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REAL TIME SMART CLASS ATTENDANCE MONITORING AND ALERT SYSTEM

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ABSTRACT *- In this digital doorway, face recognition system plays a vital role in almost all fields. It can used in finding missing peoples, protecting business against theft, enhances the security measures and most importantly reduces the number of touchpoints. Now by the same token the face recognition system can also be used for attendance marking in schools, colleges, offices, etc. The proposed system consists of 4 different steps- database creation, face detection, face recognition, attendance updation. Database is created by the face images of the students in class. Face detection and recognition is performed using Histogram oriented gradient and Deep neural network respectively. Faces are detected and recognized from live streaming video of the classroom which is later converted into frames and identification is done by using support vector machine. Attendance will be mailed to the respective faculty at the end of each class.*

Key words : Face Recognition, Face Detection, face recognition, Histogram oriented gradient Convolution neural network, attendance system.

1. INTRODUCTION

In the 21st century, everything around us has become depends upon technology to make our life much easier. Daily tasks are continuously becoming computerized. Nowadays more people prefer to do their work electronically instead of performing them manually.

In general, the attendance system can be of two different forms-

- Manual Attendance System (MAS)
- Automated Attendance System (AAS).

Manual Student Attendance Management system is a process here the lecturers concerned with the particular subject need to call the students name and mark the attendance manually or Lecturers go through manual attendance sheets and passes the signed papers to record attendance and by this there is chances of proxy also and this system is slow, inefficient and time consuming. Later yet new technologies were implemented for taking attendance like biometrics, RFID, iris recognition, but this system where not so accurate and also queue based which was time consuming and presumptuous in nature. So, to overcome the disadvantages of MAS we go with automated attendance system

AAS is a process where the students are automatically marked as present or absent in the classroom by using the different recognition techniques. We can identify student as present or absent in class by first capturing the video of the student by using webcam in a classroom and converting it into frames so it becomes well founded for the system to understand the Prescence of all students.

Many algorithms have been developed to make the face detection task easier but in real setup this task is very tough. A face recognition system must be capable of dealing with illumination, expression and variations of face images in position. The variation in the images of the same face due to different posture are always larger than variant owed to face identity. This makes face recognition task very challenging. A powerful multiple face recognition system has been used in the proposed system. The system is built up with coordination of Histogram feature descriptor and Convolution neural network. Histogram of oriented gradients (HOG) descriptor is used as face detecting algorithm and for face highlight extraction, CNN is used as face recognition algorithm.

When comparing CNN with other existing algorithm like Viola jones algorithm it can identify the face if it's in frontal position and proper lightning condition, therefore accuracy of the results drops dramatically. The Viola-Jones algorithm faces the problems in positions range like side view and for low because their features do not very well map to varying positions. In contrast, CNNs detect the faces in different positions (left, right, up, down, tilted etc) and different lighting scenarios, and therefore CNNs are much more diverse to correctly handle their input.

R-CNN we need to train every part of the image independently or we can say every feature of the face is to be trained independently. Hence the CNN algorithm is more effective for Face recognition system.

2. LITERATURE SURVEY

1. Author in [1] has implemented the attendance system by using web-based prototype. Initially the student's iris template has been taken along with necessary information like name, email, USN etc. Later when student's seats in the class the iris of each student is captured and detected iris image will be matched with the iris template stored in database if matched successfully then students are present or else absent. The system provides more accurate method for taking attendance and is cheap to implement.

2. Author in [2] did a comparison between eigen face and fisher face algorithm to detect the best facial recognition algorithm and later the best algorithm was used to implement the attendance system. Eigen face achieved an accuracy of 70% to 90%. So, it proved that eigen face are better than the fisher faces.

3. Author in [3] proposed a method of incorporating the facial recognition to RFID so that can recognise the student and mark attendance and this system also count the number of times student entered and left the class. System also keeps all the necessary record of the registered students in attendance log and provides when needed.

4. Author in [4] has implemented a automated attendance system in which the students face is captured and attendance is marked. The proposed system reduces the inaccuracy caused due to Viola jones algorithm. Total number of students were 9 in which 7 students were recognised correctly. So, hog+surf and provides a better facial recognizer.

5. Author in [5] has implemented a system by combining two technologies i.e Student Attendance system and Feedback system by using machine learning algorithms. The system is going to maintain the record of each student and also the feedback on each subject like maths, science etc. And by recognising the face student attendance is marked. And later when recognition is done details of student's attendance and marks of the students is considered as feedback.

