

Pre-R Senior Project



Senior Project Report  
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Instructor: L. Slivovsky  
Client: Dr. Sam Slishman

## **Project Overview**

The Pre-R project objective is to make health care healthier by making the public aware of medical procedure costs. This objective will be fulfilled through the design of an Android application. The app is a way for patients to share the costs of a medical procedure so they can help anyone else in a similar situation. The app would allow users to enter the cost of a medical procedure by taking a photograph of the receipt which would be sent to an online database. The input would be parsed differently depending on whether the user is insured or uninsured. The database would be completely crowd sourced and would allow users to search the cost of certain medical procedures which would display results other users inputted. The app would also recommend medical facilities based on the user location. Our team will develop Pre-R software along with our client, Dr. Sliselman, to help anyone who is seeking medical help know the cost of the procedure in advance.

This project became extended to develop a website that would search for services like that application. The website continued on with the application using the same data points gathered from the application to form a computer based form of the app. Creating a website that compliments the app was recommended to keep in mind the people who want to look into the Pre-R software without necessarily having to be on their phone.

## **Clients and Community Partners**

When we spoke with Dr. Sliselman in the first meeting he said that he had gotten into the medical field to help people. As an ER doctor Dr. Sliselman is in charge of the patients' health and well-being. He said that one of his jobs is to fill in checkboxes for the various

equipment and procedures a patient will need for treatment, but is completely unaware of the price the patient will be charged for each checkbox he marks. Because of this he said that he is unable to help the patients sometimes as the high cost of the procedure affects the patients' health. Since the doctors are kept out of the loop for the price of the procedure he has no way of knowing the cost of the procedure he just did. This is where he got the idea for the Pre-R app. He wanted to provide a way for patients to know the price of a medical procedure before they actually had the procedure done.

## **Stakeholders**

This project could help anyone who is getting any kind of medical procedure done save money. Uninsured people as well as people who need to go to the hospital frequently for routine check-ups will see the most benefits. The project can also benefit doctors who want to inform their patients of the cost of the procedure they're about to go through. Hospitals and insurance companies would have an interest in the Pre-R application, although their interest may be negative because the application will give users access to information that hospitals and insurance companies want to keep private. On the other hand, hospitals may also have a positive interest in the application if they have less expensive prices, advertising their hospital as the cheapest in the area.

## **Framed Insights and Opportunities**

For our project, we are regularly contacting our client to coordinate the expected deliverables and report our progress. Up to now, we have mostly been discussing the

broad details of the Pre-R application and how we will organize our time over the next two quarters.

Our team was first introduced to Dr. Slishman in the first week of the quarter while he was explaining his project to the Capstone class. From that presentation, we were able to grasp the general idea of what were to develop, and what features the finished product was expected to have. The Pre-R (or CrowdCentsing) project had already been started by another group in last year's class, however no work had been done on the app itself. We came into contact with one of the past team members to make use of their progress concerning the database, thanks to Dr. Slishman.

Through examples and further discussions, we have come to understand more clearly what the needs of our client are and what is expected from us. In the end, we will need to have an Android application that will have an interface that is linked to our database hosted on a third party server of our choice. The application will at least be able to display the costs of medical prices by area, as well as include the ability to add new entries to the database. To do so, end users will have the option to either enter their medical bills manually through a form or take a picture that our product will process before adding to the database. In addition, users should be able to perform these actions through a simple and intuitive interface as to not make it too complicated to use. To make this application available to a very broad audience, we realized it was necessary to have a product that presents requested information clearly and efficiently.

Shortly after our initial meeting, our liaison contacted Dr. Slishman to arrange an in-person meeting and touch base. When first discussing the project at hand, we gained a

deeper understanding of the reason why this project was being developed and who it would be useful for. Dr. Sliselman made it clear to us that there is very little information available to the public regarding medical procedures and their prices. Doctors and surgeons commonly do not know what the patient will be charged while filling out their medical charts. Our end goal then became to close the gap between the patients and the hospitals, so the general public could be well informed as to what they are getting into whenever they make a trip to the doctors. From that first meeting, we also gathered information about the first steps we should take to start developing our product. Firstly, it became clear to us that we were to focus on the application rather than on the website that has already been developed for Pre-R. We all agreed that this would both be simpler and more rational as it would be difficult for us to create both. It also made sense as it seems more intuitive for potential users to use their smartphone to use our services, especially when using the image processing feature. This meant that our efforts will now be narrowed down to working with the database and linking it to the interface we will develop for the application. However the database has already been set in place and will require less work than the application, which we need to start from scratch. In addition, it was decided upon that the application will be Android based, as some of us already have experience in that domain. We all felt more comfortable because the Android software development kit is more accessible, and not all of us have a Mac to develop iOS applications on. Finally, we discussed the development process for the application's interface in order to stay organized. Rather than starting to develop screens for each feature, we will use some of the wireframes that have already been drawn up to follow a specific workflow. This

