

Electronic Health Book System by Using Android Based Application

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Abstract: The traditional techniques of providing services by health professionals are being reshaped by e-Health, to reduce costs and increase patient-users with health services. The increased number of patients registering per year causes data health collection more difficult and easier to misplace as paper-based data collection is still being used. The purpose of this project is to design E-Health Book which is an android based applications which to be used by patient and hospital staff. The proposed system is developed using Flutter, a software development kit (SDK) for cross platform app development and uses DART as programming language. The outcome of this project is an Android based application which its efficiency was evaluated by respondents from specific background that will benefit from the application using a set of questions that was prepared by using Technological Acceptance Model (TAM) to construct the questionnaire to assess the efficiency of the application. The application received overwhelming positive feedback, where 100% of the respondents that participated in the survey expressed complete satisfaction and inclination to highly recommend it to their acquaintances.

Keywords: e-Health, Medical Recording, Flutter, Android.

1. Introduction

According to a recent publication by the Ministry of Health, in 2018 [1] that the number of patients who are admitted to hospitals and clinics has surpassed 77 million. This represents a 445% increase from 2007 where the number of admissions was just 17 million. In terms of healthcare management, hospitals are under increasing pressure to raise their management and public health standards. The traditional method of paper-based information has made it more difficult to maintain a sustainable medical recording system as it leads to hospitals becoming overcrowded, treatment delays and higher chances to make medical errors.

The advancement of technology today has helped to open up the possibility of giving e-solutions to improve the healthcare system around the world. The implementation of EHR has shown positive feedback in giving assistance to patients in having more updated records of their health status and faster access among the hospital management. A few attempts of a digital medical recording have been

developed with various templates built for the conveniences of the medical staff with a click of a button [2].

1.1 Medical Recording Application

There are several types of medical system that has been developed with various functionality and specifications. Each system developed has its unique style of working, and some of them do not handle all of the issues that users confront. The paper by Andrija Ivanovic et al. [3] focuses on the importance of digitalizing information in the insurance sector, specifically in the health insurance industry. The proposed platform allows users to access their insurance information faster and with the help of RFID cards for identification verification, promises to make the process of accessing insurance easier. The results from the Seha application in Saudi Arabia showed improved delivery of healthcare services, increased customer satisfaction, and greater system efficiency, as seen through reduced doctor visits [4]. The study also revealed that factors such as age, gender, and technological difficulties impacted the utilization of the app. Another example of a virtual healthcare platform is MyDoctor, which enables patients to access medical information and communicate with their doctor from home, as well as schedule appointments [5]. Overall, virtual information has been shown to provide a better understanding for patients.

Table 1 is a comparison table on existing medical recording application and the developed application that has been developed.

Table 1: Comparison Between Digitized Medical Health Record System

Features	System Name			
	E-Health Card	Seha	MyDoctor	E-Health Book
Allow patients to booked an appointment.		√	√	√
Show medical practitioner's availability for an appointment to patient.		√	√	
Patient can review their health records.		√	√	√
Send notifications to patient when doctor is ready to see them.				√
Medical practitioner can update		√	√	√

patient's medical records.				
Shows an indicator to medical practitioner when patient has arrived to the hospital.		√		√
Stores user insurance information	√	√		
Update user's basic information in the account.	√	√	√	√

The systems shown above are various, but they were all created with the goal of making the whole user-provider healthcare relationship easier and more convenient. The E-Health Book application has successfully integrated 75% of its intended functionality, covering 6 out of the 8 functions to provide a comprehensive digital health platform.

2. Materials and Methods

2.1 System Development Process.

Figure 1 shows the flowchart of developing the electronic health book system using Android-based application.

- Start

Begin the process of building the application using Flutter.

- Setting up Firebase

Firstly, is to create a Firebase account and then add a new project to the account. Firebase is a cloud-based platform that provides the backend services for mobile and web applications. Once the project was created, add the credentials of the project to the flutter application where the application was being built. This is to allowed storing and retrieve data from the Firebase database, which was critical in developing the medical data recording application.

