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FACE RECOGNITION BASED ATTENDANCE MANAGEMENT SYSTEM

A Project Report

Submitted by:

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in partial fulfillment for the award of the degree

of

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IN

COMPUTER SCIENCE AND ENGINEERING

At



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YEAR

DECLARATION

I hereby declare that the project entitled “**FACE RECOGNITION BASED ATTENDENCE SYSTEM**” submitted for the B. Tech. (CSE) degree is my original work and the project has not formed the basis for the award of any other degree, diploma, fellowship or any other similar titles.

Signature of the Student

Place: jalandhar

Date: 10-11-2020

CERTIFICATE

This is to certify that the project titled “**FACE RECOGNITION BASED ATTENDENCE SYSTEM**” is the bona fide work carried out by **RAJWINDER KAUR , SATNESH CHAUHAN**, a student of B Tech (CSE) of CT Institute of Engineering Management and Technology, Shahpur (Jalandhar) affiliated to Punjab Technical University, Jalandhar, Punjab(India) during the academic year 2013-14, in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (Computer Science and Engineering) and that the project has not formed the basis for the award previously of any other degree, diploma, fellowship or any other similar title.

Signature of the Guide

Place: jalandhar

Date: 10-11-2020

ABSTRACT

Face is the representation of one's identity. Hence, we have proposed an automated student attendance system based on face recognition. Face recognition system is very useful in life applications especially in security control systems. The airport protection system uses face recognition to identify suspects and FBI (Federal Bureau of Investigation) uses face recognition for criminal investigations. In our proposed approach, firstly, video framing is performed by activating the camera through a user-friendly interface. The face ROI is detected and segmented from the video frame by using Viola-Jones algorithm. In the pre-processing stage, scaling of the size of images is performed if necessary in order to prevent loss of information. The median filtering is applied to remove noise followed by conversion of colour images to grayscale images. After that, contrast-limited adaptive histogram equalization (CLAHE) is implemented on images to enhance the contrast of images. In face recognition stage, enhanced local binary pattern (LBP) and principal component analysis (PCA) is applied correspondingly in order to extract the features from facial images. In our proposed approach, the enhanced local binary pattern outperform the original LBP by reducing the illumination effect and increasing the recognition rate. Next, the features extracted from the test images are compared with the features extracted from the training images. The facial images are then classified and recognized based on the best result obtained from the combination of algorithm, enhanced LBP and PCA. Finally, the attendance of the recognized student will be marked and saved in the excel file. The student who is not registered will also be able to register on the spot and notification will be given if students sign in more than once. The average accuracy of recognition is 100 % for good quality images, 94.12 % of low-quality images and 95.76 % for Yale face database when two images per person are trained.

ACKNOWLEDGEMENT

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I am highly indebted to **PRINCE VERMA (HOD CSE-IT)** for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project. I would like to express my gratitude towards my parents & member of **CT Group of Institutions** for their kind co-operation and encouragement which help me in completion of this project.

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FACE RECOGNITION BASED ATTENDANCE MANAGEMENT SYSTEM

I. INTRODUCTION

1. PROBLEM DEFINITION:

Attendance maintenance is a significant function in all the institutions to monitor the performance of the students. Every institute does this in its own way. Some of these institutes use the old paper or file-based systems and some have adopted strategies of automatic attendance using some biometric techniques. A facial recognition system is a computerized biometric software which is suited for determining or validating a person by performing comparison on patterns based on their facial appearances. Face recognition systems have upgraded appreciably in their management over the recent years and this technology is now vastly used for various objectives like security and in commercial operations. Face recognition is a powerful field of research which is a computer based digital technology. Face recognition for the intent of marking attendance is a resourceful application of attendance system. It is widely used in security systems and it can be compared with other biometrics such as fingerprint or eye iris recognition systems. As the number of students in an educational institute or employees at an organization increases, the needs for lecturers or to the organization also increase the complication of attendance control. This project may be helpful for the explanation of these types of problems. The number of students present in a lecture hall is observed, each person is identified and then the information about the number of students who are present is maintained.

Use of face recognition for the purpose of attendance marking is the smart way of attendance management system. Face recognition is more accurate and faster technique among other techniques and reduces chance of proxy attendance. Face recognition provides passive identification that is a person which is to be identified does not need to take any action for its identity [2]. Face recognition involves two steps, first step involves the detection of faces and second step consists of identification of those detected face images with the existing database. There are number of face detection and recognition methods introduced. Face recognition works either in form of appearance based which covers the features of whole face or feature based which covers the geometric feature like eyes, nose, eye brows, and cheeks to recognize the face

2. OVERVIEW

Face recognition being a biometric technique implies determination if the image of the face of any particular person matches any of the face images that are stored in a database. This difficulty is tough to resolve automatically because of the changes that several factors, like facial expression, aging and even lighting can affect the image. Facial recognition among the various biometric techniques may not be the most authentic but it has various advantages over the others. Face recognition is natural, feasible and does not require assistance. The expected system engages the face recognition approach for the automating the attendance procedure of students or employees without their involvement. A web cam is used for capturing the images of students or employees. The faces in the captured images are detected and compared with the images in database and the attendance is marked.

As the time for corresponding subject arrives the **system** automatically starts taking snaps and then apply **face detection** and **recognition** technique to the given image and the recognize students are marked as present and their **attendance** update with corresponding time and subject id.

3. REQUIREMENTS

- **HARDWARE REQUIREMENTS**

- A standard computer i3 5th generation, 8gb ram or higher.
- High quality wireless camera to capture images.
- Secondary memory to store all the images and database.

- **SOFTWARE REQUIREMENTS**

- PyCharm professional 2017.2.4 or higher
- Python 3.5 or more
- Windows 8 or higher
- Latest version of all libraries

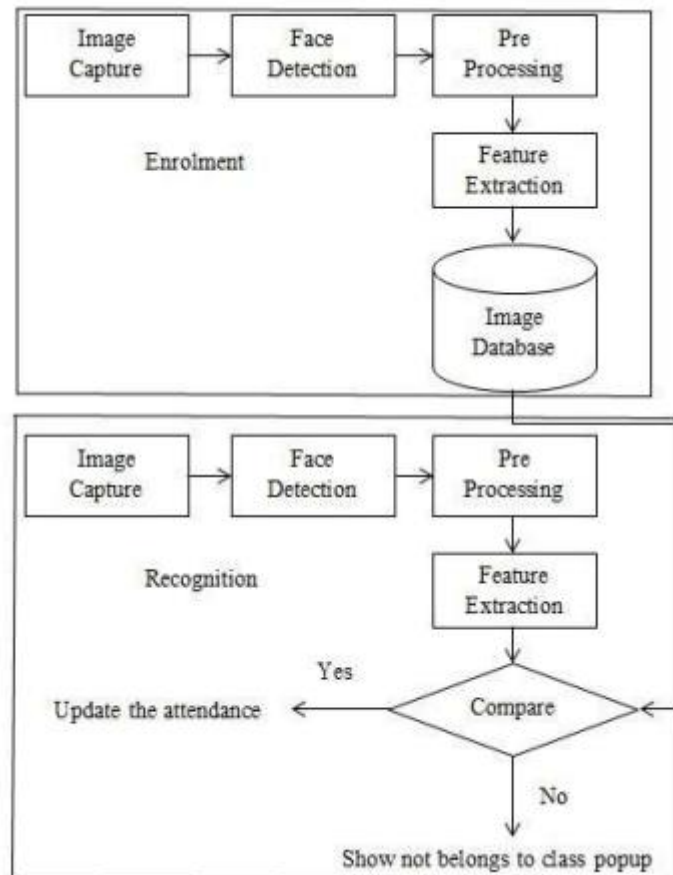
II. LITERATURE SURVEY

1. Existing System:-

Existing system is a manual entry for the students. Here the **attendance** will be carried out in the hand written registers. It will be a tedious job to maintain the record for the user. ... The retrieval of the information is not as easy as the records are maintained in the hand written registers. The existing system largely consists of physical register where the supervisor manually inputs the attendance record of all students. Other technologies which have been developed to replace this manual system include fingerprint, retina scan, voice recognition etc. The problem with existing system is that the manual system is time consuming and the advanced technologies are too expensive to be implemented on a large scale in any organization.

