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"RECOGNITION of STRESS USING FACE IMAGE and FACIAL LANDMARKS"

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Abstract: In this project, we propose a stress recognition algorithm using face images and face landmarks by using pi-camera for taking the input image. In the case of stress recognition using a biological signal or thermal image, which is being studied a lot, a device for acquiring the corresponding information is required. In order to remedy this shortcoming, we proposed an algorithm that can recognize stress from images acquired with a general camera. We also designed a deep neural network that receives facial landmarks as input to take advantage of the fact that eye, mouth, and head movements are different from normal situations when a person is stressed. Experimental results show that the proposed algorithm recognizes stress more effectively. We are using convolution neural network (CNN) for classification and training purpose, Har cascade algorithm for face detection, facial landmarks for checking eye and lips, LBPH for face detection.

Keywords: Convolution Neural Network (CNN), Local Binary Pattern Histogram (LBPH), pi-camera.

1. INTRODUCTION

Recently, as modern people suffer from extreme levels of stress, a system is being developed to recognize whether a user is under stress and to give feedback in a direction of reducing stress when under stress. In the field of stress recognition, many methods using bio-signals have been studied. However, in order to measure bio-signals, a user may feel rejection because bio-signal measuring equipment must be attached to the body. Therefore, many studies on stress recognition using thermal images have been conducted, but this also has a disadvantage in that it is difficult to recognize stress easily in daily life because it cannot be recognized without thermal imaging equipment. On the other hand, in the case of stress recognition research using a general image, most of the studies have used a relatively simple feature. In this project, we propose a method for recognizing stress by extracting high-dimensional features from face images acquired by a general camera. And in order to learn more efficient features, we use the location of facial landmarks that shows a big change when stressed.

2. RELATED WORK

A. Stress Recognition using bio-signal

Bio-signals were used in early stress recognition research because they show the body's most sensitive changes, while allowing it to identify changes in the body that are not revealed by face and behavior. In these studies, they extracted and used features that can express stress in bio-signals such as Electro- cardiogram, electro-dermal Activity, Respiration, Galvanic Skin Response, and Heart Rate Variability. And many of them used classical classifiers such as Support Vector Machine, Linear Discriminant Analysis, and K-Nearest Neighbor.

B. Stress Recognition using Thermal Image

When a person is stressed, the blood flow of the face increases and the temperature of the face increases, so a lot of research has been conducted to detect the change by using the thermal image to detect the change. In these studies, many methods were used to recognize stress by extracting features directly from thermal images or by extracting the features such as respiratory Number of blinks, skin temperature, and blood flow from thermal images.

C. Stress Recognition using General Image

When a person is under stress, eye, mouth, and head movements are different from normal situations, and research on stress recognition using general images is also being conducted. In these studies, many methods were used to recognize stress such as extracting hand-crafted features from the eyes, nose, and mouth areas or using eye size, mouth movements, and head movements as features.

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3. LITERATURE SURVEY

[1] Face expression recognition and analysis: the state of the art

The automatic recognition of facial expressions has been an active research topic since the early nineties. There have been several advances in the past few years in terms of face detection and tracking, feature extraction mechanisms and the techniques used for expression classification. This paper surveys some of the published work since 2001 till date. The paper presents a time-line view of the advances made in this field, the applications of automatic face expression recognizers, the characteristics of an ideal system, the databases that have been used and the advances made in terms of their standardization and a detailed summary of the state of the art. The paper also discusses facial parameterization using FACS Action Units (AUs) and MPEG-4 Facial Animation Parameters (FAPs) and the recent advances in face detection, tracking and feature extraction methods. Notes have also been presented on emotions, expressions and facial features, discussion on the six prototypic expressions and the recent studies on expression classifiers.

[2] Robust facial expression recognition using local binary patterns

A novel low-computation discriminative feature space is introduced for facial expression recognition capable of robust performance over a range of image resolutions. Our approach is based on the simple local binary patterns (LBP) for representing salient micro-patterns of face images. Compared to Gabor wavelets, the LBP features can be extracted faster in a single scan through the raw image and lie in a lower dimensional space, whilst still retaining facial information efficiently. Template matching with weighted Chi square statistic and support vector machine are adopted to classify facial expressions. Extensive experiments on the Cohn-Kanade Database illustrate that the LBP features are effective and efficient for facial expression discrimination. Additionally, experiments on face images with different resolutions show that the LBP features are robust to low-resolution images, which is critical in real-world applications where only low-resolution video input is available.

[3] A Study of Local Binary Pattern Method for Facial Expression Detection

Face detection is a basic task for expression recognition. The reliability of face detection & face recognition approach has a major role on the performance and usability of the entire system. There are several ways to undergo face detection & recognition. We can use Image Processing Operations, various classifiers, filters or virtual machines for the former. Various strategies are being available for Facial Expression Detection. The field of facial expression detection can have various applications along with its importance & can be interacted between human being & computer. Many few options are available to identify a face in an image in accurate & efficient manner. Local Binary Pattern (LBP) based texture algorithms have gained popularity in these years. LBP is an effective approach to have facial expression recognition & is a feature-based approach.

[4] Facial Expression Recognition Based on Facial Components Detection and HOG Features

In this paper, an effective method is proposed to handle the facial expression recognition problem. The system detects the face and facial components including eyes, brows and mouths. Since facial expressions result from facial muscle movements or deformations, and Histogram of Oriented Gradients (HOG) is very sensitive to the object deformations, we apply the HOG to encode these facial components as features. A linear SVM is then trained to perform the facial expression classification. We evaluate our proposed method on the JAFFE dataset and an extended Cohn-Kanade dataset. The average classification rate on the two datasets reaches 94.3% and 88.7%, respectively. Experimental results demonstrate the competitive classification accuracy of our proposed method.

