Location Based Selling Platform for Mobile Buyers

M. M. Buddhika Mawella

149219M

Faculty of Information Technology

University of Moratuwa

April 2017

Location Based Selling Platform for Mobile Buyers

M. M. Buddhika Mawella

149219M

Dissertation submitted by Faculty of Information Technology,

University of Moratuwa, Sri Lanka for the fulfillment of the requirement of the Honours Degree of MSc in Information Technology

April 2017

Declaration

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Name of Student — Signature of Student

M. M. Buddhika J. Mawella — Date:

Supervised by:

Name of Supervisor — Signature of supervisor

Mr. Saminda Premarathna — ……

Date:

Dedication

This dissertation is dedicated to my bellowed mother, father who gave me endless courage and support to achieve my tasks whenever I discouraged.

Acknowledgement

My heartiest thanks should go to my supervisor Mr. Saminda Premarathna for the guidance, assistance, encouragement and providing this opportunity to do the research on this field.

Also sincerely thanks to all my teachers and demonstrators who taught subjects in my MSc IT degree and the things that I learnt from many subjects helped me to fulfill the hard task to be a manageable one.

In addition to those, I would like to thank my beloved parents who encourage and helped me to make this research successful.

Last but not the least, my sincere thank should goes to all my friends who helped me in numerous ways to make this work possible

Abstract

Online selling and buying products by using online services is very popular today. It is a very popular method in western countries and getting more and more popular in the Sri Lankan community also. At the beginning people did online purchases with a personal computer. But now we can see that there is an emerging trend towards using mobile internet. Improvements in fast 4^{th} generation mobile internet connections and very sophisticated mobile phones people are now not restricted to purchase online services with a personal computer. We can see that old simple mobile phones have been replaced with fast multipurpose smart phones powered with improved operating systems such as android, iOS and Windows etc. In addition to that we can see that the mobile phones have the capability of obtaining the location of the device using GPS technology. Even the mobile phones are sophisticated we can see that we are not getting the full capability of that when it comes to online selling. Due to that reason we can see that there is a good research area to provide a location based selling service with available data mining techniques, location services and Google map technologies.

Aim of this research project is to implement a web service based, mobile enabled location based selling platform to register Sri Lankan sellers, so that mobile enabled buyers/customers can find best deals and purchase nearby services from sellers. Buyer's location is obtained from the GPS technology embedded in the mobile phone and products and services available close to their location are displayed with the help of Google maps. Some data mining algorithms running in the server are used to provide the best prices and suggestions about products to the user.

Test cases were written to test the each functionality to cover predefined functional and non-functional requirements. After verifying the functionality with testing, developed application was tested by feeding 100 sample sellers and more than 100 sample buyers to the application hosted in the web server. Sample set of deferent products were assigned to each seller. Set of mobile users were asked to install the application and requested to search the product they want. Application showed the available products based on the location provided in the mobile phone. Based on the collected feedback from the users, they have mentioned that showing product location in the Google map and suggesting product to the customer based on their buying pattern as the major innovative implementations.

Contents

List of Figures

Chapter 1
Introduction

1.1 Prolegomena

Location-based services (LBS) are a new concept integrating a user's geographic location with providing a way of satisfying users by giving a customized service, such as dialing an emergency number from a cell phone or using a navigation system in a car. Other scenario is giving the opportunity to the user to find products and services to purchase based on their location. Incorporating both mobile communication and seller and buyer data, these applications represent a novel challenge both conceptually and technically.
With this research I am trying to solve this problem by providing web service based application hosted in a server and using GPS enabled mobile phones of users to access the seller and product information of the server. Data mining techniques were used to provide best matching suggestions of products by analyzing buying patterns of the customers and the price of products.

1.2 Background and Motivation

Internet was introduced to Sri Lanka in year 1995 for the first time. At the beginning it was limited to academic organizations and also to some business organizations only. Service was provided as fixed dialup connections and speed was very low compared to today's internet. At that time the task of the internet was limited only to send emails and exchange some organization specific business data.

But today the technology has been developed and the normal internet connections are being replaced by smart phone technology (Country Overview Sri Lanka n.d. 2013). It is a process happening gradually and if a person is looking for a new mobile phone, he is now looking for a smart phone instead of a traditional basic cellular phone.

Since then the usage of internet has gone through a long journey with drastic improvements in service providers, speed and the services provided by the internet. At the beginning online shopping was a new concept to Sri Lanka. But after the expansion of service such as eBay to Sri Lanka, It opened a new way of purchasing products and services.

As time passed by, new efficient way of accessing internet was experienced by Sri Lankan people and new set of internet subscribers were created called, "Mobile subscribers". During this time, mobile internet providers dropped the service charges for mobile broadband connections.

With that it created a number of mobile internet users in Sri Lanka with the help of very sophisticated mobile phones. (Telecommunications Regulatory Commission-Stats n.d.)

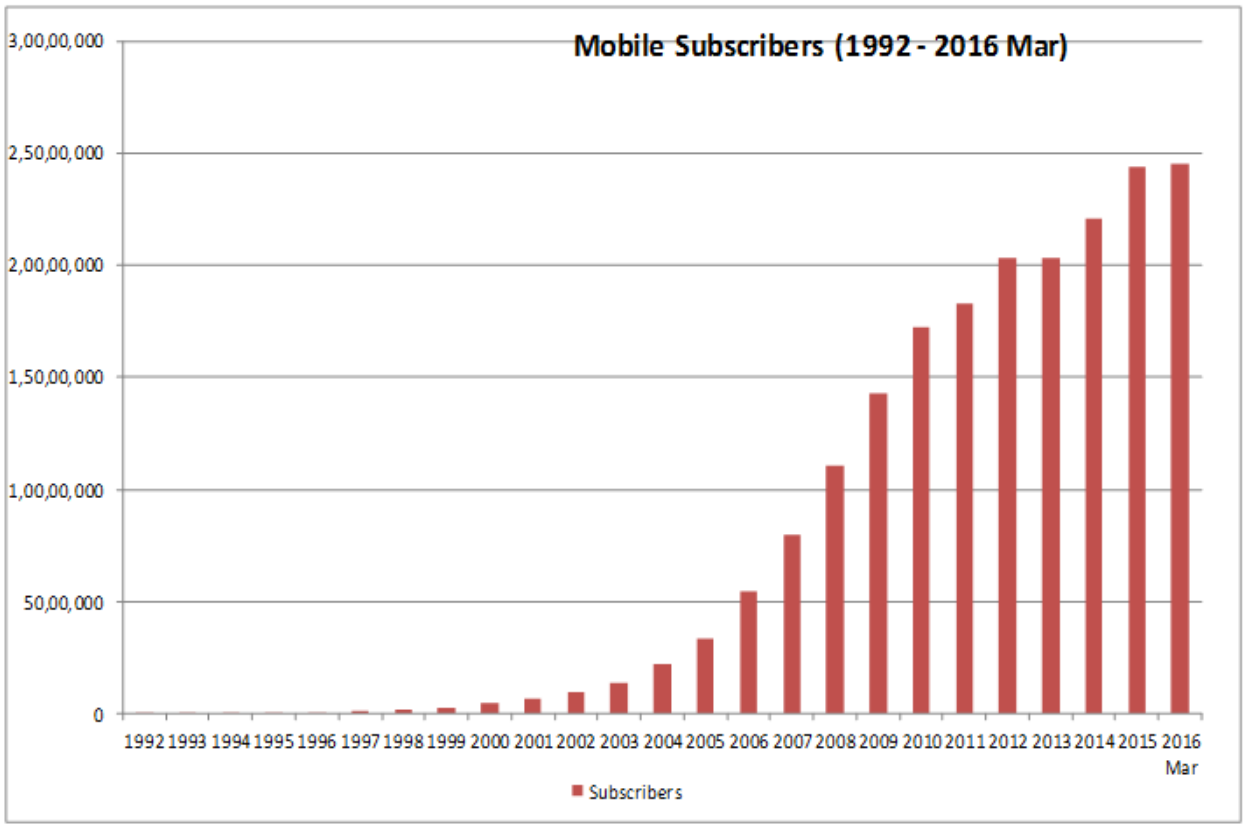

Figure 1

Based on the above graph we can find that the number of mobile subscribers of the country is getting increased rapidly. Most of growing subscribers has new mobile devices powered by mobile operating systems such as Android, Windows mobile or iOS.

Below statistical information ((Telecommunications Regulatory Commission-Stats n.d.) have been published by TRC commission of Sri Lanka and we can see that there is a potential growth in mobile internet subscribers in the country.

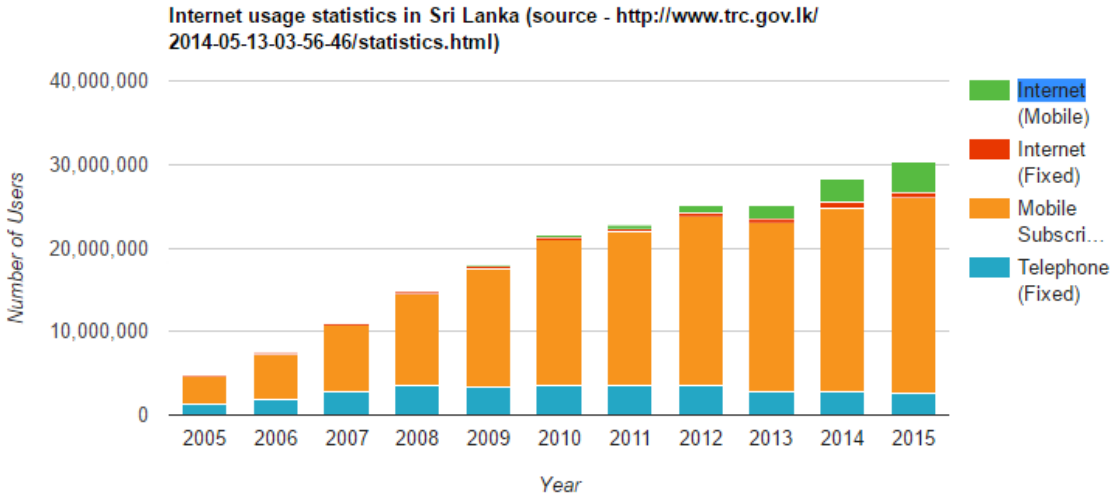

Figure 2

Even the online selling web sites and online service providers are not new concepts to Sri Lankan internet users; I found that there is a lack of usage of mobile enabled technology usage to meet Sri Lankan sellers and buyers.

1.3 Problem statement

Mobile technology and e-commerce is an emerging trend in the world. Even there are sellers and buyers in the country, they are not properly connected and still tend to use existing traditional buying and selling methods. It is believed that we can empower them with the latest available mobile technology. In Sri Lanka we can see that there are some online sellers. But they have not provided location based selling facilities in their services.

Based on those facts we can introduce the research problem as "Introducing a location based selling platform to the Sri Lanka". With this we can improve the buyer and seller communication. By doing that we can create a set of satisfied buyers and a set of sellers in the Sri Lankan community.

1.4 Hypothesis

We hypothesize that it is possible to increase the relationship between sellers and buyers of Sri Lanka by using latest computing technologies such as web services and data mining with internet enabled mobile applications.

1.5 Aims and Objectives

Aim of this research project is to implement a web service based, mobile enabled location based selling platform to register Sri Lankan sellers, so that mobile enabled buyers/customers can find best deals and purchase nearby services from sellers.

- Buyers can search and find best deals to match with their requirements that are close to their location
- Improves the buyer and seller communication.
- Buyers can rate/rank sellers, so the sellers are encouraged to provide a competitive service.
- Increase the reliability of the sellers
- Users can get the maximum benefit from the mobile phone they are using.
- Buyers are suggested with products based on their buying patterns.
- Sellers are allowed to register with the platform with their location information and providing information about their products.

1.6 Mobile based approach

With this approach it is going to be implemented a web service based, mobile enabled location based selling platform to register Sri Lankan sellers, so that mobile enabled buyers/customers can find best deals and purchase nearby services from sellers. With this solution, sellers are provided an application to register and feed the product information. Buyers can use existing GPS enabled mobile devices to find nearby sellers to fulfill their needs. Data mining and pattern mining techniques are used to provide a customized service for buyers.

1.7 Structure of the Thesis

The rest of the thesis is organized as follows. Chapter 2 critically reviews the literature related to mobile technology, location based selling and e-commerce of Sri Lanka to identify the research problems. Chapter 3 is about using mobile technology to increase the connectivity between sellers and buyers of Sri Lanka. Chapter 4 presents our new approach to implement a mobile based application that can meet sellers and buyers with the help of a server that communicate with mobile clients. Chapter 5 and Chapter 6 describe the design and implementation respectively. Chapter 7 is on evaluation of the new solution. Chapter 8 concludes the research with a note on further work.

1.8 Summary

This chapter gave an overall picture of the entire project presented in this thesis. As such we described the background/motivation, problem definition, hypothesis, objectives, and a brief overview of the solution. Next presents a critical review of literature on technologies related to location based services, mobile technologies and web service technologies.

Chapter 2

Developments in Mobile technology and transforming it into a sophisticated consumer product

2.1 Introduction

Chapter 1 gave a comprehensive description of the overall project described in this thesis. This chapter provides a critical review of the literature in relation to developments and challenges in mobile technology, mobile e-commerce and usage of technologies in online selling.

For this purpose, the review of the past researches have been presented under three major sections, namely, Developments online selling and ecommerce, developments in location based services and developments in mobile and server communication technologies. At the end, it has been identified that there are more sophisticated technology enable mobile services, mobile technologies and computing technologies are available in Sri Lanka and that technology can be used to solve the identified problem. This chapter defines the research problem as that there is a communication gap between online seller and buyers of Sri Lanka. To solve that problem, location based selling solution is suggested.

2.2 Developments in online selling and ecommerce

Liran Einav and others has done a research on Growth, Adoption, and Use of Mobile E-Commerce(Einav et al. 2014). In this research paper they analyze how mobile devices have changed internet and retail commerce. In this paper they have presented three main findings based on an analysis of eBay's mobile shopping application and core internet platform.

First is about early adopters of mobile e-commerce and the second is about the adoption of the mobile shopping application is associated with both an immediate and sustained increase in total platform purchasing. As the third point they show that while there are some differences in user behavior across the mobile applications and the regular Internet site, the differences are not yet so dramatic.

In this research they have pointed out that people can get the opportunity to search for prices and reviews, compare online and offline products, and eventually to have a significant effect on retail commerce. They have pointed out that massive adaptation of the people to the mobile technology will be facilitated by the technology and alter the competitive marketplace for selling and buying products. They mentioned that such technologies change the competitiveness in the online selling market. But the time takes for the adaptation will be slow.

