Design Document for ULearn: helping frustrated students with web-based learning

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Status: approved

Concept Summary

The goal of this work is to provide feedback to students regarding their engagement/emotion/frustration while utilizing web-based instructional material using computer vision and machine learning techniques. An Android Application will be developed that will present a simple user interface of a web-browser to the student. Based on computer vision machine learning the students facial expressions are interpreted. If the student seems to be experiencing frustration or anger the user is presented with a pop up giving different suggestions. Using the corresponding web Page's title and meta description tags a set of search tips related to currently Viewed webpage will be presented. Version 2: Google NPL Text analysis or other web services will be explored for use in tips creation.

Audience/Customer

The initial test audience will be students at CSUEB in Computer Science. Once user/acceptance test is completed the target audience will be any students who use web-based material. The application has the potential of working with anyone, not just students, who view web-based materials and could be assisted when "frustrated".

Background

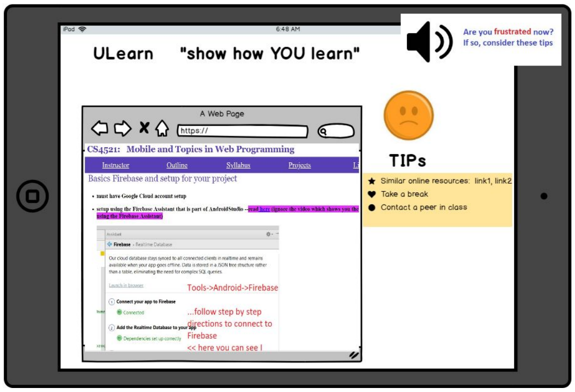
The application will be developed as an Android mobile application. Some of the core technologies involved in this project including Computer Vision, Machine Learning and Text to Speech. The front facing camera on the android device will be used to capture images of the user as they are using the application. Each image or periodically sampled images will be processed through a Machine Learning using Convolutional Neural Networks to detect the user’s emotions.

Application Cost and Projected success (optional)

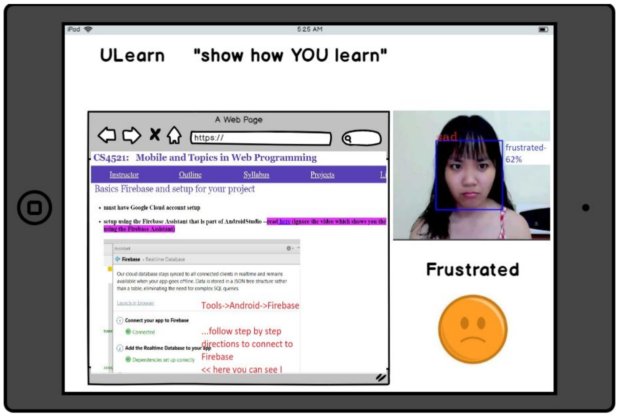
Version 1 application will run completely on the phone and will not incur any costs. Version 2 that explores the use of NLP services will incur costs and a budget will need to be invoked and once exceeded only freely generated tips version used.

Success is highly dependent on deployment to playstore once acceptance testing is done.   No current plans for marketing or advertising.