2. Proposed system

. The proposed automated attendance management system uses a face recognition algorithm. The distance between the face parts is first calculated and then to be stored in the system. The facial characters stored are to be compared with the real time image of the students. When the student enters the classroom the system starts identifying the faces of the students. The time for the period also gets started and the system now detects the faces and extracts the facial characters of the students. The extracted facial character will be compared with the database image. If the face of the student is matched with the facial character stored in the database then the attendance timing for respective student gets started.



3. FEASIBILITY STUDY

Three key considerations are involved in the feasibility analysis:

1. **Economic Feasibility:** The **economic feasibility** step of business development is that period during which a break-even financial model of the business venture is developed based on all costs associated with taking the product from idea to market and achieving sales sufficient to satisfy debt or investment requirements.
2. **Technical Feasibility:** A **technical feasibility** study assesses the details of how you intend to deliver a product or service to customers. Think materials, labor, transportation, where your business will be located, and the technology that will be necessary to bring all this together.
3. **Social Feasibility :** Considering the above keys, feasibility of this project can be understood from the following points:
 - 1.Reduces manual effort.
 - 2.Keeps track of a student's attendance correctly and gives the result.
 - 3.Implementation of camera and sensors make this project totally automated.
 - 4.Easy to be implemented in educational or commercial institutes.
 - 5.Real time operations are done.
 - 6.Images that are to be compared with the snaps taken by the camera can be easily stored in the database.
 - 7.On the basic of this method, results such as defaulters list, students lecture wise n total attendance in percentage and count can be calculated and access to these results can be made available for teachers as well as students to keep track of their respective attendance

III. SYSTEM ANALYSIS AND DESIGN

1. IMAGE PROCESSING

The facial recognition process can be split into two major stages: processing which occurs before detection involving face detection and alignment and later recognition is done using feature extraction and matching steps.

➤ FACE DETECTION

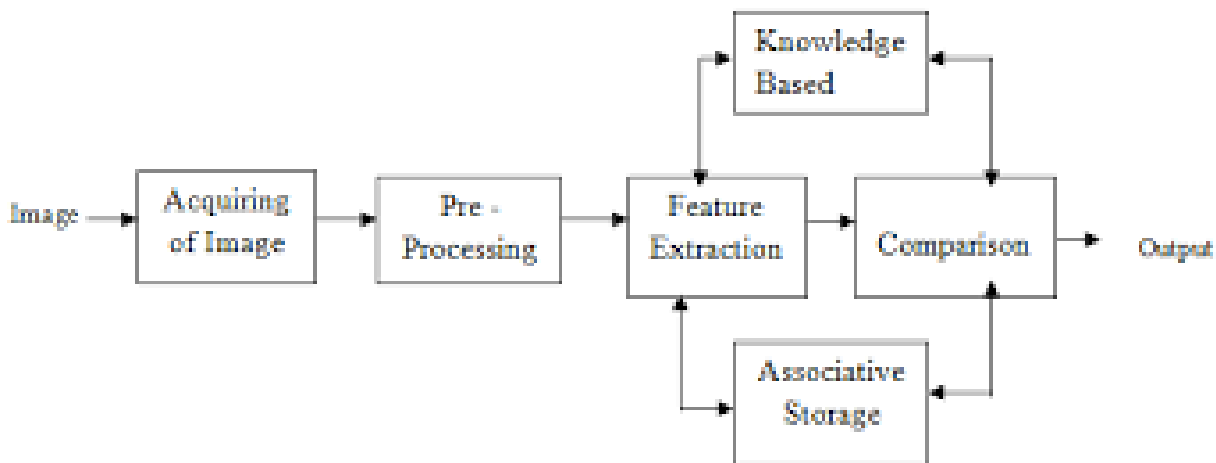
The primary function of this step is to conclude whether the human faces emerge in a given image, and what is the location of these faces. The expected outputs of this step are patches which contain each face in the input image. In order to get a more robust and easily designable face recognition system Face alignment is performed to rationalize the scales and orientation of these patches.

➤ FEATURE EXTRACTION

Following the face detection step the extraction of human face patches from images is done. After this step, the conversion of face patch is done into vector with fixed coordinates or a set of landmark points.

➤ FACE RECOGNITION

The last step after the representation of faces is to identify them. For automatic recognition we need to build a face database. Various images are taken for each person and their features are extracted and stored in the database. Then when an input image is fed the face detection and feature extraction is performed and its feature to each face class is compared and stored in the database.



2. ALGORITHM

There are various algorithms used for facial recognition.

Some of them are as follows:

1. Eigen faces
2. Fisher faces
3. Local binary patterns histograms

A. PARAMETERS:

LBPH uses the following parameters:

i. Radius:

Generally 1 is set as a radius for the circular local binary pattern which denotes the radius around the central pixel.

ii. Neighbours:

The number of sample points surrounding the central pixel which is generally 8. The computational cost will increase with increase in number of sample points.

iii. Grid X:

The number of cells along the horizontal direction is represented as Grid X. With the increase in number of cells the grid becomes finer which results in increase of dimensional feature vector.

iv. Grid Y:

The number of cells along the vertical direction is represented as Grid Y. With the increase in number of cells the grid becomes finer which results in increase of dimensional feature vector.

B. ALGORITHM TRAINING:

For the training purpose of the dataset of the facial images of the people to be recognized along with the unique ID is required so that the presented approach will utilize the provided information for perceiving an input image and providing the output. Same images require same ID.

C. COMPUTATION OF THE ALGORITHM:

The intermediate image with improved facial characteristics which corresponds to the original image is created in the first step. Based on the parameters provided, sliding window theory is used in order to achieve so. Facial image is converted into gray scale. A 3x3 pixels window is taken which can also be expressed as a 3x3 matrix which contains the intensity of each pixel (0-255). After this we consider the central value of the matrix which we take as the threshold. This value defines the new values obtained from the 8 neighbors. A new binary value is set for each neighbor of the central value. For the values equal to or greater than the threshold value 1 will be the output otherwise 0 will be the output. Only binary values will be present in the matrix and the concatenation is performed at each position to get new values at each position. Then the conversion of this binary value into a decimal value is done which is made the central value of the matrix. It is a pixel of the actual image. As the process is completed, we get a new image which serves as the better characteristics of the original image.

