TECHNO ENGINEERING COLLEGE BANIPUR

Emotica.AI

(Emotion Detection & Classification System)

Team Members

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Under the Supervision of
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TECHNO ENGINEERING COLLEGE BANIPUR

STUDENT DECLARATION

We, the undersigned solemnly declare that the report of the project work entitled "EMOTICA.AI (EMOTION DETECTION AND CLASSIFICATION SYSTEM)", is based on our work carried out during the course of study under the supervision of Mrs. Sayantani Ghosh.

We assert that the statements made and conclusions drawn are an outcome of the project work. We further declare that, to the best of our knowledge and belief that the project report does not contain any part of any work which has been submitted for the award of any other degree/diploma/certificate in this University.

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SUPERVISOR'S RECOMMENDATION

I hereby recommend that this project work report is satisfactory in the partial fulfillment of the requirement of Software Engineering project work in and be processed for the evaluation.

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Mrs. Sayantani Ghosh
Software Engineering
(Lecturer)

Date:

ACKNOWLEDGEMENT

It is a great pleasure to have the opportunity to extend our heartfelt gratitude to everyone who helped us throughout the course of this project. We are profoundly grateful to our subject teacher Mrs. Sayantani Ghosh, for her expert guidance, continuous encouragement and her willingness to spare time from her busy schedule for the project's progress reviews. Her continuous inspiration has made us complete this project and achieve its target.

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At last our special thanks to all the faculty members of CSE-IT department who directly and indirectly extended their hands in making this project a success.

1. Abstract

In this era the rampant growth of wireless technology and Mobile devices is creating a great impact on our lives. The digital economy requires services to be created in nearly real time – while continuously listening to the customer. Managing and analyzing the data collected about products from customers becomes hectic. Successful companies usually collect feedback data regarding customer behavior in a sensible manner, understand their customers and engage in constant interaction with them. But when it comes to small business owners it is very difficult for them to analyze whether their customers are really satisfied or not. It's not even an easy task to keep a record of each and every customer' feedback on a daily basis. It is also frustrating when you do not get clear feedback whether the product was satisfactory or not. It is not a problem to collect data, but it is very difficult to analyze it and it is time-consuming. To utilize the data they collect and analyze customer feedback quickly, companies require automation of customer feedback processing.
To proceed with the problem and through much research we come to the solution, if an emotion detection system can overcome this situation in real time. Emotion detection plays an important role in interpersonal relationships. People express their emotions directly or indirectly through their speech, facial expressions, gestures or writings and Now AI has harnessed the power of Learning and it can treat every object the way humans do.
Our goal is to develop a real time implementation of emotion detection system with better accuracy and make it more reliable for business.

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.

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1. INTRODUCTION

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 has progressed 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.

The system classifies facial expression 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 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, 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.

1.1 Motivation

Large corporations make huge investments to get feedback and surveys for their product satisfaction. Such corporations spend huge amounts of money. If we will be able to provide our stakeholders a system which can track the emotions of their customer automatically, then we can hear the real voice of their customers, whether they are actually satisfied. It can easily benefit by monitoring customer behavior to their products or staff service by using emotion recognition systems. This can give them proper data to improve their products and services and optimize their business model accordingly.

1.2 Problem Statement

- Companies get massively charged for the feedback & survey services offered by the third-party companies, which excludes the smaller companies from getting these facilities.
- Poor user - feedback ratio of products results in lack of reviews and thus lack of proper R & D related to the problems faced by the customers.
- User Privacy is a major concern while using facial recognition technology.

1.3 Objectives

- To develop a facial expression recognition system.
- To experiment with machine learning algorithms in computer vision fields.
- To detect emotion thus facilitating Intelligent Human-Computer Interaction.

