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EMOTSQUAD: Emotion Detection and Attendance Management System

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Abstract

The most expressive way humans display emotions is through their facial expressions. It becomes difficult for a professor to look after each student completely. Our system focuses on improvising and making existing systems convenient through an application. To analyze and monitor the behavior of students present in the classroom, the system performs face recognition and analysis is done on the data generated. In this paper, we propose an automated emotion detection and attendance management system. The system is based on face detection and recognition techniques and algorithms. It detects the student through the camera and marks the student as a present. The student is monitored throughout the lecture and emotions are captured continuously which helps us to analyze the behavior of students and the whole class behavior during each lecture. The working of the system and algorithms are described in this paper.

Keywords: *Local Binary Pattern Histogram (LBPH), Facial expression analysis, Attendance Management*

1. Introduction

Smart classrooms monitor only the physical presence of students but not their cognitive ability. Previously it was not possible to achieve one to one interaction between the teacher and student with the help of technology. Thus by using various student behavior analysis techniques it is possible to increase the effectiveness of lectures. Teacher's get data about the activity of each and every student during the lecture. So it becomes easy for the teacher to monitor the feedback of the lecture. Facial expression recognition is not a theoretical field but finds practical applications in many fields. Coupled with human psychology and neuroscience it can come up as an area that can bridge the divide between the more abstract area of psychology and the more crisp area of computation. A computer with more powerful expression recognition intelligence will be able to better understand humans and interact more naturally. Many real-world applications such as commercial call center and affect-aware game development also benet from such intelligence. Possible sources of input for expression recognition include different types of signals, such as visual signals (image/video), audio, text and biosignals. For vision-based expression recognition, a number of visual cues such as human pose, action and scene context can provide useful information. Nevertheless, the facial expression is arguably the most important visual cue for analyzing the underlying human emotions. Thus, this system not only helps the monitoring of the behavior of students in class but it also helps teachers to modify their teaching style to get a more positive response. Another use case is marketing/advertising in which the expression of customers is recorded. It helps to analyze how people react to an advertisement, product, packaging, and store design.

2. Literature Survey

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In [1] the authors have proposed a fingerprint-based attendance system. a fingerprint device has been developed which may be passed among the scholars to position their finger on the sensor during the lecture time without the instructor's involvement. This method guarantees a fool-proof method for marking attendance. The matter with this approach is that the passing of the device during the lecture time may distract the eye of the scholars. a variety of works associated with frequency Identification (RFID) based Attendance Systems exist within the literature. In [2] the authors have proposed an RFID based system during which students carry an RFID tag type ID card and that they must place that on the cardboard reader to record their attendance. RS232 is employed to attach the system to the pc and save the recorded attendance from the database. This method may produce fraudulent access. An unauthorized person may make use of a licensed ID card and enter into the organization. Iris is another biometric which will be used for Attendance Systems. In [3] the authors have proposed Daugman's algorithm-based Iris recognition system. This method uses an iris recognition management system that does capture the image of iris recognition, extraction, storing and matching. But the issue occurs to put the transmission lines within the places where the topography is bad. In [4] authors have proposed a system supported real-time face recognition which is reliable, secure and fast which needs improvement in several lighting conditions. In[4]. Experiments are carried on the FERET standard face database and therefore the creation of a brand new face database, and therefore the results show that the MLBPH algorithm is superior to the LBPH algorithm in recognition rate. In [5]authors have proposed a system using Local Binary Pattern (LBP) for feature extraction and Convolution Neural Network (CNN) for classification of the pictures. The correspondence between the trained images helps CNN to converge fast and achieve better accuracy. there's an excellent improvement compared to other traditional methods too. within the article [6] face recognition technology is employed to acknowledge someone using a picture or a video. It generally works by comparing face expression from the captured image with those already present within the database. This technology is employed in entrance control, surveillance systems, smartphone unlocking etc. within the article[7] when LBP is combined with histograms of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets. Using the LBP combined with histograms we will represent the face images with a straightforward data vector. In [8] The proposed system operates better at the minimum low resolution of 35px to spot the face in various angles, side poses and tracking the face during human motion. They have designed the dataset (LR500) for training and classification. In [9] Face recognition supported the geometric features of a face is perhaps the foremost intuitive approach to face recognition. one amongst the primary automated face recognition systems as described in [Kanade73]: marker points (position of eyes, ears, nose, ...) were wont to build a feature vector (distance between the points, the angle between them). The popularity was performed by calculating the euclidean distance between feature vectors of a pursuit and reference image. In [10] within the face recognition area, several categories of ANN had utilized for the classification, like Retinal Connected Neural Network, Polynomial Neural Network, Convolutional Neural Network, Evolutionary Optimization of Neural Networks, and Back Propagation Neural Networks. In [11] during this paper, the proposed model for automatic and smart attendance in real time was utilized in order to beat the old and traditional method of manually using utterance or logbook. This method can't detect faces from different angles since it's designed to acknowledge only the frontal part of a face using the haarcascade_frontalface classifier. In [12] This paper reviewed the previous works on the attendance management system
supported face recognition. This text doesn't only provide the literature review on the sooner work or related work, but it also provides the deep analysis of Principal Component Analysis. In [13] this literature survey only provides a summary of the categories of hardware used. prominence is then placed on the microcontroller platform, biometric sensor, communication, database storage, and other components so as to help future researchers in designing the hardware a part of biometric-based attendance systems. In [14] Md. Sajid Akbar" introduced a system which was a mixture of both face recognition and RFID technology capable of recognizing students entering into and out of the classroom. The system keeps records of each registered student for a selected semester and provides data if necessary. By using both of those technologies, the proposed model is more user friendly, accurate and arranged. Alongside the attendance system, IR modules also are installed to show the lights On/Off automatically by detecting