Another research has been done by Chayapa Katawetawaraks (Katawetawaraks and Cheng 2011) and Cheng Lu Wang regarding the Influences of online shopping decision. In their research they first provide a theoretical and conceptual background that illustrates the differences between offline and online consumer behavior process. In this research they identify some basic factors that drive consumers to decide to buy or not to buy through online channel. Finally they draw managerial implications of how online sellers can use this knowledge to improve their online stores to be more attractive and get more online shoppers. In this research they provide some influences for online shopping decision.

They are

- Convenience
- Information
- Available products and services
- Cost and time efficiency

At the same time they provide some barriers for online shopping decision. According to those researchers, they are,

- Security
- Intangibility of online product
- Social contact
- Dissatisfaction with online shopping

Finally the provided managerial implications based on their research. They are,

- Trustable and Securer website
- User Friendly Website
- Online Service
- Additional option

Other research has been done by Veronica S. Moertini and Criswanto D. Nugroho(Moertini 2012) with the title of "E-Commerce Mobile Marketing Model Resolving User Acceptance Criteria. In this research they conclude that the computer-based information system (CBIS) model used in e-commerce mobile marketing that resolves user acceptance criteria needs to be materialized into an integrated system consisting two sub systems. Those sub systems are,

- Website used by the service provider and merchants
- Mobile application used by mobile device users

Finally in the research they have mentioned that in order to develop a system meeting the user acceptance criteria, e-commerce website and mobile application development methods should be adopted, where the requirements state is improved to facilitate e-commerce website and mobile application development.

Ashok Kumar Chandra and Devendra Kumar Sinha has done other research(Chandra and Sinha 2013) on the factors that affect the online shopping behavior. They have analyzed factors affecting on online shopping behavior of consumers that might be one of the most important issues of e-commerce and marketing field. Based on their research they have found that demographical issues like age, education and income were agree for online shopping but the rate is high when the respondent are young, when the education is higher the respondents were agree for the same and the higher income group respondents are strongly agree for the same. They have motioned that some buyers worry about the condition of goods which is booked online by reporting that the ordered item is deferent compared to the displayed one. And sometimes the ordered item has been broken. Other difficulties they have provided are difficulty in returning the products and privacy concerns which results in sharing personal information with third-party companies.

In addition to the above information, by using tools such as Google, we can find that there are some online sellers in Sri Lanka. Below listed are the most popular and top ones in the Google search results.

- www.mydeal.lk

  This web site sells products online. But they do not post the products to the customer. Customer needs to go to the shop to collect the purchased product

- www.wow.lk

  This web site also provides online selling. And also they do the transportation of the purchased products.

- www.ikman.lk

  With this web site, sellers can register with the service. Customers can search the web site by providing details of the products. Web site only provides the contact information and the product details about deferent sellers. Then the customers have to contact the seller by using the contact details provided.

- www.takas.lk

  This web site also provides online selling and they provide delivery service for the purchased product.

- www.kapruka.com

  This web site also provides online selling services. But special attribute of this is that they provide users to select products from international online sellers like eBay and Amazon. They have identified that most of the sellers in online sellers does not ship products to Sri Lanka. As a solution for this, Kapruka organization let the customers to order the product and send it to a given address in the US. Then the Kapruka ships the received product to Sri Lankan buyer. Based on the Kapruka's business model they charge a small amount for the service they provide.

By analyzing these online selling sites we can see that all provide good selling services with deferent popularities. Some sell specific products and some others sell or market any product that they believe that there is a demand from Sri Lankan customers.

2.3 Developments in location based services

In addition to that a research has been done by Charles Steinfield (Steinfield 2004) about the development of location based services in mobile commerce. In their research they conclude that location is a starting point for personalization and context-aware services that use other relevant information when constructing service offers. And also they have mentioned that new development in wireless technologies is a threat and an opportunity for cellular operators, and will likely shape the future development of Location Based Services.

Another research has been done by Aditya Nath Jha and Rahul Chourasia(Jha and Chourasia n.d.). In their research they describe about the architectures related to utilize the knowledge of the geo-specific location of a location-aware mobile device and facilitate services based on that information. They have pointed out the location information can be obtained from GPS satellites, Wifi or mobile networks. In the research paper it is mentioned that technologies like android is more popular today. Due to that reason they justify that use of Android technology in providing location based services is an effective way of reaching more users. Due to that reason they have used APIs like Location API, Google Maps, Direction API and Places API which helps in making location-aware applications under android platform.

Other research related to the same domain has been done by Manav Singhal Anupam Shukla.(Singhal and Shukla 2012) In this paper they propose an implementation of location based services through Google Web Services and Walk Score transit API on Android phones to give multiple services to the user based on their location. In this paper they have mentioned that location based services can be used in areas such as follows,

- Public Safety / Emergency Services
- Maps Navigation
- Marketing /Advertising
- Location based Reminders
- Preferred Location Search

Finally these two researchers pointed out some difficulties in providing location based services. They are,

- Technology Constraints
- Infrastructure Constraints
- Market failure

Eva Dodsworth and Andrew Nicholson(Dodsworth and Nicholson 2012) has done an other research on Google mapping products. They have surveyed the popularity, and type of use of Google mapping products in an academic library setting. Their results show that over 90 percent

of the respondents use Google Earth and Google Maps either to help answer research questions, to create and access finding aids, for instructional purposes or for promotion and marketing. The authors have finally recommended expanding the mapping products' user base to include all areas.

2.4 Developments in mobile – server and communication technologies

To build a communication link between mobile devices and web servers, people have used technologies such as web services. A research related to this area has been done by Eiei Thu and Than Nwe Aung.(Thu and Aung 2016). In this research paper they pointed out the suitability of JSON and rest web services over XML/SOAP based web services in mobile communication. They have shown the suitability of JSON and Rest web services by developing a Android based application. Their solution was to access ebook library of the university using mobile phones. In addition to that they have mentioned that their architectural solution can be integrated with other modules very easily.

A research to find the best JSON library to perform mobile communication has been done by Ricardo Queirós (Queirós 2014). In this research paper they have mentioned that using a more efficient JSON processing library is very crucial in a mobile application due to the limited processing power and the battery power. To evaluate the best one they have used criteria such as the capability of Textual serialization and binary serialization. Their conclusion is that when you need to serialize/deserialize Java POJOs without sacrificing performance, it is optimal to choose Jackson. According to their analysis suitability of java libraries for JSON processing falls into following order.

1. Jackson
2. Minimal-json
3. Gson
4. Org.json

In addition to above researches, a research has been done by Shivam Jaiswal and Ajay Kumar(Shivam Jaiswal 2014) . In their research they compare the market of smart phones. For this research they have used most popular smart phone vendors namely apple iPhone and android. Based on their findings they have pointed out that Google android has more number of users than Apple has also android apps is more downloaded than apple's app but apple is earning more revenue than Google.

Another research similar to same area has done by Aijaz Ahmad Sheikh and others (Aijaz Ahmad Sheikh et al, 2013). In their research also they have compare both android and apple development environments in detail with both technically and also based on their market share. Based on the market share, they have concluded that android has a grooving market compared to the main competitor iphone. In addition to that they discuss architectural differences between each platform.

And also another research has been done by Remco R. Bouckaert and others about java data mining technologies (Bouckaert et al. 2010). According to their research they have mentioned that Weka is a popular machine learning workbench with a development life of nearly two decades. Also this research provides an overview of the factors that we believe to be important to its success. Rather than focussing on the software's functionality, they review aspects of project management and historical development decisions that likely had an impact on the uptake of the project.

Another research has been done by Eibe Frank and others (Hall et al. 2009) related the same subject area. In their search they discuss the main data mining features of java based Weka, which is a very stable data mining software product. By referring that we can see that still we are not using well established Weka java API to solve Sri Lankan data mining related problems.

2.5 Problem Definition

Based on above researches done previously we can see that mobile technology and e-commerse is an emerging trend in the world. In Sri Lanka we can see that there are some online sellers. But they have not provided location based selling facilities in their services. And also we cannot see that they are using proper data mining technologies to analyze buying patterns. Due to that reason we can see that there is a communication gap between Sri Lankan sellers and buyers.

By referring previous works done by many researchers below is the technological comparison for both iphone and android phone technologies.

Attributes	Android	IOS
Developer	Google	Apple
OS Family	Linux	OS X, Unix
Initial Release	Sep-23 2008	July-29 2007
Programmed in	C, C++, java	C, C++, objective-C
Available on	Phones And Tablets (LG, Samsung, HTC and Other)	iPod Touch, iPhone, iPad, Apple TV
Cost	Cheap	Expensive
Source model	Open source	Closed, with open source components.

Table 2.1

According to Table 2.1, although there are two main technologies in the world for mobile technology, it is noticeable that android technology is open source and it is cheap compared to the competitive iPhone technology.

Also we can see that still there is no efficient ecommerce platform for Sri Lankan people. Based on those facts we can introduce the research problem as "Introducing a location based selling platform to the Sri Lanka with available computing technology in the country". Since the solution we are going to provide is mainly for Sri Lankan customers, we intend to address the above problem using android-based technology. This is because, above researchers have shown the suitability of Andriod apps for a country like Sri Lanka to build an e-commerse application mainly due to its cheapness. With this we are going to provide a solution to improve the buyer and seller communication.

2.6 Summary

This chapter presented a comprehensive literature review on mobile phone usage of Sri Lanka, location based services based on GPS, ecommerce application and web service access methods. Based on those we have identified that observed technologies can be used to develop an efficient buyer-seller communication platform. We also identified the Android technology to address the above problem. Next chapter will discuss the technology to be used for our solution.

Chapter 3

Core technologies used to implement Location based selling platform

3.1 Introduction

This chapter describes the existing technologies that were used to implement each and every module of the application. Main programming language used to implement the application was Java and java based technologies. Mobile client has been developed on android operating system and Rest web services were used to build the communication link between client and the server.

Business logic of the server application was developed with java and Weka java Api was used to generate frequent buying patterns of the customers. Web server used to host the application was Apache tomcat. In addition to that other supporting technologies were used, such as Spring framework, Hibernate and apache Maven. Eclipse and Android development studio was used to code the application. Database used for the application was MySql.

3.2 Java programming language

Java is a programming language and computing platform first released by Sun Microsystems in 1995.Today there are many enterprise level applications that developed using java, and more are created every day. Java is fast, secure and reliable. It is used from laptops to datacenters, game consoles to scientific supercomputers, and cell phones to the Internet. To run a java program you have to install JVM to the running operating system. Java virtual machine (JVM) is an abstract computing machine that enables a computer to run a Java program.

3.3 Android

Android is a mobile operating system developed by Google, based on the Linux kernel and designed primarily for touchscreen mobile devices such as smart phones and tablets. Today it has become the biggest competitor for Apple iphone applications and android applications are developed with java. Since the android technology, development environment is free for the developers and users; it has obtained a considerable market share in the mobile application world. Development IDEs used to develop android applications are Eclipse and Android development studio. Already developed android applications can be downloaded from Google play store, hosted in https://play.google.com/store.

More information related to android application can be accessed through https://developer.android.com and waste number of online tutorials is available on the internet.

3.4 Weka Java Api

Waikato Environment for Knowledge Analysis (Weka) is a popular suite of machine learning software written in Java, developed at the University of Waikato, New Zealand. It is free software licensed under the GNU General Public License. In this project we are using Weka pattern mining technology to find frequent buying patterns of users of the application. In addition to the Weka IDE, they have provided a Weka Java Api, which can communicate with java applications. With that technology we can access Weka's data mining and pattern mining capability through java code. Being all the technologies from Weka comes with the 'free' label, it has become a ideal solution for our research task.

3.5 Hibernate

Hibernate is a free and open source java project that makes easy to work with relational databases. It is a high-performance Object-Relational persistence and query processing platform which is licensed under the open source GNU Lesser General Public License (LGPL). Hibernate not only takes care of the mapping from Java classes to database tables, but also provides data query and retrieval facilities.

When we work with object-oriented development environments, there's a mismatch between java object model and the relational database. RDBMSs represent data in a tabular format and object-oriented languages, such as Java represent it as an interconnected set of objects.

To overcome the gap between relational world and Objet oriented world, Hibernate was introduced and Hibernate is simply called Object-Relational Mapping or ORM tool.

So this technique is used for converting data between relational databases and object oriented programming languages such as Java.

3.6 Spring Framework

Spring framework is an open source Java platform that provides comprehensive infrastructure support for developing robust Java applications very easily and very rapidly. Spring framework provides facilities like below to make enterprise java development easy.

- Dependency Injection
- Aspect-Oriented Programming including Spring's declarative transaction management
- Spring MVC web application and RESTful web service framework
- Foundational support for JDBC, JPA, JMS

For our research project we have used Dependency injection, Aspect oriented programming and RESTful web service framework of the Spring framework.

3.7 Rest Web services

RESTful Web Services are REST architecture based web services. In this technology everything is a resource. RESTful web services are light weight, highly scalable and maintainable and are very commonly used to create APIs for web based applications. Below advantages are available in rest web services and we have chosen this technology as the communication medium between the Server and the android client applications.

- Fast: RESTful Web Services are fast because there is no strict specification like SOAP. It consumes less bandwidth and resource.
- Language and Platform independent: RESTful web services can be written in any programming language and executed in any platform.
- Can use SOAP: RESTful web services can use SOAP web services as the implementation.
- Permits different data format: RESTful web service permits different data format such as Plain Text, HTML, XML and JSON.

3.8 Apache Tomcat

Apache Tomcat is an open source web server that is developed by Apache software foundation.It is used to deploy Java Servlets and JSPs. It is used as the web server for this research project. And also the version we are going to use is 6.

Tomcat is a called a servlet container. A servlet, at the end, is a Java class. JSP are generated into Java code (HttpServlet), which is then compiled to .class files by the server and executed by the Java virtual machine.

3.9 MySQL

MySQL is the world's most popular open source database. With its proven performance, reliability and ease-of-use, MySQL it become the leading database choice for web-based applications, used by high profile web properties including Facebook, Twitter, YouTube, Yahoo! ect.Oracle drives MySQL innovation, delivering new capabilities to power next generation web, cloud, mobile and embedded applications. In this research project MySQL version 5.x is used as the database management system.

3.10 Apache Maven

Maven, created by Takari's Jason van Zyl, began as a subproject of Apache Turbine in 2002. In 2003, it was voted on and accepted as a top level Apache Software Foundation project. In July 2004. It is a software project management and comprehension tool. Based on the concept of a project object model (POM), Maven can manage a project's build, reporting and documentation from a central piece of information. In this research project version 3.x is used to build and maintain the source code and the dependencies of the project.

3.11 Google Maps API

Google maps API is provide a platform for developers to use existing Google services in their development environments. There is a separate Google maps API for android developments and it allows developers to Build custom map for our Android app using 3D buildings, indoor floor plans ect. In our research project we use version 3 of API to display locations of sellers and product information on a Google map.

3.12 Summary

This chapter described about the core technologies used in this research project. Next chapter will discuss the way of using these technologies to build a mobile location based selling platform for Sri Lankan buyers.