1.4 Scope and Application

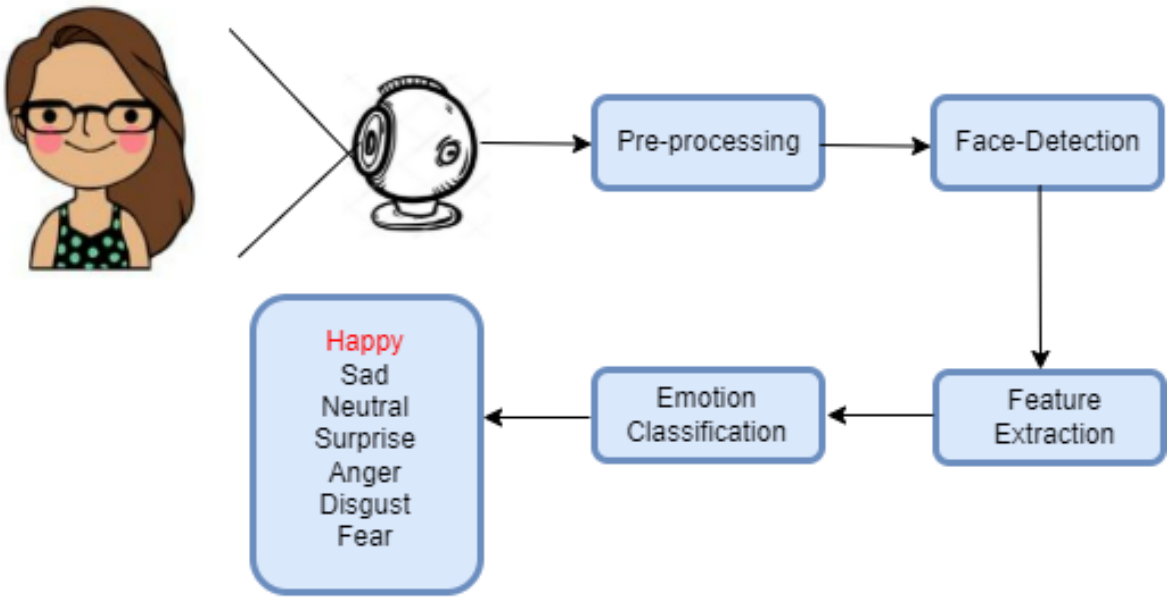
The scope of this system is to tackle the problems that can arise in day to day life.Some of the scopes are:
1.The system can be used to detect and track a user’s state of mind.
2.The system can be used in mini-marts, shopping centers to view the feedback of the customers to enhance the business.
3.The system can be installed at busy places like airports, railway station or bus station for detecting human faces and facial expressions of each person. If there are any faces that appeared suspicious like angry or fearful, the system might setan internal alarm.
4.The system can also be used for educational purposes such as one can get feedback on how the student is reacting during the class.
5.This system can be used for lie detection amongst criminal suspects during interrogation
6.This system can help people in emotion related -research to improve the processing of emotion data.
7.Clever marketing is feasible using emotional knowledge of a person which can be identified by this system.

2. PROJECT METHODOLOGY

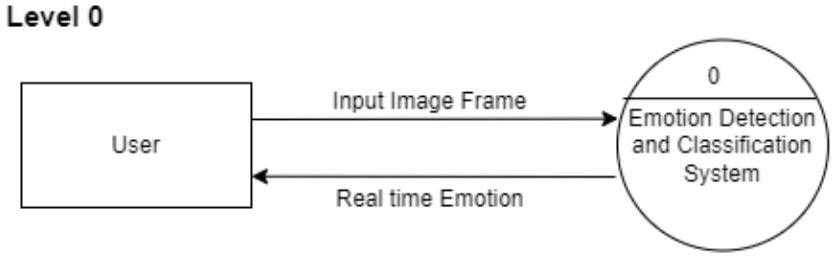
2.1 System Design

System design shows the overall design of the system. In this section we discuss in detail the design aspects of the system.

