Big Classroom Support for Instructors

02.23.2020

sddec 20-27

Ben Othmane, Lotfi - Client & Adviser

Team Members:
Brendan Niroula - Leader/ Backend Developer
Zechen Huang - Facial Recognition Developer
Ali Al Ahbabi - Mobile Developer
Jian Kai Lee - Mobile Developer

Team Email:
sddec20-27@iastate.edu

Team Website:
ssdec20-27.sd.ece.iastate.edu

Executive Summary

Development Standards & Practices Used

- Hardware: Smart glasses that has live streaming feature
- Software:
    a. Backend : Python
    b. Frontend : Flutter
    c. Face recognition algorithm
    d. MySQL for Database
- Engineering standards:
    a. Design Documents:
        - Use Cases
        - Activity Diagram
        - Component Diagram
        - Communication Diagram
    b. Documentation of code:
        - In line comments
        - JS Doc

Summary of Requirements

- Functional requirements
    - Students and Teachers can sign in
    - Students can upload their photo in the app
    - Students can send questions in chat room to teacher
    - Teacher uses smart glasses to live stream to remote server
    - Teacher sees students names and pictures via the app
    - Remote server can find the students' name

- Non-Functional requirements
  - App is secure
  - Processing an image takes less than 1 second
  - Can handle 100 concurrent users
  - Can store 400 units of picture data in the database

Applicable Courses from Iowa State University

- COMS 227 Object-oriented Programming
- COMS 228 Intro to Data Structure
- COMS 309 Software Development Practices
- COMS 472 Principle of Artificial Intelligence
- SE 319 Construction of User Interface
- SE 329 Software Project Management

New Skills/Knowledge acquired that was not taught in courses

- Smart Glasses development
- Flutter cross-platform
- Dart language
- Face recognition Algorithm

Table of Contents

1	Introduction	4
1.1	Acknowledgement	4
1.2	Problem and Project Statement	4
1.3	Operational Environment	4
1.4	Requirements	4
1.5	Intended Users and Uses	4
1.6	Assumptions and Limitations	5
1.7	Expected End Product and Deliverables	5
2.	Specifications and Analysis	6
2.1	Proposed Approach	6
2.2	Design Analysis	6
2.3	Development Process	6
2.4	Conceptual Sketch	6
3.	Statement of Work	7
3.1	Previous Work And Literature	7
3.2	Technology Considerations	7
3.3	Task Decomposition	7
3.4	Possible Risks And Risk Management	7
3.5	Project Proposed Milestones and Evaluation Criteria	7
3.6	Project Tracking Procedures	7
3.7	Expected Results and Validation	7

4.	Project Timeline, Estimated Resources, and Challenges	8
4.1	Project Timeline	8
4.2	Feasibility Assessment	8
4.3	Personnel Effort Requirements	8
4.4	Other Resource Requirements	9
4.5	Financial Requirements	9
5.	Testing and Implementation	9
5.1	Interface Specifications	9
5.2	Hardware and software	9
5.3	Functional Testing	9
5.4	Non-Functional Testing	10
5.5	Process	10
5.6	Results	10
6.	Closing Material	10
6.1	Conclusion	10
6.2	References	10
6.3	Appendices	11

1. Introduction

1.1 Acknowledgement

Our team would like to express my special thanks to our adviser and client (Professor Ben Othamane, Lotfi) who gave us the chance to work on Smart Glass technologies in Big Classroom Supports for Instructor and assist us in developing and researching smart glass application.

1.2 Problem and Project Statement

Professors everywhere are always tasked with memorizing students' names, this can be extremely challenging especially with large classrooms. As a result, we have taken upon us the task of making this easier for Professors using the power of technology. Our task is to develop an app which will allow professors to know students' names without having to memorize all of them. We will do this with the help of smart glasses. Our goal is to create an android and IOs app, which will display the students which the professor sees with their glasses onto their phone along with their names next to them.

1.3 Operational Environment

Big classroom project contains two main parts. First part is the smart glasses which will be worn by the instructor inside the classes. So there should be sufficient lighting in the room in order for the camera of the smart glasses to capture a clean video. The second part is the mobile app which will be running on all new generation phones with iOS and Android operating system.