workflow will assure that we know what needs to be done and in what order, which will help in setting milestones while actually coding the application and to track our progress.

Overall, we feel we have gathered enough information to set the project in motion and understand the needs of our client, and its potential users.

## **Goals and Objectives**

The main goal for the Pre-R project is to provide the general public with free information about the cost of medical procedures. At the end of the Capstone and Senior Project course we want to have a functional website, application and database that people will be able to use and access valid procedure cost data. Our goal is to provide this information in a clear and concise way with a friendly and intuitive interface. On the way to achieving these goals we have various objectives that need to be completed before the goals can be reached. The first step is to meet with a previous Pre-R team member, Trevor Mckee, to learn how the database was implemented. While we begin to understand the ins and outs of the database we will also begin to design the wireframes for the Android application, using the wireframes our client has created as a base design. Also in the design process we will create a logo for the Pre-R application. The next steps are to implement the wireframes and write the source code for the Android application, developing the user interface and the database interaction simultaneously. The final objective for the capstone class was to tie everything in the application together, making sure that the user interface and database interaction flow seamlessly without errors (through user testing) in the form of an Android application.

Our objective for the Senior Project class was to create a website that worked with the application. The website would use the same database as the application. We started with the framework of the website to have a general idea of the layout of the website and what we wanted to incorporate. The final objective for the senior project was to have a functional website to mirror its Android and iOS application counterparts having it become live on the internet.

### **Outcomes and Deliverables**

At the end of the Capstone courses, the final outcome shall be the functional Pre-R Android application that can be downloaded and installed by all Android users. The functional Pre-R application can be defined as an application that allows the user to search for and compare the cost of various medical procedures specific to a location. Basic functionality will also allow the user to be able to upload their procedure cost information once he/she receives a medical bill. This requires the Android application to be able to access the database from any location and for the database to store valid information. Once a functional prototype application is developed, performance testing will be done in order to fine tune the app. Documentation and a user's guide will also be delivered with the Android application to make the application user friendly.

### **Duration**

#### *1st Quarter*

- Start of project - Beginning of week 5

- Rough draft of wireframes - End of week 8
- Deep understanding of database - End of week 11
- Final draft of wireframes - End of week 11

### *2nd Quarter*

- User interface implementation - End of week 5
- Communication layer on top of database - End of week 5
- Server and application integration - End of week 6

### *3rd Quarter*

- Website design; application framework for 'search' functionality on iOS - End of week 3
- Search implementation for website and iOS - End of week 5
- Bill entering template on website; Google Maps integration on iOS - End of week 7
- Host website on GoDaddy; UI formatting on iOS - End of week 9

### **Team Mission**

Use our education and experience to design and develop an application as a team that can be useful to others.

### **Team Objectives**

- Split project evenly so that every member has work to do based on their individual skills
- Learn Android application development as a team
- Learn Website development as a team
- Help each other learn new technologies, including Android, database, server-side

development, and web development

- As a team, work and communicate with the client to meet the specification requirements

## **Team Membership and Roles**

The members of the Pre-R team are Grant Ramil, Eliot Mestre, Alex Lin, Akshay Rangnekar, and Mark Anthony Corpuz. Grant has taken responsibility to monitor the rest of the team and make sure everyone is on task thus being the Project Manager. Eliot has been the person communicating with our client, and has been effectively kept everyone up to date with their talks and emails thus becoming our Liaison. Alex and Akshay will hold the technical roles of being our Database Personales becoming the two people to know the database we will be storing our information on. Mark has the role of User Interface Designer and will be in charge of creating a capable UI for the app. The Pre-R team members will all be an application developer for this project.