2.1.1 System Block Diagram



2.1.2 System DFD



Level 1

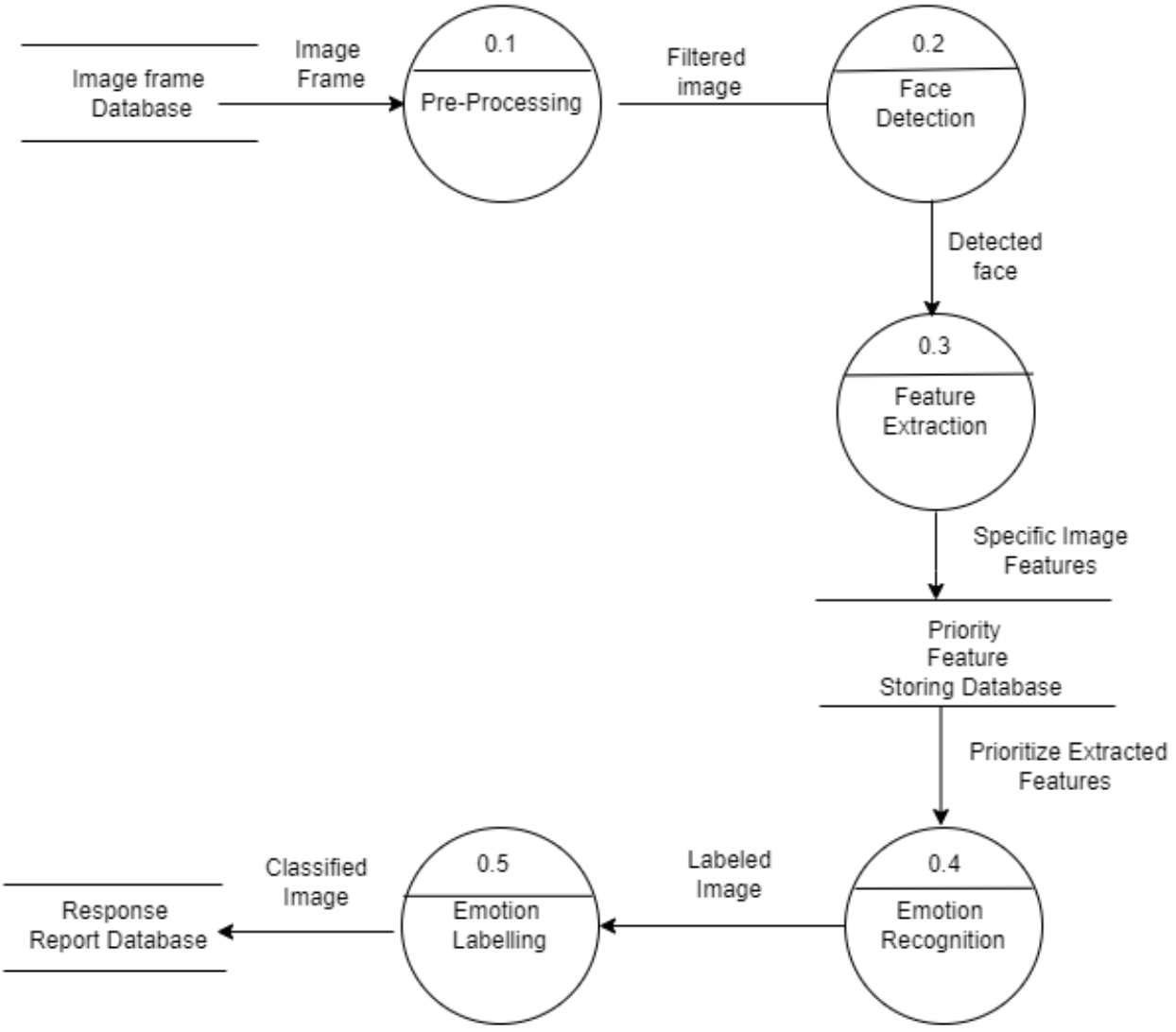
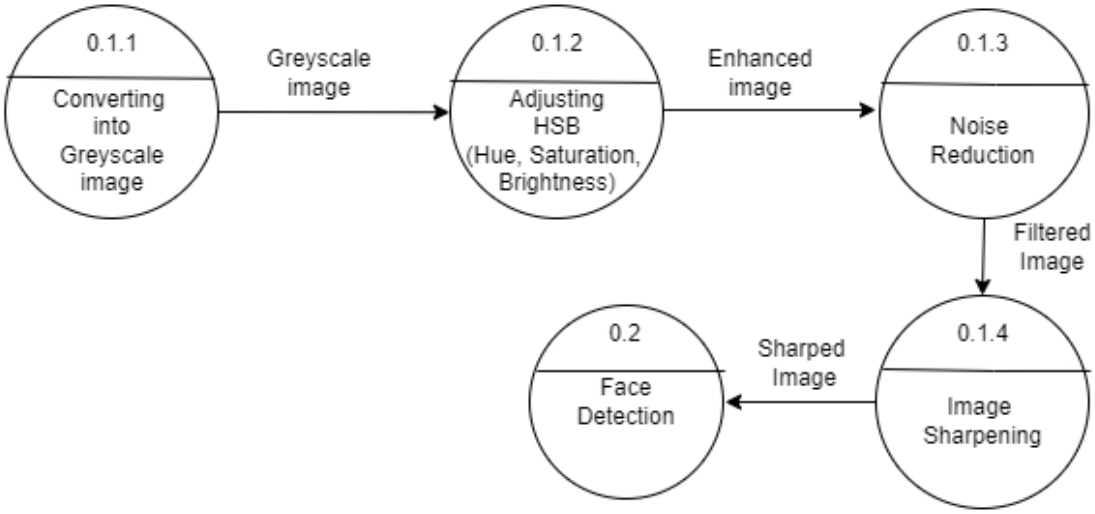


