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Real Time Image Based Attendance System using Python

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Abstract - *Attendance system is an integral part of any organisation's daily routine. The traditional method of marking attendance on paper sheets is not very efficient but also wastes a lot of time and energy. Also, the chances of errors like student proxy attendance are also high and the system is error prone. With the advancement in technology, facial recognition systems have gained great importance and also seen great development in its field of study and application. Using the current facial recognition modules or algorithms, we can develop a real time image based attendance system which will be using facial detection and recognition in marking the attendance of the students. In this paper , we have proposed a real time image based attendance system that uses computer vision techniques to detect and recognise the face(s) of a student. The system is built on mainly capturing the image, preprocessing the image, applying facial algorithms and storing the data in the database. The proposed system offers various features like accuracy, speed ,efficiency and ease of use. Moreover, the system helps to reduce the chances of errors which persist in the traditional methods and also provides real time attendance records.*

Key Words: Face recognition, Face detection, Python ,OpenCV, Haar Cascade, LBPH

1.INTRODUCTION

Attendance tracking plays an integral role in every field of the workplace whether it be schools, universities or offices. The traditional methods of marking attendance using the pen paper or punch cards are not very much efficient and accurate and can also lead to inconsistencies. With the help of current technologies, we can design a real time image based attendance system using facial recognition.

Real time attendance systems use images or videos and facial recognition to mark the attendance of the individuals as they enter a designated workplace like classroom, lecture halls, offices, etc. These systems capture images in the real time and compare them with the existing datasets provided to the system and verifies the individual's identity in a short period of time. The results produced using the above mentioned system will be more accurate, precise, trustworthy and less prone to faults and errors.

The most important advantage of real time image based attendance systems is that they can store records of attendance as it happens without wasting any time in manual sign in attendance record maintenance. Moreover, this system can be improved and can be appended as per the needs of the organisation.

Another advantage of this system is its accuracy. The traditional methods are not accurate as it can be easily affected by mistaken identities of students and false entries by the employees even. But with the help of these systems, we can easily get rid of the errors we are facing previously because the systems use biometric data (face) to mark the attendance which minimises the errors. Moreover, the systems can be modified to send notifications to the absent candidates or students or employees.

Real-time image-based attendance systems are also user-friendly and convenient for individuals. In today's world where we have to maintain good hygiene against various diseases and allergies, individuals can mark their attendance by just moving into the designated area without any kind of physical contact with paper and pen as they can be a source of virus like COVID-19. Using the above system, we can easily mark attendance and also maintain our hygiene and health.

In conclusion, real-time image-based attendance systems offer a reliable, accurate, and efficient way to track attendance in various settings. With its ability to operate in real-time, provide accurate identification, and user-friendly features, this technology has the potential to revolutionise attendance tracking for the future.

2. RELATED WORK

Our work was motivated by the research and publications of the individuals mentioned, which drew upon both physiology and information theory as well as the practical need for fast-real-time performance and accuracy. Rather than relying on the recovery of three-dimensional geometry, this computerised approach treats face

recognition as a two-dimensional recognition problem, taking advantage of the fact that faces are usually upright and have a distinct set of two-dimensional features. Their studies indicate that the automatic technique is highly accurate, although the rejection rate is not well-defined and therefore potentially suitable for certain applications. In addition to recognizing the face, our project also included gender determination and interpretation of facial expressions using independent analysis.

In [1], R.Ram Karthick has built a facial recognition system using OpenCV and for facial recognition and separation, Haar Cascades has been used. The highlighting features of this system are building a database for storage, capturing images and then face recognition and separation using Haar Cascades algorithm. The system is built to work with multiple faces at a single go. The data bank or the dataset for training purposes have been developed manually by recording the data from the users. The model developed here requires a good camera quality as a single image would cover the whole class. So to recognise every face clearly and easy for the program to segregate the faces, a combination of a good camera and face detection module are used to to approach the model and produce the most accurate and precise results. While training the images with the model, the non-required areas have been removed in order to make the model work in a more efficient way. The merits of the proposed system includes human computer interaction,object identification and recognition, face recognition, gesture recognition , motion tracking and image processing. The conclusions from the above system are that the LBP classifier can produce outcomes with accuracy rate of 94.74% and Haar Cascades is best suited for the purpose as it offers accuracy rate of 96.24%.