Chapter 4

A novel approach to location based selling for Sri Lankan buyers and sellers

4.1 Introduction

Here we describe our new approach to location based selling with the help of mobile smart phones. This section presents novel solution to address our research problem that leads to increase the buyer and seller communication among Sri Lankan community. The approach is described under the headings of hypothesis, input to the system, output of the system, process convert input to the output, users of system and features of the system.

4.2 Hypothesis

We hypothesis that the communication barrier between Sri Lankan buyers and the sellers can be eliminated with the help of smart phone enabled android application that can communicate with a centralized server by providing location specific product data with data mining by enabling to meet best sellars for suitable customers.

4.3 Users

Mostly Sri Lankan product sellers from small grocery owners to individual people who want to sell something they have will get the main benefit from this solution. In addition to that, Sri Lankan people who are looking for products and they don't know what are the nearest locations they have the product to purchase will get the main benefit. And also the people who are looking for a good product for a reasonable price will get the benefit by enabling them to search products for the lowest price with data mining technology enabled selling service. Those who are interested in study of android technology, Location based service providing, Web services and java based data mining can also use this for studying purposes.

4.4 Input

The system can accept requests from any android enabled smart phone after installing the client software downloaded from Google play service. Sellers can insert their product information into the application using seller interface. Product information includes types of products they have to sell, amounts of the products, and the product prices. Buyers and search the products by inserting the names of the product they want to buy and their location information. In addition to those

two user categories, administrators of the application can manage seller and buyer information. Also user information such as credit card information and delivery addresses information will be requested by the application if a user tries to purchase an available product that has been published for selling. System can accept user's feedbacks for the products and sellers they are dealing with.

4.5 Output

The output of the system would be product information that is available for selling for a given location that was tracked by the GPS enabled smart phone. Product information includes prices, quantities and the quality of the items. Also system outputs information about popular sellers, available locations for cheap deals also. Output for the sellers will be products that were purchased from their customers, their feedback analysis data and the product delivery locations.

4.6 Process

4.6.1 Initial process

The system executes a user authentication process before allowing a person to use the facilities of the system. This process is done by verifying of user name and the password, by asking for security information given when he or she registered for the first time. When users search for the product they want to buy in the android application, as the first step it acquires the location from the smart phone and that location information is transferred to the centralized web server. And then the server application processes and queries the product information based on user's search query.

4.6.2 Client process

Product information users want to buy and their location information is send back to the android client by the server application. Then the android client process the response obtained by the server and geographical location of the products are marked in the Google map loaded in the android application. Then clients can rank their purchase experience using mobile interface.

4.6.3 Purchasing process

If a user select a product to purchase, that information is transferred to the server application and the server performs a credit card authentication mechanism and continue with payment processing procedures implemented in the server application. Sellers can rank their selling experience for the particular buyer.

4.6.4 Data mining process

In addition to that server performs data mining algorithms executing that is used to analyze buying patterns of Sri Lankan buyers and it analyze mainly for frequent buying patterns of Sri Lankan buyers.

4.7 Features

In connection with the input, output, users and process, the over features of the system include the following characteristics.

- Online solution-
  This application is hosted in a centralized web server hosted in a web server that can be accessed from any place in Sri Lanka.
- Web service enabled communication-
  Full communication between the server and the android client is done with Rest web services, which is common communication protocols that can integrate with any application developed with any programming language.
- Runs on cheap smart phones-
  Solution is developed to run on android devoices which is cheap compared to apple smart phones.
- User friendly-
- Provide best and cheap accurate business deals-
  Weka based data mining techniques have been used to provide accurate buying patterns of users.
- Sensitive to the geographical location of the user-
  This application requests to enter user's location for product searching.

4.8 Summary

This chapter we have described overall solution of our research. We have mentioned problem definition and assumption of the solution to that problem. We have described clearly inputs to the system, outputs of the system and how convert input to output, who has beneficially of this system, and incredible features of solution. Next chapter we will describe in detail, extended design of our process and what system does.

Chapter 5

Design of the Selling platform

5.1 Introduction

The previous chapter gave full picture of the entire solution. This chapter describes the design of solution for the process presented in the approach. We design the solution as a client-server system with a backend database. Rest web services were used to build the communication between server and the android client. Here we describe the top-level architecture of the design by elaborating on the role of each component of the architecture.

5.2 High Level Architecture of selling platform

The high-level architecture of the application platform comprises of five main modules. Namely, they are as follows.

- Android application running on GPS enabled smart phone
- Server-Client communication layer build with Rest web services.
- Web server
- Business logic implementation
- Database

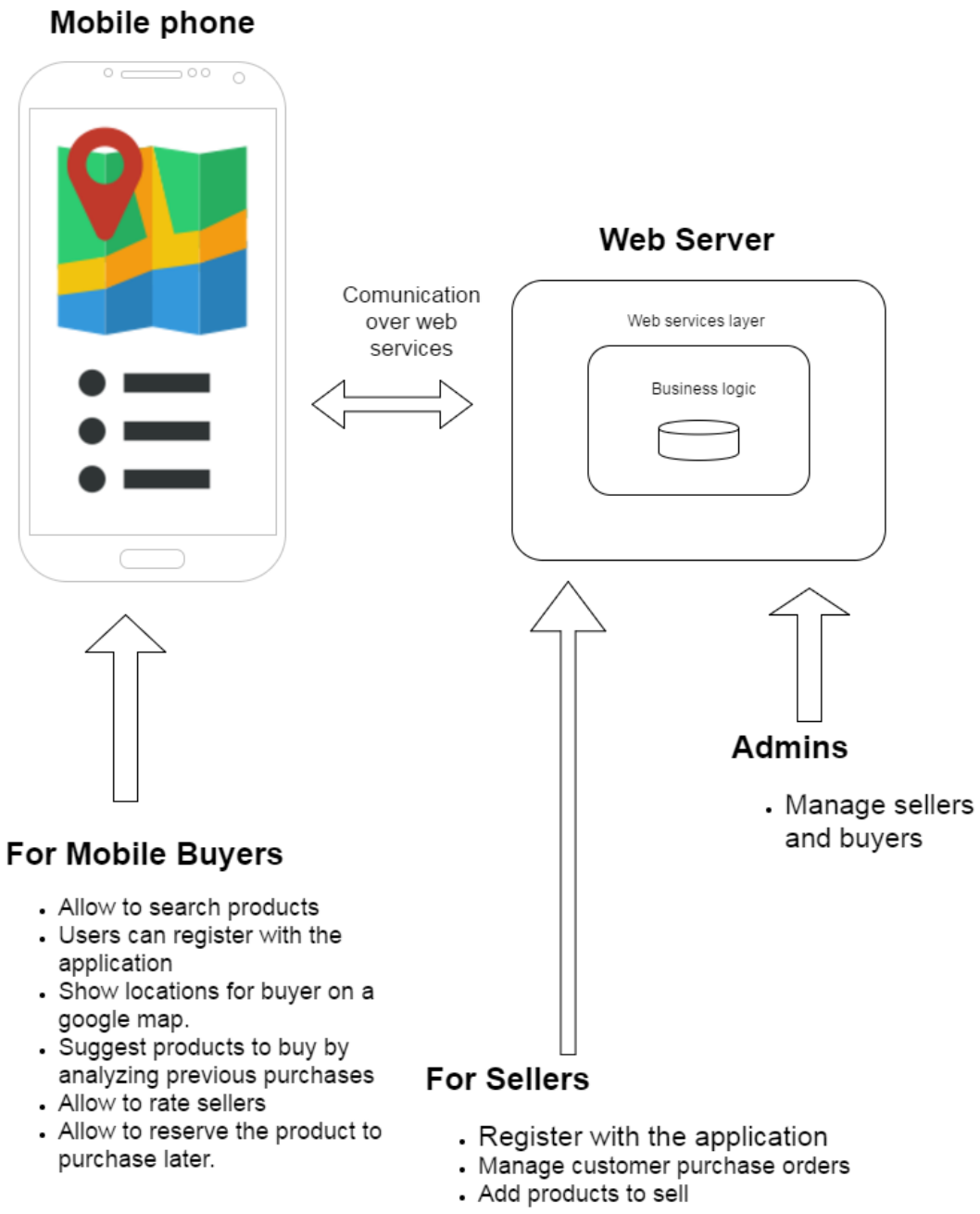

Figure 3 High Level Architecture of selling platform

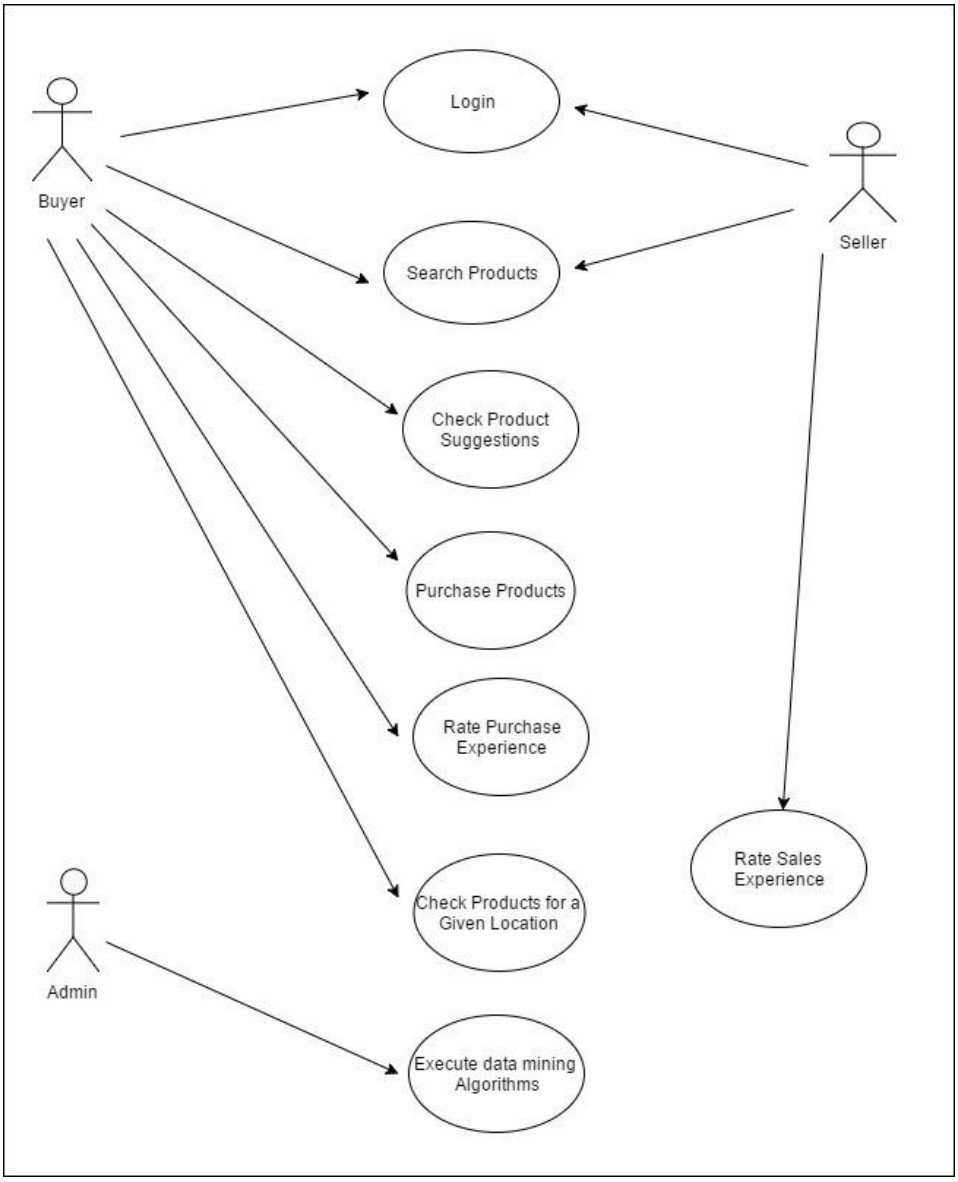

Figure 4 Use case diagram

5.3 Android application running on GPS enabled smart phone

This module gives access to the system. It enables interacting with the system through a smart phone. Through this module user authentication, secure login, etc are provided. The interface module offers facilities for entering inputs and also receiving multiple forms of output information. This module comes as a part of client side software of the solution that can be installed to an android smart phone from the google play store. The smart phone is provided with an android app to access the overall solution.

Architecture of the android client application is shown in the below diagram.

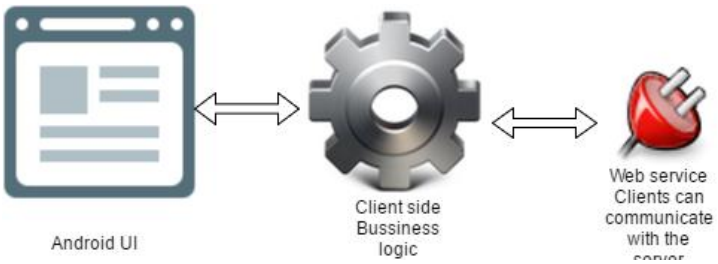

Figure 5 Architecture of the Android client application.

5.4 Server-Client communication layer build with Rest web services.

This component work as the communication layer between the server application and the android client applications. All the business methods are exposed to the android client as Rest web service methods.

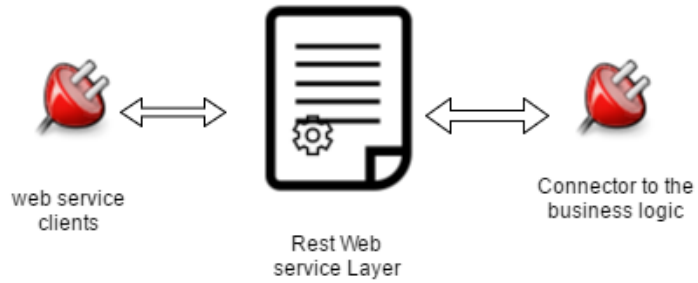

Figure 6 Web service layer

Other end of the web service layer is connected to the business logic module of the application which is hosted in the web server.

5.5 Web server

All the components related to web services and the business logic is hosted in the web server. This web server can accept requests from web services and transferred to the business logic implementation.

5.6 Business logic implementation

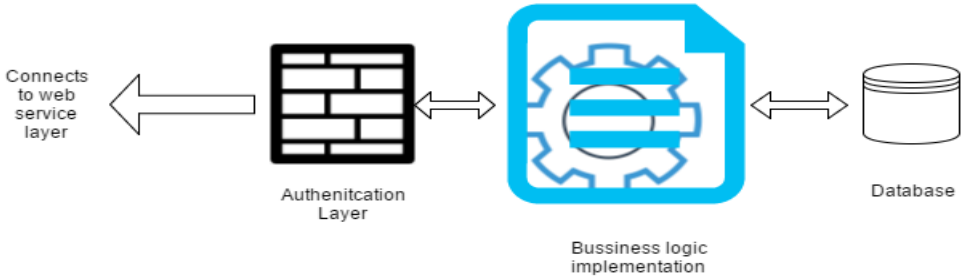

Figure 7 Implementation of business logic

Business logic implementation is hosted in the web server and it is protected by an authentication layer that limits the access only to authorized people. Business logic implementation directly communicates with the database hosted in the server. Other end of the business logic is connected to the web service implementation. Another important this that performed by the business logic layer is handling data mining tasks that are related to customer buying patterns. In addition to main business logic, this module consists of payment gateway integrations and credit card authentication sub modules.

