PROJECT REPORT

ON

Facial Emotion Recognition System

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Student Declaration

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Himanshu Kumar	06	Training the model using keras
Etesh Agarwal	74	Defining the propertied for training data set and validation data set.
Ankit Kumar Giri	75	Testing the trained model using webcam. i.e facial recognition.

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BONAFIDE CERTIFICATE

Certified that this project report “EMOTION DETECTOR” is the bonafide work of “ **Himanshu Kmar , Amit Kumar , Etesh Agarwal, Ankit Kumar Giri**” who carried out the project work under my supervision.

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Facial Emotion Recognition System

1. Introduction

Facial Expression conveys non-verbal cues, which plays an important roles in interpersonal relations. The Facial Expression Recognition system is the process of identifying the emotional state of a person. In this system captured image is compared with the trained dataset available in database and then emotional state of the image will be displayed.

This system is based on image processing and machine learning. For designing a robust facial feature descriptor, we apply the Local Binary Pattern. Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. The histogram will be formed by using the operator label of LBP.

The recognition performance of the proposed method will be evaluated by using the trained database with the help of Support Vector Machine. Experimental results with prototypic expressions show the superiority of the LBP descriptor against some well known appearance-based feature representation methods. We evaluate our proposed method on the Kaggle dataset. The precision, recall and fscore of Kaggle dataset were 83.6142%, 95.0822% and 88.9955% respectively. Experimental results demonstrate the competitive classification accuracy of our proposed method.

2. Requirement Analysis

2.1. Planning :

In planning phase study of reliable and effective algorithms is done. On the other hand data were collected and were preprocessed for more fine and accurate results. Since huge amount of data were needed for better accuracy we have collected the data surfing the internet. Since, we are new to this project we have decided to use local binary pattern algorithm for feature extraction and support vector machine for training the dataset. We have decided to implement these algorithms by using OpenCv framework.

2.2. Literature Reviews :

Research in the fields of face detection and tracking has been very active and there is exhaustive literature available on the same. The major challenge that the researchers face is the non-availability of spontaneous expression data . Capturing spontaneous expressions on video is one of the biggest challenges ahead . Many attempts have been made to recognize facial expressions. Zhang et al investigated two types of features, the geometry-based features and Gabor wavelets based features, for facial expression recognition.

Appearance based methods, feature invariant methods, knowledge based methods, Template based methods are the face detection strategies whereas Local Binary Pattern phase correlation, Haar classifier, AdaBoost, Gabor Wavelet are the expression detection strategies in related field. Face reader is the premier for automatic analysis of facial expression recognition and Emotient, Affectiva, Karios etc are some of the API's for expression recognition. Automatic facial expression recognition includes two vital aspects: facial feature representation and classifier problem.

Facial feature representation is to extract a set of appropriate features from original face images for describing faces. Histogram of Oriented Gradient (HOG), SIFT, Gabbor Fitters and Local Binary Pattern (LBP) are the algorithms used for facial feature representation [3,4]. LBP is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. The

operator labels the pixels of an image by thresholding the 3X3 neighborhood of each pixel with the center value and considering the result as a binary number [3]. HOG was first proposed by Dalal and Triggs in 2005. HOG numerates the appearance of gradient orientation in a local path of an image.

For classifier problem we use algorithms like Machine learning, Neural Network, Support Vector Machine, Deep learning, Naive Bayes. The formation of histogram by using any of facial feature representation will use Support Vector Machine (SVM) for expression recognition. SVM builds a hyperplane to separate the high dimensional space. An ideal separation is achieved when the distance between the hyper plane and the training data of any class is the largest.

The size of the block for the LBP feature extraction is chosen for higher recognition accuracy. The testing results indicate that by using LBP features facial expressions recognition accuracy is more than 97%. The block LBP histogram features extract local as well as global features of face image resulting higher accuracy. LBP is compatible with various classifiers, filters etc.

2.3. Data Collection :

Data was collected through the readily available sources like Kaggle which was having the highest accuracy rate.

2.4 Dataset Preparation :

For our project, we used 24256 images belonging to 5 classes i.e., five expression set.

We normalized the faces to 72 pixels. Based on the structure of face facial images of 256*256 pixels were cropped from original images. To identify the facial image automatic face detection was performed by using the face detector of our own system based on Haar classifier. From the results of face detection including face location, face width and face height were automatically created. Finally images were cropped in accordance to the result given by the face detector and further cropped images were used for training and testing.

3. Software Requirement Specification :

Requirement analysis is mainly categorized into two types.

