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Boredom Calculator-Facial Expression Detection

Prof.Suvarna Potdukhe¹, Suyash Patil², Sanket Mate³, Harshal Patil⁴

¹ Professor ^{2,3,4} Student, Dept. of Information Technology

RMD Sinhgad School of Engineering, Pune, Maharashtra, India

Abstract: - Human face recognition plays an important role in many user authentication applications in the modern world. Face detection and emotion selection is the one of the current topic in the security field which provides solution to various challenges. A variety of face detection methods have been proposed in recent years and they can be mainly classified into two categories: holistic feature detection and local feature detection respectively. Facial expression not only exposes the sensation or passion of any person but can also be used to judge his/her mental views and psychosomatic aspects.

Keywords: Facial Expression Recognition, Face Detection, human face.

I. INTRODUCTION

Emotions are feeling or response to particular situation or environment. Emotions are an integral part of our existence, as one smiles to show greeting, frowns when confused, or raises one's voice when enraged. It is because we understand other emotions and react based on that expression only enriches the interactions. Computers are "emotionally challenged" [6].

Emotions which can be classified like fear, happiness, joy, sadness, aggressiveness are recognizable facial expressions using computer vision. [1]

A. Approaches for Facial Expression detection are:

- 1) *Template Based Method:* This approach used the average face for each category of emotion and classifies the individual facial expression according to the best match of each template [4].
- 2) *Feature Based Approach:* It uses a training set of images for different emotion expressions. Features are extracted from each emotion subset for all facial expressions then are subsequently tested unseen facial image. The selection of Facial region is based on Facial Action Coding System (FACS) [7].
- 3) *Facial Action Coding system (FACS):* It is a human observation based system designed to detect changes in facial regions. It consists 44 anatomically based action units, which individually or in combination can represent all visible discriminate expressions. Action units are: Upper lip raiser, cheek Puffer, Nose Winkler, Lip corner puller etc.

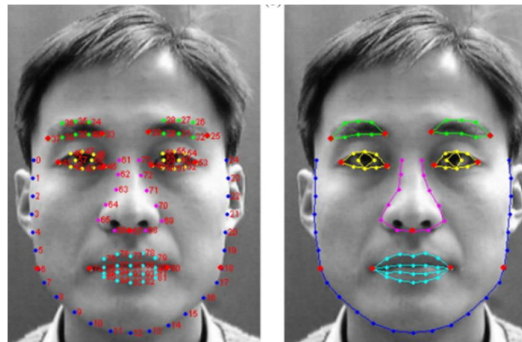


Figure: Face Detection

B. Basic Terminologies

- 1) *Face Detection:* Face detection is to determine that a certain picture contains a face we need to be able to define. Luckily human faces do not greatly differ from each other; [3,5] we all have noses, eyes, foreheads, chins and mouths; and all of these compose the general structure of a face. It is a concept of two-class classification: face versus no face. Face detection can be regarded as a specific case of object class detection. In object-class detection, the task is to find the locations and sizes of all objects in an image that belong to a given class. It can be understood as:
- 2) *Face Identification:* In this the system it compares the given individual to all the other individuals and gives a ranked list of matches [8, 9, and 10].
- 3) *Face Verification:* In this the system compares the given individual with who that individual says they are and gives a yes or no decision.[11]

The common ones are:



Figure: Facial Expressions.

II. LITERATURE REVIEW

A. Ada Boost Algorithm

Adaboost is a machine learning boosting algorithm capable of constructing a strong classifier through a weighted combination of weak classifiers. (A weak classifier classifies correctly in only a little bit more than half the cases.) To match this terminology to the presented theory each feature is considered to be a potential weak classifier. A weak classifier is mathematically described as:

$$h(x, f, p, \theta) = \begin{cases} 1 & \text{if } pf(x) \triangleright p\theta \\ 0 & \text{otherwise} \end{cases}$$

Where x is a 24×24 pixel sub-window, f is the applied feature, p the polarity and the threshold that decides whether x should be classified as a positive (a face) or a negative (a non-face) [5].

