Transform
your smile.

CS 5551 Project Report

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Introduction

For our project we wanted to create something that would actually be useful in the real world, something that could make a difference in people's lives. To that end we decided that something in the healthcare space fit that desire well. As we thought about this we realized that there are not many mobile applications out there that assist with oral health, at least that we knew of or could find. This seemed like an area that we could do something in that no one else has, which leads us to the following project goals and objectives for a mobile application that will help those with malocclusion issues get the treatment they need in the most effective manner.

Project Goal and Objectives

- Motivation

  It is estimated that nearly 30% of the world's population have malocclusions severe enough to benefit from orthodontic treatment. Malocclusions of the teeth can lead to serious oral health complications such as crowded teeth, crossbite, overbite, underbite, openbite, etc. These complications can prevent the teeth from performing their vital function, which can lead to oral health problems such as discomfort when chewing, choking, breathing problems, speech problems etc. all of which are preventable with proper treatment.

  There are many people in the United States, and throughout the world, who have malocclusions and do not get the proper treatment. For some it may be that they are just too busy; for others it may be for financial reasons, or because orthodontic care is not readily accessible. For those that are too busy, or where cost is an issue, we will give them the ability to determine if treatment is necessary, and get competitive estimates, from the couch in their living room. Where accessibility is an issue, such as those who live in rural areas or possibly in parts of the world that are not as developed as what we are used to here in the United States, we will connect them with the closest orthodontic resources, to include potentially charitable organizations such as OperationSmile, that may be able to offer treatment.

- Significance/Uniqueness

  After doing some research we could not find any mobile application on either the Apple or Android application stores that did what we are proposing. We feel that the application we would be creating would be more than just a class project but could actually be used in the real world. As such we have contacted an orthodontist, Dr. David Christensen with Christensen Orthodontics, and discussed the idea with him. He was very enthusiastic about such a mobile application, and even offered to act as an actual alpha client as we develop the application. If the application is successful, at some point, we would even like to contact the charitable organization OperationSmile and see if they could somehow leverage the application in their charitable work (as they are partnered with Invisalign which provides malocclusion treatment).

- Objectives

  The primary objective of this project is to create a mobile application that can provide a means whereby individuals can more easily, and in a more cost effective manner, access the resources

necessary to determine if they have a form of malocclusion, and if so whether treatment is necessary. Additionally, to be really successful we will need to get buy in from the actual orthodontists in the areas where it is used. However, I don't see this as a problem since the application would actually be funneling business to them.

- System Features

The application will require the mobile user to enter a minimal amount demographic information; things like first and last name, phone number, home address, email address, etc. The application will use the home address they enter to determine the location of the nearest orthodontic offices in the area, and allow the user to select the desired radius to limit the results.

The application will require the user to fill out an oral health template. The template will contain questions such as, if they are currently having any oral health problems, things they would like to change about their oral health, potential treatments they would like to know more about, any concerns they have, insurance information (may require additional demographics), etc.

The application will walk them through a wizard that will assist them in taking several pictures of their face, teeth and jaw that will be sent to an orthodontist. These pictures along with the oral health template will help the orthodontist make an initial assessment of their oral health, and whether or not they may have a malocclusion condition that needs to be treated. The application will have some machine intelligence to assist the user in taking the photos. For instance, making sure the picture taken is in focus and positioned correctly on the screen. We envision this logic being similar to logic one might find on a bank application for scanning in checks from a mobile device.

Once all the information is entered and the pictures taken the user will be able to select one or more orthodontic offices that they would like to email the information. Once received by the orthodontist, they will review the information and reply with an initial assessment of the users oral health state, along with a cost estimate (taking into account any insurance information that was provided) if they feel treatment is needed.

Related Work

- We did some research and we could not find any application in the Android or Apple application stores that come close to doing anything the application we are proposing would do.

Detail Design of Features

● Architecture diagram/Class diagram/Sequence diagram

Architecture diagram:

In this architecture diagram we have a user, server , database and orthodontist. First if the user is new he will register and if he is old he will directly login. The registered user details will be saved in database all the pages will be stored in server who is responsible to server the pages to user. After login if successfully validated then the user will be displayed with the google maps page with the nearest orthodontist available to your location. Now user will select one base on the reviews shown which will be taken from google api. Next user will be directed to the form page where the user is required to take pics and fill in the form which asks minimum fields, all these will be stored in data base of later reference. The last thing is the user will send the details to orthodontist which he selected initially and he will be displayed with the summary page of the document he sent. The orthodontist will get all the information the user sent.

