Process Documentation (CA2-Analytics Model)

For

Third Year Project

Gyalpozhing College of Information Technology

Royal University of Bhutan

Bachelor of Science in Information Technology

Smart Attendance System

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Introduction

Before the development of this project. There are many loopholes in the process of taking attendance using the old method which caused many troubles to most of the institutions. Therefore, the facial recognition feature embedded in the attendance monitoring system can not only ensure attendance to be taken accurately, but also eliminated the flaws in the previous system. This system can save resources and reduces human intervention in the whole process by handling all the complicated task to the machine. The only cost to this solution is to have sufficient space in to store all the faces into the database storage.

Requirement Analysis

Requirements that are well thought through and clearly documented are essential to any successful software engineering project.

The first thing before making any application is to understand the customer requirement and it's called a **requirement analysis.**

The end product is a document called SRS (Software Requirement Specification).

System requirements can be categorized as either functional and non-functional requirements.

Functional Requirements

Specify what the system must do in response to different inputs and what it must output.

User (Lecturer)

1. Login: User can login using their username and password.
2. Take Attendance: Display a dialog box to select a class and will open a web camera to capture face of every students and mark their attendance.
3. View Attendance: Will display the attendance record.
4. Edit attendance records: Allow user to change the attendance records.
5. Delete attendance records: Allow user to delete attendance records.
6. Share attendance records: Allow user to share attendance records with others (students).

Admin(Developers)

Can add/update/delete all records (Attendance records, face images and their details)

Non-functional Requirements

Requirements that describe how the system works. Non-functional requirements are all about system usability and meeting at least some non-functional requirements are important in a well performing system.

Some of the non-functional requirements of our application are:

1. **Security**

   Those with faces recognized in the video camera will be marked present only when the machine matches their faces with the dataset collected.

2. **Portability**

   The system is highly portable as it can easily be deployed in various platforms such as computer laptop, computer desktop, or a mobile device (mobile phone, tablet).

3. **Usability:** It is effortless for the user to use the Smart Attendance System due to the following reasons:
   a. Learnability: The user will be able to use our application very easily since the system instructions will be properly written in a simple language that can be understood by anyone.
   b. Errors: The is no option of any mistakes from user's side as they cannot make any changes to the system.
   c. Memorability: Since our application is not complex as the user does not require to learn anything to use our application, the users will not face trouble when using our application after long time also.

TECHNOLOGY

The technology and version to be used for developing this application are:

A. Google Collab: Platform to develop machine learning models.

B. OpenCV (open computer vision): Open source library for computer vision, machine learning and image processing.

Advantages of openCV over other deep learning frameworks:

1.OpenCV has everything you need for image manipulation or computer vision applications.

2.All other frameworks for machine learning/neural network models can be imported and used in openCV.

3.Unlike openCV, classical computer vision techniques cannot be achieved by deep learning tools.

4.It has high performance as running deep learning models in openCV is faster compared to other frameworks.

C. Visual Studio: Code editor to help build applications.

D. Heroku: Platform to deploy, manage and scale applications entirely in cloud.

Algorithm:

Haar Cascade algorithm in openCV will be used for face detection from the camera.

Object detection using Haar feature based cascade classifiers in an effective object detection method proposed by Paul Viola and Michael Jones. It is machine learning based approach where a cascade function is trained from a lot of positive images (images of face) and negative images (images without faces) to train the classifier. Then we need to extract features from it. Features are nothing but numerical information extracted from the images that can be used to distinguish one image from another.

LBPH (Local Binary Pattern Histogram) will be used for face recognition.

LBPH is widely used in facial recognition due to its computational simplicity and discriminative power. It is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. LBPH extracts local features in the face and match it with the most similar face image in the database. LBPH is a method that works by dividing the face image into several blocks. Histograms will be calculated for each block and in the matrix we compare the pixels with the center pixel. At the end we will get a binary number which will be converted to decimal format. It will be combined together under one vector which will help to recognize the face in the database.

