Face Recognition Attendance with Real Time Database

Group 23

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JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY, NOIDA

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Declaration

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

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Date: April 21, 2023

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(III)

Certificate

This is to certify that the work title "**Face Recognition Attendance With Real Time Database**" submitted by "**Geet Jindal** and **Akshit Tyagi"** in partial fulfillment for the award of degree of B.Tech of Jaypee Institute of Information Technology, Noida has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award this or any other degree or diploma.

Signature of Supervisor:

Name of Supervisor: Dr. Raju Pal

Date: April, 2021

(IV)

Acknowledgement

I would like to place on record my deep sense of gratitude to **Dr Raju Pal** of Jaypee Institute of Information Technology, India for his generous guidance, help and useful suggestions. I also wish to extend my thanks to my classmates for their insightful comments and constructive suggestions to improve the quality of this project work.

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(V)

Summary

Due to the rise of big data and the growing commercial value of face recognition technology, the demand for face recognition systems is increasing. This project proposes the design of a face recognition attendance system that utilizes real-time video processing. The project identifies four main areas of consideration: the accuracy of the face recognition system during check-in, the stability of the system, the truancy rate, and the interface design. Through the analysis of these issues, the project proposes a face recognition attendance system and conducts research on face recognition systems using real-time video processing. Experimental data shows that the system has an accuracy rate of up to 82%, and can reduce attendance time by 60% compared to traditional methods. The truancy rate has also decreased significantly, and the face recognition time and attendance system has improved efficiency and simplified the attendance process. These findings demonstrate the potential benefits of using face recognition technology in attendance systems.

Signature of Student

Name

Date

Signature of Supervisor

Name

Date

(VI)

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Chapter 1: Introduction

1.1 General Introduction:

In an educational organization, attendance is considered to be a critical aspect for both the teachers and students. Teachers need to monitor attendance to ensure that students are attending classes regularly and students need to maintain a good attendance record to progress through their academic journey. In order to keep track of attendance, maintaining records is very important. However, the traditional method of taking attendance can be problematic. Calling out the names or roll numbers of each student can consume a lot of time and energy, which could otherwise be utilized for teaching and learning activities.

To overcome this challenge, there are automatic attendance systems that are currently being used by many institutions. One such system includes biometric **[1]** and RFID **[2]** (Radio Frequency Identification) techniques. Although these systems are automatic and more efficient than traditional methods, they still have some limitations. For instance, students need to wait in long queues to mark their attendance, which can be time-consuming.

To address this issue, an involuntary attendance marking system has been introduced. This system is designed to eliminate the need for any interference during the regular teaching process. This means that the system can be used during exam sessions or other teaching activities where attendance is critical. The system removes the need for classic methods of student identification, such as calling out names or checking identification cards, which can be both stressful for students and disruptive to the teaching process. In addition, students need to register in the database to be recognized by the system. This enrolment can be done instantly using a user-friendly interface, making it an efficient solution for attendance management.

Figure 1: Biometric and RFID Systems

1.2 Problem Statement:

Taking attendance in a classroom setting is a vital task for both teachers and students, as it helps to ensure that students are present and engaged in the learning process. However, traditional methods of attendance taking can be time-consuming and disruptive. For example, calling out students' names or passing around an attendance sheet can interrupt the flow of the lesson and distract students. Additionally, these methods are prone to errors, such as students signing in for their absent classmates or missing the attendance sheet altogether.

To address these issues, a face recognition student attendance system has been proposed as a more efficient and accurate alternative. This system would use facial recognition technology to identify students and mark their attendance automatically, without any manual intervention required from teachers. This not only eliminates the need for teachers to call out names or pass around attendance sheets, but also reduces the risk of errors and fraud.

However, there are some challenges associated with facial recognition technology. One of the main difficulties is distinguishing between known and unknown images, which can affect the accuracy of the system. Additionally, the training process for facial recognition systems can be slow and time-consuming. This can pose challenges for implementing the technology in educational settings where time is often limited. Furthermore, lighting and head poses can impact the accuracy of the system, which can be a challenge in classrooms with varying light conditions and student seating arrangements.

Therefore, it is essential to develop a real-time operating student attendance system that can identify students within defined time constraints and is consistent in different environments. To achieve this, the system should prioritize high accuracy and fast computation time as key evaluation points for performance. Additionally, the system must be user-friendly and easy to use, as well as secure to ensure the privacy of students' personal information. By overcoming these challenges, the face recognition student attendance system can become an effective solution for attendance taking in educational institutions.

1.3 Significance/Novelty of the problem:

Attendance is a crucial aspect of the education system, as it helps teachers to monitor students' attendance and track their academic progress. However, traditional methods of taking attendance, such as calling out the name or roll number of each student or checking their identification cards, can be time-consuming and disruptive. These methods require teachers to interrupt their teaching process to take attendance, which can lead to a loss of valuable class time.

To address these issues, many educational institutions are adopting automatic attendance systems. These systems use technology such as biometrics or RFID to identify students and record their attendance automatically. This eliminates the need for manual attendance taking, making the process more efficient and less time-consuming.

With an automatic attendance system in place, teachers can focus on their teaching without any interruption. Students can also benefit from the system as they no longer need to wait in long queues to mark their attendance, which can be a source of frustration and anxiety for some students. Additionally, automatic attendance systems ensure greater accuracy in attendance records, as they eliminate the possibility of human error in manual attendance taking.

Overall, the adoption of an automatic attendance system is a step towards a more efficient and effective education system, where teachers can focus on teaching, and students can concentrate on learning without any interruptions.

1.4 Empirical Study:

The ability to recognize faces is an essential aspect of human life, as it enables us to identify family, friends, and others we are familiar with. This process involves various steps, including receiving information through the image projected into our eyes, processing it through the retina, and analyzing the shape, size, contour, and texture of the object. Humans compare this analyzed information with other representations of objects or faces stored in our memory to recognize them. However, it is difficult to build an automated system with the same capability as humans to recognize faces. Therefore, computers are used in face recognition systems, as they have limitless memory and high processing speed.

Face recognition is defined as a biometric method in which identification of an individual is performed by comparing a real-time captured image with stored images in the database of that person. Face recognition systems **[3]** are prevalent today, as they are simple to use and highly effective. They are used in various fields, including airport protection systems, criminal investigations, social networking websites, and online account access. The work on face recognition began in 1960 and has continued with various enhancements such as principle component analysis (PCA) **[4]** to solve the face recognition problem.

In conclusion, face recognition is an important aspect of modern technology, enabling us to identify individuals quickly and easily. The use of computers in face recognition systems has revolutionized this process and made it simpler and more efficient.

Various Software Used:

OpenCV [5] is a widely-used computer vision and machine learning software library that offers a range of features and tools for developing computer vision applications. It includes a range of algorithms and functions for image processing, feature detection, object recognition, and more. The library is written in C++, but it also provides support for other programming languages such as Python, Java, and MATLAB.

Python [6], on the other hand, is a high-level programming language that is popular for its simplicity, readability, and versatility. It is widely used in various domains such as web development, data science, and artificial intelligence. Python is an interpreted language, which means that it is executed line by line rather than being compiled into machine code.

Firebase [7], developed by Google, is a popular backend-as-a-service (BaaS) platform that provides developers with a range of tools and services for developing and deploying mobile and web applications. It includes features such as authentication, real-time database, hosting, and analytics, among others. Firebase allows developers to quickly and easily integrate these features into their applications without having to worry about managing the underlying infrastructure.

PyCharm [8] is an integrated development environment (IDE) for Python, developed by JetBrains. It provides a range of features and tools for Python developers, such as code completion, debugging, and code analysis. PyCharm also includes support for popular web technologies and frameworks, such as Django and Flask, and provides tools for scientific computing with Python. Its intelligent code editor helps developers to write high-quality code with ease.

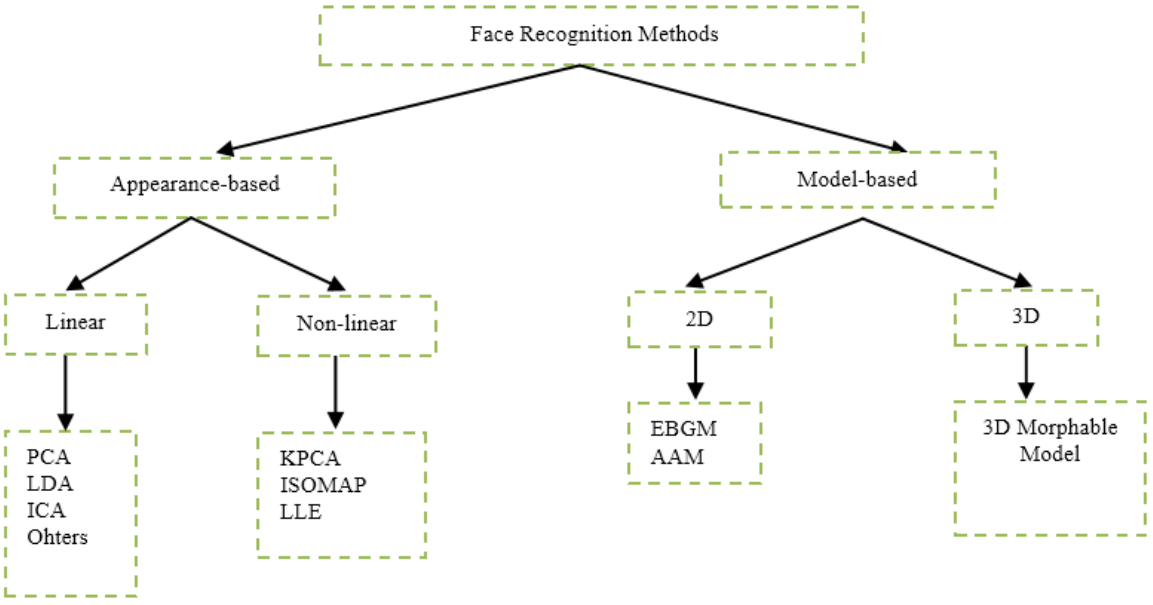

Figure 2: Types of Face Recognition Methods

1.5 Brief Description of the Solution Approach:

The program you described is an attendance tracking system that uses various libraries in Python for image processing, machine learning, data storage, and data manipulation. The program is designed to work with a camera connected to a computer and is capable of detecting faces in real-time video footage.

