



# Artificial Intelligence based Emotion Detection of Facial Expression in Various Sectors using Deep Learning Techniques

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**Abstract:** Over the past few years, automatic facial emotion recognition has received enormous attention. This is due to the increase in the need for behavioural biometric systems and human machine interaction where the facial emotion detection helps to predict the current emotions. In the past two years, the deployment of Artificial Intelligence based emotion detection is emerging in various sectors such as smart devices, robotics, cars etc. All the industries started to implement the Emotion detection to help the organizations to create better customer experience and unlock the cost savings. The purpose of this paper is to develop a machine learning model capable of utilizing web cameras to detect a human face and identify the emotion from it. This paper can be implemented in various sectors such as medical diagnosis where we can identify the emotions of the patients, even in education where it helps to identify the student anxiety levels etc. But in this paper, we are primarily focused on the Retail Sector where all the retailers have started looking for Artificial Intelligence based Emotion Detection in stores to capture demographic information and visitor's mood and reactions. This paper helps the retailers for analysing and identifies the emotions of the each and every customer when they visit their stores and while purchasing the products from the store. And even it helps to identify the customer satisfaction levels through emotions when they enter the stores even when they don't purchase the products. The chosen deep learning algorithm for this paper is Convolution Neural Network in short CNN. The hidden layers include convolution, pooling, dense and dropout layers.

**KEYWORDS:** Artificial Intelligence, Emotion Detection, Deep Learning Techniques, Neural Networks.

## I. INTRODUCTION

Humans interact not only with each other through speech. But also, through body language. We do this to emphasize certain parts of their speech and display emotions. One-way human's display their feelings are through facial expressions. It is a crucial part of communication. Though nothing is said verbally, there is much to be understood about the messages we send and receive through nonverbal communication. Facial expressions play an important role in human relations. Automation of recognizing facial expressions can be a vital component of natural human-machine interfaces. Even humans recognize facial emotions virtually; reliable expression recognition by machines is still a challenge. There have been several advances in the past few years in

the field of face detection, feature extraction mechanisms, and the techniques used for expression classification. But the development of an automated system that accomplishes this task is stagnant. In this paper we work on an approach based on Convolutional Neural Networks (CNN) for emotion recognition. An image is given as input to the ML model. We use CNN to predict the expression label that is one among the following labels: anger, happiness, fear, sadness, disgust, and neutral.

## II. RELATED WORK

In this digital era, face emotion recognition become a mode of effective communication between humans and machines which is possible by various technological advancements. Face Recognition is one of the fastest growing research

topics in which attempts to recognize human face and its features and make use of them. Growing researches in the said topic can lead to advancements in various fields like behavioural analysis, machine to human interaction.

In this literature review, it shows the implementation of emotion analysis using different techniques. Prudhvi Raj Dacha ally has proposed two independent methods for the aim of emotion detection. The first one uses representational auto encoders to construct a singular representation of any emotion. The other is to make a CNN and train it from scratch using fer2013 dataset. His proposed model consists of 8-layer CNN model. Sushmitha, Anand, Chetan Kumar has proposed that identification of human facial emotion is decided using facial muscles movements. Detecting the face is a challenging task. Even in facial detection there are various methods, one such method used is Haar classifier. Shervin Minaee, Amirali Abdolrashidi has proposed an end-to-end deep learning framework to classify the underlying emotion in the human face. For facial emotion recognition, due to the small number of classes, they developed a model using a convolutional network with less than 10 layers and attention is able to achieve promising results.