Software Development Process:

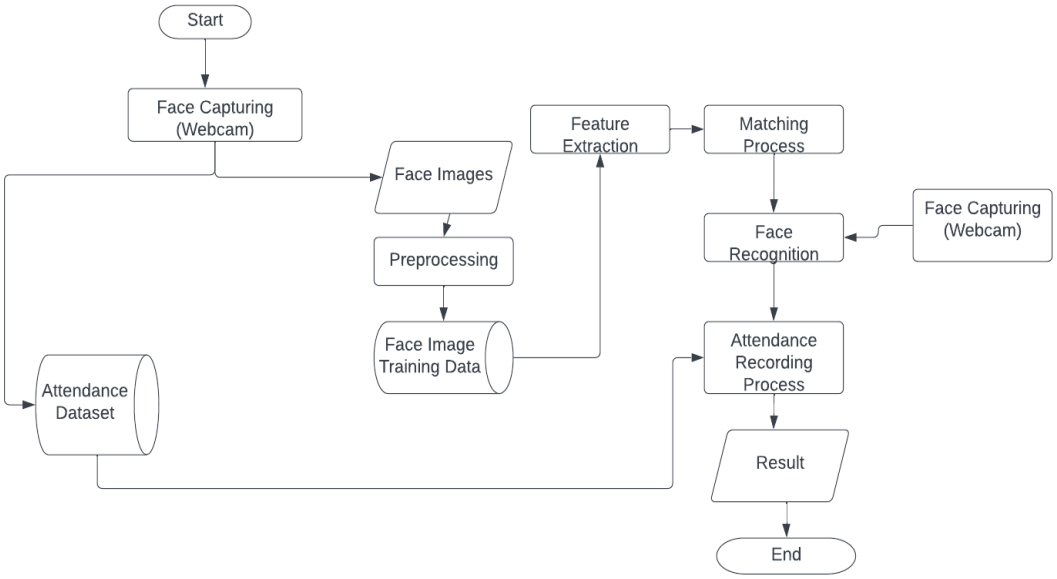


Figure 1.1 Overall workflow of Smart Attendance System

Detailed System Workflow

There are two major system flows in the software development section as shown below:

- **The creation of the face database**
- **The process of attendance taking**

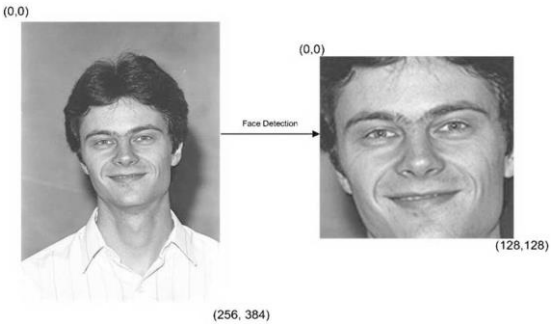
Both processes mentioned above are essential because they made up the backbone of the attendance management system. In this section, the process of both flows will be briefly described.

THE CREATION OF FACE DATABASE:

The face database is an important step to be done before any further process can be initiated. This is because the face database acts as a comparison factor during the recognition process.

1.Portrait Acquisition

The image of the student's face will be captured for a specific amount to be stored into the files.



2.Face Detection

The captured image will first undergo a face detection algorithm to ensure the system can identify a face in every portrait.

3.Portrait Pre-processing

Captured image with a confirmed face detected in it will then undergo cropping, color conversion before actually being stored into the files.

```
/home/kevin/OpenCV/face_rec/Img/s12/4.pgm;12
/home/kevin/OpenCV/face_rec/Img/s12/10.pgm;12
/home/kevin/OpenCV/face_rec/Img/s12/8.pgm;12
/home/kevin/OpenCV/face_rec/Img/s12/1.pgm;12
/home/kevin/OpenCV/face_rec/Img/s12/7.pgm;12
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/home/kevin/OpenCV/face_rec/Img/s32/6.pgm;32
/home/kevin/OpenCV/face_rec/Img/s32/5.pgm;32
/home/kevin/OpenCV/face_rec/Img/s32/2.pgm;32
```
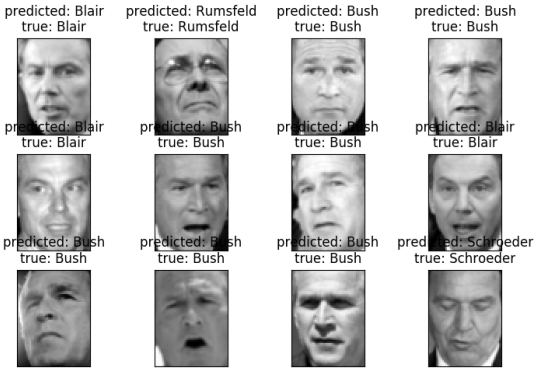

