



Android-Based Patient Healthcare Tracker with Appointment Booking Capability

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ARTICLE INFO

Article history:

Received 18 August 2023

Received in revised form 8 November 2023

Accepted 6 March 2024

Available online 3 April 2024

Keywords:

Patient; clinic; doctor; appointment;
IoT.

ABSTRACT

Managing the healthcare system presents various challenges that healthcare professionals must be well-prepared to address. Additionally, in times of pandemics, reducing human contact in crowded locations like clinics becomes crucial. Currently, many clinic departments spend a considerable amount of time manually entering and searching for patient data within their systems. This process is not only time-consuming but also notably ineffective. Hence, the development of a mobile application has become an imperative solution to overcome these issues. This project has been implemented using Android Studio with the primary aim of tracking patient health and efficiently recording patient data. This enables doctors to effectively monitor their patients. The developed application serves as a two-way communication bridge between patients and healthcare departments. Patients can effortlessly schedule appointments with their doctors for consultations and update their health status through the app. Simultaneously, doctors can conveniently issue prescriptions via the same application. We conducted a survey involving 120 participants, comprising 20 doctors and 100 patients. The results unequivocally demonstrate that the designed application has significantly improved healthcare management and fostered efficient communication between doctors and patients.

1. Introduction

The COVID-19 pandemic has expedited the development of telemedicine and digital health systems, which have altered the way healthcare is delivered by enabling remote consultations, monitoring, and improved patient participation [1]. The Internet of Things (IoT) enable people to build a network of linked devices that could improve productivity, convenience, and data-driven decision-making in a wide range of businesses [2,3]. The Internet of Things (IoT) also offers new opportunities for healthcare professionals to monitor patients, as well as for patients to monitor themselves [4-6]. For instance, integrating Electroencephalogram (EEG) technology with IoT tools can further enhance cognitive health assessments [7]. Chikly *et al.*, [8] developed an application where

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<https://doi.org/10.37934/araset.42.2.122132>

doctors can view patient history reports and keep track of the patient's health. The system was developed using Android Studio and MySQL. However, there was no approval by the health department in the booking system where an error could occur. Another application was developed by Hameed *et al.*, [9], where the patient health information is safe and secure under a specified team of surgeons. This is a safe and secure application; however, this is a one-way communication between the surgeon and the patients. The same things are observed in these research papers [10,11]. Applications using GPS were developed to track the location of patients with critical health for example acute stroke and Alzheimer's diseases [12-14].

Hantsoo *et al.*, [15] and Abu-Dalbouh [16] designed a mobile tracking application where patients can view their medical information however no alerting system was used in the system and the patient cannot be alerted on their next appointment, prescriptions, and critical issues. The journal by Chikly *et al.*, [8] is almost like this project because both applications have two-way communication where the doctor can always update the health condition of the patient and the patient can know his health problem through the application. The primary distinction between these two applications lies in the fact that this project offers an approval mechanism. When a patient chooses a clinic, they are required to await approval from the clinic. Additionally, this project facilitates the booking of medical appointments through the application. With the appointment system, patients can conserve time and effort that would otherwise be spent waiting at clinics. Furthermore, doctors can use this application to offer advice, make determinations, and issue prescriptions.

2. Methodology

2.1 Materials

This project aims to create an Android application using Android Studio that will assist society in adopting a healthier lifestyle in the medical field. This application will save patient health information and enable doctors to communicate with them more easily. The patient may schedule appointments with this software, which aids in time management and energy usage reduction. Additionally, the doctor or clinic may communicate with the patient periodically regarding their current health status through the Android application. Furthermore, the application will update the patient's medical information under the specified doctor or clinic. The Firebase real-time database helps to store and sync data from the server. Mostly, all the software coding needs to have data synchronized in real-time and an offline support system which helps to reduce time consumption. This feature helps to store the application data and synchronize between users in real-time in the cloud. Furthermore, it helps to collaborate with the user in the database structure. Whenever the coding is updated in a real-time database it will store the data in the cloud and stimulate all devices in milliseconds. Moreover, the user who lost connection can save their file in the SDK cache and store it in the cloud once online automatically. Firebase also provides database security to know who has access to the specific data and how they are structured.

Qualitative analysis was conducted to check on the user experience after using this application. The Google survey is shared on social media such as What's App, Instagram, and Facebook. There are a total of 120 respondents consisting of 100 patients and 20 doctors who have been successfully answering the survey. Besides, all the data have been collected from the Google form survey and used in the analysis part. The purpose of this survey was to analyse society's response to this application in their daily life. This application is helpful in storing patient information, medicine descriptions, and making an appointment at the clinic for a better healthy lifestyle.

