Applied Information Technology And Computer Science Vol. 4 No. 2 (2023) 1966 - 1985

AITCS

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/aitcs
e-ISSN :2773-5141

Prelove.UTHM: Second-hand items platform for UTHM community

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DOI: https://doi.org/10.30880/aitcs.2023.04.02.110
Received 24 June 2023; Accepted 27 October 2023; Available online 30 November 2023

Abstract: Wastage of second-hand items has become an issue in Universiti Tun Hussein Onn Malaysia (UTHM). This issue occurs due to several factors such as lack of specialized platform for selling second-hand items and students that graduate unable to bring everything along with them. Traditional way of selling second-hand items is inefficient since seller need to spend time in finding interested buyer. Therefore, a mobile application named Prelove.UTHM that allows students, staffs and lecturers in UTHM community to sell their second-hand items had been developed. Flutter, Dart and Firebase were applied to design an Android based application using Waterfall methodology. Users can use it to turn their second-hand items into money and buy desired second-hand items easily. Moreover, there is a donation feature to giveaway second-hand items for free. The results of test plan and user acceptance testing show that most of the respondents have high satisfaction while using the application.

Keywords: Second-hand items, platform, donation

1. Introduction

Second-hand items platform is a platform that prepared for individuals to sell and buy used items. The items sold usually slightly cheaper than a brand-new item and it includes various types of products such as clothing, furniture, electronics and so on [1]. In Universiti Tun Hussein Onn Malaysia (UTHM) community, there is no any specialized platform for second-hand items. This cause students, staffs and lecturers need to find buyers using traditional method that can be consider as inefficient. In order to overcome issue of second-hand items, a mobile application that able to act as an online platform for selling and buying of second-hand items is developed.

In this project, the main problem that being emphasize is lack of trusted and specialized platform to sell second-hand items online. This causes the students, staffs and lecturers in UTHM having difficulties to sell their used items. The traditional way of selling is not efficient as it requires seller to spend a long period of time to find buyer using limited sources. The second problem which is geographical issue also contribute to the wastage of second-hand items. Students that live far away from school area is difficult to bring everything back when they graduate especially for those who took air transport services. They only have limited weight allowance and need to pay extra amount of money if

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they exceed the quota. All the problems are expected to be overcome using the developed application. There are total of three objectives for this project which are:

1. to analyze and design a mobile-based application as a platform for users to sell their second-hand items within a community
2. to develop a mobile application that allow users to buy second-hand items with low price
3. to test functionality of the developed mobile application

The main target of this project is to develop a mobile application and provide an online platform for students, staffs and lecturers in UTHM community for selling and buying of second-hand items. In the application, user can search for their desired items by searching using related keywords. They can also filter the available items according to category. This saves the time of the user as they only need to publish their second-hand items and buyer can approach and pay for it instead of contact interested buyer and spend a long time. The application has attractive interface and easy to use so that users able to memorize the user manual easily. Besides, the user can complaint on items that have issues and administrator can take actions based on it. There are two types of users which are administrator that responsible for management and monitoring of the application and normal user that sell and buy second-hand items. Modules of the application include user management module, sell item module, buy item module, history module, donate item module, complaint module, users module, statistics module and items module.

This paper is being divided into five main sections. In the first section, the background of the project is being explained. In the second section, a review regarding related work had been conducted. Then, the methodology, analysis, and design of the project are described in the third section. The next section is results and discussion that explain and show some interface of the developed application. The last section summarizes the project and highlight the future works that might be carried out in the future to enhance the application.

2. Related Work

2.1 Second-hand items market

Second-hand item has become famous and popular among consumers since the generation of bartering. The trading of second-hand items has their own rules as the unused items are swap with something useful for them but useless for others. The market that involves selling and buying of second-hand items is a competitive for those market that selling brand new items since it might affect the sales. The second-hand items market had risen dramatically due to the new trading methods that using Internet [2]. It can also be described as a part of the common item market because it able to transform used or new items of the owner into money. The market allows consumers to obtain their preferred item by using a lower price compare to market with variety of choices instead of purchasing a brand-new item. The second-hand market had slowly transformed from traditional way to online since there are new internet platforms being created.

2.2 Second-hand items market operations

There are two ways seller can sell their second-hand items which are find customer manually via social media or using online platforms. For selling via online platforms, seller need to publish the second-hand items at first to the specific platform. After an item is successfully being published, buyer can only access to it [3]. They can search for the required items by using related keywords. The buyer can still search for it again by using another keyword. However, they might obtain results that different as their expectation such as no results and so on. If the item they preferred is found, they can decide to buy it or not. The buyer can still search for another option again by using related keyword until it fits their

requirements. In addition, the buyer can terminate the process of purchasing at any time by simply quit the platform if they do not want to search for any second-items again.

2.3 Comparison with the Existing Application

In order to design and develop a mobile application that meets the requirements of the users, several existing applications that emphasizes on selling of second-hand items have been chosen. A comparison between the existing applications which are Mudah.my, Carousell, Lelong.my [4]-[6] and developed application which is Prelove.UTHM in terms of features had been carry out. The comparison is expected to obtain features from existing application and apply it in the developed application. Table 1 shows the results of comparison for fifteen features.

According to Table 1, Mudah.my have the most special feature as it allows user to post free advertisement. All the applications have some similarities in terms of features such as user management module, my cart, chat with seller, complaint, filter during purchasing and item recommendation. Among the applications, only Mudah.my do not allow the user to buy second-hand items and make payment on the spot. It also does not provide rating and review function to the users. After comparing and considering the features of existing applications, the features of the developed application, which is Prelove.UTHM had been determined. Prelove.UTHM is a mobile application that allow the users to sell and buy second-hand items online since they can add the desired item into cart and make payment instantly. Besides, the users can view more information about an item by simple clicking on it and use filter during searching for an item to find a specific item in shorter period of time. All the published items by seller able to be view by user on the homepage. For issue item, complaint can be made and actions are taken. The user also can give their second-hand items free and donate to others via the application. Once a deal is done, the buyer can rate the seller according to their level of satisfaction.

Table 1: Comparison Between Existing Applications with The Developed Application

Feature / Application	Mudah.my [4]	Carousell [5]	Lelong.my [6]	Prelove.UTHM
Add to Favorites/My Likes/My Cart	✓	✓	✓	✓
Buy and Sell Items	×	✓	✓	✓
Chat With Seller	✓	✓	✓	✓
Complaint	✓	✓	✓	✓
Donation/Give for free	×	✓	×	✓
Filter During Purchasing	✓	✓	✓	✓
Generate Report	×	×	✓	✓
Items Recommendation	✓	✓	✓	✓
Online Payment	×	✓	✓	✓
Post Free Advertisement	✓	×	×	×
Rating	×	✓	✓	✓
Review	×	✓	✓	✓
Subscription of Packages	×	×	✓	×
Technology (Available in Android, IOS, Web-based)	✓	✓	✓	×
User Management Module	✓	✓	✓	✓

Symbolic reference: ✓-Consist of ×-Do not consist of

3. Methodology

3.1 Prototype Model

The final chosen project management methodology to implement for the development of Prelove.UTHM is waterfall model which also known as sequential development model. It is one of the software development life cycles (SDLC) which have exists for the longest period of time and famous

among project management methodology [7]. Planning, analysis, design, implementation and testing that show in Figure 1 are all the phases in the model that need to be completed within the provided period of time before able to proceed to the next phase and this avoid overlapping that give impact to the project. There is no opportunity to return to previous phase except start over from the beginning that consume more a lot of money and time. This characteristic is totally opposite with agile model that allow the changing to be carry out at any time without affecting the project.