4.Creation of CSV file

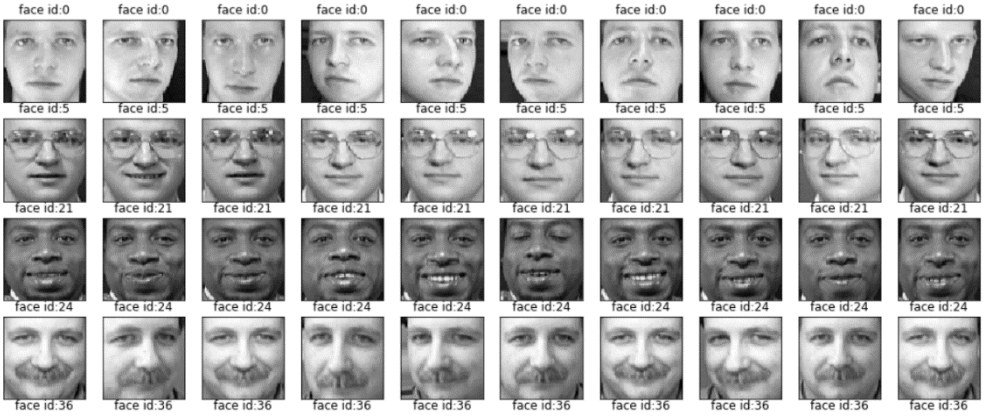
With the face database data, we need to read it in the program, here we need to use csv file to read the image data in the face database.

By using the path of the stored image, a csv file will be created.



5.Training the Recognizer

The images in the created list retrieved from the csv will then be pumped into a recognizer (a library provided by openCV for face recognition) to do the training.



6.Save the Trained Data

After the training process is done, the trained sets of data will be stored into a file which will be retrieved during the recognition process.

THE PROCESS OF TAKING ATTENDANCE:

Access the attendance management system website

The attendance taking system can be started after the lecturer login to the website with username and password.

1.Acquire Portrait

The system will then start to capture student's portraits and then undergo the same pre-processing routine and face detection process.

2.Recognize the face

Valid portraits will then be compared against the loaded gallery from the recognizer to identify the captured faces.

Enroll no	Name	Date	Time	Status
12190065	Nar	12-Mar	11:15-12:15	P
12190070	Phuntsho	12-Mar	11:15-12:15	P
12190073	Samten	12-Mar	11:15-12:15	P
12190082	Sonam	12-Mar	11:15-12:15	P

3.Mark the attendance

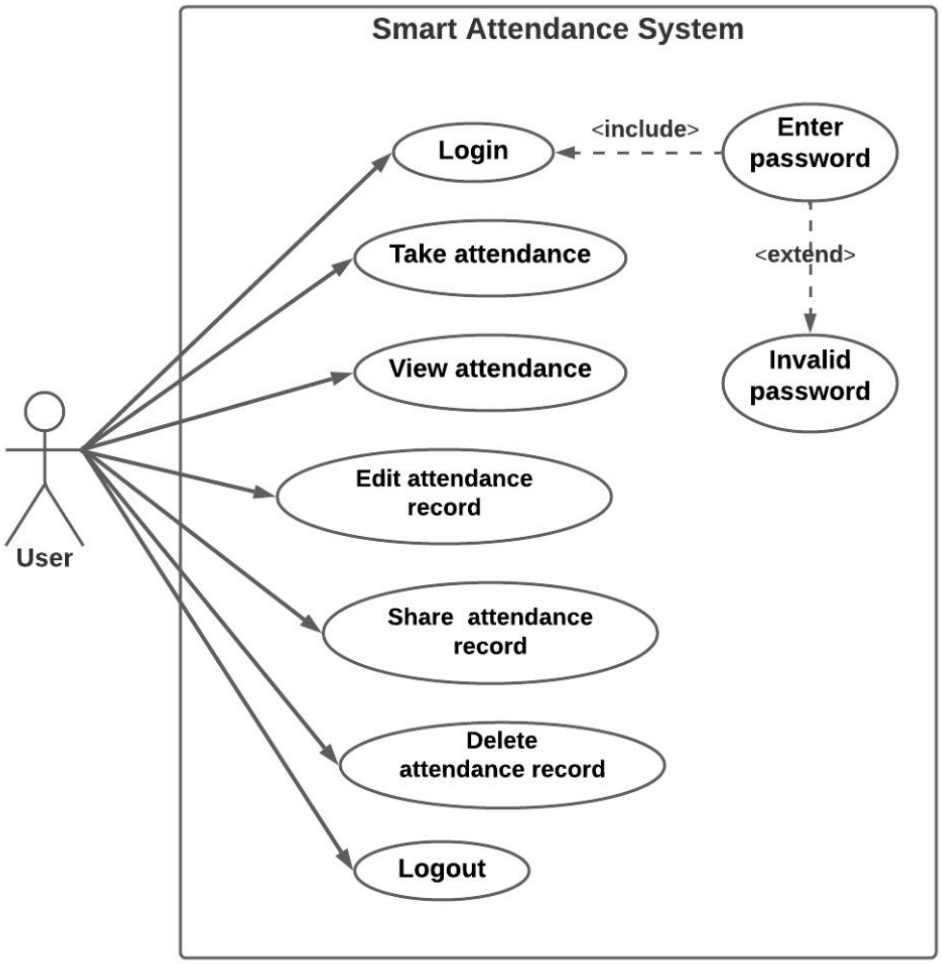
After identifying the appropriate student from the capturing process, a record of the current attendance will be added into the attendance table managed by a database.