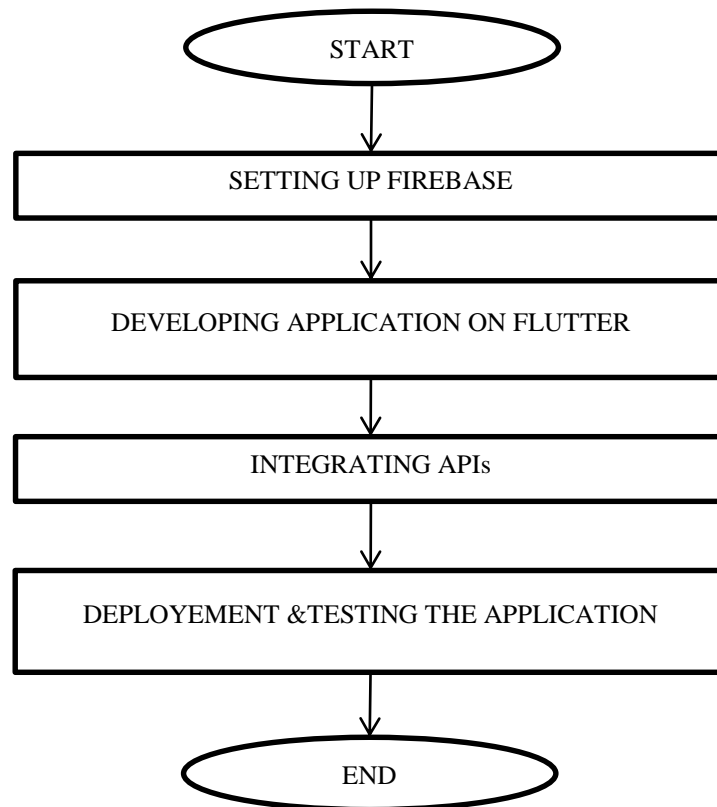


Figure 1: System Development Process

A Flutter app is linked to a Firebase project by adding an application ID, which enables access to Firebase services and resources. In order to interact with Firebase APIs and services, the application ID, also referred to as the "Google app ID," acts as the app's unique identification. As shown in Figure 2, in order to complete the procedure, a distinct application ID must first be created in Firebase and then added to the Flutter app's setup. As a result, the app may use Firebase's authentication, cloud storage, and database functionalities.

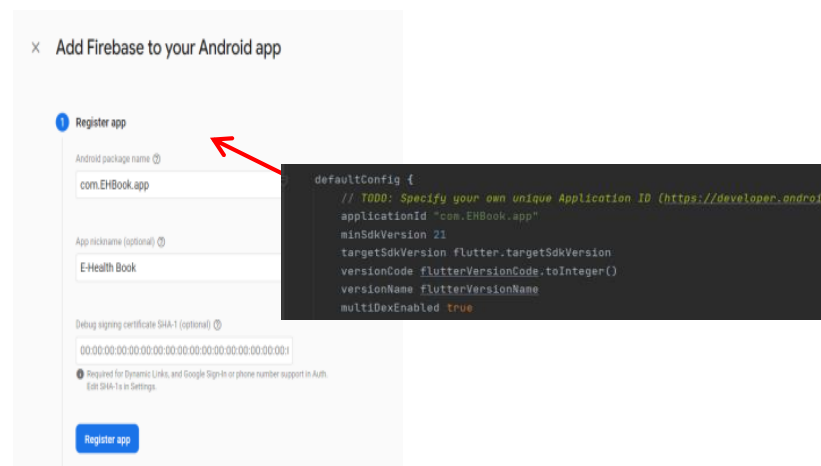


Figure 2: Inserting Application ID into Firebase

- Developing the Flutter application

Flutter is a modern, open-source programming language that was created specifically for mobile application development. It is based on the Dart programming language and is designed to allow developers to create highly responsive, visually appealing applications with ease. The framework is

known for its fast development cycle and for delivering smooth, high-performance experiences for users. To build applications with Flutter, developers create a new project and use widgets, such as TextFields, Buttons, and ListViews, as the building blocks for the user interface. This allows developers to easily create customized and engaging UIs that match their application's needs.