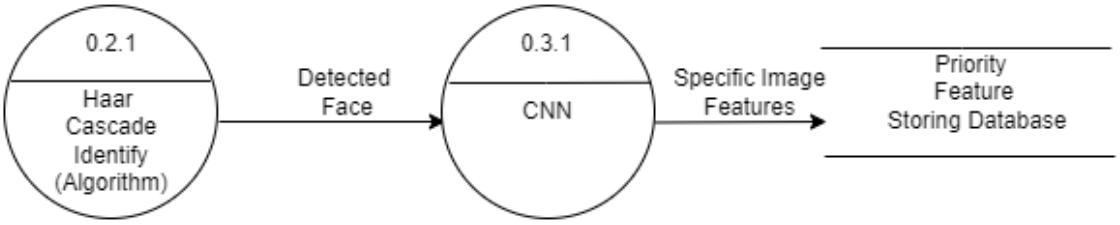
Image frame Database
Image Frame
0.1
Pre-Processing
Filtered image
0.2
Face Detection
Detected face
0.3
Feature Extraction
Specific Image Features
Priority Feature Storing Database
Prioritize Extracted Features
0.4
Emotion Recognition
Labeled Image
0.5
Emotion Labelling
Classified Image
Response Report Database

Level 2

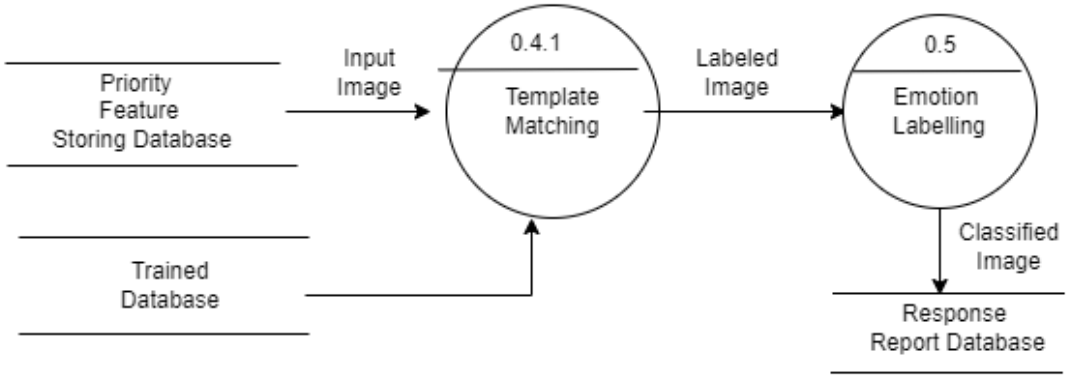
Pre-Processing



Face Detection & Feature Extraction



Emotion Recognition & Classification



Data Dictionary

Field Name	Description
Image Frame	Extracted picture frame from video
Filtered image	Grayscale image
Detected face	Image containing detected faces
Feature Extracted Image	Image containing various extracted features from face, e.g. eyes, eyebrows, cheeks, lips, etc
Labeled Image	Image containing single or multiple labeled emotions.
Classified image	Image classified and tagged with proper emotion

2.2 Phases in Emotion Detection and Classification System

The system is trained using a 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:

2.2.1 Video Acquisition

Videos used for the Emotica.AI System are real-time or dynamic and captured using a camera.

