Dr. Akhilesh Das Gupta Institute of Technology & Management

(New Delhi)

Department of CSE

ATTENDANCE MANAGEMENT SYSTEM USING FACE RECOGNITION

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Declaration

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

Vaibhav Malhotra

Yash Bansal

Rohan Babbar

CERTIFICATE

This is to certify that, the project work embodied in this report entitled, "Advanced Attendance System using OpenCV "submitted by Vaibhav Malhotra (36015602721), Yash Bansal (09915602721) and Rohan Babbar (08615602721) for the award of Third year in Bachelor of Technology degree in the subject of Computer Science and Engineering, is a work carried out by them under my guidance and supervision within the institute. The work described in this project report is carried out by the concerned students and has not been submitted for the award of any other degree of the University of Mumbai. Further, it is certified that the students were regular during the academic year 2023-24 and have worked under the guidance of concerned faculty until the submission of this project work at Dr. Akhilesh Das Gupta Institute of Technology and Management, New Delhi.

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Signature

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In conclusion, this project has been a collaborative effort, and we are truly grateful for the support and contributions of all those involved.

Abstract

This abstract introduces an innovative attendance system **implemented in Python**, which capitalizes on facial recognition technology, merging ***the realms of computer vision*** and **machine learning**. By harnessing the potency of Convolutional Neural Networks (CNNs), the system automates attendance management by swiftly identifying individuals through ***real-time facial analysis***, even amidst dynamic lighting conditions, diverse poses, and varied expressions. This pioneering solution holds the potential to significantly heighten efficiency across educational institutions, corporate environments, and event management scenarios, offering a streamlined and precise approach to attendance tracking.

At the crux of this innovation is the system's Python-based foundation, which affords a wealth of readily accessible libraries and tools, facilitating a seamless integration of cutting-edge techniques. This amalgamation ***redefines conventional attendance tracking paradigms*** by presenting a sophisticated, adaptable, and efficient alternative. By setting new benchmarks in accuracy and operational efficiency, this abstract underscores the transformative influence of the proposed facial recognition-enabled attendance system across multifarious sectors.

Chapter 1:

Introduction

Efficiently maintaining attendance amidst daily activities is a formidable challenge. The conventional approach of individually calling out student names is not only time-intensive but also prone to proxy attendance. This paper introduces a solution grounded in face recognition to revolutionize student attendance tracking. The system meticulously records daily attendance on a subject-by-subject basis, a task efficiently managed by administrators. Upon the commencement of each subject session, the system autonomously captures images, employs advanced face detection and recognition techniques, and identifies recognized students as present. Their attendance records are seamlessly updated with precise timestamps and associated subject identifiers.

Leveraging the power of deep learning techniques, this system employs the histogram of oriented gradients methodology for robust face detection within images. Additionally, deep learning methods are utilized to meticulously compute and compare distinctive facial features, facilitating accurate student recognition. Notably, this system excels in real-time identification of multiple faces concurrently.

At its core, the primary objective of this project is ***to create an automated student attendance system*** founded on cutting-edge face recognition technology. To ensure optimal performance, the approach restricts the utilization of test and training images to frontal and upright facial poses, each containing a single distinct face. Consistency is emphasized, requiring both test and training images to be captured using the same device to eliminate variations in image quality.

The user-friendly interface facilitates seamless registration, enabling students to enrol on the spot. This introduction is ***to sets the stage for a comprehensive exploration of the development, implementation, and implications of this innovative face recognition-based automated attendance system.***

Motivation

The motivation to develop an advanced attendance system arises from the limitations of traditional methods. ***Manual attendance tracking is prone to errors, proxy attendance, and consumes time*.** The imperative to address these challenges drives the exploration of cutting-edge technologies like face recognition and machine learning. The system's potential to enhance efficiency, accuracy, and convenience fuels its development.

