FACE RECOGNITION BASED ATTENDANCE SYSTEM

Industrial project submitted in fulfilment for the requirement of the Degree of

MASTER OF TECHNOLOGY

By

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First and foremost, I would like to express our gratitude to my Mentor, Dr. Amanpreet Kaur, who were a continual source of inspiration. She pushed us to think imaginatively and urged me to do this thesis without hesitation. Her vast knowledge, extensive experience, and professional competence enabled me to successfully accomplish this thesis. This endeavour would not have been possible without her help and supervision. I could not have asked for a finer mentor in my studies. This initiative would not have been a success without the contributions of each and every individual.

I would like to thank Jaypee Institute of Information and Technology for providing me with the opportunity to work on the industrial project “Face Recognition based Attendance system for Employees”. Last but not least, I would like to express my gratitude to my family, siblings, and friends for their invaluable assistance, and I am deeply grateful to everyone who has contributed to the successful completion of this project.

DECLARATION

I hereby declare that the Industrial project, titled **"Face Recognition based Attendance system"** is a record of original research work undertaken by me for the award of the degree of Master of Technology in Computer Science submitted at **Jaypee Institute of Information and Technology**. I have completed this study under the supervision of **Dr. Amanpreet Kaur**, Department of Computer Science.

I also declare that this thesis has not been submitted for the award of any degree, diploma, associate-ship, fellowship or other title. It has not been sent for any publication or presentation purpose.

I am fully responsible for the contents of my M. Tech Industrial project.

…….
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SUPERVISOR'S CERTIFICATE

This is to certify that the work reported in the M. Tech Industrial Project entitled **"Face Recognition based Attendance system for Employees"** submitted by **Shreya Gupta** at **Jaypee Institute of Information Technology, Noida**, **UP**, **India,** is a record of research work done by her during the academic year 2022-2023 under my supervision in partial fulfilments for the award of Master of Technology in Computer Science.

This work has not been submitted for the award of any degree, diploma, associate ship, fellowship or other title. It has not been sent for any publication or presentation purpose.

…….
(Signature of Supervisor)

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Date: 01 May 2023

PREFACE AND ACKNOWLEDGEMENT

This report has been prepared as part of my work for MTech. The report is being put together with the intention of including all the information related to the research I did for my industrial project.

The first part of the industrial project describes and analyses the face recognition-based attendance system's history and present situation. The core functionality of the facial recognition-based attendance system is discussed in the second section, along with how secure and authentic it is. The goal is to create an attendance system that uses face recognition technology. Here, a person's face will be taken into account while recording attendance.

In this industrial project, we suggested a system that automatically starts recording attendance when a student's face is captured by a camera and is recognised in a database. Compared to the old ways, the new one will take less time.

ABSTRACT

Everything in the world today is centralised and connected online. Machine learning, image processing, and the internet of things are all constantly developing fields. Due to this evolution, several systems have undergone full changes in order to produce more accurate findings. The move from the conventional signature on a paper sheet to facial recognition in the attendance system is an example of this. This project suggests a technique for creating a thorough embedded class attendance system that uses facial recognition and can determine if a person's face belongs to a student in a certain class or not. The system is based on a machine learning algorithm that must be implemented in Python and uses a computer or laptop camera to capture images of the students. A regular external camera may also be used, but it must be connected to the system, which is programmed to handle face recognition by utilising the Local Binary Patterns algorithm (LBPs).

The Open CV-based technique to face recognition has been suggested. This system combines a camera that records an input image, a face detection algorithm, encoding and face identification, and marks attendance in a spreadsheet. By training the system with the faces of the registered learners, the training database is established. Afterward, a database containing the cropped photographs is created and labelled accordingly. The LBPH algorithm is used to extract the features. Face identification is included in the application, saving time and removing the possibility of proxy attendance.

LIST OF ACRONYMS AND ABBREVIATIONS

LBPH	Local Binary Patterns Histogram
DNN	Deep Neural Network
SVM	Support Vector Machine
MLP	Multi-Layer Perceptron
CNN	Convolutional Neural Network
AMS	Attendance Management System
RFID	Radio Frequency Identification
LSTM	Long Short-Term Memory
CUDA	Computer Unified Device Architecture
PCL	Portable Class Library
PCA	Principal Component Analysis
FANNC	Fast Adaptive Neural Network Classifier
GUI	Graphical User Interface
API	Application Programming Interface
SMQT	Successive Mean Quantization Transform
IDE	Integrated Development Environment
VS Code	Virtual Studio Code
URL	Uniform Resource Locator
ROC Curve	Receiver Operating Characteristic Curve
HOG	Histogram of Oriented Gradients
CSV File	Comma-Separated Value File
MATLAB	Matrix Laboratory

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CHAPTER-1

INTRODUCTION

It might be difficult to keep the attendance record up with daily activities. The traditional approach of calling each student's name takes a lot of time, and there is always a possibility of proxy attendance. The method that follows uses facial recognition to keep track of student's attendance. The administrator has already stored the subject-specific daily attendance records of the pupils. The system begins capturing pictures automatically as the time for a certain topic approach. Once a face detection and identification algorithm has been applied to the provided image, students who have been identified are recorded as present, and their attendance is updated with the appropriate time and subject ID. In order to build this system, deep learning techniques were applied. The histogram of oriented gradient approach is used to identify faces in photos, and the deep learning method is used to calculate and compare facial feature data of students. Our technology has the ability to recognise numerous faces simultaneously.

Institutions of higher learning are now worried about students' attendance patterns. This is mostly because a student's participation at the institute has an impact on their overall academic success. Calling out the names or having students mark a piece of sheet are the two main traditional ways to record attendance. Both of these required more effort and time. Consequently, a Automated attendance management system is needed, that helps the supervisor automatically to keep track of attendance. In this project, I used Python to create the attendance management system which can automatically control the attendance of an individual. Our plans to create an "Automated Attendance System Based on Facial Recognition" with broad applicability have been anticipated. Face identification is included in the application, which will save a lot of time and there is no possibility for faking the attendance.

In many schools and universities, recording attendance using the traditional technique is a lengthy process. Additionally, the faculty must personally call out each student's name in order to record attendance, which might take up to five minutes for the whole session. This takes a lot of time. There is a potential that a proxy will show up. As a result, several institutions began implementing a variety of additional methods for tracking attendance, including the use of RFID, iris and fingerprint identification, among others. However, these solutions rely on queues, which might take longer and be more obtrusive.

This system is a cutting-edge solution that seeks to simplify and streamline the attendance monitoring procedure in businesses and educational institutions. This system can reliably detect and log people's presence in real-time with the use of contemporary facial recognition technology and code written in Python.

Because of their precision and ease, such systems are becoming more and more used in companies and educational institutions. These systems can precisely detect and record people's presence in real-time with the use of contemporary automated facial recognition and Python

programming, doing away with the necessity for human attendance taking and lowering the likelihood of mistakes and falsified attendance records.

The conventional approaches of collecting attendance are frequently prone to mistakes, inefficiencies, and laborious procedures. Manually collecting attendance can result in mistakes including incorrectly entering attendance, losing attendance records, and fabricating attendance. Additionally, in order to stop the virus from spreading, the current COVID-19 epidemic has raised the demand for contactless attendance systems.

The major goal of this endeavour is to create an application that can precisely identify people and track their attendance in real time. With the use of a more effective and trustworthy attendance monitoring system, the project intends to do away with the necessity for human attendance taking. By minimising interaction when collecting attendance, the device will also contribute to ensuring people's safety.

The project required creating an automated attendance monitoring system using the Python programming language and contemporary facial recognition methods. The method works by taking pictures of people and then using the OpenCV library to analyse images and recognise their faces. When faces are discovered, their identities are ascertained by comparing them to the already-existing database of people. The presence records are then placed in a central repository for further use.

With the aid of a front camera, a GUI, and the Python programming language, this system was put into practise. The system uses a SQLite database to hold the attendance records and the OpenCV library for recognising faces and identification. Because of the system's real-time functionality, attendance may be instantly recorded.

In order to guarantee the student's presence during the test sessions, it is also feasible to determine if that individual remains asleep or awake throughout the lecture. By recording the students' faces on a high-quality screen via the internet service, the actual presence of each individual can be ascertained, making it extremely dependable for the computer to recognise every student in the room. The two most popular methods for recognising faces on people are:

1. Brightness-based methodology
2. Sharpness-based methodology

1. Brightness-based Methodology

The term "brightness-based methodology" refers to a method for locating and tracking objects by measuring the luminescence of a picture or footage frame. This approach is frequently utilised in applications involving computer vision, such as object tracking, security applications, and surveillance systems. The fundamental tenet of brightness-based technique is that, based on their physical characteristics and the lighting, things in an image or video frames will have different brightness levels. The position and motion of objects in a scene can be determined by examining the amount of light in a video or picture frame.

This approach employs a variety of methods, such as feature extraction, background removal, and thresholding. Setting a brightness threshold value and segmenting the picture or video frame according to the brightness levels is thresholding. In order to emphasise the items in a picture, the backdrop of the scene is subtracted off the photo or video frame. In order to track objects in the picture, feature extraction entails locating particular characteristics in a video or picture framework, including edges, corners, or texture patterns. In comparison to other tracking methods, this approach offers a number of benefits, including simplicity, minimal computing expense, and adaptability to variations in illumination. It may also be utilised in real-time applications, making it possible to monitor objects quickly and effectively.

In comparison to other tracking methods, brightness-based approach offers a number of benefits, including simplicity, minimal computing expense, and adaptability to variations in illumination. It may also be utilised in real-time applications, making it possible to monitor objects quickly and effectively.

2. Sharpness-based Methodology

A method for determining how crisp or focused a picture is is called sharpness-based approach. This approach is frequently utilised in image processing systems, such as autofocus systems, picture repair, and enhancement. The fundamental tenet of this approach is that the difference in contrast or boundary sharpness between consecutive pixels may be used to quantify how crisp an image is. The contrast between neighbouring pixels is stronger in sharper photos and lower in blurrier ones. It is possible to gauge the degree of sharpness and make modifications to enhance the image quality by examining the amount of contrast or edge crispness in an image.

Edge identification, temporal analysis of frequency, and gradient-based approaches are just a few of the methodologies employed in sharpness-based methodology. In order to discern edges among objects in a picture, contrast between neighbouring pixels must be measured. In order to determine how crisp a picture is, spatial frequency analysis examines both its high- and low-frequency components. Gradient-based techniques determine a pixel's level of sharpness by examining the differences in intensity between neighbouring pixels.

In comparison to other image processing methods, this approach has various benefits, such as the capacity to quantify the level of crispness objectively and in quantitative terms, the ability to operate with a variety of picture formats, and the ability to give instantaneous feedback on image quality.

1.1 AIM

To precisely recognise the student faces. to automatically record attendance. to give a helpful attention system for both instructor and students by reducing the time and effort needed for

manual attendance. It offers flexibility and cuts down on lost time. There won't be an opportunity for a proxy.

The primary aim of the project is to create an automated attendance monitoring system that reliably identifies and records people's attendance in real time using cutting-edge facial recognition technology. With the use of a more dependable and effective attendance monitoring system, the project intends to do away with the necessity for human attendance taking, which may be inaccurate and inefficient. By minimising interaction when collecting attendance, the device will also contribute to ensuring people's safety.

The following are predicted results in order to meet the objectives:

1. Need to identify the facial features in the camera.
2. We need to identify the different aspects on the observed face.
3. Need to identify unique characteristics which will help to identify the observed face.
4. Keep track of all the indicated individual’s attendance.

1.2 OBJECTIVE

For both the teacher and the student in a classroom environment, attendance is extremely crucial. Therefore, keeping a record of attendance is vital. When we consider the previous method for recording attendance in a class, the issue appears. Calling a student's name or roll number for attendance causes problems with both time and energy use. So, the automatic attendance system can address all of the aforementioned issues.

There are a few automated systems for keeping track of attendance that are now being employed by several institutions. RFID technology and biometrics are two examples of such systems. Despite being automatic and a step up from the conventional method, it falls short of the deadline. For giving attendance, the student must stand in queue, which takes time.

With no disruption to regular teaching methods, this initiative introduces an involuntary attendance marking system. The technique can be used during test periods or other instructional events where attendance is crucial.

The major goal of this project is to create a system which can reliably identify people and track their attendance in real time. With the use of a more effective and trustworthy attendance monitoring system, the project intends to do away with the necessity for human attendance taking. By minimising interaction when collecting attendance, the device will also contribute to ensuring people's safety.

1.3 BACKGROUND

Basically, if we want to recognise relatives, friends, family or other people in our day-to-day life so, we use face recognition method which is very essential. We might not realise that numerous procedures have been followed in order to recognise human faces. Our ability to acquire information and analyse it throughout the recognition process is a result of human intellect.

The backdrop of this project is the requirement for precise and effective attendance tracking in companies and educational institutions. Traditional means of recording attendance, including manually filling out attendance sheets or using barcode scanners, are frequently prone to mistakes, inefficiencies, and lengthy procedures. These techniques could result in falsified attendance records, lost attendance data, and erroneous attendance records.

This approach has grown in popularity and facial recognition technology, making it a creative way to get around the drawbacks of conventional attendance monitoring techniques. The technology replaces the requirement for traditional attendance taking and offers a more effective and reliable attendance monitoring system by precisely identifying and recording the attendance of persons in real-time using advanced facial recognition algorithms.

The face of human beings is a special illustration which shows their personal identity. Face recognition is therefore described as a technique that identifies an individual by looking at the original picture which is captured a person's previously recorded photographs in a database.

Face recognition technology is widely used nowadays since it is easy to use and performs fantastically. A form of biometric technology employs algorithms to examine and identify human faces. It is a technology that uses computers that takes photographs and video frames of someone's face, examines them, and compares them to a database of faces in order to identify the individual.

The face recognition system analyses a person's distinctive facial characteristics, such as the spacing between their eyes, nose, and mouth, their face's shape, and the feel of their skin. These characteristics are turned into numerical codes by the algorithm, which then compares those codes to those in a database to determine the person. With the introduction of neural networks and artificial intelligence, technology for recognising faces has evolved substantially in recent years. These developments have made it possible for these systems to be more precise and effective, especially in difficult situations like dim illumination or entire face concealment.

1.4 PROBLEM STATEMENT

Those previous methods of taking attendance have a number of issues. By doing away with traditional attendance marking methods like calling out names and check every individual identity card, but this latest system can easily recognize and track the record of everyone’s attendance easily. Students are distracted by these factors as well as the educational procedure throughout exam periods. Within the office, the attendance list or a sheet is distributed or calling names is a hassle for everyone.

The conventional approaches of collecting attendance are frequently prone to mistakes, inefficiencies, and laborious procedures. Manually collecting attendance can result in mistakes including incorrectly entering attendance, losing attendance records, and fabricating attendance. Additionally, in order to stop the virus from spreading, the current COVID-19 epidemic has raised the demand for contactless attendance systems.

Furthermore, this automatic system for student attendance is capable of overcoming the issue of fraudulent approaches, and lecturers no longer need to count the number of students repeatedly to confirm their attendance. The resultant face traits that serve as a representation

of the students' identities must remain constant while the background, lighting, stance, and expression vary. High precision and quick computation times will be used to gauge performance.

1.5 MOTIVATION

The motive of this thesis is to improve the process and time required for taking attendance during lectures. It is neither productive or effective to utilise ID cards or to manually call out attendees and record their information on sheets. The number of faces in the class will be counted by this system, and it will also recognise them from the store database. It will be simple to determine if a student is truly in the classroom or not thanks to the face detection and recognition technology that has been installed.

The goal of this system was to offer a quick and precise way to track attendance in enterprises and educational institutions. Traditional attendance-taking techniques, such manual recording, take a lot of time, are prone to mistakes, and are simple to abuse. In addition, the COVID-19 epidemic has made it imperative to switch to contactless attendance-taking techniques in order to protect people.

By offering a dependable, effective, and contactless solution, this technology seeks to do away with the drawbacks of conventional attendance taking techniques. By minimising interaction during the taking of attendance procedure, the technology also contributes to ensuring the safety of persons.

The technology creates a more accurate and trustworthy attendance monitoring system by doing away with the necessity for human attendance taking, which lowers the likelihood of mistakes and record-keeping fraud. The technology also makes it simple to obtain and manage attendance data, which lessens the administrative load of tracking attendance.

1.6 SCOPE

We are getting ready to design a two-module system. The first one (face detector), the mobile component, records faces using a camera application and stores all of them in the file. The second one is a programme which identifies the faces in the photographs that have been recorded, save the identity of people, and then save the data in repository for further study.

With the help of this system, we will be able to automatically record student attendance in the classroom, with the required real-time output being received in an excel sheet. However, a highly effective algorithm that is insensitive to the classroom lighting circumstances has to be created in order to create a specialised system that can be used in educational institutions. A camera with the highest resolution must also be included in the system. The creation of an online attendance database and automated modification of the attendance is a crucial area where we can make progress.

The range of applications for this project is fairly broad, and they include enterprises, healthcare, and education. In order to eliminate the need for human attendance taking and to

enable contactless attendance tracking, the project intends to deliver a computerised and reliable attendance system. The technology may be utilised by educational institutions to track attendance in real-time, minimising the possibility of mistakes and record-keeping fraud. To manage client attendance while offering accurate data for billing purposes, the system may also be utilised in healthcare institutions.

Businesses and organisations may use the facial recognition-based attendance system to check staff attendance, keep track of working hours, and determine wages. By minimising the period and effort needed for attendance monitoring, the system may assist firms in increasing their efficiency. It may additionally help to assure the precision of attendance data.

1.7 CONCLUSION

The importance of this system is to decrease mistakes that frequently occur with the conventional attendance taking method. Main objective is to automate and create an algorithm which will be beneficial to the institution or other organisation. The modern and precise way for recording attendance in offices which will easily replace the previous methods. Hence, this approach is workable, trustworthy, and sufficiently safe. The system may be installed in the office without the use of specialised hardware. A camera and computer may be used to create it. The creation of this system is a creative approach that offers an effective and dependable technique for tracking attendance.

The technology removes the requirement for personal attendance taking, lowering the possibility of mistakes and attendance fraud. By minimising interaction when collecting attendance, the technology also contributes to ensuring people's safety. The system was successfully implemented utilising GUI, python libraries and the OpenCV library, and it proved to be dependable and effective for tracking attendance in real-time.

The project's goals of reliably recognising people and tracking their participation in instantaneously, storing attendance information in a database, and offering an accurate and effective attendance tracking system were all accomplished. The system's use of the OpenCV library was effective, and real-time attendance monitoring tests showed it to be dependable and effective.

By including further features like face identification in various lighting situations and facial recognition utilising deep learning algorithms, the system's accuracy and effectiveness may be increased. Nevertheless, the technology offers a solid framework for advancing facial recognition-based attendance systems in the future. Overall, this project shows how these methods may be used to provide creative answers to pressing challenges. This project has the potential to revolutionise attendance tracking in workplaces and educational institutions by offering a more effective and dependable system that can save time, cut down on errors, and ensure people's safety.

CHAPTER-2

LITERATURE REVIEW

The current literature review included is divided into four-part exploration of correlated areas:

2.1 Literature Review of 20 papers
2.2 Integrated Summary
2.3 Existing Recognition System
2.4 Research gap
2.5 Objective

2.1 LITERATURE REVIEW

The important study has been carefully examined, and some essential findings have been obtained. In this study, we primarily focus on the picture identification component and research papers that deal with image identification.

In paper [1], the major problems which were there in previous or manual system that can be overcome by the face recognition based automatic system. In this paper the researchers develop the system which can register the attendance by taking pictures, this technique is called facial recognition. These technologies work well no matter how the person is positioned, lit, or how they are looking. Since, it happened sometimes that their system doesn't always recognise every student's face within the class, there is opportunity for development. Future possibilities include creating a device with more compact ergonomics that is easier to use and will contribute to creating a better academic atmosphere.

In paper [2], One of the popular facial recognition techniques is LBPH. Our technique is effective at identifying students who experience accidental changes like donning glasses or shaving their beard. The tiny dataset in this case is a concern. A better dataset might be created in the future in an effort to really provide a more precise outcome. Throughout the creation of further training data, we are able to enhance the Haar cascade classifiers' ability to recognise unknown people. If an intruder is discovered in the class, the system notification must be there.

In paper [3], In this research, a face identification system is proposed that combines deep neural network and artificial intelligence methods. A reliable DNN basis face identificatory is utilized for face recognition. The DNN-based detection of face is very efficient and reliable than any other techniques. The facial recognition is assessed using a classifier that combines SVM, MLP, and CNN. Face input is captured via a camera while real-time output is being checked. The quality of results may decrease as different factors affect the system such as quality of light on camera or camera clarity.

The proposed mobile attendance-based systems [4], are adaptable and real-time. The development of a filtering method based on Eigenfaces, Fisher-faces, and LBP-derived Euclidean distances. The suggested solution eliminates the need for additional equipment, cuts down on time spent collecting attendance, and gives users access to the information whenever

and wherever they choose. The usage of smart gadgets for tracking student attendance in class is particularly user-friendly. The programme is available in real-time and without any limitations to teachers, students, and parents. The server's processor capacity is likewise growing on a daily basis. The proposed system's accuracy rate will rise along with these technical advancements. Other recognition methods could be used to test face recognition in greater detail. Additionally, once smart devices' processor capacities are sufficiently increased, detection and recognition operations may be carried out on them.

In paper [5], face recognition-based automated attendance systems proved to be secure and time-saving. An unidentified individual can also be identified using this approach. LBPH beats other algorithms in real-world circumstances because of its higher rate of identification and low false positive rate. The goal of future study is to increase the algorithms' capacity to recognise changes happened due to accident or age factor in a person, including: tonsure, surgery, marks, and beard growth. The technology that has been built can only recognise differences in face angles up to 30 degrees; it needs more improvement. To enhance system performance, these systems can be utilised with facial recognition systems.

In paper [6], Different attendance and monitoring tools are used in industry today. Despite the fact that these solutions are mostly automated, mistakes can still occur. A latest deep neural network facial attendance system is suggested here. The full procedure of creating the face identification component using cutting-edge techniques and deep learning innovations is detailed. The ability to achieve even greater accuracy on fewer datasets is now possible thanks to these findings, which is essential for making this solution production-ready. Different attendance and monitoring tools are used in industry today. Despite the fact that these solutions are mostly automated, mistakes can still occur. The ability to achieve even greater accuracy on fewer datasets is now possible thanks to these findings, which is essential for making this solution production-ready. Future studies may entail investigating novel augmentation techniques and using freshly acquired data.

In [7], It has been demonstrated that the automated and intelligent attendance system works well for tracking attendance in the classroom. The likelihood of proxies and bogus attendance will get decreased after using this system. There are several other biometric methods that can also track attendance, but facial recognition performs better than others. Therefore, we must put in place an accurate and effective attendance system that can simultaneously recognise multiple faces. We discovered a solution to the illumination invariant algorithm's illumination intensity and head position problems. Aside from that, no specialised hardware is needed to implement this system.

In paper [8], the typical equation of energy is shown when the value is 0. The volume gradient that changes with the seasons is known as diffusion. Diffusion may be computed from dynamic energy as the charge and magnetism across the mass using the Planck's constant and the quantity of waves (photons). There is a universal relationship between distorted time and space and the diffusion. The field too depicts how all matter interacts. As a result, the field fulfils the conditions for the Higgs field and offers a foundation for a unified energy field equation.

In paper [9], The smart attendance system based on facial identification has been proven to be a successful system in classrooms, labs, workplaces, and for security purposes. The disadvantages of the conventional attendance marking system are eliminated by this

technology, and face recognition outperforms all other biometric systems in terms of performance. By employing this technique, the likelihood of proxy attendance might be decreased. We only need a "Raspberry Pi 3 Model B Model", "Raspberry Pi Camera", servo motor, and database servers to build this system. Different head orientations and significant occlusion are problems that can be solved by employing the LBPH face recognition algorithm.

In paper [10], Despite face recognition having lower accuracy than more sophisticated biometrics like iris and fingerprint, it nevertheless exists. Face recognition is one of the most natural and "easy-to-collect" biometrics, therefore it can be used as a support system for multi-modal biometrics applications. The worst facial recognition method to be used in the Attendance System application is Eigenface. According to ROC curves utilising the present training set, the Eigenface method performed better than the Fisher-face approach.

In paper [11], In this study, some colleges are selected for instantaneous student check-in and inspection of attendance will take place when this system will capture the video and mark the attendance with the help of facial recognition within the video. The focus of this article is on four ways to think about the issues: the facial recognition system's accuracy rate during actual check-in, the stability of the truancy rate of this system with instant video and the face recognition attendance system this video processing makes it challenging to examine the facial identification attendance system. The notion of this technology is put forth after a situational analysis of these issues, and data collection of this technology has been conducted. According to data and the video has an accuracy rate of roughly 82%. With only around 13% of students skipping courses, the facial identification and previously used punching are substantially pretty reliable and accurately recognizes than control group.

In paper [12], New AI methodologies and cutting-edge libraries may potentially be helpful in this regard. Each algorithm for face detection, for instance, can produce effective results when distance is taken into account. Real-time datasets are challenging to work with since they demand a lot of work and have a strict time restriction for error checks. However, it is suggested that in order to advance and fully benefit from this new era of data and digitization, one must take action now, while artificial intelligence is still in its infancy. Making a system that prevents any educational institution or organisation from having a problem with the attendance system is the aim of the effort. Marking a person's existence in a record should be easy for everyone to do and take little time. An AI-based facial recognition system can be expanded to include criminal detection so that humanity can benefit even more. A fresh auto-encoder hybridization method that is useful for facial recognition can also improve it.

In paper [13], An outstanding instance of recording attendance in class is the suggested automated attendance system using face recognition. Additionally, this paper aids in reducing the likelihood of proxy attendance and fraudulent attendance. There are a lot of biometric systems available in the current world. However, due to its high accuracy and minimal need for human intervention, facial identification emerges as viable option. This project's goal is to offer a great level of safety. Therefore, it’s important to create an extremely effective system of class that can simultaneously recognise multiple faces. Additionally, no specialised hardware is needed for its implementation.

In paper [14], An automated Attendance Management System (AMS) utilising an integrated facial identification and classification system approaches is presented to replace the manual

labour involved in documenting attendance. For face detection and recognition, the well-known Viola-Jones method and algorithm for partial face recognition without alignment are combined. The performance of the suggested system outperforms that of the current systems in various ways:

i. The lookup of student log automatically.
ii. Reducing the amount of manual labour and the stress placed on the lecturers to accurately mark the attendance.
iii. Devoting more time to actual instruction while spending less time monitoring attendance.
iv. Improve the system's overall effectiveness.
v. Increasing safety.

In paper [15], This research improves the Alex-Net convolutional neural network after introducing the general design concept of the intelligent classroom attendance system. Additionally, they evaluate the necessity and efficacy of improvement for a variety of outlook before knowing the use of RFID in this paper. At the end, the system purpose and details are carried out. This paper shows the facial recognition-based smart classroom attendance system is reliable and successful at cutting the cost of classroom attendance.

The "Attendance Management System using Biometrics" developed by O. Shoewu et al. [16], utilises a finger print device and a database to maintain attendance information. reliability, productivity, and privacy of this suggested AI-based efficient attendance system utilising the LBPH and OpenCV methodology have shown encouraging results. It recognises faces and the separation between facial features by using a face recognition algorithm. Additionally, this is utilized to identify images in both grayscale and colour under various conditions. In terms of results, the total recommended strategy outperforms any existing attendance method.

The quick and precise way of recording attendance in a room setting which can take over the outdated handwritten method is described in this paper [17]. This approach is workable, trustworthy, and sufficiently safe. No specialised gear is required to install the system in a school environment. A camera and computer may be used to create it. To enhance system performance, it is necessary to utilise a few algorithms that can identify faces hidden behind a veil.

