

Patient Appointment Application for Mawar Medical Centre Unit – Dialysis

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Abstract: It's quite distressing to have to wait a long period for dialysis therapy from the doctors. Especially during this Movement Control Order (MCO) period. To solve this issue, a Patient Appointment Application was developed for Mawar Medical Centre - Dialysis Unit. The dialysis unit is still using a manual method which means all the documents and reports are kept in a file and organized by the unit staff. Implementation of this traditional method had brought up a lot of problems to the dialysis unit as well as to the patients. Some of the major problems are loss of data such as patient report and patient details, absence of online appointment booking for the patient to book time slot conveniently and the final problem is failure to generate statistical report for audit purpose. Next for objective this project holds three objectives. The first is i) to design a Patient Appointment Application using the Android platform. The second is ii) to develop a Patient Appointment Application that can send a reminder to the patient by using apps notification as an alert for the coming appointment. iii) to test the function of the Patient Appointment Application to work without errors. The development of this project will instantly solve the problem faced by dialysis unit management. The physical design of this application is being constructed using mobile-based technology, which are Android Studio, Firebase database and Java language. The methodology used in developing this application system is Object-Oriented System Development (OOSD) which involves four phases which are Object-Oriented Requirement Analysis, Object-Oriented Design, Object Oriented Implementation and Object-Oriented Testing. To conclude, this application will increase staff efficiency and productivity also makes it easier for the management to maintain a record the patient.

Keywords: patient, booking application, android platform.

1. Introduction

This project aimed to develop Patient Appointment Android Application for Mawar Medical Centre - Dialysis Unit where patients can and get their dialysis treatment without much difficulties. Since Mawar Medical Centre - Dialysis Unit is using manual system it causes a lot of problems to them. The first problem is loss of data such as patient report and patient details happens regularly because there is no database to store them. All the documents are managed by staff of unit dialysis. So, there is huge

possibilities for human error to occur such as misplacing the data. Besides that, since there is no database to store all the data, retrieving and managing those data becomes a major problem. The second problem is there is no online appointment system to allow patient to book their slot for treatment from their desired and convenient place. Because of that patients have to come personally to the hospital to make or adjust their appointment which is a hassle with their health condition. This will lead to delay of process in the hospital such as registration, checkup, and patient that came for treatment. The final problem is producing reports for review and audit. With the current method, the administrator did not have a mechanism to generate relevant reports for future improvement. The objective of developing this application is to analyze and design an android application for the dialysis patient to book time slot appointment for dialysis treatment. The second objective is to develop an android application that can send reminder through app notification to the patient for coming appointment. The final objective is to test and evaluate Patient Appointment Application for Mawar Medical Centre - Dialysis Unit to work without errors and as required by client.

This paper contains six main sections. Section one describes the background of the project, while section two provides the literature review. section three shows the research methodology and section four explains the findings from the analysis and design of the system. Included also are discussion about the result from testing done on prototype. The final section will be the conclusion for the overall development.

2. Related work

2.1 Android

Android software development is the process by which new applications are created for devices running the Android operating system. The Android operating system was developed by Google. It is based on the Linux kernel user interface. The operating system is designed for smartphones and tablet computers and allows users to engage with it through a touchscreen interface. Software development for mobile devices poses new challenges due to the unique features of this activity. The need to cope with various platforms, standards, protocols and network technologies, limited device capacity—although its constant evolution—, and market time demands are but a few of the issues faced. For this reason, software development for mobile devices is considerably different from traditional development [1]. Android is a mobile operating system that is based on a modified version of Linux [2]. Android applications are scripted in Java and the latest Kotlin language with the help of a rich set of libraries. This can compile Java source code directly to machine code, and it therefore doesn't require any JVM to execute [3]. Therefore, with sufficient knowledge on java a good application can be developed.

