An IoT Android App-Based Queue System using ESP32

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Abstract—Queue management system is generally used to enhance quality and free-flowing service by any Administration to its Subjects/clients. This Journal/paper proposes a simple, cost-effective, and time-saving queue management system, through an IoT approach using ESP32 to communicate (Receive or send) information from the Client sending queue request to the Admin to the Admin updating the live queue system from anywhere around the world due to its Wi-Fi functionality. The Client uses an android app developed for requesting queue number, live status of the line, and to get a reminder when it's close to your turn. The proposed system improves efficiency and client satisfaction with a minimal amount of hardware involved.

Keywords— *Queue management system, Android App, ESP32, I.O.T.*

I. INTRODUCTION

Nowadays, customer service-oriented businesses and most public services such as banks, polling units, schools, clinics/hospitals, airports, etc., where customers are always available in abundance seeking services, are faced with the challenges caused by a lengthy queue and with the rapid population growth of the 21st century, the lines are always going to keep increasing. Coupled with the novel Covid-19 pandemic, the crowd caused by such long lines is not only exhausting and non-productive but also dangerous to people's well-being. Therefore, congestion is highly not recommended, which is the norm at the gates of banks, hospitals, etc. today in Nigeria.

Improper management of these queues results in stress, the tension between the customers and the employees, and an increase in COVID 19 cases, in which case, the customers tend to shift to other service providers who can manage customers better and provide better services [1]. This is shown by statistical analysis in [2] that a customer is four times more likely to move to a competitor if the problem with a service provider is service-related than price-related. Furthermore, [3] opined that for every complaint made by a customer, 26 other customers are having the same complaint but have remained quiet about it. Thus, service-providing organizations need to deliver efficient queue management and excellent services to sustain their businesses. Therefore, most efficiently, a queue management system must be in place to organize and maintain queue formations.

The system is an I.O.T. based machine using ESP32 to receive and send live queue information wirelessly with a reminder before your turn. This makes a simple

II. LITERATURE REVIEW

A. *Types of Queue Systems*

- Paper-based queue management systems are one of the most common/conventional methods. It requires the customer to pick a ticket at the entrance and wait for the counter to call upon the specified token number, which was mostly used to organize queues in the banking sector of Nigeria [8]. Though the system helps in the organization of long lines it, however, does not provide both convenience and crowed control, couple that with the continuous paper rolls being bought for ticket printing continuously as complained in [1], it only increases the recurrent expenditure, and therefore making this system a trend that would soon be obsolete due to the emergence many communication and technological advancement such as the internet of things(IoT).
- Paperless queue machines are implemented in different ways since there all automated. This system already has the advantage of reducing costs over the paper-based device. The IoT approach has been used by [1] & [4] to communicate the information sent from the machine and the user to the internet for seamless human queue management, and [2] uses the same approach but to manage RFID logistics monitoring. [1] and [3] use SMS messages to communicate ticket number to the customer with another SMS reminder when it's close to their turn. But [5] developed a queueing algorithm that can analyze the queue status and make a decision on which customer is to be served first based on the average waiting using two different control systems applicable to the banking sector.

B. *E-services Queue Management Technique*

E-services are an excellent alternative to the traditional queuing system where people stand in a line and wait for their turns to get served. With the e-service, the number of people queuing is significantly reducing, as customers get serviced electronically. However, not all types of services can be delivered using the e-services, because, for example, customers still need to go to offices in person to renew their I.D. cards or passports, etc. [6] presents an efficient way to manage the queue at customer service offices through the

development of a paperless queue management system based on Arduino Nano, which consists of a processing unit that interfaces with a liquid crystal display (L.C. D) screen. Furthermore, as in [7], the processing unit is also linked to a GSM module, and therefore paper tickets can be replaced with SMS tickets. With the SMS ticketing technique, reminders can be sent to customers, resulting in a significant reduction in the length of queues. The detailed functionality of the proposed system can be found in [7].

