DALHOUSIE UNIVERSITY
Faculty of Computer Science

SmartShopper

CSCI 5708 Mobile Computing

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Abstract

Ever since the discovery of the internet, disseminating information has never been more efficient. World wide web has made sure that the scope of any message doesn't remain within a region or a community. Also, computers are now available almost everywhere in the form of smartphones making the process even more convenient. Moreover, the users don't even have to bother opening a web browser in order to type a URL or write a query as there are mobile applications dedicated to a particular task. Our application, "SmartShopper" strives to provide our users with the information about the cheapest groceries and other household products by comparing the prices from various stores. The goal of SmartShopper is to help its users in saving money, especially if they are planning to buy groceries in bulk.

Introduction

a. Purpose:

Smartphones and the internet have become a part of our lives. All of us rely on these two for one thing or the other. As a unitary whole, they can be one of the most efficient mediums for spreading information and mobile applications can make sure that this process is fun and interactive. If a mobile application is designed and developed in a way that it has a good user interface and lacks usability issues, it can truly make a difference in the users' lifestyles. The purpose of our application is to help the users who are frugal with their expenses. This application compares the prices of groceries and household products from various stores and provides the user with the information and the location of the store that is selling that commodity for the best price.

While using this application, the user will not have to go through the trouble of keeping track of the prices of any grocery item in different stores. All they need to do is open this application and type in the name of the commodity, the application will compare the prices and present the user with the best price for that item along with name as well as the location of the store providing that deal. Not only will that lessen the efforts that the user has to make but also will save their time as the user now doesn't need to visit all the stores to know the best price. Also, this application is going to make a big difference in the savings of the user if they are planning to buy the groceries in large or even in medium quantity. This application can also be helpful if the user is already in a store wanting to buy something and is wondering about whether they are making a good deal or not. In that case, they can use the barcode scanner feature of this application to scan the barcode of the product that they are holding and get to know about the best price.

b. Scope and Target Audience:

This application has been developed keeping in mind the people who try hard to be economical with their expenses. Our target audience is mainly the people in the low-income group such as students as well as the working professionals with moderate income. For now, this application is only developed for smartphones with the Android operating system. Also, at this moment the scope of this application is limited to Halifax city as for any product, only the prices from stores within the Halifax region will be compared.

c. Background:

The idea that motivated us to develop this mobile application is that, how as students we always try to be frugal with our expenses. Also, the same is true for many people regardless of their age group or professions. However, because of a busy schedule it is hard for many people to keep track of the best prices around the city. That is why we decided to develop an application that can make it possible while not worrying about wasting any time.

Big C and Small c

a. Big C Context: The benefits

Why use SmartShopper?
It provides the information about the cheapest groceries and other household products by comparing the prices from various stores

Benefits includes:

- Provides an economical shopping experience.
- Provides a feature to scan the barcode of a product to lookup.
- Shows the location of the store that is selling the desired product for the best prize.
- Uses Google map in order to help the user find their way to the store

b. Small c Context: The context of use

Environment: SmartShopper can be used anywhere as long as the device is connected to the internet. However, it would be difficult for users to use this application while driving as they are expected to either type or scan.

Medium: Currently, the application is developed only for Android smartphones having Android version above 5.0. The application would give its best performance with devices having at least 2GB of RAM. e. The application would also require a Camera (for scanning barcode) for best experience.

Mode: Our app serves users with providing the best deals/prices on day to day needs of an individual. The user can be in a joyous mood enjoying the weekend, users can even be stressed, users can be in a hurry or they can also be very busy and need to find cheap options quickly. In every state of mind, users can find the best outputs of the products needed.