- Integrating APIs

APIs (Application Programming Interfaces) are critical in integrating the different functionalities of the application. The example of the APIs functions into the medical data recording application to retrieve the patient's medical information from the database and to store the patient's medical information in the database.

- Deployment & Testing

Deploying a Flutter application is done to build a release version of the app. A release version is optimized for performance and lacks the debug symbols found in the development version of the app. The release version of your app will be located in the *build/app/outputs/apk/release* for Android. Testing is an essential step in the development process. In this thesis, the application was tested using unit tests to make sure that the code was working correctly. This is done before it was shared among the users.

- End

The application is now ready to be used by the end-users.

2.2 User Case Diagram

Figure 3 shows the user case diagram of the system. Before using any of the functions offered by the application, the user must first register an account with the system. The user will need to confirm their identity by verifying the account's registered using the verification link sent to their email. The patient will next schedule an appointment by selecting the doctors who are available and choosing an available time and day. Once the patient arrives at the time of the appointment, the admin will verify the booking appointment and confirm the patient's appointment to notify the doctor that the patient had arrived at the hospital. The appointment status of the patient will be communicated to the doctor using the indication bar. When a doctor is prepared to welcome the patient, they must accept the appointment after obtaining the patient's arrival status. Once the doctor has approved their appointment, a notification will be sent to the patient. The doctor and patient will be able to review the medical records when the appointment is over.

2.3 Application Efficiency Based on User's Feedback

The development of a questionnaire of the application using Google Forms will be considering the key factors of the TAM model. The questionnaire will measure the users' perceptions of the perceived usefulness and perceived ease of use of the application. The questions will be designed to determine the degree to which users believe that the application will improve their job performance and the degree to which they believe that the application is easy and simple to use. The questionnaire will also assess the users' attitudes toward using the technology, their level of trust in the technology, and their willingness to use the technology in the future.

