International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

QR code based Visitor Management System for Smart Offices

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Abstract: ***In recent years, owing to the proliferation of the Internet of Things (IoT), homes and offices are being translated into smart homes and offices. The paper demonstrates an IoT system for managing the visitors in a smart office environment. The automation system comprises Raspberry Pi equipped with camera and an android mobile phone. The Raspberry Pi equipped with camera is kept in the visitor's waiting area and the consulting person possesses an android mobile phone in which the visitor management software is installed. The visitor takes an appointment using the client application installed in his android mobile phone by selecting an available slot and receives a QR code. The consulting person has the access to information regarding each appointment through professional application installed in his android phone. Whenever the visitor shows the QR code to the Raspberry Pi camera, the professional application is notified and the consulting person is able to access the list of all the visitors in real time. An intelligent token system is used to determine the order of passage when several visitors are there at the office.***

Keywords **: *Android*, Internet of Things, OpenCV, *QR code, Raspberry Pi* .**

I. INTRODUCTION

Over the years, the office setting has changed dramatically and most probably it is one of the environments most affected by technological advancements. With office equipment and tools getting smarter every day, it is now experiencing a major transformation into what is now being referred to as a smart office. It also changes our customer habits. Booking a room online via an application has become normal. Despite all these developments, in many offices we find receptionists doing the same repetitive task such as organizing office professional's schedule, answering the phone calls, delivering the packages, managing the visitors etc. With the new technologies, the burden on the receptionists could be reduced by an intelligent system by incorporating cost-effective technological solutions combined with the capabilities of smartphones and IoT solutions that are easily accessible in the market. One of these devices that is easily accessible and is used in the design of applications is the small, low cost computer, Raspberry Pi, when connected to a camera we can create a powerful visitor management system. The system is not intended to totally replace the job of the receptionist but intended to reduce the burden on the receptionist. It also helps in reducing the burden on the office professional in the absence of the receptionist.

There are several office automation works reported in the literature based on Raspberry Pi. S.A Shaikh et.al [1] designed an intelligent office area monitoring and control system using IoT. An android mobile phone running an android application and Raspberry Pi are used to monitor and control the electrical appliances via voice commands. P.R. Rodge et.al [2] proposed an IoT based smart office interactive automation system. The system designed using Raspberry Pi is intended to reduce the electricity consumption at the office by controlling the electrical appliances based on the number of visitors. Though there are numerous IoT solutions of these types available in the literature intended to control the devices in the office environment, solutions intended for managing the visitors arriving to meet the consulting person or office professional are not much researched.

Aswin S [3] et.al designed a wireless office automation and security system using Raspberry Pi and an android mobile phone which helps the official to have direct interaction with the visitor while maintaining the visitor's record in the smart phone. The Raspberry Pi connected to a push button, LCD display and a camera is kept in the visitor's area and the official possesses an android mobile phone. Whenever the visitor presses the button, his image is captured and transmitted to android mobile via Bluetooth. The official responds through the android application by sending a preconfigured message (Eg. Busy/In meeting) which is displayed on the LCD. Santhosha Rao et.al [4] designed a smart phone based cost effective visitor management system for smart offices which comprises of a nodeMCU based wireless transmitter, nodeMCU based wireless display and an android mobile phone. The office professional or consulting person possesses an android mobile phone and the nodeMCU based transmitter and display are kept at visitor's area. The visitor enters a message using the keyboard connected to Wireless Transmitter and notes down the acknowledgement token number sent by the consulting person's android mobile phone. When the consulting person checks this message, the same token number is sent to the Wireless Display Unit indicating the visitor to consult the person.

Manuscript published on November 30, 2019.
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Though these systems are very cost effective and convenient to manage the visitors, there is no provision to take the appointments apriori. With an objective to address this problem, a cost effective visitor management system is designed which facilitates the visitor to take appointments apriori by selecting an available slot of his convenience.

II. SYSTEM DESIGN

The objective of the work is to create a system that allows a client to take an appointment with a professional. Once the appointment is made, the visitor will receive a QR code [5] to be shown to the camera to have access to the professional's office. The latter must be notified upon the visitor's arrival. If several people are in the office at the same time, a token system will determine the order of passage based on element such as the importance of the case to be processed. A professional must be able to create availability and a visitor or client is able to reserve some available slots.