3. PROPOSED SYSTEM

First the student should enter the necessary details like name, email, phone no, USN and the face image of all the respective students are captured and stored in the dataset, later the lecturer is going to enter the subject code and camera gets started and video of the entire class is been taken and converted into frames now detected face will be matched with the faces stored in the dataset. And once if face is recognised then student is marked as present or else absent. At the end of the session attendance of all the students will be sent to the respective subject lecturers.

Proposed system, System architecture is shown below-

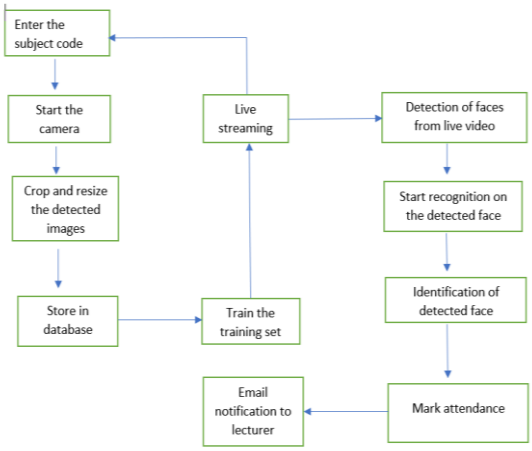

Fig 1: Overall System Architecture

The process is divided into four stages:

3.1. Dataset Creation: Dataset is formed using webcam. There are total number of 8 students. The camera gets started and for each individual around 500 images are captured with different angles, poses and even images are captured with Occlusion (face half covered with hands or the other accessories). Dataset is splitted into 3715 training image and 929 testing images.

3.2. Face detection: The HOG is aimed for the purpose of face detector which acts as feature descriptor in computer vision for the image processing. When stepping from right to left pixel by pixel, after few steps, there is a sudden change with in the pixel value i.e, from a black lower pixel number to a white higher pixel number. This sudden change in the colour is termed a gradient and going from a lighter tone to a darker tone is called a negative gradient and other way around. Going from top to down provides with the vertical gradient and needless to say going from right to left gives a horizontal gradient.

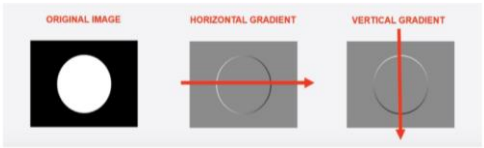

Fig 2: Gradients in image
[https://medium.com/analytics-vidhya/a-take-on-h-o-g-feature-descriptor-e839ebba1e52]

3.2.1 HOG WORKING:

HOG works with a block which is comparable to a sliding window. A block is taken into account as a pixel grid during which gradients are formed from the magnitude and direction of change within the intensities of the pixel within the block.

Step 1: Convert the given original images (RGB) images into Gray scale. It is relatively easier to deal with a single colour channel than multiple colour channels. Therefore, grey scale images are used in our proposed system.

Fig 3: RGB image

Fig 4: Gray scale conversion

Step 2: Compare the pixel of each image with neighbouring pixel and observe the present pixel how dark it's with other pixel. The pixel will be replaced with the arrowing pointing to the darker pixel.

Step 3: Now repeat this step for each pixel within the image.

Step 4: This offers the detailed requirement of the pixel. To scale back the complexity, we are visiting direct it to the 16*16 squares.

Step 5: the direction of the dominant gradient is been considered and reducing the complex structure into simple frame of face.

This can be called as HOG image, and this hog image is compared within the image stored in the dataset and hence detection process is completed.

3.3 ***Face recognition***:

Face recognition is by using the CNN algorithm where the face images are given as the input instead of giving the features of the faces. The given input will be converted into different layers and convolution filters will be applied to it after applying multiple filters it's going to extract the exact position of the eyes, nose, mouth and even edges are identified, remaining all will be filtered. Whole image is now filtered and detects the position of eyes, nose, mouth and also finds the height and width of all features.

