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Implementation of Attendance Marking System using Haar Cascade Classifier andConvolutional Neural Network

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Abstract:

Attendance is mandatory in every educational institution. Attendance marking system is crucial to reduce human effort and proxy attendance. In this paper, Automatic attendance marking system is employed using deep learning techniques. Haar Cascade Classifier is used for detecting the faces. Furthermore, Convolution Neural Network is employed to extract the features from the detected face. Finally, the attendance is marked for recognised faces along with the person's name and timestamp. The effectiveness of the implemented system is assessed on our faces in real time. Simulation results presented in this paper illustrates the accuracy of the implemented Attendance Management Systemin marking the attendance.

I. INTRODUCTION

Time is precious in this fast changing world. Man always looks for easier method in his work.So the concept of automation came into survival. The important factor of improving the student's quality of education is to make sure that the students must attend classes regularly. However, traditionally this presents additional effort from the teacher, who must make sure to correctly mark attending students, which takes extra amount of time from the teaching process. Furthermore it can get much more complicatedif one has to deal with large groups of students.

Every organization has its own method in marking attendance. Some are taking attendance manually using the blank paper or file based registers and some have adopted methods of automatic attendance using some features of biometric techniques[1]. There are many advanced methods available for this purpose i.e. biometric attendance. This method also consumes time because students have to stand in a queue to touch their thumb on the biometric device[2].

Automated attendance management system using face recognition is the advanced technology that replaces the traditional attendance marking system. Face detection and recognition became necessary field in many applications, one of them is Attendance Management System.This system includes detection of human face using familiar and popular algorithm known as Viola Jones Algorithm, Face recognition preparing .csv file for updating and marking the attendance of the respective recognized student.

II AUTOMATED ATTENDANCE MANAGEMENTSYSTEM MODEL

Attendance Management System is implemented in four modules, specifically Image Acquisition, Face Detection, Face Recognition and Attendance updation. The schematic block of the implemented system is presented in Figure 1.

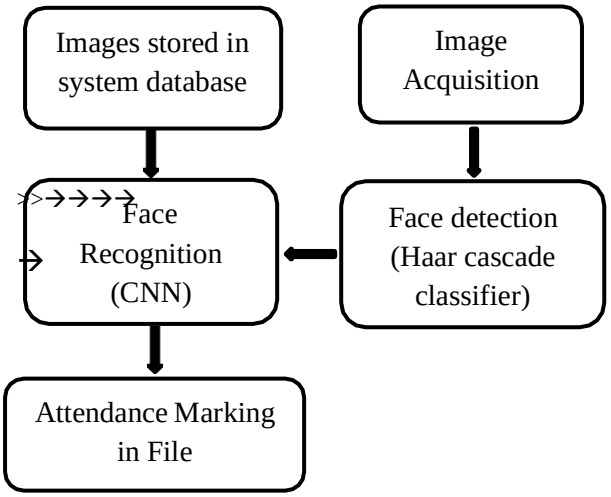

Figure 1: Block diagram of the Model

A. Image Acquisition:

Image Acquisition is the first step in the implementation of attendance management system. It can be obtained through the camera fixed in class room. From the video sequence obtained during the class hour frames of each sequence are extracted from the video[3]

B. Face Detection :

Face detection is computer technology that has wide range of applications detects the face in digital images. It locates faces not only in digital images but also videos. It is like a subset of object-class detection, in which the goal is to locate and quantify all objects belonging to a certain class. An example of face detection is shown below in the Figure2.

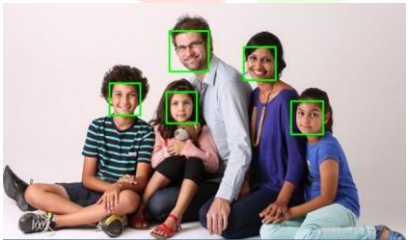

Figure 2: Face Detection

Haar cascade classifier is an object detection algorithm which is used to detect and identify the faces in an image or real time video[4]. Edge and line are the features that are used by this algorithm was firstly developed by "Viola and Jones". This algorithm is trained with a lot of positive (+ve) and negative images which doesn't consist of any of the faces. These trained model will be available in the OpenCVrepository.

In search of particular feature, the Haar feature travel across the image from the top left of the image to the bottom right of the image. Actually the different types of Haar features of Haar classifier algorithm travels over the each and every pixel of the image. Haar features will be applied for every possible sizes of the images. The sample of Haar features is shown in the below Figure 3

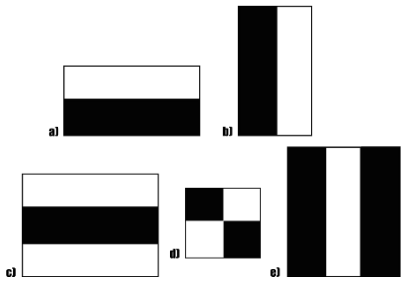

Figure 3 Different Haar features [4]

These features on the image makes it easy to find out the edges or the lines in the image, or to pick areas where there is a sudden change in the intensities of the pixels. The sample Haar calculation of Haar value is shown in the belowFigure 4.

