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Declaration by the Candidate

We **SHAMIM AKRAM Roll No 20/156, BIKASH CHAMUA Roll No 20/097, SHANGSIT NATH Roll No 20/324** B.Tech. students of the Department of Computer Science & Engineering, Assam Engineering College hereby declare that we have compiled this thesis reflecting all our works during the semester long full-time project as a part of my B. Tech curriculum.

We declare that we have included the descriptions of my project work, and nothing has been copied/replicated from other's work. The facts, figures, analysis, results, claims etc. depicted in our report are all related to my full-time project work.

We also declare that the same report or any substantial portion of this project report has not been submitted anywhere else as part of any requirements for any degree/diploma etc.

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Abstract

Attendance is an important part of the daily classroom evaluation at the beginning and end of every class. Managing attendance can be a time-consuming task when using traditional techniques such as calling out roll calls or taking a student's signature. Facial recognition-based attendance systems use facial recognition technology based on high-definition monitor video and other information technologies. Face recognition is more accurate and faster technique among other techniques and reduces chance of proxy attendance. We introduce a real-time Face Recognition System for monitoring student attendance in class in place of relying on time-consuming methods.It covers areas such as face alignment, detection, and identification as well as the creation of a web application to support the system's numerous use cases like enrolling new students, adding images to the training dataset, examining attendance records, etc. This project tries to automate the traditional attendance method in which attendance is manually recorded. This method records the in-time and out-time of students in each and every class.

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Chapter 1- Introduction

Human beings can distinguish a particular face depending on a number of factors. One of the main objective of computer vision is to create such a face recognition system that can emulate and eventually surpass this capability of humans. In recent years we can see that researches in face recognition techniques have gained significant momentum. Partly due to the fact that among the available biometric methods, this is the most unobtrusive. Though it is much easier to install face recognition system in a large setting, the actual implementation is very challenging as it needs to account for all possible appearance variation caused by change in illumination, facial features, variations in pose, image resolution, sensor noise, viewing distance, occlusions, etc.

Many face recognition algorithms have been developed and each has its own strengths. We do face recognition almost on a daily basis. Most of the time we look at a face and are able to recognize it instantaneously if we are already familiar with the face. This natural ability if possible imitated by machines can prove to be invaluable and may provide for very important in real life applications such as various access control, national and international security and defense etc.

Presently available face detection methods mainly rely on two approaches. The first one is local face recognition system which uses facial features of a face e.g. nose, mouth, eyes etc. to associate the face with a person. The second approach or global face recognition system use the whole face to identify a person. The above two approaches have been implemented one way or another by various algorithms. The recent development of artificial neural network and its possible applications in face recognition systems have attracted many researcher into this field. The intricacy of a face features originate from continuous changes in the facial features that take place over time.

Regardless of these changes we are able to recognize a person very easily. Thus the idea of imitating this skill inherent in human beings by machines can be very rewarding. Though the idea of developing an intelligent and self-learning may require supply of sufficient information to the machine. Considering all the above mentioned points and their implications we have tried to gain some experience with some of the most commonly available face recognition algorithms and also compare and contrast the use of neural network in this field.

In the last two decades, the facial recognition system has become one of the most important and interesting research areas. A facial recognition system is a software application for certifying an individual and recognizing him/her with images or videos from a source. Facial recognition can be done speedily and accurately with the open-source platform called OpenCV. A path from a face and a picture database are favorite facial features. It is usually compared to biometrics such as fingerprints and eye investigation systems, and security systems and used in thumb detection systems. The OpenCV library makes programming easy to use. This comes up with advanced proficiencies like face detection, face tracking, facial recognition, and many more methods for artificial intelligence (AI).

The main advantage of the OpenCV library is, it is a multi-platform framework; it supports Windows, Mac OS, Mac OS X. Its challenging work includes face recognition on the lowest computing cost framework such

as smartphones and embedded devices. For the person's testimony, facial recognition is used. Everyone has unique features that do not share with another person.

Attendance marking is a crucial task in educational institutions, but traditional methods such as calling out names can be time-consuming and prone to errors. In recent years, schools and colleges have started using advanced technologies such as RFID, iris recognition, and fingerprint recognition for attendance marking. However, these methods can be intrusive and time-consuming.

Face recognition technology is a non-intrusive and easily acquirable biometric feature that is increasingly being used in attendance systems. Face recognition systems can detect faces from live streaming videos and can be relatively unaffected by facial expressions. The proposed attendance system uses face recognition techniques to mark attendance by detecting students' faces from live streaming video and matching them with the database. The system comprises four phases: database creation, face detection, face recognition, and attendance update.

The proposed attendance system has numerous advantages over traditional methods and other biometric techniques. It consumes less time, reduces the chances of proxy attendance, and does not require physical contact or interaction. Moreover, face recognition technology has a wide range of applications beyond attendance systems, such as security, authentication, and identification.

In conclusion, the proposed attendance system based on face recognition technology has the potential to revolutionize attendance marking in educational institutions. It is non-intrusive, efficient, and can reduce the burden on faculty members, enabling them to focus on teaching and other important tasks.

Chapter 2- Project Work

2.1 Literature Review

PAPER 1: FACIAL RECOGNITION SYSTEM USING OPENCV*(July 2021)*[1]

SUMMARY

In this paper, OpenCV with python was used to apply face detection to some photos. The version of OpenCV for Python called OpenCV-Python was used because the project was in python. The system was implemented for detecting faces in digital images. These are in JPEG format only. Face detection uses classifiers algorithms that detect the faces in an image. It has been trained to detect the face using many images for more accuracy. OpenCV uses two classifiers, LBP (Local Binary Pattern) and Haar Cascade classifiers. We use the Haar Cascade classifier. The training data used for detecting feature extraction was in the XML file called haarcascade_frontalface_default.xml

They used the following modules and functions:-
1. detectMultiscale: Module from OpenCV to create a rectangle with coordinates (x,y,w,h) around the face detected in the image.
2. scaleFactor: The value shows how much the image size is reduced at each image scale. A small value uses a smaller step for downscaling. This allows the algorithm to find the face.
3. minNeighbors: It specifies how many "neighbors" each applicant rectangle should have. A larger value results in small detections but it detects higher quality in an image.
4. minSize: The minimum image size. By default, it is (30,30). A Smaller face in the image is best to adjust the minSize value lower.

Facial recognition has three modules. Each module has been developed by a collaborative effort of all members.
1) Detector: It is responsible to detect faces from the images captured by a webcam.
2) Data Set Creator: It is responsible to create the data set of images.
3) Trainer: It is developed to train the software to detect faces.

This paper in detail explains the development of a facial recognition system using OpenCV. We discussed the advantages of using the OpenCV library in computer vision. The process of facial recognition with the Haar Cascade algorithm can detect and recognize the face. The facial recognition process with the Haar Cascade and can be successfully performed at a distance of more than 200 cm using a webcam. For future work, while the

current system is for straight faces, it can be improved to recognize faces at different angles. Followed by the optimization of the facial recognition process for use on a small mobile device.

PAPER 2: SMART ATTENDANCE MANAGEMENT SYSTEM USING MACHINE LEARNING*(Aug 2021)* [2]

SUMMARY

An Attendance plays a vital role in the educational organization for both the teacher and student. As it plays a prime important role to keep the record of the attendance. While earlier, as we think about the traditional process of taking the attendance in class room by Calling name or roll number of each student for the attendance, the problem arises by following this traditional process is more time consumption and also it requires more energy. As the students have to wait in queue for giving their attendance, which is very much time consuming. In order to overcome with this problem an automatic attendance management system is designed, that can solve all the above related problems.

This project helps by introducing an involuntary attendance marking system, devoid of any kind of interference with the normal teaching procedure. The system can also be used by implementing the cameras during exam sessions or in other teaching activities where attendance is highly mandatory. By using this system which helps to eliminate the classical student identification such as calling name of the student, or checking respective identification cards of the student, which can not only interfere with the ongoing teaching process, but also can be stressful for students during examination sessions.