D. EXTRACTION OF HISTOGRAM:

The image obtained in the previous step uses the Grid X and Grid Y parameters and the image is split into multiple grids. Based on the image the histogram can be extracted as below:

1. The image is in gray scale and each histogram will consist of only 256 positions (0-255) which symbolises the existences of each pixel intensity.
2. After this each histogram is created and a new and bigger histogram is done. Let us suppose that there are 8x8 grids, then there will be 16,384 positions in total in the final histogram. Ultimately the histogram signifies the features of the actual image.

E. THE FACE RECOGNITION:

The training of the algorithm is done. For finding the image which is same as the input image, the two histograms are compared and the image corresponding to the nearest histogram is returned. Different approaches are used for the calculation of distance between the two histograms. Here we use the Euclidean distance based on the formula:

$$= \sqrt{\sum (h_1 - h_2)^2}$$

Hence the result of this method is the ID of the image which has the nearest histogram. It should return the distance calculated in the form of '**confidence**'. Then the threshold and the 'confidence' can be used to automatically evaluate if the image is correctly recognized. If the confidence is less than the given threshold value, it implies that the image has been well recognized by the algorithm.

ACE	FACE	
Confidence factor based on output is 2,000-3,000.	It is 100-400.	
Threshold value is 4,000.	Threshold value is 400	Threshold value is 7.
Principle of dataset generation is component based.	It is component based.	It is pixel based.
Basic principle is PCA.	Basic principle is LDA.	Basic principle Is Histogram.
Background noise is maximum.	Background noise is medium.	Background noise is minimum.
Efficiency is minimum.	Efficiency is greater than Eigen face.	Efficiency Is maximum.

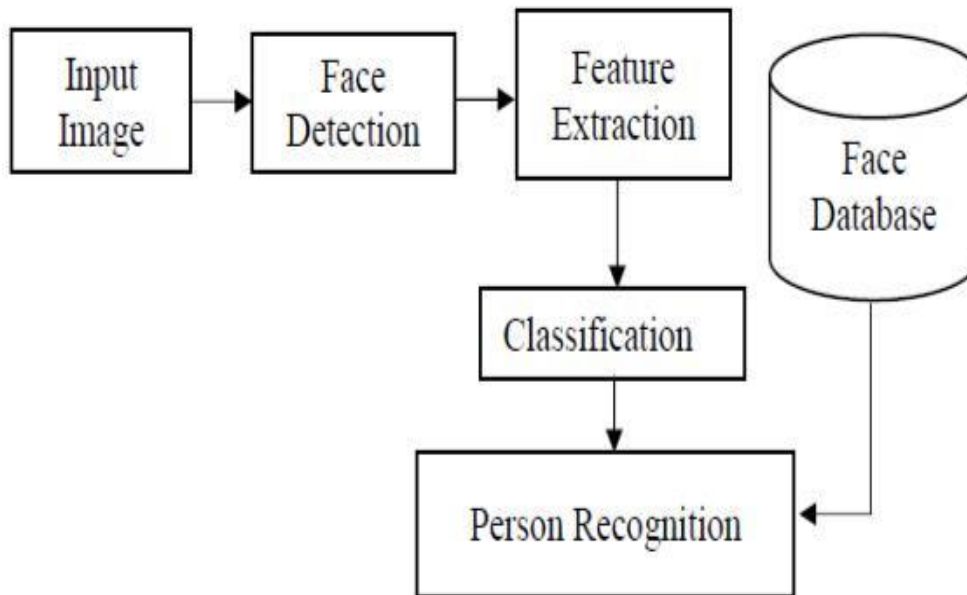
Table 1. Comparison of LBPH with other algorithms.

ADVANTAGES OF USING LBPH ALGORITHM:

1. It is one of the simplest algorithms for face recognition.
2. The local features of the images can be characterized by this algorithm.

3. Using this algorithm, considerable results can be obtained.
4. Open CV library is used to implement LBPH algorithm.

BLOCK DIAGRAM



the recording of the frontal face. The number of frame to be taken for consideration can be modified for accuracy levels. These images are then stored in the database along with the Registration ID.

TRAINING OF FACES:

The images are saved in gray scale after being recorded by a camera. The LBPH recognizer is employed to coach these faces because the coaching sets the resolution and therefore the recognized face resolutions are completely variant. A part of the image is taken as the center and the neighbors are thresholded against it. If the intensity of the center part is greater or equal than its neighbor then it is denoted as 1 and 0 if not. This will result in binary patterns generally known as LBP codes.

FACE DETECTION:

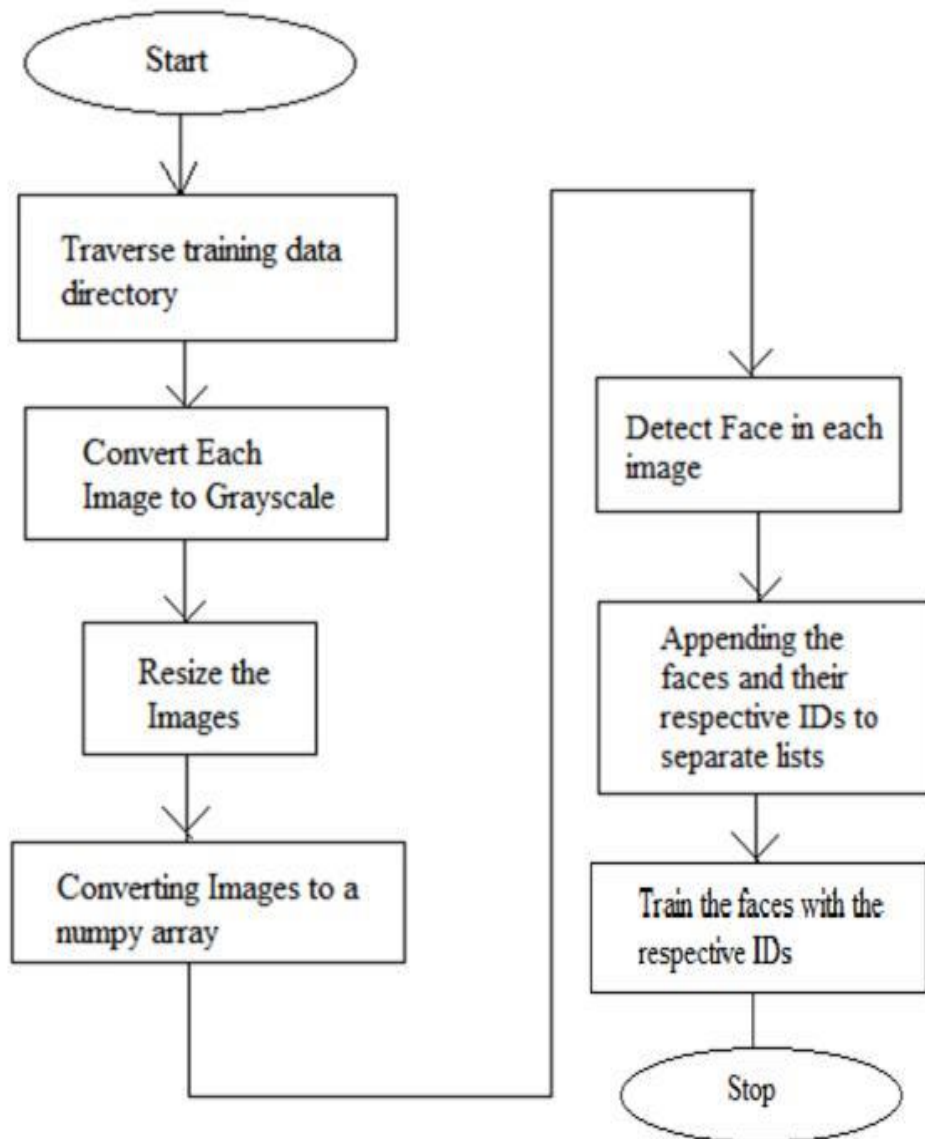
The data of the trained faces is stored in .py format. The faces are detected using the Haar cascade frontal face module.

