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Android Mobile Application for tranSMART API

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A project submitted in partial fulfillment of the requirements for the degree of

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at

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April, 2014

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Guenter Tusch   **Date**

1 Table of Contents

2 Abstract

The efforts to process biological data has been really fascinating as the power of computational devices has increased tremendously. One of the major computational platforms in biological data is tranSMART. "TranSMART is an emerging global open source public private partnership community developing a comprehensive informatics-based analysis and data-sharing cloud platform for clinical and translational research." TranSMART is very simple to use web application and it processes biological data really efficiently, however its power is not available to use from any mobile application. Thanks to the recently developed RESTful API it could be really easy to integrate with other applications. The goal of the project is developing a mobile interface in Android for tranSMART. TranSMART could run from multiple hosts within an organization, so the mobile application gives the flexibility of choosing the desired host and storing their addresses for future use. Also this mobile application implements the same search interface available on the web in a more user friendly way through optimizing auto completion of search terms. The screens displaying the results of the RESTful calls are optimized as well to display the key details of each biological experiment by showing experiment descriptions and biological information. This application brings the power of tranSMART Big Data platform closer to the user, through allowing flexibly in choosing different hosts where tranSMART could be running from, facilitating the search screen for a mobile device and adjusting the results in a more responsive way.

3 Introduction

Mobile Applications have been gaining popularity very rapidly because they make our life so much easier by providing a quick and convenient gateway to information. Many of these Mobile Applications serve as interfaces to very powerful web applications such as Dropbox, Facebook, YouTube and Twitter. They bring to the users the power of these cloud platforms. "TranSMART is a Web-based knowledge

management platform that enables scientists to develop and refine research hypotheses by investigating correlations between genetic and phenotypic data, and assessing their analytical results in the context of published literature and other work" (tranSMART, 2013). This Web Platform has a very intutitive Google like web interface, however tranSMART is not currently available as a Native Mobile Application.

The motivation behind this project is to bring the power of tranSMART in the mobile world by developing a Native Android Mobile Application that ustilizes tranSMART RESTful APIs (Application Programming Interfaces). According to Authorize.Net an API is a specification of remote calls exposed to consumers (Authorize.Net, 2014). These remote calls make it possible to the Mobile Application to connect directly to the Web Servers where tranSMART is running, extract information and transfer it to the Mobile Application. TranSMART is used by scientists in various organizations, the Mobile Application facilitates the process of accessing the clinical and biological information.

The goals and objectives are to use the current APIs that tranSMART is exposing and keep expending the Mobil Application as new APIs come available. TranSMART is Open Source project which "as a development model promotes a universal access via free license to a product's design or blueprint, and b) universal redistribution of that design or blueprint, including subsequent improvements to it by anyone" (Lakhani, 2003) (Gerber & Molefo O, 2010) and the Mobile Application of this project will be part of this Open Source community in the future.

4 Background and Related Work

This project (tranSMART Mobile Application) is based mainly on utilizing tranSMART Platform for this reason let us explore tranSMART in more detail:

4.1 What Is TranSMART

According to Dan Housman "tranSMART is an open source framework for knowledge management of translational research data including both molecular information such as DNA, RNA, and proteins along with clinical information such as clinical trial outcomes and patient demographics and disease conditions" (Housman, 2013). It is a Web Application very intuitive to use since it has a "Google-like" interface where scientists can type the search terms and the results will bring historical experiments or other information related to the search terms that the users provided.

4.2 How Did TranSMART Originate and What Was Its Purpose

TranSMART was created from Johnson and Jonson and hosted on Amazon's Elastic Computing Cloud (EC2). Amazon's Elastic Computing Cloud allows users to "rent" virtual computers and run their own computer applications and it is supports elastic demand of computing power (LaMonica, 2008). TranSMART development started in the summer of 2008. Its purpose is to facilitate the drug discovery process, supporting translational medicine, which analyzes research from the laboratory to help create safer and more effective clinical trials. (Housman, 2013)

4.3 What Are Some of the Objectives of TranSMART

TranSMART objective is to support drug discovery research by breaking down the silos that come from government regulations, compliance and competitive reasons. These kind of limitations make it difficult to access data that could be of interest to researchers in R&D. TranSMART provides a "lending zone" for the research data that anybody with the appropriate authorization level could access. Also this platform allows the researchers to identify differences in gene expressions, when comparing test results (comparing genes) after medication has been given to the patients whose data is collected

and is stored in tranSMART in the form of experiments. Another area of interest could be identifying potential diseases just by examining various gene expressions and based on these observation and analyses, apply medication (or administer the drugs) only when it is necessary and on the right time. The genes contain various markers and identifying the markers that are associated with certain deceases could help in building more solid experiments and gaining this way financial benefits as well by minimizing costs that could come from a trial and error process. All of these benefits are available to various organizations as long as each organization keeps sharing the data to the community through tranSMART. (Housman, 2013)

