# Online Appointment Scheduling System for Hospitals–An Analytical Study

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**Abstract- Appointment scheduling systems are used to manage access to service providers. Many factors affect the performance of appointment systems which include arrival and service time variability, patient and provider preferences, available information technology and the experience level of the scheduling staff .Thus a proper scheduling system has to developed by considering all these factors which will increase patient satisfaction, which in turn increases profit. An online scheduling system allows individuals to conveniently and securely book their appointments online. Compared to the usual queuing method, the web-based appointment system could significantly increase patient's satisfaction with registration and reduce total waiting time effectively. This paper focuses on detailed study of online appointment scheduling system with architecture and merits.**

**Keywords: Online Appointment System, Scheduling, Software Architecture**

## I. INTRODUCTION

The term of "appointment" refer to the period of time allocated in the schedule to a particular patient's visit and "service time" refer to the amount of time the physician actually spends with the patient (which may be shorter or longer than the appointment duration).[1]

Based on Cayirli and Veral [2], Appointment scheduling can be classified into two broad categories. Static and Dynamic. In static appointment scheduling all decisions must be made prior to the beginning of a session, which is the most common appointment system in healthcare. In dynamic appointment scheduling the schedule of future arrivals are revised continuously over the course of the day based on the current state of the system. This is applicable when patient arrivals to the service area can be regulated dynamically, which generally involves patients already admitted to a hospital or clinic.

The appointment-scheduling process which is either dynamic or static can be viewed as burden in hospitals, which can be eliminated through an efficient online appointment scheduling system. The benefits of implementing this technology touch everyone involved in the scheduling process. Administrators and staff can conduct their tasks more efficiently and accurately, while patients have the ability to book their appointments and reservations quickly and more conveniently.

Online appointment scheduling system is a system through which a user or simply, a patient can access the website of the doctor, and through the online software, the patient can easily make their appointments. In addition to that, patient can also provide additional information to the doctor, making the doctor aware of their situation and giving the doctor time to prepare the necessary information for when the patient's arrives. In this way, online appointment scheduling can help the practitioner, the office staff, and the patient's. There is several online appointment scheduling tools in the marketplace, some of which are feature-loaded, easy to setup and cheap. For doctors, online appointment scheduling brings a lot of value add services and benefits, like engaging the patient, making the patient feel appreciated, and being able to store patients' data securely for future reference. But the most wonderful and useful advantage is that online appointment scheduling is amazingly low cost. [3]            .

II  DIFFERENT TYPES OF PATIENT SCHEDULING

A number of different methods are available to schedule  appointments in the medical office.They include the following: [4]

1.  Double  Booking
2.   Like Visits Together
3.  Ten Minute Increments
4.  Modified Wave Scheduling.
5.  Staggered Starts
6.  Group Meetings

**Double booking**: Double booking appointments is a basic technique for minimizing down time  by ensuring that there always is a patient ready to be seen when the physician is available. It Increases physician productivity and creates an   incentive for patients to arrive on time (first come, first-served).But the drawback is it greatly relies on the physician's innate ability to modulate  time imbalances throughout the day and to "catch up" as needed to finish on time.

**Like Visits Together**: Efficiency tends to increase when patients with similar health status or chronic conditions are scheduled close together. Industry long ago discovered that repetition of the same task eliminates set-up time, permits continuous work flow and accelerates process speed. This method is an efficient way to organize the repetitive services and it is more productive for scheduling certain categories of patients back-to-back.