Rectilinear layer (Relu layer): After convolution, rectilinear layer is applied it extract the image and going to down sample i.e, if the images are of 512*512 then it's going to down sample it, if down sampling is down by 2-256*256 image is obtained. Down sampling is going to scale back the dimensions of the image. Again, the convolution + relu layer, down sampling is applied and hence image size will be reduced and cycle repeats for 7 layers. Totally seven layers are used because each and every size of the image and it's going to extract the position of eyes, nose, mouth and even the height, width, mean and variance all the above parameters are available at final level. Finally, when 7 layers are applied or down sampling by 7, image of 8*8 is obtained-

512*512-> 256*256 -> 128*128-> 64*64-> 32*32->16*16 -> 8*8.

Finally, 8 values are provided for every image which can be represented in matrix form. Matrix to array conversion is termed as Flatten. Totally 8 classes are obtained. Set of 1 person images will be taken as class 1 and set of 2 person images will be taken as class 2 and so on. Like this the layers are been connected that's is termed as fully connected layer. After fully connecting layer, next step is SoftMax which is employed for training the images. Training is completed as – the given features belong to this particular class. Every iteration it'll trained, after training error are going to be feedback to the convolution layer based on the error it'll do the same process until the proper result is obtained after following multiple repeats error will be reduced and results will be saved. From webcam we are going to capture the image and the given RGB images are converted into grey scale. 512*512*3 number of pixels are been obtained. All the images will be of grey colour and there will be no loss of information during conversion. After detection, the input image is given for the model prediction, for model prediction certain steps are followed they are-

1. Convolution + relu
2. Flatten
3. Fully connected
4. SoftMax

Pred=Mask_model.predict(test_tensors) ->

The above code anticipated class and score if class one has highest score, then it provides the name of the corresponding class.

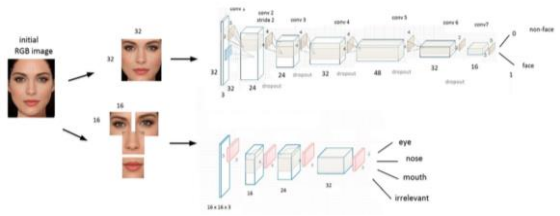

Fig 5: CNN steps [https://www.google.com/search?q=face+recognition+in+cnn+steps&rlz=1C1RXQR_enIN947IN947&sxsrf=ALeKk01NH5DnRgAw3aUCz8IqYLLW5iQ8PA:1623296502455&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjX7pLbkozxAhWQyDgGHXmOAUkQ_AUoAnoECAEQBA&biw=1536&bih=722&dpr=1.25#imgrc=3or-Tuesy1cNPM]

Packages used for detection and recognition:

1.From imutils import face_utils

2.import dlib

3.import cv2

4.import TensorFlow as tf

5.from keras.models import load models

3.4 Attendance updation: After the recognition process is completed the attendance excel sheet is updated, if the face is recognised, student is marked as present else absent along with subject code, student name, date and time. And at the end of every class the email will be sent to respective lecturers.

4. RESULTS

The student has to enter all the necessary details like name, USN etc and once this process is over the camera gets started automatically and n number of images are been captured and stop the capturing of the image by clicking cltr+q and images are pre-processed and stored in the dataset folder, whenever new student's details are added every time the training code is executed to train the images.

Later the lecturers have to enter their respective subject code and camera gets started takes the overall video of whole class and converts into frame and recognise the individual students in classroom with name and later attendance is updated in the excel sheet along with subject code, date and time it also gives the number of classes a student was present in the respective class and email is sent to respective lecturers.

The overall accuracy of the system is 99.86. Which can recognise the student in different poses, angles and also solves the occlusion and illumination problem.

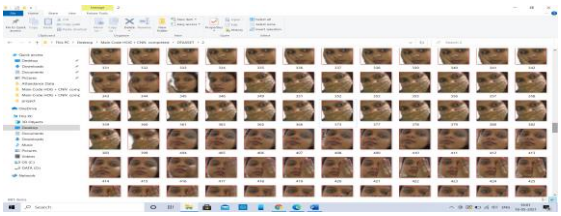

Fig 6: Dataset creation with different poses and angles.

