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REPORT

FACIAL EMOTION THRESHOLD BASED DATA DISPATCHER

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To:

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Abstract

Predicting the human emotions is not so easy without analysing their expressions on the face. Face emotions are one of the most informative gestures. So, we make use of these gestures on the face for the emotion recognition of the person. The state of the response can be decided based on the mood of the opposite person. To continuously monitor the expressions of a person and predicting the emotions of that person is difficult. So, the automation process makes it completely flexible to analyse and dispatch the emotions of person in the form of data. The project is about facial detection and emotional recognition of a person using Convolutional neural network (CNN). In facial recognition, the model recognizes the face of a person and in the emotion recognition the model recognizes the facial expression of that particular person using feature extraction and the nodal points. This is a hybrid model of facial emotional recognition and data dispatcher. It records the feelings of an individual in each frame of a video that is taken by means of webcam and dispatch the information. Dispatching of emotional data can be used for alerting the status of a person's emotion via a means of message (mail or message) during certain period of time. Convolutional neural network has outperformed in the field of image classification of emotion of a person as it is very dynamic in nature and the mood changes within a second. This project can analyse seven different facial expressions such as happy, sad, disgust, anger etc in real-time. The main objectives include classifying and predicting emotions in real time, storing the data of person indicating the status of the emotions and dispatch data when needed. This model tries to develop these decision-making and classification skills by training the machine. Neural network has been used to get the better results. This project mainly focuses on market research domain that can get the customer feedback. It can be used to find their interests that helps to improve the marketing strategy.

1.

2. Introduction

It is important to know a person's emotion while they are doing something. It can be used to find their interest in doing it. Our brains have neural networks which are responsible for all kinds of thinking (decision making, understanding). This model tries to develop these decisions making and classification skills by training the machine. It classifies multiple faces and predict different emotions at the same time. In order to obtain higher accuracy, we take the models which are trained over thousands of datasets. Charles Darwin, the first scientist stated that recognizing facial expression is one of the most powerful and immediate means for human beings to communicate their emotions, intentions and opinions to each other. Facial expression can also provide information about cognitive state, such as interest, boredom, confusion, and stress. Human life is a complex social structure. For humans it is not possible to navigate without reading the other persons. They do it by identifying the faces. The state of response can be decided based on the mood of the opposite person. A person's emotion can be figured by observing his emotion. This concept can be used in many areas such posting ads or what kind of products they are more interested, by continuously observing their expression in whatever they watch, if they are watching it with more happiness and surprised, then we can say that they are more interest in it. Face Recognition and Facial emotion recognition are similar problems. In the face recognition system, the model recognizes using the face expression of the person Whereas in facial emotion recognition, the model identifies the emotion of the face expressed by someone using facial expression and also the nodal points. The recent trends show that deep learning applications have gotten noticeable performance in computer vision applications. and therefore, the convolutional neural networks have outperformed within the field of image classification.

3. Literature Survey

- **Abdullah, S. M. S. A., Ameen, S. Y. A., Sadeeq, M. A., & Zeebaree, S. (2021). Multimodal emotion recognition using deep learning. *Journal of Applied Science and Technology Trends, 2*(02), 52-58.**

  This paper presents a review of emotional recognition of multimodal signals using deep learning and comparing their applications based on current studies.

- **Zhang, J., Yin, Z., Chen, P., & Nichele, S. (2020). Emotion recognition using multi-modal data and machine learning techniques: A tutorial and review. *Information Fusion, 59*, 103-126.**

  In this paper, the emotion recognition methods based on multi-channel EEG signals as well as multi-modal physiological signals are reviewed. According to the standard pipeline for emotion recognition, they review different feature extraction (e.g., wavelet transform and nonlinear dynamics), feature reduction, and ML classifier design methods (e.g., k-nearest neighbor (KNN), naive Bayesian (NB), support vector machine (SVM) and random forest (RF)). Furthermore, the EEG rhythms that are highly correlated with emotions are analyzed and the correlation between different brain areas and emotions is discussed. Finally, they compare different ML and deep learning algorithms for emotion recognition and suggest several open problems and future research directions in this exciting and fast-growing area of AI.

