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HOG – Neural Network Based Student Attendance System

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Abstract— With great advancements in technology, topics like machine learning, artificial intelligence, and big data are trending right now. These technologies are touching the lives of millions of people around the world. Data is being produced at exponential rates and computer engineers want to put this data to good use. In this project, we discuss the scope of machine learning and image processing to record the attendance of students in a classroom. This method is extremely efficient compared to the traditional attendance registration wherein the teacher has to manually mark the attendance of each and every student. With this system, the attendance is marked every hour and reports are generated automatically for easy consolidation. A combination of the HOG and Neural Networks are used for detection and recognition in our system. It eliminates the need for paper-based records and helps in quick consolidation.

Keywords— Facial Recognition; Image Processing; HOG; Neural Networks; Face API; Attendance System

I. INTRODUCTION

The fields of pattern recognition and machine learning are rapidly developing and large organizations want to make use of these core technologies to improve the performance and effectiveness of their workforce. The first and most important aspect of a successful organization is the workforce itself and the organization needs to be able to effectively monitor their performance. A simple way to monitor the performance of a person is to record his/her attendance and whether they are regularly present at the organization. In most offices, fingerprint scanners are used for attendance marking. But this is done only twice a day, when the person comes into the organization and when they leave the organization. This does not allow for a continuous evaluation of the person and this is where facial recognition comes in to play. The example we are looking at is that of a college, but this can be expanded to almost any organization that requires an attendance system. Face recognition is also a type of biometric recognition and is considered to be one of the most successful applications of image analysis and processing. Apple recently replaced the fingerprint scanner on its latest iPhone with a facial recognition system. Just like any biometric system, facial recognition also follows three main steps, detection, feature extraction, and matching.

A) Face Detection and Feature Extraction

A picture may contain a lot of faces or no faces at all. So, it is extremely important to find out the locations of the faces and separate them from the rest of the picture. This is the foundation of the system from where the rest of processes can take place. Once the faces have been detected, it is vital to extract features from the face that is required to identify different people.

B) Face Recognition

The next step is to compare the features of a random face with that of a stored face and see whether they match. The decision is made based on a sufficient confidence score and the ones below the confidence are neglected.

The paper is organized in the following manner; with Section I containing the introduction, Section II highlighting some of the related work happening in this field, Section III containing the methodology, Section IV showing the actual results and Section V containing the conclusion.

II. RELATED WORK

E. Varadharajan's says about the biometric attendance management system. Maintenance of student attendance is the most difficult task in various institutions. Every institution has its own method of taking attendance such as using an attendance sheet or by using some biometric methods. But these methods consume a lot of time. Mostly student attendance is taken with the help of an attendance sheet given to the faculty members. This consumes a lot of work and time. We do not know whether the authenticated student is responding or not. Calculation of consolidated attendance is another major task which may cause manual errors. In some other cases, the attendance sheet may become lost or stolen by some of the students. To overcome such troubles, we are in need of an automated attendance

management system. The automatic attendance management will replace the manual method, which takes a lot of time and is difficult to maintain. There are many biometric processes, among which face recognition is the best method. He uses face recognition to describe attendance without human interference. In this method, the camera is fixed in the classroom and it will capture the image, the faces are detected and then it is recognized with the database and finally, the attendance is marked. If the attendance is marked as absent, the message about the student's absent is sent to their parents. The Eigen face is one of the methods for comparing faces and is also one of the easiest. Eigenfaces is a set of Eigenvectors which are used in computer vision problem for face recognition. The advantages of this system are that it reduces the manual workload on the teachers and it is also extremely easy to use. The identification accuracy is also high [1].