**Ten Minute Increments**: Internists traditionally design schedules around 15 minute time increments, thus producing standard appointments of 15, 30 and 45 minute durations. In contrast, pediatric practices, and some family practice groups, tend to use 10 minute increments with resulting planned visits of 10, 20, 30 and 40 minutes. In this method physicians can reduce down time and the need for     double booking by calibrating scheduled time closer to actual visit time. But it increases the complexity for scheduling personnel

**Modified Wave Scheduling**: In a modified wave system, patient appointments overlap so that when one finishes early, another patient is waiting to be seen by the physician. In this way a constant flow of patients smooths out any imbalances in the lengths of visits. no patient is delayed by more than a few minutes beyond the scheduled appointment time

**Staggered Starts**: If a modified wave schedule is not appropriate, some of the same benefits can be achieved by staggering visits in five or 10 minute intervals. One patient can be scheduled for a 15 minute visit beginning at 9 a.m. and the next one at 9:05 a.m. If the first patient arrives late, only five minutes are lost before the second patient arrives. If the next set of patients is scheduled at 9:20 and 9:25, the physician hopefully can work in the late patient without delaying anyone else by more than five or 10 minutes. This approach is particularly useful at the beginning of a session to prevent the first patient from throwing off the whole day's schedule by arriving late, or not showing at all. It also may be useful during the rest of the day in practice settings where patients tend to be late or the lengths of visits are particularly unpredictable. Visits still overlap, but the workload is spread out somewhat and patients are less aware of double bookings.

**Group Meetings:** Group scheduling is an alternate method of processing patients with similar, often chronic, conditions. By seeing such patients as a group, some physicians have found they can save time, create a highly supportive atmosphere, and devote more time to patient education and health issues than would be possible during traditional office visits.

III ANALYSIS BETWEEN TRADITIONAL AND  ONLINE APPOINTMENT SCHEDULING

In traditional appointment system patients has to come to the hospital and queue at the appointment window to make the appointment. But they usually end up waiting for very long periods of time. The patient can, however decide to schedule an appointment, but this option does not usually work well for all parties involved. Parties involved includes: the patient, the medical personnel and the hospital. The patient wishes for readily available and convenient appointment times. When they do not find a close enough appointment time they experience long periods of indirect waiting time (time between scheduling the appointment and that appointment becoming available).

 The patient also wishes to be seen either immediately or within minutes of their arrival (whether they scheduled an appointment or not). The time that the patient waits from the scheduled start time of their appointment to the time that they actually receive service is called direct waiting time. The patients using this method waste much unnecessary waiting time standing in line at the registration window to ensure a successful registration with a certain physician.

The medical personnel wish to have some control over the uncertainty in the number of patient appointments in a day and the mix of appointments on any given day. These factors can affect their earnings as well as their job satisfaction levels. The hospital wishes to use its resources (personnel and equipment) in the most efficient manner. Therefore the hospital doesn't wish for the medical personnel to have long periods of "wasted time". So the challenge is to provide a solution that allows patients to minimize both direct and indirect waiting time, also to provide some control over medical personnel appointments and finally to provide the most efficient use of the hospital's valuable resources.[5]

In online appointment scheduling system patients are given an appointment number. At the designated appointment time, patients arrive at the hospital and get the registration that is allotted to their appointment number. These patients need not queue at the registration window. In this way both direct and indirect waiting time can be minimized and hospital's valuable resources can be utilised efficiently.