This is how our architecture of our system will work.
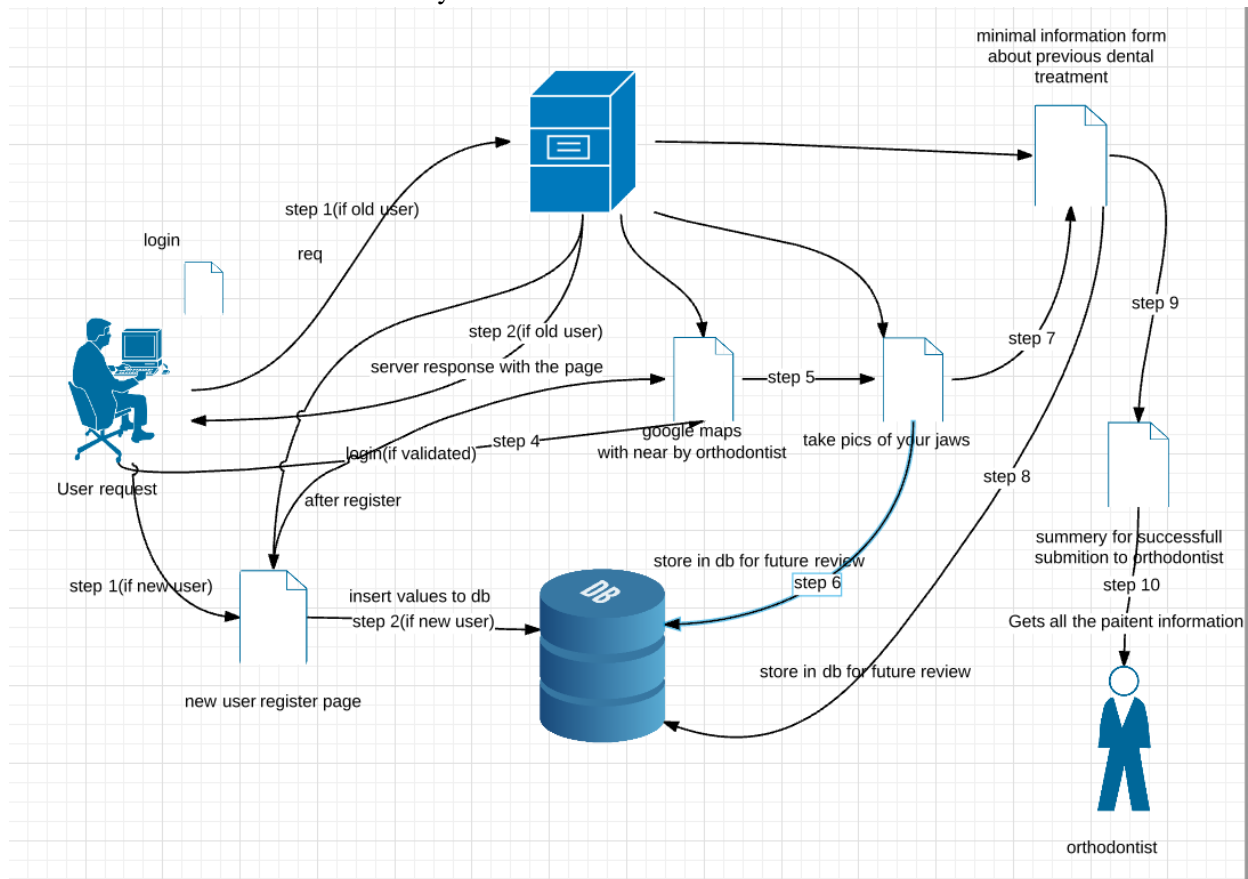
Class Diagram: Our class diagram consists of three class Patient, System and Orthodontist.
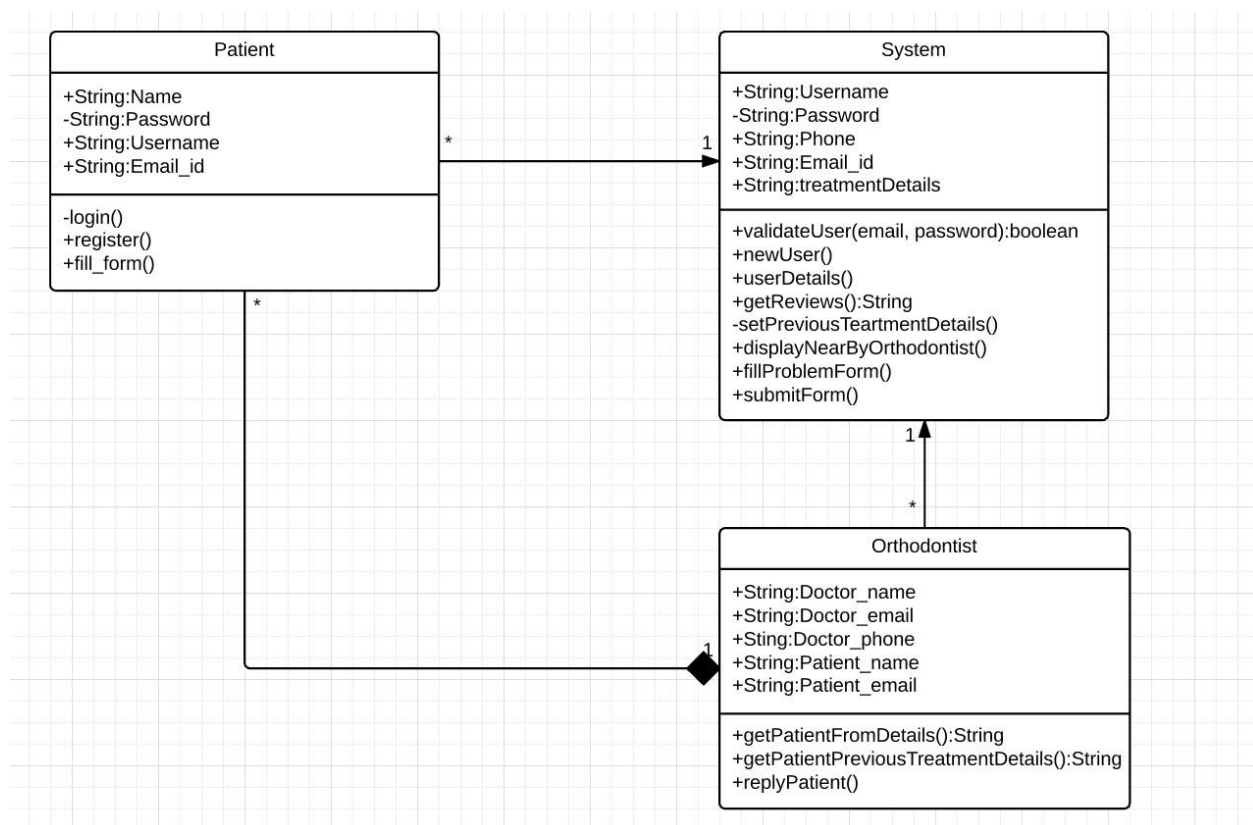
Sequence Diagram: The work flow of our sequence diagram is shown below:

- We have two main conditions one if user is old he can directly login else if new he needs to register.