FACE RECOGNITION:

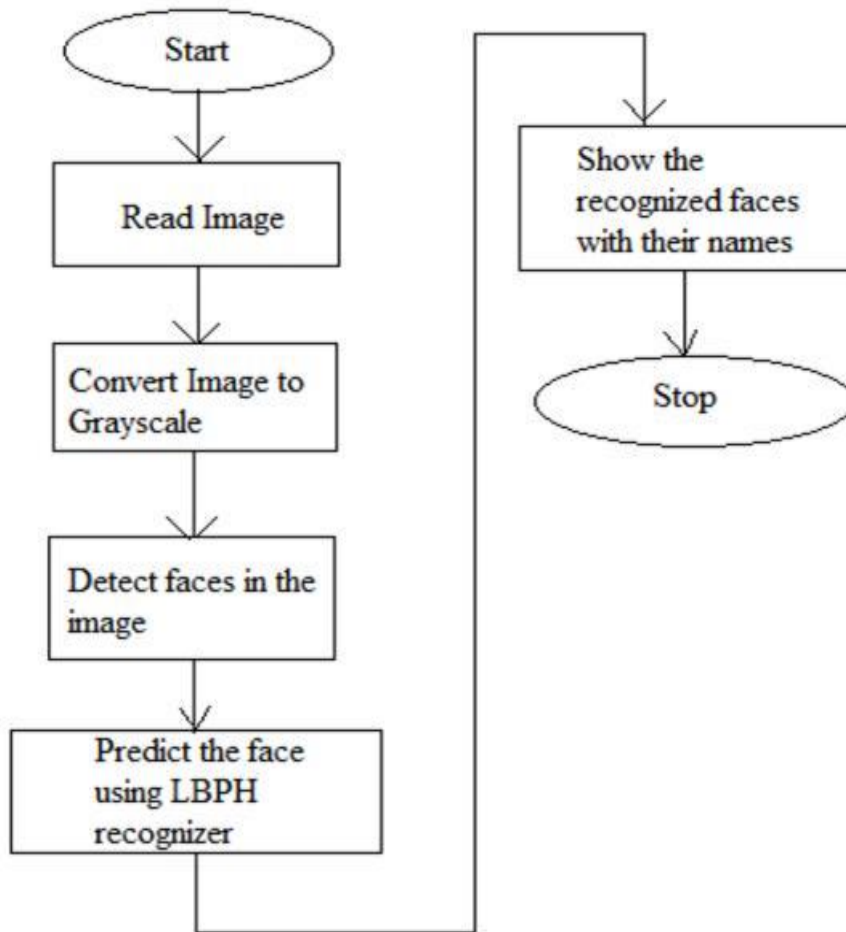
The data of the trained faces are stored and the detected faces are compared to the IDs of the students and recognized. The recording of faces is done in real time to guarantee the accuracy of the system. This system is precisely dependent on the camera's condition. The training process starts with traversing of the training data directory. Each image in the training data is converted into gray scale. A part of the image is taken as center and thresholded against its neighbors. If the intensity of the middle part is more or equal than its neighbor then denote it with 1 and 0 if not. After this the images are resized. Then the images are converted into a numpy array which is the central data structure of the numpy library. Each face in the image is detected. Creation of separate lists of each face is done and the faces are appended into them along with their respective IDs. The faces are then trained with their respective IDs.

3. FLOW CHART:

By **using Facial Recognition**, the process of taking **attendance** can be significantly improved to save time and provide a hassle-free way to automatically mark **attendance**. Since the number of students in an institution are more, **using** an automated **system** improves the productivity and standard of the college.



FLOW-CHART OF THE METHODOLOGY USED FOR TRAINING PROCESS



The input image is read by the camera of the phone. After the image is read it is converted into gray scale. The faces in the image are detected using the Haar Cascade frontal face module. Using the LBPH algorithm, the faces in the image are predicted. After the images are predicted, the recognized faces are shown in a green box along with their names.

4. SOFTWARE DESCRIPTION

1. OpenCV

Open CV (Open Source Computer Vision Library) is a open source computer vision software library for the purpose of machine learning. Open CV was developed to serve the purpose of computer vision applications and to stimulate the usage of machine perception in the commercially viable products. Open CV is a BSD- licensed product which is easy for the utilization and modification of the code. The library contains more than 2500 advanced algorithms including an extensive set of both typical and state-of-the-art computer vision and machine learning algorithms. These algorithms can be employed for the detection and recognition of faces, identification of objects, extraction of 3 D models of objects, production of 3 D point clouds from stereo cameras, stitching images together for production of a high resolution image of an entire scene, finding similar images from an image database, removing red eyes from images taken using flash, following eye movements, recognition of scenery and establishing markers to overlay it with intensified reality etc. It includes C++, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. Open CV mainly involves real-time vision applications taking advantage of MMX and SSE instructions when available. A full-featured CUDA and Open CL interfaces are being progressively developed. There are over 500 algorithms and about 10 times functions that form or back those algorithms. Open CV is written inherently in C++ and has a template interface that works harmoniously with STL containers.

2. Pandas

Pandas is an open source Python package that caters diverse tools for data analysis. The package contains various data structures that can be used for many diverse data manipulation tasks. It also includes a range of methods that can be invoked for data analysis, which becomes feasible when working on data science and machine learning problems in Python.

3. Idle

IDLE is Python's Integrated Development and Learning Environment. IDLE is completely coded in Python, using the tkinter GUI toolkit. It works mostly uniformly on Windows, Unix and macOS. It has a Python shell window (interactive interpreter) with colorizing of error messages, code input and code output. There is a multi-window text editor with multiple undo, Python colorizing, smart indent, call tips, auto completion, and other features. Searching within any window, replacing within editor windows and searching through multiple files is possible. It also has configuration, browsers and other dialogs as well.

4. Microsoft Excel

Microsoft Excel is a spreadsheet program incorporated in Microsoft Office suite of applications. Spreadsheets prompt tables of values arranged in rows and columns that can be mathematically manipulated using both basic and complex arithmetic functions and operations. Apart from its standard spreadsheet features, Excel also extends programming support via Microsoft's Visual Basic for Applications (VBA), the capacity to access data from external sources via Microsoft's Dynamic Data Exchange (DDE) and extensive graphing and charting abilities. Excel being electronic spreadsheet program can be used to store, organize and manipulate the data. Electronic spreadsheet programs were formerly based on paper spreadsheets used for accounting purpose. The basic layout of computerized spreadsheets is more or less same as the paper ones. Related data can be stored in *tables* - which are a group of small rectangular boxes or cells that are standardized into rows and columns.

IV. RESULT ANALYSIS

The interface for the Smart Attendance System has been created. Using the interface the images of the individual students is being recorded and stored in the training dataset. Simultaneously their information is stored in the database i.e. excel sheet. Finally the images of the students is being tracked and recognized.