Diagrams

a. UML Diagram

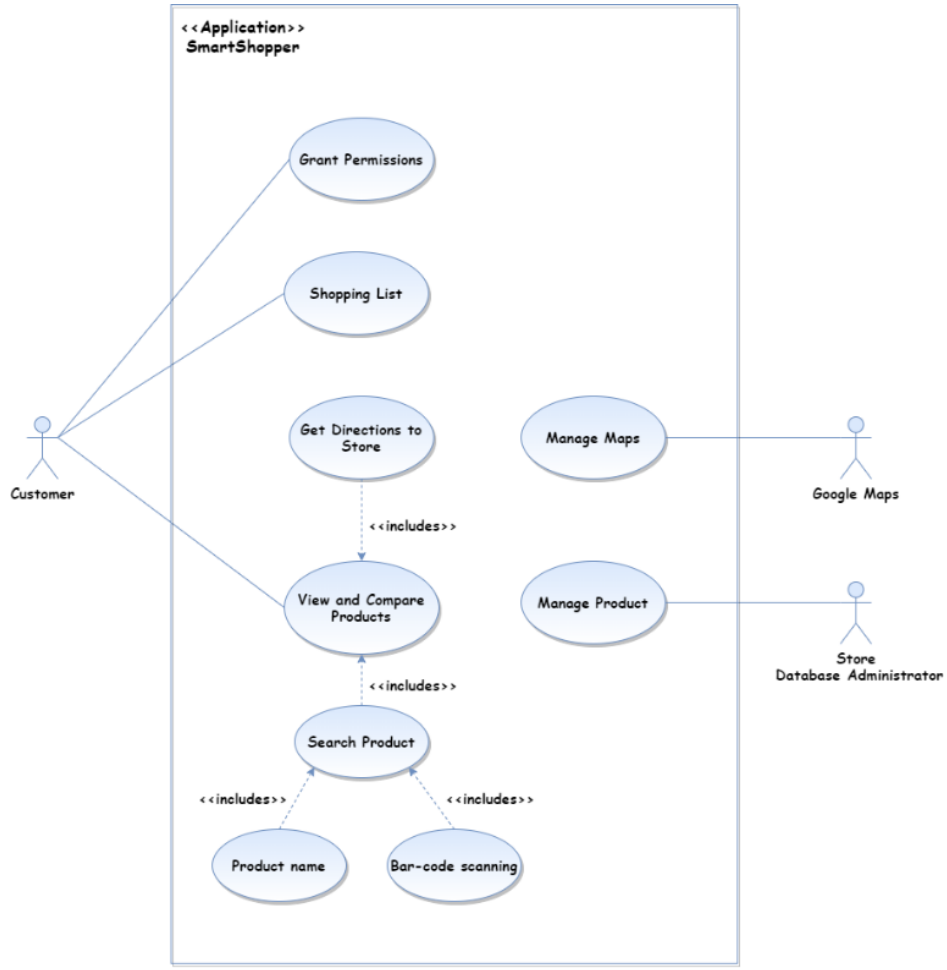

Figure 1: UML Diagram

b. Click Stream

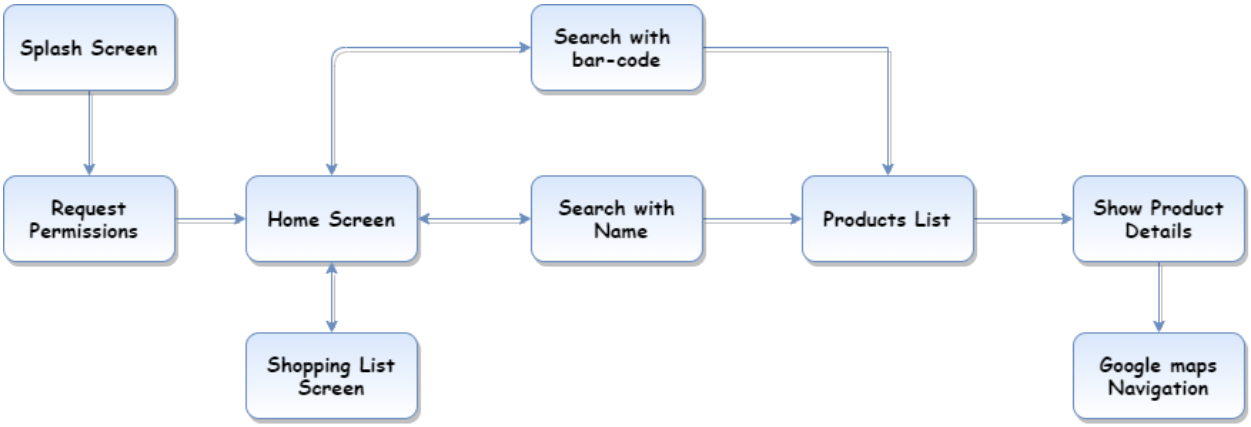

Figure 2: Click Stream

c. Site Map

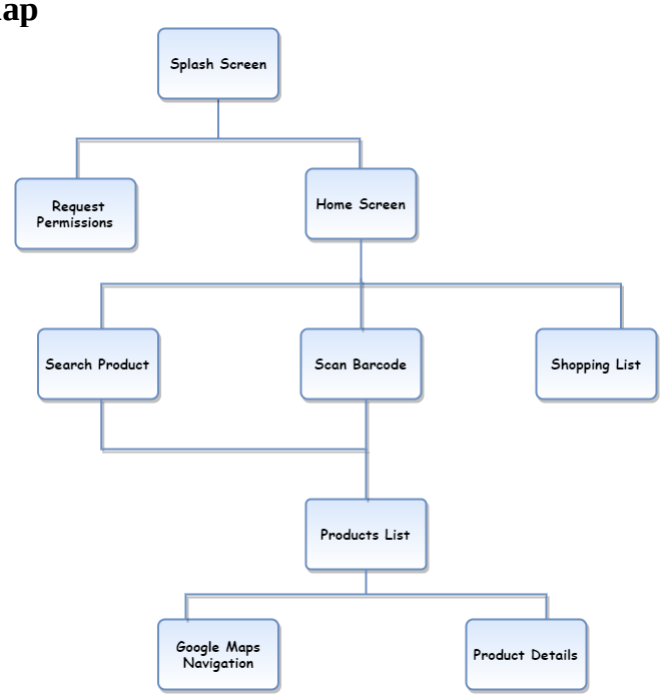

Figure 3: Site Map

Features

a. Splash Screen

User would see the Splash screen when the app starts. The Splash Screen is visible for 3-4 seconds. We have used a beautiful gif file in the splash screen.