In this paper [18], the TensorFlow platform was used to assess the algorithms for image processing on various parallel processing units. Almost all examined algorithms can benefit from simultaneous execution on a GPU to boost performance. This study employed a TensorFlow application on a CPU, and it found that the execution timings were significantly influenced by the amount of input data. According to the results, GPU speedups for the majority of algorithms can range from 3.6 to 15 times. Due to the way TensorFlow handles computation, every single node has taken over a system for calculation in lieu of processing the entire graph simultaneously on several systems, so computation on the more compact data set has lower speedups.

On a single system, this paper [19], tested four of the best deep learning frameworks: Caffe, Neon, Theano, and Torch, in a range of configurations. Here are our key findings:

i. When it comes to supporting a wide range of deep architectures and libraries, Theano and Torch are among the most adaptable frameworks. One of Theano's most advantageous properties for building unconventional deep structures is symbolic differentiation. The torch community is attempting to close this gap.
ii. Torch, Theano, and Neon all perform better than Neon for CPU-based instructing and installation of any assessed deep network architecture.
iii. Torch and Theano are the two finest options for GPU-based deployment of trained convolutional and fully linked networks.
iv. We found that Torch is faster for bigger networks while Theano is faster for smaller networks when training convolutional completely connected networks using GPUs. For massive convolutional networks, Neon is quite competitive on the GPU.
v. Theano delivers the highest performance for recurrent network deployment and training on GPUs (LSTM).
vi. Improved oversight debugging tools and more comprehensive documentation of Torch's libraries and features would be extremely helpful.

In this paper [20], they investigated the drafting as well as execution challenges of CUDA-based GPU-based image processing algorithms. The GPU effectively parallelizes the chosen algorithms. To configure statistically the properties of simultaneous execution of particular algorithms, a set of metrices was presented. Additionally, these metrics can be applied in a different way to contrast the 2 GPU variations on the same method.

Individual algorithms' rate of change of velocity is assessed with reference to the suggested metrices, and extensive scrutiny is done to demonstrate the suitability of the suggested metrics. Other researchers can use these findings to determine if their method is suitable for parallel implementation.

2.2 INTEGRATED SUMMARY

As we examined these research papers, the common theme that emerged was that CNN was the technology used in the majority of them. Some of them had restrictions, while others had the right strategy. The authors of this article suggested a strategy to integrate facial recognition technology into the attendance system utilising the Eigen face database and Principal Component Analysis (PCA) methodology with MATLAB GUI. These project's design start taking an individual’s image, processes it, applies a directory created by Eigenface, and then compares the captured profile picture to the saved picture which is present in directory. This attendance grading was kept in a form of Microsoft Excel sheet coupled with MATLAB GUI when the similarity distance test resulted in a score greater than the threshold value of 0.3, which ultimately resulted in the face not being recognised. 15 people's faces are represented by 10 photos in the original face database, each with a distinct location and orientation. In this study [3], the authors created and put into use a face verification and RFID dependent classroom attendance management. The system utilizes the RFID card to identify students, and Fast Adaptive Neural Network Classifier (FANNC) facial recognition technology has been included for further identification verification. The classifier was honed and put to the test using photos of human faces. For the classifier to recognise each student's photograph, they

must each take seven images of themselves in different head postures. The facial system's front face accuracy for six different student photos examined was up to 98%.

The researchers concentrated on replacing the conventional manual attendance system with a digital one that utilised facial recognition. This experiment revealed that the system's sensitivity increased as the background changed and the subject's head was oriented differently.

Traditionally, attendance systems were mostly focused on manual techniques, such as printed registers, on which students or workers wrote their given names or created an impression to show their presence. These approaches were prone to mistakes and required lengthy processes. Furthermore, they limited real-time monitoring, making tracking attendance and monitoring attendance patterns difficult.

To address these issues, numerous automated attendance systems, such as scanning bar codes mechanisms, RFID technologies, and biometric systems, have been created in recent years. To record attendance, barcode scanning systems scan the code located on a student or staff ID card. RFID systems detect RFID tags included in ID cards and utilise electromagnetic radiation to determine identity and track attendance. Biometric systems determine and monitor attendance by using physical or behavioural traits that include fingerprints, face recognition, and iris scans.

While automated methods have enhanced the accuracy and effectiveness of tracking attendance, they are not without limits. Manual scanning is required by barcode scanning systems, that can be tedious and error-prone. RFID systems can be costly to install and have a limited range, rendering them inappropriate for large-scale applications. Biometric technologies raise security and privacy concerns, and some people may be dissatisfied with their personally identifiable information being gathered and retained.

Overall, a more productive, precise, and contactless attendance system which removes these restrictions is required. As a result, facial recognition-based attendance systems have been developed, which employ sophisticated technology for facial recognition to precisely determine and save attendance in real-time. These devices provide a precise and effective solution for attendance tracking while eliminating interaction and assuring individual safety.

Table 2.1: Comparison of different system

System Type	Advantages	Disadvantages
RFID	Uncomplicated	Deceitful conduct
Voice recognition	Reduction in net time	Inaccurate in comparison to Others
Fingerprint recognition	Reliable	It takes a lot of time

Iris recognition	Reliable	Intrusion upon seclusion

2.3 EXSISTING RECOGNITION SYSTEM

1. System for fingerprint-based recognition: A portable fingerprint device that is already set up with the student's fingerprint is required for the existing fingerprint-based attendance system. To confirm their attendance for the day, the student must register their fingerprint on the set device later, either during or before the lecture hours. The issue with this strategy is that it could divert students' attention throughout the lesson.

2. A recognition system based on RFID (Radio Frequency Identification: A Radio Frequency Identity Card must be carried by the student in the RFID-based system for saving data related to their presence for the day. The ID be there on the card reader system for fingerprint recognition. This method has the ability to connect to RS232 to save attendance in a database that has already been recorded. There is a chance that a fraudulent access will take place. When a certain student is missing, some students may use the ID of another student to prove their attendance, or they may even do to abuse it rarely.

3. Iris based System for Identification: The student must be present close to of an image sensor for the Iris scanning portion of the Iris based instructional system. The data of the student contained within the directory and then assimilate with scanned iris, and further data on their presence has to be updated. The institute's faculty member has less work to do using paper and pencil as a result. This lessens the possibility of proxies in the class and aids in keeping the student records secure. It is a wireless biometric approach that addresses the issue of fictitious attendance and the difficulty of constructing the necessary network.

4. Face Recognition Software: A high-resolution digital camera that can detect and recognise faces of students can be used to record attendance using facial recognition technology. The system matches the recognised face with student face photos saved within the directory. The attendance is noted within attendance directory for further computation after the student's face is compared with the image that has been saved. If the acquired image doesn't match with an individual’s face that is already saved in directory, a new image is added to the database. However, there is possibility that camera was not placed perfectly or will not be able to take pictures of every person.

2.3.1 Traditional attendance system VS Proposed attendance system

The human methods used in traditional attendance systems, such as calling out names of students or workers and marking them off on an actual paper or computerised attendance sheet, are rather common. This technique can be complicated, prone to mistakes, and easily tricked by anyone trying to fabricate or scam their attendance records.

The suggested facial recognition-based attendance system, on the other hand, could computerise the registration procedure and offer a more precise and secure method of recording attendance. This technology can automatically register people's attendance by detecting and recognising them using cameras and face recognition algorithms.

Additionally, the suggested system can offer real-time attendance tracking, enabling instructors or administrators to rapidly determine who is present and who is missing. It can also create attendance graphs naturally, saving time and lowering the possibility of mistakes.

Overall, a Python-based facial recognition-based attendance system may increase the effectiveness and accuracy of attendance tracking and lower the risk of fraud. However, it's crucial to take privacy issues into account and make sure that the right safeguards are in effect to secure personal data.

Traditional attendance systems usually use manual techniques, such keeping attendance records on paper, or technological techniques, like barcode or RFID scanners. These procedures can take a lot of time to handle and are prone to mistakes.

Whereas, the suggested system that uses Python can automate and improve the attendance process. The two systems are contrasted in the following:

Table 2.2: Comparison

TYPICAL ATTENDANCE APPROACH	PROPOSED ATTENDANCE APPROACH
physical labour is necessary to register attendance	automates the taking of attendance
vulnerable to mistakes like inaccurate data input or attendance fraud	can correctly recognise people by their faces
Possibly unable to supply real-time attendance data	able to offer real-time attendance data
can take a lot of time to handle	Possibly more effective than conventional techniques

maybe need more hardware to function	does not need anything more than a camera or webcam.
	Integration with other systems, such as salary or management of students. systems, is possible.

Both systems have the ability to export attendance data in a tabular format. However, the suggested facial recognition system utilising Python can include more information like the duration and date of arrival and a picture of the person. This can lower the possibility of fraud and make it simpler to validate attendance statistics.

Overall, compared to conventional techniques, a suggested face-based attendance system can offer a means of controlling attendance that is more effective, precise, and secure.

2.4 RESEARCH GAP

Since it was created for a specific system, we use this library. When compared to MATLAB, OpenCV does not offer the same level of usability. A flann library is built into OpenCV. When you attempt to utilise the PCL library with the OpenCV library, this leads to conflict concerns.

Table 2.3: Review

S. No.	Existing work	Features	Benefits	Limitations
1	Automated Attendance system using face recognition	Recognise faces using Eigen faces	High precision.	Multiple faces could not be distinguished.
2	Face recognition-based system by Nevon	stores the recognised faces and records attendance automatically.	Used in organisations for security reasons.	recognises incorrectly in dim lighting.

3	Smart attendance system	Face Recognition for Student Registration topic addition with the matching time. A produced attendance sheet is imported into Excel (xlsx) format.	This has the data organised in a way that makes it simple to access.	High-definition camera is necessary.
4	A toolkit for programmed system for attendance	Stages include face identification, preliminary processing, characteristic collection, and categorization	High precision.	Camera needs to be fastened in a certain location.
5	Smart application using face recognition for AMS	makes use of Android mobile and CCTV.	An algorithm for 3D facial recognition is utilised.	A pricey Android phone can only recognise one face at once.
6	Attendance system in class with the help of video recording	Discrete Cosine Transform and Wavelet Transform are used.	It was feasible to detect many faces.	There are just 82% successes.
7	Attendance system using eigen face and PCA algo	This algorithm uses the Illumination invariant one.	The issues with head posture and light intensity were resolved.	Faces hidden by masks were not recognised.

8	Algorithm for attendance management: face recognition	Skin categorization and the median filter are utilised.	No specialised hardware is required, and many faces may be identified simultaneously.	Low precision Only 50% of faces could be identified.

2.5 AN OVERVIEW

2.5.1 IMAGE PROCESSING

The processing of digital images with the help of computer system is said to be digital image processing. Techniques for digital image processing are driven primarily by three key applications:

i. Increasing the effectiveness of visualisation for people to perceive.
ii. Image processing for applications involving autonomous machines.
iii. Effective transmission and storage.

2.5.2 DIGITAL IMAGE REPRESENTATION

A 2-D light intensity function,

$$f(x,y) = r(x,y) \times i(x,y) - (2.0),$$

Equation 2.1: Describes a picture

where r (x, y) is surface reflectivity of the associated picture point. i (x, y) shows the brightness of the light that was incident. Grids and quantization are used to discretize the brightness and spatial coordinates of a digital picture f (x, y).

The picture may be conceptualised as matrices with row and column that indicate points within picture and particular values that identify the grey level value at those points. Pixels or pels are the names for these components.

The picture size that is typically utilised for image processing applications is 256 × 256 pixels, 640 × 480 pixels, or 1024 ×1024 pixels. Due to the three colour planes' individual 8-bit colour depths, these matrices values are quantized at 8 bits for monochrome images and 24 bits for colour ones.

2.5.3 STEPS OF IMAGE PROCESSING

The following fundamental tasks are involved in digital picture processing:

i. The acquisition of images refers to the process of digitising the signal generated by an image sensor.
ii. Pre-processing improves the quality of the images by filtering, enhancing contrast, etc.
iii. Segmentation divides an input picture into the individual components of objects.
iv. The description of picture objects that are appropriate for additional computer processing is extracted using the description/feature selection tool.
v. Recognising and interpreting an item involves giving it a label which depends on details supplied by the descriptor.
vi. Knowledge Base: This promotes module collaboration and efficient processing.

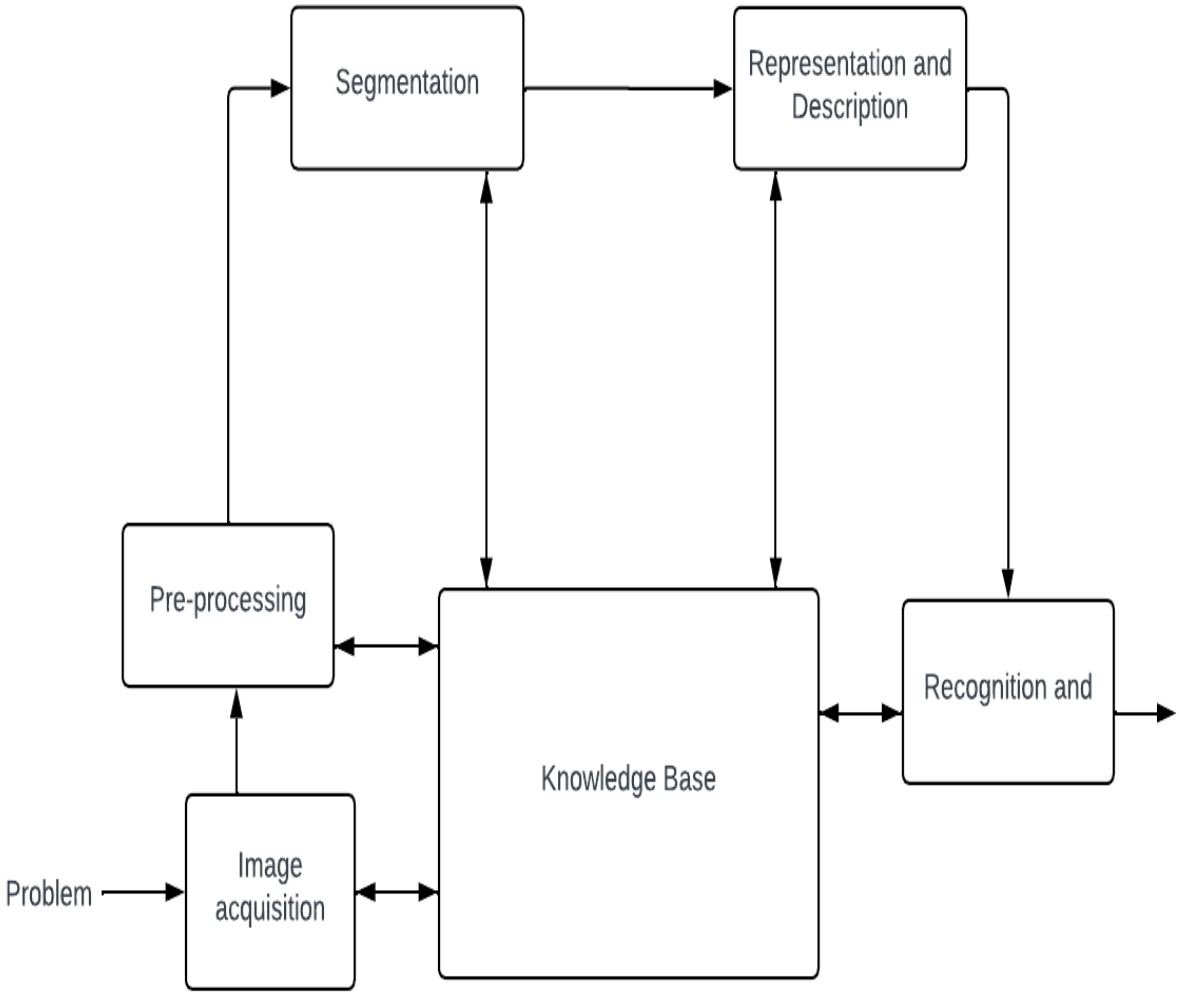


Figure 2.1: Processing

2.5.4 DEFINITIONS

2.5.4.1 Face Detection

Face detection involves finding and recognising every face that is visible within an image or video, independent of its position, dimension, height, or expression. Face finding is a type of machine vision that detects and locates human faces in pictures or video frames. It is an important stage in a variety of applications, such as identification of faces, surveillance systems, and picture and video analysis.

Face detection algorithms locate areas with distinguishing face characteristics, such as the mouth, nose, and eyes, by analysing the colour values of a photograph or video frame. These methods discover and recognise patterns in images that suggest the presence of a face using mathematical frameworks and machine learning approaches.

2.5.4.2 Face Identification

Identification of faces is a technique that employs machine learning algorithms to determine and verify the identification of a person depending upon their facial traits. It's a biometric authentication technology that's gaining traction in privacy and surveillance applications.

Face recognition systems function by analysing a person's geometric patterns on their facial features, including the space across their eyes, nose, and mouth, then contrasting them to a database of recognised faces. A face template is a model of mathematics that expresses the facial characteristics as a series of numerical values.

Face recognition thus means just the process of classifying a face that has previously been identified as either a known or unknown face, or in more complex situations, identifying the precise person whose face it is.

Difference

"Where in the world is the face?" is a query that is answered by face detection. It locates an item in the user's image and recognises it as a "face". On the other hand, face recognition provides a response to the query, "Who is this?" Whose face is that, or? It determines if the detected face is that of a person. Therefore, it is clear that the output of face detection—the identified one—will our input for system, and output of the system will be last judgment—whether the face is identified or not.

2.5.4.3 Face Detection

Face finding is a computer technique that recognises and discovers human beings in photographs or movies. It is the initial stage in developing a system for face identification since faces must be detected and localised preceding the system can analyse and recognise them.

These algorithms locate areas with distinguishing face characteristics, especially the eyes, nose, and mouth, by analysing the colours in the pixels of a photograph or video frame. These methods discover and recognise patterns in visual information that suggest the presence of a face using mathematical representations and machine learning approaches.

Face detection may be divided into two approaches: feature-based and appearance-based. To detect faces, feature-based algorithms employ pre-defined characteristics such as corners, edges, and textures. The majority of face identification algorithms solely rely on visual clues to identify faces. A sub window scans the input picture at all potential sizes and places.

Using statistical learning techniques, the face/nonface classifier is trained on instances of faces and absences of faces. The Viola Jones detection of objects framework, which is built on Haar Cascades, provides the foundation for the majority of contemporary methods. These approaches are quick and efficient, but they may not function well under varied lighting circumstances or with different facial positions.

Facial detection technology has a wide range of applications, including security, surveillance, and facial recognition systems. It's also employed in recreational and social media apps like tags for photographs and online testing apps.

Table 2.4: Comparison between face detection algorithms

Face detection methods	Advantages	Disadvantages
Viola Jones algorithm	1. Rapid detecting. 2. High Precision.	1. Prolonged training. 2. Restrained Head Pose. 3. Unable to recognise dark faces.
SMQT and SNOW Classifier	1. Able to handle illumination issues while detecting objects. 2. Reliable in mathematical computing.	The zone that contains a lot of regions with similar grey value will be mistaken for a face.
Local Binary Pattern Histogram	1. Simple math operations. 2. Superior capacity for fluctuations in monotonous lighting.	1. Used just for binary and grayscale pictures. 2. When compared to the Viola-Jones algorithm, overall performance is erroneous.

Neural-Network	Excellent precision was only possible with training on large-scale images.	1. The detection technique is cumbersome and computation intensive. 2. The performance is often worse than the Viola-Jones method.
Ada Boost algorithm	No prior understanding of facial structure is required.	The outcome is significantly influenced by the training data and poor classifiers.

The widely utilized technique to locate the face segment from a static picture or video frame is the Viola-Jones algorithm, which was developed by P. Viola and M. J. Jones in 2001. It is a feature-based technique that detects faces in photos or videos by combining Haar-like characteristics and the AdaBoost machine learning algorithm.

The AdaBoost method is used to choose the most useful features and integrate them into a powerful classifier capable of distinguishing between face and non-facial areas. The approach iteratively trains a series of weak classification models, each of which is a single-feature decision rule. Using an unbiased majority voting system, the weak classifiers are integrated into a strong classifier, with the weights changed at every phase to focus on incorrectly categorised cases.

The Viola-Jones technique is prominent in real-time face identification applications due to its excellent detection accuracy and speed. It does, however, have several limitations, including difficulties recognising faces in non-frontal positions or obscured faces.

The method scans a photograph or multimedia frame using a window that rotates of various widths and aspect ratios, looking for regions that match specific criteria. These characteristics are characterised as rectangular picture portions with varying brightness levels. The technique computes the total number of the values for pixels in each rectangle and compares them to a threshold value using a series of pre-defined Haar-like features. If the total surpasses the specified limit, the software considers that region to be a potential face candidate and proceeds to the next window.

A well-liked approach for real-time object recognition in computer vision is the Viola-Jones algorithm, which depends on the Haar based on features cascade classifiers. A picture was categorised into tiny parts subregions, and system analyses every subregion to see if it includes a face. In order to effectively assess each sub-region, it employs a cascade of classifiers. Every neural network is trained to discriminate between areas with features and locations without faces using a collection of scenarios that are both positive and negative.

The very effective Viola-Jones algorithm is capable of real-time face detection. Numerous applications, such as safety equipment, surveillance, and picture editing software, have made use of it. The Viola-Jones method has numerous drawbacks even though it is quite good at detecting faces.

It might not function well in certain lighting situations, and it might not be able to recognise features that are obstructed by objects or disguised by them. In general, the Viola-Jones technique, which is often employed in computer vision applications, is a potent face detection tool.

2.5.4.4 Local Binary Pattern Histogram

LBPH is an abbreviation for Local Binary Patterns Histograms. It is a common facial identification algorithm that extracts information from images and uses them to produce a distinctive depiction of an individual's face. After calculating the LBP codes, a histogram is generated to depict the probability of presence of every linear pattern. The resultant histogram is then utilised for representing the face as a feature vector.

During recognition, the LBPH method uses a measure of distance that includes Euclidean distance or cosine similarity to compare the feature vector of the input picture to the corresponding feature vectors of each picture in the database. The identification of the individual in the input photograph is then determined by the closest match.

A feature extraction approach called LBPH (Local Binary Patterns Histograms) has been used for identifying faces and other computer vision applications. Timo Ahonen, Abdenour Hadid, and Matti Pietikäinen created it in 2004.

The method compares a collection of predefined patterns to an image's local binary patterns (LBP), which is how it operates. A texture descriptor called LBP compares each pixel's intensity to the magnitude of its neighbours to indicate the spatial framework of a picture. LBP creates an integer sequence for each pixel by encoding the intensity connections among every pixel in a local neighbourhood. The textured surface of the image is then described using these binary patterns.

The LBPH method creates a visual representation of the patterns by extracting the LBP characteristics from every sub-region of the picture. The image is represented by this histogram, which serves as a feature vector. The topic of the image is then determined by comparing the feature vector to a database of recognised feature vectors.

Given its resilience to changes in illumination, face expression, and stance, LBPH is particularly well suited for facial recognition. It is a well-liked option for facial recognition applications since it has been demonstrated to be successful under controlled and uncontrolled conditions.

Free and open-source computer vision libraries like OpenCV frequently employ LBPH. Numerous applications, such as safety devices, surveillance, and authentication using fingerprints have made use of it.

Original

5	**2**	**3**	4	1
1	**5**	**4**	2	3
2	2	1	3	4
3	5	6	4	5
4	1	3	2	6

Integral

5	7	10	14	15
6	13	**20**	26	30
8	17	25	34	42
11	25	39	52	65
15	30	47	62	81

5 + 2 + 3 + 1 + 5 + 4 = 20

Original

5	2	3	4	1
1	**5**	**4**	**2**	3
2	**2**	**1**	**3**	4
3	5	6	4	5
4	1	3	2	6

Integral

5	7	10	14	15
6	**13**	**20**	**26**	30
8	**17**	**25**	**34**	42
11	25	39	52	65
15	30	47	62	81

5 + 4 + 2 + 2 + 1 + 3 = 17

34 – 14 – 8 + 5 = 17

Figure 2.2: Image Integral

LBPH algorithm steps

It has 5 steps that are as follows:

1. *Picture processing:* The input picture is processed in this stage to eliminate vibration, improve the contrary, and normalise lighting conditions. The following is done to increase the image quality and precision of the visage identification procedure.

2. *Feature extraction:* The source picture is split into tiny sections or cells, and a binary pattern is created for every single pixel in each cell through contrasting its intensity value to the hues of its neighbouring pixels. Each cell's discrete sequences are concatenated to generate a feature vector.

3. *Histogram generation:* For each cell, a histogram is constructed by considering the number of instances of appearance of each linear pattern. Concatenation of these histograms results in an ultimate vector of characteristics for the original image.

4. *Executing the Facial identification:* Using a metric for distance such as a Euclidean distance or cosine similarity, the feature vector of the input picture is compared to the feature vectors of the photos in the database. The identification of the individual in the supplied photograph is determined by the closest match. Face recognition is carried out in this stage because the algorithm has already been trained. Each histogram produced serves as a representation of one of the training dataset's images. In order to build a histogram that accurately depicts a picture, we repeat the process for a fresh image after receiving an input image. Based on the following formula, we may apply the well-known Euclidean distance in this example:

$$D = \sqrt{\sum_{i=n}^{n} (hist1 - hist2)^2}$$

Equation 2.0.2: Distance formula

5. *Post-processing:* The identification of the recognised face is confirmed and authenticated in this stage by comparing it to other parameters including beard, hat, expressions, gender, and different qualities. This improves the reliability of the facial recognition system and helps to avoid erroneous positives.

2.6OBJECTIVE

To precisely identify the student faces. to automatically record attendance. to give a helpful attention system for both instructor and students by reducing the time and effort needed for manual attendance. It offers flexibility and cuts down on lost time. There won't be an opportunity for a proxy. Main objective of this system is to create an attendance management which is automated. The followings are the final results which meet the criteria of the system:

1. Need to identify the facial features in the camera.
2. We need to identify the different aspects on the observed face.
3. Need to identify unique characteristics which will help to identify the observed face.
4. Keep track of all the indicated individual’s attendance.

CHAPTER-3

DESIGN, ANALYSIS AND MODELLING

3.1 INTRODUCTION

Face identification entails dividing photograph into 2 segments, 1 of which contains facial and turns the other into clutter in the backdrop. It is challenging because, despite the similarities across faces, they might differ greatly like height, weight, complexion and ageing. Different lighting situations, image pixels, and geometries, as well as the threat of slight obstruction and concealment, which made issue much more challenging. Therefore, idle facial identificatory will be able to identify every facial against different background, in any lighting situation. The 2 steps of face detection method are:

In beginning one, an identifier job is used to determine if there are any faces in an input image. This task accepts any photograph as an i/o and result in a binary number 1 or 0. The face localization challenge, which comes in second, tries to take an image as i/p and provide o/p the scale of facial features within that photo as any box's boundaries with axis (x, y) and breadth and height. This algorithm will evaluate the texture of the photos in the repository once the image is taken and present the most relevant outcome.

We'll make use of Tkinter, a webcam, Visual Studio, the open CV platform, and Python to code.

3.2 PROPOSED MODEL

We suggested an attendance tracking system based on identifying faces in the lecture hall in order to gather the attendance, locations, and face pictures. The technique uses constant observation and recording to estimate each student's attendance and placement. A camera is now being used to acquire real-time facial recognition at the entrance to the classroom. Due to the difficulty of manual and other traditional methods of attendance systems, we want to develop an attendance tracking system using facial recognition in this project. constructing an approach that can be included with current IoT configurations. making the solution very scalable and resilient.