To maintain the attendance record with day to day activities is a challenging task. The conventional method of calling name of each student is time consuming and there is always a chance of proxy attendance. The following system is based on face recognition to maintain the attendance record of students. The daily attendance of students is recorded subject wise which is stored already by the administrator. As the time for corresponding subject arrives the system automatically starts taking snaps and then apply face detection and recognition technique to the given image and the recognize students are marked as present and their attendance update with corresponding time and subject id. We have used deep learning techniques to develop this system, histogram of oriented gradient method is used to detect faces in images and deep learning method is used to compute and compare feature facial of students to recognize them. Our system is capable to identify multiple faces in real time.

1. PROJECT SNAPSHOTS:

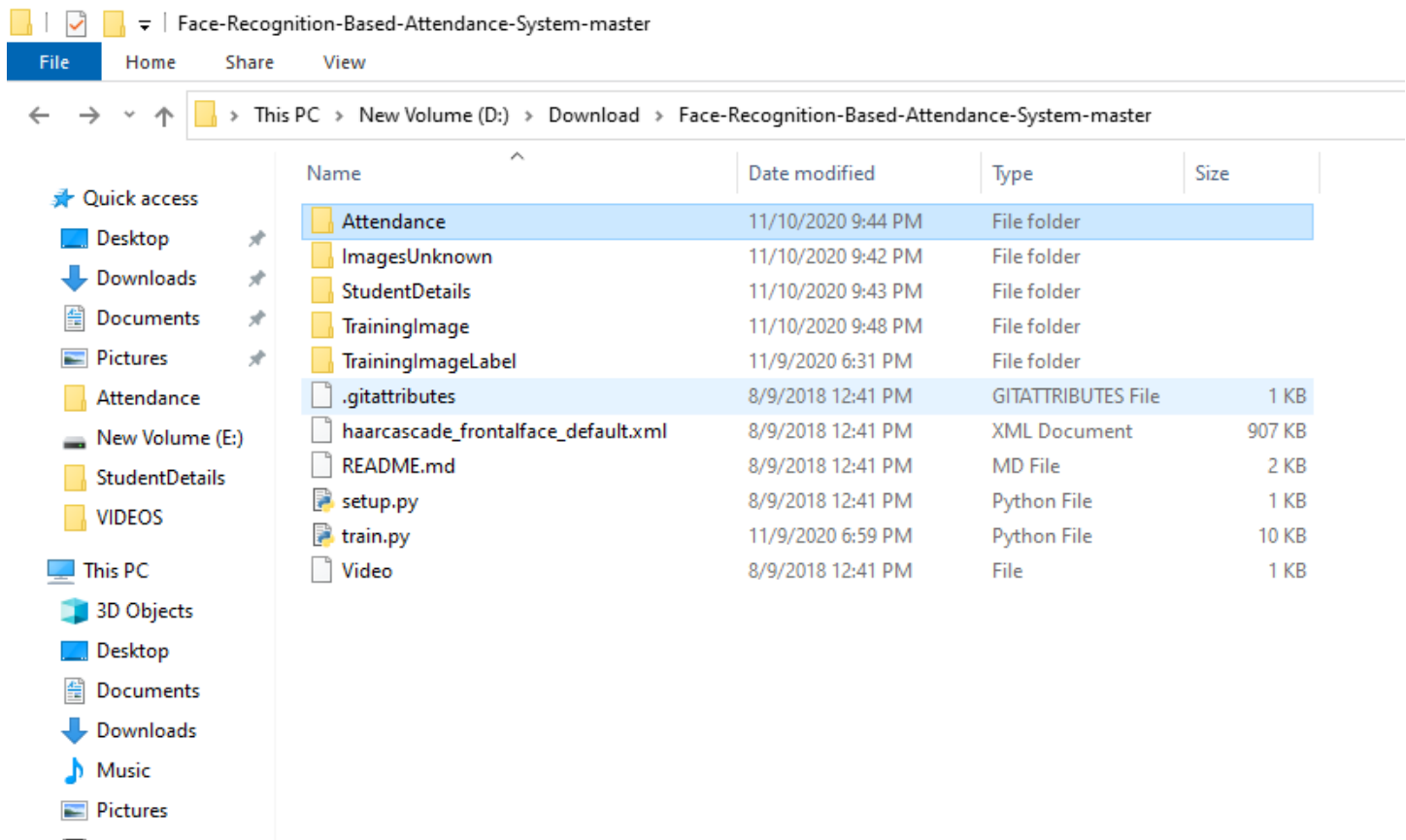


Fig 1. The different folders have been created.

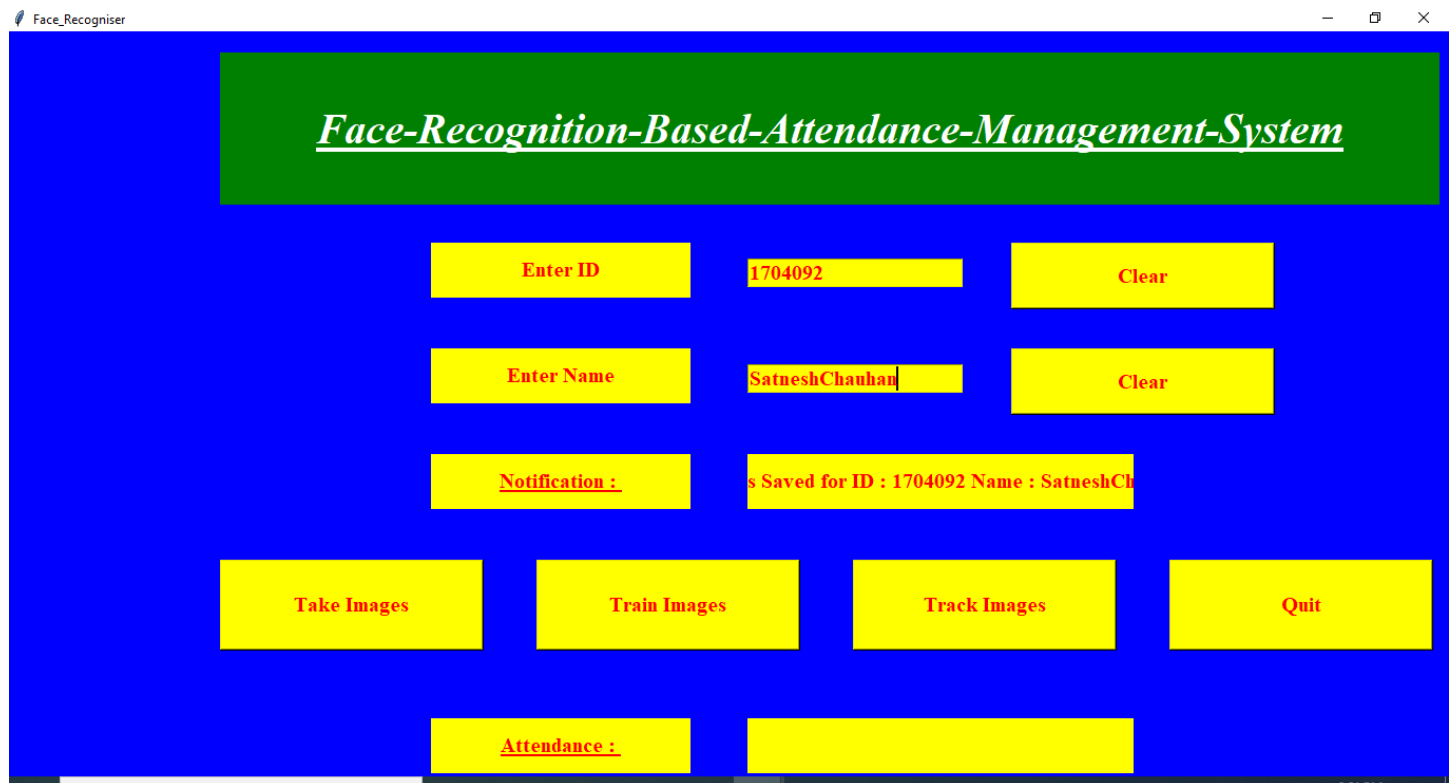


Fig 2. The interface for Face Recognition Based Attendance system in which Id and Name of the respective students are stored.

