Design and Development of HelloDr: A Mobile App for Healthcare Services Management

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Abstract: A clinic is a place that provides primary healthcare and simple medical treatments to patients. However, most clinics, more specifically in small towns, use a manual registration system that takes too much time and effort to register the patients. This study aims to identify the requirements and develop an electronic system that allows patients to register, make appointments, view doctors' information and availability, and receive timely announcements. The system Prototyping approach was followed to develop a mobile healthcare application called HelloDr. A HelloDr prototype was released and evaluated by 50 participants to test its usability and ease of use. The results indicate that this application is useful and easy to use, and the users are very satisfied. Using HelloDr, patients can save time and effort, and clinic staff can effectively manage registration and appointment processes.

1. Introduction

A clinic is a place that provides healthcare and medical treatment to patients. Compared to a hospital, a clinic is smaller and does not provide a too complex and professional treatment. Therefore, most clinic only gives treatments to outpatients or light-wounded patient. Currently, most clinics in Malaysia are using a manual registration system [1]. By manually registering, clinic staff and patients will waste a lot of time and energy. It is because clinic staff will need to key in the information for patients individually, and patients must queue up and wait for a long time. Moreover, even after registration, patients are still not confirmed with their meeting or consultation time with the doctor [2].

A problem is found where only one or very few clinics in a specific area will cause all patients to focus on going to that clinic. It causes patients to queue at the counter long to get registered and wait in the waiting room for their turn to be called. Patients will be forced to waste their precious time, doing nothing but wait for their turn. If too many patients are registered on that day, doctors might not be able to finish consulting all the patients, and the rest of the patients will be forced to wait until the next day. At the same time, the clinic's staff and doctors will also face problems managing all the patients as they need to register them manually. It will affect the efficiency of the clinic and will then delay the meeting time of patients and doctors [3].

Moreover, mHealth needs to be improved in Malaysia [4]. Thus, a healthcare services management system is required so patients can register online by themselves for their meeting with the doctor. It will not only save time for the

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patients but also save energy and time for clinic staff to record and manage the processes. A mobile app for the e-healthcare system can provide an online platform for mobile users to book appointments with doctors in a clinic. In this study, HelloDr is developed as a mobile application that allows patients to register to have a meeting and consult the doctors in the clinic. In detail, the user can register as a patient using the HelloDr app. after the patient log in to the application. He will be able to check for the doctor's availability. This application allows users to self-register and chooses their preferable time to meet the doctor. He can later choose an available time and make an appointment. As for doctors, they can manage their availability and view the appointments booked with them. Therefore, the time is more flexible while using this system. Using this application saves users time to queue up at the clinic. Instead, they can stay at home, use their time wisely, and wait for the appointment.

2. Background

Some existing web-based systems for e-healthcare services and similar mobile applications such as appointment management have been analyzed and used to develop the HelloDr mobile app. These systems may provide valuable information that may help develop a current application that meets users' or market target's needs [5]. Besides, studying a similar app may also help to identify the usability problems to be avoided during the development of the current app. Also, useful functions and information can be used and added during the design process.

For example, scheduling is an online mobile application that allows users to schedule consultation appointments. Users can choose a date, enter important messages and details in the meeting log, and schedule the appointment. The price will be shown for the appointment.