In [2], Akhilesh has developed a Real Time Attendance Management System. The system is proposed with OpenCV and Viola Jones algorithm. The system proceeds with the detection of facial features. The system is developed using the concepts of deep learning and the entire system has been developed over the cloud service Google Colaboratory. The dataset for the model is stored as the images of the students with their name in the Google Drive folder. The whole image is cropped into smaller parts with face in them. Thus, removing the excess areas to make it easy for the face recognition modules to work with images and also produce the results as quickly as possible. For face detection purposes, Haar Cascade classifier has been used which classifies the various features like nose, eyes, lips and make it easier for the face recognition module to recognise the faces and produce the output for the same more efficiently and conveniently. To store and manage the attendance data, Excel sheets have been used to manage the data storage purpose. The data is saved as the name of the student along with the status of the attendance i.e. either absent or present with the date as the heading for that particular column. The final output of the image processing unit is stored in the form of excel sheets. We can conclude from this research that facial recognition algorithms are seen to upgrade day by day. The latest modern algorithms can perform facial recognition with accuracy more than 98%.

In [3], Drishti Lalwani has proposed a system with facial recognition modules LBPH and Viola Jones which are used for face recognition and face detection respectively. The system follows a basic approach beginning with the capturing of the face image, then face detection followed by face recognition. At the end of the whole process, the last step is the storage of the output produced by the image processing unit. The data storage is done using the folder where images are stored for each student as trained data. For the face detection purpose, the Viola Jones classifier has been used. The classifier classifies the captured images as face images as positive images and non face images as negative images on the basis of which the face recognition uses only face images for the purpose of facial recognition. For the face recognition purpose, LBPH(Local Binary Pattern Histogram) has been used. It divides the entire image into smaller sections for which LBP code is defined for every pixel and the pattern is used as the reference to compare the input image with the trained data. Once the image is captured, it is processed through the image processing unit combinly constructed by Viola Jones and LBPH. The output of the image processing unit results in the marking the status of the attendance i.e. either positive(present) or negative(absent) The proposed system aims to overcome the problem of head orientation and substantial occlusions

In [4], Sikandar khan has built a Real Time Automatic Attendance System for Face Recognition Using Face API and OpenCV. Current biometric attendance system is not automatic, which consumes time, is difficult to operate, and necessitates a wait for scanning fingerprints to indicate their attendance. The system follows a basic approach for facial detection and recognition as capturing the images, preprocessing them for face detection, counting the number of students, face recognition and then finally marking the attendance as the final output. The system is also capable of For face detection, they have used the YOLO V3 (You Only Look Once) method, and for face recognition, they have used the Microsoft Azure face API (face database). For the storage of the final output of the processing unit, spreadsheets have been used. The designed system performs efficiently in real time implementation for counting and detection. The entire system has demonstrated remarkable accuracy and performance in face detection and also stores the data in an impactful manner without any kind of loss of data from the spreadsheets.

ln[5]Dr. V Suresh et. al has made Facial Recognition Attendance System Using Python and OpenCv. The project's major goal is to create a facial recognition-based attendance monitoring system for educational institutions in order to improve and modernise the current attendance system and make it more effective and efficient than it was previously. Face databases have been established for this project in order to pump data into the algorithm for the recognizer. The input image is cropped to a particular frame size so that only faces are present for the face recognition task and the output is stored in the form of the excel sheets. The additional feature proposed in this system is that the record or the excel files can be shared through the mail service which is designed using the Python code. Then, during the period for recording attendance, faces will be checked against the database to try to identify anyone. When a person is recognized, the attendance will be recorded automatically, recording the essential data into an excel sheet.