Theo Ephraim develops optimizations to the Viola-Jones face detection method to make it suitable for use in a web browser running on a standard laptop or a desktop equipped with a webcam. In our security-obsessed world, governments agencies are becoming increasingly interested in surveillance tasks that can be automated. These tasks include tracking the movement of people in video feeds using static or moving cameras and the deployment of face recognition systems. In these settings, rapid face detection is often the first step. There are also numerous applications in the consumer realm, for instance, auto-focusing on faces in digital cameras, Wii-style gaming, and head-tracking webcams. For the majority of these applications to be successful, detection must happen in real-time. In this setting, certain assumptions can be made about the number and location of faces to find, and information from a previous frame can help to localize the search. These optimizations lead to an algorithm which performs real-time face detection using a slow scripting language, even on low-end computers. Specifically, we have implemented the algorithm in Adobe Flash (ActionScript 3.0) and our implementation can be deployed via a web browser without any extra installation [2].

Mohammad Da'san discusses human face detection and recognition which is a hot topic and an active area of research. It is common in several fields such as image processing and computer vision. It is the primary and the first step in a wide range of applications such as face recognition, personal identification, identity verification, facial expression extraction, and gender classification. He has shown a multi-stage model for face detection which is integrated based on Viola and Jones algorithm, Gabor Filters, Principal Component Analysis, and Artificial Neural Networks (ANN). This model was trained and tested using the CMU (Carnegie Mellon University) data set. The model showed enhanced performance in terms of face detection rate [3].

Hemantkumar Rathod wants to change the conventional method of taking attendance which is done manually by the teacher or the administrator and requires a considerable amount of time and efforts also involving errors and proxy attendance. As the number of students is increasing day by day, it is a challenging task for universities or colleges to monitor and maintain the record of the students. Automated systems involving the use of biometrics like fingerprint and iris recognition are well developed in recent years however, it is intrusive and cost required for deployment on large scale gets increased substantially. To overcome these issues, a biometric feature like facial recognition can be used which involves the phases such as image acquisition, face detection, feature extraction, face classification, face recognition and eventually marking the attendance. The algorithms like Viola-Jones and HOG features along with SVM classifier are used to acquire the desired results. Various real-time scenarios need to be considered such as scaling, illumination, occlusions and pose. The problem of redundancy in manual records and keeping attendance is solved by this system. Quantitative analysis is done on the basis of PSNR values . Checking the performance of students and maintaining attendance is a tedious process for the institute. Each institute has adopted its own method of taking attendance i.e. calling the names or by passing the sheets. Several very popular automatic attendance systems currently in use are RFID, IRIS, FINGERPRINT, etc. However, making queue is essential in these cases thus requires more time and it is intrusive in nature. Any damage to the RFID card can make inappropriate attendance. Apart from this deploying these systems on a large scale does not cost efficient. In order to have a system both time and cost efficient with no human intervention, facial recognition is a suitable solution also face is people's preliminary scheme of person identification. With the rapid development in the fields of image processing such as pattern recognition, facial recognition, and signature recognition the efficiency of this system is kept on increasing. This system is attempting to provide an automated attendance system that carries out the face recognition task through an image/video stream to record the attendance in lectures or sections and keeping the database of attendance. After creating the database of the students/candidates, it requires almost zero efforts from the user side. Thus intrusive nature is absent in this system and makes the system effective [4].

Nazare Kanchan Jayant believes that attendance recording of a student in an academic organization plays a vital role in judging students' performance. As manual labor involved in this process is time-consuming, an automated Attendance Management System (AMS) based on face detection and face recognition techniques is proposed by Nazare Kanchan. The system employs a modified Viola-Jones algorithm for face detection and alignment-free partial face recognition algorithm for face recognition. After successful recognition

of a student, the system automatically updates the attendance in the excel sheet. The proposed system improves the performance of existing attendance management systems by eliminating manual calling, marking an entry of attendance in institutional websites [5].

