PROJECT REPORT

WITH LITERATURE SURVEY & DOCUMENTATION

Facial Recognition Attendance Manager

*Submitted in fulfilment of the requirements for the paper*

Bachelor in Technology

In

**Information Technology**

Submitted By,

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**Declaration**

We hereby declare that the project work being presented in the project proposal entitled “Facial Recognition Attendance Manager” in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology in Information Technology** at **Calcutta Institute of Engineering and Management** is an authentic work carried out under the guidance of Ms Tuhina Sinha. The matter embodied in this project work has not been submitted elsewhere for the award of any degree of our knowledge and belief.

Date: 23-10-2022

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**Abstract**

The attendance system has developed into a clever and effective approach to monitor attendance for a group of people. In the past, maintaining hard copy attendance registers which took time and were prone to mistakes was one of the manual methods used for managing attendance. However, thanks to the technological revolution, attendance management is now more simplified and practical.

Tracking attendance has been made much easier with the development of software tools like Microsoft Excel, Google Sheets, and other spreadsheet programmes. The automatic computations, data validation, and data sorting capabilities of these spreadsheet applications have improved the accuracy and effectiveness of attendance management. Additionally, these software options make it simple to enter, customise, and analyse data, which makes it straightforward for organisations to handle attendance data for a large number of people.

The use of spreadsheet- and database-based attendance systems has replaced manual attendance registers with systems that are more accurate, dependable, and efficient. Automated attendance systems minimise manual data entry and offer real-time access to attendance data, which has decreased administrative costs and increased productivity.

Attendance systems provide benefits to individuals in addition to organisations. For people to register their attendance, examine their attendance history, and get automated notifications, they offer a user-friendly interface. This encourages accountability and gives people the power to own up to their attendance.

**Introduction**

A facial recognition system is a system which is capable of detecting a human face from a given image or video. It primarily works by detecting facial landmarks on a face and comparing it with the predefined landmarks of an image in the database. [1]

Broadly the Steps of Facial Recognition can be classified into four parts:

1) Representing the Image on a 2D graph: Representing an image on a 2D graph is one of the most fundamental steps in image processing. It is the process of mapping an image's pixel values onto a 2D plane, where each pixel's coordinates represent its location in the image. This representation enables a range of image processing techniques, such as filtering, segmentation, and feature extraction.



[2] Actual Image

2) Detecting Landmarks: Facial landmarks are typically determined by the help of predefined features such as the nose, eyes, lips, and chin. These features act as reference points that can be located on a face image, allowing for the identification of the position of different facial landmarks. However, identifying these features is completely based on a set of datasets that contain values in the form of a 2D matrix defining how a human facial feature would generally look like. These datasets are usually created by manually annotating a large number of facial images with the corresponding landmarks.



[2] Image with Landmarks

3) Generating Blueprint of Face: After the facial landmarks are identified and located on an image, the next step in facial recognition is to generate a blueprint of the face. The blueprint is created by connecting the dots of the facial landmarks using mathematical algorithms. The resulting structure is unique for each individual, except for identical twins in some cases. The blueprint of the face is commonly referred to as a facial template or face print. It contains important information about the geometry of the face, including the distance between different facial features and the angles at which they are positioned. This information is used to create a digital representation of the face, which is then compared to a database of face prints to identify the person. The accuracy of the facial recognition process heavily relies on the quality of the faceprint. Therefore, it is crucial to ensure that the facial landmarks are correctly identified, and the blueprint is accurately generated. Factors such as lighting conditions, facial expressions, and occlusions, such as glasses or hats, can affect the accuracy of the face print.



[2] Blueprint of the Image

4) Comparison: The final step in facial recognition is comparing the generated facial template with the faceprints stored in the database. The faceprint obtained from the new image is compared with all the other faceprints in the database to find the closest match possible. The process involves calculating the distance between the facial template and the faceprints in the database and selecting the one with the smallest distance.

The accuracy of the facial recognition process depends on the quality of the facial templates and the size and diversity of the database. A larger and more diverse database increases the chances of finding a match and improving the accuracy of the process. In most cases, a matching accuracy of more than 70-80% is considered reliable and is used as a threshold for positive identification.

**Aims and Objective**

The project aims to create a system that can automate the process of taking attendance in a classroom. This system will provide a more efficient way for teachers to take attendance, reducing the time and effort required to complete this task. The following are the objectives of the project:

**1. Login portion for the Teacher who is going to give attendance to students of a particular department:**

The first objective is to create a login system for teachers. This will allow only authorized teachers to access the attendance system. Teachers will be able to log in using their unique credentials, such as their department id and password. Once logged in, they will have access to the attendance system.

**2. Uploading of the Image of the class taken during the class:**

The second objective is to allow the teacher to upload an image of the classroom taken during the class. This image will be used to detect the faces of the students present in the class. The teacher can use any camera device such as a phone camera or any other camera. Once the image is uploaded, the system will start processing it.

**3. Detecting all the faces present in the class:**

The third objective is to detect all the faces present in the uploaded image. The system will use machine learning algorithms such as Eigen Vectors to detect the faces. The system will be designed to handle multiple faces in the image. For the purpose of the project we will be using the face-api-js api[3] which is built using Eigen Vector detection of faces.

