PERSONAL SHOPPING ASSISTANT

BY

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DECLARATION OF ORIGINALITY

I declare that this report entitled "**PERSONAL SHOPPING ASSISTANT**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature :

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Date : 4/4/2016

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ABSTRACT

The name of this project is Personal Shopping Assistant. The main purpose of this project is to develop a mobile application that can assist shopper to make a smarter shopping plan. It allows shoppers to make shopping plan at anywhere and anytime to make their shopping easier and efficient. The main objective to be achieved the mobile application is save shopper's time and cost during shopping.

The methodology chosen for the development of the application is Incremental & Iterative Development from Agile Development. The reason of choosing this methodology is because improvement and modification can be made on the system through the project lifecycle due to frequently changing requirements. Design modifications and new functional capabilities will be added into the system for every iteration process until a full system is completed.

Survey is conducted in the form of questionnaire in the process of gathering requirements. The reason of using questionnaire is due to the ability to collect sufficient amounts of information from a large number of people in a short period of time and in a cost effective way. Document analysis is also done to gather the information from some of the previously existing similar application. The result of the requirements gathering is in the form of user requirements definition.

The application implemented is able to provide a number of features. One of them is the navigation to provide user the location of the store. Next, product information will be displayed to user based on search and price comparison can be made by displaying all the same type of products. Besides that, budget estimation can be made through the shopping list. Users will be informed about the sales and promotion currently going on. Orders can be made by users and being confirmed by the seller. Lastly, user rate and review on products and interact with each other's through comment.

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LIST OF ABBREVIATIONS

PDSA	Personal Digital Shopping Assistant
SAGO	Search and GO
RFID	Radio Frequency Identification
SDLC	System development life cycle
ERD	Entity Relationship Diagram
DFD	Data Flow Diagram
PHP	Hypertext Preprocessor

Chapter 1: Introduction

1.1 Problem Statement

There are numbers of problems exist for shoppers without using any shopping assistant application during their shopping activities. One of the problems is that they found it difficult in locating a store which sells the items they want to buy. When people want to buy a particular product, they often do not have idea where they can purchase the items. Thus, it is troublesome for them when they could not find the items at a store they've arrived and causing them to have to travel to another store to find the items. This is very time-consuming and cost-wasting.

Another problem is that shoppers are not able to make price comparison for a same type of product. Normally, shoppers can know the price of a product through catalogue or advertisement, but there are only a limited amount of products displayed to them. Making price comparison is impossible as they do not know the price for the other of the same type of products. The product information on the catalogue and advertisement is also very limited, thus shoppers could not fully understand the products and caused them problems in making choices for their shopping plan.

Shoppers often face problem in estimating budget accurately in their shopping plan, causing them to spend over their budget limit during shopping. This is due to different store might have different prices for a particular product and shoppers do not know about the prices, thus making them difficult in estimating an accurate budget.

There are some similar mobile application exist on the market, but some of them do not provide feature which allow users to make a rate and review on the product in order to share their opinion among each other. Therefore, shoppers could not know the good or bad of a product based on user experience and the consequence is it will lead them in making decision they might regret later. Lastly, most of the shoppers like to shop in sales and promotion event because they want to purchase item in a low and discounted price. However, they could not know the first-hand information about sales and promotion going on because the only way they could know it is through advertisement and banner.

1.2 Background and Motivation

In this modern era, information technology is one of the most significant developments. The technology keeps improving drastically, one of the examples are on smart phones and mobile devices in the aspect of software and hardware capabilities.

Over time, the amount of people who owns a smart phone is increasing rapidly. It is safe to say that four out of five urban peoples own at least a smart phone. Smart phone is now becoming a basis and necessary tools for most of the peoples in their daily life. The reason is because we can do possibly everything with a smart phone in everywhere such as messaging, web surfing, e-mail, video call, media entertainment and so on.

With the rapid growth of Internet, various industries have developed many new ways in conducting business; one of it is mobile application. The development of mobile application has successfully brought a great impact on many industries. The aim of the mobile application is not only for conducting business, but it is also for providing information and allows users to perform task. The mobile application will be published by developer to the app store and allows users to download it through Internet.

The development of this project is motivated due to the fact that shopping is considered as one of the fundamental activities for most of the people. When people wants to shop, they must go to the store and look for the items they want to buy. However, it might bring troubles to them if they could not find the items in the store which they will have to travel to another store to find it. Therefore, with the development of the Personal Shopping Assistant, shoppers will no longer face difficulty in obtaining the information and details of the products such as price, location, description, seller's information and so on. The mobile application allows them to obtain all the important information of products and helping them in making a better shopping plan before going out to shop.

Lastly, the motive behind this project is to provide a support tool to deliver useful and sufficient information of various products to the people. The project will definitely ease people in doing their shopping more efficiently.

1.3 Project Objectives

i. To develop a mobile application which provide the product information to users

This project allows sellers to post the product information in their shop into the application. This information includes price, description, shop's name and location, rating and comment. When shoppers search for products, the application will display a list of products with price and distance from their current location. Thus, shoppers are able to make comparison between products and improve their decision making in shopping planning.

ii. To provide a feature to navigate users to the shop's location

The project displays the address of the shop to users, but users might not know their way to the shop. This project will provide a route plan on a map to the users which will navigate them from current location to the shop. Therefore, users do not need to worry about clueless or getting lost on their way to the shop to buy the products they want. In the other hand, it will also save user's time and cost as they do not need to travel to different shop to find the products they want to buy.

iii. To provide a feature which helps users to make an accurate budget calculation before shopping

This project allows users to add products they want to buy into a shopping list in the mobile application. The shopping list will then calculate the total price of all the products automatically and display it to users. Therefore, users can avoid the problem of spending beyond budget during shopping.

iv. To provide a feature to allow users to rate and review on the products

This project allows shoppers to provide rating and review on every product. The purpose is to let every shopper share their opinion and personal experience on a product. Thus, it helps shoppers to make a better decision before choosing the products they want to buy after checking other's review.

v. To develop a mobile application which inform users about the sales and promotion event

This project allows sellers to promote the sales and promotion event they are organizing. Through the mobile application, users can obtain information about the sales and promotion event immediately. This will definitely benefits the shoppers who want to purchase low price or discounted items.

1.4 Proposed Approach

The proposed approach in this project is to develop a web-based mobile application, named Personal Shopping Assistant. In this application, there are a number of features will be implemented. Firstly, sellers are allowed to register their products on the application with required information. Shoppers can search products on the application by either typing in the product keywords or choosing product category. The product list from the search results will be displaying the price and distance of the products from shopper's current location.

On the other hand, the application enables shoppers to sort the product list based on lowest or highest price, oldest or newest product, and nearest and furthest distance. Therefore, shoppers can make a comparison in term of price and distance, and decide which products they want to go for. Besides that, the application will provide a product suggestion from the search result by shopper when requested. The product suggestion will be based on the distance and duration calculated from the user's location to the shop's location and provides a smarter decision for shopper.

By tapping into the particular products in the list, the applications will display more useful information regarding the product, such as the rating, seller's information, description and comments. From here, shoppers are able to add product into shopping list. The shopping list will automatically calculate the total price of all the items. This feature allows shopper to estimate their shopping budget accurately and avoid problem of insufficient budget during shopping. This application also allows shoppers to make an order with the sellers in advanced before going out to purchase the item from the shop. Thus, shopper does not need to worry out-of-stock problem as sellers can reserve the products for them.

On the other hand, if the shopper does not know how to go to the seller's shop, he or she can use the store locator feature which will provide a map indicating the navigation between current location and the shop's location. The application has a rate and review feature, in which it allows shoppers to provide rating and make a review on the product. The purpose of this feature is to exchange user's experience and opinion on a particular product, therefore enhance the decision making of other

users in choosing the product. Shoppers and sellers can interact with each other by entering comment for each product, in order to make queries and provide information to one another. User interaction is very important in a web-based mobile application because it can attract users and maintain their loyalty.

Lastly, the application also allow seller to register sales and promotion event with necessary information such as starting and ending date, address, seller's details and so on. Shoppers can look for more information by selecting a particular event from a list of sales and promotion. Both shoppers and sellers can make comment for each sales and promotion event in order to make queries and provide information to one another.

1.5 Project achievement

This project is encouraging shoppers to have a concept and idea of managing a smart shopping plan. In fact, most shoppers often do not have a shopping plan before going out for shopping because they do not have the actual information for the products they wanted to buy. Thus, they often face the problem of spending more than expected budget during shopping because they are not able to make estimation on the budget. This project makes a huge contribution in providing them the product information, helping them in organizing their shopping plan as well as controlling their budget.

One of the achievements done by this project is saving shopper's time and cost. The mobile application will navigate shoppers to the location of store to purchase the items. Therefore, shoppers do not have to waste time and traveling cost unnecessarily for the attempt to look for the items they want by travelling to other different store. Besides that, it also allow them to make order and sellers can inform users about the order status so that users do not need to worry about the stock availability in the store. Thus, this project definitely makes their shopping more efficient and save them from troubles.

On the other hand, this project also greatly contributes to the sellers by providing a platform to promote their products as well as sales and promotion event in a simple, quick and cost-efficient way. Thus, this application is also beneficial to shoppers because they can find the information easily and immediately.

1.6 Report Organization

The main body of this report is preceded by detailed contents such as table of contents, list of figures, tables, and abbreviations. There are a total of 7 chapters in this report.

Chapter 1 identifies the problem statement, defines the objectives, describes the project background and motivation, project achievement and proposed approach.

Chapter 2 contains 6 literature reviews about the similar previous work found from the Internet. The literature review consists mainly of description and strength and weakness of the system. Comparison is made between the proposed approach and previous work in order to find out how is the proposed approach is better.

Chapter 3 has a number of system design diagrams such as system flowchart, use case diagram, activity diagram, context diagram, entity relationship diagram, level-1 data flow diagram, sequence diagram and system architecture diagram. The purpose of the diagrams is to describe in detail how the system is developed.

Chapter 4 discusses the methodology chosen in the project after comparing several methodologies, technologies involved to develop the system, and technique for requirements gathering.

Chapter 5 provides the description of the seller's flowchart found in chapter 3, stating the user's requirements and verification plan for testing purpose.

Chapter 6 provides the description of the shopper's flowchart found in chapter 3, stating the user's requirements and verification plan for testing purpose.

Chapter 7 provides a conclusion of the project which mainly discuss about project achievement, objectives, problems encountered and further improvements.

A list of references had been provided after all of the chapters. Appendices are also provided at the end of the report. These appendices include survey sheets, charts and data table.

Chapter 2: Literature Review

2.1 Flash-based Personal Digital Shopping Assistant Mobile Application (PDSA)

PDSA is an application developed for handheld devices such as Smart Phones, Tablets and Personal Digital Assistant. The aim of the development of the application is to facilitate customers by solving the difficulties they faced during shopping, for example, unable to find the products in a particular shop and its location, making comparison of product price and brand, as well as obtaining latest promotions and information.

The development of this application is focused on shopping centres, the purpose is to assist customers during shopping by providing information such as store locations, price of the product, events and promos, news and so on. Although there are terminals provided in existing shopping centres which works to provide this information, but its terminal is only located at particular location and customers must approach to the location of the terminal which is troublesome and inconvenient to them.

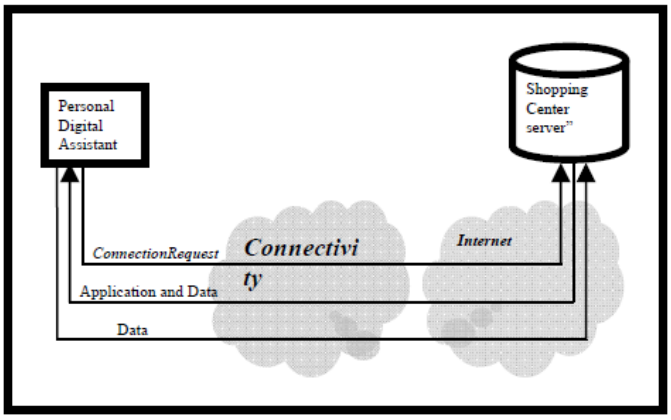

Figure 2-1 PDSA Application Modules (Djoni Haryadi Setiabudi, 2011)

In this application, there were two modules designed as shown in Figure 2-1. Adobe flash is used to develop the main PDSA mobile application. One of the modules is for the main PDSA mobile application, which is meant

for visitors to use it as a facility on the application. The data which will be shown in application will be processed by Adobe Flash programs by transmitting the data to server and get response from the server.

On the other hand, PHP programming language is used to develop another module which is for administrator. In this module, MySQL database is also used for data storing. The purpose of using PHP programming language is to access the database and allow existing data in the database to be processed into a data text file in order to be accessible by Adobe Flash. Meanwhile, the function of administrator module is mainly for entering, changing, and deletion of data in web administrator at shopping centre server.

For PDSA application, connections is used to connect it to the shopping centre's server through Internet, thus the application and data files can be downloaded from the server into mobile phone or PDA. Once the applications and data obtained, the application can be used even without connection with the server. The users are only required to connect to shopping centre's server in order to download latest data.

According to the results collected from the questionnaire which is distributed to customers, conclusion is made. The conclusion indicates that PDSA application can be suitably used by all ages, be it teenagers or adults. The PDSA application is claimed to be user friendly with 85% of average rating. It definitely works in assisting customers and streamlines their shopping activities due to a 100% rating.

From the review, there are several strengths and weaknesses can be found in the application.

Strengths	Weaknesses
Adobe Flash application is compatible in various mobile devices without needing to create different version from it.	In Android devices, the browser cookies do not allow Flash Player to write data on it, so limiting the function for offline data storage.
Application can be used directly without requiring the application installation on mobile device.	PDSA application cannot be used in iOS devices as all the iOS devices do not support Flash Player.
The map feature in the PDSA application allows customer to find the location of stores easily.	Lack of usability as application not able to display the right size for different mobile screen resolutions.
Users can use the application in offline mode once they had downloaded the whole application files.	Application could not find users current location automatically thus it is harder for them to track their route.

Table 2-1 Strengths and Weaknesses of PDSA

2.2 Ma$$ive – An Intelligent Mobile Grocery Assistant

Main focus of this application is to provide support for customers during their shopping activities. Ma$$ive is designed based on a shopping list paradigm, which allow customers to use free-form natural language to create a shopping list.

In-store interviews and questionnaires have been conducted to study customers' shopping habits and attitude. From the survey, it is a fact that a shopping list is an important tool during grocery shopping, whereas features that help to create and manage shopping list were considered most important. Besides that, customers prefer grocery aids which allow them to use it on personal devices and they valued systems which help to locate products, provide itemized pricing as well as information about special offers.

A survey study has been conducted to investigate which features on grocery aid in the mobile phone are considered important by customers, and how these preferences are being affected by the shopping habits and demographic variables. The survey study is conducted in the form of questionnaire within a large supermarket. There are two parts in the questionnaire, in which the first part surveyed participant demographics and the second part listed a number of potential features in the mobile grocery assistant which required them to make a rating based on the importance of each feature.

The results gathered from the questionnaire indicated that as much as 91% of customers shop frequently for groceries and a large proportion of them use shopping list as a supporting tool during grocery shopping activities. Besides that, participants considered the features that are able to facilitate budgeting and time usage as the most important, followed by features that provide aids for basic shopping tasks such as searching product and examining product information.

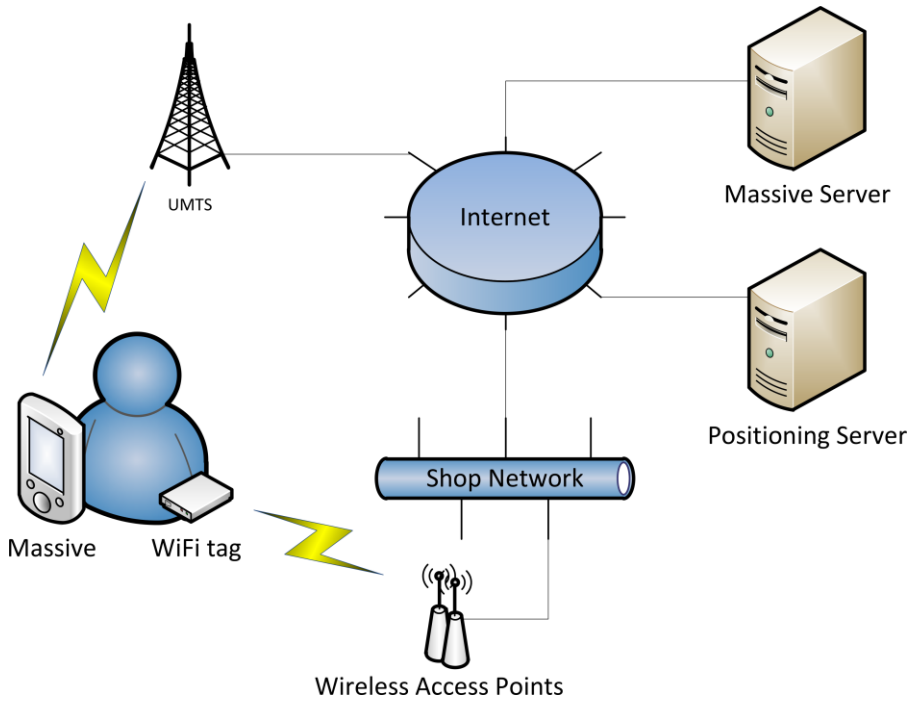

Figure 2-2 Ma$$ive Architecture Diagram (Sourav Bhattacharya, 2012)

Ma$$ive is implemented based on a client-server architecture as shown in Figure 2-2. On the remote server, the main application logic is responsible to store all the user data. There are 2 Ma$$ive client versions have been implemented. The web-based first client can be accessed through web browser, while second client is an application running on Nokia mobile devices. Both the client and server perform all the communication through HTTP. The Wi-Fi tag is required to be carried by user for positioning purpose. The features developed in this application are support of the shopping list in natural language, predictive text input, indoor positioning, product searching and recommendation.

From the review, there are several strengths and weaknesses can be found in the application.

Strengths	Weaknesses
The items in the shopping list will be map to product category through the natural language shopping list feature.	Users must use the application in online mode to enable positioning.
Predictive text input feature can reduce the amount of errors made, make text input faster and therefore satisfy user.	Users cannot interact with each other in this application.
The indoor positioning feature will determine customer's current location.	The application can only be use in a particular store.
This application can display all the current special offers in the shopping centre.	