[5] Person-Independent Facial Expression Recognition Based on Compound Local Binary Pattern (CLBP)

In this paper, we present a robust facial feature descriptor constructed with the Compound Local Binary Pattern (CLBP) for person-independent facial expression recognition, which overcomes the limitations of LBP. The proposed CLBP operator combines extra P bits with the original LBP code in order to construct a robust feature descriptor that exploits both the sign and the magnitude information of the differences between the center and the neighbor gray values.

[6] A real time facial expression classification system using Local Binary Patterns

In this paper, a facial expression classification algorithm is proposed which uses Haar classifier for face detection purpose, Local Binary Patterns (LBP) histogram of different block sizes of a face image as feature vectors and classifies various facial expressions using Principal Component Analysis (PCA). The algorithm is implemented in real time for expression classification since the computational complexity of the algorithm is small. A customizable approach is proposed for facial expression analysis, since the various expressions and intensity of expressions vary from person to person. The

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system uses grayscale frontal face images of a person to classify six basic emotions namely happiness, sadness, disgust, fear, surprise and anger.

[7] Facial Expression Recognition Based on Local Binary Patterns and Local Fisher Discriminant Analysis

In this paper, a new method of facial expression recognition based on local binary patterns (LBP) and local Fisher discriminant analysis (LFDA) is presented. The LBP features are firstly extracted from the original facial expression images. Then LFDA is used to produce the low dimensional discriminative embedded data representations from the extracted high dimensional LBP features with striking performance improvement on facial expression recognition tasks. Finally, support vector machines (SVM) classifier is used for facial expression classification. The experimental results on the popular JAFFE facial expression database demonstrate that the presented facial expression recognition method based on LBP and LFDA obtains the best recognition accuracy of 90.7% with 11 reduced features, outperforming the other used methods such as principal component analysis (PCA), linear discriminant analysis (LDA), locality preserving projection (LPP).

[8] Facial expression recognition using Support Vector Machines

This paper proposes a facial expression recognition approach based on Principal Component Analysis (PCA) and Local Binary Pattern (LBP) algorithms. Experiments were carried out on the Japanese Female Facial Expression (JAFFE) database and our recently introduced Mevlana University Facial Expression (MUFE) database. Support Vector Machine (SVM) was used as classifier. In all conducted experiments on JAFFE and MUFE databases, obtained results reveal that PCA+SVM has an average recognition rate of 87% and 77%, respectively.

[9] Real Time Facial Expression Recognition in Video using Support Vector Machines

In this paper, we present a real time approach to emotion recognition through facial expression in live video. We employ an automatic facial feature tracker to perform face localization and feature extraction. The facial feature displacements in the video stream are used as input to a Support Vector Machine classifier. We evaluate our method in terms of recognition accuracy for a variety of interaction and classification scenarios. Our person-dependent and person-independent experiments demonstrate the effectiveness of a support vector machine and feature tracking approach to fully automatic, unobtrusive expression recognition in live video.

4. METHOD

The major problem obtained while doing this project is that creating a dataset and recognition of the facial expressions by the dataset. In the proposed algorithm, face image and facial landmark detection is performed first for stress recognition. We used a Convolution Neural Network (CNN) algorithm. In the proposed network, the face images and expression detected earlier are inputted to output stress recognition results. The results of face recognition are composed of students present in the class.

Step 1: Convolution A convolution is a joined integration of two methods that demonstrates to you how one method changes the other.

Step 2: Apply the RLU (Rectified Linear Unit)

In this step, the corrective function is used to increase nonlinearity on CNN. The data set is made up of different objects which are not linear to one another. Under this function, the grouping of information can be seen as a linear problem, although it is a non-straight problem.

Step 3: Pooling

Spatial invariance is a term that does not influence the neural network's ability to detect its particular feats when finding an item in the data collection. Pooling helps CNN to detect swimming pools, such as max and min pools, for example.

5. SOFTWARE SPECIFICATON

5.1 OpenCV

OpenCV is a library of programming functions mainly aimed at real-time computer vision. It has a modular structure, which means that the package includes several shared or static libraries. We are using image processing module that includes linear and non-linear image filtering, geometrical image transformations (resize, affine and perspective warping, and generic table-based remapping), color space conversion, histograms, and so on. Our project includes libraries such

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as Viola-Jones or Haar classifier, LBPH (Lower Binary Pattern histogram) face recognizer, Histogram of oriented gradients (HOG).

5.2 OpenCV-Python

Python is a general-purpose programming language started by Guido van Rossum, which became very popular in short time mainly because of its simplicity and code readability. It enables the programmer to express his ideas in fewer lines of code without reducing any readability. Compared to other languages like C/C++, Python is slower. But another important feature of Python is that it can be easily extended with C/C++. This feature helps us to write computationally intensive codes in C/C++ and create a Python wrapper for it so that we can use these wrappers as Python modules. This gives us two advantages: first, our code is as fast as original C/C++ code (since it is the actual C++ code working in background) and second, it is very easy to code in Python.

- cv2.IMREAD_COLOR: Loads a color image. Any transparency of image will be neglected. It is the default flag.
- cv2.IMREAD_GRAYSCALE: Loads image in grayscale mode.
- cv2.IMREAD_UNCHANGED: Loads image as such including alpha channel display an image.
- cv2.IMSHOW(): To display an image in a window.