The following flowchart shows traditional v/s online appointment scheduling system
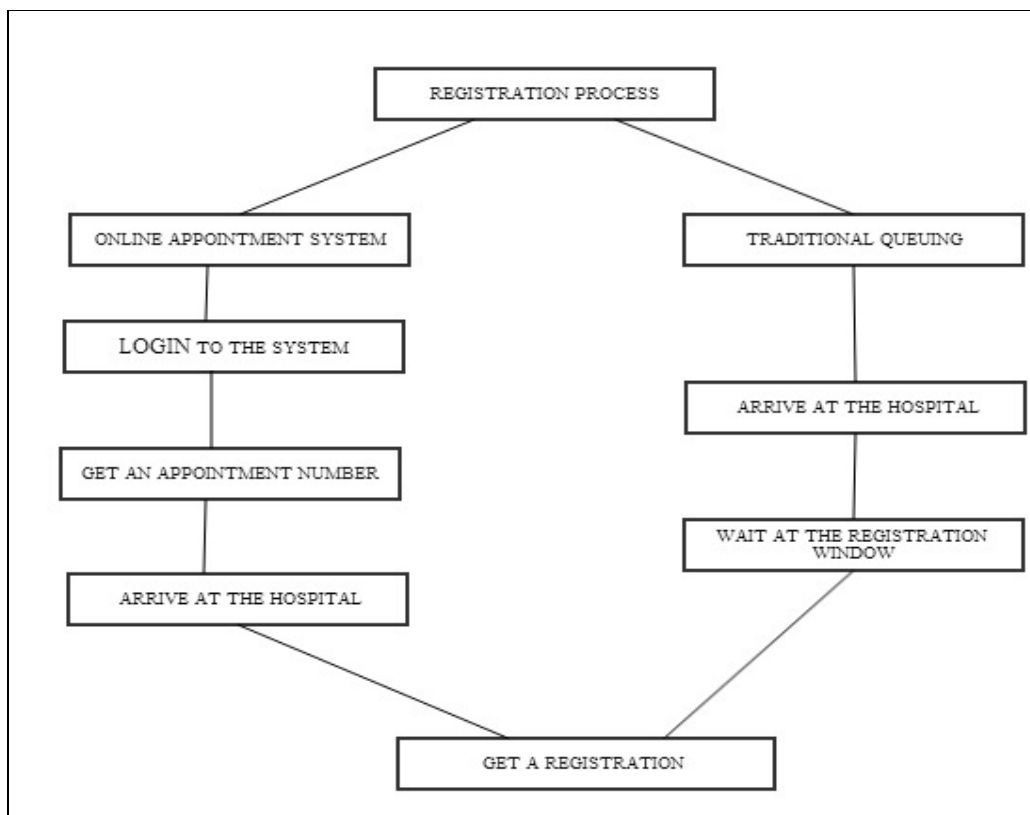


Figure 1 Flowchart for Traditional v/s Online Appointment system

### IV SOFTWARE ARCHITECTURE FOR ONLINE APPOINTMENT SYSTEM

Figure 2 gives an overall view of online appointment system with the key features listed below:-

- Schedule daily appointment list of patients
- View patients complete information
- Reschedule the appointment
- Assign time slot to each patient
- Cancel the appointment
- Check Doctors availability for patient's appointment
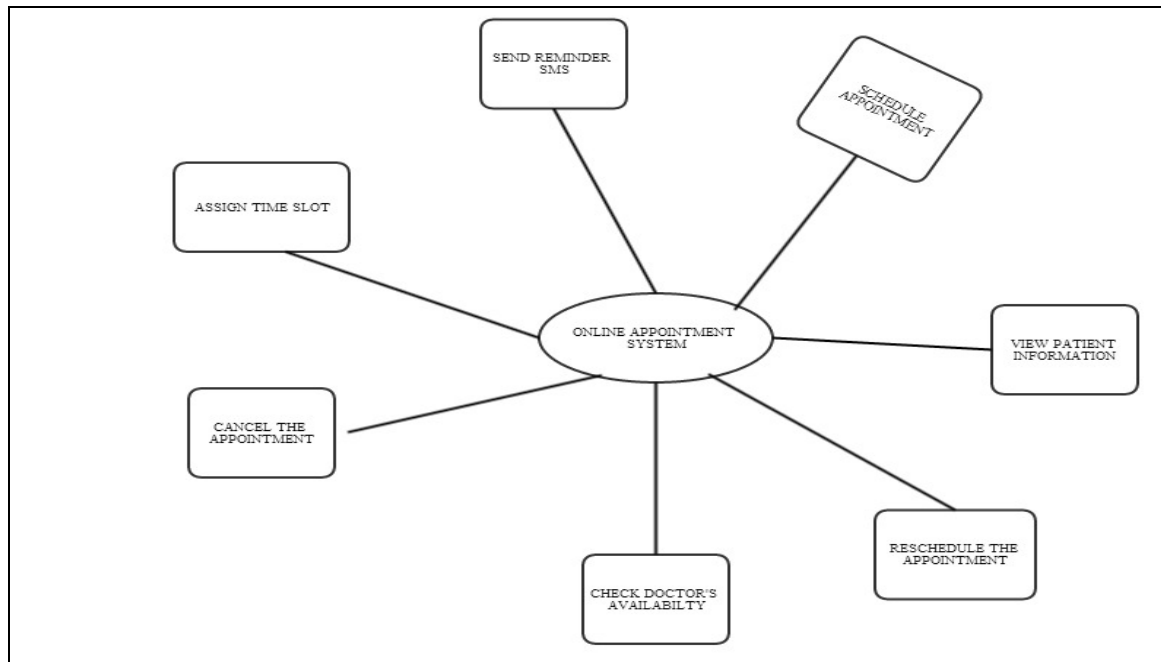- Send reminder SMS to patients