5.7 Seller and buyer ranking

In the application buyers are allowed to rank their buying experience and sellers are allowed to rank their selling experience. And finally application will assign a ranking color for each and every buyer and also for the seller. Seller rankings scheme is as follows. Buyers are also assigned a color based on the ranks given by sellars.

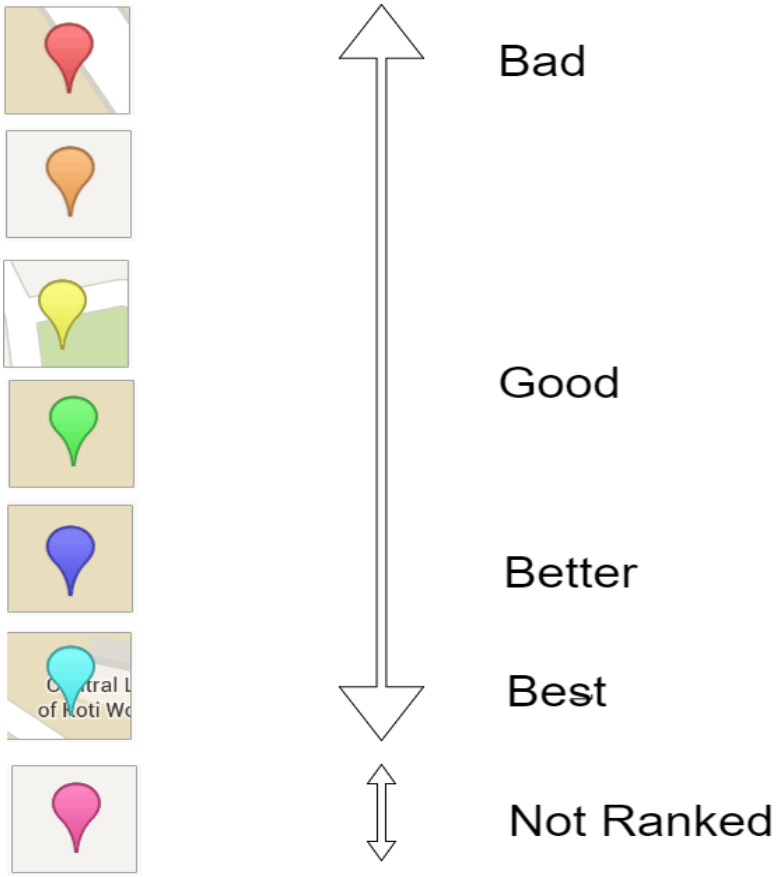

Figure 8 : Seller ranking scheme

5.8 Buying pattern analysis

In the application we are going to design a business logic implementing to mine frequent buying patterns. For that we have used frequent pattern mining algorithm known as Apriori algorithm. With this algorithm we can analyze past purchase data and generate frequent buying patterns with their confidence level to provide product suggestions for buyers.

Below diagram shows how the algorithm is performed and finally generate

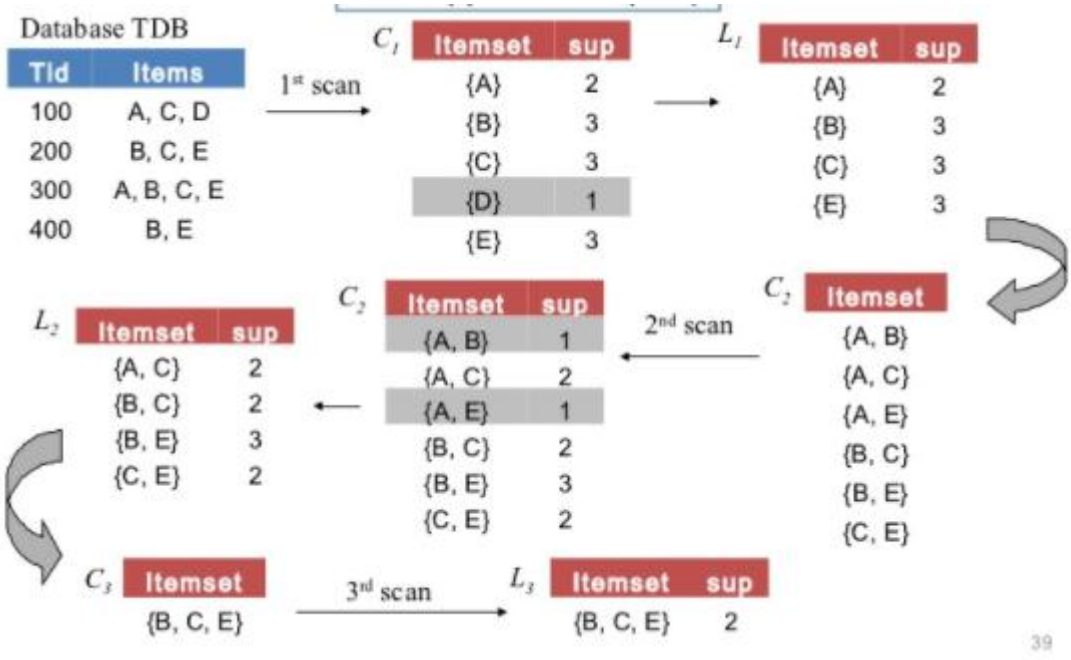

Figure 9 Apriori algorithm description based on diagrams

5.9 Database

Database consists of all the buyer information, Seller details and product information related to each and every seller. In addition to that database holds customer buying patterns which were derived from pattern mining of customer purchase data.

5.10 Summary

In this chapter we have described extended design of our process and what system does in detail manner. We have described five main modules namely, Android application running on GPS enabled smart phone, Server-Client communication layer build with Rest web services, Web server, Business logic implementation and Database. We have described clearly relationships and links between above modules. In this chapter we have discussed the design of each and every sub module. With a clear Idea about what we have done during this study, in the next chapter we have described how we have implemented each module and how entire solution works.

Chapter 6
Implementation of the Location based selling platform

6.1 Introduction

The previous chapter provided a detailed design of location based selling platform and what each component of the system does. We have described the purpose of each and every module and link between those modules. This chapter describes the implementation of the solution of our novel approach. This chapter describe how we implement the solution and how the implementation is done in major modules namely, Android application running on GPS enabled smart phone, Server-Client communication layer build with Rest web services, Web server, Business logic implementation and the Database. Here we have described how the prototypes are build with the help of material such as pseudo codes, main code segments and data mining algorithms.

6.2 Overall solution

Overall solution has been implemented as an Open source based application that can be accessed by any client running on Android. This is primarily client-server architecture with extensions for smart phone and payment gateways. Business logic is primarily written in java. Below figure (Figure 6.2) shows the high-level java package hierarchy of the implementation. Mainly there are two maven modules in the application. One package responsible for business logic implementation and the other is for web service layer implementation.

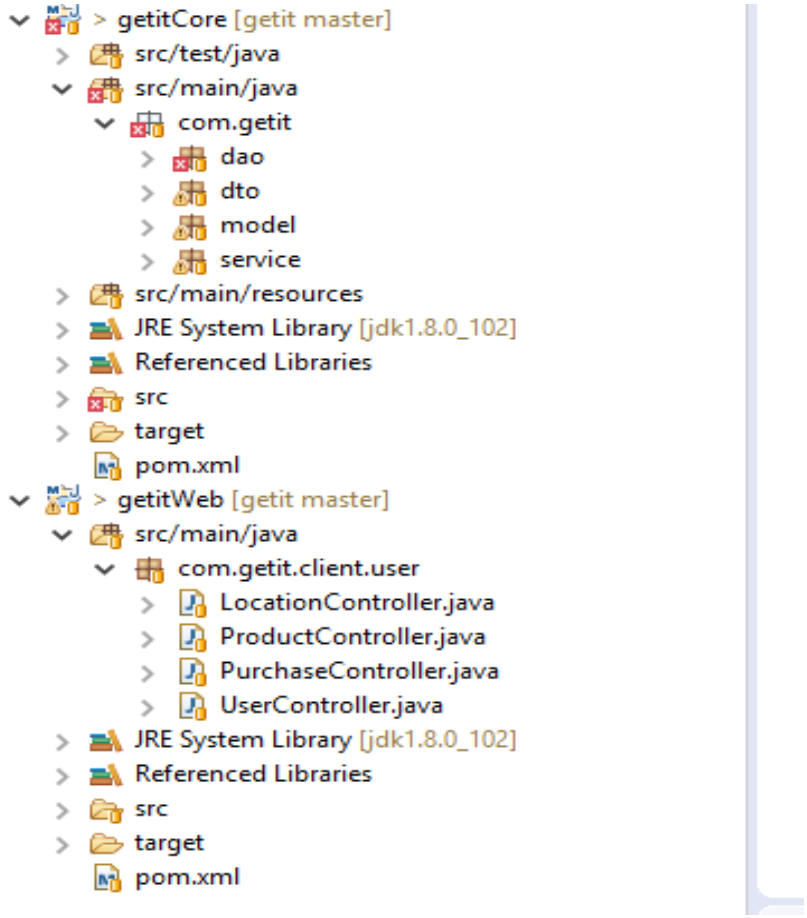

Figure10 High level package structure

6.3 Implementation of Android application running on smart phone

The interface module has been designed to validate user authentication, password login etc. The client side of the application has also been implemented with android and web service clients that can communicate with a server. This module is developed using Java. The interface for the smart phone has been developed as an android app. Figure 6.3 shows a screenshot of the main Interface through smart phone after login to the system. This shows wide range of input and output facilities offered by the client application. User can type the name of the product they want to search and the application will shows the locations of that the relevant product is available to purchase. Client's location is obtained from the GPS technology embedded in the smart phone.