5.3 Image processing module

The purpose of image processing is divided into 5 groups. They are:

1. Visualization- Observe the objects that are not visible.
2. Image sharpening and restoration- To create a better image.
3. Image retrieval- Seek for the image of interest.
4. Measurement of pattern– Measures various objects in an image.
5. Image Recognition– Distinguish the objects in an image.

5.4 NumPy

NumPy is the fundamental package for scientific computing with Python. NumPy is an acronym for "Numeric Python" or "Numerical Python". It is an open-source extension module for Python, which provides fast precompiled functions for mathematical and numerical routines. Besides that, the module supplies a large library of high-level mathematical functions to operate on these matrices and arrays.

It contains other things like:

a) A powerful N-dimensional array object

b) Sophisticated (broadcasting) functions

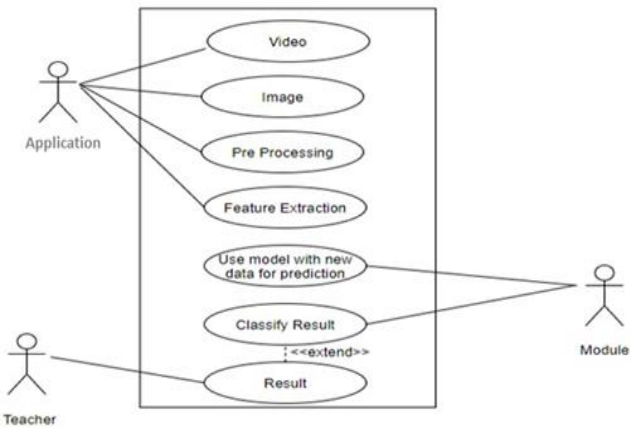
c) Tools for integrating C/C++ and Fortran code

d) Useful linear algebra, Fourier transforms, and random number capabilities.

6. SYSTEM DESIGN

6.1 Use case diagram

A use case diagram is a dynamic or behavior diagram in UML. Use case diagrams model the functionality of a system using actors and use cases. Use cases are a set of actions, services, and functions that the system needs to perform. In this context, a "system" is something being developed or operated, such as a web site. The "actors" are people or entities operating under defined roles within the system. The "scenario" is a specific sequence of actions and interactions between actors and the system. "Use case" is a collection of related success and failure scenarios, describing actors using the system to support a goal.



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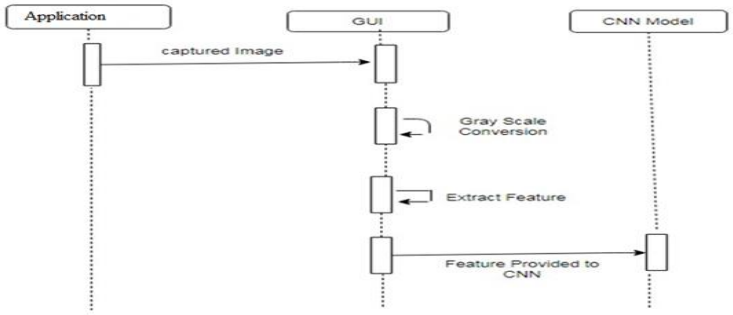
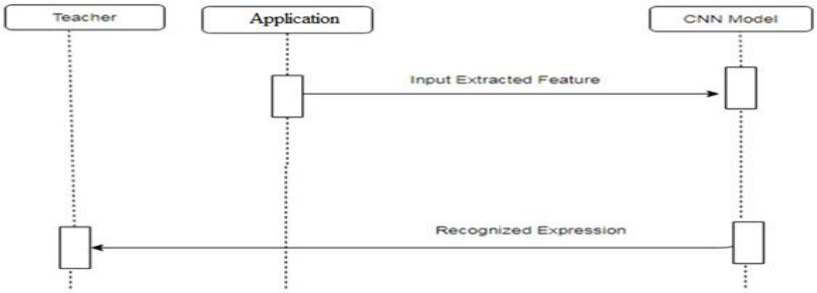
6.2 Sequence Diagram

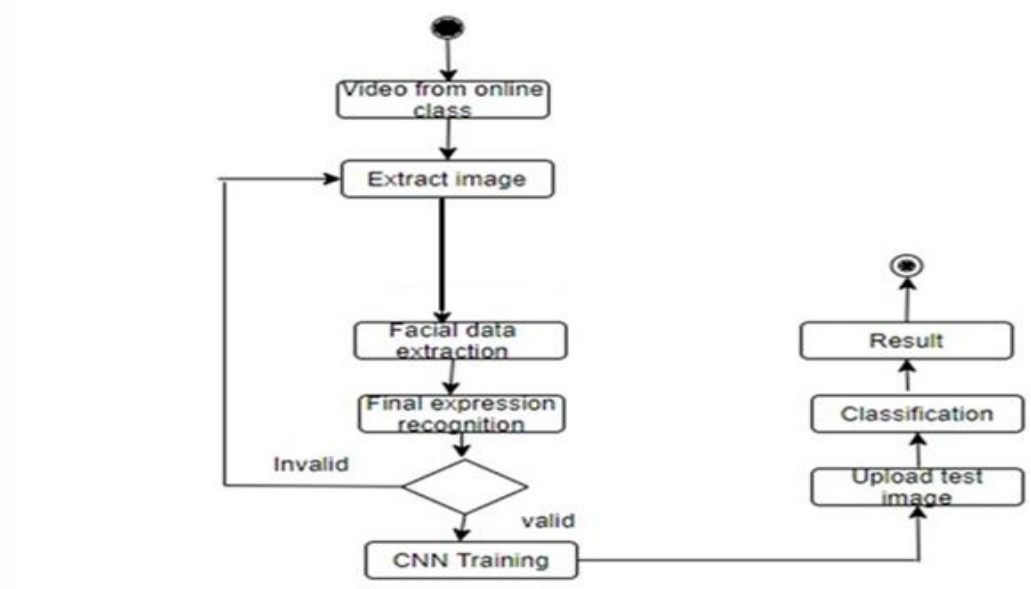
A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the Logical View of the system under development. Sequence diagrams are sometimes called event diagrams or event scenarios.