Arduino is an open-source and easy-to-use platform for prototyping hardware and software. A typical Arduino board contains a microcontroller that is controlled using the programming language of Arduino, which is based on C++. Arduino device families such as Arduino Nano, Arduino Mega, Arduino Due, and Lilypad Arduino, are available. Because of their simplicity, low development costs, and multi-platform support, Arduino boards are now widely used in various applications, such as digital sound processing, automated control systems, motor drives, and learning tools, among others [5].

C. Other Queue Management Techniques

Various queue management techniques exist, and they are mostly physical barriers, signage and signaling systems, and automatic queue measurement systems [4]. Physical barriers are used to guide queue formations and to organize it. The signage and signaling systems are used to provide information to people in queues so as to have efficient queue formation flow as well as to set service expectations. While the above queue measurement systems involve manual processes, the automatic queue measurement system uses technologies, which predicts and measures lengths of queues and waiting times, thus providing management information to help service levels and resource deployment.

D. Algorithm Development

A rule-based system is a system. Which problems can be written in the form of IF-THEN rules. The problem is usually small. If too many IF-THEN rules, the system becomes harder to maintain and can have a dip in performance. In this Algorithm, there are three rules will be looking at before deciding which one will be implemented in the system among the three tested methods, we are able to choose the one with the least time consuming to finish all the customers, and thus the rule will be used throughout this project.

E. Queuing System Model

This model presents a different technique for the queue management system in banks proposed by [1]. The method develops a control system that automates the queue using the D.Q. Concept. This selects the next point on the string to serve for a determined time interval. The system selects an appropriate algorithm among more than one scheduling algorithm, which are FCFS and SPF (Short Estimated Processing Time First).

F. Easting Queue Management System

There are other products available in the market for delivering optimum customer service, which includes the Stand-Alone Queue System, the Advanced Queue System, and the Centralized Control Queue System [12].

G. Stand Alone Queue System

The Stand-Alone Queue System (SAQS), as shown in Figs. 1 and 2, is also designed based on First Come First Serve. Unlike the FCFS queue model, where there is only one service counter operation, and all customers are managed at a single counter. This system (SAQS) operates by calling or displaying numbers in sequential or random order, and the customers feel fairly treated. The SAQS is performing well in a single department service operation environment such as a clinic

FIGURE 1: STAND ALONE QUEUE SYSTEM

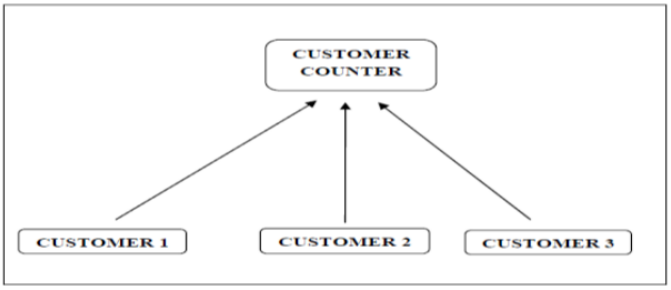


FIGURE 2: OPERATIONS OF STAND-ALONE QUEUE SYSTEM

H. Centralized Control Queue System:

The centralized control queue system is a high-end server-based queue system. It can support more than 20 departments where each department is having different services and several counters up to 32 turns and 60 counters. The system is compatible in a network where each department located at other buildings can be connected through LAN or the internet. The centralized control queue system is more to an internet-based connection rather than a stable wireless connection in a standalone queue system or advanced queue system [5].

FIGURE 3: CENTRALIZE QUEUE SYSTEM

I. Advance Queue System :

Advance Queue System (A.Q.S.), shown in Fig. 4, is based on SAQS design where additional service counters are added to give flexibility in the queue system process. This system can support up to 32 service counters with an addition of up to 60 more counters [6]. It also can provide useful queue features as well as comprehensive reports. Furthermore, it allows real-time monitoring for the queue management analysis. A.Q.S. is performing well in banks, hospitals, and any organization that has multiple department service operations.

FIGURE 4: ADVANCE QUEUE SYSTEM

In the advance queue system, a large number of customers can be supported, and various services are applicable, as illustrated in Fig. 5. A different customer coming for other purposes can be recognized and called to the proper counter accordingly.