- **Wieckowski, A. T., Flynn, L. T., Richey, J. A., Gracanin, D., & White, S. W. (2020). Measuring change in facial emotion recognition in individuals with autism spectrum disorder: A systematic review. *Autism, 24*(7), 1607-1628.**

  The purpose of this review is to synthesize the extant research on measurement of facial emotion recognition in the context of treatment. They conducted an electronic database search to identify relevant, peer-reviewed articles published between January 1998 and November 2019 to identify studies evaluating change in facial emotion recognition in autism spectrum disorder.

- **Ulusoy, S. I., Gülseren, Ş. A., Özkan, N., & Bilen, C. (2020). Facial emotion recognition deficits in patients with bipolar disorder and their healthy parents. *General hospital psychiatry, 65*, 9-14.**

  This study included 38 patients with bipolar I disorder and 30 healthy controls for patients as well as 30 healthy mothers and 30 healthy fathers of these patients and 30 healthy controls who matched the mothers and fathers for age, gender , and education (total 188 participants). Facial Emotion Identification and Discrimination Test s were applied to all participants ; the Hamilton Depression Rating Scale and Young Mania Rating Scale were applied to patients and their control group.

- **Akhand, M. A. H., Roy, S., Siddique, N., Kamal, M. A. S., & Shimamura, T. (2021). Facial Emotion Recognition Using Transfer Learning in the Deep CNN. *Electronics, 10*(9), 1036.**

  This study proposes a very Deep CNN (DCNN) modeling through Transfer Learning (TL) technique where a pre-trained DCNN model is adopted by replacing its dense upper layer(s) compatible with FER, and the model is fine-tuned with facial emotion data. A novel pipeline strategy is introduced, where the training of the dense layer(s) is followed by tuning each of the pre-trained DCNN blocks successively that has led to gradual improvement of the accuracy of FER to a higher level

- **Jain, N., Kumar, S., Kumar, A., Shamsolmoali, P., & Zareapoor, M. (2018). Hybrid deep neural networks for face emotion recognition. *Pattern Recognition Letters, 115,* 101-106.**

  This paper proposed a Facial Action Coding System (FACS) that could be a helpful structure that classify the human facial actions by their advent on the face using Action Units (AU).

- **Mostafa, A., Khalil, M. I., & Abbas, H. (2018, December). Emotion recognition by facial features using recurrent neural networks. In *2018 13th International Conference on Computer Engineering and Systems (ICCES)* (pp. 417-422). IEEE.**

  They have used the concept of emotion recognition by facial features using recurrent Neural Networks. In the experiment, a total of 94 participants were examined and none of them had affective or related disorders. They form the following age groups: 18-35 (N = 35; 16 men / 19 women); 36-50 (N = 31; 13 men / 18 women); 51-65 (N = 28; 15 men / 13 women). The emotion recognition field was the main point of researchers in the psychology.

4. Real Application

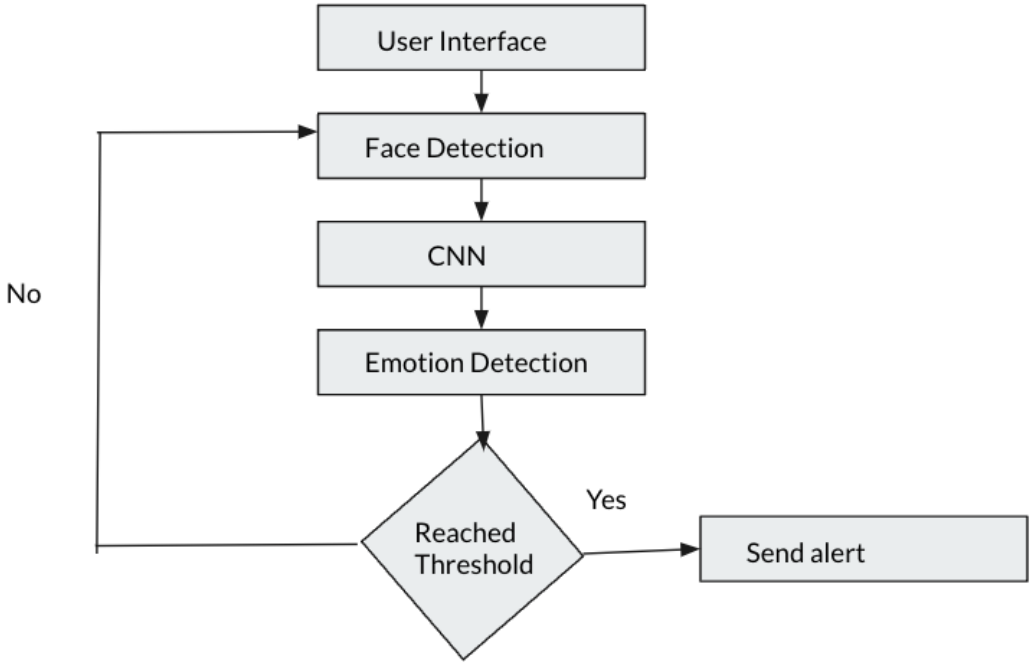
Human emotions are very complex to understand. Facial emotion recognition reveals complex mental states and indicate the internal states that are crucial in social interaction. This technology can be used in Psychotherapy to understand the patients and to get a better picture of their condition. Emotion recognition in psychiatric patients is essential in the matter of both their treatment and diagnosis.