## **Related Applications**

The PreR Android application and database will be unique in that the data that will be collected will be crowdsourced. However, there are similar websites and applications that offer users the ability to search for costs of medical procedures. One main competitor of the PreR app is a website called Health Care Blue Book. It's main advantage is that they allow many ways of filtering their searches for costs (hospitals, specific physicians, procedures, medication, etc.). Health Care Blue Book also offers mobile applications on

both iOS and Android which gives it an edge to the Android-only PreR app. Another competitor of PreR is the FairHealth educational site. This website is not as polished as Healthcare Blue Book, but it does offer some different features. Some advantages of this system are the options to search for insured and uninsured prices, the ability to search by CPT codes, and the option to search locally by zip code. It is also accompanied by both iOS and Android mobile applications. An interesting competitor of the PreR system is an application provided by the insurance company Aetna. Aetna provides its members with a payment estimator. This is a very unique tool in that allows insured patients to find the cost of a procedure before it's done, which is hard to do since most insurance companies keep this information private until a patient receives the actual bill. While this tool is very useful for Aetna members, it does not target the broad, general population as PreR does. However, their data is guaranteed to accurate since it is being provided directly by the insurance company as opposed to being crowdsourced.

## **Formal Product Definition**

### *Marketing Requirements*

1. Easy to use interface, easily accessible
2. Presents information in a clear and concise way
3. Useful for all audiences in US
4. Allows users to find and compare medical procedure costs and find cheapest care to meet their needs from crowdsourced data
5. Finds and uploads information quickly
6. Uses minimal battery life.
7. All information is anonymous.

Marketing Requirements	Engineering Requirements	Justification
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9	The application shall have a user input response time of < 50 ms.	Users are more likely to use the application if it responds quickly.
9	The application shall have client-server-client communication time of < 5s.	Users are more likely to use the application if it responds quickly.
9	The application shall have a client-server image upload time of < 10s.	Users are more likely to use the application if it responds quickly.
10	The application will be implemented so that it only uses up to 5% of the CPU.	Users will be able to use the application for a longer period of time.
2	The application shall be backwards compatible with Android versions 1.6 and above.	This will give the application the largest available target audience.
1, 3, 6	A user should be able upload a bill in 3 clicks.	To reduce the number of screens the user sees and makes the user interface simple.
1, 3, 5	A user should be able to search for an operation in 5 clicks.	To reduce the number of screens the user sees and makes the user interface simple.
2, 4	The application shall be obtainable at no costs to the user.	This will give the application the largest available target audience.
6, 7	The database should be constructed from user inputted data.	Only way to get information about medical procedure cost.
1, 3, 6	95% of the users should be able to learn how to upload a bill in less than 5 minutes.	The application will have an intuitive interface so users do not have to take much time to learn how to use it.
1, 3, 5	95% of the users should be	The application will have an

	able to learn how to search for a procedure in less than 10 minutes.	intuitive interface so users do not have to take much time to learn how to use it.
11	The application will not disclose any private information.	Safeguard against legal backlash.
-	The application will be updated at least every year and at most every 3 months.	To comply with new Android API's.
-	The application should have one or less bug related crashes per day.	Users will not use the application if it crashes.
1, 6, 7	The application should scan in data accurately so that the user would only have to retake the picture once every 10 times.	Users will not use the application if it wastes their time.
2, 4	The application should be easily accessible and free to anyone using an Android phone or tablet.	This will give the application the largest available target audience.

## Criteria

- Speed
- Power Consumption
- Compatibility
- Usability
- Maintainability
- Reliability

## Personas

**John Smith**

John Smith is a 42 year old uninsured construction worker. For him, being healthy is very important; if he is not healthy, he cannot make a living. However, his chronic back problems force him to visit the hospital more frequently than he'd like. John is also a single parent with two kids aged 8 and 10. He hopes to save up enough money to send both of them to college, but his hospital bills are getting in the way of making that dream a reality.

John's work environment is very hazardous and injuries on the job are inevitable. The workplace hazards are often compounded by workers not keeping the workspace clean and organized. The work itself requires lots of physical labor - John is constantly working to move, fix, build, and demolish whatever his boss requires. As the father of two kids, John's home life is hectic and stressful. His kids are still young, so he is in charge of all the household duties. Because of his limited salary, John cannot afford a house and instead shares a one bedroom apartment with his kids.

Because of his obligations to his family and his job, John has a strict daily structure. His weekday schedule involves waking up early, getting the kids to school, work, picking up the kids and driving them to their after-school activities, and then finally going home. On weekends, John will often work, and sometimes also has to drive his kids to sports tournaments and activities. Occasionally this schedule is broken up by his hospital visits.

