System Requirement Specifications (SRS)

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2 Problem Statement

The current system of manual attendance taking in Nanyang Technological University (NTU) entails two methods:

(1) the students sign on the attendance sheet for the lesson themselves, which is unreliable. This is because attendance for the lesson can be faked easily as absent students can ask their friends to sign on their behalf.

(2) the tutor does a name call to sign attendance for students. This is inefficient, especially for a big tutorial class with more than 30 students.

Therefore, an automatic face-recognition-based attendance system can be developed as a more reliable alternative to the current attendance-taking methods. The tutors can also make use of this new system to differentiate late-comers from the rest of the students, as well as automate the process of sending e-mails to the absent students.

3 Overview

3.1 Background

As the student population of NTU grows over time, the volume of students per class increases, which makes it increasingly time consuming for tutor to do name call for attendance taking. Many tutors, thus, switch to the attendance method, where students can sign on the attendance sheet themselves. However, this is unreliable as attendance can be faked by absent students.

Moreover, tutors have to go through the trouble of updating the student attendance status manually from the attendance sheet to the NTU system, and checking for absent students and sending them emails manually. This could be increasingly frustrating when each tutor has to look after more students when the volume of students in NTU increases.

In alignment with the NTU's aim to be the greenest campus and the smart campus, together with the frustrations due to slow or unreliable attendance taking methods, there is an increasing demand to develop an automated attendance taking system.

3.2 Overall Description

To address the problems with efficiency and reliability of the current attendance taking system, E-Tendance is proposed, a face-recognition-based attendance taking system.

E-Tendance leverages on the existing mature facial recognition technology (Amazon Rekognition). The students can take attendance by simply standing in front of the camera, which is fast and efficient. Moreover, the system allows the tutors to send emails to all the absent students with a simple click of a button. Furthermore, there will be automatic updates of the student attendance status, which reduces the workload for the tutors. This system also ensures that attendance cannot be faked as students need to be physically present for their attendance to be recorded. Therefore, this also ensures the reliability of the attendance taking.

4 Investigation & Analysis Methodology

4.1 System Investigation

The E-Tendance attendance taking system requires the tutor to enter the course index. The course index has associated information about the students enrolled in the course, class time, late interval (after which, the student will be considered as late), absent interval (after which, the student will be considered as absent). Then, the webcam will be turned on, and live video will be captured. The photos with faces detected will be sent to the back-end, which will be sent to the Amazon Rekognition to detect if it is recognized. The return message will either be the student ID with student name, or "unrecognized", which will be sent to the front-end. The front-end will display the success message or unrecognized accordingly. The students whose attendance are taken will be updated on the "present" or "late" lists depending on the time of attendance taking. On the other hand for the "unrecognized", the students will be prompted to indicate if they want to input new photos in the database with a single click of button. These extra photos of the students allow the system to have a higher recognition rate, with more training data.

4.2 Analysis Methodology

4.2.1 Feasibility Study and Requirements Elicitation

The Team will be initially divided into a research team and a development team. The research team will conduct interviews with the tutors and find out about their user needs, as well as what additional features would be appropriate to be included with the facial recognition system. On the other hand, the development team will analyse various architectural designs and styles that can be used to implement the system. A weekly meeting will be arranged with both the research team and development team, to design the solutions that target the user pain points.

4.2.2 System Analysis and Requirements Specification

4.2.2.1 Requirement Analysis
Based on the interviews with the various stakeholders, the desired features of the new system include:

- Recognize students' faces for attendance taking
- Distinguish students' attendance status (present / late / absent)
- Allow students to input new photos when they are unrecognized
- Generate report of the class attendance at the end of the lesson
- Send emails to the missing / late students

4.2.2.2 Scope and Limitations

Analysis methodology will involve:

- Business analysis: The business rules, sponsorship and associated project budget requirement
- Requirement analysis: User requirement definition and functional requirement
- Data analysis: Data collection process, data validation, data storage, data manipulation and data retrieval
- Process analysis: Data flow analysis and process decomposition