- Another condition is if User is logged In then he can do the process for Treatment.

- For each and every new user the system maintains some control statements as shown in the below sequence diagram.
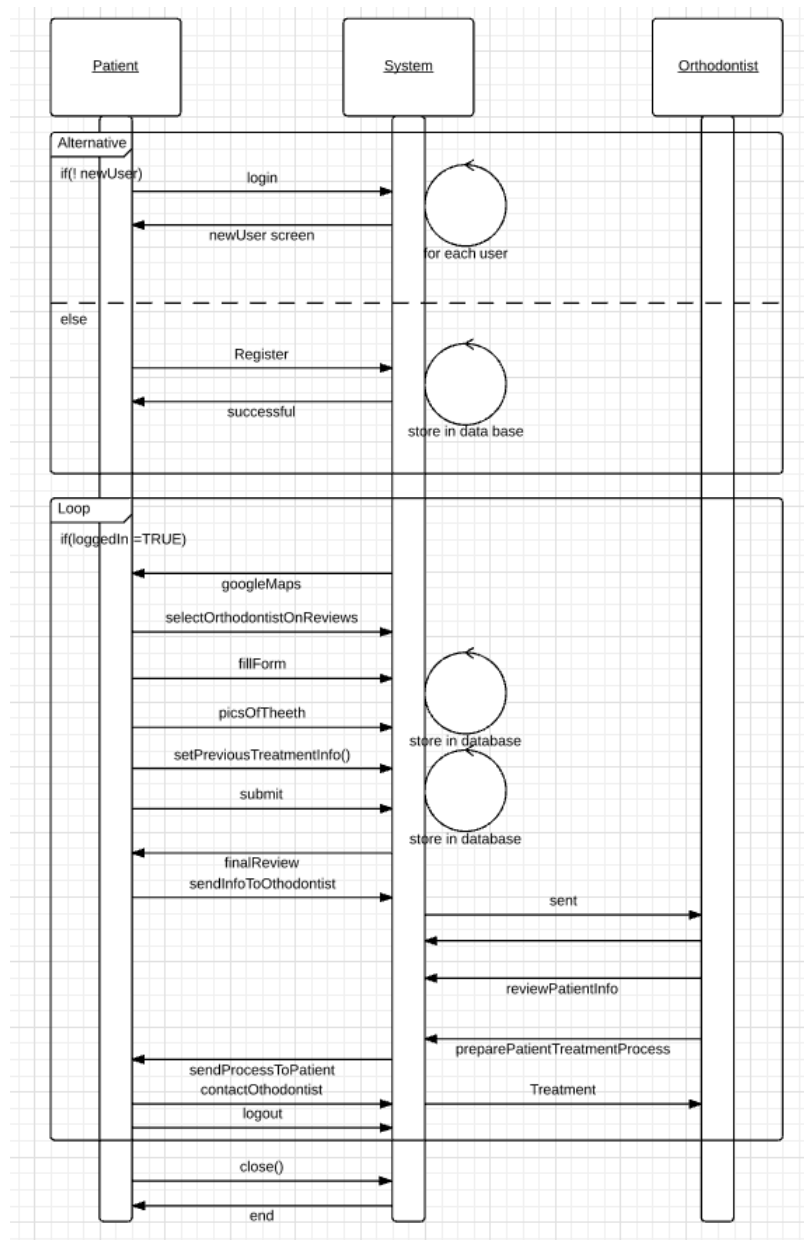
User story/Use Cases/Service description:

By using the login page, patients can access the detail dental diagnose instruction page and further functions. If users already registered in the system then user don't need to register again and they can login then. If they are the first time user, they would have the option to directly use the app features instead of register since what customers most concerned about is the related cost of dental issues rather than how the register page/form fill out process. Or new users have the options to register if they are interested to create a long term relationship with dentist etc. Meanwhile, the personal information could be potentially shared with dentists for further internal analysis usage only. All the data will be stored in secure locations and also we will need to make sure information will not be leaked. The firebase services will be used as our main database support since we are planning to store all the clients information inside which include their string type information and the specific human face pictures from different angles based on dentist's requirements such that they can make relatively quick decisions for remote patients based on the current pictures that are stored in firebase.

Existing Services/API

Currently our team will use google map API, and Android phone camera, and firebase database services to form our fundamental application. Therefore, we will utilized some of the shared code online from google API community as well as the specific source code that asking users to turn on the geographical location sharing function in order to determine the relative location of patients to surrounding dentist locations. For the firebase, we will use it as our main backend database where could store the critical information such as user's first name, last name, email address, passwords and many others as well.

Implementation (using Android/Angular.js/Bootstrap)
Mobile Client Implementation: Implementation of Mobile Apps:
In order to show that our application is really easy to use. We determine to implement the app under the android studio environment since it is basically an open source and easy to use software. Especially the open source community is a huge support to our current development process and the features that we are using and for those we are planning to use in the next step.

Server Implementation:
In order to store clients information, we decided to use firebase as our database, which will provided us one the most critical pieces -users information.

Service composition:
As an overall project, we are planning to implement Google Map API , Firebase services version cell phone version at the same time. For Google Map API, we will include the additional features such as

related search recommendation, dental location general review, pricing information, dentist contact information.