In order to predict the mental state of the patient, psychiatrists can use this technology to keep track of a patient mental state and monitor them by continuously getting updated by their emotions each second. In particular, fear recognition will be higher in residents with high anxiety and hostility scores, and enthusiastic qualities will be connected with the recognition of disgust. It is considered that accurate emotional recognition and analysis may have a significant impact on the patient- doctor relationship. It is valuable to know how the ability of facial emotion recognition would impact the quality of patient-clinician interaction.

5. Tools and Technology Used

- **Computer vision:** Computer Vision algorithms perform image processing to extract features and use them for classification.
- facial recognition. Deep learning model learns them self and extracts features automatically.
- **D-CNN (Deep Convolutional Neural Network)**: the DCNN model, the convolution and sampling layers are combined into a single layer. Based on the already trained network, greatly improve the image recognition rate.
- **GPGPU (General purpose graphic processing unit):** Reduce the complete load on the CPU for the real time use of the video capturing for the face recognition part.
- **SMTP (Simple Mail Transfer Protocol)**: it helps in controlling the mailing server to mail from an email account with the help of a software
- **Tkinter Python Module**: The following module of python is to be used for the interface part of the project.

6. Proposed System Process Flow



7. Working Methodology

• The Aim of the project is to predict the emotion of the person by their facial expression and send the detailed information of the result to the user. There are 7 types of human emotions that are recognised universally namely anger, happiness, disgust, fear, sad, surprise and neutral.

• **Preparing the dataset:** It involves the preparation of dataset upon which the training algorithm work. The Model we will be using contains different datasets of faces for example 'FER2013' dataset and some images followed by applying it to convolution neural networks. This model will help to recognize emotions of the person.

• **Detecting faces:** This is done by using HAAR course work in OpenCV by recognizing the appearances, the image is changed to grey -scale and is resized to a similar size as the images in dataset. A HAAR course is fundamentally a classifier which is used to detect specific objects from the source.