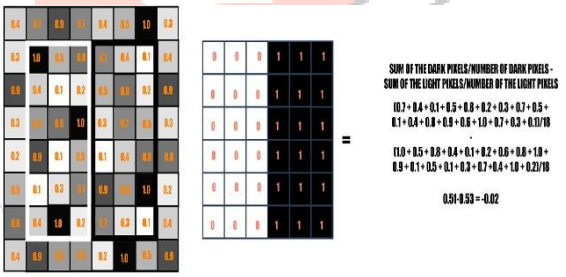

Figure 4 Calculation of Haar features[4]

Haar features are mainly classified into three categories of features based on the features that each one is searching. The first classifies group of Haar features is rectangle features two which are responsible for identifying or detecting the edges in a horizontal or in a vertical direction.

The second classified category *is* three rectangle features. These are responsible for identifying whether there is a lighter region surrounded by darker regions on either side or vice-versa are not. The third category is four rectangle features are responsible for realizing the change of intensity of pixels across diagonals.

Haar features on an image involve a lot of mathematical computations. For a single rectangle on either side, it involves 18 pixel value additions (for a rectangle involving 18 pixels). Visualize doing this for the entire image with all possible sizes of the Haar features. This would be a restless operation even for a high performance machine.

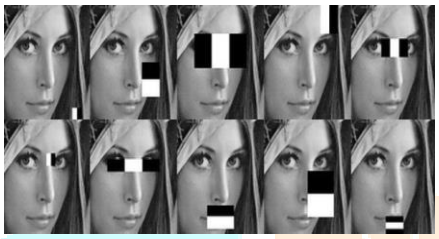

Figure 5 Haar features on the digital image[4]

Face detection procedure follows mainly three steps:

- Firstly, the Haar cascade classifier algorithm mainly uses the different types of Haar features for the detecting and identifying features in the input image.
- Secondly, the algorithm introduces the new image illustration which is known as the integral image to the detector which allows the features to be calculated very quickly.
- Next, simple and efficient algorithm to choose a small number of typical visual features from a very huge set of potential features is built using AdaBoost learning algorithm [6].
- Finally, combine classifiers in a cascade which allows background regions of the image to be rapidly deleted while spending calculation on hopeful face-like regions.

Haar features are similar to the convolution kernel which is used to detect the presence of the features in the given input image. Each feature provides results in a single digit which can be calculated by subtracting the sum of pixels under white rectangle from thesum of pixels under black rectangle.

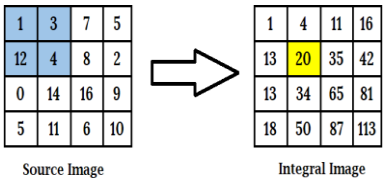

Figure 6 Original and Integral image[4]

Adaboost was all about the features and the representation of the image that are used in the original Haar Cascade research. Basically, there will be a set of features that contain specific facial structures like eyebrows, lips, or the bridge between the both of the eyes that are captured. But the truth is the set of features were not limited to this. Approximately the feature set contains 1,80,000 but now it got declined to 6000.The reason for this will be discussed further.

Most of these features doesn't work properly or will be irrelevant to the features of the face. So here there is a necessity of Feature Selection technique which is designed to select a subgroup of features from the broad set which not only select features that performs better than the other features, but also this technique will eliminate the unwanted and irrelevant ones. For this a Boosting Technique called AdaBoost, in which each of these 180,000 features were applied to the images uniquely to create Weak Learners. Some of those features produced low error rates as they were separated the Positive images from the Negative images better than the others, while some didn't. These weak learners are designed in such a way that they would misclassify only a minimum number of images. They can perform better only based random guess. By this technique the 1,80,000 features got reduced to 6000.

The subset of all 6000 features will again run on the training images to detect if there's a facial feature present or not. Now the authors have taken a standard window size of 24x24 within which the feature detection will be running which is time consuming.

Features are applied on the images in stages. The stages in the beginning contain simpler features, in comparison to the features in a later stage which are complex, complex enough to find the nitty gritty details on the face. If the initial stage won't detect anything on the window, then discard the window itself from the remaining process, and move on to the next window. This way a lot of processing time will be saved, as the irrelevant windows will not be processed in the majority of the stages.

C. Face recognition:

Facial recognition system is an innovation that the matches the digital images or video in real time with the digital images or id's present in the dataset.[5]

Convolution Neural Network is a deep learning algorithm[6] where convolutional Neural Network (CNN) layers were chosen as the building blocks for our model architecture. When pictures are processing, CNNs are known to behave how the human brain functions.