DEPLOYMENT

The model and the web application will be deployed in Heroku platform.

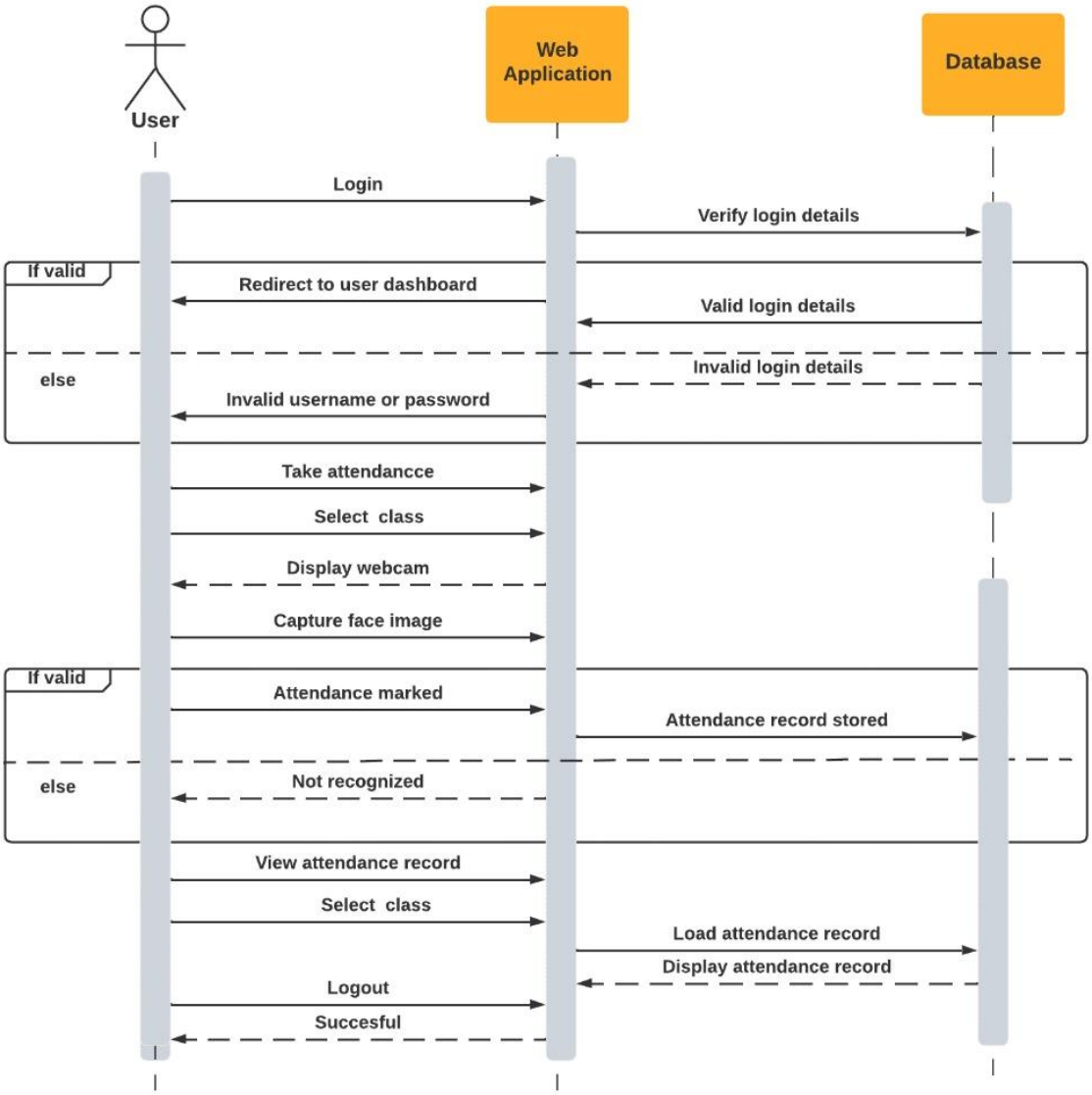
UML Diagrams

Use case Diagram



The use case diagram identifies the goal of the system in meeting user requirements. User will login with username and password to the website. To take the attendance, user can take action by clicking on the take attendance button where it will display a web camera. The system will try to recognize the face captured in the web camera and when the face gets recognized, the particular student will be systematically marked present. The user can check the attendance records by clicking on the view attendance. The attendance records will be stored in the database which will be displayed on request from the user. The user can also edit, delete or share attendance records. After all the actions are being done, user can finally logout from the website.