The proposed system task is to capture the face of each individual student and to store it in the database for students attendance. The student face needs to be captured in such a way that all the students face features needs to be detected and even the posture and the seating of the student needs to be recognized. There is no need for the teacher to take the attendance manually in the class because the system records a video and through further processing steps the face is being recognized and finally the attendance database is updated.

OpenCV: OpenCV (Open Source Computer Vision Library) is a library of programming functions mainly aimed at real-time computer vision. OpenCV is developed by Intel and later supported by Willow Garage and then Itseez. The library is free for use under the open-source BSD license. Python is dynamically typed and garbage is collected. It supports multiple programming paradigms, including structured, objectoriented and functional programming. Python is often described as a "batteries included" language because of its comprehensive standard library. The proposed face recognition is categorized into four major steps namely, i. Image Acquisition ii. Face Detection iii. Face Recognition iv. Attendance Marking

Image Acquisition- The first step involved in the second phase is image acquisition, that is obtaining the face image of the students which is present in the classroom. It can be obtained through the High Definition Video Camera that installed in each classroom. From the video sequence which will be obtained during the lecture hour, the frames of each sequence are extracted from the video and numbered for further processing. From the extracted frames, two or more frames are taken at random and proceed with further processing steps.

Face Detection- From the frames which are extracted, each face of the image needs to be segregated (divided).For this segregation purpose, we go with the face region bounding box methodology process usually it is called marking the region of interest using HAAR cascade classifiers that is available in the OpenCV and facerecognition library respectively. After dividing the frame, the first frame is taken and the face image is detected and then it is marked. Then next the second frame is taken and again the face image is detected and marked. Again the same process is repeated for all the frames.

Face Recognition- The face image detected in each frame is taken and compared with the directory where the pre-trained face image of the student has resided. Again the same process is repeated for all the frames. To perform this comparison the process of Super Vector Machine Learning algorithm is employed.

Attendance Marking- If face image presenting the frame1matches the pretrained image the n the attendance is obtained of the particular student for the concerned lecture hour. If the student named as frame1 and that is not available in the trained dataset then student's face saved as image1doesn't belong to the particular class, which means that the particular student may belong to the different class. The attendance can be maintained in any kind of csv file for further retrieval of attendance data of the student.

The working process of this system includes the following steps:

i. Database Creation.

ii. Training the Model.

iii. Recognition of Person.

The following are necessary libraries that are imported:

i. Imutils: A series of convenience functions to make basic image processing functions such as translation, rotation, resizing and displaying Matplotlib images easier with open cv and python 3

ii. Time: Provides many ways of representing time in code, such as objects, numbers and strings

iii.Open CV: Used to process images and videos to identify objects, faces or even the hand writing of human.

iv. Numpy: It is in the form of arrays to work with a pixels.

v. OS: It is used to create/change and also to open directory.

vi. Pickle: It is used for serializing and deserializing python object structures.

vii. XLSX: to create/read/write to excel sheet.

Database Creation- A Database of the students is created first, from the images captured by the video frame which is done before the recognition process. Data set is created only to train the system and the data set includes the Name, USN, and images of the students in different variations and poses. Image count of 50 is captured for better accuracy. Here we use csv file to store student data

Training Model- The next step is to train the model. The model is trained with the extracted images from the video. The pre-processing step is taken for feature extraction from the video and then generate variations and alignments from the video. This is done using face_imutils feature from imutils module. These features that are extracted are then dumped to a pickle(pkl) file, with names and images properly mapped using pickle.

Recognition of Student- The last step is Recognition of the student. This step is done only when the detecting and processing of the face is completed. It compare the face present in the database of the students and then update the attendance of the students.

Smart attendance management system is designed to solve the issues of existing manual systems. We have used face recognition concept to mark the attendance of student and make the system better. The system performs satisfactory in different poses and variations. In future this system need be improved because these system sometimes fails to recognize students from some distance, also we have some processing limitation, working with a system of high processing may result even better performance of this system.

PAPER 3: Face Detection and Recognition using OpenCV and Python*(Oct 2020)* [3]

SUMMARY

Face recognition is the technique in which the identity of a human being can be identified using ones individual face. Such kind of systems can be used in photos, videos, or in real time machines. The objective of this article is to provide a simpler and easy method in machine technology. With the help of such a technology one can easily detect the face by the help of dataset in similar matching appearance of a person. The method in which with the help of python and OpenCV in deep learning is the most efficient way to detect the face of the person. This method is useful in many fields such as the military, for security, schools, colleges and universities, airlines, banking, online web applications, gaming etc. this system uses powerful python algorithm through which the detection and recognition of face is very easy and efficient.

The most useful area in which face recognition is important is the biometrics that is used for authentication process which makes the work mor easier. Face recognition is one of the widely used technologies or systems in which it has the potential to perform tasks such as to have records provided in by the dataset in many areas such as the school and colleges attendance systems, it can also be helpful in catching the thieves or the terrorist, can be helpful in the security of common people and the much needed security areas in the country.
The main aim or objective of this paper is to provide or develop a system that will use the camera of the computer or the system that would detect and recognize the person's face or the face of the individual using the tool in OpenCV called as the Open Face and python programming language in deep learning domain.

In order to create this system first we will have to make the datasets. When the image quality becomes favourable different procedures will take place in the face recognition system the tasks are performed using the python queries "python encode_faces.py". The input will be taken from the dataset which will be received in the "encodings.py". There will be precision formatting in the system wherein face embedding for each face will occur. Secondly a file "recognize_faces_images.py" will contain all the required methods and the techniques for the process of identification of the face of the person from the given image of the dataset. The given file will be executed by the python command "python recognize_faces_image.py-encodings". We can resize or turn the image for approximity with the goal for getting the desired output. The present classifier along with OpenCV libraries will enhance the outcome or results in the face recognition system

The advantages of the face recognition system include faster processing, automation of the identity, breach of privacy, massive data storage, best results, enhanced security, real time face recognition of students in schools and colleges, employees at corporate offices, smartphone unlock and many more in day to day life. Few disadvantages in this system include the costing, or the funding, very good cameras of high definition are required, poor image quality may limit the effectiveness of this system, size of the image will matter because it becomes difficult to recognize the face in small images, Face angles can limit the face recognition reliability, massive storage is required for this system to work effectively.

Face recognition systems are currently associated with many top technological companies and industries making the work of face recognition easier. The use of python programming and OpenCV makes it an easier and handy tool or system which can be made by anyone according to their requirement. The proposed system discussed in this project will be helpful for many as it is user friendly and cost_ efficient system. Hence by the use of python and OpenCV the face recognition system can be designed for various purposes.

PAPER 4: FACIAL RECOGNITION ATTENDANCE SYSTEM USING PYTHON AND OPENCV [4]

SUMMARY

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 I maintained.

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. 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 neighbours. A new binary value is set for each neighbour 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.

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. 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. 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 a4. Microsoft Excel Microsoft Excel is a spreadsheet program incorporated in Microsoft Office suite of applications.

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.

PAPER 5: Smart Attendance Management System Using Face Recognition [5]

SUMMARY

According to the previous attendance management system, the accuracy of the datacollected is the biggest issue. This is because the attendance might not be recorded personally by the original person, in another word, the attendance of a particular person can be taken by a third party without the realization of the institution which violates the accuracy of the data. For example, student A is lazy to attend a particular class, so student B helped

him/her to sign for the attendance which in fact student A didn‟t attend the class, but the system overlooked this matter due to no enforcement practiced. Supposing the institution establish an enforcement, it might need to waste a lot of human resource and time which in turn will not be practical at all. Thus, all the recorded attendance in the previous system is not reliable for analysis usage. The second problem of the previous system is where it is too time consuming. Assuming the time taken for a student to sign his/her attendance on a 3-4 paged name list is approximately 1 minute. In 1 hour, only approximately 60 students can sign their attendance which is obviously inefficient and time consuming. The third issue is with the accessibility of those information by the legitimate concerned party. For an example, most of the parents are very concerned to track their child‟s actual whereabouts to ensure their kid really attend the classes in college/school. However in the previous system, there are no ways for the parents to access such information. Therefore, evolution is needed to be done to the previous system to improve efficiency, data accuracy and provides accessibility to the information for those legitimate party.
The main intention of this project is to solve the issues encountered in the old attendance system while reproducing a brand new innovative smart system that can provide convenience to the institution. In this project, an application will be developed which is capable of recognising the identity of each individuals and eventually record down the data into a database system. Apart from that, an excel sheet is created which shows the students attendance and is directly mailed to the respected faculty.