### III. OBJECTIVE

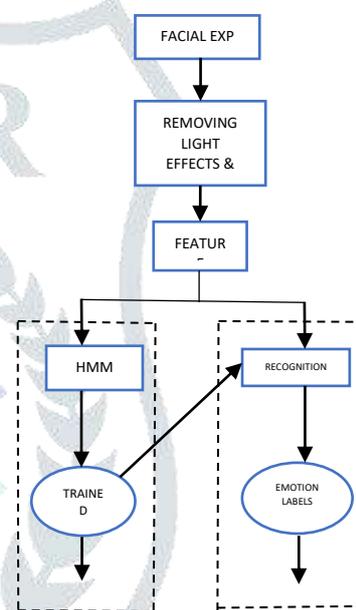
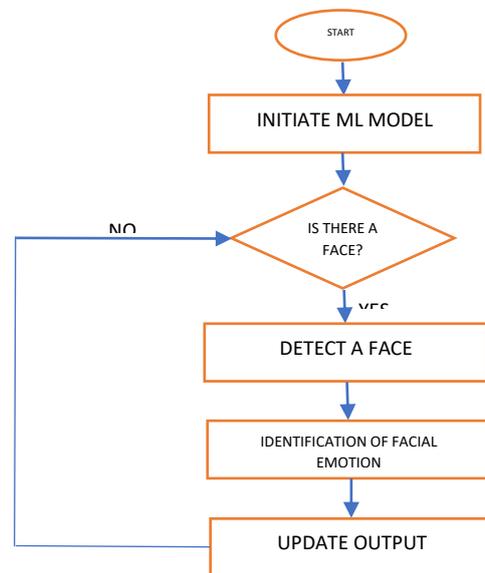
The purpose of this paper is to develop a ML model capable of utilizing web cameras and python modules to detect a human face and identify the emotion. Emotion detection can be implemented in various cases like to detect the emotions of a candidate and help the interviewer assess the nature and personality traits of the candidate. This can also be used for detecting a person's facial expressions while driving and identify whether he/she is awake or sleepy.

### IV. METHODOLOGY

The below flowchart depicts Emotion Detection System Model:

#### (a) Working of the Flowchart:

- 1) Run the python file containing the saved ML model.
- 2) A person faces the camera module.
- 3) If the face is detected without any problems.
  - a) Then give the face input to the ML model.
  - b) Else wait for a person's face to be detected.
- 4) The person's facial expression is identified and an expression is given as output.



(b) System Architecture

### V. EVALUATION

The machine learning model is executed and trained with the dataset in Google Colab. The execution of code for the camera module is done in Visual Studio Code with Jupyter Notebook.

Working:

- (i) First, train the model using the dataset in Google Colab.
- (ii) This model is saved in 'h5' format.
- (iii) Now ensure that the python code for camera module, saved model and frontal face.xml for face detection are in the same folder.
- (iv) Next, open the camera module code in Visual Studio Code's Jupyter Notebook and python as the compiler and execute the code.
- (v) Make sure the room is well-lit for face detection.
- (vi) The output is displayed on the screen.

- (vii) If any face is detected then it will predict the type of emotion on the person's face.
- (viii) But if a face is not detected, then there will no prediction.

## VI. RESULTS AND CONCLUSION

Once the final model is trained it is used for predicting the results. The data set is pre-processed and given as input to the model. After the training, the test set is given and the output produced by the model is compared with test set to compute the performance of the trained model. The designed model was implemented using keras. The training process was applied for 60 epochs with a batch size set to 64. The training took around 10 minutes in Google Colab. In the implementation phase, various OpenCV functions and keras functions have been used. First the video frame is stored in a video object. A Haar cascade classifier is used to detect facial region of an image. The image frame is converted into grey scale and resized and reshaped with the help of NumPy module. This resized image is given as input to the model which is loaded by keras models. load\_model () function. The max argument is output. A rectangle is drawn around the facial regions and the output is shown above rectangular box.

An accuracy of around 62% was achieved. These may be due to less dataset for each class of emotion. It is proposed to use learning with large amount of data for better accuracy and using various combination in designing convolution layers. Some sample output screens are:



**Neutral Emotion**



**Happy Emotion**



**Angry Emotion**



**Fearful Emotion**

The concept of seamless interaction with robots has always been a dream for humans. There have been advancements made in the past couple of years to make the AI a reality. The advancement of technologies like cars, and other devices and also machine learning techniques has given rise to new possibilities in terms of interaction with the digital world. Understanding human language and their way of communication has always been the core of constructing AI technologies like Google Now and Siri. As for future work, emotion detection can be applied to various fields of technologies like robots, self- driving cars and much more.

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