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SMS DISTRIBUTER BASED PATIENT APPOINTMENTS SYSTEM

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ABSTRACT

Models with advanced access in general practice have been introduced worldwide in order to enhance healthcare services throughout last decade. This has led to obtaining benefits such as eliminating waiting lists, enhancing patient's timely access to services and lowering no show. Despite, implementing these models in Kurdistan's public hospitals, more precisely, in places with no internet access or low internet literacy, these systems will be less used. The current paper work appointment systems introduce one of the main problems arise in hospitals which is missing appointments by the patients due to the long queues given by the secretary of doctors. In the high light of this problem, there have been several web applications developed to show the exact date of appointments, however, according to latest report by UNDP report on Iraq development more than 50 % of patients in Erbil city don't have internet access or they don't know how to use internet. We are proposing an optimal solution for this problem which is an SMS based patient appointment system. Patients will be notified by an SMS a day before the actual appointment after they have been to hospital and registered themselves into an online registration system by the secretary. These are carried out in practice using SMS distributer, SQL Server database and ASP.NET and C# programming languages.

1. INTRODUCTION

Today patient management process which includes patient appointment, health forms, health records, and priority calls is considered important because it supports health care sector and reflect its quality. For the purpose of improving health care sector, it's imperative to look at the process of patient management such as time management and how to make more efficient. The biggest part of complaints made by

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patients are concerned with the longtime of waiting between patient arrival to a clinic and the actual starting time of consultation. One of the main problems of patients is the lengthy time during patient appointment reservation till the time of actual meeting with the related doctor or consultation [1] [2]. Moreover, appointments periods are not systematized since there are no fixed number of appointments per day, and patient might miss or forget appointment date which lead to cancelation of appointment and repeating appointment reservation process for new period if the patient asked again for appointment. Therefore many patients are not satisfied with current traditional system of appointments, especially those having urgent needs. This problem caused by missing of appropriate system that could re-arrange appointments and remind patients about their consultation time to reduce raised delay and number of missed appointments [3] . Figure 1 shows the current general flow of patients' appointment to the consultation hour in Kurdistan region, and this flow needs improvement [4]. Usually, patient will visit or contact the dentistry secretary to book an appointment then waits for that particular date and time of appointment. As soon as appointment date is approached, patients need to fill in registration forms in arrival. Next, from the time of registration till consultation hour, the waiting time of patients could be separated into these two parts:

- Patient's earliness – Period spent from early arrival till the designated appointment time.
- Internal waiting time – Time of waiting for the queue before starting the consultation hour.

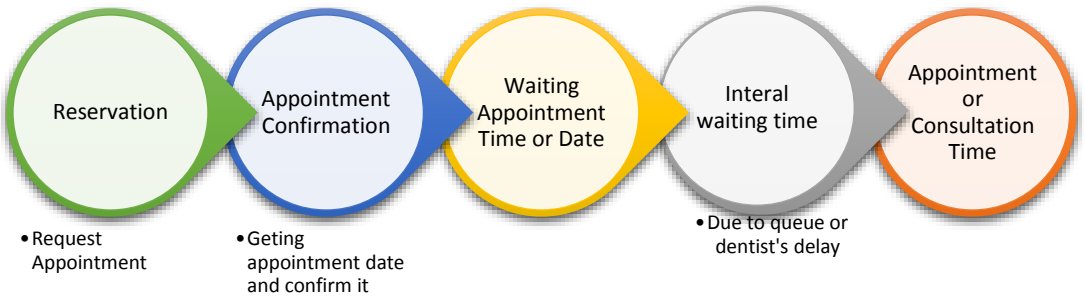

Figure 1: Outpatient stream inside a dentistry

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The common process within dentistry or health clinics is based on first come, first served system, where two available methods of getting a consultation :

A- Visit the dentistry on the appointment day and wait if any queue is there.

B- Call the dentistry on the appointment day and ask about the suitable time to come to avoid any internal waiting time such as queue's time.