4.4 How tranSMART Interface Looks Like

The next image is a screen shot displaying a running instance of tranSMART.
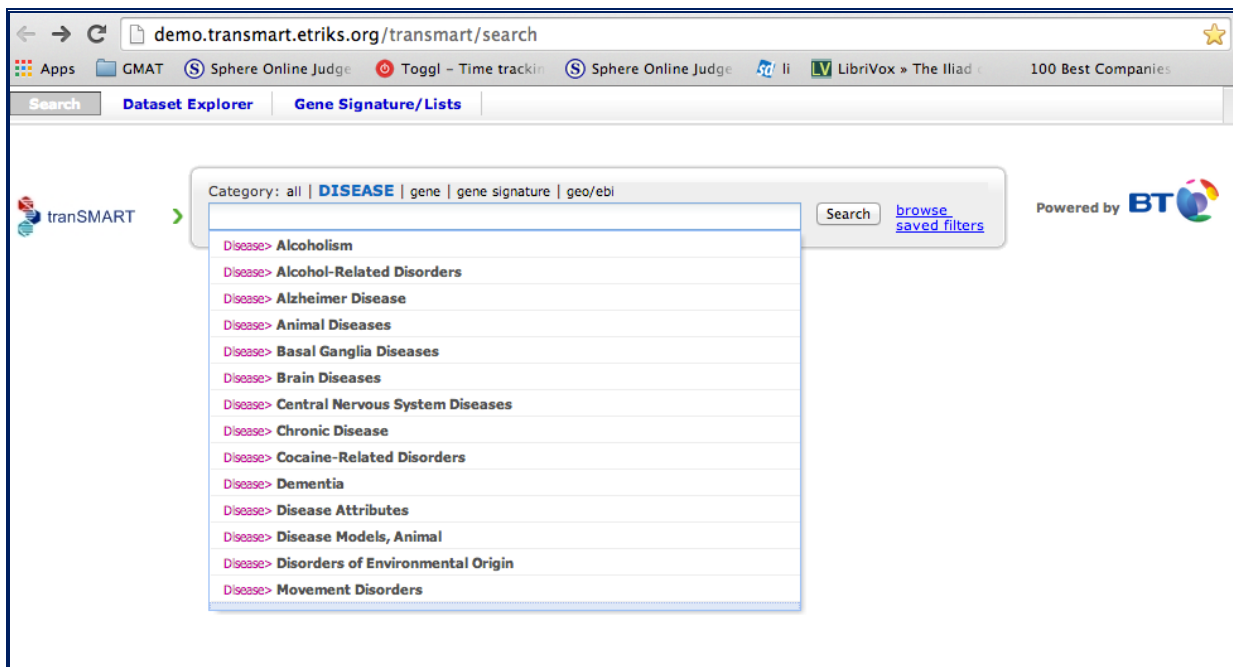
TranSMART seems very intuitive to use, and it is referred to as a "Google like" interface. Where all the user has to do is type the search terms. In case the user is not certain about the terms than tranSMART can help again by providing various categories

that the user could choose from such as DESEASE, gene or geo/ebi. Once one of these categories is selected a list comes down and gives various choices based on the selected category.

5 Program Requirements (Functionality of tranSMART Mobile Application)

TranSMART Mobile Application has various functionalities that could be grouped in three major categories based on the screen that the user could be using at any time. These categories of screens are Host Selection Screen, the "Google - like" Search Screen and the Results Screen. These screens flow in the order described and are very intuitive since this is one of the goals for tranSMART as a platform as well. These screens are developed in such a way that would maximize user experience. This was achieved by moving long time consuming processes such as service calls in the background and calling them asynchronously. The results than would refresh the local database with the most recent information and this way the user would have always something to look at while data is being processed. Each of the previously mentioned screens in addition to efficient RESTful calls has also its own characteristics described in the following sub sections.