Figure 2 Online Appointment System

According to Browse/Server Model an online appointment system consists of two sets of functions .[7]The first set of functions are online registration functions including register and login,selection of department,date,doctor and other registration booking functions.Fig 3 shows the operational flowchart of an online appointment system.
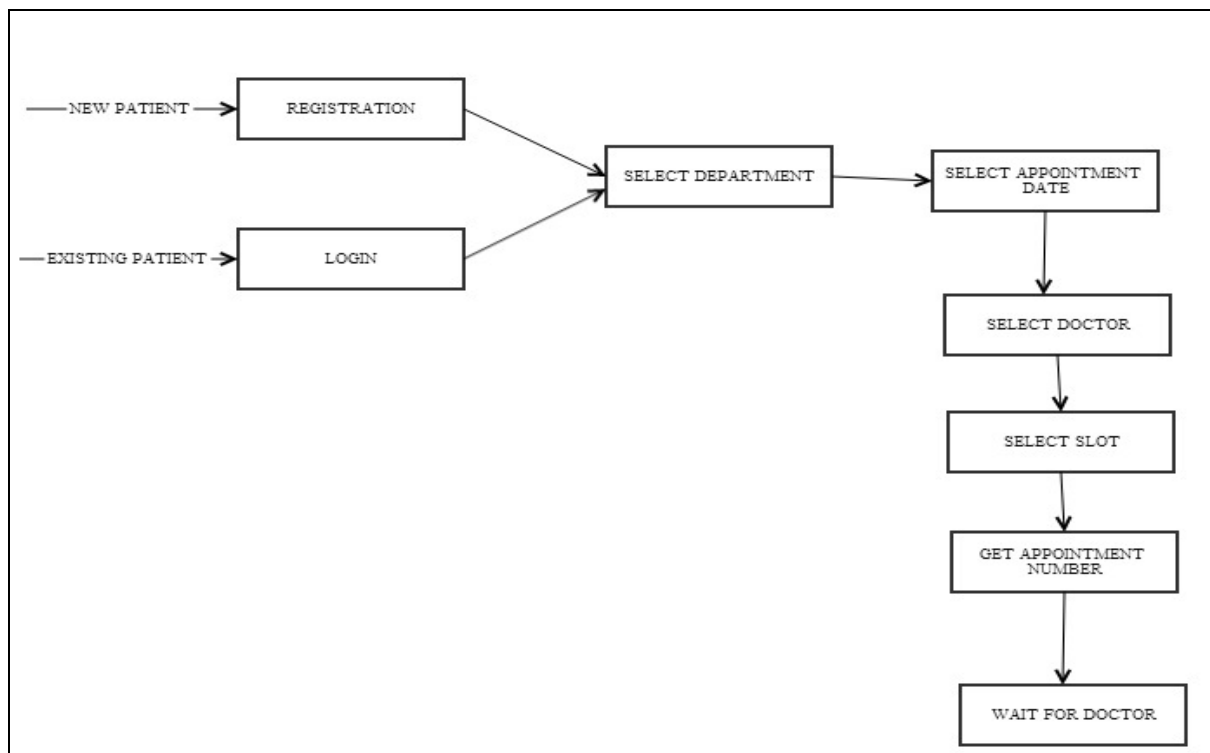
Figure 3 Operational Flowchart