2.2 Patient Appointment Application for Mawar Medical Centre – Dialysis Unit

This application is designed to help patient to book time slot for appointment from the management of the hospital. By using this application patient can make appointment for their dialysis treatment from anywhere and at any time with a sufficient internet access. With this feature it will reduce the number of patients visiting the hospital and indirectly helps smoothens the flow of process in the dialysis unit. Patients also have the privilege to reschedule their appointment if there are any emergency issues with the patients. Besides that, in this application there is question and answer platform created which will allow patient to clear their doubt with the hospital administrator if there is any. All the questions will be sent immediately to the administrator and the questions will be answered within working hours which is 6.00am until 9.30pm. Other than that, this application is linked to the database where all the details of patient are stored. Therefore, the loss of data issue can be solved and at the same time all the data can be managed well and retrieved easily when needed.

2.3 Similar Related System

Research and analysis on existing systems in Google Play Store is very useful as a reference to get more information and knowledge before the development process. Research is done on three applications which are Appointfix Application, Setmore Application and Booking System. Moreover, a comparison has been done with these three applications and the Patient Appointment application. The purpose of conducting research and comparison between existing applications is to identify the advantages and disadvantages of the application. The findings can be used as a guide and easy to develop a better application.[4]. Table 1 shows the comparison made between three similar applications with Patient Appointment Application for Mawar Medical Centre – Dialysis Unit.

Table 1: Comparison between three similar application with Patient Appointment Application for Mawar Medical Centre – Dialysis Unit

Features	Appointfix	Setmore	Booking System	Patient Appointment Application for Mawar Medical Centre – Dialysis Unit
User	Public	Administrator	Administrator	Patient, Administrator
Language	English	English	English	English
User Interface	Arranged in regular form, very systematic and flexible	Less usage of graphics components and simple user interface	Attractive interface and well organized	Arranged in, systematic and well organized together with colorful view
Login and Register	Yes	Yes	Yes	Yes
Database	Yes	Yes	Yes	Yes
Statistics	Yes	No	No	No
User Support System (Administrator)	Yes	Yes	Yes	Yes
Messaging platform	Yes	No	No	Yes
Subscription	Paid	Paid	Paid	Free

3. Methodology/Framework

Methodology refers to the whole process of the developing a system. Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Typically, it encompasses concepts such as paradigm, theoretical model, phases and quantitative or qualitative techniques [5]. Patient Appointment Application for Mawar Medical Centre – Dialysis is developed by using the Software Development Object Orientation methodology approach or better known as its Object-Oriented System Development (OOSD) methodology. This method is a methodology of modular design based on the construction of each other known as objects. The main three advantages of using OOSD are ranked from an easier modeling process followed by improved modularity of systems and the third one is improved maintainability of systems [6]. There are four phases that will be involved in this development using this OOSD such as object orientation, design object orientation, implementation object orientation and test object orientation. Figure 1 shows the task breakdown

3.1 Analysis phase

Studies on software, application management systems, data management information will be done in this phase. Information on the application constraints and requirements is also identified. Observations are made on the most peak time in the dialysis unit and number of patients visiting the unit per day. Reviews of books, journals, magazines and reports are also made from time to time. As a result of the study, several key points have been identified such as problem background, project's objectives, scope of action and potential application users. In addition, a Gantt chart is also used to plan the system development process for activities in each phase of the Software Development Object Orientation (OOSD) methodology.