Table 2-2 Strengths and Weaknesses of Ma$$ive

2.3 Mobile Shopping Assistant J2ME application

This mobile shopping assistant is a J2ME application designed to be used on mobile phones. When customers are in a particular shop, it allows them to access the Web Services that are published by the shop. These web services are such as promotions, product search, product descriptions, product location and payment.

In this application, customers are able to make a shopping list from the product or product category before starts shopping. The application will receive promotions and product description corresponds to the shopping list once the customer is inside the store. Besides that, customer can get information about a specific product by using product search in the shopping assistant. The application is able to display floor plan of the store to navigate users with a shortest route from current location to product location. The products can be added into a virtual shopping cart by the customer. Through the Payment Web Service in the application, customer does not need to queue at the counter to make payment.

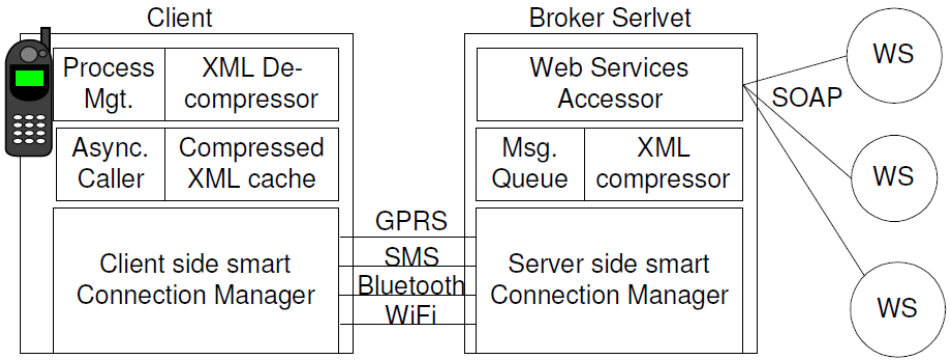

Figure 2-3 J2ME Shopping Assistant Architecture (Huaigu Wu, 2007)

Figure 2-3 is the architecture of the mobile shopping assistant. A Web Service request submitted by client will be sent to the asynchronous caller queue. The request is sent directly to the server once there is an available connection channel. A broker will receive the request on the server side and put it into a message queue, and then it will be transfer to the corresponding Web Service as a SOAP

message. An XML compressor will process all the responses and transfers the result stream to the client and then store it into a compressed XML cache. It will be de-compressed from the cache when clients need the data. The XML compression mechanism can help to make the data exchange highly efficient and provide a compact data storage.

A Smart Connection Management is designed in this application to allow asynchronous communication for every possible channel found on a mobile phone, such as GPRS, SMS, Bluetooth and Wi-Fi to prevent the long delay and cancel the entire transmission due to unstable network. There is various input modes can be used in the mobile shopping assistant such as camera, key pad, Bluetooth and voice. The camera is for implementation of image-based product search and bar-code scanner. The voice input can be used for voice-based product search. The Bluetooth is for implementation of location-based navigation assistance.

From the review, there are several strengths and weaknesses can be found in the application.

Strengths	Weaknesses
The application provides high usability due to availability of various input modes.	J2ME's interface is very limited compared to Android as well as other platform.
The application can determine user's current location and navigate them with shortest route.	The reliability of J2ME automatic application update is low compared to other platform.
Make users' shopping easier by using shopping list feature.	The application does not provide user interaction feature.
Inform users about promotion and product description based on the shopping list.	The application is only limited to be used in a particular store.
Compatible for various mobile phones with different operating system.	

Table 2-3 Strengths and Weaknesses of Mobile Shopping Assistant J2ME application

2.4 Smart location-based mobile shopping Android Application

This mobile shopping application is named Search and GO (SAGO). This application utilizes the Geo-position of mobile device to produce location information. The flow of SAGO is that user perform a product search, the application will then identify the user's location, and then perform product searching on the closest shops. The application will obtain the product prices along with stock details and a smart listed product list from each store.

SAGO is an Android application which is developed in Android 2.2 version. Service-Oriented Modelling Framework is used in designing SAGO architecture based on UML. The application is developed using Object-Oriented programming language.

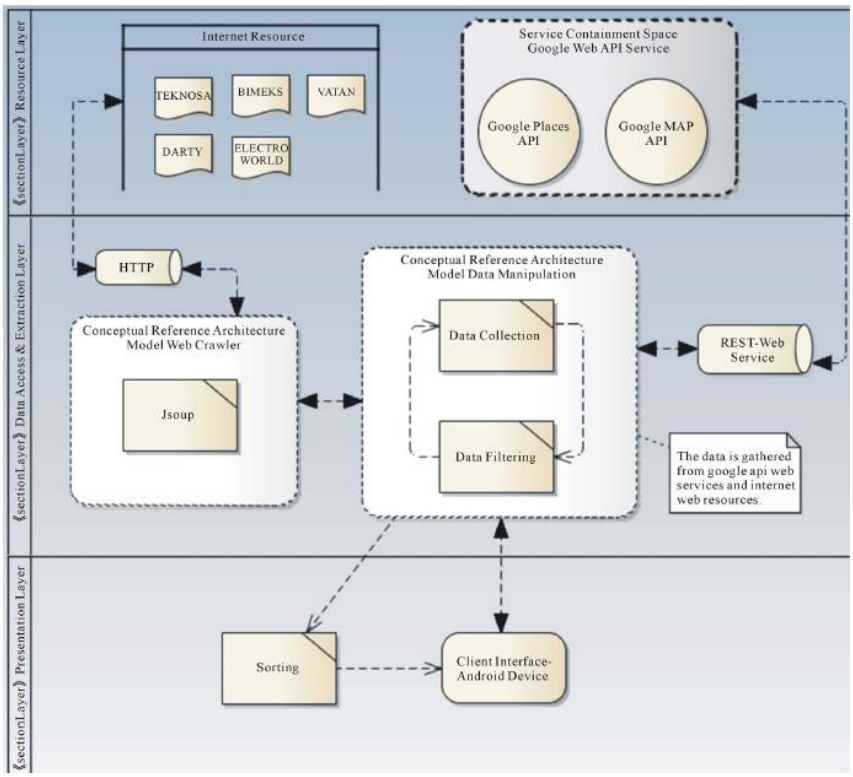

Figure 2-4 SAGO System Architecture (Günay Gültekin, 2014)

Figure 2-4 is SAGO mobile shopping application system architecture. It consists of three layers which are Resource Layer as the 1st layer, Data Access and Extraction Layer as the 2nd layer, and Presentation Layer as the 3rd layer. The

Resource Layer that includes all of the related data used in the application which most of it collected from the local stores as they are internet resources.

Data Access and Extraction Layer consists of data extraction and tools. The tool used is Jsoup which is a Java HTML Parser and also an open-source project. The function of Jsoup is to use collect data from web resources by using HTTP protocol. The 3rd layer is Presentation Layer that includes the sorting of relevant results which are gathered from 2nd layer. The aim of this layer is to display the results in a logical and meaningful way to fulfil user's requirements.

SAGO mobile shopping application proposes Smart Filtering Algorithm to ensure the search and listing results are precise and has no error. The Smart Filtering Algorithm has a number of algorithms, such as Agglomerative Clustering Algorithm, Greedy Search Algorithm and Scoring Products. Agglomerative Clustering Algorithm is used for calculation and filtering as well as clustering the results. Irrelevant information is removed from the data by using Greedy Search Algorithm. Clustering approach is used to facilitate the Smart Filtering Algorithm to display the product search results to users more efficiently.

From the review, there are several strengths and weaknesses can be found in the application.

Strengths	Weaknesses
Application able to provide an accurate product search results in a short time.	No user interaction feature in the application.
Application can determine users' current location and navigate them to nearest store.	Application does not provide a feature for users to manage their shopping list.
Application has a high performance compared to other similar mobile application.	Application does not inform users about offers and promotions.
Application can be used for many other stores instead of only a particular store	

Table 2-4 Strengths and Weaknesses of SAGO

2.5 iShopper

iShopper is a dual-mode prototype of an Intelligent Shopping Assistant. iShopper focuses on providing users with a range of services that aims at reducing shopping time, cost, and cognitive energy for the customer. iShopper services are fully integrated with web interface and mobile access to maximize convenience of users shopping where they can organize shopping list ahead of time and save time while shopping.

iShopper utilized Radio Frequency Identification (RFID) technology and business intelligence (BI) infrastructure to improve shopping experience and marketing. RFID is a method which uses short range radio signal for automatic identification of object and users; while BI refers to the skills, technologies, applications and practices used to help acquiring a better understanding of the business commercial content. In the application, the RFID make it possible to implement a finely grained and immediate data collection, which in turn enables more precise and detailed analyses on the business intelligence side.

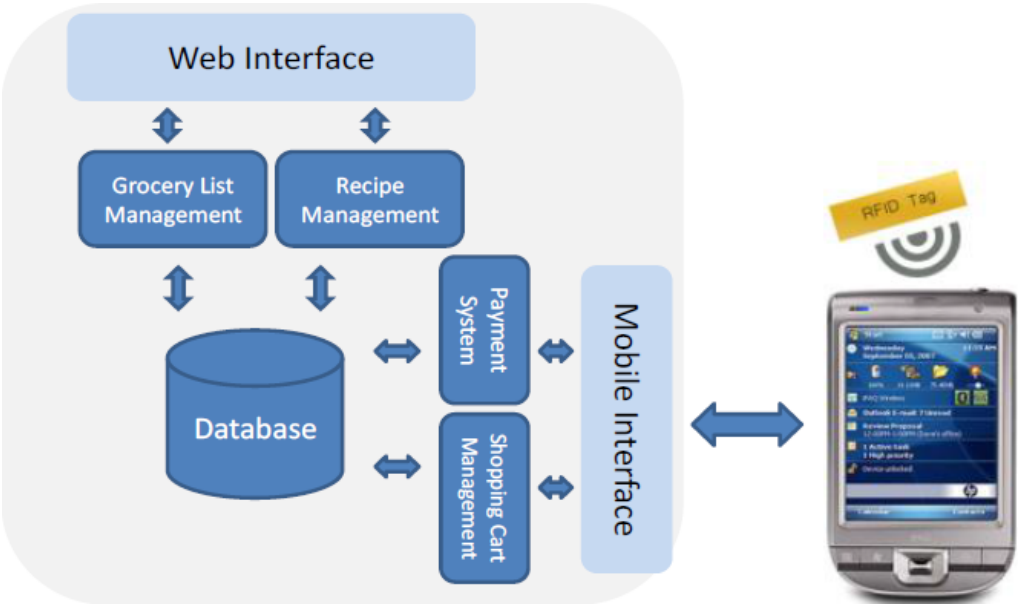

Figure 2-5 Architecture and Main Components Diagram (Lilac A. E. Al-Safadi, 2010)

Figure 2-5 is the architecture of iShopper. iShopper has two modes of interaction which are web and mobile phone. The architecture consists of three components, which is the RDIF reader embedded in mobile phone (a transceiver), a transponder (RFID tag) placed on shop items, and the store's server consists of a central database with items full information.

When user places mobile phone near the item, the unique identifier stored on the product's RFID tag will contacts the database to retrieve more information about the product and display it to user. Users can selects the product and add to cart if they decided to purchase.

To enhance the shopping experience for grocery shoppers, iShopper provides features as below:

- Grocery list management – Allow users to create and manage multiple grocery lists as well as adding and removing items. Furthermore, enable them to create, delete and send grocery lists to other shoppers.
- Shopping cart management - Users can add and delete items in shopping cart, and then able to collect items to be purchased while shopping.
- Item information retrieval – Provides ability to retrieve and display item information such as name, category, price, quantities available, ingredients and location in store.
- Recipe management – Enable users to create recipes and link the ingredients to items from the store's database.
- Personalized recommendation – Provides customers with personalized recommendation of items while managing grocery list and during shopping.
- Targeted promotions – Provides targeted promotions technique based on customer preferences and allow them to view promotions on items from grocery list
- Budget saving – When requested, provides customer with alternative grocery list with lower budget.

- Self-check-out and auto payment – Customers can make a check out by waiving mobile phones at an RFID reader and use the market stored value payment.

From the review, there are several strengths and weaknesses can be found in the application.

Strengths	Weaknesses
Application has a community for interaction of shoppers where they can create, share and review recipes.	Application only provides the location of items in store but unable to locate the user's current location, thus they have to work out the path by themselves.
Application able to recommend items to customers corresponds to their grocery list.	The application can only be used in a particular store.
Provide convenience to customers while shopping as it enables them to create grocery list and provide them alternative grocery list for budget saving purpose.	User's mobile device must be connected to Internet before using the application.
Application enables customers to automatically check out using mobile phone without requiring to queue.	

Table 2-5 Strengths and Weaknesses of iShopper

2.6 iGrocer

iGrocer is a smart grocery shopping assistant that focuses only on food item. This application can facilitate and provide advice to users such as what product to buy and to avoid based on the price constraints or nutrition criteria. iGrocer is an application designed for the new generation of smart phone that has a bar code scanner. The aim of the application is to help the user to create and maintain their shopping lists in order to make a plan and preparation for the weekly grocery shopping. iGrocer is simply handy for peoples as it aid users in making decision on buying food items. Based on the compatibility check between the user's health profile and food item's nutrition content, it will helps users to decide which food items to buy and avoid.

Similar to most of the shopping assistant application, iGrocer does allow users to add items to a shopping list by different means. This application can provide the shortest path to users and display an interactive map with the location of each of the items on shopping list indicated. Moreover, it has automated check-out function which allows customers to perform a trusted queue-less checkout. iGrocer has a quick shopping feature for the shoppers who are only interested to purchase items on the shopping list with maximum ease. This feature will work to sort out shoppers' shopping plan automatically without requiring them to make unnecessary choices. Besides that, iGrocer has an expense history option which generates a report showing the user's spending statistics over the previous month. Thus, users can make use of the statistic in deciding whether they are within their shopping budget limits during their shopping before proceeding to check out.

iGrocer has a number of features which allow user to shop healthy as well as making grocery shopping quick and convenient. The following are the features included:

- Nutrition Profile: Provide a list of medical conditions which requires users to choose and allows them to customize their calorie intake.

- Scan Item: By scanning the near empty item, users can add the item into shopping list.
- Add by Recipe: By viewing recipe ingredients, items can be added to shopping list.
- Wish List: Children can maintain all the items they desired from the grocery store in a wish list. Upon parental confirmation, the items from the list will be moved to shopping list.
- Personalize Categories: Provide users the option in customizing their product categories based on user's shopping habits.

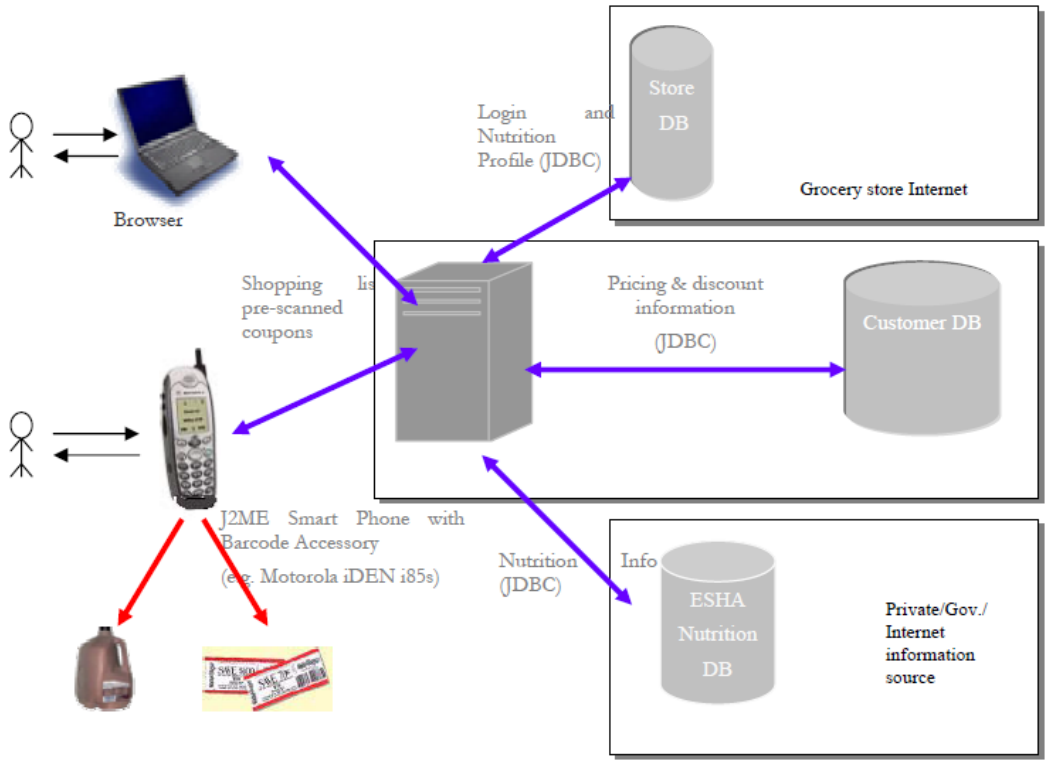

Figure 2-6 iGrocer System Architecture (Sangeetha Shekar, 2003)

iGrocer was developed using J2ME development kit and MotoSDK wireless kit. Client-proxy server architecture is used in the application to handle all the intermediate communication with the proxy server. Users are able to create profile in the application from either the client or through website. The new user information will then be sent to proxy and stored in the

customer database. The latest version of user's shopping list is downloaded from the database when user logs in to the application. Queries will be performed by the proxy to the nutrition database via JDBC connectivity. The nutrition and brand information of each of the items on shopping list is then retrieved. The store database is then queried and all the pricing information of each of the products will be retrieved.

From the review, there are several strengths and weaknesses can be found in the application.

Strengths	Weaknesses
Save user's time as they can perform queue-less check out by using the application.	The application does not provide user interaction feature.
Convenient for shoppers as they can scan the items and add it to the shopping list automatically.	The application can only be used in a particular grocery store.
Application is able provides interactive map and lead users to the product location by shortest path.	The application does not inform users about the special offers or promotion running in the store.
Application can save user's expense history, helping them to manage their grocery shopping budget easily.	

