Mental Health Detection Using Predictive Analysis

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ABSTRACT — **People from different regions and ages are living with burden of some of disorders. It includes mood disorders, anxiety, personality disorders and many more. Various social issues are factors that prevent people to seek help or mental health services. The biggest issue is that people afraid to personally go and seek help from psychologist. People are confused about their mental health and therefore they are reluctant to visit the doctor. Ultimately they suffer a lot silently. Psychological disorder, if not taken care of, will cause disability, permanent loss of memory, manipulation, or perhaps self-harm.**

The Mental health of an individual refers to his/her's cognitive, behavioural, and emotional well-being. There are Several factors damage mental health, namely stress, anxiety, etc. If proper care is not given to a person suffering from mental illness the consequences may be bad. Applications implemented using machine learning and Artificial intelligence algorithms can be used to predict such onsets and can serve as a monitor for any unusual behaviour in individuals. The system consists of 4 modules namely -1) Questionnaire 2) Facial Emotion Detection 3) Socio emotional Detection 4) BOT Assistant.

Keywords— Mental health , physical health , web app , mental state, anxiety.

INTRODUCTION — In today's fast-paced and more complex world, mental health has arisen as a critical concern impacting people of all ages and backgrounds. This approach is a ground-breaking initiative to address the issues of mental health awareness, early intervention, and support. This revolutionary system consists of four distinct modules, each of which is intended to play a critical part in improving individuals' overall mental well-being.

The first module, the Questionnaire, is a crucial tool for self-assessment, allowing individuals to analyse their mental health and voice their concerns in a confidential and non-judgmental context. As it stimulates self-reflection and opens up the door to addressing any mental health issues, this first step is crucial in breaking down the obstacles that sometimes prevent people from getting treatment. It employs predictive models to provide a proactive method to self-evaluation. This module, which employs predictive algorithms, provides early detection of risk indicators, paving the way for appropriate intervention.

The second module, the Facial Emotion Detection, makes use of cutting-edge Convolutional Neural Networks (CNN) technology. It goes into the domain of emotions by analysing facial expressions, providing a greater knowledge of an individual's emotional state. This non-invasive, real-time technique is critical for detecting emotional changes and potential mental health problems.

The third module, Socio-emotional Detection, is based on predictive analytics. It functions as an early warning system, detecting trends and anomalies in a person's social and emotional behaviour. The technology can highlight aberrant behaviour by continuously monitoring these crucial indications, providing a safety net for those in need of assistance.

The fourth module, the BOT Assistant, completes the ecosystem which provides rapid and accessible assistance. It answers queries, provides direction, and links users to appropriate resources, ensuring that they always have a source of help at hand.

These four modules work together to establish a complete framework for identifying individuals at risk of mental health illnesses, providing support, and raising mental health awareness. The successful adoption of this system has the potential to transform how we perceive and manage mental health concerns, producing a more empathic and informed society. Through this initiative, we hope to create a safer and more supportive atmosphere for those dealing with mental health issues, ultimately leading to healthier, happier lives for people all around the world.

RELATED WORK — In order to achieve high accuracy with the model they properly cleaned and preprocessed data until it is well fitted. To do this they used python libraries like NumPy, pandas and matplotlib. In order to get the best result for their work they had to pass each dataset through multiple ML algorithms like logistic regression, SVM, random forest, k-neighbours etc. Example: - for anxiety, the above

mentioned algorithms are used and achieved accuracy of 97.27%, 94%, 81%, 80% etc. respectively. Same was the case for the other three diseases which had different levels of accuracy. For their system they chose the algorithm which gave them the true and highest accuracy.[1]

The target in this research is to categorize the emotional behavior from the target set of the individuals. For making this possible, it has been implemented on the tweets that have been tweeted by the user. For that they have proposed to use machine learning algorithms SVM and CNN. SVM is used to transform the tweets into vectors.SVM helps in defining the best fit which further classifies which label belongs to the concerned category. CNN is used to obtain the important features of text through the pooling.The resultant system gives accuracy of 83.76%.[2]

To determine the stress of individuals at the factors like depression, anxiety, or sleeplessness, a questionnaire focusing on these factors is prepared and circulated to generate survey data.The data is collected by conducting the survey and the dataset is generated.After Data Collection via Questionnaire, the dataset is uploaded to perform data cleaning. Then the algorithms like KNN, Random Forest & CNN-Adaboost are applied to the refined dataset which will generate an ensemble learning model for future stress prediction.In this paper, they compared the model which was trained using the CNN algorithm and stacking algorithms mainly – KNN, Random Forest and CNN-Adaboost. And compared the accuracy of both the models and found that the accuracy of the Stacking model was much better in the prediction of the stress level.[3]

The system consists of 4 modules namely -1) Pulse-based Depression detection 2) Facial Emotion Detection 3) Questionnaire 4) BOT Assistant. In Facial Emotion Detection using Open CV they used CNN to classify the emotion detected on a person's face.The FER-2013 dataset is used to train this model.Sentimental analysis is done by using chatbot and questionnaire. The chatbot is trained using social media dataset like twitter using NLP and bags of word is created.The output of all the models is combined and by analysis ,the final outcome is given in the form of prediction of the user's state of mind.[4]

In this research paper, they propose a Convolutional Neural Network (CNN) model that leverages both text data and emoji representations for accurate identification of depressive moods in Twitter data. The model is developed using popular Python libraries, including pandas, scikit-learn, TensorFlow's Keras, and NLTK. The performance of the

CNN model is evaluated using metrics such as accuracy, precision, recall, and F1-score.