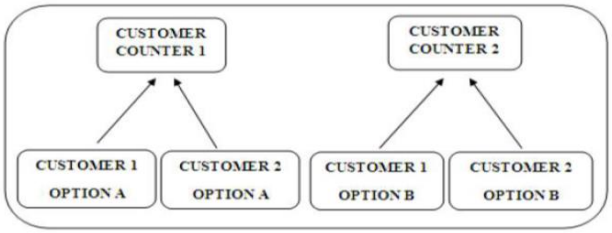


FIGURE 5: OPERATION OF ADVANCE QUEUE SYSTEM

III. PROPOSED METHOD

In this research, a prototype was considered for a small clinic/hospital to utilize an appointment-based system without the development of congestion, as is common in Nigerian hospital appointments. This system aims to provide booking and live feed of the queue via an Android App on your phone.

Based on cost consideration and simplicity for a minimal amount of hardware, the system was broken into three main parts as follows:

A. Client-Side/User interface

The User interface was created using an ionic framework for mobile phone app development.

The client-side initiates the customer to input his mobile number for first-time users to keep the information, select which Doctor he wants to see, check free space in the queue, then book the open room, then go about his/her business. The Android app user interface link to the server for information updates. Below is the Flow Chart for the system and the connection.

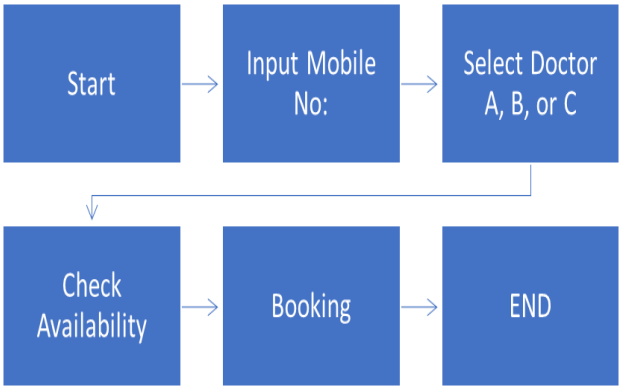


FIGURE 6: ANDROID APP USER INTERFACE FLOW CHART

B. Server Side

This site was published on MySQL webserver on private hosting.

The system stores the mobile number and generates a ticket assigned to that number, while the interface provides the Client the live view of the queue. A sample of the Flow chart is provided below:

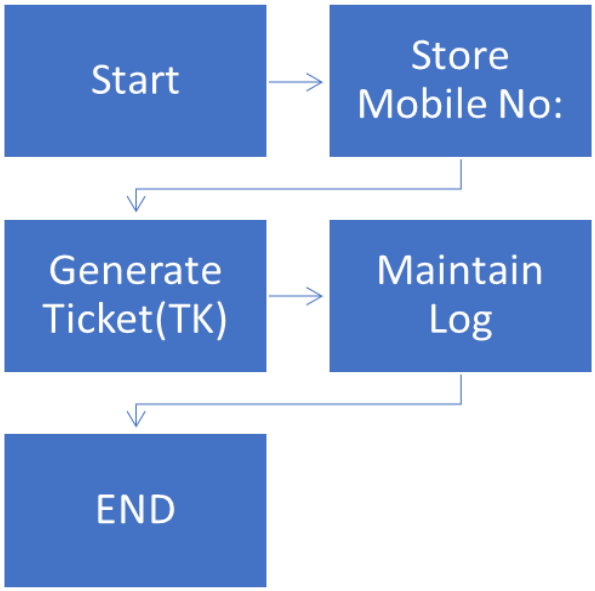


FIGURE 7: SERVER FLOW CHART

C. *Admin/Counter Side*

The side of the Doctor needed something simple for increment the number and reducing the queue on the status updated on the server using three switch buttons and 3 ESP32 devices for separate Doctors, as shown in Fig. 9. It provides control to call the next person on the queue and the system to monitor and update. Below is the Flowchart of the system