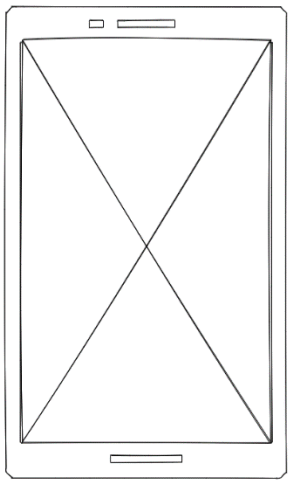

Figure 4: Wireframe – Splash Screen

Figure 5: Screenshot – SplashScreen

b. Introduction Slides

User will see the introduction slides only for the first time while installing the application. There are three introduction slides which displays the details on the features the application provides. We have used heinrichreimersoftware library to implement these slides. We have used gifs in the slides to make the UI better. Also, we ask for run time permissions for camera in the introduction slides itself.

'igure 6: Screenshot– Introduction Slides

Figure 7: Screenshot – Introduction Slides

'igure 8: Screenshot– Introduction Slides

Figure 9: Screenshot– Introduction Slides

c. Barcode Scanning

The user can directly scan the barcode of the product in the application to find cheaper options. The barcode scanner is implemented by using the ZXing library in android. The library is imported and is launched in the fragment. The barcode is scanned and the product that matches the barcode is showed in the Recycler view with its description.

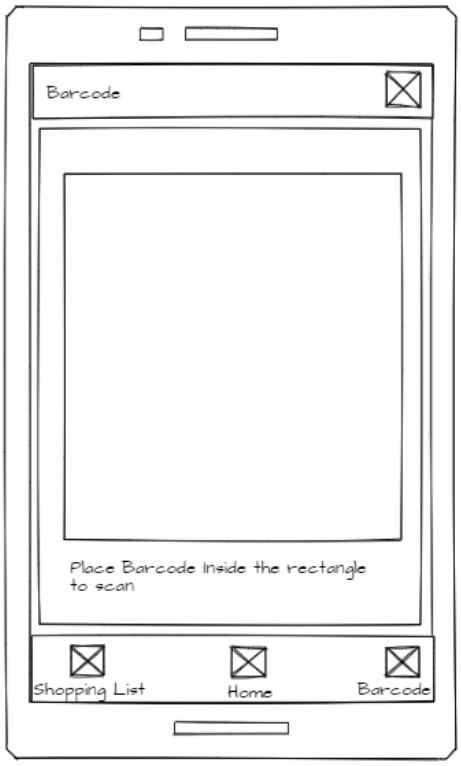

Figure 10: Wireframe – Barcode Reader Screen

Figure 11: Screenshot – Barcode Reader Screen

d. Product Search

Sometimes a barcode is tampered, torn or the product is very heavy, and we cannot scan the barcode. So, we also implemented Search functionality where a user can search for its product and can find cheaper options. The product with similar name will be displayed using Recycler view with its description.

Figure 12: Wireframe – Product Search Screen

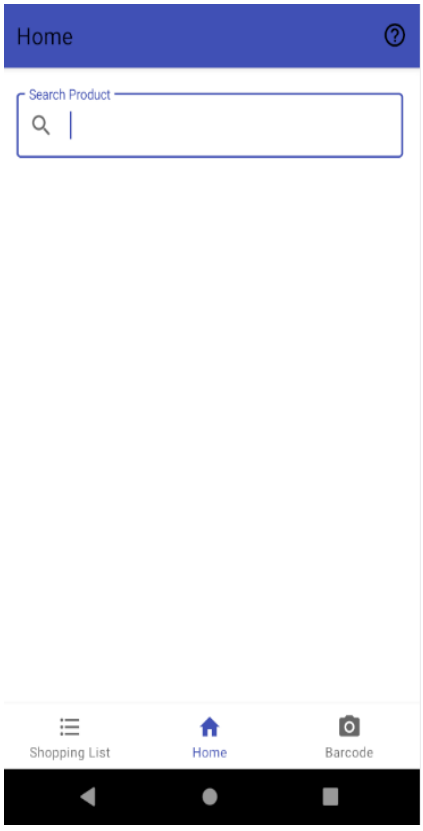

Figure 13: Product Search Screen

e. Shopping List

This feature is implemented for user to make a check list of all the products s/he is planning to purchase. User can make a list of products and save them in the shopping list functionality of the application. In the Shopping list, user can add, delete and edit the products in the list. User can also maintain a check by clicking on the check box provided besides the product name to make sure that the product is already purchased. The list of products is stored in the phone storage and we have used Shared Preferences for that. The data is stored into the Shared Preferences with the help of gson libaray. Also, we have implemented a Delete All button which clears the entire shopping list.

