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Emotion Detection and Recognition

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Abstract **-** Detecting and recognizing the emotions of a person based upon the facial expressions produced by them. Usually, one has a talk with a person to know about his/her emotions or mental state. But, it seems uncomfortable for one to talk about his/her mental health. So, instead of asking a person directly to talk about it, a tool is designed which can read the emotions by using the facial expressions. This paper helps to make an inference about the mental health of a person using the primary categories of emotions which are happiness, sadness, anger, surprise, fear and disgust. The proposed tool can be used at various places such as hospitals (to read a patient's expressions), at airports (to detect suspicious facial expressions), in schools/colleges (to analyze the mood of students), etc. For example, teenagers who might be facing difficulties with their studies/social life tend to have a mental imbalance after long time of battling with their own emotions. Unfortunately, they ultimately become mentally weak and enter into a mental state generally called depression. They might take a wrong step to take their own life and end up into an unfortunate incident for the society. If the emotions of such teenagers are read using this tool in the early stages of struggling, it might help the society to help them get out of their situation.

Keywords- Python, Emotion Detection, Quality of life, OpenCV, Tensorflow, FER python, Image processing, etc.

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1. INTRODUCTION –

In the world of mixed emotions of people, their detection and recognition has not been easy for anything apart from humans themselves. Identification of human emotions, nowadays, has become an important factor in determining the mental health of human beings. Mental health is as important as physical health, so recognition of emotions using facial expressions can help in analyzing one's mental conditions and take necessary treatments/actions to have positive impacts on the same. Recognition of human emotions can be done on the basis of seven general categories which are happiness, sadness, anger, surprise, fear, disgust and neutral. These primary categories can help in understanding the current mind state of a particular person when analyzed. Usually, one has a talk with a person to know about his/her emotions or mental state. But, it seems uncomfortable for one to talk about his/her mental health. So, instead of asking a person directly to talk about it, we can design a tool which can read the emotions by using the facial expressions. An example of needing to detect human emotions is to spot the emotions of a patient before visiting a doctor so that it becomes easier for the doctor to decide the way of treating the patient. Even, if the facial expressions of students entering into a classroom are detected, the teacher might find a way out to generate enthusiasm amongst them if they feel burdened to attend the classes.

2.PROBLEM STATEMENT–

The detection and recognition of human emotions without human perception. Usually the emotions of a person can be classified into different categories based upon their facial expressions. Nowadays, detection and recognition of human emotions in society has become a need in order to ensure emotional balance or a peaceful life within the society. Developing a tool/device which detects and recognizes the emotions of human beings based on facial expressions and helps the community to encourage them to have a positive and cheerful living experience.

3.LITERATURE SURVEY –

From the literature referred for this paper, we can observe different methodologies used byvarious researchers. A convolutional neural networks (CNN) based deep learning system foremotion detection from images is proposed in one of the papers[1] . Facial emotion recognition is discussed based upon Valence-Arousal dimensional emotion model and design of facial emotion valence dimension prediction system which is based upon CNN is done in a research[2] . This model comprises of detection of face, extraction of features, and prediction of valence grade[2]. In one of the researches, the authors give insights on the datasets and the algorithms that are used for detection and Facial Emotion Recognition (FER)[4]. The used algorithms vary from simple Support Vector Machines (SVM) to complex Convolutional Neural Network (CNN)[5]. The authors elaborate the algorithms through the basic research papers and highlight on the application to the task of Facial Emotion Recognition. In one of the referred literature, it can be seen that systems that analyze emotions are being utilized in most of the businesses as well as social fields, since opinions and emotions play an important role in all human activities and make severe impact on behavior of people[6]. In this work, the authors propose detecting and analyzing human emotions based upon similarity using VSM and STASIS method [6]. Compared to keyword based method, VSM has shown better results[6].