In educational institutions, precise attendance is crucial for effective teaching and learning assessment. In workplaces and events, accurate records aid in accountability and resource management. By automating attendance processes, the system reduces administrative burdens and errors, allowing institutions and organizations to focus on core activities.

The motivation lies in the system's ability to transform attendance management across sectors. By optimizing this process, it aims to increase productivity, accountability, and transparency, aligning with the pursuit of technological progress and operational excellence.

Problem Statement

The research **problem for face detection attendance system arises from the limitations of traditional attendance management systems**, which are **time-consuming**, **prone to errors**, and require manual input. These limitations oftenresult in inaccurate attendance records, which can affectpayroll processing, student performance evaluation, and other critical functions. Biometric technology, such as face recognition, has emerged as a promising solution to address these issues by automating the attendance management process and reducing errors. However, the implementation of face recognition-based attendance systems in educational institutions and workplaces requires careful consideration oftechnical feasibility, accuracy, and user acceptance.

The lack of research on the feasibility and accuracy of face recognition-based attendance systems in different contexts, such as different lighting conditions, poses, and occlusions, is a major research gap. Moreover, the user acceptance and ethical implications of using biometric technology also needto be investigated. Therefore, the research problem is to evaluate the feasibility, accuracy, and user acceptance offace recognition-based attendance systems, identify the factors that affect their performance and adoption, and address the ethical and legal implications of using such technology in educational institutions and workplaces.Ultimately, the goal is to provide recommendations for improving the efficiency, accuracy, and user acceptance of attendance management systems while ensuring ethical and legal compliance

Objective

To ***design and implement an advanced attendance system that utilizes face recognition technology*** using Python to improve the accuracy and efficiency of recording and managing attendance data in educational institutions and workplace environments. Concept in a classroom with large number of students, it is a very tedious and time-consuming task to take the attendance manually. Therefore, we can implement an effective system which will mark the attendance of students automatically by recognizing their faces. The process of this face recognition system is divided various steps, but the important steps are detection of face recognition of face. Firstly, to mark the attendance of students, the image of students' faces will be required. This image can be snapped from the camera device, which will be placed in the classroom at a suitable location from where the whole classroom can be covered. This image will act as input to the system. For the effective face detection, the image needs to be enhanced by using some image processing techniques like grayscale conversion of image and histogram equalization. To identify the students sitting on the last rows neatly, the histogram equalization of image needs to be done. Hence, there is a need to develop a real time operating student attendance system which means the identification process must be done within defined time constraints to prevent omission. The extracted features from facial images which represent the identity of the students have to be consistent towards a change in background, illumination, pose and expression. High accuracy and fast computation time will be the evaluation points of the performance.

Feasibility Study

Conducting a feasibility study for an ML-based attendance system follows a structured process aimed at evaluating the viability of developing a predictive model for attendance management. The study encompasses four key aspects: **training data, predictive features, data sources, and production.**

In the realm of training data, the focus is on the necessity of collecting substantial labeled attendance data for effective model training. Collaborating with educational institutions becomes pivotal in obtaining these records, even though it involves a notable investment of time and resources. The benefits of accurate attendance prediction and automation make this effort promising.

The predictive features stage involves input from domain experts who identify factors correlated with attendance patterns. These could span historical attendance records, class schedules, student behaviour data, and even external factors like weather conditions. Importantly, most of these features are readily accessible within educational institutions' repositories.

Data sources evaluation revolves around assessing the accessibility of both internal and external data repositories. This involves collaborating with data engineers to facilitate access to internal attendance data. On the other hand, the utilization of external data sources such as weather APIs incurs costs that need careful consideration.

The production phase encapsulates the development, deployment, and maintenance efforts. Iterative model training and fine-tuning are essential, followed by collaborative deployment efforts involving data scientists, engineers, and administrators to integrate the model into existing systems. Continuous monitoring and maintenance ensure sustained model performance.