2.2 Methods

There are three phases as shown in Figure 1 which are the input, controller, and output. The input will be the sign-in information for both doctors and patients. The controller Android Studio will help to store information in the cloud and each time a patient triggers and adds new information it will immediately save it. Firebase's real-time database helps to send or receive information on time. In this application, four databases are constructed the first one is the signing-up database, where the patients must insert their Google identification. The second database is for inserting patient and doctor information such as name, phone number, address, and doctor's specialists. Next, is the interaction between patients and clinics where the patient can view all registered clinics under the application and for appointment scheduling while the fourth database is for the interaction between clinics and patients where doctors can give medical information and prescriptions through the application. Finally, the output will be the interaction between the doctor and the patient. This application helps patients to get their medicine description and helps them to book an appointment slot with the clinic easily with a preferred doctor. Besides, the doctor can get updates and give advice to patients on their health conditions.

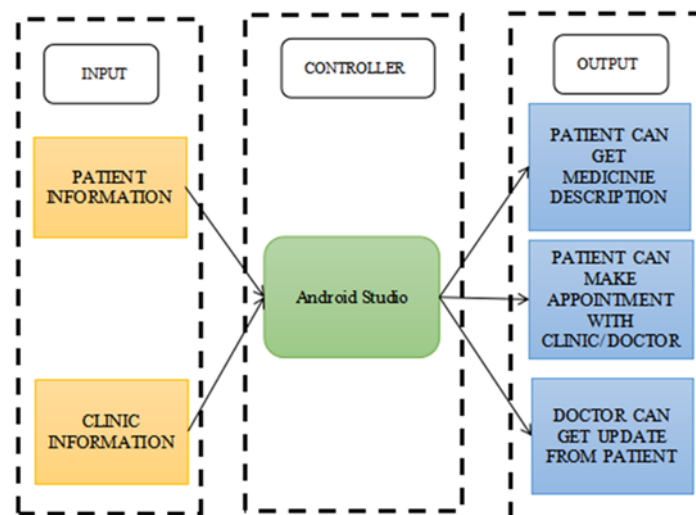


Fig. 1. Block diagram of mobile application

2.3 The Software Development Kit

Android SDK Build-Tool, Android Emulator, Android SDK Platform-Tools, and documentation for Android Studio SDK are needed for the development of the application. For SDK Build Tools, it required actual binaries for the component to build. SDK Platform-Tools is needed to give support to the interface that takes place with the Android platform on another device for testing purposes. Installing and debugging application features in Android Debug Bridge helps to interact with the device. Unix shell will provide a variety of commands in the device which can be used in running the code. Besides, the Android Virtual Device (AVD) which represents the Emulator, is known as a virtual phone device for Android software. In this project, it helps to run the code output, debug, and test the result in the Android application easily. Figure 2 shows the coding output from Android Studio. The Build APK is a system used to convey success coding into an application on our mobile phone. From this system, we can view our project output layout in our own mobile. The output from Build APK is shown in Figure 3, while Figure 4 and 5 shows the layout design for this project.