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someone's presence. In [15] Wenxian Zeng" combined the concept of deep learning to boost AlexNet convolutional neural networks and for improving network training, WebFace data set is employed. So as to form the system simpler and stable, an RFID technology is combined with the face recognition technique to develop a sensible classroom attendance system capable of working effectively at various angles. In [16] this the system, which is predicated on face detection and recognition algorithms, automatically detects the scholar when he enters the category room and marks the attendance by recognizing him. This paper also proposes the techniques to be utilized in order to handle the threats like spoofing. In [17] during this work, a highly efficient, economical, and VRPN system was developed. this method uses smart IR sensor to detect moving objects, a camera to capture the image,extract the text from the image, and save the text on an internet page.In [18] Lin Zhi-heng" proposed a methodology which uses installed camera in the classroom for real time face recognition and data acquisition. The collected video information is first divided into multiple static frames and depending upon the clarity and visuals of the image, several pictures are selected and then fed for final recognition results. In [19] Sujit Kumar Gupta" proposed a Computer Vision based Unobtrusive Classroom Attendance Management System which consists of a rotating camera for recognizing the faces of the students in real time. So, it detects the faces of students in a classroom at multiple angles i.e. with various pose variations. It uses Max Margin Face Detection Technique for face detection and is trained using Inception-V3 CNN technique for student's identification. In [20] Various factors that act as challenges in face recognition are illumination, orientation, size, clarity, expression and intensity of facial images. With the help of training dataset, system is trained to detect the figures representing faces (positive images) and distinguish it from background (negative images) environment.The proposed system contributes to human face detection with the help of Viola Jones algorithm and face recognition with Fisher Face algorithm and achieves accuracy of 45% to 50%. The [21] paper proposes one such system that uses Viola Jones face detection algorithm to keep a count of the number of visitors at railway stations throughout the day and heuristic data mining technique to analyze this stored data and suggest the required action.

3. Proposed Model

The Emotion detection and attendance management system is based on a face recognition algorithm. When the lecture begins the teacher has to login to the system and enter the details of the lecture like name, duration and time as soon as this procedure is completed the camera which is installed in the classroom will capture the image of the class. The system will detect each face, compare it with the database and a CSV file is generated for each lecture and the students are marked as present. During the lecture the system will constantly monitor the faces of students and capture the level of emotions he/she has. The value of each emotion is mapped against the name of the student and in the end, the prominent emotion is calculated.

3.1. Image Capture: The camera is set up at the center of the classroom to capture the images of the students. The captured image is preferred to be of the size 640x480 to avoid resizing of the image in the back end as we observed resizing may sometimes result in poor performance.