Figure 1. The main interface of scheduling (left) and booking appointments (right)
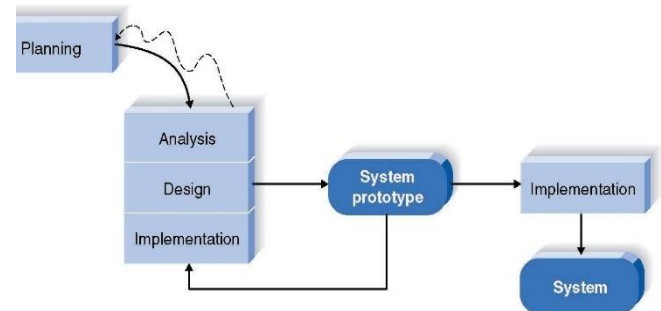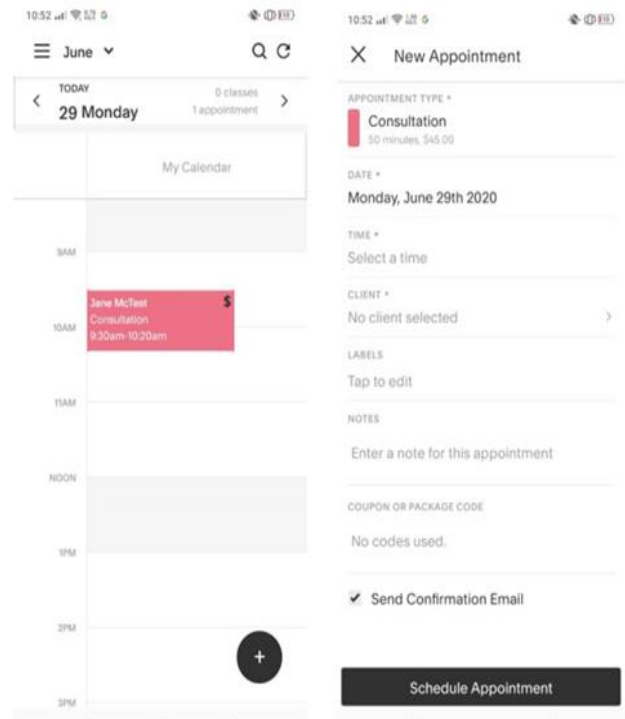
3. Methodology of the study

The study was conducted following the System Prototyping methodology. The System Prototyping model is a methodology that is treated as a software development model where a prototype is constructed and then tested, which is an approximate premature sample of the end product [6]. Then the analysis and design phase will be carried out a gain once there is any new requirement. It can be considered a method of trial-and-error involving both the developers and the users [7].

Figure 2. The phase of System Prototyping Methodology

In the planning phase, a problem was identified in the current situation: patients must wait for their turn to be manually registered at the clinic. At this stage, a plan is proposed to develop a system that can provide an alternative to manual patient registration. There are also problems while using manual registration. A project proposal is drafted explaining the problems, objective, significance, scope and schedule of the project. During the analysis phase, the requirements of this e-healthcare system are analyzed through a process of requirements analysis. There are two types of requirements which are functional and non-functional requirements. The requirements will be gathered by analyzing similar apps, and an online questionnaire will be distributed to gather data from the potential user of the clinic. Use Case diagram is provided in this phase. Use case diagram is used to show what all the users can do. Class Diagram, Entity Relationship Diagram and Sequence diagrams are developed during the design phase. Use case Diagram is used to determine the relationship between actors

and use cases, while an entity relationship diagram is used to determine how each entity is related to others. On the other hand, sequence diagrams are used to determine how the system should perform.

In addition, tools such as Flutter, Android Studio and Dart programming are used to design the system's interface. In the implementation phase, a low-fidelity prototype is developed. The low fidelity prototype examines whether basic functions are correct and ready to proceed to the next step. Finally, a high-fidelity prototype with more functions is produced. The final system will be released if the high-fidelity prototype is good and has no problems. Then, the project's outcome will have the full functionalities and be ready to be evaluated.

4. Design and development of HelloDr

This section introduces the requirement specification document that specifies all system requirements that will be used during the development and implementation of HelloDr app. It helps to define the details and scopes of the system as well as the definition of terms specific to this system. Table 1 presents the functional requirements of HelloDr.