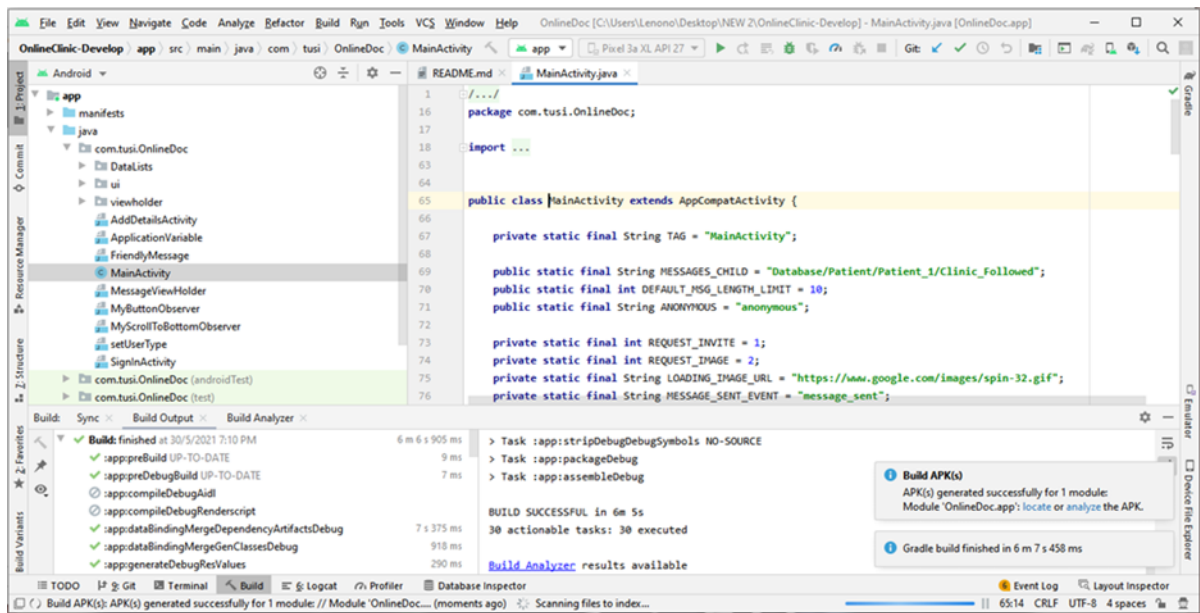


Fig. 2. Coding output from android studio

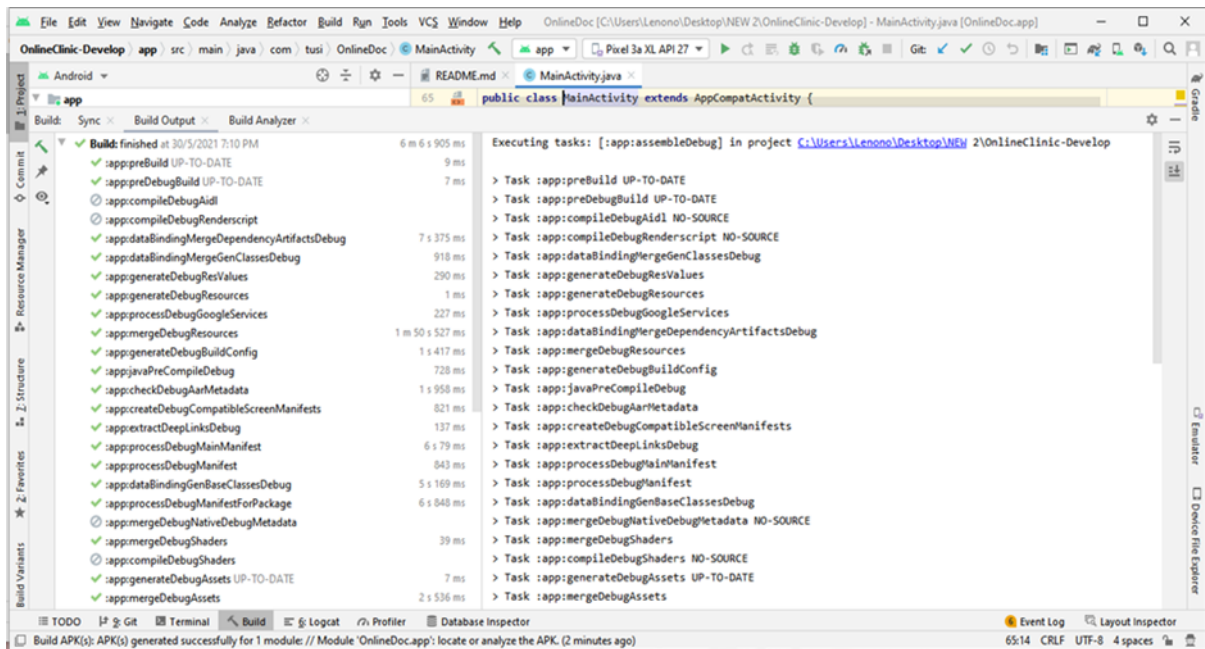


Fig. 3. Output from build APK



Fig. 4. Project layout for sign in process

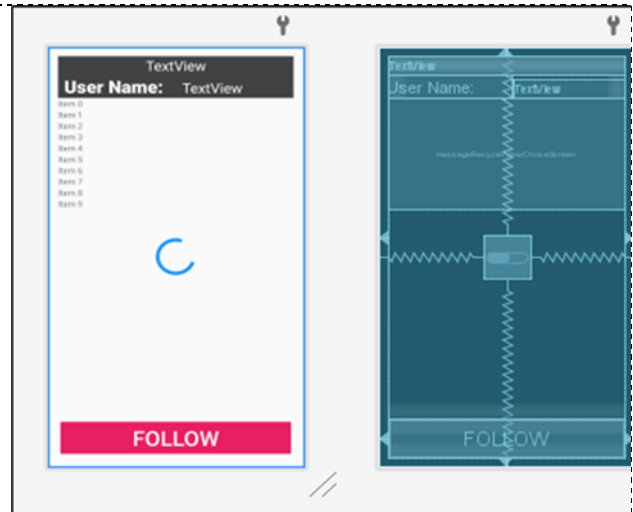


Fig. 5. Project layout for choice screen

2.4 Project Flowchart

The application begins with a patient and doctor signing up procedure, in which patients provide information such as their name, phone number, and address. The doctor will register by stating his or her clinic and expertise, which allows patients to simply select through the choices. Once the patient has been identified, the clinic will accept them and go over their general information. Furthermore, following the treatment section, the doctor will update the health and medicine descriptions of the patients in the application, which will be visible under the assigned doctor and clinic. If a patient does not want to come to the clinic due to the pandemic and has a history of the same illness, they can communicate with the clinic via the designed application and have medicine prescribed for them with the doctor's advice.

Patients can also book treatment sessions with the designated clinic using the application. In case patients have trouble with face-to-face treatment, the clinic will provide a virtual treatment appointment using Zoom, Google Meet, or Skype. Aside from that, patients can easily rearrange their treatment appointments with the facility. Clinics can also remind patients that they have an appointment for treatment one day ahead of schedule, which makes it easier for them to remember. Furthermore, if patients have an emergency, they can get the clinic's contact numbers from the application for further information. The call is done from the patient personal mobile phone. Doctors can keep track of their patient's health and medication use from time to time while patients can arrange an appointment with the clinic so that they can receive treatment right away once they arrive. Figure 6 and 7 shows the flowchart of the designed application. The application can be divided into two side views, one is from the patient's view and the other one is from the doctor's view. The patient's view has options for booking an appointment and communicating with doctors while the doctor's view is more toward rejecting or accepting appointments made by patients as well as giving advice or medical prescription.

