

A Prototype Mobile Application for Clinic Appointment Reminder and Scheduling System in Erbil City

Payam Wali M.Hussein¹, Mohammad Salim¹ and Bilal Ismael Ahmed¹

¹*IT Department / Faculty of Science*

¹*Tishk International University, Erbil, Iraq*

payam.wali@ishik.edu.iq

Abstract

In healthcare, the goal of clinics and hospitals is to serve the patient in a skillful way, due to the sensitivity of patients and the high competitiveness among healthcare service providers. Across many countries systems with cutting-edge solutions have been introduced in order to enhance healthcare services throughout last years. However, in Iraq and Kurdistan region still there is a lack for such systems and particularly for clinics. Patients need to go through a time-consuming process which might require a considerable effort especially for the time of making appointment to the consultation hour. Moreover, the current available appointment systems come up with problems such as missing appointments by the patients due to the long queues given by clinics. By implementing technological solutions it's possible to obtain benefits such as eliminating waiting lists, enhancing patient's timely access to services and reducing no show problem. Therefore, we suggest creating a mobile application system to enhance the process of booking appointments at clinics. Thus, providing a mobile application tailored to the clinic's needs is the main goals of this paper. Our approach is to design a prototype mobile system to facilitate the whole appointment process from the beginning to the end. The system will cover both client and clinics side. In this paper, we will propose a mobile system to improve appointment scheduling system for clinics. The findings show that 91 % of patients whom participated in the study were ready to use any sort of online appointment systems to book their next consultation hour.

Keywords: *Mobile App, Patient Appointment, Marvel app, Clinics*

1. Introduction

During the last years clinics have become more central in healthcare systems because of the emphasis on prophylactic medical procedures, shorter hospital stays, and service delivery on clinical basis [1]. Appointment systems (ASs) are important components for efficient care delivery at clinics. Our proposed mobile system is intended especially for clinics which have huge traffic on them. In this case, usually appointments are given a few days later after registration, therefore patients are asked to visit at a later day for their appointment. According to a survey we conducted among 34 people in Erbil 67.6% of them have visited clinics for any condition 1 to 3 times in the last 12 months, 17.6% have visited 4 to 9 times. Among those people who has visited the clinics 88.2% claims that the clinic that they visited did not provide any sort of online platforms like websites or mobile applications to book their appointments. 58.8% of them booked an appointment by phone call whereas 26.5% states that they personally visited the clinic for the booking process. At the same time there is a small percentage which is 14.7% that went to the clinic without an appointment. 67.6% of those people who booked an appointment were not given a choice of choosing their appointments.

Sometimes patients find it difficult to wait for several days so they go to another clinic and this will lead to no show problem where some patients will be absent at the

appointment day according to our study among the patients who needed an appointment, only 35.5% went to the clinic and got an appointment immediately. 65.5% of them had to wait at least one day up to 3 months. According to [2] no show of patients caused by many reasons and this phenomenon has been studied by many researchers. In the survey it shows that 42.2% of the patients' conditions got worse while waiting for their appointment. Gender is found an important influence by several studies in addition to age, patient waiting time and family were the mainly reasons behind no show. Many systems were developed to decrease no show and waiting time issues and most of them are reminder systems to send automated SMS reminder to patients while other systems are developed to making appointments via websites. One of the major issues which requires optimization by using appointment systems for outpatients is the time [3]. According to the survey we conducted even though services provided in the clinics such as temperature and finding a place to sit while waiting were considered generally 'satisfactory', the levels of satisfaction were lowest about how long patients waited to see a doctor. 91.2% of the patients stated that they waited to see the doctor up to 2 hours. Therefore, we proposed the mobile system to facilitate registration process for patients and it also works as a reminder system which reminds patients about their appointment before a specified time to optimize the time and decrease no show issue.

In this paper, the goal is to explore the feasibility of prospective outpatients using a smartphone application to facilitate the process of booking appointments in crowded clinics where a patient might wait a few days for the queue. The mobile application will allow outpatients to book and follow-up their appointments instead of going physically or making many phone calls, then it will remind patients via push notifications message to reduce no show problem. We explored potential users' experiences to develop a prototype application for appointments scheduling between patients and clinics or doctors. We evaluated the prototype to determine the extent to which the application supported appointments booking by potential users.