Tiemeng Li uses face detection as one of the key technologies for face information recognition. Currently, face detection is mainly based on the RGB image, which might lead to unexpected results when dealing with non-real 2-dimensional face, which printed on clothes and papers. His work proposes a face detection approach based on features of the depth image. He has used a depth camera to obtain the raw depth data and then mapped it to the 2D image combined with smooth image processing method to get the depth image. An improved HOG-LBP algorithm was designed to profiling the features of face depth, and SVM-light was used for machine learning. Finally, an online video face detection system was accomplished.

Face detection, used for finding a human face and its pose in images or video stream, is one of the key techniques in face information processing. Based on face detection, the further application could be implemented, like face recognition, face tracking and pose tracking. In most common face detection works; the system usually encounters the following challenges. One issue is that the imaging circumstances are quite complicated that it is difficult to distinguish foreground and background. The typical resolution is training a good template using better and bigger sample collections. However, this method is usually based on a single RGB camera without depth information, which leads to another problem. For the camera, face object could either be a real face on one's head or be an image face printed on a paper or magazine. In this situation, the traditional method with the traditional camera device is invalid for identifying the real face [6].

Ramandeep Kaur says that the strategy of face recognition involves the examination of facial features in a picture, recognizing those features and matching them to 1 of the many faces in the database. There are lots of algorithms effective at performing face recognition, such as for instance: Principal Component Analysis, Discrete Cosine Transform, 3D acceptance methods, Gabor Wavelets method, etc. His work is centered on Principal Component Analysis (PCA) method for face recognition in an efficient manner [7]. There are numerous issues to take into account whenever choosing a face recognition method. The main element is Accuracy, Time limitations, Process speed, and Availability. With one of these in minds PCA way of face, recognition is selected because it is really a simplest and easiest approach to implement, extremely fast computation time. PCA (Principal Component Analysis) is an activity that extracts the absolute most relevant information within a face and then tries to construct a computational model that best describes it [8].

III. METHODOLOGY

The system has been implemented using Python on Ubuntu 16.04. The face detector is made using the now classic Histogram of Oriented Gradients (HOG). This type of object detector is fairly general and capable of detecting many types of semi-rigid objects in addition to human faces. The initial phase is the training phase, where we capture 10 to 15 images of a student and then store it in a directory of faces. This is then repeated for each student. After that, we train the neural network with the faces of each person.

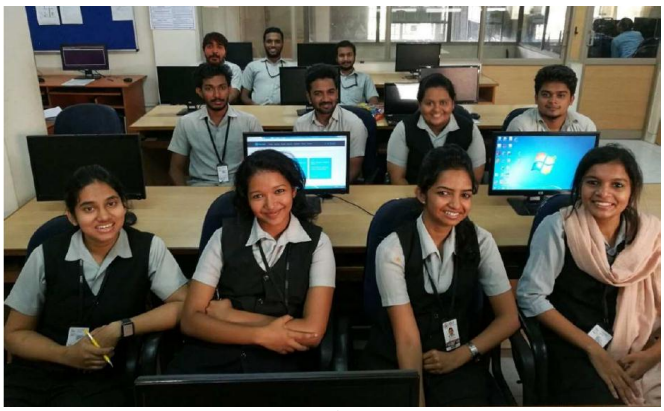


Figure 1: Image was taken for testing with 11 students

Once the training phase is completed, we move on to the testing phase. A test image may contain a number of faces and we first detect the number of faces after which we perform recognition.