The video footage will be obtained via a physically linked camera system, from which face recognition frames will be taken. After pre-processing the obtained photos, an image detection algorithm will be used to determine the facial characteristics. The identify of the captured person will subsequently be ascertained using the identification algorithm. For face recognition in this project, OpenCV's Local Binary Patterns Histograms (LBPH) are used.

Typically, this approach combines methods for processing images, neural networks, and data management. The primary premise of the suggested model is to extract pertinent characteristics from facial photos using an already trained machine learning algorithm, which includes a

neural network made up of convolutions (CNN), and then to utilise these features to identify specific faces and record attendance in accordance with them.

The phases in this suggested model that are commonly included are picture capture, identification of faces, facial recognition, and tracking attendance. Image acquisition is the process of taking pictures of people with a camera or another image-capturing tool. Face detection includes identifying and locating faces within the collected pictures utilising a Haar cascade or comparable algorithm.

The suggested model is attempts to simplify the enrolment process in an educational or business context. To identify and verify individuals' identities in real-time, the system employs cutting-edge face detection and identification methods including Viola-Jones and Local Binary Patterns Histograms (LBPH). The system is intended to be used with a camera or another visual input device, and it may be combined with pre-existing records or information about learners' systems. The suggested model has various advantages, including precision, rapidity, and productivity, and it is able to be customised to meet the organization's unique demands.

Attendance data is securely saved in a database and can be retrieved and analysed in real time to create attendance records and analytics. The suggested strategy has the ability to transform the attendance process while also increasing the general efficacy and effectiveness of educational and business organisations.

The system's goal is to use computer vision technology to facilitate the attendance-taking procedure at educational institutions or enterprises. The Viola-Jones method will be used for face detection, while the LBPH algorithm will be used for face recognition. The supplied photo will be prepared to eliminate noise and improve image quality. To extract features, the input image will be divided into tiny cells and histograms will be generated for each cell.

Face identification entails extracting characteristics from the detected faces and comparing them to a database of recognised faces applying an already trained machine learning technique, which might be an LBPH or Viola-Jones algorithm. In order to manage attendance, attendance data must be stored in a central repository or another information management system, and reports and analytics must be generated using this data.

This model could also come with other features including support for numerous cameras and image capture devices, real-time attendance tracking, interaction with other systems and programmes, and support for other applications and systems. In general, the suggested model seeks to offer a trustworthy and effective alternative for attendance administration throughout a range of contexts, including schools, universities, businesses, and other organisations.

Facial identification and registration will be performed using the final feature vector. The software will additionally incorporate a user interface that will allow the administrator to monitor attendance data and create reports. This suggested methodology has the ability to substantially decrease the quantity of time and effort necessary for manual attendance taking while also improving attendance record accuracy.

3.3 DESIGN REQUIREMENTS

To create the system, we employed a few tools. It would not be able to complete the task without the aid of these instruments. We'll talk about the most significant one here.

1. Feature recognition: Using machine learning methods like Haar cascades, HOG, or neural networks with deep learning, the algorithm should be able to identify faces in still photos or moving pictures.

2. Image identification: Using machine learning methods like neural networks that are deep or Eigenfaces, the Artificial intelligence and ML algorithm ought to be capable of identify people based on their facial traits.

3. Repository administration: The system ought to contain a database that stores the photos and physical characteristics of people who need to be identified in order to verify their attendance.

4. Managing of attendance: The system must be able to track who has been identified as present or absent in order to control attendance. It needs to be able to offer up-to-date attendance data.

5. The customer interface: Both administrators and users should be able to register their attendance using the system's user-friendly interface.

6. Protection: To safeguard the confidentiality of users' face characteristics and attendance information, the system should be constructed with security in mind.

7. Efficiency: The infrastructure should be built to operate effectively even with big datasets and lots of users.

8. For versatility and user-friendliness, the system should be accessible with a range of camera kinds, formats, operating systems, and coding languages.

9. Adaptability: The system must be able to accommodate an increase in the number of users and attendance records.
10. Collaboration: To offer more functionality and convenience, the software should be able to link with other systems like payroll, HR, or educational systems.

Overall, the facial recognition-based attendance system should be created with precision, efficacy, safety, and accessibility in mind, and it should be flexible enough to be used in a range of situations.

3.4 DETAILED REQUIREMENT

3.4.1 Hardware specifications:

1. Camera with 720p resolution or higher
2. Laptop with 8 GB of RAM or more

3.4.2 Software requirements:

3.4.2.1 Microsoft Office

Microsoft Office is a collection of productivity software created by the company. It comes with a number of programmes, including the following: Word, Excel, PowerPoint, Access, Publisher, and Outlook, to name a few. Create, edit, and distribute spreadsheets, presentations, documents, and other sorts of information with the aid of Microsoft Office.

Several of the primary services within the Microsoft Office accessible are:

1. Word is a word processing programme used to write and edit documents including resumes, reports, and letters.

2. Excel is a spreadsheet programme for data organisation, analysis, and visualisation. Data modelling, financial analysis, and budgeting are a few examples of the activities it may be utilised for.

3. PowerPoint: A programme for making presentations, slideshows, and interactive multimedia material.

4. Database management software called Access is used to create and maintain databases for both personal and professional purposes.

5. Publisher is a desktop publishing programme used to design and distribute a variety of electronic and print materials, including newsletters, flyers, and brochures.

6. Outlook: a messaging programme and private information management programme used for communicating via emails, organising rendezvous, and keeping track of contacts and tasks.

Microsoft Office is a robust collection of tools that may be used in a variety of contexts, including company, school, and personal usage. It offers users a variety of features and tools to make creating and managing material easier and more productive.

3.4.2.2 Tkinter

Tkinter is a Python package used to create graphical user interfaces (GUIs). It includes a suite of technologies and features that allow designers to create interactive and aesthetically appealing desktop apps. Tkinter depends on the Tk GUI toolkit, which is a multi-platform toolkit extensively used for constructing graphical user interface (GUI) software.

Tkinter allows developers to generate open spaces, structures, switches, classifications, lines of text, radio controls, verify packages, and other GUI components required for desktop application development. Tkinter provides a number of options for customising the appearance and behaviour of these GUI aspects, permitting developers to construct interfaces that are specific to their applications' needs.

Tkinter is a good alternative for novices who wish to construct desktop apps using Python since it is simple to learn and use. It is also extensively reported and has a big developer community that contributes to its continued growth and provides user assistance.

Tkinter may be deployed and exported with any Python configuration because it is a component of the standard library for Python. It is frequently used to develop cross-platform software that runs on several operating systems, such as Linux, macOS, and Windows. The application is simple to put together with a GUI using Tkinter. For making the application we have to do the following things as listed below:

- Tkinter functionality import.
- Make the GUI interface's window.
- Add gadgets from above mention list or more to the GUI programme.
- To respond to each event that the user has triggered, enter the primary triggering loop.

Tkinter's key characteristics include:

1. Tkinter offers a collection of widgets, including controls, packaging, text boxes, and menus, that may be used to create graphical user interfaces (GUIs).

2. Inter-platform: Tkinter may be used to build apps that run on several operating systems.

3. Event-driven computing: Tkinter employs an event-driven programming paradigm in which operations are initiated in response to events like button pushes or keystrokes.

4. Layout management: To assist organise the positioning of widgets in a GUI, Tkinter offers a number of layout managers.

5. Customization: Tkinter lets you change widgets' colours, typefaces, and other attributes as well as how they look and behave.

6. Simple integration: Tkinter is a valuable tool for creating applications since it is simple to use with other Python resources and modules.

Overall, Tkinter is a flexible and strong framework for Python developers who want to build desktop programmes with graphical user interfaces. It is a fantastic option for developers that wish to rapidly and effectively create cross-platform apps.

3.4.2.3 Visual Studio Code

Microsoft's Visual Studio Code (VS Code) is an absolutely free and freely available code editor. It comes with an IDE, or integrated development system, that supports a variety of languages for programming, including Python.

VS Code has a number of coding-enhancing features including code emphasising auto-completion, debugging instruments, and repository integration. It also comes with a set of extensions that may be added to offer further capabilities and support for many different languages or frameworks.

One of the advantages of VS Code is its compact and versatile building design, which allows for easy customization and extension. It's also cross-platform, which means it works on Mac OS X, Windows, and Linux. VS Code provides a built-in terminal as well as integration with distant expansion, which allows programmers to collaborate on endeavours maintained on external servers or containers.

In the end, VS Code is a strong and flexible programming editor which is famous across engineers because of its simplicity of use, versatility, and feature set.

Microsoft created the free and open-source. Developers frequently use it to write and debug code in a number of languages for programming, such C++, Python, JavaScript, among others and many more.

The following are some of Visual Studio Code's important features:

1. Cross-platform: Since VS Code can work on Windows, Mac OS X and Linux, it is a popular option for developers who use many OSes.

2. Developers may create code more quickly and easily thanks to Intellisense, which is a feature of Visual Studio Code.

3. Debugging: Python debugging tools are available in VS Code and may be utilised alongside a number of coding languages.

4. Support for extensions: VS Code offers a huge extension library that can be used to tailor the editor's capabilities for various programming languages and processes.

5. The Git repository integration: Git integration for Visual Studio Code (VS Code) makes it simpler to handle modifications to the source code and work with other developers.

6. Embedded Interface: VS Code has an integrated terminal that enables developers to execute scripts and commands from within the editor.

7. Customization: VS Code's colour plans, key bindings, and settings may all be changed to accommodate specific developer tastes.

In its entirety, it is a well-liked and potent software editor with a number of tools and features that make it a great option for professionals working in a variety of contexts and programming languages. It is a favourite among developers due to its adaptability, support for extensions, and customization possibilities.

3.4.2.4 OpenCV

We utilised Python's OpenCV requirement. A large number of image processing tools are offered in the OpenCV package. This package for image processing is really helpful. Even one can achieve the desired result without writing a single line of code. Famous free-source artificial intelligence and deep learning library OpenCV (Open-Source Computer Vision) is made for immediate time computer vision applications. It contains Python and other computer language bindings and is developed in C++. Object identification, video and photograph interpreting, detection of faces, and machine learning are just a few of the many uses for OpenCV.

Under the open-source BSD licence, the library is available for use on all platforms and is free. Below are some examples of supported functions:

- Hough transforms: lines, segments, circles, and geometrical shape identification. Derivation: Gradient/Laplacian computing, contours delimitation.
- Watershed categorization: thresholding, proximity evolve, foreground/background identification.
- Histograms: computation, equalisation, & object location with back projection technique.
- Filtering: morphological operations, waterfall sensors and licence plate recognition.
- Interest areas include matching and detection, panoramic photography, optical flow, background removal, and camshaft (object tracking) in video processing.
- Image inpainting, high-definition imaging (HDR), and panoramic realisation in photography.

OpenCV's primary features include the following:

1. Image processing: A variety of image processing operations are available with OpenCV, including distortion, settling, screening, and background subtraction.

2. OpenCV has robust object detection techniques, including Haar cascades, that are frequently used for face recognition in pictures and movies.

3. Machine learning: Decision trees, support vector machines, and neural networks are just a few of the machine learning methods that are supported by OpenCV.

4. Camera calibration: OpenCV comes with instruments for camera calibration that may be used to increase accuracy in programmes like augmented reality and 3D reconstruction.

5. Rendering of graphics: OpenCV comes with built-in assistance for displaying graphics in 3D, including the capacity to build 3D models and carry out 3D transformations.

6. Support for several operating systems: OpenCV runs on a variety of operating systems, namely Linux, macOS, Windows, and iOS, and Android.

7. Compatibility with other libraries: TensorFlow and PyTorch are only two examples of the widely used libraries and frameworks with which OpenCV is quickly and simply integrated.

For developers & academics working within the area of artificial intelligence and ML algorithm, it's a popular choice due to its comprehensive feature set, cross-platform compatibility, and interoperability with other libraries.

3.4.2.5 IDE for Python

There are several IDEs for Python. They include PyCharm, Thonny, Ninja, Spyder, and others. Both Ninja and Spyder are wonderful and cashless, however we chose Spyder since they have more features than Ninja. Spyder weighs somewhat more than Ninja but is far easier than PyCharm. We will execute these and use ssh-Y to obtain a GUI on your PC. Spyder was set up via the command line.

Python has a number of well-liked IDEs (Integrated Development Environments), each with a unique set of capabilities and advantages. Several of the most popular Python IDEs are listed below:

1. PyCharm: Made by JetBrains Inc PyCharm is well-liked IDE for Python that offers a variety of capabilities, such as adaptive code finishing, troubleshooting, evaluation, and code analysis. Additionally, it has built-in support for well-known web frameworks like Flask and Django.

2. Microsoft created the lightweight and potent IDE known as Visual Studio Code, which has a wealth of capabilities for Python development. It has extensions for connecting with well-known Python libraries and frameworks, which enable troubleshooting, linting, and completion of codes, among other features.

3. Spyder: It is a Python IDE for science that has tools for testing, debugging, and data analysis. It has a variable explorer for data exploration and manipulation, an interactive console, and code completion.

4. Jupyter Notebook is a freely available web tool that enables you to generate and share documents with live code, equations, visuals, and text. Projects involving machine learning and data science frequently use it.

5. IDLE: IDLE, the standard IDE provided with Python, is a straightforward and portable choice for new users or those who like a simple editor.

The most well-known Python IDEs are only a handful of them. Depending on your unique requirements and tastes, you may choose the ideal IDE.

3.5 SYSTEM DESIGN

3.5.1 Input Design

The input design typically involves the following steps:

1. Collect photos: The platform should be built to collect images of people checking in for attendance. This may be accomplished with the use of the lens, including a live webcam or cell phone camera.

2. Facial capturing: The collected photos should be processed in order to identify and identify the persons' faces. A face detection method, like the Viola-Jones or Haar Cascade, can be used to do this.

3. Facial Identification: Face recognition should be performed on the discovered faces using an appropriate technique, which might include LBPH or Eigenfaces. To increase the reliability of the method of identification, the technique ought to be developed with a dataset of recognised faces.

4. Database administration: The framework should be built to maintain an inventory of registered persons, comprising their last name and other pertinent information. As persons are recognised and verified in for attendance, the record of information must be updated in real time.

5. Attendance logging: The software should be constructed to record people' attendance in an appropriate structure, including a CSV file or SQL. The presence record ought to record the individual's name, the precise moment and date of registration, and any other pertinent information.

6. User dashboard: The system should include a user dashboard which enables members to interact with it, register new users, and examine the attendance log. Depending on the project needs, the user interface might be an online programme or a separate desktop programme.

In the end, the input design should concentrate on collecting and analysing photographs of persons, identifying and recognising their faces, keeping a database of enrolled individuals, registering enrolment, as well as offering an intuitive interface for customers to engage with the system.

3.5.2 Output Design

The output design is depended on the specific requirement and features of the system that are as follows:

1. Attendance summary: The system should provide a report that displays each student's or employee's attendance. The file may include the person's name, date, and time of attendance. The report might be presented in a chart or any other style that is simple to read and comprehend.

2. Actual attendance dashboard: The system should feature a real-time interface that indicates students' or employees' attendance as they check in. This display could include an LCD panel or an electronic device that shows the person's image and attendance status.

3. Alerts: The system should provide alerts to students or workers informing them of their presence status. This notice can be sent through text message, email, or any other media that the user chooses.

4. Error messages: When there is a problem with data entry or processing, the system should create error messages. These warnings ought to be clear and simple to comprehend, and they should include ideas for how to resolve the problem.

5. User administration: The system should provide a user administration dashboard which enables managers to add, update, and delete users. The user interface should be simple to use and equipped with enough security safeguards to prevent unauthorised access.

6. Database administration: The system should provide a database administration dashboard that enables executives to view, add, update, or remove information stored in the database. The user interface should be simple to use and equipped with enough security safeguards to prevent unauthorised access.

Overall, the attendance system output design ought to be intuitive, efficient, and successful in serving the demands of the users. It should track attendance accurately and reliably, and it should have adequate safety precautions to avoid fraudulently or misuse.

3.6FLOW CHART

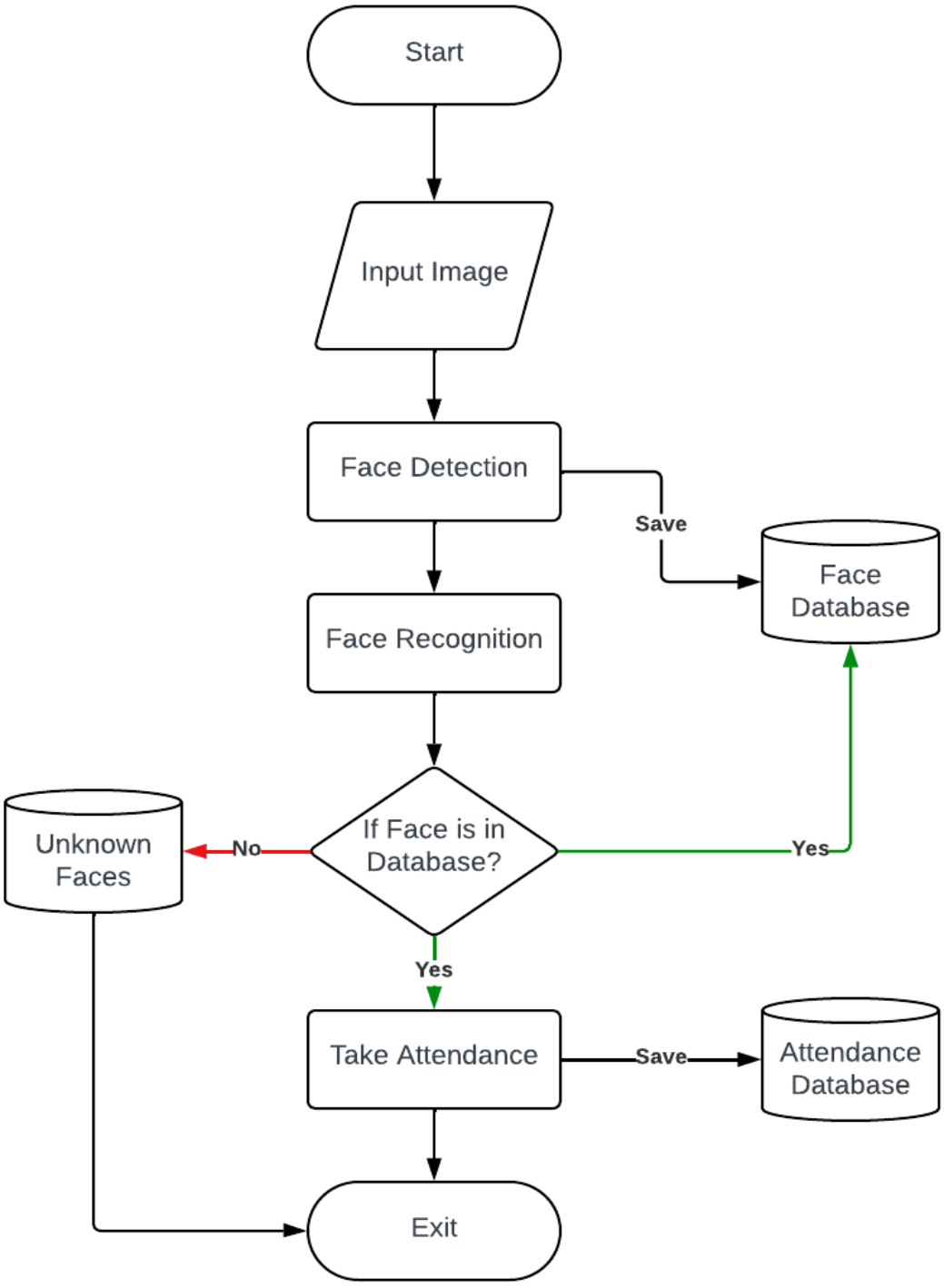


Figure 3.1: Project outline

3.7 SYSTEM ARCHITECTURE

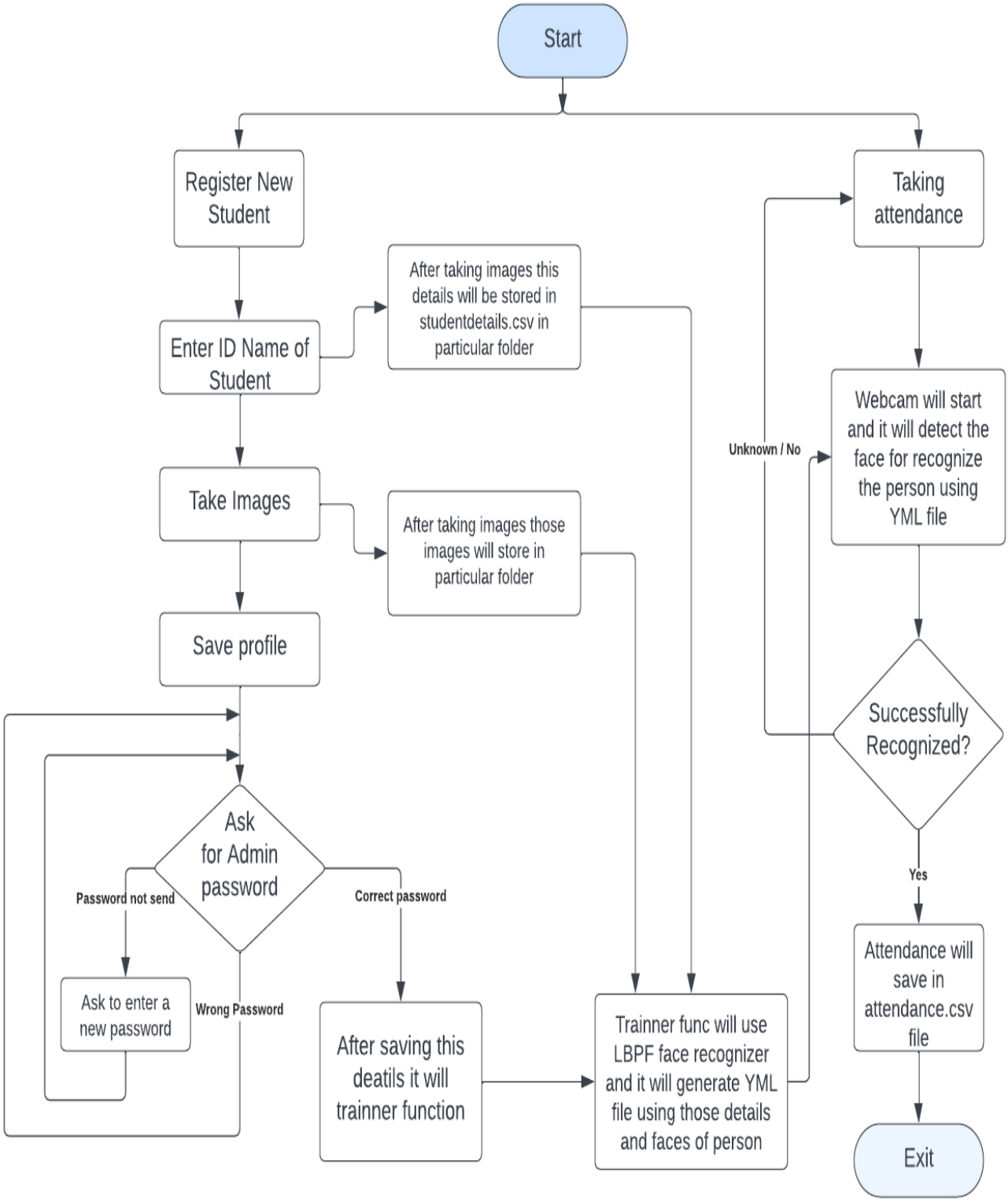


Figure 3.2: System Flow

3.8 BLOCK DIAGRAM OF GENERAL FRAMEWORK

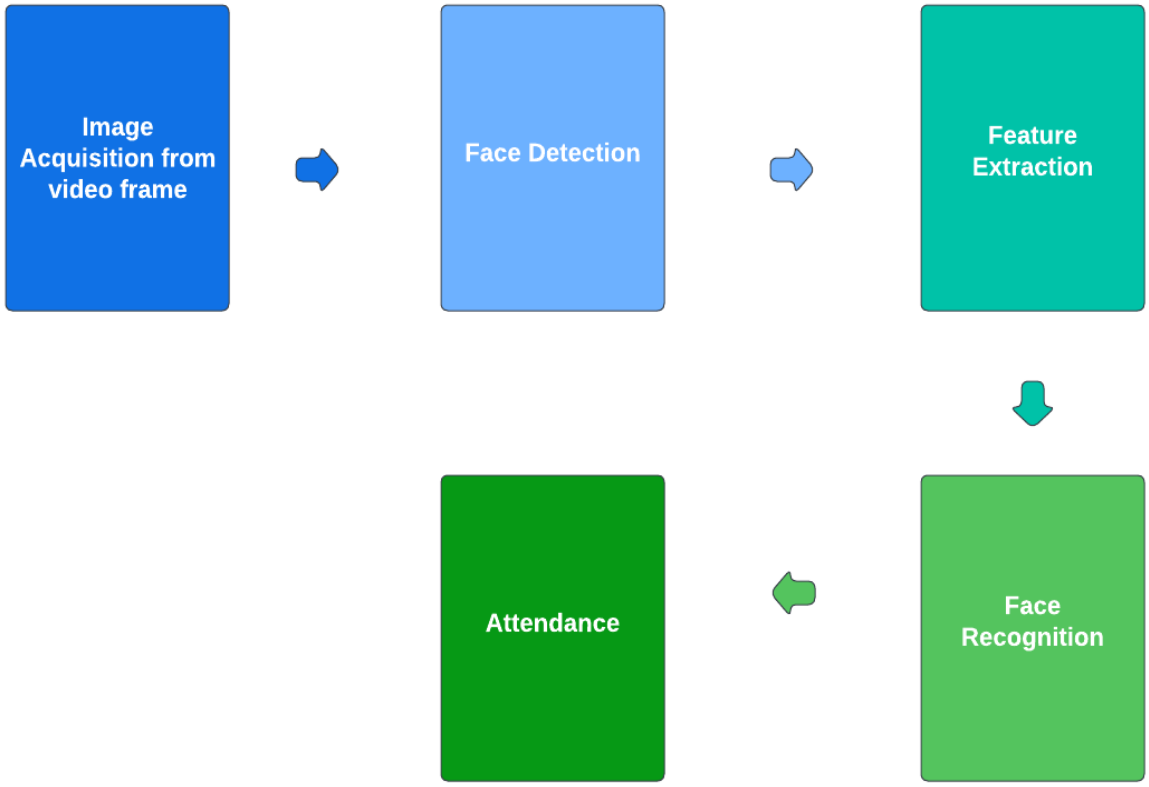


Figure 3.3: Block diagram

3.9 FRAMEWORK

The widely utilized technique to locate the face segment from a static picture or video frame is the Viola-Jones algorithm, which was developed by P. Viola and M. J. Jones in 2001. It is a feature-based technique that detects faces in photos or videos by combining Haar-like characteristics and the AdaBoost machine learning algorithm.

The AdaBoost method is used to choose the most useful features and integrate them into a powerful classifier capable of distinguishing between face and non-facial areas. The approach iteratively trains a series of weak classification models, each of which is a single-feature decision rule. Using an unbiased majority voting system, the weak classifiers are integrated into a strong classifier, with the weights changed at every phase to focus on incorrectly categorised cases.

The Viola-Jones technique is prominent in real-time face identification applications due to its excellent detection accuracy and speed. It does, however, have several limitations, including difficulties recognising faces in non-frontal positions or obscured faces.

The method scans a photograph or multimedia frame using a window that rotates of various widths and aspect ratios, looking for regions that match specific criteria. These characteristics are characterised as rectangular picture portions with varying brightness levels. The technique

computes the total number of the values for pixels in each rectangle and compares them to a threshold value using a series of pre-defined Haar-like features. If the total surpasses the specified limit, the software considers that region to be a potential face candidate and proceeds to the next window.

