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Emotion Recognition Using Deep Learning

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ABSTRACT: Facial emotions play a significant role in psychology. Identification of psychological problems using traditional or medical approach requires a physical exam, Lab tests and psychological evaluation. It is of significant importance to detect and manage stress before it turns into severe problems. However, existing stress detection methods usually rely on psychological scales or physiological devices, making the detection complicated and costly. Here we explore to automatically detect individual's psychological stress via facial emotions; this work presents deep learning algorithms used in facial recognition for accurate identification and detection of early psychological problems. The facial features are captured in real time and processed using haar cascade detection. The sequential process of the work is defined in different phases where in the first phase human face is detected from the camera and in the second phase, the captured input is analyzed. In the next phase human face is authenticated to classify the emotions of human as angry, disgust, scared, happy, sad, neutral, and surprised. Finally, the performance of automatic face detection and recognition is used to detect and manage the stress before it turns into severe problem. The software used to test the functionality is Anaconda and python 3.5. For Face detection viola jones and haar cascade algorithms are used. Similarly, FER2013 dataset are used with convolution neural network model for face recognition and classification. The result of the experiments demonstrates the perfections in face analysis system. Finally, the performance of automatic face detection and recognition is measured with the overall accuracy of 65.48%.

I. INTRODUCTION

Deep learning is subset of machine learning methods based on artificial neural networks with representation learning. The technique teaches computers to do what comes naturally to humans. In deep learning a computer model learns to perform classification tasks directly from images, text or sound. Models are trained by using a large set of labeled data and neural network architectures that contains many layers. Deep learning technique is a standard paradigm to represent the working of human brain with neurons. This learning usually consists of neural network model.

Human computer interaction is a common trend and innate ability to distinguish among multiple faces. Face recognition applications are used to detect and classify face features. As these features and expressions helps in classify the emotions of human face.

Psychological problem detection remains a large issue at the present stage. Recent decades, many efforts have been devoted to detect psychological problems by researchers from diverse areas. They have developed many methods to measure psychological problems, including questionnaire-based interviews and signal-based measures. However, these methods have their limitations in many aspects. Psychological questionnaires often contain a range of questions designed by psychologists. People are usually unwilling to do these questionnaires unless they have to. Physiological methods usually require professional devices to measure user's physiological and biochemical properties and need specialists to analyse the acquired data. Thus, it is very important and useful to find a way to detect user's early psychological problem reliably, automatically and non-invasively.

The process involves three different phases: face detection, face recognition and emotion classification. The process of face recognition and classification includes steps such as preprocessing, detection, extraction of features and classification of emotion. These tasks are easily performed with deep learning model. For face detection Haar cascade is used similarly for face recognition and emotion classification CNN is used. The basic/early psychological problems such as angry, disgust, scared, sad, neutral, surprised can be detected from negative emotions.

II. SYSTEM ANALYSIS

Existing system:

In the existing system, classification is done through simple image processing to classify images only and its focuses on facial expression recognition using state-of-the-art hand-crafted feature extraction algorithms. Local Binary Patterns and Local Phase Quantization have received respectable performance in Face Recognition. However, the

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performance degrades dramatically when applied on images taken in unconstrained environments such as varying facial alignment, expression and illumination.

Proposed system:

In this proposed system, deep learning Models are used. The design starts with the initializing CNN model by taking an input image by adding a convolution layer, pooling layer, and dense layers. Convolution layers will be added for better accuracy for large datasets. Train the large dataset for better accuracy and result that is the object class for an input image. Based on those features it performs convolution layers and max pooling. The project mainly aims to come up with solution to the facial emotion recognition problem by dividing it into sub-problems of classification of some specific facial features.

For this, different methodology and techniques for feature extraction, selection and classification are considered. The resulting system comes up with solutions to these problems as well as taking the computational complexity and timing issues into consideration. Finally, the facial emotion of the human is classified to detect early psychological problem. The system is designed to work efficiently with minimum error.

III. EXPERIMENTAL RESULTS

Experiments provide insight into cause-and-effect by demonstrating what outcome occurs when a particular factor is manipulated. Experiments vary greatly in goal and scale, but always rely on repeatable procedure and logical analysis of the results.