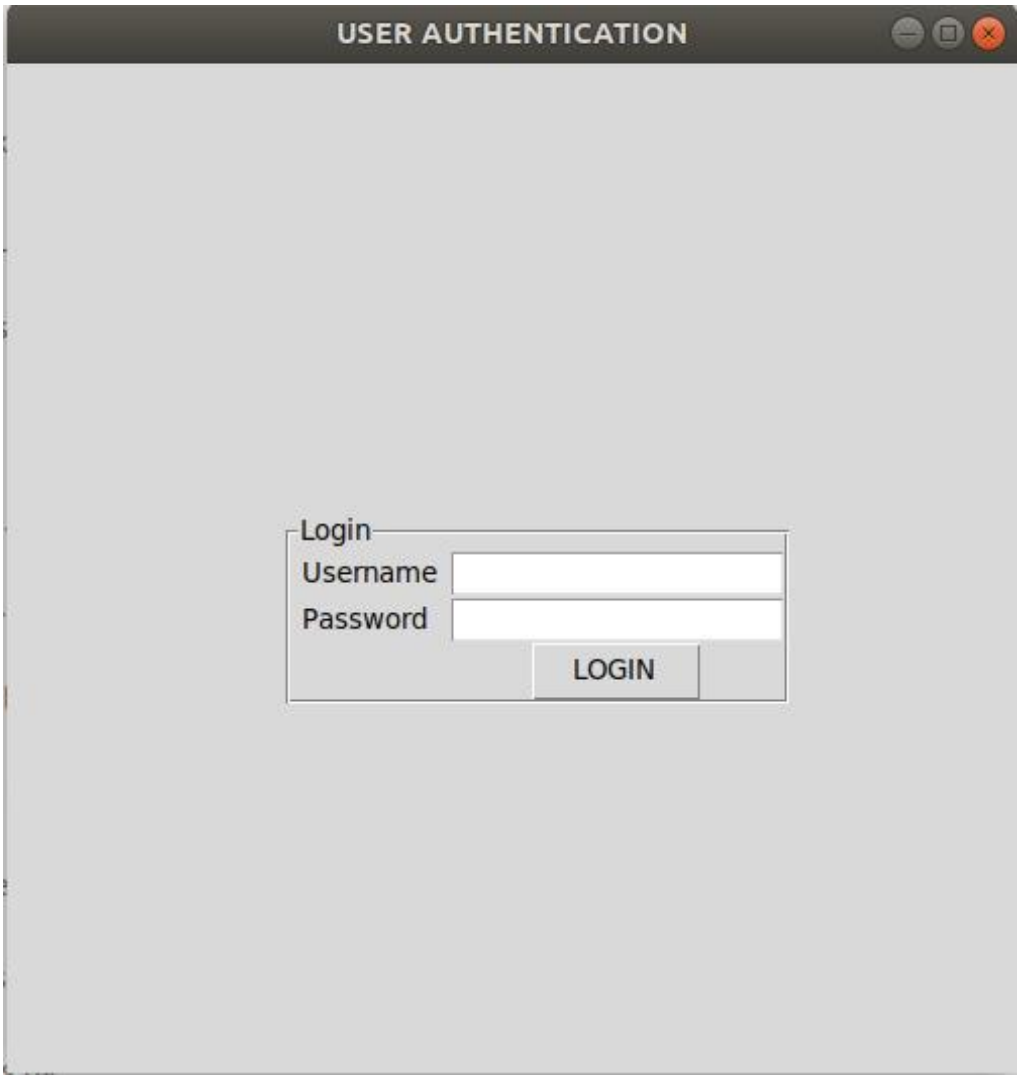
• **Swapping emotions in place of face:** This is the important step to recognize emotion and it involves placing the appropriate emotion over the face of the person according to their emotion. The HAAR cascade function returns the coordinates of the face detected and these coordinates can be used to place the emotion of the person at the correct place.

• **Parsing the data and emotions:** We will parse the data frame by frame and the output will be in the form of text file containing emotions frame by frame. Now we will set a limit for certain emotion like fear for which it sends the data if the limit is crossed.

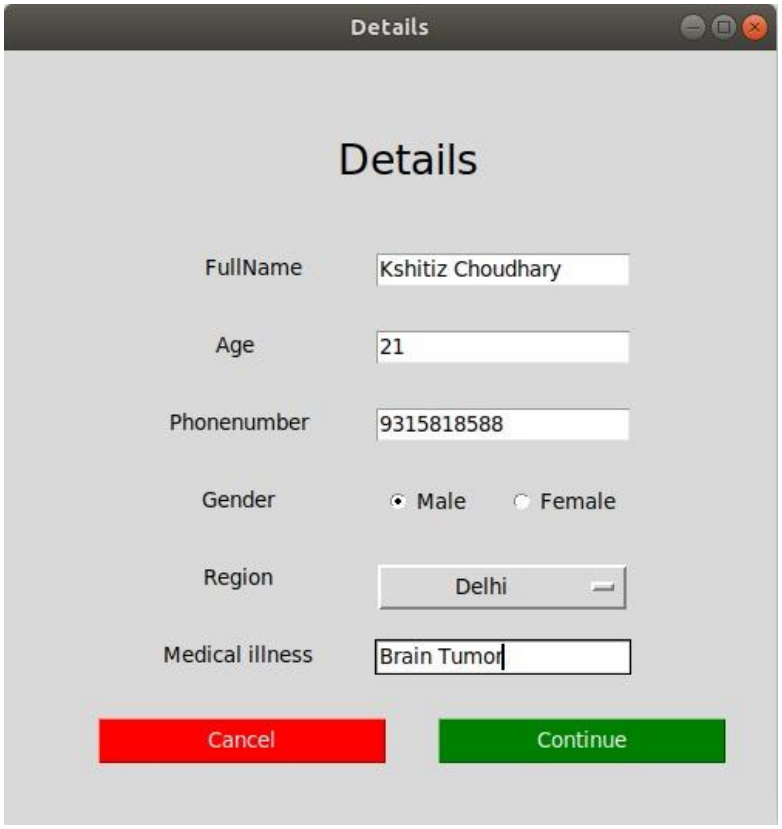
• **Data dispatched through SMTP:** All the text files containing personal information and the emotions frame by frame will be send to the receiver's email address immediately.