A well-liked approach for real-time object recognition in computer vision is the Viola-Jones algorithm, which depends on the Haar based on features cascade classifiers. A picture was categorised into tiny parts subregions, and system analyses every subregion to see if it includes a face. In order to effectively assess each sub-region, it employs a cascade of classifiers. Every neural network is trained to discriminate between areas with features and locations without faces using a collection of scenarios that are both positive and negative.

The very effective Viola-Jones algorithm is capable of real-time face detection. Numerous applications, such as safety equipment, surveillance, and picture editing software, have made use of it. The Viola-Jones method has numerous drawbacks even though it is quite good at detecting faces.

It might not function well in certain lighting situations, and it might not be able to recognise features that are obstructed by objects or disguised by them. In general, the Viola-Jones technique, which is often employed in computer vision applications, is a potent face detection tool.

3.9.1 Haar Cascade Algorithm

Viola and Jones introduced the Haar cascade, an automated learning-based classification system, in 2001. To recognise objects in a picture, the method employs a series of haar-like characteristics. Features resembling Haar are rectangular arrangement of dark and bright cells that are employed to define an object's local characteristics.

Once trained, the classifier may be used to recognise the item in fresh photos. The method scans the picture using a window that rotates of different dimensions and aspect ratios. The haar-like characteristics are computed and given into the classifier at each location of a sliding window in order to detect whether or not the item is present. A boundary line is drawn around the object if it is detected.

Identification of faces, identifying pedestrians, and other recognition tasks have all been successfully completed using the Haar cascade technique. It is a well-known technique because it is quick and precise, and it is able to be trained on big datasets to identify a broad variety of objects. It is, however, susceptible to changes in illumination and other environmental conditions, and it may not perform well in complicated scenarios with several objects.

The approach works by using a set of both favourable and unfavourable pictures to train a classifier. Positive pictures have instances of the thing that the system is attempting to detect, but images that are negative do not. These photos are used by the algorithm to discover the haar-like traits that are unique to the item.

A picture is fractionated further into subregions, and system analyses every subregion to see if it includes the item being identified. The colour saturation of the photons in the sub-region are

compared to a collection of pre-established sequences referred to as Haar features to do this assessment. The existence of specific visual elements in a picture, such as corners and edges, is captured by haar features, which are geometric patterns of pixels.

An extensive dataset of both positive and negative pictures is required for moulding the Haar cascade classifier. Negative photos lack the identified item, but positive images do. After that, based on the Haar characteristics, the computer learns how to differentiate between favourable and unfavourable pictures using machine learning techniques. When additional photos or video streams are created, the resultant classifier may be utilised to find the item.

Numerous applications, including recognition of faces, tracking of objects, and pedestrian identification, make use of the Haar cascade technique. It is a strong and effective technique for finding objects in videos and photo streams, and open-source libraries like OpenCV make it widely accessible.

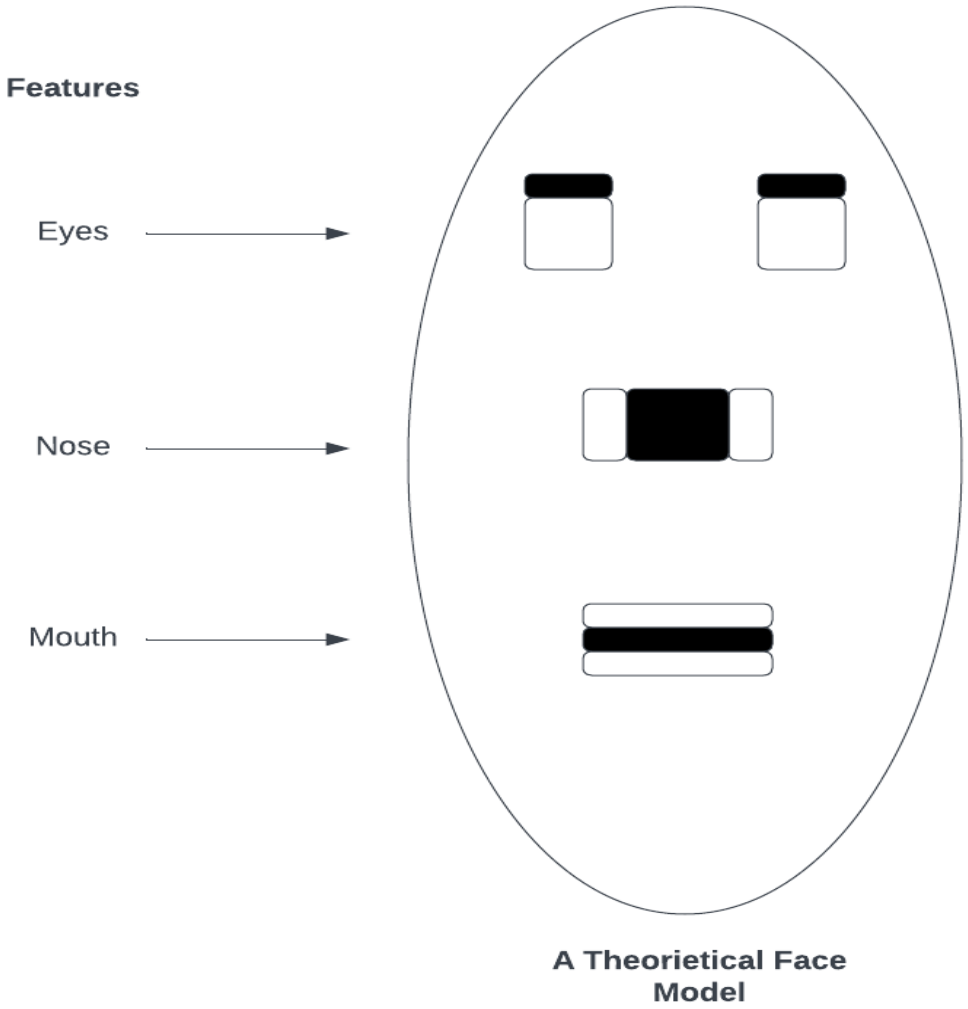


Figure 3.4: Haar Feature

3.9.2 LBPH Algorithm

LBPH is an abbreviation for Local Binary Patterns Histograms. It is a common facial identification algorithm that extracts information from images and uses them to produce a distinctive depiction of an individual's face. After calculating the LBP codes, a histogram is generated to depict the probability of presence of every linear pattern. The resultant histogram is then utilised for representing the face as a feature vector.

During recognition, the LBPH method uses a measure of distance that includes Euclidean distance or cosine similarity to compare the feature vector of the input picture to the corresponding feature vectors of each picture in the database. The identification of the individual in the input photograph is then determined by the closest match.

A feature extraction approach called LBPH (Local Binary Patterns Histograms) has been used for identifying faces and other computer vision applications. Timo Ahonen, Abdenour Hadid, and Matti Pietikäinen created it in 2004.

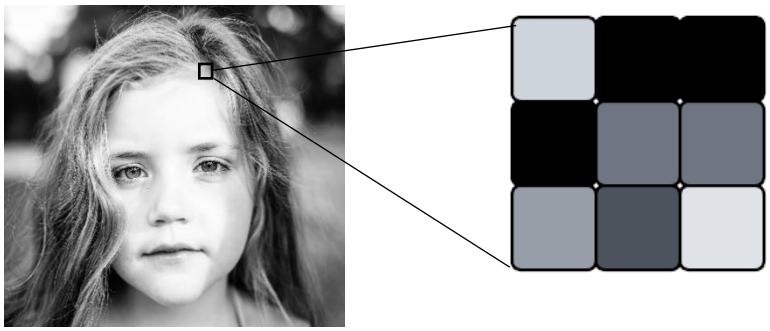
The method compares a collection of predefined patterns to an image's local binary patterns (LBP), which is how it operates. A texture descriptor called LBP compares each pixel's intensity to the magnitude of its neighbours to indicate the spatial framework of a picture. LBP creates an integer sequence for each pixel by encoding the intensity connections among every pixel in a local neighbourhood. The textured surface of the image is then described using these binary patterns.

The LBPH method creates a visual representation of the patterns by extracting the LBP characteristics from every sub-region of the picture. The image is represented by this histogram, which serves as a feature vector. The topic of the image is then determined by comparing the feature vector to a database of recognised feature vectors.

Given its resilience to changes in illumination, face expression, and stance, LBPH is particularly well suited for facial recognition. It is a well-liked option for facial recognition applications since it has been demonstrated to be successful under controlled and uncontrolled conditions.

Free and open-source computer vision libraries like OpenCV frequently employ LBPH. Numerous applications, such as safety devices, surveillance, and authentication using fingerprints have made use of it.

1. 3×3 pixel



2. Threshold 90

200	50	50
50	90	100
160	70	210

3. Binary 10001101

1	0	0
0		1
1	0	1

4. Decimal 141

150	90	80
30	141	

Figure 3.5: LBPH algorithm

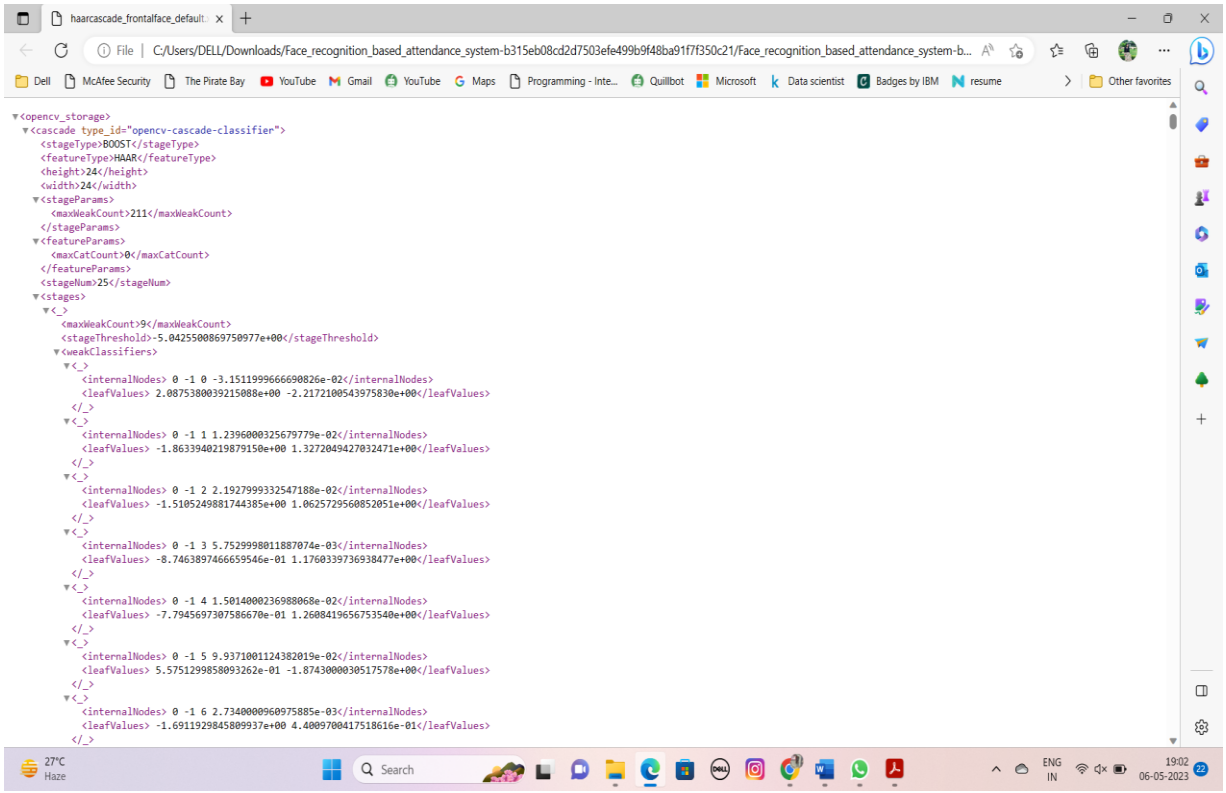


Figure 3.6: Haar Cascade Algorithm

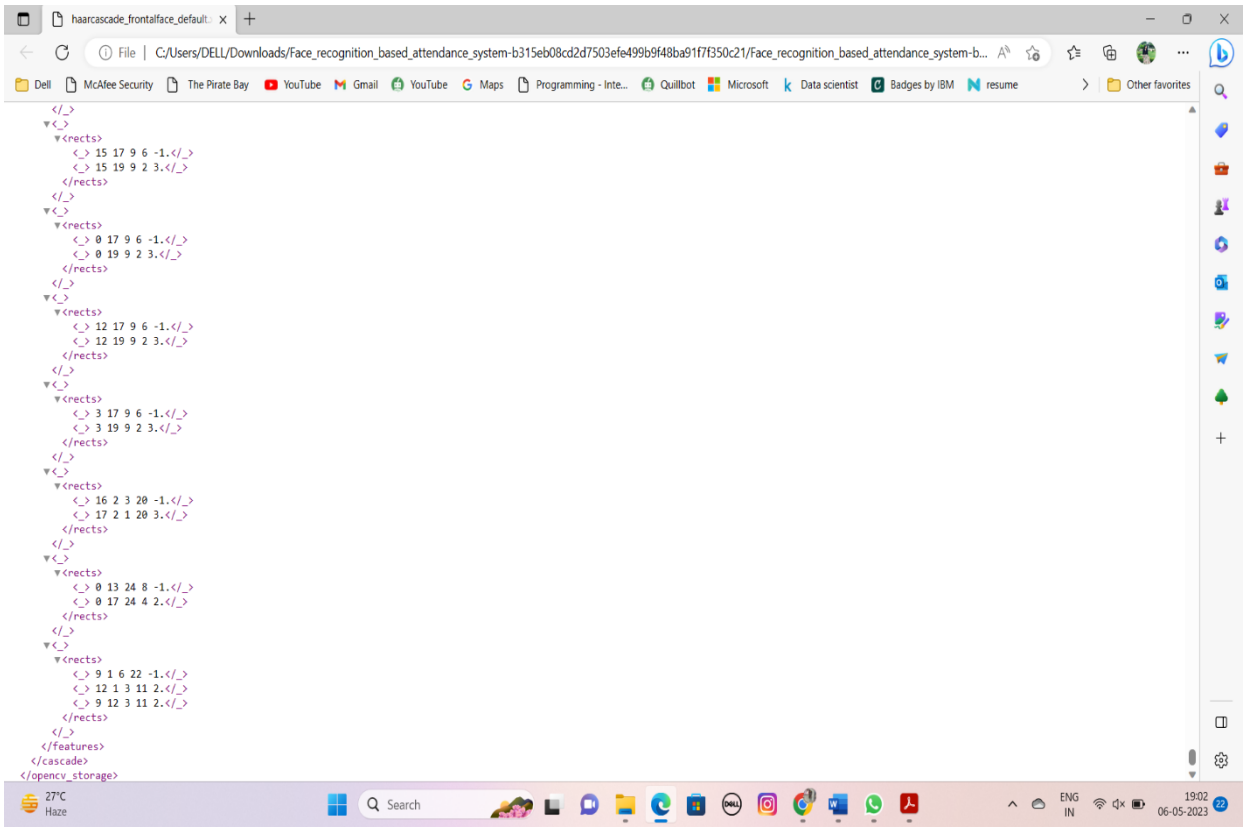


Figure 3.7: Haar Cascade

3.9.3 OpenCV Library

A free and open-source software library for visual analysis and artificial intelligence is called OpenCV. It is an artificial intelligence and machine learning library that offers a variety of methods and instruments for image and video processing, object identification and recognition, and deep learning. A well-known free-source artificial intelligence and machine learning library is OpenCV (Open-Source Computer Vision Library). Since its original creation by Intel Corporation in 1999, it has grown to rank among the most used frameworks for computer vision tasks.

For applications including video and photo processing, object identification and monitoring, recognition of visages, artificial intelligence, and more, OpenCV offers a wide range of features and capabilities. Python, C++, and Java are among the programming languages it supports. OpenCV has a number of important characteristics, including:

1. Numerous systems, include Windows, Linux, macOS, iOS, and Android, are supported.

2. Integrated features for processing images and videos, including sorting, edge recognition, and recognition of features.

3. Assistance with ML methods including NN, decision tree, and SVM.

4. Support for a variety of input and output types, including network streams, picture and video files, and webcams.

5. High-level interfaces and APIs enabling simpler interaction with other frameworks and libraries.

Numerous industries, involving automation, automobiles, privacy, imaging for medicine, and more use OpenCV. It is also commonly utilised in artificial intelligence and neural network research and teaching.

3.9.4 NumPy Package

'Numerical Python' is the name of a Python package. NumPy is foundational library for mathematical computations and includes the potent n-dimensional array as well as capabilities for integrating C, C++, and other programming languages. Additionally, it helps with random number generation and linear algebra. Popular freely available Python package NumPy supports big, multiple dimensions matrices and arrays and offers a variety of mathematical methods for using these arrays. Since its initial release in 1995, it has grown to rank among the most popular libraries for analytical computation and information analysis. Among NumPy's primary characteristics are the following:

1. Capable for broad, multiple dimensions matrices and arrays that can be built and worked with utilising NumPy's robust indexing and slicing features.

2. There are several mathematical operations that may be performed on arrays, such as component-wise actions, linear equations, Fourier transformations, and more.

3. Assistance with broadcasting, which enables the organic combination and manipulation of arrays of various forms.

4. Integration of SciPy, Matplotlib, and Pandas, as well as additional Python libraries and frameworks.

5. NumPy's use of low-level languages like C and Fortran to implement itself allows for efficient memory utilisation and calculation.

Numerous applications, including research calculating, analysis of data, artificial intelligence, and others, use NumPy. It is frequently used together with other libraries like SciPy, Matplotlib and Pandas. It is especially well-suited for jobs that require working with massive volumes of data, such image and signal analysis.

3.9.5 Pandas Library

Wes McKinney created the sophisticated data manipulation programme known as Pandas. It is based on the NumPy library and uses the Data Frame as its primary data structure. You can save and manage data in table form in which observations are in row side and variables are in column side using data frames. A Python library that is freely available for data analysis and manipulation is called Pandas. Wes McKinney originally made it available in 2008, and it has since grown to be one of the leading resources for data visualisation and analytics. Among the essential characteristics of pandas are:

1. Support for processing and modifying huge, well-structured datasets, including time-series data and data tables.

2. A strong and adaptable data selection and indexing system that enables sophisticated data filtering and aggregation.

3. A broad spectrum of formats for files, that include a CSV file Excel, ranging SQL databases, and others, are supported for importing and exporting data.

4. Several built-in data manipulation features, including the ability to connect and merge datasets, reshape data, and handle lost or unreliable information.

5. combining NumPy and Matplotlib alongside additional Python resources and instruments for data analysis.

Numerous fields, such as economics, finance, sociology, and the field of engineering, employ Pandas. It is especially well suited for jobs like data exploration, visualisation of data, and machine learning that need cleaning, processing, and analysis of massive datasets.

3.9.6 Tkinter Module

Tkinter is a Python package that is used to create graphical user interfaces (GUIs). It includes a suite of widgets and widgets for creating programmes, menus, controls, labels, and other graphical user interface components. Tkinter is built on the 1980s-developed Tcl/Tk GUI toolkit, and is still extensively used today.

Creating graphical user interfaces (GUIs) for applications for desktops uses the Python package Tkinter. It offers a selection of gadgets (UI components) and building blocks for creating user interfaces, including menus, buttons, labels, and more. The majority of Python installs come with Tkinter, which makes Python GUI programming simple to begin. Tkinter's important characteristics include:

1. Button, label, text box, menu, and other modules and resources for creating user interfaces are available.

2. Support for several geometry managers, including as grid, pack, and put, for placing widgets on the screen.

3. Integration with various Python machine learning, data visualisation, and scientific computing tools and frameworks, such as NumPy and Matplotlib.

4. Tkinter-based programmes may operate on a variety of computer operating infrastructure, such as Windows, macOS, and Linux, because of compatibility between platforms.

When creating GUI programmes in Python, such as desktop programmes, educational software, and tools for data analysis and visualisation, Tkinter is frequently utilised. It is a popular option for novices thanks to its simplicity and usability, and it can also handle more complicated applications owing to its versatility and customization choices.

3.9.7 Time Module

For tasks involving time, Python includes a module called time. We must import the module first before using any functions that are declared in it. A number of functions are available to manipulate and deal with time using the built-in Python module known as the time module. It is utilised for activities including timing programme execution, timing and delaying events, and manipulating date and time information. The time module performs a number of crucial tasks, including:

1. Gives the current moment in a second since the start of the epoch (January 1, 1970) using the time() function.

2. Sleep() pauses the current thread's activity for a specified period of time.

3. Localtime(): Creates a tuple of local time from a time value expressed in milliseconds since the epoch.

4. Using a given format string, the strftime() function converts a time tuple into a string.

5. The function perf_counter() returns the result of a high resolution (HR) performance counter, which is useful for tracking how long a programme takes to run.

For activities like data analysis, scientific computing, and machine learning, the time module is frequently used when combined with additional Python modules and applications, such as NumPy and Pandas. It is frequently employed in system management activities as well, including scheduling tasks and keeping track of system performance.

3.9.8 Date and Time Module

Python does not have a built-in date type for dates, but we may import the datetime module to work with dates as date objects. An integrated component of Python called date offers classes for dealing with dates and timings. It is employed for activities including formatting, parsing, and changing date and time information. The date module offers a number of important classes and methods, including:

1. A course on working with dates that covers how to obtain and set the calendar year, every month, and week.

2. Using the seconds, hours, minute, and second may be done using the methods in the time class, which also includes working with time values.

3. Datetime: A class that has methods for conducting arithmetic operations and comparing date and time data, combining the values of date and time into a single object.

4. A class for describing time durations called timedelta includes comparison and arithmetic operations as well as methods for expressing timedelta as a class of time durations.

5. Using a given format string, the strftime() function encodes an expiration date or time structure as a string.

6. According to a given format string, the strptime() function parses an array and produces a datetime object.

For purposes like data analysis and visualisation, the date module is frequently utilised alongside with additional Python modules and applications, such Pandas and Matplotlib. In web development, it's frequently used for tasks like managing time and date information in online applications and APIs.

3.10 ADVANTAGES AND DISADVANTAGES

3.10.1 Advantages

1. Automated process: It is much simpler to track employees' time using an automated system like artificial intelligence-based attendance. It is not necessary to watch over personnel throughout their whole time on the property. This system can send information on each employee's attendance, absences, and overtime in an accurate and timely manner.

2. Saving time and money: For businesses, this technique can result in significant time and cost savings. Companies won't need to hire additional staff to do this task because the facial recognition technology maintains automated track of employees' working hours and access to various locations on the property. The automatic method accurately records hours worked and helps to avoid human mistake.

3. Enhanced safety: The use of a contactless biometric attendance facial recognition system not only makes it possible to accurately track the working hours of your staff, but it also strengthens and tightens the security measures already in place. You may also include information on guests that occasionally visit your property in addition to staff information. Access will not be granted to anyone who could not be located in the database. In the event that an unfavourable or unlawful incident occurs and authorities are called to investigate, a face recognition system can also offer proof.

4. The touchless function: The person does not need to contact any surfaces for the facial recognition technology to work. In the case of the present COVID-19 pandemic, it is crucial to avoid contacting any unclean surfaces since they may harbour the virus and expose individuals who encounter them to infection. Employees won't need to touch anything while using a Touchless biometric attendance facial recognition system, and they may enter and depart the building much faster. In addition to saving workers a tonne of time, it will reduce viral propagation.

5. Simple to set up: Facial recognition can be quickly added to attendance systems powered by AI. Most applications are compatible with this software, and businesses may easily integrate it into their current systems. The hands-free process offered by the facial recognition technology aids in accuracy and hygiene maintenance.

3.10.2 Disadvantages

1. Privacy invasion: Face Recognition systems provide the government the power to violate people's private rights, especially in nations where such rights are not highly valued. Authorities are free to make whatever use of technology they desire, including

spying on others. Without the subjects' knowledge, they can gather the information and utilise it for any purpose they like.

2. In a similar vein, the police force can trace criminals using this technology. However, they are also able to track anyone at anytime, anywhere using the same technology. They are able to identify the individual via surveillance footage, mobile devices, videos, social media posts, and other internet activity. It might be challenging to determine if data privacy can still be upheld in the aftermath of face recognition technology.

3. Biased results: Sometimes it happened that face recognition software will not distinguish between women or persons of colour. Despite the widespread belief that it is only a myth, tales of the same event occurring have surfaced. When originally implemented, this might become an issue because the dataset is small and only includes information with a few specific features.

4. Not as dependable: A research by the Massachusetts Institute of Technology (MIT) found that face recognition algorithms frequently misidentify people. Poor lighting, the incorrect camera angle, poor picture or video resolution, and other issues may cause the system to behave incorrectly.

3.11 Use Case

1. Academic facilities: This system may be used by educational institutions including higher education institutions to automate the process of recording teacher and student attendance. The software generates data that may be used for a number of tasks, including estimating attendance ratios and identifying kids who are regularly missing, and it can properly track attendance.

2. Industrial organizations: Employers may use this technology to automatically track staff attendance, which can increase productivity and lower mistake rates. Reports produced by the algorithm can also be utilized for processing payroll and other tasks.

3. Medical facilities: To make sure that the facility has a sufficient staffing level, healthcare institutions, such as health care centers and hospitals, can utilize this technology for monitoring the attendance of health care staff. The technology may also be used to monitor patient attendance, which can be useful for organizing appointments and cutting down on wait times.

4. Event management: This system allows event planners to keep track of attendees at gatherings like meetings, training sessions, and workshops. The technology can precisely track attendance and produce data that may be utilized for a variety of tasks, including analyzing participant demographics and gauging the event's performance.

5. Security and surveillance: To enhance access control and keep track of activities in secure areas, the facial recognition-based attendance system may be connected with

safety and surveillance systems. The system's ability to precisely identify users and keep track of their entry and leave timings can aid in limiting unauthorized access and enhancing security.

6. Administration organizations: Government institutions, including the judiciary, prisons, and military sites, can track staff attendance and identify those accessing security areas using facial recognition-based attendance systems. This can increase security and lower the possibility of unauthorized access.

7. Attendance at work: A facial recognition-based system is utilized to monitor employee attendance at work. Managers may use this to process payroll and verify that workers are putting in their allotted time. The system may be coupled with additional human resources management systems to give more information for metrics and performance reviews.

Overall, Python-based facial recognition attendance systems can be helpful in a variety of contexts and sectors where precise and effective attendance monitoring is crucial.

CHAPTER-4

IMPLEMENTATION AND RESULT

4.1 IMPLEMENTATION

This facial recognition-based attendance system is a Python project that employs a face recognition algorithm that can recognise people and automatically register their attendance. The system is made to take a picture of a person's face, extract its features, then compare them to features in a database. If the features match, the attendance is marked.

There are various processes involved in putting the concept into action. We must first get headshots of everyone who will be utilising the attendance system. The photos must be of high quality, properly depict the face from all angles, and be taken in various lighting situations. Once the images have been gathered, they must be labelled and pre-processed by being resized to a standard size, converted to grayscale or RGB colour format, and had their pixel values normalised to a range.

The features from each face image in the database are then extracted utilizing a facial identification algorithm. The particular aspects of each face, such as the separation between the eyes, the form of the nose, etc., should be represented numerically by these features. After the features have been extracted, we store them in a database along with the labels that go with them.

We use a camera or webcam to take a picture of the person's face in order to take attendance. We next use the face recognition method to pre-process the captured picture and extract its characteristics. If the retrieved features and the features in the face database match, we can identify the individual. Once the person has been identified, we record their appearance in a CSV file or records along with their name or ID and the exact time and date of the event. The findings, including the person's name and the time of their arrival, are then shown on the screen.