6.3 Activity Diagram

The activity diagram is an UML diagram that describes the system's dynamic aspects. In fact, it is a flowchart that regulates the flow every event. The event can be described as the operation of the system. The control flow shall be taken between operations.



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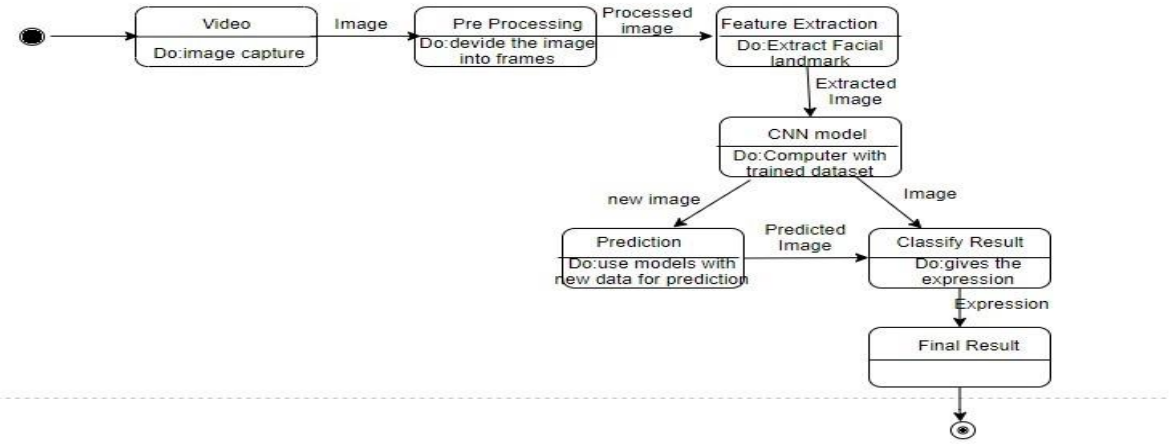
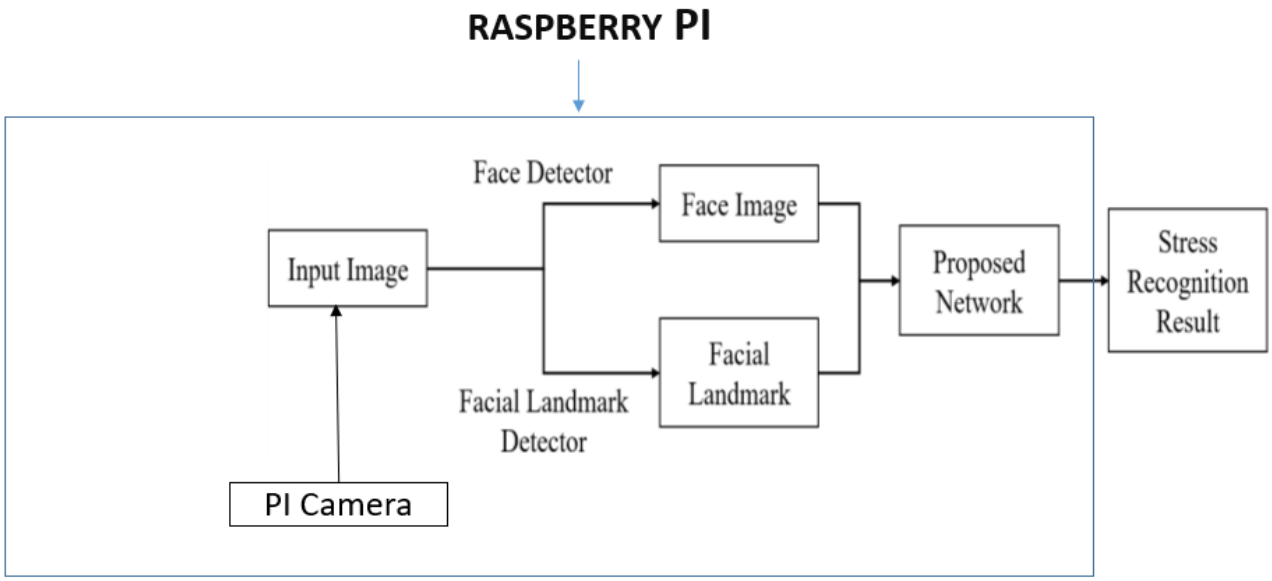
6.4 State Chart Diagram

State chart diagram is one of the five UML diagrams used to model the dynamic nature of a system. They define different states of an object during its lifetime and these states are changed by events. State chart diagram describes the flow of control from one state to another state.



6.5 System Architecture



Input Image: The input image is taken from the pi camera which is connected to the Raspberry pi kit for the processing of the emotion recognition.

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 angry, disgust, normal, sad, surprised, happy.

Image Acquisition: Images used for facial expression recognition are static images or image sequences. Images of face can be captured using pi-camera.

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.