For the last two decades, IT has made big innovations which become available to organizations and people, together with the health sector. In the past couple of years, there are significant developments in health sector to assure the performance quality and standards effectiveness of healthcare and its services [5]. In [6] it is stated that the Internet generally holds a big influence toward developing the healthcare system as compared to all other technologies that been adopted a few years ago. Nevertheless, because of some struggle related to guarding confidentiality of the patients' records which hinder the greatest expectation of the Internet in health sector.

To avoid burden of queues and manual hand reservation for appointments, scheduling appointment via phone or messages (SMS) is considered one of the best solution. Regarding the appointment scheduling no reminder system is there on all platforms for appointments which have been affirmed by the dentistry secretary [7]. Our proposed system is designed especially for public clinics as there is huge traffic on them with visitors and the appointment is not the same day, so they will be asked to comeback in few days ,and sometimes there will be misunderstanding and patients forget the exact day. That is why we have designed the reminder system specifically for clinics especially dentistry.

This paper organized as follows. Part 1 introduction about patient smart notifying system, then Part 2 which state some literature about IT utilization in the health industry concerning patient appointment. Part 3 shows the architecture of the proposed smart patient notifying system, followed by part 4 on the implementation of our recommended system and its operation. Part 5 provides the conclusion plus some future work.

2. LITERATURE REVIEW

In this section we are going to explore in brief on the adoption of various systems for patients reminder on their appointments in health sector.

2.1. PAPER BASED APPOINTMENT SYSTEM

In Iraq and Kurdistan region still wide part of health sector not taking advantage from technology development. It should be clear that in an outpatient clinic the process of

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consultation involves registration process plus appointment scheduling procedure that is paper-based in most clinics and dentistry especially the governmental ones and those situated outside the city [8]. 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 the survey report in 2008 [9], majority of the complaints related to the time expended in the waiting hall and 19% of the outpatients criticized that they could not get their appointments within one week time. Moreover, hundreds of outpatients' 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. This problem still considered as a challenge to health care industry in Kurdistan region and worldwide. In our solution we propose as system to deal with these issues, this system will enable the registrar to fill in patients information into web form then these data will be saved into database . Later before one day of the appointment the system will send SMS reminder to patients to remind them on the consultation time.

2.2. ONLINE APPOINTMENT SYSTEM

Another type of systems being used worldwide is online registration and scheduling system for instance (RegisterPatient.com). This website works 24 hours plus everyday per week system and health care registrar is reported automatically on future schedules and recorded patient via the online web system. This system enables patients to fill out their registration forms at a suitable time to avoid a queue. After registration has been finished, the patient will be notified about the nearest clinic. On the other hand, there are some issues concerning this system. First of all, registration demand patients to fill in sensitive data such as phone, ID, credit card numbers, and etc. As this system is a web-based, these sensitive data can be stolen by hackers. Another issue, most of the scheduling appointment and online registration system require monthly payments to the provider. Thirdly, some online appointment systems are restricted to less noticed symptoms such as vomiting, abdominal pains, and diarrhea [5]. Therefore when some of the symptoms are not available on the web system, patients must call in for any available appointment periods and be waiting for confirmation. For these urgent situations of needing consultation, this inadequacy might be leading to troubles for healthcare staff and patients. Lastly, this system does not offer any prioritization for scheduling the appointments. Nonetheless, it has been noticed to have such shortcomings and ineffectiveness to the online system. Firstly, reserved patients have to show their consultation cards which fixed with barcode for scanning to inform attendance. The inconvenience will appear once the card unintentionally mislaid, then inpatients are to be entered as an outpatient instead. Furthermore, in the emergency case, the patient is obligated to book physically at whatever clinic or by calling in and waiting for the confirmation by registrar for attainable periods. Another case arise if an interruption of consultation happened because of delay to access to the electronic web system. To access records of a patient, one must set and present his/her ID to the registrar. As a final point, priority levels might be set

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manually by depending on status of registration and age, regardless the illness level. At this time, there is no enough research accessible in the improvement of prioritization in any health care clinics throughout the world [10]. However our proposed electronic system will deal with urgent cases and priority levels by and will not have a problem with slow access to the system because only one person (registrar) or administrator will create the records for the patients.