B. Viola-Jones Face Detection

Viola Jones is the oldest and most recognized face algorithm available for the face detection from the image. The basic principle of the Viola-Jones algorithm is to scan a sub-window capable of detecting faces across a given input image. The standard image processing approach would be to rescale the input image to different sizes and then run the fixed size detector through these images. This approach turns out to be rather time consuming due to the calculation of the different size images. [6] Viola-Jones has devised a scale invariant detector that requires the same number of calculations whatever the size. This detector is constructed using a so-called integral image and some simple rectangular features reminiscent of Haar wavelets.

C. k Nearest Neighbor (KNN)

The k Nearest Neighbor (KNN) is one of the most commonly used methods for pattern recognition and has been applied in a variety of cases [7]. KNN Classifier works as follows. First for each one of the training set elements a classification of it is performed based on various neighborhoods. The k value that maximizes the DC of each classification is found. Therefore, for each training set there corresponds a particular k value which is considered the best available. Afterwards, for each unknown element, the nearest neighbor is found and its k value is assumed (based on the "optimum" k array). Then, the KNN classifier is applied on that test element, using that k value. As a concept, this is something similar to one of the ideas presented in [7].

"Dolly Reney" et al focuses on face detection and emotion selection is the one of the current topic in the security field which provides solution to various challenges. Beside traditional challenges in captured facial images under uncontrolled settings such as varying poses, different lighting and expressions for face recognition and different sound frequencies for emotion recognition. For the any face and emotion detection system database is the most important part for the comparison of the face features and sound Mel frequency components. For database creation features of the face are calculated and these features are store in the database.

"Shruti Bansal", et.al discusses that human emotions are conveyed by different medium such as behaviors, actions, poses, facial expressions and speech. Multitudinous researches have been carried out to find out the relation between these mediums and emotions. This paper proposes a system which automatically recognizes the emotion represented on a face. Thus, a Bezier curve

based solution together with image processing is used in classifying the emotions. Coloured face images are given as input to the system. Then, Image processing based feature point extraction method is applied to extract a set of selected feature points.

D. MEL Frequency Cepstral Coefficients

MFCC's are very useful features for audio processing in clean conditions. However, performance using MFCC features deteriorates in the presence of noise. There has been an increased effort in recent times to find new features that are more noise robust compared to MFCCs. Features such as, spectro-temporal modulation features [8] are more robust to noise but are computationally expensive. Skowronski and Harris [9] suggested modification of MFCC that uses the known relationship between center frequency and critical bandwidth. They also studied the effects of wider filter bandwidth on noise robustness. Herein, we suggest different modifications to MFCCs that make it more robust to noise without adding prohibitive computational costs. MFCC features approximate the frequency decomposition along the basilar membrane by a short-time Fourier Transform.

E. HoG Algorithm

The first step in emotion detection is the extraction of the facial region. To accomplish this HoG algorithm is implemented. However, some small adaptations are made in the original algorithm. The initial step of the HoG algorithm [8]: color normalization with a power law equalization, can be discarded. The reason is due to the modest effect it has on performance because similar results are obtained by the subsequent descriptor normalization. The pixel gradients in the x- and y-direction are now calculated for a n n pixel cell. Therefore two 1-D point centered masks are used.

III. PROPOSED SYSTEM

A. Frame Extraction / Live Camera

User uploads a video / grabs images using live camera on the application, application then extracts frames from the video. These frames are saved on local machine. Frames are usually in 640x480 formats.

B. Face Detection

Apply the Haar cascade Classifier for the face detection in images.

C. Pre-Processing on images

Once we get the faces apply the preprocessing on images like noise removal, normalization etc.