5.1 Host Selection Screen

This User Interface provides the choice to the user to select the instance of tranSMART that they want to use.
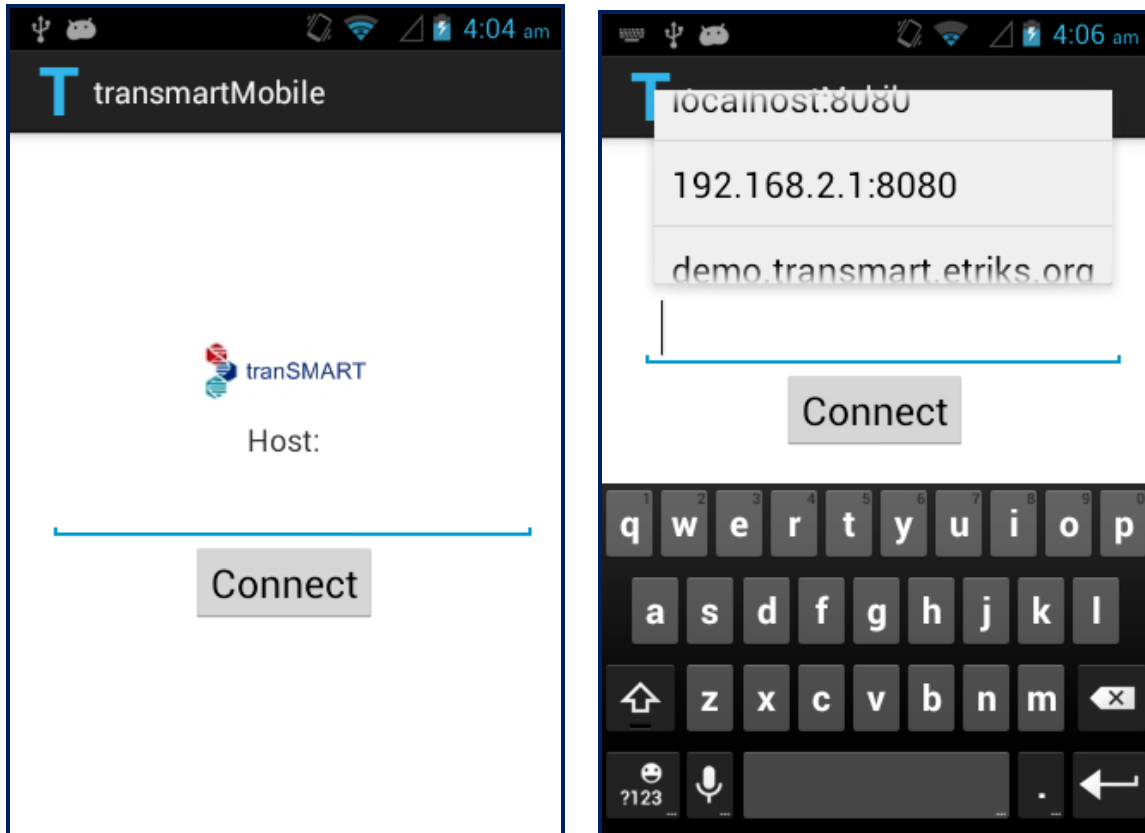
Initially the users would have to type the host, but after they hit the "Connect" button and the connection is successful, the address (host) is stored in the Mobile Application's local SQLite database which compared to other database management systems, is not a separate process that is accessed from the client application, but an integral part of it (SQLite, 2014). The next time the application would start than the host would be retrieved from the database and available to be inserted by tapping on the Text View or by starting to type the host and the rest of the text will automatically start to complete.
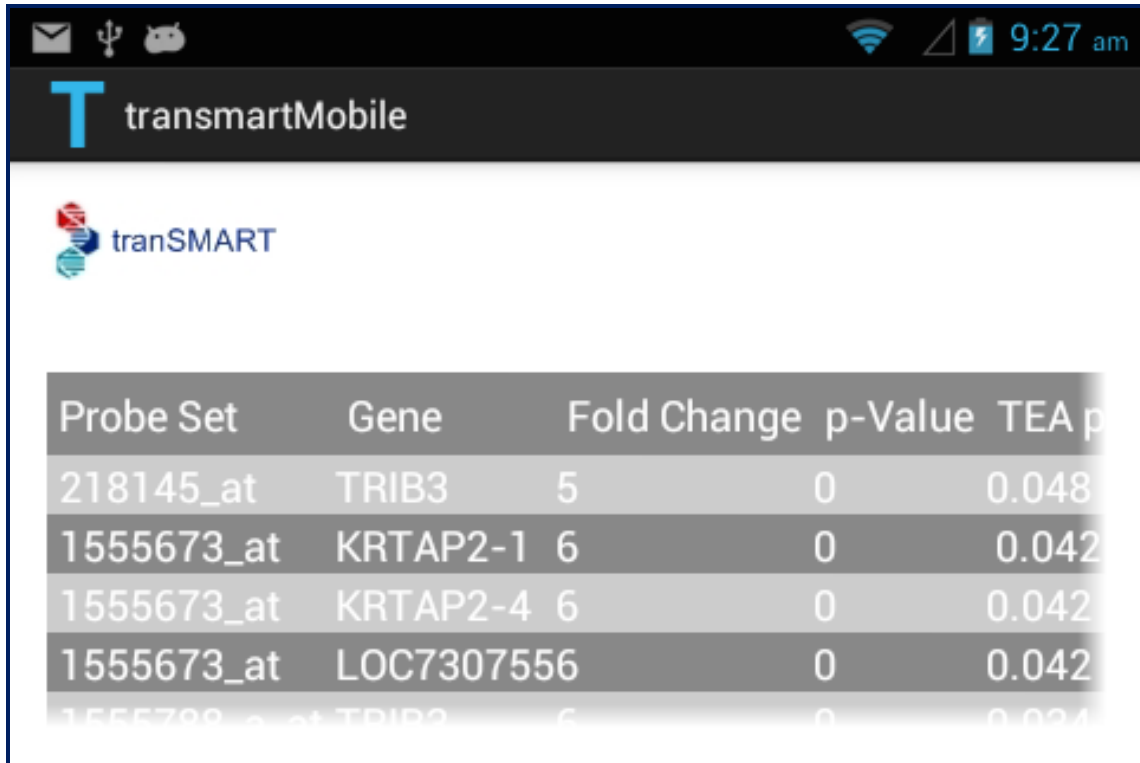
5.2 "Google - like" Search Screen