The rest of the paper is organized as follows. In Section 2, we illustrate certain related work about adopting IT systems for appointments of clinics and bring the current achievements in this domain. Section 3 describes the basic design of the proposed outpatients' mobile appointments and its functionality. Finally, in section 4 we present implementation of our proposed system and conclusion.

2. Related Work

This part of our paper aims to show current situation of making appointments and reminder services for clinics and patients. In addition, this section will illustrate certain related work about adopting IT systems for appointments of clinics and bring the current achievements in this domain throughout different parts of the world.

2.1. Traditional Appointment and Reminder Systems

Healthcare system in Iraq and Kurdistan region lack major technological progresses. The number of clinics and hospitals that offer online appointment system are very few. According to the survey we conducted, 88.2 % of the patients state that the clinic they visited did not provide any sort of online platforms (Website, Mobile application...etc.) to book their appointment; only 11.8 % of the participants have booked their appointment through a computer based system. 58.8 % of the patients have called the clinic by phone to book an appointment which is in most of the cases a paper-based system [4]. Usually patients' health records and files are kept in tangible storage and will be passed by administrator or registrar to the office of doctor for appointment. This traditional system or method is not efficient and taking a long time, and the possibility of losing or mislaying records is obvious. The paper-based registration generally demands that patients should

fill the forms and give to the register's table then wait for their turns till calling the names. One of the important issues what would happen if unregistered patient came or a patient's records are not to be found. Usually the registrar or admittance staff will delay or postpone his/her consultation or appointment time. According to our survey 14.7 % of the patients went to the clinic without any prior appointment. According to another the survey report in 2008 [5], majority of the complaints related to the time expended in the waiting hall and 19% of the patients criticized that they could not get their appointments within one-week time. Moreover, hundreds of patient's appointments are postponed to another day more than one time. Gratification of patients with health care process didn't associate only with waiting time but then over one-third decided to not follow the appointment schedule as they anticipated to have to wait for long times. These kinds of problems are still considered as a challenge to the healthcare industry in Iraq and Kurdistan region also. Our solution is to propose a mobile appointment application to tackle with part of these issues; the proposed system will let the patients to book an appointment using their mobile phones. The patient will select a specific doctor and date, then this data will be saved into an online database to facilitate the following up process for the clinic side which they have another application to manage appointments. Later at least one day or 6 hours before the appointment starts, the system will notify patients about the consultation time.

2.2. Online Appointment System

One of the ways to classify patients is to distinct them based on scheduled patients and walk-in patients. Scheduled patients, who book an appointment before arriving at the clinic, they can be separated into two subclasses: pre-scheduled patients, who are scheduled in advance of their appointment days, and same-day (open-access) patients, who are scheduled on the same day that they call for an appointment [6]. However Walk-in patients are patients who arrive at the clinic without a prior appointment during the consultation session. There are two major walk-in patient types: urgent and regular [7]. The urgent walk-in patients (urgent walk-ins) often need to be treated as soon as possible, whereas regular walk-ins have a lower priority in the system; they are placed in slots left open for potential walk-ins or must wait for no-show slots. It should be noted that walk-in patients unlike same-day (open-access) patients, who are scheduled and served on the same day. Fig. 1 below shows patients types according to the literature.