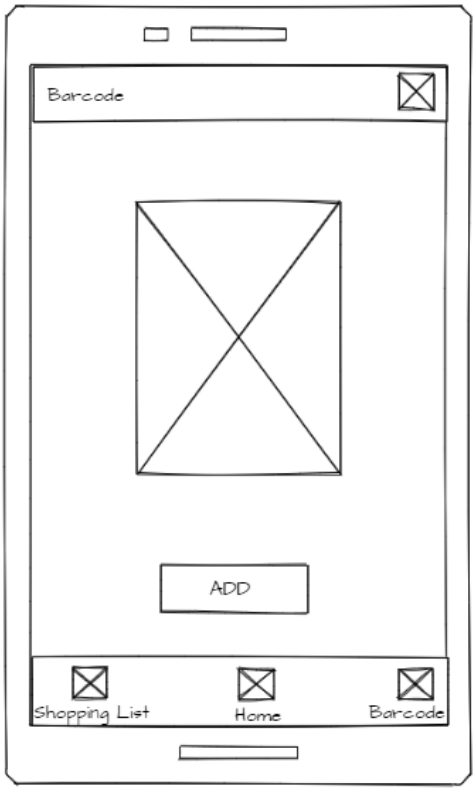

Figure 14: Wireframe – Empty Product List Screen

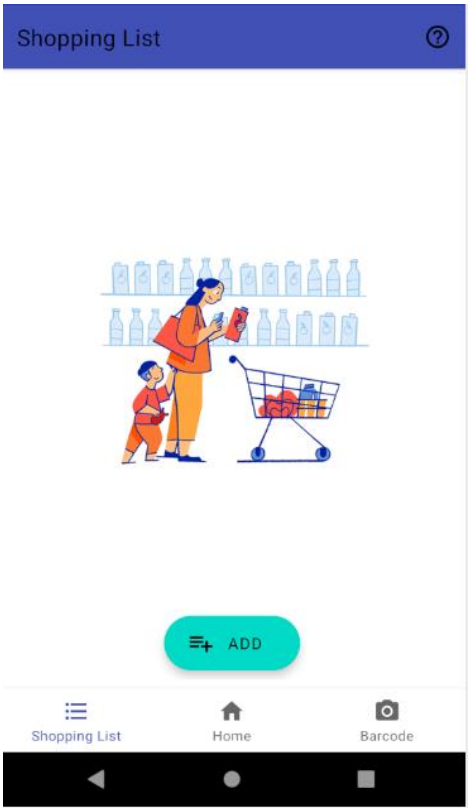

Figure 15: Screenshot – Empty Product List Screen

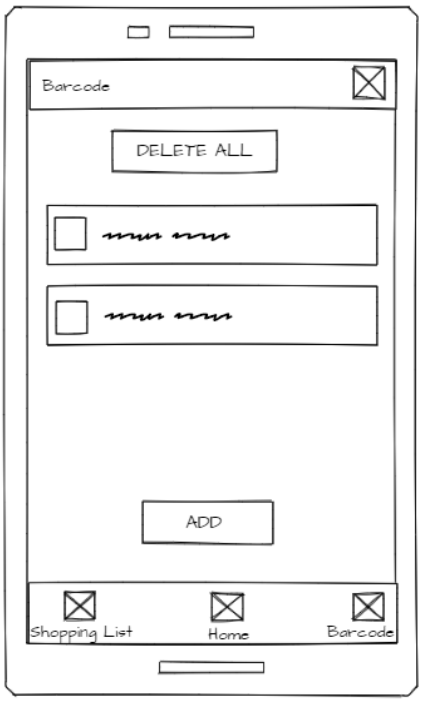

Figure 16: Wireframe –Product List Screen

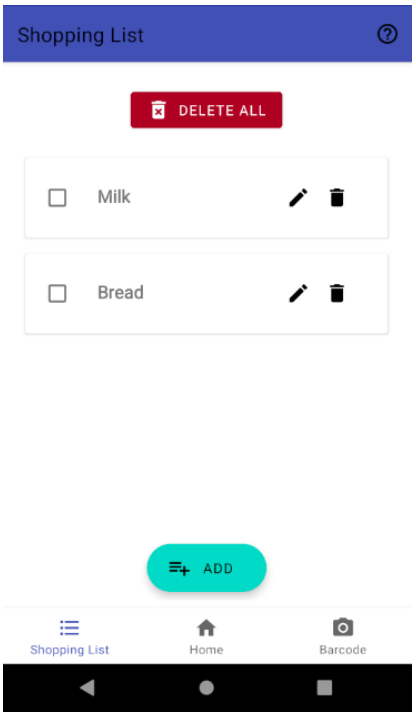

Figure 17: Screenshot –Product List Screen

f. Show Google Maps

On getting the results of product with affordable prices in different stores, the user can find the location of the store by clicking the directions button in the Recycler view for product description. For this we have used Google Maps and on clicking the direction button the user would be navigated to the Google Maps App.