Additionally, the paper explores the integration of emoji representations to enhance the detection of depressive moods.[5]

METHODOLOGY —

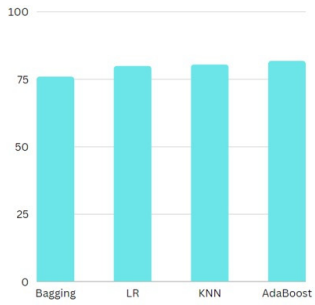
Questionnaire based approach:

A useful technique that combines data analysis with psychological evaluations to discover possible mental health problems in individuals is the use of predictive analysis and a questionnaire-based approach in the detection of mental health concerns.This method's description is as follows:

1. Questionnaire Design: Creating a thorough questionnaire covering a variety of psychological, emotional, and behavioural topics is the initial stage in this process.In order to tap into users' minds and assess their present mental states in order to offer comparable answers, the suggested model examines users' responses to in-depth psychological inquiries.
2. Data Collection: A variety of platforms, including paper surveys, internet forms, and mobile applications, can be used to conduct the questionnaire. It has been given to those who are prepared to take part and share their experiences and feelings. Anonymity and confidentiality are essential to encourage honest responses.
3. Feature Engineering: Take significant characteristics or features that are related to mental health and relate to questionnaire results. The objective is to develop models that, from the answers to the questionnaires, can forecast the possibility of a mental health problem. For more complicated models, some often used methods are deep learning, decision trees, and logistic regression.
4. Model Validation: Use methods such as holdout testing and cross-validation to evaluate the prediction models' performance. Make sure the model has good data generalisation.
5. Monitoring and Feedback: Keep an eye on people's mental health conditions and get input on how well interventions are working. Based on this feedback, modify intervention tactics and predictive models.

In addition to detecting depression, this software can forecast present mental states such as loneliness, rejection, rage, humiliation, guilt, anxiety, jealousy, tension, or hurt, as well as occasionally several conditions, and provide straightforward, appropriate treatments. This is achieved through a thorough analysis process.

Comparative analysis of algorithms :



Comparison of different Algorithms

Facial Emotion Detection using CNN:CNN (Convolutional Neural Network) approaches for facial emotion identification use deep learning models to automatically identify and categorize human emotions from facial expressions in pictures or video frames.

1. Gathering and Preparing Data:

The FER2013 dataset, which contains face photos displaying a range of emotions, including happiness, sorrow, rage, surprise, fear, disgust, and neutral expressions, has been utilized in this instance Preprocess the data by normalizing pixel values to a specific range (e.g., 0 to 1), converting to grayscale format, and resizing photos to a consistent size (e.g., 48x48 pixels).

2.Create a CNN architecture that is especially suited for detecting face emotions.
Important elements of the architecture:
1)Convolutional layers: These layers take the input image and use convolution operations to extract spatial characteristics. During the model design process, the quantity and dimensions of the filters are decided.
2)Activation functions: To add non-linearity to the model, common activation functions such as ReLU (Rectified Linear Unit) are used.
3)Pooling layers: To improve translation invariance and lower computing complexity, pooling layers down sample feature maps.
4)Fully linked layers: These layers process the features that have been extracted and forecast emotions.
3.Create training, validation, and test sets from the dataset.
By minimizing a loss function that gauges the difference between expected and actual emotions, such as categorical cross-entropy, you can train the CNN with the training set.To update the weights and biases of the model, use optimization techniques such as Adam. Use strategies like learning rate scheduling and early stopping to avoid overfitting and improve generalization.
4. Hyperparameter Tuning :Tune the model's performance by experimenting with hyperparameters such as learning rate, batch size, dropout rate, and network architecture.
5. Inference:Apply the trained model to make predictions on new facial images or video frames. The model will predict the emotion displayed in the face based on the learned features.

Procedure : First step is to comprehensively collect and prepare the dataset of this project. This entails gathering a diverse set of facial photos, recording distinct emotional expressions, and gathering behavioural data indicative of socio-emotional patterns. Data privacy and ethics are given careful consideration, ensuring the anonymous management of sensitive information. To preserve user privacy, the obtained data is subjected to rigorous preprocessing, which includes normalising pixel values to a uniform range, and anonymizing any identifying information.