The second set of functions are data management functions allowing the database administrator has to add,delete,modify,inquiry,restore and back up.Add,delete,modify and inquiry are the basic operations of database management. They can effectively maintain the consistency of the database to meet the actual need. The data backup and restore can enhance security of the system. Even if the data loss occurs the system can be restored easily. Figure 4 shows the data management structure.
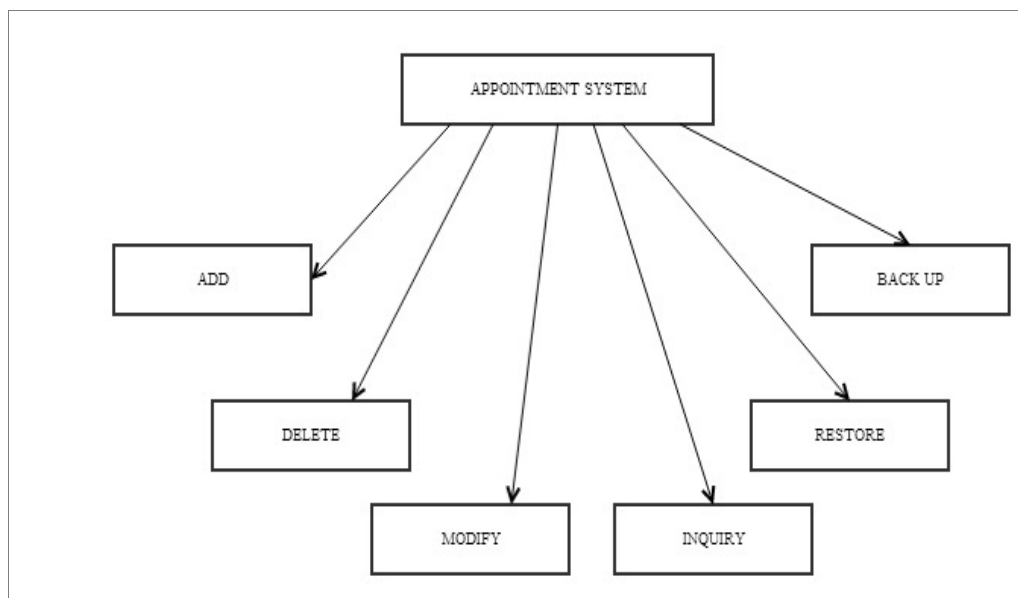


Figure 4 Database Management Structure

Easily making an appointment with preferred date and time is a main characteristic of any patient-centered health care system[8]. An integrated online patient appointment scheduling approach based on Web-Services architecture enable the establishment of patient-centered health care system easily. The goal of automated patient appointment scheduling process is to integrate distributed clinical systems into a set of consistent and convenient services accessible via a web browser.

A 2-tier architecure is explained here which is a modified form of 3-tier architecture proposed by[9].This model consists of 2-tier ,first- tier, patients can access appointment information with a web-browser through Internet.The 2-tier connects with first tier for information exchange using web sevices. The 2-tier uses a web server to connect to the Internet and handles the HTTP requests exclusively for the static contents, such as static HTML files and images. It responses user's request with HTTP protocol, such as sending back a HTML pages. In case the HTTP request is related to patient appointment scheduling services,the web server will delegate the dynamic response to another server side application located at application server to process the request.The results response from application server will be converted into HTML format through web server and displayed in the standardized HTML Web Page. [9]