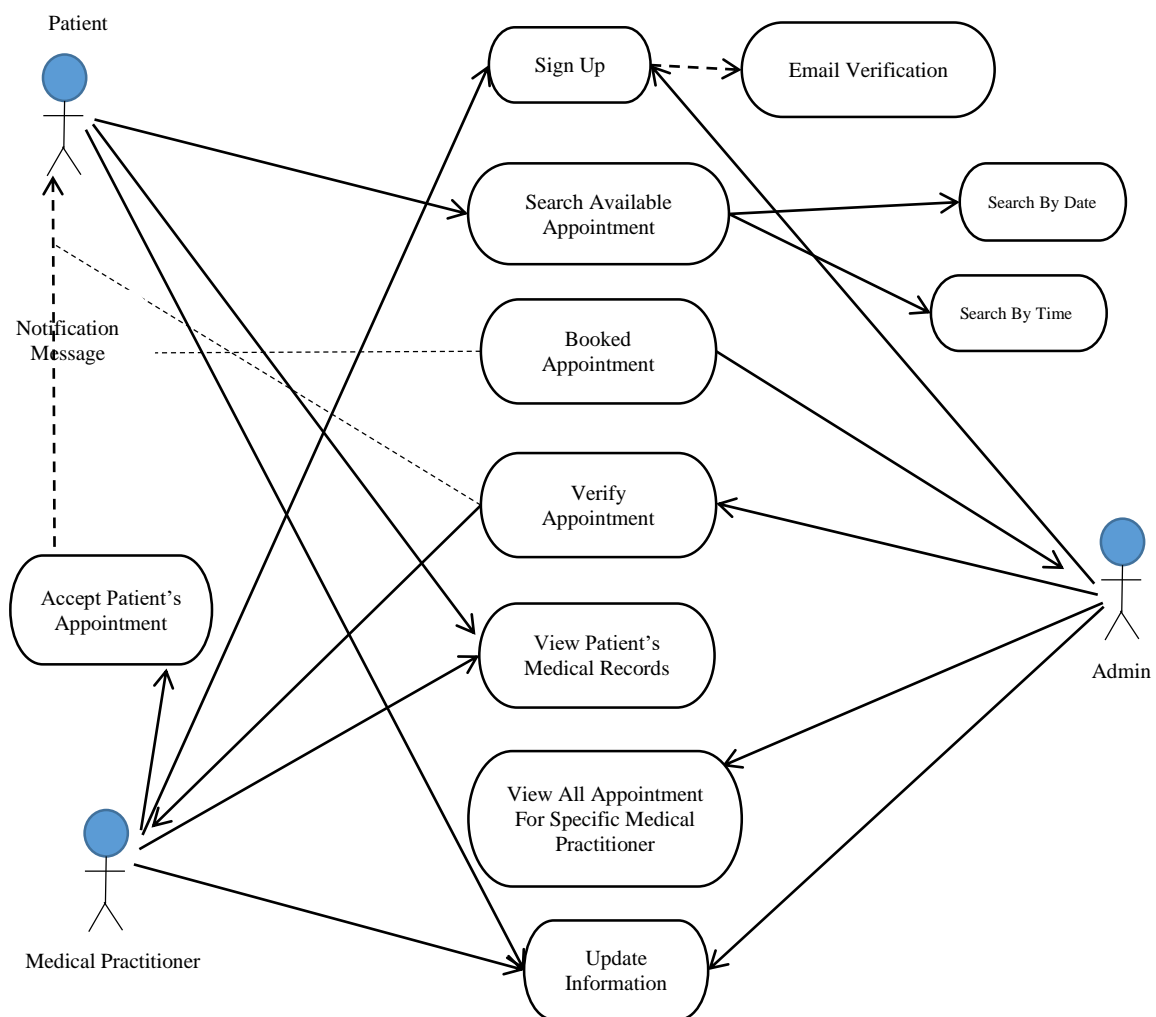


Figure 3: User Case Diagram

3. Results and Discussion

The development of an android-based application, E-Health Book using the Flutter software development kit was a resounding success. The application was designed to streamline the process of recording medical information and booking appointments, making it easier for healthcare professionals to manage their workload and ensure that all necessary information was captured accurately and efficiently and for the patient to manage their appointment with their doctors and view their medical records.

3.1 Unit Testing of the Proposed system

A software testing technique called unit testing involves evaluating individual software application units or components apart from the rest of the program. Unit testing's objective is to confirm that every unit of the application features complies with the requirements.

The proposed system can be schematically shown in Figures 4-12:

- Login To the Application

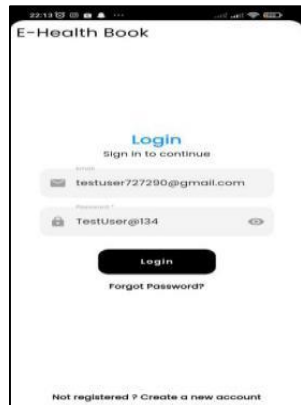


Figure 4: Login Input

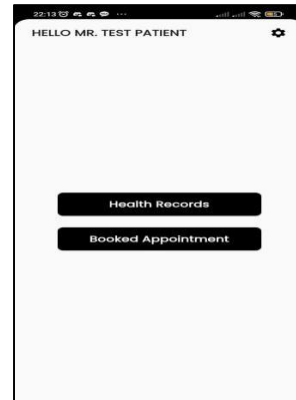


Figure 5: Success Login

Figure 4 shows the user inserted the correct registered email and password during registration. This allows the system to retrieve the user data. Figure 5 shows that the user had successfully login to their account. Access to the application is denied if the user inputs incorrect login details.

- Booking An Appointment



Figure 6: Booking Appointment



Figure 7: Appointment Booked

The patient must go to the booking page to set an appointment with their doctor. Figure 6 and Figure 7 show an appointment was successfully set in the patient's page.