Table 1. List of requirements for HelloDr

ID	Requirement Description	Priority
1	**Register account**	
1.1	Patient users shall be able to register an account by entering their name, email, contact number, and password and re-enter the password.	High
1.2	Admin of HelloDr is able to register for the user by inputting a user name, email, contact number, and password and re-enter the password.	High
1.3	If the mandatory field is left empty, an error message will pop up to tell the user to recheck the field.	Medium
2	Login	
2.1	Users shall be able to log in to HelloDr by keying in their email and password.	High
2.2	Users shall be able to log in to the system if the email and password are correct.	High
2.3	If the user forgets the password, the user can change the password by keying in the email in forgot password and using a code to change the password.	High
3	Manage Availability	
3.1	Doctors can update their availability by setting their time as "available" or "booked".	High
3.2	The system will display an updated message successfully after the doctor confirms the update.	Medium
4	Manage Notification	
4.1	A doctor shall be able to post a notification for patients.	High
4.2	A doctor shall be able to delete the notification.	Medium
5	Manage Appointment	
5.1	Patients shall be able to view the availability of a doctor.	High
5.2	Patients shall be able to book a time with chosen doctor.	High
5.3	The system shall display booking success message upon successful booking.	Medium
5.4	Patients shall be able to cancel a booking.	High
5.5	Patients shall be able to delete the booking.	High

The requirements, as shown in Table 1, were translated into the computer system functionality. The requirements from the table above will then be visualized using suitable modelling methods and tools. In this step, a modelling language, Unified Modelling Language (UML), was used to visualize the requirements in the form of diagrams [8]. The models used in this work use case diagrams, sequence diagrams, and a class diagram representing the application's structural components. The diagrams were designed using STAR UML software. Figure 3 illustrates the use case diagram and the communications between the use cases and the actor for a mobile app that can be used to create and manage the functions. The main use cases are registering, logging in, managing appointments, notifications, and availability.
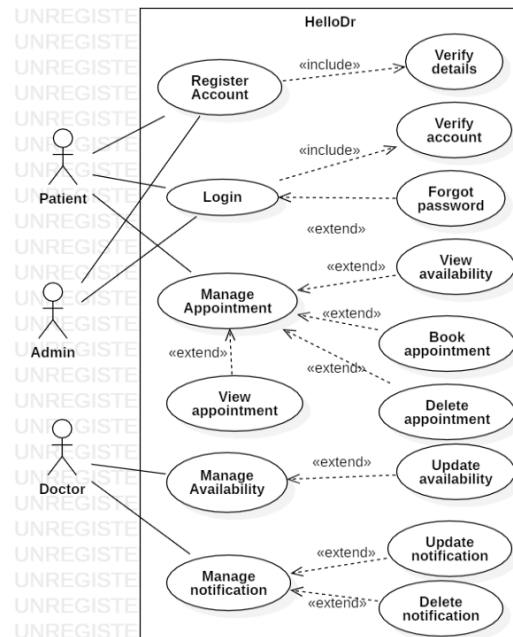

Figure 3. The use case diagram for HelloDr to manage appointments and availability

The use case diagram is detailed to show the behavior of HelloDr. After that, the object interaction arranged in time sequence is shown in the sequence diagram (see Figure 4).
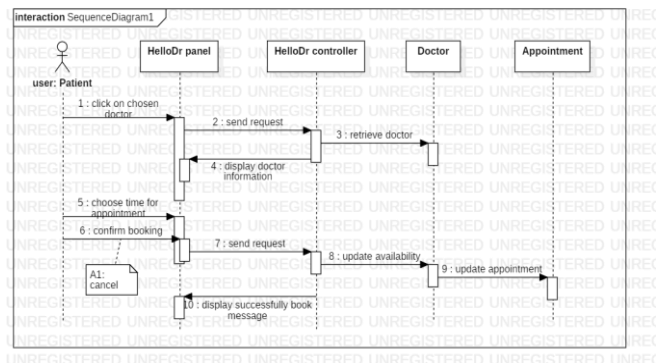
Figure 4. Sequence diagram for patient booking appointment