2.3. MOBILE APPOINTMENT SYSTEM

Lately, health sector has started gradually moving towards employing cloud-based systems, despite of security concerns which might happen or not. By the presence of these systems, data size and capability to maintain data and records will be handled in a central manner. This system will improve the effectiveness of shared data among health care specialists nationwide, in addition to decrease the operating expenses of the health sector mostly since there will not be any repetitions. On the other hand, cloud networking are still rare where just a few IT experts have the ability to manage well the structure of database besides security issues. "Application of Intelligent Agents in Hospital Appointment Scheduling System" uses an intelligent agents that excludes the human ones to perform the related search actions in scheduling processes aim to improve the workflow and accordingly saving the effort and time of healthcare staff [5]. This system offers the consultation and arranging of the appointments by adopting mobile applications, Android 2.2 Froyo. The mobile system relied on setting the precedence level of patients into appointment booking. The developed agents are working using fuzzy orientation, to collect information from patients and schedules appointment with the health clinic. The testing of this system was performed by the use of JADE-LEAP in Android 2.2 Froyo mobile OS. There are some disadvantages discovered in this system. Initially, unregistered patients are demanded to book an appointment before twenty four hours or more before the planned time. After approval, these patients will automatically became a registered patients. In urgent cases, this method certainly not useful. Moreover, it only deals with one central health center, nevertheless of clinics nearby. Finally, there are no automated system calls as a reminder before the scheduled date. Our proposed reminder system will tackle these issues by sending SMS automatically to patients based on the data entered by the administrator or clinic's secretary.

3. METHODOLOGY

The aim of designing appointment reminder system is to reduce waiting time and make scheduled appointments well-arranged by setting fixed number of appointments per-day. The reminder system will be able to send reminder SMS to patients one day before the consultation, by fixing the number of appointments per day so each day will have a group of patients and their number can be set by the clinic administrator or doctor's secretary. Regardless of deep research from previous work in enhancing operations of healthcare, some problems are still unsettled. There are still concerns for walk-in patients; sometimes they must wait for a long time to reach their turns. Patient may schedule the appointment; but, they still need to wait for their appointment to be affirmed by administrator of a clinic. The process of waiting for scheduled appointments may take weeks or even months for any available periods. Both of the mentioned scenarios are not appropriate for all parties: patient, healthcare personnel and the healthcare clinic. This proposed reminder system would help as

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a queuing system to access patient's appointment information which will alert patients before 12 hours of the actual appointment by an SMS message. This system focusing only on the basic outpatient standard system such as registration, and scheduling appointment. Figure 3 below shows the proposed system layers.