Features like real-time monitoring, automated email or SMS messages, and report generation may be added to the project to make it even better. In comparison to conventional methods, this system offers a faster and more accurate way to record attendance while also reducing errors.

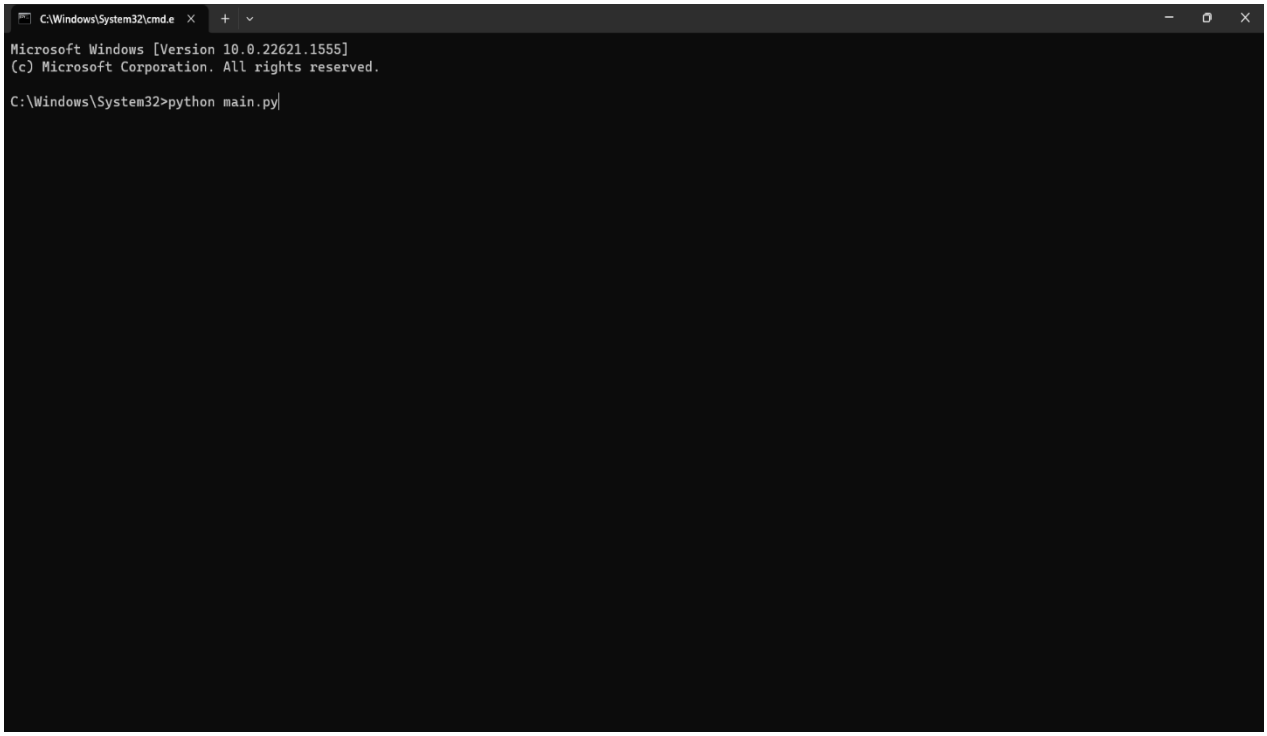


Figure 4.1: Implement the code

4.1.1 Software Development

The software development area has two main system flows, which are illustrated below:

1. The face database was established.
2. The procedure for recording attendance

Because they served as the foundation for the attendance management system, both of the aforementioned procedures are crucial. Both flows' processes will be briefly discussed in this section. Meanwhile, the following chapter will cover their complete functionality, particular requirements, and strategies for achieving these goals.

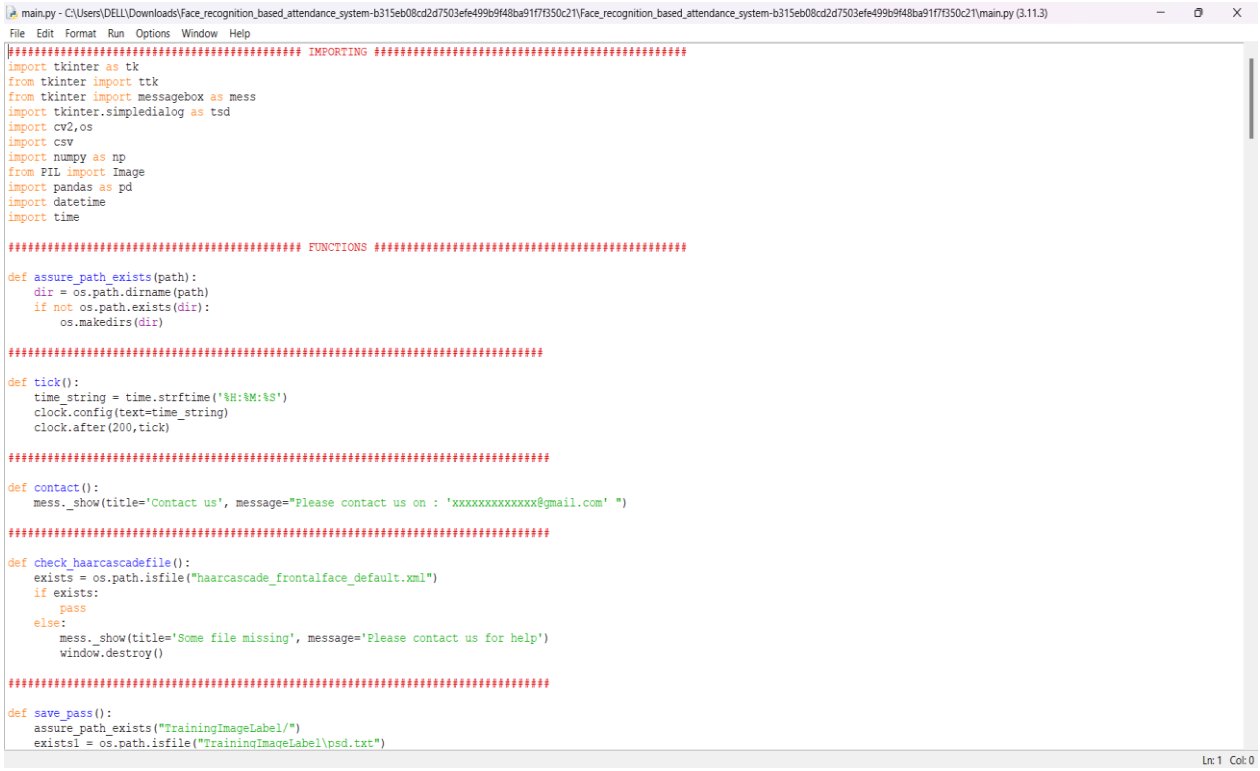


Figure 4.2: Backend

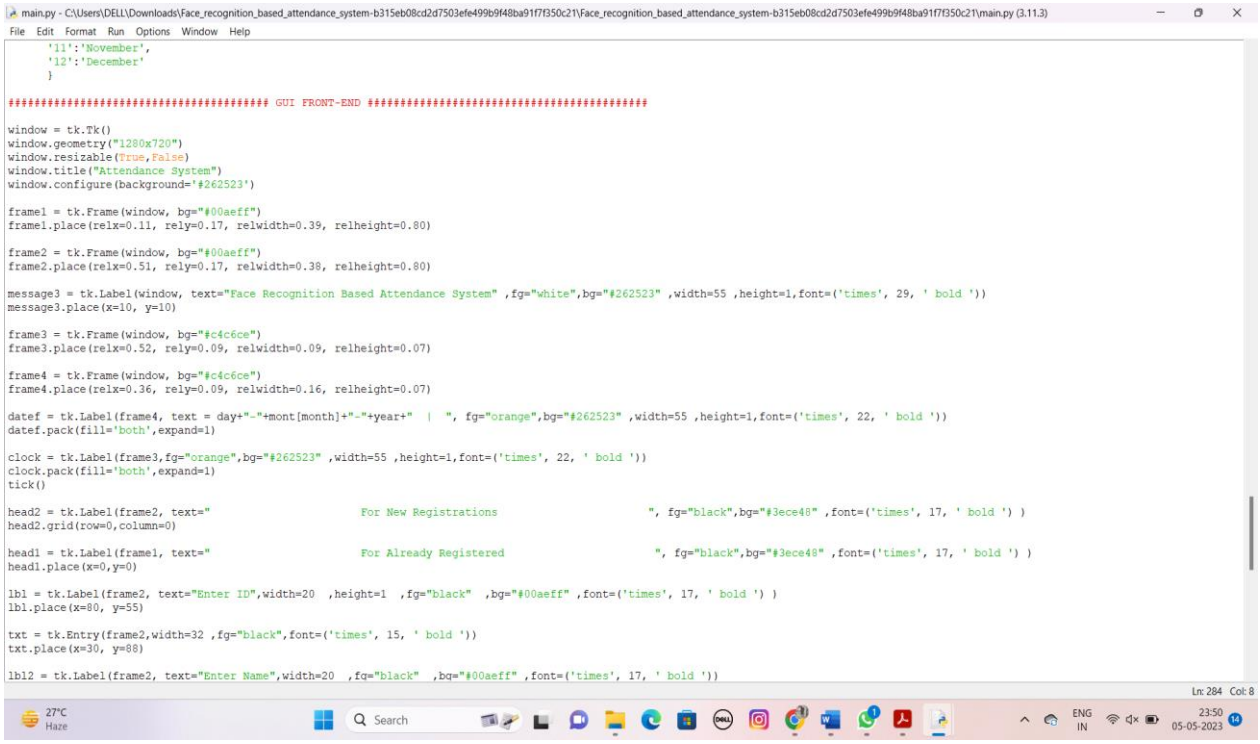


Figure 4.3: GUI Frontend

4.1.2 Face Database Creation

The creation of the face database must be done before continuing with the procedure. This is due to the fact that during the recognition process, which will be covered in a later section, the face database serves as a comparison component. Because each student will have multiple portraits stored, in the process above, a csv file is made to help with the image labelling process. Labels are used to separate the portraits so that they can be grouped together under the name of the same person. These photographs will then be added to a recognizer so it can begin training. Due to the time-consuming nature of the training procedure as the student face database got larger, training is only carried out as soon as a batch of fresh student photos has been added. Following are the steps:

1. Image collection of faces: Take pictures of the faces of those who will be utilising the attendance system. The photos must be of high quality, properly depict the face from all angles, and be taken in various lighting situations.

2. Label the photos: After gathering the facial photographs, you must give each one a name. This entails giving each photograph a special label or identification that may be used to locate the individual who is in the picture.

3. Resize the photographs: to a standard size, convert them to grayscale or RGB colour format, and normalise each pixel to an appropriate range to pre-process the images.

4. Identify features: Each face picture in the database may have its characteristics identified using a face recognition algorithm The specific aspects of each facial features, comprise the separation between the eyes, shape and structure of nose, etc., should be represented numerically by these features.

5. Save the features: Save the extracted features and their accompanying labels in a database.

6. Utilise the face dataset: to train the system by using the facial identification algorithm. This entails labelling face photos and the appropriate facial traits to feed the algorithm.

7. Test the system: After it has been trained, put it to the test on some fresh face photographs to see how accurate it is.

8. Update: the database when new people are added by gathering and labelling photographs of their faces, separating out features, and adding them to the repository.

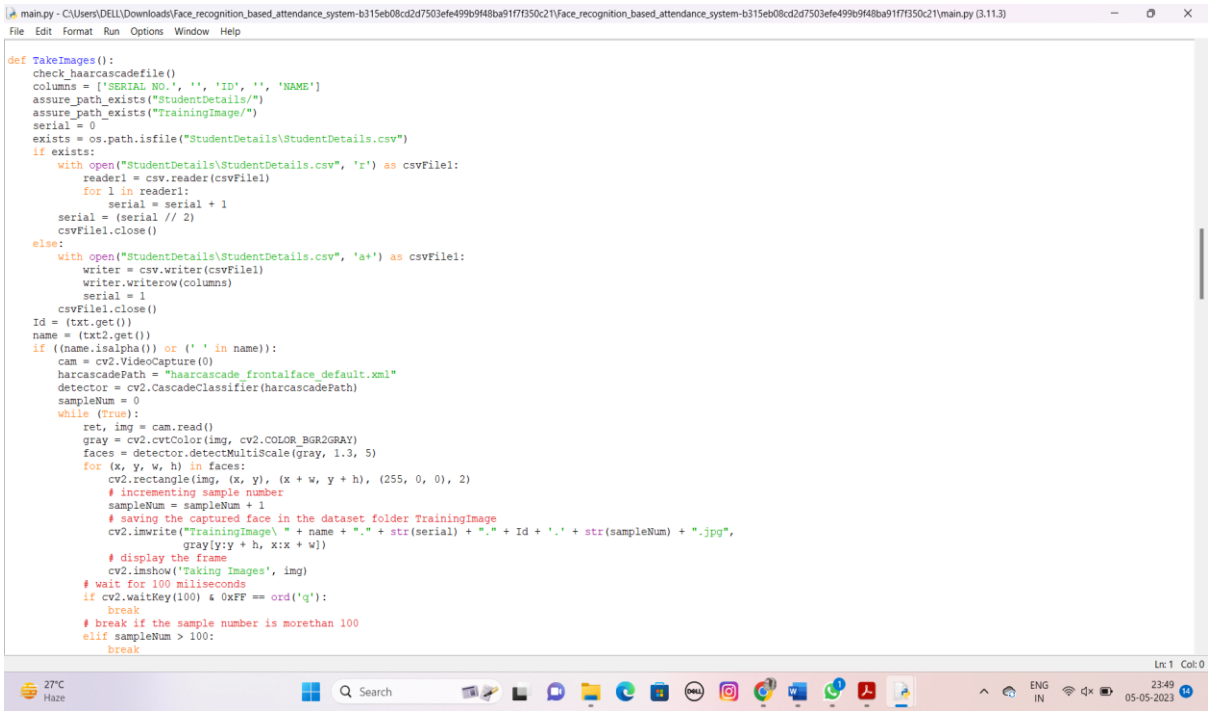


Figure 4.4: Taking image

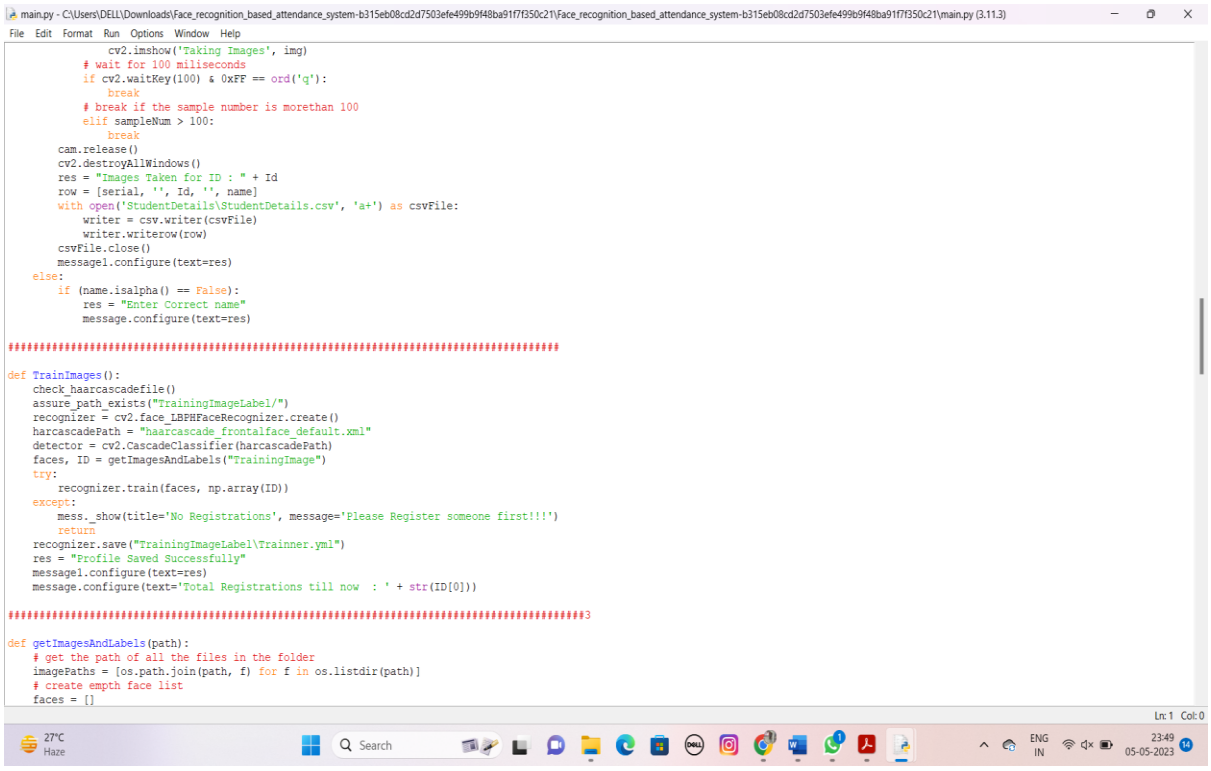


Figure 4.5: Train image

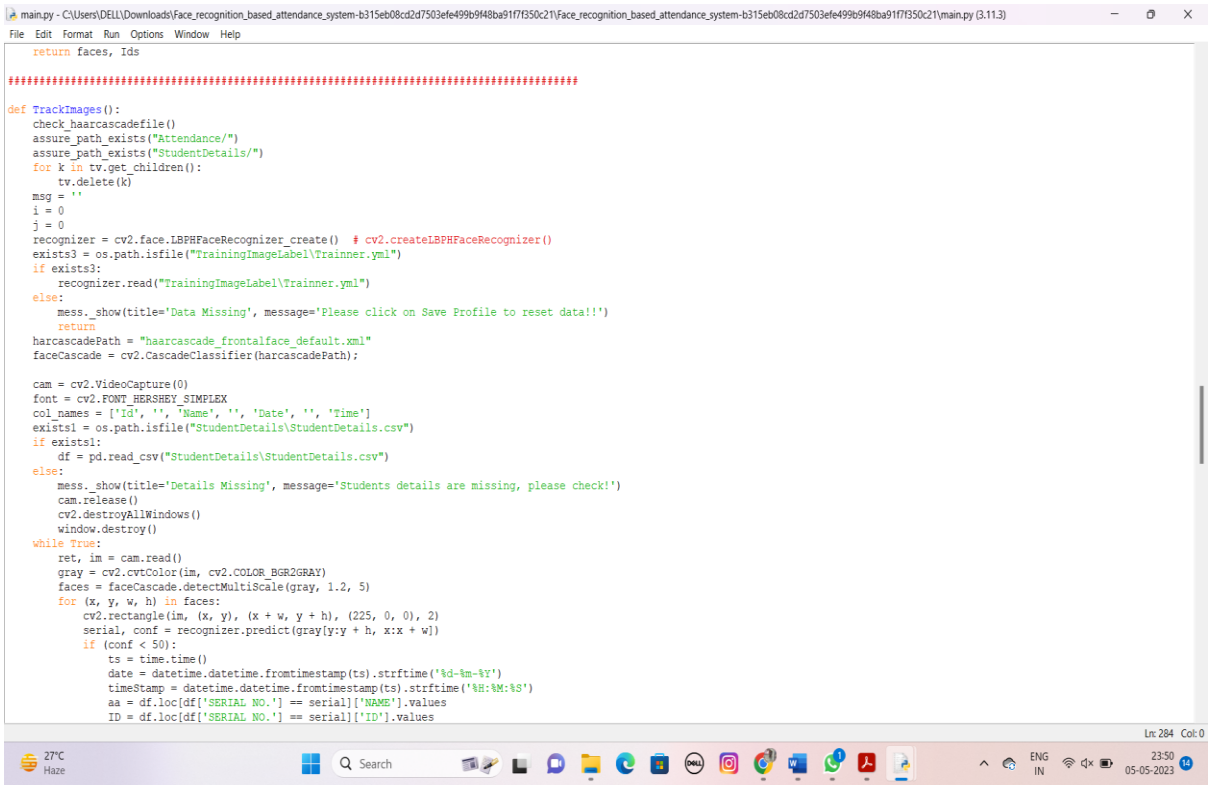


Figure 4.6: Track image

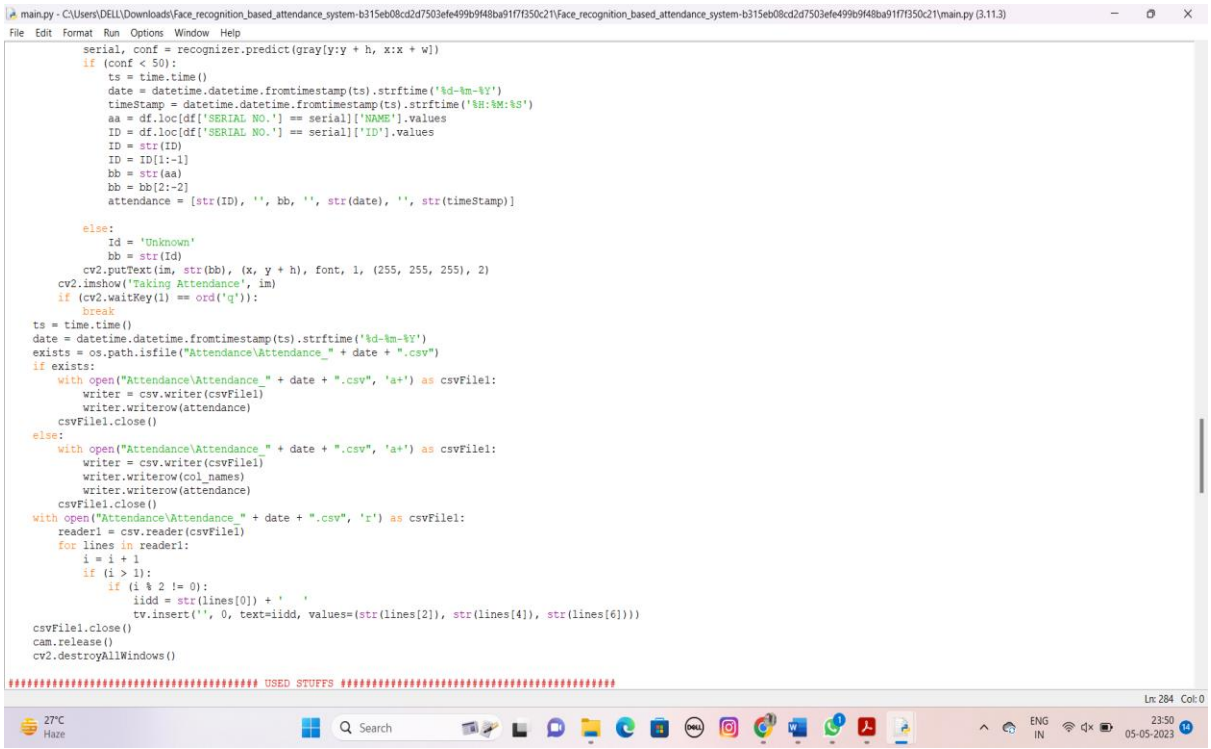


Figure 4.7: Track image-2

4.1.3 Attendance taking Procedure

The methods below to develop a face-based attendance taking process:

1. Use a digital camera or webcam to take a picture of the individual's face to capture the image.
2. Resize the image to a typical dimension, convert it to grayscale or RGB colour format, and normalise the values of each pixel to a standard range to pre-process the image.
3. To extract characteristics from the pre-processed image, use a face identification algorithm. These should be numerical descriptions of the distinctive aspects of the face.
4. Features comparison: Compare the features from the recorded picture that were extracted with the features from the face database.
5. Determine the individual: If the characteristics correspond to any of the photos in the database, pinpoint the individual.
6. In a CSV file or database, note the person's attendance after they have been located. Along with the person's name or ID, you can also include the time and date of their attendance.
7. Results display: Show the outcomes on the screen, including the person's name and the time of their arrival.
8. For every individual who has to take attendance, repeat the procedure.