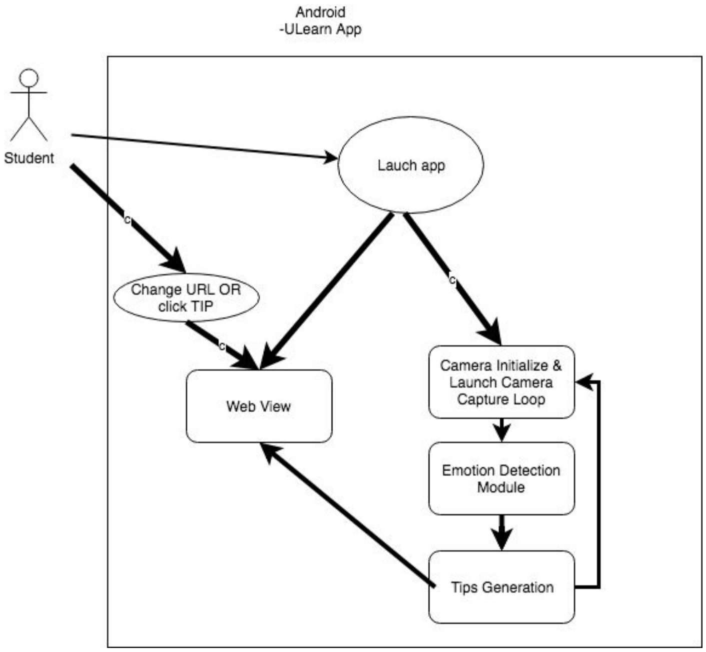
Interface Mockups


iPad
6:48 AM
ULearn
"show how YOU learn"
Are you frustrated now?
If so, consider these tips
A Web Page
https://
CS4521: Mobile and Topics in Web Programming
Instructor
Outline
Syllabus
Projects
Basics Firebase and setup for your project
must have Google Cloud account setup
setup using the Firebase Assistant that is part of AndroidStudio --read here (ignore the video which shows you the using the Firebase Assistant)
Tools->Android->Firebase
...follow step by step directions to connect to Firebase
<< here you can see I
TIPs
★ Similar online resources: link1, link2
♥ Take a break
● Contact a peer in class

Diagnostic interface will show camera

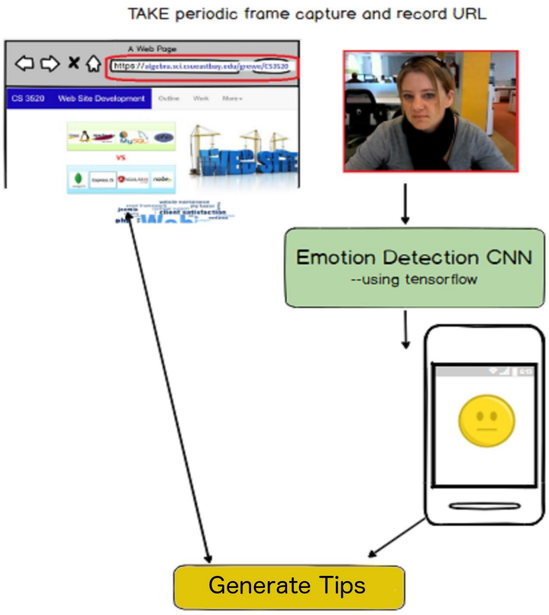

iPad
5:25 AM
ULearn
"show how YOU learn"
A Web Page
https://
CS4521: Mobile and Topics in Web Programming
Instructor
Outline
Syllabus
Projects
Basics Firebase and setup for your project
must have Google Cloud account setup
setup using the Firebase Assistant that is part of AndroidStudio --read here (ignore the video which shows you the using the Firebase Assistant)
Tools->Android->Firebase
...follow step by step directions to connect to Firebase
<< here you can see I
sad
frustrated-62%
Frustrated

Design - Use Case Diagram(s)



Design - Detailed Design

Following the use case diagram above the following shows a more illustrative system diagram



- **Camera Capture Module=** Control and capture of image frames

- **Emotion Detection Module =** using Machine learning
    - Version 1.A = using Tensorflow CNN
    - Version 1.B = using Google cloud vision
    - **Face Detection =** because the project is less than 2 weeks to create for version 1, and student is "close" to device to be able to read webpage we are going to test what results we can get without a prior face detection stage. For version 2 we will look at adding face detection leveraging OpenCV.
- **Generate Tips Module =** initial version using currently viewed webpage title and description. Google Search will be used in the creation of tips, which are links to (hopefully) related web pages. Potentially, a future version, can extend to use semantic Natural Language Understanding to generate further search tips.

Related Work

- **Data -** use FER2013 dataset found at https://www.kaggle.com/c/challenges-in-representation-learning-facial-expression-recognition-challenge/data which is a collection of 28,709 48x48 labeled images.