**4. Identifying the student’s faces who belong to that class:**

The fourth objective is to identify the faces of students who belong to that particular class. The system will compare the detected faces with the images of students in the database to identify which students are present in the class. If the system identifies a student, it will mark them as present in the attendance.

**5. Submitting the attendance for those student in the database:**

The final objective is to upload the student’s present status along with the name of the class and date. The server will be taking the data and adding them accordingly in the database.

In conclusion, the attendance system will provide an efficient way for teachers to take attendance in the classroom. It will reduce the time and effort required to complete this task and provide accurate attendance data. The system will be designed to handle multiple classes, and the data can be used for administrative purposes. Overall, this project will be a valuable addition to the education system, making the attendance process more efficient and effective.

**Literature Review**

Facial recognition is a way of identifying or confirming an individual’s identity using their face. It is a category of [biometric security](https://www.kaspersky.com/resource-center/definitions/biometrics).  The technology is mostly used for security and law enforcement, though there is increasing interest in other areas of use. The technology is used for a variety of purposes. These include:

**1. Unlocking phones**

Facial recognition technology has become increasingly prevalent in recent years, with its applications ranging from security and law enforcement to personal device authentication. One such application is the use of facial recognition technology to unlock mobile devices such as smartphones. Apple, one of the leading technology companies, has integrated facial recognition technology into their latest iPhone models, providing a new level of security for users. The face recognition technology used in Apple's iPhones relies on a complex algorithm that analyses the unique features of a person's face, such as the distance between their eyes and the shape of their nose. This algorithm creates a mathematical model of the user's face, which is then stored on the device as a reference for future authentication attempts. When the user attempts to unlock their phone, the device's camera captures an image of their face and compares it to the stored reference model to determine if the user is authorized to access the device. Apple claims that the chance of a random face unlocking an iPhone is about one in 1 million, making the technology highly secure. However, some experts have expressed concerns about the potential for false positives or false negatives, which could lead to unauthorized access or denied access for legitimate users. Despite these concerns, facial recognition technology has become an increasingly popular method of authentication for mobile devices. It offers a fast and convenient way for users to unlock their devices without the need for a password or PIN code. Additionally, it provides a higher level of security than traditional methods, as it is much more difficult for someone to impersonate another person's face than it is to guess a password or PIN code. [6]

### 2. Law enforcement

Facial recognition technology has become a controversial topic, particularly when it comes to its use by law enforcement agencies. The technology has been adopted by many police departments around the world, claiming that it can help them to identify and apprehend criminals. However, there are growing concerns over the accuracy and potential misuse of the technology. According to a report by NBC, facial recognition technology is becoming increasingly popular among law enforcement agencies in the United States. The report suggests that over 50% of American adults are already in a law enforcement facial recognition database, with the technology being used for a variety of purposes such as identifying suspects in criminal investigations, tracking missing persons, and monitoring public gatherings. The use of facial recognition technology by law enforcement agencies is not limited to the United States. Many countries around the world have also adopted this technology, including China, which has one of the most extensive surveillance systems in the world. In China, facial recognition technology is used for a range of purposes, including monitoring public gatherings, tracking individuals, and identifying suspects in criminal investigations. Despite its growing popularity, the use of facial recognition technology by law enforcement agencies has been met with criticism from civil rights groups and privacy advocates. Concerns have been raised about the accuracy of the technology, particularly when it comes to identifying individuals from ethnic minority groups. There have also been concerns about the potential misuse of the technology, including its use for mass surveillance and the infringement of individuals' privacy rights.

### 3. Airports and border control

Facial recognition technology is becoming increasingly popular at airports around the world. With the rise in air travel, there has been a growing need to streamline the airport experience and make it more efficient. Facial recognition technology offers a solution to this problem, allowing airports to speed up the check-in and security processes while also improving security. One of the most significant developments in the use of facial recognition technology at airports is the introduction of biometric passports. These passports contain a microchip that stores the holder's biometric data, including their facial image. This data can then be used to verify the traveller's identity at automated e-Passport control points, which are now present at many airports worldwide. The use of facial recognition technology at airports has several benefits. For travellers, it means that they can avoid long queues and reach their gates faster. It also provides a more seamless and convenient experience, reducing stress and anxiety levels associated with travel. For airports, it means that they can process travellers more quickly and efficiently, allowing them to handle higher volumes of passengers. Facial recognition technology also offers improved security at airports. By using facial recognition to verify travellers' identities, airports can more accurately screen for individuals who may pose a security risk. This can help to prevent potential threats and improve overall safety and security for all travellers. However, the use of facial recognition technology at airports has also been met with criticism from privacy advocates. Concerns have been raised about the potential misuse of biometric data, including the risk of data breaches and the possibility of facial recognition being used for surveillance purposes. [8]

### 4. Banking

Biometric online banking using facial recognition is rapidly gaining popularity as a secure and convenient way for customers to access their accounts and authorize transactions. With traditional authentication methods such as passwords and one-time passwords becoming increasingly vulnerable to hacking and phishing attacks, facial recognition offers a more secure alternative. By using facial recognition, customers can simply look at their smartphone or computer to authenticate themselves, without the need for complex passwords that can be easily compromised. This makes the online banking experience more convenient, faster, and more secure, as there are no passwords for hackers to steal or crack. Moreover, facial recognition technology has the capability of detecting and preventing fraudulent activity by identifying whether the source of a biometric sample is a live human being or a fake representation. This technique, known as 'live less' detection, helps to prevent fraudsters from using stolen biometric data to impersonate someone else. The adoption of facial recognition technology in online banking has the potential to make debit cards and signatures obsolete. Facial recognition is a more secure and reliable way of verifying identities, and it is much harder for fraudsters to replicate or steal someone's facial features compared to a signature or a physical card. This could lead to a reduction in fraud, making online banking more secure for customers and the banking industry as a whole. However, despite the many benefits of facial recognition in online banking, there are also concerns about privacy and security. Some people are uncomfortable with the idea of their biometric data being stored and shared with third parties. There is also the possibility of facial recognition systems being hacked, leading to the theft of biometric data and potential identity theft.