4.IMPLEMENTATION –

The proposed solution for the problem statement discussed earlier would be the development of a computer application or a implementation of hardware model which comprises of a controller along with several peripherals. The emotions of a person can be detected and recognised by various methods such as using facial expressions, using the speech by the person or through chats with the particular person. In the proposed solution, the emotions are detected and recognised using the facial expressions produced. Using the image acquisition taken as input, the image is processed against a computer program and emotions are recognised. The developed software uses python scripts to meet the purpose with the use of python packages namely Tensorflow, OpenCV, FER (Facial Emotion Recognition), Matplotlib, etc. The program outputs the emotions of a person in various categories i.e happiness, sadness, anger, surprise, fear, disgust and neutral.

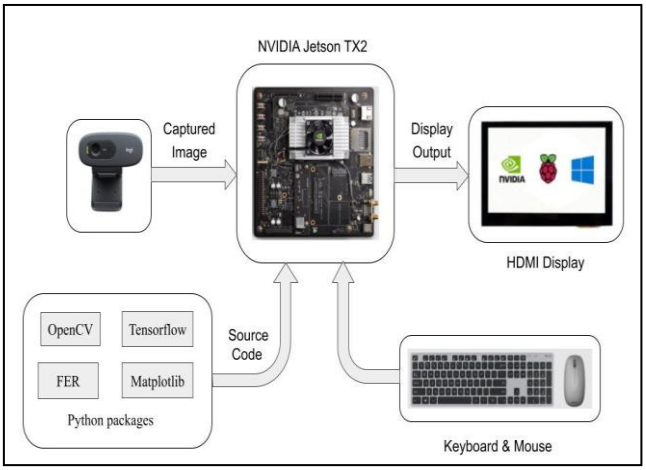

Fig.1 Block Diagram of Proposed System

As shown in Fig.1 the paper incorporates the combination of hardware components with software. The hardware components include a camera module and a display module interfaced with a processor. The assembly is readily available with a computer specifically a desktop or laptop. The software used is an editor like Atom IDE or Jupyter Notebook for using python programming language. The python packages such as OpenCV, Matplotlib, Tensorflow, FER, PIL, etc. are used to write the python program. OpenCV plays an important role to interface camera for capturing images and processing them. Using Matplotlib the output in terms of pie charts and bar graphs can be produced. FER (Facial Expression Recognition) library is an integration of a deep neural network using Tensorflow and Keras libraries that are implemented in python. With use of all these libraries a python program is written and this program along with the captured image from camera module is provided to the processor.

5.WORKING FLOW –

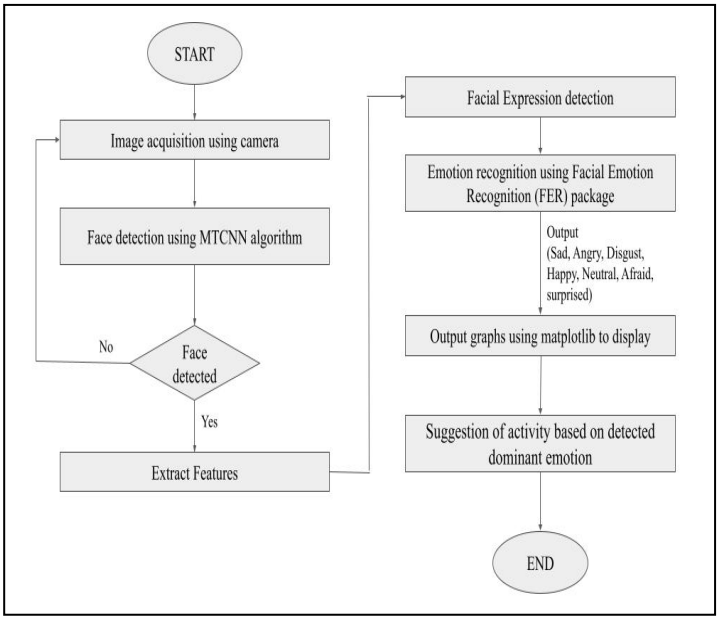

Fig. 2 Flowchart

There are multiple face detection and recognition algorithms some of which are machine learning algorithms such as ELM, PNN, KNN, RF, SVM and DT are used to classify facial emotion. In this paper, another algorithm called as MTCNN is used. By default, the faces are detected using OpenCV's Haar Cascade classifier. For using the more accurate MTCNN network, the parameter 'detector = FER(mtcnn=True)' is added. FER uses a Keras model.