In conclusion, a systematic feasibility study aids educational institutions in determining the potential of implementing an ML-based attendance system. By navigating through training data, predictive features, data sources, and production considerations, institutions can weigh the investment against the anticipated benefits of accuracy enhancement and automation. This comprehensive evaluation facilitates informed decision-making regarding the adoption of predictive models for attendance management.

Significance of Project

The advanced attendance system utilizing face recognition using Python has significant benefits and advantages. Here are some of the key significance of this system:

Automation: The system automates the attendance process by using face recognition technology. It eliminates the need for manual attendance marking, reducing human error and saving time.

Accuracy: Face recognition technology is highly accurate in identifying individuals. It can recognize faces with a high level of precision, ensuring accurate attendance records.

Efficiency: The system operates quickly and efficiently. It can process a large number of faces in real-time, making it suitable for industries, organizations, and companies with a large workforce.

Security: Face recognition technology provides an additional layer of security. It ensures that only authorized individuals can mark their attendance, preventing attendance fraud or proxy attendance.

Integration: The system can be integrated with other existing systems or software. It can be connected to HR systems, payroll systems, or access control systems, streamlining administrative processes.

Cost-effective: Implementing an advanced attendance system utilizing face recognition using Python can be cost-effective in the long run. It reduces the need for manual labor, paper-based systems, and reduces the chances of errors or discrepancies in attendance records.

Overall, the advanced attendance system utilizing face recognition using Python offers significant advantages in terms of ***automation, accuracy, efficiency, security, integration, and cost-effectiveness***. It is a valuable tool for industries, organizations, and companies looking to streamline their attendance processes and improve overall efficiency.

Beneficiary of the system

Key Beneficiaries of the Advanced Face Recognition Attendance System using Python:

- **Industries and Organizations:** Efficiently tracks employee attendance, ensuring timely presence.
- **Educational Institutions:** Streamlines attendance for students and staff, reducing errors and manual effort.
- **Remote Workforce Companies:** Enables accurate attendance marking for remote employees anywhere.
- **HR Departments:** Automates attendance tracking, reducing administrative burden and disputes.
- **Security Personnel:** Enhances security by preventing attendance fraud and proxy marking.
- **Managers and Supervisors:** Accesses real-time attendance data, aiding workforce management decisions.
- **Employees:** Offers a swift and accurate attendance process, eliminating manual tasks.
- **IT Professionals and Developers:** Provides practical experience in implementing face recognition technology using Python, enhancing skills in computer vision and machine learning.
- **Efficiency Improvement:** Optimizes attendance processes across sectors, saving time and resources.
- **Accuracy Enhancement:** Ensures precise attendance records, minimizing discrepancies and errors.

Chapter 2:

LITERATURE REVIEW / RELATED RESEARCH OUTCOMES

In [1] 2017 Samuel John presented a Face Recognition Attendance System with GSM Notification. This system uses the Viola Jones algorithm. This algorithm used for detect faces. Also, Fisher faces algorithm was used to create patterns of the faces which were caught. That created templates stored in the database. This system used library which is OpenCV and used Software Development Kit (SDK) to create the graphical user interface. In[2] otherpaper, Jenif D Souza introduces a Automated Attendance Marking and Management System by Facial Recognition. This system marked students attendance automatically by the camera which captures the photo of studentin the class. This system uses the algorithm called Histogram. Histogramalgorithm used for face identification purpose. In this algorithm, The face image is converted to matrix form. Histogram are used for recognize of the exact faces. This system overcome the problem of time consuming. In[3]

2019 Nandhini R. introduced Attendance System based on face recognition. This system captures the video of the students, convert it into frames and store it in the database. Also, Convolution Neural Network (CNN) algorithm is used to detect faces. This System helps in improving the accuracyand speed.

In[4] 2016, E Vardharajan, R Dharani, S Jeevitha,S Hemalata introduced Automatic Attendance Management System Using Face Recognition. In this system the use Eigen Faces, Eigen Weight method for face detection this system the camera detention the image and then system crop the faces ofstudent and tie the faces with student database.