4.2.3 Object-Oriented Design using UML

A detailed object-oriented design for the registration system will be developed. UML will be used for the visual representation and documentation of the system design, along with its main actors, roles and actions. The system will primarily concern with the attendance taking process with facial recognition. In essence, the professor of the lesson will input the course index to start the system. Thereafter, the incoming students can stand in front of the camera for the system to detect his/her face, and mark the attendance accordingly. At the end of the lesson, the professor can view the summary report of attendance of the class, and send email to absent students.
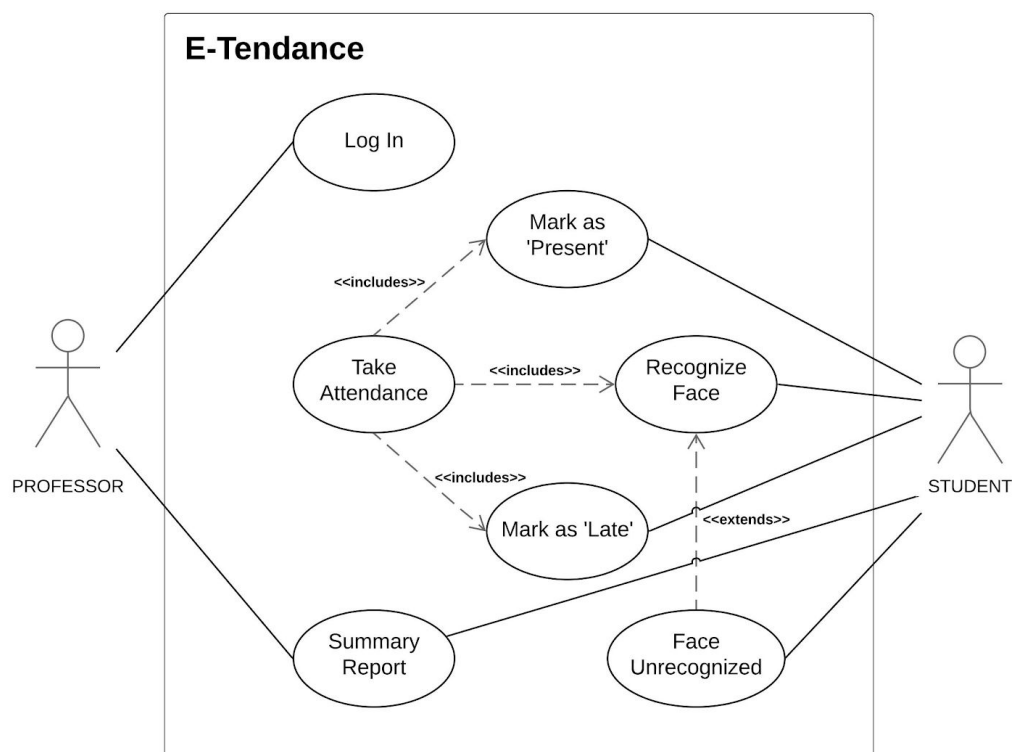
4.2.4 Prototyping

The Agile methodology is adopted. Hence, the Team aims to first come up with the minimum viable product (MVP) , which is the facial recognition feature . The MVP developed will be used to gather feedback from the users. Additional features will then be added to the prototype accordingly, based on their assigned priority level. Once the features are added, the prototype will be enhanced to improve its performance and effectiveness.

5 Constraints

5.1 Costs

The E-Tendance system requires the use of Amazon Rekognition API, which incurs extra cost per use. The first 1 million images processed per month will incur 1.25SGD per 1,000 images processed.

5.2 Hardware

The E-Tendance system requires a computer with a camera, to capture the live video feeds. Moreover, fast Internet is required to ensure the efficiency of the system, as online API calls are required.

5.3 Project Schedule

There is a three-month timeframe to implement the face-recognition-based attendance taking system, from project commencement in August 2019.

6 Operational Requirements

6.1 Help Desk Support

The Professor will be able to contact an IT support team during office hours. This can be done via phone or skype call. IT support team can then help with problems such as lagging, the crashing of the application and other errors.