Figure 18: Wireframe – Navigate to nearest store (Google Maps)

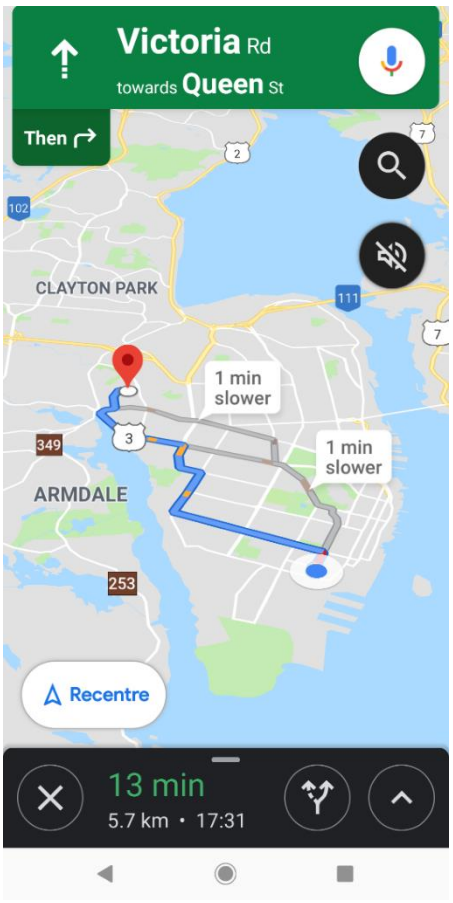

Figure 19: Screenshot – Navigate to nearest store (Google Maps)

g. List all searched Products & product details

User after searching a product by its name in the search bar will see the list of products displayed as the Recycler View. We have used the Ramotion folding cell library to show the product description. We created two custom layout one which only shows product name and the other that shows product description. We integrated both the layout for the library and hence the Custom view for product description is created.

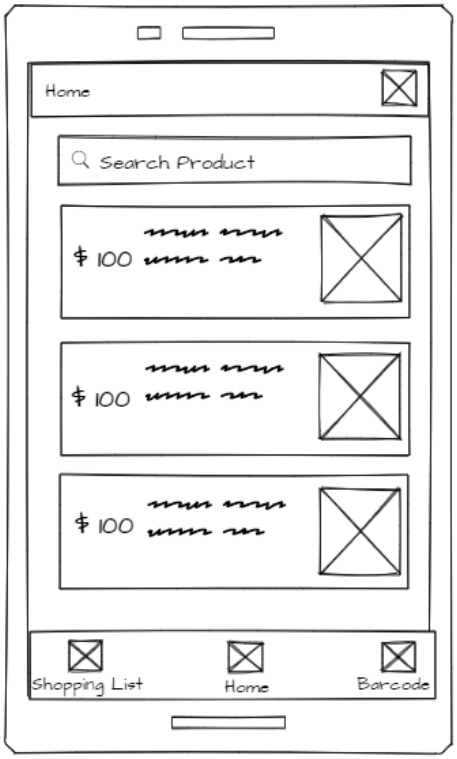

Figure 20: Wireframe – Products List Screen

Figure 21: Wireframe – Products List Screen

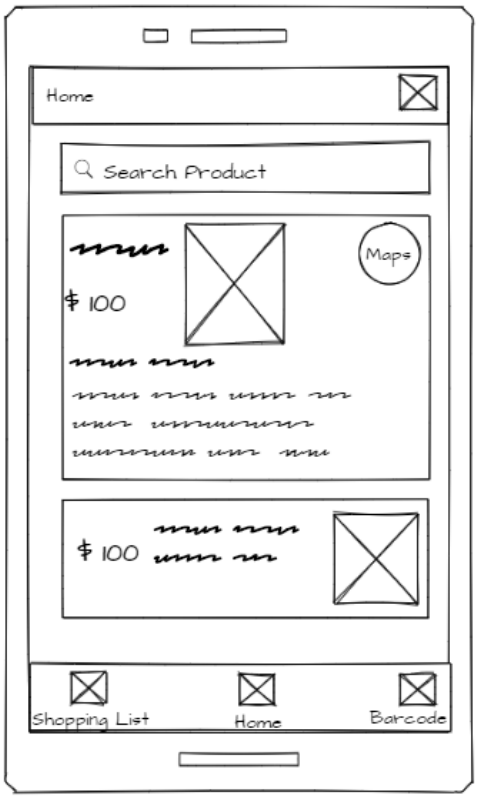

Figure 22: Wireframe – Products List Screen

Figure 23: Wireframe – Products List Screen

h. Help & Documentation

User will be guided on the functionality that the app does in the form of slides as shown in the introduction slides. We have used gif to make the UI more attractive. Also, it will have an email ID for user's if they want to reach out to us.