ln[6]Aparna Trivedi built a Face Recognition Based Automated Attendance Management System. Facial recognition-based attendance systems use face recognition technology based on high-definition monitor video and other information technologies to solve the issue of recognizing faces for the purpose of collecting attendance. In this work, we describe a real-time Face Recognition System for tracking student attendance. The attendance will be promptly updated in a SQLite database with the pertinent data following completion of the recognition. FOr the design of images processing unit, OpenCV has been used which is one of the prominent libraries for designing image based AI and ML models. The proposed system offers another great feature that is of time bound attendance marking.

In [7] Ghanj Rizky Naufal et al made a DEEP LEARNING-BASED FACE RECOGNITION SYSTEM FOR ATTENDANCE SYSTEM. Our research aims to minimise fraud committed during the absence procedure images in the live footage that is being captured by the camera. A program will be created using OpenCV with Python that combines Haar Cascade and deep learning to train the picture in the database and implement it to the camera as the primary tool in the attendance process. Since the concept of deep learning has been used here, the images are classified layer by layer thus improving the quality and speed of the output. CNN (convolutional neural network)has been used to interpret images layer by layer.

In [8] Shizen Huang et al have proposed a video based facial recognition system for marking attendance of the students/employees. The system has been designed in Python language. The facial detection has been done using MTCNN (Multi Task Convolutional Neural Network) algorithm [8] and the face recognition has been done using FaceNet algorithm. The liveness of the video is detected using ERT(Ensemble of Regression Tree) algorithm and the entire implementation is based on the TensorFlow framework. The proposed system works accurately in various conditions and also produces results with great accuracy and precision. The system has achieved a landmark to produce results with false accept rate of less than 2% and the recognition can be as stable as 20 FPS.

In [9] Riya Goyal et al has proposed a facial recognition system using Viola Jones algorithm and LBPH classifier. The Viola Jones algorithm treats face images as positive images and non face images as negative images. The new faces are trained and further are used to mark attendance of the registered students. The face detection is performed using LBPH classifier which converts the whole image in form of LBP number for every specific pixel which is further used for comparing input image with the database images. The final output i.e. status of attendance is stored in form of Excel sheets.

In [10] Khusbu Gupta et al has proposed a facial recognition attendance system along with temperature monitoring. The proposed system follows a simple approach to mark attendance i.e. image capture, image processing and storage of dara. The proposed system also offers another important feature i.e. temperature monitoring. The proposed feature can prove to be helpful to monitor the health of the students/employees. The system has been designed using the concepts of OpenCV and CNN(Convolution Neural Network) which helps in easy management and processing of images and recording temperature data.

3. PROPOSED SYSTEM

The proposed system in our research paper **Real Time Image based Attendance System using Python** performs recording and analysis of facial images with great efficiency, accuracy and precision, we have used various algorithms in order to produce the best results with minimum error percentage. Further we have stored the record of students' attendance in the form of Excel CSV files.

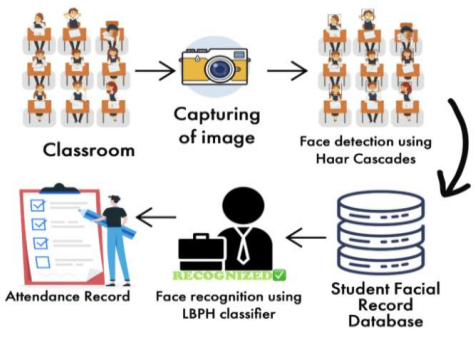

Figure 1. Pictorial View of Methodology

The proposed system will be covered in mainly four steps:

STEP 1 Capturing of Images:

The first step is to capture the image of the student(s) based upon which the whole system will be working upon. We have used the integrated webcam of our computer system as external webcam may not respond to the designed code sometimes. To avoid any such kind of issues in our program, we have used the integrated webcam of the system. Webcam captures 50 photographs of the candidate and stores them in a folder with ID_NAME.