1.4 Requirements

Functional Requirement:

- Students and Teachers can sign in
- Students can upload their photo in the app
- Students can send questions in chat room to teacher
- Teacher uses smart glasses to live stream to remote server
- Teacher sees students names and pictures via the app
- Remote server can find the students' name

Non - functional Requirement

- App is secure
- Processing an image takes less than 1 second

- Can handle 100 concurrent users
- Can store 400 units of picture data in the database

Economic/Market Requirement:

- Budget = $500
- Components = Smart Glasses with live streaming ability

Environmental Requirements:

- Sufficient lighting in the room for video capture
- 150 students maximum in each classroom
- Clear line of sight to each student

UI requirement:

- Question lists
- SIgn in/ Sign up
- Profile tab
- Upload photo tab

1.5 Intended Users and Uses

There are two types of users: instructors and students. Instructors are going to wear smart glasses during the lecture. The smart glasses will stream live video to a mobile app which will be installed on the instructor phones. The instructor will be able to sign in for a teacher mode in the app. This mode allows instructors to read students' questions along with their names. The instructor also will have the option to capture an image or a short video of the live stream. Students will be able to sign up into students mode which will ask them to upload their photos. Also, they are going to use the mobile app to ask the instructor questions anonymously.

1.6 Assumptions and Limitations

Assumptions:

- The maximum number of students in a class is 60 - 70.
- The maximum number of names which will appear is 5.
- The app will only be used in the U.S. for universities.
- The maximum amount of students in the database will be 300.

Limitations:

- The glasses must be lightweight and not distracting.
- The project must be finished by December 2020.
- The budget must not exceed $500.
- The app must be accessible to all people with disabilities.

1.7 Expected End Product and Deliverables

The end product of this project is an android/IOs app which has capability to receive live stream data from a pair of camera glasses and display the names of students onto the phone screen using face recognition. This app will also allow students to communicate with the professor during class via the app. The expected delivery date for this product is December 2020.

2. Specifications and Analysis

2.1 Proposed Approach

After we have the pictures from students, and analyze them with algorithms, we will have students' data stored in server for future use (Functional requirements: Students and Teachers can sign in; Students can upload their photo in the app.)

We use smart glasses to capture pictures or video streaming to the server, then the server will identify the students and the one who speaks. After that, the server will send the name and the picture to the phone app (Functional requirements: Teacher uses smart glasses to live stream to remote server; Teacher sees students names and pictures via the app; Remote server can find the students' name.)

We also need a discussion room within the app where students can send questions. The teacher can see these questions through the phone app (Functional requirements: Students can send questions in chat rooms to the teacher.)

Also, the process of this approach needs to be finished in no longer than 1 second, and at least 100 users should be supported. The server should be able to store at least 400 students' data. The data flow between devices should be secured (App is secure; Processing an image takes less than 1 second; Can handle 100 concurrent users; Can store 400 units of picture data in the database.)

We have found decent smart glasses named VUZIX that can take pictures or video. We also have found several face recognition algorithms that can be used in our project, and they

are written by Python or Nodejs. We have tested several api that are provided by these algorithms like getting people's face data from the pictures.

The standard we use inside smart glasses is Android Lollipop, and Android app for the phones. For the server, we use Mysql and Face recognition algorithm with Python.

2.2 Design Analysis

We have found decent smart glasses named VUZIX that can take pictures or video . We also have found several face recognition algorithms that can be used in our project, and they are written by Python or Nodejs. We have tested several api that are provided by these algorithms like getting people's face data from the pictures.

So far, the algorithm works fine as we followed the instructions from github.

In the future, we will use the embedded Android system inside glasses. We have observed that finding the right glasses is very hard, and we will stay on this one. Our idea is using Server-client architecture. The Android system is a strength because **it has a mature development kit to use. Weakness may be the system may not be efficient enough while in use because glasses are too small to put powerful components.**

2.3 Development Process

We are going to use Agile because it is one of the most used development processes in the world. We are going to use server-client architecture. We are going to use gitlab to manage the tasks we need to do. We are going to use Slack for team communication.

2.4 Conceptual Sketch