DESIGN AND DEVELOPMENT OF AN AUTOMATIC PATIENT CALLING SYSTEM FOR HOSPITAL

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ABSTRACT

Queue management is still a challenge for both customers and facility managers, especially in medical facilities, in both traditional and electronic-based queue systems. In a typical queue, patients are seated in chronological order before moving forward while early arrivals meet with doctors. When a patient leaves and wants to return to his previous position, the arrangement is generally upset. The electronic-based lines, on the other hand, use dedicated electronic technology to call patients but fail to account for those who are not there. While the problem of arranging patients in chronological order of arrival was solved with the introduction of electronic queue management systems, the issue of absent patients is still beyond current technology, even the most advanced system in which the patient calling system is linked to the patient database, which solves the physical file movement problem. The Enhanced Patient Calling System is a microcontroller-based queue management system that uses the slot-back model equation' written onto Arduino Uno microcontrollers to handle absent patients from the queue in the form of a slot-back.' The developed device presented here is capable of electronically queuing patients for doctor consultations, allowing a doctor to send patients to the pharmacy or other units within the facility, allowing a doctor to slot-back an absent patient, and allowing the doctor to attend to other issues such as emergencies via the use of the 'busy' key.

Keywords: *Queue management, Medical facilities, Electronic queues, Patients, Calling system*

INTRODUCTION

Time is a non-renewable and continuous quantity. In many applications, any method that saves time and space is deemed essential because time and space is a valuable resource that must be efficiently managed. The waste of time and energy associated with queuing is unavoidable, and it is in this context that the presence of a microcomputer-based enhanced patient calling system becomes critical. Patients confront long lines and unexpected wait times on a regular basis, producing tension and worry among both patients and doctors, and resulting in a decrease in efficiency. Queuing, in general, is a line of people waiting to be served that moves from a central location to a specified location. As a result, a queue management system must deal with the establishment of a well-organized queue (Arun, 2013).

The present hospital facilities will continue to be strained as the population grows. Long lines will continue to be synonymous with visiting a hospital or other public service facility as a result of the cycle of inadequate facilities and associated personnel shortages. People must wait in line for as long as they require services (Hossain, 2011). Whether the problem is caused by a lack of staff, equipment, or the hospital's capacity is insufficient for the population served, it must be addressed. Long lines are an unwelcome and unneeded strain on both the public and hospital workers. Long lines are related with a bad perception of the hospital experience, although most people are unable to avoid being subjected to the current system (Aboaba, 2017).

Patients who come to see a doctor in a hospital must wait in a line in chronological order under the current system, which results in long lines and unpredictable wait times for patients. Patients change in their seats as one patient is attended to until it is their turn to meet the doctor. Their file is taken from storage and brought into the doctor's office as they go in for their appointment. In poor countries, this condition continues to persist (Hitwe, 2008).

This method of queue management causes stress, particularly for seriously ill patients and even facility staff involved in queue management. Patients are counted and the tally number is displayed on a screen when it is the time of the patients to consult with the doctor in advanced scenarios, and files are collected manually at the record office and then organized before the doctor (Bhupender, 2017). In a more advanced scenario, the electronic tallying and calling system is linked to the patients' electronic database, resulting in a called patient medical record appearing on the doctor's PC, where he reads and writes his observations and prescriptions before passing the record to the next location. However, all the aforementioned queue management systems do not take care of patients that are absent from the queue as at when called (absent queue) (Wakil, 2019).

One of the key flaws in the systems described above is the lack of a feature that allows patients to leave for urgent affairs while still remaining in line. Patients may require the use of restrooms, drink, or even meals, and in their absence, their turn may be reached (Basil, 2013). When they return, they may have to re-enter the queue from the beginning, which is extremely stressful. The solution is to build and deploy an upgraded patient calling system based on a microcontroller. It enables patients to be confident in their coordination in order to prevent long periods of waiting. Because of a slot back, patients will be able to go and do required things like go to the bathroom or acquire food and water because of a slot back feature that will put the patient back in the queue (Maun, 2011).

The following is a description of the proposed system's service scenario:

1. As each patient enters the Medical Centre, he or she will be issued a tally number.
2. Using a keypad, the administrator will enter the tally number into the system.
3. If the patient is called and is not there, he or she will be slotted back in.

We develop a microcontroller-based enhanced patient calling system in this research. After a patient has been phoned and confirmed absent, the system allows them to be called again at a later time. This helpful mechanism is designed to allow patients the opportunity to be contacted when their phone number has been called and they are not available.

There are various issues with the current medical center system. For starters, because there is no true system in place, patients can simply disorganize the queue. Patients have gotten into fights over who came first and who should see the doctor next. Workers must also be present in order to maintain calm and order. Patients must also change frequently until they reach their destination.

