Emotion Detection System Using Machine Learning

Savata Arsude[1], Rajvardhan Pimple[2], Prakash Shelar[3], Sahil Joseph[4], Prof. Mandar Mokashi[5]

[1] Student, Computer Department, TSSM's BSCOER, Maharashtra, India
[2]Student, Computer Department, TSSM's BSCOER, Maharashtra, India
[3] Student, Computer Department, TSSM's BSCOER, Maharashtra, India
[4] Student, Computer Department, TSSM's BSCOER, Maharashtra, India
[5]Professor, Computer Department, TSSM's BSCOER, Maharashtra, India

ABSTRACT

This paper describes an emotion detection system based on real-time detection using image processing with human-friendly machine interaction. Facial detection has been around for decades. Taking a step ahead, human expressions displayed by face and felt by the brain, captured via video, electric signal, or image form can be approximated. To recognize emotions via images or videos is a difficult task for the human eye and challenging for machines thus detection of emotion by a machine requires many image processing techniques for feature extraction. This paper proposes a system that has two main processes such as face detection and facial expression recognition (FER). This research focuses on an experimental study on identifying facial emotions. The flow for an emotion detection system includes the image acquisition, preprocessing of an image, face detection, feature extraction, and classification. To identify such emotions the emotion detection system uses KNN Classifier for image classification, and Haar cascade algorithm an Object Detection Algorithm to identify faces in an image or a real-time video. This system works by taking live images from the webcam. The objective of this research is to produce an automatic facial emotion detection system to identify different emotions based on these experiments. The system could identify several people that are sad, surprised, happy, and angry, etc.

Keyword: - *Machine Learning, Emotion Detection, Haar Cascade, KNN, Face Detection.*

1. INTRODUCTION

Human Emotion Detection is applied in many areas where additional security or data about the person is a big requirement. To set up, the second layer of security gives the opportunities to not only detect faces with emotion but can be useful to verify whether it is a 2-dimensional representation or a particular person standing in front of the camera. Besides this, another advantage of using EMS using machine learning is for business promotions. Many large-scale businesses thrive on customer responses to their services or products such as OTT platforms, movie theaters, etc.

By creating an AI system that can capture and identify real-time emotions based on using images or videos, big companies can decide on whether the customer liked or disliked the product, service, or offer. Security has been the main reason for identifying an individual user based on fingerprint matching, voice recognition, passwords, and retina detection, etc. With the detection of emotion, it is also mandatory to identify threats to find the intent of the person. Such cases can be applied in vulnerable areas like airports, concerts, and large gatherings. Human emotion detection can be classified as anger, fear, surprise, happiness, disgust, and neutral. Detecting differences in human emotion based on their facial muscle contortions a slight difference can result in different expressions.

In this paper, we propose a facial emotion detection system using machine learning algorithms for pattern recognition and classification. For a machine-learning algorithm, the most important aspects are its features; in this case, the KNN classifier and Haar Cascade-like feature are used to extract each facial region.

2. LITERATURE SURVEY

[1] Weihong Deng, Jiani Hu, et.al, the author of this paper explores the necessary characteristics of the training dataset, feature representations and machine learning algorithms for a system which operates reliably in more realistic conditions. A new database, Real world Affective Face Database (RAF-DB), is presented which contains about 30,000 greatly diverse facial images from social networks. Crowdsourcing results suggest that real-world expression recognition problem is a typical problem in imbalanced multi-label classification. The balanced, single-label datasets currently used in the literature could potentially lead the research into misleading algorithmic solutions. A deep learning architecture, DeepEmo, is proposed to address the real-world challenge of emotion recognition by learning the high level feature representations that are highly effective for discriminating between realistic facial expressions. Extensive experimental results show that the deep learning method is superior to handcrafted features, and with the near frontal pose constraint, human-level recognition accuracy is achievable.

