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AUTOMATED QUEUING AND SCHEDULING SYSTEM (AUCHI POLYTECHNIC LIBRARY)

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ABSTRACT

Despite the importance of automated queuing systems on organizational performance as evidenced by human resource management literature, academics have given little attention to queuing entities held by higher institutions, particularly in Nigeria. Studies have found conflicting conclusions about the relationship between automated queuing systems and organizational effectiveness, necessitating the need for more research to fill in the gaps. Automated queuing and scheduling system is a web-based queuing system that allows students to join a virtual queue and schedule appointments with service providers as needed. It aids service providers or managers in organizing the flow of students in a crowded business or workplace. Again, automated queue management system is a system that helps service provider to manage student in efficient way. The system can ease the student flow management which is useful for manager of the service provider. This study looked at existing queuing models and created a template based on the unique needs of the service region (Auchi Polytechnic Library). For all connected components of this study, web approaches will be used. Students will be able to join a virtual line utilizing a mobile application, the virtual queue website, or a kiosk terminal at the service area. The virtual queue will be presented in the service area via digital signage.

Keywords: Automated Queuing,Scheduling System**,** Library, Kiosk Terminal

1. INTRODUCTION

A queue management system is a mechanism for organizing people in lines in a retail or government agency. It can be reactive, with a system that organizes the current queue, or proactive, with a queue management statistic gathering system that identifies and anticipates trends. People who join a standing line queue are either directed to the next available position by the system or given a ticket. Students are taken out of the standing line queue with a ticketed system, which can provide comfort and reduce stress for students while also ensuring that their turns are not overlooked. This queuing environment is an important part of our daily lives, and manufacturers must create the most cost-effective queuing solution possible.

Long lines are a problem for student service-oriented businesses these days. These issues were common in banks, post offices, and airports, and they grew worse as the clock approached peak hour. Students and employees will be tense and stressed as a result of poor queue management. Students will tend to switch to other service providers that offer better services, lowering employee work satisfaction. "A student is four times more likely to defecate to a competitor if the problem is service related than price or product related," according to Bain & Company net, a global management consulting firm. Furthermore, according to Lee Resources International online, a general business consulting firm, "for every student complaint, there are another 26 unsatisfied consumers who have remained silent." As a result, in order to attract clients and maintain a profitable business, any company must give excellent service.

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 efficiently handle and coordinate queue creation. Nigerian colleges currently have a large number of students and a high demand for services in their various departments and/or offices. Admission inquiries and requests for assistance during the application process for prospective students, course registration for admitted students, finance and tuition services, library services, and departmental services such as clearance, registration, and submission of files are all examples of these services. Though there are many more of these types of activities within institutions, these are some of the most important ones in any higher education institution. These services are frequently time-limited, and a large number of pupils seek them in large numbers. The management of students and users of these services is typically done by hand, which often leads to chaos as some students try to beat the queue by any means necessary in order to be seen first.

The need for inventive solutions using an Information System comes to mind when dealing with situations like these. These issues could be solved by using computer techniques that include queuing and scheduling capabilities. Students would be able to join a virtual queue on their websites, mobile phone apps, and at a kiosk at the service provider's location in any of the offices where services are needed. Both the learner and the service provider will be able to track their progress and see when it is their turn to be seen. The mechanism will simply enforce the idea of "first come, first served." Students will be able to join a virtual queue while attending lectures or from their homes, estimating when it will be their turn to be attended to. They will be able to organize their time depending on the average wait time for the service using this information.

Many companies offer queue management systems for controlling crowds of people in a queuing area in a variety of conditions and places. For a limited space and a basic movement, the majority of the approaches are done manually. Automated queue management systems, on the other hand, deal with a wider space and a more complex flow. These can be found at a variety of places, including banks, hospitals, clinics, and post offices. A Microcontroller Based Electronic Queue Control System was designed by Bylayat, Nahid, Moqbull, and Habibur (2011). The goal of those systems is to keep a queue in order and efficiently. EQC system-1 and EQC system-2 are two different queue control systems that have been implemented with slightly different queue control systems that have been implemented with slightly different features in the research. EQC system-1 displays token number and service counter number, whereas EQC system-2 displays token number separately in each service counter with separate displays.

The designed system's fundamentals are comparable to those that are often used in queuing areas nowadays. Students have the option of being processed by more than one service point, and service points can handle many client classes. The system, on the other hand, is unable to connect to the number of clients at any one time. When there are few students in the waiting area and when there are many students in the waiting area, the system cannot change and remain the same.