The structure of the HelloDr application for booking and managing appointments is shown in the class diagram in Figure 5. The class diagram shows the attributes and operations of the classes of HelloDr. There are seven main classes: HelloDr controller, HelloDr panel, Patient, Admin, Doctor, Announcement and Appointment. The relationship and interaction between the classes are shown in the diagram.
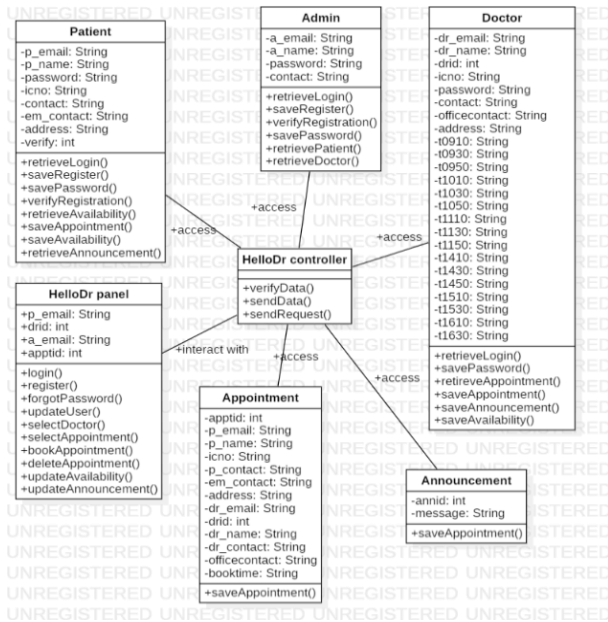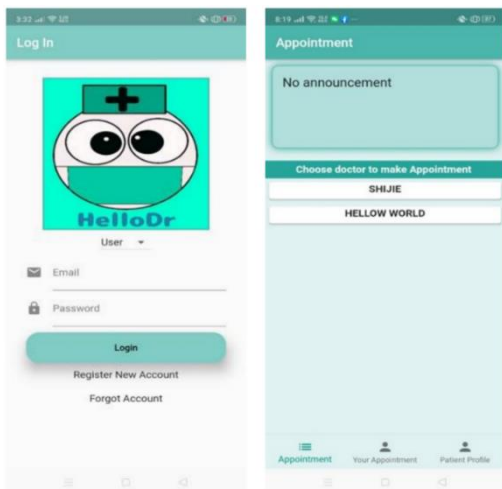
section. This prototype is used to demonstrate the requirements so that users can provide comments and suggestions based on their experience while using the prototype. Visual Studio Code was used for developing the prototype. The prototype was developed with dart language, and the data will be stored in JomHosting. Figure 6 shows the login screen interface and the main interface for patients in HelloDr. Figure 7 illustrates the interface for booking and viewing the appointments. Finally, Figure 8 shows the main interface for Doctors and their availability.

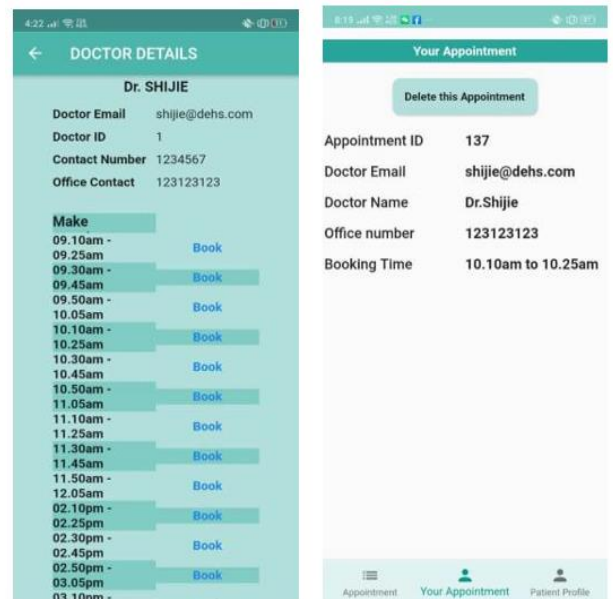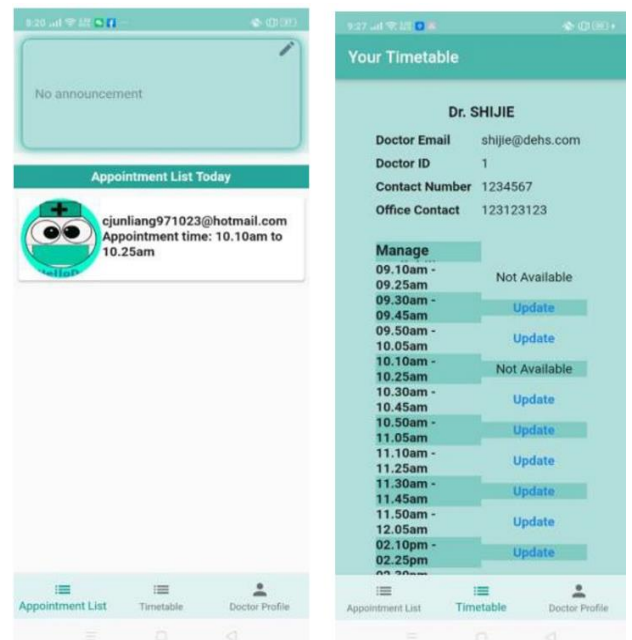Figure 5. Class diagram of HelloDr for managing appointments, availability and announcement