8. Implementation Results and User Interface

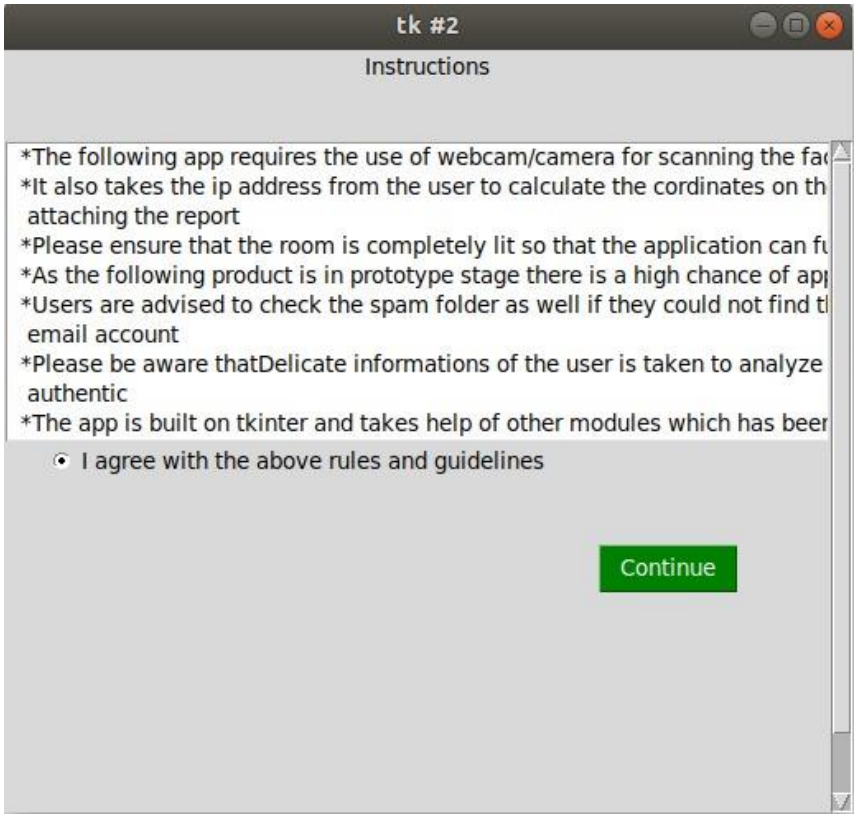
This is login form where only admin has the access to use this software. The admin has to type username and password to login to the application



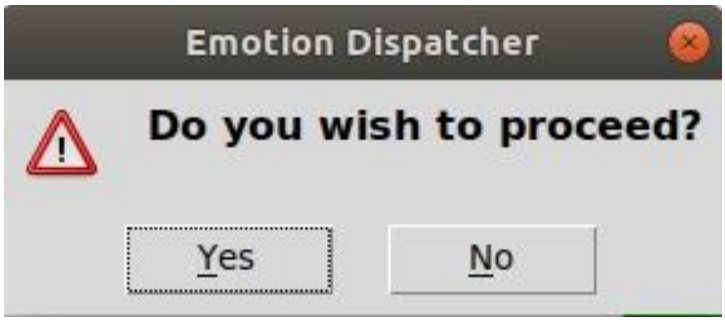
This is the registration form to fill the details of the user and the details will be sent to the mail after detecting their emotions. This can help the companies to visualize them and help to improve their market strategy. The registration form contains the following components: Name of the person, Age, Phone Number, gender, region and their medical illness details.