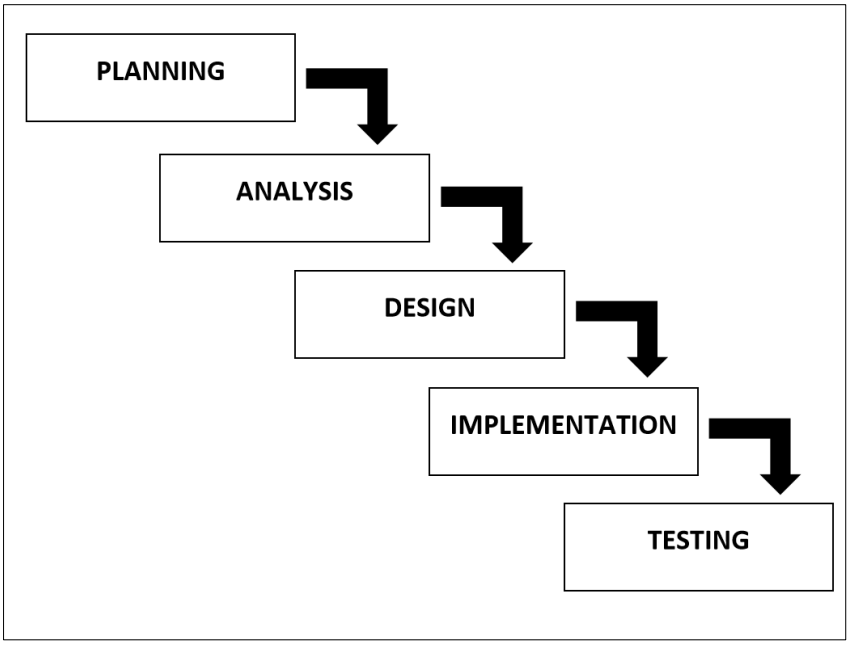

Figure 1: Prototype Model [8]

By referring to waterfall model, the first phase is planning phase which is crucial since author need to brainstorm and do a lot of related researches about the title of their undergraduate project. The chosen title needs to be unique and do not have many similarities with others so that it does not duplicate. A brief that includes the details of the chosen title such as problem statement, objectives, methodology and so on need to be provided to the supervisor so that she able to have a clear view about is being developed. The result of discussion had led to the determination of title of undergraduate project which is a mobile application that going to play a role as second-hand items platform for UTHM community. The name of the application is Prelove.UTHM that allows user to sell and buy second-items in an easier and convenient way. In order to divide the given time appropriately into every activity throughout the project, a Gantt Chart is created. All the related activities for the phases being recorded clearly with its respective time range and it is expected to help author in completing every activity on time taking extra time.

Analysis phase is the second phase in waterfall model that collect all the useful information which is helpful in determining the interface, functionalities, modules and so on. In order to obtain data and opinion from community in UTHM, the author had created a questionnaire with several questions using Google Form. The questionnaire is being deliver to them by using latest messaging application which is WhatsApp as the platform that saves time.

The third phase in waterfall model is design phase that going to determine the interface and architecture of the mobile application after referring to the user requirement obtained via questionnaire. The first activity that conducted in this phase is designing of wireframe for the mobile application. Wireframe able to highlight the functional scope of the mobile application by visualize what steps user need to go through in order to done certain actions. A high-fidelity wireframe is generated by the author to have a clear image regarding the mobile application. Use case diagram is require in this project to

show the use cases of the mobile application. In addition, activity diagram, sequence diagram and class diagram show the interactions between the objects and flow of the mobile application. Next, the entity relationship diagram (ERD) that plays an important role in the developing of the database had been generated. The database is design according to ERD and data dictionary that able to give a clear view regarding attributes, data types of data that lead to a logical database. An efficient database can help administrator to organize and manage all the information without facing issues that might affected operation of the mobile application.

The implementation phase can be described as the process of converting all the designed wireframe, modules, ERD and so on into the real mobile application, Prelove.UTHM which consume a long period of time since author need to code a functional mobile application from scratch. All the related designs in previous stages had been implemented to build the mobile application that meet the requirements of the target user. In this project, Dart is the chosen programming language that apply C-style syntax and firebase act as the database to manage the large number of datasets that able to provide a few services at the same time. Flutter that famous for compiling Dart code within a few seconds by applying hot reload feature is the chosen platform because it can help author to develop application that able to run on two types of operating systems that specialize for mobile application which are iOS and Android.

After the mobile application had been developed successfully, several testings are carried out to figure out all the bugs that might affect the performance of it. The testing that conducted covers both user and admin site to ensure no issue will occur when using the mobile application. A mobile application that does not undergo testing might reduce the user satisfaction if there are any error occurs. There are several types of tests that are done on it such as functional testing and user acceptance testing to identify whether it meet the user requirements, functional and non-functional requirement that had expected to be achieve at the end of the development. The tests are conducted by the author and individuals from UTHM community so that the results are precise and correctly. The mobile application only can be published and access by the users if it successfully passed the testing without any problems. Maintenance is carried out instantly to fix the bugs if there are any issues regarding the mobile application.

Waterfall model separates all the activities throughout the project into five phases which are planning, analysis, design, implementation and testing. Each of the phase consists of activities that must be conducted and the expected output should be achieve. All the phase are interconnected because one phase needs to be completed before able to proceed to the next one. Table 2 shows the workflow of the development of Prelove.UTHM.

Table 2: Workflow of the Development of Prelove.UTHM

Phase	Activities	Output
Planning	I. Brainstorming for title of undergraduate project II. Determine problem statements, objectives and scope of the chose title III. Find related information via several resources IV. Investigate and look for similar mobile applications	I. Generate proposal for undergraduate project II. Generate Gantt Chart III. Generate Literature Review IV. Conduct comparison with similar existing mobile applications
Analysis	I. Create questionnaire II. Determine hardware and software requirements III. Identify functional and non-functional requirements IV. Arrange the workflow	I. Data collected for determination of user requirement II. Hardware and software requirements had been determined III. Functional and non-functional requirements had been identified
Design	I. Design the wireframes II. Design use case diagram III. Design sequence diagram IV. Design activity diagram V. Design class diagram VI. Design Entity Relationship Diagram (ERD) VII. Design database	I. Generate wireframes II. Generate use case diagram III. Generate sequence diagram IV. Generate activity diagram V. Generate class diagram VI. Generate ERD VII. Generate database
Implementation	I. Start the development according to the created modules II. Connect the frontend with backend III. Run the mobile application	I. First version of the mobile application II. Record any related issues
Testing	I. Carry out comprehensive testing II. Record issues or bugs III. Highlighted limitation and area of improvements in the future	I. Generate a report about testing II. Fix the errors III. Finalize for the latest version of mobile application

3.2 System and Analysis and Design

In this section, some of the unified modeling language (UML) diagrams such as use case diagrams, sequence diagram and entity relationship diagram (ERD) are show with several explanations. A use case diagram can be defined as summary of interaction among all the user in a system in graphical form which includes relationship between functions and actors. The actors in the developed application are seller, customer and administrator. There are total of twenty-one use cases being identify for the developed application. Figure 2 shows the use case diagram of Preloved.UTHM.

