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ANALYSIS FOR EMOTION DETECTION USING AI AND ML

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Abstract. Emotion recognition systems based on facial gestures can analyze and tag emotional states from video recordings in real time. These systems work on the premise that specific facial expressions correspond to particular emotions. Among the six primary emotions, depression is notably significant as a mood disorder characterized by feelings of sadness, anger, or loss that disrupt daily activities. Early detection of depression is vital to prevent severe consequences. The project aims to analyze user emotions through real-time video using Convolutional Neural Networks (CNN). If depression is detected, an interactive chatbot created with the Tkinter library appears, allowing users to share their feelings. This chatbot helps uplift the user's mood, assesses the level of depression, and assists in recovery. Continuous evaluation differentiates betweensadness and depression for effective intervention.

Keywords: Key Words: Emotion Recognition, Depression, ConvolutionalNeural Networks, Tkinter

1 Introduction

The interface and interaction between humans and computers have received much attention recently, aiming to develop natural human interactions with computers. [1-3]. It is the manner in which a person feels. It involves physical responses, such as the heart pounding with enthusiasm. Additionally, it contains vocalizations and facial gestures that convey emotion, such as when you utter "woah" in awe of something [3-6Chatbots play a crucial role as human-computer interfaces.. It is software that simulates typed conversation, with the agenda of temporarily luring the human into thinking they were talking to another human. Chat bot, basically acts as a conversational agent that can talk to any user in given field using the Natural Language Processing [4].

Students are said to be in sate of depression when they find themselves feeling sad or hopeless almost every day for two or more weeks in a row. Such students then start retrieving from their social life [5-7]. Creating an effective facial representation from original face images is essential for successful facial expression recognition. Impaired emotion control is a symptom of depression. It is an aberrant emotional state that has a deep and long-lasting impact on our thoughts, perceptions, and behaviour. A tough or stressful scenario, a loss, or a change in circumstances are not always the root causes of depression. In actuality, it frequently happens without any such stimuli. With 264 million sufferers globally, depression is a widespread disorder. [8-10]. Clinical depression, unlike mood fluctuations, is common mental disorder that lasts longer and causes disability and reduced functionality. A recent World Health Organization (WHO 2012) survey estimated that 350 million people worldwide are affected by depression [10-12]. The system focuses on recognizing sadness, which is key to our analysis. When sadness is detected, a chatbot with a questionnaire based on DSM-5 criteria appears. The user's responses help determine whether they are experiencing symptoms of depression or just general sadness. If clinical depression is detected, the

chatbot provides helpline numbers. If it's just a negative mood, like momentary sadness, the chatbot offers personal recommendations to improve the user's mood.

2 Literature Survey

Aliaa A. A. Youssif and Wesam A. A. Asker developed an automatic facial expression recognition (AFER) system using computer vision. The system involves three main steps: detecting the face using OpenCV and the Viola & Jones algorithm, extracting facial features by segmenting the face into areas like the mouth, nose, eyes, and eyebrows, and then classifying the expressions using a radial basis function artificial neural network. This process creates a feature vector from geometric and appearance features. The AFER system achieves high accuracy, with recognition rates between 90% and 99% for person-dependent data and between 83% and 100% for person-independentdata [1].

Enrique Correa, Arnoud Jonker, Michael Ozo, and Rob Stolk presented a paper on emotion recognition using Convolutional Neural Networks (CNN). Their method uses a dataset ranging from a few hundred high-resolution photos to tens of thousands of smaller images. To improve accuracy, they increased the training dataset size from 9,000 to 20,000 images from FERC. The results showed that their CNN approach achieved 90% accuracy for recognizing happy emotions, 80% for neutral, and 77% for surprised, outperforming other methods like SVM and LVQ [2].

Kartika Candra Kirana, Slamet Wibawanto, and Heru Wahyu Herwanto proposed using the Viola-Jones algorithm for both face detection and emotion recognition. While typically used for face detection, the Viola-Jones algorithm, with its rectangular feature and cascading AdaBoost techniques, is adapted here for recognizing emotions as well. The method uses Russel's Circumplex model for more efficient emotion classification. It involves three stages: capturing an image from a video, removing unwanted rectangular areas, and recognizing the emotion in the picture. This approach achieved an accuracy of 74%.[3]

3 Methodology

3.1 Convolutional Neural Network

A Convolutional Neural Network (ConvNet) is designed similarly to the way neurons connect in the human brain, specifically inspired by the Visual Cortex's organization. It consists of convolutional and pooling layers that together make up each layer of the network. To capture more detailed features from complex images, additional layers canbe added, though this requires more computational power.

1. Facial Expression dataset:

There are many publicly available facial expression datasets. For our work, we used a dataset from Kaggle containing 48x48 pixel grayscale images of faces. The training set includes 28,709 examples, covering seven emotions: happy, sad,surprised, fearful, angry, disgusted, and neutral.

2. Convolutional neural network architecture:

The proposed CNN architecture is designed to process pixel values in regions containing facial expressions. It operates in three stages before the data is passed to the fully connected layers. Each stage consists of two convolutional layers with ReLU activation, followed by max-pooling layers. The network also includes three fully connected layers with ReLU and softmax activation functions. After the convolutional and max-pooling operations, each image frame is fed into the fully connected layers, where the classifier predicts one of seven differentemotional states.