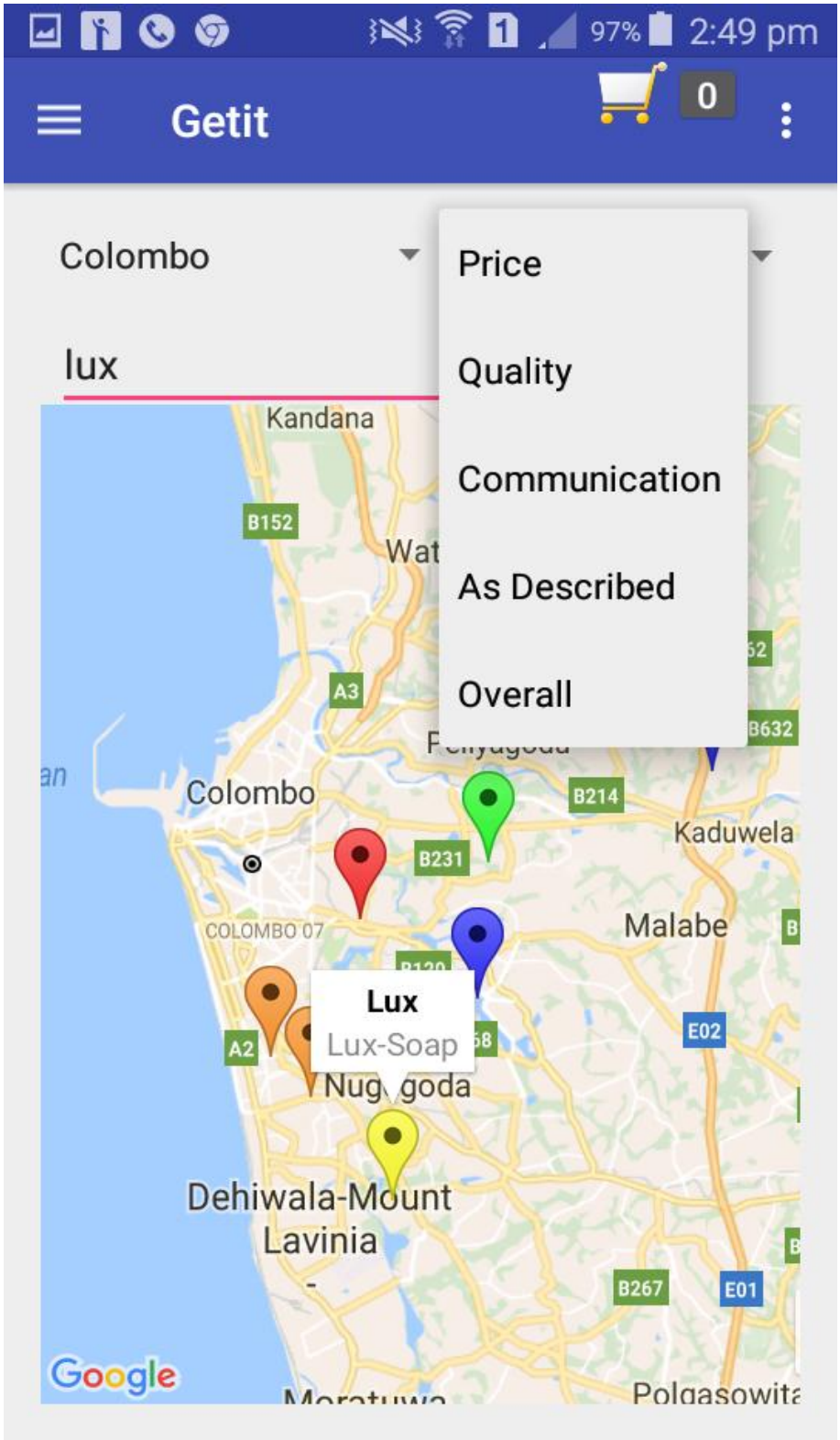

Figure 11 Screen shot of the main interface

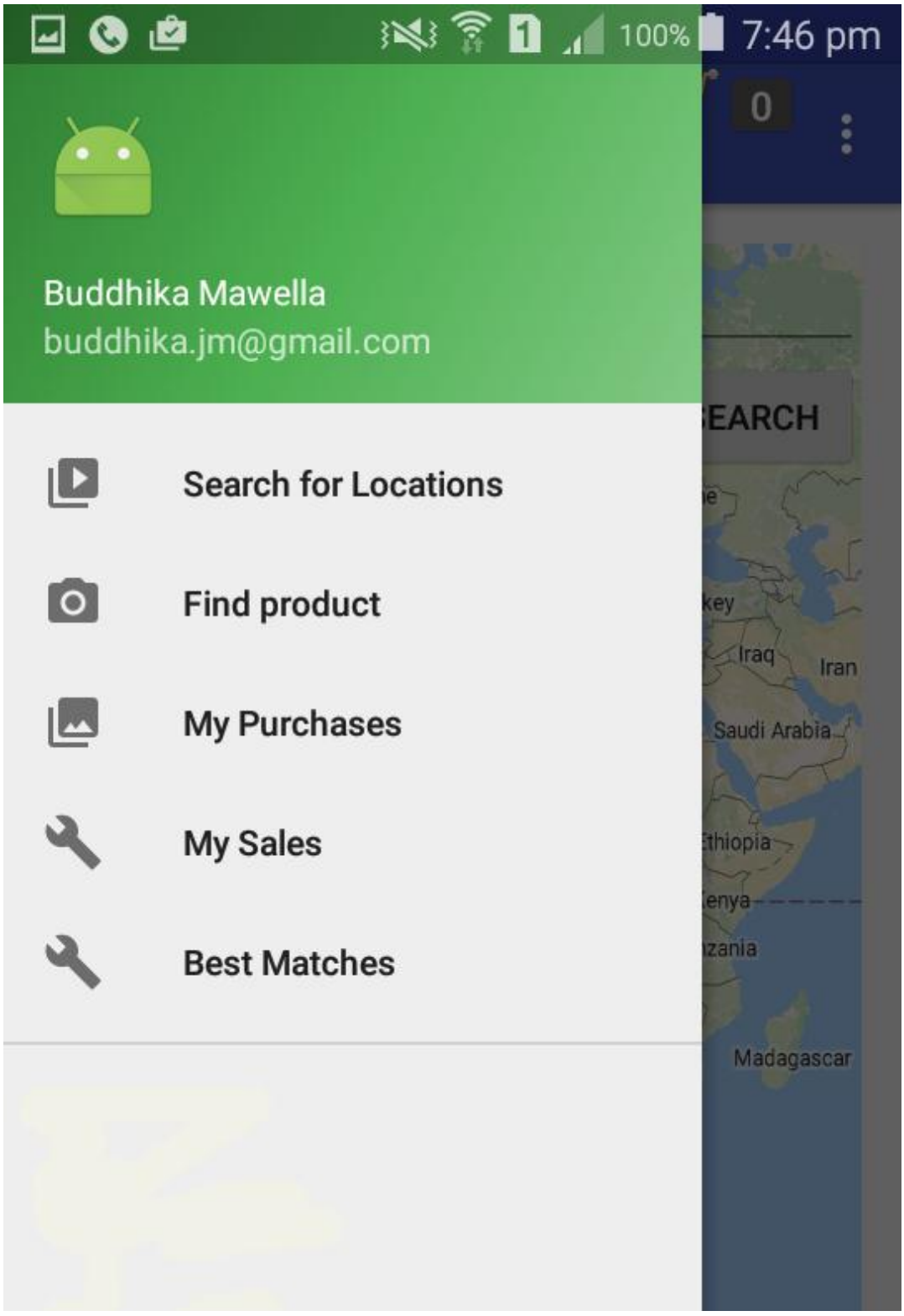

Figure 12 Screen shot of the navigation menu

Following code segments presents the implementation of marking locations in a Google map loaded into the android mobile phone.

```
private void markLocationsInMap()
{
    findLocationsButton.setOnClickListener(new View.OnClickListener()
{
        @Override
        public void onClick(View v)
 {
          For(Location loc : locationList)
             LatLng location = new LatLng(loc.getLat(), loc.getLong());
googleMap.moveCamera(CameraUpdateFactory.newLatLngZoom(location3, 12));
            googleMap.addMarker(new MarkerOptions()
                    .title(loc.getTitle())
                    .snippet(loc.getSnippet())
                    .position(location));
  }
    });
}
```

More source code related to location marking in Google maps has been attached to appendix section B.

Following android/Java code segment displays the code segment written for the authentication of the user who want to login to the application.

```
public class LoginActivity extends AppCompatActivity {

    Button loginButton;
    EditText userNameEditText;
    EditText passwordEditText;
    String userName;
    String password;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_login);
        doLogin();
    }

    void doLogin() {

        loginButton = (Button) findViewById(R.id.loginButton);
        userNameEditText = (EditText) findViewById(R.id.loginEmailEditText);
        passwordEditText = (EditText) findViewById(R.id.loginPasswordEditText);


        loginButton.setOnClickListener(new OnClickListener() {
            @Override
            public void onClick(View vw) {

                userName = userNameEditText.getText().toString().trim();
                password = passwordEditText.getText().toString().trim();
                new HttpRequestTask(userName, password).execute();

            }
        });
    }


    private class HttpRequestTask extends AsyncTask<Void, Void, User> {
```

```
        private String userEmail;
        private String password;
        final GlobalApplication globalVariable = (GlobalApplication)
getApplicationContext();

        public HttpRequestTask(String userEmail, String password) {
            super();
            this.userEmail = userEmail;
            this.password = password;
        }

        @Override
        protected User doInBackground(Void... params) {
            try {

                final String url = globalVariable.getServerUrl() +
"/GetIt/user/authenticate?userEmail=" + this.userEmail.trim() + "&password=" +
this.password.trim();
                RestTemplate restTemplate = new RestTemplate();
                restTemplate.getMessageConverters().add(new
MappingJackson2HttpMessageConverter());
                User user = restTemplate.getForObject(url, User.class);
                return user;
            } catch (Exception e) {
                Toast.makeText(getApplicationContext(), e.getMessage(),
Toast.LENGTH_LONG).show();
            }

            return null;
        }

        @Override
        protected void onPostExecute(User user) {

            if (user != null && user.getUserId() != null) {
                globalVariable.setUser(user);
                Intent intent = new Intent(LoginActivity.this, MainActivity.class);
                startActivity(intent);
            } else {
                Toast.makeText(getApplicationContext(), "Invalid credentials ",
Toast.LENGTH_LONG).show();
            }
        }

    }
}
```

For this purpose we have created a Rest web service client using android and the created client is used to communicate with the server. As parameters we send user's email and password to the server though the Rest service client. If the login is invalid, invalid message is shown to the user. If the login attempt is a successful one, we redirect the android application to the main application home page.

6.4 Implementation of Server-Client communication layer builds with Rest web services.

Server-client communication channel was implemented with Building a RESTful Web Services. In the server we have hosted this web service layer with the business logic. Blow code segment represent the implementation of the web service layer for user authentication purposes.

```
@Controller
@RequestMapping("/user")
public class UserController {
	@Autowired
	private UserService userService;

	@RequestMapping(value = "/authenticate", method = RequestMethod.GET)
	public @ResponseBody UserDto authenticateUser(@RequestParam String userEmail,
@RequestParam String password) {
		User user = userService.getUserbyEmail(userEmail);
		boolean isValid = false;
		if(user != null){
			isValid = user.getPassword().trim().equals(password.trim());
		}
		final UserDto userDto = new UserDto();
		if (isValid) {
			userDto.setFirstName(user.getFirstName());
			userDto.setLastName(user.getLastName());
			userDto.setEmail(user.getEmail());
			userDto.setUserId(user.getId());
			return userDto;
		} else {
			return userDto;
		}

	}
}
```

```
[{"productId":2,"productName":"Lux","description":null,"productCategory":null,"unitPrice":5.0,"sellerRatingValue":3.5
,"quantity":10,"totolProductCountForQuery":8,"productOwner":7},
{"productId":217,"productName":"Lux","description":"Soap","productCategory":null,"unitPrice":10.0,"sellerRatingValue"
:3.5,"quantity":100,"totolProductCountForQuery":8,"productOwner":1},
{"productId":218,"productName":"Lux","description":"Soap","productCategory":null,"unitPrice":12.0,"sellerRatingValue"
:2.8125,"quantity":102,"totolProductCountForQuery":8,"productOwner":2},
{"productId":219,"productName":"Lux","description":"Soap","productCategory":null,"unitPrice":12.0,"sellerRatingValue"
:2.0,"quantity":30,"totolProductCountForQuery":8,"productOwner":3},
{"productId":220,"productName":"Lux","description":"Soap","productCategory":null,"unitPrice":10.0,"sellerRatingValue"
:0.75,"quantity":40,"totolProductCountForQuery":8,"productOwner":4},
{"productId":221,"productName":"Lux","description":"Soap","productCategory":null,"unitPrice":10.0,"sellerRatingValue"
:1.2916666,"quantity":123,"totolProductCountForQuery":8,"productOwner":5},
{"productId":222,"productName":"Lux","description":"Soap","productCategory":null,"unitPrice":234.0,"sellerRatingValue
":0.0,"quantity":32,"totolProductCountForQuery":8,"productOwner":6},
{"productId":223,"productName":"Lux","description":"Soap","productCategory":null,"unitPrice":12.0,"sellerRatingValue"
:-1.0,"quantity":13,"totolProductCountForQuery":8,"productOwner":8}]
```


Figure 13 Sample Rest Web service response for product search

In the above code web service method named ‘authenitcate’ accepts user’s email and the password as parameters and if the authentication is valid, it returns a json message with the user information. More source codes related to web service methods that implement services related to product information and seller information has been attached to appendix B.

6.5 Web server

The server has been implemented to run on Linux or windows operating system. The server uses the Apache tomcat web server for all communication. The server has been hosted at Sri Lanka Telecom. Server computer is powered with a server cloud service provided by the same service provider.

6.6 Business logic implementation

Server business logic has been implemented with java. For the persistence layer that saves data we have used data persistence framework named Hibernate. In addition to that we have used spring framework to do java dependency injection and to implement database transaction management.

Below code segment displays a method written to process data mining rules stored in the database.

```
@Repository("productDao")
public class ProductDaoImpl extends HibernateDao<Product, Long> implements ProductDao
{

	public List<Product> findFrequentProducts(Long productId) {
		Criteria criteria = currentSession().createCriteria(MiningRule.class);
		criteria.add(Restrictions.eq("purchasedProductId", productId));

		DetachedCriteria maxConfidence =
DetachedCriteria.forClass(MiningRule.class)
				.setProjection(Projections.max("confidenceLevel"));

		criteria.add(Property.forName("confidenceLevel").eq(maxConfidence));
		List result = criteria.list();
		return result;
	}

}
```

To perform data mining of the application we have used Weka java Api in with the business logic module.

Below code segment displays the source code written to find frequent buying patterns in the purchase history. In the below code segment we have dumped purchase history of the buyers into a .arff file and those data processed with java Weka Api to generate frequent buying patterns. Finally, generated frequent patterns are stored in the database to use in providing product suggestions for buyers.

```
	private static void generateMiningRules() {
		Instances data = null;
		try {
			BufferedReader reader = new BufferedReader(new
FileReader(fileLocation));
			data = new Instances(reader);
			reader.close();
			data.setClassIndex(data.numAttributes() - 1);

		} catch (IOException e) {
			e.printStackTrace();
		}

		double deltaValue = 0.05;
		double lowerBoundMinSupportValue = 0.1;
		double minMetricValue = 0.5;
		int numRulesValue = 100;
		double upperBoundMinSupportValue = 1.0;
		String resultapriori;
		Apriori apriori = new Apriori();
		apriori.setDelta(deltaValue);
		apriori.setLowerBoundMinSupport(lowerBoundMinSupportValue);
```

```
		apriori.setNumRules(numRulesValue);
		apriori.setUpperBoundMinSupport(upperBoundMinSupportValue);
		apriori.setMinMetric(minMetricValue);
		try {
			apriori.buildAssociations(data);
		} catch (Exception e) {
			e.printStackTrace();
		}


		resultapriori = apriori.toString();

		AssociationRules associationRules = apriori.getAssociationRules();
		List<AssociationRule> associationRuleList = associationRules.getRules();

		String buyingPatternString = "";
		List<MiningRuleDto> miningRuleList = new ArrayList<MiningRuleDto>();
		for (AssociationRule associationRule : associationRuleList) {

			Collection<Item> premiseCollection =
associationRule.getPremise();
			int premiseCounter = 1;
			MiningRuleDto miningRuleDto = new MiningRuleDto();
			for (Item item : premiseCollection) {
				Attribute attribute = item.getAttribute();
				String met = attribute.name();
				buyingPatternString = buyingPatternString + met + ", ";

				if (premiseCounter == 1) {
					miningRuleDto.setProbableProduct1(met);
				} else if (premiseCounter == 2) {
					miningRuleDto.setProbableProduct2(met);
				} else if (premiseCounter == 3) {
					miningRuleDto.setProbableProduct3(met);
				}

				premiseCounter = premiseCounter + 1;

			}
			buyingPatternString = buyingPatternString + " -------> ";
			Collection<Item> consequence = associationRule.getConsequence();
			for (Item item : consequence) {
				Attribute attribute = item.getAttribute();
				String met = attribute.name();
				miningRuleDto.setPurchasedProduct(met);
				buyingPatternString = buyingPatternString + met;
			}

			int premiseSupport = associationRule.getPremiseSupport();
			int totaSupport = associationRule.getTotalSupport();

			double confidenceNonFormatted = (float) totaSupport /
premiseSupport;
			DecimalFormat twoDForm = new DecimalFormat("#.###");
```

```
                    String formatedNumberString =
twoDForm.format(confidenceNonFormatted);
                    Double formattedConfidence =
Double.valueOf(formatedNumberString);

                    buyingPatternString = buyingPatternString + " | Confidence (" +
formattedConfidence+")";

        miningRuleDto.setConfidence(Float.valueOf(formattedConfidence.toString()));
                    System.out.println(buyingPatternString);
                    buyingPatternString = "";
                    miningRuleList.add(miningRuleDto);

                }
                insertMinigRule(miningRuleList);
        }
```