The experiment is carried out to detect early psychological problems. Emotions play a crucial role in psychology. To classify the emotions, the first step is to detect the face and then recognise the human face.
The real_time_video.py file contains OpenCV that comes with a lot of pre-trained classifiers. For instance, there are classifiers for smile, eyes, face, nose, etc. These come in the form of XML files and are located in the location: haarcascade_files/haarcascade_frontalface_ default.xml and similarly for emotions we have used pre-trained data in the form of hdf5 file: models/_mini_XCEPTION.102/0.66.hdf5

The real_time_video.py file is executed using the following commands:

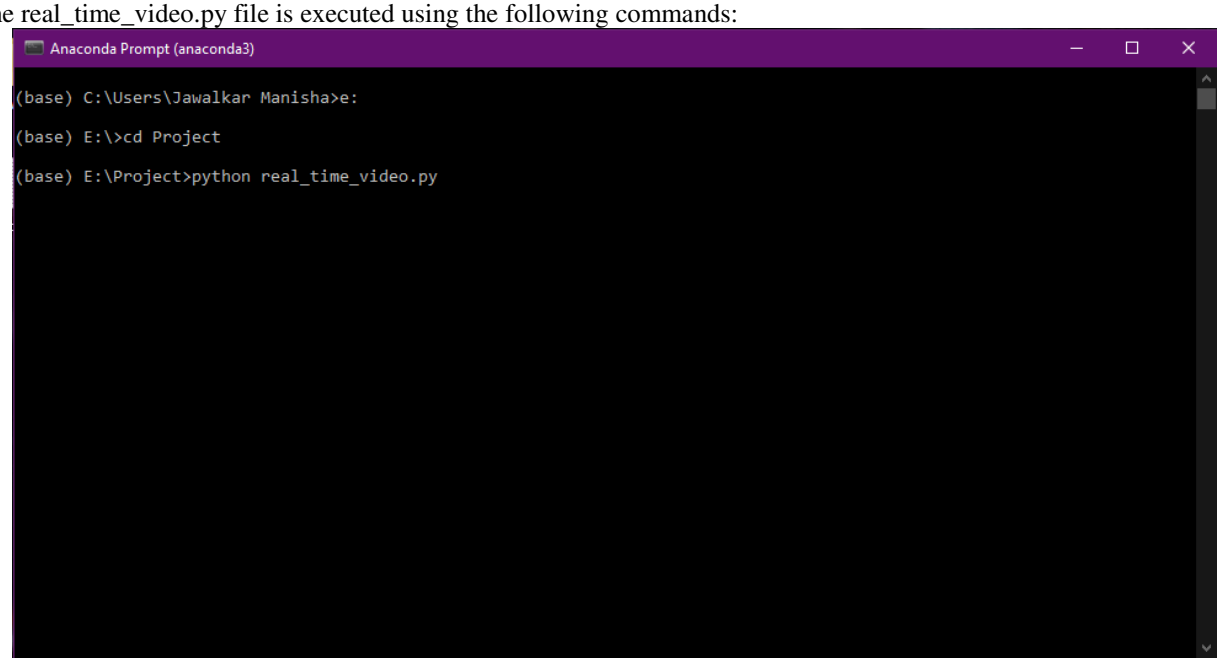

Fig 1: Commands for executing the file

If the code is executed successfully, it automatically uses webcam for real time image processing for detecting the emotion.
Input: Face is captured through webcam in real time

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Sample output: Rectangle with coordinates (x,y,w,h) around the scared emotion face with its detailed probability canvas for real time video.

The trained model was used to test against 3,589 images for emotion classification in real-time and its results are shown

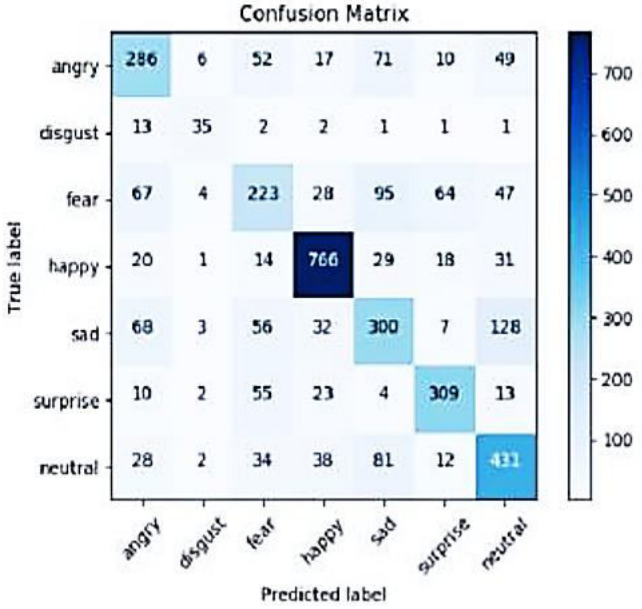

Fig 2: Confusion matrix to represent accuracy of the system in numbers

The above table is a confusion matrix Confusion matrix to represent accuracy of the system in numbers. Out of 3,589 testing images the classifiers was able to classify 2,350 images. The confusion matrix depicts how the classifier classified each example and what mistakes the classifier made

Overall Accuracy:

$$\text{Overall Accuracy} = \frac{\text{Number of correct predictions}}{\text{Total number of predictions}}$$

$$= \frac{286+35+223+766+300+309+431 \times 100}{3589}$$

$$= 65.48\%$$

The output presents itself as a probability for each emotion class. Therefore, the model is able to show the detail probability composition of the emotions in the face. Our expressions are usually much complex and contain a mix of emotions that could be used to accurately describe a particular expression. Performance As it turns out, the final CNN had a validation accuracy of 65.48%. This actually makes a lot of sense. Because our expressions usually consist a combination of emotions, and only using one label to represent an expression can be hard.