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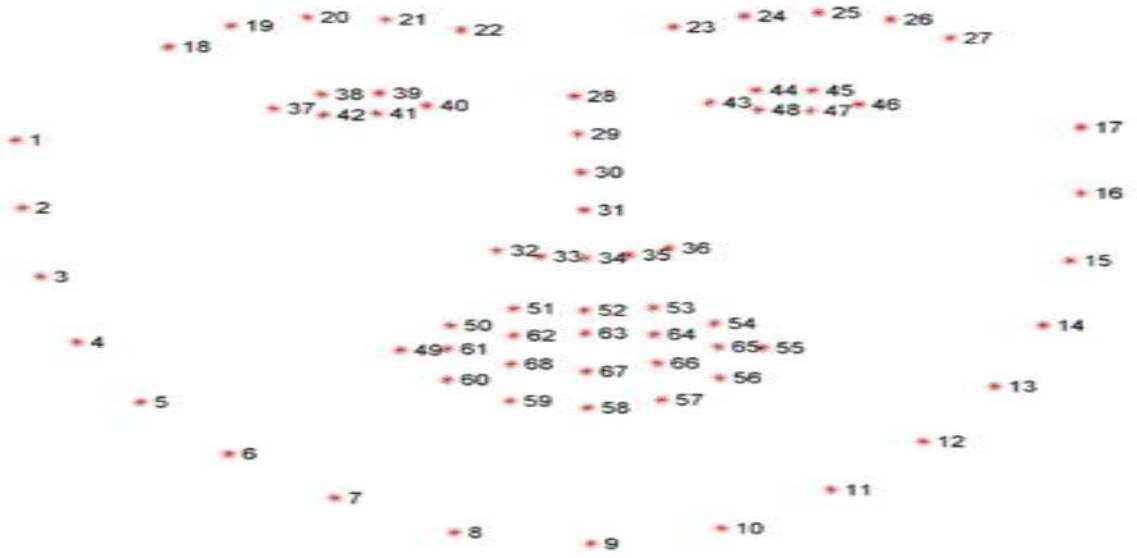
Image Pre-processing: Image pre-processing includes the removal of noise and normalization against the variation of pixel position or brightness.

- Color Normalization
- Histogram Normalization

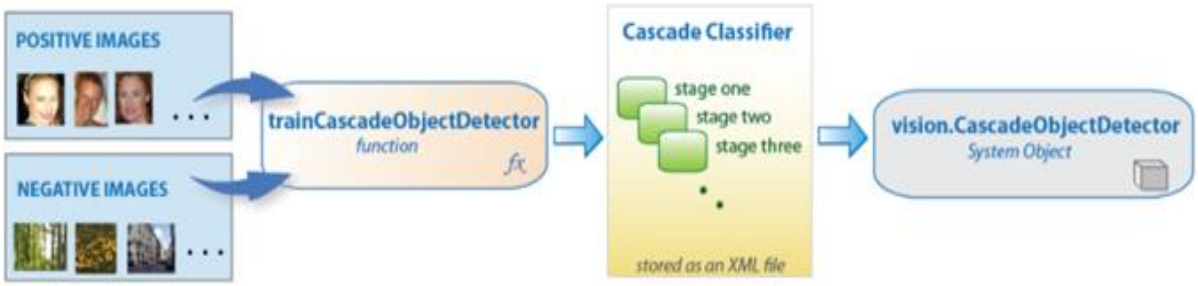
Feature Extraction: Selection of the feature vector is the most important part in a pattern classification problem. The image of face after pre-processing is then used for extracting the important features. The inherent problems related to image classification include the scale, pose.

7. ALGORITHMS

1.Facial Landmark - Face landmark detection is the process of finding points of interest in an image of a human face. For example, we have shown the ability to detect emotion through facial gestures, estimating gaze direction, changing facial appearance (**face swap**), augmenting faces with graphics, and puppeteering of virtual characters.



2. Haar Cascade - Haar Cascade is a machine learning object detection algorithm used to identify objects in an image or video. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. It is well known for being able to identify almost any object. First step is to collect the Haar Features. A Haar feature considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums.



3. CNN - In this model, we are using CNN classifier. The classifier is utilized for the classification of the Image Fusion and Recursive Filtering features. A convolution multiplies a matrix of pixels with a filter matrix or 'kernel' and sums up the multiplication values. Then the convolution slides over to the next pixel and repeats the same process until all the image pixels have been covered.