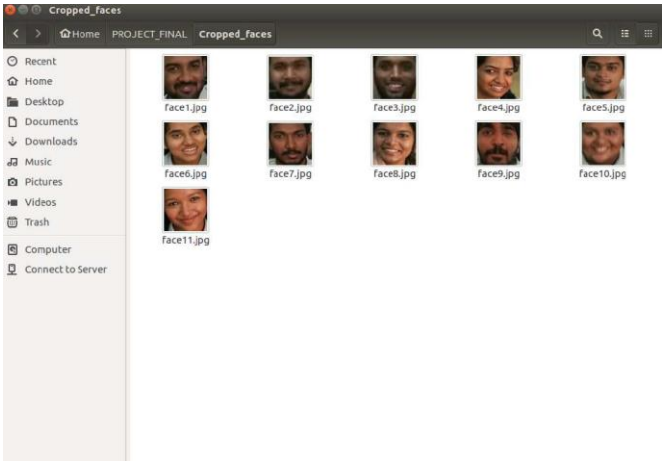
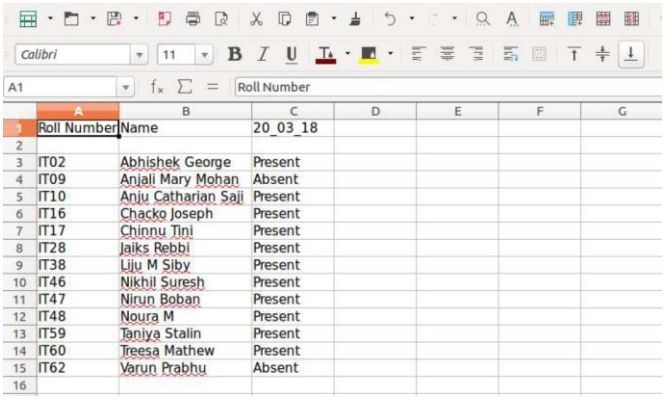


Figure 2: Images cropped after face detection

The image is first converted into a grey scale. Then we'll look at every single pixel in our image one at a time. For every single pixel, we want to look at the pixels that directly surrounding it. Our goal is to figure out how dark the current pixel is compared to the pixels directly surrounding it. Then we want to draw an arrow showing in which direction the image is getting darker. Then we'll end up with such a

representation for the image. Since this contains a lot of information for each pixel, we will convert the image into a smaller size, like 16x16 or 32x32 pixels. Then we compare the HOG pattern from the input image with the HOG pattern that we have obtained from the training images. Once the pattern similarity is found, the face is detected.



Roll Number	Name	20_03_18
IT02	Abhishek George	Present
IT09	Anjali Mary Mohan	Absent
IT10	Anju Catharian Saji	Present
IT16	Chacko Joseph	Present
IT17	Chinnu Tini	Present
IT28	Jaiks Rebbi	Present
IT38	Liju M Siby	Present
IT46	Nikhil Suresh	Present
IT47	Nirun Boban	Present
IT48	Noura M	Present
IT59	Taniya Stalin	Present
IT60	Treesa Mathew	Present
IT62	Varun Prabhu	Absent

Figure 3: Attendance report generated of the students present

The HOG face detector detects the location of the faces and then we use OpenCV to crop the image and write it to a directory. Once that is completed, we perform recognition on the cropped faces. Recognition is done using the Face API based on the trained faces [9]. The directory of the image is converted into a URL and sent to the API where it processes it on Microsoft's proprietary neural network and returns the name of the person along with the confidence value.

Table 1: Trial runs with accuracy

Number of people	Successfully identified	Accuracy
1	1	100%
2	2	100%
4	4	100%
11	11	100%
22	22	100%
40	40	100%
50	50	100%

Once that is complete, an Excel report is generated instantly and the attendance of the student is marked. The creation of the Excel sheet is done using the OpenPyxl library.

IV. RESULTS AND DISCUSSION

The results of our system have been extremely positive and there is a huge potential for it to be converted into a product that will totally eliminate the use of traditional attendance marking systems. The tests were conducted for a class of 4, 11 and 20 students respectively and the accuracy was 100%. This can also be expanded to a class of 50 or more students without any issues in accuracy.

Figure 1 shows the picture taken from the front of a computer lab with 11 students present. This picture is then given as input to the face detection system, which then detects the faces and crops them out and stores them in a folder.

Figure 2 shows that the system successfully identifies 11 faces in the picture and then stores it in a folder. This folder's path is then given as input to the facial recognition system, which goes through each image one by one, and then compares it with the trained faces. With Microsoft's Face API using a very deep neural network, the accuracy of the system was always spot on.