The user login and registration requests are processed by the portal server which located in 2- tier. The application server is a component that manages the complete end-to-end appointment tracking and scheduling services. The key functions of application server include: (1) multiple-practitioner scheduling, (2) centralized and consolidated patient appointment tracking, (3) available appointment searching, (4) appointments rescheduling, and (5) appointment confirmation and cancellation. Detailed information about each scheduled appointment slot, such as patient login and contact information, is also stored into the 2-tier database.[9]
Figure 5 shows the 2-Tier System Architecture for Online Appointment System.
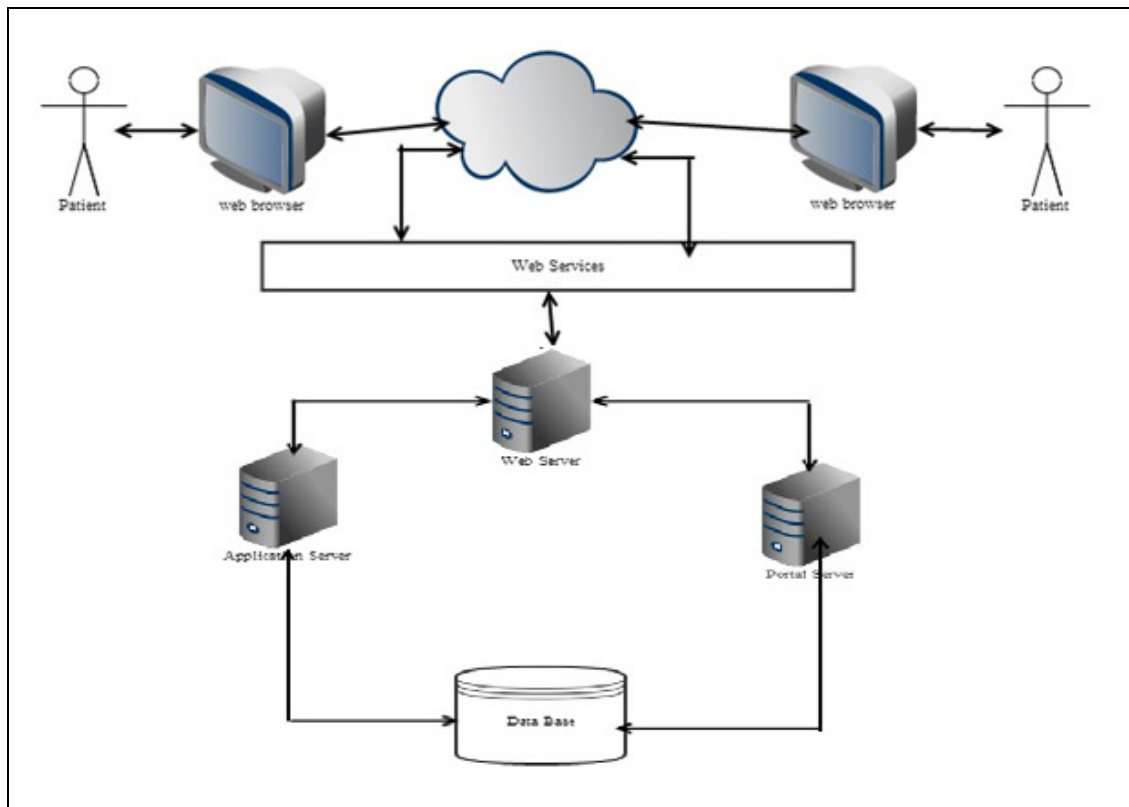
Figure 5 2-Tier System Architecture for Online Appointment System

V  BENEFITS  OF ONLINE SCHEDULING SYSTEM

Online appointment System provides the following benefits:-
- Schedule patients for various medical procedures-test,treatment
- View daily,weekly,monthly patient schedule
- Create Patient Records and Appointment reports
- Helps to track Patient Flow based on arrival , visit and departure time
- Avoid no-show,missing,over-booking patients and other conflicts
- Email appointment schedule reminder
- Provide daily appointment scheduling reports

The flexibility of online scheduling system  enables it to be utilized for a variety of different services and activities  such as:
- All the appointment can be aggregated from the website, phone enquiries or direct enquiry
- Scheduling patient appointments, treatments and services
- Booking  vaccine

VI CONCLUSION

One of the biggest reasons that online appointment scheduling is getting popular day by day is that it helps the patient to make the appointment to their doctor, clinic or hospital in an easier way. It makes it through the computer, access a website or software and makes an appointment, than to go to the hospital, wait in a line for a number of hours, just to make an appointment with the doctor for the next week or next month. And through this, patients can also involve in the health decisions that they have to make. They can make an appointment to another doctor other than theirs, by nothing more than a click.

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