- Verify Appointment

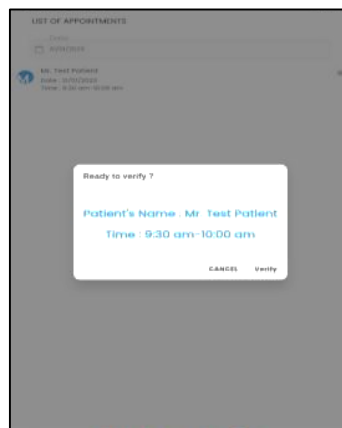


Figure 8: Verifying Appointment on Admin Page

Figure 8 shows the admin page, the admin will verify the patient’s appointment to shows that the patient has arrived to the hospital. Once verify, the assigned medical practitioner will be notified using the indicator on doctor’s appointment list. The patient will receive a notification informing that their appointment has been verified by the admin.

- Medical Recording

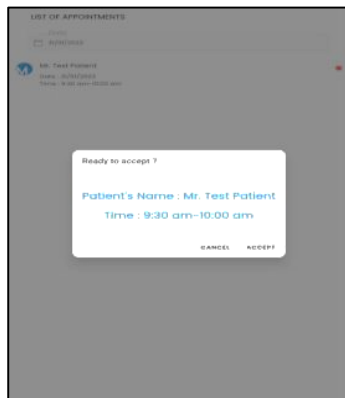


Figure 9: Accepting Appointment



Figure 10: Medical Recording

Figure 9 shows the doctor needs to accept the patient’s appointment to notify the patient that the doctor is ready to see them. The doctor’s page for the doctor to insert medical recording on the patient on that day is shown on Figure 10.

- View Patient’s Medical Record



Figure 11: Medical Records on Doctor’s Page

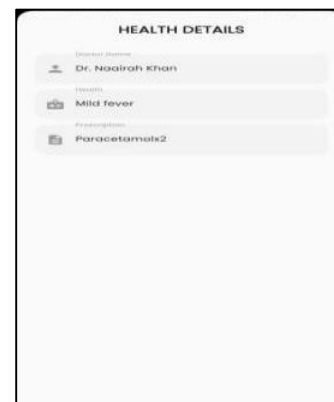


Figure 12: Medical Records on Patient’s Page

Figure 11 shows the doctor’s page and Figure 12 shows the patient’s page on the patient’s medical recording.

3.2 Analysis on User’s Feedback on The Proposed System Using TAM

The development of a questionnaire of the application using Google Forms will be considering the key factors of the TAM model. The questionnaire will measure the users' perceptions of the perceived usefulness and perceived ease of use of the application. The questions are designed to determine the degree to which users believe that the application will improve their job performance and the degree to which they believe that the application is easy and simple to use. The questionnaire also assesses the users' attitudes toward using the technology, their level of trust in the technology, and their willingness to use the technology in the future. The analysis of the E-Health Book application's survey results are shown in Figures 13-17.