**Previous works on facial recognition system:**

* **Amazon** previously promoted its cloud-based face recognition service named **Rekognition** to law enforcement agencies. [9]
* **Apple** uses facial recognition to help users quickly unlock their phones, log in to apps, and make purchases.
* **British Airways** enables facial recognition for passengers boarding flights from the US. Travellers' faces can be scanned by a camera to have their identity verified to board their plane without showing their passport or boarding pass. [10]
* **Facebook** began using facial recognition in the US in 2010 when it automatically tagged people in photos using its tag suggestions tool. The tool scans a user's face and offers suggestions about who that person is.
* **Google** incorporates the technology into **Google Photos** and uses it to sort pictures and automatically tag them based on the people recognized.
* **Snapchat** is one of the pioneers of facial recognition software: it allows brands and organizations to create filters which mould to the user’s face — hence the ubiquitous puppy dog faces and flower crown filters seen on social media.[5]

**How Facial Recognition Attendance System is Different from previous works:**

* All the previous facial recognition systems were able to recognize one face at a time but this system can recognize multiple faces at a time. User needs to click a picture of a class and using this system each face will be matched from database and if matched that particular student will be marked as present and if any student doesn’t belong to that particular class (i.e. checked from database) then it’ll also identify that.
* For all the previous facial recognition system a particular software needs to be installed in system but for this no need to install any additional software. It works on any modern browser, one only needs to locally download the repository.

**Methodology**

Facial Recognition Attendance Management is capable of identifying individual faces from an image including a group of people with different faces. In this way we can generate a list of student present in a class by taking images of the class from 2-3 angles. Once the list of students is generated their attendances can be allotted in a databases by making a POST API call.

For the working of this system no other software is needed to be installed because the entire process can be implemented on a website.

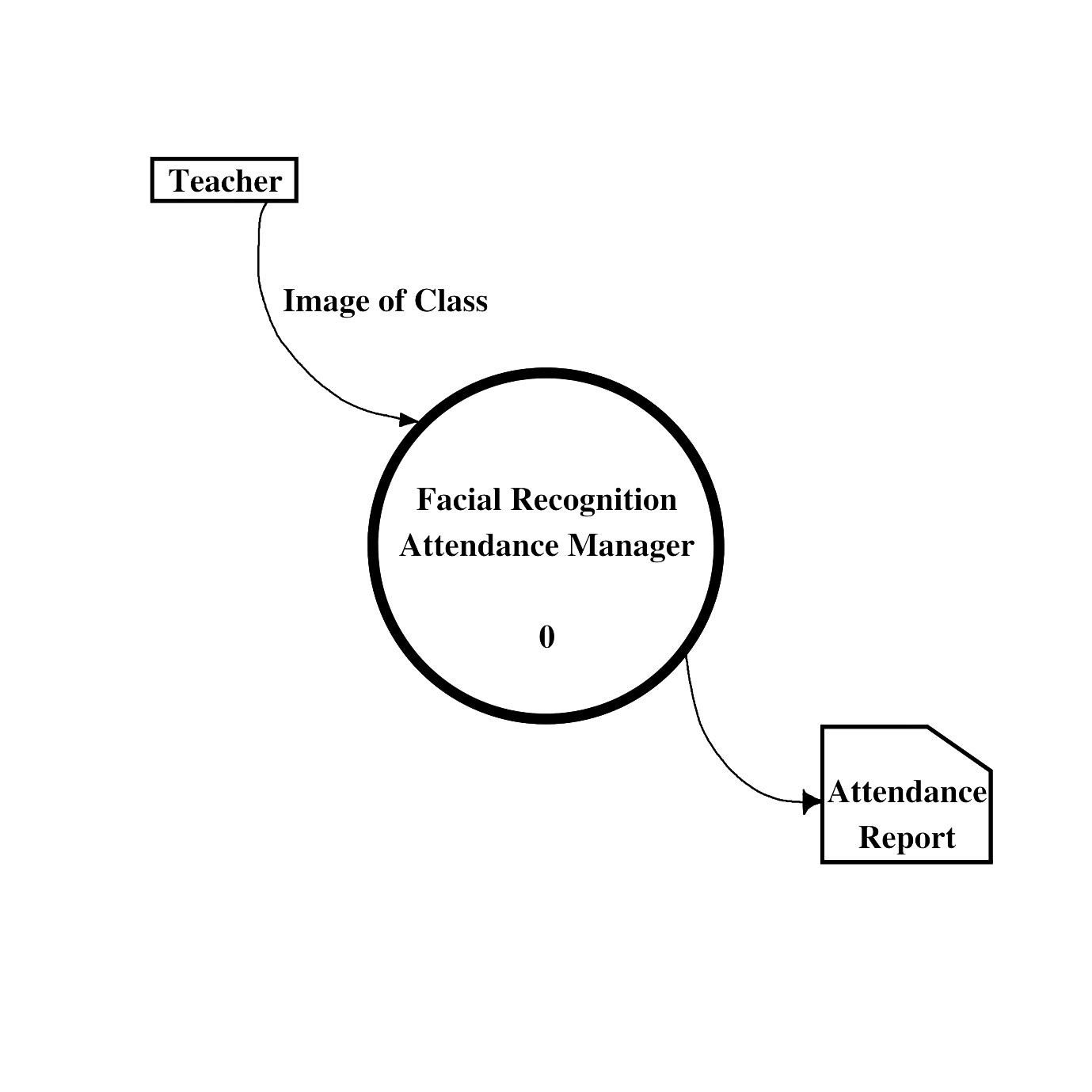
Thus Technologies which will be required for this project are:

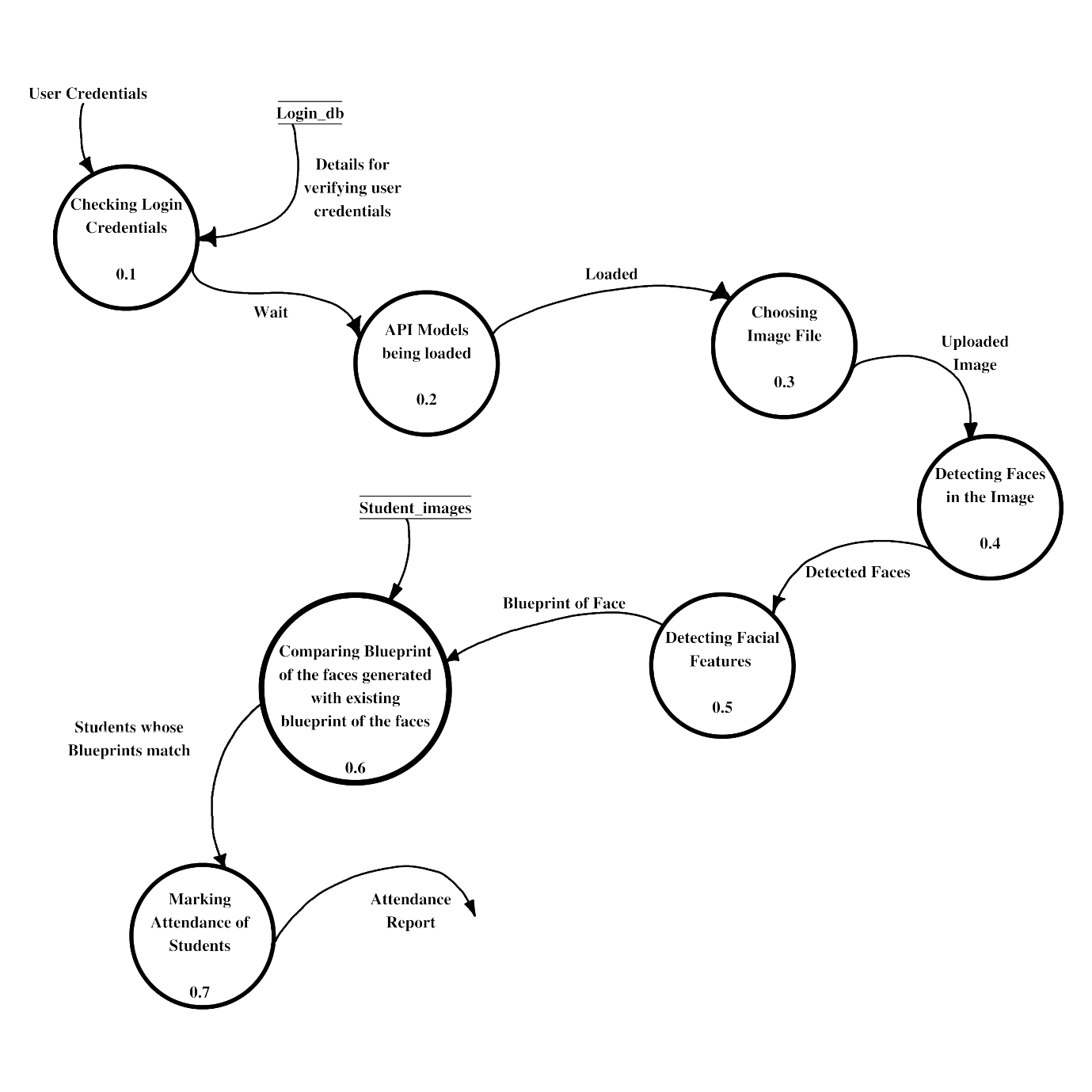
1. Mongo DB (For recording student attendances persistently)
2. Node.js (For making the APIs needed for this project)
3. HTML (For frontend scripting of the website)
4. CSS (For styling the frontend)
5. Vanilla JavaScript (For making the API calls)