2. PROBLEM STATEMENT

In Auchi Polytechnic, there are over five thousand students. Various Academic departments, Libraries, Heath Centre, Student affairs, Security Unit, Bursary are overcrowded by students/users seeking for one or more services. The students are queued manually and physically while waiting for their turns in a simple flow. In most cases, few of the students find a way to jump the queue. This, they do by getting some members of staff to pass in their request at the expense of other students who might have been in thequeue, waiting.To eliminate these issues, it is proposed that this virtual queuing system be implemented to have effective service delivery to our teaming users while allowing users to manage their time as well as bringing equity to all.This system is tailored towards resolving the Auchi Polytechnic Library peculiarities. However, with few modifications, it can be implemented in any other departments/units of the Polytechnic where queue and crowd management is required.

3. OBJECTIVES

The aim of this research is to design a working system for queuing management that meets the requirements of Auchi Polytechnic Libraryand solving the queuing problems.

- Investigate the existing systems bycomparing and contrasting with the conventional physical queuing management.
- Evaluate the system for effectiveness.
- Enforce a seamless crowd management
- Improve service delivery

4. LITERATURE REVIEW

A queue management system is the arrangement of people in a particular order so as to get service delivery.Automated queuing and scheduling management system is a two-component design that allows users to join a queue online and also schedule an appointment prior to the service period. It uses a set of queuing and scheduling algorithm geared towards controlling clienteles flow and streamlining the queuing experience(Tšernov, 2020).It affords the service providers the ability to manage crowd since there would be no need for the conventional queue (physical queue). The problem with the conventional one arises when the influx of clienteles exceeds the capabilities of employees. The fewer service clerks there are, the smaller the crowd they can manage (Tšernov, 2020). Queue management technologies are required in service areas where there are queues.By using the appropriate scheduling algorithm,he scheduling modulewill analyze which student to be served based on the type of service demand and the availability of a service clerk at the service counter, and then order the next clientele in. What exactly is a queue?

According to Geeksforgeeks(2020) an online website,a Queue is a linear structure which follows a particular order in which the operations are performed. Aside from the physical techniques of using barrier and signage to control queues, there are different models for queuing theories such as Single Queue (SQ), Multiple Queue (MQ), and Diffuse Queue (DQ) (Al-Jumaily, & Al-Jobori, 2011).In the**SQ**, the clientele waits until the service counter is ready to attend to him/her. In the **MQ**, the clientele chooses the shortest queue from the multiple queues, while in the **DQ**model; each clientele takes a ticket from a ticket machine with single or multiple buttons each for specific service. After the clientele registers his/her place in the queue using a ticket, he/she will monitor the ticket number assigned. The clientelescannot estimate when they will be served.

There are two types of queues, which are structured and unstructured queues. Structured queue is a queue in a fixed form and people that included are in predictable position. We can see this at supermarket paying counter and some other retail locations such as banks and post offices. This type of queue systems often being set up to manage ticket ranking for a service with identification and thus enable a stress-free waiting (Al-Jumaily, A. S., & Al-Jobori, H. K., 2011). Extending the different possibilities, some of this system is planned reception by appointment or remotely rank allocation on Smartphone or through SMS.

According to Agyei, W., Asare-Darko, C., & Odilon, F. (2015), queuing management system gives benefits either to student service provider or to the student itself. The benefits can be directly or indirectly to the system. There are:

- Keeps track and forecast the flow of students.
- Optimum utilization of staff forecast.
- Constant monitoring the staff's performance.
- Enhance productivity and morale of the staff, as operation were efficient and systematic.
- Gives flexibility in dealing with students.
- Increase service reliability, as students are treated fairly and efficient.
- Producing statistical reports, which facilitate top management's decision-making process.

Others queue concepts are First Come First Serve (FCFS), Shortest Process First (SPF), and Head of Queue (HQ) (Uddin, Nasir, & Ahmed, 2015).Various related literature indicate the need for the combination of these different techniques to make a robust system that can automatically switch between different algorithms to determine queue process depending on the service time, service type, service position or level etc., However, the 'first in first out' (FIFO) principle gives sense of transparency and equity in queuing management. These and many more issues will be evaluated in this research.

5. METHODOLOGY

Tertiary Institutions have been one of the major units of the public for the past years. Many researchers try to develop new technology in order to increase student satisfaction. Thus, active research should be focuses on analysing the queues to optimize their operations, which student's waiting time can be reduced. In this research paper, an automated queue control system has been developed in Auchi Polytechnic for organizing queue in banking for a low-cost and efficient way. The system can analyse the queue status and take decision which student to serve, as the factor of the average waiting time is taken into consideration. Desk research was carried out to enable a robust evaluation of the existing systems, while onsite interviews were conducted to understand the conventional approaches of the use case in queue management.From the outcome,suitable system analysis and designprocedures as elucidated in the results and discussion were adopted to deliver a complete effective queuing management system for the use case. The interview data was subjected to thematic content analyses for interpretation. Based on the findings, a system with intuitive user interface was developed. Thereafter, simulation experiments were carried out on the new system developed.