Table 2-6 Strengths and Weaknesses of iGrocer

2.7 Comparison between Similar Applications

	Flash-based Personal Digital Shopping Assistant Mobile Application (PDSA)	Smart location-based mobile shopping Android application	Mobile Shopping Assistant J2ME application	Ma$$ive – An Intelligent Mobile Grocery Assistant
Provide Store Location	Yes	Yes	Yes	Yes
Detect User Location	No	Yes	Yes	Yes
User Interaction	No	No	No	No
Shopping List	No	No	Yes	Yes
Sales & Promotion	Yes	No	Yes	Yes
Use by Various Store	No	Yes	No	No
Product Comparison	Yes	No	No	Yes
Interface Design Attractiveness	Low	Low	Moderate	Low
Sufficient Product Information	Yes	Yes	Yes	Yes
Estimate Budget	No	No	No	No
Make Order	No	No	No	No

	iShopper	iGrocer	Proposed Mobile Application
Provide Store Location	Yes	Yes	Yes
Detect User Location	No	Yes	Yes
User Interaction	Yes	No	Yes
Shopping List	Yes	Yes	Yes
Sales & Promotion	No	No	Yes
Use by Various Store	No	No	Yes
Product Comparison	Yes	No	Yes
Interface Design Attractiveness	Moderate	Low	High
Sufficient Product Information	Yes	Yes	Yes
Estimate Budget	Yes	Yes	Yes
Make Order	No	No	Yes

Table 2-7 Comparison between Similar Applications

Chapter 3: System Design

3.1 System Flowchart

3.1.1 Seller's side System Flowchart

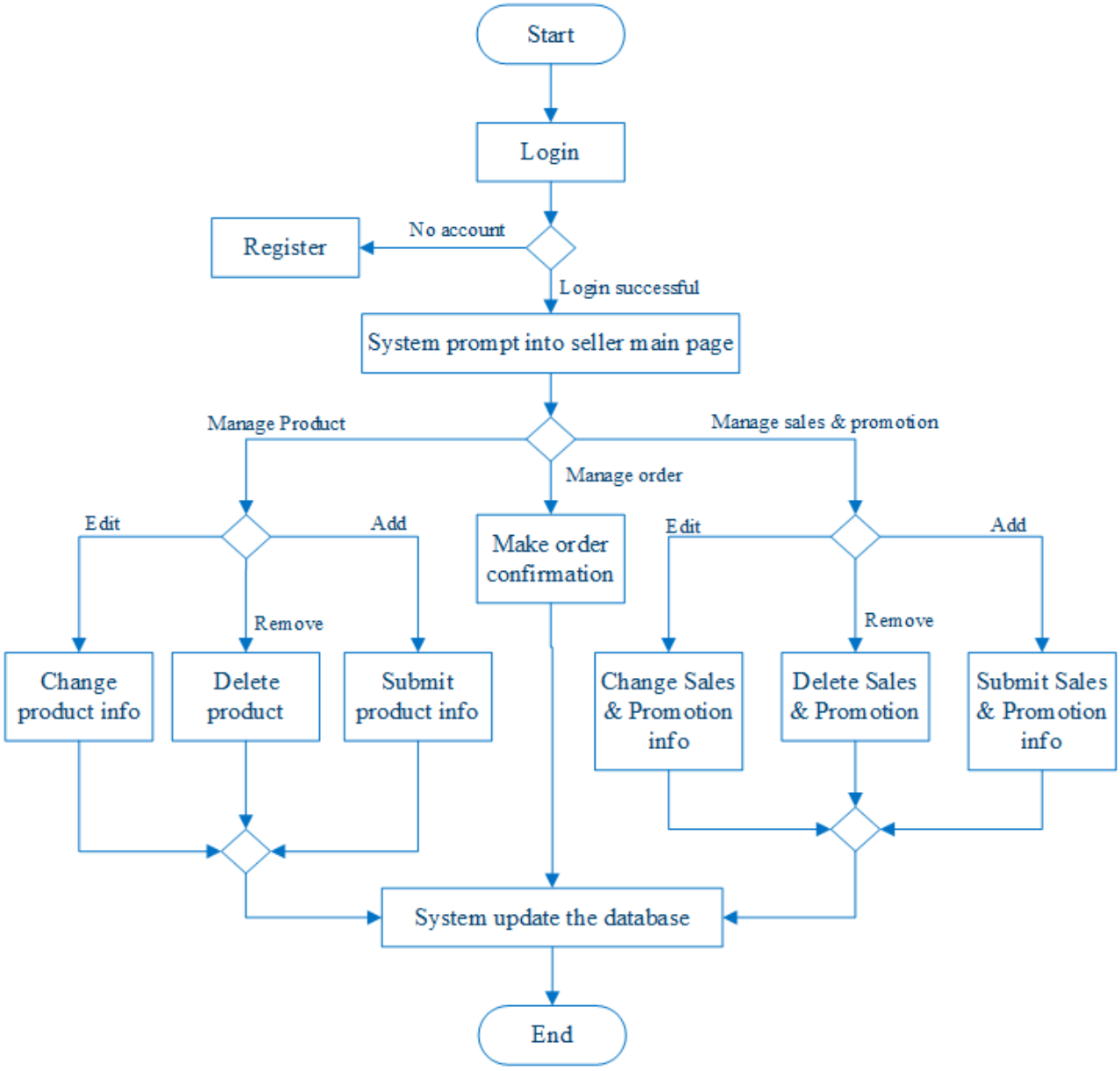

Figure 3-1 Seller's side system flowchart

3.1.2 Shopper's side System Flowchart

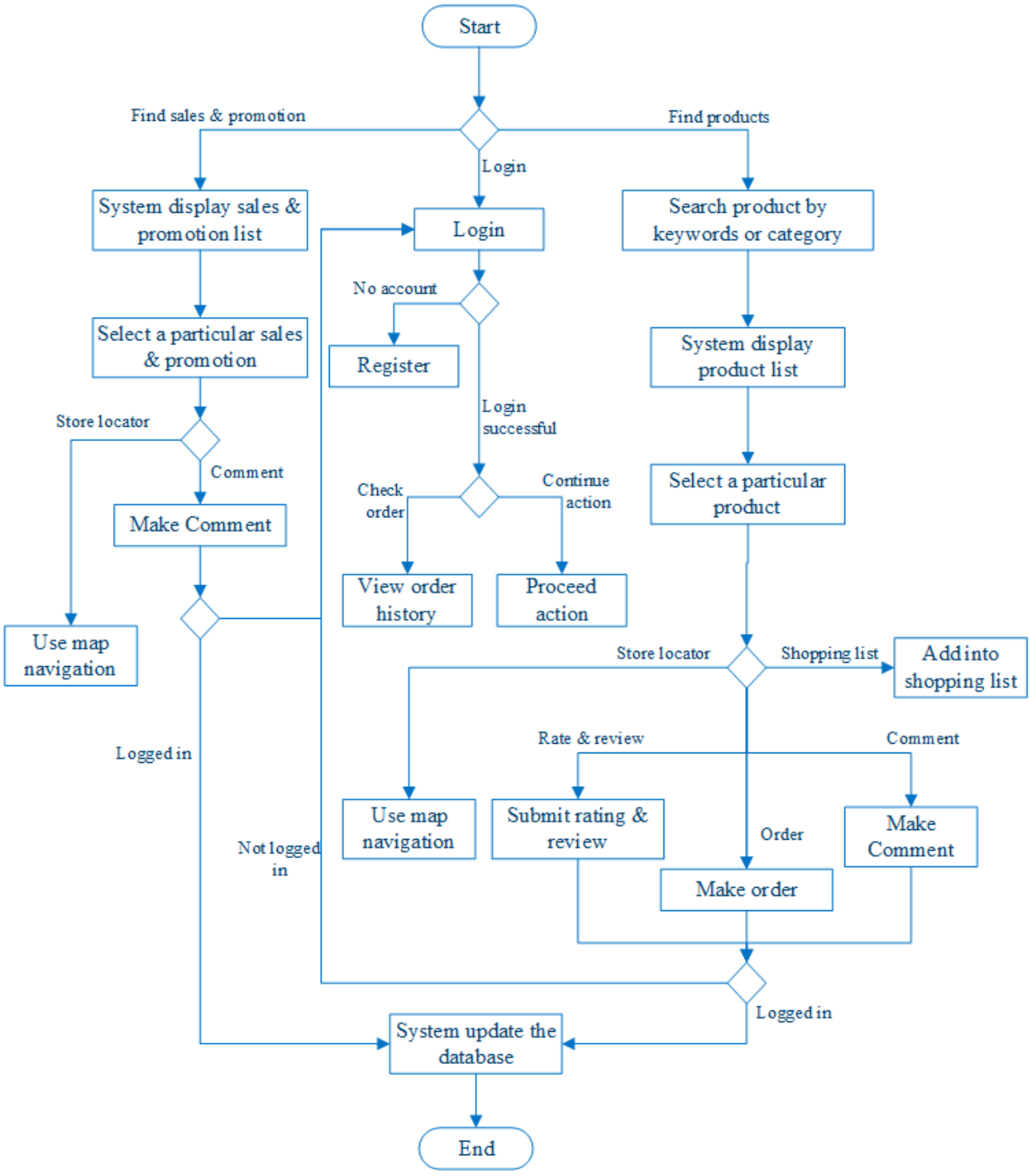

Figure 3-2 Shopper's side system flowchart

3.2 Use Case Diagram

Use Case diagram represents the interaction of the user with the system. It shows the relationship between users and all of the use cases which involve the users.

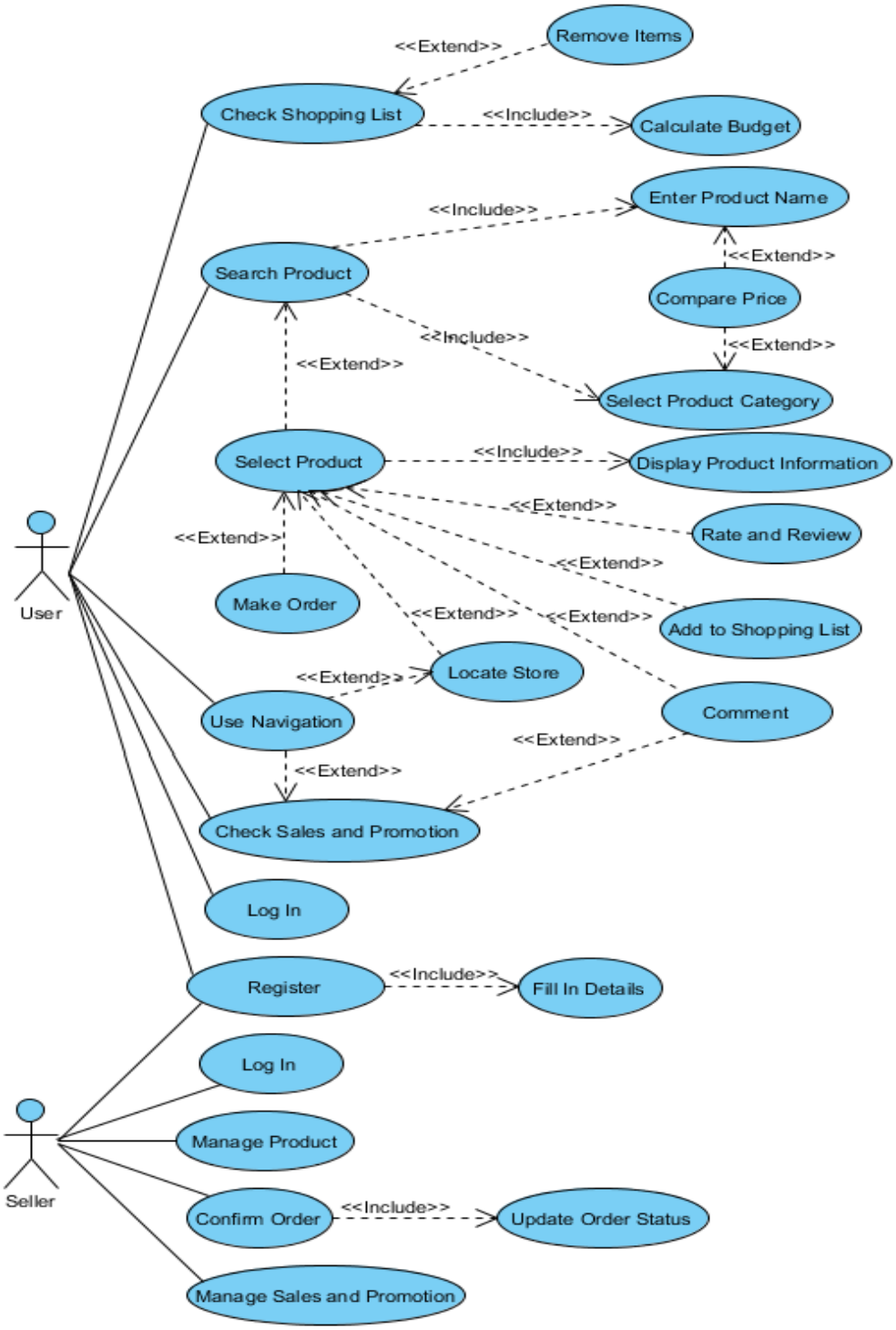

Figure 3-3 Use Case Diagram

3.3 Activity Diagram

The activity diagram is a representation of process flow for every activities performed in the system.

Log In

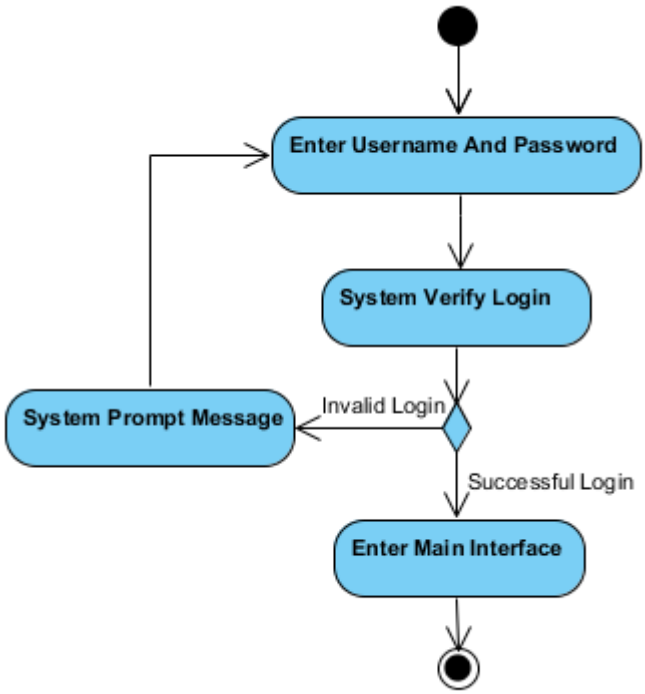

Figure 3-4 Log In Activity Diagram

User is required to enter username and password before log in to the system. Once user click to proceed to login, the system will verify the login to check whether the login is valid. If the login is invalid, system message is shown to user and they need to re-enter username and password correctly. If login is successful, user enters the main interface of the application.

Register

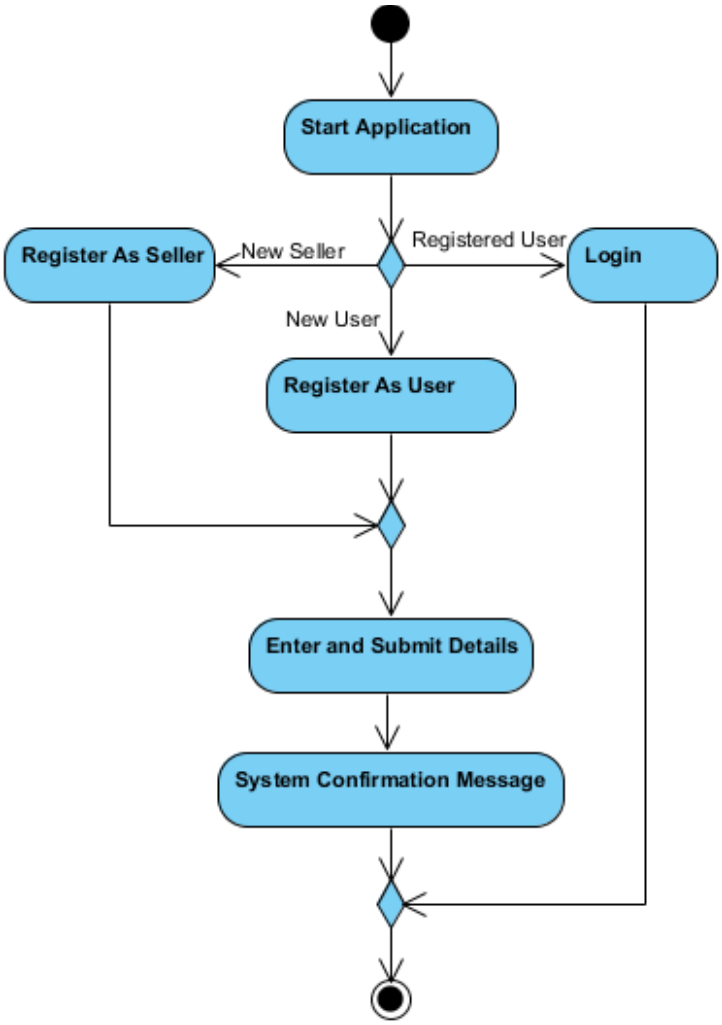

Figure 3-5 Register Activity Diagram

If the user has already registered, he/she can proceed to login. Else, he/she can choose to register as user or register as seller. He/she is required to fill in the details in registration form and submit it. Once the details are filled completely, system will shows confirmation message to user indicating the register is successful.