The face database is an important step to be done before any further process can be initiated. This is because the face database acts as a comparison factor during the recognition process which will be discussed in later section. In the process above, a csv file is created to aid the process of image labelling because there will be more than one portrait stored for each student, thus, in order to group their portraits under the name of the same person, labels are used to distinguish them. After that, those images will be inserted into a recognizer to do its training. Since the training process is very time consuming as the face database grew larger, the training is only done right after there is a batch of new addition of student‟s portraits to ensure the training is done as minimum as possible. Before the attendance management system can work, there are a set of data needed to be inputted into the system which essentially consist of the individual‟s basic information which is their ID and their faces. The first procedure of portrait acquisition can be done by using the Camera to capture the faces of the individual. In this process the system will first detect the presence of a face in the captured image, if there are no face detected, the system will prompt the user to capture their face again until it meets certain number of portraits which will be 10 required portraits in this project for each student. The decision of storing only 10 portrait per student is due to the consideration of the limited storage space in the raspberry pi because the total amount of students in the university is considered heavy. Then, the images will undergo several pre-processing procedures to obtain a grayscale image and cropped faces of equal sized images because those are the prerequisites of using the EigenFaces Recognizer. Both of the processes mentioned above can be represented in the diagram below.

Before the development of this project. There are many loopholes in the process of taking attendance using the old method which caused many troubles to most of the institutions. Therefore, the facial recognition feature embedded in the attendance monitoring system can not only ensure attendance to be taken accurately and also eliminated the flaws in the previous system. By using technology to conquer the defects cannot merely save resources but also reduces human intervention in the whole process by handling all the complicated task to the machine. The only cost to this solution is to have sufficient space in to store all the faces into the database storage. Fortunately, there is such existence of micro SD that can compensate with the volume of the data. In this project, the face database is successfully built. Apart from that, the face recognizing system is also working well. At the end, the system not only resolve troubles that exist in the old model but also provide convenience to the user to access the information collected by mailing the attendance sheet to the respected faculty.

PAPER 6: AUTOMATED ATTENDANCE USING FACE DETCTION [6]

SUMMARY

According to the previous attendance management system, the accuracy of the datacollected is the biggest issue. This is because the attendance might not be recorded personally by the original person, in another word, the attendance of a particular person can be taken by a third party without the realization of the institution which violates the accuracy of the data. For example, student A is lazy to attend a particular class, so student B helped him/her to sign for the attendance which in fact student A didn‟t attend the class, but the system overlooked this matter due to no enforcement practiced. Supposing the institution establish an enforcement, it might need to waste a lot of human resource and time which in turn will not be practical at all. Thus, all the recorded attendance in the previous system is not reliable for analysis usage. The second problem of the previous system is where it is too time consuming. Assuming the time taken for a student to sign his/her attendance on a 3-4 paged name list is approximately 1 minute. In 1 hour, only approximately 60 students can sign their attendance which is obviously inefficient and time consuming. The third issue is with the accessibility of those information by the legitimate concerned party. For an example, most of the parents are very concerned to track their child‟s actual whereabouts to ensure their kid really attend the classes in college/school. However in the previous system, there are no ways for the parents to access such information. Therefore, evolution is needed to be done to the previous system to improve efficiency, data accuracy and provides accessibility to the information for those legitimate party.

The main intention of this project is to solve the issues encountered in the old attendance system while reproducing a brand new innovative smart system that can provide convenience to the institution. In this project, an application will be developed which is capable of recognising the identity of each individuals and eventually record down the

data into a database system. Apart from that, an excel sheet is created which shows the students attendance and is directly mailed to the respected faculty.

There are two major system flows in the software development section as shown below: The creation of the face database The process of attendance taking Both processes mentioned above are essential because they made up the backbone of the attendance management system. In this section, the process of both flows will be briefly described. Meanwhile, their full functionality, specific requirements and also the methods/approach to accomplish such objectives will be discussed in the upcoming chapter.

The face database is an important step to be done before any further process can be initiated. This is because the face database acts as a comparison factor during the recognition process which will be discussed in later section. In the process above, a csv file is created to aid the process of image labelling because there will be more than one portrait stored for each student, thus, in order to group their portraits under the name of the same person, labels are used to distinguish them. After that, those images will be inserted into a recognizer to do its training. Since the training process is very time consuming as the face database grew larger, the training is only done right after there is a batch of new addition of student‟s portraits to ensure the training is done as minimum as possible. Before the attendance management system can work, there are a set of data needed to be inputted into the system which essentially consist of the individual‟s basic information which is their ID and their faces. The first procedure of portrait acquisition can be done by using the Camera to capture the faces of the individual. In this process the system will first detect the presence of a face in the captured image, if there are no face detected, the system will prompt the user to capture their face again until it meets certain number of portraits which will be 10 required portraits in this project for each student. The decision of storing only 10 portrait per student is due to the consideration of the limited storage space in the raspberry pi because the total amount of students in the university is considered heavy. Then, the images will undergo several pre-processing procedures to obtain a grayscale image and cropped faces of equal sized images because those are the prerequisites of using the EigenFaces Recognizer. Both of the processes mentioned above can be represented in the diagram below.

Before the development of this project. There are many loopholes in the process of taking attendance using the old method which caused many troubles to most of the institutions. Therefore, the facial recognition feature embedded in the attendance monitoring system can not only ensure attendance to be taken accurately and also eliminated the flaws in the previous system. By using technology to conquer the defects cannot merely save resources but also reduces human intervention in the whole process by handling all the complicated task to the machine. The only cost to this solution is to have sufficient space in to store all the faces into the database storage. Fortunately, there is such existence of micro SD that can compensate with the volume of the data. In this project,

the face database is successfully built. Apart from that, the face recognizing system is also working well. At the end, the system not only resolve troubles that exist in the old model but also provide convenience to the user to access the information collected by mailing the attendance sheet to the respected faculty.

PAPER 7: SMART APPLICATION FOR AMS USING FACE DETECTION [8]

SUMMARY

According to the previous attendance management system, the accuracy of the datacollected is the biggest issue. This is because the attendance might not be recorded personally by the original person, in another word, the attendance of a particular person can be taken by a third party without the realization of the institution which violates the accuracy of the data. For example, student A is lazy to attend a particular class, so student B helped him/her to sign for the attendance which in fact student A didn‟t attend the class, but the system overlooked this matter due to no enforcement practiced. Supposing the institution establish an enforcement, it might need to waste a lot of human resource and time which in turn will not be practical at all. Thus, all the recorded attendance in the previous system is not reliable for analysis usage. The second problem of the previous system is where it is too time consuming. Assuming the time taken for a student to sign his/her attendance on a 3-4 paged name list is approximately 1 minute. In 1 hour, only approximately 60 students can sign their attendance which is obviously inefficient and time consuming. The third issue is with the accessibility of those information by the legitimate concerned party. For an example, most of the parents are very concerned to track their child‟s actual whereabouts to ensure their kid really attend the classes in college/school. However in the previous system, there are no ways for the parents to access such information. Therefore, evolution is needed to be done to the previous system to improve efficiency, data accuracy and provides accessibility to the information for those legitimate party.
The main intention of this project is to solve the issues encountered in the old attendance system while reproducing a brand new innovative smart system that can provide convenience to the institution. In this project, an application will be developed which is capable of recognising the identity of each individuals and eventually record down the data into a database system. Apart from that, an excel sheet is created which shows the students attendance and is directly mailed to the respected faculty.

