MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)

Project Report

on

Facial Expression Recognizer

Submitted By:

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0901CS191032

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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GWALIOR - 474005 (MP) est. 1957

MAY-JUNE 2022

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A project report submitted in partial fulfilment of the requirement for the degree of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE AND ENGINEERING

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CERTIFICATE

This is certified that **Devashish Ojha** (0901CS191032) has submitted the project report titled **Facial Expression Recognizer** under the mentorship of **Mir Shahnawaz Ahmad , Asst. Professor, MITS** in partial fulfilment of the requirement for the award of degree of Bachelor of Technology in Computer Science and Engineering from Madhav Institute of Technology and Science, Gwalior.

09/05/22

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CERTIFICATE

This is certified that **Naman Shrivastava** (0901CS191064) has submitted the project report titled **Facial Expression Recognizer** under the mentorship of **Mir Shahnawaz Ahmad , Asst. Professor, MITS** in partial fulfilment of the requirement for the award of degree of Bachelor of Technology in Computer Science and Engineering from Madhav Institute of Technology and Science, Gwalior.

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DECLARATION

We hereby declare that the work being presented in this project report, for the partial fulfilment of requirement for the award of the degree of Bachelor of Technology in Computer Science and Engineering at Madhav Institute of Technology & Science, Gwalior is an authenticated and original record of my work under the mentorship of **Mir Shahnawaz Ahmad , Asst. Professor, Computer Science and Engineering Department**

We declare that we have not submitted the matter embodied in this report for the award of any degree or diploma anywhere else.

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ABSTRACT

These Human facial expressions convey a lot of information visually rather than articulately. Facial expression recognition plays a crucial role in the area of human-machine interaction. Automatic facial expression recognition system has many applications including, but not limited to, human behaviours understanding, detection of mental disorders, and synthetic human expressions. Recognition of facial expression by computer with high recognition rate is still a challenging task. Two popular methods utilized mostly in the literature for the automatic FER systems are based on geometry and appearance. Facial Expression Recognition is usually performed in four-stages consisting of pre-processing, face detection, feature extraction, and expression classification. In this project we applied various deep learning methods (convolutional neural networks) to identify the key seven human emotions: anger, disgust, fear, happiness, sadness, surprise and neutrality

- **Keywords:** Facial Expression, Detection, Feature Extraction, Classification.

सार:

मानवीय चेहरे के भाव बहुत सी जानकारी को दृष्टिगत रूप से व्यक्त करते हैं । चेहरे की अभिव्यक्ति पहचान एक महत्वपूर्ण भूमिका निभाती है मानव-मशीन संपर्क के क्षेत्र में । स्वचालित फेशियल अभिव्यक्ति पहचान प्रणाली में कई अनुप्रयोग शामिल हैं, लेकिन मानव व्यवहार समझ तक सीमित नहीं है, मानसिक विकार का पता लगाना, और कृत्रिम मानव अभिव्यक्तियाँ। चेहरे की पहचान उच्च पहचान दर वाले कंप्यूटर द्वारा अभिव्यक्ति अभी भी एक है चुनौतीपूर्ण कार्य। साहित्य में अधिकतर प्रयोग की जाने वाली दो लोकप्रिय विधियाँ स्वचालित एफईआर सिस्टम ज्यामिति और उपस्थिति पर आधारित होते हैं।

चेहरे की अभिव्यक्ति पहचान आमतौर पर चार चरणों में की जाती है प्री-प्रोसेसिंग, फेस डिटेक्शन, फीचर एक्सट्रैक्शन, और अभिव्यक्ति वर्गीकरण। इस परियोजना में हमने विभिन्न गहन शिक्षण विधियों को लागू किया (संक्रामक तंत्रिका नेटवर्क) प्रमुख सात मानवों की पहचान करने के लिए भावनाएं: क्रोध, घृणा, भय, खु

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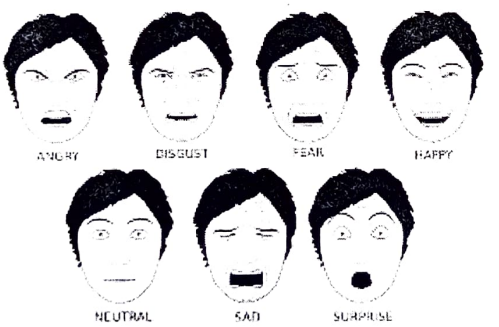
CHAPTER 1 INTRODUCTION:

1.1 PROJECT OVERVIEW:

With the advent of modern technology our desires went high and it binds no bounds. In the present era a huge research work is going on in the field of digital image and image processing. The way of progression has been exponential and it is ever increasing. Image Processing is a vast area of research in present day world and its applications are very widespread. Image processing is the field of signal processing where both the input and output signals are images. One of the most important application of Image processing is Facial expression recognition. Our emotion is revealed by the expressions in our face. Facial Expressions plays an important role in interpersonal communication. Facial expression is a non verbal scientific gesture which gets expressed in our face as per our emotions. Automatic recognition of facial expression plays an important role in artificial intelligence and robotics and thus it is a need of the generation. Some application related to this include Personal identification and Access control, Videophone and Teleconferencing, Forensic application, Human-Computer Interaction, Automated Surveillance, Cosmetology and so on. The objective of this project is to develop Automatic Facial Expression Recognition System which can take human facial images containing some expression as input and recognize and classify it into seven different expression class such as :

I. Neutral
II. Angry
III. Disgust
IV. Fear
V. Happy
VI. Sadness
VII. Surprise

Several Projects have already been done in this fields and our goal will not only be to develop an Automatic Facial Expression Recognition System but also improving the accuracy of this system compared to the other available systems.



1.1(Seven Expressions)

1.2 Objectives and Scope:

The objective of emotion recognition is identifying emotions of a human. The emotion can be captured either from face or from verbal communication. In this work we focus on identifying human emotion from facial expressions. Facial emotion recognition is one of the useful task and can be used as a base for many real-time applications. It can be used as a part of many interesting and useful

applications like Monitoring security, treating patients in medical field, marketing research, E-learning etc;. We humans can easily identify the emotion of other humans without any effort. Automatic detection of emotion of a human face is important due to its use in real-time 2applications

1.3 Project Features:

In our project the input for expression detection is taken through the webcam of the system on which the project is running in video format and then it's given to a pre-trained deep learning model to give output from our given list of expressions . The returned output will be displayed on output video

1.4 Feasibility: Before starting the project, a feasibility study is carried out to measure the viability 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:

1.4.1 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 (Python and Jupyter) existed.

1.4.2 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. 10 The captured image is then (identified which category)

1.4.3 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

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

1.5 System Requirements:

> Fluently working laptop
> Web Camera
> GB RAM

1.6 Technologies Used:

1.6.1 NumPy :

NumPy is a Python package. It stands for 'Numerical Python'. It is a library consisting of multidimensional array objects and a collection of routines for processing of array.

1.6.2 OpenCV :

OpenCV is a cross-platform library using which we can develop real-time computer vision applications. It mainly focuses on image processing, video capture and analysis including features like face detection and object detection.

CHAPTER 2: LITERATURE REVIEW

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 [1]. Capturing spontaneous expressions on images and video is one of the biggest challenges ahead [2]. 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 [3]. 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 [2].

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 [4].

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. [3].

CHAPTER 3: DETAILED DESIGN

3.1 Algorithm :

- **Step 1** - Collection of FER dataset present online.
- **Step 2** - Detection of face from each image in the dataset.
- **Step 3** - Conversion of detected face image to grayscale.
- **Step 4** -Ensure that every face image can be fed into the input layer as (48,48) numpy array.
- **Step 6** - Numpy array gets passed to Convolutional2D layer
- **Step 7** - Convolutional method generates a feature map.
- **Step 8** - Pooling method called MaxPooling2D that uses (2,2) window across the feature map only keeping the maximum pixel value.
- **Step 9** - During training, forward and backward propagation performed on the pixel values.
- **Step 10** -The softmax activation function presents itself as a probability for each emotion class