2.2.2 Pre-Processing

Image pre-processing includes the removal of noise and normalization against the

variation of pixel position or brightness. a)Converting into grayscale image b)Noise Reduction c) Image Sharpening.

2.2.3 Face Detection

Face Detection is useful in the detection of facial images. Face Detection is carried out in a training dataset using a Haar classifier called Viola-Jones face detector and implemented through Opencv. Haar like features encodes the difference in average intensity indifferent 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

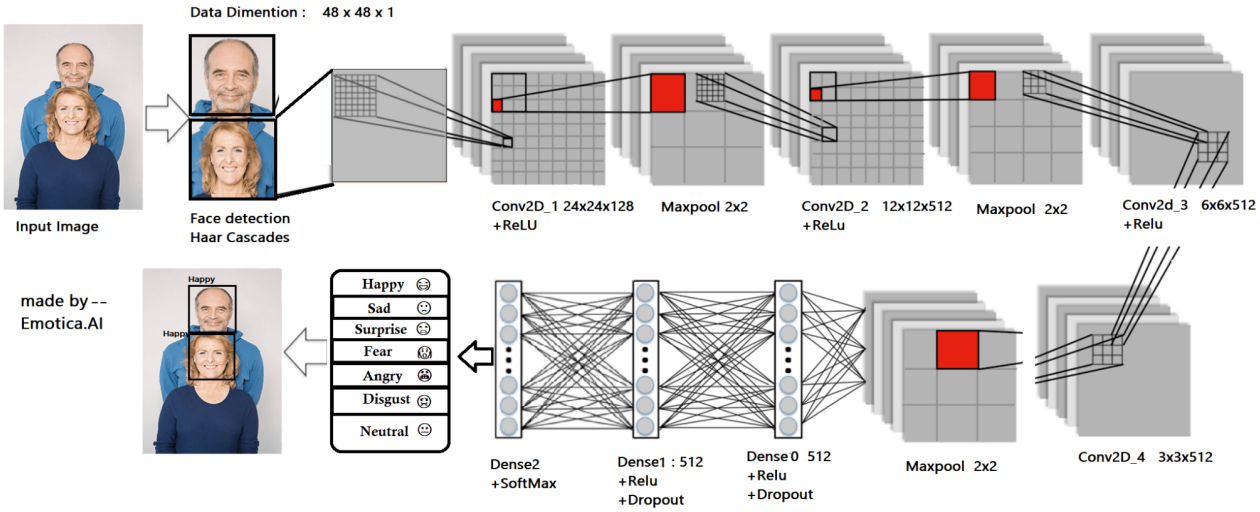
2.2.4 Feature Extraction

Emotica.AI is using CNN for facial feature extraction with CNN through which we will pass our features to train the model and eventually test it using the test features. We have 48x 48-pixel resolution so we have width and height as 48. Then we have 7 emotions that we are predicting namely (0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral), so we have 7 labels. We will be processing our inputs with a batch size of 64.Next, we load the features and labels into `x` and `y` respectively and standardized `x` by subtracting the means and dividing by the standard deviation.We have used a combination of several different functions to construct CNN.

1. `Sequential()` - A sequential model is just a linear stack of layers which is putting layers on top of each other as we progress from the input layer to the output layer.
2. `model.add(Conv2D())` - This is a 2D Convolutional layer which performs the convolution operation as described at the beginning of this post. To quote Keras Documentation " This layer creates a convolution kernel that is convolved with the layer input to produce a tensor of outputs." Here we are using a 3x3 kernel size and Rectified Linear Unit (ReLU) as our activation function.