There are two major system flows in the software development section as shown below: The creation of the face database The process of attendance taking Both processes mentioned above are essential because they made up the backbone of the attendance management system. In this section, the process of both flows will be briefly described. Meanwhile, their full functionality, specific requirements and also the methods/approach to accomplish such objectives will be discussed in the upcoming chapter.

The face database is an important step to be done before any further process can be initiated. This is because the face database acts as a comparison factor during the recognition process which will be discussed in later section. In the process above, a csv file is created to aid the process of image labelling because there will be more than one portrait stored for each student, thus, in order to group their portraits under the name of the same person, labels are used to distinguish them. After that, those images will be inserted into a recognizer to do its training. Since the training process is very time consuming as the face database grew larger, the training is only done right after there is a batch of new addition of student‟s portraits to ensure the training is done as minimum as possible. Before the attendance management system can work, there are a set of data needed to be inputted into the system which essentially consist of the individual‟s basic information which is their ID and their faces. The first procedure of portrait acquisition can be done by using the Camera to capture the faces of the individual. In this process the system will first detect the presence of a face in the captured image, if there are no face detected, the system will prompt the user to capture their face again until it meets certain number of portraits which will be 10 required portraits in this project for each student.

Before the development of this project. There are many loopholes in the process of taking attendance using the old method which caused many troubles to most of the institutions. Therefore, the facial recognition feature embedded in the attendance monitoring system can not only ensure attendance to be taken accurately and also eliminated the flaws in the previous system. By using technology to conquer the defects cannot merely save resources but also reduces human intervention in the whole process by handling all the complicated task to the machine. The only cost to this solution is to have sufficient space in to store all the faces into the database storage. Fortunately, there is such existence of micro SD that can compensate with the volume of the data. In this project, the face database is successfully built. Apart from that, the face recognizing system is also working well. At the end, the system not only resolve troubles that exist in the old model but also provide convenience to the user to access the information collected by mailing the attendance sheet to the respected faculty.

PAPER 8: Algorithm for Efficient Attendance Management: Face Recognition based approach [9]

SUMMARY

According to the previous attendance management system, the accuracy of the datacollected is the biggest issue. This is because the attendance might not be recorded personally by the original person, in another word, the attendance of a particular person can be taken by a third party without the realization of the institution which violates the accuracy of the data. For example, student A is lazy to attend a particular class, so student B helped him/her to sign for the attendance which in fact student A didn‟t attend the class, but the system overlooked this matter due to no enforcement practiced. Supposing the institution establish an enforcement, it might need to waste

a lot of human resource and time which in turn will not be practical at all. Thus, all the recorded attendance in the previous system is not reliable for analysis usage. The second problem of the previous system is where it is too time consuming. Assuming the time taken for a student to sign his/her attendance on a 3-4 paged name list is approximately 1 minute. In 1 hour, only approximately 60 students can sign their attendance which is obviously inefficient and time consuming. The third issue is with the accessibility of those information by the legitimate concerned party. For an example, most of the parents are very concerned to track their child‟s actual whereabouts to ensure their kid really attend the classes in college/school. However in the previous system, there are no ways for the parents to access such information. Therefore, evolution is needed to be done to the previous system to improve efficiency, data accuracy and provides accessibility to the information for those legitimate party.
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consideration of the limited storage space in the raspberry pi because the total amount of students in the university is considered heavy. Then, the images will undergo several pre-processing procedures to obtain a grayscale image and cropped faces of equal sized images because those are the prerequisites of using the EigenFaces Recognizer. Both of the processes mentioned above can be represented in the diagram below.

Before the development of this project. There are many loopholes in the process of taking attendance using the old method which caused many troubles to most of the institutions. Therefore, the facial recognition feature embedded in the attendance monitoring system can not only ensure attendance to be taken accurately and also eliminated the flaws in the previous system. By using technology to conquer the defects cannot merely save resources but also reduces human intervention in the whole process by handling all the complicated task to the machine. The only cost to this solution is to have sufficient space in to store all the faces into the database storage. Fortunately, there is such existence of micro SD that can compensate with the volume of the data. In this project, the face database is successfully built. Apart from that, the face recognizing system is also working well. At the end, the system not only resolve troubles that exist in the old model but also provide convenience to the user to access the information collected by mailing the attendance sheet to the respected faculty.

2.2 Methodology

2.2.1 Tools Required

2.2.1.1 SOFTWARE TOOLS

There are several **software** tools and technologies that can be used for developing a smart attendance management system using machine learning. Here are the ones that we have used:

1. ***Python***: Python is a popular programming language for data science and machine learning. It has a vast number of libraries and tools that can be used for machine learning tasks.
2. ***OpenCV***: OpenCV is an open-source computer vision library that can be used for tasks such as face recognition, object detection, and image processing.
3. ***MySQL***: MySQL is a popular relational database management system that can be used for storing attendance data and managing the database.
4. ***VS Code***: VS Code are popular integrated development environments (IDEs) for Python. They can be used for writing and debugging code.
5. ***NumPy***: NumPy (Numerical Python) is a popular open-source Python library that is widely used for scientific computing and data analysis.

2.2.1.2 HARDWARE TOOLS

The **hardware** tools that will be needed to complete this project are:

1. ***Cameras:*** High-resolution cameras can be used for capturing attendance data and for tasks such as face recognition.
2. ***Display Units:*** Display units such as LED panels or LCD screens can be used for displaying attendance data, notifications, and alerts.
3. ***Power Supply:*** Power supply units such as batteries or power adapters can be used for powering the devices and hardware components.

2.2.2 Architecture Overview

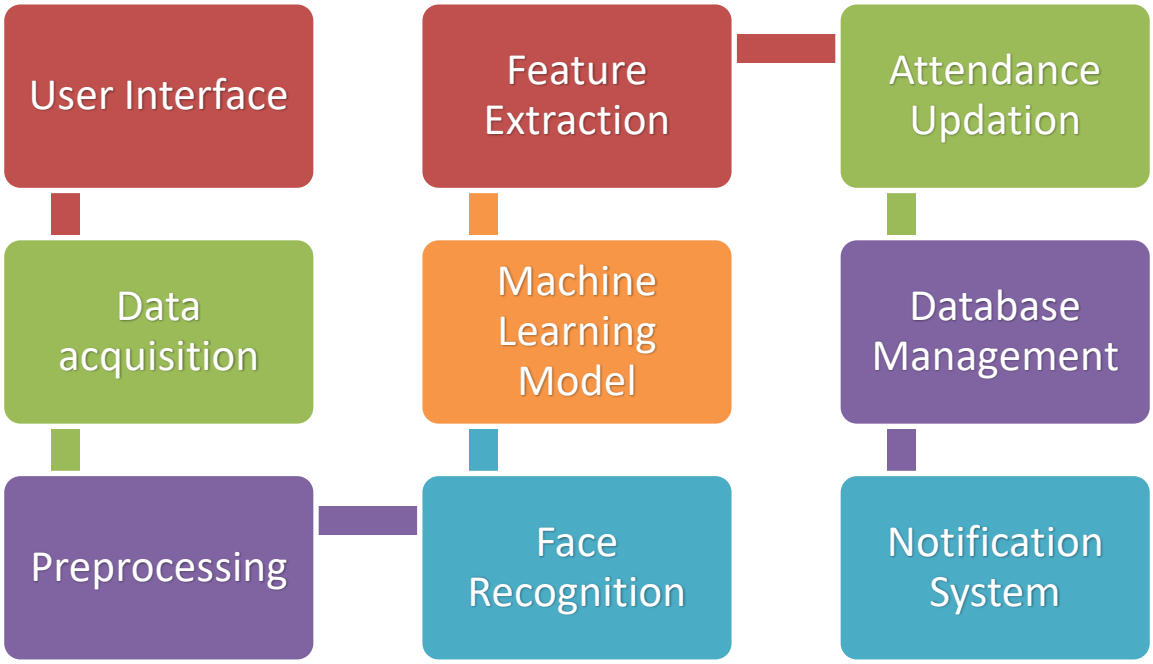

Figure 2. 1 : Project Architecture

2.2.3 User Interface

The smart attendance management system has been designed to be easy to use and navigate, with a simple and intuitive interface that can be used by people without prior technical knowledge. The main screen of the system features eight clearly labelled buttons that represent different functions of the software, including managing student details, training the system with facial data, taking attendance, displaying attendance records, accessing developer information, contacting the help desk, and exiting the application.