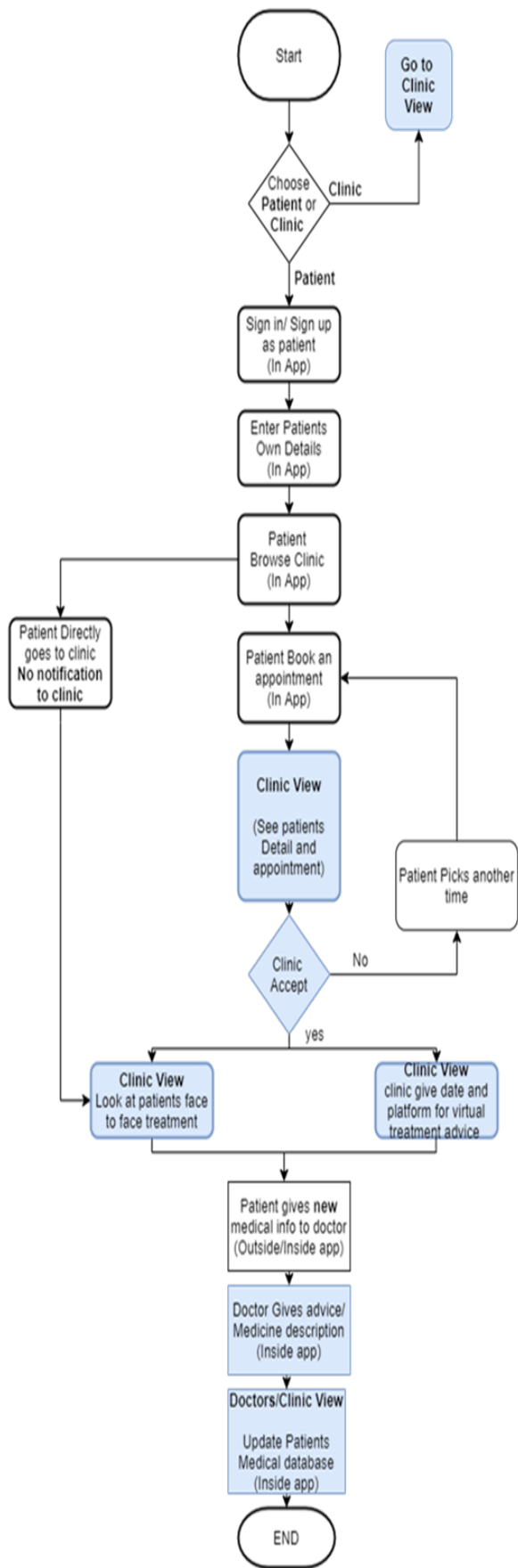


Fig. 6. Patient view flowchart

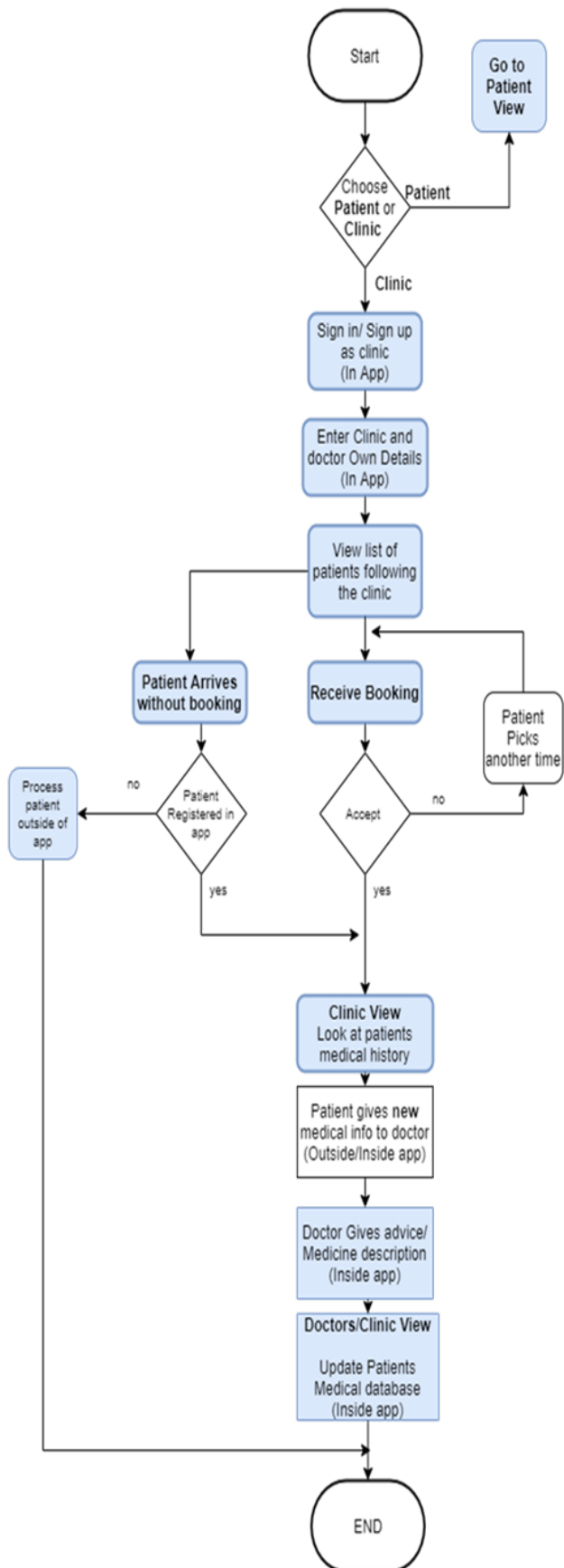


Fig. 7. Clinic view flowchart

3. Results

The application home page is shown in Figure 8, where the sign-in process occurred. Once a user signs in, a drop-down menu will allow them to select between a clinic and a patient. The clinic will use the business email identification for the application where the patients use their personal email addresses. This is depicted in Figure 9. A form will appear in Figure 10 for the clinic department and in Figure 11 for the patient. They need to fill out their information for the first time.

The patient can only book an appointment with the clinic they followed, and the list of the clinic will appear on the booking screen as depicted in Figure 12. Figure 13 shows the appointment features, which allow patients to choose a day and time for their treatment session. The booking will be added to the clinic's Google Calendar and will be forwarded to the clinic's email address.