3.2 Detailed Description :

A Facial expression is the visible manifestation of the affective state, cognitive activity, intention, personality and psychopathology of a person and plays a communicative role in interpersonal relations. It has been studied for a long period of time and obtained progress in recent decades. Though much progress has been made, recognizing facial expressions with a high accuracy remains to be difficult due to the complexity and varieties of facial expressions [2]. Generally human beings can convey intentions and emotions through nonverbal ways such as gestures, facial expressions and involuntary languages. This system can be significantly useful, nonverbal way for people to communicate with each other. The important thing is how fluently the system detects or extracts the facial expression from the image. The system is growing attention because this could be widely used in many fields like lie detection, medical assessment and human computer interface. The Facial Action Coding System (FACS), which was proposed in 1978 by Ekman and refined in 2002, is a very popular facial expression analysis tool [3]. On a day to day basics humans commonly recognize emotions by characteristic features, displayed as a part of a facial expression. For instance happiness is undeniably associated with a smile or an upward movement of the corners of the lips. Similarly other emotions are characterized by other deformations typical to a particular expression. Research into automatic recognition of facial expressions addresses the problems surrounding the representation and categorization of static or dynamic characteristics of these deformations of face pigmentation [8]. The system classifies facial expressions of the same person into the basic emotions namely anger, disgust, fear, happiness, sadness and surprise. The main purpose of this system is efficient interaction between human beings and machines using eye gaze, facial expressions,

cognitive modeling etc. Here, detection and classification of facial 2 expressions can be used as a natural way for the interaction between man and machine. And the system

intensity varies from person to person and also varies along with age, gender, size and shape of face, and further, even the expressions of the same person do not remain constant with time. However, the inherent variability of facial images caused by different factors like variations in illumination, pose, alignment, and occlusions makes expression recognition a challenging task. Some surveys on facial feature representations for face recognition and expression analysis addressed these challenges and possible solutions in detail.