3.2. Face Detection: Many algorithms are proposed for face detection such as Face geometry-based methods, Feature Invariant methods. Out of all these methods face detection using the Haar feature-based cascade classifier is an effective face detection method proposed by Paul Viola and Michael Jones, a machine learning approach in which cascade function is trained repeatedly using various images. It is then used to detect faces in other images. It is noted that this algorithm gives better results in different lighting conditions and we combined multiple haar classifiers to achieve better detection rates up to an angle of 30 degrees. The detection of face is shown in Figure 2

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3.3. Preprocessing: The detected face is extracted and forwarded for pre-processing. This preprocessing step involves histogram equalization of the extracted face image and is resized to 100x100. Histogram Equalization is the most common Histogram Normalization technique. This improves the contrast of the image as it stretches the range of the intensities in an image by making it more clear.

3.4. Database Development: We create our own dataset: the dataset contains a total of more than 1000 images of each student with 60×60 resolution of each image. The students were asked to pose for different emotions and they were made comfortable by telling us how to pose and showing visual cues as well as real day to day positions in which all students sit for a lecture and are associated with the particular emotional state. These images were captured in ideal conditions which were free from noise and other distractions. The images were captured in ambient light conditions. According to experience obtained from preliminary studies, the light conditions were as subjects are generally accustomed to and not being very bright or dull. Closed rooms were used for the conduction of shoot sessions. The students were made well aware about the experiment and also how it will help in future scientific studies. The subjects were asked to sit comfortably taking the support of the chair. They were allowed time to ease them for elicitation of emotions. Thereafter images were captured by posing for neutral, anger, contempt, disgust, happiness, fear, sadness and surprise. In order to avoid disturbance the rooms were kept close during the different shooting sessions. The images were taken from the web camera of laptop.database is shown in Figure 1 below.

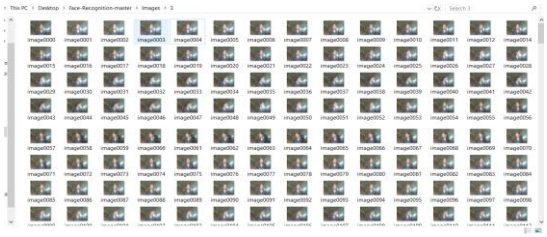

Figure 1. Dataset of One Student

3.5. Emotion Detection: At this stage, the dataset is preprocessed for the feature extraction process. The dataset images have been converted into grayscale images for feature extraction, and then normalized those images for good recognition neighbor features detection, Haar modules have been used to detect these local features in a given input image. Here, the input image refers to the digital image captured by the camera. After detecting features, the classifier will classify the input image as a face image as shown in Figure 3

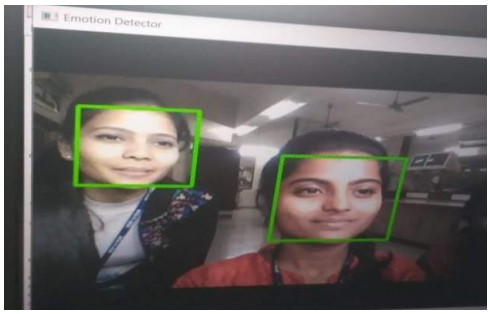

Figure 2.Face Detection

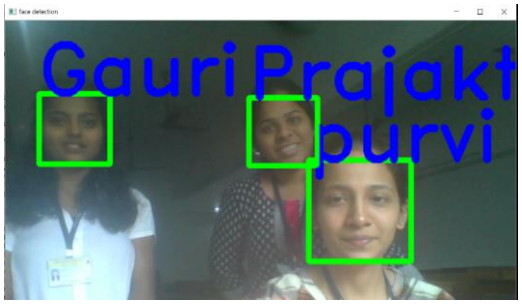

Figure 3.Student Identification

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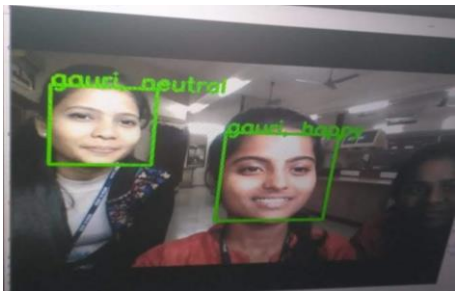

Figure 4.Emotion Detection

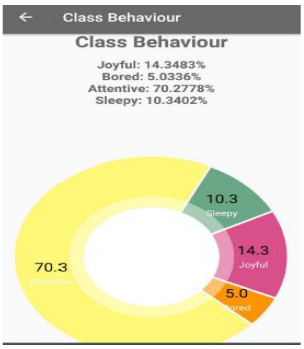

Figure 5.Overall Class Behaviour

3.6. Post Processing: In the proposed system, the camera will detect the face of every student in the class and after every ten second it will recognize the emotion of students and update it into an excel sheet. The value of each emotion is mapped against the name of the student and at the end the prominent emotion is calculated.

