A Secured Medical Booking System Using Qr-Code Authentication

Aderibigbe Ayodeji Azeez[1], Aminat Ajibola[2], Musa. M. Yahaya[3]

Department of Computer Science, University of Abuja, FCT-Abuja, Nigeria[1, 2, 3]

Corresponding Author's Email: cayodey@gmail.com

ABSTRACT

In recent times due to the ever-increasing fast pace of life the number of missed appointments in medical institutions in Nigeria has caused problems, hence the need for a web based healthcare platform to intervene and provide seamless care for patients. Medical appointment scheduling, as the starting point of most non-urgent health care services, is undergoing major developments to support active involvement of patients. Medical appointment scheduling system lies at the intersection of providing efficiency and timely access to health services. By using the Internet as a medium, patients are given more freedom in decision making about their preferences for the appointments and have improved access. In this work a Web-based appointment scheduling system is designed to meet the needs under the current health care environment. The security of patients has been taken under consideration, QR code is been used as the e-authentication technique to protect patients' and hospital information from unauthorized individuals. The system was developed using PHP, QR code authentication technique, VScode environment, apache and MySQL. This is to ensure that the application is robust, cheap, secured and is able to run on different platforms. The system provides the platform to facilitate the booking and management of patients' appointment bookings. Patients can also view their appointment reports and progress. The system also provides healthcare workers an easy secured access to manage patients' appointments, medical records and to generate relevant reports.

Keywords : Healthcare, Quick Response Code (QR-code), Patients, One-Time Password (OTP).

I. INTRODUCTION

The expression "appointment" refers to the timeframe given in the calendar to a specific patient's visit and "service time" refer to the total time the doctor actually spends with the patient (which might be shorter or longer than the appointment time). Web based booking has developed in popularity during recent years. In view of [1], Appointment scheduling can be characterized into the following: Static and Dynamic. In static appointment scheduling, all choices must be made before a session begins, which is the most widely recognized appointment system in healthcare. In dynamic appointment scheduling, the schedules are updated continuously over the course of the day based on the present condition of the system. An online appointments scheduling system within a hospital makes perfect sense as it frees up valuable time, not only for doctors, but also for patients and medical staff. In both theory and practical, this system has to be secure and e-Healthcare service providers are trusted with the responsibility to handle the sensitive information [2].

In the world today, where the present condition in the healthcare domain requires efficiency and high level of security, the amounts of missed appointments and a weak authentication system which may result in leakage of sensitive information have led to a

tremendous problem for healthcare organizations. Therefore, it is important to have a secured and efficient healthcare system that will give constant care and facilities for both inpatients and outpatients.

The purpose of the purposed system is to develop and evaluate an online appointment scheduling system for doctors and patients, where all processes of appointments are verified with a secured authentication system. The authentication process includes the use of QR Code (Quick Response), OTP (One Time Password) and smartphone, together with the web application and web services that can handle many transactions at a time and be able to detect the electronic device details.

II. LITERATURE REVIEW

Nowadays, waiting is inevitable. Waiting is done for almost everything. Most patients who have experience bring their magazines, books to the hospital in order to maximize their waiting time. But most waiting rooms are not conducive enough to be used for useful or pleasant things and most patient just wait idle till their names are called.

A medical appointment scheduling system provide the interface between the patients demands and doctor's availability. Therefore, appointment scheduling must balance the needs of these two groups. Patients seek to minimize the time they spend waiting for doctors' service while doctors seek to minimize the amount of time resources left idle, and the amount of overtime to complete the scheduled service. Patients' fulfillment with the online scheduling system when they endeavor to book a non-critical appointment is influenced by their capacity to book with a doctor of choice and to book an appointment at a convenient time of day [3]. Scheduling appointments properly and also doing that without error is urgent to the smooth operation of a hospital.

A patient appointment system for hospital started quite a while back [4]. Dealing with a patient's appointment has earlier worked and has grown with an easy queuing models and genuinely static booking conditions. Additional effort was made using the mathematical queuing models to reduce waiting time between patient and doctor [4]. Notwithstanding; the appointment system has shown that the doctor's time is more vital compared to the patient's time [5]. So an appointment system was produced to decrease the doctors' idle time yet current arranging of an appointment system relies upon indisputable factors concerning the patient and doctor [6].

As indicated by Dexter (1999), overseeing patient appointment system is a computer application used to supervise, minimize patient waiting time in the hospital [7]. As indicated by Chua (2010) Due to the disturbing amount of missed appointments health sectors are forced to recognize how they provide care services for an improved healthcare system [6].