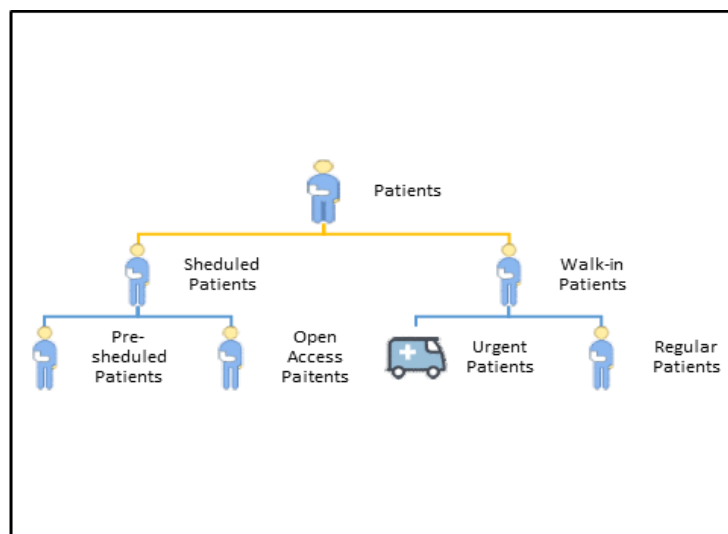


Figure 1: Types of Patients

Our proposed mobile application works with scheduled patients' cases because walk-in patients could come and finish within the same day and even within the same time in some cases or short time of waiting. Moreover, many web-based appointment scheduling applications with different features have been developed recently such as supersaas, capterra and software advice [7]. Authors in [8] has developed an Android application called Mr. Doc which is an online hospital management application that makes the task of making an appointment for the doctor and users easy and reliable. Mr. Doc was developed to acts as a client whereas the database containing the doctor's details, patient's details and appointment details is maintained by a website that acts as a server, so it has two modules one for patients and another for doctors. Accordingly, in this study we intend to develop two prototype mobile applications, one for the patients to make the appointment and the other for clinic to manage the appointments scheduling.

3. Methodology

The aim of this study is to design mobile application for appointment scheduling system to reduce long waiting times and reduce no show problem via reminding patients by push notifications. The methodology is based on a recent study done by [9], which contains of four phases: 1) needs analysis and quality assessment phase; 2) prototype development; 3) prototype refinement via usability inspection methods; and 4) formative evaluation through usability testing with 20 prospective users. Figure 2 presents description of these phases.

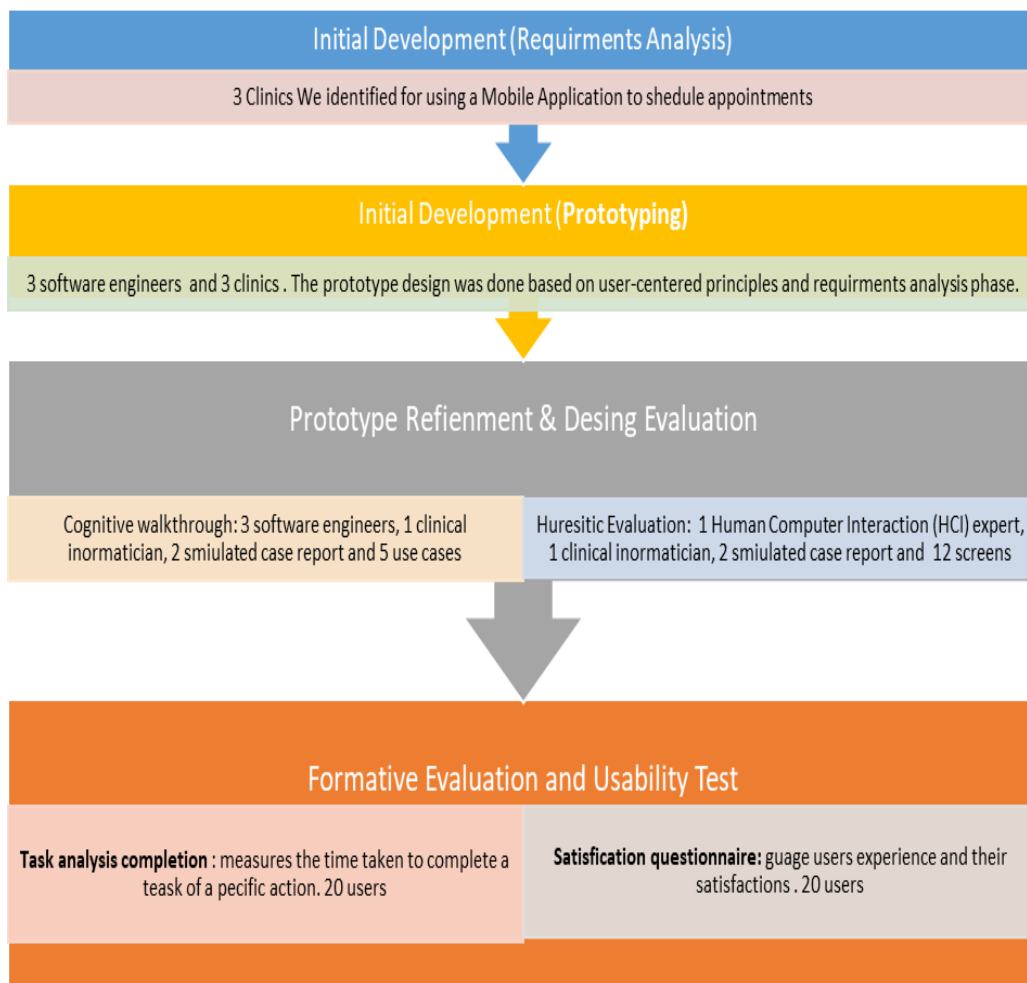


Figure 2: Prototype design phases

1-Needs Analysis: Before starting of development the application, we conducted a survey among 34 people 67.6% of them have visited clinics for any condition 1 to 3 times in the last 12 months, 17.6% have visited 4 to 9 times. 90 % of them state that it is necessary to have an online appointment system and 85 % show their interest to book their next appointments online. Requirements has been gathered from 3 different clinics and interviews are done with doctors who worked at the clinics to better understand their needs related with appointments scheduling system.