3.3 Data Flow Diagrams :

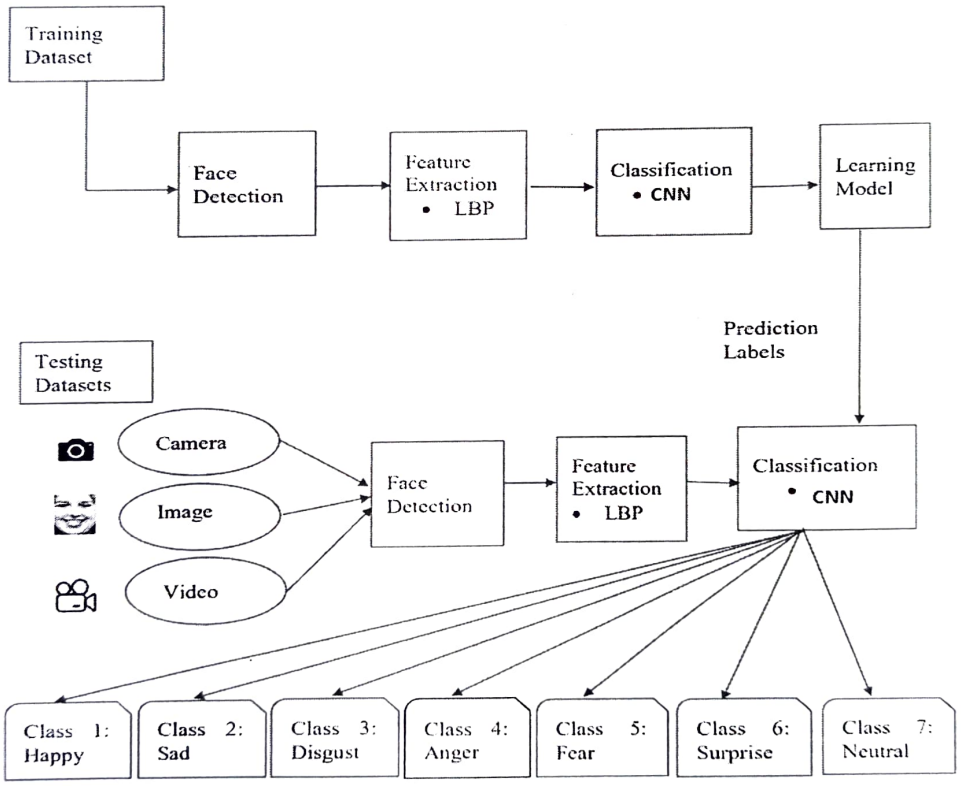


Fig 3.1 System Diagram

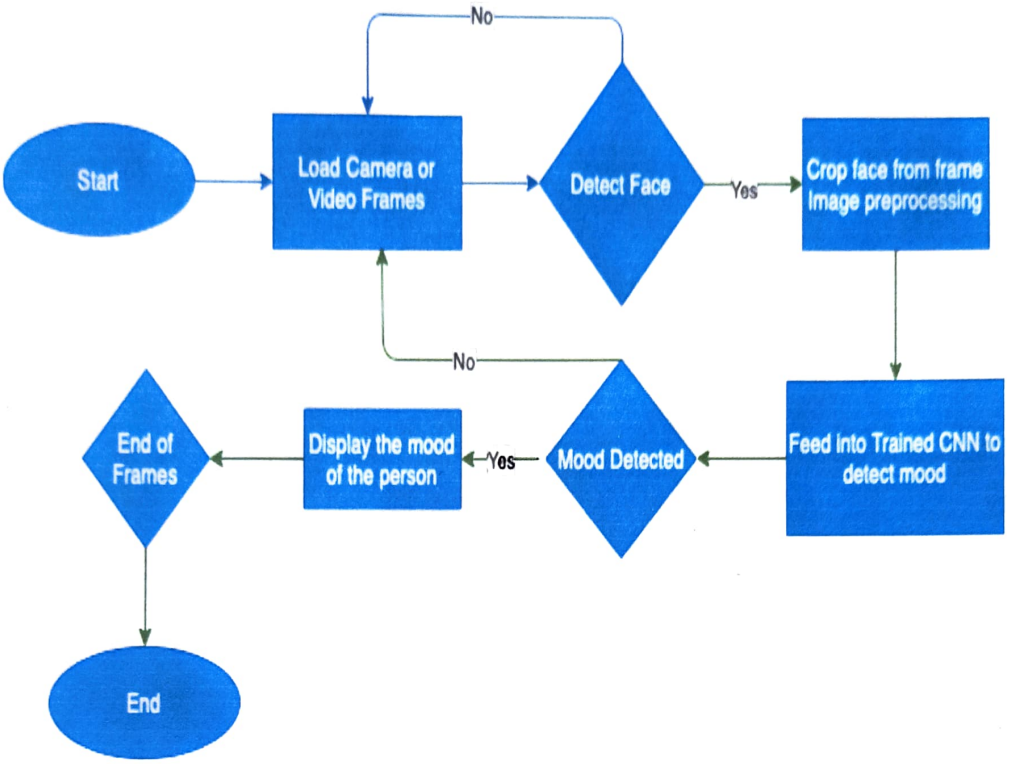


Fig 3.2 Flow of Data in Facial Expression Recognizer

CHAPTER 4: FINAL RESULT

4.1 Result:

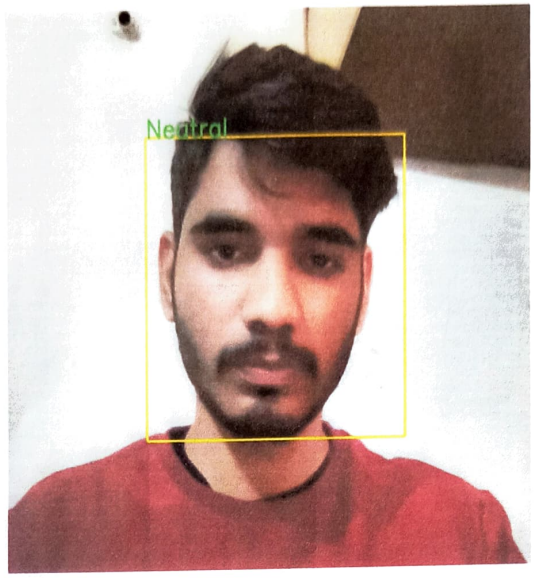


Fig 4.1 Neutral

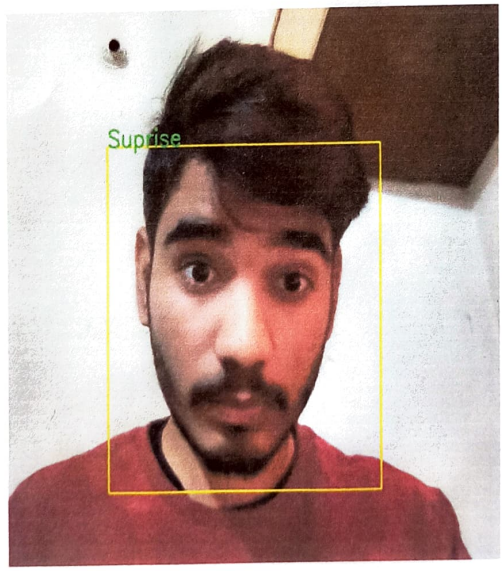


Fig 4.2 Surprise

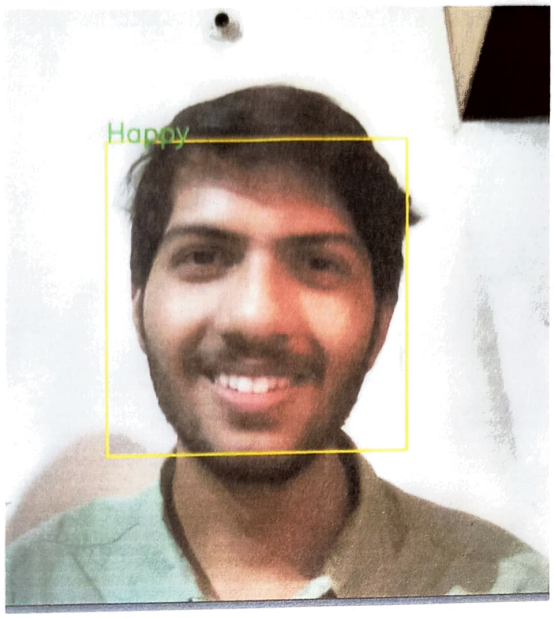


Fig 4.3 Happy

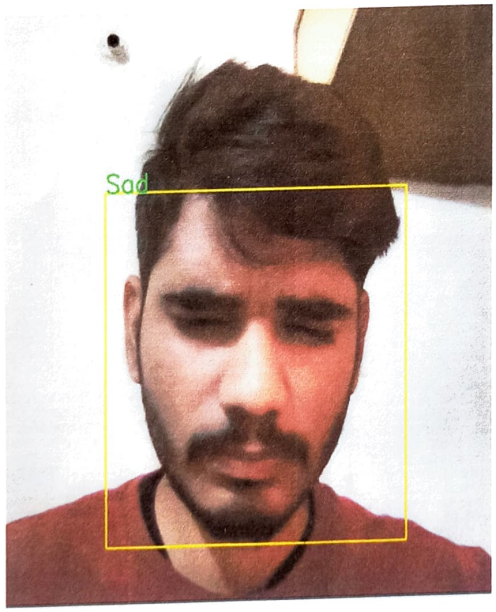


Fig 4.4 Sad

4.2 Applications:

Movie Creators : Creators such as Disney Entertainment uses real time emotion recognition to take feedback from viewers during screening of upcoming projects.

Food Companies : Kellogg's is just one high profile example which uses it to test audience reaction to ads for its cereal.

Corporate Industries : Industries can use this to check emotions of employees at work.

Medical Research : Mental diseases diagnosis and human social/physiological interaction detection.

CHAPTER 5 CONCLUSION:

In this case, when the model predicts incorrectly, the correct label is often the second most likely emotion. The facial expression recognition system presented in this research work contributes a resilient face recognition model based on the mapping of behavioral characteristics with the physiological biometric characteristics. The physiological characteristics of the human face with relevance to various expressions such as happiness, sadness, fear, anger, surprise and disgust are associated with geometrical structures which are restored as base matching template for the recognition system. The behavioral aspect of this system relates the attitude behind different expressions as property base. The property bases are alienated as exposed and hidden category in genetic algorithmic genes. The gene training set evaluates the expressional uniqueness of individual faces and provide a resilient expressional recognition model in the field of biometric security. The design of a novel asymmetric cryptosystem based on biometrics having features like hierarchical group security eliminates the use of passwords and smart cards as opposed to earlier cryptosystems. It requires a special hardware support like all other biometrics system. This research work promises a new direction of research in the field of asymmetric biometric cryptosystems which is highly desirable in order to get rid of passwords and smart cards completely. Experimental analysis and study show that the hierarchical security structures are effective in geometric shape identification for physiological traits.

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