5.1 RESULTS AND DISCUSSIONS

a. Analysis on Input Module

i. Push Button: There are total of six push buttons used for connecting the Galileo. The pins used are digital pin 2 to digital pin 7. Push buttons for digital pin 2, 3 and 4 used for collecting data from students. They will choose either service A, B or C. In contrast, push buttons for digital pin 5, 6 and 7 are place at the service counter. Teller will use it to call for next student to provide require service. The way a push button works with Galileo is that when the button is pushed, the voltage will go Low, which in turn Galileo read this and reacts accordingly. A pull-up resistor is use to keep the voltage HIGH when the push button is not being press. In other words, a small amount of current is following between VCC and the input pin (not ground). thus, the input pin reads close to VCC.

ii. DS1307 RTC Module:The DS1307 RTC module works very well in keeping the time. However, the external temperature can affect the frequency of the oscillator circuit, which drives the DS1307's internal counter. This may sound like a problem; however, it usually results with the clock being off by a round five or so minutes per month. Besidesthat, proper ventilation is use for the container in this project.

b. **Analysis on Output Module**

i. LCD: A standard 16x2 LCD is use but using just two pins. The way it can achieve by the PCF8574, an I/O expander that communicates with Galileo by 12C. With this IC, two ports of Galileo can control up to eight digital I/O ports. In the 12C protocol, each IC has different address. In this project, first four of the address is use as there are four different LCDs used.

ii. Buzzer A piezo buzzer will makes a small "click" when voltage is applying to it. If the voltage is turn on and off hundreds of times per second, the piezo buzzer will produce a tone. Then, if a bunch of tones is string together, it will produce a music. Simple music will ring when a service counter calls a student.

c. **Algorithm Development**

i. Rule Based System Rule based system is a system. which problems can be written in the form of IF-THEN rules? The problem is usually is not large. If there are too many rules, the © 2016 Global Journals Inc. (US) 35Global Journal of Management and Business Research Volume XVI Issue I Version I Year () A 2016 Automated Queue Management System can become difficult to maintain and can suffer a performance hit. In this project, there are three rules will be looking at before deciding which one will be implemented in the system. There are:1) Rule 1: All service counters are multipurpose type. 2) Rule 2: Service counter 1 only for student choosing Service-A. 3) Rule 3: Each service has one service counter. In addition, two parameters set for all the rules, which are Service-A, B and C have duration to complete 60sec, 120sec and 180sec respectively. The second parameter is that student is assume to follow this arrangement: "student-A student-B student-C student-A student-B student-C…"

ii. Queuing System Model This part presents a different technique for queue management system in banks proposed by Ahmed and Huda (2011). The technique can build an automated queue control system by using the DQ concept. To select the next student to be serve during a specific period, the system chooses and appropriate algorithm among more than one scheduling algorithm, which are FCFS and SPF. Moreover, to achieve the best waiting time for all the students that are waiting to be serve, it is depend on the testing result for selecting the scheduling algorithm. To achieve this, additional components to the traditional queue management system are need.

iii. iii. Result Analysis: To test the performance of the new proposed system, several simulations were carried. A randomized generated number is use to generate a sequence of student's arrival time and option of services that they can choose. The different services are open an account, transaction and balance with the period of each service which are 15, 10 and 5 minutes respectively. In this proposed system, two scheduling algorithm are used which are FCFS and SPF. Differs to the ordinary system (FCFS) which is usually being use in the most of the banks queuing system. The proposed system will test the queuing system using testing algorithm every specific period, consider in this research to be 15 minutes. Then, make comparison of the results of waiting time and average waiting time. The results shown in figure 5.1 and figure 5.2 respectively.