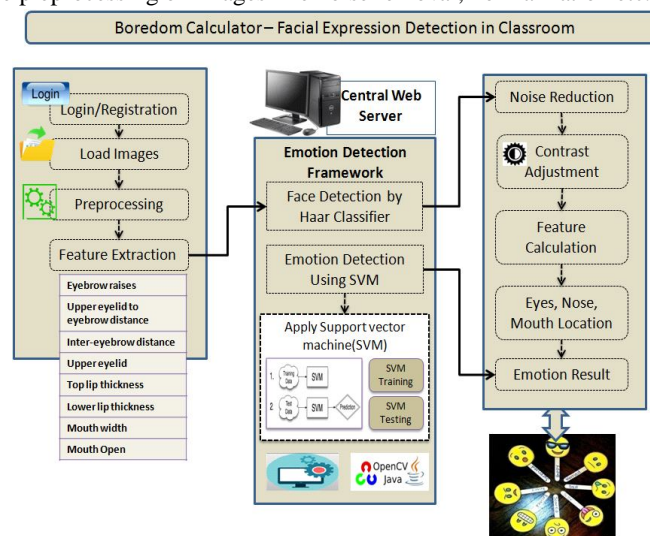


Figure: - System Architecture

- 1) *RGB to Gray Scale Image* : Convert the image into Gray scale by taking the average of the each pixel RGB.
- 2) *Image Normalization* : Normalization is a process that changes the range of pixel intensity values to avoid mental distraction or fatigue from the images.



- 3) *Noise Removal* : Removing errors in the image acquisition process that result in pixel values that do not reflect the true intensities of the real scene.

D. Feature Extraction

A SVM consists of an input and an output layer. SVM will classify the features on the basis of training dataset. Extracts the Features of faces from the image like nose, lips, and eyes in the form of points as follows,

Eyebrow raises
Upper eyelid to eyebrow distance
Inter-eyebrow distance
Upper eyelid
Top lip thickness
Lower lip thickness
Mouth width
Mouth Open

E. Feature Calculation

In the phase all extracted features are calculated and determine the eyes, mouth and nose location on person face. On basis of this calculation face motion is detects.

F. Emotions Detection and Boredom Calculation

By applying SVM classifier on the extracted features Happy, Neutral, Sad emotions also called as boredom can be calculated.

IV. ALGORITHMS USED

A. Haar cascade Classifier for Face Detection

In this system we used Haar classifier algorithm for face detection when one of these features is found, the algorithm allows the face candidate to pass to the next stage of detection. A face candidate is a rectangular section of the original image called a sub-window. Generally these sub-windows have a fixed size (typically 24×24 pixels). This Sub-window is often scaled in order to obtain a variety of different size faces. The algorithm scans the entire image with this window and denotes each respective section a face candidate. The algorithm uses an integral image in order to process Haar features of a face candidate in constant time. It uses a cascade of stages which is used to eliminate non-face candidates quickly. Each stage consists of many different Haar features. Each feature is classified by a Haar feature classifier. The Haar feature classifiers generate an output which can then be provided to the stage comparator. The stage comparator sums the outputs of the Haar feature classifiers and compares this value with a stage threshold to determine if the stage should be passed. If all stages are passed the face candidate is concluded to be a face.

- 1) *Haar Feature Classifier*: A Haar feature classifier uses the rectangle integral to calculate the value of a feature. The Haar feature classifier multiplies the weight of each rectangle by its area and the results are added together. Several Haar feature classifiers compose a stage. A stage comparator sums all the Haar feature classifier results in a stage and compares this summation with a stage threshold. Each stage does not have a set number of Haar features. Depending on the parameters of the training data individual stages can have a varying number of Haar features.
- 2) *Haar Features*: Haar features are composed of either two or three rectangles. Face candidates are scanned and searched for Haar features of the current stage. Each Haar feature has a value that is calculated by taking the area of each rectangle, multiplying each by their respective weights, and then summing the results.

B. Support Vector Classification Algorithm

Support vector machine (SVM) proposed by vapnik and Cortes have been successfully applied for gender classification problems by many researchers. An SVM classifier is a linear classifier where the separating hyper plane is chosen to minimize the expected classification error of the unseen test patterns.

SVM is a strong classifier which can identify two classes. SVM classifies the test image to the class which has the maximum distance to the closest point in the training.