2- Prototype: The Marvel app prototyping tool was used to build and test an interactive prototype for a touch screen mobile phone, which was then used in the evaluation process. Two prototype applications were developed, one for patients and other for clinics or doctors. The interactive demo of the two applications is shown in Figures 3 and 4. The smartphone used in the evaluation setup was an Apple iPhone 8.



Figure 3: Main screen of patient's app



Figure 4: Main screen of clinic's app

First type of users as patients begin with a standard login screen where a username and a personal identification number are entered. Next, the user selects “book an appointment” and is prompted to select a doctor’s name and a specific day and time where the reported data would be transmitted. Moreover, users can use calendar to book their appointments according to days and hours of availability. Patients at the same time can see their previous personal appointment history. In addition, ‘call button’ makes direct call if there is something urgent and push notifications messages will remind the user before his/her appointments. Second type of users is the clinic admin or doctors, where they begin with a standard login screen where a username and a personal identification number are entered. Next, the doctor selects active appointments list or completed appointments. The doctor or clinic can send push notification message to a patient or number of patients to make an announcement or a reminder. Finally, the doctor or clinic can search for previously registered patients and check their information or call them.

3- Usability Inspection Results:

- a- **Cognitive walkthrough:** this process identified one potential usability problem that could interfere with adding an appointment. The problem is there is a need for choosing a specific doctor since a clinic has more than one doctor usually. This screen was later modified to create a more natural progression of tasks.
- b- **Heuristic evaluation:** the two evaluators rated two violations as high severity and the remaining as medium or low severity. Most of the medium and low severity violations included texts that required rephrasing and design issues that were reasonably simple to revise.
 1. Error Prevention: the user, when asked to choose a doctor to consult, had the option to select “none”. Clearly, this choice is improper because the user needs to book an appointment with a specific doctor. Hence, it is a high severity violation and the “None” option was removed later.
 2. Visibility of System Status: the application did not provide any feedback or visual indication to acknowledge that the user booked an appointment. Once this violation was discovered, a final confirmation screen was added into the interface to prevent future confusion.
- c- **Assessing End User Usability:** We engaged ten participants (10 males, 10 females) to participate in the usability study between the ages of 20–54 years old. All the selected participants had a long experience using smartphone devices.

4- Assessing End User Usability

Assessment of the end user usability was done depending on the following two factors:

- a- Timed task-completion analysis: All participants successfully completed the simulation of a case report in less than 3 minutes. Participants took the most time (average 1 minute) completing information on three screens (screens 1–3). These are most important screens in the application as shown in figures 5, 6 and 7.



Figure 4: Main screen of clinics app

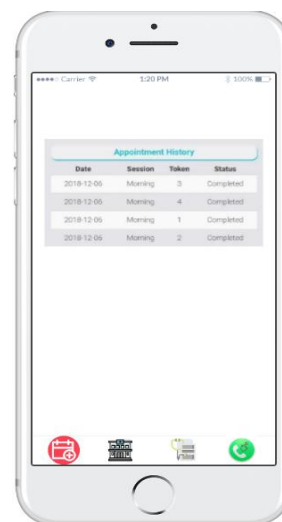


Figure 5: Add appointment Screen

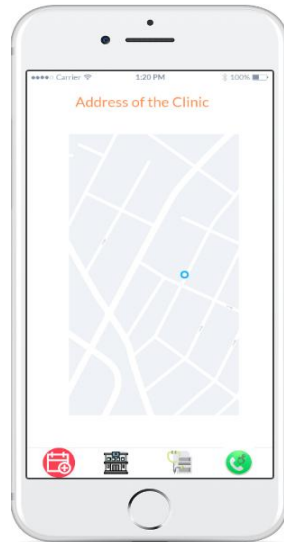


Figure 7: Location of clinic screen

- b- User satisfaction: the questionnaire assessed users' satisfaction of the application's screen layout, terminology and system information, learnability, capability, and their overall reaction. 95 % of the participants rated very good for the overall functionality of the application.