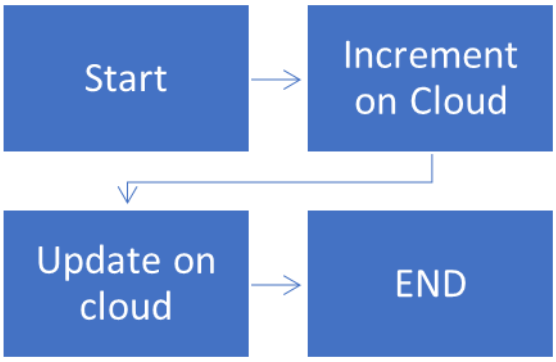


FIGURE 8: ADMIN SIDE FLOW CHART

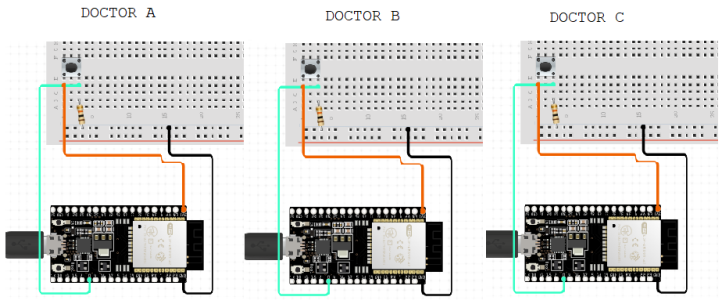


FIGURE 9: COUNTER BUTTON FOR 3 QUEUES

IV. PROJECT OUTCOME

The project produced a working prototype which revolves mostly on the mobile App as the primary interface for clients/customers, the view of progress on the server, and the Admin part with the Entire system as shown below:

1) The android Application operates well. This is where the customer enters his name and phone number once, after which the system will keep his record in order to serve clients better and becomes the medium he will receive a reminder for a ticket.

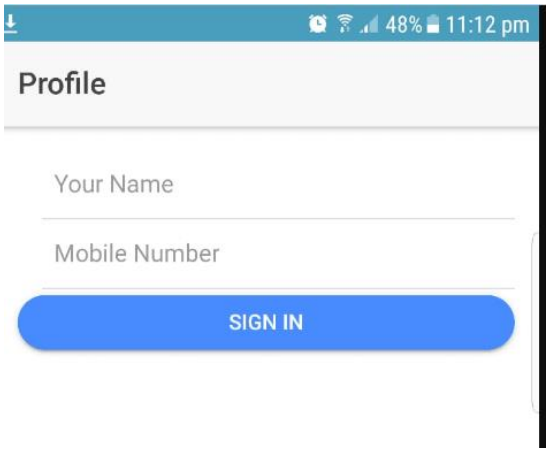


FIGURE 10: ANDROID APP SIGN IN

2) After which, You will select The Queue/Doctor you want to consult and book the available space, as seen below.

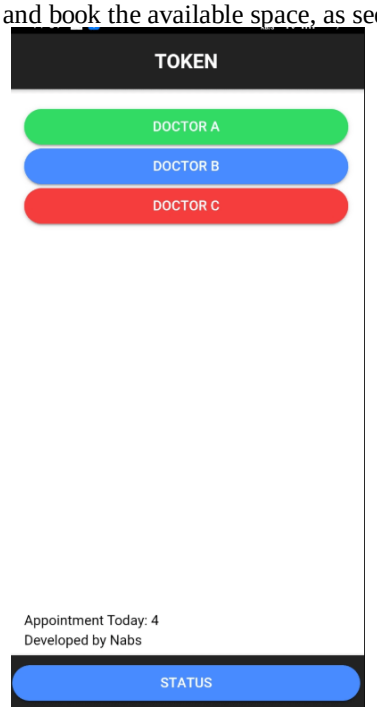
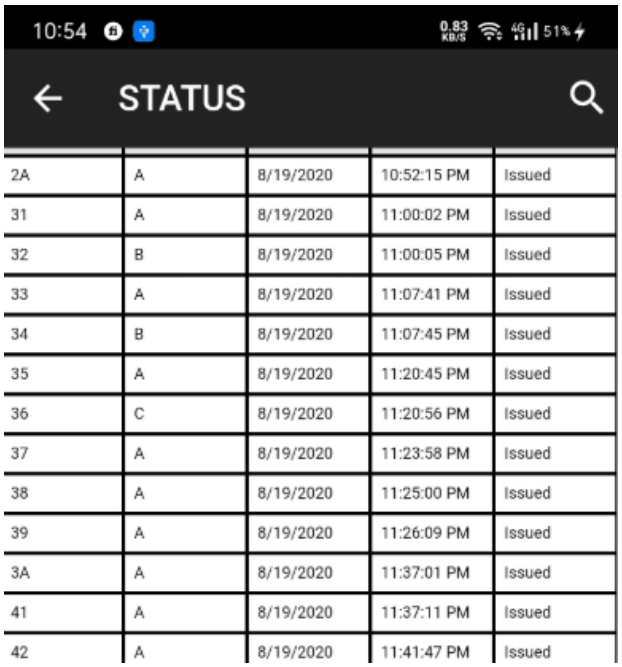