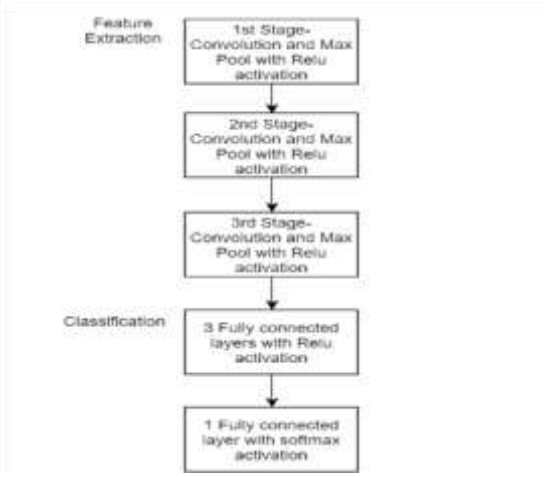

Fig 1 - CNN Model Architecture- The layers used in the construction of theCNN Model

3.2 Chat Bot

A chatbot is a computer program that mimics human conversation through voice or text interactions. In this implementation, a button-based chatbot is used. This type of chatbot provides a set of button-like options for the user to click on, allowing them to select the most appropriate response easily.

1. Building a chatbot:

Building a button-based chatbot involves using Tkinter along with other Python functions and libraries. Tkinter is a popular toolkit for creating graphical user interfaces (GUIs). In this implementation, radio buttons and regular buttons are utilized alongside text boxes to display questions to the user. Each question is presented in a text box, accompanied by four options that are selectable using radio buttons. Users can choose an option and respond, which the chatbot then analyzes. The code incorporates various functions to manage these interactions and ensure the chatbot operates smoothly.

Function Name	**Description**
ch(),des(), des1()	Destruction of windows
window()	Creation of window and
	setting orientation of the window
I4(), func2(), func1(), func()	Functions to collect basic information of user
page2(), page3(), sad(), dep(), dep1()	Function to display different questions based on the analysis made by thesystem
last()	Function to record the feelings of the user

Table 1-Functions used

Analysis:

The system determines if a user shows symptoms of depression by using a hidden variable called "score." This variable's value dictates which questions are presented next to the user, aiding in predicting their emotional state as either sad or depressed. Each answer option for a question contributes a specific number to the score variable. The initial questionnaire begins with basic questions, and if the score reaches 16, the user proceeds to a depression test. A score of 16 or higher indicates depression, and the system displays helpline numbers for assistance. Scores below 16 suggest sadness, and the user receives recommendations to improve their mood. If the score is 4 on the basic questionnaire, the system concludes the user is happy. Scores between 4 and 16 prompt the user to take a sadness test, and based on the score, they may move on to a depressiontest.

4 Results & Discussions

The training and test datasets are prepared by extracting sentences and their corresponding labels. The labels are converted to categorical codes. The model is then trained using the training data (`X_train` and `y_train`) with a validation set (`X_test` and `y_test`). The training process involves a batch size of 256 and runs for up to 300 epochs, with early stopping implemented to prevent overfitting if the validation performance does not improve for 3 consecutive epochs. Class weights are used to handle any class imbalances. After training, the model's performance is evaluated on the test set, with the test loss and accuracy being printed.

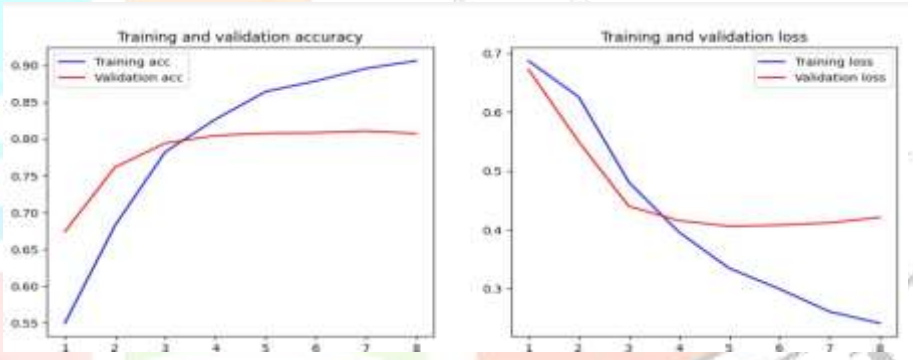

Fig 2- Training and validation

The model's predictions on the test set (`X_test`) are obtained and the predicted labels are determined. The `classification_report` function then generates a detailed report showing precision, recall, and F1-score for each class, using the true labels (`y_test`) and the predicted labels (`y_pred`). Additionally, a confusion matrix is displayed using `ConfusionMatrixDisplay.from_predictions`, which visually represents the performance of the classification model by showing the true versus predicted labels for each class. This helps in evaluating the accuracy and identifying any misclassifications.

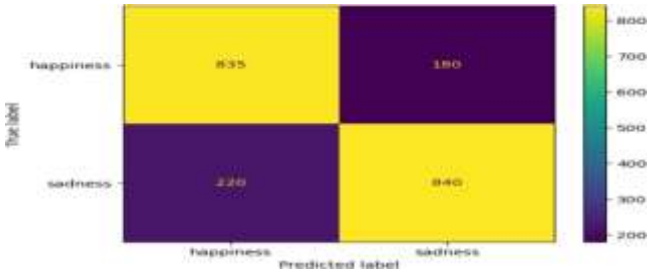

Fig 3-sklearn.metrics._Plot.confusion_matrixs display

5 Conclusion

An automated Facial Expression Recognition System has numerous applications in psychological research and human-computer interaction. By revealing a person's affective state, cognitive activity, personality, intention, and psychological state, it enhances communication in interpersonal relations. The system comprises three modules: face detection using Haar Cascade, emotion recognition using a Convolutional Neural Network (CNN) with Keras, and a chatbot that utilizes DSM-5 criteria to analyze symptoms of depression. These algorithms were chosen for their efficiency and ease of implementation. The system is effective in distinguishing between sadness and depression, making it a valuable tool for early detection and intervention.

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