Figure 6. Interface for login (left) and main interface for the patient (right)

Figure 7. Interface for booking an appointment (left) and

5. The Prototype Development of HelloDr

A prototype of HelloDr was developed to manage appointment, availability and announcement processes. It represents the requirements set out in the previous sub-

viewing an appointment (right)

Figure 8. The main interface for the doctor (left) and manage availability (right)

6. Evaluation of HelloDr

Numerous evaluation methods are used to test the usability of a system; however, a recent review of usability methods concluded that there is no current consensus on models applied to usability [9]. In addition, while a questionnaire is a common technique, it is unclear which questionnaire is most suitable for a specific context. Therefore, the appropriate type (post-study or post-task), general structure and content and usability aspects should be considered to aid questionnaire selection [10].

In this usability testing, 50 respondents participated. Due to the MCO, the developer runs this usability testing online. Invitations were sent to random participants regardless of gender, race, age and educational background. The tools that were used for the evaluation test are the prototype of HelloDr and a set of questionnaires in the Google form. The post-task questionnaire was adapted [9]. The post-task questionnaire consists of five sections: the respondents' demographic, the usefulness of the helloDr apps, ease of use of HelloDr apps, satisfaction with the HelloDr apps, and functionalities of HelloDr apps. The respondents were asked to download the HelloDr apps from a link given in the questionnaire, use it, and give their opinion on a scale from one to five for each section except demographic, where one represents strongly disagree, and five represents strongly agree.

The analysis of the demographic of the respondents shows that 72% of the respondents are female while 28% are male. Most of the respondents, which is 39 out of 50 respondents, are in the age group between 21 years old to 30 years old, while four respondents are in the age group between 31 years old to 40 years old, and only three respondents are in the age group of fewer than 21 years old. Based on the result, 88% of the respondents only visit the clinic when needed, 8% visit the clinic every half year, and only 4% visit the clinic every month. Most respondents visit the clinic mainly for two reasons, which are emergency or to take medicine. Each has 32% respondents. In addition, 18% of respondents visit the clinic for a body check, 16% visit the clinic to accompany family or friends, and only 2% visit for other reasons. As for

the method of making appointments, 72% of the respondents never make appointments before visiting the clinic, 24% of the respondents make an appointment via phone, and only 4% of the respondents make appointments via email. For the experience of using online clinic appointment apps, 94% of the respondents have no experience using online clinic appointment apps, while 6% are not sure.

In this section of the post-task questionnaire, an investigation was performed on the results obtained. This section shows the satisfaction and attitude of the respondents towards the performance of HelloDr. In addition, this section includes the respondents' opinions regarding usefulness, ease of use, satisfaction, and functionalities of HelloDr. Figures 9-11 show the results of analyzing participants' responses to their satisfaction with using HelloDr, its usefulness, ease of use and the functionalities covered in HelloDr. Results showed that most items scored four, which indicates that respondents agree with the statement. It was followed by a score of five, which indicates strongly agree with the statement. Only a few stand neutral, and only one
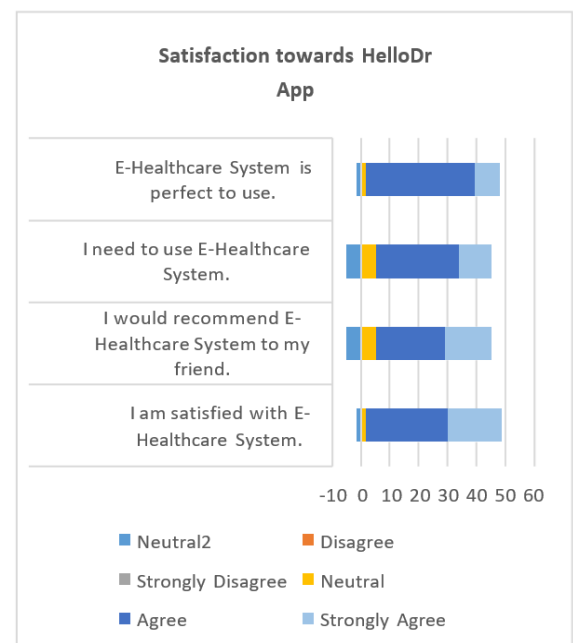
stated disagree with two certain statements about the usefulness of the HelloDr application.