Deployment

Deploy your mobile app to smartphones and describe it including the screenshots

The first picture below indicate the basic log in page that we current have from android emulator screen, which requires users to input email address, password as the input field. And users can also view the password that they just input to make sure they input the right one. Then the "SIGN IN" and "REGISTER" button will users to access as different options.
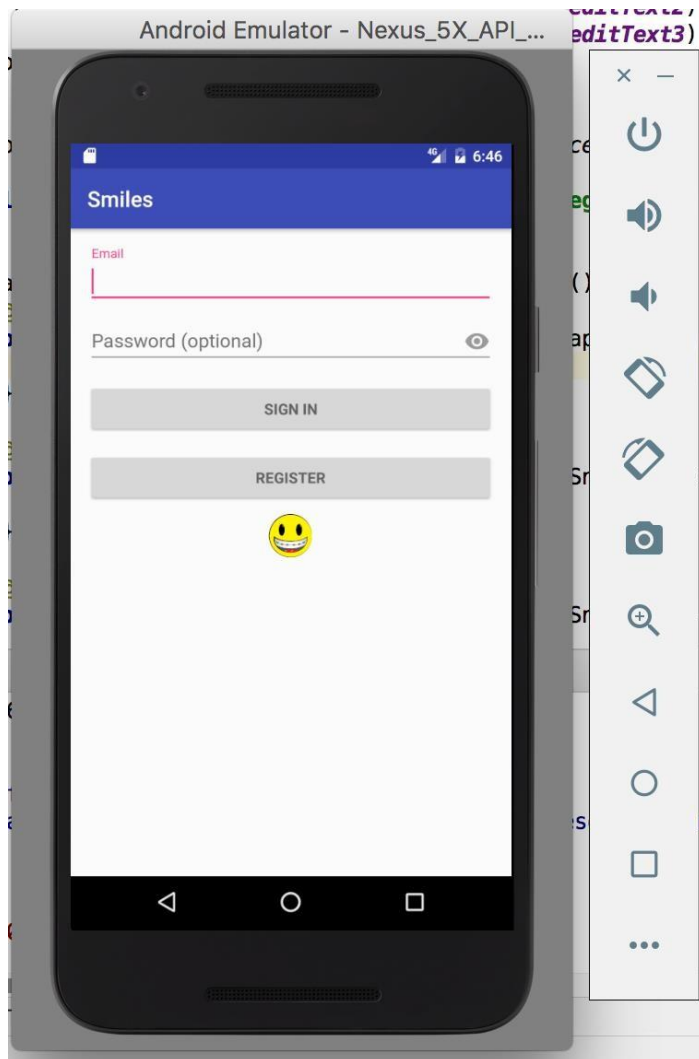
When the user hits the register button in the Smiles activity, the user is redirected to RegisterActivity which asks for Email and password with which the user registers and the credentials are added to Firebase Auth.