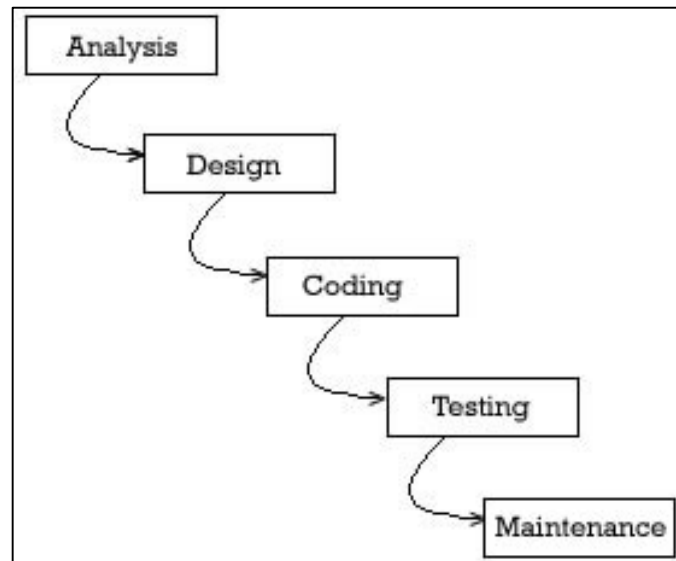


Figure 1: Object-Oriented System Development

3.1.1 Requirement Analysis

Requirement analysis refers to the process of defining all the client expectations. Requirement analysis consists of two categories which are functional requirements and non-functional requirements. Functional requirements refer to the task or function that needs to be performed and also the task that is prohibited for the application. As for the non-functional requirements, it refers to the system's operation capabilities and the constraints that will increase the system's performance. Table 2 shows the functional requirements and Table 3 shows the non-functional requirements of the application.

Table 2: Functional Requirement

Modules	Functionalities
Search Function	Application should allow patient to search for available appointment slots
Cancel function	Application should allow patient to cancel his/her appointment
View Function	Application should allow dialysis unit administrator to view patient's details
Update Function	Application should allow patients to update their personal details
Trace Function	Application should allow dialysis unit administrator to trace a patient on his/her personal ID code.
Notification Function	Application should send automatic reminders to the patient of an upcoming appointment.
Reliability	Application should be usable for visually impaired people
Availability	Application should be available in 3 languages.
Scalability	Application should follow Responsive Web Design rules
Manageability	Dialysis unit administrator should be able to trace a patient on his/her address

3.1.2 Use Case Diagram

Use case is one of the most important tool under the category of UML to represent or show the operation involved in a system. Use case diagram consist of actor which is the user in the real world interacting with entities or object to give a clear picture of the process in the system. All the user will be listed together with the activities before constructing a use case diagram. For Patient Appointment Application for Mawar Medical Centre – Dialysis unit there are two actors involved. Which is administrator of Dialysis Unit and the dialysis patient. Based on Figure 2, there are ten use cases consisting of patient account creation, admin and patient logins, patient slot searching, patient slot booking, cancel appointment, message with administrator, administrator view patient details, administrator manage patient, and admin and patient log out. Each use case diagram is a key component of this system. Figure 2 shows the Use Case Diagram for Patient Appointment Application for Mawar Medical Centre – Dialysis unit