Figure 2: Use Case Diagram of Prelove.UTHM

A sequence diagram is a model that shows the interactions between objects within a specific use case [9]. It demonstrates how different system components work together to perform a specific function. The objects in the sequence diagram are arranged in the order of their interactions and the timing of those interactions. Figure 3 and Figure 4 are two randomly chosen sequence diagram from total of twenty-one sequence diagrams. The first sequence diagram is complaint for customer and the second sequence diagram is register for customer and seller which showing the interactions of the objects. Once a complaint is made by the customer, it is recorded to database and return a success message. For

registration of customer, they only can use a new email. In otherwise, there is error message be return and indicates that the email had been used.

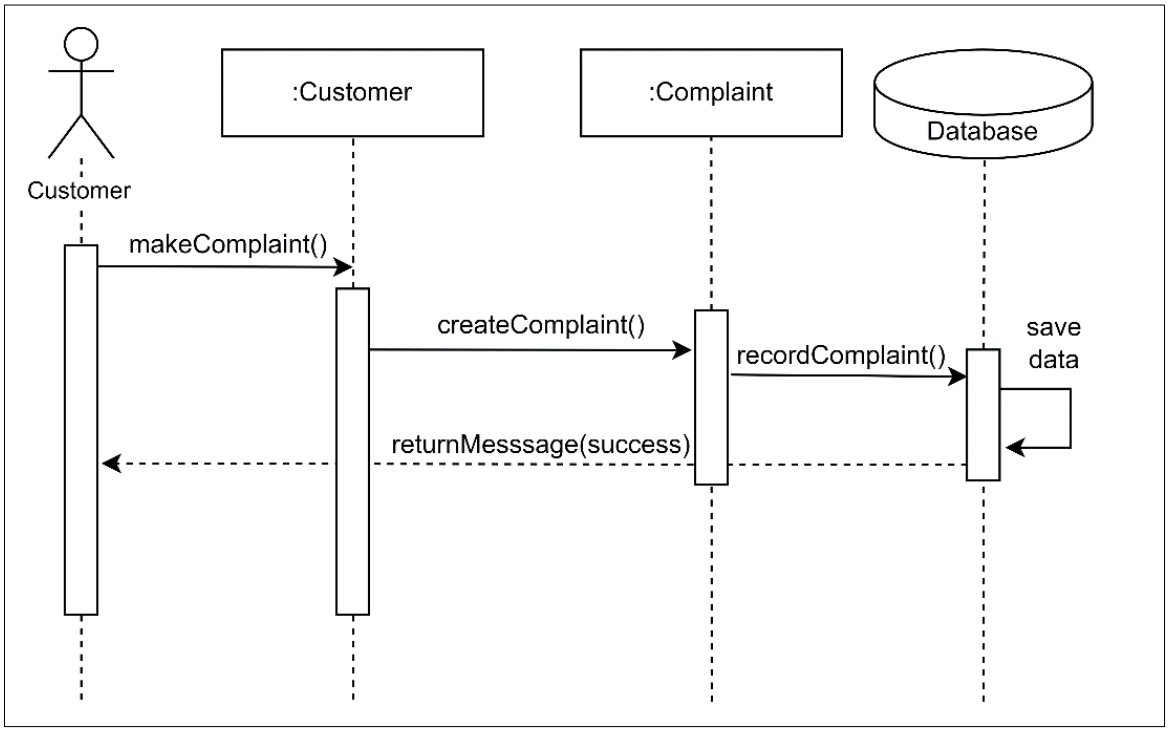

Figure 3: Sequence Diagram of Complaint for Customer

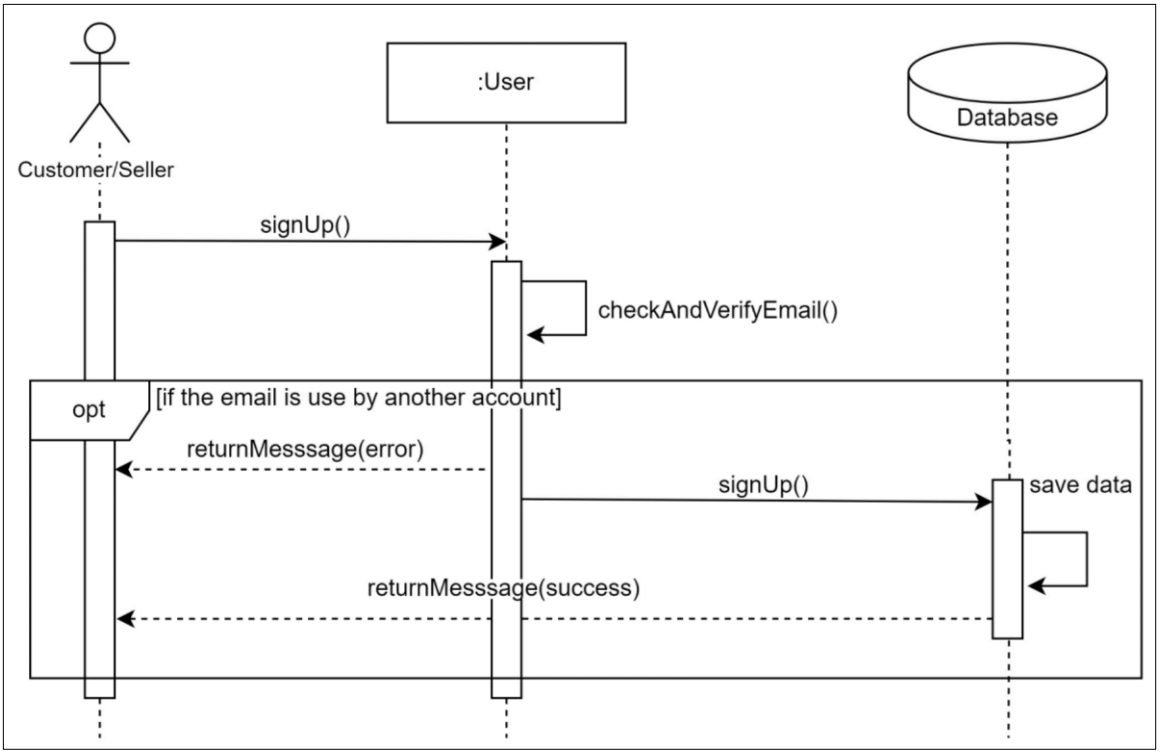

Figure 4: Sequence Diagram of Register for Customer and Seller

ERD can be defined as one of the diagrams in UML that able to represent structure of a database system along with its behaviour [10]. The components of the diagram can be divided into three major parts which are entities, relationships and attributes. In addition, there are variety of cardinality

notations that able to represent different types of relationships in the database. Figure 5 shows the ERD of Prelove.UTHM. The ERD of Prelove.UTHM are built up of seven entities and each of them consists of their own attributes respectively. It is used for the development of database system that responsible to store all data of the application virtually. Moreover, some of the data in the application are being retrieve and display from the database so that user able to view the real time data.