However, despite all of the hardships that he is faced with, John still maintains a positive attitude on life. He works hard to be the best father and best construction worker that he can be. He wants to stay healthy so he can support his kids physically and financially. Because of his financial goals, John tries to find as many bargains as possible. He wants to make sure he is not overpaying for the things he buys. Late at night, John can

often be found on his computer or smartphone, searching for bargains on food, clothes, and other essential items. Something John would really appreciate is a way to find bargains on his back surgeries and appointments. One back appointment might cost John a month's salary; reducing that cost, even by a little, would go a long way in helping John through his financial struggles.

### ***Jane Doe***

Jane Doe is a 26 year old hospital administrator. Growing up, Jane was raised by her grandparents since her parents were killed in a car accident when she was 5 years old. She learned good morals and the act of caring while growing up and to this day has the same mindset. To this day Jane helps watch over her elderly grandparents, helping them bookkeep and manage their finances for them as well as watch over them health wise.

Jane continued to had a daily routine of going to work for 8 hours a day and then went to visit her grandparents to make sure they were all right before heading home to sleep at night. One day this schedule changed drastically when her grandma became diagnosed with stage 3 lung cancer from her constant smoking from the past. This disease was taxing on the grandparents wallets as they spent all their money taking care of Jane and putting her through college. Hearing of this circumstance that came about Jane wanted to do everything she could do to help her dear old grandparents.

Jane went with her grandparents to find treatment options and to learn more on what the next steps are to help her grandmother's health. They went to many different hospitals at first to see what they would say about treatments. Most said it would be best to start

chemotherapy right away to help stop the spread of the stage 3 cancer. Understanding the situation, Jane wanted to give her grandma the best shot at living as well as not hinder their life away into debt.

Doing online research to figure out the costs as well as looking into cancer costs at her own hospital, Jane realized costs for each hospital or clinic visit would strain her grandparent for money. Jane wanted to find something that will tell her where the cheapest places to get treatments done to help her grandparents and eventually the people whom she would see everyday at the hospital. Finding something like this would be revolutionary in the way that people thought of medical care and hospital visits. Then she stumbled upon the Pre-R app.

## **Design**

### **1. Android Application**

Screenshots of the final design are shown in Figures 1-7 below.