3.1. Functional requirements :

The functional requirements for a system describe what the system should do. Those requirements depend on the type of software being developed, the expected users of the software. These are statement of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situation.

3.2. Non-Functional requirements :

Nonfunctional requirements are requirements that are not directly concerned with the specified function delivered by the system. They may relate to emergent system properties such as reliability, response time and store occupancy. Some of the nonfunctional requirements related with this system are hereby below:

3.2.1.Reliability: Reliability based on this system defines the evaluation result of the system, correct identification of the facial expressions and maximum evaluation rate of the facial expression recognition of any input images.

3.2.2. Ease of Use: At this stage, it's little complex to use this project because the ui will be developed soon and that will help to use this concept with ease. Till now we have to run a specific program by the name of test.py in order to make it functional.

3.3. Feasibility Study

Before starting the project, feasibility study is carried out to measure the viable of the system. Feasibility study is necessary to determine if creating a new or improved system is friendly with the cost, benefits, operation, technology and time. Following feasibility study is given as below:

3.3.1. Technical Feasibility

Technical feasibility is one of the first studies that must be conducted after the project has been identified. Technical feasibility study includes the hardware and software devices. The required technologies (Anaconda with Jupyter Notebook and VS code) existed.

3.3.2. Operational Feasibility

Operational Feasibility is a measure of how well a proposed system solves the problem and takes advantage of the opportunities identified during scope definition. The following points were considered for the project's technical feasibility:

The system will detect and capture the image of face.

The captured image is then (identified which category)

3.3.3. Economic Feasibility.

The purpose of economic feasibility is to determine the positive economic benefits that include quantification and identification. The system is economically feasible due to availability of all requirements such as collection of data from Kaggle.

3.3.4. Schedule Feasibility

Schedule feasibility is a measure of how reasonable the project timetable is. The system is found schedule feasible because the system is designed in such a way that it will finish prescribed time.

4. Software and Hardware Requirement

4.1. Software Requirement

Following are the software requirement necessary of the project:

a) Python Programming Language

b) Anaconda with Jupyter notebook

c) Tensorflow and Keras Library

d) OpenCV framework

4.2. Hardware Requirement

Following are the hardware requirement that is most important for the project:

a) Fluently working Laptops

b) RAM minimum 4Gb

c) Web Camera

5. PROJECT METHODOLOGY :

5.1. Phases in Facial Expression Recognition

The facial expression recognition system is trained using supervised learning approach in which it takes images of different facial expressions. The system includes the training and testing phase followed by image acquisition, face detection, image preprocessing, feature extraction and classification. Face detection and feature extraction are carried out from face images and then classified into six classes belonging to six basic expressions which are outlined below:

5.1.1. Image Acquisition

Images used for facial expression recognition is image sequences. Images of face can be captured using camera.

5.1.2. Face Detection :

Face Detection is useful in detection of facial image. Face Detection is carried out in training dataset using Haar classifier called Voila-Jones face detector and implemented through Opencv. Haar like features encodes the difference in average intensity in different parts of the image and consists of black and white connected rectangles in which the value of the feature is the difference of sum of pixel values in black and white regions.

5.1.3. Image Pre-processing

Image pre-processing includes the removal of noise and normalization against the variation of pixel position or brightness.

a) Color Normalization

b) Histogram Normalization

5.1.4. Feature Extraction

Selection of the feature vector is the most important part in a pattern classification problem. The image of face after pre-processing is then used for extracting the important features. The inherent problems related to image classification include the scale, pose, translation and variations in illumination level. The important features are extracted using LBP algorithm which is described below

6. Algorithms :

6.1. Local Binary Pattern

LBP is the feature extraction technique. The original LBP operator points the pixels of an image with decimal numbers, which are called LBPs or LBP codes that encode the local structure around each pixel. Each pixel is compared with its eight neighbors in a 3 X 3 neighborhood by subtracting the center pixel value. In the result, negative values are encoded with 0 and the others with 1. For each given pixel, a binary number is obtained by merging all these binary values in a clockwise direction, which starts from the one of its top-left neighbour. The corresponding decimal value of the generated binary number is then used for labeling the given pixel. The derived binary numbers are referred to be the LBPs or LBP codes.

6.2. Support Vector Machines

SVM is widely used in various pattern recognition tasks. SVM is a state-of-the-art machine learning approach based on the modern statistical learning theory. SVM can achieve a near optimum separation among classes. SVMs is trained to perform facial expression classification using the features proposed. In general, SVM are the maximal hyperplane classification method that relies on results from statistical learning theory to guarantee high generalization performance.