This is a difficulty for patients who are critically unwell. As patients leave to attend to urgent requirements, there is a risk that their turn will arrive and they will miss it, forcing them to rejoin the queue all over again (Ramasamy, 2013). The goal of this research is to build a microcontroller-based enhanced patient calling system in the Federal Polytechnic Mubi Clinic to eliminate disorderly waits, improve efficiency, and improve service quality, and to design a computerized patient calling system with pharmacy integration (Megalingan, 2009). A queue management system is a mechanism for organizing people in lines in a retail or government agency. It might be reactive, with a system that organizes the current line, or proactive, with a queue management statistics gathering system that identifies and anticipates patterns. People who join a standing line queue are either sent to the next available place by the system or given a ticket. Customers are taken out of the standing line queue with a ticketed system, which can provide comfort and reduce stress for customers while also ensuring that their turns are not overlooked. This queuing environment is a vital part of our daily lives, and manufacturers must create the most cost-effective queuing solution possible (Nasiruddin, 2016).
Figure 1 depicts the typical queuing management methods most commonly used in hospitals: queue card and smart queue. People in the queue are assigned numbers according to their arrival order when utilizing the queue card system. This strategy enables patients to manage their time by estimating the amount of time they have until their number is called. Going outside of the immediate neighborhood is always a risk. According to the number priority, the queue number may ensure service; however, a delay in returning may result in the loss of a queue place (Ngorsed, 2016).

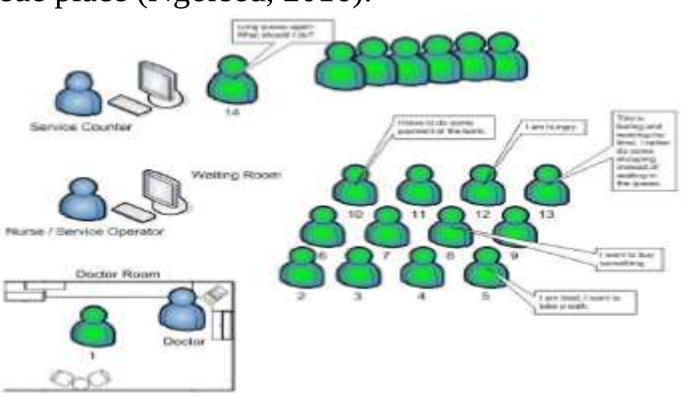

Fig. 1: Typical State Management Hospital Queue Management System

For their consumers, most private hospitals offer a sophisticated queue system, as well as helpdesks and counter services. On a progressive basis, the smart queuing system provides automatic queue numbers, automatic voice calling, and LED display panels. Patients must still assemble in the immediate vicinity to check the progress of queue numbers being handled under this technique. This service just eliminates the need to wait in a queue, but it does not address a more efficient way of utilizing time (Ngorsed, 2016).

Structured queues and unstructured queues are the two sorts of queuing. A structured queue is one in which the persons who are part of it are in a predictable place. This can be seen at supermarket checkout counters as well as other retail establishments such as banks and post offices. This form of queue system is commonly used to manage ticket ranking for a service that requires identification, allowing for stress-free waiting. Extending the range of options, some of this system's features include scheduled reception by appointment or rank allocation through smartphone or SMS (Nasiruddin, 2016).

Unstructured queues, on the other hand, occur when people form a line in unpredictable and varied locations and orientations. This is common in several types of retail, taxi lines, automated teller machine lines, and many other circumstances when demand is great. Rank allocation for service, pages or RFID badges, or simply reading the customer card are some of the present alternatives. In fact, successfully implementing a method of arranging these queues is difficult. The reason for this is that human behavior is difficult to predict (Nasiruddin, 2016).

The design of a stand-alone queuing system is based on the first come first serve queue concept, with only one service counter. At a single counter, all clients will be served. Customers will be treated equitably by this method, which works by calling or displaying numbers in a sequential or randomized manner (Mohammed, 2015).

In a stand-alone queue system, just one counter is active. For the single service operation, all customers will be managed at the same counter. The first in first out queue model was used. The notion of first come, first served will ensure that all customers are treated fairly. In a single department, service operation environment such as a clinic, the stand-alone queuing system is performing well.

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Fig. 2: Stand-Alone Queue System (Wong, 2008)

Additional service counters are introduced to give flexibility to the queue system process in an advanced queue system based on freestanding queuing design. Up to 32 service counters and an extra 60 counters can be accommodated by this system. It can also provide important queuing functions and detailed reports. It also provides for real-time monitoring status management for queue management analysis. In a bank, a hospital, or any other institution with several departments, an advanced queuing system works well (Mucsi, 2011).