Check Sales and Promotion

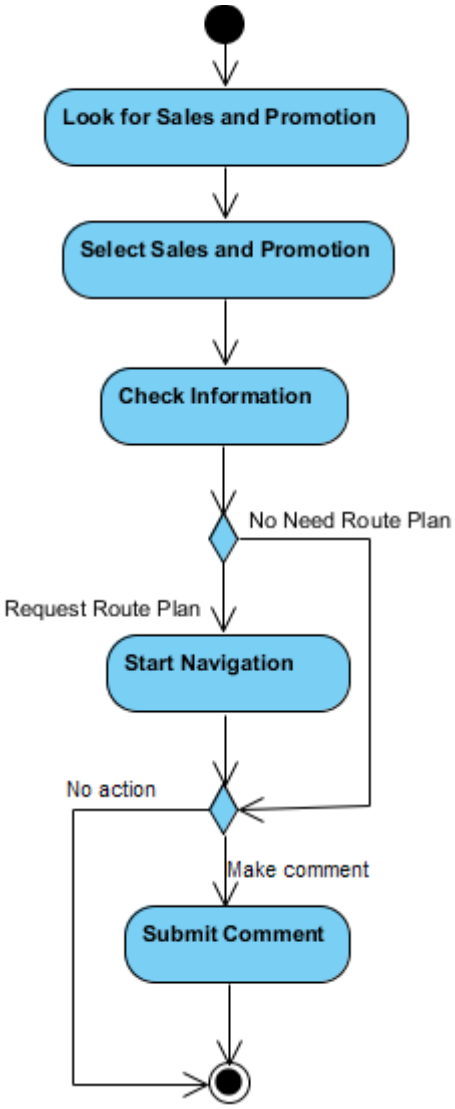

Figure 3-6 Check Sales and Promotion Activity Diagram

User is able to check the page listing all the sales and promotion. Then, user can select particular sales and promotion, and then a page containing the sales and promotion information will be shown to user. If user request route plan, navigation will be started. If no route plan is requested, the activity is ended directly. User can also make a comment if they are logged in.

Search Product

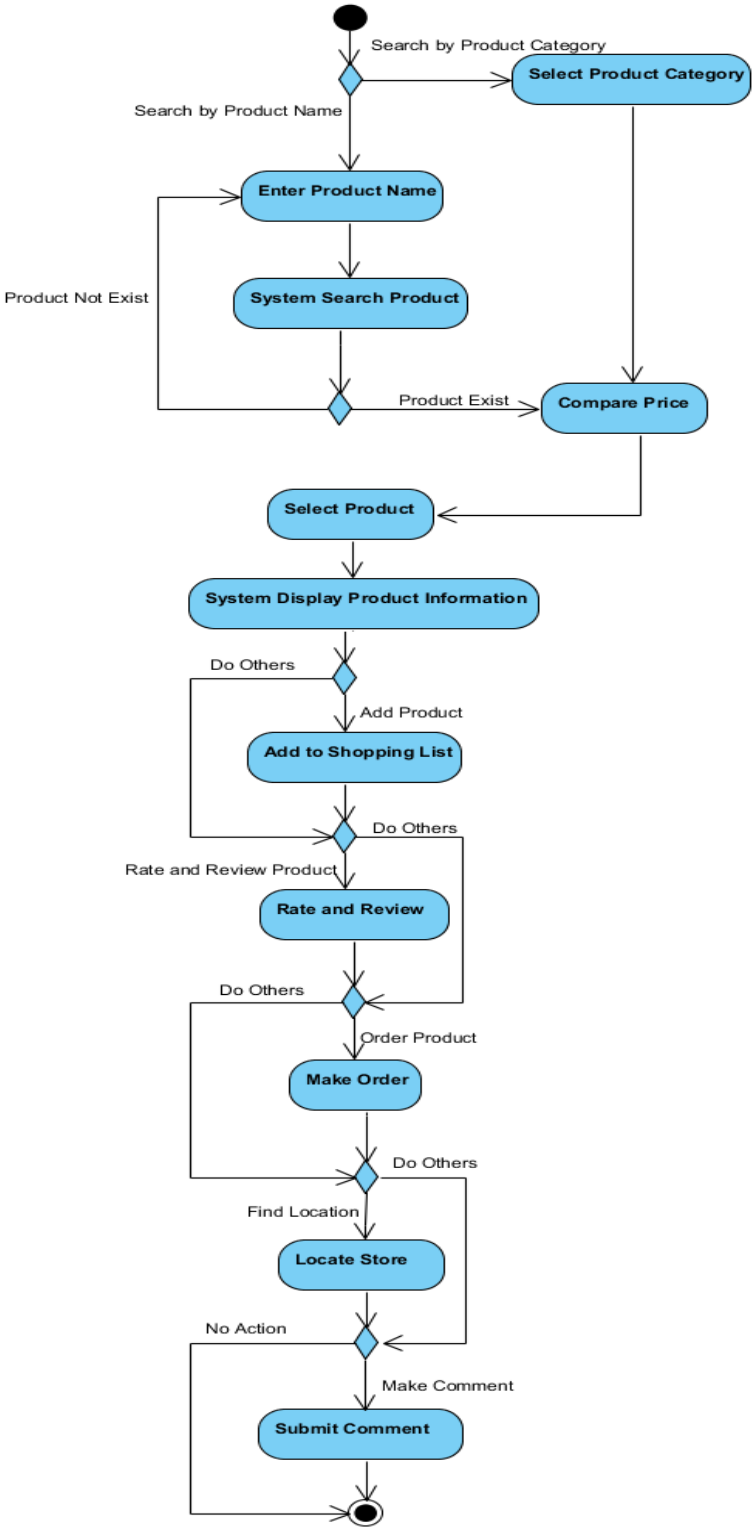

Figure 3-7 Search Product Activity Diagram

User can search for product by enter the product name or select through product category. Once user enter product name, system will search for the product. If the product does not exist, system will notify user that no product is found. A page containing all the relevant products is shown to user so that he/she can make price comparison. Once user selects a particular product, product information page is displayed to user. In the page, user can perform certain actions such as add to shopping list, rate and review, make order, locate store and make comment.

Use Navigation

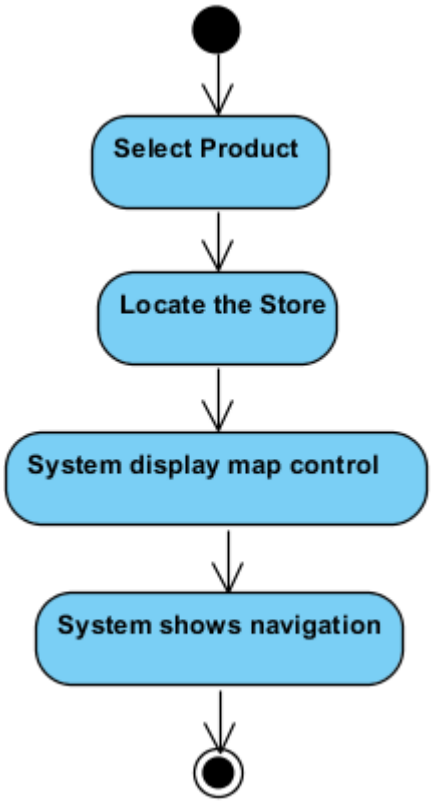

Figure 3-8 Use Navigation Activity Diagram

Once user selected the product and click on locate the store, system will display the map automatically and work out the navigation to the store.

Check Shopping List

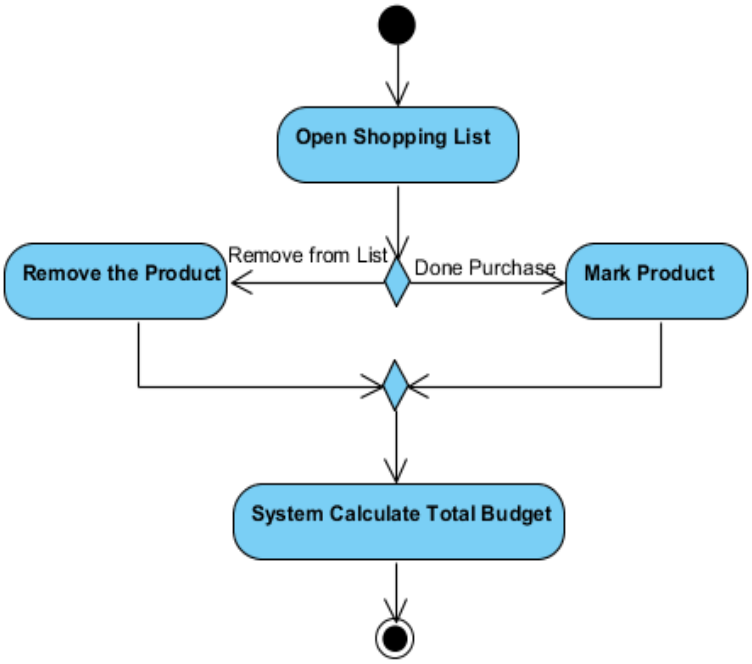

Figure 3-9 Check Shopping List Activity Diagram

User can check shopping list by open the shopping list from the application. Then, user is able to remove the product from the list or mark the product as done. Later on, system will calculate the total budget from all the items in the shopping list.

Manage Product

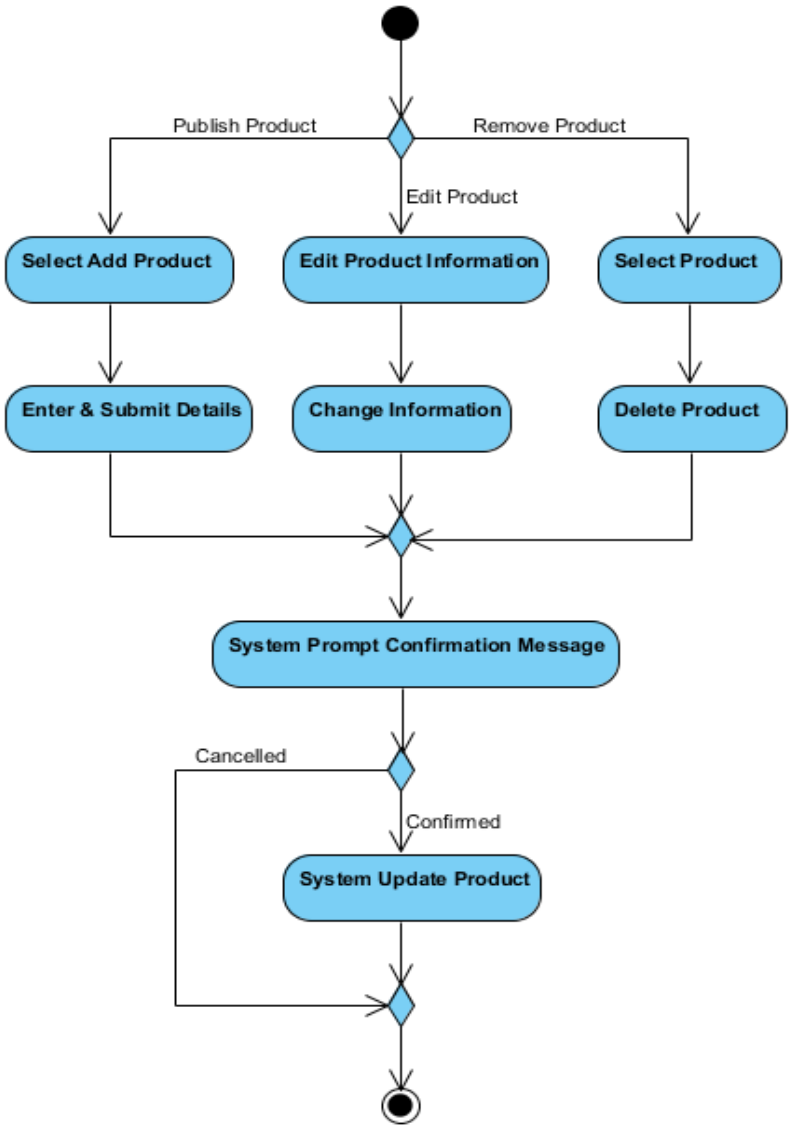

Figure 3-10 Manage Product Activity Diagram

Seller can manage product with three actions, which are add product, edit product and remove product. In adding product, seller needs to fill in details and submit it. In editing product, seller can change the information for the selected product. To delete product, user is required to select a particular product. After these action, system will shows message to make a confirmation with user. Once confirmed, the product list will be updated automatically.

Manage Sales and Promotion

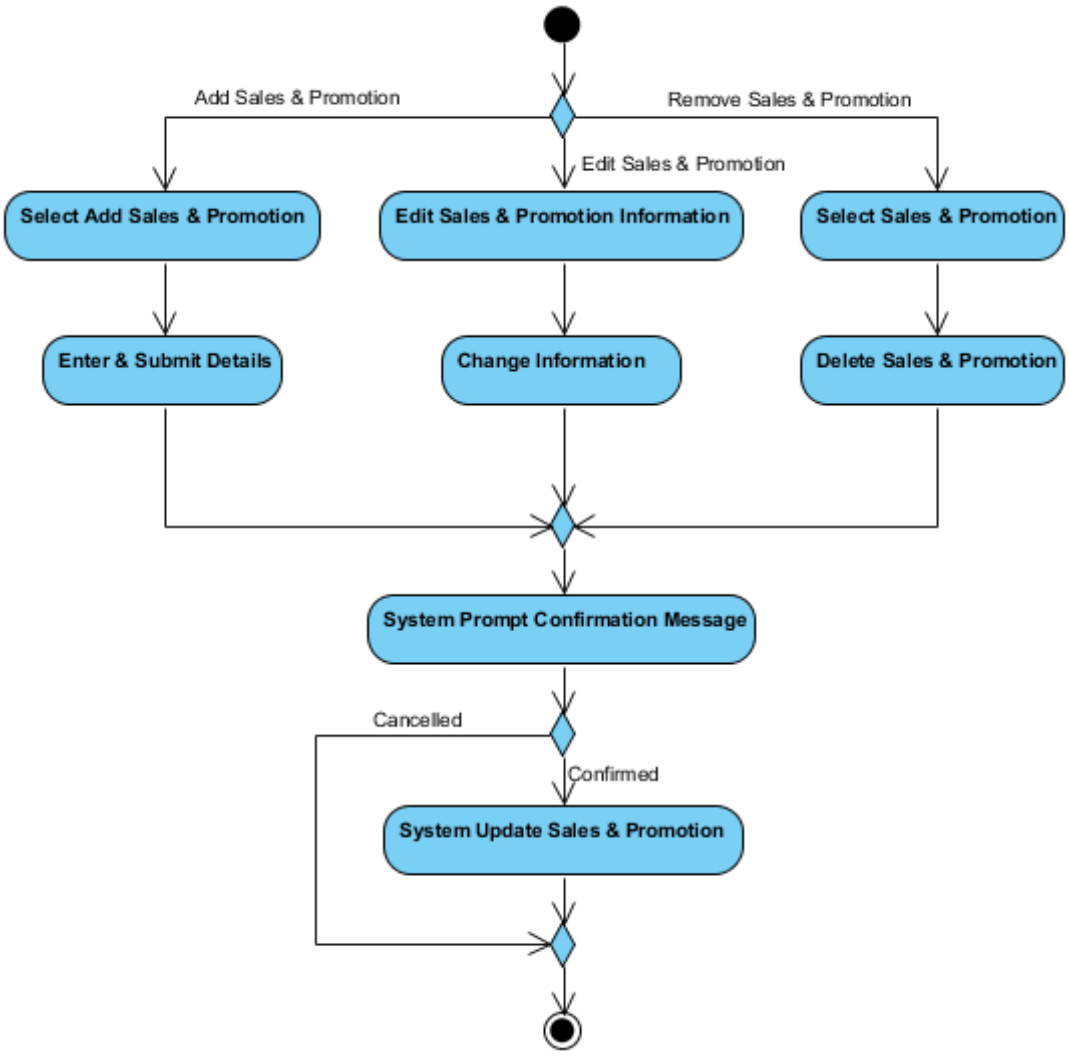

Figure 3-11 Manage Sales and Promotion Activity Diagram

Seller can manage sales and promotions with three actions, which are add, edit and delete. In adding sales and promotions, seller needs to fill in details and submit it. In editing sales and promotions, seller can change the information for the selected sales and promotions. To delete sales and promotions, user is required to select a particular sales and promotions. After these action, system will shows message to make a confirmation with user. Once confirmed, the sales and promotions list will be updated automatically.

Confirm Order

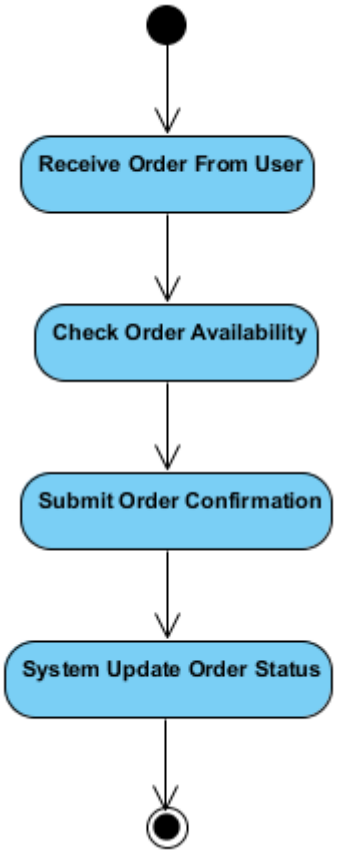

Figure 3-12 Confirm Order Activity Diagram

Once user makes an order, seller will receive the order immediately. First, seller has to check whether the order is available. After checking, seller will send the order confirmation to user. Then, the order status for the user will be updated automatically in order to inform user.

3.4 Sequence Diagram

Sequence diagram is an interaction diagram showing how and in what order the processes operate with one another.