A similar look and feel would continue to persist throughout the Mobile Application and this would be the case to the Search Screen as well:
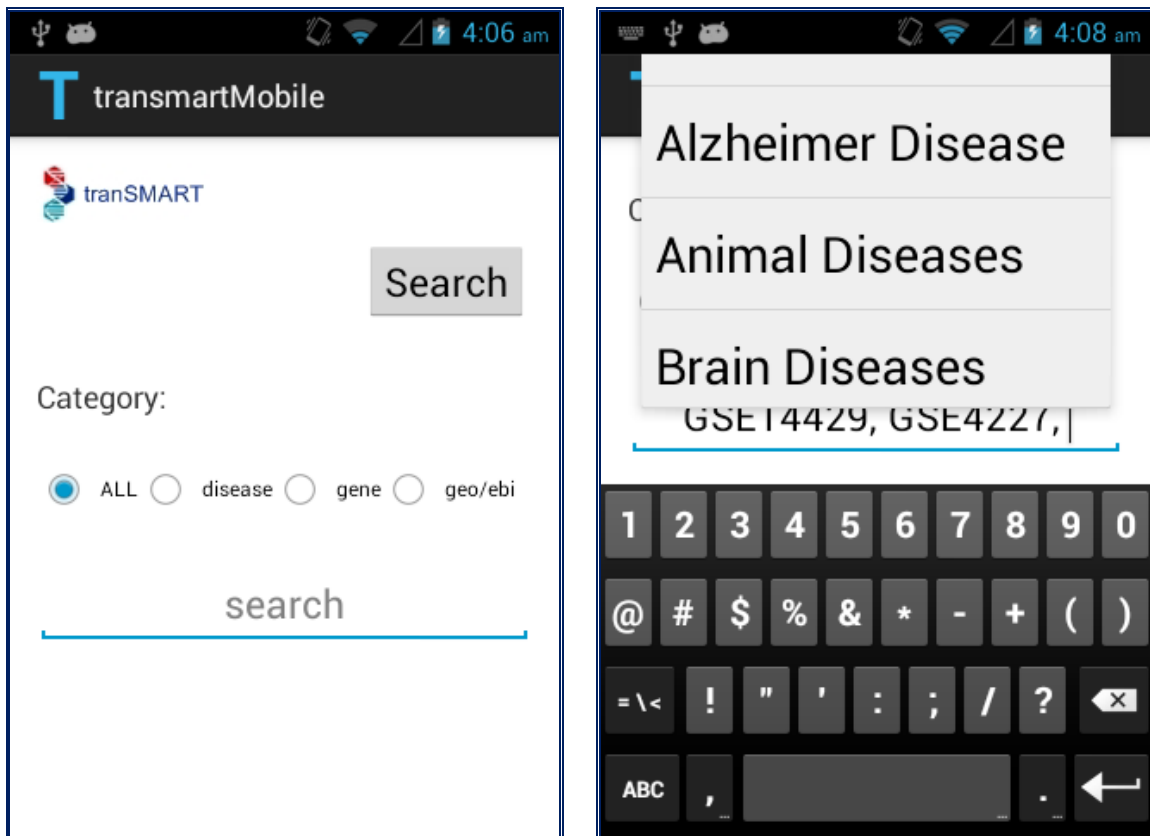
The way this screen works is very similar to the actual Search Screen in tranSMART, the user could start typing the search terms and separate them by comma and, at the end, hit the "Search" button. He or she can also select the Radio Buttons according to their preferred category (disease, gene or geo/ebi) and tap the Text View where a list of options will show up and the user could select the one that they prefer or they could select more than one search term as well. The auto complete functionality is implemented here as well and also applies even on each of the multiple search terms.