One application developed to manage patients' appointment scheduling has used exponential enter arrival times. This model assumes that the exponential enter arrival times could not be directly validated by date, and it is limited due to the nature of the appointment scheduling [8].

In [9], they developed another method for managing patients' appointment using multiple schedule appointment in multiple period environments. Patients can call for any appointment time but if the period time is full, they should replace the appointment to another time.

In [10], they proposed a technique for authentication and authorization for e-Healthcare is proposed. The work suggests that authorization and authentication are to be performed simultaneously and sequentially for the access control. The limitation is that design and implementation are not provided.

[11] proposed an idea of using one-time password scheme with QR Code based on mobile phone was proposed. The major concern of this scheme is to make use of the deployed widespread QR Code techniques. It is separated into two phases: Registration and Verification phases. The paper shows the security analysis which is proved to be safe from illegal users' attempt and man-in-the-middle attack.

III. SYSTEM DESIGN AND IMPLEMENTATION

A. System Overview

Fig. 1 depicts the architecture of the proposed system, which shows the overall process. Web service is implemented as an intermediary consumed by web application and mobile application. Any web-based programming language can be used to implement. A database is built along with the web service to store data when users interact via website interface. More emphasis should be placed on the mobile application that can handle QR Code, and transmit the decoded message to the web server.
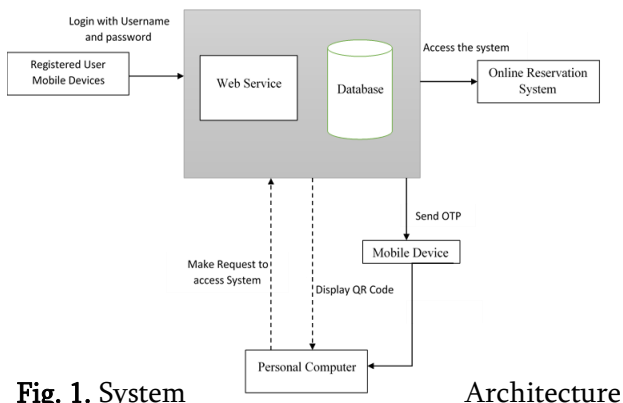

Fig. 1. System   Architecture

Registration Process

Fig. 2 depicts the registration process which is the primary step for every type of user. When a register for an account, information must be provided. The information includes a pair of username and password, device serial number, and mobile number. All the user information is encrypted and stored in the database of

e-Healthcare system. These parameters shall be verified when an access is requested. All the registered information will be stored in the web server.
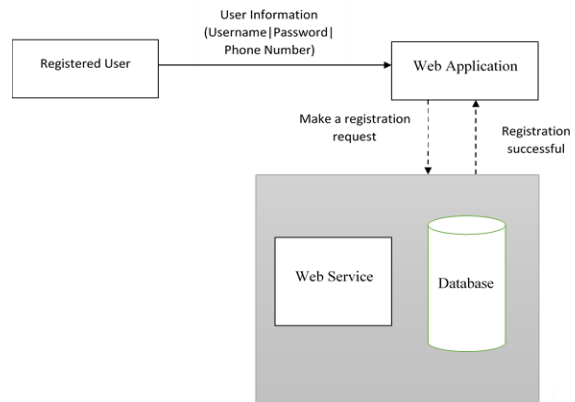

Fig. 2 : Registration Process

B. Validating Process

Figure 5 depicts the verification process which is required when a user request an access to the system. This figure shows the process when a user accesses the system using unregistered device; says personal computer. User inputs username and password normally via the web interface. The authentication server would detect that the device information is not in the list, and one-time password will be encoded into the form of QR Code and displayed on user's personal computer. The user is then required to use registered mobile device to decode the given QR Code and send to the web authentication server, using the specific mobile application. Lastly, the authentication server will verify the information including mobile device serial number, and mobile number. Once the verification process is completed, the access request will be granted.
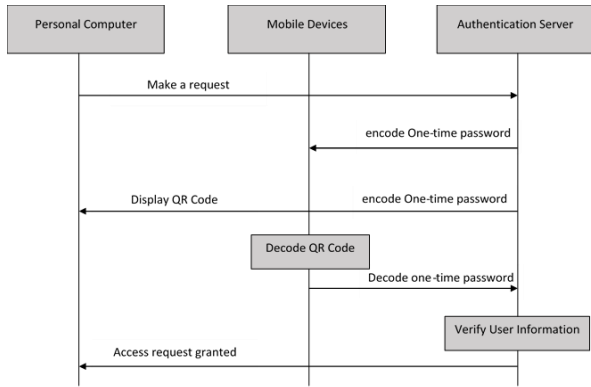
Fig.3 : Validation Process