Fig 7: Face recognition with frontal face

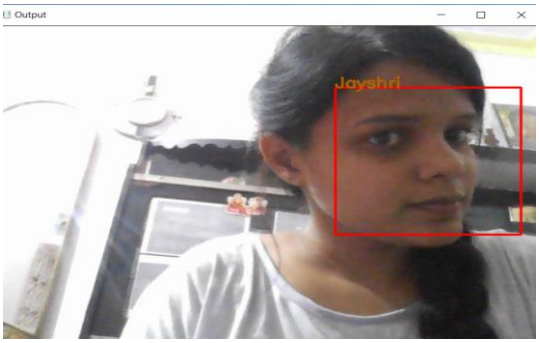

Fig 8: Face recognition with face left tilted

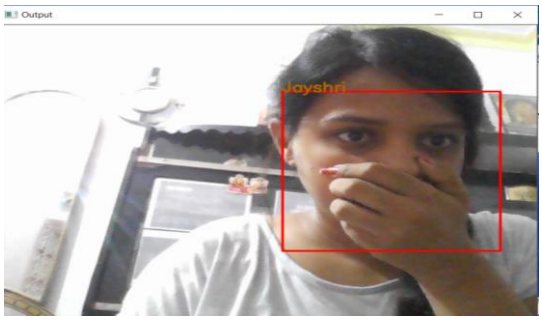

Fig 9: Face recognition with Occlusion

Fig 10: Total number of classes students are present for NLP class

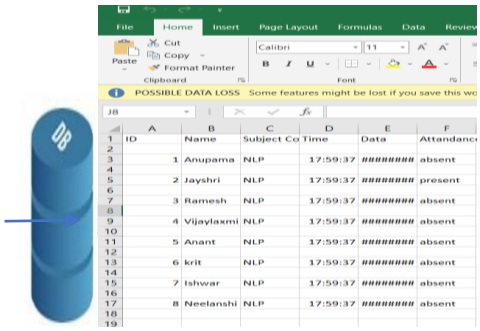

Fig 11: Attendance updation

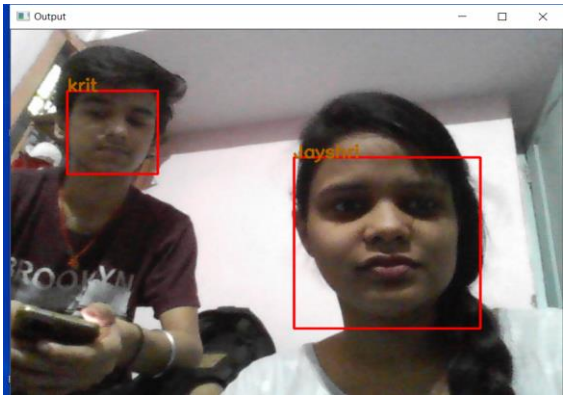

Fig 12: Recognition of multiple students in a class

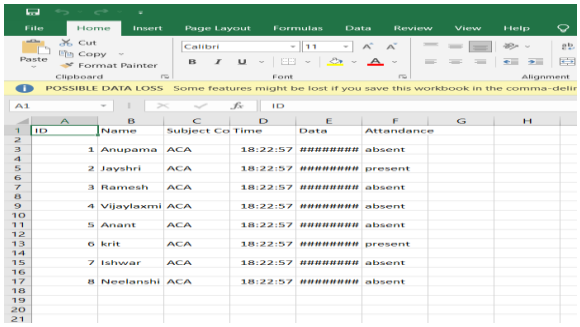

Fig 13: Updating the attendance in excel sheet

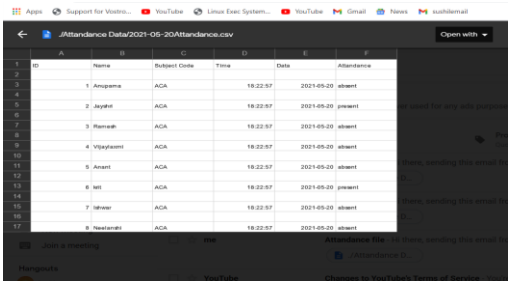

Fig 14: Email sent to respective lecturer

Epoch	ETA	MS/STEP	LOSS	ACCURACY	VAL_LOSS	VAL_ACCURACY
1/25	8	242	1.6102	0.3990	1.1042	0.6538
2/25	7	219	1.0290	0.6923	1.0025	0.6387
3/25	6	212	0.8034	0.7791	0.6956	0.8129
4/25	6	188	0.5833	0.8400	0.7907	0.7204
5/25	5	184	0.5595	0.8184	0.5771	0.8151
6/25	6	185	0.4428	0.8702	0.3934	0.8753
7/25	6	194	0.3672	0.8891	0.2774	0.9140
8/25	5	183	0.2793	0.9126	0.4016	0.8473
9/25	6	186	0.2693	0.9126	0.2435	0.9355
10/25	5	184	0.1922	0.9339	0.1936	0.9484
11/25	5	184	0.1637	0.9466	0.1505	0.9591
12/25	6	188	0.1414	0.9655	0.1489	0.9441
13/25	6	192	0.1443	0.9532	0.01014	0.9634
14/25	5	184	0.1138	0.9678	0.0850	0.9806
15/25	6	186	0.0946	0.7293	0.1669	0.9484
16/25	5	184	0.0977	0.9691	0.0548	0.9849
17/25	5	182	0.0918	0.9696	0.0483	0.9806