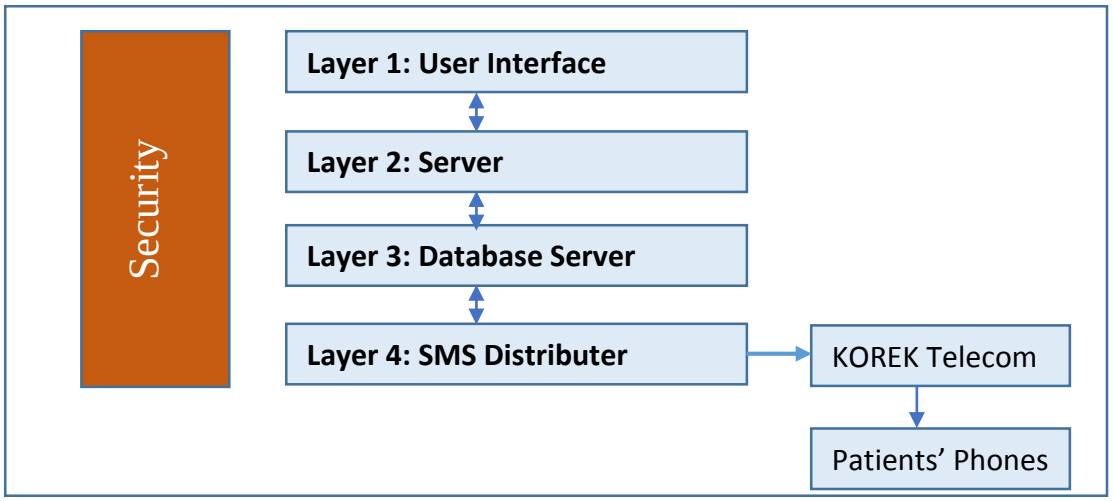

Figure 3: Four basic layers of patients' reminder system

3.1. LAYERS OF THE PROPOSED SYSTEM

For the purpose of creating the system that we proposed to remind patients on their appointments, the researchers have developed the system by working on these four layers:

1- User interface: this is considered the first step of using the system and it is represented by a web-based screen. This screen will enable the user whether he/she is an admin or a secretary to enter the data of the patients, figure 2 is a snapshot of this screen.
2- Server: This is a web server which host our web-based application to make available for users which are admins and secretaries of clinics. We a host on a public server which supports our web application.
3- Database server: this layer is responsible for saving all the data of the patients, so the proposed system can use these data to automatically remind the patients on their appointments before a specific number of hours. However, next layer (database distributer) will work on notifying the potential patients.
4- SMS distributer: The main job of this layer is to send notifications to the patients through SMS messages which is considered one of the most efficient way of communication these days especially in rural areas where internet service is still rarely used. This layer or service will utilized with Korek Telecom Bulk message, because it's the most popular telecommunication network in Erbil city of Kurdistan region and most of the patients are clients with Korek Telecom.

3.2. USE CASE DIAGRAM OF THE PROPOSED SYSTEM

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Figure 4 shows the use case diagram of the proposed web based application. There are three main actors playing this application who are Admin, Patient and Secretary. The admin has the capability of inserting new users for the system as well as modifying them and deleting one when required. Admin can also for patients and modify them plus delete them when needed. The patients will receive bulk messages from GSM companies for notification purpose of the appointment. The secretary can insert new patients' information plus a search, edit and delete old patients.

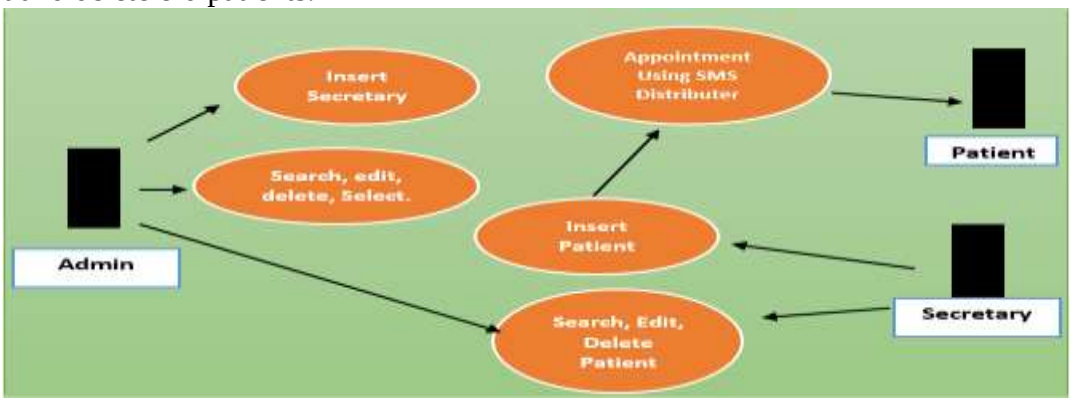

Figure 4: Use case diagram for the proposed system

4. RESULTS AND CONCLUSION

This sections has three main parts, the first one will explore the results of implementing the proposed system, second will present some feedback from involved parties to validate this paper work, and third part which focus on drawing conclusions and gives potential future work for researchers and industry people.

4.1. SYSTEM IMPLEMENTATION RESULTS

After the system has been implemented, its database is connected with a GSM company using SMS distributer so that through Bulk messages, the notification message is sent to patients based on the information presence in the database about the date and phone number of the patient.