Figure 3 shows the Excel report generated from the system. As you can see, the system was trained on 13 faces, but 2 of the students are absent and it successfully marks them as absent. The beauty of the whole process is that it can be done even after school hours, and the only thing that is required is the pictures that are taken on an hourly basis.

Table 1 shows the trial runs we conducted ranging from 1 person in a classroom to 50 people. In all cases, the number of people that were successfully identified was spot on and the accuracy was never below 100%.

V. CONCLUSION AND FUTURE SCOPE

There may be various types of lighting conditions, seating arrangements, and environments in various classrooms. There may also exist students portraying various facial expressions, varying hairstyles, beard, spectacles, etc.

All of these cases are considered and tested to obtain a high level of accuracy and efficiency. Thus, it can be concluded from the above discussion that a reliable, secure, fast and an efficient system has been developed replacing a manual and unreliable system. This system can be implemented for better results regarding the management of attendance and leaves.

The system will save time, reduce the amount of work the administration has to do and will replace the stationery material with electronic apparatus and reduces the amount of human resource required for the purpose. Hence a system with expected results has been developed but there is still some room for improvement

The major improvements that we have in the pipeline are to build a product around this system which comes with an intuitive interface with the ability to log in and log out when needed and generate other useful reports from the attendance recorded. Since this is using a proprietary API for facial recognition, we need to replace that with an open-source neural network that can be tweaked to our preferences [10].

That will also be useful for collecting important metrics that be used for further improvement down the road.

REFERENCES

[1] E. Varadharajan, R. Dharani, S. Jeevitha, B. Kavinmathi, S. Hemalatha, *"Automatic attendance management system using face detection"*, Green Engineering and Technologies (IC-GET), Online International Conference, **India,** pp.**1-3, 2016**

[2] T. Ephraim, T. Himmelman, K. Siddiqi, *"Real-Time Viola-Jones Face Detection in a Web Browser",* CRV '09 Proceedings of the 2009 Canadian Conference on Computer and Robot Vision, **Canada,** pp.**321-328, 2009**

[3] M. Da'san, A. Alqudah, and O. Debeir, *"Face Detection using Viola and Jones Method and Neural Networks"*, IEEE International Conference on Information and Communication Technology Research, **UAE,** pp.**40-43,2015.**

[4] N. K. Jayant, S. Borra, *"Attendance management system using hybrid face recognition techniques"* Conference on Advances in Signal Processing (CASP), **India,** pp.**412-417, 2016**

[5] H. Rathod, Y. Ware, S. Sane, SurS.esh Raulo, V. Pakhare, I. A. Rizvi, *"Automated attendance system using machine learning approach"*, 2017 International Conference on Nascent Technologies in Engineering (ICNTE), **India,** pp.**1-5, 2017**

[6] T. Li, W. Hou, F. Lyu, Y. Lei, C. Xiao, *"Face Detection Based on Depth Information Using HOG-LBP",* 2016 Sixth International Conference on Instrumentation & Measurement, Computer, Communication and Control (IMCCC), **China,** pp.**779-784, 2016**

[7] B. Patel, T. Mokadam, S. Kernse, S. Gundety, *"Collective Face Recognition System"*, Vol **2**, Issue **2**, pp. **1063-1066**, **2017**

[8] R. Kaur, Himanshi, *"Face recognition using Principal Component Analysis",* 2015 IEEE International Advance Computing Conference, **India,** pp.**585-589, 2015**

[9] H. Kim, T. Kim, P. Kim, *"Interest Recommendation System Based on Dwell Time Calculation Utilizing Azure Face API"*, **France,** pp.**1-5, 2018**

[10] P. L. Agarwal, D. D. Patil, *"Wearable Face Recognition System to Aid Visually Impaired People"*, Vol **2**, Issue **2**, pp.**372-376**, **2017**

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