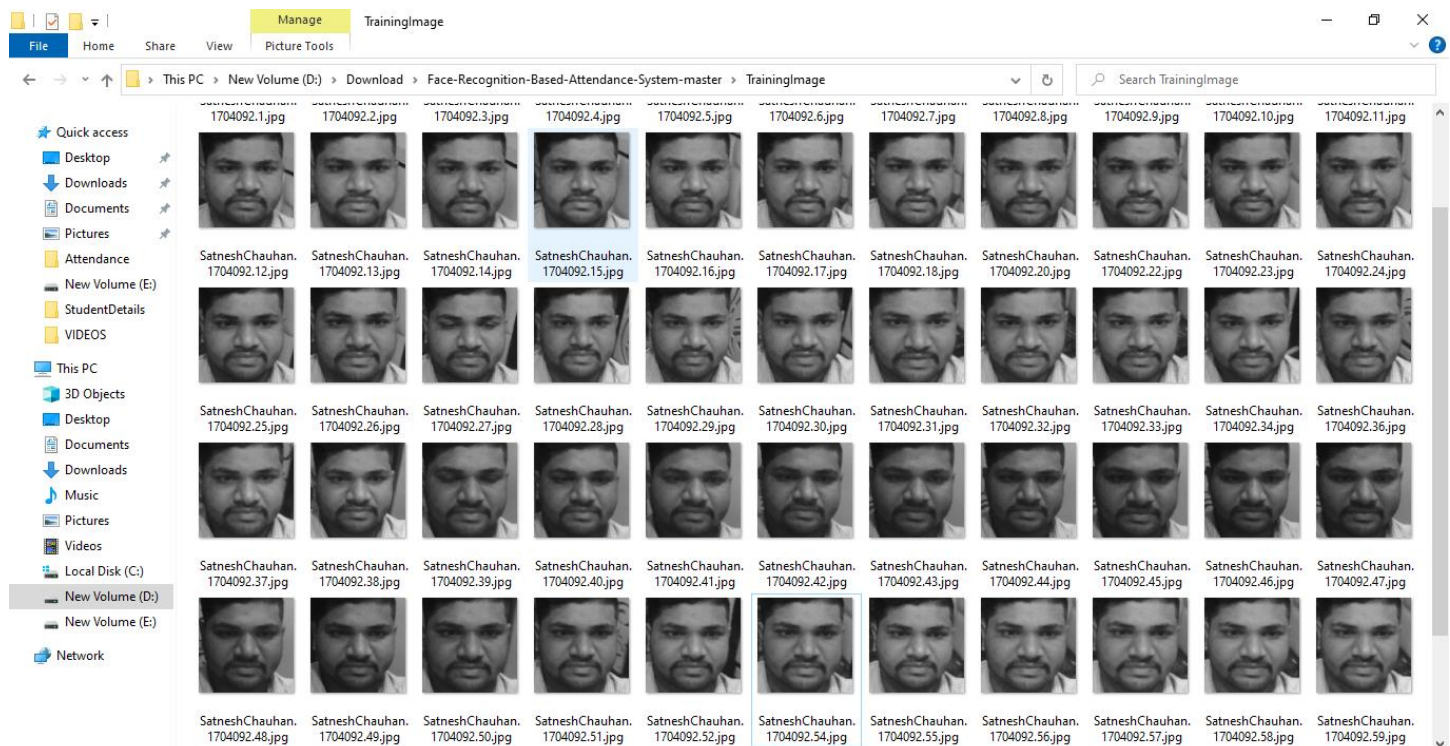


Fig 3. The images are stored in a folder named “TrainingImages”.

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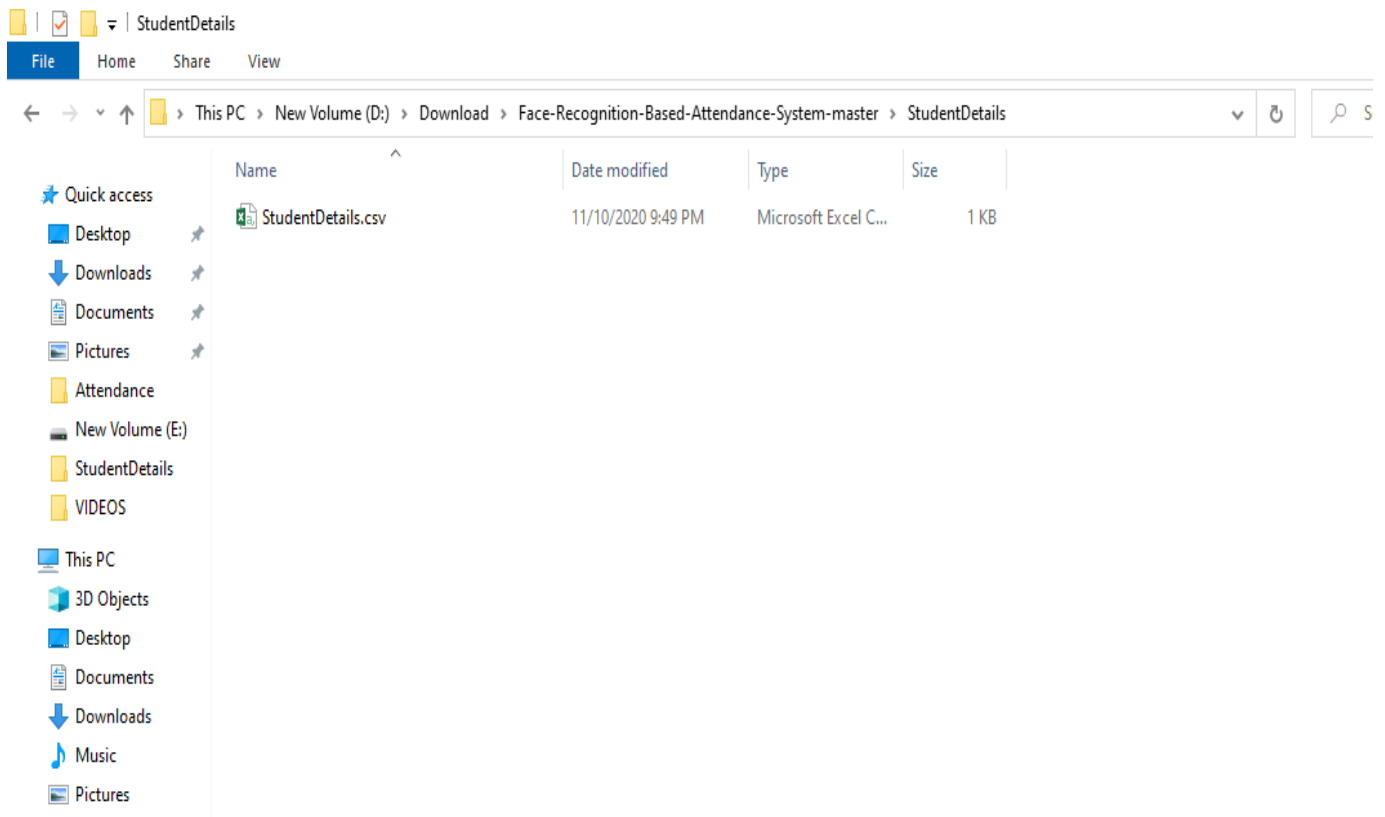


Fig 4. The excel sheet for the student details is created.