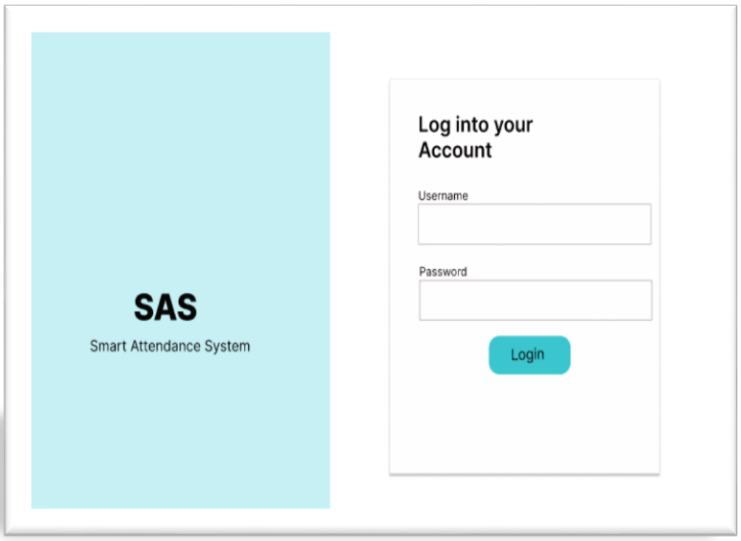
Sequence Diagram



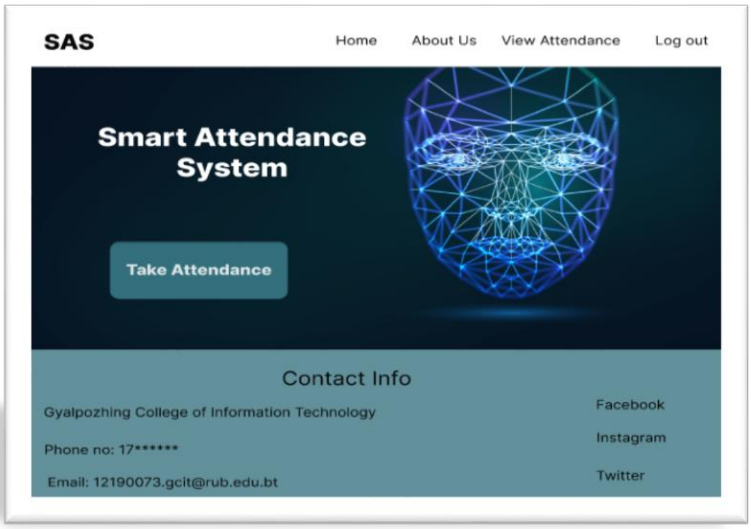
User will login to the website where the system will verify whether the login details (username and password) entered by the user matches the one stored in the database or not. If it matches, it will display the user dashboard (Homepage of website) or else, will display a message saying "invalid username or password". To take attendance, system will give an option to select a particular class and will display a web camera to capture face image. If the face gets recognized, attendance will be marked and stored in the database. User can view attendance record where the system will retrieve the attendance records from the database and display the attendance records base on the selected class. User can logout from the website.