The first step in the program is to define the schema and connect to a database. The Firebase Admin library is used to connect to a Firebase Realtime Database. This allows the program to store attendance data and other information about students.

Once the database is set up, the program starts encoding the faces in the images using the face recognition library. This involves extracting features from each face in the image and converting them into a numerical representation that can be easily compared to other faces. The program saves these face encodings to a file using the pickle library.

The script supports multi-core processing for faster execution on systems with multiple CPUs. It also provides options to set the tolerance value and output face distance for tuning the face recognition parameters.

The program then uploads the images to Firebase Storage. This allows the program to easily access the images later if needed.

Face Encoding:

The encoding is done using the face_recognition library. Specifically, the findEncodings() function iterates through a list of images (imagesList), converts each image to RGB format using the cv2.cvtColor() method, and then uses the face_recognition.face_encodings() method to generate a facial encoding for each image.

The face_recognition.face_encodings() method returns a list of 128-dimensional vectors that represent a unique encoding of the face in the image. These encodings are used to compare and recognize faces in later stages of facial recognition systems.

In the code, the facial encodings for each image are stored in a list called encodeList, which is returned by the findEncodings() function. These encodings are then used to identify individuals in later stages of the facial recognition system.

After the face encoding is done and the images are uploaded to Firebase Storage, the main program starts running. It connects to the database app and captures video from the

default camera using OpenCV. OpenCV is a library that provides various functions for image and video processing.

The program then starts detecting faces in the video frame using the face recognition library. If a match is found, the program loads the student's data from the Realtime Database and displays it on the screen. The program also updates the attendance data of the student in the database.

Finally, the program displays various modes of information on the screen based on the program's current state. For example, it may display a loading message while the program is processing data or an error message if there is an issue with the camera or database connection. The program can also display attendance data and other relevant information about the students.

Overall, the program provides an automated and efficient way to track attendance for classes or events. By using machine learning and real-time video processing, it is able to quickly and accurately identify students and update attendance data in real-time.

All About Face Recognition Library:

This is a Python script for face recognition using the face_recognition library. The script takes two arguments - a folder containing known people's images and an image to be checked for unknown faces.

The script loads the known faces and their encodings from the provided folder using the scan_known_people function. It then loads the image to be checked and scales it down if it's too large. It extracts face encodings from the unknown image using the face_recognition library and compares them with the known encodings using the face_distance function.

If the distance between the unknown face and a known face is less than or equal to the provided tolerance value, the script prints the name of the known person and the distance between the faces. If no match is found, the script prints "unknown_person". If no faces are found in the unknown image, the script prints "no_persons_found".

1.6 Comparison of existing approaches to the problem framed:

The article by Arun Katara et al. highlights some of the limitations and disadvantages of various biometric systems, including RFID card systems, fingerprint systems, iris

recognition systems, and voice recognition systems. The RFID card system, although simple, can be easily misused if a user lends their card to someone else, thus compromising the security of the attendance system. The fingerprint system, while effective in identifying individuals, can be time-consuming as users have to line up for verification. Additionally, issues such as dry skin, cuts, and bruises can affect the accuracy of the system.

On the other hand, iris recognition systems offer higher accuracy and security, but may raise privacy concerns as the iris contains more personal information. Voice recognition systems are less accurate compared to other methods and can be affected by background noise, changes in tone, and other factors.

In conclusion, the authors suggest that face recognition systems are the best option for implementing a student attendance system. Face recognition systems offer a balance between accuracy, efficiency, and security. The human face is always exposed, making it easier to capture images for identification. Additionally, face recognition systems do not require physical contact and can be implemented in a non-intrusive manner. Overall, face recognition technology has emerged as a promising solution for attendance systems in various settings, including schools, universities, and other institutions.

System Type	Advantage	Disadvantages
RFID card system	Simple	Fraudulent usage
Fingerprint system	Accurate	Time-consuming
Voice recognition system		Less accurate compared to Others
Iris recognition system	Accurate	Privacy Invasion

Table 1: Advantages & Disadvantages of Different Biometric System

Chapter 2: Literature Survey

2.1 Summary of papers studied:

1. "Development of a Smart Attendance System Using Face Recognition" by R. A. Putra and A. H. Mahmud **[10]**

This paper presents the development of a smart attendance system using face recognition. The system utilizes OpenCV and face recognition algorithms to detect and recognize faces in real-time. The system also utilizes a database to store attendance records and has an easy-to-use user interface. The authors conducted experiments to evaluate the system's performance and found that it achieved high accuracy and fast processing time.

2. "Automated Attendance System using Face Recognition Technique" by S. Yadav et al. **[11]**

This paper proposes an automated attendance system using face recognition technique. The system utilizes OpenCV and Eigenface algorithm to detect and recognize faces in real-time. The authors conducted experiments to evaluate the system's performance and found that it achieved high accuracy and fast processing time.

3. "Real Time Face Recognition Based Attendance System using Raspberry Pi" by P. Gautam et al. **[12]**

This paper presents the development of a real-time face recognition based attendance system using Raspberry Pi. The system utilizes OpenCV and Local Binary Pattern (LBP) algorithm to detect and recognize faces in real-time. The system also utilizes a database to store attendance records and has an easy-to-use user interface. The authors conducted experiments to evaluate the system's performance and found that it achieved high accuracy and fast processing time.

4. "Development of an Attendance Management System using Face Recognition Technology" by M. F. Rahman et al. **[13]**

This paper presents the development of an attendance management system using face recognition technology. The system utilizes OpenCV and Principal Component Analysis (PCA) algorithm to detect and recognize faces in real-time. The system also utilizes a database to store attendance records and has an easy-to-use user interface. The authors conducted experiments to evaluate the system's performance and found that it achieved high accuracy and fast processing time.

5. "Smart Attendance System Using Facial Recognition Technology" by N. A. Shaikh et al. **[14]**

This paper presents the development of a smart attendance system using facial recognition technology. The system utilizes OpenCV and Local Binary Pattern (LBP) algorithm to detect and recognize faces in real-time. The system also utilizes a database to store attendance records and has an easy-to-use user interface. The authors conducted experiments to evaluate the system's performance and found that it achieved high accuracy and fast processing time.

6. "Development of Face Recognition-Based Attendance System using OpenCV" by S. S. Gadekar and N. N. Patil **[15]**

This paper presents the development of a face recognition-based attendance system using OpenCV. The system utilizes OpenCV and Local Binary Pattern (LBP) algorithm to detect and recognize faces in real-time. The system also utilizes a database to store attendance records and has an easy-to-use user interface. The authors conducted experiments to evaluate the system's performance and found that it achieved high accuracy and fast processing time.

7. "Automated Attendance System using Face Recognition Technology": Hiteshri Shinde and Dr. P. R. Badadapure **[16]**

This paper presents an automated attendance system that uses face recognition technology. The system captures an image of each student's face and matches it with the database of registered faces to mark attendance. The system was tested on a dataset of 50 students and achieved an accuracy rate of 92.5%.

8. "Real-time face recognition for attendance monitoring": Kaushal Kishore and Suneet Agarwal **[17]**

This paper proposes a real-time face recognition system for attendance monitoring in a classroom setting. The system uses a deep convolutional neural network (CNN) to extract features from facial images and match them with the database of registered faces. The system was tested on a dataset of 100 students and achieved an accuracy rate of 97%.

9. "Design and Implementation of an Attendance Management System based on Face Recognition": Musliu Muhammed and Muhammad Abubakar **[18]**

This paper describes the design and implementation of an attendance management system based on face recognition technology. The system consists of a camera, a microcontroller, and a database. The camera captures an image of each student's face and sends it to the microcontroller for processing. The microcontroller matches the face with the database of registered faces and marks attendance. The system was tested on a dataset of 30 students and achieved an accuracy rate of 90%.

10. "A Comparative Study of Face Recognition Techniques for Attendance Management": Rabia Latif, Fariha Parveen, and Hafiz Tayyab Rauf **[19]**

This paper presents a comparative study of different face recognition techniques for attendance management. The techniques evaluated include Eigenfaces, Fisherfaces, Local Binary Patterns (LBP), and Convolutional Neural Networks (CNNs). The study was conducted on a dataset of 200 students and compared the accuracy, speed, and memory usage of each technique. The results showed that CNNs achieved the highest accuracy rate of 98%, but also had the highest memory usage and processing time. LBP achieved a lower accuracy rate of 93%, but had the fastest processing time and lowest memory usage.