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Output:

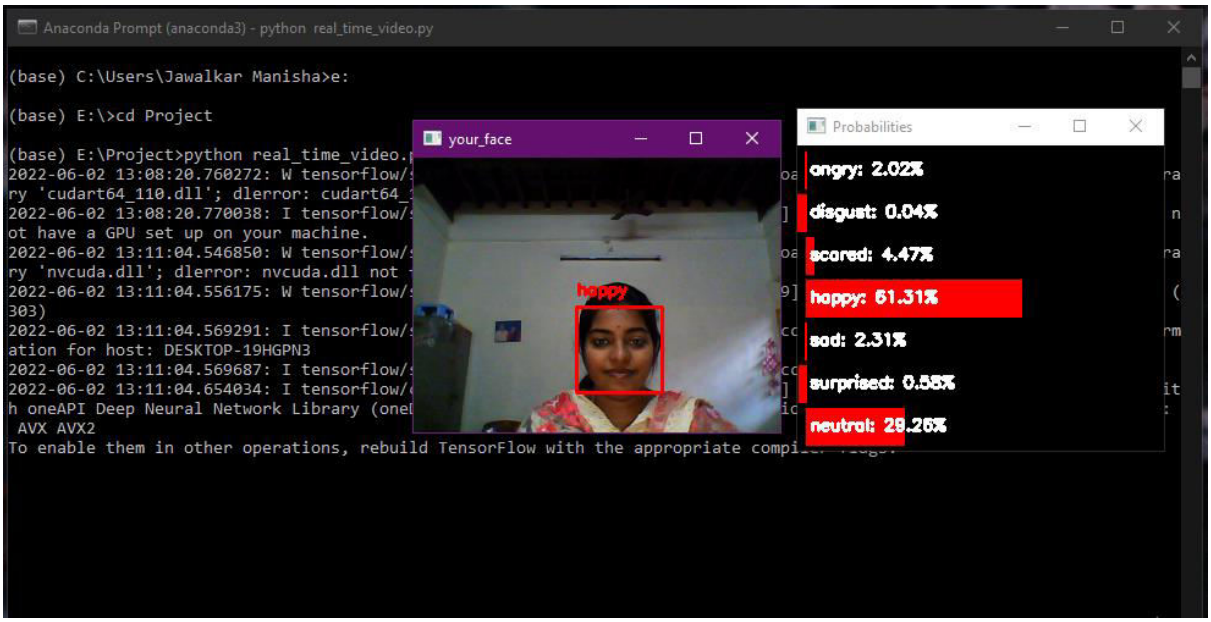

Fig 3: Final output

IV. CONCLUSION

The project "Emotion Recognition Using Deep Learning" has been designed and tested. The Proposed project represents a major step towards a self-consistent theory of facial emotion recognition for early detection of psychological problems. For Face detection viola jones and haar cascade algorithm are used. This project proposed a new framework for facial expression recognition using a convolutional neural network. We also provided an extensive experimental analysis of our work on seven popular facial expression recognition databases, and showed promising results. We explore to automatically detect individual's early psychological problem via facial emotion recognition. The performance of the CNN on real time application is analyzed. Also, we have deployed a visualization method to highlight the salient regions of face images which are the most crucial parts thereof in detecting different facial expressions.

V. FUTURE WORK

Future work includes the implementation of Facial Emotion Recognition with evaluation metrics for comparison. Evaluation metrics have been widely evaluated in the field of recognition, and precisions and recall are mainly used. A new evaluation method for recognizing consecutive facial expressions, or applying micro-expression recognition for moving images, should be proposed. If emotional oriented deep-learning algorithms can be developed and combined with additional Internet of Things sensors in the future, it is expected that Facial Emotion Recognition can improve its current recognition rate, including even spontaneous micro-expressions, to the same level as human beings.

Several emotions such as happiness, anger, surprise and fear are better classified using facial recognition. Some other are classified better using speech input such as sadness and fear. So in order to achieve better accuracy, we need to integrate both audio and facial based systems into a single system.

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