Above code segment is used to call Weka java api and mine the patterns from the purchase history. Generated patterns are stored in the database to provide product suggestions.

```
SELECT * FROM getit.mining_rule;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content: | Fetch row

mining_rule_id	purchased_product_id	probable_product_1	probable_product_2	probable_product_3	confidence_level
1	13	18	32	83	0.894
2	13	18	64	83	0.874
3	13	18	32	83	0.873
4	13	18	61	86	0.87
5	13	18	32	86	0.869
6	13	14	64	83	0.868
7	13	18	32	61	0.868
8	13	61	64	83	0.867
9	13	18	83	86	0.866
10	13	14	61	64	0.865

Figure 14 Stored frequent patterns in the database by executing apriori algorithm

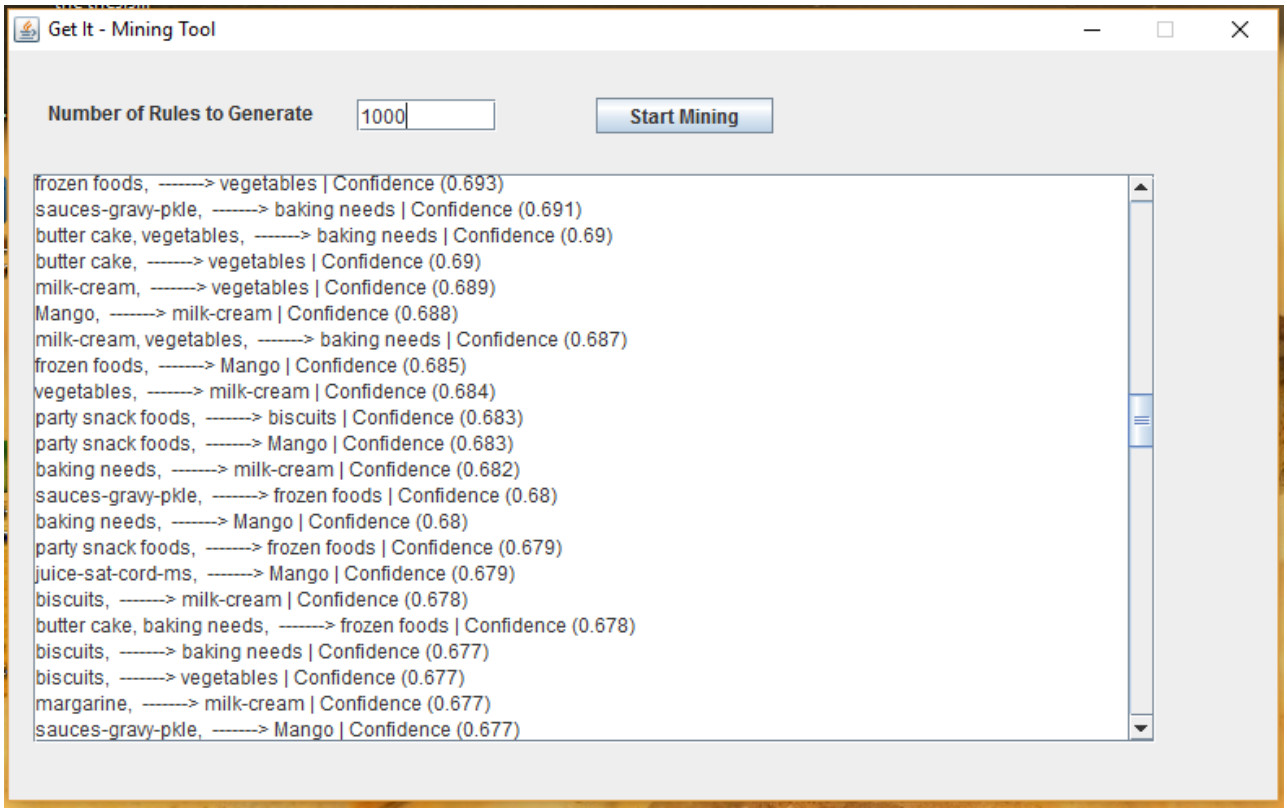

Figure 15 Screen shot of the data mining tool – This tool generate frequent buying patterns and stores in the database.

6.7 Implementation of the Database

Database of this application has been implemented with MySql database technology. Database stores product details, purchase history of buyers, seller and buyer information and product locations. Database has been normalized up to the 3rd normal form and necessary indexing has been used for frequent data tables to improve the performance. Figure 6.6 shows the high-level normalized database diagram of the application. Please refer appendix B for more information related to other data tables of the application.

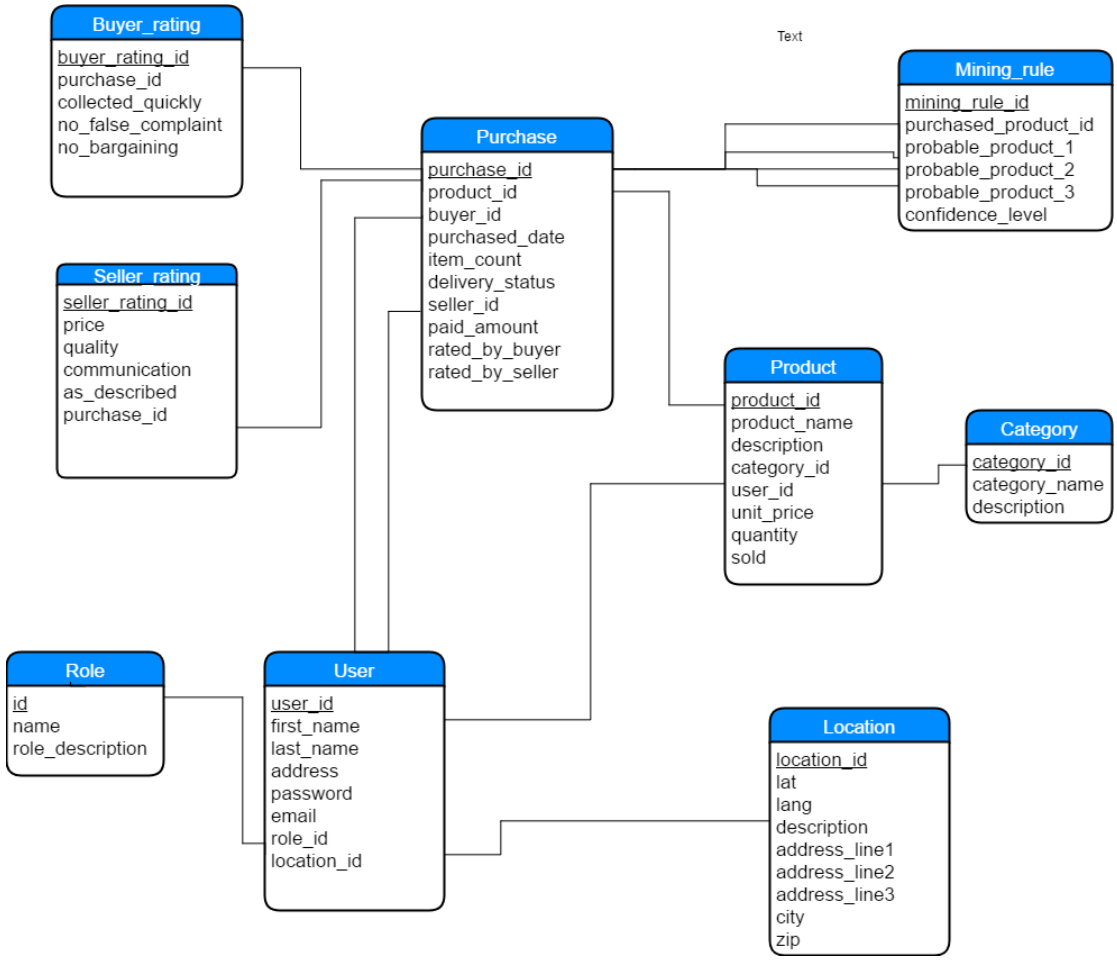

Figure 16 Database diagram

6.8 Summary

Above detailed implementation details of the each module has given a broad understanding about the way the seller platform works. Next chapter discusses the evaluation of the results we obtained from the implementation based on sample data.

Chapter 7
Evaluation and Testing of Location based selling system

7.1 Introduction

Previous chapter described about the implementation details of the Location based selling system. It included software and hardware requirements and some sample code segments with some interfaces. In this section we discuss the evaluation of the system with sample test cases. Further this will discuss that the system meets objectives defined earlier.

7.2 Aim

The aim of this work is to develop an android based application that can improve the seller-buyer relationship by communicating with business logic hosted in a web server through web services.

7.3 Objectives

- Buyers can search and find best deals to match with their requirements that are close to their location
- Improves the buyer and seller communication.
- Buyers can rate/rank sellers, so the sellers are encouraged to provide a competitive service.
- Increase the reliability of the sellers
- Users can get the maximum benefit from the mobile phone they are using.
- Buyers are suggested with products based on their buying patterns.
- Sellers are allowed to register with the platform with their location information and providing information about their products.

When we look at the system we can say that the system successfully met its aim and the objectives defined earlier.

7.4 Evaluation Strategy

For the evaluation of results, set of sample data was inserted into the system database and tested the actual results with expected results. To test the data mining module, sample set of purchase history data was downloaded from the internet and feed into the system. Data mining module was unit tested and verified to check if the data mining program produces expected results. Server application was hosted in a sample server and few android devices with deferent screen sizes were used to test the user interface stability and to check the outputs were correct. Both verification and validation was done.

Following testing methods were used during testing processs.

- Unit testing
- Integration Testing
- Validation Testing
- Systems Testing
- Acceptance Testing

Detailed descriptions about 14 test cases are include in appendix B.

7.5 Evaluating the location based selling application