Search Product

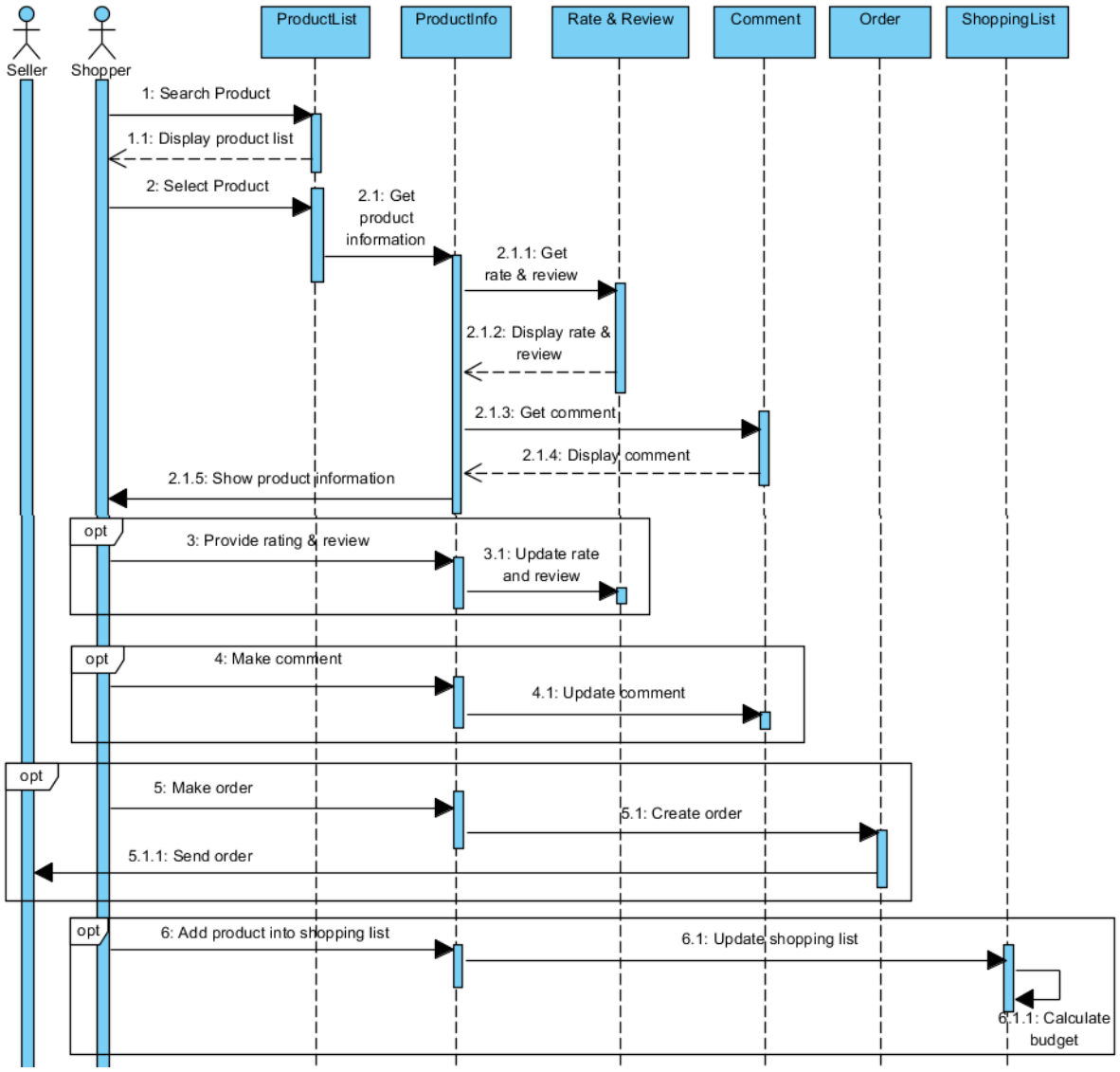

Figure 3-13 Search product sequence diagram

Manage Order

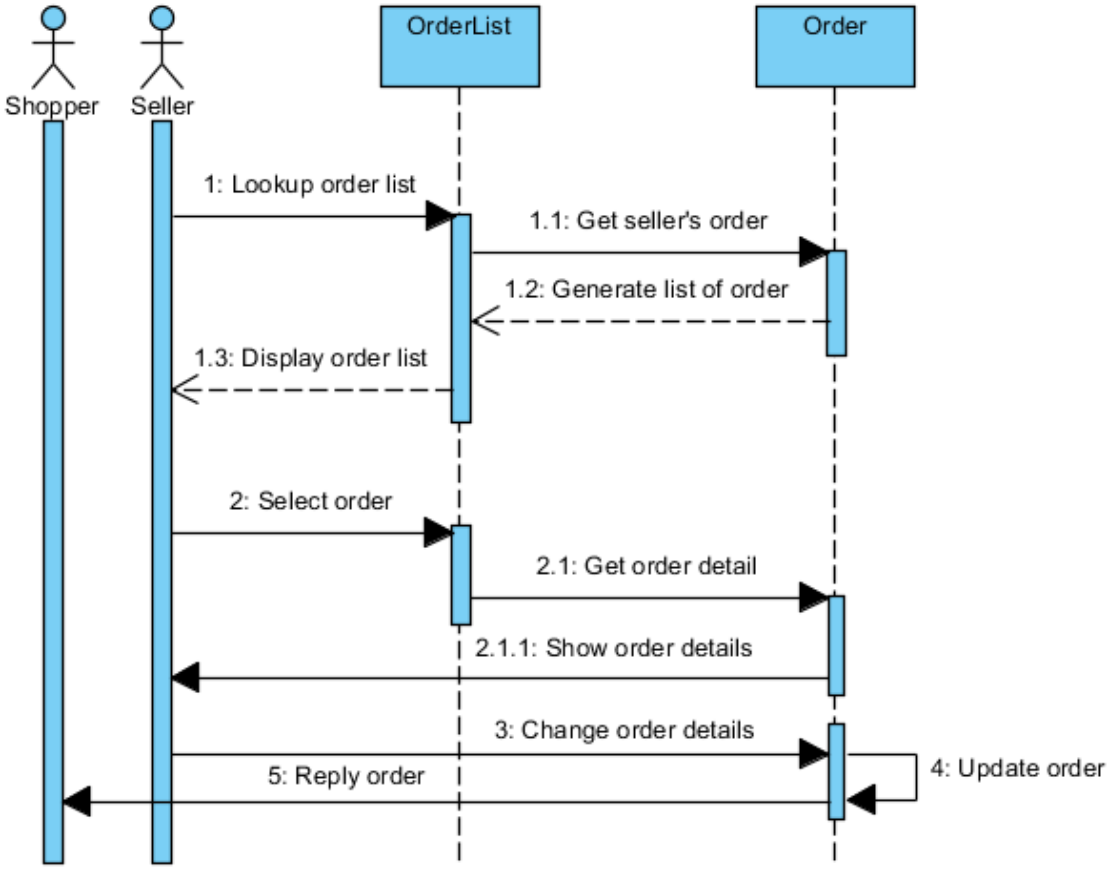

Figure 3-14 Manage order sequence diagram

Manage Product

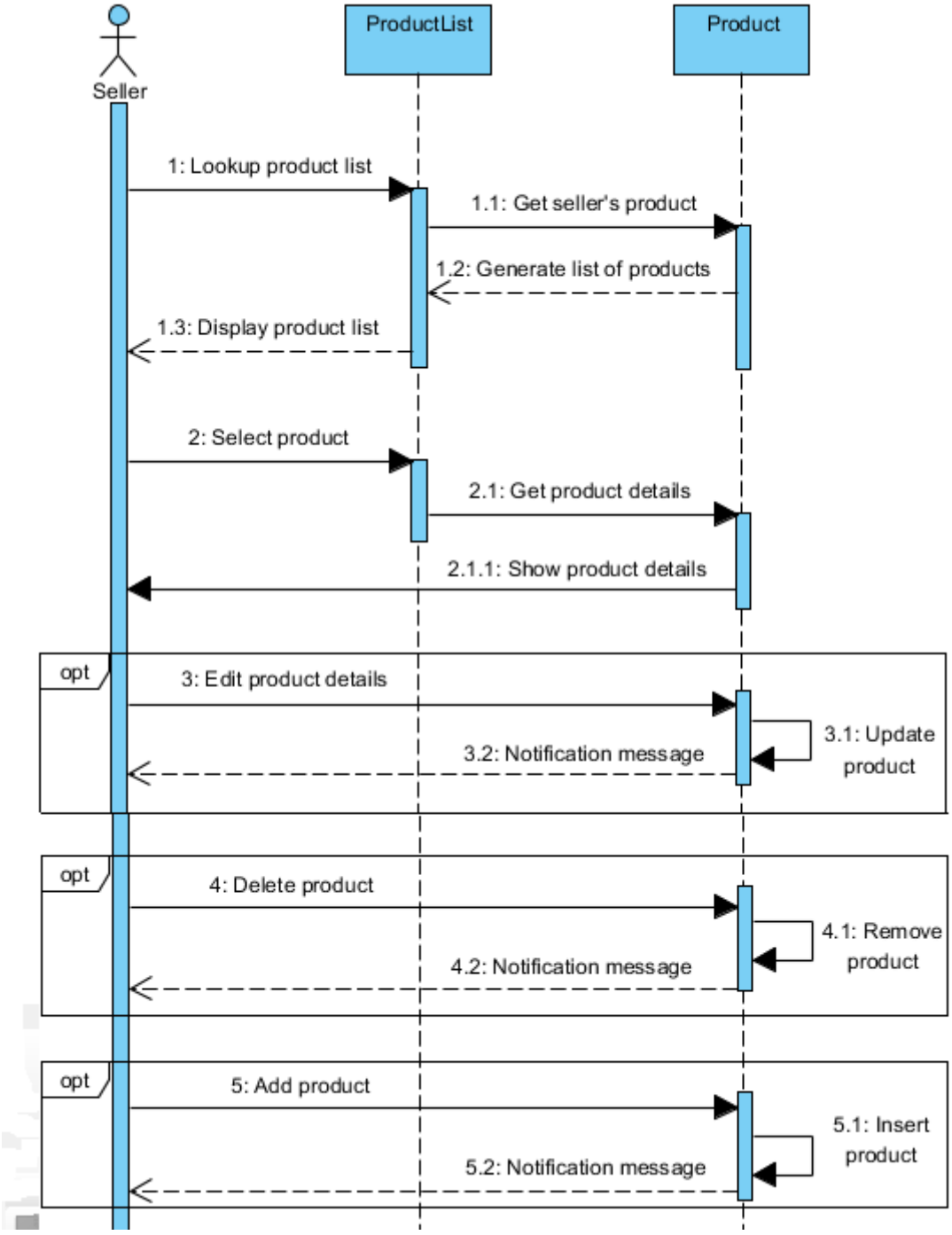

Figure 3-15 Manage product sequence diagram

Manage Sales and Promotion (S&P)

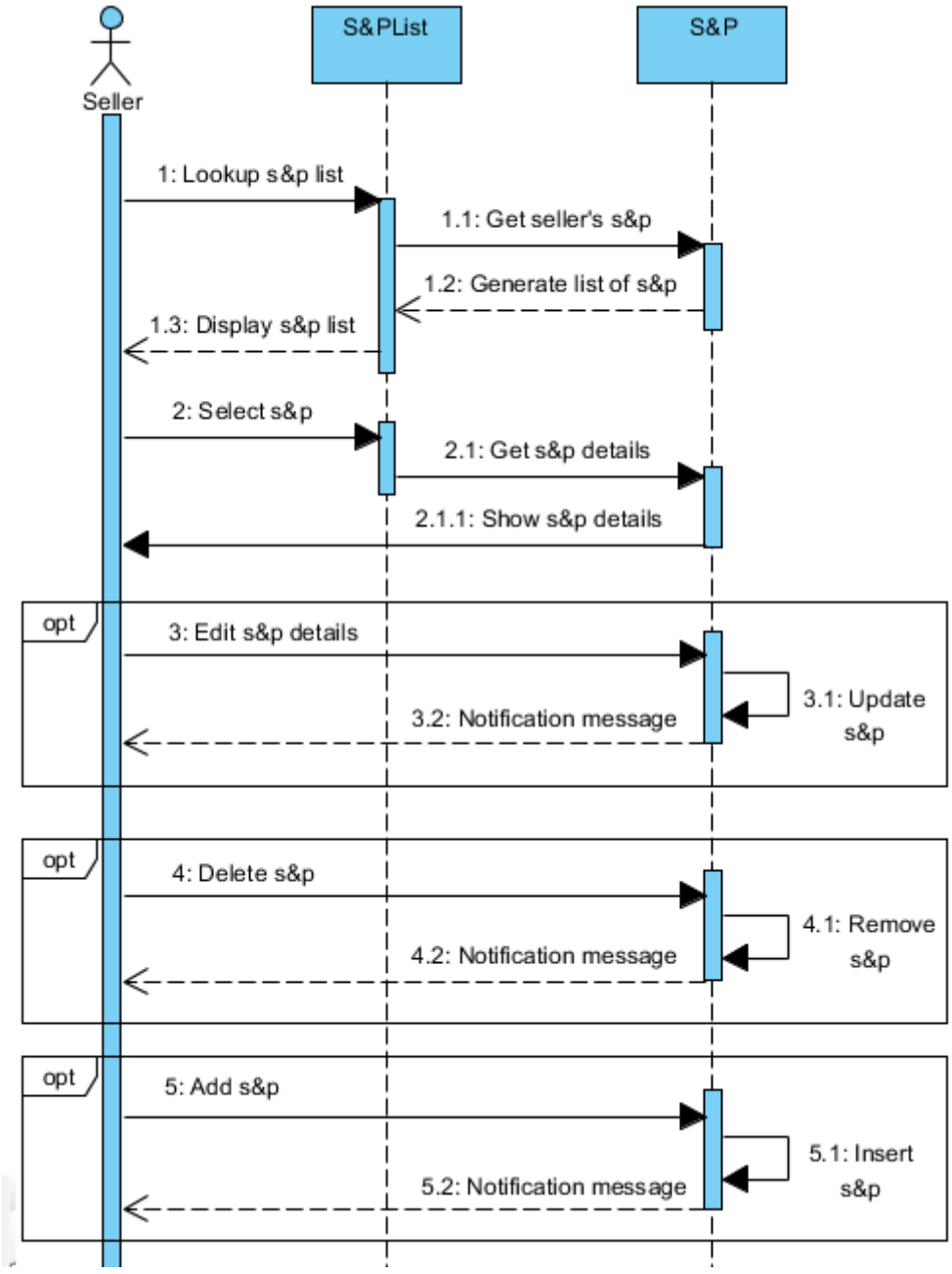

Figure 3-16 Manage sales and promotion sequence diagram

3.5 Entity Relationship Diagram (ERD)

Entity Relationship Diagram is a data model that describes the data or information of a business domain and its process requirements. It is a representation of the relational database being implemented in the system.

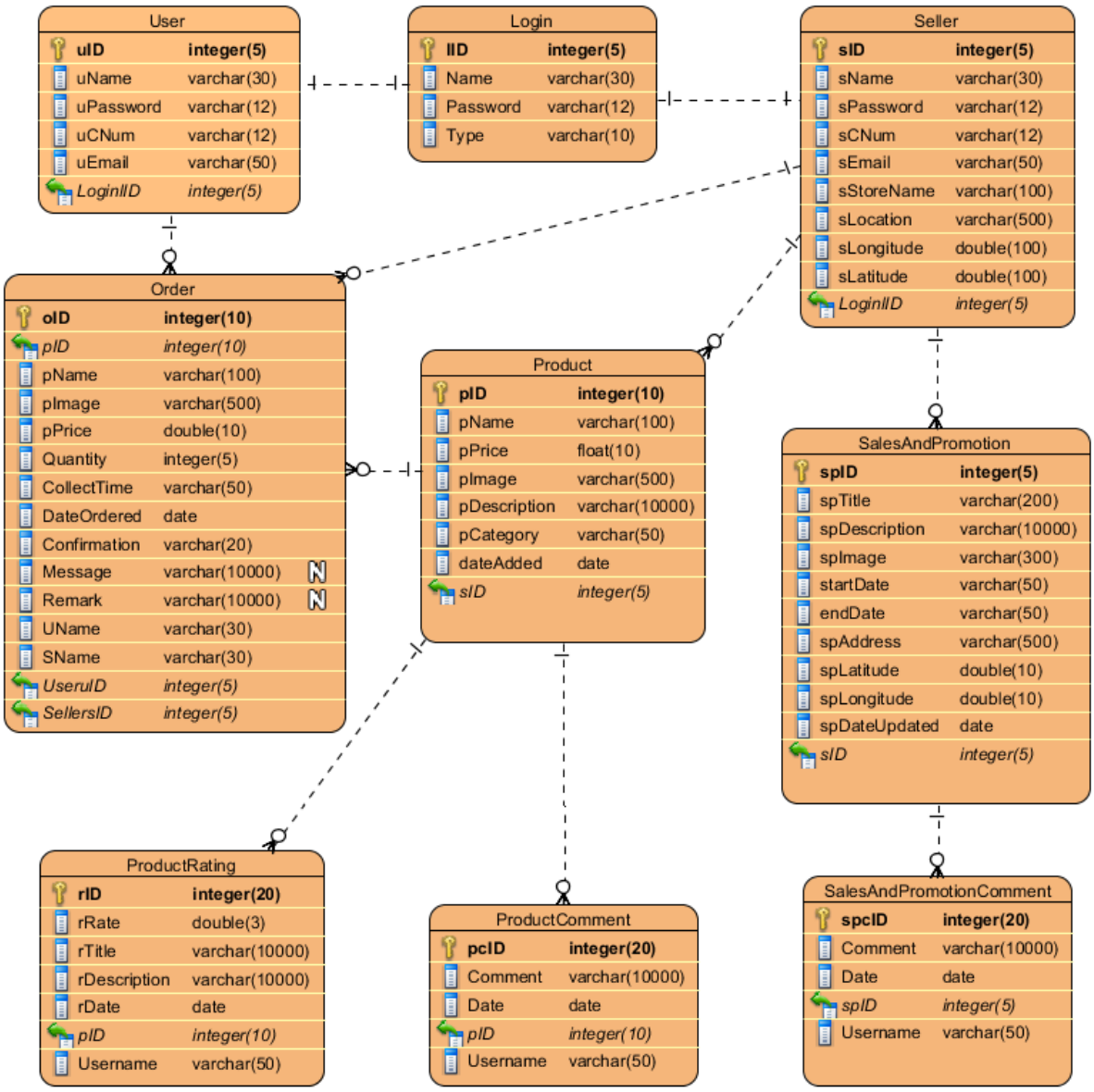

Figure 3-17 Entity Relationship Diagram

3.6 Data Dictionary

I. Product Entity

Name	Attributes	Description	Data Type	Null
Product	pID	Unique identification of product	Integer(10)	No
	pName	Name of the product	Varchar(100)	No
	pPrice	Price of the product	Float(10)	No
	pImage	Image of the product	Varchar(500)	No
	pDescription	Description of the product	Varchar(10000)	No
	pCategory	Category of the product	Varchar(50)	No
	dateAdded	Date added of the product	Date	No
	sID	Unique identification of seller	Varchar(5)	No