Authors in [5] researches to get best facial recognition algorithm (Eigenface and Fisherface) provided by the Open CV 2.4.8 by comparing the Receiver Operating Characteristics (ROC) curve and then implemented it in the attendance system. Based on the experiments carried out in this paper, the ROC curve proved that, Eigenface achieves better result than Fisherface. System implemented using Eigenface algorithm achieved an accuracy rate of 70% to 90%. In [6], authors proposed a method for student attendance system in classroom using face recognition technique by combining Discrete Wavelet Transforms (DWT) and Discrete Cosine Transform (DCT). These algorithms were used to extract the features of student's face followed by applying Radial Basis Function (RBF) for classifying the facial objects. This system achieved an accuracy rate of 82%. attendance management process and reducing errors. However, the implementation of face recognition-based attendance systems in educational institutions and workplaces requires careful consideration of technical feasibility, accuracy, and user acceptance.

The lack of research on the feasibility and accuracy of face recognition-based attendance systems in different contexts, such as different lighting conditions, poses, and occlusions, is a major research gap. Moreover, the user acceptance and ethical implications of using biometric technology also need to be investigated. Therefore, the research problem is to evaluate the feasibility, accuracy, and user acceptance of face recognition-based attendance systems, identify the factors that affect their performance and adoption, and address the ethical and legal implications of using such technology in educational institutions and workplaces.Ultimately, the goal is to provide recommendations for

improving the efficiency, accuracy, and user acceptance of attendance management systems while ensuring ethical and legal compliance.

Chapter 3:

Methodology of the project / Implementation

This Proposed system improve the attendance management system using of our unique characteristics of their face. For the purpose of confirmation and documentation face acknowledgment technique is used. The algorithm which uses for biometric facial recognition follow different steps of image processing. Capture- The first step of this system isto gather physical or communication tests in predefined situations and through the state period of that time. Extraction- In this step, all data will be extracted from the samples created to make template using facial recognition. Comparison- After finishing the extraction step collecteddata is compared with existing that templates. Matching-In this last stage of face recognition, the face features of a gathered samples are matching with the one from a facial database or not. It will take just a second. In this system we can use Haar Cascade method. A Haar Cascade is used in image recognition and image processing that us specially designed for pixel data.

TOOLS / TECHNIQUES TO BE USED FORDATA ANALYSIS:

- OpenCV: OpenCV is an open-source computer vision library that can be used for face detection and recognition. It has built-in algorithms for face detection and recognition and can be used with Python, C++, and Java.
- Microsoft Excel: Microsoft Excel is a widely used tool for data analysis. It has built-in features for descriptive statistics, regression analysis, and data visualization.
- Pickle: It is a commonly used Python library for serializing and deserializing Python objects.It allows you to save Python objects, such as trained models, to disk and load them back intomemory later.When it comes to face detection systems, Pickle can be used to save and load trained face detection models.
- KNN: KNN is primarily a classification algorithm, it can be used for face detection by treating it as a binary classification problem (i.e., determining whether a given image contains a face or not).It is a simple and intuitive algorithm that doesn't require explicit training in the traditional sense. It relies on comparing new instances with labeled instances in the training set.
- win32com.client: This module is used for interacting with the Windows COM (Component Object Model) interface. More specifically, it is used to utilize the Microsoft Speech API (SAPI) for text-to-speech functionality. Here's a breakdown of the role performed by the win32com.client module and its associated Dispatch class.