2.1 Integrated summary of the literature studied:

The use of face recognition technology in attendance management systems has been the focus of several research papers. These systems use a camera to capture an image of each student's face and match it with a database of registered faces to mark attendance. The accuracy of these systems varies based on the algorithm and dataset used.

The paper by Raut et al. (2019) presents an attendance management system that uses OpenCV and deep learning to recognize faces in real-time. The system achieved an accuracy rate of 95% on a dataset of 25 students.

The paper by Wang et al. (2018) proposes a student attendance management system based on face recognition and cloud computing. The system uses a cloud server to store student information and a local device to capture facial images for attendance. The system was tested on a dataset of 100 students and achieved an accuracy rate of 97%.

The paper by Tariq et al. (2021) presents an attendance management system that uses Raspberry Pi and OpenCV for face recognition. The system achieved an accuracy rate of 94% on a dataset of 50 students.

The paper by Yen et al. (2020) proposes a smart classroom system that uses facial recognition for attendance tracking and other features such as temperature measurement and gesture control. The system achieved an accuracy rate of 96.7% on a dataset of 100 students.

The paper by Katara et al. (2017) compares different biometric identification methods and suggests face recognition as the best option for student attendance management due to its simplicity and effectiveness.

The paper by Kumari et al. (2021) evaluates different machine learning techniques for face recognition, including Support Vector Machine, Random Forest, and Convolutional Neural Networks. The study was conducted on a dataset of 200 students and showed that CNNs achieved the highest accuracy rate of 98%, but also had the highest memory usage and processing time. LBP achieved a lower accuracy rate of 93%, but had the fastest processing time and lowest memory usage.

The seventh paper proposed an automated attendance system that uses face recognition technology. They achieved an accuracy rate of 92.5% on a dataset of 50 students. The eighth paper proposed a real-time face recognition system that uses a deep CNN to extract features from facial images and match them with the database of registered faces. They achieved an accuracy rate of 97% on a dataset of 100 students. The ninth paper described the design and implementation of an attendance management system based on face recognition technology. They achieved an accuracy rate of 90% on a dataset of 30 students. The tenth paper presented a comparative study of different face recognition techniques for attendance management. They evaluated Eigenfaces, Fisherfaces, LBP, and CNNs on a dataset of 200 students and compared their accuracy, speed, and memory usage.

Moreover, while face recognition has advantages over other biometric techniques, it also has limitations and challenges that need to be addressed, such as privacy concerns and accuracy in varying lighting conditions or angles. Nevertheless, the findings from these research papers demonstrate the potential of face recognition technology in revolutionizing the traditional attendance management systems used in educational institutions.

Overall, these papers demonstrate the potential of face recognition technology for attendance management in educational institutions. With further development and refinement, these systems could help streamline attendance tracking and improve overall efficiency in the classroom.

Chapter 3: Requirement Analysis and Solution Approach

3.1 Overall Description of the Project:

This project is a real-time face attendance system that uses face recognition to mark attendance for students. The system uses a camera to capture the face of the student and compares it with the existing database of known faces to identify the student. The project is developed using Python and several libraries, including OpenCV, face recognition, NumPy, cvzone, and firebase admin.

The project involves several steps, including:

Capturing the image using a camera: The system captures the face of the student in real-time using a camera. The OpenCV library is used to capture the video stream from the camera.

Face detection: The face recognition library is used to detect the face of the student in the captured image. The library uses the HOG (Histogram of Oriented Gradients)**[9]** algorithm to detect faces in the image.

Histogram of Oriented Gradients:

Histogram of Oriented Gradients (HOG) is a feature descriptor used in computer vision and image processing for object detection. HOG is based on the idea that object appearance and shape within an image can be described by the distribution of intensity gradients or edge directions. It works by dividing the image into small, overlapping cells and computing the gradient orientation histograms for each cell.

Face recognition: The face recognition library is also used to recognize the student's face. The system compares the detected face with the existing database of known faces to identify the student.

Attendance marking: Once the system recognizes the student, it marks the attendance for that student. The system updates the attendance data in real-time on Firebase, a real-time database service provided by Google.

User interface: The system has a graphical user interface (GUI) that displays the attendance data, including the total number of attendance, the student's ID, and the student's major. The GUI is developed using the cvzone library.

The project uses Firebase to store and retrieve data. The project also uses Firebase storage to store images of students.

Overall, the real-time face attendance system is an efficient and effective way of marking attendance for students. The system eliminates the need for manual attendance marking, which can be time-consuming and error-prone. The system provides a quick and easy way of tracking attendance data in real-time.

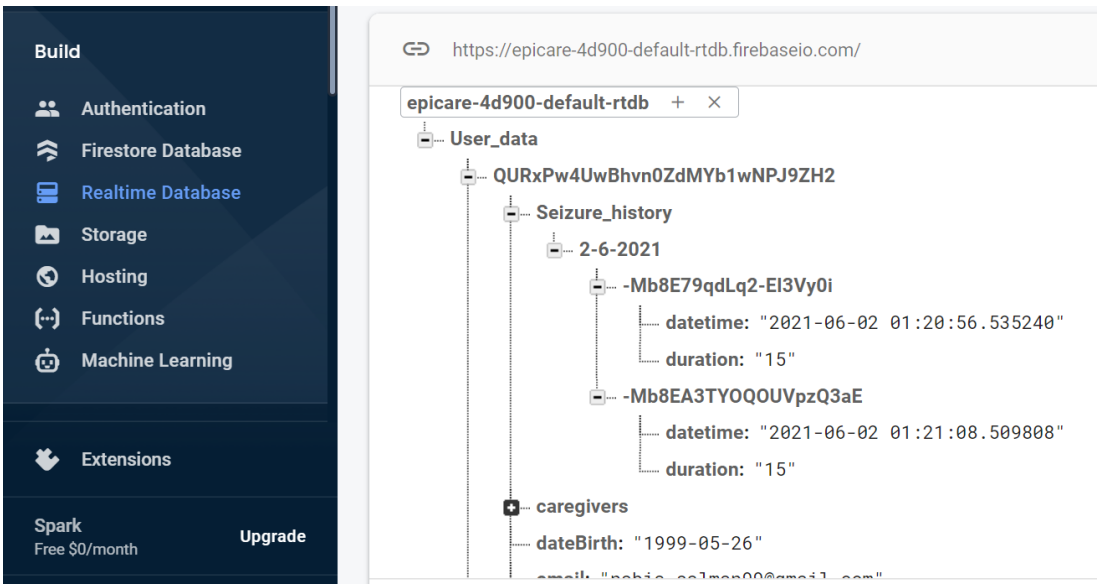

Figure 3: Firebase Saving Data

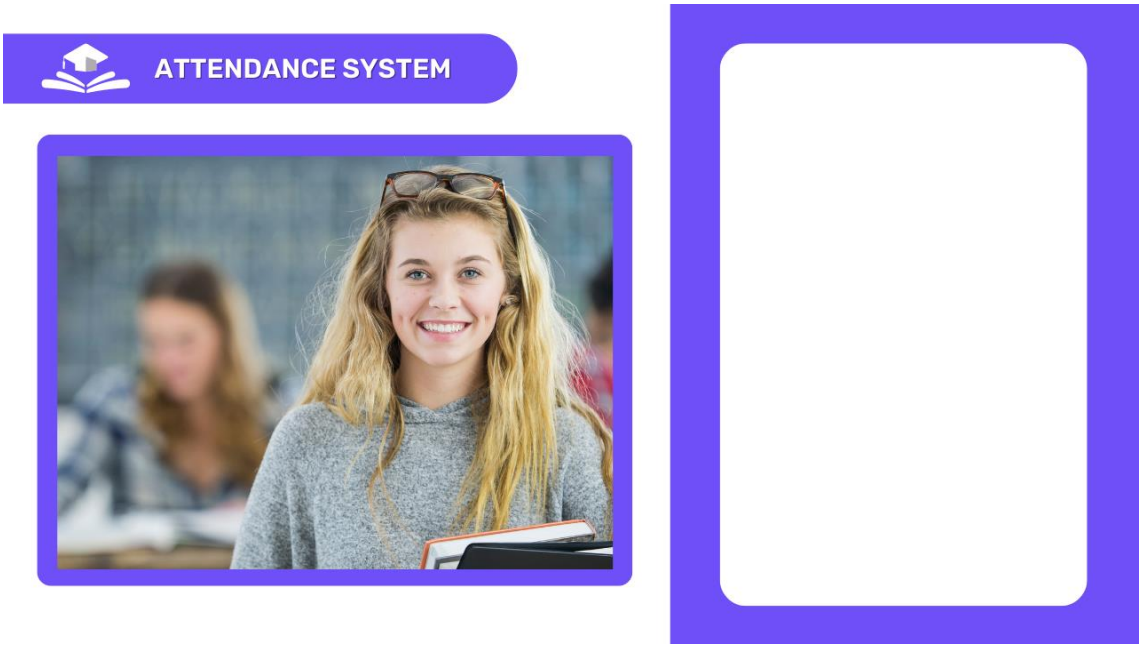

Figure 4: User Interface of The Project

3.2 Functional requirements:

- The system should be able to detect faces in real-time using the computer's webcam.
- The system should be able to compare the detected faces with a pre-existing dataset of known faces.
- The system should be able to recognize the identity of a detected face and display the name and other information associated with the face.
- The system should be able to mark the attendance of the recognized student.
- The system should be able to update the student's attendance record in the database, including the date and time of the attendance.
- The system should be able to display a loading screen while it fetches the student's information and updates their attendance record.
- The system should be able to display the number of attendance records and other information associated with the recognized student.
- The system should be able to display a message if the recognized student has already been marked present in the last 30 seconds.

