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A REVIEW ON DIFFERENT TECHNOLOGIES USED FOR APPOINTMENT SYSTEMS AND QUEING TECHNIQUES

[1] Dr.M.Nasiruddin, [2] Ruhma Aqdas Sheikh, [3] Sana Bano khan, [4] Awes Quarni
[1] Associate Professor, [2] Student , [3] Student [4] Student
[1,2,,3,4] Department of Electronics & Telecommunication
[1,2,3,4] Anjuman College of Engineering and Technology, Nagpur, India
[1] nasiruddin@anjumanengg.edu.in [2]ruhmasheikh2002@gmail.com, [3]sanabanokhan3@gmail.com,
[4]Awesk7532@gmail.com

Abstract :
Efficient management of patient appointments and queues is vital for optimizing healthcare service delivery and ensuring patient satisfaction. This paper provides a comprehensive review of various technologies and techniques employed in patient appointment systems and queue management within healthcare settings. The review encompasses a broad spectrum of approaches, including traditional appointment scheduling methods, as well as modern technological solutions such as electronic appointment systems, mobile applications, and web-based portals. Additionally, it explores the integration of Artificial Intelligence (AI) and machine learning algorithms in predicting appointment durations and optimizing scheduling processes. Furthermore, the paper delves into queueing techniques utilized in healthcare facilities to streamline patient flow and minimize waiting times. It discusses strategies such as priority-based queueing, appointment-based queueing, and real-time queue management systems, highlighting their advantages and limitations. Through an in-depth analysis of existing literature and case studies, this review aims to provide insights into the strengths and weaknesses of different patient appointment systems and queueing techniques. It also identifies emerging trends and future directions in the field, emphasizing the importance of adopting innovative technologies to enhance the efficiency and effectiveness of healthcare service delivery. Ultimately, this research contributes to the ongoing discourse on optimizing patient scheduling and queue management processes in healthcare, with implications for improving patient outcomes, resource utilization, and overall healthcare system performance.

Keywords: Scheduling , appointment , GSM , RFID

Introduction

Patient-centeredness is becoming more and more important in the healthcare industry. The growing understanding of the patient's involvement in the planning and delivery of health care is essential to this change. Major advancements are being made in medical appointment scheduling, which serves as the foundation for the majority of non-urgent health care services, in order to encourage patient participation. Patients have better access and more flexibility when choosing their preferences for appointments when they use the Internet as a medium. Time is a constant, non-renewable resource. In many applications, any procedure that conserves time and space is deemed essential. Time is a valuable resource that has to be effectively handled. Time wasted in a line is never negotiable, and it is for this reason that the current queue management system is so crucial. "How could time be smartly utilized?" is the basic question that inspires the concept of the system. The inconvenience of having to wait in a lengthy line to be attended to will be eliminated by this clever queue management system. Medical visits have often been scheduled in person or over the phone with schedulers. These

techniques provide for the greatest degree of flexibility in complex circumstances and are based on verbal contacts with actual individuals. Unfortunately, the availability of appointment slots is not the only factor limiting the ability to secure a timely appointment using these traditional techniques; schedulers and phone lines also play a role. The capacity of patients to schedule appointments with the appropriate health service providers at the appropriate time affects their level of satisfaction with the process. There are several ways to establish a manual patient appointment system, ranging from basic paper-based systems to more sophisticated spreadsheets or calendars. An overview of how to set up a manual patient appointment system is provided below:

Appointment Book or Calendar: You can record patient appointments in a real appointment book or calendar. There should be opportunities for several appointment times on each page or day.

Appointment Time Slots: Using the plan for your practice, set up time slots for each day. For instance, based on the type of appointments, you may have slots every 15 or 30 minutes. Patient Information Sheet: Make a standard form or sheet that you may use to gather patient data, including name, contact information, visitation purpose, and any other pertinent information.

Procedure for Appointment Scheduling:

Note the patient's details and chosen appointment time in the appointment book or calendar when they phone to schedule a visit.

Assign a patient an available time slot and complete the information page if they walk in to make an appointment. Verify the appointment's specifics, such as the time, date, and any special instructions, with the patient.

Appointment Confirmation:

Take into account putting in place a method to let patients know when their appointments are. Reminders by email, text message, or phone call might be used for this.

Updates and Modifications to Appointments: Establish a procedure for managing alterations or cancellations of appointments. Make sure you can quickly update the calendar or appointment book and alert the impacted patients to any changes. Keep a waiting list in place for those who aren't able to receive appointments right away. In the event that appointments need to be postponed or cancelled, you can fill these openings from the waiting list.

Maintaining Records: Keep a log of every visit, including the patient's information, the time of the session, and any necessary notes or follow-up activities. Review the appointment book/calendar on a regular basis to make sure it's accurate and to spot any conflicts or problems with scheduling.

Data security and patient privacy: Make sure that patient data is managed safely and in accordance with applicable privacy laws, s.