The buttons are labelled with icons to provide a visual cue for users. The icons are designed to be easily recognizable and to represent the different functions of the software in a clear and concise manner.

2.2.4 Data Acquisition

Student details like name, address, email-ID, phone number is taken and a unique ID is given to each student. 100 images corresponding to each student is taken for training the model.

2.2.5 Pre-processing:

2.2.5.1 CONVERSION OF IMAGES TO GRAYSCALE

1. **Simplicity:** Working with grayscale images is simpler than working with colored images. A grayscale image only has one channel, whereas a colored image has three (red, green, and blue). This means that we can perform the same face detection and recognition tasks using only a single channel of information, which simplifies the algorithms and makes them more efficient.
2. **Reduced Noise:** The grayscale conversion removes the color information, which can help to reduce the amount of noise in the image. By removing color, the image data is less complex, and there is less chance of having noisy pixels that could interfere with the detection process.
3. **Increased Contrast:** Converting to grayscale can help to increase the contrast of the image, making it easier to detect features such as edges and lines that are important for face detection and recognition.

2.2.5.2 CONVERSION OF GRAY SCALE IMAGES TO NUMPY ARRAY

1. Converting an image to a NumPy array is necessary when working with OpenCV because it allows us to take advantage of the powerful NumPy array operations and functions that OpenCV provides.

2. The NumPy array representation also provides a convenient way to store and pass image data between different functions and modules in our code.

2.2.6 Feature Extraction

In this step, we extract the features from the image, with the help of edge detection, line detection, and centre detection. Then provide the coordinate of x, y, w, h, which makes a rectangle box in the picture to show the location of the face. It can make a rectangle box in the desired area where it detects the face.

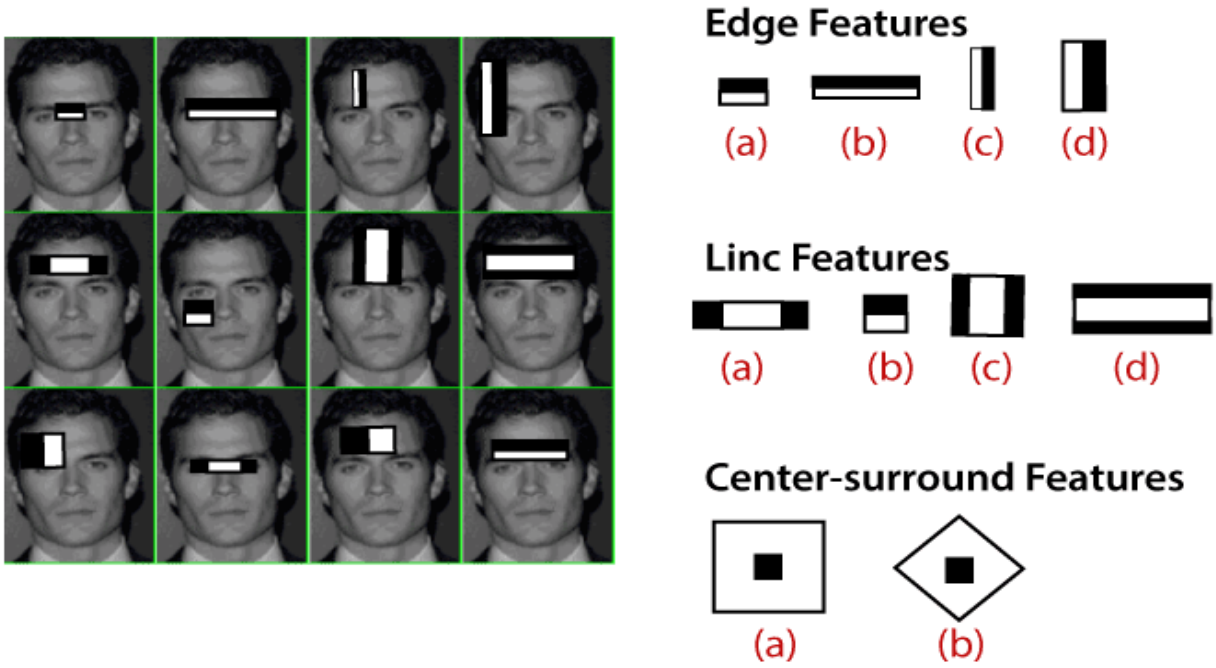

Figure 2. 2 :Feature Extraction

2.2.7 Algorithm Selection

There are various algorithms that can be used for face recognition that are available in OpenCV. Some them are listed below:

- Eigenfaces (1991)
- Local Binary Patterns Histograms (LBPH) (1996)
- Fisherfaces (1997)
- Scale Invariant Feature Transform (SIFT) (1999)
- Speed Up Robust Features (SURF) (2006)

Amongst all the algorithms we have selected LBPH for the following reasons:

LBPH (Local Binary Patterns Histograms):

LBPH captures local patterns in an image by comparing each pixel with its surrounding neighbours and encoding the result as a binary pattern. It then constructs histograms based on these patterns to represent the image.

Advantage over other algorithms:

Robustness to illumination changes: LBPH is particularly effective in handling variations in lighting conditions. By comparing local patterns, it becomes less dependent on global illumination and can better handle different lighting conditions compared to algorithms like Eigenfaces and Fisherfaces, which primarily focus on the global structure of the face.

Local feature representation: LBPH considers local texture patterns, enabling it to handle facial variations caused by pose, expression, and occlusion. This local representation can be beneficial in scenarios where these variations are significant, setting it apart from algorithms like Eigenfaces and Fisherfaces that focus more on global features.

Eigenfaces (1991):

Eigenfaces use principal component analysis (PCA) to represent faces as eigenvectors of the covariance matrix calculated from a training set.

Key points:

Dimensionality reduction: Eigenfaces project face images into a lower-dimensional space by retaining only the most significant eigenvectors. This reduces the computational complexity of face recognition tasks.

Global feature representation: Eigenfaces capture the overall structure of the face but may not handle local variations as effectively as LBPH. They are more suitable for scenarios where global features play a dominant role, such as face verification with minimal variations.

Fisherfaces (1997)

Fisherfaces, also known as Linear Discriminant Analysis (LDA), aim to find a projection that maximizes class separability by considering both within-class and between-class scatter matrices.

Key points:

Discriminative power: Fisherfaces optimize the separation between different classes, making them suitable for scenarios where class discrimination is crucial, such as face recognition in large databases.

Global feature representation: Similar to Eigenfaces, Fisherfaces focus on the overall structure of the face and may not capture local variations as effectively as LBPH.

SIFT (Scale Invariant Feature Transform) (1999)

SIFT is a popular algorithm for feature detection and description. It identifies distinctive local features and extracts their descriptors from an image.

Key points:

Robustness to scale and rotation: SIFT features are invariant to changes in scale, rotation, and affine transformations, making them suitable for scenarios where faces exhibit these variations.

Feature-based representation: SIFT emphasizes extracting and matching local features across different images. While it can handle scale and rotation changes, it may not be as effective as LBPH in handling illumination changes.

SURF (Speed Up Robust Features) (2006)

SURF is an algorithm that aims to improve the computational efficiency of SIFT while maintaining robustness to scale and rotation changes.

Key points:

Efficiency: SURF achieves faster processing times compared to SIFT by approximating certain computations, making it suitable for real-time applications or resource-constrained environments.