[2] Almudena Gil, et.al, presents a simple and fast expression recognition algorithm that aims at running in a secondary plane to provide emotion awareness for primary applications such as e.g. exergames, in real time. The algorithm is based on the extraction of 19 facial landmarks, which are used to detect some of the Action Units (AUs) that are defined in the Facial Action Coding System (FACS) and a newly created one. In addition, the new concept of Combined Action Units (CAUs) is presented and well described. Those are grouped AUs which are detected as a unit. On the one hand, results are weak for individual emotion recognition due to two problems: one is the difficulty to analyze the action units robustly with few facial landmarks. The other is the sparse matrix used to train the decision tree. On the other hand, very good results are obtained for a fast estimation of the mood of a person. This knowledge can be used as valuable knowledge by a primary application. The applied emotion classification is based on logical rules, no learning is involved in it. The implementations have been made on a mobile platform. Ashim Sahaa, et. al., The author implemented the HSV (Hue-Saturation-Value) color model for the detection of the face in an image. PCA that is principal component analysis has been used for reducing the high dimensionality of the eigenspace and then projecting the test image upon the eigenspace and calculate the Euclidean distance between the test image and mean of the eigenfaces of the training dataset the expressions are classified. A generic dataset is used for the purpose training. The gray scale images of the face is used by the system in order to classify five basic emotions such as surprise, sorrow, fear, anger and happiness. The training dataset consists of images of different people and when tested it gives satisfactory results but there exists a resemblance between Sorrow and Fear to some extent and can be improved by more extensive training.

[3] The author Pravin Nagar, proposes a system which automatically recognizes the emotion represented on a face. The Bezier curve based solution together with image processing is used in classifying the emotions. Colored face images are given as input to the system. Then, an Image processing based feature point extraction method is applied to extract a set of selected feature points. Finally, extracted features like eyes and mouth, obtained after processing, are given as input to the curve algorithm to recognize the emotion contained. The Canny Edge Location calculation was utilized through OpenCv API as a part of which haar cascades record, for eyes and mouth was predefined. The experiment shows the recognition results under different facial expressions such as smile, sad, surprise and normal. The method gives successful emotion recognition of ratio 60.

3. SYSTEM DESIGN

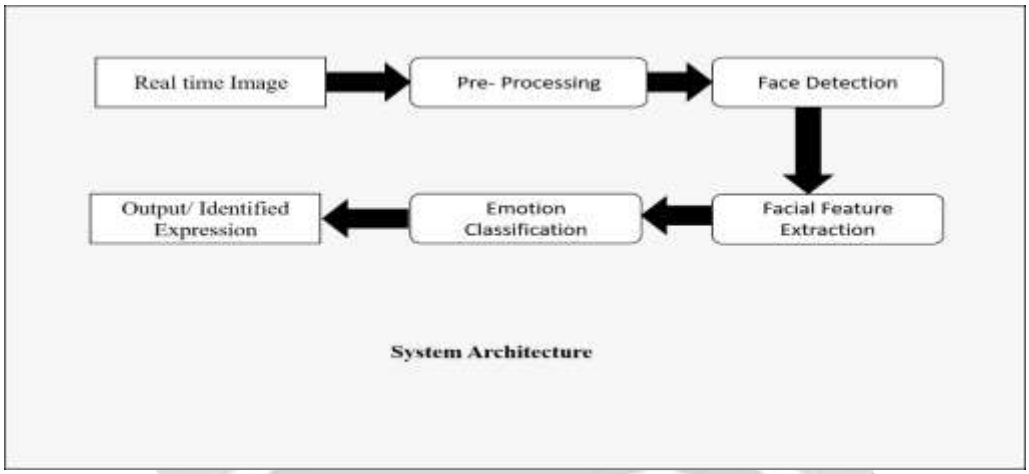


Fig -1: System Architecture

The above system architecture depicts the functioning of emotion detection wherein a certain frame the system captures a real-time image and simultaneously does the feature recognition by using a machine learning algorithm. Here the model is trained to improve its accuracy in extracting useful facial landmarks. After successful extraction of face, in its final stage, the system uses a non-linear classifier algorithm to detect whether the user is happy, sad, or neutral.

For facial emotion detection, face detection algorithms are used on an image or the captured frame. The flow for the emotion detection system is as follows:

Step 1: Acquisition of Image
In the first step the haar-cascade algorithm detects the object to identify face in an image or real-time video.

Step 2: Preprocessing of an Image

For better classification and to improve the quality of image the preprocessing of image will suppress the undesired distortions.

Step 3: Face Detection
Using the machine learning algorithms the system detects face within the frame at real-time.

Step 4: Feature Extraction
To improve the accuracy of the model, feature extraction is an important step. The aim here is to extract useful characteristics from the data.