18/25	5	182	0.0471	0.9912	0.0476	0.9871
19/25	5	184	0.0573	0.9808	0.0624	0.9806
20/25	5	183	0.0418	0.9860	0.0370	0.9892
21/25	5	183	0.0485	0.9989	0.0276	0.9914
22/25	5	182	0.0405	0.9885	0.0258	0.9935
23/25	5	182	0.0315	0.9915	0.0245	0.9957
24/25	5	184	0.0252	0.9943	0.0181	0.9957
25/25	8	103	0.0098	0.9970		

Table 1: Accuracy with epoch=25

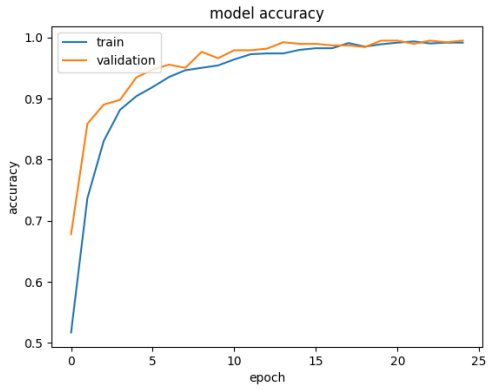

Fig 15: Model Accuracy

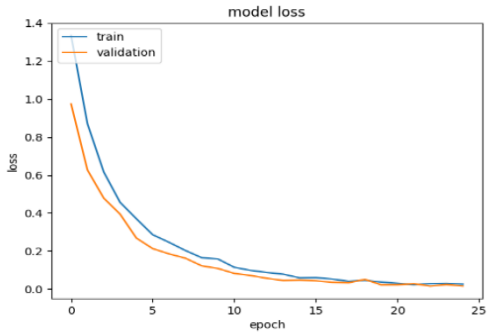

Fig 16: Model loss

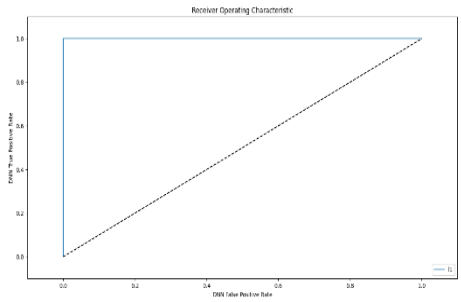

Fig 17: ROC Curve

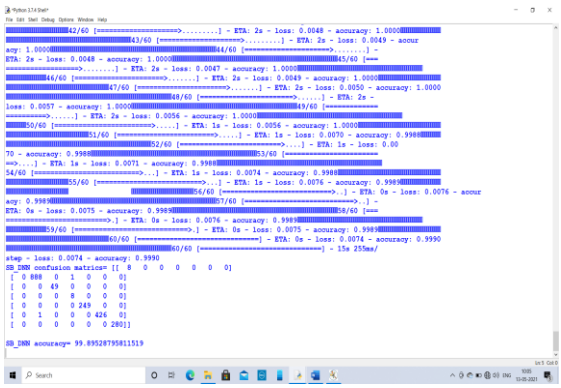

Fig 18: Overall Accuracy

5. CONCLUSION

The system takes attendance of each student by continuous observation when lecturers enter the subject code. The result of our preliminary experiment shows improved performance in the estimation of the attendance. The automated attendance system based on the face recognition is effective, time saving, secured and better than traditional methods. The system is also capable of identifying the unknown person. In real time scenarios Convolutional neural network outperforms other algorithm by giving low false positive rate and with better recognition rate. The system also overcome the problem of occlusion, lightning condition and different poses.

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