The model is a convolutional neural network (CNN) with weights saved to HDF5 file in the data folder relative to the module's path. It can be overriden by injecting it into the FER() constructor during instantiation with the emotion_model parameter. FER Facial Expression Recognition) is a library which is an integration of a deep neural network using Tensorflow and Keras libraries that are implemented in python. The processor interprets the program and produces the corresponding output for captured/selected image. The results are displayed with help of display module interfaced with the processor.

Proposed System Flow:

1. Capturing facial image using camera/ selecting an existing facial image from the computer storage.

2. Detection of face using MTCNN algorithm.

3. If the face is detected, pass it to the emotion recognition model, if the face is not detected raise an exception to capture/select an image which contains a face along with better surrounding light conditions.

4. Extract the features in the facial expression image to analyse it.

5. Display the output on the HDMI display in the form of a bar graph and pie chart.
6. Suggestion/display of images to help boost one's mental health to be in a good mood according to their emotions' analysis.

6.RESULTS –

The figure below represents the facial expressions image captured/ selected for its analysis against the emotion detection and recognition model. As can be seen in the image, the face produces vivid emotions majorly like 'Fear', 'Angry', 'Surprise' and 'Sad', 'Neutral' up to a small extent.

Fig. 3. Test Image 1 for analysi

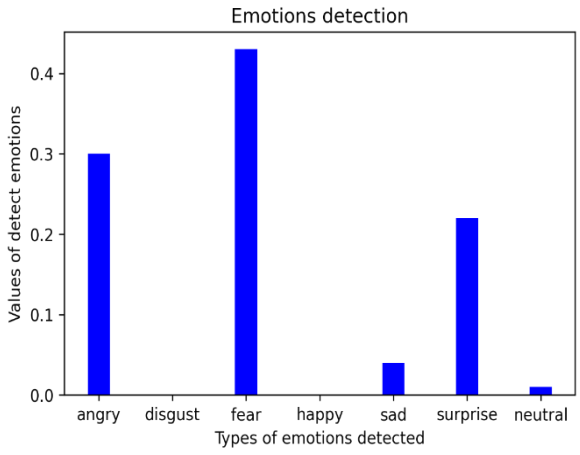

Fig. 4. Bar graph of detected emotions

A bar graph which shows the extent of emotions detected in a captured test image is shown in figure 4. On the plot, the x axis describes the categories of emotions whereas the y axis shows the extent of emotions on the scale of 0 to 1 with reference to the extent of most dominant A bar graph which shows the extent of emotions detected in a captured test image is shown in figure 4. On the plot, the x axis describes the categories of emotions whereas the y axis shows the extent of emotions on the scale of 0 to 1 with reference to the extent of most dominant emotion.

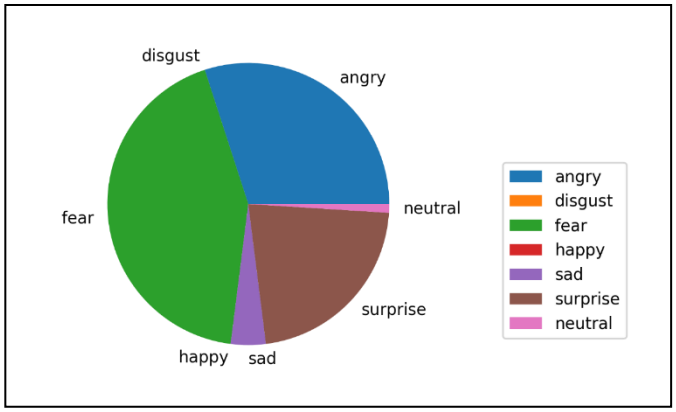

Fig. 5. Pie chart of based on categories of emotions detected in the face

A pie chart which represents the breakdown of emotions detected in a captured test image is shown in figure 6. As seen in the chart, the list describes different types of emotions which are then mapped in a 360º two dimensional shape with corresponding colors.