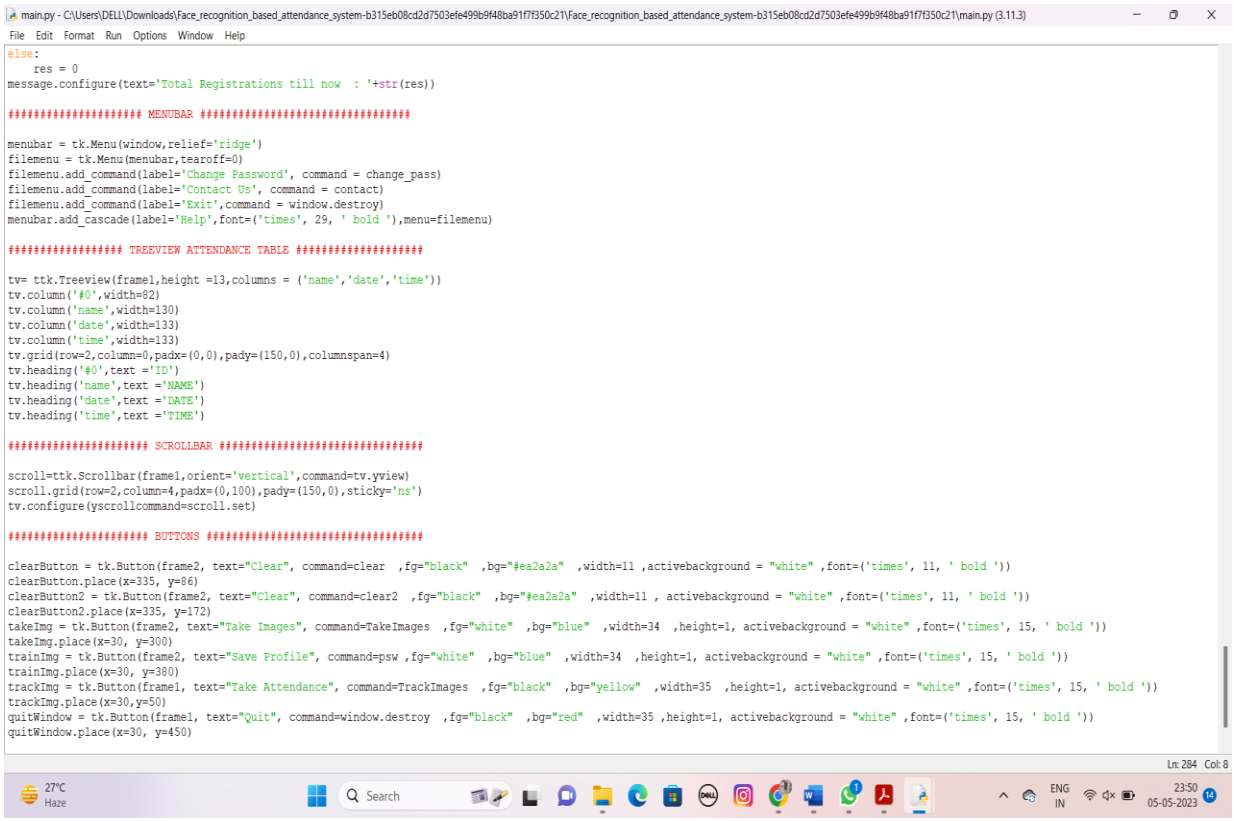


Figure 4.8: Creation of scrollbar, button, attendance

4.2 RESULT

4.2.1 Initial page

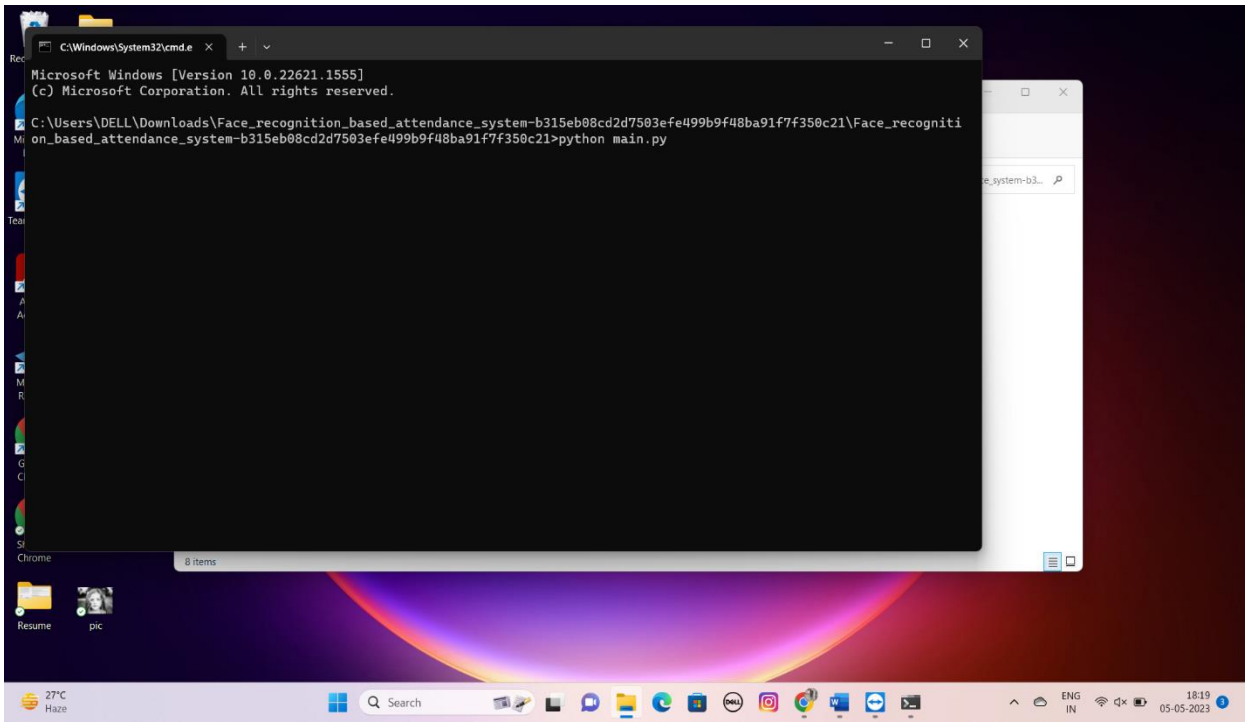


Figure 4.9: Command line window

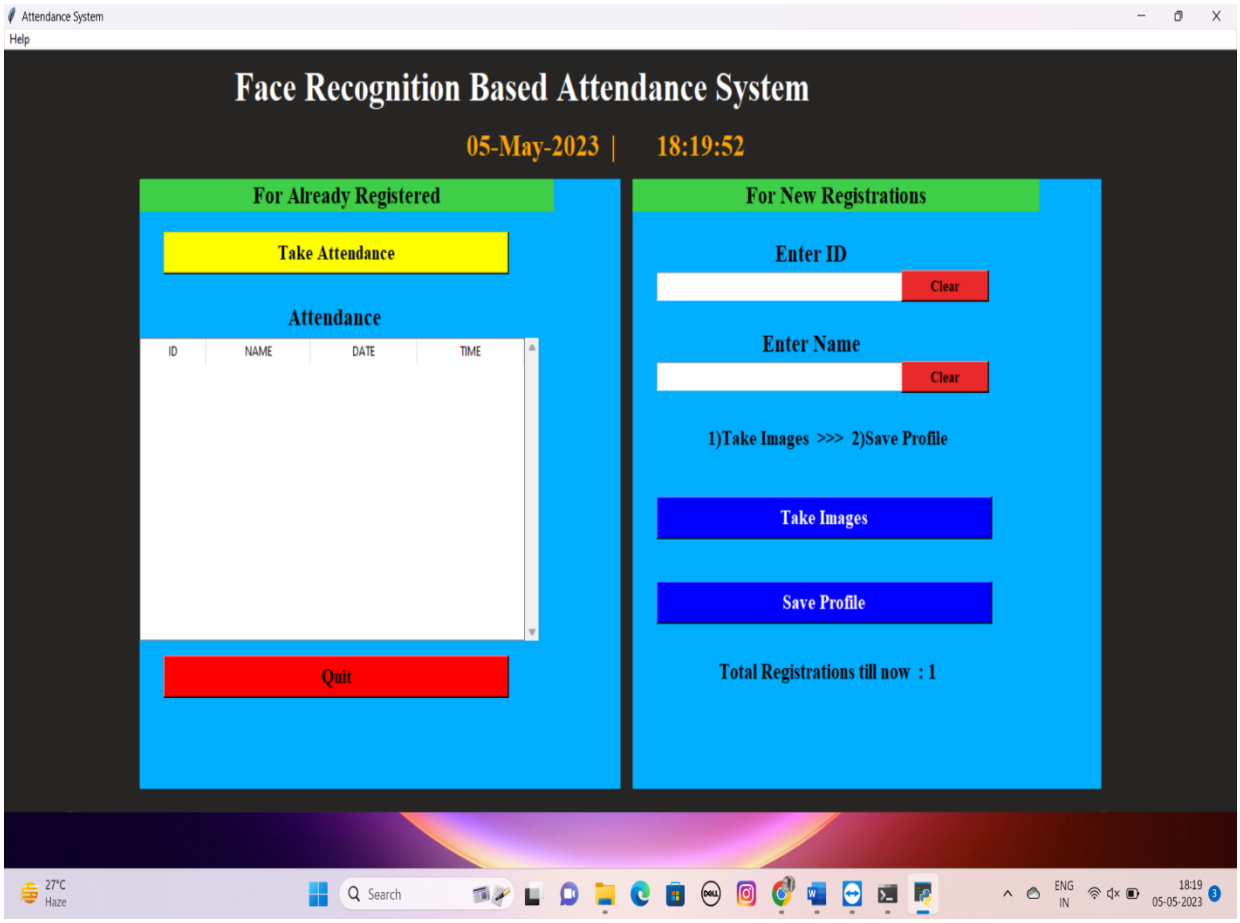


Figure 4.10: Main screen

4.2.2 Registering profile

We evaluated the output of each function we developed using test photos that already existed and in real time. Screenshots of the results of various functions are provided in the part that follows. With the assistance of four volunteers, the system has undergone testing utilizing captured photos to build the test repository.

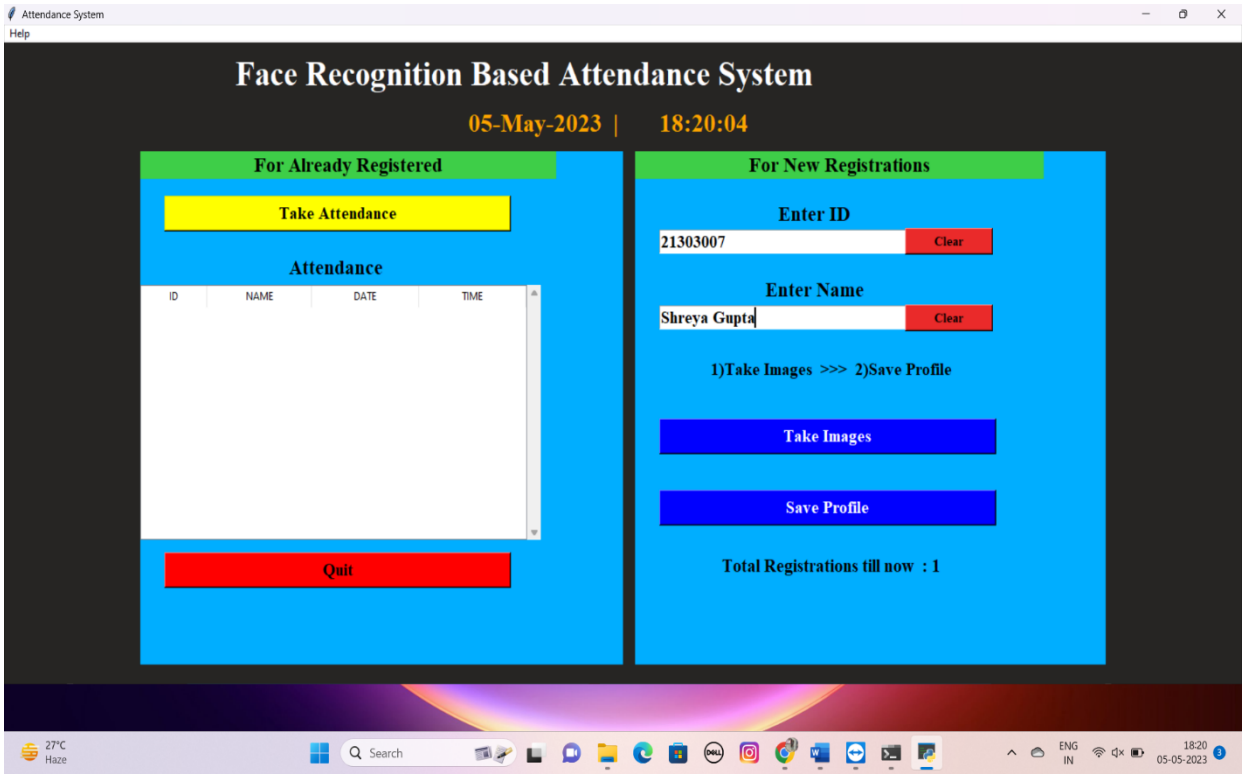


Figure 4.11: New Registration window

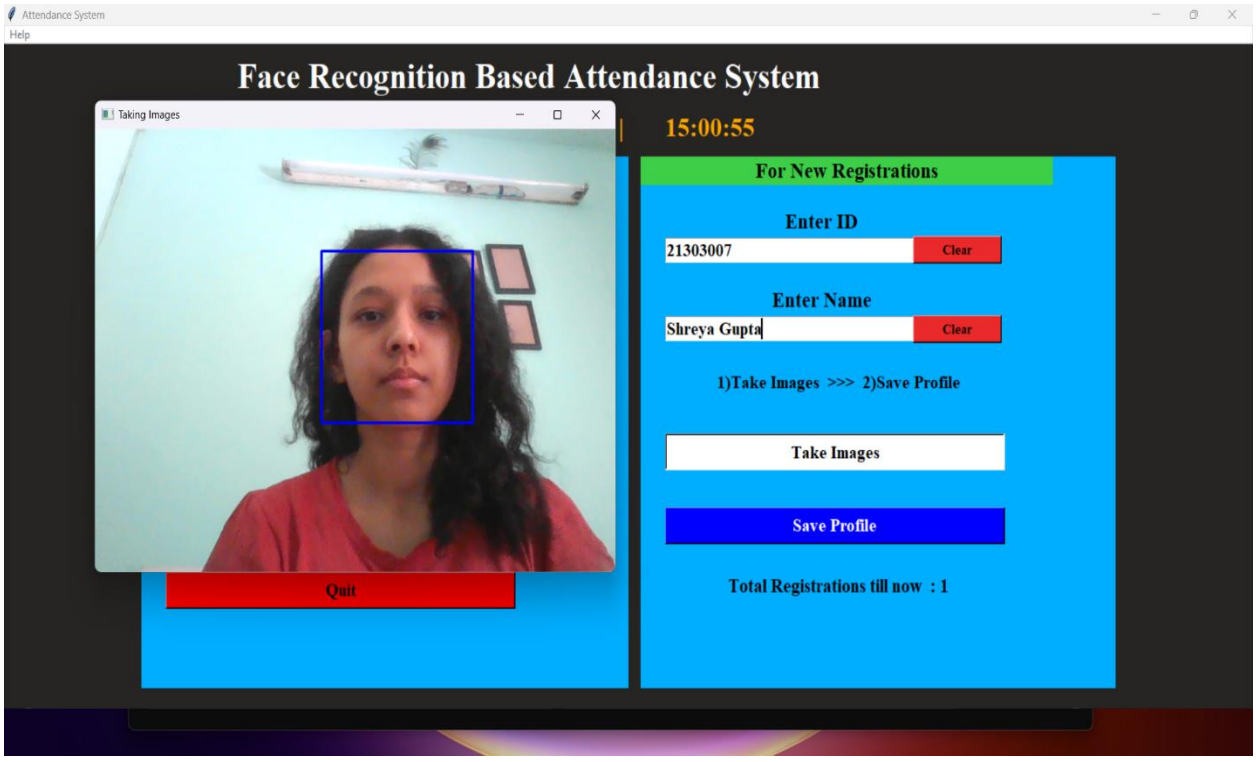


Figure 4.12: Taking image for registration process

4.2.3 Saving profile

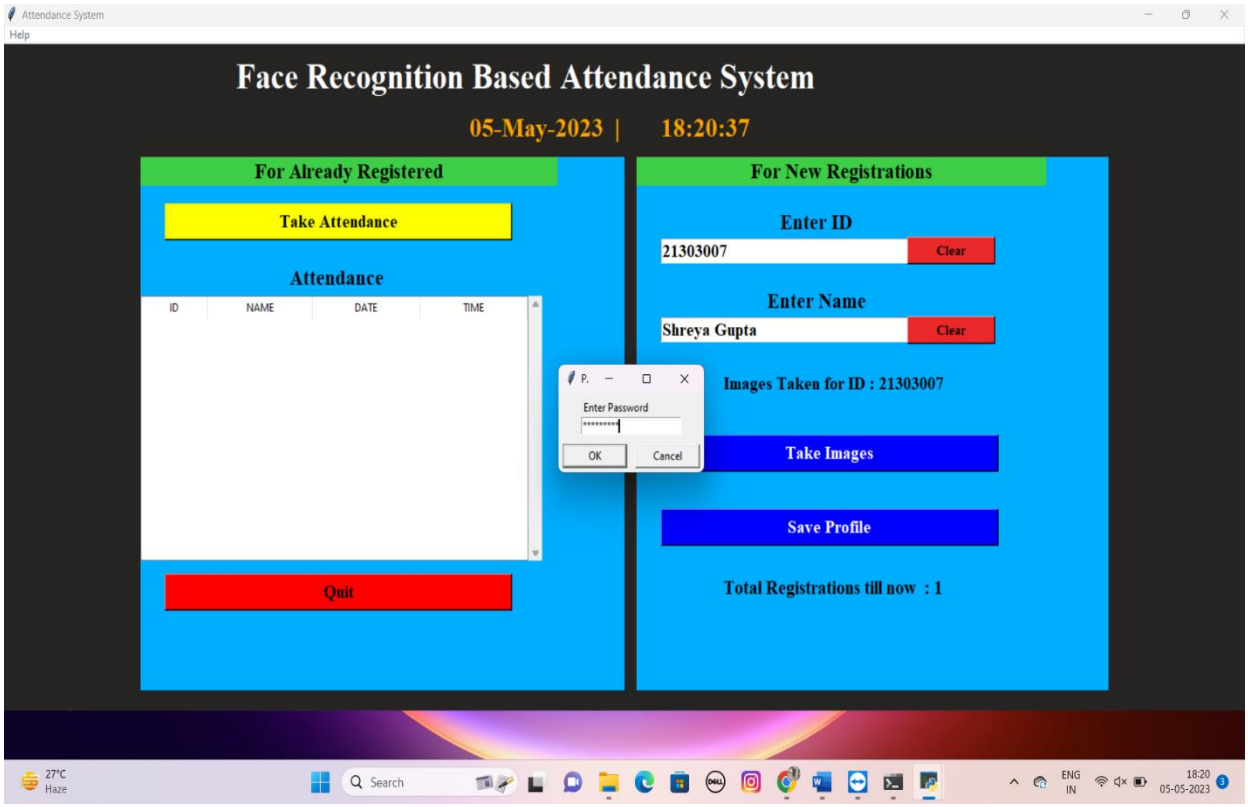


Figure 4.13: For registering it will ask for password

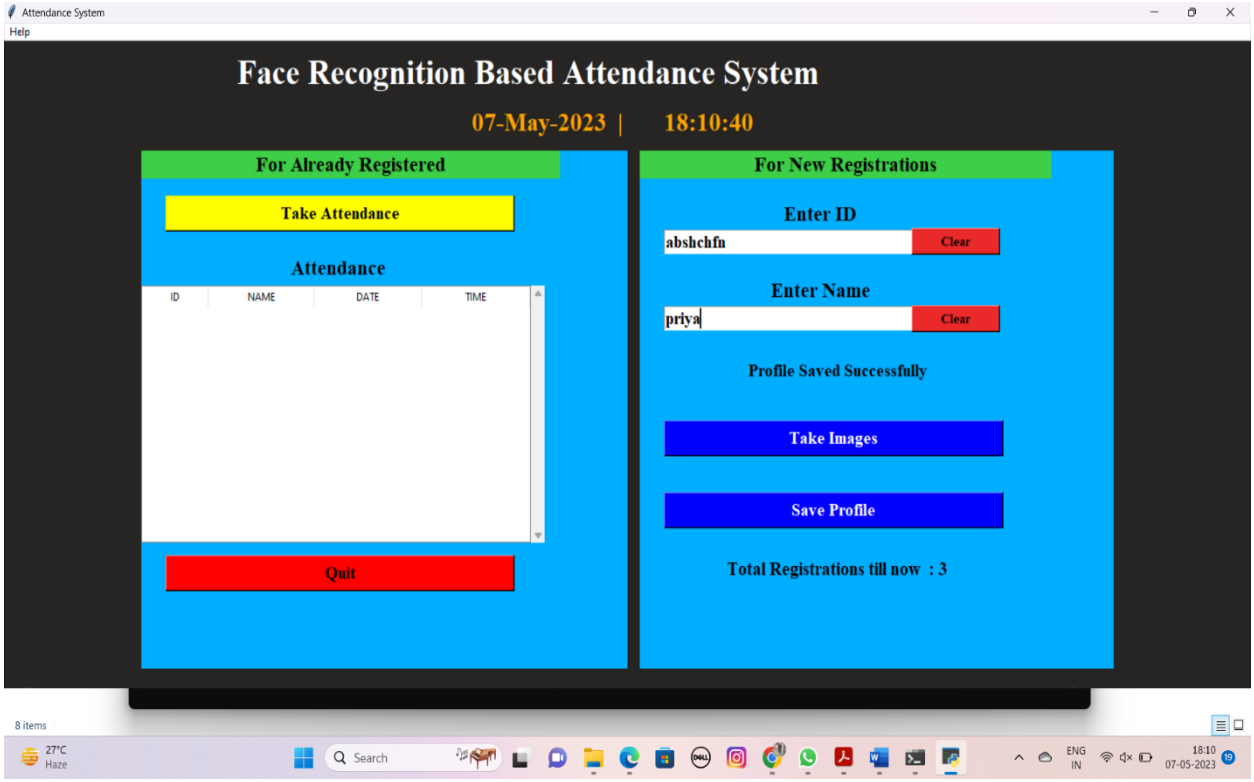


Figure 4.14: Saved profile in Database

4.2.4 Collect training dataset

We establish a database of the registered students using the function TrainDatabase, and it is saved in the folder.

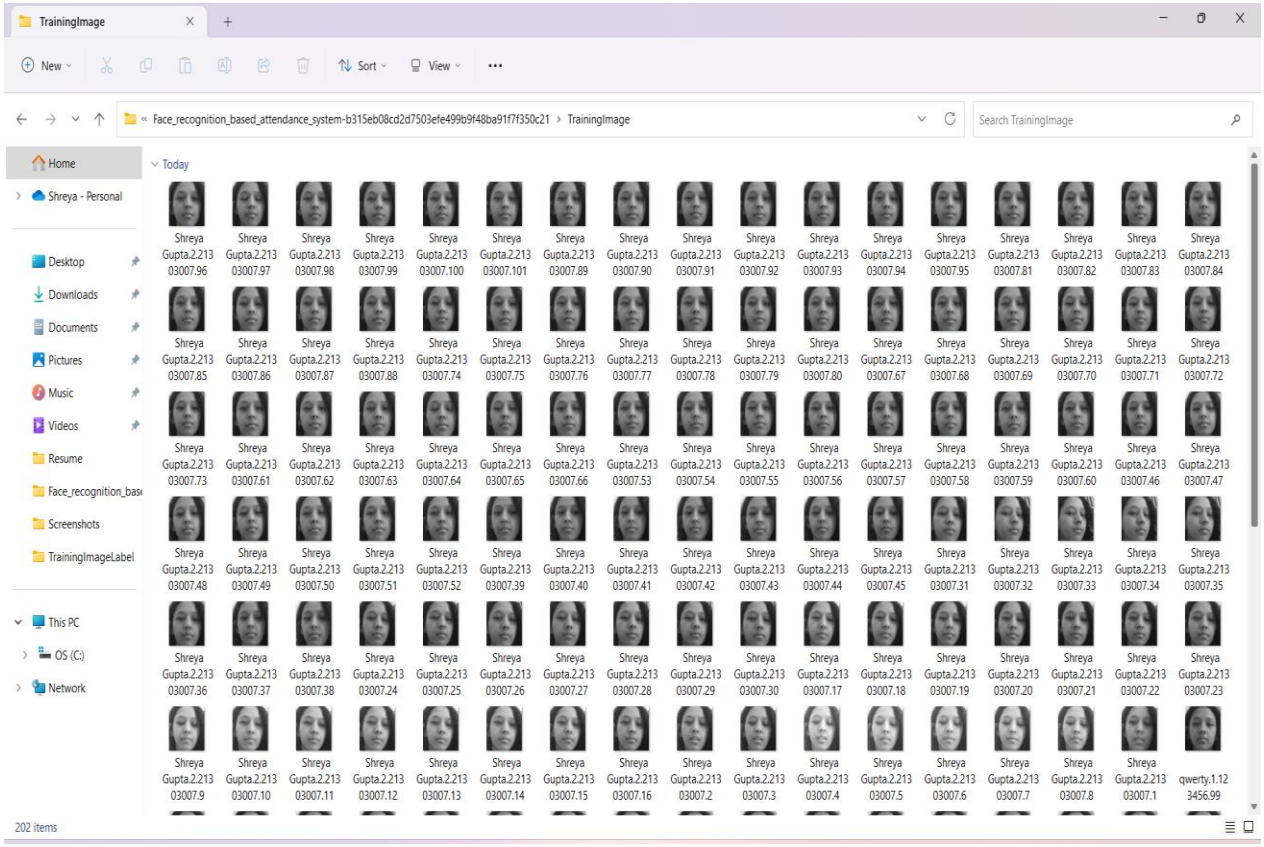


Figure 4.15: Dataset-1

Four volunteers helped to save three photos of each applicant in the database. For the best accuracy, we can increase the number of training pictures however, computing time will get slower.

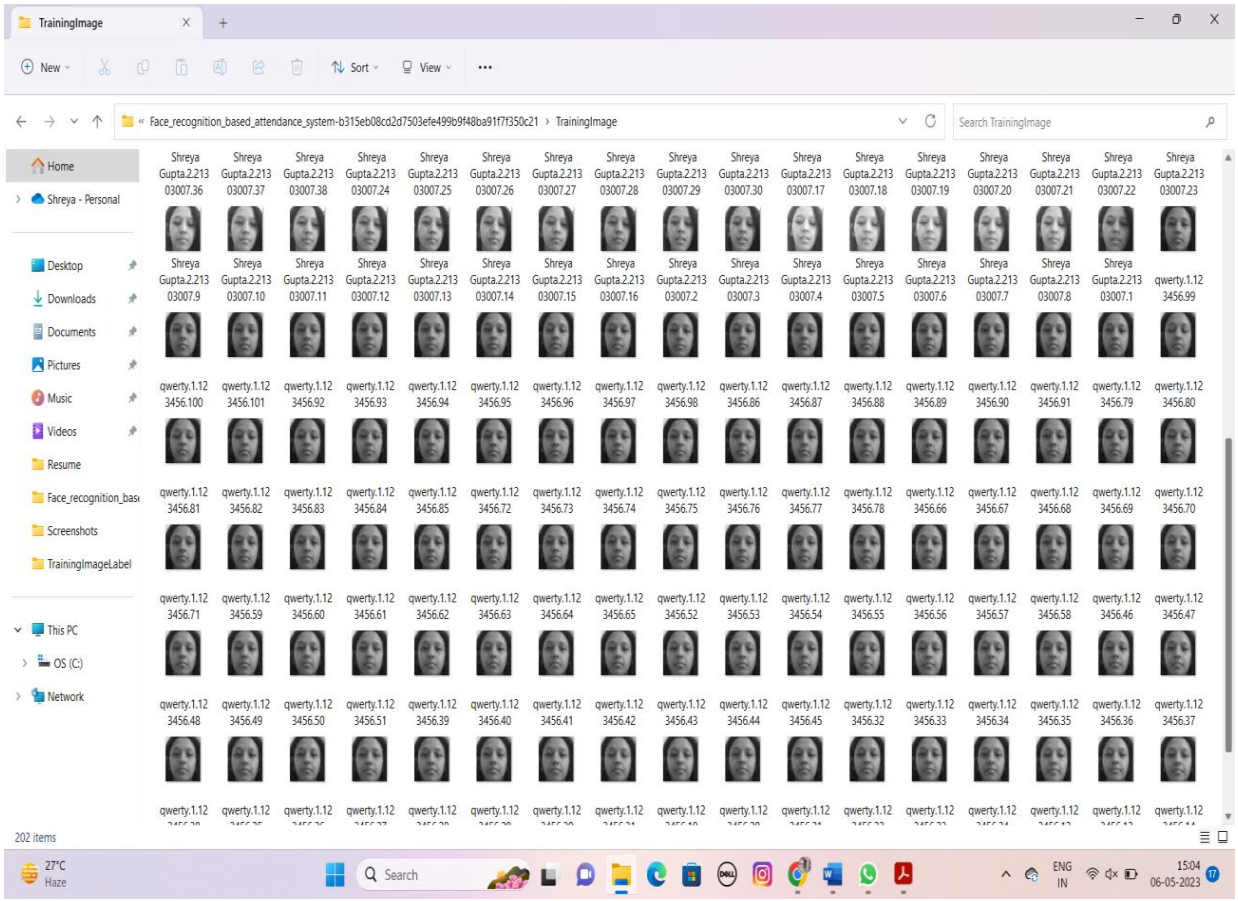


Figure 4.16: Dataset Collection

For our application, though, a variance in calculation speed won't be a problem because classes normally last at least an hour, which is far longer than the amount of time needed for the algorithm to complete its calculations. One thing to keep in mind at this stage is that the facial features should readily apparent and picture must be captured in bright lighting.

To best performance, here ought to be a slight change in an individual’s position or facial expression in every picture.