Prototype

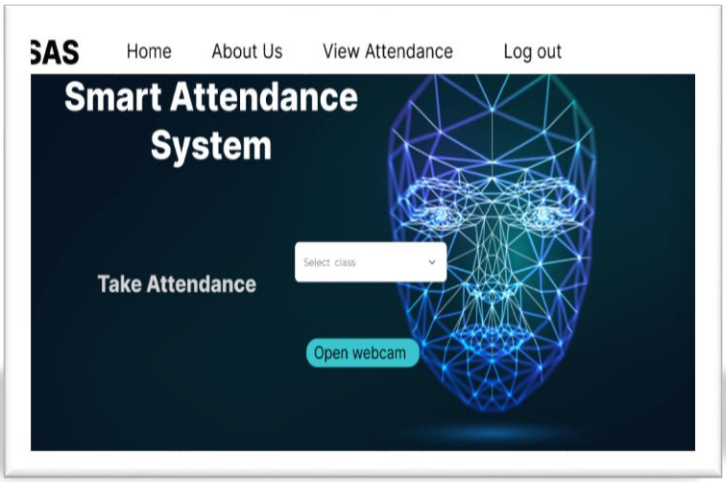
To design prototype for smart attendance system, prototyping tool called "figma" is being used.

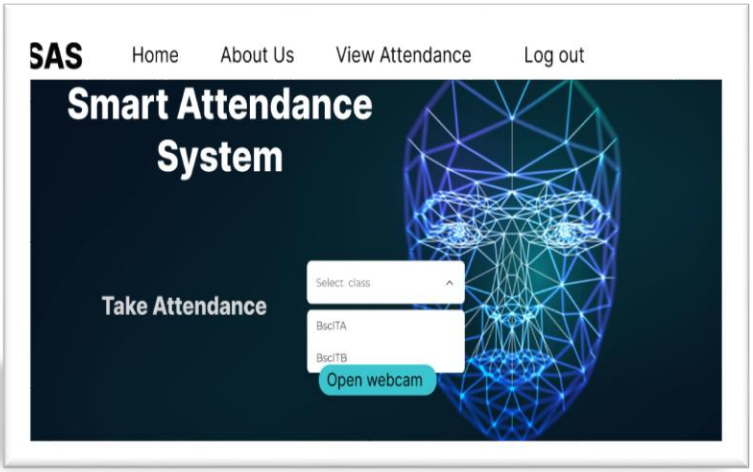


User (Lecturer) will login to the system using their username and password.

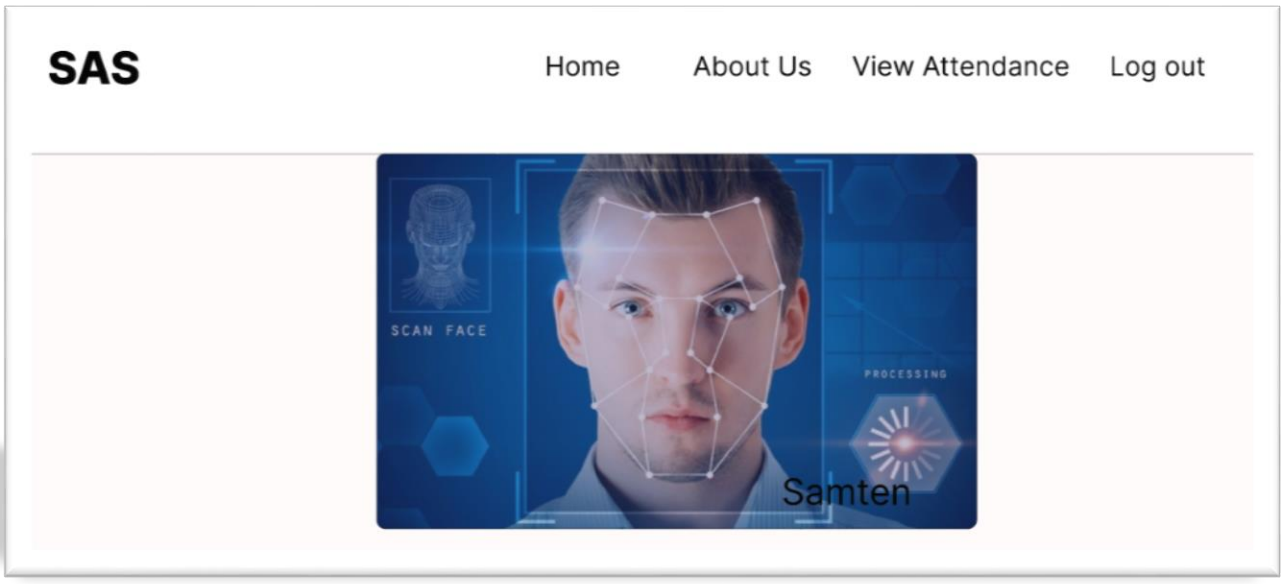


After successful login, home page of the website (user dashboard) will be displayed.