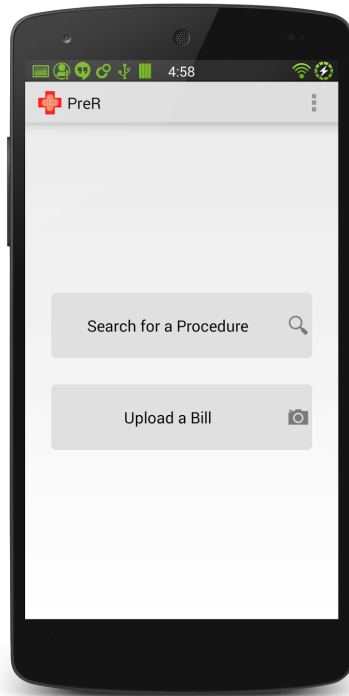


Figure 1: Home Screen

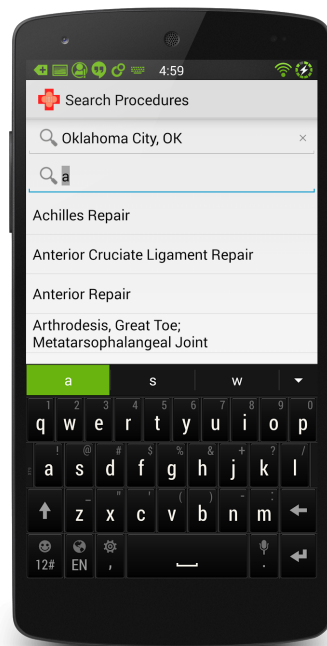


Figure 2: Screen to Search for Procedures

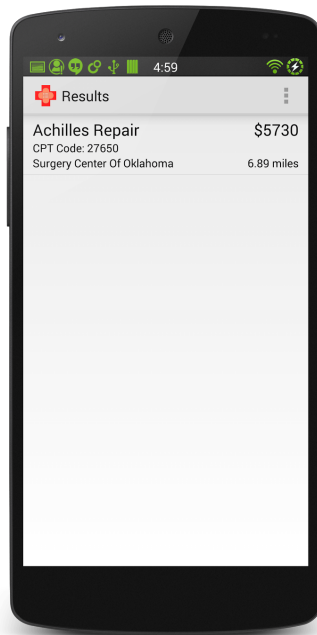


Figure 3: Search Results Page

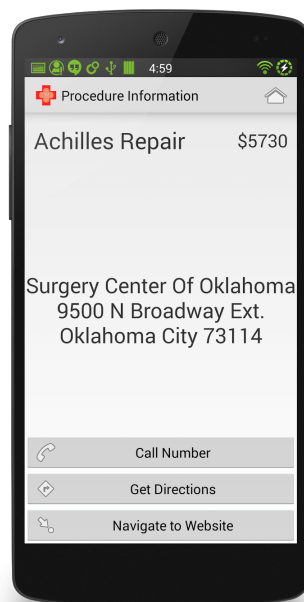


Figure 4: Hospital Procedure View

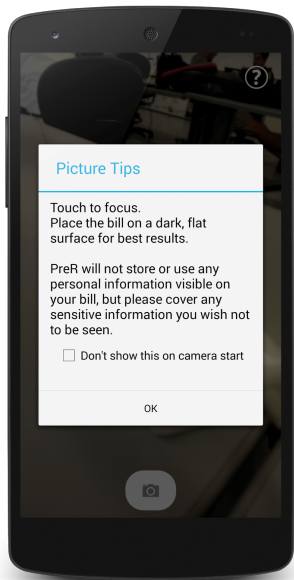


Figure 5: Camera Tips

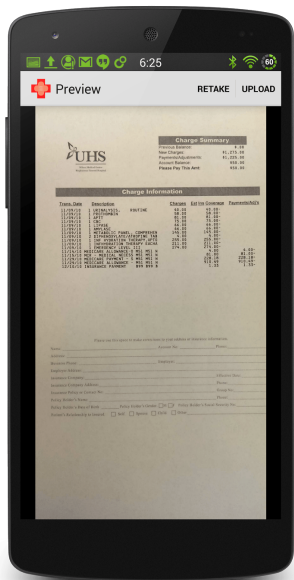


Figure 6: Review the Bill Picture

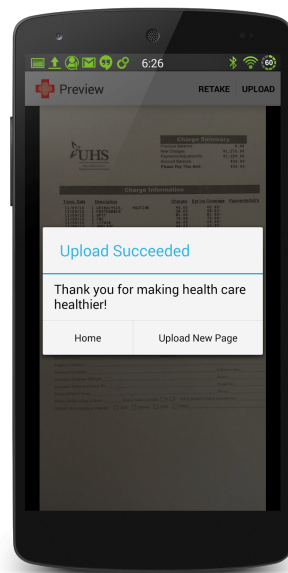


Figure 7: Upload Status Alert

## 2. iOS Application

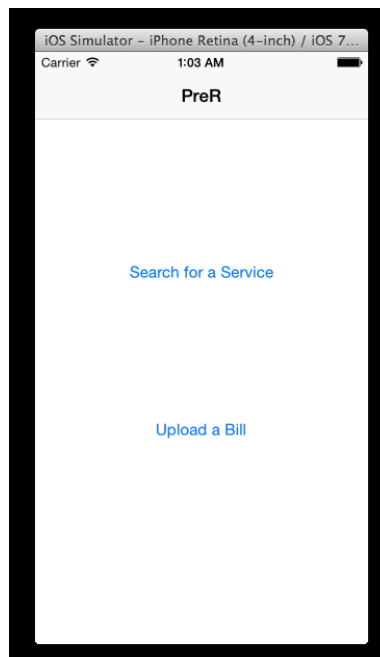


Figure 1: iOS Home Screen

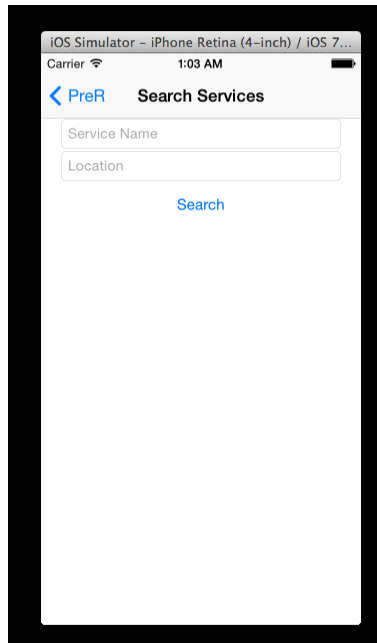