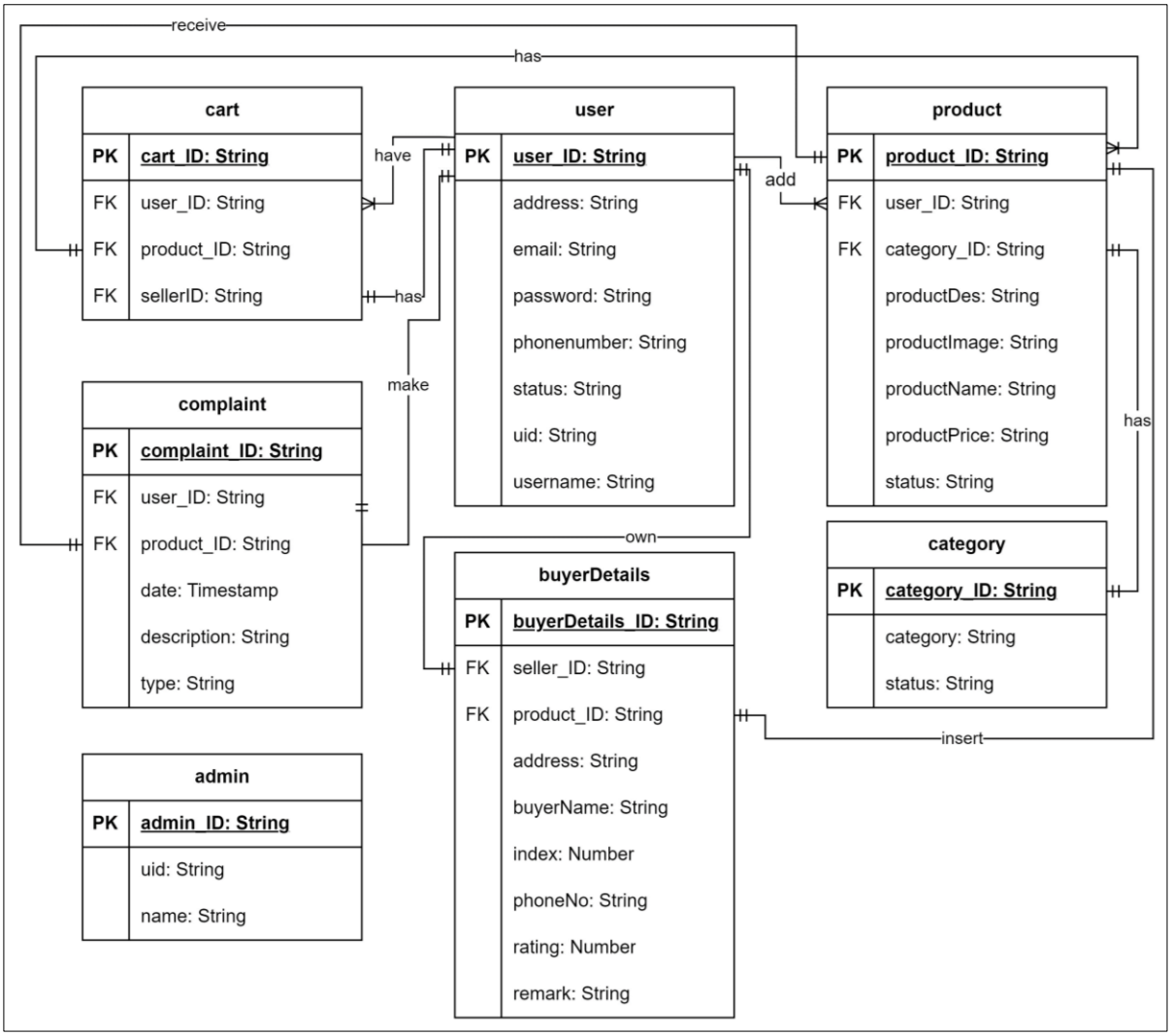

Figure 5: ERD of Prelove.UTHM

4. Results and Discussion

In order to develop the application, the open-source framework, Flutter and the programming language that famous for developed application which is Dart had been applied [11]. Firebase is the chosen database as it has a lot of ready use features that allow developer to use it easily. In this section, the system implementation and system testing of the developed application are discusses in detailed.

4.1 System Implementation

The login of both the administrator and users to the application is being done using Firebase Authentication and the interface is being shown in Figure 6. It is one of the famous services provided by Firebase. By applying this service, the process of managing account of user is easy and convenient. Among all the authentication methods, email and password authentication is the chosen methods.

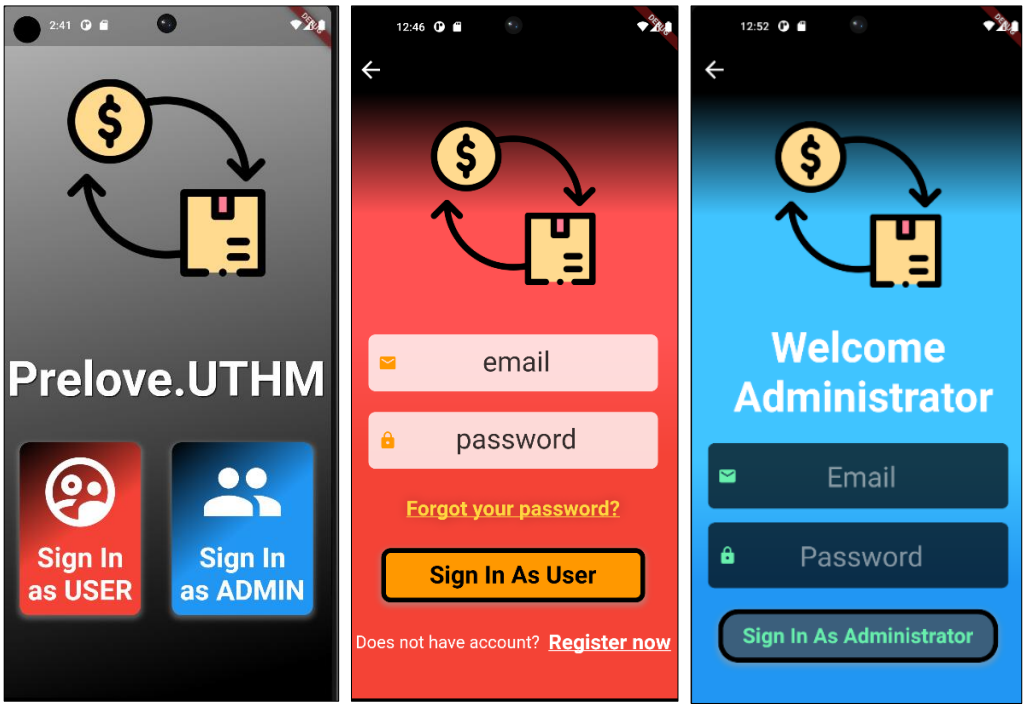

Figure 6: Login Page of User and Administrator

For new user of the application, they need to create their own account by register. During the process of registration, they need to provide their personal details such as username, email address, phone number, address and their password. All the fields have its own validator to ensure the user input correct details, else the specific error message is shown. Figure 7 is showing the interface of register page for new account.