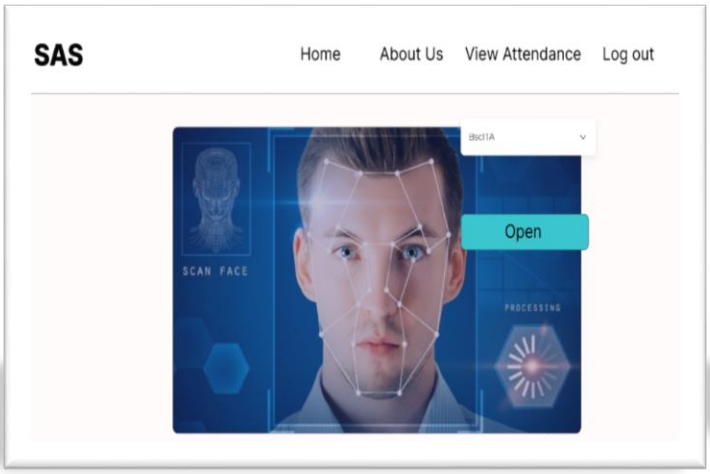


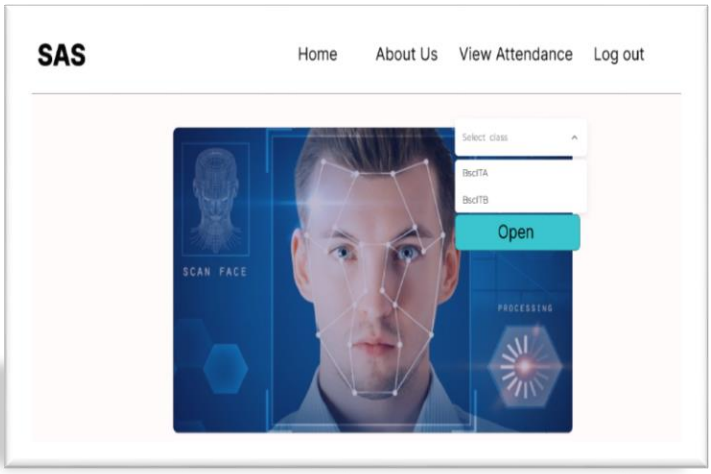


To take attendance, user have to click on “Take Attendance” button where it will display a select class option. After selecting a specific class, user have to click on “Open Webcam” button to open web camera.

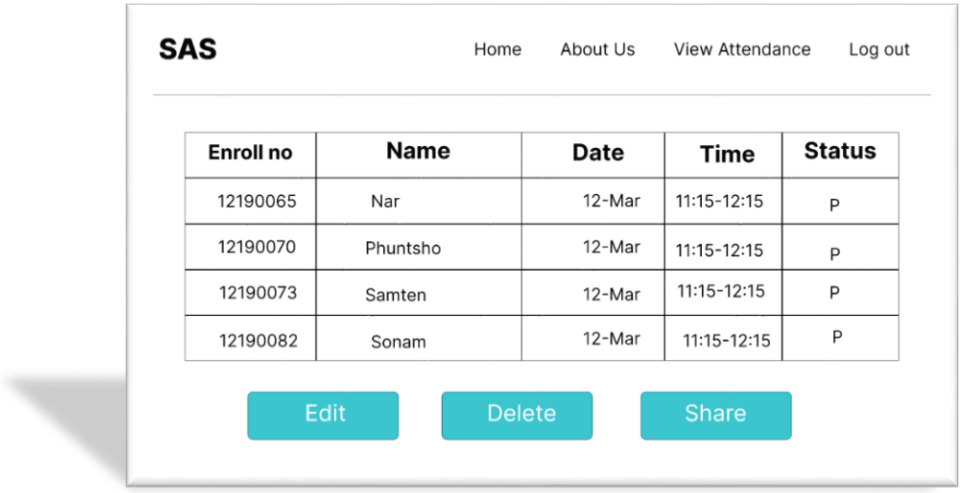


Through web camera, user can capture the face of the students to mark their attendance.