5.3 Results Screen

The last screen in the process flow is the Results from the Search Screen:

This screen displays information such as the Probe Set, Gene, Fold Change, p-value and TEA p-value for each of the experiments selected earlier. The results are displayed in such a way that the resultant table could be scrolled left and right and up and down. All the results of the search are stored in the local SQLite database time (until they are overwritten from the most recent run that would contain the most up to date data) and can be accessed in a second in the future if the Mobile Application is not able to connect to the network.

6 Implementation

The Mobile Application works by compiling the code in the ADT (Android Developers Toolkit) for eclipse (Google, 2014) and deploying it to an mobile device which runs on Android.

The integration with tranSMART happens at the Business tier usin Web Services with JSON as can be seen in the following diagram (tranSMART wiki, 2014):
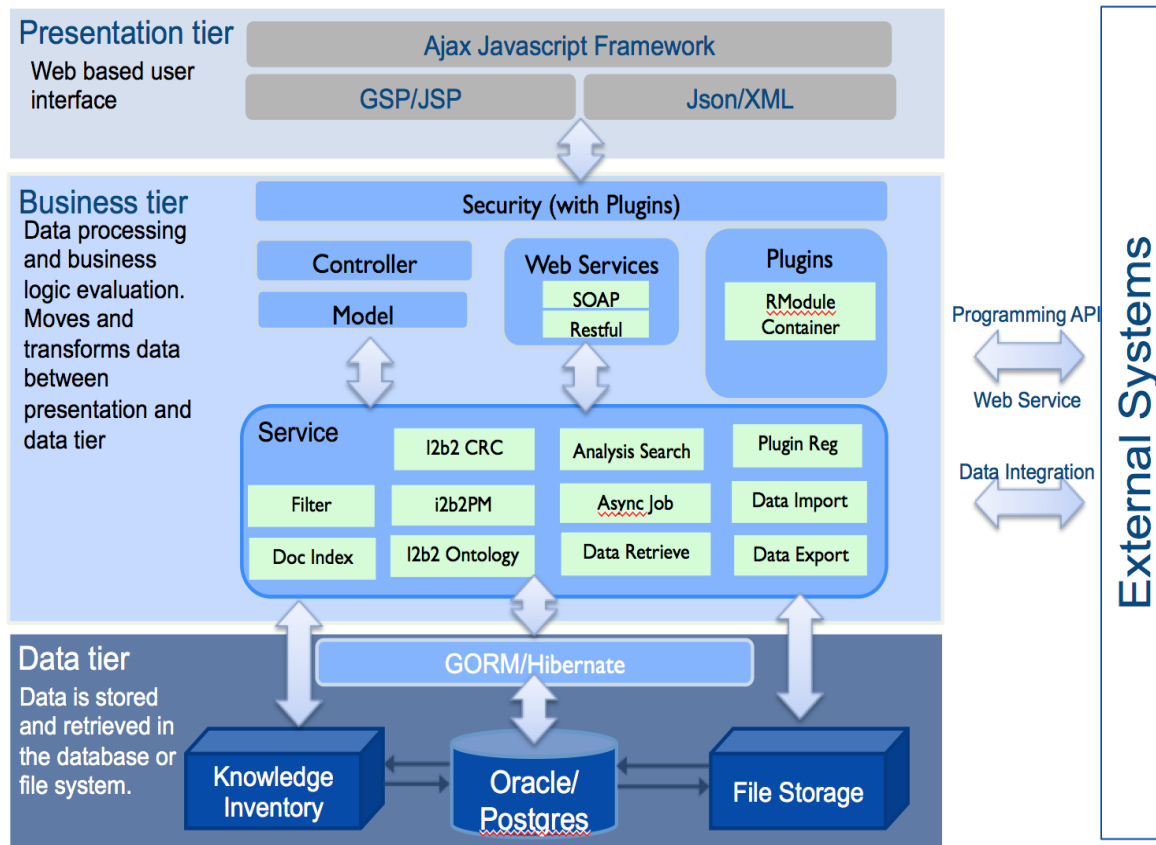
6.1 Technology Used