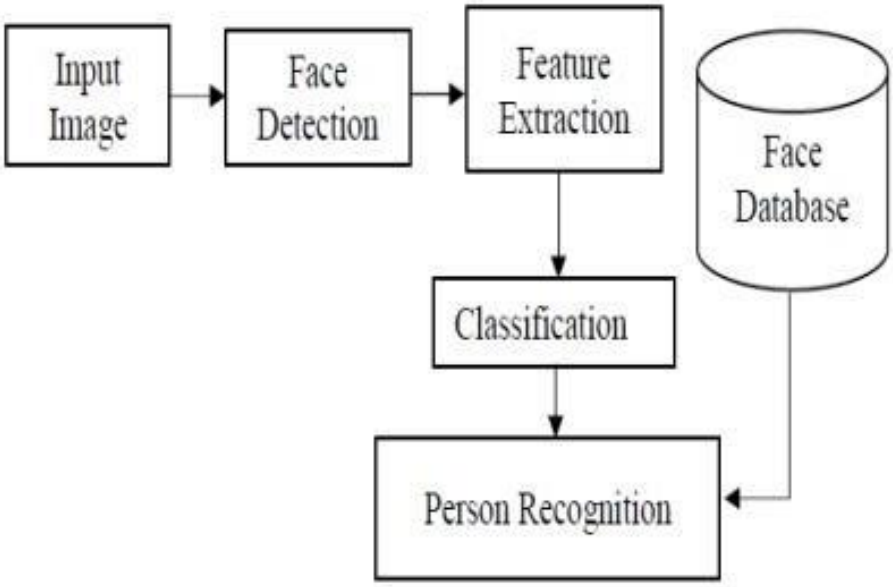


Fig 1. Block Diagram

SOFTWARE DESCRIPTION

- **OpenCV** Open CV (Open Source ComputerVision Library) is a open source computer vision software library for the purpose of machine learning. Open CV was developed to serve the purpose of computer vision applications and to stimulate the usage of machine perception in the commercially viable products. Open CV is a BSD-licensed product which is easy for the utilization and modification of the code. The library contains more than 2500 advanced algorithms including an extensive set of both typical and state-of-the-artcomputer vision and machine learning algorithms. These algorithms can be employed for the detection and recognition of faces, identification of objects, extraction of 3 D models of objects, production of 3 D point clouds from stereocameras, stitching images together for productionof a high resolution image of an entire scene, finding similar images from an image database, removing red eyes from images taken using flash, following eye movements, recognition of scenery and establishing markers to overlay it with intensified reality etc. It includes C++, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. Open CV mainly involves real-time vision applications taking advantage of MMX and SSE instructions when available. A full-featured CUDA and Open CL interfaces are being progressively developed. There are over 500 algorithms and about 10 times functions that form or back those algorithms
- **Pandas** is an open source Python package that caters diverse tools for data analysis. The package contains various data structures that can be used for many diverse data manipulation tasks. It also includes a range of methods that canbe invoked for data analysis, which becomes feasible when working on data science and machine learning problems in Python.
- **Idle** is Python's Integrated Development and Learning Environment. IDLE is completely coded in Python, using the tkinter GUI toolkit. It works mostly uniformly on Windows, Unix andmacOS. It has a Python shell window (interactive interpreter)

with colorizing of error messages, codeinput and code output. There is a multi-window text editor with multiple undo, Python colorizing, smart indent, call tips, auto completion, and other features. Searching within any window, replacing within editor windows and searching throughmultiple files is possible. It also has configuration, browsers and other dialogs as well.