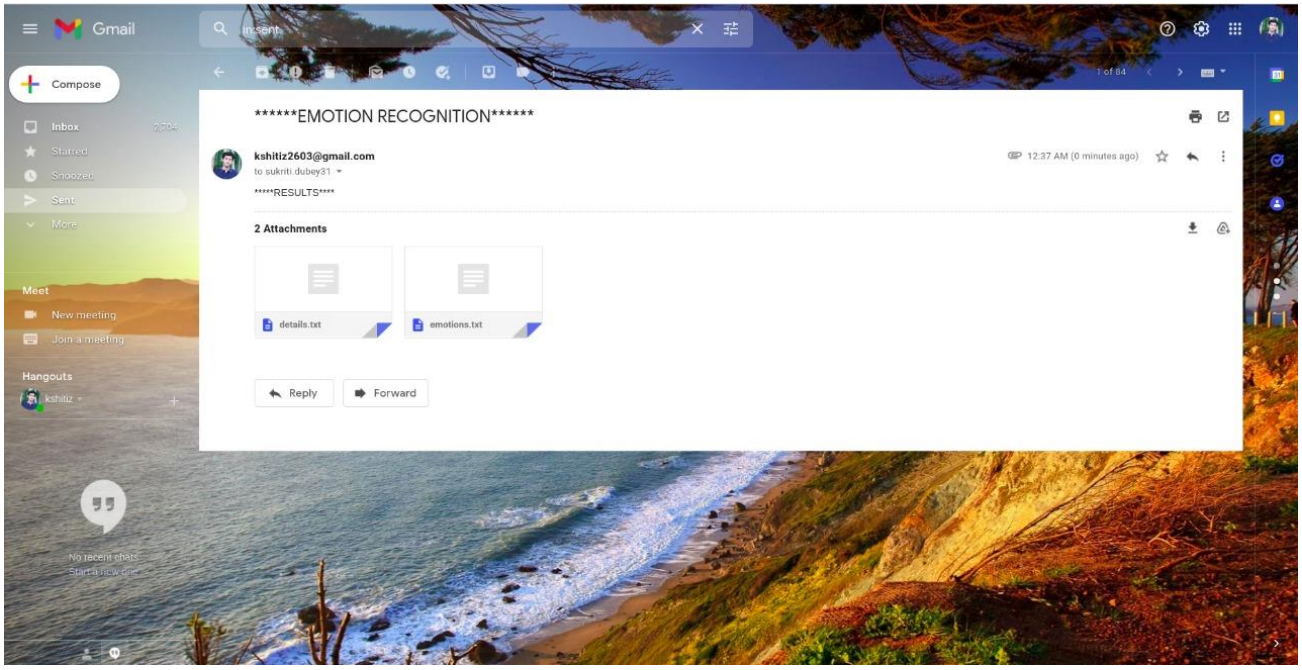
This page consists of instructions to be followed while using this application.



To detect the face, asking the user's permission to allow the access to the webcam.