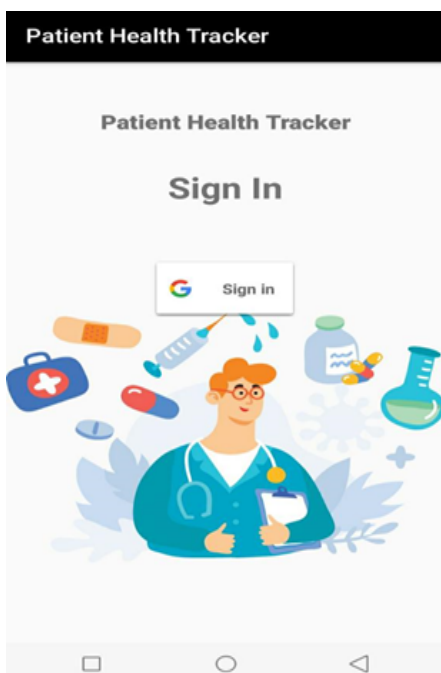


Fig. 8. Main page

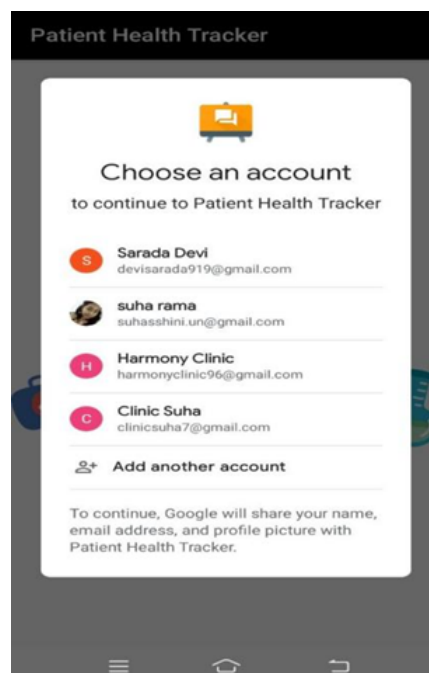


Fig. 9. Sign-in display

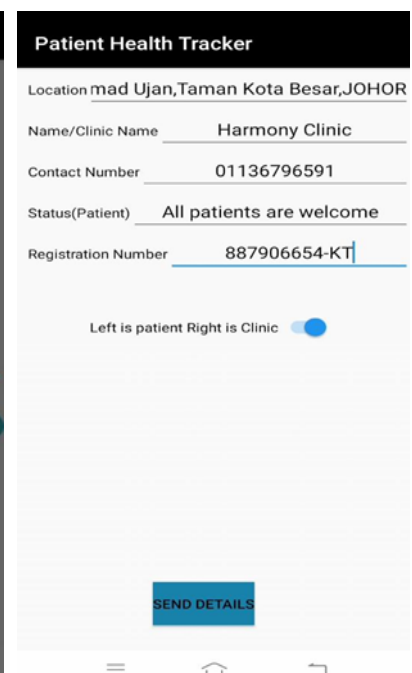


Fig. 10. Clinic key in details

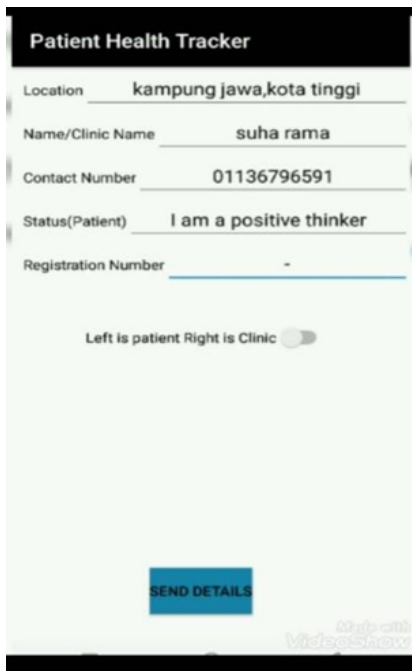


Fig. 11. Patient key in details

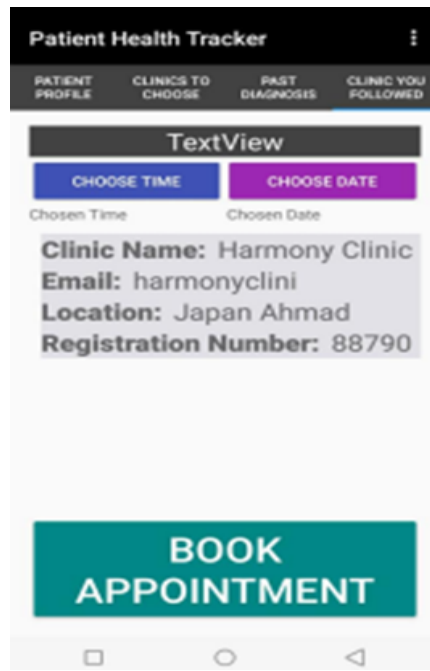


Fig. 12. Booking appointment with the doctor



Fig. 13. Choosing date and time

A notification will appear on the clinic application indicating the event has been created. As a response to the patient appointment, the clinic will receive a Google Calendar notification requesting them to accept or reject the appointment as in Figure 14. When the clinic accepts the patient's request, it will be marked as accepted in the patient's Google Calendar. The patient can then walk into the clinic for receiving medical treatment. If the appointment is canceled, the patient may propose a new time at the clinic. Figure 15 shows the patient's email showing the appointment has been accepted by the clinic. The clinic then will update the patient's health detail in the application where descriptions such as disease, clinic visiting date, the doctor in charge, and prescriptions taken. All this information will be updated on the patient's past diagnosis screen as in Figure 16. This way, the clinic, and patients always get updated on their current health conditions.