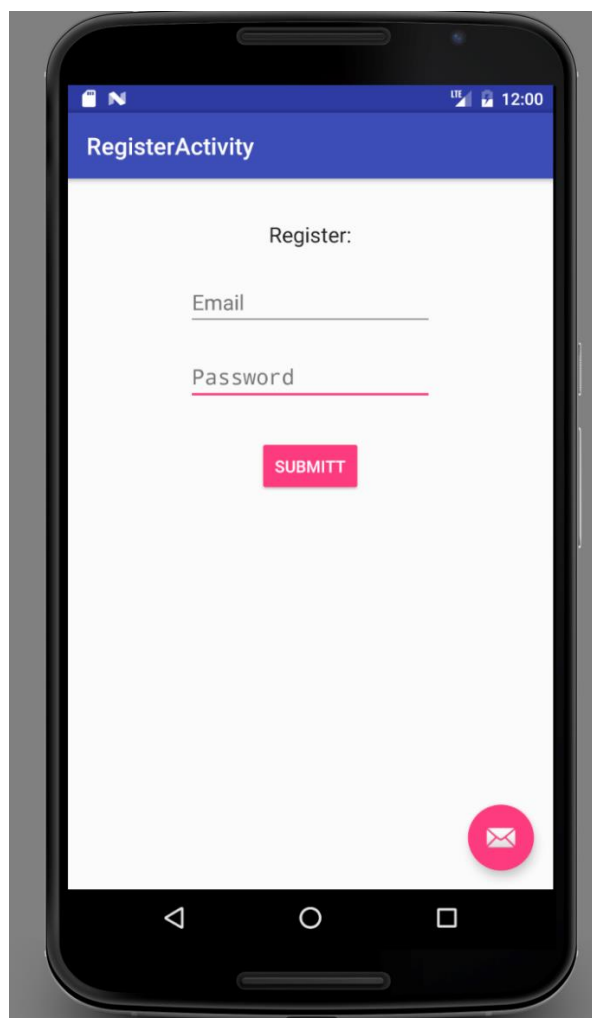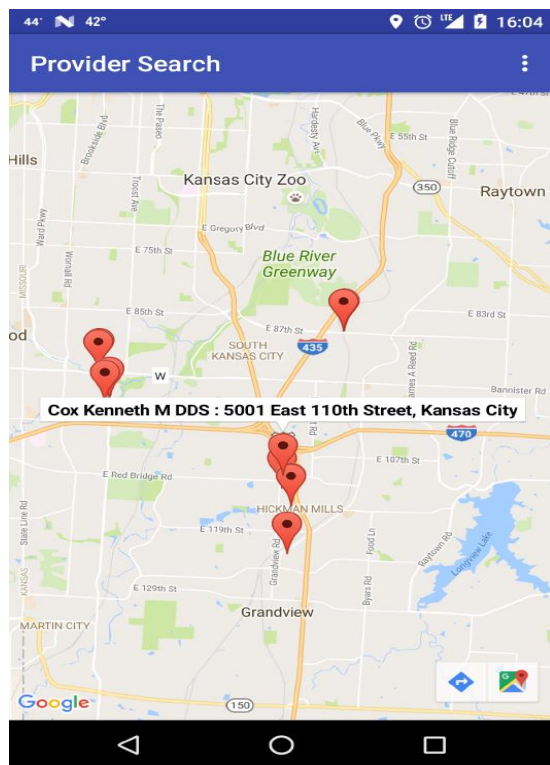
When the user hits the submit button the search activity google maps indicating the users location is rendered.
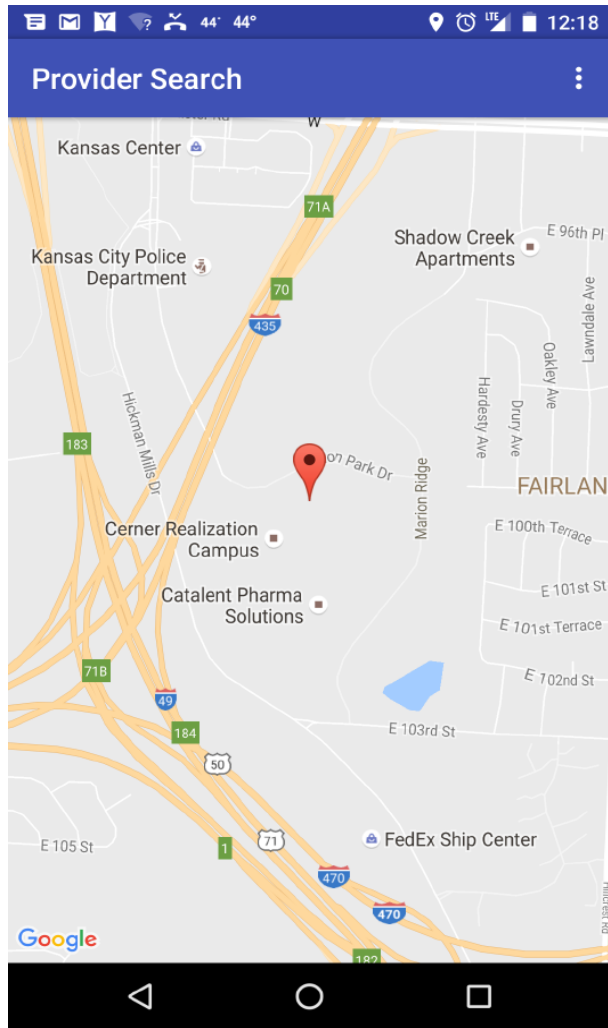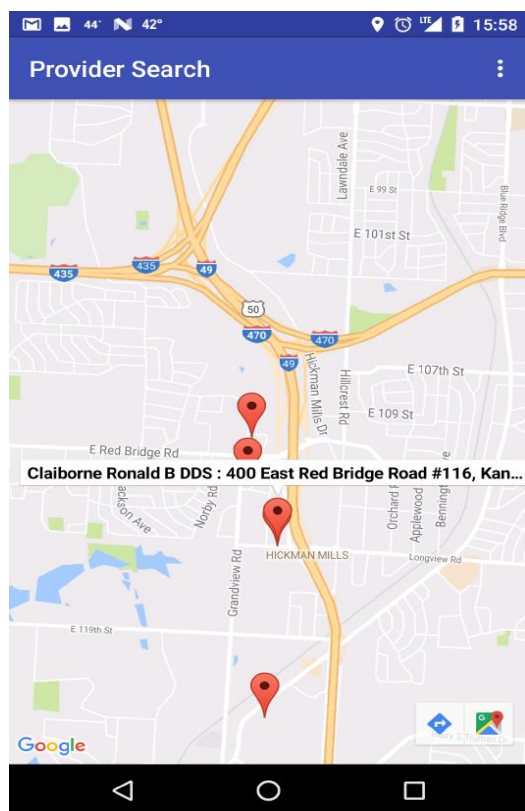
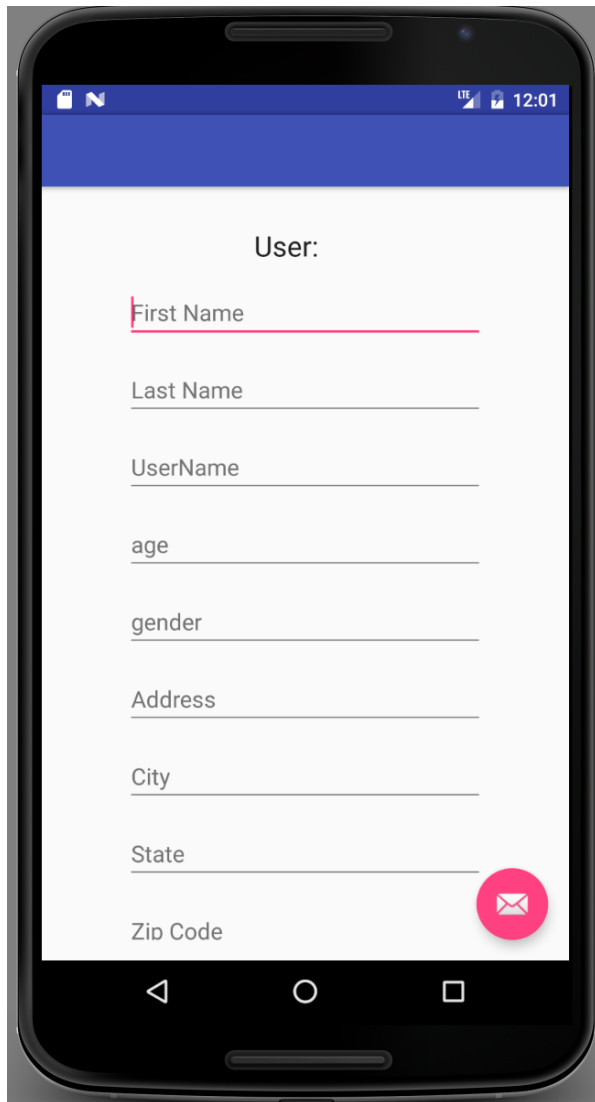It has a provision of menu option at the top where the user can select and customize the search
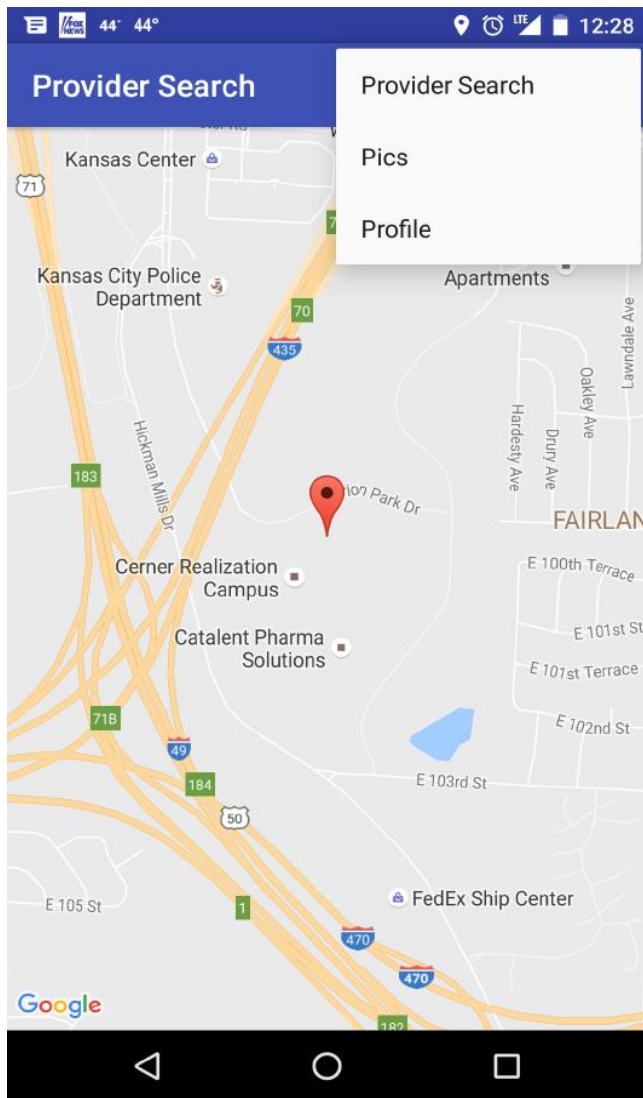
When the user searches about the orthodontists the screen gives pop-up locations of various orthodontists in google maps as below