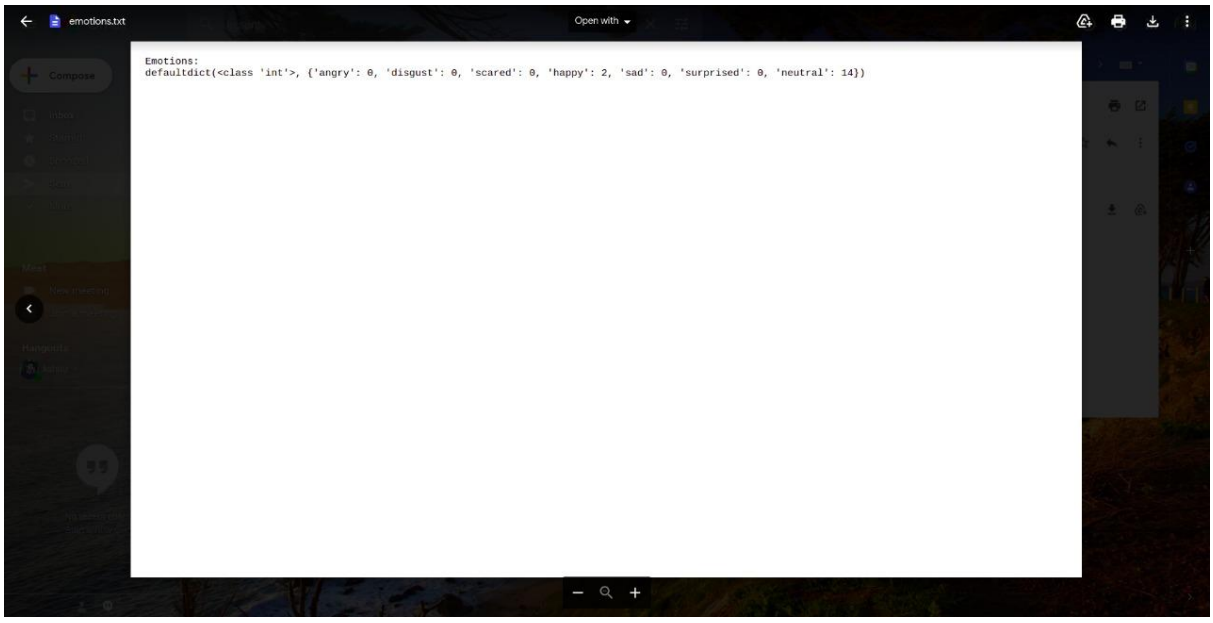


The program will create a window to display the scene capture by web camera and a window representing the probabilities of detected emotions. The expressions at each frame are recorded and stored in a text file. After a certain period of time detected emotions and the details of the user is dispatched through mail. Three files will be dispatched at every detection.



Details.txt → This file contains details of the user which is filled in the form.

Emotions.txt → This file contains counter of each emotion.



9.

10. Comparative Analysis

Comparison of models:

Model	Size	Top-1 Accuracy	Top-5 Accuracy	Parameters	Depth
VGG16	528MB	0.713	0.901	138,357,544	23
InceptionV3	92MB	0.779	0.937	23,851,784	159
ResNet50	98MB	0.749	0.921	25,636,712	-
Xception	88MB	0.790	0.945	22,910,480	126
InceptionResNetV2	215MB	0.803	0.953	55,873,736	572
ResNetXt50	96MB	0.777	0.938	25,097,128	-

VGG-16

VGG-16 is a less difficult design model since it’s not utilizing many hyper boundaries. It generally utilizes 3 x 3 channels with a step of 1 in the convolution layer and uses the SAME cushioning in pooling layers 2 x 2 with a step of 2.

GoogLeNet

The champ of ILSVRC 2014 and GoogLeNet engineering is otherwise called the Inception Module. It goes further in equal ways with various open field sizes and it accomplished a best 5 blunder rate with 6.67%.

ResNet (2015)

The victor of ILSRVC 2015, it likewise called as Residual Neural Network (ResNet) by Kaiming. This engineering presented an idea called "skip associations". Ordinarily, the info lattice figures in two straight change with ReLU actuation work. In Residual organization, it straightforwardly duplicates the info network to the subsequent change yield and entirety the yield in the last ReLU work.

Inception:

The Inception module registers numerous various changes over a similar information map in equal, interfacing the outcomes into a solitary yield. For each layer, it does a 5x5

convolution, 3x3 convolution, and max pooling, each conveys distinctive data, which obviously is computationally exorbitant. Consequently, the creators of Inception chose to conquer this issue by presenting the measurement decreases.

MobileNet:

The main idea behind MobileNet is lighter deep neural networks are assembled using depthwise separable convolutions. Usually, in the convolutional layer, the convolution kernel or filter is applied to all of the channels of the input image, by calculating the weighted sum of the input pixels with the filter and then slides over the next input pixels across the images. This regular convolution is used by MobileNet only in the first layer. The next layers are the depthwise separable convolutions which are the combination of the depthwise and pointwise convolution.

Xception:

Francois Chollet proposed Xception Model. Xception is an extension of the inception Architecture that replaces the standard Inception modules with depthwise Separable Convolutions. Xception is a convolutional neural network that consists of 71 layers. This allows us to load a pre-trained version of the network trained on more than a million images from the ImageNet database. The pre-trained network can classify images into 1000 object categories, such as vehicles, keyboards, mouse, and many animals. Thus, the network has learned rich feature representations for a wide range of images. The network has an image input size of 299-by-299.

11. Conclusion and Future Scope

Facial emotion recognition is an emerging field now-a-days. Non-verbal communications like facial expressions are used in many applications in human computer and interaction which is used to convey the facial emotions. There is lot of complexity and variability involved in recognizing facial emotions. This project proposed a new method for facial recognition and its various applications in real time scenario. Predicting emotions give us accurate information of how the user feels. So this proposed method helps the psychiatrists to analyse their patients effectively. We believe that this proposed method has given promising results in detecting the emotions and dispatching the data.

12. References

- Abdullah, S. M. S. A., Ameen, S. Y. A., Sadeeq, M. A., & Zeebaree, S. (2021). Multimodal emotion recognition using deep learning. *Journal of Applied Science and Technology Trends*, *2*(02), 52-58.
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