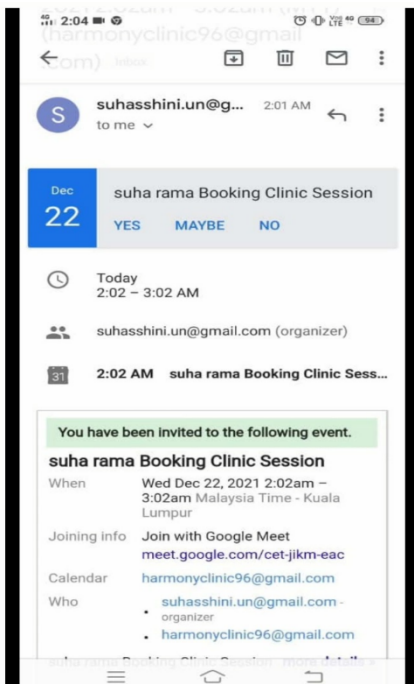


Fig. 14. Email notification to the clinic

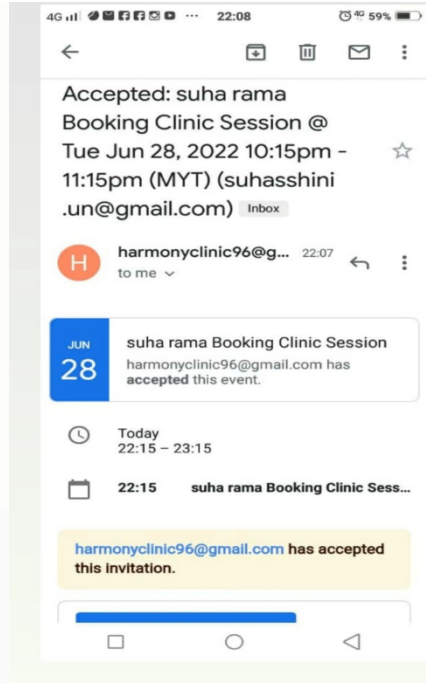


Fig. 15. Patient email (confirmation of acceptance)

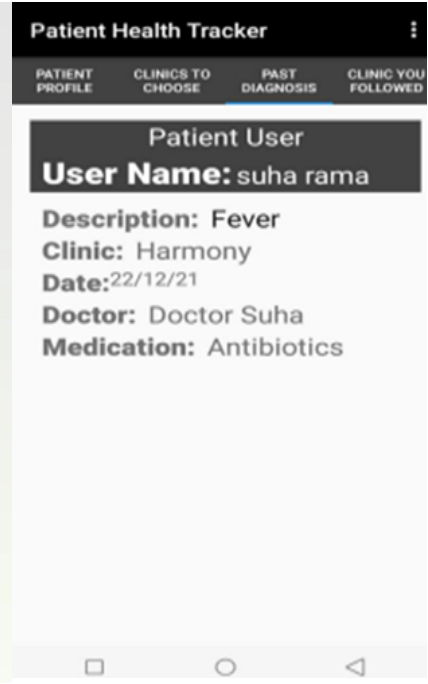


Fig. 16. Patient past diagnosis screen

The Google survey was shared on social media and received responses from 100 patients and 20 doctors. Of these number, 39.2 % of them is male in gender while 60.8% are female. A video about how to use the application is provided for the respondents and a link to install the application was also provided in the google form. In the second part of the survey, fourteen questions were designed to learn about the user's comfort level with the application. The rating is based on a qualitative scale of 1 to 5, from less attractive, good, well done, best idea, and excellent. All questions and responses are tabulated in Table 1. From the survey, most respondents gave scales of 4 and 5. This gives an indication the developed system is useful and beneficial to be used in the future. From the questionnaires, question number 4 received a slightly lower percentage of 55.8 percent. This could be due to a lack of standard procedures on how to conduct two-way communication between patients and doctors. A short briefing is necessary to overcome this situation. Figure 17 shows the survey answers to whether Android Patient Tracker is the solution to the problem and can be used in the future. As can be seen from the graph, most responses agree that the Android Patient Tracker is helpful and can be used in their daily use especially when dealing with clinics.