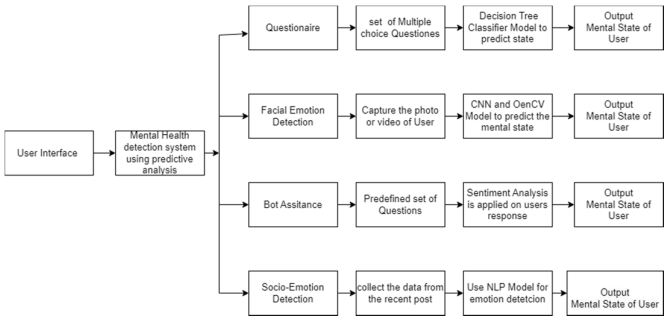
Second step includes development of the project's four core elements. The "Questionnaire" module is intended to measure a person's mental well-being based on user replies, while employing predictive models to provide insights and early

detection capabilities. The "Facial Emotion Detection" module analyses and classifies emotions from facial photos using Convolutional Neural Networks (CNN), offering real-time emotional insights. The "Socio-emotional Detection" module monitors social and emotional behaviours using predictive analytics, providing an early warning system for potential mental health issues. Simultaneously, the "BOT Assistant" is designed to be an intelligent and accessible resource, acting as a helpful companion to answer questions, provide assistance, and provide users with useful resources.

Third Step moves on to the integration and testing phase. This step entails integrating all four parts to produce a coherent system. The modules are carefully tested to ensure

that they can communicate successfully, sharing data and user interactions. Each component is thoroughly evaluated for accuracy, efficiency, and usability. End-to-end testing is used to validate the system's overall functionality and ensure that it works as an integrated solution.
Fourth Step is to examine the system's effectiveness in terms of early detection, intervention, and user support. User feedback is crucial in defining the system's progress, directing iterative adjustments to increase the system's impact on mental health care.

System Architecture :-



RESULTS : Precision, Recall, mAP, and F1 score are the metrics we used to assess the classification models.

Precision is a model's capacity to recognise only the pertinent objects. The ratio of correctly classified positive samples (True Positives) to all classified positive samples is what is used to define it.

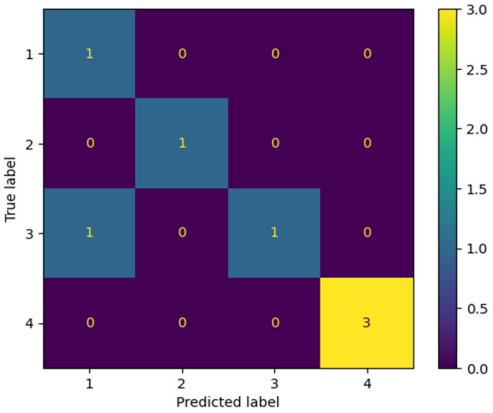
$$\text{Precision} = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

A model's recall is its ability to find all ground truth bounding boxes. The recall is calculated as the proportion of Positive samples that were correctly classified as Positive to the total number of Positive samples.

$$\text{Recall} = \frac{True\ Positive}{True\ Positive + False\ Negative}$$

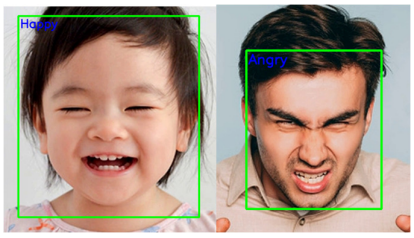
F1 score-: The F1 score tries to combine precision and recall into a single metric. At the same time, the F1 score was designed to perform well on unbalanced data. The F1 score is calculated using the harmonic mean of precision and recall.

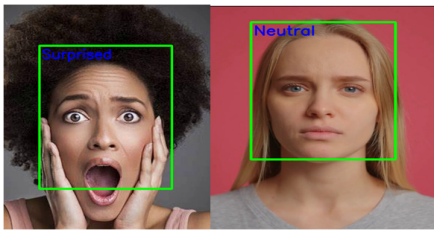
$$F_1 = 2 * \frac{precision * recall}{precision + recall}$$



Here are some examples of the outcomes from our model-:

Facial Emotion Detection using CNN:





CONCLUSION —

Mental health disorders, such as mood disorders, anxiety, and personality disorders, are prevalent and often untreated, leading to serious consequences such as memory loss, self-harm, or manipulation. The integration of machine learning and artificial intelligence (AI) technologies has led to the development of a system for early detection and monitoring of mental health disorders. The system comprises four modules: the Questionnaire, Facial Emotion Detection, Socio-emotional Detection, and the BOT Assistant. These modules use predictive analysis to identify individuals at risk of mental health disorders and provide timely support.

The Questionnaire allows users to self-assess their mental well-being anonymously, easing hesitance to seek help. Facial Emotion Detection uses AI to analyze facial expressions, providing insights into emotional states. Socio-emotional Detection uses predictive analytics to identify patterns and anomalies in an individual's social and emotional behavior, acting as an early warning system. The BOT Assistant provides immediate support, answering queries, and providing information and resources.

The Mental Health Detection Using Predictive Analysis project aims to break barriers to mental health awareness, access to services, and early intervention by creating a safer and more supportive environment for those facing mental health challenges. The successful implementation of this system could revolutionize mental health issues, leading to healthier, happier lives worldwide.

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