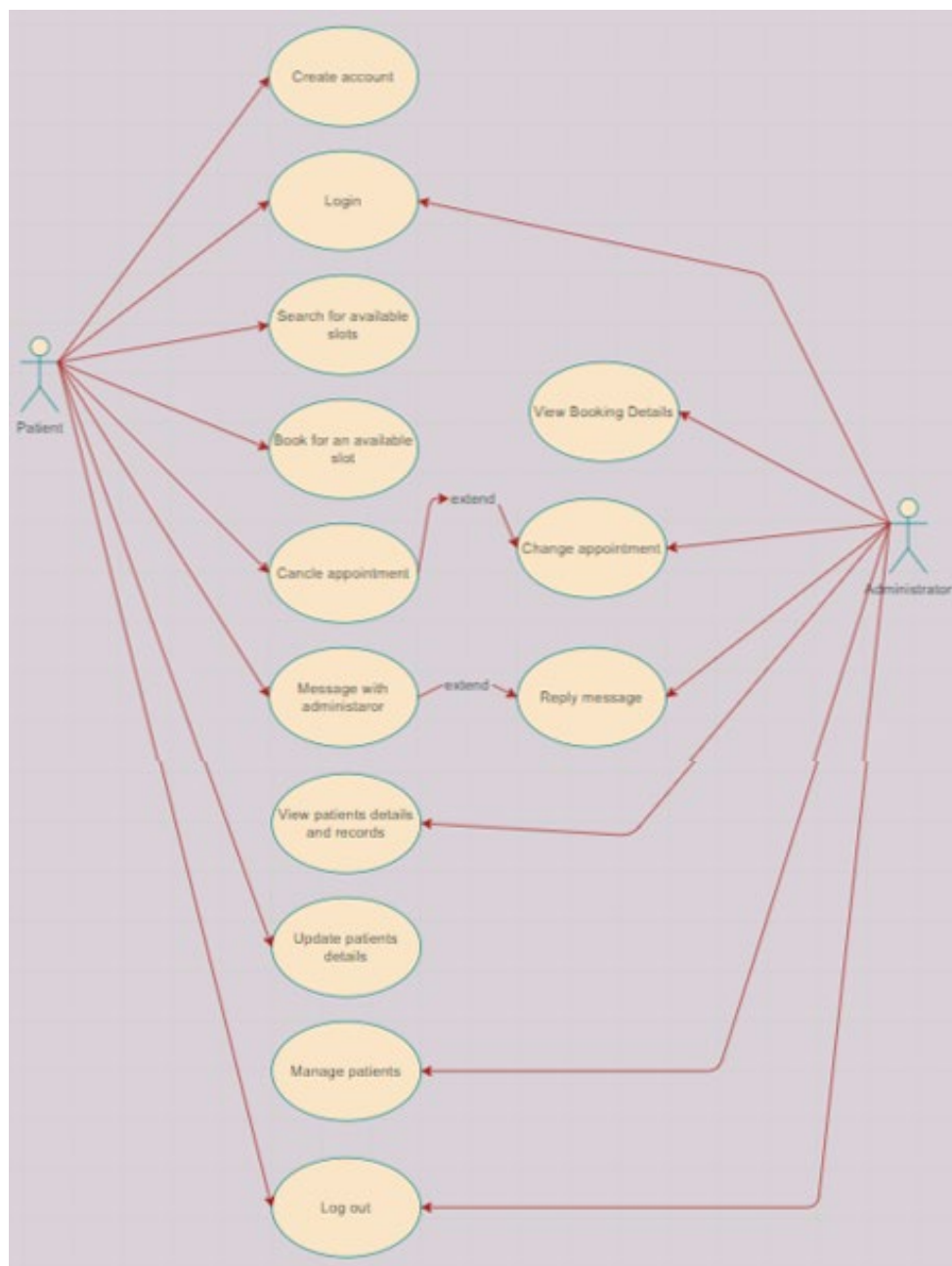


Figure 2: Use Case Diagram for Patient Appointment Application for Mawar Medical Centre – Dialysis unit

3.1.3 Activity Diagram

The flow for this developed system can be seen through the activity diagram. The purpose of this activity diagram is to simplify the system developer's planning by referring to the flow of the plan. The activity diagram consists of two part which are activity diagram for administrator and activity diagram for patient. In activity diagram for administrator the flow and task of administrator in the application can be seen clearly. As for activity diagram for patient the flow and task of patient in the application is shown.

3.1.3.1 Activity Diagram for Administrator

This system activity starts when an administrator logs in with a valid email address and password to allow the administrator access to the application. Then, the connection will be made by selecting the menu on the main page. The features on main menu will be manage patients, replying patients' message, and view patient details. Once all the task is done the administrator can click log out button. The activity diagram for the process performed by the administrator is illustrated in Appendix A.