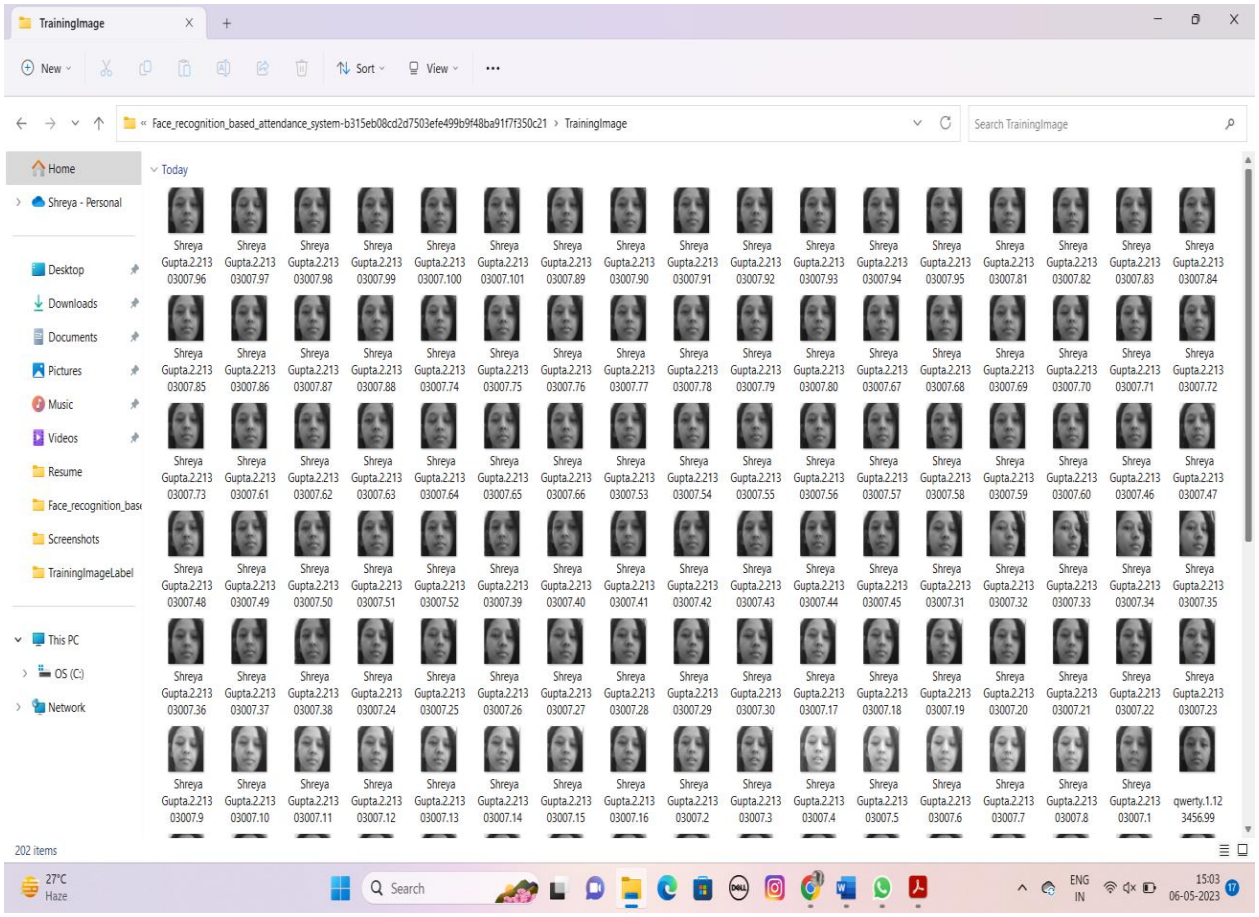


Figure 4.17: Dataset-2

The faces of the students are accurately caught under typical lighting circumstances and based on their correct seating posture. The lighting in the classroom needs to be carefully retained. In case of blackouts, suitable solutions must also be planned. All of the identified faces that are visible in the figure have been edited and stored in the folder for the Test Database. This method read a picture where it has left before and continues processing it. The folder's precise path has to be mentioned. Additionally, names for each face are automatically assigned numbers. This makes it simpler to read the photographs in the folder.

4.2.5 Face recognition

We will provide the cropped picture as an input and the picture processed with the help of Eigen faces method, and after that it will differentiate with the repository. Then, we will get the output as shown in the report.

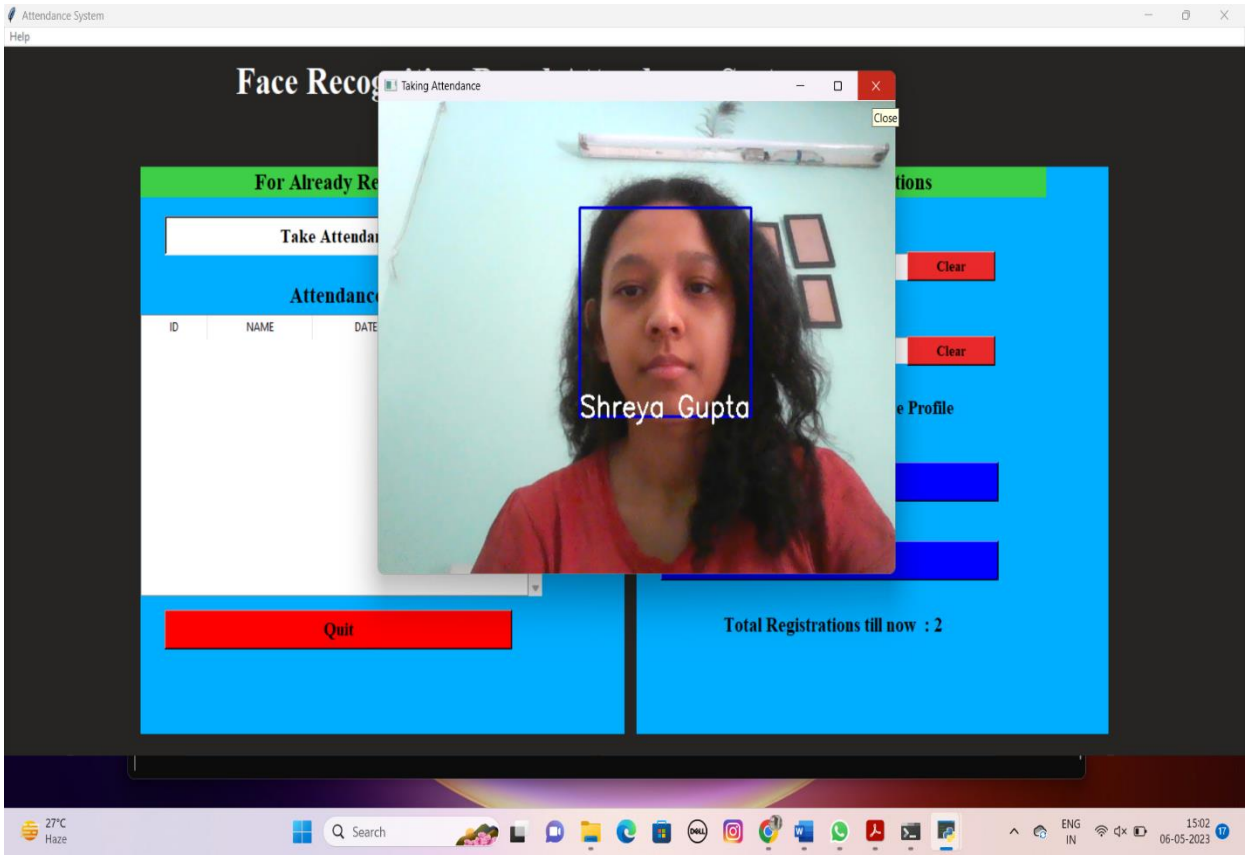


Figure 4.18: Person is identified and name is visible

An individual's image is just disregarded or shown unknown if their database does not have them. Hence, if we want to circumvent wrong or erroneous output, appropriate illumination should arrange.

4.2.6 Taking attendance

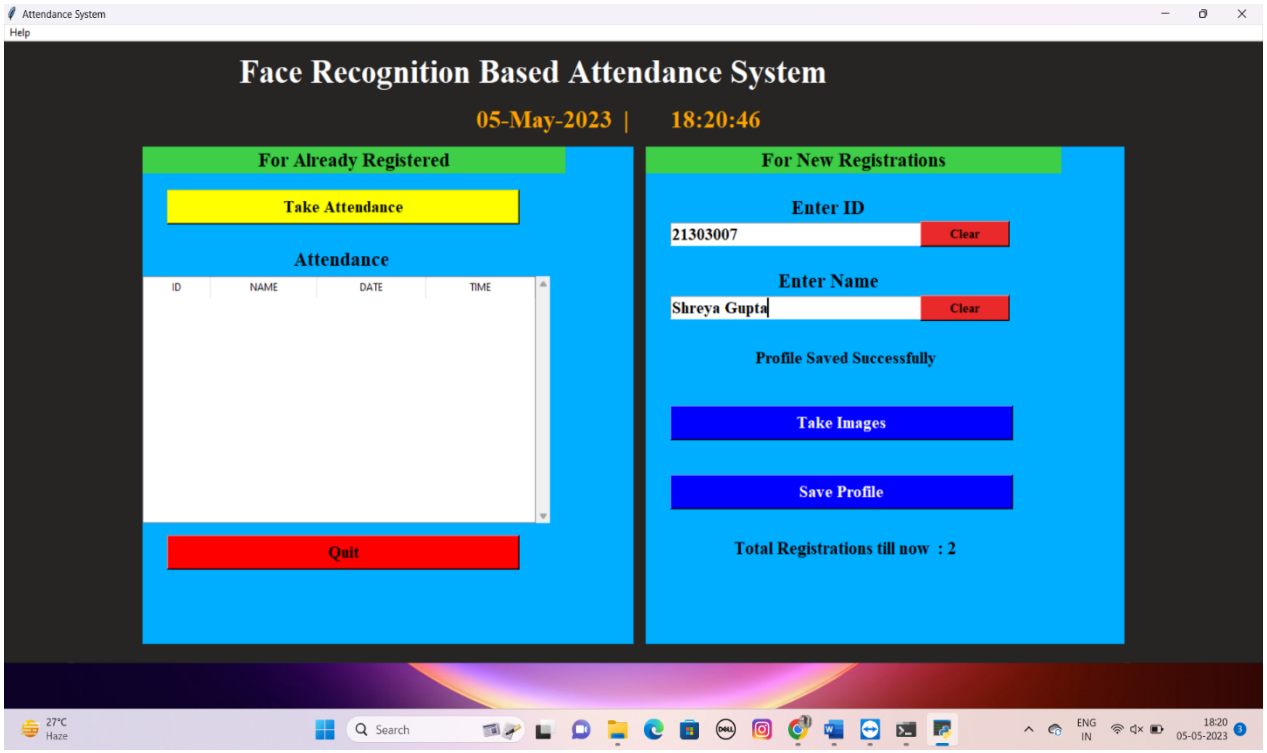


Figure 4.19: Taking attendance

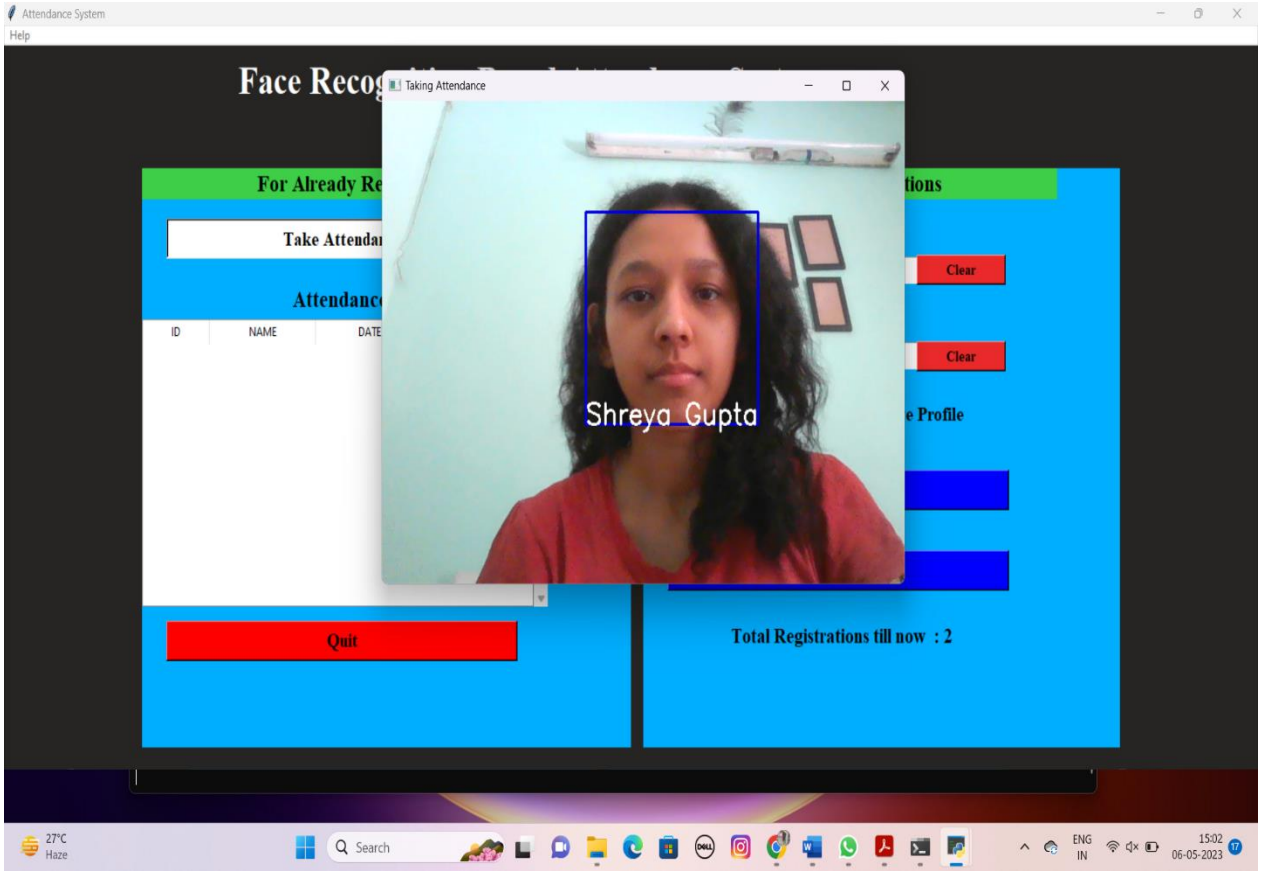


Figure 4.20: Recognizing registered person

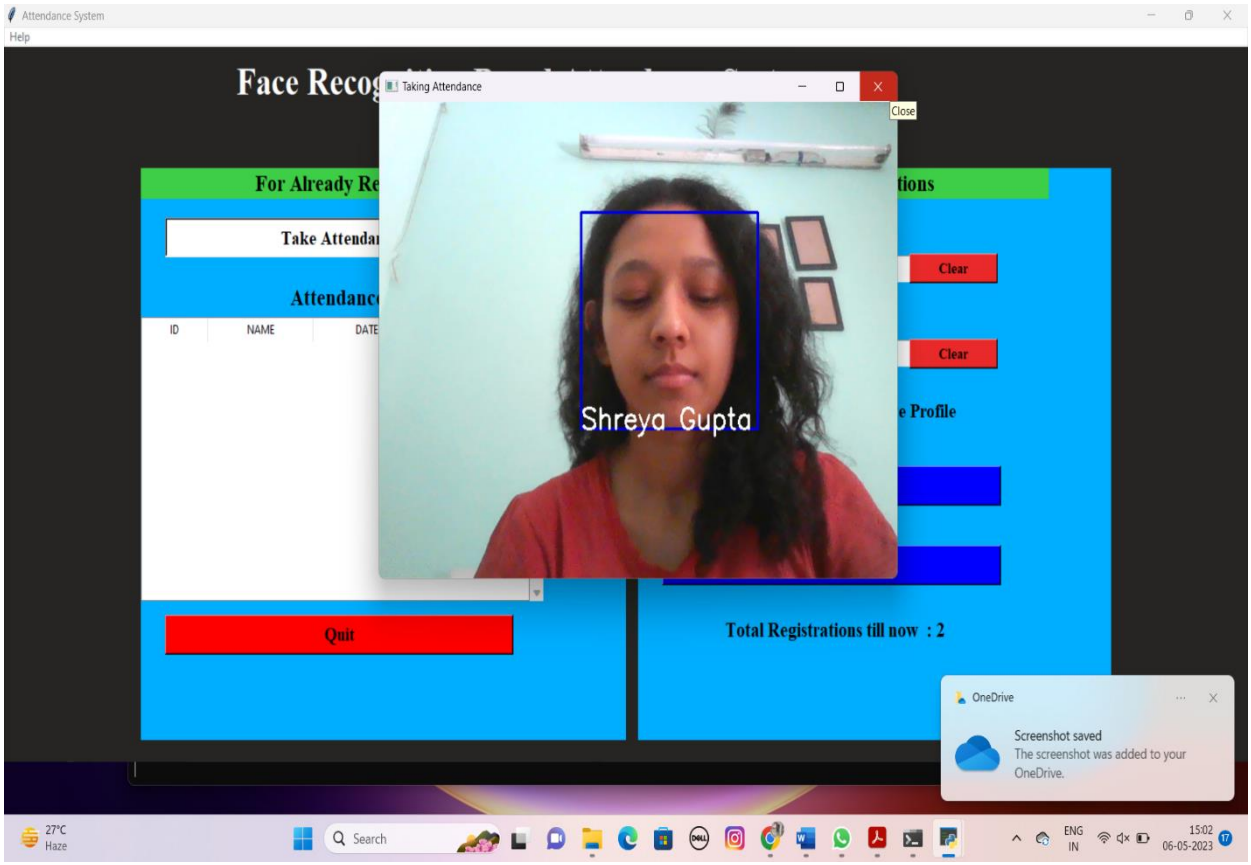


Figure 4.21: Side profile

4.2.7 Excel sheet forms as an output

We receive the results as shown below. The results may then be derived using various functions in the spreadsheet in the proper format. By utilising this format as output, as indicated in the picture, we may obtain the following parameters. The PYTHON Spreadsheet Link Ex toolbox is used to carry out this task.

1. If an individual is present, a "1" is sent to the student's specific field.

2. The sheet also receives the time and date.

If we use a higher quality image capturing equipment, we can utilise this technique to incorporate any amount of student's data.

The next part explains how we use the Graphical User Interface (GUI) to combine all of these functions. This offers consumers a user-friendly interface.

Figure 4.22: Attendance recording

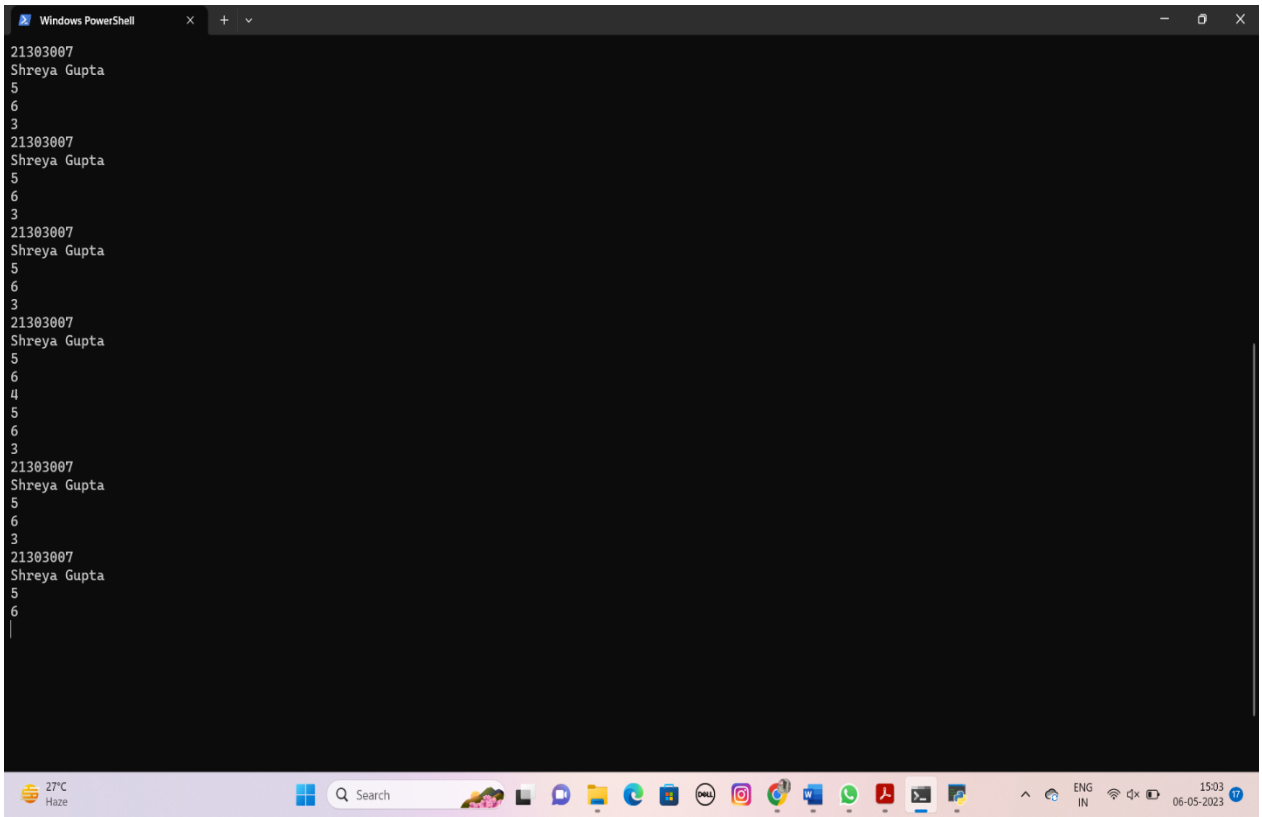


Figure 4.23: Taking attendance

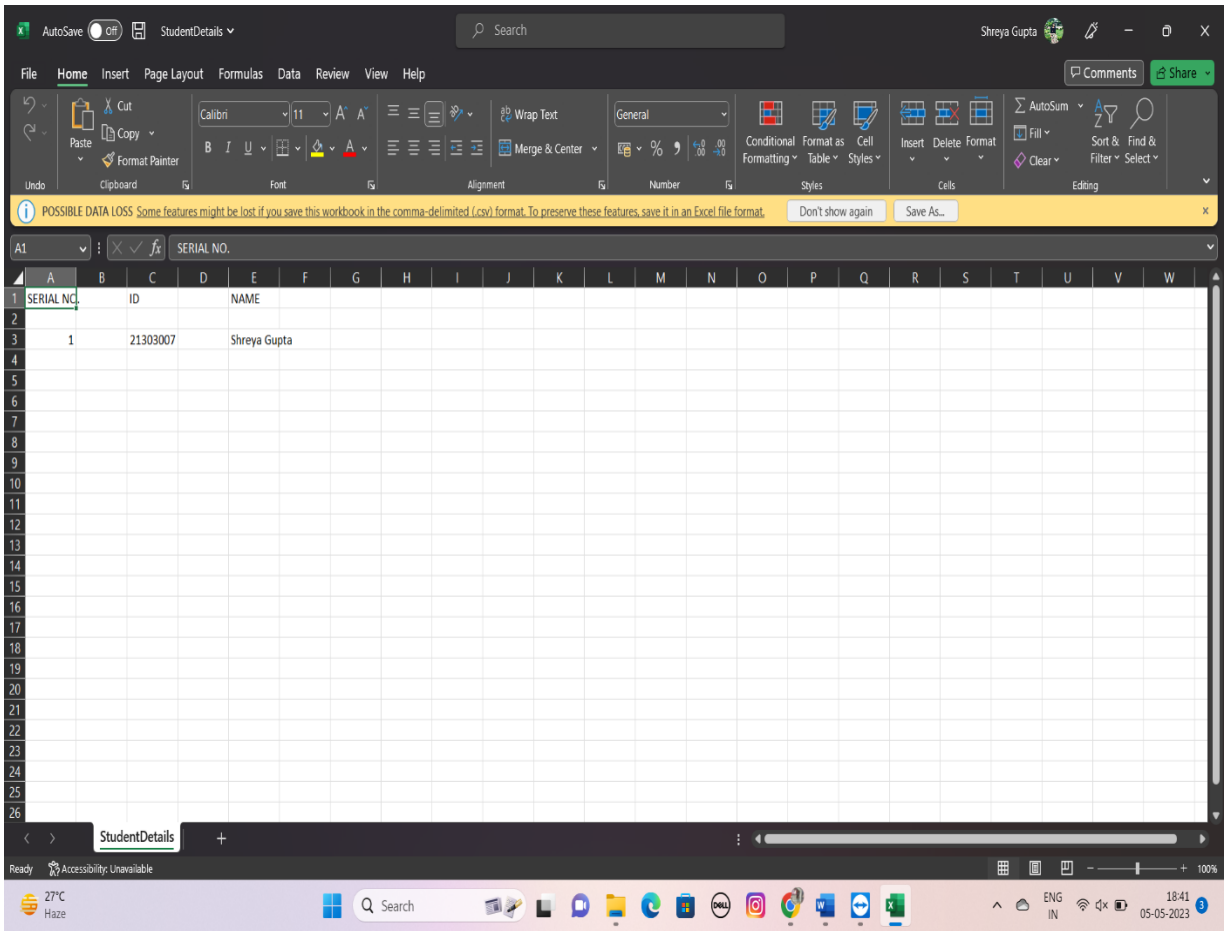


Figure 4.24: Output obtained in MS Excel format

CHAPTER-5

TESTING AND EVALUATION

5.1 TESTING

5.1.1 Test Objective

Each field entry must function correctly.

1. The input screen, messages, and answers must not be postponed.
2. Pages must be launched via the designated URL.

Developers can make sure a project works properly, performs effectively, is safe, and offers a positive user experience by evaluating it against these goals.

5.1.2 Test Approaches

Manual field evaluations will be done, and comprehensive functional evaluations will be prepared. Developers may make sure a facial recognition-based attendance system is dependable, performs effectively, satisfies user expectations, and can withstand high load situations by employing these test methodologies.

5.1.3 TYPES OF TESTINGS

5.1.3.1 Unit Testing

Test case designing of unit testing verifies if the core program logic runs as expected and produces valid results from program inputs, so verifying both the internal code flow and all decision branches is an important step. The evaluation involves scrutinizing the different pieces of software that make up the application and each individual unit is finished before completing it during integration. Conducting an accurate invasive structural examination necessitates comprehending how it was built, so to ensure functionality in systems and applications at the component level against a particular configuration, unit testing analyses them. Unit tests guarantee compliance to stated specifications by evaluating every divergent path in an enterprise process along with clearly defined input-output pairs.

5.1.3.2 Integration Testing

Testing interconnected software components to see if they function as a single programme is what integration tests are intended to do. Results from screens or fields are given special attention in event-driven testing, so integration testing validates that combining these satisfactory individual components results in an accurate and consistent whole even though

each one passed unit tests. Integration testing serves the purpose of revealing any issues that may arise during component combination.

5.1.3.3 Functional Testing

Methodical proof is provided by functional tests that the tested functions are available in accordance with technical and business requirements, system documentation, and user manuals. The following areas are the focus of functional testing:

1. Classes of valid input indicated by the valid input must be recognised.
2. Recognised categories of incorrect input must be rejected.
3. Functions that have been recognised must be used.
4. Application output classes that are output-identified must be used.

Systems/Procedures:

1. It is necessary to call interacting systems or processes.
2. Organizing and preparing functional tests with a focus on requirements and important functionalities.

5.1.3.4 Network Testing

This method comprises testing the system in its entirety to make sure it operates properly and complies with the requirements. The preciseness of the tracking of attendance function and the system's capacity to support numerous users concurrently may both be tested as part of testing the system for a facial recognition-based attendance system.

5.1.3.5 Acceptance Testing

This strategy entails evaluating the system in light of user needs to make sure it satisfies them. The user friendliness, accuracy, and dependability of a facial recognition-based attendance system may be tested during acceptance testing.

5.1.3.6 Regression Testing

In this method, the system is retested after modifications or updates to make sure no new problems or functionalities were broken as a result of the changes. Testing the system following modifications to the algorithm for face recognition or the attendance monitoring module may be part of regression evaluation for a facial recognition-based attendance system.

5.1.3.7 Efficiency Testing

Testing the efficiency of the system under heavy loads to see if it can handle a lot of user traffic and applications without collapsing or slowing down is known as load testing. To evaluate the

system's reactivity and scalability, load testing for the system may entail simulating the high number of users and queries.