Fig. 3: Advance Queue System (Wong, 2008)

The goals of this design are to determine the average consultation time, time spent on some critical activities that patients may need to complete, and distances between important locations for patients in order to design a slot-back for absent patients and include a priority scheme in the calling system. The pharmacist will also be involved in the development of the improved patient calling system. This research is significant because the Enhanced Patient Calling System will aid in the formation of orderly lineups, which will save time for patients who are waiting.

Patients who need to attend to urgent matters will eventually be able to use the slot back feature if their turn comes up while they are away. Another benefit of the calling system is that it will prevent situations where one doctor is inundated with patients while another is idle. Finally, the technology will aid to accelerate the queue and ensure orderliness among the waiting patients.

MATERIALS AND METHODS

The Arduino Uno, Numeric key pad, Liquid crystal display, control switch, and electric transformer are the major components used in the design and execution of a microcontroller-based enhanced patient calling system.

Arduino Uno

The ATmega328P-based Arduino Uno is a tiny, comprehensive, and breadboard-friendly board. It has the same connectivity and specifications as the Arduino Uno board, but in a smaller package. It's our system's brain, and it'll take commands from the keypad and send a signal to the doctor and drugstore. The sound recognition module provides 5 volts to the Arduino Uno, which it uses to operate. We chose Arduino Nano since it is a microcontroller with a user-friendly interface. As a result, unlike the 555timer, it does not necessitate any calculations (Analog).

Fig. 4: Arduino Uno

Fig. 5: Numeric Keypad

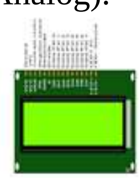

Fig. 6 Liquid Crystal Display

Fig. 7 Control switch and push button

Fig. 8 Transformer

Numeric Key

A numeric keypad is a block or pad of buttons that display digits, symbols, or alphabetical letters. Numeric keypads are numbers-only pads that are used with computers. Calculators, television remotes, push-button telephones, vending machines, Point of Sale devices, combination locks, and digital door locks are all examples of equipment with keypads.

Liquid Crystal Display

A liquid crystal display screen is a type of electrical display that has a wide range of uses. A 16 x 2 LCD is a simple module that can be found in a wide range of devices and circuits. Seven-segment LEDs and other multi-segment LEDs are chosen over the modules. (Amrita, 2010).

Switch

The switch or push button is the most basic input. The push button was employed in this experiment because it can work with just one additional support component, such as a pull-up resistor. When the switch is flipped on, the circuit's output voltage is raised to +5V via the resistor. As a result, there is no voltage loss, and the output voltage must equal (+5V) the source voltage. The output is linked directly to 0V when the switch is closed, preventing the supply voltage from being shorted to ground.

Transformer

This device is powered by a transformer and a voltage regulator. A transformer is a passive electrical device that transmits electrical energy between two or more electrical circuits. A changing current in any one transformer coil causes a changing magnetic flux in the core, which causes a changing electromotive force across all other coils coiled around the same core. Without a metallic link between the two circuits, electrical energy can be moved between them.

RESULTS AND DISCUSSION

A transformer and a voltage regulator provide electricity to this gadget. A transformer is a type of passive electrical device that transfers electrical energy between two or more circuits. A change in current in any transformer coil generates a change in magnetic flux in the core, which induces a change in electromotive force across all other transformer coils coiled around the same core. Electrical energy can be transferred between the two circuits without the use of a metallic link. Switch C is pressed if the patient requires medication, and his or her card number is sent to the pharmacy. Switch D is pressed while the Doctor is busy or attending immersion, displaying 'Doctor Busy' on the screen outside the consulting room. If the current patient is free to go home, the doctor simply presses switch A to call the next patient.

Fig. 9: Fully implemented system

CONCLUSION

The goal was to create a more efficient and dependable patient calling system, which was completed successfully at the end of the design and construction phase. The option to slot back a missing patient is one feature that contributes to the product's distinctiveness. The system was put to the test and found to be performing as expected. It is a model for a low-cost, dependable method of controlling lineups in public locations, but its execution is based on data from the Federal Polytechnic Mubi Medical Centre.

RECOMMENDATIONS

1. A GSM modem could be installed, which would send an SMS alerting an absent patient and informing him of the estimated time he would be called again.
2. The improved patient calling system shown here might be expanded as a model to incorporate more consultation rooms, laboratory tests, radiology units, wards, and any other parts to which a doctor might direct a patient.
3. The improved patient calling system might be developed to connect to a computer system that is linked to the hospital database.
4. Implementation of an intelligent queue management system that learns the hospital's queuing pattern and determines high and low activity periods, providing Hospital Management with the information they need to attack and plan ahead of time. Furthermore, by utilizing the cloud, the IQMS can learn more from other IQMSs in order to improve its performance.
5. It might be adapted to other locations where queue management is required, such as banks, restaurants, and so on.

6. Finally, the usage of this gadget in our hospitals should be encouraged in order to promote order and efficiency.

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