Fig 6. Test image 2 for analysis

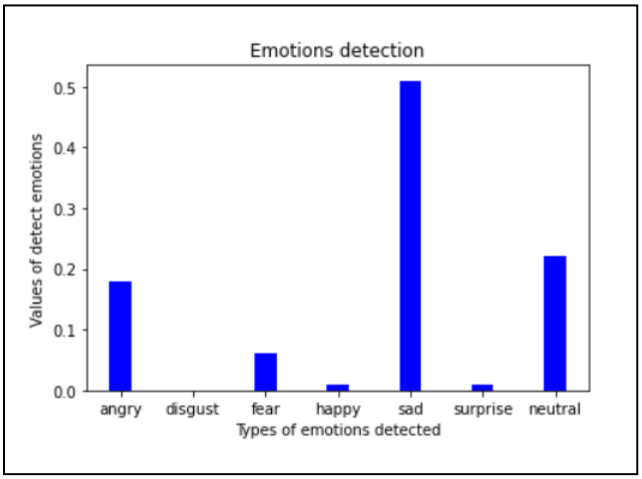

Fig 7. Bar graph for test image 2

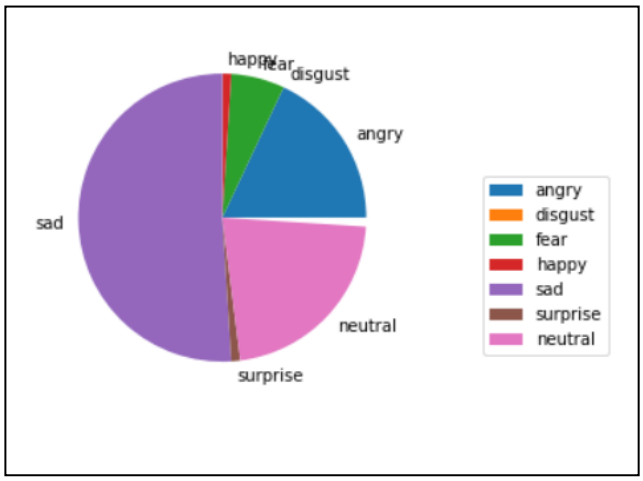

Fig. 8 Pie-chart for test image 2

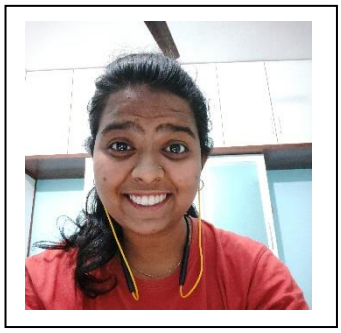

Fig 9. Test image 3 for analysis

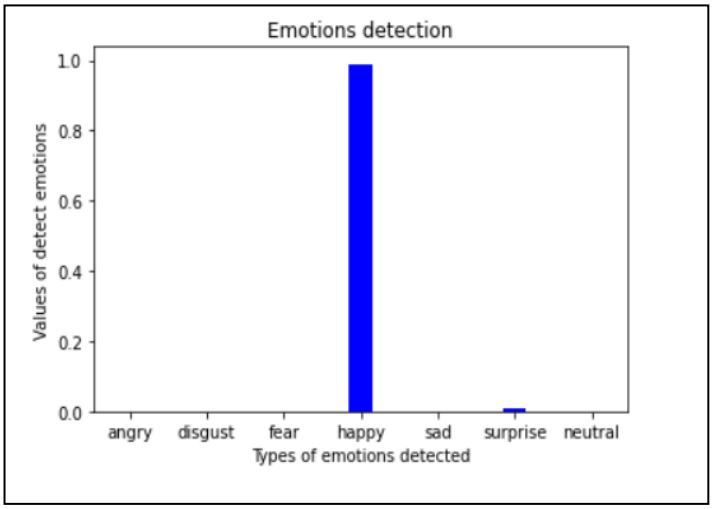

Fig 10. Bar graph for test image 3

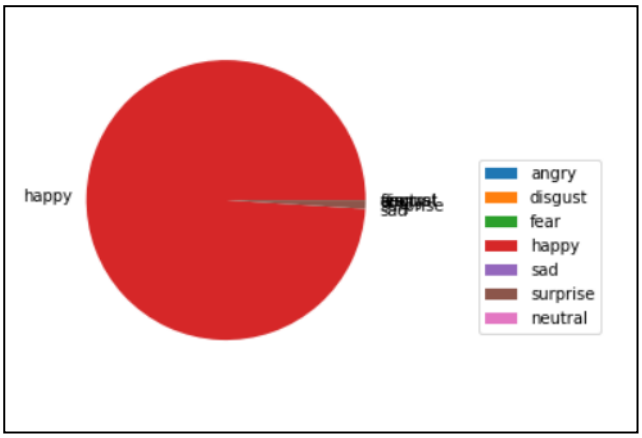

Fig. 11 Pie-chart for test image 3

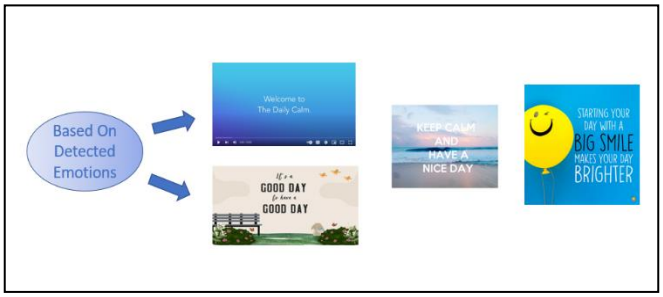

Fig. 12 Suggestion of viewing an image to improve the mental condition of the person.

Figure above shows that on the basis of emotions recognized from a person's facial expressions, this tool suggests them simple activities to make a positive impact on their current emotional situation. For example, a person detected with dominant emotion as 'sad' can be suggested with a refreshing music track to listen to or a short breathing exercise to relax.

7. ADVANTAGES –

1) Emotions of students can be recognized and can be taken an action upon, if they are detected to be depressed or afraid.

2) Being implemented with Python, the tool can be used on multiple platforms.

3) Accidents can be avoided by alerting a driver if the emotions detected on their face are 'Disgust' or 'Angry'.

4) It would be easier for counsellors/mentors to guide their counselee based upon their detected emotions.

5) Similarly, a teacher can find ways to cheer their students up or generate enthusiasm amongst them if their emotions detected while entering the classroom are found to be 'Fear' or 'Sad'

6) Serious tragedies like suicide can be avoided if the emotions of such kind of people are detected in early stage by counselling them properly.

8.CONCLUSION –

This paper helps to make an inference about the mental health of a person using the primary categories of emotions which are happiness, sadness, anger, surprise, fear and disgust. The extent to which the emotions like Angry, Disgust, Fear, Happy, Sad, Surprise, and Neutral will be displayed for the user on the scale of 0 to 1 i.e. 0% to 100%. According to the values of emotions detected on the scale of 0 to 1, a Bar graph and a pie chart showing

the same will be generated and displayed to the user. The visual effects produced by both of these help in analyzing the extent of emotions as per the above mentioned categories. By having a view on the results, a user can analyze the emotions detected on one's face from the imported image and the corresponding facial expressions detected. The proposed tool can be used at various places such as hospitals (to read a patient's expressions), at airports (to detect suspicious facial expressions), in schools/colleges (to analyze the mood of students), etc. The proposed tool is able to detect and recognize the emotions of human beings based on facial expressions and might help the community to encourage them to have a positive and cheerful living experience. Also, on the basis of emotions recognized from a person's facial expressions, this tool suggests them simple activities to make a positive impact on their current emotional situation. For example, a person detected with dominant emotion as 'sad' can be suggested with a refreshing music track to listen to or a short breathing exercise to relax.

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