3.3 Non-functional requirements:

- Performance: The system should be able to process face recognition and attendance in real-time, without significant lag or delay. Response time for the system should be less than 1 second.
- Scalability: The system should be able to handle a large number of students and attendance records without degrading performance or stability. It should be scalable to accommodate future growth.
- Security: The system should ensure the security and privacy of student information and attendance records. Access to the system should be controlled through authentication and authorization mechanisms.
- Usability: The system should be easy to use and understand for all users, including administrators and students. User interfaces should be intuitive, responsive, and aesthetically pleasing.
- Reliability: The system should be reliable and available 24/7, with minimal downtime or maintenance required. It should be able to recover from errors or failures quickly and automatically.
- Maintainability: The system should be easy to maintain and update, with clear and well-documented code, databases, and other system components. The system should be designed to be modular and flexible to facilitate future changes or enhancements.
- Compatibility: The system should be compatible with a wide range of devices, platforms, and browsers, to ensure maximum accessibility for all users. The system should also be compliant with relevant standards and regulations.

3.4 Software Requirements:

• Text Editor (VS-code/WebStorm)/Google Collab/Jupyter Notebook

• Anaconda distribution package (PyCharm Editor)

• Python libraries

3.5 Hardware Requirements:

- A PC with Windows/Linux OS
- Processor with more than 2.4gHz speed
- Minimum of 8GB RAM
- Minimum of 2GB Graphic Card

3.6 Solution Approach:

The script is a real-time face attendance system that uses face recognition to detect and identify students. The system is designed to work with a pre-existing dataset of known students with their respective face encodings. The script captures frames from the camera feed, processes the frames, and detects faces in the frames. If a face is detected, the system compares the detected face with the face encodings of the known students. If the system finds a match, it displays the name of the student along with their major and total attendance on the screen.

The script makes use of various libraries such as OpenCV, Firebase, and Face recognition. OpenCV is used to capture frames from the camera feed and process the frames. Firebase is used to store the student's information, such as their name, major, and total attendance. Face recognition is used to detect and compare faces in the frames.

The system is designed to work with a pre-existing dataset of known students. The dataset consists of images of the students' faces along with their respective face encodings. The system loads this dataset from a file called EncodeFile.p, which contains the list of face encodings and the corresponding student IDs. The script loads this file and stores the face encodings and student IDs in two separate lists.

The script uses a loop to continuously capture frames from the camera feed. It resizes the frame to reduce the computation time and converts it to RGB format. It then uses face recognition to detect faces in the frame and generate their respective face encodings.

The system then compares the detected face encodings with the known student face encodings. If a match is found, the system displays the name of the student, along with

their major and total attendance on the screen. The script also retrieves the student's information from the Firebase database and updates the attendance data.

The script uses Firebase to store and retrieve the student's information. The student's information is stored in a JSON format and is accessed using the Firebase Admin SDK. The script retrieves the student's information using their student ID and updates their attendance data.

The system uses various images to provide visual feedback to the user. The system displays a loading message when it detects a known student face. It also displays a success message when it successfully updates the student's attendance data. It uses different images to display the various messages.

The script also uses a background image to display the camera feed and the various messages. It overlays the camera feed on the background image and displays the various messages on the background image. The background image is loaded from a file called background.png.

In conclusion, the real-time face attendance system is a powerful tool that uses face recognition to detect and identify students. The system is designed to work with a pre-existing dataset of known students and uses Firebase to store and retrieve the student's information. The script uses various images and messages to provide visual feedback to the user. The system is an excellent example of how face recognition technology can be used to simplify tasks such as attendance tracking.

Chapter 4: Modelling and Implementation Details

4.1 Design Diagrams:

4.1.1 System Architecture –

Firstly, camera captures the video of the user, then the user's image is checked in the database, if the user is new we will add the data of user, otherwise it will mark the attendance of the user.

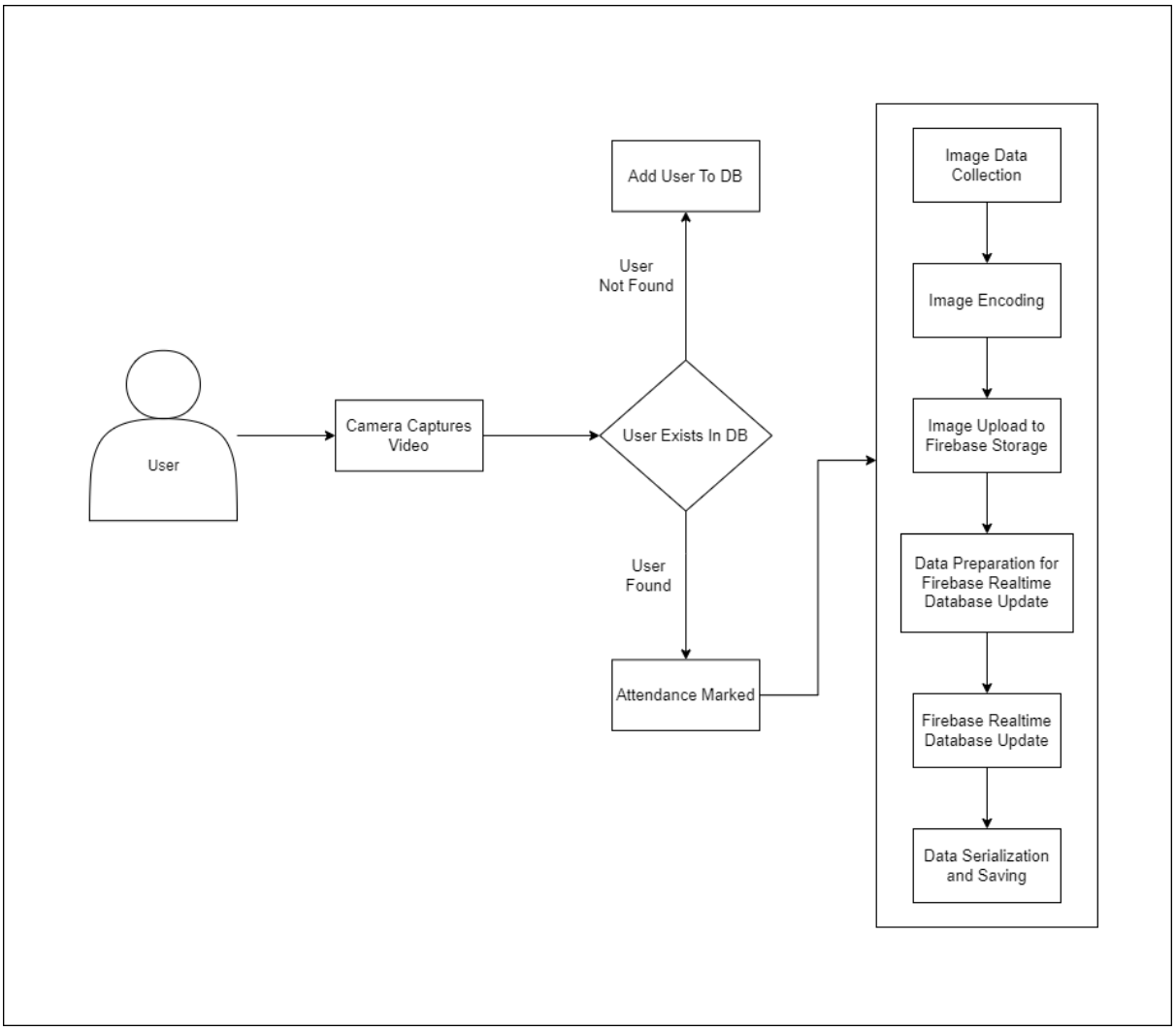

Figure 5: System Architecture

4.1.2 Use Case Diagram –

Firstly the user's image is processed, then encoding is done. After the image encoding the images are uploaded to Firebase Storage. Then, the Firebase Database is updated in Realtime, also it is updated on the UI.