The users can filter the orthodontists' location within a specified radius(5 miles here.) as shown below

From the dropdown menu when the user selects the profile the following page is rendered, which allow users to input their basic information and this information will be stored under the firebase service for further usage (patient information can be passed to specific dentist if permissions are given from users directly. And this information can also be collected for internal customer analysis and find out what are the app users' characters, age, genders, common symptoms etc.)

The aforementioned activity has lot of fields.When the user scrolls down the following fields are visible which the user needs to fill.

Third Increment Report

Detail Design of Features

User story/Use Cases/Service description

Authentication:

For increment three, we have implemented the authentication function on it, which allow users/clients to input their usernames, age, password, emails etc into the registration page. When users try to log in the system again, those information will be asked again for authentication purposes. Users also have the options that skip the registration page/process and jump to the orthodontist search function directly in our application, in which, potential users are treated as a temporary clients and they are not sure if they want to use this app as long term application and the only information that are required from them are just the specific face and teeth photos. Therefore, users will have some degree of flexibility to simply the registration process and jump to the main content directly. Once they feel that this is good application that they can use for long term, they can goes back to the registration page and fill out the form as well. Then, the filled information (client's name, age, gender, address, contact information etc) will be stored in the firebase, which served as our backend storage solutions so that when the same client log into our app again, they do not need to fill out the same basic information over and over again.

Google map radius function:

In our main orthodontist function, beside the core service we have, our application will also offer the additional search feature based on the current Google map. Within the map, users can customize the search radius based on the specific address that users defined. Then recommendations for orthodontist locations will be provided based on it. Then, several pins will be shown on Google map, in which, related orthodontist contact information/ Phone numbers/ pricing details/ address/ overall patients reviews etc. will be posted once the curser moves onto it. And users can contact one of them once they feel it is a good one to choose from.

Also, we are going to add the night mode to our current Google map features so that to better enhance clients' using experience and to better serve users in the night for better graph illustration and searching results demonstrations and so on.

User template:

In increment three, we also designed user template which mainly served as the place where clients can filled their basic information and application will store their input into our firebase, which served as our backend database securely. Once users finish the form filling process, those critical information will be send to specific orthodontist service location and doctors/service agent (hospitals) can potentially use it to perform in depth analysis on who visit the hospital, when do they execute the visit action, what are the age group that patients are in, what are patients' income/family status so that each orthodontist service agent can better adjust their services, pricing, and marketing strategies and attract more customers based on the similarities or other patients' characters. Meanwhile, the information that users filled can also served as the potential prefilled details when the same users try to login again. If the same users tempt to create a new user account again, the system might potentially stop this activity Due to the one on one

relationship between patients and the number of accounts they can register. A proper notation will be shown on the screen and indicate that client already registered an account within current system and there is no need to register for a new one. Such kind of verification will be performed based on the information users newly input to against the previous information that stored in the firebase. In such a way, it prevents the wrong/duplicate information being inputted and it can effectively prevent the misleading results/conclusions that draw from the database in the future for service

Picture Option:

Once the user logs in or registers in order to send the current status of the user pictures of the user in various positions are required by the orthodontist to decide the further course of action .Hence a provision for providing the orthodontist with the user pictures has been included. The user will be asked to do so right after the registration or even in the guest option as well.

Project Management
Project Timelines, Members, Task Responsibility
Work completed
Description

- The users who already registered can login to the app. The ones who did not have the option to register.This functionality has been integrated in the login page.

- Firebase has been integrated with both registration page. Sample inputs have been given and the data was successfully stored and retrieved form the database.