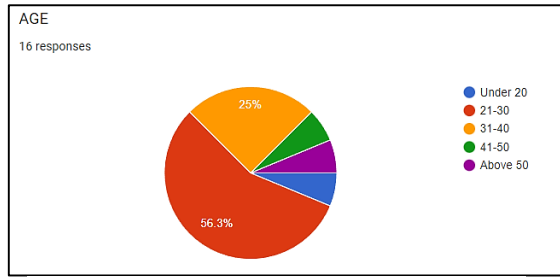


Figure 13: Respondent's Age Group

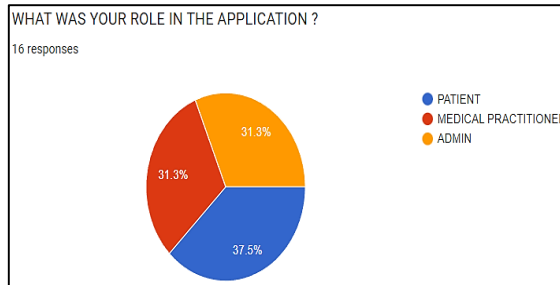


Figure 14: Respondent's Role Group

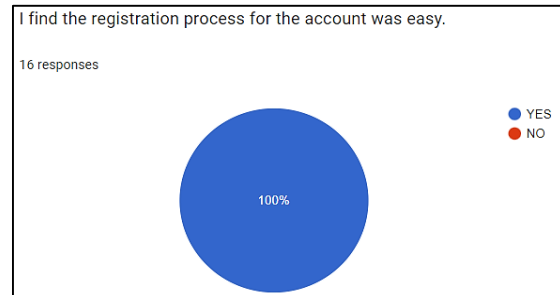


Figure 15: Feedback on Registration Process

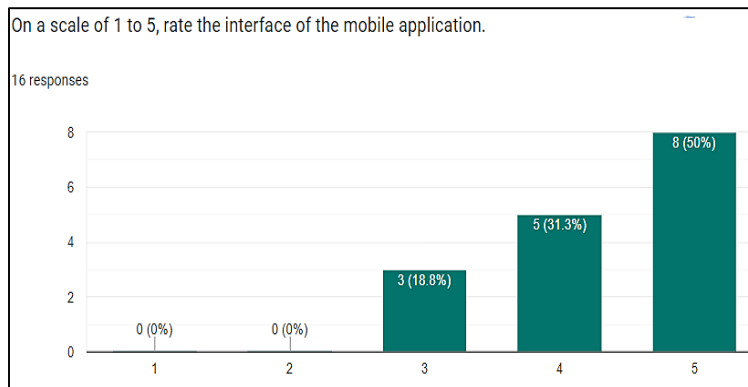


Figure 16: Feedback on App Interface

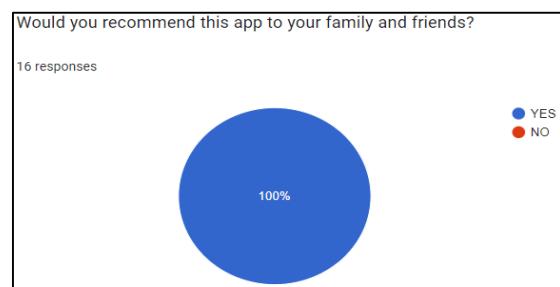


Figure 17: Feedback on Recommending the App to Family and Friends

The analysis of the E-Health Book application's survey results from Fig. 13 to Fig. 17 shows that most of the respondents are from the age group of 21-30 (56.3%). There were 6 respondents who are patients and 5 respondents who are medical practitioners or administrators. All the respondents agreed that the registration process was easy to understand, and 15 respondents agreed that they understood their roles and functions on the application. The overall user experience was also positive with only one respondent scoring 3. The majority of the respondents were satisfied with their experience using the application and would recommend it to their family and friends.

The benefits of using Technology Acceptance Model (TAM) in making the questions can be seen in the results of the survey. By using TAM, the questions were able to measure the user's attitude towards the technology, perceived usefulness, and perceived ease of use. This helped to determine the overall satisfaction and likelihood of users recommending the application to others. TAM also helps to identify areas that need improvement and to understand the factors that influence users' acceptance and usage of technology. This can benefit when updating the application in the future by focusing on the users' needs and expectations and improve the overall user experience of the application.

4. Conclusion

In this current healthcare system, it is uncommon to have a digitized records of health records. Therefore, hopefully with the development of this application in this project it can spread the benefits of having health records digitized. The importance is that it improved accessibility to all the user's role. A digitized health history allows patients a simple interface to keep track of their health history, at any time using a smartphone making it easier for patients to keep track of their health history from the health centre. This project has the feature for patients to book an appointment with their selected doctor. This will allow admin and the doctor prior knowledge regarding the appointment and interact with an interface which is easy to understand.

The Technology Acceptance Model (TAM), which was used in the development of the user feedback questionnaire, also guarantees that the app is user-friendly, simple to use, and fits user needs. Furthermore, choosing Flutter as the development platform has its own set of advantages, including affordability, adaptability, and scalability. Overall, it is deemed appropriate to grant the patients access to their health records and booked appointment. This will allow them to better manage their healthcare and ensure that their personal information is accurate and up to date.

Acknowledgement

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