A convolutional neural network's usual architecture includes an input layer, some convolutional layers, some dense layers (also known as fully-connected layers), and an output layer. CNN got a tremendous change in the path that we learn images. It made learning and classifying images easier than before.

CNN modifies the way the humans look to the images, by concentrating on one portion of the image at a time and scanning the entire image.

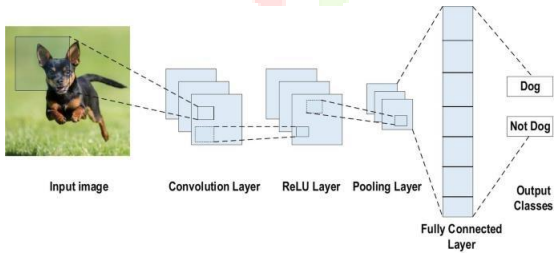

Figure 7 Architecture of CNN[7]

A Convolutional Neural Network (ConvNet /CNN) is a Deep Learning algorithm which takes image as input, allocates the weights and biases to the distinctive objects in the image and CNN has ability to differentiate or classify the images from one another. The pre-processing that is required will be available in the ConvNet is much lower when compared to other classification algorithms. While in primitive methods filters simulates occurs in hands, with enough training. Meanwhile ConvNets have the ability to learn these primitive type filters/characteristics.[8]

CNN turns every image into vectors (vector of numbers) using convolution operation. This can be learned using the fully connected Dense layers of ANN(Artificial Neural Network). Convolution operation on digital image is shown in the below.

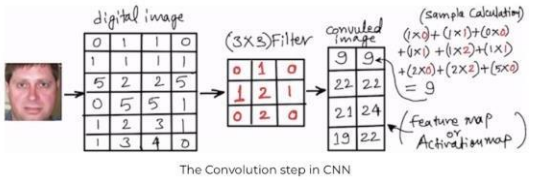

Figure 8 Convolution operation on input image[9]

D. Attendance updation model:

Attendance is updated making dataset comprising of the concerned person's name and the timestamp. It is updated in the .csv file.

III Simulation Results

The automated attendance marking system is implemented in the Pycharm IDE using python programming language. The software prototype is designed using python libraries such as Numpy, Keras, OpenCV.

The quantitative results of the implemented system was assessed in real time representing the detected faces. Detected faces are represented in the blue colour square box, recognized faces, attendance marking sheet comprising of person's id with time.

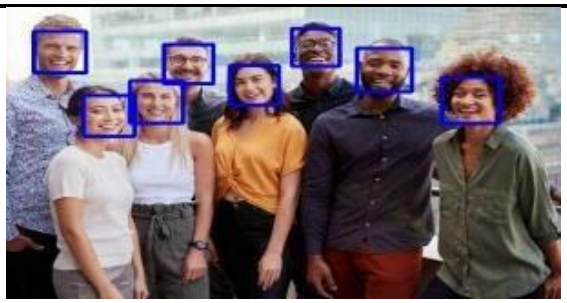

Figure 9 Qualitative Results of Face Detection Module

The effective results of face recognition module is represented in green colour square boxes along with the person's name in real time and also the attendance.

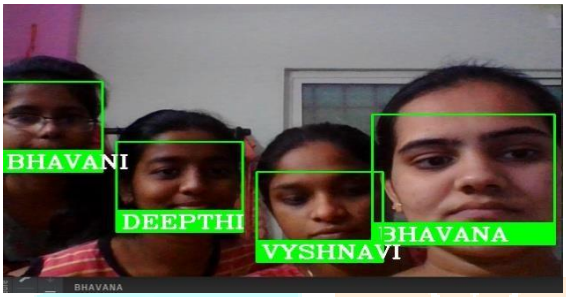

Figure 10 Qualitative Results of Face Recognition inReal Time

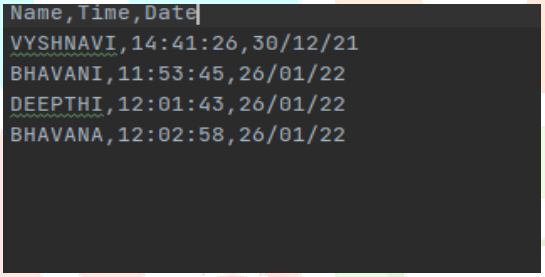

Figure 11 Screenshot of Attendance Timestamp

IV CONCLUSION

In this paper, Attendance Management System has been implemented. Haar Cascade Classifier algorithm was utilized to detect the faces. Furthermore, Convolution Neural Network is employed to extract the features from the detected faces. Finally, the attendance was generated in a file with person name, time and date. As evident from the simulation results, the implemented system is foundaccurate.

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