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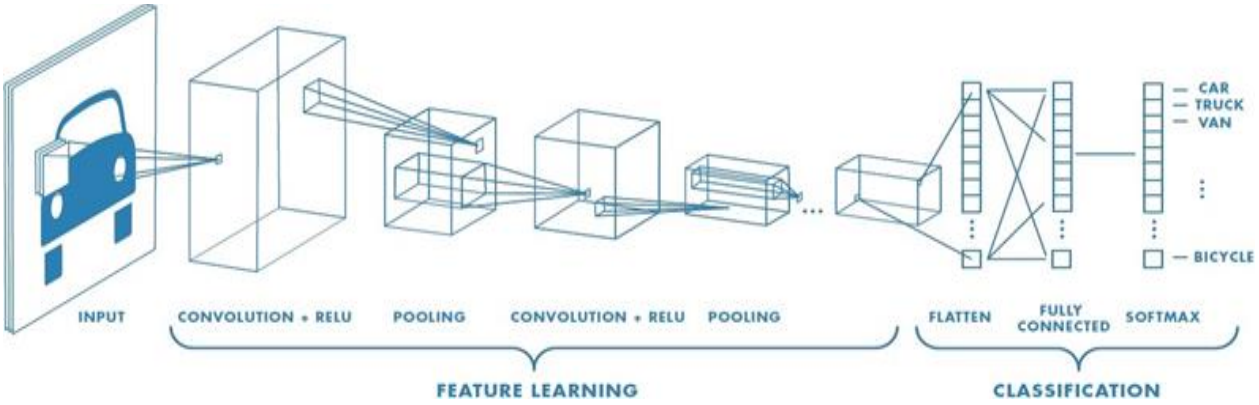
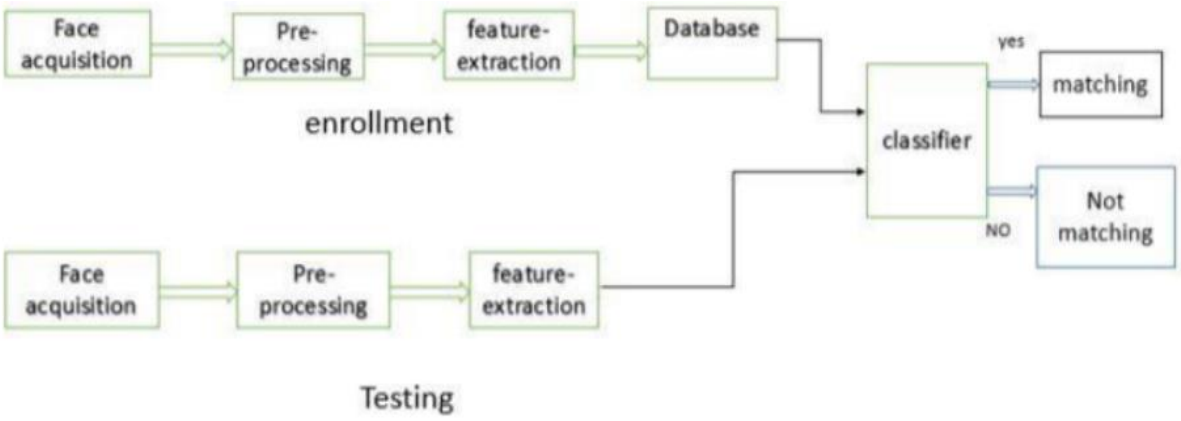


4. LBPH - The Local Binary Pattern Histogram (**LBPH**) algorithm is a simple solution on face recognition problem, which can recognize both front face and side face. Local Binary Patterns Histogram algorithm was proposed in 2006. It is based on local binary operator. It is widely used in facial recognition due to its computational simplicity and discriminative power.

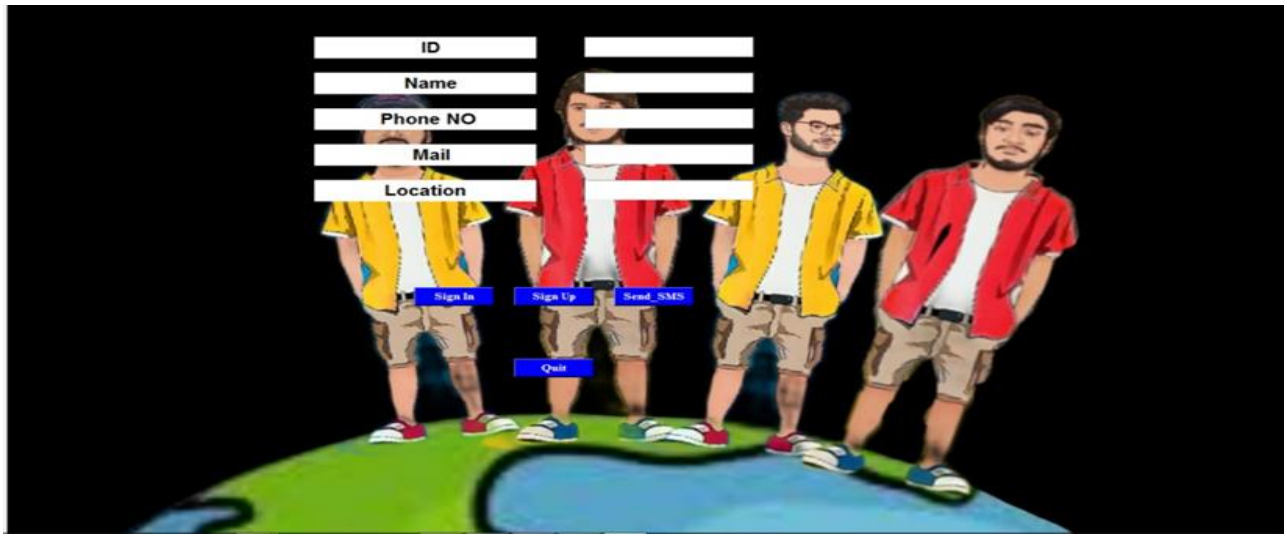


8. SYSTEM IMPLEMENTATION

8.1 MODULES

Module-01 REGISTERATION:

Here we fill the id, name, phone number, mail, location and sign up where the data will be stored in XL sheet for further information of the candidate where it can be used.