IV. RESULT AND DISCUSSION

The system usability evaluation was carried out so as to measure user satisfaction, effectiveness and efficiency. Effectiveness defines precision and completeness with which users can reach stated goals, while efficiency defines the effort and resources required in order to reach goal attainment. User's satisfaction is defined as user's attitude towards using a system. In carrying out the usability evaluation, questionnaires were distributed to users. The designed questionnaire had three sections: Background information of respondents (6 questions), user satisfaction (4 questions), efficiency (4 questions) and effectiveness (5 questions) of the system. The questions were administered via a five-point rating scale where 1= strongly disagree, 2 = disagree, 3= undecided, 4 = agree and 5= strongly agree. A total of 10 questionnaires were administered and all 10 responses were received and analyzed.

Based on the retrieved questionnaire, Gender shows that 5 (50%) are male and 5 (50%) are female.

The total score of all the respondents was calculated for each of the usability features by finding the mean of all the scores on the survey questionnaires that was administered. The mean, median, standard deviation and variance of all the results collected for the usability features

From the result of the usability evaluation, the average user satisfaction was given as 3.75, efficiency as 4.0 and the effectiveness as 3.82.

A system with very bad usability has 1 as its overall mean rating, bad usability has 2 as its mean rating, average usability has 3 as its mean rating, and good usability has 4 as its mean rating and excellent usability has 5 [12], [13]. From the above analysis, it can be established that the prototype system developed has an "Above average usability" proven by the overall average rating of 3.85.

The usability analysis of the system for all evaluated attributes (user satisfaction, efficiency and effectiveness) is shown in Fig. 4 and Fig. 5.
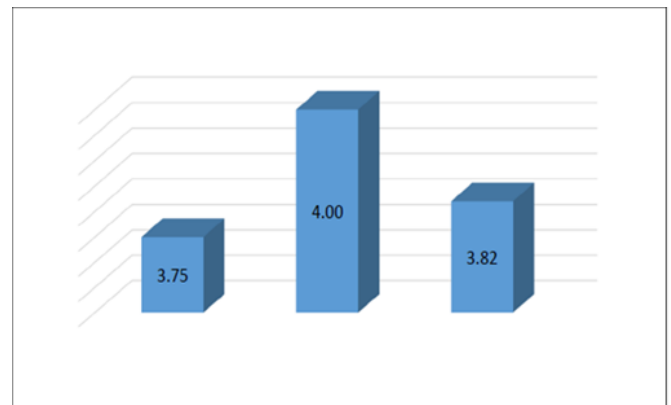

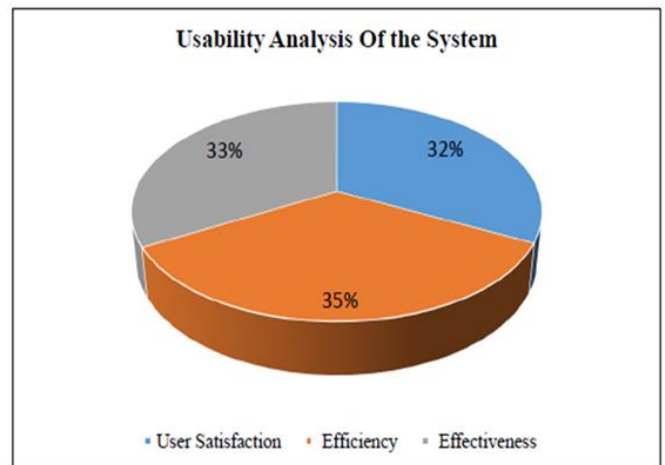**Fig 4:** Usability Analysis of the system for All Evaluation Attributes

Fig 5 : Usability Analysis of the system in Percentage

V. CONCLUSION

This work has presented a Medical booking system that can be used in medical organization for booking appointments with patients' using a much-secured authentication technique. In order to ensure proper security of patients' information an effective technique which is the QR-code authentication method was used for this purpose. The web application that was developed was a robust system that allows more than one medical organization to be part of the platform for better service delivery to patients. Each registered medical organization will have its own database that will be created on registration containing important information about the hospital. The medical booking system was developed using PHP programming language and MySQL was used to manage the robust database of the application. The medical booking system was evaluated in terms of usability of the system. To carry out the usability test of the system, twenty (20) persons (patients and doctors) were used to evaluate in terms of user satisfaction, efficiency and the effectiveness of the system, thereafter questionnaires were shared to these users to fill in their experience with the system.

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