Table 3-1 Product entity

II. Sales and Promotion Entity

Name	Attributes	Description	Data Type	Null
SalesAndPromotion	spID	Unique identification of sales and promotion	Integer (5)	No
	spTitle	Title of the sales and promotion	Varchar(50)	No
	spDescription	Description of sales and promotion	Varchar(10000)	No
	spImage	Image of sales and promotion	Varchar(10000)	No
	startDate	Starting date of sales and promotion	Varchar(50)	No
	endDate	Ending date of sales and promotion	Varchar(50)	No
	spAddress	Address of the store	Varchar(100)	No
	spLatitude	Latitude of the address coordinate	Double(10)	No
	spLongitude	Longitude of the address coordinate	Double(10)	No
	spDateUpdated	Date updated of the sales and promotion	date	No
	sID	Unique identification of seller	Integer (5)	No

Table 3-2 Sales and Promotion entity

III. Seller Entity

Name	Attributes	Description	Data Type	Null
Seller	sID	Unique identification of seller	Integer (5)	No
	sName	Login name of the seller	Varchar(30)	No
	sPassword	Login password of the seller	Varchar(12)	No
	sLocation	Location of the store	Varchar(500)	No
	sCNum	Contact number of the seller	Varchar(12)	No
	sStoreName	Store name of the seller	Varchar(100)	No
	SEmail	Email address of seller	Varchar(30)	No
	sLongitude	Longitude of the address coordinate	Double(10)	No
	sLatitude	Latitude of the address coordinate	Double(10)	No
	LoginlID	Unique identification of login of seller	Integer(5)	No

Table 3-3 Seller entity

IV. Login Entity

Name	Attributes	Description	Data Type	Null
Login	lID	Unique identification of login	Integer(5)	No
	Name	Username of the login user	Varchar(30)	No
	Password	Password of the login user	Varchar(12)	No
	Type	Type of the user	Varchar(10)	No

Table 3-4 Login entity

V. Order Entity

Name	Attributes	Description	Date Type	Null
Order	oID	Unique identification of order	Integer(10)	No
	pID	Unique identification of product	Integer(10)	No
	pName	Name of the product	Varchar(100)	No
	pImage	Image of the product	Varchar(500)	No
	pPrice	Price of the product	Double(10)	No

	Quantity	Quantity of the product ordered	Integer(5)	No
	Collecttime	Collect time of the order by shopper	Varchar(50)	No
	DateOrdered	Date ordered by the shopper	Date	No
	Confirmation	Order confirmation status by seller	Varchar(20)	No
	Message	Message sent by seller	Varchar(10000)	Yes
	Remark	Remark sent by shopper	Varchar(10000)	Yes
	UName	Username of the shopper	Varchar(30)	No
	SName	Username of the seller	Varchar(30)	No
	UseruID	Unique identification of shopper	Integer(5)	No
	SellersID	Unique identification of seller	Integer(5)	No

Table 3-5 Order entity

VI. User Entity

Name	Attributes	Description	Data Type	Null
User	uID	Unique identification of shopper	Integer(5)	No
	uName	Login name of the shopper	Varchar(30)	No
	uPassword	Login password of the shopper	Varchar(12)	No
	uCNum	Contact number of the shopper	Varchar(12)	No
	uEmail	Email of the shopper	Varchar(50)	No
	LoginlID	Unique identification of the login user	Integer(5)	No

Table 3-6 User entity

VII. Rate and Review Entity

Name	Attributes	Description	Data Type	Null
ProductRating	rID	Unique identification of rate and review	Integer(5)	No
	rRate	Rating on the product	Double(3)	No
	rTitle	Review title on the product	Varchar(10000)	No
	rDescription	Review description on the product	Varchar(10000)	No

	rDate	Date of rate and review by user	Date	No
	pID	Unique identification of product	Integer(5)	No
	Username	Username providing rate and review	Varchar(50)	No

Table 3-7 Rate and Review entity

VIII. Product Comment Entity

Name	Attributes	Description	Data Type	Null
ProductComment	pcID	Unique identification of product comment	Integer(20)	No
	Comment	Comment made by user	Varchar(10000)	No
	Date	Date of comment made	Date	No
	pID	Unique identification of product	Integer(10)	No
	Username	Username making the comment	Varchar(30)	No

Table 3-8 Product Comment entity

IX. Sales and Promotion Comment Entity

Name	Attributes	Description	Data Type	Null
SalesAndPromotionComment	spcID	Unique identification of sales and promotion comment	Integer(20)	No
	Comment	Comment made by user	Varchar(10000)	No
	Date	Date of comment made	Date	No
	spID	Unique identification of sales and promtion	Integer(5)	No
	Username	Username making the comment	Varchar(30)	No

Table 3-9 Sales and Promotion Comment entity

3.7 Context Diagram

Context diagram is a diagram that defines the boundary between the system and its environment, showing the entities that interact with it. It provides a high level view of a system.

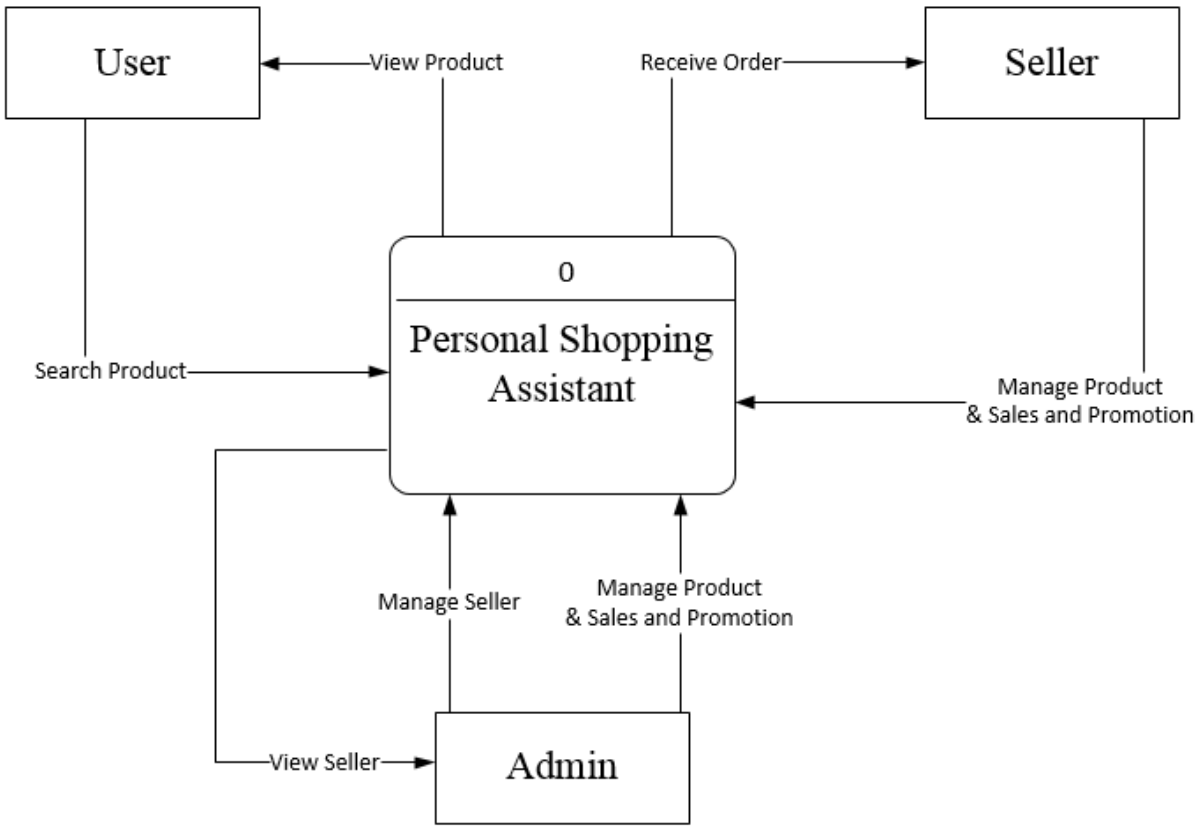

Figure 3-18 Context Diagram

3.8 Level-1 Data Flow Diagram (DFD)

It is a diagram that shows how the data flow through the entire system. The diagram visualizes the data processing and provides an overview of the system.

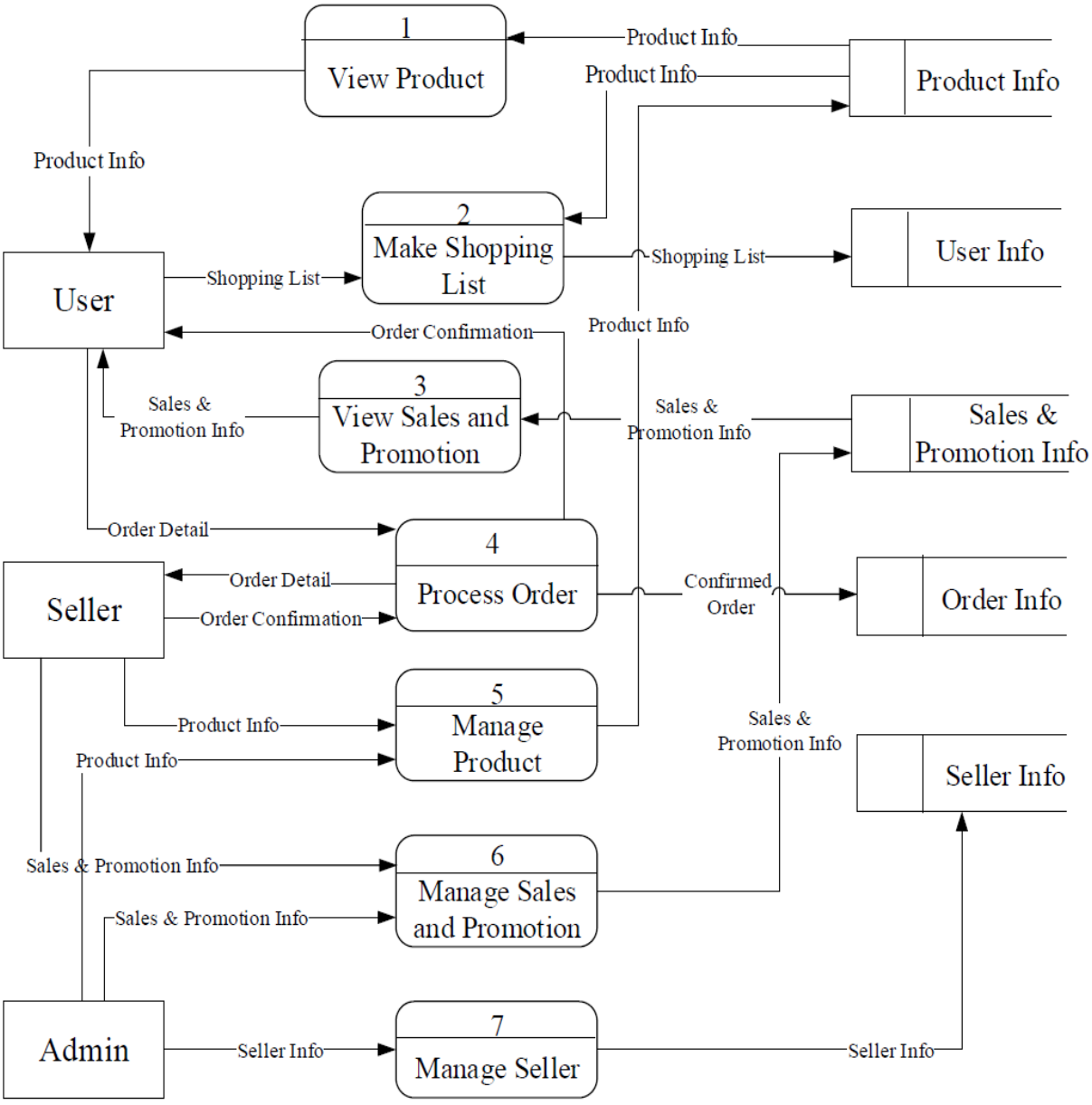

Figure 3-19 Level-1 Data Flow Diagram

3.9 System Architecture Diagram

System Architecture Diagram is a diagram consists of conceptual model which represents the behaviour, structure, and a complete view of the system. It comprised of system components, externally visible properties of these components, and the relationships between them.

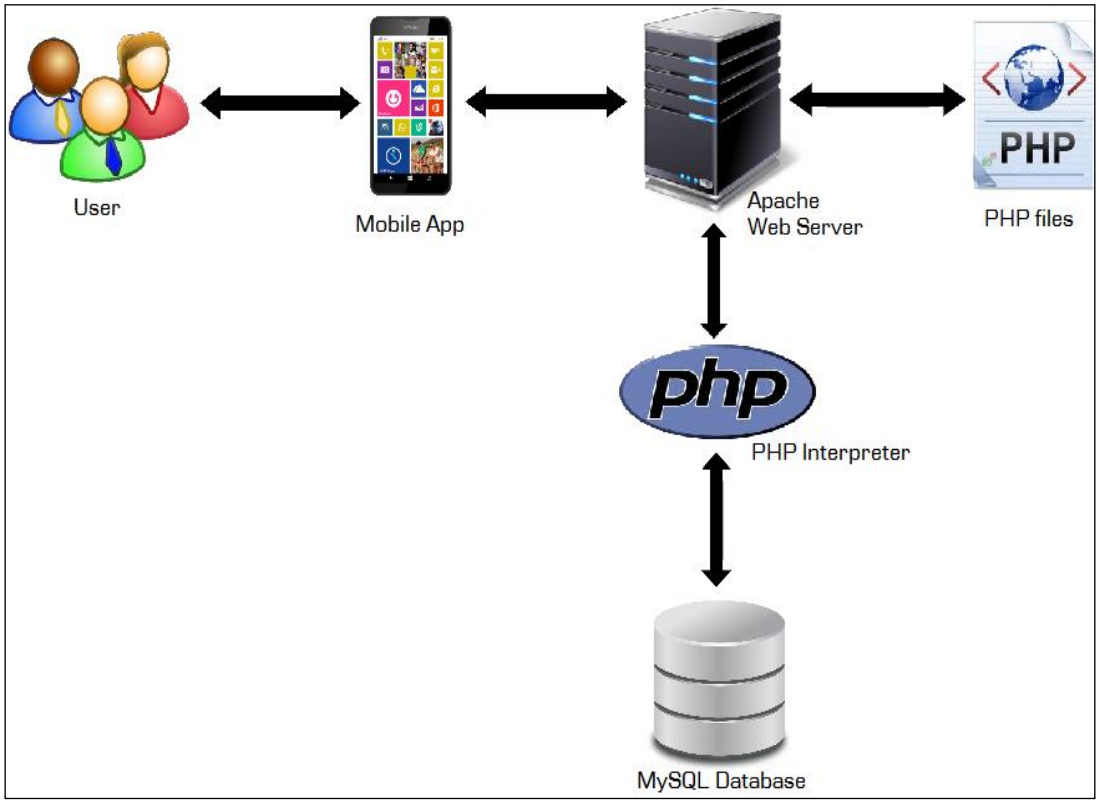

Figure 3-20 System Architecture Diagram

First, user will access the Personal Shopping Assistant mobile application through smartphones. The mobile application will then send PHP page request to the Apache web server. Web server will collect the requested PHP page from its document root (www folder in WAMP). The content of the PHP file is sent to PHP interpreter for the purpose of interpreting the PHP code and executes it. Database operation is performed when required to fetch or save data in the database. If the PHP code has any output, PHP interpreter will generates the output and sends it to web server. The web server immediately sends the content to mobile application and renders it to user's screen.

Chapter 4: Methodology and Tool

4.1 Type of Methodologies

System development life cycle (SDLC) is a methodology consists of planning, analysis, design, implementation, testing and maintaining information system. There are a various number of methodologies exist for developers to choose in the process of developing a system. An appropriate and suitable methodology is required in the development of the system to ensure a quality system will be delivered. Therefore, to select the most suitable methodology for this project, I have studied and compared three types of methodologies, which are waterfall development, iterative and incremental development, and spiral development.

4.1.1 Waterfall Development

Waterfall Model is the oldest and most well-known among the SDLC models. Waterfall model's main feature is its sequential steps, in which the process flows downward through each of the phases. Due to its intensive documentation and planning, waterfall model is very suitable for projects which majorly concerned on quality control. The stages carried out in this model are not overlapping stages as it begins and ends one stage before starting the next one.

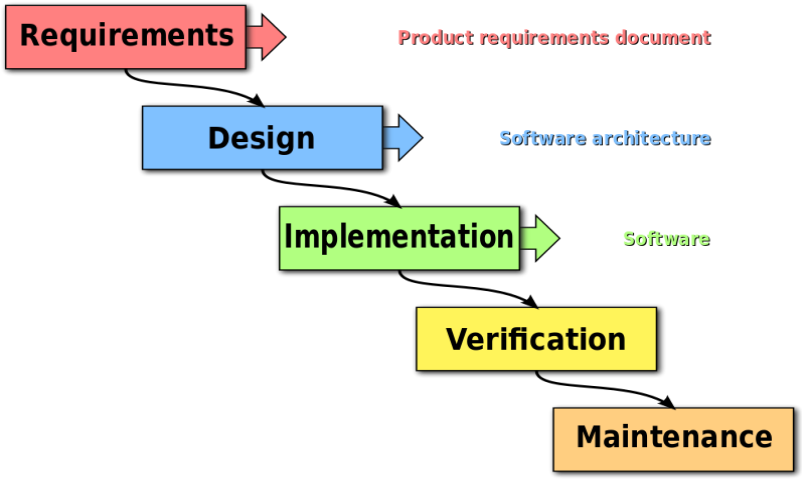

Figure 4-1 Waterfall Model (Wikipedia, 2015)

Below are the advantages and disadvantages in using waterfall development.

Advantages	Disadvantages
Detailed requirements are identified in early stage before moving on to the next stage in order to prevent requirement changes.	All of the requirements must be known upfront before developing the system.
Widely used and known because it is easy to understand and implement.	Backtracking in the stage to solve mistakes is difficult.
Phases are carried out and finished one at a time.	High risk and uncertainty because small changes or errors arise may cause a lot of problems.
	User involvement in the project is low as users have little opportunity to preview the system and provide feedback.
	Unsuitable model for complex and object-oriented projects.