As it can be seen from figure 4, the secretary will be filling out a form containing all required information on the patient specially the name and phone number. The form is validated such that the user should fill all the fields. As soon as the form filled out, the data will be stored on a public server on the internet. The database is connected to SMS distributer. When the day of the appoint approaches, the patient will receive a notification message as it can be seen in figure 5.

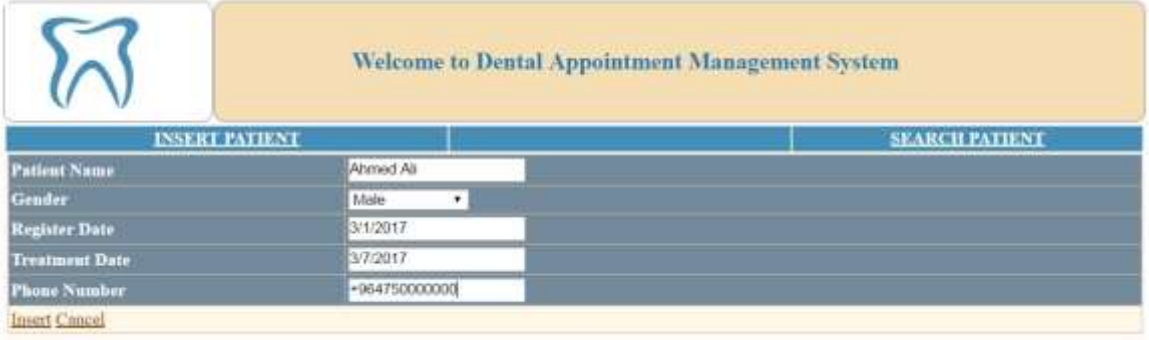

Figure 5: Patient Insert User Interface

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Besides having internet-less notifications to patients, hospital visitors can access online web page and search for their appointment by Name, visiting Date and Phone number. The figure 6 shows that, using our web based application, the secretary can search for patients too.

Figure 6: Patient Search by Phone number User Interface

Figure 7: Mobile SMS appointment reminder

As it can be seen from figure 7, the patient will receive a bulk message from the GSM Company about the appointment before 12 hours. Through this way the appointment missing rate will be reduced and patients arrive to the hospital on exact date and time.

4.2. VALIDATION OF THE SYSTEM

After the application implemented, we connected it the appointment database with Korek Telecom using SMS distributer. We subscribed to Korek GSM using 2000 Bulk messages.

The application installed on the secretary work station and put under test for one week. After seven days, the opinions on the application and the solution provided for appointment procedure from several personals who used the system.

The general director of the Shaqlawa believes that the solution will reduce the appointment problems to a great extinct which were causing troubles before. He thinks that

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the application is very suitable for a place like Shaqlawa city since around %50 of people don't have internet access or they don't know how to use the internet.

The general director of the hospital says that from now, our data is saved in a safe place and we can retrieve it whenever needed in a very easy way. He believes that this system will reduce the cost of paper in future.

The Doctors mentioned that the application have had the troubles facing with wrong or missed appointment being solved. Doctors found the search feature for patients very useful to know the number of patients they are going to treat in an exact day.

The secretaries believe that this system will reduce the force, work and miss-understandings between patient and hospital in appointment issues.

The patients look comfortable with the system since they get the notification in a very convenient way without having concern on internet and emails plus a correct day for treatment.

5. CONCLUSIONS

1. The missing appointments by the patients due to the long queues considers the real main problems arise in hospitals.
2. Using the proposed appointment management system, the percentage of missed appointments by patients is decreased tremendously as most of the population in rural areas have mobile devices regardless being a smart phone while no need for internet access and knowledge on using the internet.
3. During this research, it is found the proposed SMS distributer based appointment system is the optimal and the most efficient way to remind patients about their appointment regardless having internet access such as in rural areas.
4. Using this system helps the clinics' secretary to manage the workflow of appointments since the system can specify fixed number of daily appointments then remind them automatically via SMS.

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