Module-02 FACE RECOGNITION:

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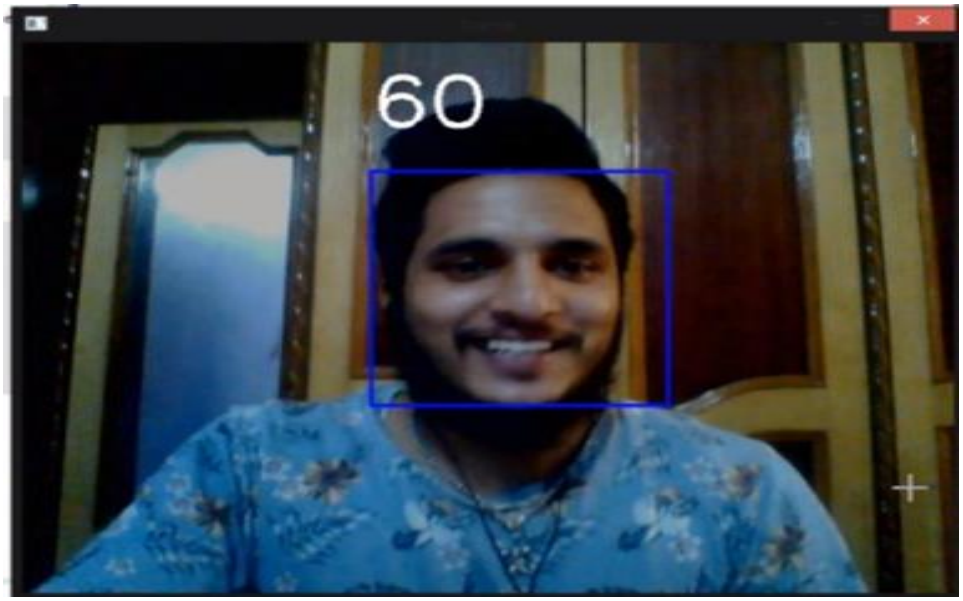
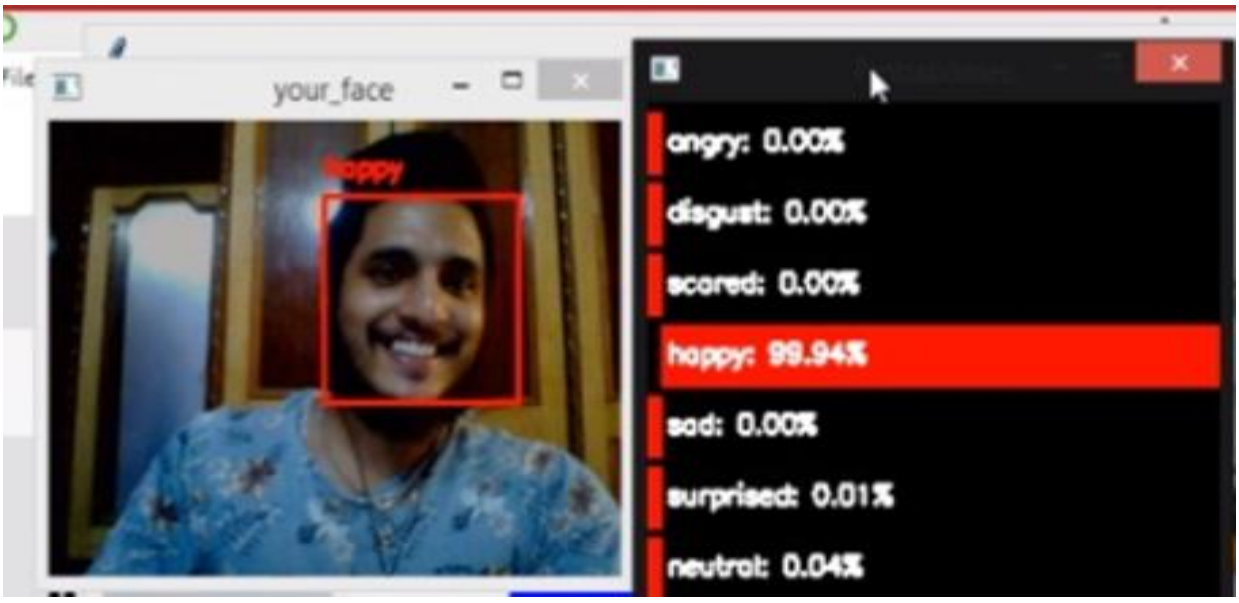
In this part, we use an algorithm called Harr cascade for face recognition in which we convert the input image to gray scale image and then resize the image according to our purpose. We take about 121 photos for training with some delay for one after another and the image capturing shall be shown on the window, after capturing 121 photos the window shall destroy.



Module 03- EMOTION RECOGNITION:

In this section we recognize different kinds of emotions through the previously performed CNN model. Here we recognize of about 7 emotions they are angry, disgust, scared, happy, sad, surprised, neutral, where these emotions are lively recognized in a small window. After some delay the window gets destroyed and if the emotion is angry, sad, disgust is more than 55% the it gets termed as stress for the following person and it shall be even stored in the XL sheet for further information.



9. RESULT and FUTURE WORK

Here different kinds of emotions can be seen, where the emotion angry, sad, disgust is more than 55% the it gets termed as stress for the following person and it shall be even stored in the XL sheet for further information. Here Twilio account is used for sending message for concerned student and principal, if the student is under stress or not, as the data