7. DEVELOPMENT AND TESTING

7.1. Implementation Tools :

1. Python
2. Anaconda with Jupyter Notebook
3. Visual Studio Code

7.2. Frameworks

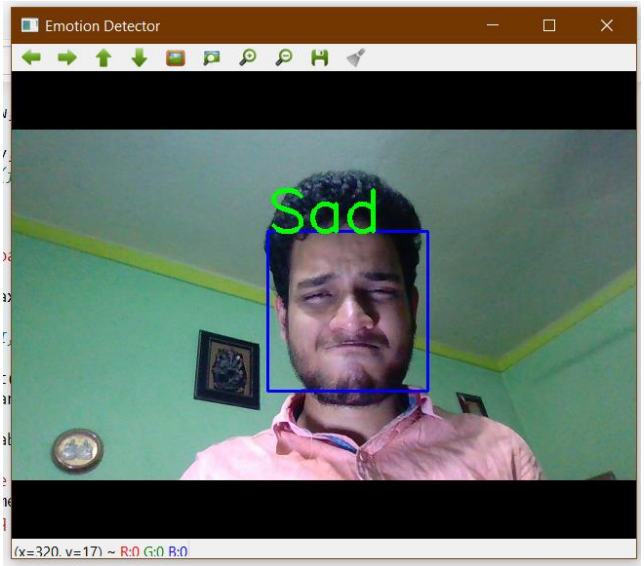
a. TensorFlow

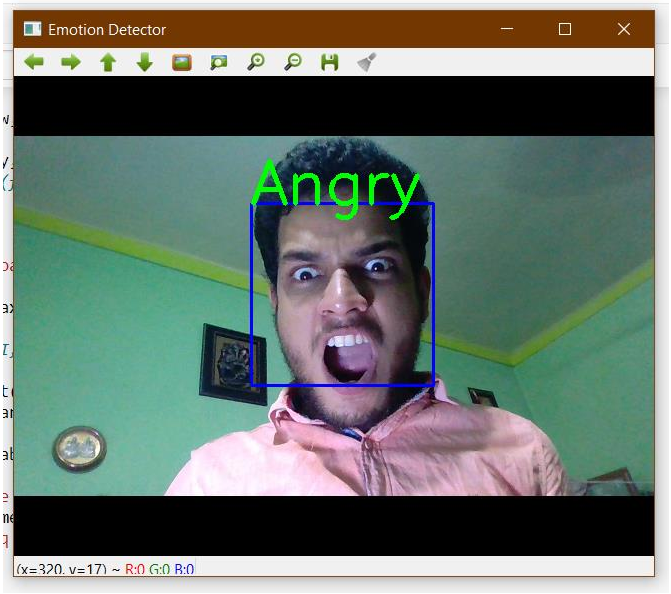
b. Keras

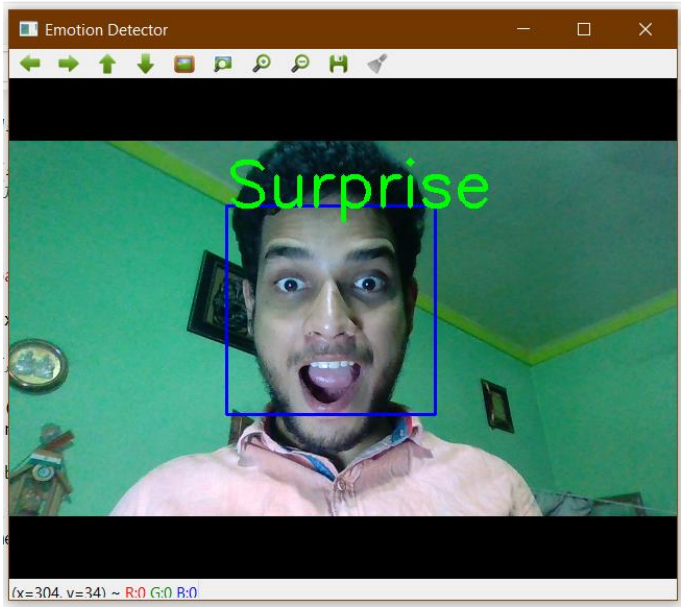
c. OpenCV

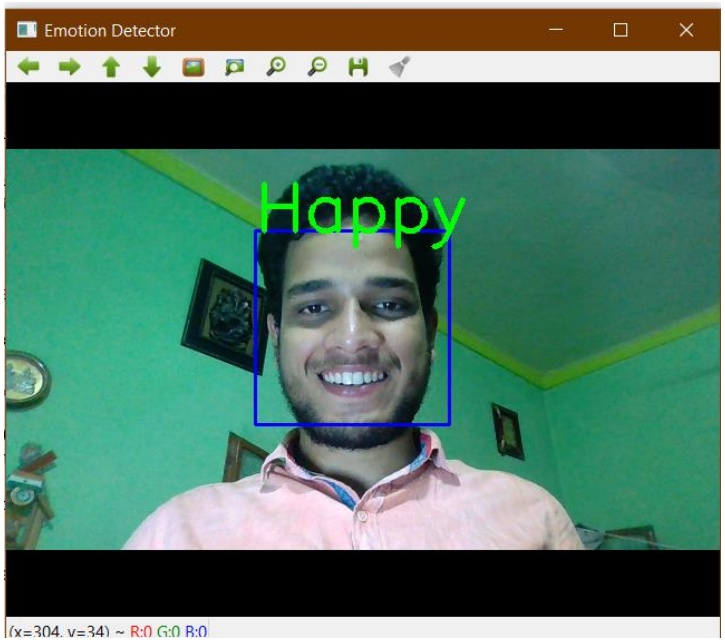
8. EXPERIMENT AND OUTPUT:

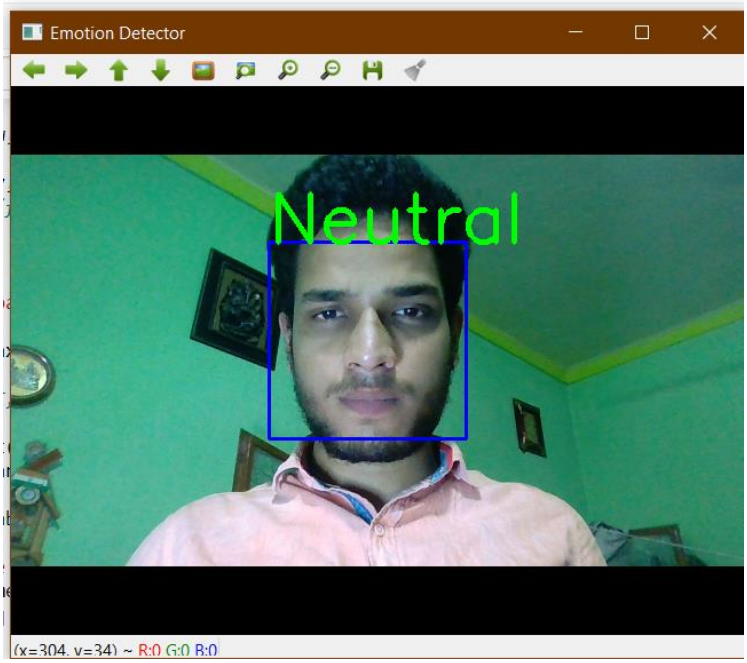
After our model was trained and tested with the dataset, we ran the test program and following output images were captured.




Emotion Detector
Angry


Emotion Detector
Surprise





9. CONCLUSION AND RECOMMENDATION

This project proposes an approach for recognizing the category of facial expressions. Face Detection and Extraction of expressions from facial images is useful in many applications, such as robotics vision, video surveillance, digital cameras, security and human-computer interaction. This project's objective was to develop a facial expression recognition system implementing the computer visions and enhancing the advanced feature extraction and classification in face expression recognition.

In this project, seven different facial expressions of different persons' images from different datasets have been analyzed. This project involves facial expression preprocessing of captured facial images followed by feature extraction using feature extraction using Local Binary Patterns and classification of facial expressions based on training of datasets of facial images based on Support Vector Machines. The use of libraries like TensorFlow and Keras proved to be really very precise and accurate.

10. Future Scope

Face expression recognition systems have improved a lot over the past decade. The focus has definitely shifted from posed expression recognition to spontaneous expression recognition. Promising results can be obtained under face registration errors, fast processing time, and high correct recognition rate (CRR) and significant performance improvements can be obtained in our system. System is fully automatic and has the capability to work with images feed. It is able to recognize spontaneous expressions. Our system can be used in Digital Cameras wherein the image can be captured only when the person smiles. In security systems which can identify a person, in any form of expression he presents himself. Rooms in homes can set the lights, television to a person's taste when they enter the room. Doctors can use the system to understand the intensity of pain or illness of a deaf patient. Our system can be used to detect and track a user's state of mind, and in mini-marts, shopping center to view the feedback of the customers to enhance the business etc.