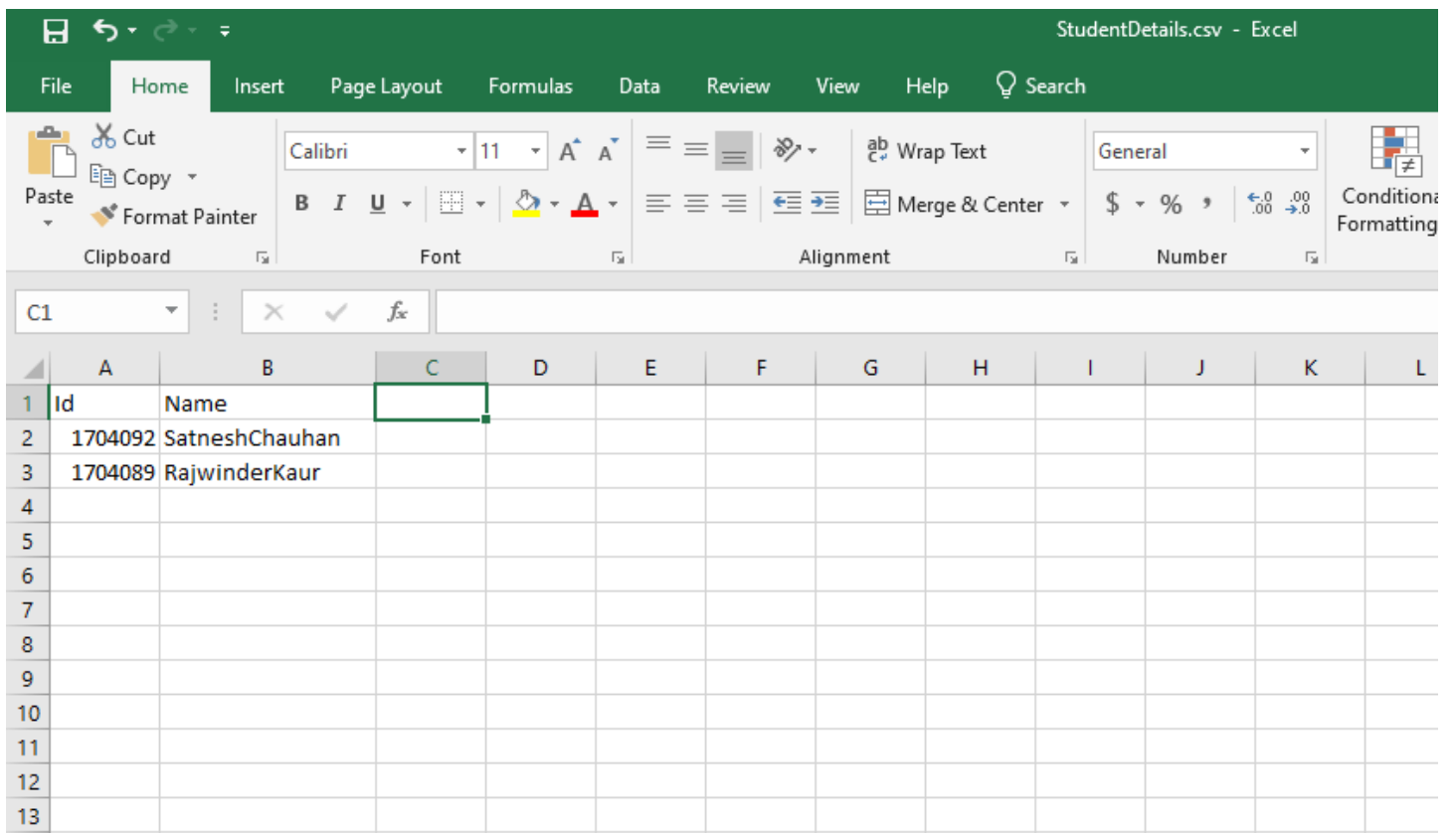


Fig 5. The names of the students have been stored in the StudentDetails excel sheet.

Face_Recogniser

Face-Recognition-Based-Attendance-Management-System

Enter ID: 1704092 Clear

Enter Name: SatneshChauhan Clear

Notification : Image Trained

Take Images Train Images Track Images Quit

Attendance :

Fig 6. The images of the students is trained.

Face_Recogniser

Face-Recognition-Based-Attendance-Management-System

Enter ID: 1704092 Clear

Enter Name: SatneshChauhan Clear

Notification : Image Trained

Take Images Train Images Track Images Quit

Attendance :

Id	Name	Date	Time
04092	[SatneshChauhan]	2020-11-10	22:0

Fig 7. After tracking the images are attendance of the students is marked.

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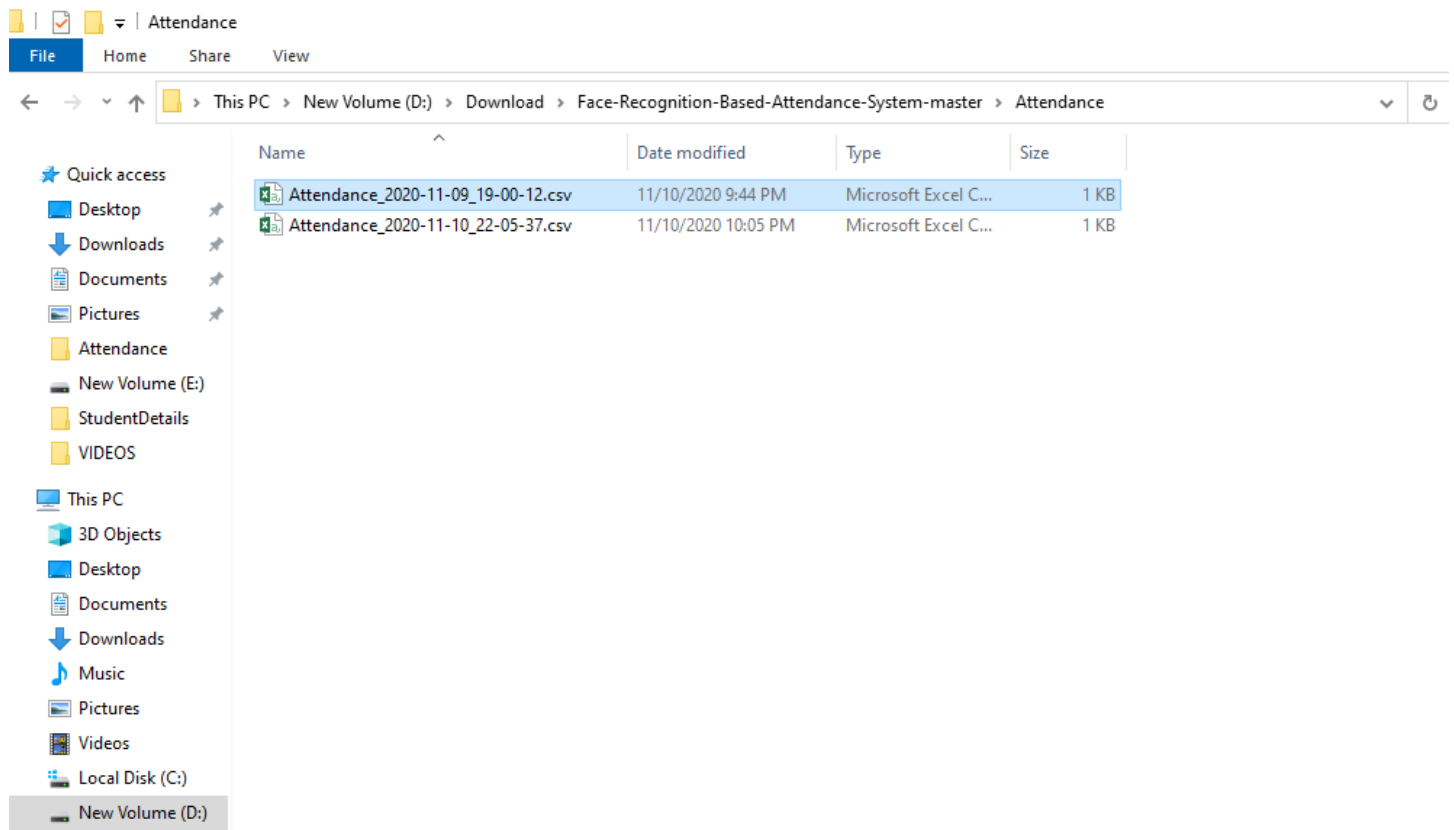