3. `model.add(BatchNormalization())` - It performs the batch normalization operation on inputs to the next layer so that we have our inputs in a specified scale say 0 to 1 instead of being scattered all over the place.
4. `model.add(MaxPooling2D())` - This function performs the pooling operation on the data as explained at the beginning of the post. We are taking a pooling window of 2x2 with 2x2 strides in this model. If you want to read more about MaxPooling you can refer the Keras Documentation or the post mentioned above.
5. `model.add(Dropout())` - As explained above Dropout is a technique where randomly selected neurons are ignored during the training. They are "dropped out" randomly. This reduces overfitting.
6. `model.add(Flatten())` - This just flattens the input from ND to 1D and does not affect the batch size.
7. `model.add(Dense())` - According to Keras Documentation, `Dense` implements the operation: `output = activation(dot(input, kernel)`where `activation`is the element-wise activation function passed as the `activation` argument, `kernel` is a weights matrix created by the layer. In simple words, it is the final nail in the coffin which uses the features learned using the layers and maps it to the label. During testing, this layer is responsible for creating the final label for the image being processed.

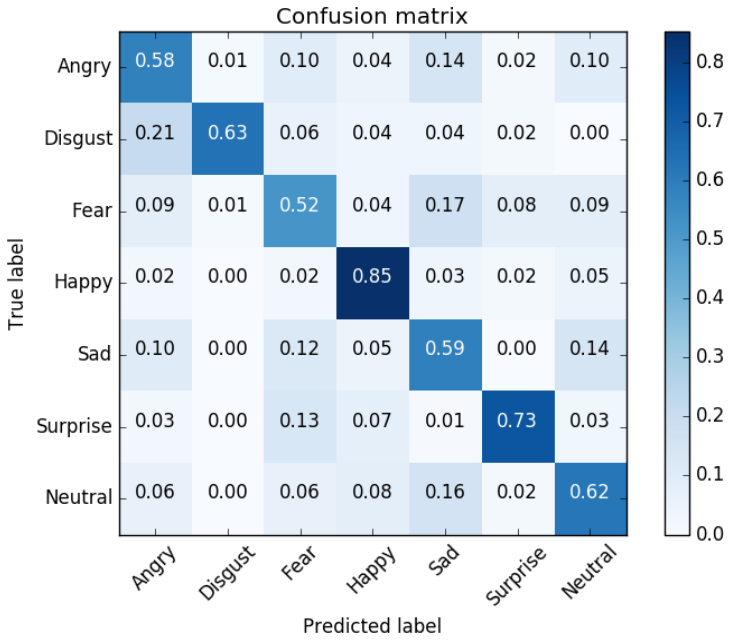
The model is compiled with categorical_crossentropy as the loss function and using Adam optimizer. We are using accuracy as the metrics for validation.



2.2.5 Classification

The dimensionality of data obtained from the feature extraction method is very high so it is reduced using classification. Features should take different values for object belonging to different class so we pre labeled our dataset with the 7 class names.

Confusion matrix to find out which emotions usually get confused with each other more often and it looked something like this-