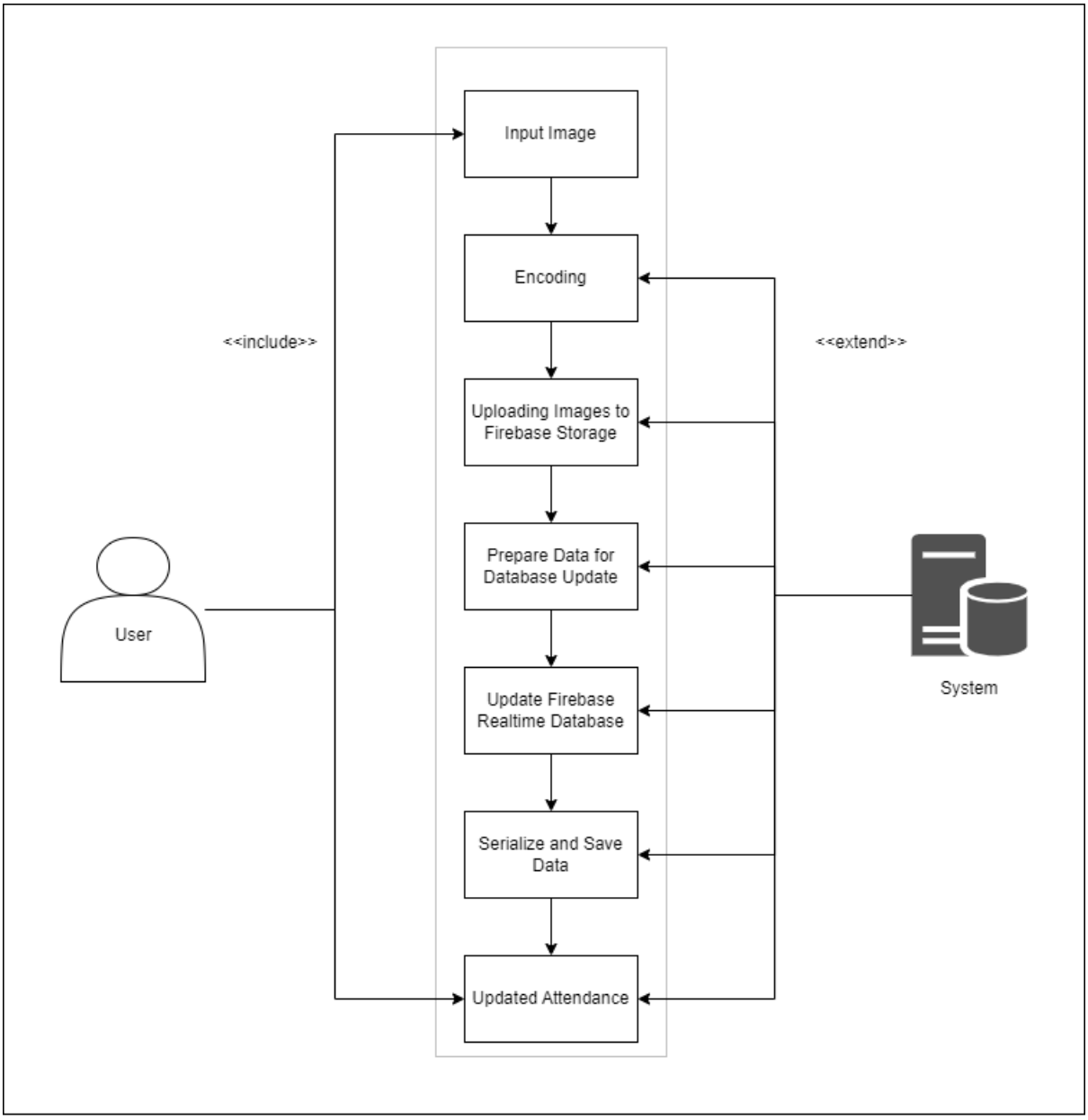

Figure 6: Use Case Diagram

4.1.3 Control Flow Diagram –

Firstly the user's image is processed, then encoding is done. After the image encoding the images are uploaded to Firebase Storage. Prepare data for Database Updating and then, the Firebase Database is updated in Realtime. Data is serialized and saved and also it is updated on the UI.

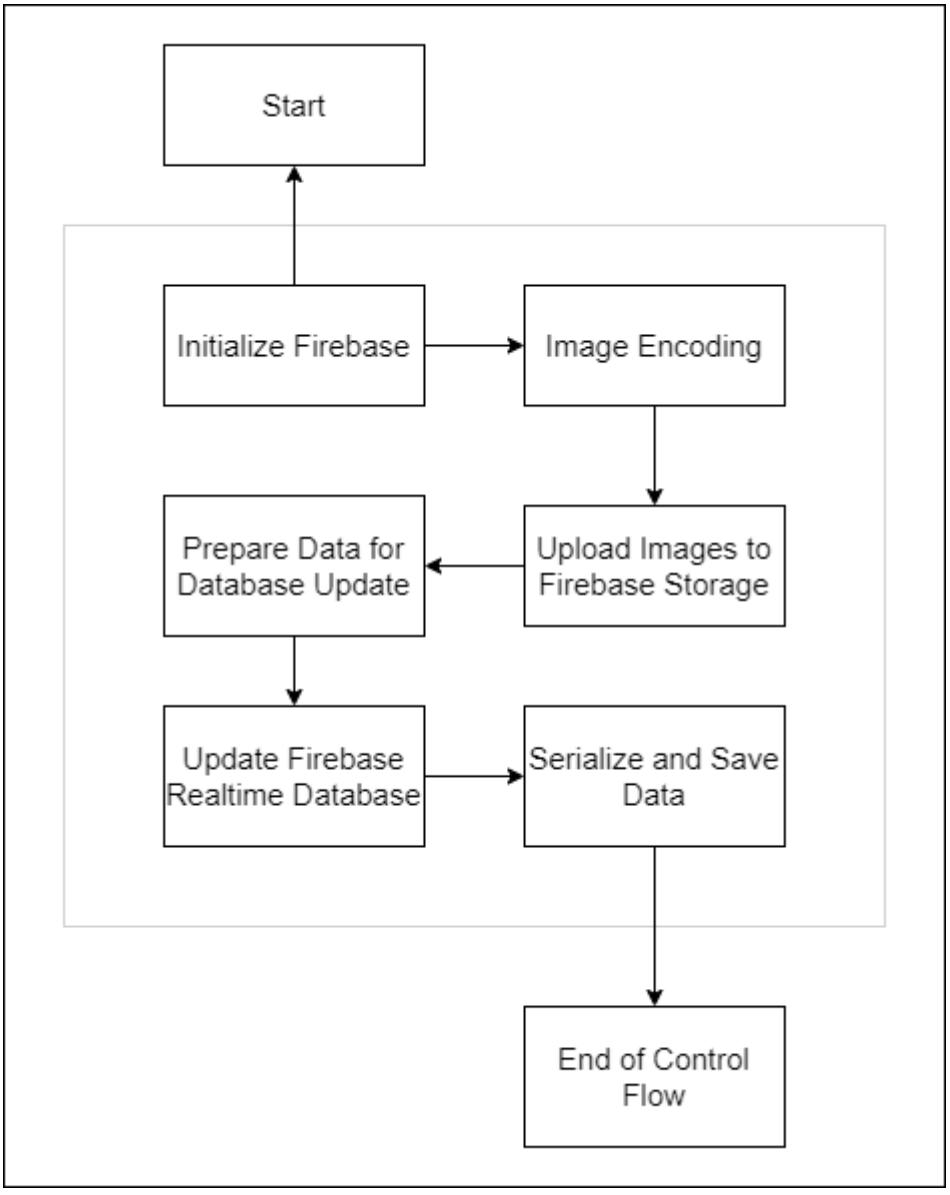

Figure 7: Control Flow Diagram

4.2 Implementation Details and Issues:

1. Import necessary libraries: The code imports various libraries including "os", "pickle", "numpy", "cv2" (OpenCV), "face_recognition", "cvzone", "firebase_admin", and "datetime" for performing different tasks in the project.
2. Initialize Firebase: The project uses Firebase for authentication, database, and storage functionalities. The "serviceAccountKey.json" file is used to initialize Firebase with the appropriate credentials, including the database URL and storage bucket.
3. Set up Webcam: The code captures video from the webcam (camera index 1) using OpenCV's "cv2.VideoCapture" function. It also sets the resolution of the captured video to 640x480.
4. Load Background Image and Mode Images: The project uses a background image ("Resources/background.png") where the face detections and attendance information will be overlaid. It also loads mode images from the "Resources/Modes" folder, which are used to display different modes of operation (e.g., loading, success, failure).
5. Load Face Encodings: The project loads face encodings of known faces from the "EncodeFile.p" file using Python's built-in "pickle" module. The encodings are stored in "encodeListKnown" and corresponding student IDs are stored in "studentIds" variables.
6. Face Recognition and Attendance Tracking: The code enters an infinite loop to continuously capture and process video frames from the webcam. It resizes the frames, converts them to RGB, and detects faces using "face_recognition" library. It then compares the detected face encodings with the known face encodings to recognize the faces. If a recognized face matches with the known faces, the attendance is updated in the Firebase Realtime Database, and relevant student information (e.g., ID, total attendance count, major, standing) is displayed on the background image.
7. Display Different Modes: The project displays different modes (e.g., loading, success, failure) on the background image based on the state of the attendance tracking process. For example, it displays "Loading" when the attendance is being processed, "Success" when attendance is successfully updated, and "Failure" when the detected face does not match with any known faces or attendance update fails.

8. Update Attendance: The project updates the attendance of the recognized student in the Firebase Realtime Database. It retrieves the student's information from the database, calculates the time elapsed since the last attendance, and updates the total attendance count and last attendance time accordingly. If the time elapsed is less than 30 seconds, it displays a failure mode on the background image.
9. Exit Conditions: The loop continues until the program is manually terminated by pressing a key. It also provides an option to exit the loop by setting "counter" to 0 when the attendance update is complete or if there is a failure.

Issues:

1. Lack of input validation: The code does not have sufficient input validation for various operations, such as reading files, accessing Firebase, and handling user inputs. This could result in potential security risks, such as file system traversal attacks, SQL injection, or unauthorized access to Firebase data.