4. Conclusion

The aim of this study is to design mobile application for appointment scheduling system to reduce long waiting times and reduce no show problem via reminding patients by push notifications. According to the survey we conducted in Erbil, 95 % of the participants state that it is necessary to have an online appointment system and 91 % show their interest to book their next appointments online. The proposed application was shown to users to test and comment. As a result, 95 % of the participants rated very good for the overall functionality of the application. All the clinics that we cooperated with them showed their interest in applying the system in practice once the application is ready to use. The study concludes that technology need to show its impact on the healthcare system in Iraq and Kurdistan Region and further researches and studies need to be done in the area by professionals.

References

1. T. Cayirli and E. Gunes, "Outpatient appointment scheduling in presence of seasonal walk-ins", *Journal of the Operational Research Society*, vol. 65, no. 4, pp. 512-531, 2014. Available: 10.1057/jors.2013.56.
2. Y. Zhou, D. Dong and W. Jiang, "Influence Factors of Patient No Show in a Outpatient Department", *IOP Conference Series: Materials Science and Engineering*, vol. 439, p. 032047, 2018. Available: 10.1088/1757-899x/439/3/032047.
3. A. Ahmadi-Javid, Z. Jalali and K. Klassen, "Outpatient appointment systems in healthcare: A review of optimization studies", *European Journal of Operational Research*, vol. 258, no. 1, pp. 3-34, 2017. Available: 10.1016/j.ejor.2016.06.064.
4. T. Al Hilfi, R. Lafta and G. Burnham, "Health services in Iraq", *The Lancet*, vol. 381, no. 9870, pp. 939-948, 2013. Available: 10.1016/s0140-6736(13)60320-7.
5. L. LaGanga and S. Lawrence. "Service Appointment Scheduling and Walk-in, Short term and Traditional Scheduling".2008. Available from <http://mhcd.org/resource-library/serviceappointment-scheduling-walk-short-term-andtraditional-scheduling>.
6. A. Ahmadi-Javid, Z. Jalali and K. Klassen, "Outpatient appointment systems in healthcare: A review of optimization studies", *European Journal of Operational Research*, vol. 258, no. 1, pp. 3-34, 2017. Available: 10.1016/j.ejor.2016.06.064.

7. T. CAYIRLI and E. VERAL, "OUTPATIENT SCHEDULING IN HEALTH CARE: A REVIEW OF LITERATURE", *Production and Operations Management*, vol. 12, no. 4, pp. 519-549, 2009. Available: 10.1111/j.1937-5956.2003.tb00218.x.
8. S. Malik, "Mr. Doc: A Doctor Appointment Application System," *International Journal of Computer Science and Information Security (IJCSIS)*, vol. 14, no. 12, p. 452-460, 12 December 2016.
9. C. Stein, X. Xiao, S. Levine, T. Schleyer, H. Hochheiser and T. Thyvalikakath, "A prototype mobile application for triaging dental emergencies", *The Journal of the American Dental Association*, vol. 147, no. 10, pp. 782-791.e1, 2016. Available: 10.1016/j.adaj.2016.03.02

Authors



Payam Wali (Assistant Lecturer) received her MSc degree in Computer Engineering from Fatih University in 2015 (Turkey) and her Bsc in Information Technology from University of Kurdistan-Hewler in 2011 (Iraq/Erbil). Currently, she is a full-time lecturer at the Department of Information Technology, Tishk International University in Erbil city (Kurdistan Region of Iraq). She is currently teaching Introduction to Information Technology and E-business courses.



Mohammad Salim (Assistant Lecturer) received his MSc degrees in Information Technology from the Universiti Tenaga Nasional in 2012 (Malaysia). Currently, he is a full-time lecturer at the Department of Information Technology, Tishk International University in Erbil city (Kurdistan Region of Iraq). He is currently teaching Java programming and Android mobile applications development courses. In addition, he is a member of ACM (Association of Computing Machinery) and he has published several articles related to IT in education. His research interests include cloud computing, information systems and IT governance.



Bilal Ismael Ahmed, (Assistant Lecturer) received his MSc degrees in Computer Engineering from Fatih University (now Istanbul University) in 2016. Currently, he is a full-time lecturer at the Department of Information Technology, Tishk International University in Erbil city (Kurdistan Region of Iraq). His research interests include Image processing, Security and Networking.