Automatic Attendance Cameras for Classrooms

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Project Description

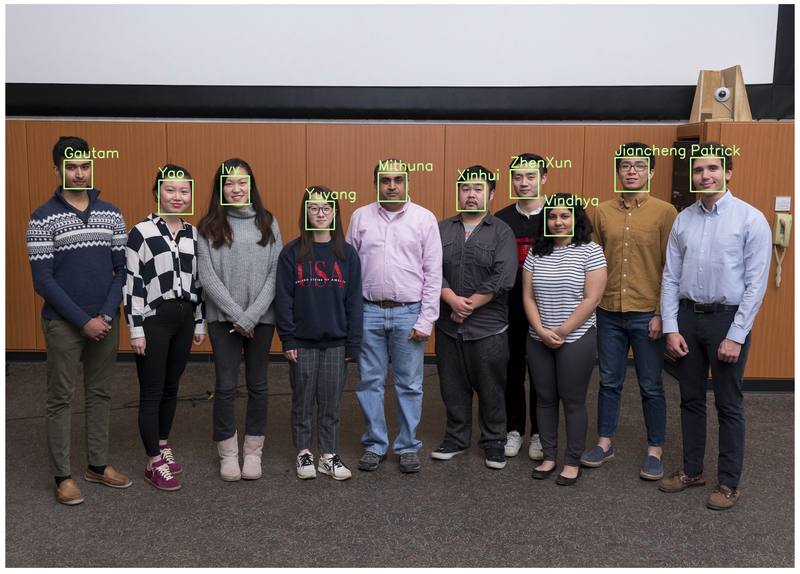
The goal of this project is to achieve automatic attendance tracking in classrooms by leveraging state-of-the-art facial recognition techniques. We demonstrate that it is possible to achieve high-accuracy recognition in a practical classroom setting. Typical users for this system would be K-12 instructors, or higher-level educators.

In the previous semester we have demonstrated proof-of-concept for small classroom settings (6-12 students). This semester we are focusing on two key goals:

First, we are expanding the system for classrooms of approximately 20 students. A sub-team (Backend team) is focused on scaling, refining and optimizing the algorithm behind the facial recognition and determining the attendance for the students.

Second, another sub-team (Mobile App team) is developing a mobile application (iOS and Android) to enable easy use of our system. This task focuses on design for intuitive user experience for teachers who will be able to keep track of student attendance in their classes with minimal effort.

The Team



Acknowledgements

Our project builds on several Open Source codebases and free online services such as: (1) React Native by Facebook, (2) Firebase Database service by Google, (3) FaceNet and Tensorflow by Google, and (4) OpenFace framework by the OpenFace team at Carnegie Mellon.
We would also like to thank Professor Mithuna Thottethodi for his support and guidance on this project.

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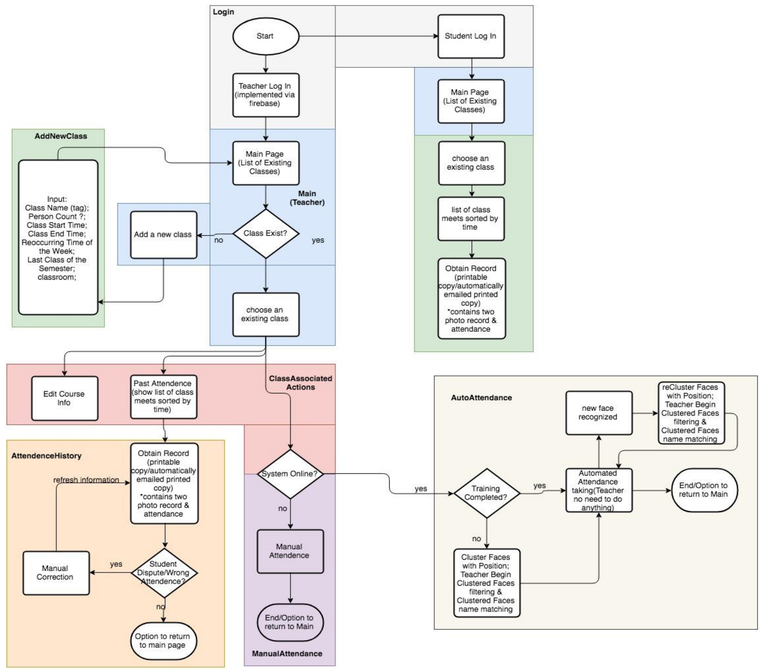
App Design