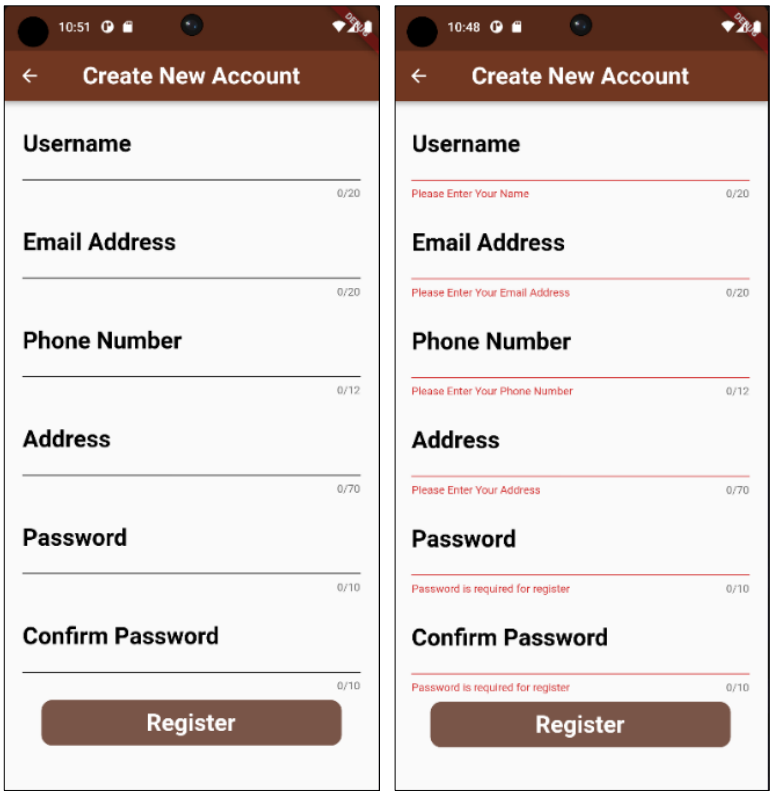

Figure 7: Register Page of New User

After the user successfully sign in into the application, they are directed into homepage as shown in Figure 8. All the items that published by other users are display with its respective name and image. There is a search bar provided for user to search for the specific item by using their name and they can also sort the display items according to the available category. The bottom navigation is prepared for user to navigate between the pages.

Figure 8: Home page of the application

When user intend to sell a used item, they can simply publish it by upload the related image and details which are item name, item description, category status and item price. It is visible to another user in homepage once it had been uploaded successfully. However, there is specific error message if any of the field is leave empty. The interface of publish new item and error message if the specific field is leaving empty is being shown in Figure 9.

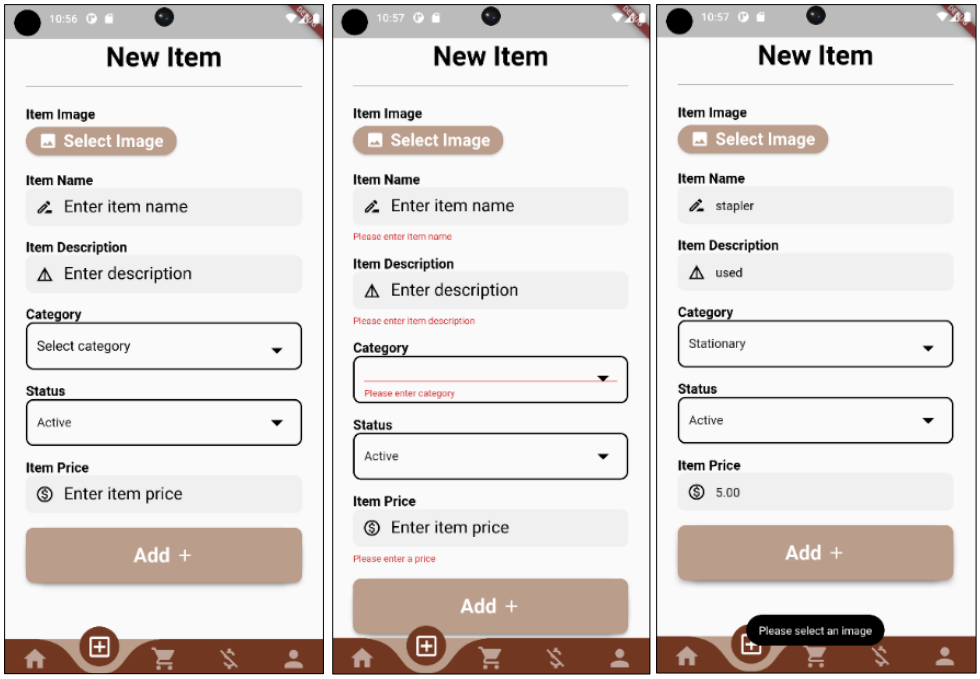

Figure 9: Publish new sell item for user

If the users that want to donate their used item, they can simply publish it by upload the related image and details which are item name, item description, category status and item price. It is visible to another user in donation page once it had been uploaded successfully. However, there is specific error message if any of the field is leave empty. The interface of publish new item for user and page that display donation items is being shown in Figure 10.

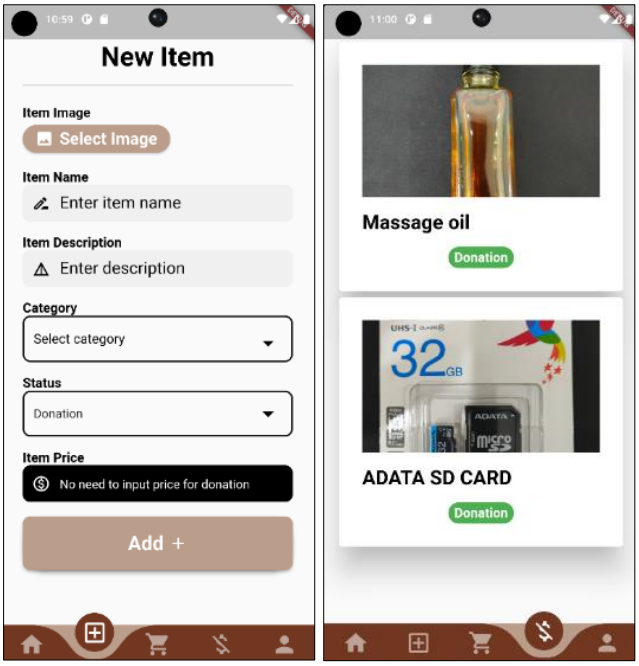

Figure 10: Interface for user to publish item as donation

Figure 11 shows the item details of an item when user click on it. In the appbar, there is a complaint icon provided to make complaint. Then, the category, seller and rating of the seller are being displayed. It is followed by a row that consists of image and details of an item. There is a button provided too to add the item into cart.