Figure 24: Wireframe – Help Screen

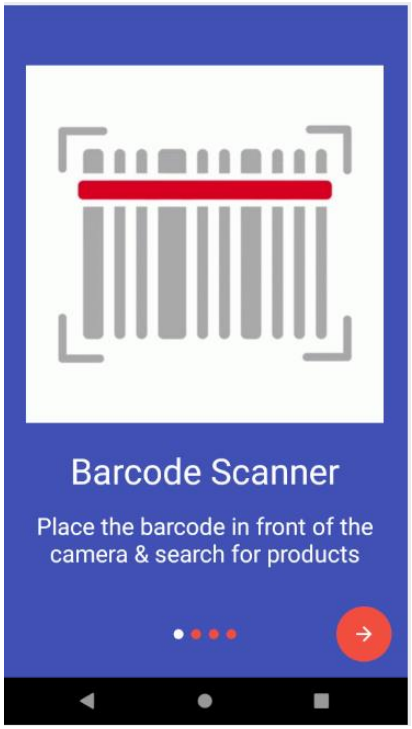

Figure 25: Screenshot – Barcode Scanner Help

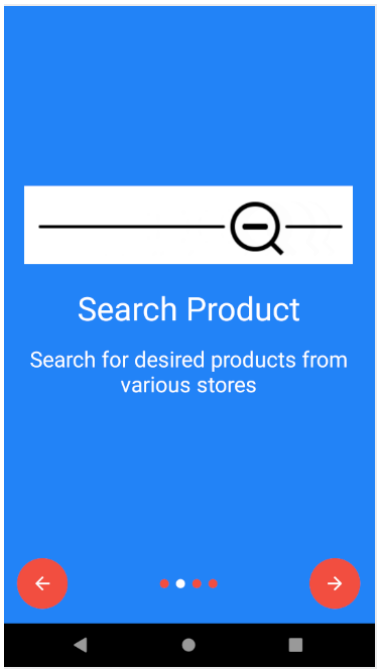

Figure 26: Screenshot – Search Product Help

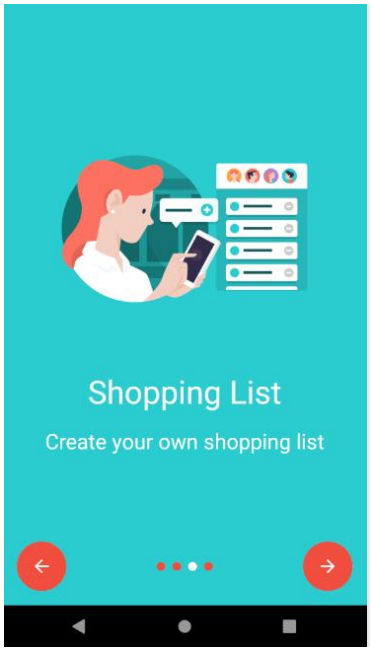

Figure 27: Screenshot – Shopping List Help

Figure 28: Screenshot – Contact Us

Database and Data Model

The app uses *Firebase Real-Time Database* for storing data. The entities required for the app's data are stores/marts and items/products. These data are usually made available by the store's API. However, these API require API keys, which we could not obtain for most of the stores. Hence, the data need to be created from scratch by identifying the required attributes of the entities for storing in a NoSQL database like Firebase DB.

Firebase uses parent-child hierarchy for storing key-value pairs which is very similar to JSON. In fact, the data from Firebase DB can be imported with or exported into a JSON file. The JSON structure for the mock data had to be designed by keeping query optimization in mind. The structure for the data is shown in figure-22. The structure contains data about stores each of which is a JSON object with store IDs as keys. The stores have storeName, storeLogo and the items in the particular store as their attributes. Each item in the store is a represented as a JSON object with UPC (Universal Product Code), name, price, image and description as the attributes. Thus, "items" becomes a JSON of JSON objects. Here, "items" is not considered as list. This allows faster retrieval and simple query structure.