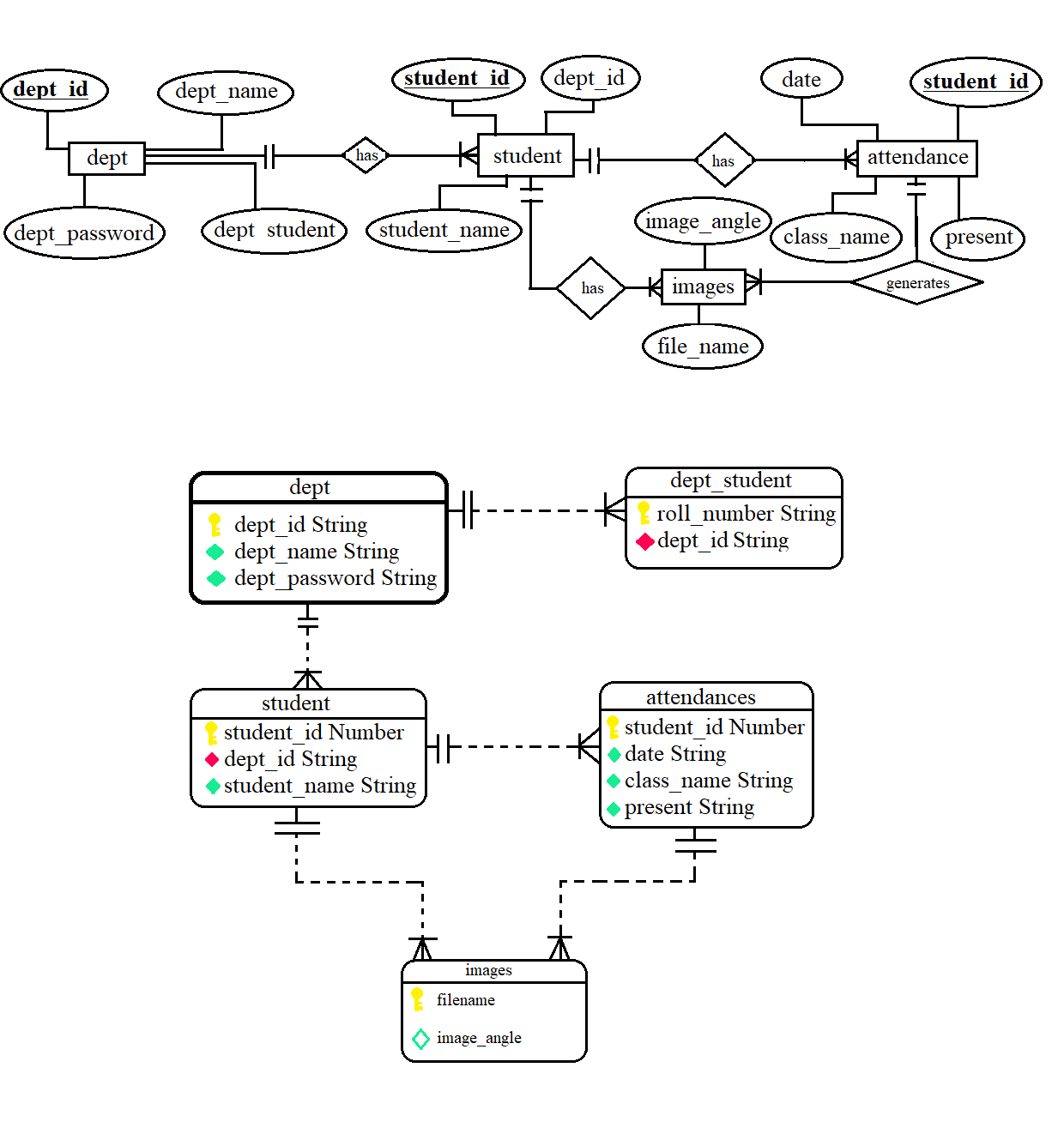
Other open source services used:

1. face-api.js by Vincent Muhler [3]
2. Cloudinary [4]