Without the location based selling applications, if customers have to find matching sellers, they have to walk in to the shops and they face to a great difficulty in finding matching best seller to satisfy their needs.

But the location based selling application provides closest locations for products with their price, availability and other information. In additions to that, application provides locations of sellers with their provided rankings by buyers.

Also by giving a chance to sellers and buyers to rank individuals, we can see that the communication between sellers and buyers has been increased.

By providing products suggestions for buyers by analyzing purchase history and data mining, the application supports the users to sell best suitable products for their needs.

By analyzing the expected output and the actual output, we can determine that the system is behaving well.

7.6 Summary

This chapter discussed about the evaluation and the testing aspects of the system according to the aims and objectives defined earlier. Test results were analyzed and bugs were fixed to bring the system into an acceptable level. Next chapter will describe the conclusion of the research project and further work that can be implemented.

Chapter 8
Conclusion and Further work

8.1 Introduction

Overall achievement of Location based selling system is a successful one. Following are the main tasks that should be achieved by the system.

- Users can find nearby shops to purchase products
- Products suggestion using data mining techniques
- Ranking sellers and buyers based on different criteria

8.2 Conclusion

Implementation of Location based selling platform was successfully completed through this research process. By studying data mining techniques I was able to find a method to apply frequent pattern mining techniques with Java Weka API for the project.

Furthermore, by doing this project I was able to study about rest web services, android technology and MVC pattern. Also the project implementation increased my RDBMS knowledge.

8.3 Further work

Even the implemented application provide product suggestions using data mining techniques, Application can be improved by applying more data mining techniques like clustering as an improvement.

Also the current solution only provides an android application for sellers and buyers. But since the application communication is done with web services we can improve it by extending to other mobile platforms like apple iphones and windows mobile phones.

8.9 Summary

This chapter provided a conclusion of overall achievement met through the research project called Location based selling platform and future work and improvements related to the location based selling platform.

References

- Bouckaert, Remco R., Eibe Frank, Mark A. Hall, et al.
  2010 WEKAâˆ’Experiences with a Java Open-Source Project. Journal of Machine Learning Research 11(Sep): 2533–2541.

- Chandra, Ashok Kumar, and Devendra Kumar Sinha
  2013 Factors Affecting the Online Shopping Behaviour: A Study with Reference to Bhilai Durg. International Journal of Advanced Research in Management and Social Sciences 2(5): 160–177.

- Dodsworth, Eva, and Andrew Nicholson
  2012 Academic Uses of Google Earth and Google Maps in a Library Setting. Information Technology and Libraries (Online) 31(2): 102.

- Einav, Liran, Jonathan Levin, Igor Popov, and Neel Sundaresan
  2014 Growth, Adoption, and Use of Mobile E-Commerce. American Economic Review 104(5): 489–494.

- Hall, Mark, Eibe Frank, Geoffrey Holmes, et al.
  2009 The WEKA Data Mining Software: An Update. ACM SIGKDD Explorations Newsletter 11(1): 10–18.

- Jha, Aditya Nath, and Rahul Chourasia
  N.d. Location Based Services in Android with Google Maps Integration. http://www.academia.edu/download/35703258/Location_Based_Services_in_Android_.pdf, accessed September 3, 2016.

- Katawetawaraks, Chayapa, and Lu Wang Cheng
  2011 Online Shopper Behavior: Influences of Online Shopping Decision. Asian Journal of Business Research 1(2). http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2345198, accessed September 16, 2016.