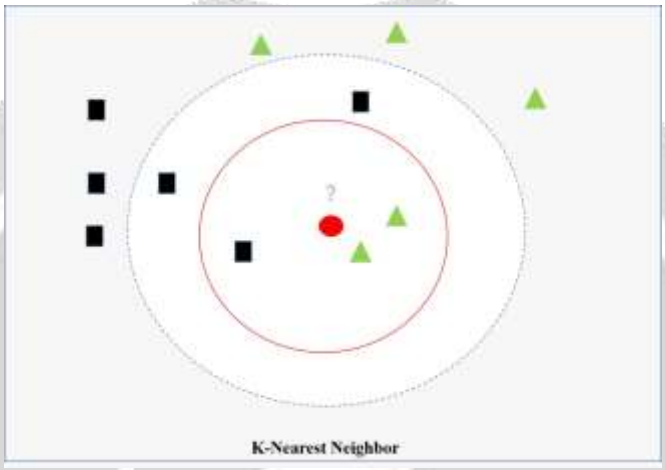
Step 5: Classification
By using KNN, the non-linear classifier is used to classify facial emotion to provide accurate results.

4. PROPOSED SYSTEM

Facial emotion classification

In this work, two machine learning algorithms such as KNN, and Haar Cascade are used to identify and classify facial emotion.

A. K nearest neighbor



KNN is a simple nonlinear classifier model that classifies data points based on similar points. To make an "educated guess" it uses test data to classify the unclassified point that should be classified as. KNN algorithm is often used in image recognition technology, decision-making models, and simple recommendation systems. KNN is a non-probabilistic learning algorithm used to classify unknown test data based on the majority of similar data among the k-nearest neighbors closest to test/anonymous data.

KNN algorithm works on deeply rooted mathematical formulas that are used for classification. When implementing KNN, the foremost step is to transform data points into feature vectors, or a certain mathematical value. Then the algorithm processes it by finding the distance between the mathematical values of these points. The most common way to find a distance is by using Euclidean Distance.

$$d(\mathbf{p},\mathbf{q}) = d(\mathbf{q},\mathbf{p}) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2}$$

$$= \sqrt{\sum_{i=1}^{n} (q_i - p_i)^2}.$$

KNN runs this formula to compute the distance between each data point and the test data. It then finds the probability of these points being similar to the test data and classifies it based on which points share the highest probabilities.

B. Haar Cascade Algorithm

Haar Cascade Detection algorithm is a machine learning-based approach where a cascade function is trained using lots of positive and negative images and then used to detect objects in other images. Haar Cascade is an object detection algorithm to identify faces in an image or real-time video. It uses edge or line detection features.

5. CONCLUSION

In this paper, the proposed system hopes to be very promising and develops facial emotion detection; the proposed system is independent of factors such as gender, age, ethnic group, beard, backgrounds, and birthmarks. The given proposed EMD system using machine learning can detect face-to-state classifications accurately. In particular, the paper discussed machine learning algorithms like KNN and Haar-Cascade for image identification and classification. Facial expressions captured in reality to detect emotions may have various hurdles such as face posture, occlusion, and blurring. To address this concern, as future work, we will investigate more robust models which satisfy real conditions.

6. REFERENCES

[1]. Pravin Nagar, "Emotion Recognition From Facial Expression Based On Bezier Curve" , International Journal of Advanced Information Technology,2015, Vol. 5, No. 3/4/5/6.
[2]. Weihong Deng, Jiani Hu, et.al, "DeepEmo: Real-world Facial Expression Analysis via Deep Learning", IEEE VCIP 2015.
[3]. Tengfei Song, Wenming Zheng, Cheng Lu, et al. MPED: A Multi-Modal Physiological Emotion Database for Discrete Emotion Recognition [J]. IEEE Access, 2019, 7: 12177-12191.
[4]. Kumar N, Bhargava D. A scheme of features fusion for facial expression analysis: A facial action recognition[J]. Journal of Statistics and Management Systems, 2017, 20(4):693-701.
[5]. Lee S H, Yong M R. Intra-Class Variation Reduction Using Training Expression Images for Sparse Representation Based Facial Expression Recognition[J]. IEEE Transactions on Affective Computing, 2017, 5(3):340-351.