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

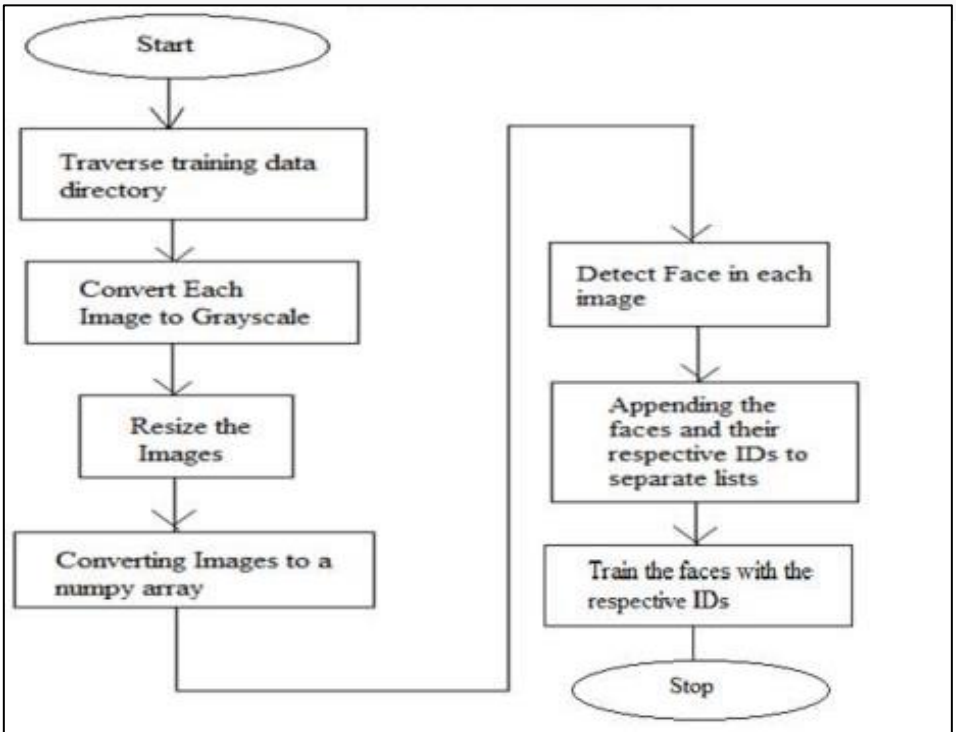
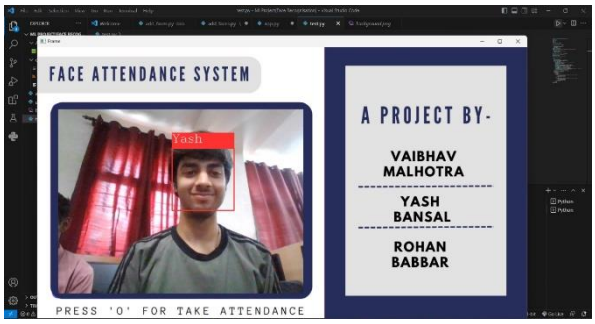


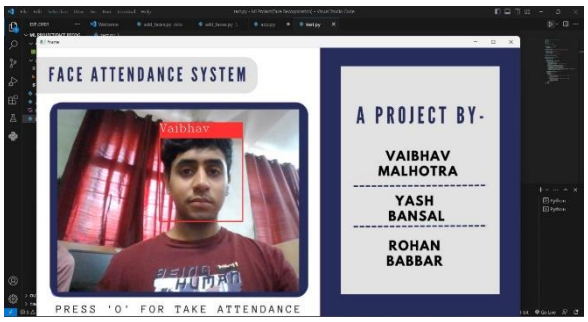
Fig 2. Flow-chart of the methodology used for Training Process

- **DATABASE CREATION**: The first step in the Attendance System is the creation of a database of faces that will be used. Different individuals are considered and a camera is used for the detection of faces and the recording of the frontal face. The number of frames to be taken for consideration can be modified for accuracy levels. These images are then stored in the database along with the Registration ID.
- **TRAINING OF FACES**: The images are saved in gray scale after being recorded by a camera. The LBPH recognizer is employed to coach these faces because the coaching sets the resolution andtherefore the recognized face resolutions are completely variant. A part of the image is taken as the centre and the neighbors are threshold against it. If the intensity of the centre part is greater or equal than it neighbor then it is denoted as 1 and 0 if not. This will result in binary patterns generally known as LBP codes.
- **FACE DETECTION:** The data of the trained faces is stored in .py format. The faces are detectedusing the Haar cascade frontal face module.
- **FACE RECOGNITION:** The data of the trained faces are stored and the detected faces are compared to the IDs of the students and recognized. The recording of faces is done in real time to guarantee the accuracy of the system. This system is precisely dependent on the camera's condition.