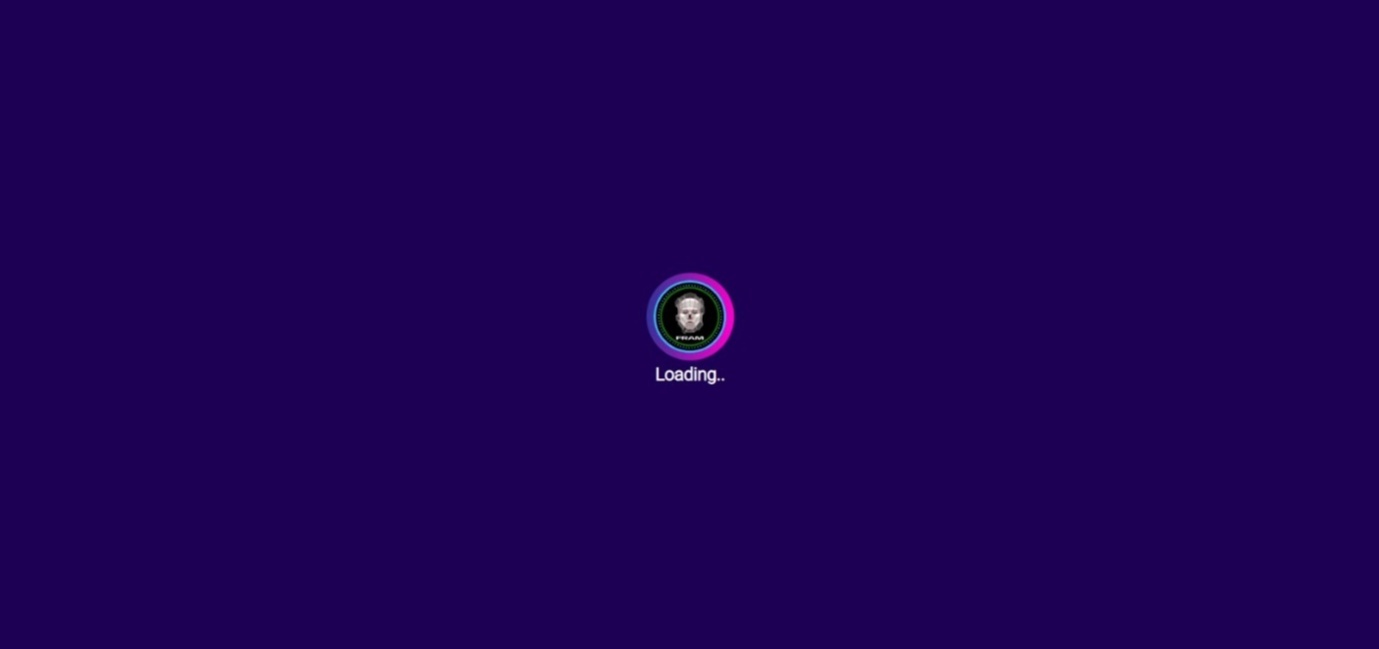
**Data Flow Diagrams**

Level Zero:

Level One:

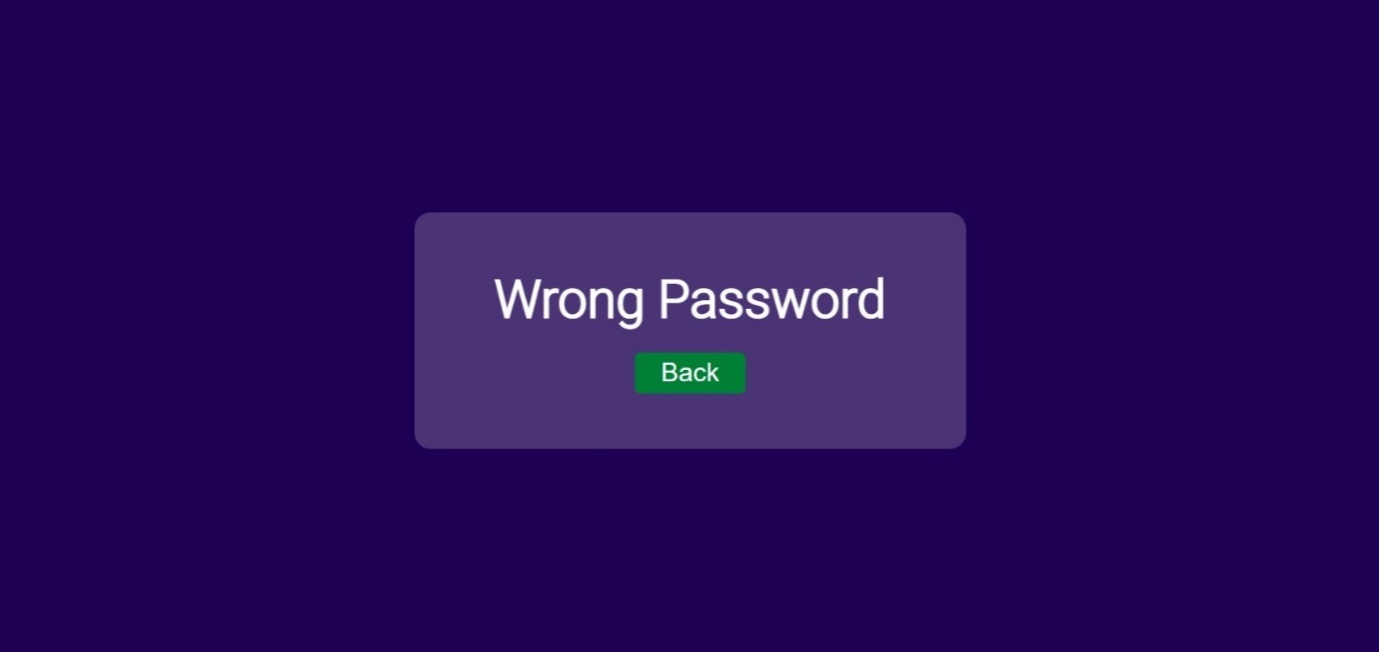
**Entity Relationship Diagram**

**Result and Analysis**

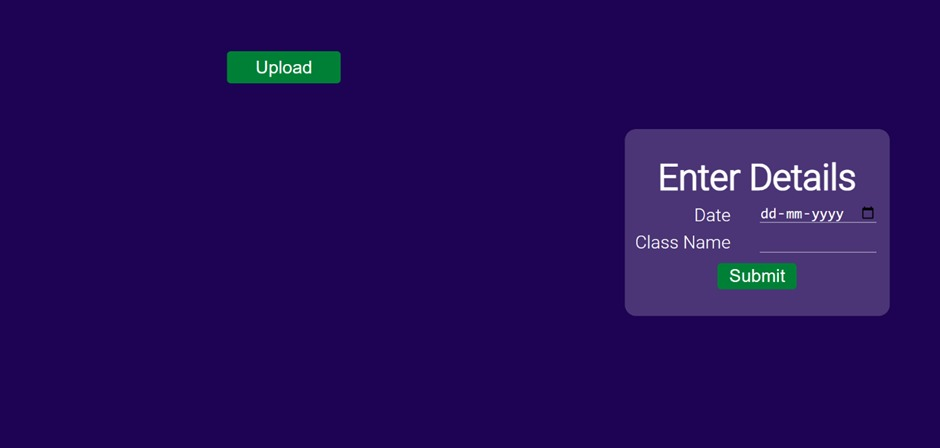
First teachers have to open our web application. After opening it a “**Loading**” page will be shown. It may take few times to load the models for our application. 