Speed and accuracy trade-off: Due to the approximations made for efficiency, SURF may introduce a trade-off between speed and accuracy compared to more computationally intensive algorithms like SIFT.

In summary, LBPH stands out due to its robustness to illumination changes, simplicity, and local feature representation. It can effectively handle variations in lighting conditions and capture detailed local patterns, making it suitable for real-world face recognition tasks. However, other algorithms like Eigenfaces, Fisherfaces, SIFT, and SURF have their own strengths and may be more suitable for specific scenarios where global features, discriminative power, or efficiency are more critical factors to consider. The choice of algorithm should be based on the specific requirements and constraints of the application at hand.

2.2.7.1 LBPH algorithm

All things considered and taking into account the region, Local Binary Pattern (LBP) can be a clear yet effective surface that leaves marks on certain areas of the image by obstructing the area.

as a paired width as a result. It was determined that the securing execution of more informational indexes is improved when LBP is combined with histograms of characterised angles (HOG) directed. We can represent to confront images with a vector of direct information using LBP combined with histograms.

The LBPH algorithm is composed of the following 5 steps:

i. The LBPH employs 4 parameters:

Radius: The radius is a local binary pattern-making tool that depicts the area surrounding the centre pixel. One is chosen as the frequency.

Neighbours: the quantity of sample points needed to create a binary's circular region. Remember that the cost of the computer increases as you add more points. It is tuned to 8 cycles per second.

Grid X: the quantity of cells arranged horizontally. The better the grid, the bigger the vector size of the emerging element, and the more cells. It's set to 8 cycles per second.

Grid Y: refers to how many cells are in a straight line.

The better the grid, the bigger the vector size of the emerging element, and the more cells. It's set to 8 cycles per second.

ii. Algorithm Training

The model must first be trained. We achieve this by using a database that includes pictures of the people we want to tell. The next step is to add an ID (also known as a number or a name) to each image so that the algorithm can use this information to identify the input image and output the result. The ID for each image of the same individual must match. Let's examine the LBPH process phases since the training set has already been made.

iii. Applying for LBP operation

The next step is to develop an intermediary image that clarifies the initial photograph taken on a roadway with face light. Algorithmic law does this by utilising a window view that supports a variety of frames and neighbours.

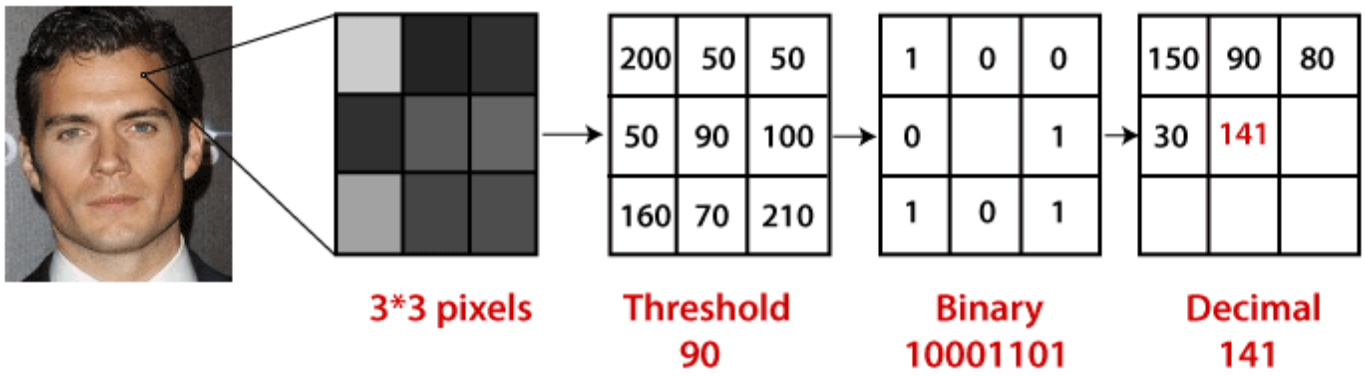

Figure 2. 3: Conversion of Image to Grayscale

- We have a photo of a grey face.
- This image can be represented in part as a 3x3 pixel window or as a 3x3 matrix holding the range of pixel thicknesses (0 to 255).
- After that, we must determine the matrix's median value, which will serve as the limit and be utilised to characterise fresh values from eight neighbours.
- We establish a new binary value for each median of the middle value (limit). We set 0 values below the limit and 1 value greater than the limit.
- Now, regardless of average value, the matrix will only include binary values. Line by line, we must estimate each binary value from each place in the matrix to the new binary value (for example, 10001101). Note that while some authors synchronise binary values using different techniques (such as clock direction), the outcome will always be the same.
- This binary number is then converted to a decimal value and set to the matrix's centre value, which is a pixel from the first image.

- After this procedure (LBP process), we obtain a new image that more accurately captures the characteristics of the original image.

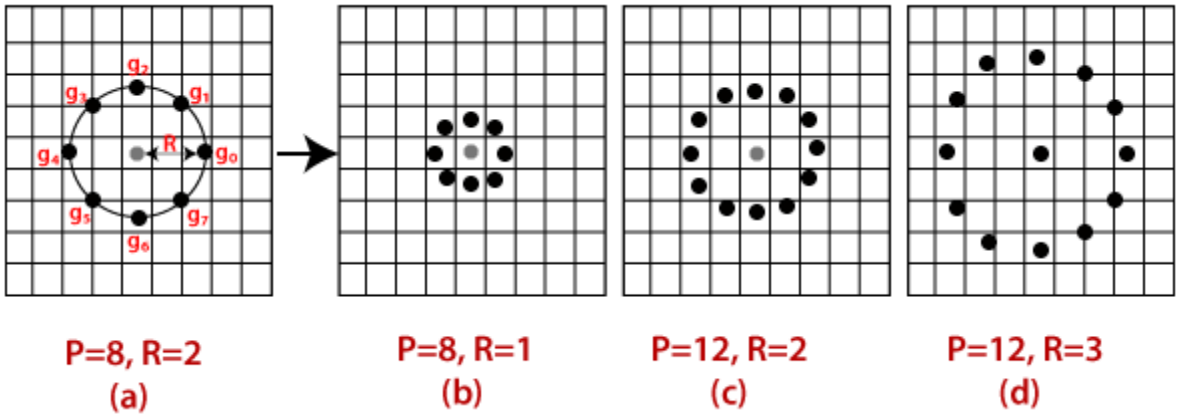

Figure 2. 4:Bilinear Interpolation

Bilinear interpolation is an option for doing this. When determining the location of a new data point, values from the four (2x2) closest pixels are used if the new data point is within one pixel.

iv. Recording histogram:

Now, using the image created in the last step, we can use the Grid X and Grid Y parameters to split the image into multiple grids, as can be seen in the following picture:

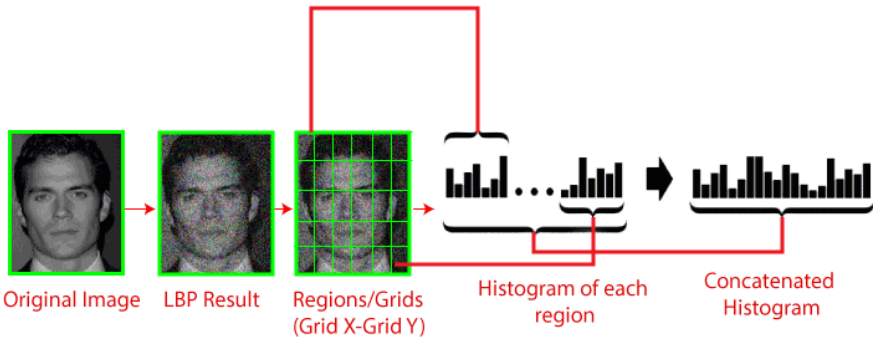

Figure 2. 5:Conversion to Histogram

Each histogram (from each grid) will only have 256 (0 255) positions because our image is grey; these places reflect the potential for each pixel power. Then, in order to construct a new and larger histogram, we must sync each histogram. The final histogram will have 8x8x256 = 16.384 places if we assume that we have 8x8 grids. The characteristics of the initial image are depicted in the final histogram.