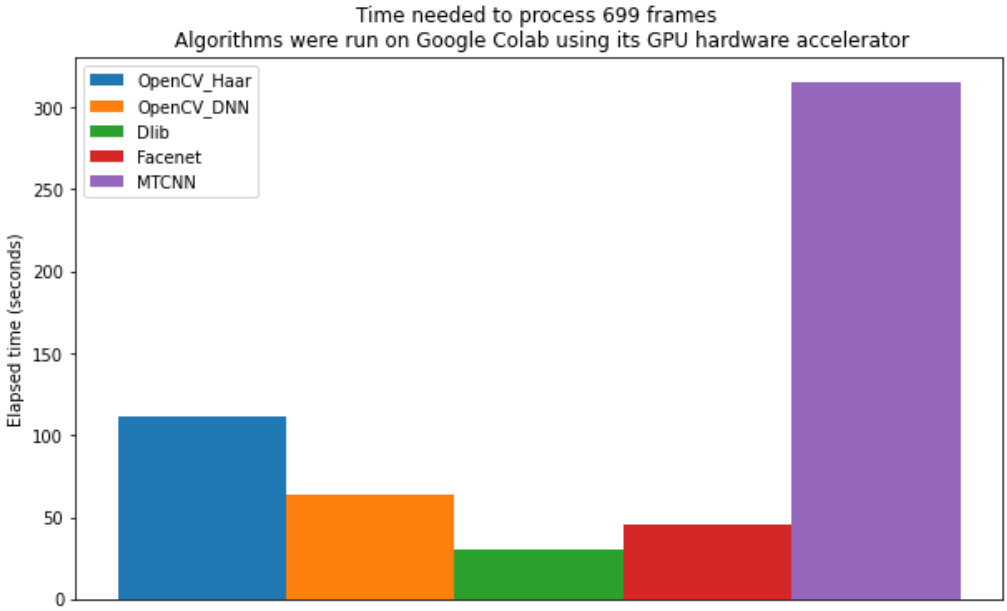


3. Experimental Results

Artificial intelligence techniques are applied to identify patterns in the data. We used a lot of AI techniques to determine the emotion of a person and then collected the data. We further extended our research and used those data to solve real-life problems.

A. Face detection

We tested some algorithms on a single video and the outcomes were like this :



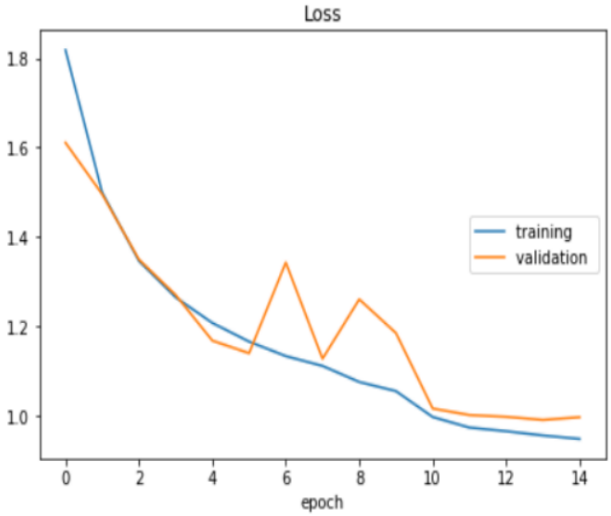
Here we have selected the Haar cascade identifier algorithm to detect faces in our project . We have more powerful techniques available for face detection but we are considering our stakeholders using normal PCs which are available in the market. Therefore this simple algorithm for face detection uses minimum computational power.

B. Emotion Classification

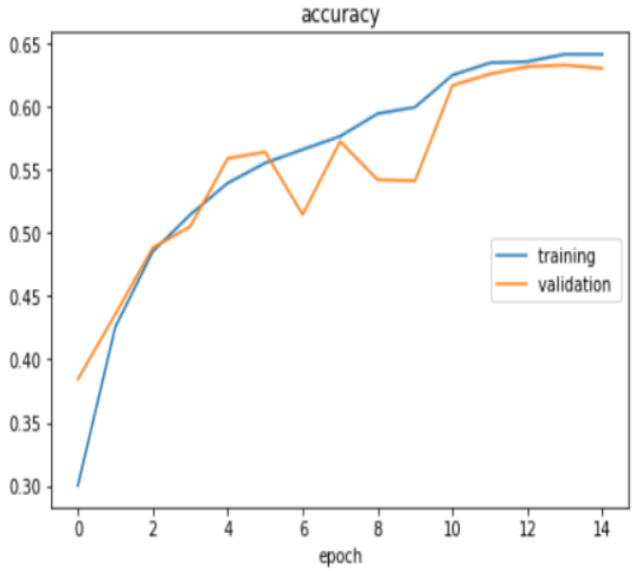
Emotion classification is as important as feedback meant to you.
We came across many emotion classification mechanisms and we chose the best possible mechanism for your problem.