4. Algorithms

Local Binary Pattern (LBP) is a simple yet efficient face recognition algorithm based on the local binary operator that labels each pixel of an image by thresholding each neighbor pixel and store the result as a binary number.

Steps:

1)LBPH makes use of 4 parameters
a.Radius
b.Neighbors
c.Grid x(Number of cells in horizontal directions)
d.Grid y(Number of cells in vertical directions)

2)Train the algorithm
To train the algorithm we need the dataset of individual images. It is necessary to set ID to images. Algorithms will use this to recognize the input and give results.

3)Applying the LBP operation:
a. The very first step is to create an intermediate image. We have images in grayscale which are stored in the form of 3 x 3 pixels.
b.Then compute the threshold by taking central pixel value and comparing its value with Neighborhood pixels. If the value of the central pixel is less than the neighbor pixel then it is set as 1 otherwise 0 Now we have a table in binary numbers. Convert binary values to decimal values. At the end of this step,we have a new image.

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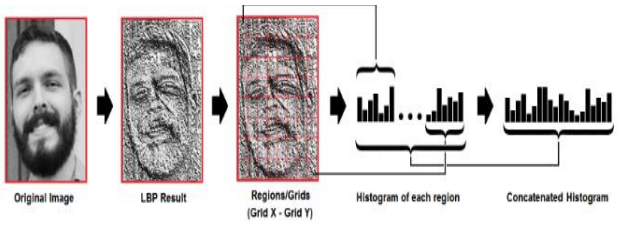

Figure 6. Histogram Extraction

4)Extracting the Histograms: Using the image generated in previous step, we can use of Grid x and Grid y parameters values to extract the histogram from the images.
5)Performing face recognition: The algorithm is already trained, given input images we need to perform the same step and create a histogram of input images. Now for face recognition we need to compare the two histograms and return the resultant image with the closest histogram. In Figure 3 the faces are recognized.

Haar Cascade:
Haar Cascade is a object detection algorithm that detects objects in an image or video. In the Haar cascade cascade function is trained from lots of positive and negative images,The algorithm follows four steps..
1.Haar Feature Selection
2.Creating Integral Images
3.Adaboost Training
4.Cascading Classifieds
1)First stage is to collect the Haar Features. A Haar feature is nothing but adjacent rectangular regions at a particular location in a detection window, adds the pixel intensities in every region and calculates the difference between these sums.

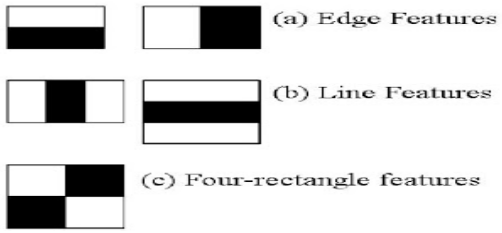

Figure 7. Feature Extraction

2)Integral Images are used to make this process super fast.
3)To select the best features out of all the features we are using a concept called Adaboost which selects the best features and trains the classifiers that use them.Adaboost algorithm selects small numbers of features from large sets for efficient results.
4)The Haar cascade classifier has a collection of stages.Each stage of the classifier labels the region defined by the current location of the sliding window as either a positive or negative label. Positive label indicates that an object was found and a negative label indicates no objects were found. If the label is negative, the classification for that region is complete, and the detector slides the window to the next location. If the label is positive, the classifier passes that region to the next stage.

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5. Conclusion

Our proposed system monitors student behavior by classifying emotions into different categories throughout the lecture. Main activities are handled in application, namely Class behavior, Individual student behavior, attendance. Facial emotion recognition has tremendous applications and one of them is Analyzing the behavior of students present in the classroom for effectiveness of lecture. Emotions of humans can influence the decision and help in mental presence. This helps in monitoring the behavior of students during the lecture and based on statistics generated individual attention can be given to students which are returning negative expressions. Our system helps in improving the quantity of knowledge shared among the students and effectiveness of a lecture using emotion analysis.

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