FIGURE 11: SELECT DOCTOR

3) Queue status can be viewed from anywhere for convenience, as shown in Fig. 12.



2A	A	8/19/2020	10:52:15 PM	Issued
31	A	8/19/2020	11:00:02 PM	Issued
32	B	8/19/2020	11:00:05 PM	Issued
33	A	8/19/2020	11:07:41 PM	Issued
34	B	8/19/2020	11:07:45 PM	Issued
35	A	8/19/2020	11:20:45 PM	Issued
36	C	8/19/2020	11:20:56 PM	Issued
37	A	8/19/2020	11:23:58 PM	Issued
38	A	8/19/2020	11:25:00 PM	Issued
39	A	8/19/2020	11:26:09 PM	Issued
3A	A	8/19/2020	11:37:01 PM	Issued
41	A	8/19/2020	11:37:11 PM	Issued
42	A	8/19/2020	11:41:47 PM	Issued

FIGURE 12: LIVE STATUS OF QUEUE

4) A reminder is sent to you when it is close to your turn, seen below in Fig. 13, while the live Server logs are presented in Fig. 14.

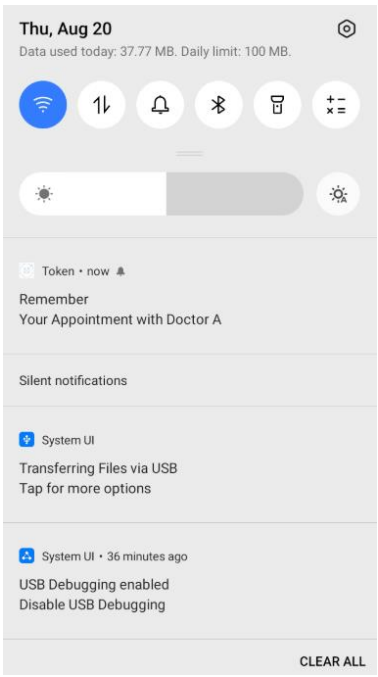


FIGURE 13: REMINDER ALERT

sno	ap_id	mobile_number	status	ap_date	time	doctor
48	48	03402068903	processed	2020-08-19	17:04:43	A
49	49	03402068903	processed	2020-08-19	17:19:51	A
50	4	03402068903	processed	2020-08-19	17:21:05	A
51	51	03402068903	processed	2020-08-19	17:22:22	A
52	52	03402068903	processed	2020-08-19	18:00:52	A
53	53	03402068903	issued	2020-08-19	18:01:51	A
54	54	03402068903	processed	2020-08-20	10:24:16	A
55	55	03122374750	processed	2020-08-20	12:13:22	A
56	56	03122374750	processed	2020-08-20	12:14:17	A
57	57	03122374750	processed	2020-08-20	12:20:50	A
58	58	03122374750	processed	2020-08-20	12:26:57	A
59	59	03122374750	processed	2020-08-20	12:42:52	A
60	60	03122374750	processing	2020-08-20	12:59:14	A
61	61	03122374750	issued	2020-08-20	13:01:36	A
62	62	03122374750	issued	2020-08-20	13:36:53	A

Figure 14: ADMIN SERVER VIEW

CONCLUSION

The system works as shown, but there should be a casing for ESP32 with the switch button. Furthermore, the system can have an estimated 30 minutes reminder before your turn based on the average time it takes for a specified task to be done. Therefore a person can choose when to be reminded for the system to be able to serve him better.

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