- The home page was created. Google maps API has been used and the user is provided with the google maps interface as soon as they login to the home page. Currently it shows the user location on the maps along with a radius for the user to choose within they can select orthodontists.

- The authentication has also been done so that the existing users can use the app with less things to fill in and new users need to register to get a flexibility to reuse the app later.

- The user template has been created with lot of authentication and input features.

- We prefer android instead of ionic as the potential application of the app is less likely to be on web as taking pictures in different positions using a webcam is unlikely to occur. Even if someone takes the pictures through mobile, uploading them through web does not make sense when they are using mobile to take pictures. Hence we limited our application to a mobile based one due to which we found ionic to be superfluous.

Responsibility

- The responsibilities of tasks were evenly distributed among all of us. Most of the time we worked together on the code and one of us did the commits arbitrarily

- However, in order to break down the tasks, login page and home page integration with the google maps API as well as customizing it by including features like popping up a menu list were assigned to Wayne

- Registration and firebase integration and desigining user information template were assigned to Naren.

- Wei was assigned the task of setting up the radius feature for the google maps and user interface. The documentation work is also being taken care of by them.

- Karthik was assigned the task of camera wizard and user interface. The documentation work is also being taken care of by them

Contributions
- Wayne did the customization and addition of features to the google maps such as menu list etc.
- Firebase integration and user template were assigned to Naren
- Karthik added the feature of taking uploading pictures and did documentation part as well.

- Wei did the documentation and radius stuff too.

Time taken
Approximately 300 hours

Work   to   be   completed
Description
- Retrieve the names of the orthodontists in that radius around the user has to be incorporated

- The complete picture wizard that walks the user through various steps in which they take pictures is to be done

- Storing the user information and sending to the doctor they choose through email

- Firing emails to user from doctors

- Making calls and retrieving user info other than images
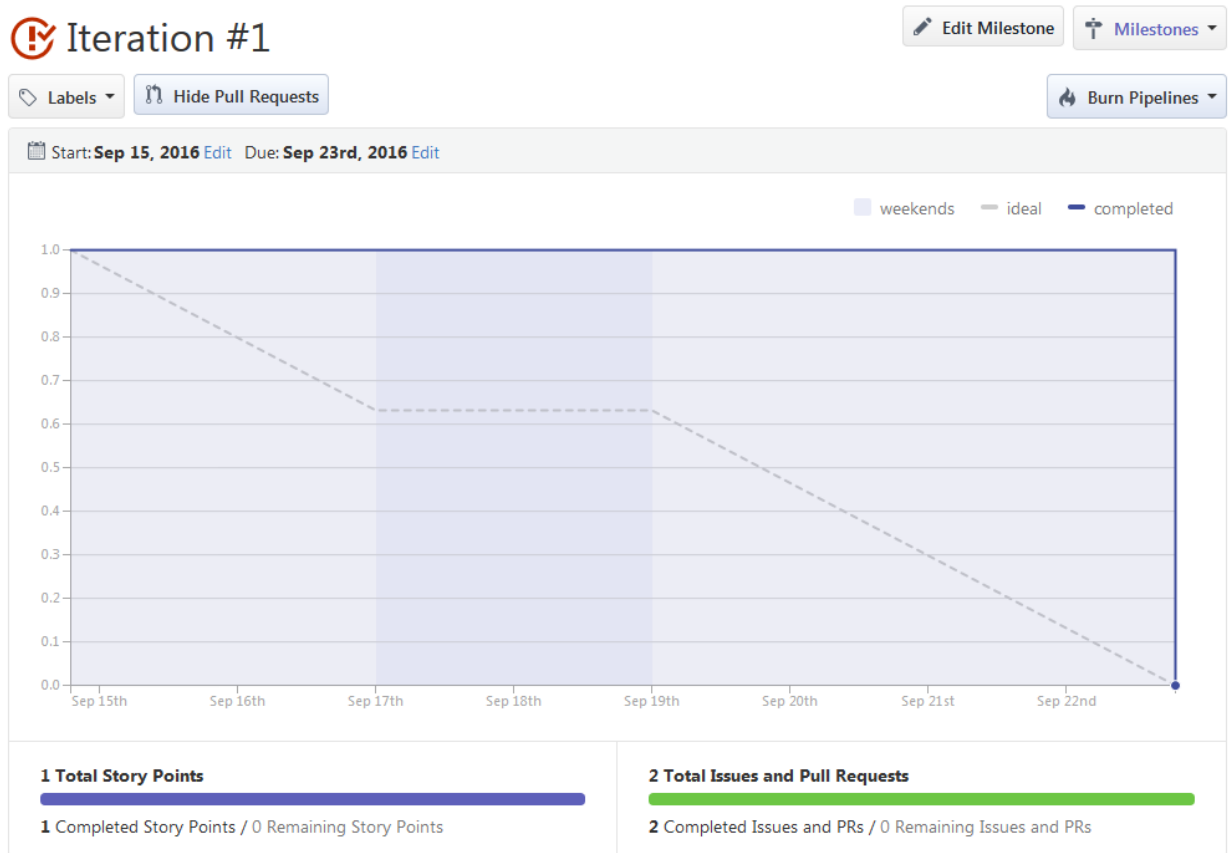
- Testing

Responsibility
- Wayne will futher work on the maps and backend part,emails.