Employee Training: To guarantee efficiency and uniformity, provide training to employees who will oversee the scheduling system. When a practice expands, a manual appointment system may become burdensome even if it may function effectively for smaller clinics or practices. It could be more effective in certain situations to switch to an electronic scheduling system. However, with the right setup and administration, a manual system can still function well. Smaller practices with limited resources can utilize manual methods since they are simple to set up and operate, requiring nothing in the way of technology infrastructure. A manual system often has a low initial cost since it mostly uses paper-based procedures or standard office supplies.

Employees who are accustomed to manual systems may find them more comfortable since they use conventional techniques for storing records and scheduling.

Drawbacks:

Prone to mistakes: Manual systems are more prone to human mistake, which can result in inefficiencies and possibly unhappy patients. Examples of this error include duplicate booking or misplacing appointment records.

Limited Accessibility: Patients may experience difficulties obtaining real-time appointment

availability information or making appointments outside of typical business hours. Time-consuming: Staff members and managers may find manual appointment scheduling and administration procedures to be time-consuming. Patient appointment scheduling made easier using an automated system that lets patients make appointments online whenever it's most convenient for them and lessens the administrative burden on staff. Patients may use any internet-enabled device to access appointment scheduling platforms around-the-clock, which increases accessibility and convenience. Automated solutions minimize no-show rates and maximize appointment usage by providing automated reminders and real-time updates on appointment availability. Smaller practices may find it expensive to invest in the initial software and hardware infrastructure, staff training, and other costs associated with automated solutions. Automated appointment systems, like any technology-dependent system, are susceptible to malfunctions or outages that might cause scheduling procedures to be interfered with. Workers might need some time to become used to new automated procedures and systems, which could affect output while things are changing. Automated systems are simple, inexpensive, and offer real-time updates, enhanced accessibility, and better efficiency. Practice size, finances, staff experience, and patient preferences are some of the elements that influence the decision between automated and manual systems. Many practices choose hybrid techniques, which incorporate the advantages of both systems. Recently, another way to schedule appointments has been over the Internet. Scheduling appointments online has been a major area of study. According to satisfaction assessments done in several research , Recently, another way to schedule appointments has been over the Internet. Scheduling appointments online has been a major area of study. Web-based appointment scheduling is a very essential feature, according to several studies that performed satisfaction surveys, and the majority of patients said they would use the service again. Web-based appointment systems come in two flavors: real-time and asynchronous. When using an asynchronous mode, schedulers manually handle appointment requests that are sent through emails or electronic forms on the provider's website. Patients can communicate directly with schedule management systems used by providers in the real-time manner [3,13]. The asynchronous Web-based appointment systems essentially mimic the telephone-based appointment scheduling procedure, albeit utilizing the Internet as a media as well [13]. If an appointment is requested in the asynchronous mode outside of a provider's regular business hours, it won't be handled until the schedulers go back to work. The backlog of phone calls in the queue typically limits Web-based appointment requests as they are placed in the same queue as phone appointments. An online clinical appointment is a web tool that allows patients to make appointments by registering online. A straightforward way of living is the most convenient approach to log on. The patient uses the online technique in order to live a more convenient, safe, and easy existence. Directly manipulating patients through paper-based activities is difficult. In many developing nations, fitness care has become the most important kind of healthcare within the past ten years. Making direct touch with the hospital and waiting in a long line to get an appointment is difficult. The main goal of this work is to create a timetable using an online tool that helps patients with their problems. The patient's obstacles are reduced with this utility, which also shows the doctor's print and availability hours. Patients and physicians may arrange their own schedules since it is a solution. The rationale for developing the online scheduling tool is to facilitate frequent check-ups and patients in a more straightforward way. It is more convenient to endure the PC, visit a website, and book an appointment than to visit the clinic and wait in line for a very long period. Patients who make reservations on paper often have to wait in line

for quite some time when they need medical services [8]. This is because most medical care establishments complete their patient enrollment forms utilizing paper arrangements. Web-based planning software allows for the complete implementation of a patient reservation framework with meticulous arrangements. Through a single source, it provides information into the medical clinic and patient data. It provides information about the medical facility and patient information on a single platform and offers a straightforward way to make reservations in accordance with patient accommodations.[9] This is an excellent foundation for well-being medical checkups that includes patient enrollment. Healthcare practices may save time and effort when scheduling and managing appointments with the help of an automated patient appointment system. Patients may schedule appointments online whenever it's convenient for them, doing away with the necessity for phone calls or in-person scheduling, thanks to specialist software or programs. The electronic health records (EHR) system of the practice is usually integrated with the system, facilitating easy access to patient data and scheduling preferences. Automated SMS or email reminders for appointments can lower no-show rates and increase overall appointment adherence. The capacity of automated systems to handle appointment availability in real-time is a crucial feature. Viewing available timeslots, patients may select the one that most conveniently matches their schedule. Additionally, the system is capable of automatically handling rescheduling and cancellations, updating the schedule in real-time and informing impacted parties. This effectiveness maximizes the use of healthcare practitioners' time and resources while simultaneously improving patient happiness. In addition, telemedicine integration, virtual waiting rooms, and patient intake forms are just a few of the extra features that automated appointment systems frequently provide to improve both office efficiency and patient satisfaction. Automated patient appointment systems allow medical professionals to concentrate more on patient care by lowering administrative stress and increasing accessibility. They also guarantee a more convenient and effective scheduling procedure for patients and staff.