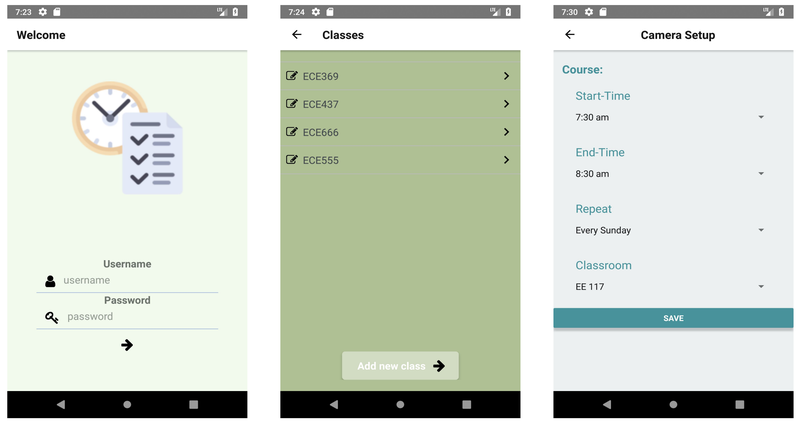
For Teachers:
Provides a user friendly interface to access the Automatic Attendance System. A secure and versatile platform to take and keep track of attendance history for different classes. Overall, a easy to use app for class attendance management.

For Students:
Provides a user friendly way to check his/her attendance history for classes that uses our system. Provides simple solution for students to submit attendance miss-marks to teachers. Overall, a easy to use app to help keep track of class attendances.



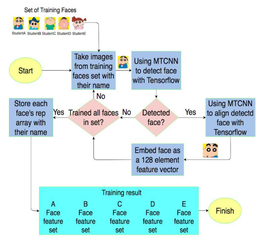
Flowchart for the App lifecycle

App Interface

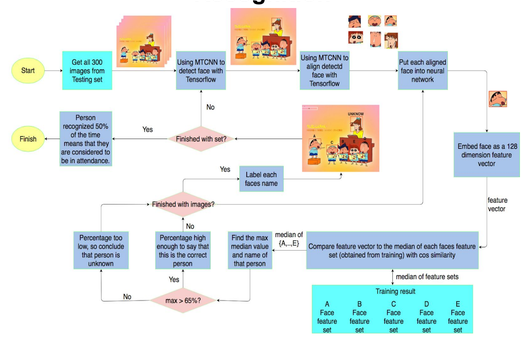


Backend Design

Training



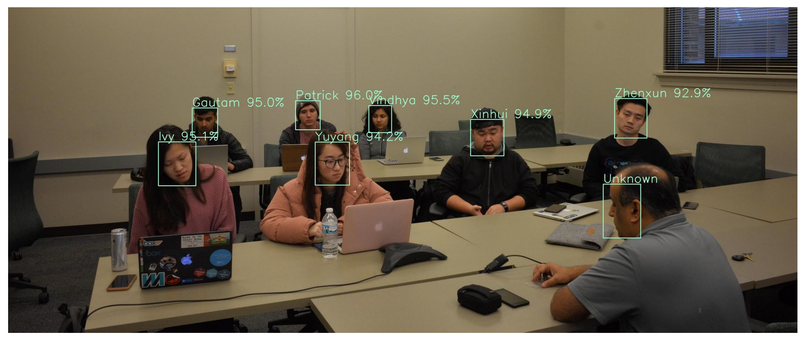
Recognition



We have highlighted the overall flow of the backend algorithm for the training and recognition phases above.
The key components are the Multi-task Cascaded Convolutional Neural Networks (MTCNN) (for detecting and aligning faces), the Deep Convolutional Neural Network that FaceNet created is then used for embedding faces in a 128-dimensional vector, and then a Cosine-similarity classification algorithm is used for recognition. If the classification algorithm is not at least 65% confident that the current face to be identified matches any of the trained faces, we conclude that it is not a high enough similarity, and the face is identified as unknown. We store how many times a person has been identified and we set a threshold (usually around 50% of the number of images in the test set). If a person was identified more than that we consider them to be present in the class. This data is then encoded into a json file for the app team to interpret.

Results

We have trained with class sizes of ten or fewer students with promising results. The current system is fairly accurate in identifying students with around 90% confidence as well as recognizing new faces as “Unknown.” The image below shows an example of a class size of seven with the professor being identified as unknown. We are currently working on analyzing the accuracy of this system with a class of around twenty students. In the future we hope to optimize the system by increasing the speed it the process takes without losing accuracy.



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