Figure 11: Interface of item details

In the cart page, all the items that being added by the user are displayed. User can manage by delete it after tick on the specific items. They only need to select the specific items and press on check out as shown in Figure 12 if they really interested in purchase it.

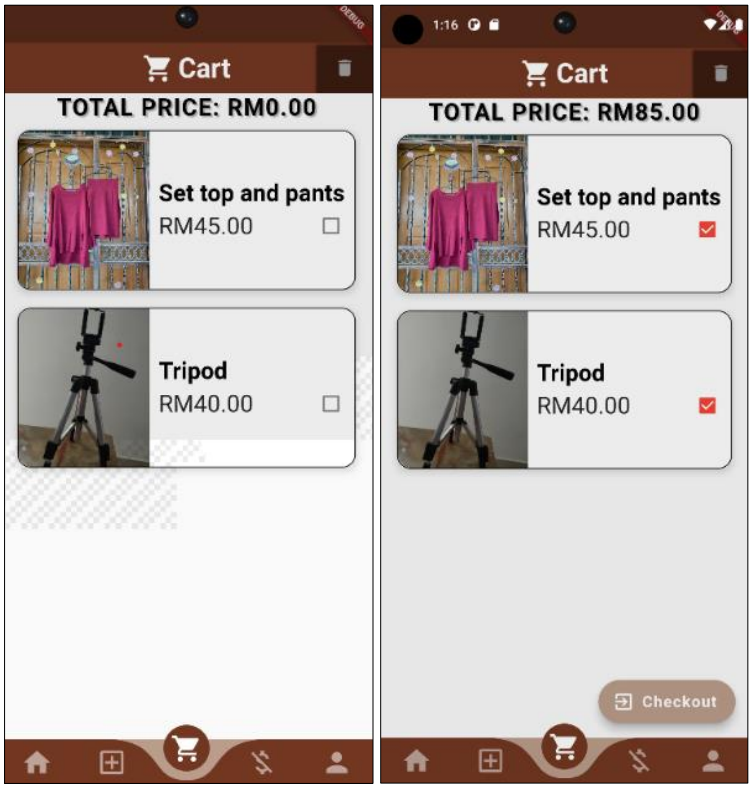

Figure 12: Interface of cart

For user they wish to view their sell history, they can navigate to user profile page using bottom navigation and click on 'SELL HISTORY'. All the related details are shown in the list and user can click on any of the item to view full details as shown in Figure 13.

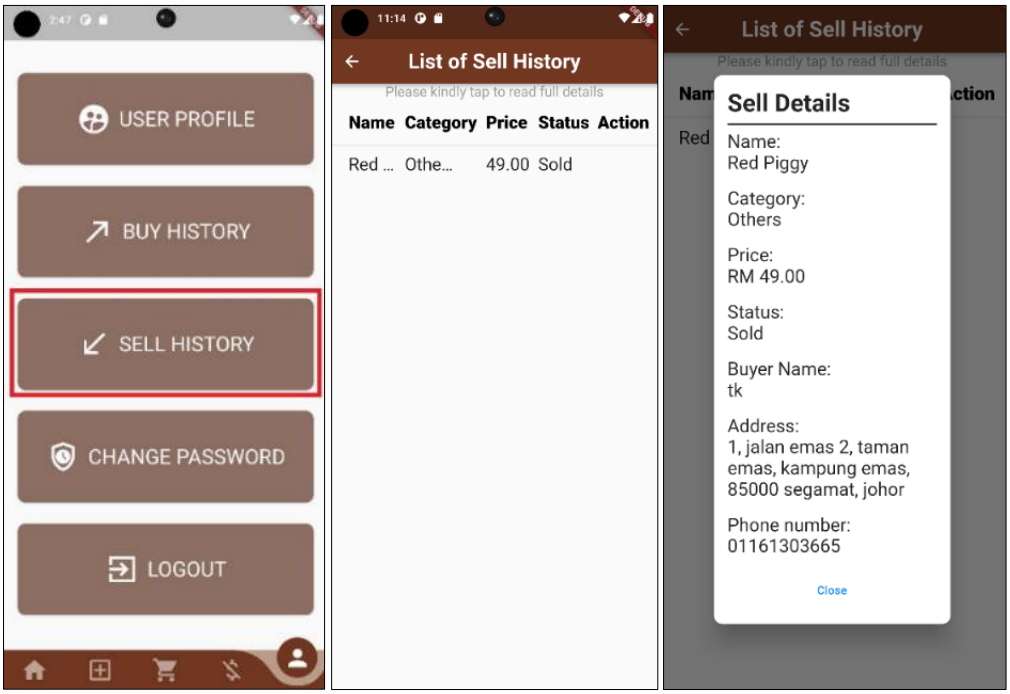

Figure 13: Interface of view sell history page

Next, for users that intend to make complaint, they only need to click on the icon provided of the specific item and they can choose the type of complaint and it is optional to provide additional details. In addition, user can make complaint regarding the seller in buy history by pressing on the button provided as long as they no rate the user yet. This send and update at administrator site so that they can take related actions regarding the issue. Once they had made rating, the button is not be visible again. Figure 14 shows the interface of making complaints.

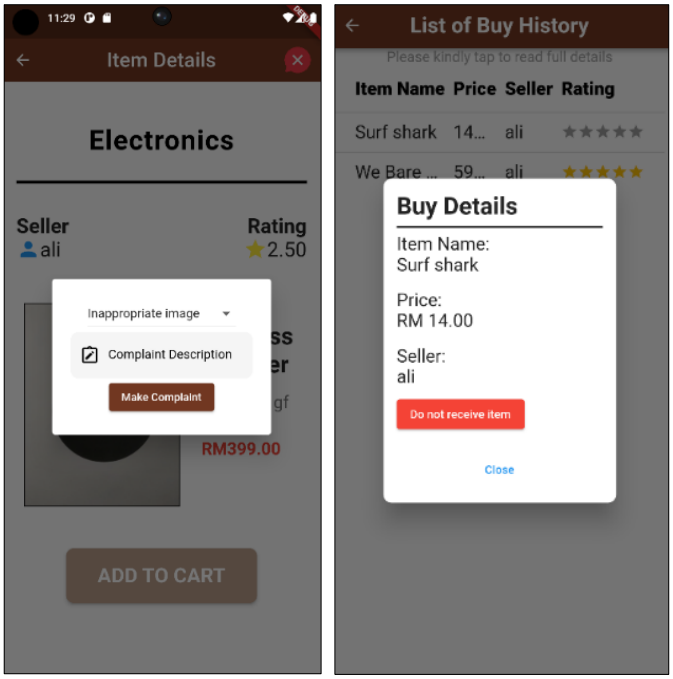

Figure 14: Interface of making complaints

For administrator that intend to view the complaint made by users, they need to login using their email and password. Then, they can navigate to the page by using the bottom navigation. The details of complaint such as type, description, date, item name and name of user who made complaint are displayed. Figure 15 shows the interface of list of complaints for administrator.