Once the images are captured, all the images are converted to GRAY images as it gets more complex for Haar Cascades to detect features in RGB images rather than GRAY images. The grayscale images are generated from RGB images using cvtColor function provided by OpenCV which is an open source computer vision and machine learning software library. The grayscale operation is performed by averaging the most prominent and the least prominent colours present in the image. OpenCV uses the given expression for calculating the lightness method :

$$\{\max(R,G,B)+\min(R,G,B)\}/2$$

The luminosity method is a more advanced method of the lightness or the average method as it results in a more weighted average which is also better for human perception. The expression for luminosity method is

$$0.299R+0.587G+0.114B$$

STEP 2 Face detection using Haar Cascades Algorithm

After the preprocessing of the images, the next major operation is to detect features from the faces captured in the preprocessed images. For this purpose we have used the Haar Cascades classifier as it can draw features with great accuracy. Also it can draw features from faces which are not oriented properly. The preprocessed images in which faces are present are known as positive images and the ones with no faces are known as negative images. Haar Cascade applies to different features of the face like nose,eyes,lips,etc. When all the features are made to detect using Haar Cascade on a positive image, the output results with the regions highlighted with dark spots where the Haar feature is detected.

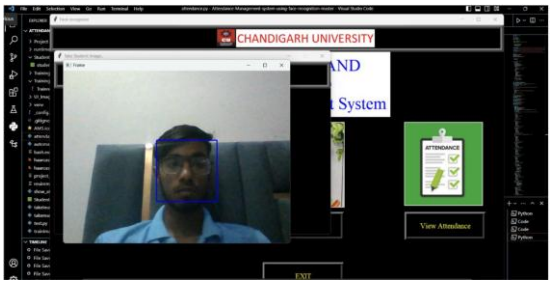

Figure 2. Recording and training of new face data

The difference between the number of pixels present in the white region and the black region gives a single value for every Haar feature which represent each αfeature. In order to make the calculations easier, only the corner pixel values of white and black regions are used to represent the whole rectangle of Haar feature(s). Once all the necessary features are extracted from the positive image, we need to get rid of the reluctant region of the face from the image. AdaBoost performs the above mentioned task by removing the non-face regions or the reluctant region and keeps the necessary features. It performs the task by selecting the weak classifiers that can be used to differentiate between two different faces. Further it constructs a strong classifier which is actually used to differentiate between face and non face images or two different images. A strong classifier is obtained using the linear aggregate of weak classifiers α1f1,2f2,α3f3,etc. The expression for a strong classifier can be obtained using the following expression:

$$\mathbf{F=\alpha 1f1+\alpha 2f2+\alpha 3f3+....+\alpha nfn}$$

If the final value of **F** we obtain is high, then the face is detected, else the face is not detected.

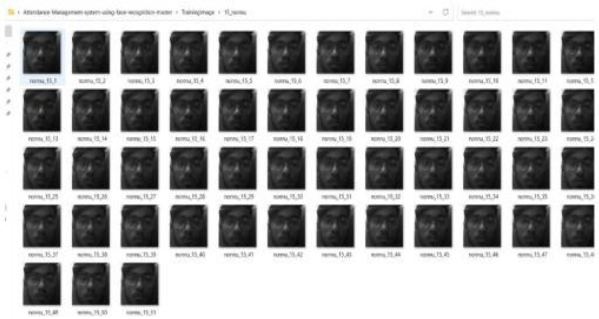

Figure 3. Trained data which is going to be used for face detection

STEP 4. Face Recognition using LBPH(Local Binary Pattern Histogram) Classifier

Once the images are cropped,resized and other necessary operations i.e. extracting features are done using Haar Cascades Algorithm, the next operation is to perform facial recognition. For facial recognition, we have used the LBPH(Local Binary Pattern Histogram) algorithm/classifier which is provided by OpenCV. LBPH performs facial recognition for the test image based on the images dataset trained previously with the system at a great speed along with high precision and accuracy.

