ORIGINAL RESEARCH PAPER

Computer Science

FACIAL EMOTION RECOGNITION SYSTEM USING CNN

KEY WORDS: Facial Emotion, CNN, human-machine interaction.

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ABSTRACT

Humans share a universal and fundamental set of emotions which are exhibited through consistent facial expressions. The Human Facial expression convey a lot of information visually. Emotions control our thinking, behavior and actions. Facial expression for emotion detection has always been an easy task for humans, but achieving the same task with a computer algorithm is quite challenging. An algorithm that performs detection, extraction, and evaluation of these facial expressions will allow for automatic recognition of human emotion in images and videos. It plays a crucial role in the area of human-machine interaction.

1. INTRODUCTION

Emotion is triggered by specific situations, and the recognition of human emotion is a crucial topic in the study of human-computer interfaces (HCIs) to empathize with people. Emotions are expressed in a variety of ways, such as facial expressions, voices, physiological signals, and text. Facial Expressions plays an important role in interpersonal communication. One of the important wings in artificial intelligence and robotics is the recognition of facial expression. Some applications of this are related to Forensic application, Human-Computer Interaction, Automated Surveillance, Cosmetology and so on.

1.1 Problem Definition : With the help of activation of facial muscles, it is possible to know the facial emotions. Through this, it is possible to monitor audience engagement in events by entertainment producers, to consistently create desired content.

"Developing an Automatic Facial Expression Recognition System which can take human facial images containing some expression as input and recognize and classify it into different expression classes such as Happy, Sad, Angry, Neutral, Surprise and Fear".

1 LITERATURE SURVEY

Literature survey is the most important step in the software development process. The data required to find the emotions is to be analyzed for finding the feelings. Such data may be obtained from different physical features such as face, voice, body movements, and other biological physical signals. However, learners' emotions are expressed first through facial expressions. This can be divided into various kinds of categories like : sadness, happiness, surprise, fear, anger and disgust. The facial recognition process consists of three main stages: acquisition, feature extraction, and emotion classification.[6]

The technologies that can be used in this context may include Python, Flask Frame Work and
Bootstrap.

ANALYSIS

3.1 Existing System :

In the existing System, Haar-Cascades algorithm is used, in which there were pre trained modules which caused difficulty for face detection when there were bulk amount of images as it couldn't inspect all the images, the other drawback was faces are detected where there really aren't any faces present and also it was able to detect faces only with clear edges and lines.

3.2 Proposed System

There are several different methods for Facial Emotion Recognition. In this system we are using Convolutional Neural Networks (CNN). A CNN is a Deep Learning Algorithm which can have hundreds of layers and each layer learn to detect different features of an image. This helps to overcome the disadvantages of the previous systems. CNN has high computational speed. Preprocessing requirement is much lower in this algorithm compared to others and also it is possible to correctly predict the emotions with 96% accuracy

3.3 Scope

This paper deals with measuring the facial expressions of human beings. It does not deal with rest of body of the humans. As there exist some methods which do the same job they are also considered here. It is not so easy to identify the emotions in the real-time environment. Different type of tests will be implemented using proposed strategy like visualization of the experimental results and drawing appropriate performance analysis. Appropriate conclusion will be made based upon performance analysis.

3.4 Functional Requirements

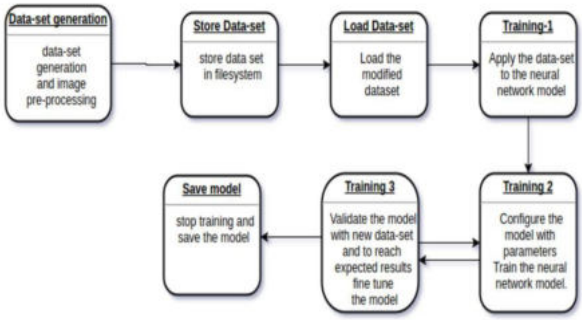
The following are the functional requirements:

FR1: Loading face images
FR2 : Preprocessing of Images.
FR3: Face Detection
FR4: Loading the model

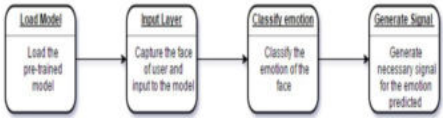
4. DESIGN

4.1 DATA FLOW DIAGRAM:

Data Flow diagram for Training:



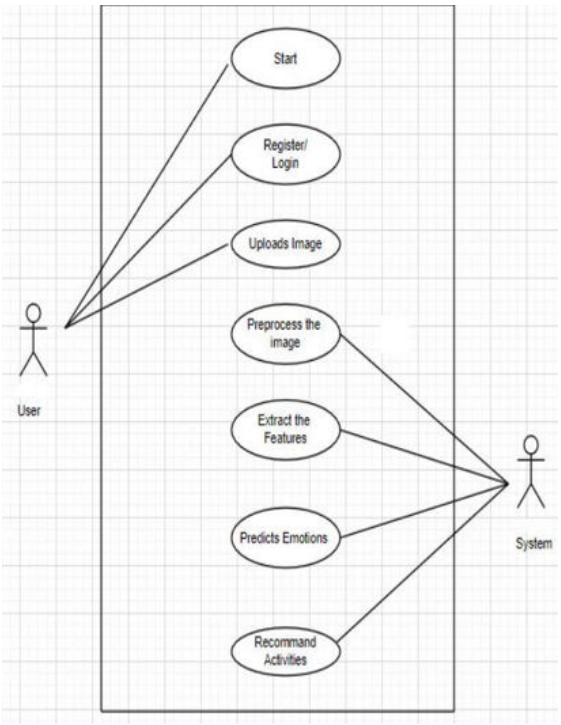
b) Data Flow diagram for Testing :



4.2 UML DIAGRAMS

a) Use Case Diagram

We use a specialized symbols and connectors in the UML, as follows :

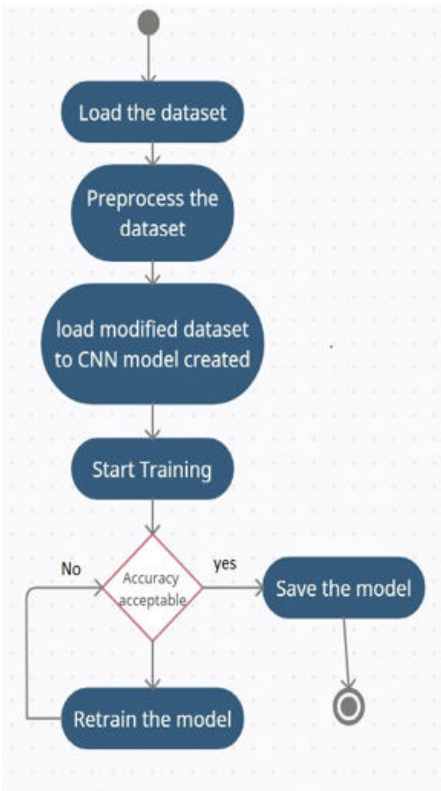


b) Activity Diagram :

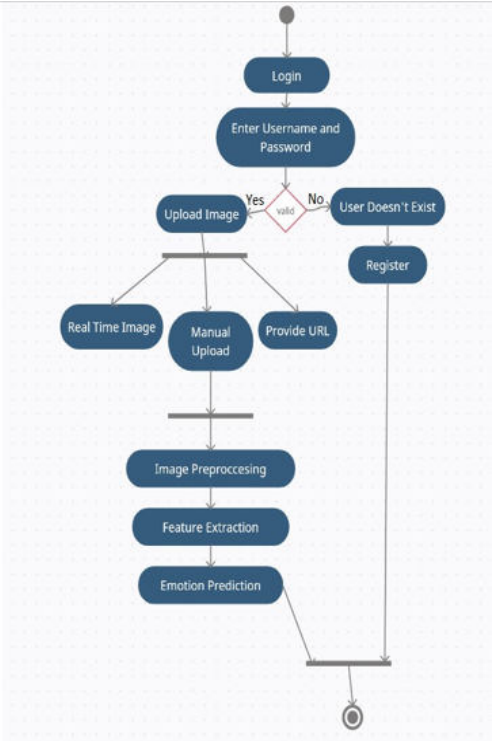
The flow from one activity to other activity can be represented by 'Activity Diagram'.

There are three types of flows : sequential, branched or concurrent.