Fig. 5.1: Ordinary Queuing System Gantt chart

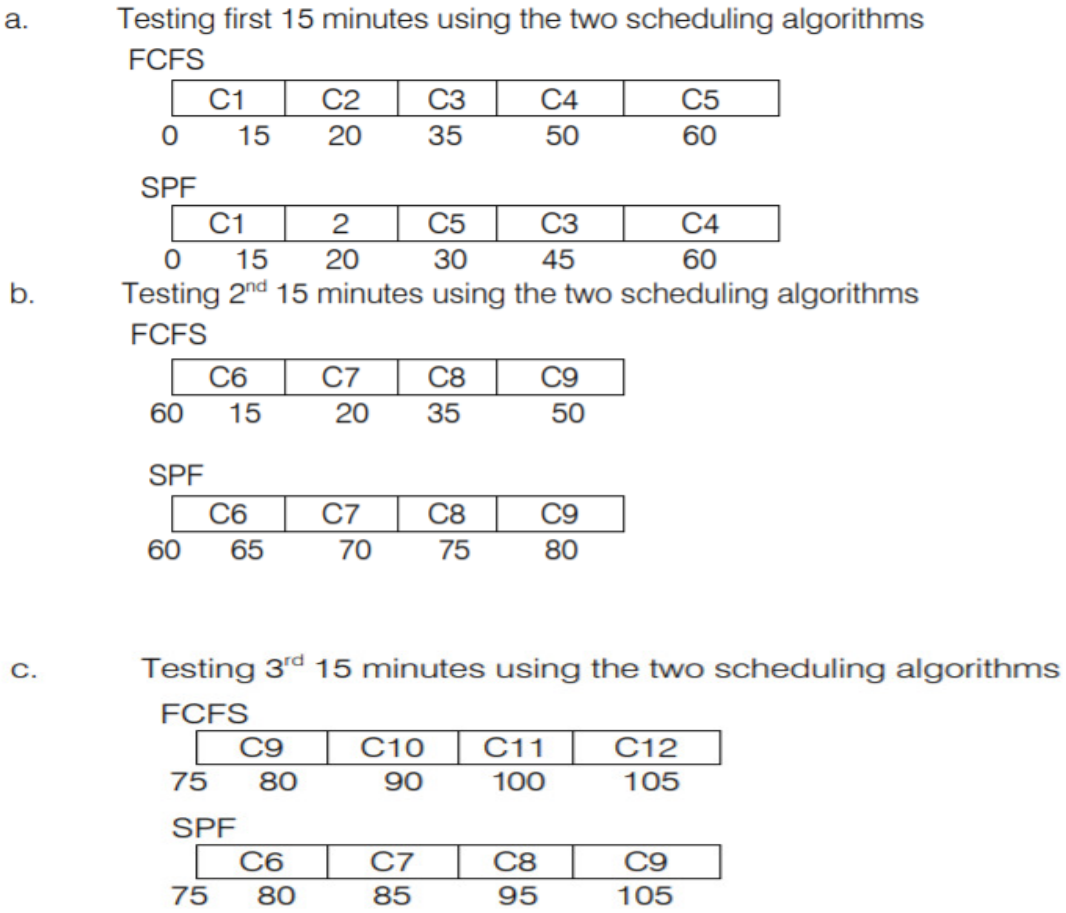

Fig. 5.2: The New Queuing System Gantt chart (a, b, c,d)

The primary purpose of the numerous experiments is to determine the new queuing system's potential to compete with the traditional queuing system. Figure 5.2 demonstrates that the new technique reduces average waiting times when compared to the traditional queuing system, and Table 5.1 displays the average waiting times for the traditional and new queuing systems for the students.

Table 5.1: The Average Waiting Time Comparison between the Ordinary Queuing System and the New Queuing System

Time Slice	Average Waiting Time and Algorithm (Ordinary Queuing System)	Average Waiting Time and Algorithm (New Queuing System)	Difference the between Ordinary and New Algorithm
1st Group	16.4/FCFS	14.4/SPF	2
2nd Group	42.5/FCFS	42.5/FCFS	0
3rd Group	47/FCFS	43.66/SPF	3034
Total Average Waiting Time	32.75	31.083	1.667

Equation 1 used to calculate the waiting time for each student and Equation 2 used to calculate the average waiting time for each group of students (Willin, 1999).

$$CWT\ I = SSTC\ I - ATC\ I$$

Where:
CWT is a Customer Waiting Time
SSTC is a Start Serving Time for a Customer
ATC is Arrival Time for a Customer
I is the number of customer

$$AWT = (\Sigma CWT\ i)/TN$$

Where:
AWT is Average Waiting Time
CWT is a Customer Waiting Time
TN is total number of customer served
i is the number of customer

6. CONCLUSION AND RECOMMENDATION

a. Conclusion:The design and development of an Automated Queue Management System begins with a thorough understanding of the queue system itself, which is critical for broadening one's horizons. Then, as guidelines for completing this project, the consideration of the control strategy and component to be used is critical. In addition, a number of publications were examined in order to learn more about the current approaches to queue management systems. Although current approaches have proven to make life easier for service providers and provide benefits, there is still room for improvement in order for a queue system to function effectively.

b. Limitation: The queuing theory's assumptions may be too limited to accurately reflect real-world events. While it comes to mathematical models, certain assumptions are frequently made, such as an endless number of clients, limitless queue capacity, or constant inter-arrival or service times (for the same service type), when it is clear that these boundaries do not exist in reality. To put it another way, the theoretical answer might not be useful because it isn't sufficiently informative.

c. **Recommendation:**Some enhancements are possible, such as the addition of camera sensors that can detect clients at a specific moment. This strategy can improve the effectiveness of a queuing system by alerting the manager and allowing them to react quickly to the issue. Finally, the system might be developed into a product, despite the fact that this project was created just for the purpose of research and learning.

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