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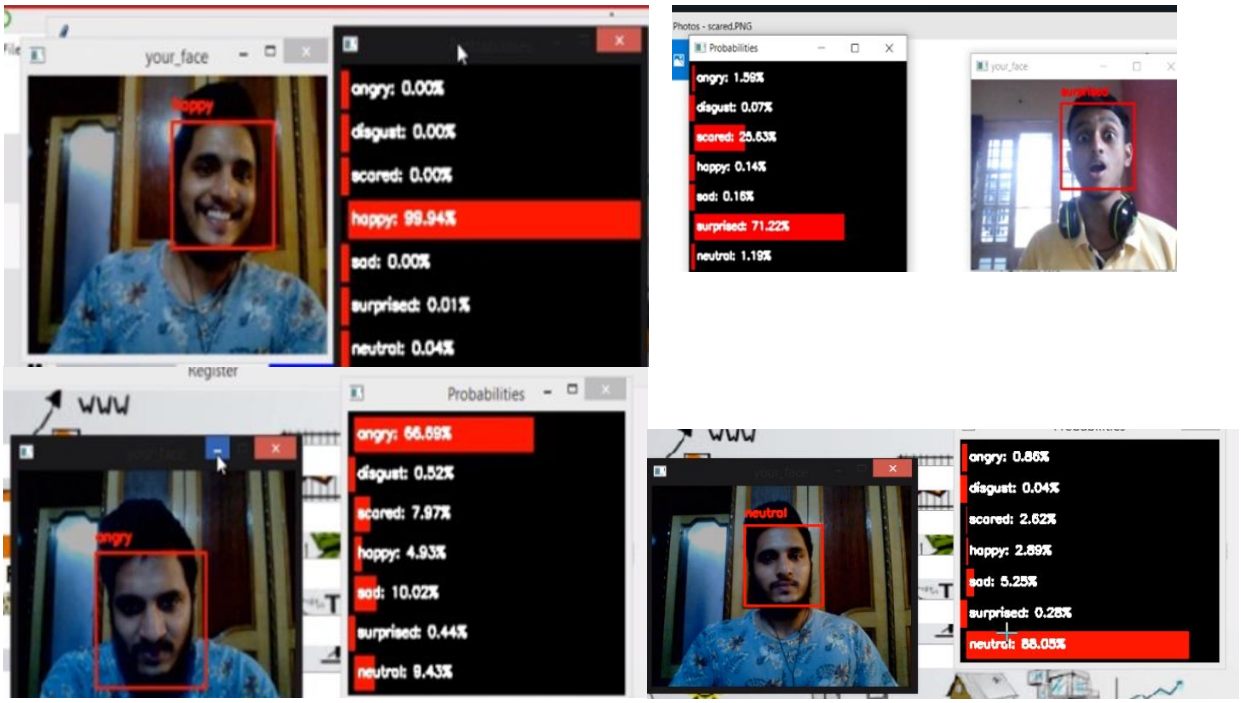
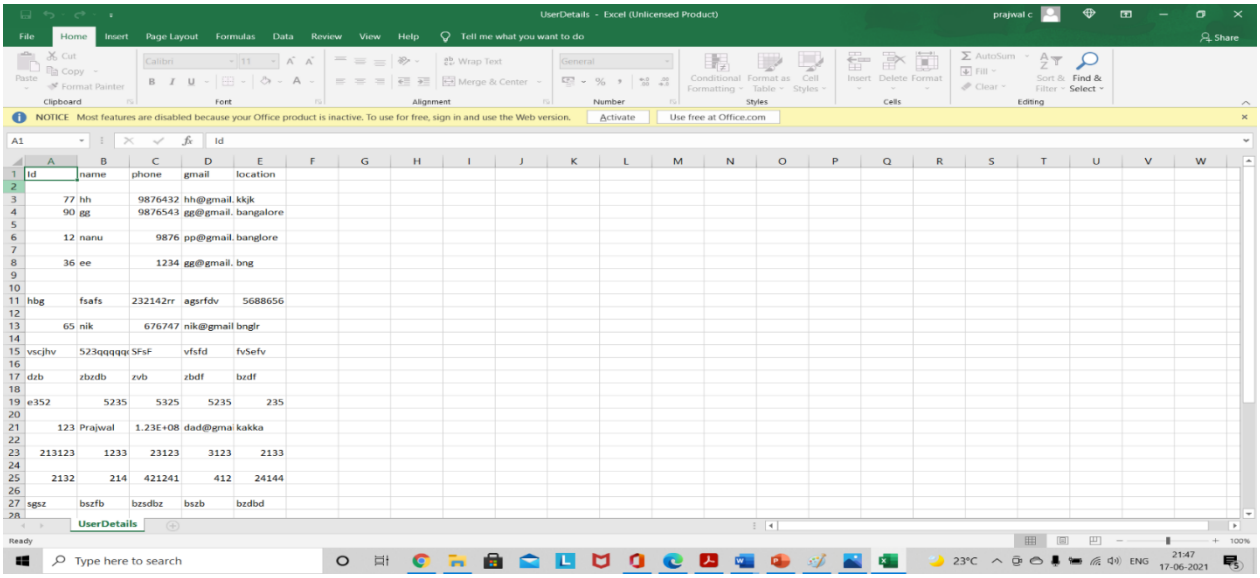
shall be stored in the XL sheet and will be accessible for the principal he shall be monitoring on every student. In future by using more dataset the accuracy of the emotions can be further improved and other features can also be added.





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65	nik	676747	nik@gmail	bnglr
vscjhv	523qqqqq	SFsF	vfsfd	fvSefv
dzb	zbzdb	zvb	zbdf	bzdf
e352	5235	5325	5235	235
123	Prajwal	1.23E+08	dad@gma	kakka
213123	1233	23123	3123	2133
2132	214	421241	412	24144
sgsz	bszfb	bzsdbz	bszb	bzdbd

10. CONCLUSION

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. Here seven different facial expressions of students' 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 convolutional neural network. This project recognizes more facial expressions based on JAFFE, COHN-

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KANADE face database. To measure the performance of proposed algorithm and methods and check the results accuracy, the system has been evaluated using Precision, Recall and score.

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