Activity diagram for Training:

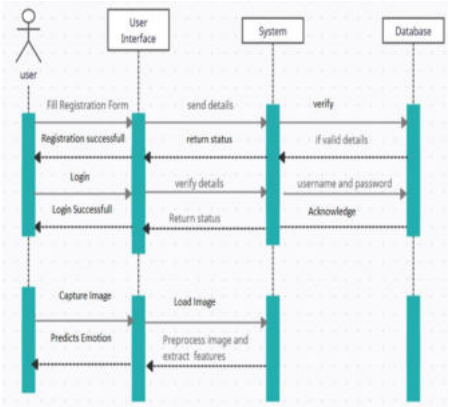


Activity Diagram for Testing :



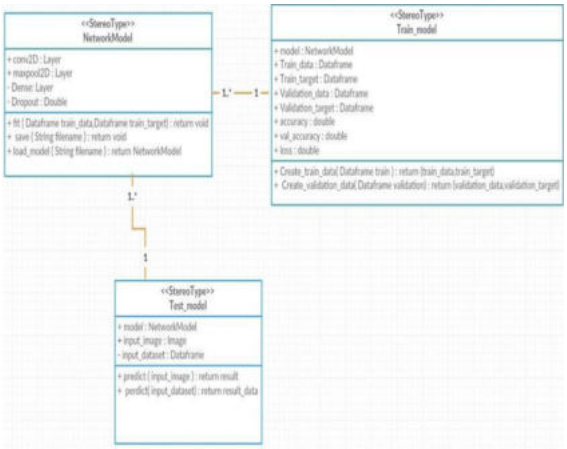
c) Sequence Diagram

Sequence diagrams specifically focus on lifelines, or the processes and objects that live simultaneously, and the messages exchanged between them to perform a function before the lifeline ends.



d) Class Diagram

Class diagrams are used for constructing executable code of the software application. It is also known as a structural diagram.



5. IMPLEMENTATION

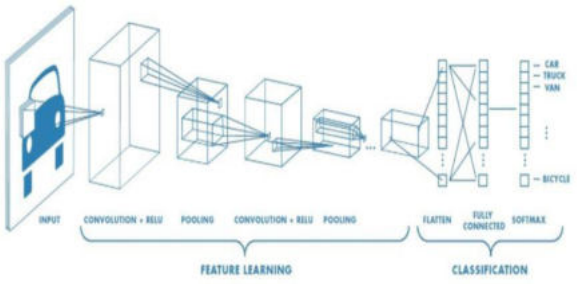
5.1 APPROACHES USED

CONVOLUTIONAL NEURAL NETWORK(CNN):

One of the artificial neural network, used in image recognition is CNN.

A CNN is a type of artificial neural network used in image recognition. This comes under category of multilayer perceptron.

The are four layers in CNN : input layer output layer
hidden layer normalization layer



The Network Layers:

- **Image Input Layer** An Image Input Layer is where you specify the image size
- **Convolutional Layer** It is a CNN filter , where inputs are filter size and number of neurons.
- **Batch Normalization Layer** Batch normalization layers normalize the activations and gradients propagating through a network.
- **ReLU Layer** It is a linear rectified unit , it is used to convert negative feature to 0.
- **Max-Pooling Layer** It is used for down sampling and to reduce redundant features.
- **Fully Connected Layer** It is used to connect all neurons and we provide number of classes in it.
- **Softmax Layer** It is used to find out the probability of object in the image.

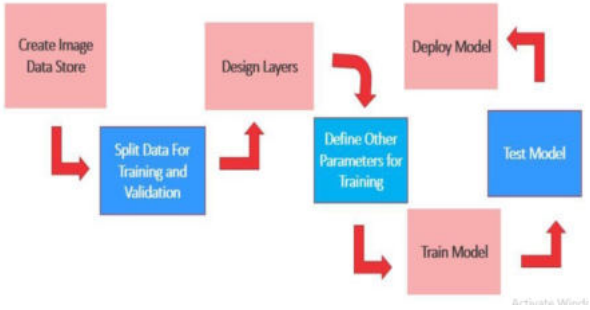
Classification Layer Based on the softmax layer it identify the object from the image.

WORKFLOW:

VGG-16:

VGG16 is a CNN model. The model achieves 92.7% top-5 test accuracy in ImageNet, which is a dataset of over 14 million images belonging to 1000 classes. It makes the improvement over AlexNet by replacing large kernel-sized filters with multiple 3×3 kernel-sized filters one after another.