Hence, we are using a model trained in CNN(Convolutional Neural Network) for this purpose :

Accuracy score for loss and validation:

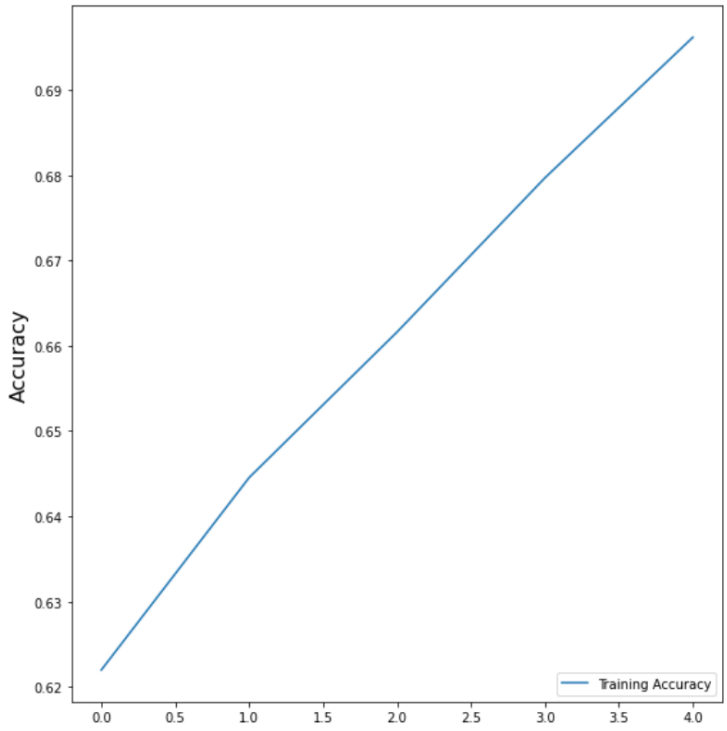


1.Loss per epoch



2.Accuracy per epoch

Overall accuracy:



4. Conclusion

Emotica.AI is an important improvement in the area of customer feedback system .The proposed work is used to identify facial emotions from the real-time video and classify different emotions. In Emotica.AI, Haar-Cascade Algorithm is used to detect the face and to extract the features then for final emotion recognition, each facial emotion is predicted and classified using a trained model with CNN. Accuracy of this model is around 69~71% is achieved for seven emotions on a real -time basis.

5. Future Scope

The market for Facial Expression Recognition(FER) technologies is estimated to grow from $19.5 billion in 2020 to $56 billion by 2024.

Uses for Expression Recognition

Deep Fake Detection

With increase in deep fake technology and videos, spread of misinformation is becoming rampant.
In 2019, the Computer Vision Foundation partnered with UC Berkeley, Google, and DARPA to produce a system claimed to identify deepfake manipulations by analyzing facial expressions in the targeted subjects.

Medical Research into Autism

Patients suffering from autism spectrum disorder (ASD), where they have developmental and long-term difficulties in evaluating facial emotions can be helped to improve their emotion recognition skills.
Even children can be diagnosed with autism and already a project has used machine learning to develop an app to identify children for autism by running the subject's facial reactions to a movie through a behavioral coding algorithm in order to identify the nature of their responses.

Automotive Industry

Automotive is another industry where emotion detection and recognition technologies are in high demand.
A number of cars trained by machine learning already have emotion recognition included. Such systems can understand if a driver is not looking at the road, is making a hands-on phone call or if the driver is falling asleep and can give appropriate alerts/warnings and make changes to the autonomous driving system.

Facial Emotion in Interviews

A candidate-interviewer interaction is susceptible to many categories of judgment and subjectivity, which may make it hard to determine whether a candidate's personality is a good fit for the job. Identifying what a candidate is trying to say involves multiple layers of language interpretation, cognitive biases and the context that lies in between.Emotica.AI can measure the candidate's facial expressions to help assess their moods and personality traits. Employee morale can also be perceived using this technology by holding and recording interactions on the job. In the Human Resources (HR) field, this tool can be useful for recruiting strategies and potentially to help design HR policies that bring the best performance out of employees.

6. Reference

https://www.semanticscholar.org/paper/Human-Face-Expression-Recognition-Majumdar-Avabhrith/0c6ae7bf7a82e216d8ac55b01a0ca9fbdbf8cfc5/figure/1
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