Table 4-1 Advantages and Disadvantages of Waterfall Development

4.1.2 Iterative and Incremental Development

It is a software development which combines iterative method with incremental build model. Iterative and Incremental Development model allows developer to develop a system in a repetitive manner and in a smaller portion at a time. The idea of this methodology is that developer will first build an initial version of the system, and then being tested by user. The developer will then further improve the system according to the feedback from user. For each of the iteration process, design is modified and new functional capability is added. The evolving version of the system will be built iteratively until a full system is implemented.

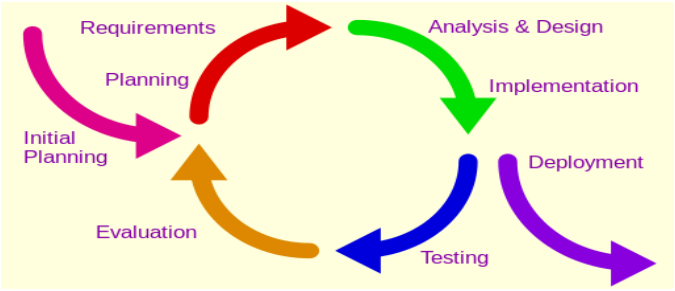

Figure 4-2 Iterative and Incremental Models (Wikipedia, 2015)

There are advantages and disadvantages in using Iterative and Incremental Development as shown in table 4-2.

Advantages	Disadvantages
The requirement changes are allowed and risk of failure can be reduced.	A complete and fully functional system need to be defined earlier to allow the definition of every increment.
Developers are able to obtain lessons after every incremental delivery, resulting in positive revision for next increment.	Requires users to involve actively in the project to provide feedback frequently.
Able to deliver important functionality to user earlier so that they can respond and provide feedback for each build.	Requires heavy documentation.
High-risk or major functions can be developed first so that it can be tested earlier to prevent failure in the system.	

Table 4-2 Iterative and Incremental Development Advantages and Disadvantages

4.1.3 Spiral Development

It is a software development which combines both the design and prototyping stages, so that to gain the benefits from bottom-up concepts and top-down concepts. This model breaks a project into smaller segments because of the major concern on risk assessment and minimizing project risk, thus provides better ease-of-change throughout the development. In spiral model, the developer starts with s small set of requirements and goes through each of the development phases for those set of requirements. Thus, developers have an opportunity to learn new lessons from initial

iteration. In every increasing "spirals", functionality for additional requirements will be added by developer until the system is ready for implementation and maintenance phase. Each of the iteration prior to the product version is known as a prototype for the application.

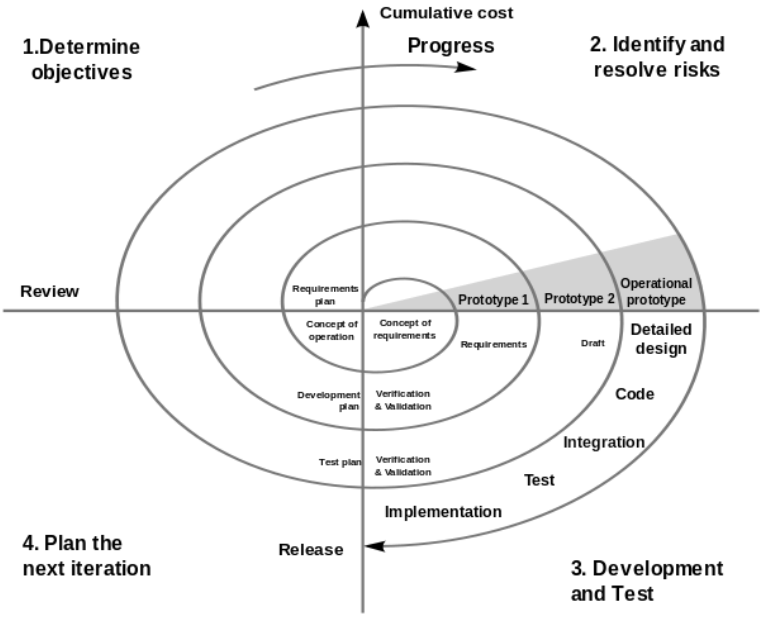

Figure 4-3 Spiral Model (Boehm, 2000)

Below are the advantages and disadvantages of using Spiral Development.

Advantages	Disadvantages
Additional functionality can be added to the system later.	Cost involved is usually high.
High amount of risk analysis.	Risk assessment expertise is required.
User can review each phase and loop earlier due of rapid prototyping tools, thus provide early and frequent feedback.	The success of project depends highly in risk analysis phase.
System can be produced early in the system life cycle.	Large amount of time consumed in the process of risk evaluation for small and low-risk projects
Suitable for developing a highly customized product.	

Table 4-3 Advantages and Disadvantages of Spiral Development

4.2 Comparison between Methodologies

	Waterfall	Iterative and Incremental	Spiral
All of the requirements must be specified in the beginning.	Yes	No	No
Frequently hanging requirements.	Not suitable	Suitable	Suitable
Complex & long-term Project	Not suitable	Suitable	Suitable
Cost	Low	High	High
Flexibility	No	High	Low
Component reusability	High	High	Low
Testing	Late	After every iteration	After each phase
Maintenance	Least maintainable	Maintainable	Maintainable
Guarantee of success	Low	High	High
User involvement	Low	High	Low
Ease of Implementation	Easy	Easy	Complex

Table 4-4 Comparison between Methodologies

4.3 Chosen Methodology

In this project, based on the comparison above, Incremental & Iterative Development from Agile Development has been chosen as a methodology in developing the mobile application. The main reason of choosing this methodology is due to easy implementation, the system development is flexible as the system can be modified and improved through the project lifecycle due to frequently changing requirements, high component reusability, all of the requirements do not need to specify in the beginning, testing is done after every iteration to reduce the risk of failure in the final system, system is maintainable and high guarantee of success.

In Iterative and Incremental Development, there are 7 stages which are Planning, Analysis, Design, Implementation, Testing, Evaluation and Deployment. All of these stages are carried out in the system development.

1st stage – Planning

In the beginning of the project development, planning has been done. After proposing the project idea to supervisor, a project named "Personal Shopping Assistant" has been produced. Then, decision had made to develop the project in mobile application as it is considered the fact that shopping assistant application would be more useful and convenient to user if it is used in portable mobile device which allow them to use it at anywhere and anytime.

During planning, other than doing research on similar application, opinion has been collected from a few people regarding the project, such as what problems they faced during shopping, what features they preferred in the application and what impact the application will do to them. The functionalities and flow of the proposed system are then identified. After that, the scope of the project is also known.

The problem statements are created from the opinions and researches done. Based on the problem statements, the project objectives have been defined, in which the main objective is to save people's time and cost during shopping.

2nd stage – Analysis

First, the requirements for the system are analysed. Literature reviews based on the previous existing similar application has been done. In the literature reviews, the concept and features of the existing application has been studied. From the review, information has been obtained in term of system feature, way to implement the system, basic requirements of the system and so on. This information will be included into consideration in developing the project.

Besides that, survey has been conducted with the students in the university by using a questionnaire created. The result from the survey is that developer can know what user expected from the proposed system, therefore the user requirements of the project are known easily. After the literature review and survey, the requirements including functional and non-functional requirements are gathered. These requirements are an essential part in the project as the system will be developed based on it. Later, a system requirement document consists of the list of functional and a non-functional requirement is created.

Moreover, a collection of methodology is studied and compared to define the most suitable methodology to be used in the project. Lastly, a methodology is chosen considering the advantages and appropriateness for this project.

3rd stage – Design

In this stage, the requirements are organized and used in designing the system. The system design is necessary to understand the detail of the process flow in the system and how each of the feature works. Several types of diagrams have been drawn in the report. Besides that, the design of database is also done. Entity Relationship Diagram (ERD) is created to show all the entities included in the whole system. All the data elements in the system are included and assigned properly to give a clear picture of the whole system database. Normalization is then performed from the tables to remove data redundancy.

Moreover, decision on user interface of proposed system is made. The appearance of the application must be appropriate and attractive and functions in the

application must be clearly stated. The interface design on the system included the layout of the application, component used in the interface, position of information being displayed, number of links in a single interface, and colour and font used in the interface.

4th stage – Implementation

During this stage, the database is first created based on the database design. After the creation of database, development of initial version of system is begin based on the requirements gathered from the analysis stage. The system is developed using a specified programming language and a suitable tool. During implementation, user interface is designed and feature is later added into the system. Development of the partial version of the system must be done in a reasonably short time as the methodology focuses on the functions in term of breadth rather than depth.

5th stage - Testing

After the system has been developed, testing is required to be done on the system. The user is required to input the test data into the system, and then check whether the output is as expected. The testing result will then be recorded for the system evaluation purpose. During testing, four stages of testing will be carried out. Below are the description of every stages of testing.

i) Unit testing

Unit testing is a software testing method in which each of the individual components in the system is tested. The testing is done for every single unit in the program, in which a unit is referred to entire interface such as a class. The purpose of unit testing is isolating every part in the program and validates its correctness. In the application, there are several individual units will be tested with test cases which are stated in the verification plan.

ii) Integration testing

Integration testing is performed when the individual components in the system are integrated and tested as group. The goal of integration testing is to determine functional, reliability and performance requirements on the major designed items.

One of the approach will be used in integration testing is bottom up testing. The lowest level components will be first tested, and then used to assist the testing of components in higher level. Firstly, all the low-level components are integrated and tested, and then next level components which are formed will be used for integration testing. The testing is repeated until the testing is done for the component at top hierarchy.

iii) System testing

System testing will be performed when the system is fully integrated in order to evaluate whether the system comply with all of the specified requirements. The purpose is to detect inconsistencies between all of the software units which are integrated.

Black-box testing technique will be used during system testing. It is used to examine the functionality of the system without peering into its internal structures or workings. The test cases for this test are derived from user requirements specification and system requirements definition.

iv) Acceptance testing

Acceptance testing will be carried out after system testing is completed. The application is delivered to a user and the user runs black-box acceptance test based on their expectations of the functionality in the system. The aim of acceptance testing is to ensure the system meets user requirements and works as intended for the user so that user will accept it.

6th stage – Evaluation

Evaluation is made on the system to check whether the system functions as expected. Based on the testing by user, it is determined whether the system meets the user requirements. Later, decision will be made on whether the system will go into next iteration or incremental on existing functions is required. If the user wants to have more function on the system, the system will go into next iteration where the development will go back to planning stage. If the user wants to enhance the existing function, then the system will go through incremental which lead the development to go back to the planning stage as well.

7th – Deployment

In this stage, the developed system has meet all the user requirements and all of the functions work as expected to support user in performing tasks. Thus, the system is finally ready for deployment and ready to be used by the user. The whole process of development is documented to ensure the developed system is easy to maintain in the future, in the meanwhile guide users in operating the system.

4.4 Technologies Involved

4.4.1 Microsoft Visual Studio 2013

Microsoft Visual Studio is used as the main tool in developing the mobile application. Windows Phone SDK 8.1 is installed in the Microsoft Visual Studio 2013. It is a Windows phone development tool that allows developer to code in mobile platform and also provides a Windows Phone Emulator for developer to run and test the program.

Extensible Application Markup Language (XAML) is used to create and design the user interface of the application. The interface design is quick and simple because of the drag and drop tool, which does not require developer to code manually.

C# is used as the programming language in the code behind to process the application at client side such as performing function, validation checking, and sending request to web server. The reason of choosing C# is because the structure code is easier to be reuse due to its object-oriented programming and encapsulation.

Moreover, it has type safety which allows developers to detect and isolate bugs faster and easier at compile time. The build, run and test cycle in mobile development is lengthened because the program is required to be specialized packaged and deployed into the emulator or mobile device. Therefore, type safety is an important characteristic as developers are able to find obvious errors without having to wait until the program crashes.

4.4.2 Hypertext Preprocessor (PHP)

This is a server-side scripting language used for the mobile application. The purpose of using PHP is to process the request sent by the user and then generate output to the user's mobile device. The code in the PHP file is processed in order to perform database operation for fetching or saving data into database based on the request sent from the application. The main reason of choosing PHP is because it is very easy to use. PHP does not require to be compiled but instead, the script only needed to be written and then upload to the server. Besides that, PHP provide

integrated database support due to the built-in support for various popular databases, such as MySQL (database used in this project). The MySQL functions can be used directly without requiring installation of additional drivers.

4.4.3 MySQL

In this project, MySQL database is used because it needs to provide storage to store large amount of data provided from both the user's and seller's side. Therefore, these data can later be retrieved from the database when request is made from the mobile application. Besides that, phpMyAdmin which is a web-based admin tool is used to handle the administration of MySQL database over the web.

4.4.4 Apache Server v2.4.9

In this project, Apache Server is used as a web server to handle the request between mobile application and database. The main reason of using Apache Server is because it is free and provides support for PHP as a server-side scripting language. On the other hand, it is a powerful web server software that comes with a numbers of features and has a long history of reliability and performance.

4.5 Requirements gathering

Firstly, the target user of the proposed system is those mobile users whom often use mobile phone in performing their daily task. This is due to the main focus of proposed mobile application is on user perspective about how the application will affect their shopping activities. Therefore, the opinion from them would be useful in facilitating developer in developing the project.

In requirements gathering, the technique used is conduct survey by using questionnaire. The questionnaire was distributed to a group of mobile user. In the questionnaire, the target users were asked about the preferred feature of the proposed application, how the application will affect their life and the outcome they expected from the application.

The reason of using questionnaire is because it is a cost effective and time saving method to collect information from a large number of people. Besides that, results collected from the questionnaire can be analysed immediately and easily as they are well documented.

Moreover, another technique is document analysis. Information is gathered by studying and analysing some of the previously existing similar application. The feature and design of the application can be taken into further consideration in developing the project.

Through the requirement gathering, there are some user requirements being defined. The user requirement consists of both functional and non-functional requirements.

Chapter 5 Seller's side System Flowchart Specification

5.1 Description

Seller is required to login before they can proceed to perform any action. If the seller is a new user and does not have an account, he or she can register as a seller by submitting required information. During registration, seller is required to fill in a valid address of the store so that the system will work out the coordinate of the location and store it in the database. After seller has logged in, the system will prompt into the seller's main page which consists of the list of orders sent by shoppers. From the list of orders, seller can select a particular order to update the status and make a confirmation with shopper.

Seller can select "Manage Products" in which the system will prompt into a page consist of the list or products added by the seller. Seller can choose to add product, in which the system will prompt into another page consisting of a form which requires seller to fill in the product information. From the product list, he or she can also choose to edit or delete a particular product. To edit product, system will prompt user into another page consisting of a form which requires seller to change the information. A confirmation message will be sent to seller if they choose to delete a product. After seller performs any of the action, system will update the database and sent a notification message to the seller in order to let them acknowledge that the action is successful.

Besides that, seller can also select "Manage Sales & Promotion" in which the system will prompt into a page consisting of the list of sales and promotion events added by the seller. When seller chooses to add or edit, the system will prompt into a page consisting of a form which requires seller to fill in or change the information. A confirmation message will be sent to seller if they choose to delete a particular sales and promotion. System will update the database after any action done by seller, and notification message will be sent to seller to inform about the successful action.

5.2 User Requirements

5.2.1 Functional requirements

1. Register

   This application should allow user registration as a seller before he or she can login and perform any action.

2. Manage products

   The application should allow user to add product by submitting required information, edit product by changing the information and delete product.

3. Manage sales and promotion

   The application should allow user to add sales and promotion by submitting required information, edit sales and promotion by changing the information as well as delete sales and promotion.

4. Manage order

   The application should allow user to check the order and update the order status.

5. Interact with shopper

   The application should allow user to interact with shopper through comment on product or sales and promotion page.

5.2.2 Non-functional requirements

1. User friendliness

   The application must have a simple and attractive interface, and displaying well-organized information to make sure user understand how to use it.

2. Performance

   The application should update the database after actions done by user in a reasonably short time.

3. Usability

   The application should provide functions or features which is helpful and easy for user to perform task.

4. Extensibility

   The application should be able to extend through the addition of new functionality or modification of existing functionality.

5.3 Verification Plan

i) Register

No	Test Case	Attribute and Value	Expected Result
1	Select "Register As Seller", fills in every detail and submits.	Username: S01 Password: 654321 Contact: 01234567 Email: tlkhor@gmail.com Store: Nike Shop Address: 10, Jln Seksyen 3/9, 31900 Bandar Barat, Kampar	Display notification message to indicate user register is successful.
2	Select "Register As Seller" and submit blank details.		Unable to register and error message is shown to user to indicate invalid input data.
3	Select "Register As Seller", fills in detail with used username and submits.	Username: S01 Password: 654321 Contact: 01234567 Email: tlkhor@gmail.com Store: Nike Shop Address: 10, Jln Seksyen 3/9, 31900 Bandar Barat, Kampar	Unable to register and error message is shown to user to inform about invalid username.

Table 5-1 Register verification plan

ii) Login

No	Test Case	Attribute and Value	Expected Result
1	Verify user login once "Login" button is clicked with valid input data.	Username: S01 Password: 654321	Successfully log into the main interface of the application as seller.
3	Verify user login once "Login" button is clicked with invalid input data.	Username: S01 Password: 654333	Unable to login and error message is shown to the user.

Table 5-2 Login verification plan

iii) Manage order

No	Test Case	Attribute and Value	Expected Result
1	User selects an order, enter order information and submit.	Order status: Available Message: Please collect your order on time.	Shopper received an order update which indicates the availability of the order.

Table 5-3 Manage order verification plan

iv) Manage product

No	Test Case	Attribute and Value	Expected Result
1	Select "Add", fills in details and submits.	Image: nike.jpg Name: Nike AirMax Price: RM 199 Category: Shoe Description: New arrival!	Product list is added with one product.
2	Select "Add" and submit blank details.	Image: Name: Price: Category: Description:	Product is not added and error message is shown to user to inform about invalid input data.
3	Select a particular product and click "Delete".		The product is removed from the product list.
4	Select a particular product and click "Edit", change the information and submit.	Name: Nike AirMax 501 Price: RM 250	The product information is updated and shown in product list.
5	Select a particular product and click "Edit", left information blank and submit.	Name: Nike AirMax 501 Price:	Product is not modified and error message is shown to user to inform about invalid input data.