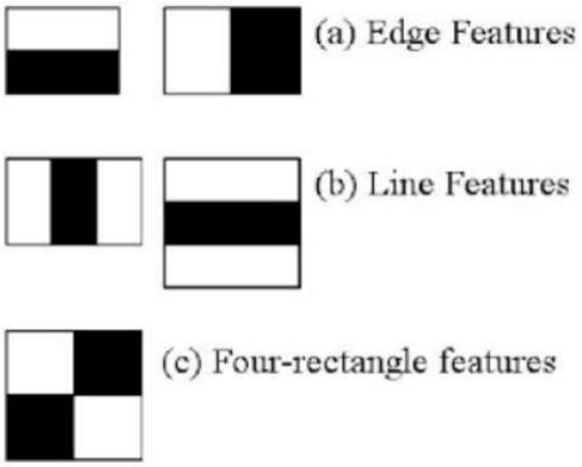
VGG-16:



5.2 Haar Cascades Algorithm for Face Detection:

This algorithm is an effective method of detecting object, which is proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. The case study for this algorithm requires a lot of positive images and negative images. Then features will be extracted.

The following is an example, where each feature is a single value obtained by subtracting sum of pixels under white rectangle from sum of pixels under black rectangle.



Here, the concept of Cascade of Classifiers in this context is introduced. Then, group the features into different stages of classifiers and apply one-by-one. If a window fails the first stage, discard it. We don't consider remaining features on it. If it passes, apply the second stage of features and continue the process. The window which passes all stages is a face region.

Authors' detector had 6000+ features with 38 stages with 1, 10, 25, 25 and 50 features in first five stages. So this is a simple intuitive explanation of how Viola-Jones face detection works.

5.1 Cascading:

For every 24*24 window, we need to calculate 2,500 relevant features that are picked by AdaBoost..

The basic principle of the Viola-Jones face detection algorithm is to scan the detector many times through the same image — each time with a new size.

- Even if an image should contain one or more faces it is obvious that an excessively large amount of the evaluated sub-windows will still be negatives.
- So the algorithm should concentrate on discarding non-faces quickly and spend more on time on probable face regions. [9]
- Hence a single strong classifier formed out of the linear combination of all best features is not good to evaluate on each window because of computation cost.

Here, the viola-Jones face detection algorithm is trained and weights are stored in the disk.

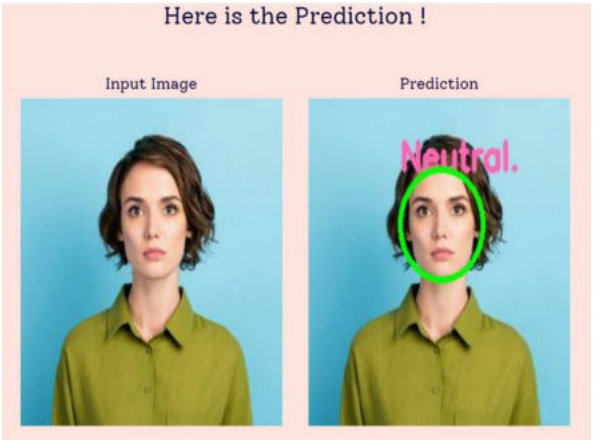
6. TESTING

Introduction to Testing

According to ANSI/IEEE 1059 standard, Testing can be defined as - A process of analyzing a software item to detect the differences between existing and required conditions (that is defects/errors/bugs) and to evaluate the features of the software item.

Test Case Scenarios:

S.No	Test-Case Name	Input	Expected Result	Actual Result	Pass/Fail/Not Executed
1	TC1	Upload the Image	System moves forward	System moves forward	Pass
2	TC2	Doesn't Upload the Image	System doesn't move forward	System doesn't move forward	Fail



7. CONCLUSION

The Human Emotion Recognition System is developed based on Face detection and Facial expression Analysis. This is all about how computers detect emotion properly from its various sensors. In this we have used facial image as a medium to read human emotions.

There are some basic emotions such as happy, sad, angry, neutral etc.. that are universal to human beings that can be recognized from human facial expression. Thus it helps in reducing the gap of human-computer interaction.

8. FUTURE ENHANCEMENT

The Haar cascading algorithm has some limitations. So, it may be suggested to use Gabor filter based feature extraction in combination with neural network for the recognition of different facial emotions with more accuracy and better performance.

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