3.1.3.2 Activity Diagram for Patient

This system activity starts when patients logs in with a valid email address and password to allow the patient access to the application. Then, the connection will be made by selecting the menu on the main page. The features on main menu will be search available slot, booking slot, message administrator and cancel appointment. Once all the task is done the patient can click log out button. The activity diagram for the process performed by the patient is illustrated in Appendix B

3.1.4 Class Diagram

Class diagrams are the classes that exist in the application of a system and the relationships between each of the other classes involved. Besides it shows the static structure of classifiers in a system [7]. Class diagrams also provide graphical notation for each of the entities' modelling and relationship classes by describing the objects that are present. Figure 3 shows the class diagram of the Patient Appointment Application for Mawar Medical Centre – Dialysis unit.

3.2. Design Phase

This phase contains two main stage which are system design and object design.

3.2.1 System Design

On the system design a complete architecture of the Patient Appointment Application for Mawar Medical Centre – Unit Dialysis is developed. All the modules and subsystem in the application is composed in a hierarchy of interacting objects and grouped into classes. This system design is executed based on the analysis model and proposed system architecture.

3.2.2 Object Design

This phase designs applications that have been sketched in specific forms by specifying how the system can be developed. Unified Modelling Language (UML) is used to design the application system which is a use case, class sequence diagram and activity diagram. This will establish interaction among classes and hierarchies of classes is defined. The activities involved in the design phase is designing classes, system support interfaces as well as application system interfaces within the Android platform. The use of the types of text, colors, images and icons that will be included in this application system is also emphasized during the system design process.

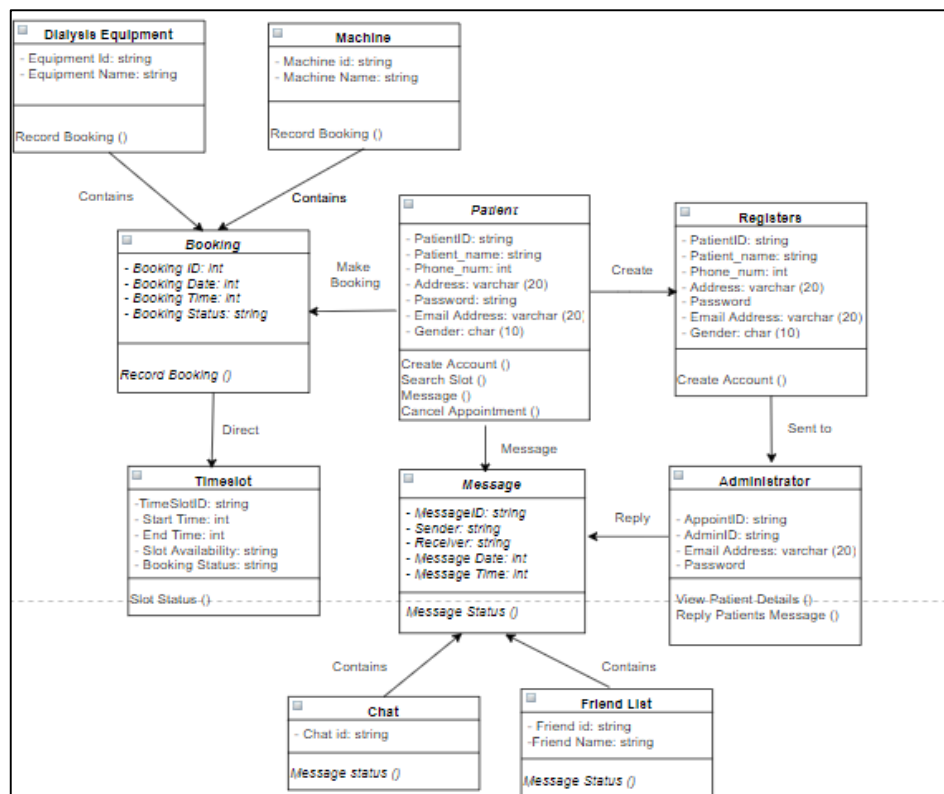


Figure 3: Class diagram of the Patient Appointment Application for Mawar Medical Centre – Dialysis unit.