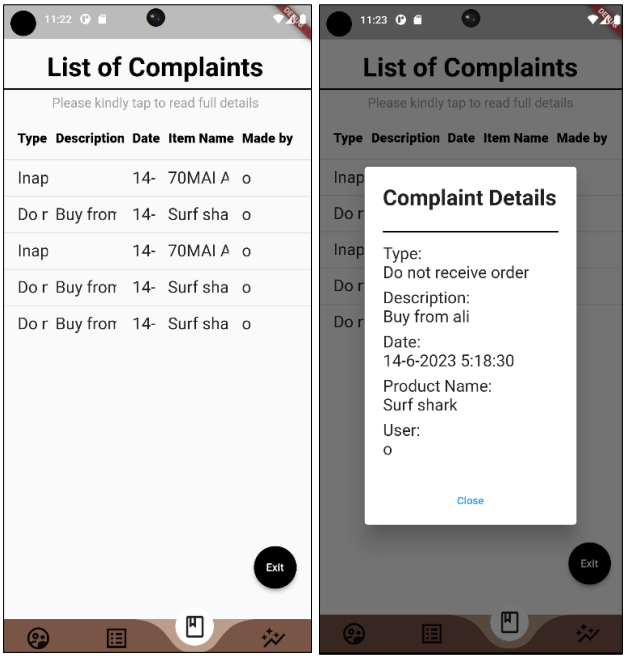

Figure 15: Interface of list of complaints

For administrator that intend to view the details of user, they are require to login using their email and password. Details of user such as name, email, phone number and status are shown. User can tap on any details and there is a dialog pop up. However, the administrator only has the permission to change the status of user between active and inactive. Figure 16 shows the interface of list of users for administrator.

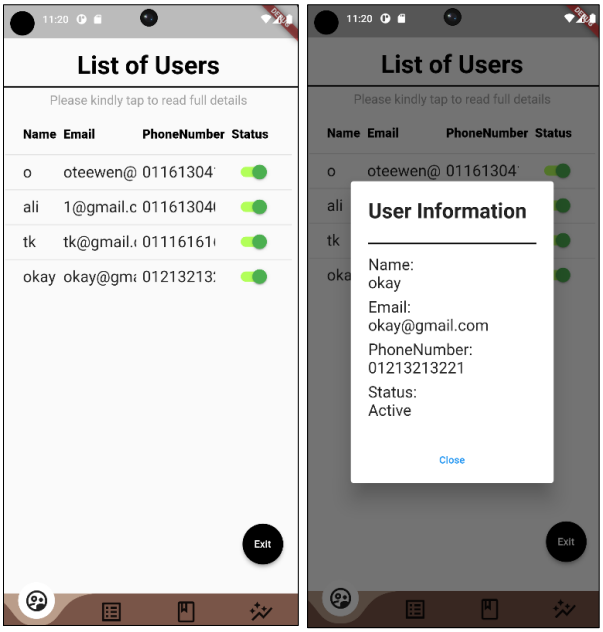

Figure 16: Interface of list of users

There is a page prepare for administrator to view the details of items but the preconditions are they need to login to the application using their email and password. All the items are being categorize according to status. The available status is ‘Active’, ‘Inactive’, ‘Sold’ and ‘Donation’ that can be differentiate easily using different colours. Among all the items, only those with ‘Active’ and ‘Inactive’ status and be modify. Figure 17 shows the interface of list of items for administrator.

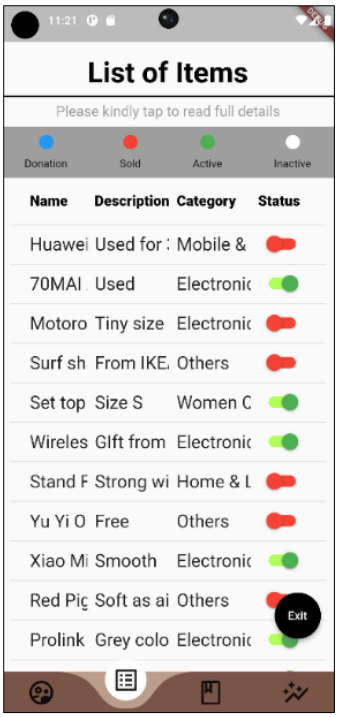

Figure 17: Interface of list of items

In addition, when the administrators intend to view the overall statistics which reveal total users and items with its respective status, they still need to login using their email and password. Figure 18 shows the interface of statistics for administrator.

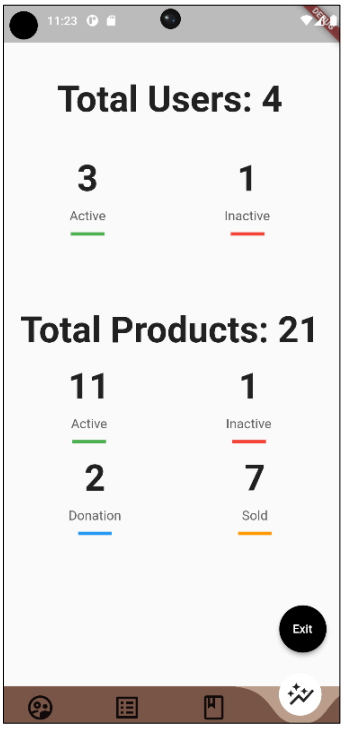

Figure 18: Interface of statistics page

In order to overcome the issue where user forget their password, a reset function is provided. User only need to input their email and a reset link is send to the email. They only need to click and be directed to new page to enter a new password as shown in Figure 19.