SVM training algorithm built a model that predict whether the test image fall into this class or another. SVM require a huge amount of training data to select an affective decision boundary and computational cost is very high even if we restrict ourselves to single pose (frontal) detection.

The SVM is a learning algorithm for classification. It tries to find the optimal separating hyper plane such that the expected classification error for unseen patterns is minimized. For linearly non-separable data the input is mapped to high-dimensional feature space where they can be separated by a hyper plane. This projection into high-dimensional feature space is efficiently performed by using kernels. More precisely, given a set of training samples and the corresponding decision values $\{-1, 1\}$ the SVM aims to find the best separating hyper plane given by the equation $WT x+b$ that maximizes the distance between the two classes.

V. RESULT AND DISCUSSION

In this project we are going implement an efficient method to create face and emotion feature database and then this will be used for face and emotion recognition of the person. For detecting face from the input image we are using Haar-Cascade face detection algorithm and to evaluate the face and emotion detection SVM classifier is used.

Screenshots Of Projects

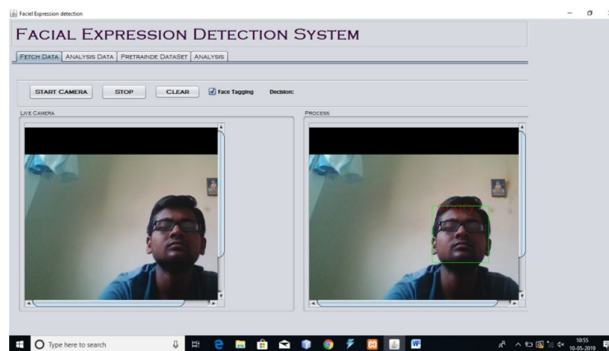


Fig: Facial Expression Detection (live camera)

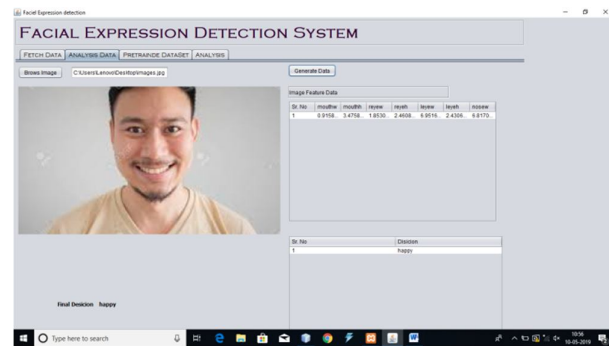


Fig: Facial Expression Detection (loading image)

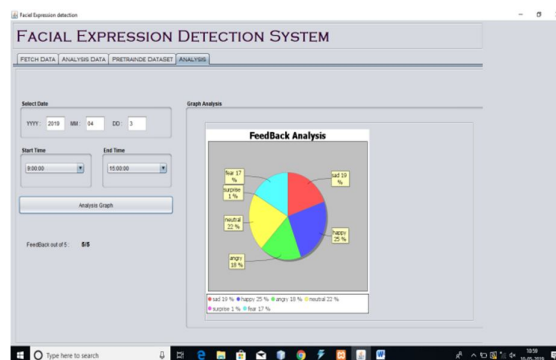


Fig: Feedback Analysis



VI. ADVANTAGES

- A. Easy feedback without manual work
- B. Avoids proxy feedback.

VII. APPLICATIONS

- A. Computer-aided Detection of a Shopper's Intent to Purchase.
- B. Detection of emotion of students for evaluation of teacher's performance.

VIII. CONCLUSION

The goal of this project was to implement real-time facial detection system. Haar cascade is used for face detection. Haar cascade has high performance as compared Naïve Bayes and SVM performance which is not easily estimated. Various classifiers have been discussed. Hence, the extension of this work will review all above mentioned techniques and methods to detect the faces. Haar cascade has a good solution as a compared Adaboost algorithm. The SVM classifier used for detection of emotions.

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