3.3 Implementation Phase

For the implementation part it focuses on the deployment of the successfully developed User Interface. For the deployment of the interface and database designed previously firebase console and android version 4.1.1 is used as it contains few functions that is integrated with the application. Through this phase, interfaces and modules of Patient Appointment Application for Mawar Medical Centre – Unit Dialysis will be transformed into programs and linked together in a database to fulfil all the functionality set. The interface design developed is based on the system interface sketch performed in the previous phase. In addition, prototype building based on each module built to determine whether the system meets the user requirements.

Figure 4 shows administrator main page interface and figure 5 shows the code written for the main page. Figure 6 shows the conversation between patient and admin. All the message will be sent in real time and the message will be stored in firebase. Figure 7 shows the coding applied to validate the patient Id entered by the administrator to avoid any duplication or invalid Id. Figure 8 shows patients making booking. In this step patient needs to select the available time slot then click on next button for final step

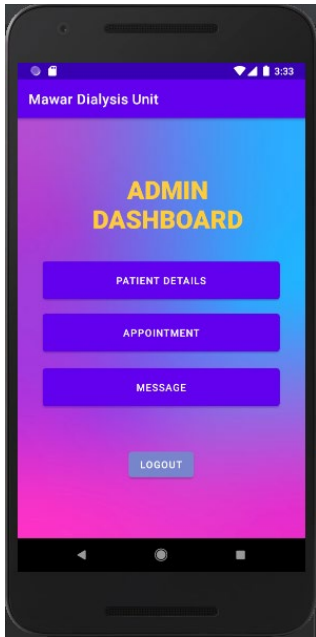


Figure 4: Administrator's Main interface

```

Button AdTimeSlotBtn;
Button AdDetailBtn;
Button AdMessageBtn;
@Override
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_adminmainpage);

    AdDetailBtn = findViewById(R.id.patientdetailbtn);
    AdDetailBtn.setOnClickListener(v -> startActivity(new Intent(getApplicationContext(), PatientActivity.class)));

    AdMessageBtn = findViewById(R.id.messagebtn);
    AdMessageBtn.setOnClickListener(v -> startActivity(new Intent(getApplicationContext(), chatMainActivity.class)));

    AdTimeSlotBtn = findViewById(R.id.appointmentbtn);
    AdTimeSlotBtn.setOnClickListener(v -> startActivity(new Intent(getApplicationContext(), AdminsideTimeslot.class)));
}

public void logout(View view) {
    FirebaseAuth.getInstance().signOut();//logout
    startActivity(new Intent(getApplicationContext(), loginpage.class));
    finish();
}
    
```