The Mobile Application was implemented for the Android Platform. "Android apps are written in the Java programming language. The Android SDK tools compile your code—along with any data and resource files" (Google, 2014). Google provides many libraries to facilitate the development process and for this project have been used some of the following:

- ScrollView – made possible the scrolling of the screen up and down.

- HorizontalScrollView – made possible the scrolling of the screen left and right.

- TableLayout – helped organizing the data in the Results Screen.

- SQLite Database – helped to store the data for all the screens and keep the data persistent even when the application has been closed and re-opened.

- AutoCompleteTextView – made possible the autocompleting of host selection.

- MultiAutoCompleteTextView – made possible the autocompleting of the multiple search terms.

- RadioButtons – helped to provide a way to select various categories of search terms.

- JSON (RESTful API) – makes possible the connection with tranSMART instance and the data retrieval to the Mobile Application.

- AsyncTask – helps in eliminating wait time for the Web Service calls to finish by running these calls in the background.

- Multiple screen sizes – this project runs on multiple screen sizes since all components are dynamic and will adjust to any kind of screen.

- Both orientations are supported so the mobile device can be held either on Vertical Mode or in Landscape Mode.

6.2   What I Learned

I was familiar with Android development process earlier because I have developed a few Android Mobile Applications but this project helped me explore more features and dig deeper in the Android framework. 90% of the features I mentioned earlier were new to me. Also this project gave me the chance to explore tranSMART as a platform and get familiar with it and may lead me to possibly use tranSMART in future projects. I also learned more about the open source community since this is the first open source project I looked into.

6.3   Alternative considerations

Other technologies were also considered for developing this Mobile Application. The iOS environment would have been a possible option because of its high popularity also because of the high learning potential but due to time limitations this option could be seen as a future project.

7   Results, Evaluation, and Reflection

Bringing tranSMART as a Mobile Application brings the power of this platform even closer to the end user. This project's goal is to enhance the user experience and provide a more convenient way of accessing biological and clinical data. However the services used on the app do not cover the full blown solution of tranSMART and as a result there is still room for growing this app as new services become available. Given the scope of the project all expectations were met and next steps would be working with the open source community for making enhancements based on the user's needs.

8 Conclusions and Future Work

TranSMART is a really powerful platform. Bringing this platform to the mobile level (closer to the user) has been a great learning experience for me. In the future, this project may turn out to be beneficial for tranSMART as well when we will share the application with the Open Source community. "Mobility—rising from its humble beginnings—is on a roll, driven by ever-higher-performing smartphones, tablets, and other devices enabled by 3G and 4G networks, as well as an explosion of innovative applications (Janaki Akella, 2012)". Many exciting channges are happening in the mobile development world that are improving the quality of life through the quality of information and I am sure tranSMART mobile is one of them.

9 Acknowledgements

I feel very fortunate for working on this project because of the exposure to such an amazing platform such as tranSMART and I am really thankful to Dr. Tusch for being my mentor and making this possible. Also I would like to thank Dr. Terry E Weymouth (University of Michigan) and Kees van Bochove (CEO at The Hyve) for their support on providing install instructions for tranSMART and also Web Services overview. Special thanks go to all GVSU faculty and staff for educating (us) students.

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11 Appendices

11.1 Service API Sample

GET /studies

returns a list of studies

GET /studies/<studyId>/subjects

returns the subjects for the given study

GET /studies/<studyId>/subjects/<subjectId>

returns all data for the given subject (within the given study).

GET /studies/<studyId>/observations

returns all observations for the given study

URL: "http://transmart_server/transmart/CALL"