6.2 System administration

System administration is dedicated to maintaining the reliability of the application. The hosting servers can be accessed by people with sufficient permissions all the time. The system is kept available and monitored.

6.3 Technical Support

Application developers are able to access and update the source code, which is hosted on github. Technical support consists of making sure that the code changes do not introduce new bugs to the system.

6.4 Hardware Support

User-facing hardwares such as computers to take attendance are required to be up and running all the time and functional during office hours. Hardwares should be maintained as part of a maintenance schedule. In case of hardware failures, an emergency team will be dispatched to the location for fixing and providing backup.

6.5 Transaction Logging

The attendance will be captured along with a photo and timestamp before being saved in the database. This ensures the integrity of the system.

7   Functional Requirements

7.1 Facial Recognition

The application is required to automatically and accurately detect and recognise students' appearance in the class based on photos that have their faces on it.

7.2 Attendance-Taking

The application is able to update the database to mark a student as present, late or absent for a class. A real-time attendance status is displayed on the screen for the current class.

7.3 Unrecognized Faces

In the case of unrecognised faces, the application is required to prompt students with the faces that are not recognised and take further input for re-training the system.

7.4 E-Mail Students

The system will automatically dispatch a batch of emails informing absent students. The email contains the details of the class and the actions that students need to take, such as submitting an MC.

8 Input Requirements

8.1 Course Code/Index

Professors are authorised to input the course code/index of the current class. Students who take their attendance following it will should be registered for that class.

8.2 Webcam Footage

Photos from the webcam are taken every second and sent to the back-end system for recognition. The photos are stored in a data storage such as AWS S3 for training and future references.

9 Process Requirements

9.1 Durable Object Storage

Photos are taken by the front-end application and are sent to the back-end service and subsequently get stored in Amazon S3. These photos will then be used by the Amazon Rekognition API to recognise the students.

9.2 Data Integrity

Attendances are updated in a relational database which is ACID (Atomicity, Consistency, Isolation, Duration) by natural. Transactions can be rolled back in the case of the system recognizing wrong students.

9.3 Data Validation

Professors are prompted when they enter wrong class indexes. Multiple layers of data validating logics are implemented in both the front-end and the back-end application.

10 Output Requirements

10.1 Summary Report

At the end of each lesson, a full attendance sheet is displayed with the relevant statuses of the students (Present / Absent / Late) for the particular lesson. The tutor will have access to change the status of a student marked as 'Absent' to 'Valid Reason' if the student has informed the professor earlier about it.

10.2 Real-Time Attendance Status

The list of students signed up for the lesson will be continuously displayed on the screen under the 'Absent' category once the Professor starts the attendance-taking system. As a student walks into class, his/her name will be moved from the 'Absent' list to the 'Present' or 'Late' list accordingly.

10.3 E-Mails

E-mails will be generated automatically for students who were absent from the lesson, asking them to submit their Medical Certificates or a valid proof for why they could not attend the lesson.

11 Hardware Requirements

11.1 Network

- University-wide Network Infrastructure with Access to Internet Connection

11.2 Client Computers

- Any Operating System Installed

- Any JavaScript-compatible Web Browser Installed

- Webcam Attached

11.3 Production Support Systems

Hardware Support such as:

- Uninterruptible Power Supply

- Back-Up Tape Drives

- Load Balancer

12 Software Requirements

12.1 Client Operating Systems

Any of the following:

- Microsoft Windows

- Apple macOS

- Linux

12.2 Client Application

Any JavaScript-compatible Web Browsers such as:

- Google Chrome

- Firefox

- Safari

- Internet Explorer

12.3 Network System

- Transmission Control Protocol (TCP) / Internet Protocol (IP)

- HyperText Transfer Protocol (HTTP) / HyperText Transfer Protocol Secure (HTTPS)

- File Transfer Protocol (FTP)

12.4 Database System

- Amazon Simple Storage Service (S3)

- Local CSV File

12.5 Licenses

- Amazon Web Services (AWS)

13 Deployment Requirements