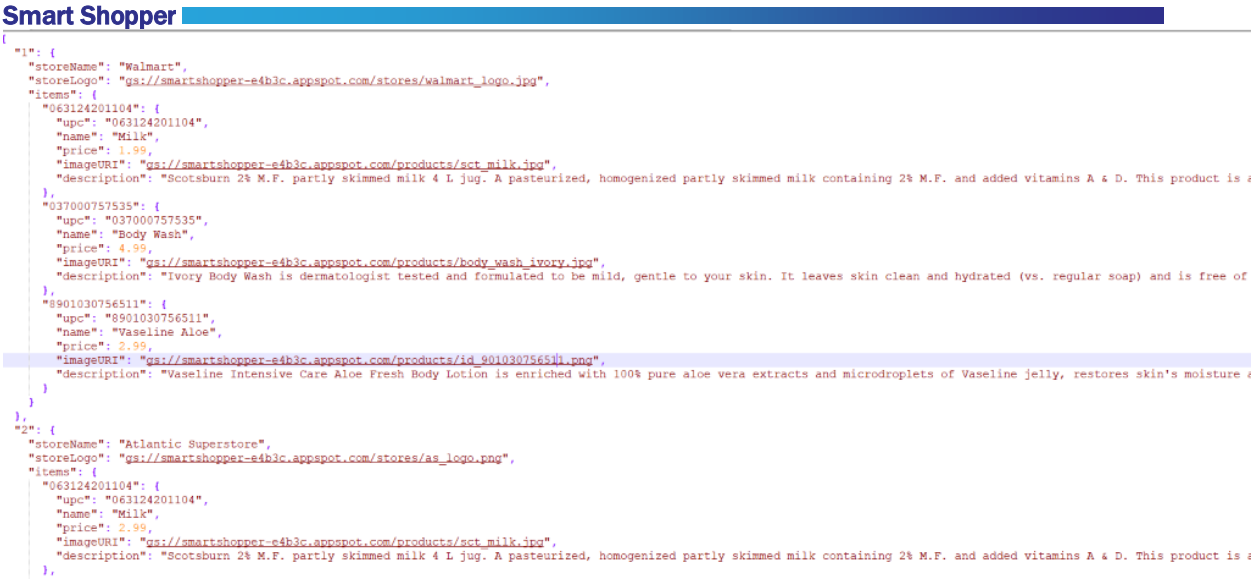

Figure 29: Screenshot – JSON Data

Design choices

a. Material Design

Material Design is an **Android**-oriented **design** language created by **Google**, supporting onscreen touch experiences via cue-rich features and natural motions that mimic real-world objects. Designers optimize users' experience with 3D effects, realistic lighting and animation features in immersive, platform-consistent GUIs. Introduced in lollipop, google defines **Material Design** as 'bold graphic **design** and smooth motion to create beautiful experience.' It is recommended to use.

b. Benefits on UX

It provides a variety of components like the Bottom Navigation, Floating Action Buttons, Card view, check box, Tab layout and many more. We have used a variety of material components in our application like Card View, Floating Action Button, Bottom Navigation, check box. Also. material design adopts Minimalism and make enough use of icons to replace text as much as possible. By creating layering and shadows which creates a beautiful look and feel for the application, we have also kept in mind to follow the Nielson's heuristics for a better UX. The Heuristics like Minimal design, Help and Documentation page, User control and freedom

c. Application Color Choices

The Material Design color theming system is used to create a color scheme that reflects your brand or style. The Material Design color theming system uses an organized approach to applying color to your UI.

Quality Assurance

Sr. No	Test For	Steps	Expected Result	Observed Result	Status (Not Exec/Fail/Pass)
1	Asking for the permissions on opening the app for the first time	Step 1: Open the application after installing. Step 2: Tap the next button at the right end of each slide. While, on the third slide press "Grant Permission" button.	This should allow the application to use the camera.	The permission to use the camera was granted and the camera was opened.	Pass
2	Searching the product	Step 1: While on the "Home" fragment, tap on the search bar. The system keyboard should come up.	If the product is found, a list should appear. If the product can't be found, a message should pop up, "Item not found."	For the item that was found, the list appeared. After searching for a random string, "lorem ipsum" the message, "Item not	Pass

		Step 2: Enter the name of any product and press search button on the keyboard.		found" popped up.	
3	Scanning the barcode	Step 1: Tap on the "Barcode" button on the bottom navigation bar. Step 2: Focus the camera on the barcode.	After scanning the barcode, the number should be generated and the list of items corresponding to it will appear on the "Home" fragment.	After scanning the barcode, the unique number was generated and the list of items corresponding to it appeared on the "Home" fragment.	Pass
4	Shopping list	Step 1: Tap on the "Shopping List" button on the bottom navigation bar. Step 2: Tap on the "ADD"	The item should be added to the shopping list.	The item, "Milk" was added to the shopping list.	Pass

		button. A small window should appear. Step 3: Tap on the edit text field and type the name of any product, e.g. Milk.			
5	Clearing the shopping list	Step 1: Tap on the "Shopping List" button on the bottom navigation bar. Step 2: Tap on "DELETE ALL" button.	The shopping list should be emptied.	The shopping list was cleared.	Pass
6	Help and Documentation	Step 1: Press the question mark button on the top right corner of the screen.	Slide navigation screen should cover the screen	Slide navigation screen with instructions appeared on the screen.	Pass

		Step 2: Slide navigation should cover the screen. Every slide contains a basic instruction. Step 3: To go to the next slide, tap on the next button on the bottom right corner of the screen.			

Learning Curve

a. Research and Documentation

Thinking of an idea for the application, research on the application having or performing same features, details study for the app, Planning for Application and many more integral documents necessary for app development were learnt during this entire project. The document contained every small detail including the deliverables, scope and purpose of project, work distribution, tracking our progress by submitting Status reports. We realized the importance of documentation in app development and did a lot of research while preparing this document. At the end of the project we realized the importance of each, and every document designed in the phase.

b. Android Programming in Kotlin

1. Learning Kotlin Language

Kotlin is a general **purpose**, open source, statically typed "pragmatic" programming language for the JVM and Android that combines object-oriented and functional programming features. It is focused on interoperability, safety, clarity, and tooling support. As Kotlin is the official

language for app development in Android we were very eager to learn the language. Kotlin has very simple syntax and is an easy to learn language. Initially, our team was facing major issues with learning Kotlin, but then gradually everyone learned the basic concepts and syntax of Kotlin. Also, learning the Android life cycle and different list views helped the most in creating the application.