- Moertini, Veronica S.
  2012 E-Commerce Mobile Marketing Model Resolving Users Acceptance Criteria. International Journal of Managing Information Technology 4(4): 23–40.

- Queirós, Ricardo
  2014 JSON on Mobile: Is There an Efficient Parser? *In* Symposium on Languages, Applications and Technologies (SLATE), 3rd Pp. 93–100. Schloss Dagstuhl–Leibniz-Zentrum fuer Informatik. https://recipp.ipp.pt/handle/10400.22/5109, accessed September 16, 2016.

- Singhal, Manav, and Anupam Shukla
  2012 Implementation of Location Based Services in Android Using GPS and Web Services. IJCSI International Journal of Computer Science Issues 9(1): 237–242.

- Steinfield, Charles
  2004 The Development of Location Based Services in Mobile Commerce. *In* E-Life after the Dot Com Bust Pp. 177–197. Springer. http://link.springer.com/chapter/10.1007/978-3-662-11659-3_10, accessed September 3, 2016.

- Telecommunications Regulatory Commission-Stats
  N.d. http://www.trc.gov.lk/2014-05-13-03-56-46/statistics.html.

- Thu, Ei Ei, and Than Nwe Aung
  2016 Developing Mobile Application Framework by Using RESTFul Web Service with JSON Parser. *In* Genetic and Evolutionary Computing. Thi Thi Zin, Jerry Chun-Wei Lin, Jeng-Shyang Pan, Pyke Tin, and Mitsuhiro Yokota, eds. Pp. 177–184. Cham: Springer International Publishing. http://link.springer.com/10.1007/978-3-319-23207-2_18, accessed September 16, 2016.

- ANALYSIS - Country Overview Sri Lanka
  N.d.

Appendix A

Interfaces of the Location based selling platform

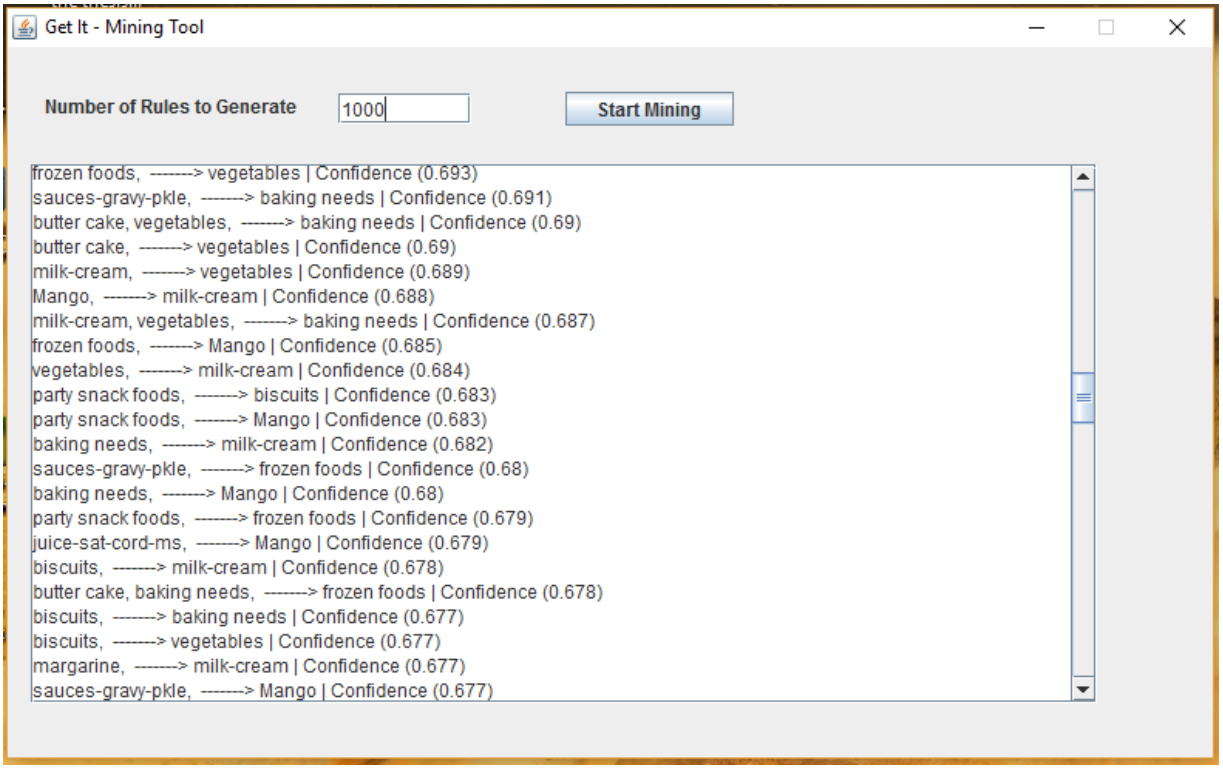

Figure 17 Screen shot of mining tool

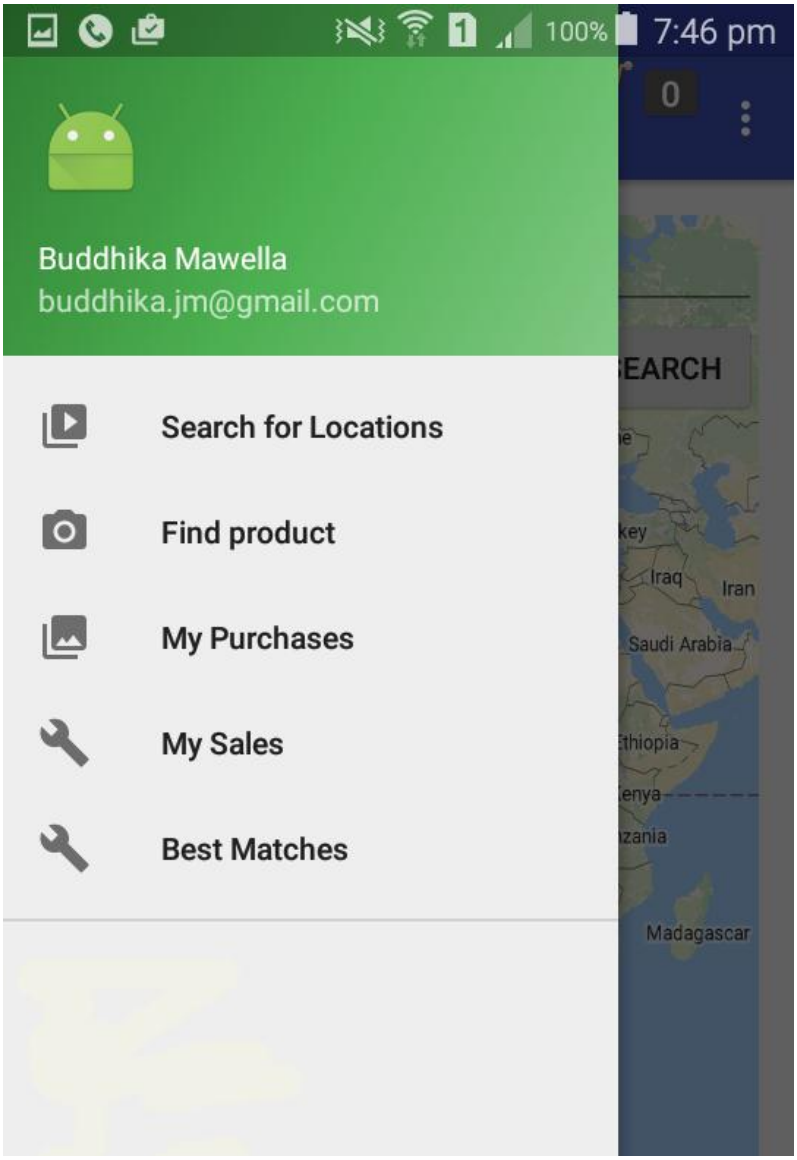

Figure 18 Main navigation menu of the mobile application.

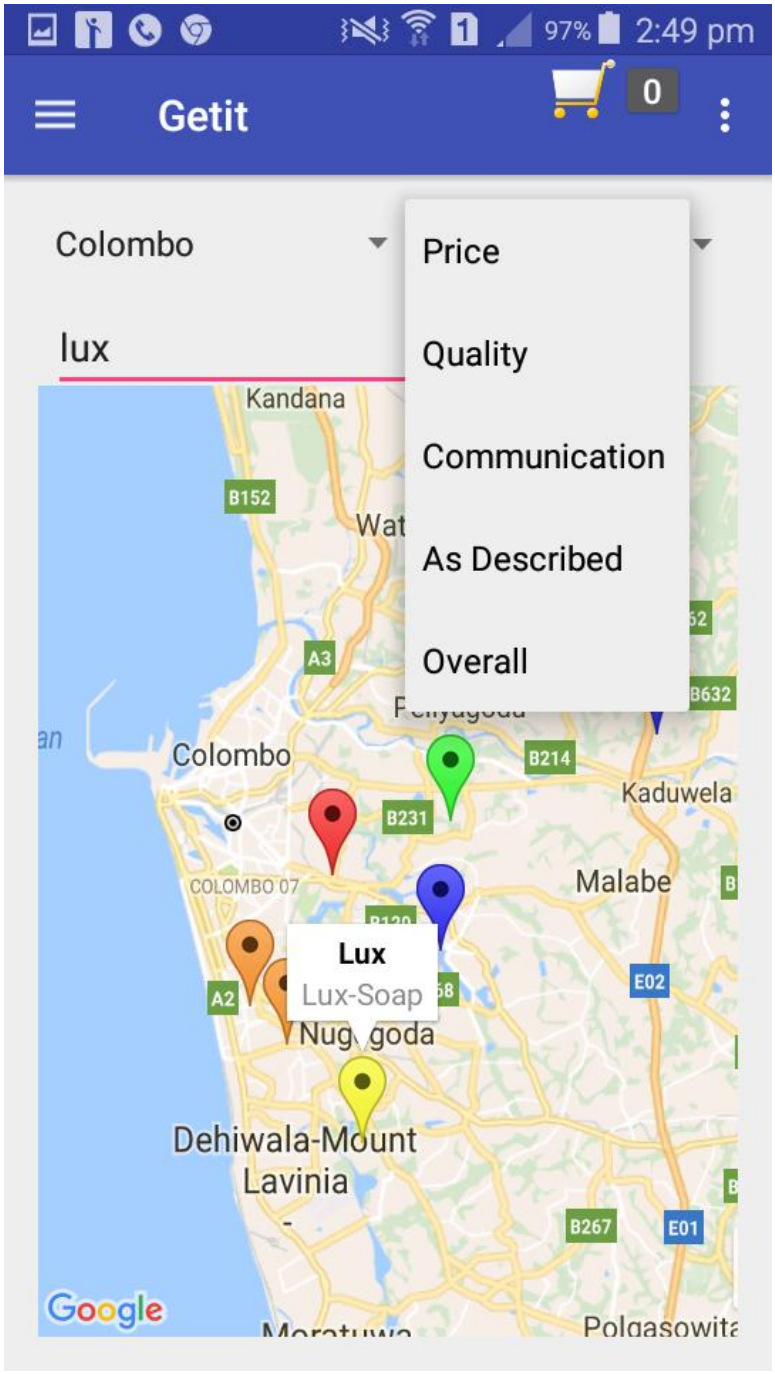

Figure 19 Location searching window of the mobile application

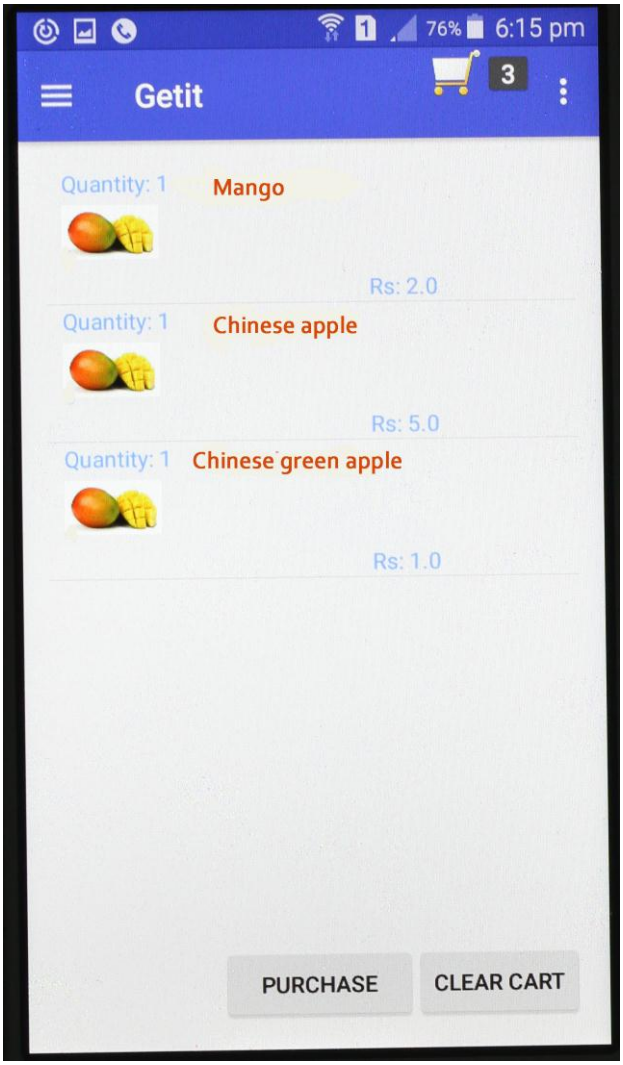

Figure 20 Shopping cart

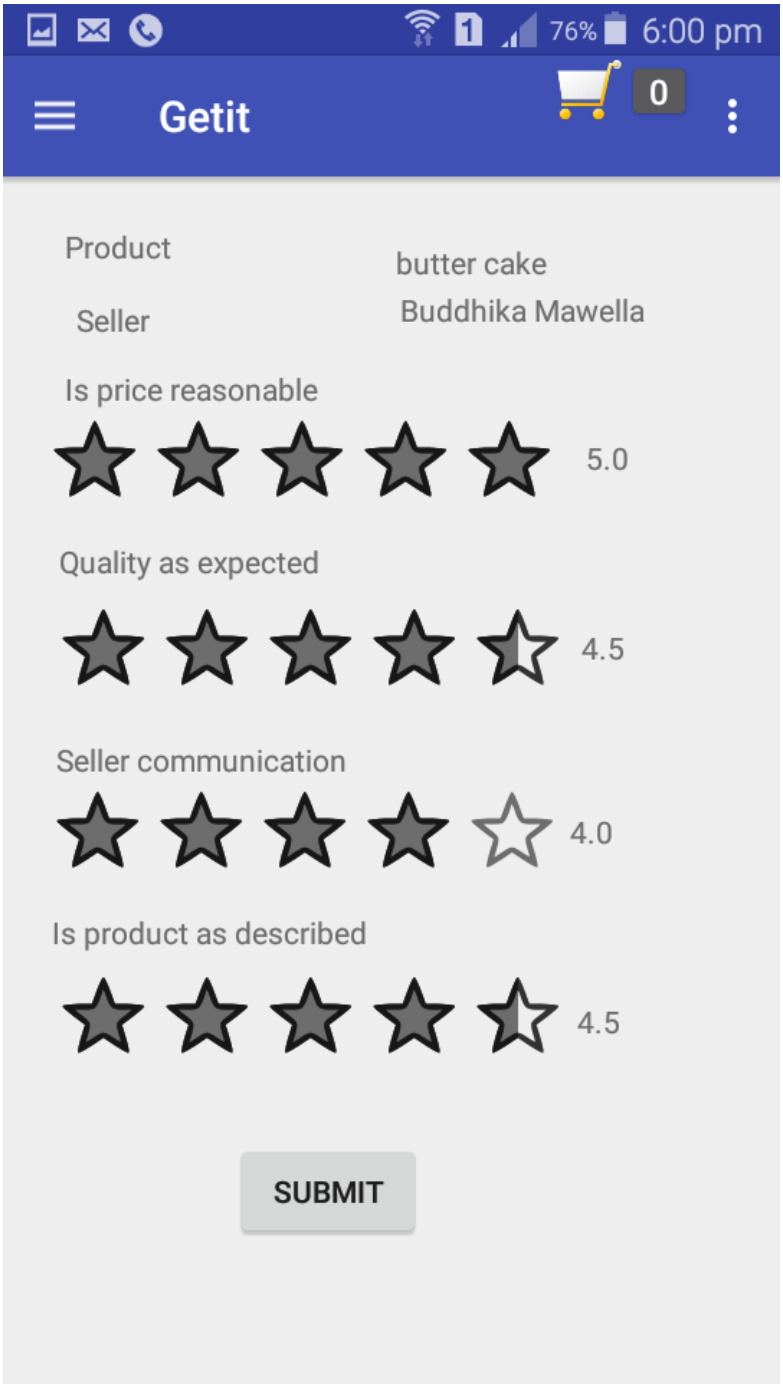

Figure 21 Seller ranking page.

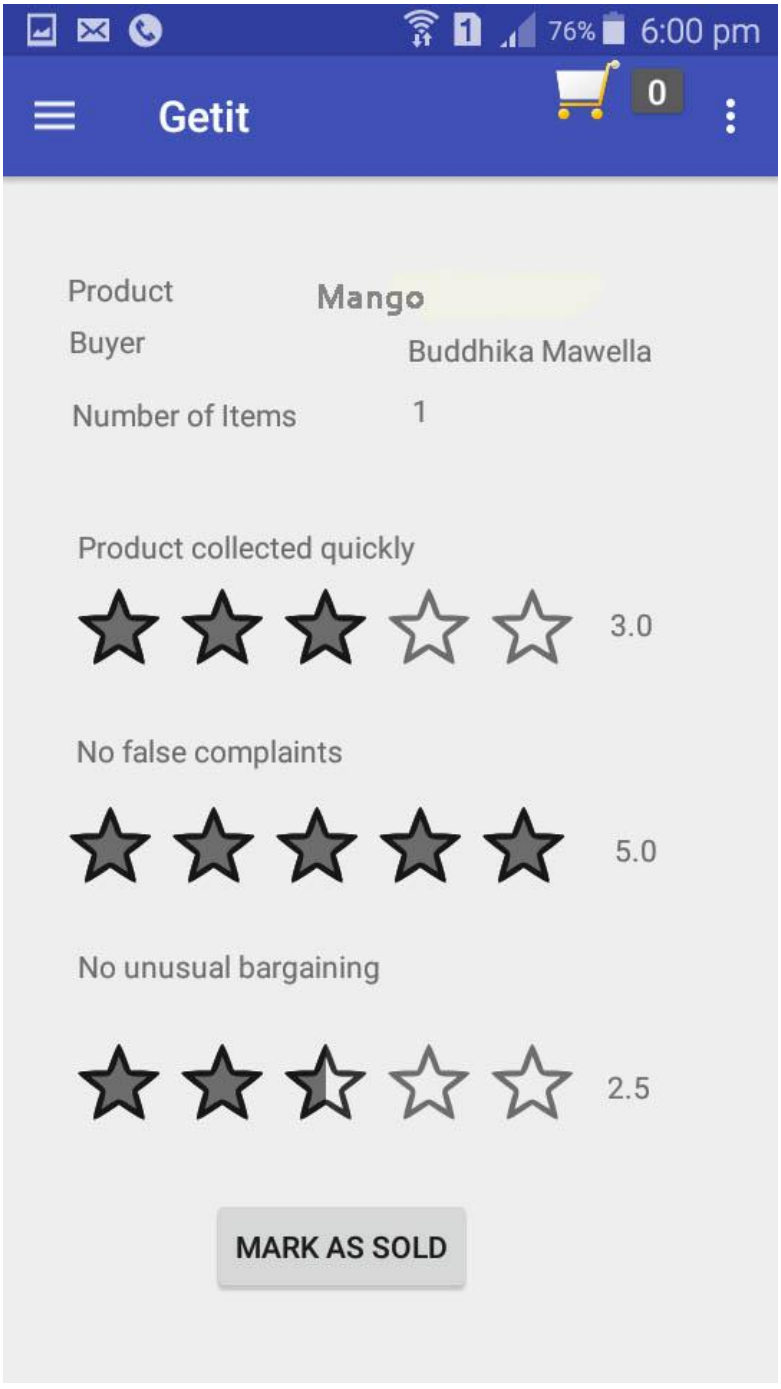

Figure 22 Buyer ranking page.

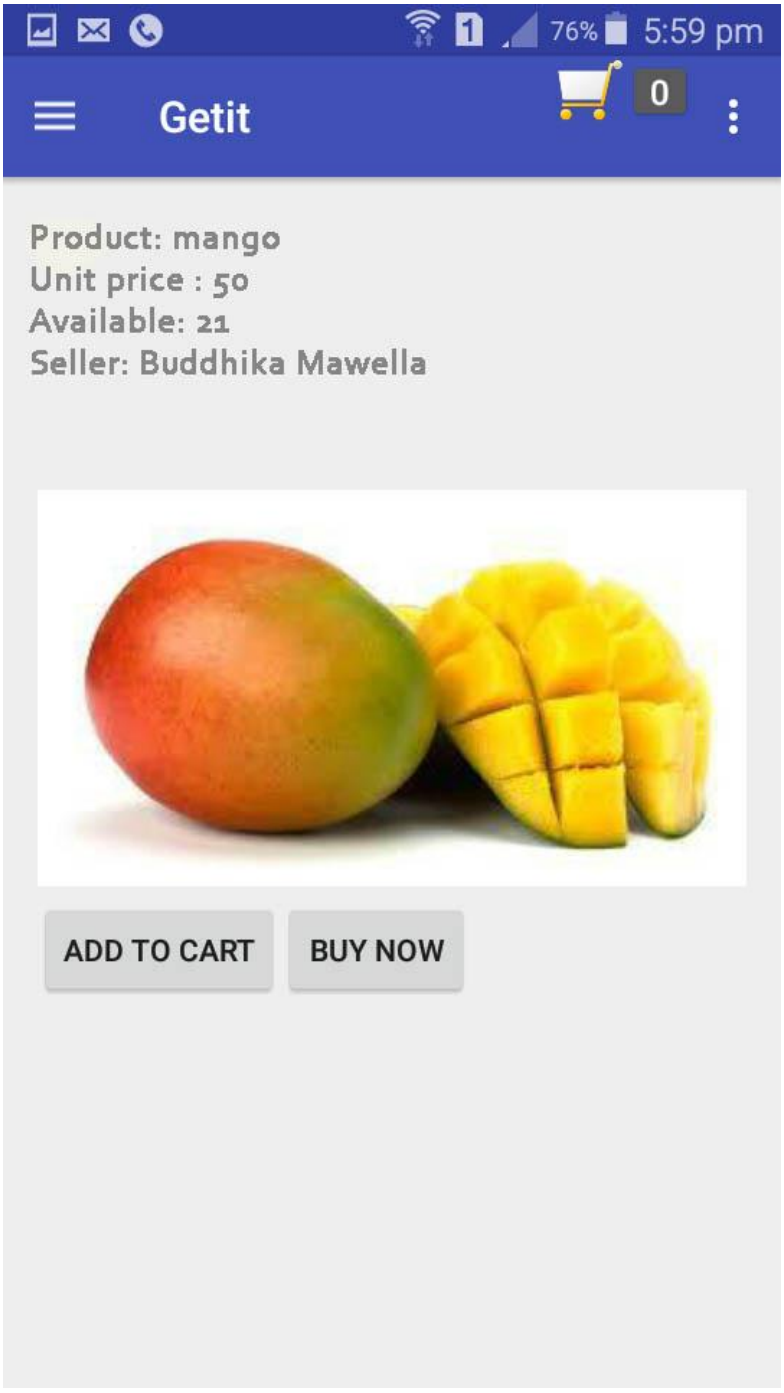

Figure 23 Product page

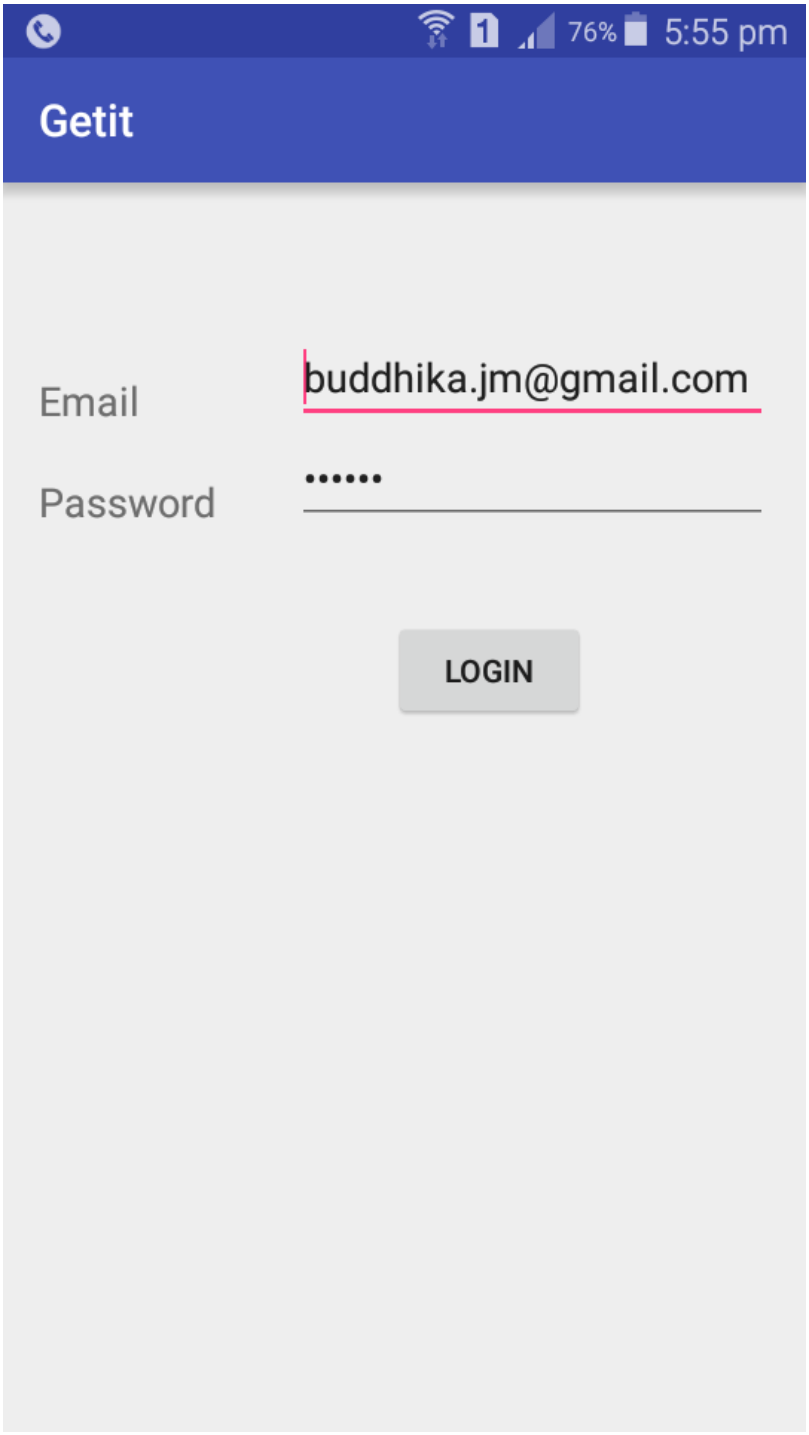

Figure 24 Login page.

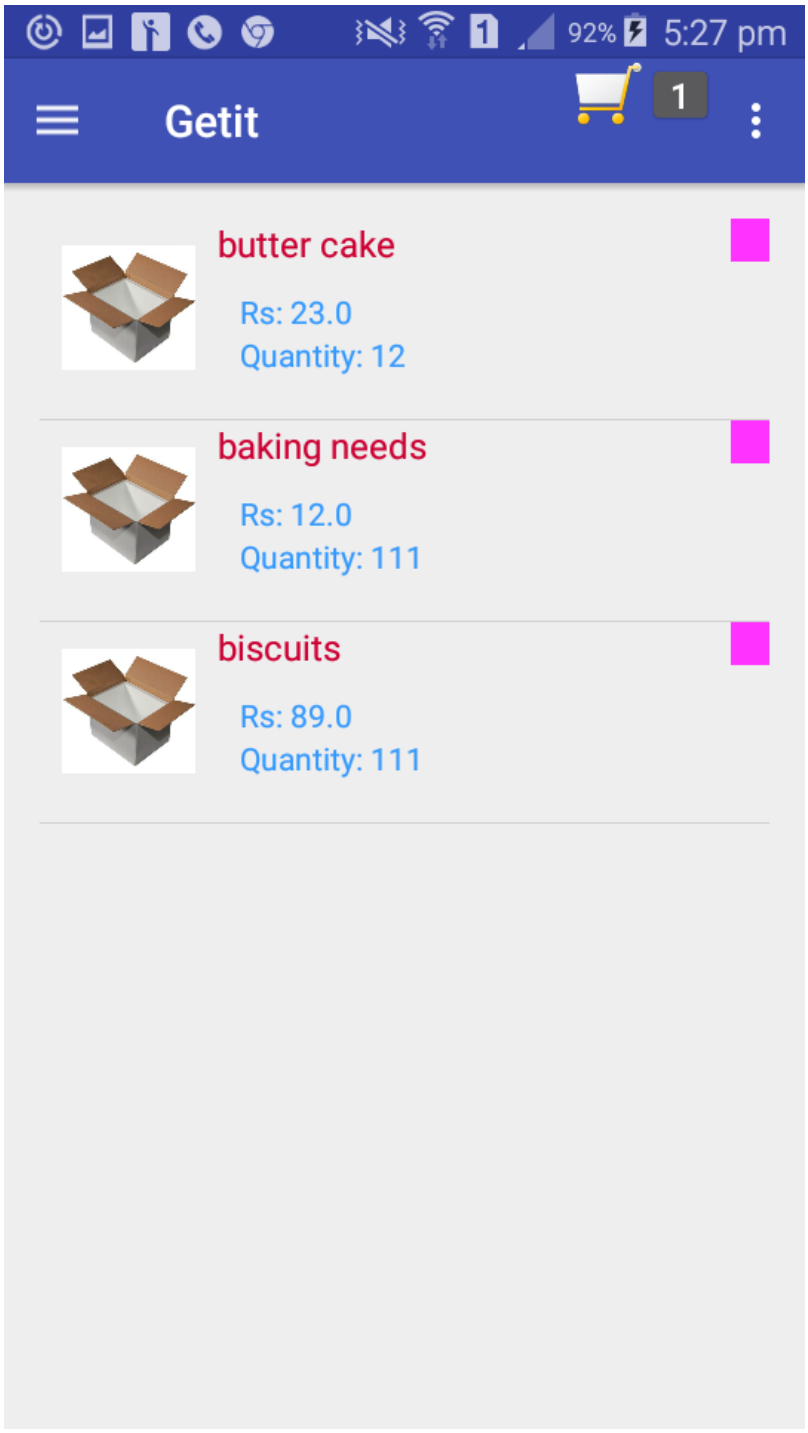

Figure 25 Product suggestions page

Appendix B
Testing and Evaluation with Test data

Sample Test cases for Black box Testing

Test no	Test Data	Expected Results	Actual Results	Conclusion
1	Logged with incorrect user name	Operation must be aborted	Message – Invalid Credentials	Achieved
2	Logging with incorrect password	Operation must be aborted	Message – Invalid Credentials	Achieved
3	Logging with incorrect user name and password	Operation must be aborted	Message – Invalid Credentials	Achieved
4	Login by providing empty user name and password.	Operation must be aborted	Message – Invalid Credentials	Achieved
5	Login with a user name and with a password	Operation must be aborted	Message – Invalid Credentials	Achieved
6	Search sellers by giving a product name	Locations of the sellers are displayed.	Locations of the sellers are displayed with appropriate color of the map marker	Achieved
7	Search sellers by giving a	Operation must	Message- No	Achieved

	empty product name	be aborted	locations found	
8	Click on ‘Buy’ button	Operation success	Message- Purchase success message completed	Achieved
9	Click on product suggestions link	Product suggestions are displayed	Product suggestions are displayed	Achieved
10	Click on My purchases link	Purchases are displayed	Purchases are displayed	Achieved
11	Click on My sales link	Sales are displayed	Sales are displayed	Achieved
12	Click on add to shopping cart button	Product added to the shopping cart	Product added to the shopping cart	Achieved
13	Click on shopping cart button	Shopping cart items are displayed	Shopping cart items are displayed	Achieved
14	Click on ‘Clear shopping cart’ button	Shopping cart items are cleared	Shopping cart items are cleared	Achieved