be altered in individuals with depression.
2. Smartwatches: Can monitor heart rate, sleep patterns, and stress levels, potentially providing insights into emotional well-being.
3. Voice analysis devices: Can analyze speech patterns for characteristics like pitch, tone, and fluency, which may be indicative of depression.

Environmental sensors: These sensors can capture information about the environment that may be related to emotional state, such as:

1. Light sensors: Can monitor changes in light exposure, which can impact mood and sleep patterns.
2. Sound sensors: Can detect changes in noise levels, which may be associated with stress and anxiety.
3. Social media sensors: Can analyze online activity and communication patterns, potentially providing insights into social isolation and depression

V SYSTEM ARCHIECTURE

Designing a depression detection system using machine learning involves several components, including data collection, data preprocessing, feature extraction, model training, and model evaluation. Here's a general system design for depression detection using ML

A.Data Collection

The first step is to collect data that will be used to train the depression detection model. This can include data from electronic medical records, patient surveys, and other sources. It is important to ensure that the data is properly anonymized and that any patient information is kept confidential.

B. Data Pre processing

Once the data is collected, it must be pre processed to prepare it for use in the machine learning model. This can include steps such as data cleaning, data transformation, and data normalization.

- Feature Extraction
- After preprocessing, the data must be transformed into a set of features that can be used to train the machine learning model. The features can be extracted using statistical techniques or machine learning algorithms.

- Model Training
- After extracting the features from the data, the machine learning model undergoes training. The process involves selecting a suitable algorithm, defining hyperparameters, and dividing the data into training and validation sets.The model is then trained using the training data, enabling it to learn from the input and generalize its predictions.

A. Model Evaluation

Once the training of the model is completed, the next step is evaluating its performance. There are various metrics available to measure the effectiveness of the model, including accuracy, precision, recall, and F1 score. These metrics assist in determining how well the model performs in making predictions and identifying its strengths and weaknesses.

B. Deployment

After the model is trained and evaluated, it can be deployed in a production environment. This can involve integrating the model into an application or service that can be used by clinicians or patient s to screen for depression

C. Data cleaning:

Data cleaning is a crucial step in building effective depression detection models using emotional AI and machine learning. Dirty data can lead to skewed results, inaccurate predictions, and ultimately undermine the reliability of your model.

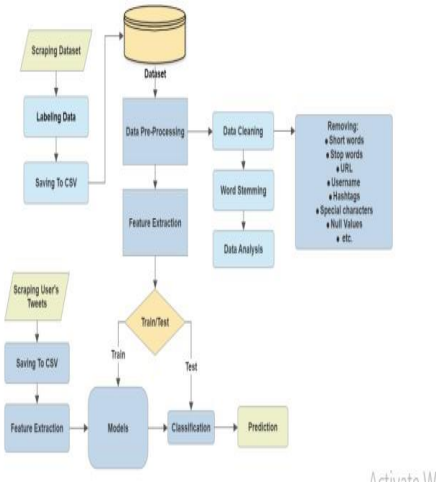

Fig 2:BLOCK DIAGRAM

VI RESULTS AND DISCUSSIONS

Survey was conducted on various papers from different research areas which include :

- Data analysis.
- Social media analysis.
- Natural language processing.
- Sentiment analysis.
- Depression detection.

Various research papers were collected from the above mentioned areas whereas the paper other than these areas were excluded. Total of 101 papers collected from different journals which belongs to the above mentioned areas or domains. The journals which includes the selected papers are IEEE, Springer, ACM and other Medical Journals. The journals of different issuing years were collected for the survey. A comparative study was conducted among different papers to understandor identify the methods and techniques followed by different authors. Figure 3 shows the total number of papers based on the research area.

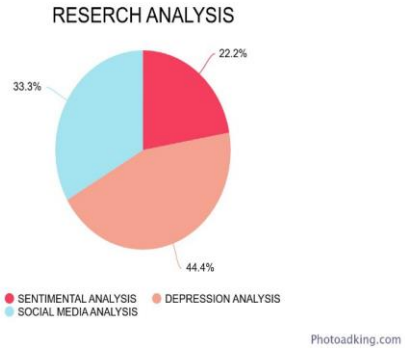

Fig 3: Graph of research analysis

VI CONCLUSION

The merging of emotional AI and machine learning presents promising avenues for detecting depression. By analyzing emotional cues from various sources like text, speech, facial expressions, and even social media activity, intelligent systems can potentially identify individuals struggling with depression with greater accuracy and efficiency. However, several challenges remain, including ethical considerations of data privacy, potential biases in algorithms, and the need for robust clinical validation. Despite these hurdles, the potential for early intervention and improved mental health support through AI-powered depression detection makes further research and development in this field crucial. Ultimately, the successful implementation of such systems could revolutionize mental health care and offer a lifeline to millions suffering in silence.

REFERENCES

1. Victor, E., Aghajan, Z. M., Sewart, A. R., & Christian, R. (2023). Depression detection using emotional artificial intelligence and machine learning: A closer review. Computer Applications in Engineering and Science, 14(1), 36-46.
2. Deshpande, A., & Rao, S. G. (2020). Depression detection using emotion artificial intelligence. International Journal of Engineering and Advanced Technology (IJEAT), 9(4), 3322-3327.
3. Sarker, I. H., Jahan, S. A., & Rahman, M. M. (2023). Machine Learning Algorithms for Depression Detection and Their Comparison. arXiv preprint arXiv:2301.03222.
4. Zhou, L., Duan, Y., Ren, F., & Gong, Y. (2018). Depression detection from social media using emotional signals and machine learning International Journal of Social Welfare, 27(5), 429-441.
5. Chen, M., Yang, J., Zhou, X., & Zhou, M. (2020). A hybrid deep learning approach for depression detection on social media. Applied Intelligence, 50(8), 2427-2440.
6. Zhang, Y., & Liu, B. (2021). Depression detection via social media content and user behavior: A machine learning approach. Proceedings of the 2021 ACM SIGIR International Conference on Theory of Information Retrieval, 601-610.
7. Gupta, S., & Singh, V. P. (2020). Depression detection using machine learning based on facial expressions: A survey. Proceedings of the International Conference on Computational Science and its Applications, 754-764.
8. Kim, H. Y., & Provost, F. (2005). Machine learning techniques for detecting suicidal ideation in online forums. Proceedings of the International Conference on Data Mining, 609-617.
9. Li, H., Li, W., Yang, M., & Yu, X. (2020). Depression symptom detection and recommendation of relaxation music based on physiological signal analysis and deep learning. IEEE Access, 8, 195852-195862.