Table 1
 Questions and responses from the survey

No	Question	Answer scales				
		1	2	3	4	5
1	The follow-up clinic method in the application is easy to be done	0%	0%	8.3%	20.8%	70.8%
2	The clinic gives good feedback to the patient in the application.	0%	0%	6.7%	31.7%	60.8%
3	The application is easy to install and user-friendly.	0%	0%	5.8%	30.0%	64.2%
4	Two-way communication helps the patient to deal with the clinic.	0%	0%	5.0%	39.2%	55.8%
5	A healthy history screen helps patients and doctors to know past diagnoses.	0%	0%	6.7%	31.7%	61.7%
6	The patient's health condition is clearly stated and updated by the clinic in the application.	0%	0%	4.2%	34.2%	61.7%
7	It is portable to bring the application to the clinic compared to a medical file.	0%	0%	3.3%	35.8%	60.8%
8	The appointment method in the application is easy to implement for any age of the patient.	0%	0%	5.0%	28.3%	65.8%
9	The patient can choose the time and date for treatment according to their available time.	0%	0%	5.8%	27.5%	66.7%
11	This application helps old, aged people to remind their health condition and medicine description.	0%	0%	6.7%	30.0%	63.3%
12	The sign-in and details fill-up is a simple and fast process.	0%	0%	3.3%	30%	65.8%
13	This application helps patients to save more time and energy compared to the manual way of getting treatment.	0%	0%	5.0%	32.5%	62.5%
14	All details about the patient or clinic in the application are clear and trustworthy.	0%	0%	5.8%	32.5%	61.7%

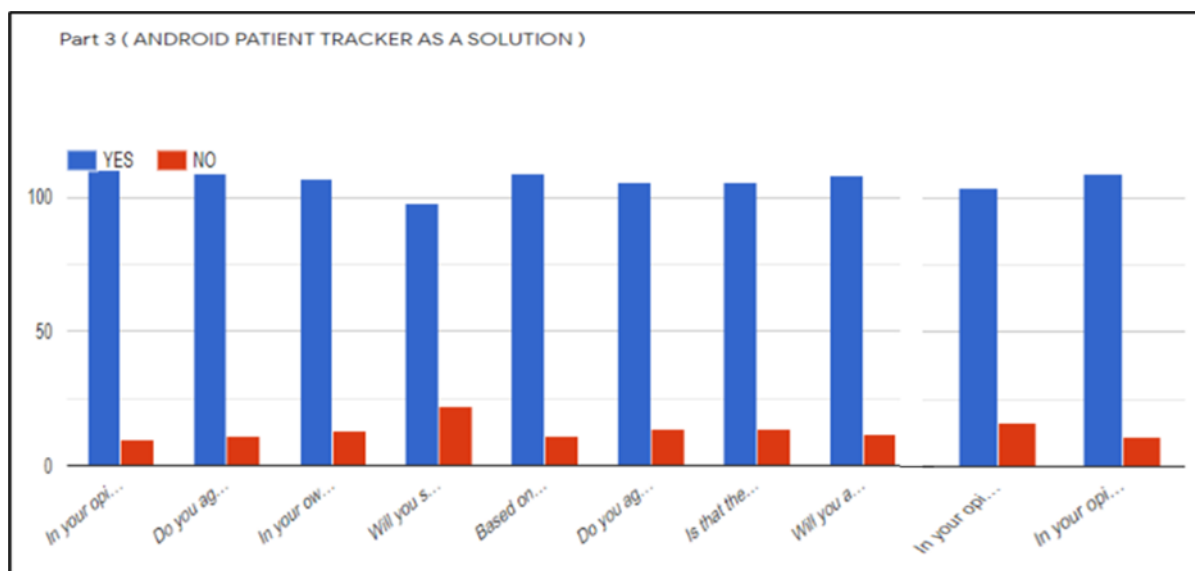


Fig. 17. Graph of responses for survey questionnaires

4. Conclusions

The patient health tracker application was successfully designed and developed. This project can improve the overall quality of living by giving people an effective way of managing their health personally. In the future, this project could be added with other sensors such as heart rate and blood pressure so that clinics are able to monitor patient's health in detail.

Acknowledgement

The authors would like to acknowledge the Faculty of Electronics & Computer Technology and Engineering (FTKEK), University Technical Malaysia Melaka (UTeM), and those who give energetic and full support in carrying out this research. This work was supported by the Ministry of Higher Education (MoHE) Malaysia through the Fundamental Research Grant Scheme (FRGS) under Grant FRGS/1/2020/TKO/UTEM/03/11.

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