Figure 2: iOS Screen for Searching Services

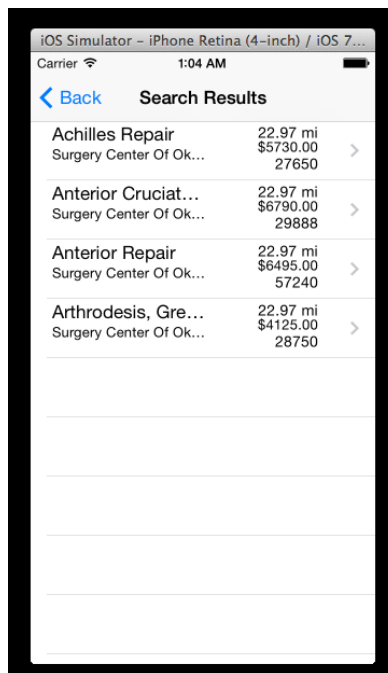


Figure 3: iOS Search Results Screen

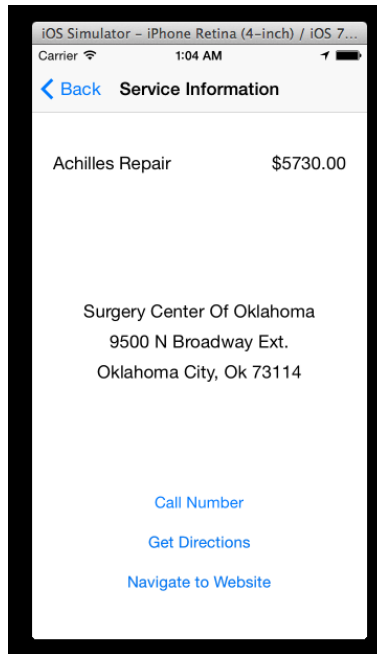


Figure 4: iOS Service Information

### 3. Website

Screenshots of the final design are shown in Figures 1-3 below.

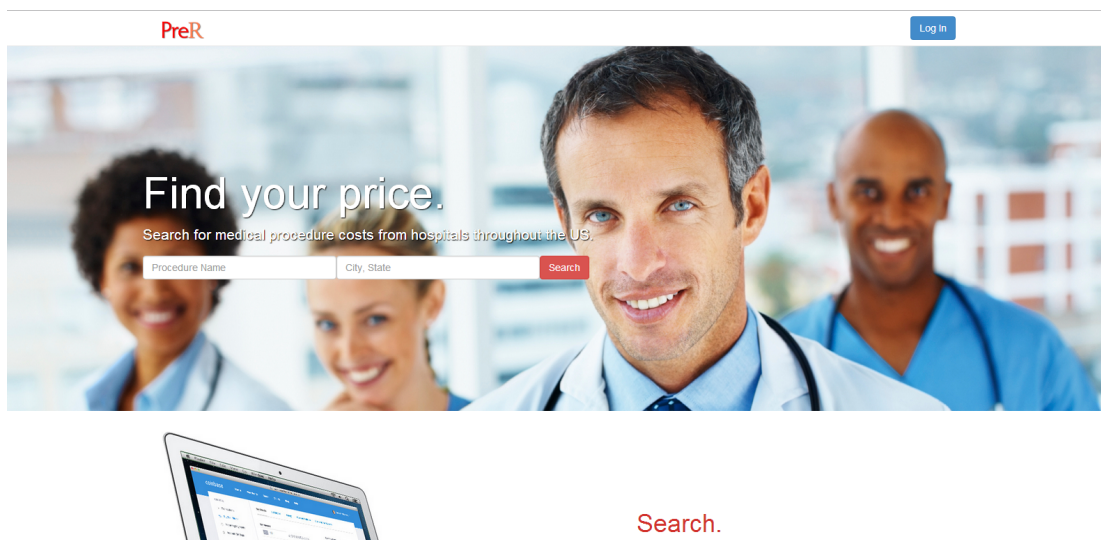


Figure 1: Main Landing Page



Figure 1 below demonstrates how our software will communicate with each other in our final application. Figure 2 below shows a mockup of what the server will be storing as data such as the different hospitals in the area and the different medical procedures those hospitals provide.