V. Performing face recognition:

The algorithm has already been trained at this point. Each histogram produced serves as a representation of a different image from the training database. As a result, whenever we are given an image to insert, we repeat the steps and produce a histogram for the new image.

- Thus, all that is required to create an image that is comparable to an input image is to compare the two histograms and replace the image with the histogram that comes closest.

- Different techniques, such as the Euclidean distance, square-chi, total value, etc., can be used to compare two histograms and determine their distance from one another. Based on the following calculation, we can utilise the Euclidean (most common) range in this example:

Distance Between two histograms

- So, the output of the calculation is an ID from a picture with a close-by histogram. The calculation ought

$$D = \sqrt{\sum_{i=1}^{n}(\text{hist}\,1_i - \text{hist}2_i)^2}$$

Figure 2. 6: Distance Calculation

to likewise restore a determined reach, which can be utilized as a proportion of 'certainty'. Note: don't be tricked by the word 'certainty', since low camouflage is better since it implies that the separation between the two histograms is nearer.

- We can then use the threshold limit and 'confidence' to automatically adjust if the algorithm has detected the image correctly. We can assume that the algorithm has detected success when confidence is below the defined limit.

2.3 Working Overview

1. "Students Details" button: This button will allow you to view and manage the details of all registered students, such as their names, IDs, and photos, which are stored in the database.
2. "Train Data" button: This button is used to train the system with facial data of the registered students so that the system can recognize them accurately during attendance taking.
3. "Take Attendance" button: This button initiates the face recognition process to capture students' images during a class session and then compares the images with the previously stored data to mark attendance automatically.
4. "Display Attendance" button: This button will display the attendance data of students who were present, absent, or late for a particular class session or for an entire semester.
5. "Developers" button: This button will provide information about the developers who built the system, including their names, photos, and contact details.
6. "Help Desk" button: This button will allow users to access the system's support team for any assistance or technical issues they may encounter while using the system.
7. “Photos” button: It shows all the collected photos of students.
8. "Exit" button: This button will exit the attendance management system and close the application.

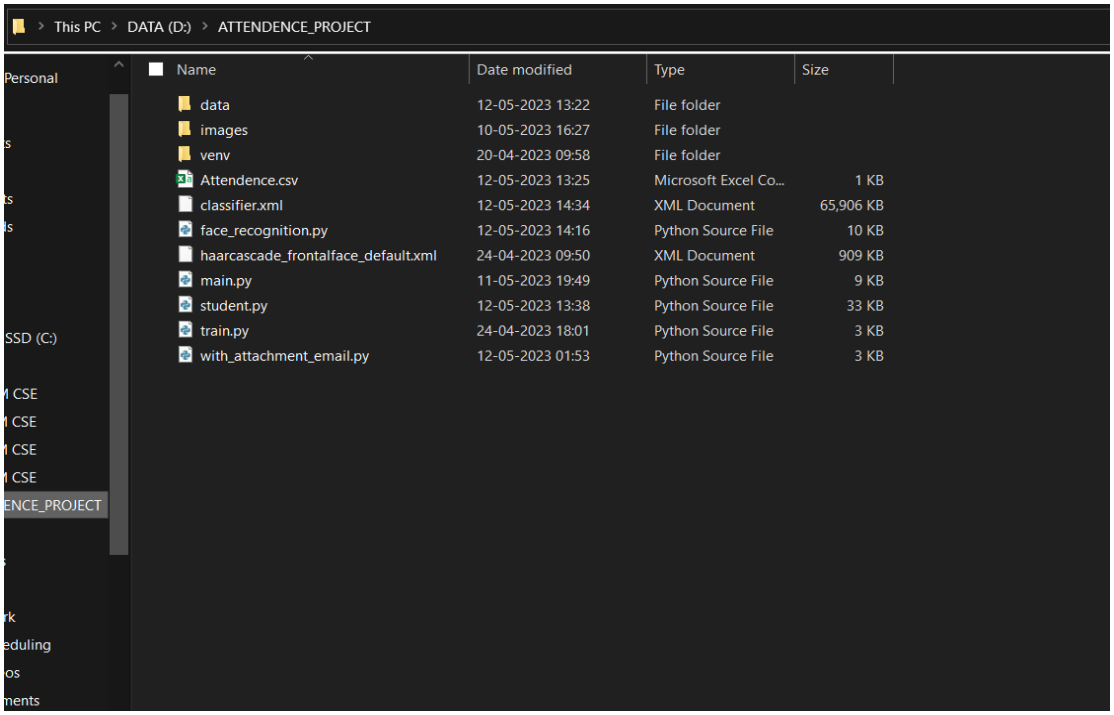

Figure 2. 7 File Architecture

Figure 2. 8: Home Page

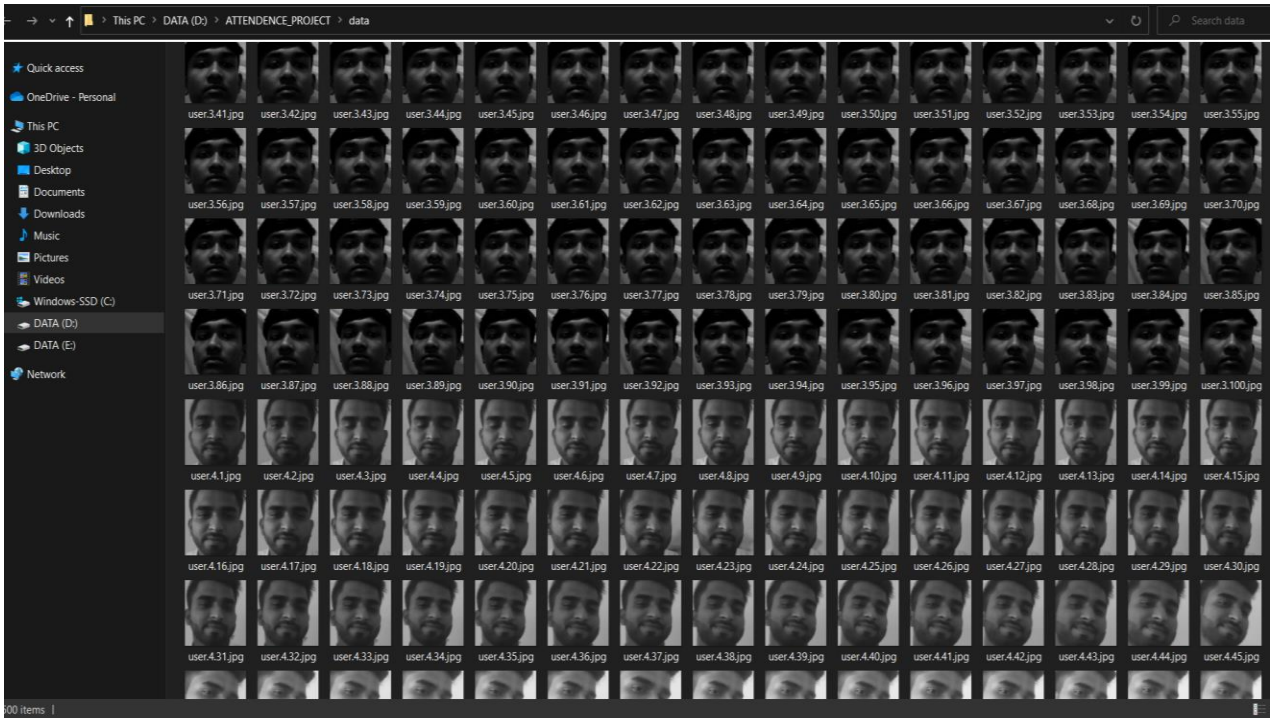

Figure 2. 9: Photo Sample with Unique ID

Chapter 3-Results and Discussion

The attendance management project that we have created is a powerful tool for tracking attendance records and managing databases. With its ability to detect multiple people and its ease of use, the system offers a reliable and efficient solution for managing attendance. One of the key strengths of the system is its ability to handle multiple students at once. This means that attendance can be taken quickly and easily, without the need for manual counting or recording. Whether it's a small classroom or a large lecture hall, the system can effortlessly identify and record the attendance of every individual present. This not only saves time but also reduces the chances of errors that may occur when taking attendance manually.