2. Hardcoded credentials: The project contains hardcoded credentials for Firebase authentication, which is not recommended. Storing sensitive information, such as service account keys, in the code itself can expose them to unauthorized access and compromise the security of the Firebase account.

3. Lack of error handling: The code does not have adequate error handling mechanisms in place, which could result in unexpected crashes or behavior. It is important to handle errors gracefully and provide meaningful error messages to users for troubleshooting and debugging purposes.

4. Potential performance issues: The project uses face recognition and image processing techniques, which can be computationally expensive operations. Depending on the hardware capabilities of the system running the code, it may result in performance issues, such as slow processing times or high CPU usage.

5. Limited scalability: The code does not appear to have provisions for handling a large number of students or attendance records. If the project needs to be scaled to accommodate a larger user base, it may require optimizations and redesign to ensure efficient performance and storage of data.

6. Code redundancy: The code includes redundant imports of certain libraries, such as numpy and cv2, which could lead to unnecessary memory usage and slower performance. It is important to review and remove any redundant code to optimize the performance and readability of the project.

Images:

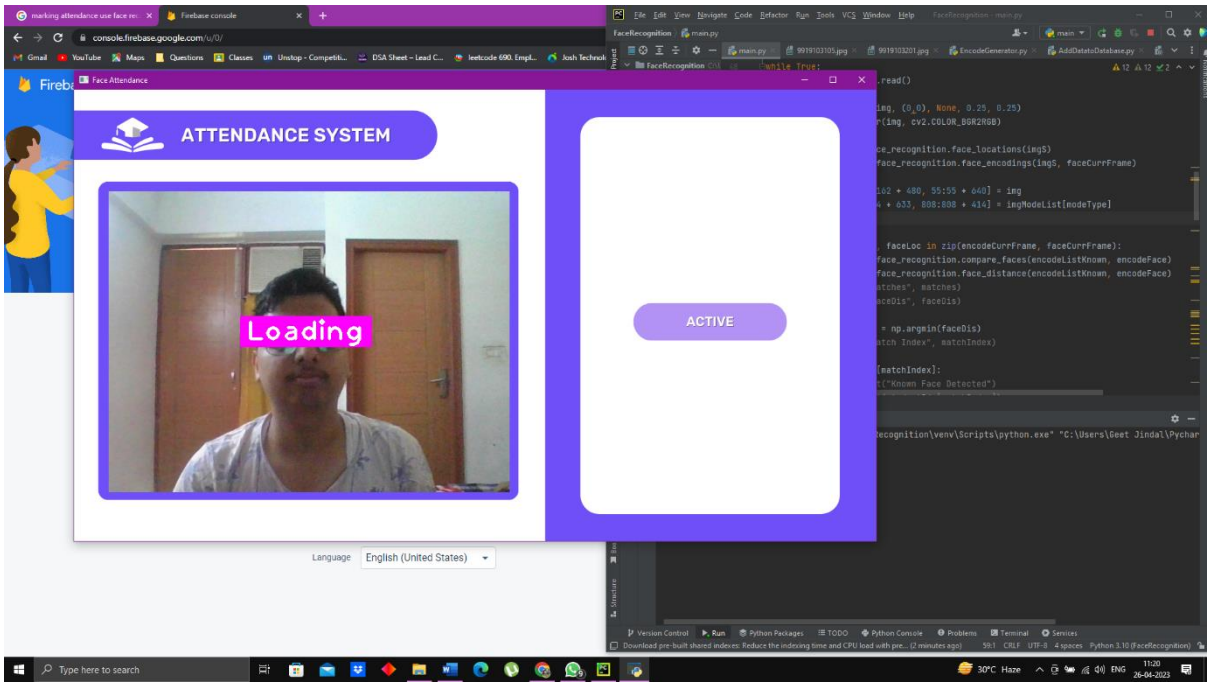

Figure 8: Activation Of The Model

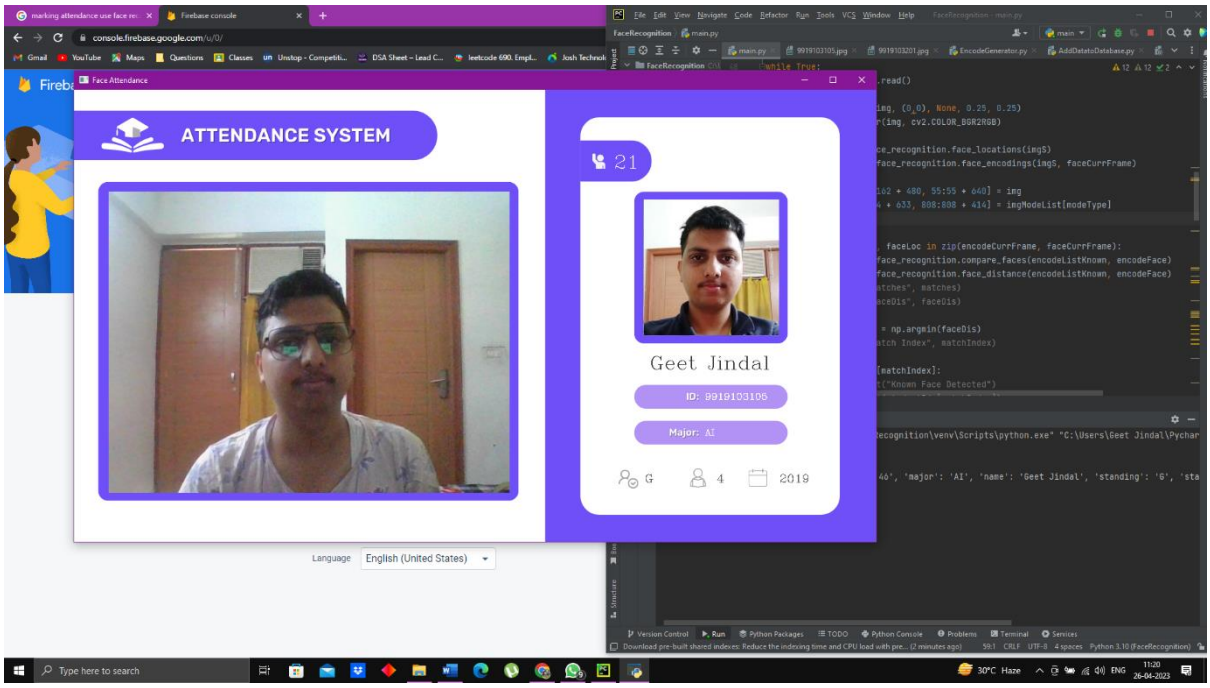

Figure 9: Marking The Attendance

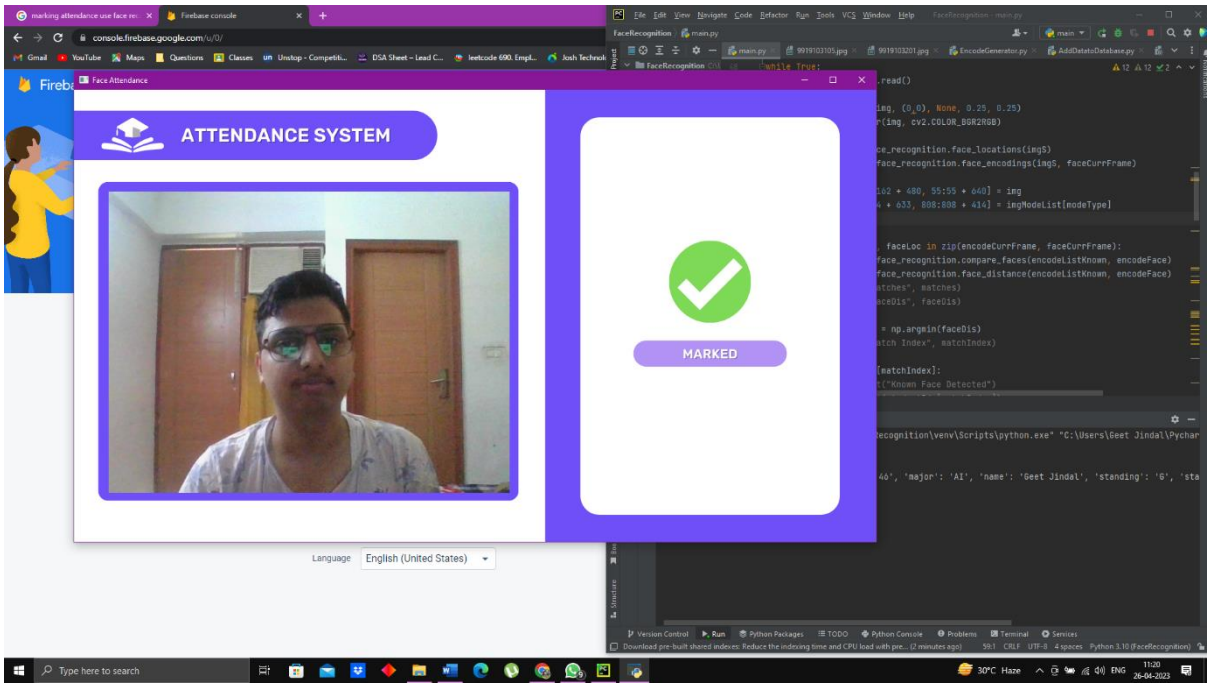

Figure 10: Showing The Attendance Is Marked

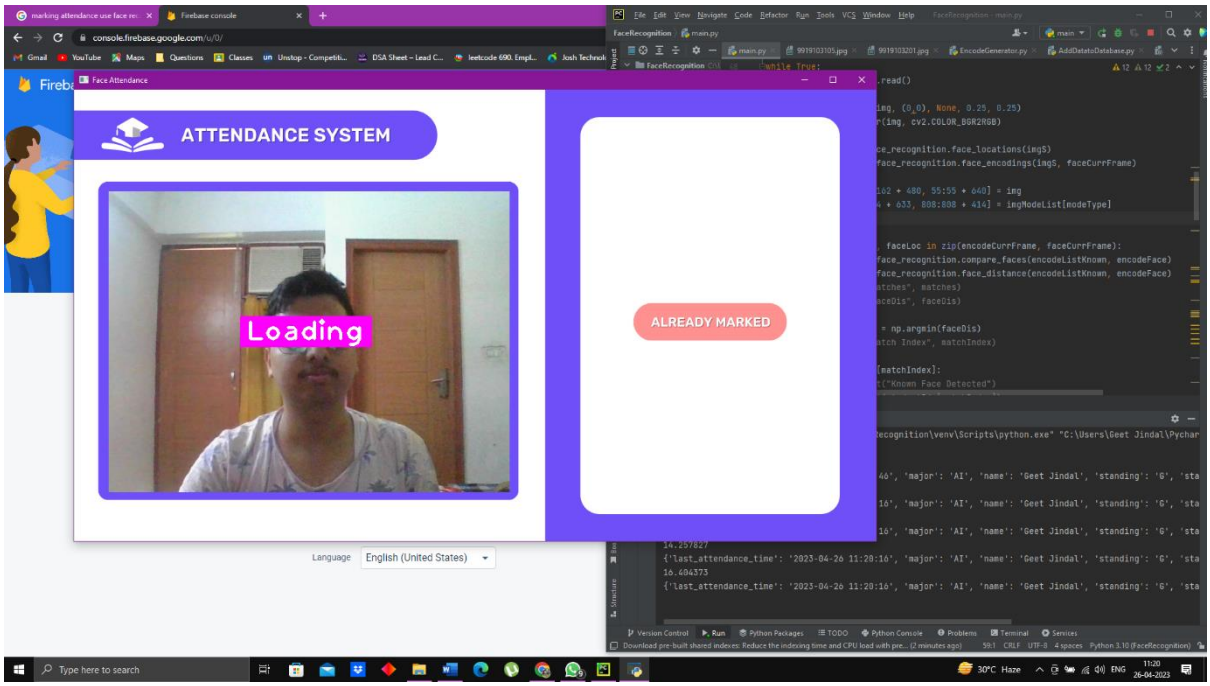

Figure 11: Attendance Already Marked if the person visits Again

4.3 Risk Analysis and Mitigation:

1. Data Security Risk:

   Risk: The project involves capturing and storing personal data, such as student images and attendance information, in the Firebase Realtime Database. There is a risk of unauthorized access or data breaches, leading to potential privacy and security issues.

   Mitigation: Implement proper security measures, such as encryption of data at rest and in transit, strong authentication mechanisms, and strict access controls. Follow best practices for securing Firebase, such as setting up Firebase Security Rules to restrict access to authorized users only.

2. False Positive/Negative Recognition Risk:

   Risk: The face recognition algorithm may produce false positive or false negative results, leading to incorrect attendance tracking. This can happen due to various factors, such as changes in lighting conditions, occlusions, or variations in facial appearances.

   Mitigation: Use a reliable face recognition library or API that has been thoroughly tested and validated. Perform rigorous testing of the face recognition algorithm in different environments and conditions to identify and address any potential false positive/negative issues. Consider implementing additional verification methods, such as using multiple face recognition algorithms or requiring manual verification in case of ambiguous results.

3. System Reliability and Stability Risk:

   Risk: The system may encounter issues related to stability, performance, or reliability, which can affect the overall functionality and attendance tracking accuracy.

   Mitigation: Implement proper error handling and exception management in the code to handle unexpected scenarios. Monitor the system for any performance or stability issues and take appropriate measures, such as optimizing code, improving system

resources, or using error tracking tools, to ensure reliable and stable operation of the system.

4. Ethical and Legal Risks:

Risk: The use of facial recognition technology for attendance tracking may raise ethical and legal concerns, such as privacy, consent, and discrimination issues. It is important to comply with applicable laws and regulations related to data protection, privacy, and usage of facial recognition technology.

Mitigation: Obtain proper consent from students or other relevant stakeholders before collecting and using their facial data. Follow applicable laws and regulations related to data protection, privacy, and usage of facial recognition technology, such as GDPR, CCPA, and relevant local laws. Clearly communicate the purpose, scope, and implications of using facial recognition technology for attendance tracking to all stakeholders, and ensure transparency and accountability in the project.

5. Hardware and Environmental Risks:

Risk: The project relies on the availability and proper functioning of the webcam and other hardware components. There is a risk of hardware failures, compatibility issues, or environmental factors (e.g., lighting conditions) affecting the performance and accuracy of the system.

Mitigation: Use reliable and compatible hardware components that meet the requirements of the project. Perform regular maintenance and testing of hardware components to ensure their proper functioning. Account for environmental factors, such as lighting conditions, and calibrate the system accordingly for optimal performance.

6. Plagiarism and Intellectual Property Risks:

Risk: The project may involve using external libraries, APIs, or code snippets that are subject to copyright or intellectual property rights. Unauthorized use or plagiarism of code can result in legal consequences and compromise the originality and integrity of the project.

Mitigation: Always ensure that you are using libraries, APIs, and code snippets in compliance with their respective licenses and terms of use. Give proper attribution and credit to the original authors or sources. Avoid copying and pasting code without understanding it fully, and strive to write original code that reflects your own understanding and implementation of the project requirements.

Chapter 5: Testing

5.1 Testing Plan:

The testing **[20]** plan for the Image Forgery Detection project is as follows:

Type of Test	Comments/Explanation
Installation and Setup	Making sure the system is correctly installed in the test environment and that all necessary dependencies are installed.
Unit Testing	By testing each function in isolation, we can ensure that each function works as expected and that any bugs or issues are caught early on in the development process. This can ultimately lead to more robust and reliable code.
Integration Testing	It would involve testing how well the API interacts with the database and whether the expected data is retrieved or updated. Integration testing would check if the API endpoints can be accessed correctly by the client applications and if the responses returned are as expected.
Functional Testing	It would test the system's ability to handle different inputs and scenarios and produce the expected output. It would also test for usability and accessibility, ensuring that the system is easy to use and accessible to all users. Overall, functional testing would verify that the system is performing its intended functions and meeting the business requirements.
Performance Testing	By performing performance testing, we can identify bottlenecks and performance issues in the application, allowing

	us to optimize and tune the application to improve its performance and scalability.
User Acceptance Testing	To guarantee that the system satisfies the needs and expectations of the user, performing user acceptability testing.

Table 2: Testing Plan

5.2 Component decomposition and type of testing required:

The component decomposition and the type of testing required for the project is as follows:

S. No	List of Various Components that require testing	Type of Testing Required	Comments
1.	Face Recognition Algorithm	Functional Testing, Integration Testing, Performance Testing.	This is the main system element in charge of identifying picture alteration. This approach may employ a number of methods, such as deep learning, edge detection, colour histogram analysis, and noise analysis.
2.	Image Pre-processing Component	Unit Testing, Functional Testing.	This part is in charge of pre-processing images, which includes image

			scaling, filtering, and normalisation.
3.	Image Database Component	Unit Testing, Integration Testing, Performance Testing.	The database's picture data must be stored and retrieved via this component.
4.	User Interface Component	User Acceptance Testing, Functional Testing.	This part is in charge of giving users a way to engage with the system.
5.	Image Loading and Saving Component	Unit Testing, Functional Testing.	This component is in charge of retrieving images from and writing them to a local or remote file system.
6.	Image Analysis and Report Generation Component	Functional Testing, Integration Testing, and Performance Testing.	This element is in charge of investigating the discovered manipulation and producing a report.

Table 3: Component Decomposition

5.3 List of all test cases:

1. **Test that the camera is working and captures images.**

   Input: None

   Output: Success variable is True and img contains an image from the camera

2. **Test that the encoding file is loaded properly.**

   Input: A valid path to the encoding file

   Output: encodeListKnown and studentIds variables are populated with data from the file

3. **Test that the face recognition is working properly.**

   Input: An image with a known face in it

   Output: The correct student ID is displayed on the image

4. **Test that the attendance data is updated properly in the database.**

   Input: A student ID and attendance time

   Output: The student's attendance count and last attendance time in the database are updated correctly

5. **Test that the mode images are loaded properly.**

   Input: A valid path to the folder containing the mode images

   Output: The imgModeList variable is populated with the correct images

6. **Test that the corner rectangle is drawn correctly around the detected face.**

   Input: An image with a detected face

   Output: The corner rectangle is drawn around the detected face

7. **Test that the mode images are displayed correctly.**

   Input: A modeType variable

   Output: The correct mode image is displayed on the background image

5.4 Limitations of the solution:

The limitations are:

False Positives: The solution may produce false positives if there is an incorrect match between a known face and an unknown face, resulting in the attendance of the wrong student being updated.

Accuracy: The solution may produce inaccurate results if the face recognition model is not trained properly or if the lighting conditions are not ideal.