5.1.3.8 Performance Testing

In this kind of testing, the system's performance is assessed under a variety of circumstances, such as a high load and continuous use. Some instances of performance evaluation scenarios for this system include:

1. Calculating the time needed for face recognition and detection.
2. Evaluating the responsiveness of the system during high use.
3. Assessing how well the system performs when attempting to access a big database of attendance information.

5.1.3.9 Security Testing

Testing for security entails making sure the system is safe and capable of preventing unauthorised access to user information. Instances of safeguarding test cases for this system includes:

1. Testing the verification and access control procedures of the system.
2. Confirming the system properly encrypts user data that the network has defences against hackers and unauthorised access.

5.1.3.10 Usability Testing

Testing for usability entails assessing the system's user interface and overall user experience. Some instances of usability test scenarios for this system includes:

1. Evaluating the user interface of the system for usability and clarity.
2. Assessing how accessible the system is to individuals with impairments.
3. Checking to see if the system displays user-friendly, clear error messages.

Table 5.1: Accuracy

Number of Test	Image number	Pass	Fail	Accuracy
1	100	91	9	91%
2	100	93	7	93%

3	200	185	15	92.5%
4	200	189	11	94.5%
5	200	181	19	90.5%

5.2 EVALUATION

1. Efficiency: The system's accuracy is influenced by the standard of the face photographs in the storage system, the effectiveness of the facial recognition technique, and the circumstances surrounding the image capture. We may compute the true optimistic rate, erroneous positive rate, and the rate of false negatives to assess the system's correctness. The proportion of accurate identifications is measured by the true positive rate, and the proportion of false positives is measured by the false positive rate. The percentage of missed identifications is gauged by the false negative rate.

2. System performance: The system's performance is based on the hardware it is running on as well as how quickly the facial recognition algorithm is processed. By comparing the amount of time, it takes to process each image and record attendance with the amount of time required by conventional techniques, we can determine how effective the system is.

3. Scalability: The database size and user count both affect the system's capacity to grow. We may monitor the time it takes to add new users to the database and the size of the database as it expands to assess the system's scalability.

4. User experience: The system's usability, dependability, and capacity to give users with feedback all affect how the users feel about it. We can perform user surveys to gauge user happiness, usability, and comprehension in order to assess the system's user experience.

5. Functionality: How effectively the system complies with the criteria and standards determines how functional it is. We may examine the system's capacity to collect and prepare face photographs, extract attributes, compare features, identify people, record attendance, and provide reports in order to gauge its functionality.

6. Performance: The system's performance is influenced by the memory utilisation, processor speed, and other resources used. By measuring the amount of time it requires to analyse each image and record attendance, we can compare the system's performance

to that of more conventional approaches. Additionally, we can monitor the system's memory and CPU usage at various points in the procedure.

7. Dependability: The system's ability to operate effectively and consistently without mistakes or faults determines how reliable it is. We may test the system in various settings and conditions, such as varying the lighting, position, and face expression, in order to assess its dependability.

8. Maintainability: The system's ability to be modified, tested, and bug-fixed determines how easily it can be kept up to date. We may assess the readability and transparency of the code, the efficacy of the testing framework, and the success of the bug monitoring and fixing procedure to gauge how maintainable the system is.

9. Accessibility: The system's usability is based on how simple, clear, and easy to use the user interface is. We can perform user surveys to gauge user happiness, comprehension, and usability in order to assess the system's usability.

5.2.1 The following list of experiment steps is provided:

Face Recognition:

Begin:

Taking pictures using the client's web camera

Start by:

Extracting the face from the acquired image during pre-processing determine the acquired face image's eigen value and compare it to the eigen values of other features in the database.

Upload a new facial photo details to the repository (xml file) if the wavelet digit is different from any of the pre-existing ones.

End:

The identification process should only be completed if new eigen value match with the previous one.

Finishing Face Recognition:

The subsequent actions would be taken for face identification using the PCA algorithm:

Begin:

Find the matching face image's face information in the database. Change the log table to reflect the student's associated face picture and system time, completing the attendance record for that specific student.

End:

The experiment's findings, which involved capturing the face in a 50x50 pixel greyscale picture, are presented in this section.

Table 5.2: Evaluation-1

Code data	Assumed details	Output	Accepted or Not
Cam()	Set connections with the video camera and begins to play.	Camera begins	Accept
Contact()	Message will appear for contacting us.	Message appear “Contact us and Email-id”.	Accept
Load Haarcascadefile()	The frontal face's Haar classifier cascade files.	Prepares to be extracted	Accept
TakeImages()	Starts taking picture of the person who is visible to the screen	Camera start capturing pictures.	Accept
Password()	Enter the password to save the data or picture of the person who wanted to be registered.	Enter the Password	Accept
Change_pass()	To change the password	New password entered	Accept
TrackImages()	Opens the Haar cascade file for face extraction framework.	Face generated	Accept

TrainImages()	Start algorithm	Modernises the facedata.xml	Accept
Tick()	Date time will appear on the screen	Date time appears	Accept
Recognizer()	The input facial features will collate with the saved faces.	Closest face	Accept

Here are our datasets:

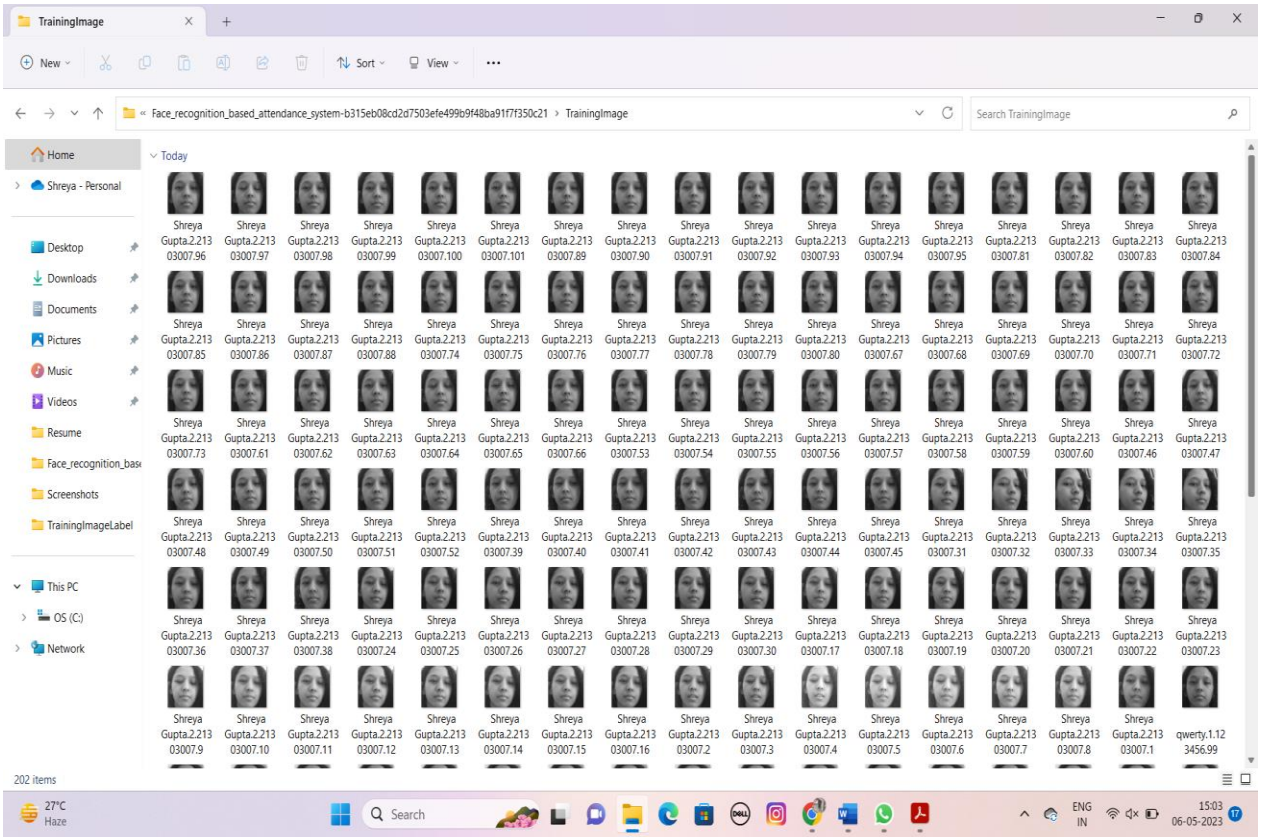


Figure 5.1: Dataset-1

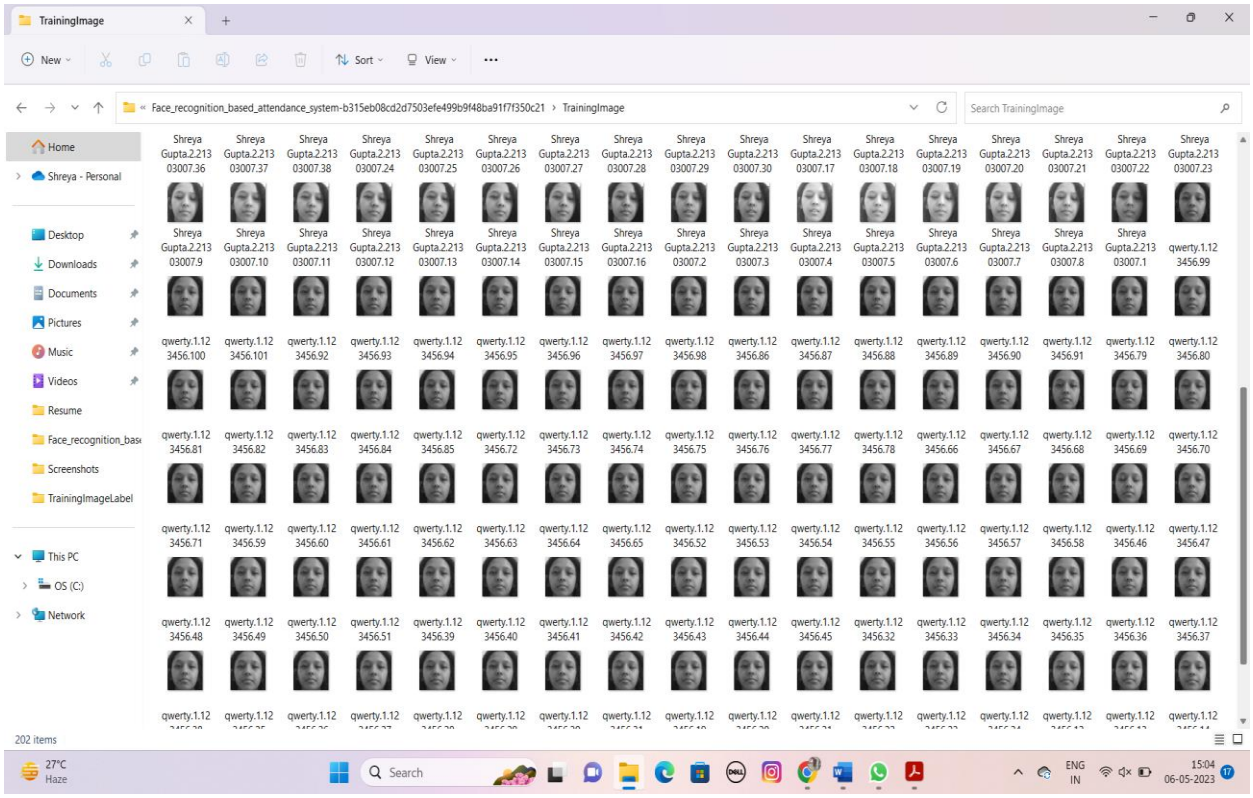


Figure 5.2: Dataset-2

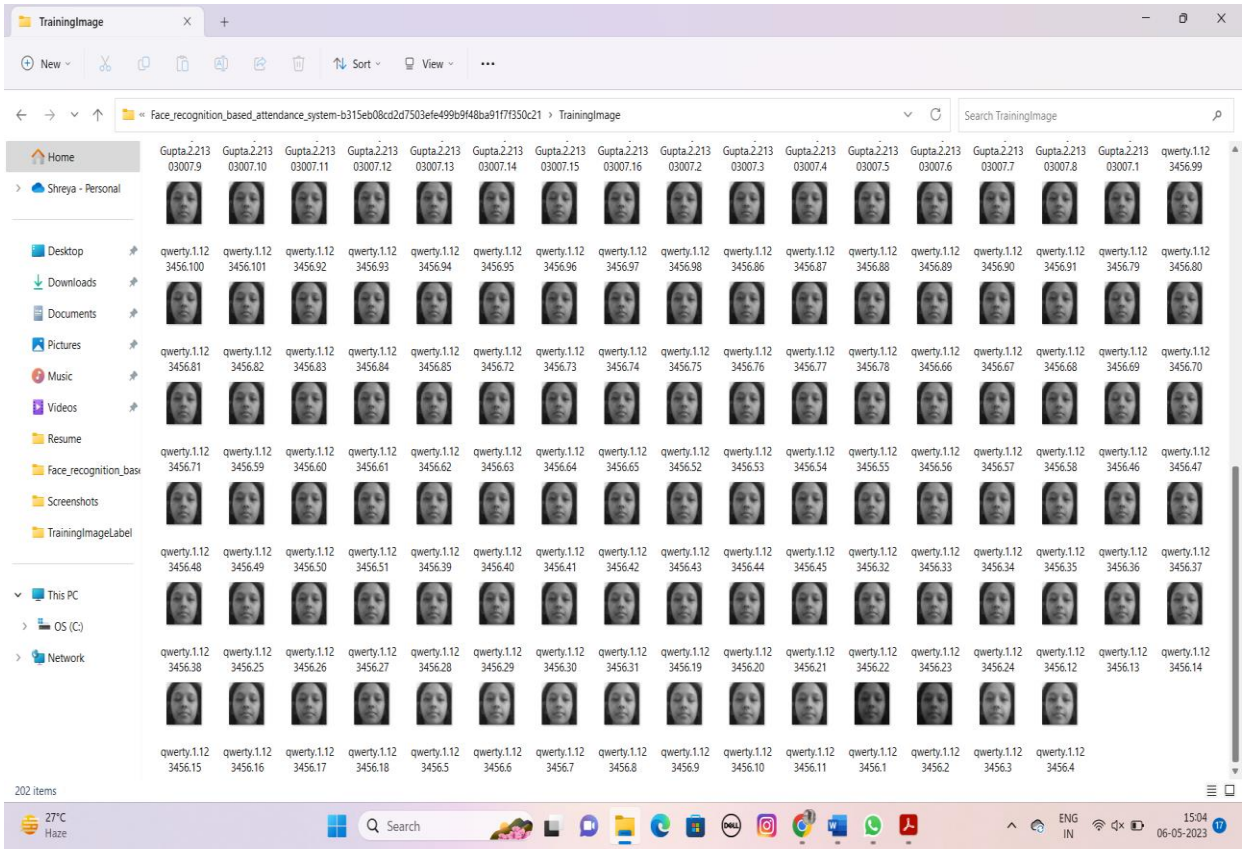


Figure 5.3: Dataset-3

Table 5.3: Evaluation-2

Face Positioning	Detecting rate	Recognition rate
0˚(Straight face)	97.3%	93%
18˚	82%	76%
54˚	52.8%	55%
72˚	0.0%	0.0%
90˚(profile)	0.0%	0.0%

To illustrate the effectiveness of the suggested strategy, we carried out a series of tests. The training set includes 30 various photographs of 10 different people. Figure 3 displays an example binary picture that was identified using the LBPH Collecting Frame detection technique when utilising the recognizer() function.

CHAPTER-6

PERFORMANCE ANALYSIS

6.1 INTRODUCTION

This project performance is measured in a variety of ways in order to pinpoint locations where the system might be improved for greater effectiveness and speed. In the instance of this project a performance evaluation would entail assessing the system's performance across a number of domains, including recognition and detection of faces, gaining access to databases, and overall system responsiveness.

These measurements and performance bottlenecks are measured using methods like targeting, benchmarking, and load evaluation as part of performance analysis. Performance analysis can assist increase the overall effectiveness and rapidity of this system by identifying project components that need to be optimised.

To demonstrate how the system performed in various scenarios, we ran a number of tests. We were able to obtain the distance vs. confidence level graph above by running those tests. The graph suggests that the assurance level is higher when the face is nearer to the camera, and reversed. We may thus register attendance for the individual according to the criteria by maintaining a confidence level threshold.

6.2 ANALYSIS

This project whose performance study includes assessing several performance indicators, including processing time, accuracy, memory use, and scalability.

1. Processing time: The amount of time needed by the system to find faces, identify them, and record attendance may be assessed. The time it takes to finish each operation may be calculated by inserting time stamps at various locations in the source code and contrasting them.

2. Reliability: By contrasting the system's predictions with the actual predictions, the precision of the algorithm may be evaluated in terms of recognising faces. This can be accomplished by personally checking the records of attendance or by comparing the outcomes using automated methods.

3. Storage utilisation: The system's memory consumption may be monitored to make sure it isn't consuming too many resources. This may be achieved by keeping track of the memory utilisation as the project progresses and optimising the code to use less memory.

4. Scalability: The system's capacity to accommodate a high number of users may be tested to see how well it scales. This may be achieved by replicating many different users and evaluating the system's responsiveness and accuracy.

5. User comments: Gathering user comments might be useful for assessing the system's performance. User feedback may be gathered by questionnaires or evaluation sessions and utilised to pinpoint areas that need to be improved.

6. Accurate face identification is a crucial parameter that gauges how well a system can recognise faces in various lighting scenarios, orientations, and emotions. For accurate attendance monitoring, a high degree of precision is required.

7. An essential performance parameter is the system's recognition speed, or how quickly it can identify a face. Faster identification rates can shorten the total amount of time needed for tracking attendance and enhance system responsiveness.

8. System responsiveness: The system's responsiveness gauges how rapidly it reacts to human input, including requests for face detection and identification. Multiple requests may be processed simultaneously by a responsive system without causing it become sluggish or crash.

9. Database access time is a crucial performance parameter since it measures how long it takes the operating system to retrieve and access data from the database. Faster information access speeds can enhance system performance as a whole.

10. Utilisation of resources: The performance of this system can be affected by how much system assets, such as CPU and memory, are utilised. System responsiveness and speed may both be enhanced by effective resource management.

In general, a performance study of this project can assist in locating bottlenecks, streamlining the code, and enhancing user experience.

Here, we focus on one fixed aspect of light intensity. We conducted several studies at various angles and distances. We measured the degree of confidence at various sites by gradually extending the distance. We used the coordinates for y and x to plot the graph, taking into account the values for x as well as the accuracy or confidence level. the distance in centimetres, and y values.

6.3 FLOW CHART

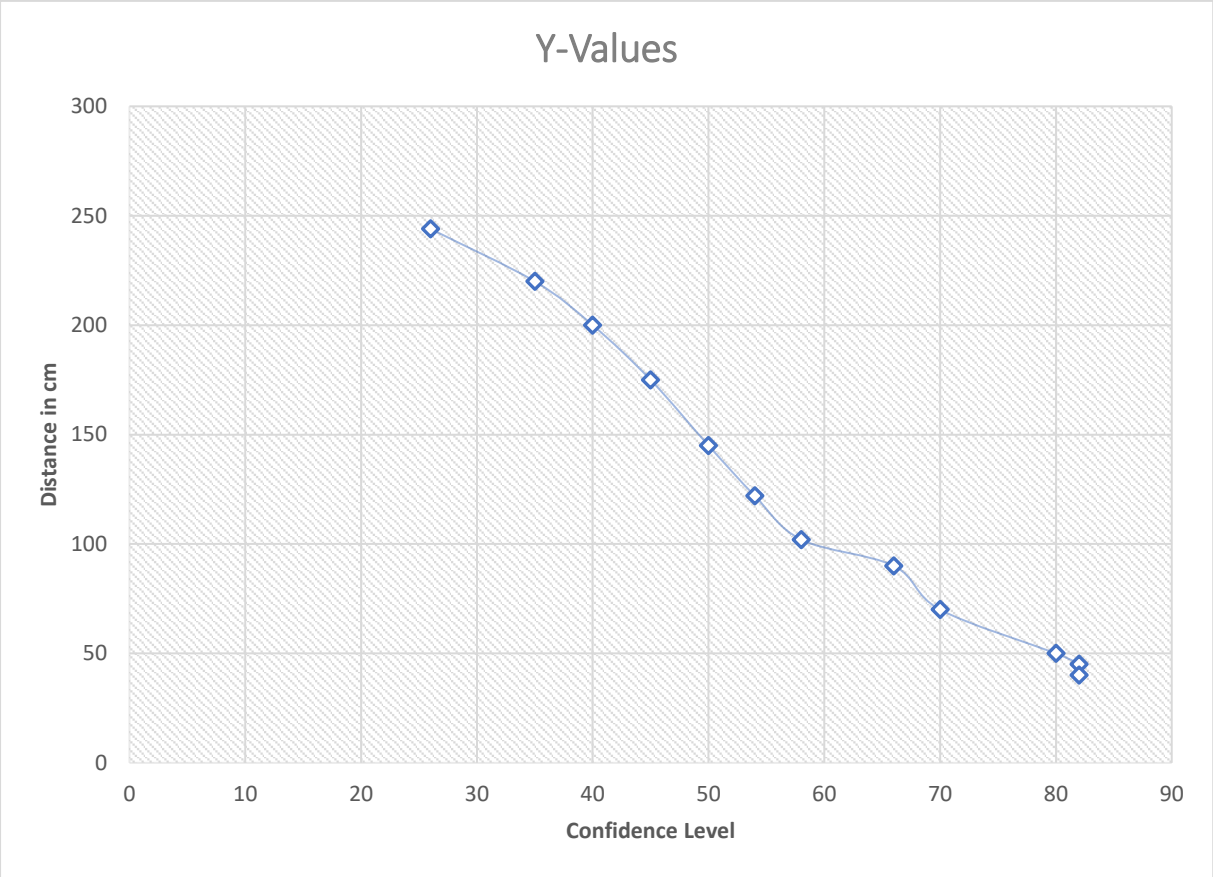


Figure 6.1: Graph

Table 6.1: Dataset

X	Y
26	244
35	220
40	200
45	175
50	145
54	122
58	102
66	90
70	70
80	50
82	45
82	40

X= (100 × Confidence) and Y= Distance (cms)

CHAPTER-7

CONCLUSION

7.1 CONCLUSION

The main objective of this project is to decrease mistakes that frequently occur with the conventional (previous) methods taking attendance. The goal is to electricize and create an infrastructure which will be beneficial to the institution or other organisation. The modern, precise way of taking attendance in offices that may substitute the traditional, manual ones. This approach is workable, legitimate, and sufficiently safe. The system may be installed in the office without the use of specialised hardware. A camera and computer may be used to create it. In this system, a professor or assistant instructor can record students' attendance by using this project for a session, webinar, or lab.

Universities may choose to employ facial recognition technology. Main idea of this System is to minimise the inaccuracies that can arise with the current (manual) method of recording attendance. The goal is to automate and create a system that is beneficial to the institution or other organisation. This approach is workable, trustworthy, and sufficiently safe. Multiple faces can be detected by the proposed algorithm, and the system's performance is satisfactory.

In conclusion, this system is a potent tool that may increase overall efficiency of various contexts, including educational institutes, universities, and workplaces, by streamlining attendance monitoring, lowering mistakes and time-consuming manual processes. To reliably identify unique faces and record attendance in accordance, the system combines machine learning, image analysis, and data management strategies.

The system may be modified and tailored to fit the unique requirements of various organisations, including integrating real-time monitoring and other systems and applications. Convolutional neural networks and other already trained models using deep learning can improve the precision and dependability of recognising faces, while NumPy and Pandas data management systems can offer comprehensive data storage, processing, and reporting capabilities.

Overall, this project has the ability to speed up the process, lower expenses, and enhance attendance management in general. The capacity to develop and use such systems is becoming more and more accessible to organisations of all sizes because to technological advancements and the accessibility of free software and frameworks.

7.2 LIMITATIONS

1. Absence of adequate federal restrictions: Demand for face recognition has dramatically increased. This technology's market is expanding rapidly. According to a study, the US face recognition market might reach $7.0 billion by 2024, with surveillance and marketing being the key drivers of growth. One of the main issues for the populace is the absence of adequate government rules. They are concerned about the invasion of their privacy, incomplete accuracy, and skewed or incorrect outcomes.

2. Error in Identity: This technology are using now-a-day several law maintain organisations and departments to find offenders and do other searches. However, since people are already concerned about the system's results' partial accuracy, this could result in misidentification. Authorities could find the incorrect person guilty, which might have negative long-term effects and be highly detrimental to that person's reputation in society.

3. Infringement against UN Human Rights: The UN has acknowledged the human rights concept that surveillance should only be used when it is appropriate and required. Instead of enabling others to inadvertently interfere with other people's freedom and fundamental rights, it indicates that monitoring should only be used in cases of serious wrongdoing. Users of this project will able to keep an eye on others' whereabouts at any time. People have every reason to be sceptical of this technology and the motives of those who use it to undermine national security.

4. Negative impact on public event attendance by citizens: A lack of active attendance and engagement in public events, such as political campaigns and protests, may be caused by citizens' suspicion of this technology and the government's intentions in employing it. This may significantly impede individual's rights and freedom.

5. Can be utilised to target additional, more exposed areas of the building: Security of individuals, monitoring and tracking of lawbreakers, keeping track of employee attendance and working hours, and many more uses are all made possible by facial recognition technology. On the other side, it may also be applied to target certain societal groups in an effort to undermine them. For instance, there has been a lot of backlashes against the use of face recognition software by organisations like US Immigration and Customs Enforcement (ICE). The organisation has received harsh criticism for how it handles the migrants.

7.2.1 To address the issues, something that must be done:

There is no entirely fault-proof technology. Each of them has ups and downs as well as facial recognition. Software for managing attendance that uses AI is not an exception. However, it is crucial to consider how this technology is affecting people's human and civil rights, particularly in light of current global circumstances. AI and face recognition technologies are developing, and they will continue to evolve in the years to come. However, its benefits might be lasting. Lawbreakers could be able to get past it in the future, and the list of security and confidentiality worries will keep growing. Unless, of certainly, experts figure out a means to make sure that this innovation is used correctly, that it operates well, and that no one abuses it.

7.3 FUTURE SCOPE

The system here is simply intended to track students' attendance in class. However, this system will improve and adapt in many different ways which includes multinational corporations for the maintenance of the surveillance huge repository, filled with a sizable no. of data of the employees doing job in a specific organisation. This will be able to aid in maintaining security and also allow the business to check over their employees whether they are able to work for required nos of hours each day. Banks may also use this strategy. The ATMs could acquire this

system. Only once the clients' faces have been recognised by the ATM machine through comparison with photographs that have already been recorded in the database would they be permitted to access their bank accounts. This might contribute to reducing money thefts and boosting ATM security.

A project of this nature requires more thorough investigation. The techniques employed could be coupled with others to get outstanding outcomes. The literature review indicates that several tactics have been employed in the past. A login option will be added to the system for safety considerations. The technology will be made available to other institutions as a standalone system. The photographs of new pupils are taken at the beginning of each academic year and kept in the institution's databases. Every student has the right to know whether or not a face recognition attendance system will utilise their faces. Government restrictions on moral concerns, in addition to regulations regarding data protection and rights, must be followed in this. Participants must provide their consent for their pictures to be used as proof of attendance.

On this project, there are still a few tasks that need to be finished in order to notify the student via SMS about his or her their attendance. By using a GSM module, this is made possible. The parent of the pupil receives this SMS notification. The technique that has been provided is meant solely for testing because it is not entirely trustworthy.

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