LBPH compares the preprocessed or live image with the trained or previously stored dataset of images.LBPH works with creating an intermediate image from the original image by dividing the whole image into a matrix which is further divided into smaller matrices of size 3X3. The central pixel is represented by the neighbouring pixels

with a specific radius around it, giving a binary matrix designed with respect to the central pixel. The decimal values of every pixel is assigned on the basis of the intensity of the colour of the pixel. The binary values are assigned to neighbouring pixels based upon the given expression.

$$LBP = \sum_{n=0}^{7} s(i_n - i_c)2^n$$

Figure 4. Expression for calculating LBP for a pixel

where,

ic = central pixel value

in = n th neighbouring pixel value

n = position of the neighbouring pixel

s(z)={1,z=>0;0,z<0}

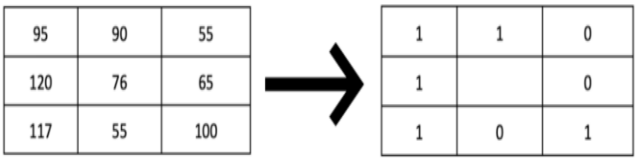

Figure 5. Conversion of intensity of pixels to corresponding binary values

Once the matrix of binary numbers gets generated, the binary number is written with the most significant bit (MSB) as the upper left corner. In the above case, the binary number for the central pixel will be 11001011 in binary format or 203 in decimal format. Like the above process, the whole image is converted into a matrix with the corresponding decimal value for the central pixel for every small 3x3 matrix.

The final matrix created for the test image of the student is then compared to the final matrix created for the trained images of the student. If the match is found for the test image in the dataset, the output will be marked positive for that particular test image i.e. the attendance will be marked for that particular student.

STEP 5. Storing the recorded data

Once all the steps are completed for a test image i.e. face detection using Haar Cascades and face recognition using LBPH, the last task is to store the output of LBP whether positive or negative as a means of proof of attendance of students for the authorities in the educational institutions. For output storage, we will be using a CSV file to store the final output along with the name and ID of the student for every particular student. The writing operation for the records is done using the csv. writer() function into the data files.

4. CONCLUSIONS

With the development of an automatic attendance recording system, the teacher or the lecturer can record attendance records with less time consumption, less human error, high efficiency and less student proxy error. The combination of Haar Cascades algorithm and LBPH algorithm is capable of producing results with great accuracy and precision and less errors to provide a secure, stable and trustworthy system.

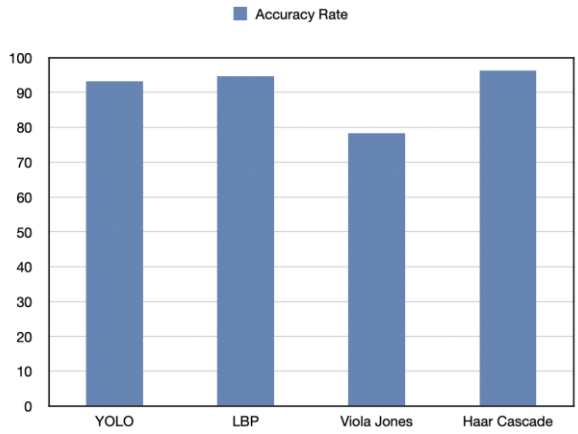

Figure 5. Comparison between face detection algorithms

5. FUTURE SCOPE

The above system can be improved to work with live video instead of real time images for better results as the system favours different face orientations. Further modification can be done to mark attendance for existing records where there are some minor facial changes like makeup is applied over the face

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