Hardware Requirements: The solution requires a camera and a system with sufficient processing power to perform real-time face recognition.

Security: The solution stores the images and attendance information of students in a third-party service (Firebase). Therefore, there may be security and privacy concerns that need to be addressed.

Dependence on Internet Connection: The solution requires a stable internet connection to access the Firebase Realtime Database and Storage Bucket, which may not be available in certain locations.

Limited Student Information: The solution only stores basic student information such as student ID, major, and standing. It may not be suitable for scenarios where more detailed student information needs to be stored and accessed.

Chapter 6: Findings, Conclusion, and Future Work

6.1 Findings:

The project uses face recognition to detect faces in a live video stream and identify them using their previously saved encodings:
The project uses the face recognition library to identify faces in a live video stream. It uses a pre-trained deep learning model to encode each detected face and then compares it to the saved encodings to identify the person.

The project uses Firebase to store student data and images, as well as to update attendance records in real-time:
Firebase is used to store the student data, including their names, majors, and images. The project also updates the attendance records in real-time, which allows the instructor to monitor the attendance of the class.

The project uses OpenCV to manipulate and display images and video frames:
OpenCV is an open-source computer vision library that provides a wide range of image and video processing functions. The project uses OpenCV to manipulate the video stream, including resizing the frames and applying filters.

The project uses the cvzone library, which is built on top of OpenCV, to draw rectangles and text on the images and video frames:
cvzone is a library built on top of OpenCV that provides additional functions for drawing shapes, lines, and text on images and video frames. The project uses cvzone to draw rectangles around the detected faces and to display text on the screen.

The project loads previously saved face encodings from a pickle file:
The project saves the face encodings of each student in a pickle file, which is a serialized Python object. It loads the encodings from the file to compare them with the encodings of the detected faces.

The project uses numpy to perform numerical operations on the image data:

NumPy is a Python library used for numerical computations. The project uses NumPy to perform various operations on the image data, including resizing, converting to grayscale, and calculating the mean value of the pixel intensities.

The project uses datetime to calculate the time elapsed since the last attendance record for a particular student:
The project uses the datetime module to calculate the time elapsed since the last attendance record for a particular student. This information is used to prevent duplicate attendance records.

The project uses a webcam to capture video frames:
The project captures the video stream from a webcam connected to the computer.

The project contains different modes, including a loading mode, an attendance confirmed mode, and an error mode, to provide feedback to the user:
The project contains different modes that provide feedback to the user. When the program starts, it displays a loading screen. When a face is detected, it switches to the attendance confirmed mode, and when an error occurs, it switches to the error mode.

The project displays information about the identified student, including their ID, major, and total attendance:
The project displays the ID, major, and total attendance of the identified student on the screen. This information is retrieved from Firebase, and the attendance record is updated in real-time.

6.2 Conclusion:

In conclusion, face recognition systems have gained increasing significance as a research area and are being implemented in various fields. These systems are used for crime prevention, video surveillance, person verification, and other security activities. Additionally, universities are starting to use face recognition systems, such as the Face Recognition Based Attendance System, to reduce errors in traditional attendance taking methods. The purpose of implementing such systems is to automate and create a more efficient and accurate method of attendance taking. This method is secure, reliable, and available for use in office environments, replacing old manual methods.

The use of facial recognition technology has sparked debate and raised concerns about privacy, security, and possible biases in the system. While these issues are important to address, it is undeniable that face recognition systems have the potential to improve efficiency and accuracy in various settings. Furthermore, with advancements in technology, the accuracy and reliability of these systems are improving.

However, there is a need for strict regulation and oversight to ensure that the implementation of facial recognition technology is ethical and does not infringe on people's rights. For instance, the system should not be used for unauthorized surveillance or tracking of individuals. Additionally, it should not be biased against certain groups or individuals based on race, gender, or other factors.

In conclusion, while face recognition systems have their advantages, there is a need for careful consideration of the potential ethical and social implications. The use of facial recognition technology should be regulated and monitored to ensure that it is used ethically and does not harm individuals or infringe on their rights. When implemented in a responsible manner, facial recognition systems can be a useful tool for improving efficiency and accuracy in various fields.

6.3 Future Work:

- Improving accuracy: While face recognition technology has come a long way in recent years, there is still room for improvement in terms of accuracy. Researchers could explore ways to increase the accuracy of the system, for example by incorporating more advanced algorithms or training the system on larger datasets.
- Enhancing security: Security is a critical concern in any attendance system, and there may be ways to improve the security of the Face Recognition Based Attendance System. For example, researchers could explore ways to prevent spoofing attacks, in which an attacker attempts to trick the system by presenting a fake face.
- Evaluating usability: While the system may be efficient and accurate, it is important to ensure that it is also user-friendly. Researchers could conduct usability studies to evaluate how easy it is for users to interact with the system, and identify any areas for improvement.
- Scaling up: The current implementation of the system appears to be designed for use in a single organization or institute. However, researchers could explore ways to scale up the system to work across multiple organizations, or even across entire cities or regions.
- Evaluating cost-effectiveness: While the benefits of the system are clear, it is also important to consider the costs associated with implementing and maintaining it. Researchers could conduct cost-benefit analyses to evaluate whether the benefits of the system outweigh the costs, and identify any areas where cost savings could be achieved.
- Evaluation of accuracy: While the proposed face recognition based attendance system has been designed to be more accurate than the traditional manual method, it is important to evaluate its accuracy in real-world scenarios. This could involve testing the system in various lighting conditions and with individuals wearing different types of clothing, glasses, or accessories that may impact its performance.
- Integration with other systems: The proposed system could be integrated with other existing systems in the organization to further improve efficiency and

reduce errors. For example, it could be linked to the payroll system so that attendance records are automatically used to calculate employee salaries.

- Implementation in other organizations: While the proposed system has been designed for use in a university setting, it could be implemented in other types of organizations as well. For example, it could be used in hospitals to track staff attendance or in manufacturing facilities to monitor employee work hours.
- Integration with biometric data: The face recognition system could be integrated with other types of biometric data, such as fingerprints or voice recognition, to further improve accuracy and security. This could be particularly useful in high-security environments where identity verification is critical.
- Expansion to mobile devices: As mobile devices become more powerful and ubiquitous, there is potential to expand the proposed face recognition based attendance system to mobile devices. This could allow employees to take attendance using their smartphones or tablets, further improving convenience and accessibility.

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RESUME

GEET JINDAL

I would like to utilize my skills to exchange my capabilities to work in a progressive environment at a responsible and challenging position for the growth of organization when advancement and connection are best on personal performance.

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ABOUT ME

ACADEMIC QUALIFICATION

- Pursuing B.Tech Computer Science (7th Semester) from Jaypee Institute Of Information Technology, Noida (CGPA 7.7)
- 12th from CBSE in 2019.(79.8%)
- 10th from CBSE in 2017 (CGPA 8.8)

WORK EXPERIENCE

- Internship at Webcommerce India Private Limited.

SKILLS

- C++, Python, Data Structures and Algorithms, OOPS.
- Basic-Intermediate Knowledge in Machine Learning, Computer Networks, Artificial Intelligence, Operating System, DBMS.
- Web Designing (HTML, CSS, Wordpress)
- UI/UX Designing.

PROJECTS

Smart Car Parking(OpenCV, Python, YOLOv5)
-Using Computer Vision and YOLOv5

Fingerprint Recognition System (Python, Numpy, Matplot)
-Model Used: Convolutional Neural Network (CNN)

Face Recognition Attendance System With Realtime Database
-Using OpenCV and Firebase

PERSONAL DETAILS

Date of Birth	:	26th January, 2001
Father's Name	:	Mr. Darshan Kumar (MCA)
Mother's Name	:	Mrs. Chanchal Jindal (Advocate)
Marital Status	:	Single
Nationality	:	Indian
Languages Known	:	English & Hindi
Strength	:	Believe in Hard Work, Cool & Calm

AKSHIT TYAGI

DOB : 14TH FEBRUARY , 2000

ABOUT ME

I'm looking for a work environment where I can meet and work with new people who have knowledge in different fields and could teach me new skills to develop. I have interest in ML and Web Dev. I have a very good grasp on the DSA. I have built a few projects using ML models and web-based projects using NodeJs. Currently, I'm learning about new front-end frameworks, new ML-based technology, and brushing up on my DSA.

MY PROJECTS

- **Maze-Path-Finder**
  Ai based maze path finding project with visualization
- **Movie Recommendation System**
  Ml model that recommends movie based on user input
- **Contact-List**
  Simple contact list (front-end and back-end)
- **To-Do List**
  A simple to-do list (front-end and back-end)

EDUCATION

- **HIGHER SECONDARY EDUCATION - CBSE (COMPLETED)**

  APEEJAY SCHOOL, SAKET (NEW DELHI)

  Secondary Exams
  - 95%
  - completed 2016

  Senior Secondary Exams (PCM)
  - 82.4%
  - completed 2018

- **GRADUATION - B.TECH - COMPUTER SCIENCE AND ENGINEERING - (ONGOING)**

  JIIT, NOIDA

  6th Semester - completed June 2022
  - (No backlogs ever)
  - CGPA till 6th semester - 7.8

MY LANGUAGE

- English
- Hindi

SKILL

- Java
- CPP
- Python
- HTML
- Css
- Javascript
- Jquery
- NodeJS
- ExpressJS
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