Table 5-4 Manage Product verification plan

v) Manage sales and promotion

No	Test Case	Attribute and Value	Expected Result
1	Select "Add", fills in details and submits.	Image: sales.jpg Title: Nike warehouse sales Start: 13/3/2016 End: 16/3/2016 Address: 10, Jln Seksyen 3/9, 31900 Bandar Barat, Kampar Description: 50% discount!	Sales and promotion list is added with one event.
2	Select "Add" and submit blank details.	Image: Title: Start: End: Address: Description:	Event is not added and error message is shown to user to inform about invalid input data.
3	Select a particular event and click "Delete".		The event is removed from the sales and promotion list.
4	Select a particular event and click "Edit", change the information and submit.	Title: Nike stock clearance	The event information is updated and shown in sales and promotion list.
5	Select a particular event and click "Edit", left information blank and submit.	Title:	Event is not modified and error message is shown to user to inform about invalid input data.

Table 5-5 Manage sales and promotion verification plan

vi) Make comment

No	Test Case	Attribute and Value	Expected Result
1	Select a product, click "Comment", fill in comment and submit.	Comment: This is new arrival.	Comment section is updated with one comment.
2	Select a product, click "Comment", did not fill in comment and submit.	Comment:	Comment is not submitted and error message shown to user to inform about invalid input data.

Table 5-6 Make comment verification plan

Chapter 6: Shopper's side System Flowchart Specification

6.1 Description

Shopper can search for product by typing in the keywords or select a product category. System will then display a list of product as the search result and shopper can select a particular product. Shopper will be prompt into a page containing of more detailed information about the product such as price, description, seller's information, rating and comment. If shopper is interested to shop for the product, he or she can add it into shopping list. Shopper can select "Locate the store" if he or she does not know the location of the store and needs a route plan. System will then prompt into a page containing a map with highlighted path from shopper's current location to the seller's store.

Besides that, if shopper is logged in, he or she is allowed to make order by submitting the order information to the seller. Shopper can check the order history to view their previous orders or update on the orders. Shopper can also submit rating and review, and comment on the product page. These review and comment can be viewed by every user accessing the same product page.

Besides that, shopper can look for a list of sales and promotion event by selecting "Sales and Promotion". By choosing a particular event, system will prompt into a page containing more details about the sales and promotion event. Shopper can choose "Locate the store" in order to request a route plan from the system. On the other hand, comment can also be made on the sales and promotion page.

6.2 User Requirements

6.2.1 Functional requirements

1. Search for product

   The application should allow user to search for products by typing in keywords or selecting a product category.

2. Navigate to the store

   The application should allow user to find out the path from current location to the store's location through map navigation.

3. Sort the products

   The application should allow user to sort the products based on product price and distance from current location to the store.

4. Add product into shopping list

   The application should allow user to add products they intend to buy into a shopping list.

5. Estimate budget

   The application should allow user to find out the total budget from all the items added into the shopping list.

6. Provide rating and review

   The application should allow user to submit rating and review in order to provide a better experience for other users.

7. Make comment

   The application should allow user to make comment on every product in order to interact with other users for the purpose of making queries and exchanging information.

8. Find out sales and promotion event

   The application should allow user to look for sales and promotion event available so that to provide a better shopping experience.

9. Make order

   The application should allow user to make order with the seller to make sure the product is reserved for the user to avoid out-of-stock problem.

6.2.2 Non-functional Requirements

1. Usability

   The application should provide functions and features which is helpful and easy for user to learn and understand in performing any task.

2. User friendliness

   The application should have a simple and attractive appearance, and well-organized information in order to make sure user is not distracted and understand how to use it.

3. Performance

   The application should display the products from the search result and retrieve product information in a reasonably short time.

4. Accuracy

   The application should provide an accurate result from the product searching done by user.

5. Extensibility

   The application should be able to extend through the addition of new functionality or modification of existing functionality.

6. Effectiveness

   The application should provide functions or features which makes user's shopping planning more effective.

6.3 Verification Plan

i) Register

No	Test Case	Attribute and Value	Expected Result
1	Select "Register As Shopper", fills in every detail and submits.	Username: A01 Password: 654321 Contact: 01234567 Email: tlkhor@gmail.com	Display notification message to indicate user register is successful.
2	Select "Register As Shopper" and submit blank details.		Unable to register and error message is shown to user to indicate invalid input data.
3	Select "Register As Shopper", fills in detail with used username and submits.	Username: A01 Password: 654321 Contact: 01234567 Email: tlkhor@gmail.com	Unable to register and error message is shown to user to inform about invalid username.

Table 6-1 Register verification plan

ii) Login

No	Test Case	Attribute and Value	Expected Result
1	Verify user login once "Login" button is clicked with valid input data.	Username: A01 Password: 654321	Successfully log into the main interface of the application as shopper.
3	Verify user login once "Login" button is clicked with invalid input data.	Username: A01 Password: 654333	Unable to login and error message is shown to the user.

Table 6-2 Login verification plan

iii) Search product

No	Test Case	Attribute and Value	Expected Result
1	Type in product name and click "Search"	Search: Phone	Product list is displayed to user and matches the search result.
2	Select a product from product list.		The correct product information page is displayed to user.
3	Click "Search" after typing non-existing product.	Search: Tablet	System message is shown indicating no product is found.
4	Select a category from the product category list.		The product list under the selected category is displayed to user.

Table 6-3 Search product verification plan

iv) Shopping List

No	Test Case	Attribute and Value	Expected Result
1	Select a product and click "Add to Shopping List".		A product is added into the shopping list.
2	Select a product in shopping list and click "Remove".		The product is removed from the shopping list.
3	Go into shopping list and check budget.		The budget calculated shown to user matches the expected value.

Table 6-4 Shopping list verification plan

v) Make Order

No	Test Case	Attribute and Value	Expected Result
1	When logged in, click "Make Order" and submit order details.	Quantity: 2 Collect Date Time: 14/3/2016 3.15 PM Message: Red color	The order information is sent and displayed to seller.
2	When logged in, click "Make Order" and submit blank details.	Quantity: Collect Date Time: Message:	The order is not sent and error message display to user indicating invalid input data.
3	When not logged in, click "Make Order".		User is navigated to login page.

Table 6-5 Make order verification plan

vi) Provide rating and review

No	Test Case	Attribute and Value	Expected Result
1	When logged in, click "Rate and Review" and submit the details.	Rate: 3 Stars Title: Good product. Description: Can improve more.	The rate and review section in the product information page is updated.
2	When logged in, click "Rate and Review" and submit empty details.	Rate: Title: Description:	The rate and review is not submitted and error message is shown to user indicating invalid input data.
3	When not logged in, click "Rate and Review".		User is navigation to login page.

Table 6-6 Provide rating and review verification plan

vii) Make comment

No	Test Case	Attribute and Value	Expected Result
1	When logged in, click "Comment" and submit the details.	Comment: What colour is available?	The comment section in the product information page is updated.
2	When logged in, click "Comment" and submit empty details.	Comment:	The comment is not submitted and error message is shown to user indicating invalid input data.
3	When not logged in, click "Comment".		User is navigation to login page.

Table 6-7 Make comment verification plan

viii) Locate the store

No	Test Case	Attribute and Value	Expected Result
1	In the product/ sales and promotion information page, click "Locate the store".		User is navigated to another page with map indicating the correct path from current location to the store location.

Table 6-8 Locate the store verification plan

ix) Check sales and promotion

No	Test Case	Attribute and Value	Expected Result
1	Select "Sales and Promotion".		User is navigated to a page listing all sales and promotion.
2	Select a particular event from the list.		The correct sales and promotion information page is displayed to user.

Table 6-9 Check sales and promotion verification plan

Chapter 7: Conclusion

Mobile application has successfully brought a great impact on many industries. The mobile application does not only help in conducting business, it also facilitate mobile user to perform task and provide information to them. The motivation of this project is due to a number of problems exist among shoppers, therefore a mobile application named Personal Shopping Assistant is developed to provide solution to the shoppers.

This application provides product information to the shoppers, thus allowing them to compare products before making a shopping plan. Shoppers often face difficulty in finding the store to purchase the desired products, therefore the application can help them to locate the store and provide a route plan. Besides that, shoppers are able to avoid spending over budget limit because the application can help them to calculate their shopping budget automatically. Moreover, shoppers can get informed about sales and promotion event currently going on through the application in order to enhance their shopping experience. The application enables shoppers to provide rating and review which allows them to share their opinion and personal experience on the products, therefore helping others to have a better decision making in selecting products.

In in the progress of developing the mobile application, there are some problems encountered. One of the problems is time constraint because of the limited time allowed for system implementation. The application is built from scratch, thus designing the interface consumed a large amount of time. Errors and bugs are often discovered during system testing, thus solving the problems also occupied an amount of time. Challenges are faced in the process of user interface design. The screen size of mobile device is relatively small compared to desktop, therefore consideration must be taken carefully in making the interface simple yet attractive and displaying an appropriate amount of information in order to provide better user experience and high usability. Besides that, another challenge is to work out the mobile application to load data as minimum as possible. It is important to minimize the data to be loaded and

only displaying necessary data in the application in order to optimize the system performance.

In the future, there are improvements can be made on the Personal Shopping Assistant. Firstly, live chat feature can be embedded into the application. The feature will provide a direct and effective communication for every user by allowing them interact with each other. Therefore, users can send and receive messages from others immediately and avoiding the problem of missing out any messages. This feature has a great contribution in helping them to make queries and provide information to others in a better and efficient way. Bes

Lastly, Personal Shopping Assistant can solve all the problems faced by the shoppers by saving their time and cost during shopping because it is a tool to assist them in shopping activities. The application provides a number of features to help them to make a smarter shopping plan before going out to shop. Therefore, the mobile application can definitely makes their shopping activities easier and efficient. On the other hand, the application is also beneficial to seller because they can promote their products and promotion event without any cost.

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Appendix A: Survey Sheet

A.1 Questionnaire

Questionnaire

Name: _____

Age: _____

1. How often do you shop? _____

2. What tool do you use to make a shopping plan?

   ☐ Mobile device ☐ Paper note ☐ Computer ☐ Never Other: _____

3. Please rate the features you preferred. (1 being least preferred, 5 being most preferred)

Features	1	2	3	4	5
Provide store location					
Check product information					
Estimate budget					
Inform about promotion					
Do queue-less checkout					
Make order					
Item recommendation					
Make shopping list					
Scan item					
Rate and review product					

Other features: _____

4. Is the shopping assistant application useful for you?

   ☐ Yes ☐ Moderate ☐ No

5. How do you hope the shopping assistant application will help you during shopping?

   _____

Appendix B: Charts and Data Table

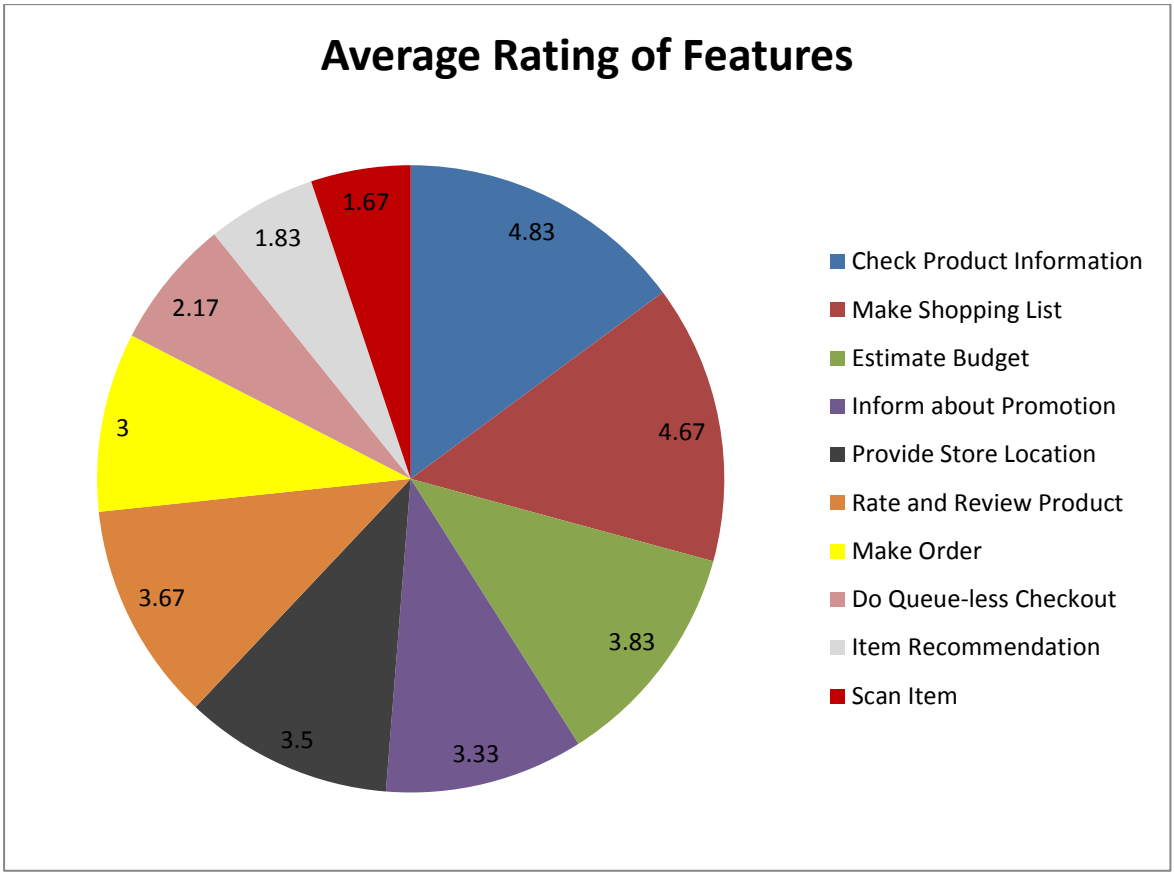
B.1 Data Table

Data Table

Features	Average Rating	Preference Level
Provide store location	3.50	High
Check product information	4.83	Most
Estimate budget	3.83	High
Inform about promotion	3.33	Moderate
Do queue-less checkout	2.17	Low
Make order	3.00	Moderate
Item recommendation	1.83	Low
Make shopping list	4.67	Most
Scan item	1.67	Low
Rate and review product	3.67	High

B.2 Bar Chart

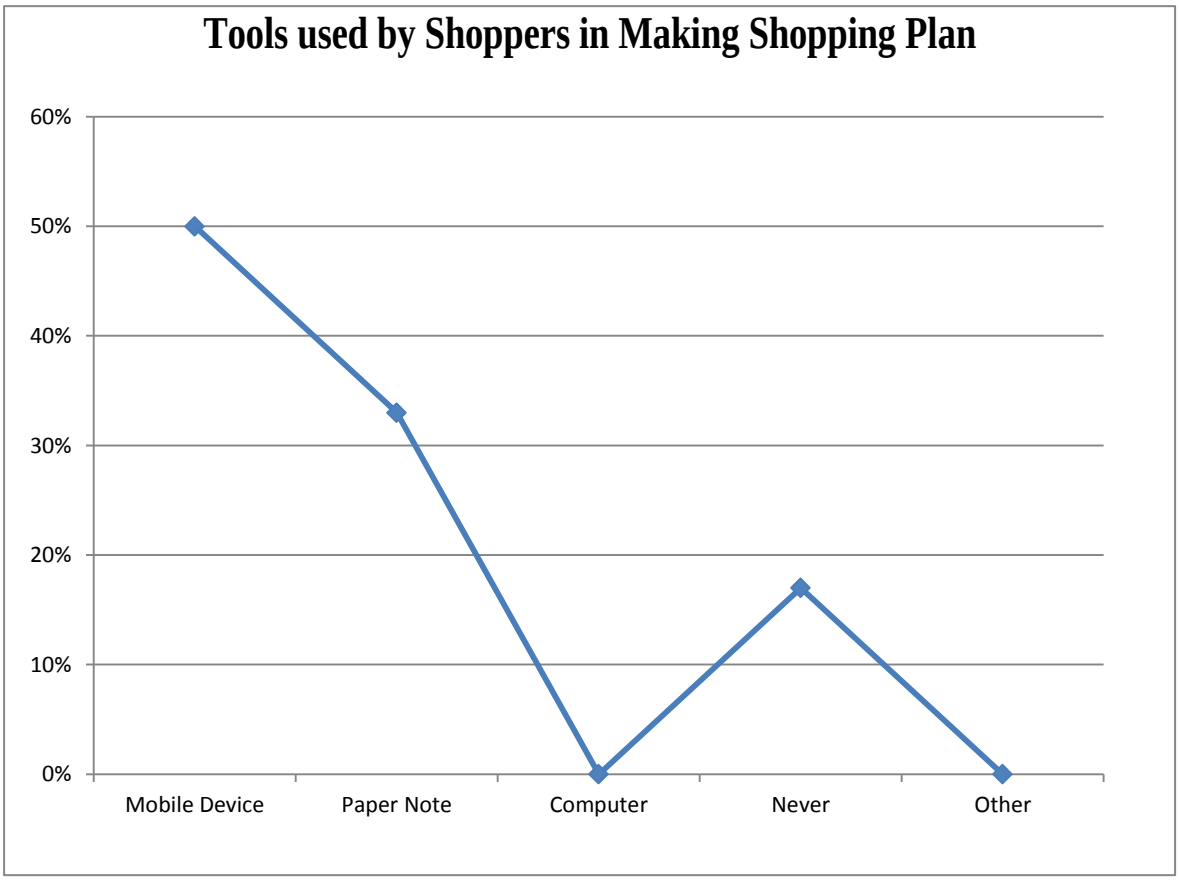
Bar Chart



From the data collected, it is found that two features which are check product information and make shopping list have the highest average rating among all of them. Besides that, there are other features which are rated as more than 3.00, which mean shoppers are moderately or highly preferred them. In contrast, item recommendation, scan item and do queue-less checkout have the low average rating. Therefore, these three features are less likely to be considered in the development of the mobile application.

B.3 Graph Chart

Graph Chart



The data collected shows that as much as 50% of the shoppers used mobile device to make shopping plan. Whereas, there are 33% of shoppers who used paper note and 17% of them never make shopping plan. Therefore, it can be concluded that mobile device is the tool that major shoppers used, thus developing a shopping assistant for mobile device is the right choice.

Summary of Plagiarism Checking Result