2. Comments and maintaining Code Standards

Our team initially was not giving internal comments for the code and also not following the coding standards. But in the later phase of app development while integrating or merging the code we felt the need to have internal comments provided in the code. This helped us in cultivating a good skill of writing internal comments while coding.

3. Using Third party libraries

We have used a number of different libraries which helped us in achieving different functionalities in the application. We have used the zxing library for barcode reader, gson library for storing data of shopping list, ramotion's folding cell library. These libraries helped in enhancing the UI of the app or helped in achieving the core functionalities of the application. We faced certain issues with implementing certain libraries in the fragment which were solved gradually in the app development.

4. Using phone Hardware

In this application we have used Camera and Phone storage resources of the device which is most important part of the application. We have scanned the barcode using the camera and the shopping list details are stored in local storage by Shared Preferences. For this we have used run time-permission asked during the start of the application in the introduction slides.

c. Code Debugging

We faced issues while integrating libraries or by storing data through Shared Preferences in the fragment. We solved these issues by debugging the code in Android studio.

d. Git Lab

Most of the members in the group had already experienced gitlab and were known to all its basic commands like push, pull, fetch, commit, checkout and solve conflicts. Every member of the group was working on its separate branch created from the master branch and then merged all the branches one by one into the dev branch. The final code was pushed in the master branch at the end.

Incomplete Functionalities or Limitations:

Shopping List Data backup:

A shopping list that a user creates in our application is saved only in the local memory of the device using shared preferences. So, if the user un-installs the application the data will be lost permanently and therefore it cannot be recovered even if the application is re-installed.

- To handle this problem, we will have to create a backup of the data in a remote database (ex: firebase) and then we will also have to create a sign-up/login feature to uniquely identify each user. These features can then be used combinedly to upload or download data from a database.

Product Details API is Mocked:
• We were unable to find any for free APIs that provided product details from Walmart, Atlantic Super Store or Sobeys. Therefore, we decided to mock the data.
• Although the application gets the product information from a mocked data-source we have simulated the code, close to the actual scenario, to get it from a REST API.
• Hence the limitation of this application is that any data (particularly the product prices) provided by it is not accurate.

Google maps activity within the application:
• The free key provided by the Google Maps teams can be used without any restriction for many features like getting the current location or tracking the user's movements.
• But the free API key we used had a limit of 2 requests per day for searching nearby places. This is a primary requirement for us to display the nearby stores once the user selects the store name.


```
{
    error_message: "You have exceeded your daily request quota for
    this API. If you did not set a custom daily request quota, verify
    your project has an active billing account: http://g.co/dev/maps-
    no-account",
    html_attributions: [ ],
    results: [ ],
    status: "OVER_QUERY_LIMIT"
}
```


Figure 29: Daily Limit Reached Response of Google Maps API

Due to this limitation we were not able to completely implement and test this with in the activity maps functionality. Alternatively, we decided to show the same information inside either the default google maps application or inside its website using the navigation with intent feature of the Android SDK.

Satisfaction

SmartShopper has been very close to our heart and it was a complete pleasure developing such an application. We and many of our friends had tight budget and would always sneak out to places having cheaper grocery and necessities. They made a lot of efforts finding stores with cheaper products and wasted a lot of time. We wanted to contribute to lives of each and every people who had a tight budget to handle or had a very low income to save some bucks of their money. Being a developer, we feel that we should always contribute to the society by making the best use of computing which can be beneficial to many people.

Regrets and Problem

a. Regrets

1. We did not get free API for real product description
2. We are not able to sort stores based on the location

b. Problems

Integrating Third party libraries

We have used the bottom navigation bar for navigation from one fragment to another. So, they were newer version of Fragments in the bottom navigation. But the libraries we used supported the older version of fragments. So, we faced certain issues with incorporating the libraries into the fragment which were gradually solved.

Firebase setup

Querying Firebase Real-time Database is not as flexible as other NoSQL database. Hence, we had to spend a lot of time on designing the JSON structure for storing our mock data so that it can be queried with ease.

Conclusion

Developing Smart Shopper was a great journey and we did a good job in completing this project. During the development process we learnt a lot about project deliverables, teamwork, working on Version controls, Android App Development, and also solving and helping with issues within the team members. Accepting and considering each other views was the most important quality we learned and developed during the app development. SmartShopper is an application which strives to provide our users with the information about the cheapest groceries and other household products by comparing the prices from various stores. The goal of SmartShopper is to help its users in saving money, especially if they are planning to buy groceries in bulk. Developing this application gave us all a real time exposure to industry projects and how to deal with last moments chaos. At the end, we would just like to say it was a great experience.

Git Repo - https://git.cs.dal.ca/tarpara/smartshopper

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