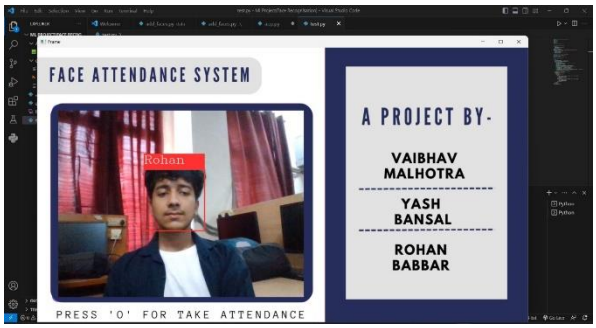
Chapter 4:

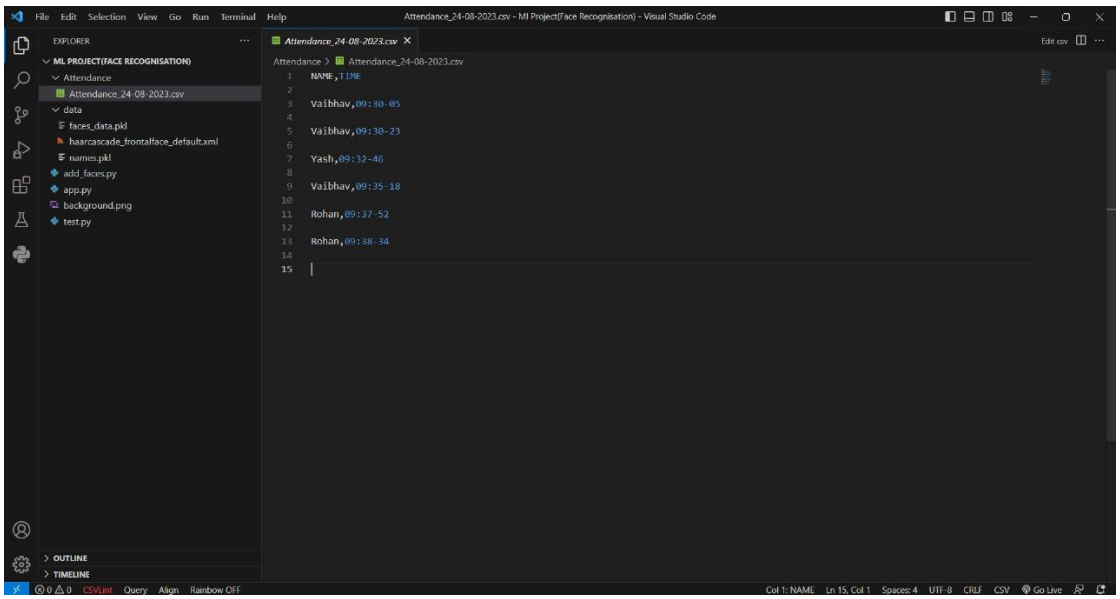
RESULT and ANALYSIS



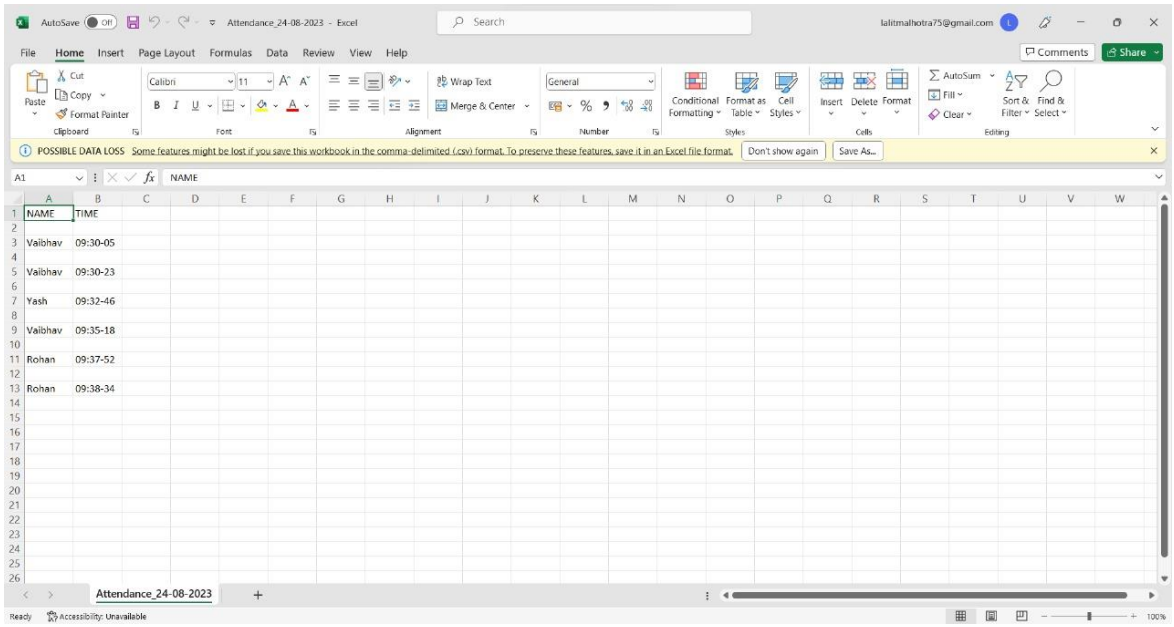


Testing and Processing of the Face image for Recognition





The different folders have been created.



The following Csv File is Created with the Attendance

Evaluation:

The project "Face Recognition and Attendance System" effectively achieves its primary objective of automating attendance through face recognition technology. It demonstrates proficiency in integrating OpenCV for face detection and recognition and utilizes Pandas for attendance record management. However, a notable consideration is the presence of data underfitting, which can result in inaccuracies in face detection and recognition due to the models' inability to capture the intricacies of real-world scenarios. To address this, employing more advanced face detection models or implementing data augmentation techniques could enhance accuracy and robustness. Overall, the project holds promise for further development, with potential improvements in underfitting mitigation and potential for GUI implementation, real-time notifications, and database integration to enrich its functionality.

Chapter 5:

Conclusion

In conclusion, face recognition using OpenCV has made significant progress in recent years, thanks to advances in deep learning and other techniques. The methodology and echnology of face recognition using OpenCV involve several steps, including face detection, feature extraction, and face matching, as well as various tools and techniques such as OpenCV libraries, the Haar Cascade classifier and k-NN algorithm, The results of various studies have demonstrated the effectiveness of these algorithms and techniques in achieving high accuracy and performance in face recognition.

Future scope

The prospects of advanced attendance systems are promising, driven by ongoing technological advancements across industries. There are several potential avenues for development. Firstly, integrating more sophisticated biometric technologies like facial recognition, iris scanning, and fingerprint recognition can enhance accuracy and eliminate the need for physical identification cards. Secondly, leveraging artificial intelligenceand machine learning algorithms can make attendance systems more intelligent, enabling them to analyze patterns, predict future attendance, detect anomalies, and generate insightful reports. Real-time monitoring capabilities would provide supervisors with up-to-date attendance data for better decision-making. Integration with mobile and wearable devices would offer convenientattendance marking options, while IoT integration would enable connectivity with other organizational systems. Advanced analytics and insights derived from attendance data would aid in identifying trends and making data-driven decisions. Automation and customization features, along with a strong focus on privacy and security, are also key considerations., the future of advancedattendance systems will likely witness continuedinnovation and adoption, shaping various industries.

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