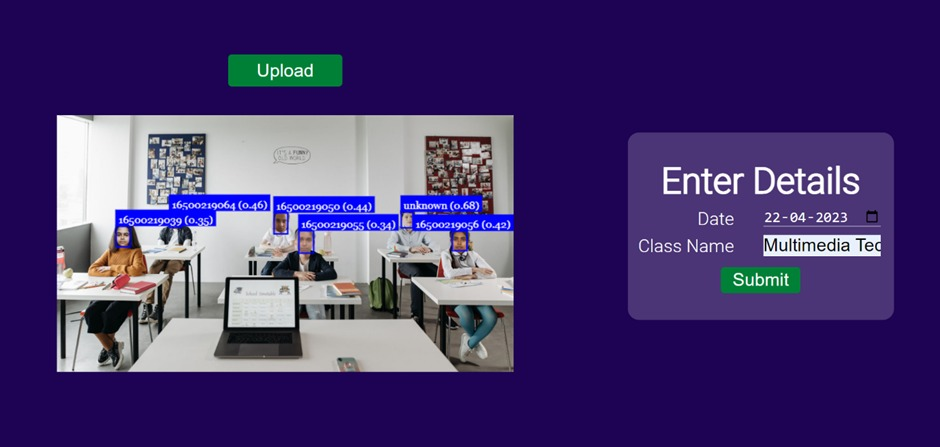
After the page is loaded a new page will appear where teachers have to login in our application with the necessary credentials

The login credentials are already present in the database. Teachers have to login with that credentials only. If the teacher gives the right Department ID and password then the page will redirect to the next page where teachers can upload the photo of classroom to mark the attendance.

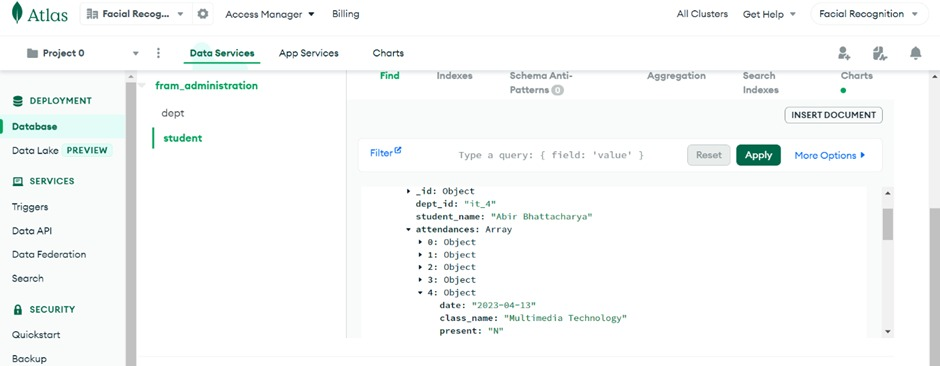
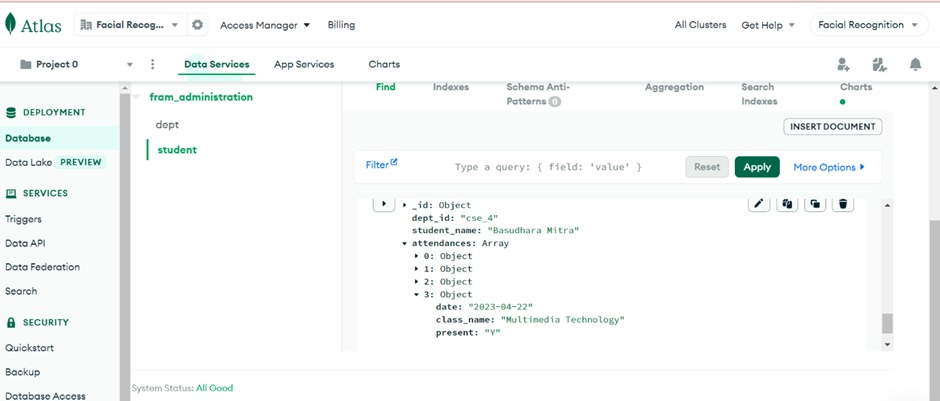
If the teachers give wrong Department ID and password then it will redirect to another page where there is a warning that she/he has given the wrong login credentials. 