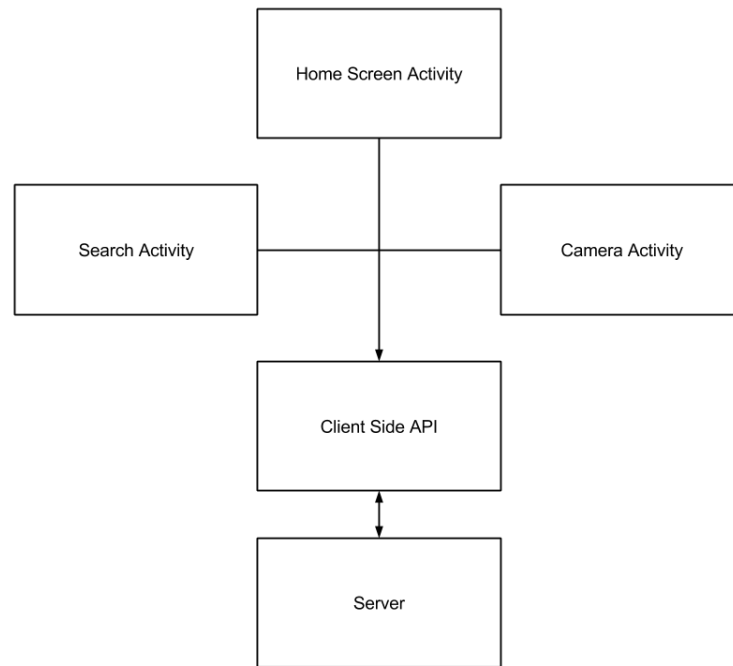


Figure 1: Overall System Architecture and Communication



Figure 2: Server Architecture

## Functional Scenario Testing - Mobile

## Main Flow

- User opens camera - verify device has a camera
- User takes a picture - temporarily store image for viewing
- User uploads bill or re-opens camera - delete image if user desires

## Error Handling

- Notify user if the device doesn't have camera hardware
- Allow user to navigate to search screens

## Upload Functionality

### Main Flow

- User chooses to upload bill - save or delete image per user request
- Open network connection - verify device connectivity
- Send image data to server - verify data transfer

### Error Handling

- Notify user of save or delete error
- Notify user of data connection error (no service or WiFi) - allow to reattempt
- Notify user of data upload failure - allow to resend

## Search Functionality

### Main Flow

- User chooses to search
- User location is found (current zip code)

- User searches for procedure - results (if any) are displayed
- User selects hospital

#### Error Handling

- Notify user if location cannot be obtained (no GPS)
- Notify user if no search results are found - stay at search screen

#### Access Control Testing - Mobile

- Positive Access Control
  - User can access procedure information stored on the server via the application
  - User can upload images of medical bills to the server via the application
- Negative Access Control
  - User cannot access images of medical bills stored on the server

#### Regression Testing - Mobile

Sanity bucket (application-critical functionality; ~10% of test cases):

- All features that are core to our application's functionality, including:
  - Using the camera to take a picture
  - Saving picture to internal storage
  - Sending picture to server
  - Querying server for procedures

Full regression bucket (~30% of test cases):

- All features that are complement to core functionality, including:

- Viewing detailed information about a single procedure
- Retrieving pertinent results from server
- Being able to launch third-party applications from our application (Maps, Phone)

## Conclusion

From our testing we came out with an android application that is fully functional application. Our testing allowed our app to continue working when it could have crashed in cases such as not having internet when the application starts, not entering a field when searching for a procedure, as well as trying to take a picture without a camera. Our testing also continued to the database having the pictures uploaded saved correctly.

## Appendices

### Gantt Chart

Week	Eliot	Alex	Mark	Grant	Akshay
4	ALPHA	ALPHA	ALPHA	ALPHA	ALPHA
5	Search Functionality	Upload Screen	Results List	Client-Server Communication	Hospital View Functionality
6	Search Functionality	Upload picture	Search Functionality	Upload data/OAuth	External Intents
7	Test Cases	Test Cases	Test Cases	Test Cases	Test Cases
8	BETA	BETA	BETA	BETA	BETA
9	Test Cases	Test Cases	Test Cases	Test Cases	Test Cases
10	Test Cases	Test Cases	Test Cases	Test Cases	Test Cases