Figure 5: Administrator Main Page Coding Segment

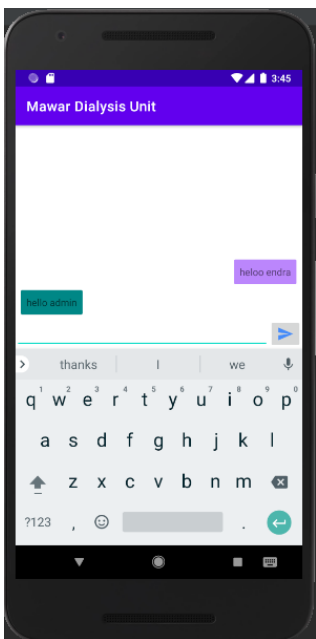


Figure 6: Patient and Admins Conversation

```

fabAdd = findViewById(R.id.fabAdd);
fabAdd.setOnClickListener(v -> {
    final Dialog dialog = new Dialog( context.chatMainActivity.this);
    dialog.setTitle("Enter User UID");
    dialog.setContentView(R.layout.dialod_add);
    dialog.show();

    final EditText edtID = dialog.findViewById(R.id.edtID);
    Button btnOk = dialog.findViewById(R.id.btnok);

    btnOk.setOnClickListener(v1 -> {
        String idUser = edtID.getText().toString();
        if(TextUtils.isEmpty(idUser)) {
            edtID.setError("required");
        }else{
            firestore.collection( collectionPath "patient").whereEqualTo( field: "PatientID", idUser)
                .get().addOnSuccessListener(queryDocumentSnapshots -> {
                    if (queryDocumentSnapshots.isEmpty()) {
                        edtID.setError("ID not found");
                    } else {
                        for (DocumentSnapshot documentSnapshot : queryDocumentSnapshots.getDocuments()) {
                            String uidFriend = documentSnapshot.getId();
                            if (uid.equals(uidFriend)) {
                                edtID.setError("wrong ID");
                            } else {
                                dialog.cancel();
                                checkFriendExist(uidFriend);
                            }
                        }
                    }
                });
        }
    });
}
    
```

Figure 7: Patient's Id Validation Coding Segment

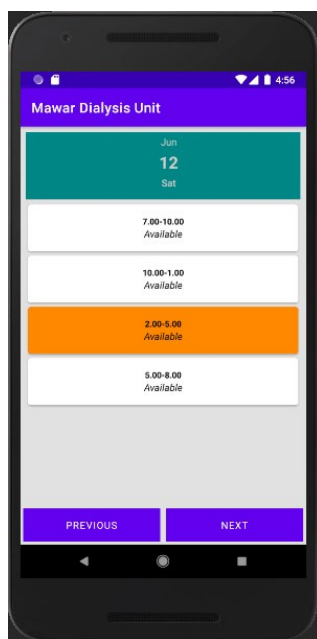


Figure 8: Patients Selecting Timeslot

3.4 Testing Phase

Testing is performed to ensure that the program does not encounter any errors and the system works properly. Testing processes will be performed on the database to ensure that data can be stored, updated and accessed from the database. The correction will be made, in case of error or defect in the system. The system testing of this application will be done by the end user, dialysis unit administrator and dialysis patient. System interfaces testing will be carried out to ensure that the Patient Appointment Application for Mawar Medical Centre- Dialysis Unit is user-friendly.

4. Result and Discussion

Testing is one of the important parts for the whole project development process. Testing is done to find out if there is any error in the flow of the developed project. The application must be test to ensure all functionality run without issue. Usually testing is done with the with user of the application to show and get their opinion on the developed project. Testing consist of two type. First one is functional testing and the second is user acceptance testing.

4.1 Functional Testing

Functional testing is done on the modules that exists in the application. This testing is carried out to ensure that the developed application performs exactly like how the user required. Other than that, if any bug is found during the test, will be recorded. Table 4 shows one of the test plan result obtained for the login module in the application.

Table 4: Test Plan for Login Module

No	Test Cases	Expected Output	Actual Output
T1-1	Enter valid email address and password	Successfully login and navigate user to verification process	Expected Result
T1-2	Enter the wrong email address or password	Received error message stating "wrong email address or password"	Expected Result
T1-3	Enter null credential either email address or password	Received error message stating "email address or password required"	Expected Result

4.2 User Acceptance Testing

User acceptance testing is performed by the actual user of the application. This testing is performed to check whether the application met the requirement. This testing was done by dialysis patient of Mawar Medical Centre and the administrator of the dialysis unit. Since the government has announced MCO due to the pandemic disease, a virtual meeting was conducted to present the flow and function of the application. A questionnaire was created and distributed to the users so that they can rate and give feedback based on the presented application. Table 5 shows the result obtained from users of the application.