Frameworks/Services/Cloud/Backends

The following are to be used in ULearn

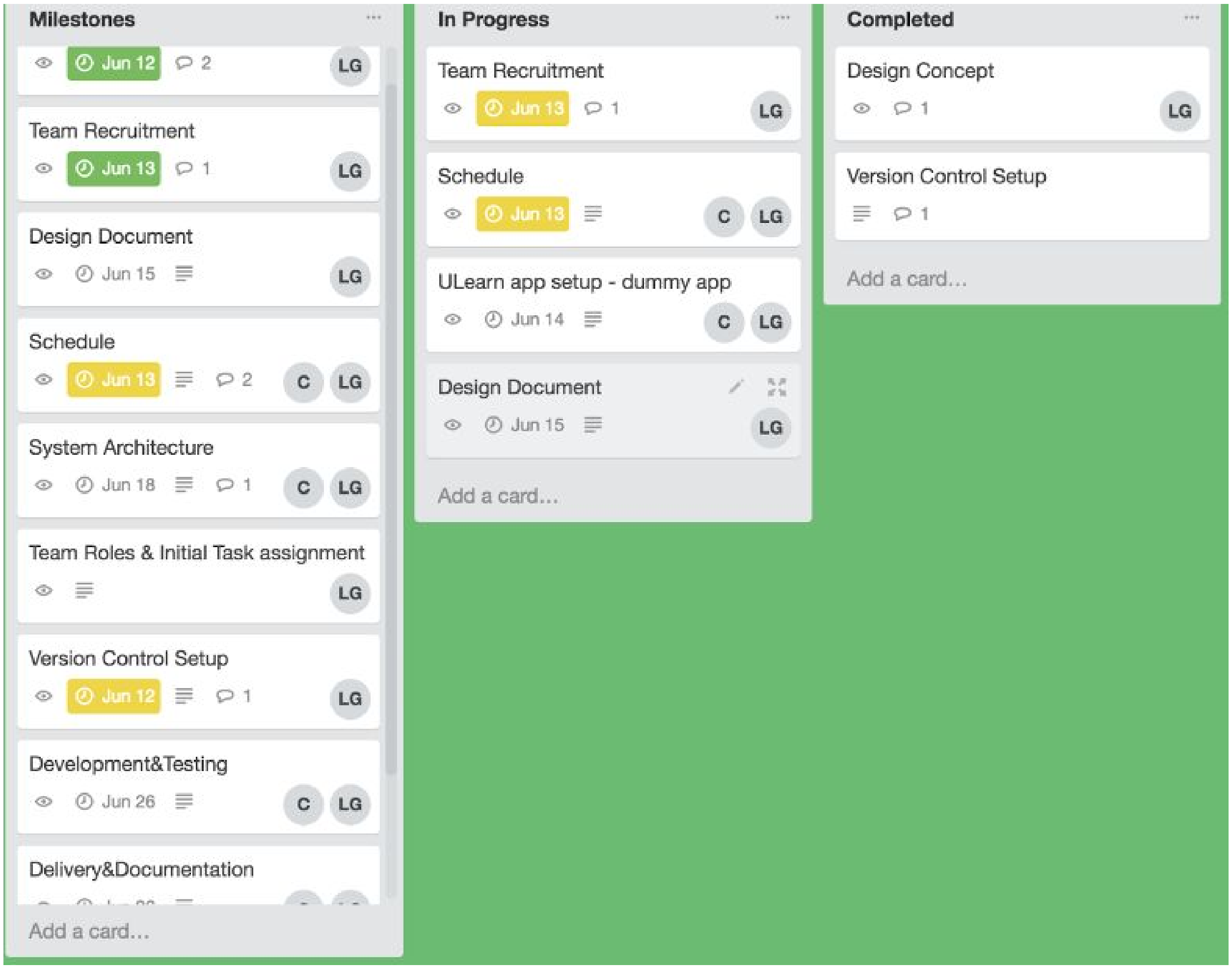
- Android = mobile platform
- Tensorflow = for CNN development
- Google Cloud Vision Face Detection service = to compare with Tensorflow and in case schedule is tight and can not complete Tensorflow. Disadvantage over using CNN on mobile device is that there is a cost involved. The requirement of being on the Internet is already necessary for the application as the student is looking at web-based material in ULearn already.
- OpenCV = Computer vision framework with support in Android, used for image manipulation.

Testing

Do to the quick (<2 week) timeline, unit testing will be the sole responsibility of each developer on the team. Integration testing will be performed during Code Review time.

Schedule

Will use Trello board for monitoring Schedule. The following snapshot of the schedule is shown below and is already in progress.



Milestones

- Jun 12 · 2 · LG
- Team Recruitment
Jun 13 · 1 · LG
- Design Document
Jun 15 · LG
- Schedule
Jun 13 · 2 · C LG
- System Architecture
Jun 18 · 1 · C LG
- Team Roles & Initial Task assignment
LG
- Version Control Setup
Jun 12 · 1 · LG
- Development&Testing
Jun 26 · C LG
- Delivery&Documentation

Add a card...

In Progress

- Team Recruitment
Jun 13 · 1 · LG
- Schedule
Jun 13 · C LG
- ULearn app setup - dummy app
Jun 14 · C LG
- Design Document
Jun 15 · LG

Add a card...

Completed

- Design Concept
1 · LG
- Version Control Setup
1

Add a card...

Dependencies

- Access to data and tensorflow model for retraining is necessary but this is already obtained.