Literature Review

These days, a lot of hospitals have systems in place requiring people to schedule an appointment online. However, a lot of individuals in certain rural areas do not even know about internet systems or processes, let alone utilize cellphones. Thus, they were unable to accept appointments made online. As a result, they ought to visit the hospital and schedule an appointment, which will take time.

[1] **"Online Appointment Scheduling System for Hospitals–An Analytical Study"**

Services provided by outpatients have grown in importance within the medical field. Outpatients frequently travel great distances, which takes up their time. If a doctor is unavailable, they may also have to wait a lengthy period. Thus, they spend time using the SMS-based hospital reception system.

[2] **"GSM based appointment booking system"**

Global System for Mobile Communications (GSM) technology is used by a GSM-based patient appointment system to make scheduling and managing appointments in healthcare settings easier. Patients can use their mobile phones to make, change, or cancel appointments with this technology, which usually combines GSM modules with software for scheduling appointments. Patients initiate the procedure by submitting requests for appointments using SMS (Short Message Service) to a predetermined phone number linked to the medical institution. The appointment management system subsequently handles these requests, confirming or suggesting different appointment times depending on predetermined criteria and verifying availability. Following the scheduling of an appointment, the patient receives a

confirmation SMS from the system that includes information about the appointment, including the date, time, and any further instructions. Additionally, patients might get

In order to lower the number of no-shows and increase appointment adherence, patients may also get reminder messages closer to the scheduled time. When it comes to staff planning and resource allocation, the GSM-based solution helps healthcare providers by providing them with instant access to patient data and appointment calendars. In order to facilitate data-driven decision-making and process improvement, the system may also produce reports and analytics on appointment patterns, patient preferences, and no-show rates. [3] Because mobile data transmission enables users to send data from remote areas to other remote or fixed sites, it has grown to be a very significant and quickly developing technology. With the advent of cellular technology, which made it possible to connect a huge number of people by efficiently utilizing frequencies, mobile telephony took off. More complex and user-friendly digital services are possible because to developments in software technology, the widespread usage of devices, and the growing amount of digital knowledge. One of the more contemporary ideas in ubiquitous computing, mobile software agents 135 have great potential for addressing a number of real-world issues. The application of artificial intelligence (AI) techniques inside the massive data and widespread use of mobile communications may allow mobility [4] One of the AIs is agent-based systems technology. In recent years, generation has created a great deal of enthusiasm because to its benefits and prospects for introducing a novel approach to the planning, creation, and use of software systems [5]. The ability of intelligent agents to help with data searching is one of its main advantages. The concept of the mobile agent is a valuable and significant technology that makes ubiquitous and pervasive computing possible. In [6], authors outline a hospital laboratory workflow, present system modeling that addresses security issues pertaining to data stored in smart cards, and use RFID bracelets attached to hospitalized patients' arms for identification. They also use RFID tags adhered to patient sample containers to accurately identify the patient who donated the samples. Wireless technology is used to monitor patients with a dependable health monitoring system that is introduced in [7]. Through the use of mobile technologies and wireless body area networks, it processes a vast amount of biological signals. A novel lightweight RFID identification scheme based on dynamic ID is presented in [8] and is intended to improve patient safety. The authors of [9] place a strong focus on the automatic test production of conceptual models for verification and validation using formal approaches in a cost-effective manner. The formal specification and testing of two microprocessor-based cryptographic devices—a message authentication device and one that regulates access to a network of workstations—are described by the authors in [10]. In [11], a logical architecture for forest fire detection is described. This architecture aids in the generation of an algorithm, and it is then transformed into a formal model equivalent through the use of the Vienna Development Method-Specification language (VDM-SL). The author of [12] provides a formal axiomatic model for ubiquitous healthcare systems that outlines the formal specifications needed for healthcare systems, including those pertaining to functionality and security. Authors assess the several languages that might be utilized to officially demonstrate in [13].

Conclusion

The accessibility and ease of a GSM-based patient appointment system for both patients and healthcare professionals is one of its main benefits. Without the need for specific software or internet connectivity, patients may use their mobile phones to schedule appointments at any time and from any location. This flexibility can save wait times and administrative workload

while improving patient participation and satisfaction. But it's important to take into account the possible drawbacks of GSM-based systems, such poor network connectivity, unsuccessful SMS delivery attempts, and the requirement for strong security measures to safeguard patient data. When deploying such systems, healthcare institutions must also make sure that they are in conformity with all applicable laws pertaining to patient privacy and data protection. In general, the efficiency and efficacy of appointment scheduling procedures in healthcare settings may be greatly increased by using a well-designed GSM-based patient appointment system. agents' mobility and intelligence make them perfectly suited for adapting to changing circumstances in ubiquitous systems. Agents alter their information retrieval and locations in response to newly accessible data as a consequence of this combination. Therefore, in order to maintain the efficacy of such a system design, its framework has to be constructed.

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