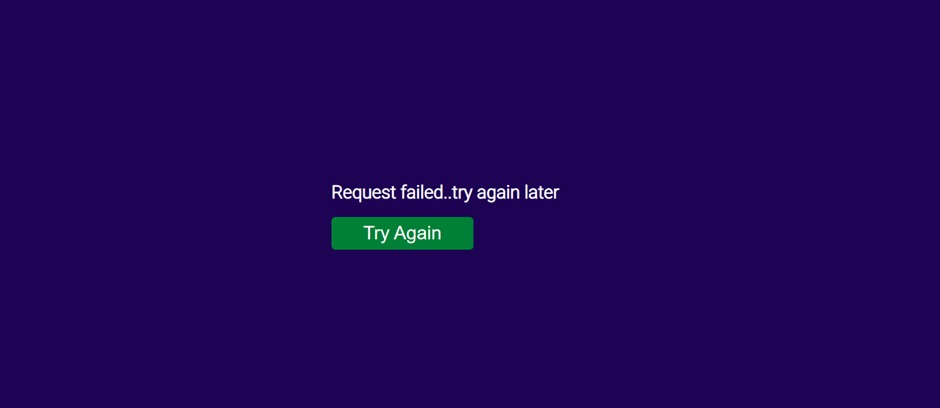
After giving wrong ID and password this above page will appear. Teachers have to click on the back button and it will again redirect to the login page and give the right credentials and go to the upload photo page.

After successful log in teacher needs to upload the class image by clicking on the “upload” button. 

And the students who belong to that class and present in that image, their face will be identified. Then teacher needs to enter the class name and the date of the class took place. Then teacher needs to click on the “submit” button. 

If every input field is filled correctly then the attendance will be marked for those students who are present and it will get saved in the database. Then teacher can log out by clicking on the “log out” button, which will redirect the user back to the home page. 

 These are the database snapshots where the respective student’s attendance is marked.

If the teacher doesn’t enter either of the class date or subject name then an error message will be shown to them.  Teacher needs to click on the “Try Again” button to get back to the upload page to enter the details correctly.

**Discussion**

**Advantages**

1. All existing attendance systems that use Face Recognition techniques have one thing in common which is to detect faces individually and mark their attendances. However that process is time consuming as it leads to students standing in a queue generally for getting attendance and takes away time from their classes. Our system captures the entire class in a single snap and allots attendances thus it is not time consuming.
2. In normal attendance system which is followed in most classes, a teacher marks attendances on pen and paper which takes 10 - 15 minutes from a class. Our attendance system will require just a minute to click an image of the entire class.
3. The entire process is created with safety in mind where a teacher can upload attendances by accessing this portal through a certain IP Address which is one of the department’s faculty computer or any other such administrative computers. As a result of which if someone gets their hands on the credentials they still can’t upload attendances.
4. It is a common practices in many classes where a student’s attendance is marked even though that student isn’t present when some other individual says “Yes Ma’am” or “Present Ma’am” when that absent student’s name is called. Such kind of malpractices can’t be done in our Attendance System.

**Disadvantages**

We currently went with the 5 angle approach, where an individual’s face is captured from 5 different angles. Thus there is there is no dataset images present where an individual’s face might not get detected when he or she is wearing a hat, sunglasses or have beards.

**Conclusion**

Face recognition is an emerging technology that can provide many benefits. This application is completely based on web therefore no installation is required separately on the computer. Unlike other systems which require installation of the software in the local computer.

Our Facial Recognition Attendance Manager will help the teachers to save their time. On average a professor would take 10 minutes for taking attendance. That would mean 5 minutes of less study in a class. If there are 4 subjects taught in a day that would mean approximately 40 minutes in a day wasted. Compared to our system which would take much less time for completion of taking attendance of the entire class.

Other System available in the market would detect one face at a time and register their attendance. Our system is going to take an image of the entire class and save the time.

Thus our system is a unique and easy to use and fast way of collecting attendances.

**Future Scope**

The following are the future scopes related to this project

1. Using of more face recognition algorithms for getting more accurate results.
2. Using of 8 angle face detection approach so that we can detect faces even if someone is having a beard, hat or sunglasses.
3. Encrypting the credentials.

**Appendix**

**Image Dataset**

The database consists of five sets of images each having five sample images. The five sets of images are of five people and the five samples are images of different sides of each face. The sides are front, left, right, front-left and front-right. The images are sourced manually. All images are in RGB colour-space and stored in the JPEG format.

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| padma\_1[11] | padma\_2[12] | | padma\_3[13] |
| padma\_4[14] | | padma\_5[15] | |

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| arkamitra\_4[19] | | arkamitra\_5[20] | |

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| --- | --- | --- | --- |
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| anusweta\_4[24] | | anusweta\_5[25] | |

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| --- | --- | --- | --- |
| basudhara\_1[26] | basudhara\_2[27] | | basudhara\_3[28] |
| basudhara\_4[29] | | basudhara\_5[30] | |

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| --- | --- | --- | --- |
| abir\_1[31] | abir\_2[32] | | abir\_3[33] |
| abir\_4[34] | | abir\_5[35] | |

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[11]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680198582/LabelledImages/16500219039/1.jpg>

[12]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680198581/LabelledImages/16500219039/5.jpg>

[13]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680198581/LabelledImages/16500219039/2.jpg>

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[29]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680163649/LabelledImages/16500219050/4.jpg>

[30]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680163649/LabelledImages/16500219050/5.jpg>

[31]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680106543/LabelledImages/16500219064/2.jpg>

[32]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680106543/LabelledImages/16500219064/1.jpg>

[33]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680106543/LabelledImages/16500219064/5.jpg>

[34]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680106544/LabelledImages/16500219064/3.jpg>

[35]<https://res.cloudinary.com/dvzh3aj7y/image/upload/v1680106543/LabelledImages/16500219064/4.jpg>