- Naren will work on the orthodontists and user information storage

- Karthik will work on the pictures wizard
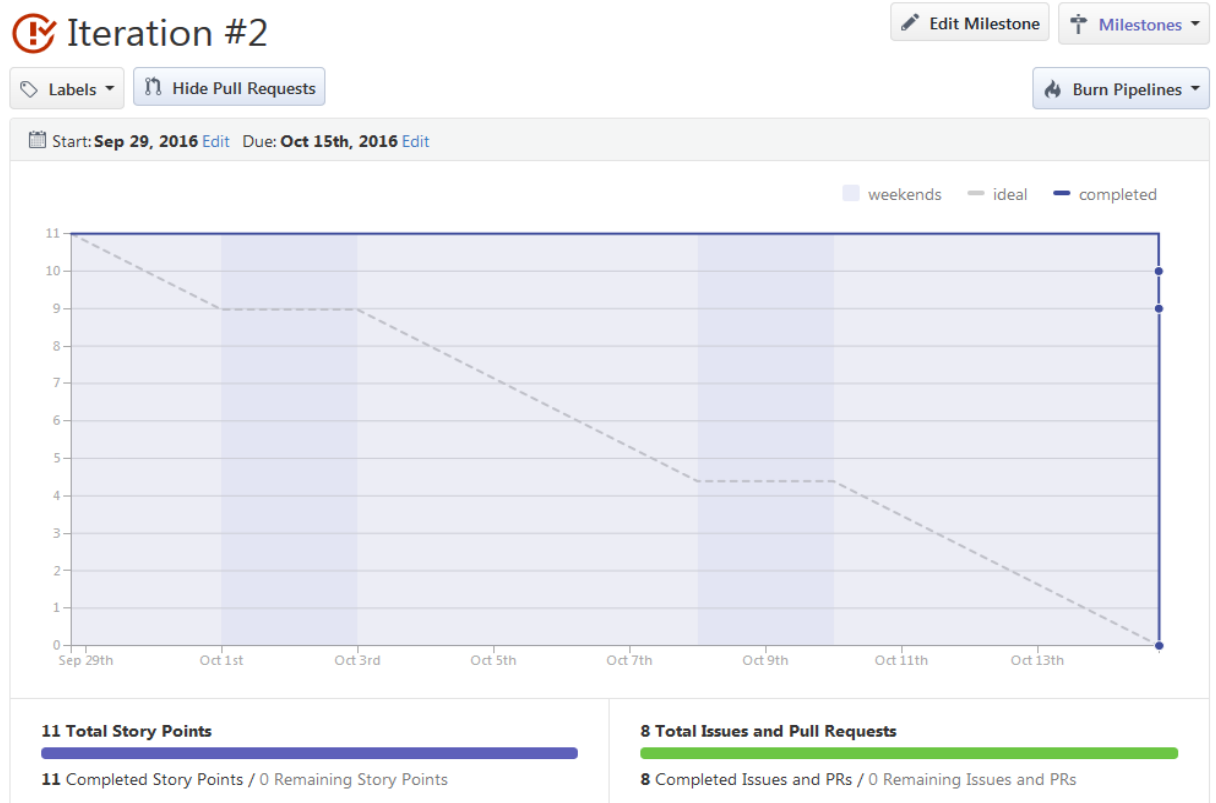
- Wei will work on the UI

BurnDowns and Issues

Iteration1

Issues

Initially in the first increment we concentrated on designing the architecture, class diagrams, figuring out the technologies and prepared the report and plan.

Iteration2

Issues

The major tasks that were done during this increment were to set up the login page, registration page, setting up the firebase database and checking its working.

Iteration3

Iteration #3

✎ Edit Milestone   ⊤ Milestones ▾

🏷 Labels ▾   ⇅ Hide Pull Requests   🔥 Burn Pipelines ▾

📅 Start: **Oct 18, 2016** Edit   Due: **Nov 4th, 2016** Edit

weekends   — ideal   — completed

3 Total Story Points

0 Completed Story Points / 3 Remaining Story Points

14 Total Issues and Pull Requests

10 Completed Issues and PRs / 4 Remaining Issues and PRs

Issues

The major issues done in this iteration are providing the authentication for all the pages, designing the user profile, designing the menu bar in the search, doing the firebase auth and storage, checking for user image facility and some other issues as shown below

The issues closed are

Completed Issues and Pull Requests	Story points
ⓕ **Build the Registration Form** CS5551-Project **#12**	Not estimated
ⓕ **Add support for Registration Form** CS5551-Project **#13**	Not estimated
ⓕ **Build Oral Health Template form** CS5551-Project **#14**	Not estimated
ⓕ **Add Support for the Oral Health Template Form** CS5551-Project **#15**	Not estimated
ⓕ **Photo Upload Feature** CS5551-Project **#16**	Not estimated
ⓕ **Store and retrieve pics from mobile storage** CS5551-Project **#17**	Not estimated
ⓕ **Email Proof-Of-Concept.** CS5551-Project **#32**	Not estimated
ⓕ **Support for Map Radius** CS5551-Project **#33**	Not estimated
ⓕ **Add Menu to Map Form** CS5551-Project **#35**	Not estimated
ⓕ **Research sending Email from Android.** CS5551-Project **#36**	Not estimated

The remaining issues are as follows which were moved to iteration 4

Remaining Issues and Pull Requests	Story points
ⓘ Add Support for the Login Form CS5551-Project #9 ‖‖ New Issues	2
ⓘ Build out the DB tables. CS5551-Project #11 ‖‖ New Issues	1
ⓘ Build Search Form CS5551-Project #18 ‖‖ New Issues	Not estimated
ⓘ Add Support for Search Form CS5551-Project #20 ‖‖ New Issues	Not estimated

Time to be taken
Approximately 250 hrs.

Bibliography

1. Dr. David Christensen DMD, MS with Christensen Orthodontics (www.christensenorthodontics.com)

2. Wikipedia (https://en.wikipedia.org/wiki/Orthodontics)

3. HealthLine (https://healthline.com/health/malocclusion-of-teeth#Overview1)

4. Operation Smile (http://www.operationsmile.org/content/invisalign-brand-celebrates-major-milestone)

5. CS 5551 Lab tutorial 3

6. CS 5551 Lab tutorial 5

7. CS 5551 Lab tutorial 6

8. CS 5551 Lab tutorial 7