Fig 8. The excel sheet for attendance of the students is created.

2. Advantages and disadvantages of Face Recognition based attendance system;

➤ Advantages:

- **Automated time tracking system:** Automation simplifies time tracking, and there is no need to have personnel to monitor the system 24 hours a day. To err is human, and with automated systems, human error is eliminated. A time and attendance system using facial recognition technology can accurately report attendance, absence, and overtime with an identification process that is fast as well as accurate.
- **Labor cost savings:** Facial recognition software can accurately track time and attendance without human error. It keeps track of the exact number of hours an employee is working, which can help save the company money. You will never have to worry about time fraud or “buddy punching” with a facial recognition time tracking system.
- **Tighter security:** Facial biometric time tracking allows you to not only track employees but also add visitors to the system so they can be tracked throughout the worksite. Access can be denied to any person not in the system. If an incident should occur, facial recognition software can provide evidence for an investigation with a scanned image of a person or persons who have entered the area.
- **Time saving and reduced contagion:** When contagious illnesses such as colds and viruses spread throughout the workforce, it can increase the incidence of employee absences and significantly reduce productivity. With facial recognition, employees can enter and leave the facility in considerably less time. There is no need to touch the surface of the system to clock in or out. This saves time, as well as minimizing the spread illnesses due to physical contact.
- **Ease of integration:** Biometric facial recognition technology can be easily programmed into your time and attendance system.

➤ Disadvantages:

- **Image quality:** The quality of the reference image plays an important role in the identification process. If the resolution of the said image is not high enough, it can cause cameras to be tricked into believing that the person being scanned is not the same as in the photo. An easy solution is to ensure that both the reference images and scanning are performed by similar cameras.
- **Storage:** Depending on the quality of the input data, a system would need an appropriate amount of storage. This could be troublesome if the data collected is of high quality and requires large amounts of storage space especially for events with a large expected attendance.
- **Angles:** Many non-premium facial recognition systems cannot account for faces that are captured at angles other than straight into the capturing camera. The disadvantage of this is that it makes the attendance marking process slower and less efficient.

V. CONCLUSION

In order to reduce the faculty effort and to manage the time effectively the authors proposed automated attendance system base on face recognition in schools/colleges. The system takes attendance for particular amount of time and after the time expires the system automatically closes the attendance. The result of the experiment shows improved performance in the estimation of attendance compared to traditional pen and paper type attendance system. The current work is mainly focussed on face detection and extraction by PCA algorithm in video frames or images. In further work authors are intended to improve face recognition by comparing 3D face images with 2D face images (Real time). Also the authors are intended to improve on multiple face recognition at the same time so that the effectiveness of time can still be managed and try to improve on the portability of the system.

This paper features the most productive Open CV face recognition method accessible for Attendance Management. The system has been implemented using the LBPH algorithm. LBPH excels other algorithms by confidence factor of 2-5 and has least noise interference. The implementation of the Smart Attendance System portrays the existence of an agreement between the appropriate recognition rate and the threshold value. Therefore, LBPH is the most authentic and competent face recognition algorithm found in Open CV for the identification of the students in an educational institute and marking their attendance adequately by averting proxies.

REFERENCES

- [1] M. A. Turk and A. P. Pentland, "Face Recognition Using Eigenfaces," in Proc. IEEE Conference on Computer Vision and Pattern Recognition, pp. 586–591. 1991.
- [2] A. J. Goldstein, L. D. Harmon, and A. B. Lesk, "Identification of Human Faces," in Proc. IEEE Conference on Computer Vision and Pattern Recognition, vol. 59, pp 748 – 760, May 1971.
- [3] T. Ahonen, A. Hadid, M. Peitkainen, Face recognition with local binary patterns. "In Proc. of European Conference of Computer Vision", 2004.
- [4] M. H. Yang, N. Ahuja, and D. Kriegmao, "Face recognition using kernel eigenfaces," IEEE International Conference on Image Processing, vol. 1, pp. 10-13, Sept. 2000.
- [5] Y. Zhang and C. Liu, "Face recognition using kemel principal component analysis and genetic algorithms," IEEE Workshop on Neural Networks for Signal Processing, pp. 4-6 Sept. 2002.
- [6] M. A. Fischler and R. A. Elschlager, "The Representation and Matching of Pictorial Structures," IEEE Transaction on Computer, vol. C22, pp. 67-92, 1973.
- [7] P. Sinha, B. Balas, Y. Ostrovsky, and R. Russell, "Face Recognition by Humans: Nineteen Results All Computer Vision Researchers Should Know About," in Proceedings of the IEEE, vol. 94, Issue 11, 2006.
- [8] A. T. Acharya and A. Ray, Image Processing: Principles and Applications, New York: Wiley, 2005.
- [9] T. D. Russ, M. W. Koch, and C. Q. Little, "3D Facial Recognition: A Quantitative Analysis," 38th Annual 2004 International Carnahan Conference on Security Technology, 2004.
- [10] S. S. R. Abibi, "Simulating evolution: connectionist metaphors for studying human cognitive behaviour," in Proceedings TENCON 2000, vol. 1 pp 167-173, 2000.
- [11] B. Tacacs and H. Wechsler. Face recognition using binary image metrics. In Proceedings, Third International Conference on Automatic Face and Gesture Recognition, pages 294–299, April 1998.
- [12] Y. Cui, J. S. Jin, S. Luo, M. Park, and S. S. L. Au, "Automated Pattern Recognition and Defect Inspection System," in proc. 5 th International Conference on Computer Vision and Graphical Image, vol. 59, pp. 768 – 773, May 1992.