The system's facial recognition technology is a game-changer in ensuring accurate attendance records. By analyzing unique facial features, the system can precisely identify each student and mark their attendance accordingly. This eliminates the possibility of impersonation or proxy attendance, providing an additional layer of security and accountability.In addition to its efficiency, the system boasts a user-friendly interface that simplifies the management of the attendance database. The clear and intuitive screens make it easy for authorized personnel to add, edit, or delete student records as required. This feature ensures that student data is always up-to-date and readily accessible, promoting effective record-keeping and organizational efficiency.

Another strength of the system is its comprehensive tracking capability. It allows for the monitoring of attendance records over time, providing valuable insights into attendance trends for individual students and the class as a whole. Teachers and administrators can access attendance reports and analyse attendance patterns effortlessly. This data-driven approach enables them to identify and address attendance issues promptly, leading to improved student engagement and academic performance. To enhance the system's accuracy, it is highly recommended to utilize a high-quality camera. While the system already delivers impressive accuracy, an upgraded camera can provide even more reliable results. A high-resolution camera captures finer facial details, improving the precision of facial recognition and minimizing false positives or negatives. This becomes particularly crucial during critical situations such as exams or when monitoring attendance in important classes, where precise attendance records are of utmost importance.

Overall, the attendance management system offers a powerful and efficient solution for tracking attendance records and managing student databases. Its ability to detect multiple individuals simultaneously, combined with its user-friendly interface and comprehensive tracking features, makes it an invaluable tool for teachers and administrators alike. Furthermore, by incorporating a high-quality camera, the system's accuracy and reliability can be further enhanced, solidifying its status as an essential tool for schools and other educational institutions. The seamless integration of technology with attendance management ensures smoother administrative processes and contributes to a positive learning environment.

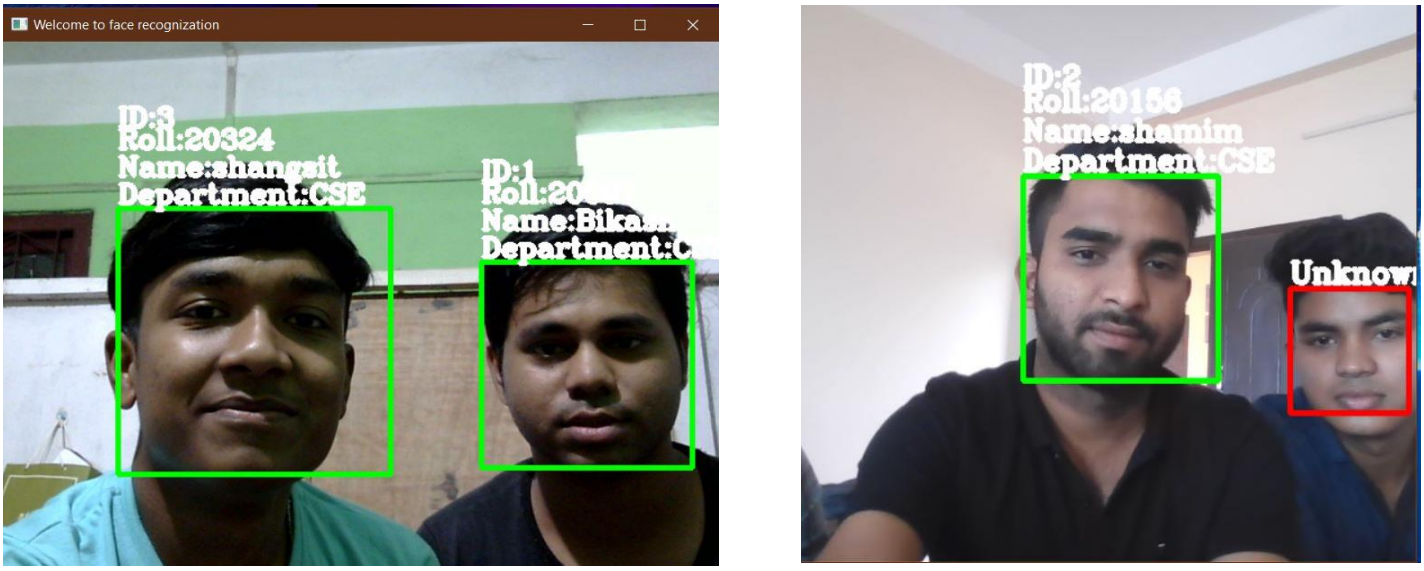

Figure 3. 1:Detecting known and Unknown faces

Attendence.csv

Normal | Arial | 10

	A	B	C	D	E	F	G	H
1	1	20097	Bikash	CSE	01:54:17	12/05/23	Present	
2	2	20150	Saurav	Mechanical	13:00:35	12/05/23	Present	
3	3	20324	shangsit	CSE	13:08:44	12/05/23	Present	
4	4	20156	Shamim	CSE	13:24:51	12/05/23	Present	
5	5	20382	Ahbab	CSE	13:25:41	12/05/23	Present	
6								
7								

Figure 3. 2: Updating Attendance to CSV file

Chapter 4-Conclusion and Future Scope

The completion of a project, including its evaluation and testing, has resulted in the development of a highly successful system that has effectively achieved its intended goals and objectives. However, it is imperative to conduct a thorough examination of the project to address any potential areas for improvement and explore additional techniques that can be integrated to enhance the system's performance and outcomes.

Utilization of Varied Approaches: Through an extensive literature review, it has been observed that diverse approaches have been employed in the past for face recognition systems. In this project, due to certain issues encountered in the recognition component of the system, a decision was made to base the system's parameters on a relatively limited class size. This strategic choice aimed at optimizing the system's accuracy and minimizing potential errors associated with larger datasets.

Security and Data Privacy Considerations: Considering the importance of security, the system necessitates the implementation of login functionality. This ensures that only authorized individuals have access to the system and its data. Furthermore, the aspect of data privacy holds paramount significance. Therefore, the organization must adhere to stringent policies and regulations regarding the capture, storage, and usage of individuals' facial images.

Informed Consent and Ethical Considerations: Respecting individuals' rights and privacy, it is essential to inform users that their facial images will be used within a face recognition attendance system. Prior consent should be obtained from each person, granting permission for the usage of their photos for attendance purposes. It is crucial to align the organization's practices with government policies, moral guidelines, and legal frameworks pertaining to information protection.

Potential for Future Advancements: The interaction between the technology developed in this project, the students, and the teachers offers significant potential for future work aimed at improving face detection accuracy. By integrating this technology with desegregation video-streaming services and a lecture archiving system, the overall system can be further enhanced, enabling it to cater to a wider range of applications. Notably, the integration of the system into remote education platforms, course management systems (CMS), and support for college development (FD) holds promising prospects.

Continual Improvement and Testing: To ensure the system's robustness and accuracy, it is advisable to conduct rigorous testing with larger student populations. By allowing students to switch places and simulating various seating arrangements, the system can be thoroughly evaluated and fine-tuned. This iterative process will facilitate the refinement of the approach, resulting in an increasingly accurate and reliable face recognition attendance system.

In conclusion, the developed face recognition attendance system has achieved its intended objectives and proved to be highly successful. However, ongoing examination and improvement are necessary to refine the system's performance. The incorporation of additional techniques, adherence to security and data privacy protocols, informed consent procedures, and future integration with related technologies present opportunities for expansion and enhancement. By continually testing and refining the system, it is possible to create a highly accurate and reliable solution with broader applications in the field of education and beyond.

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