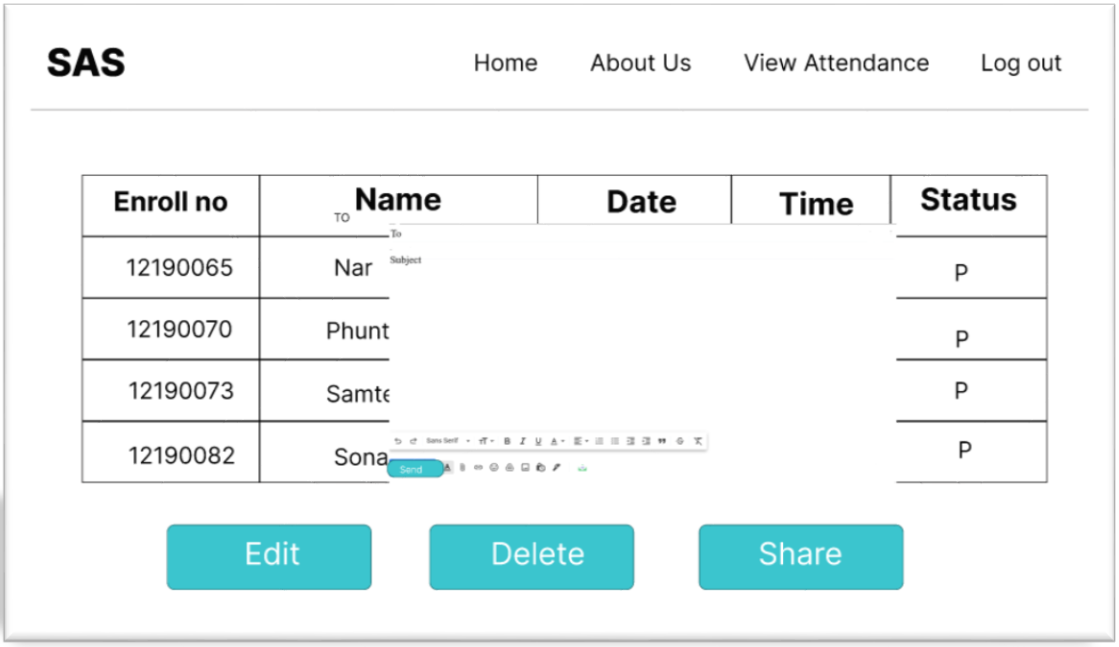




To view the attendance records, user can click on “View Attendance” option. From there, user can select the class to view the attendance record of that particular class.

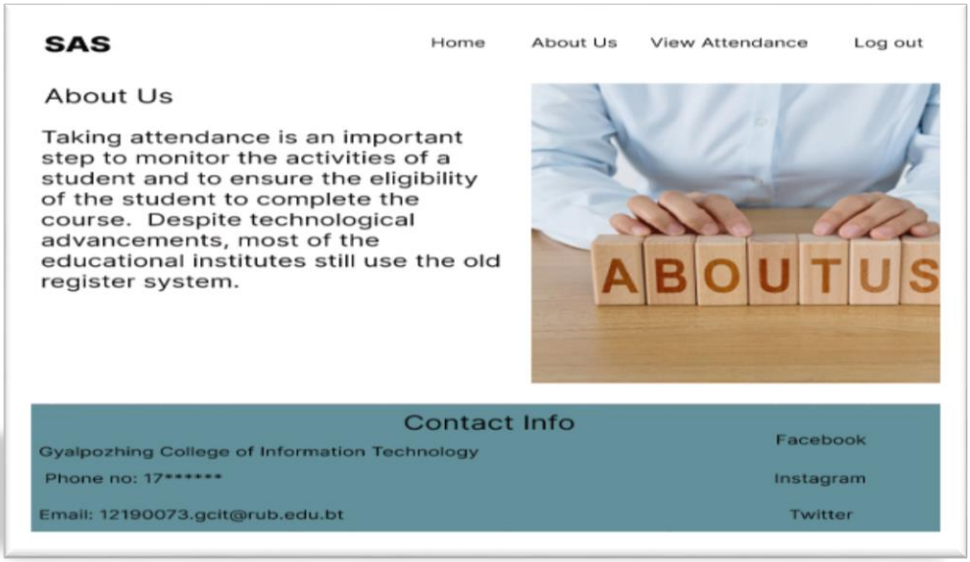


After clicking on the “open” button, the system will display an attendance record of the students along with the student’s detail (Enrollment Number, Name, Date, Time and Status).



User can edit as well as delete the attendance records.

User can also share the attendance record on request from the students through “share” option.



User can also check about the website through “About Us”. It will display about the website, developers and contact information.

Finally, user can logout from the website.