Figure 9. The respondents' responses on the satisfaction with HelloDr

Usefulness of HelloDr App

Functionalities of HelloDr App

E-Healthcare System allows me to view announcement from the doctor.

E-Healthcare System allows me to view appointment information.

E-Healthcare System allows me to view doctor information.

E-Healthcare System allows me to update my profile information.

E-Healthcare System get my information correctly.

E-Healthcare System allows me to book appointment with doctors.

-10 0 10 20 30 40 50 60

■ Neutral2 ■ Disagree
■ Strongly Disagree ■ Neutral
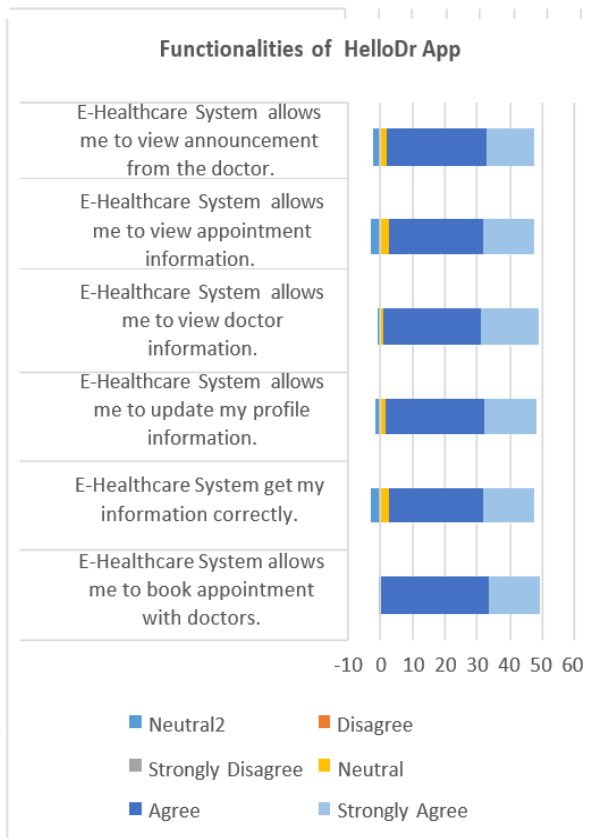■ Agree ■ Strongly Agree

Figure 10. The respondents' responses on the usefulness of HelloDr

Figure 11. The respondents' responses on the ease of use of HelloDr

Figure 12. The respondents' responses on the functionalities of HelloDr

The evaluation result indicates that HelloDr is useful and very easy to use. Based on the result, the respondents are generally satisfied with the performance and functionalities provided by the HelloDr app. HelloDr helps the respondents save time and energy, and the performance of HelloDr is consistent. According to the study, the interface was user-friendly and easy to understand. Overall, the respondents react that they will recommend HelloDr to their friends.

7. Conclusion

This paper described the design and development of HelloDr, a mobile application for making appointments with doctors in a clinic. Overall, this HelloDr performs and functions well, and the respondents have no issues with the interface. In the future, it is suggested that a live chat function can be added to a message system can be added to improve the two-way communication that allows doctors and patients to exchange information.

8. Acknowledgements

9. References

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