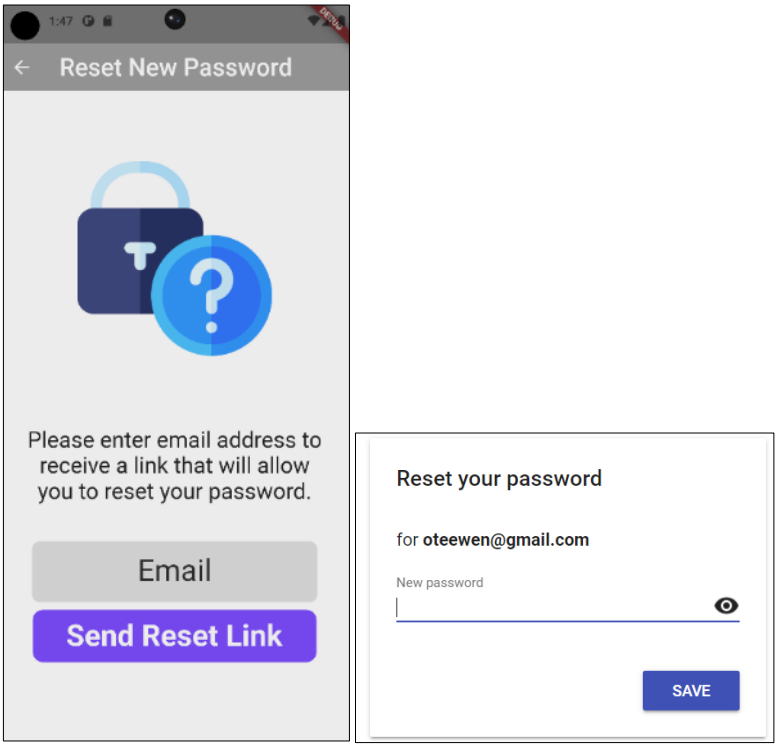

Figure 19: Interface of reset new password

4.2 System Testing

The system testing had been conducted to ensure that the developed application meet the functional requirements systems ongoing as well as comply with the objectives that are set in this project. Function testing and User Acceptance Testing (UAT) are included in this section.

4.2.1 Functional Testing

Functional Testing is carried out to test the application to ensure and guarantee that the application can run and functions as it needed and intended. Table 3 and Table 4 show the test plan result for Administration and Test Plan for user.

The test plan that had been conducted for administrator had showed that all the functions are pass as expected. The administrator can login, manage users, manage items, manage complaints and view statistics successfully and there is error message to indicate that reason they unable to proceed.

Table 3: Test Plan for Administrator

No.	Functions	Test case	Expected output	Actual output
I	Login	Incomplete data input	Alert message pop up to prompt administrator fill all fields	Pass
		Complete data input with wrong details	Alert message pop up to inform administrator they enter wrong details	Pass
		Complete data input with correct details	Alert message pop up to inform administrator they login successfully	Pass
II	Manage users	Read details of existing users	The administrator can read all details of existing users via admin site	Pass
		Change status of existing users	The administrator can change status of existing users via admin site	Pass
III	Manage items	Read details of existing items	The administrator can read all details of existing items via admin site	Pass
		Change status of existing items	The administrator can change status of existing items via admin site	Pass
IV	Manage complaints	Change status of items	The item being stop from selling	Pass
V	View statistics	Read details related to sales and items	All the information related to the sales and item such as quantity of item, new item and so on can be view	Pass

For test plan for user, all the functions which are login, sign up, user management module, sell item, donate item and buy item able to operate well. Besides, the alert message is playing the role to notify the user regarding the status of their actions. This show that the application is being developed successfully and fulfill all the requirements.

Table 4: Test Plan for User

No.	Functions	Test case	Expected output	Actual output
I	Login	Incomplete data input	Alert message pop up to prompt user fill all fields	Pass
		Complete data input with wrong details	Alert message pop up to inform user they enter wrong details	Pass
		Complete data input with correct details	Alert message pop up to inform user they login successfully	Pass
II	Sign up	Incomplete data input	Alert message pop up to prompt user fill all fields	Pass
		Complete data input with invalid details	Alert message pop up to prompt user fill all fields correctly	Pass
		Complete data input with valid details	Alert message pop up to inform user they sign up successfully	Pass
III	User management module	View personal information	User able to see all personal information	Pass
		Update personal information and filled all required fields	Alert message pop up to inform user they update successfully	Pass
		Update personal information and do not fill all required fields	Alert message pop up to prompt user fill all fields	Pass
IV	Sell item	Publish item when all required fields are filled	Alert message pop up to inform user they publish successfully	Pass
		Publish item when not all required fields are filled	Alert message pop up to prompt user fill all fields	Pass
		Check sell history	History of selling able to be view	Pass
		Remove item that publish for sell	Item being stop from selling	Pass
V	Donate item	Publish item when all required fields are filled	Alert message pop up to inform user they publish successfully	Pass
		Publish item when not all required fields are filled	Alert message pop up to prompt user fill all fields	Pass
		Check donate history in sell history	History of donate able to be view	Pass
		Remove item that publish for donate	Item being stop from selling	Pass
VI	Buy item	Add to cart	Item being save in cart	Pass
		Fill all required fields for payment	Alert message pop up to inform user they pay successfully	Pass
		Do not fill all required fields for payment	Alert message pop up to prompt user fill all fields	Pass

4.2.2 User Acceptance Test

The Table 5 shows the result of user acceptance testing for administrator site which conducted using the online tool, Google Form [12] to obtain feedback from respondents regarding the application. It shows that majority of the features for administrator is highly satisfied because Ranking 5 show high satisfaction while to Ranking 1 is unsatisfied. There is only one Ranking 3 which show moderate level of satisfaction for manage complaints feature. This indicates that they have overall high satisfaction while using the application and are likely to continue using it in the future.

Table 5: Result of User Acceptance Testing for Administrator

No.	Features	Ranking				
		1	2	3	4	5
I	Login and Sign Up					10
II	Manage Users				1	9
III	Manage Items				2	8
IV	Manage Complaints			1	2	7
V	View Statistics				2	8
VI	User Interface				2	8
VII	Easy To Use					10

The next table which is Table 6 shows the result of user acceptance testing for user site. The result is not as good as the previous result for administrator since there are total of three Ranking 3 given by the user. However, the overall result is considered excellent because most of the Ranking are 4 and 5. This shows that the users are satisfy and enjoying while using the application.

Table 6: Result of User Acceptance Testing for User

No.	Features	Ranking				
		1	2	3	4	5
I	Login and Sign Up					10
II	User management			2	2	6
III	Sell item				1	9
IV	Buy item				2	8
V	Donate item				2	8
VI	User Interface			1	2	7
VII	Easy To Use				1	9

5. Conclusion

Prelove.UTHM is a fully functional online mobile application that provide a platform for the users which are students, lecturers and staffs to buy and sell their second-hand items. One of the special features of the mobile application is user can donate their used items to others without required any payment. Although the application had been developed within the given timeline, there are still some limitations that might lower the satisfaction of the users. Moreover, the user only can provide one single photo for every item that they publish. The limitation in terms of number of photos lower down the confidence of user to buy an item. The next limitation is there is only one payment method prepare for the user which is not convenient. They can only use the provided gateway to make payment and might have related issue. However, the sellers and buyers have no opportunity no chat directly to obtain more detailed information regarding a specific product.

In order to provide user a more user friendly and functional platform, some enhancements can be made in the future. The first enhancement is addition of sorting feature that allow user to categorize displayed items based on price, name and date published. This totally reduce the time spent of user when looking for a specific item. In addition, the function of uploading multiple photos should be prepare for seller so that buyer can have more information regarding an item based on the provided

photos. Besides, more payment options such as Cash on Delivery (COD), QR code payment, online banking and cheques should be added for buyer to make payment so that they are not limited by one payment gateway only. Finally, a direct chat function that involve both buyer and seller should be create to allow the exchange of related information regarding an item that led to success of buying an item.

Acknowledgement

The authors would like to thank the Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia for its support.

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