Table 5: User Acceptance Testing Form

No	Acceptance Requirement	Test Result (Number of people)	
		Accept	Reject
1	Registration module working well.	2	
2	Login module working well.	2	
3	Patient details module	2	
4	User update profile	2	
5	Appointment booking module	1	1
6	Message module	2	
7	Buttons in the application are functional.	2	
8	Colours and graphics are appropriate	2	
9	Interface is attractive	2	
10	Application are user friendly	2	

5. Conclusion

To conclude this application was developed to improve the workflow of the Mawar Medical Centre Dialysis Unit and to help the dialysis patient to make appointment booking without attending the hospital. The administrator has the privilege to view patient details and access them. This privileged allows administrator to manage patient's data. The patients can make a booking from anywhere with sufficient internet access. Besides all the data are stored in the firebase and can easily retrieve it at any time. Thus, the problem of loss of data can be overcome. Although this application is developed successfully, yet there is some improvement that can be made to make it even better. The first one is this application can be upgraded to be deployed on IOS operating system. The second is this application can be modified to be used as offline application which means internet connection is not required to use this application.

Acknowledgement

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Appendix A

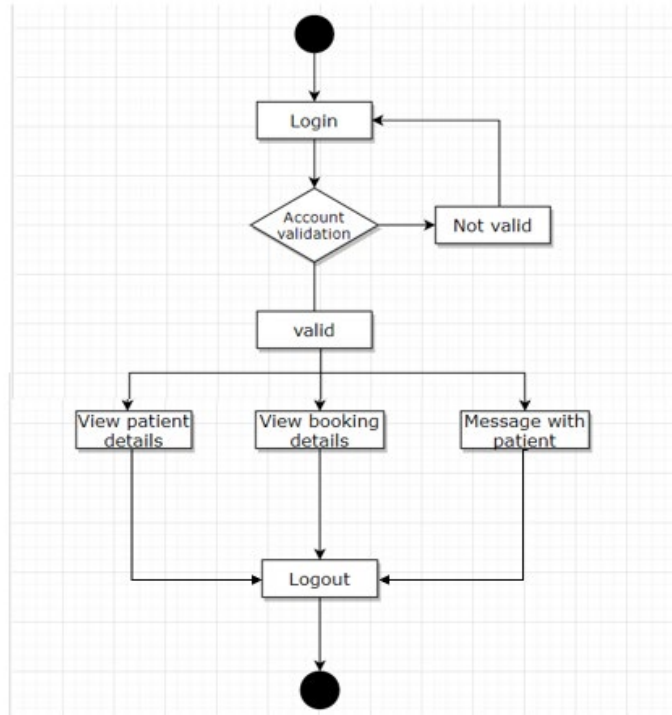


Figure A: Activity Diagram for Administrator

Appendix B

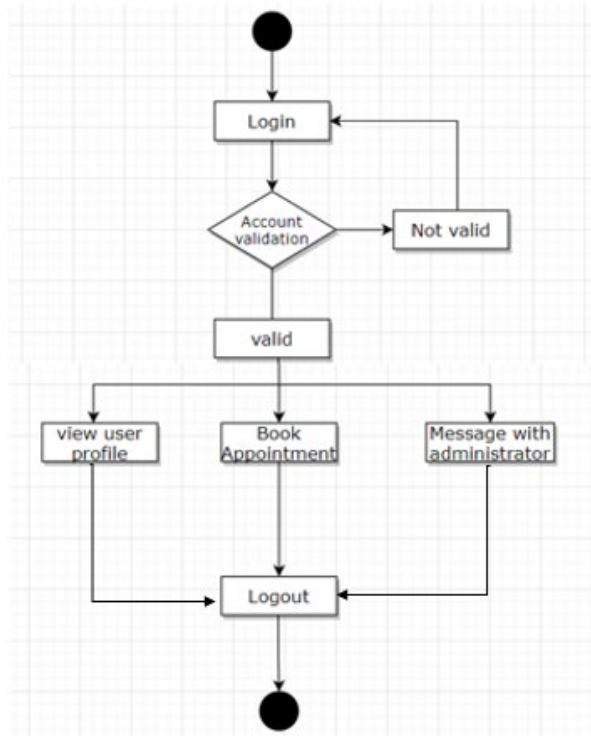


Figure B: Activity Diagram for Patient

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