The server is the communication hub between Client App, Professional App and Raspberry Pi equipped with camera as depicted in Fig.1. Raspberry Pi board [6] houses Broadcom BCM 2837 ARM cortex A53 quad core 1.2 GHz processor, 1 GB RAM, 10/100 Ethernet port, 40 pin GPIO header, Broadcom videocore lV GPU, Bluetooth 4.1, microSD storage. The 5MP Omnivision 5647 Camera [7] Module is a custom designed add-on for Raspberry Pi, is connected to Raspberry Pi by means of one of the two small sockets on the board's upper surface. This interface uses the dedicated CSI interface, which was designed particularly for interfacing to cameras. Raspberry Pi to camera connection is depicted in Fig.2.

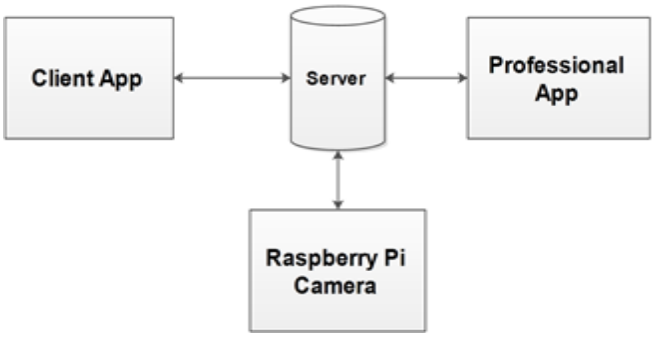

Fig. 1.System Model

Fig. 2.Raspberry Pi to camera connection

The client and professional applications send http request to the server and use the response to obtain data. The server URL is defined on the attribute URL from the singleton. The Raspberry Pi also sends http request to the server. As the client and professional applications have several common services, it was decided to combine them. Each device can only add, update or request data on the database. To send the data, the POST request method is used. Each request has an attribute "request", which is a number that corresponds to a specific request. For example, to add a new person in the database, request value is 1. User information data is provided in the POST request and 1 is received if person is added else 0. The request 2 is for login. The application sends the email address and the password. The server checks the password with the hash password stored in the database and sends the user data if authenticated else 0. To show appointments, the current date is sent with the request value of 4. To receive the list of appointments, the person ID is sent with 5 as request value. An appointment is defined by the person ID and availability ID. This information is sent to add one to the database with request value 6. The server response is 1 for success or 0 for a problem. After decrypting the QR code, the person ID and availability ID are sent to the server with request value 7. Fig.3 shows the use case diagram of the system.

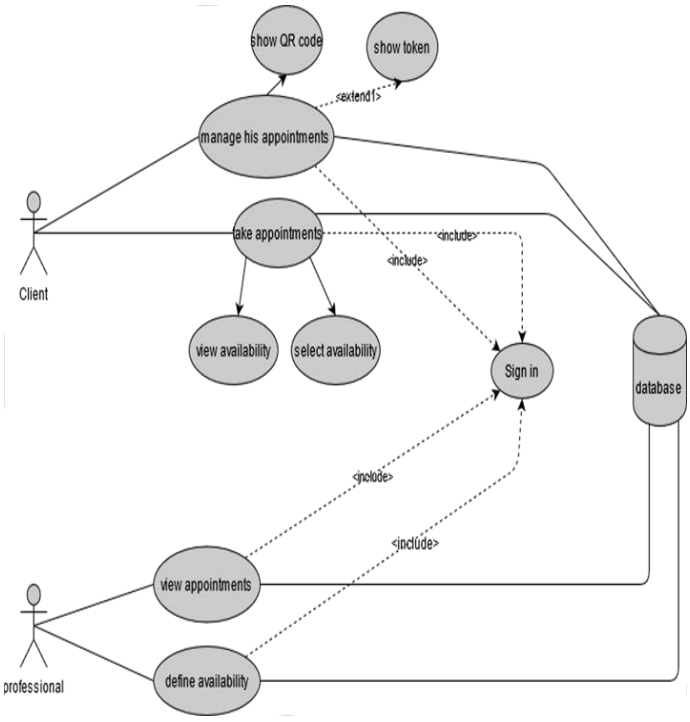

Fig. 3.System use case diagram

The data is organized in 3 entities namely, Person, Availability and Appointments. An appointment is created when a person is associated with an availability. Pro is 1 if the person is professional else 0. Rating is the rate attributed by the professional. The rate is between 0 to 10 and the default value is 5. The date_start, date_end are the dates on which the availability begins and ends respectively. The priority is the indication of severity by the client. The database design diagram is depicted in Fig.4.

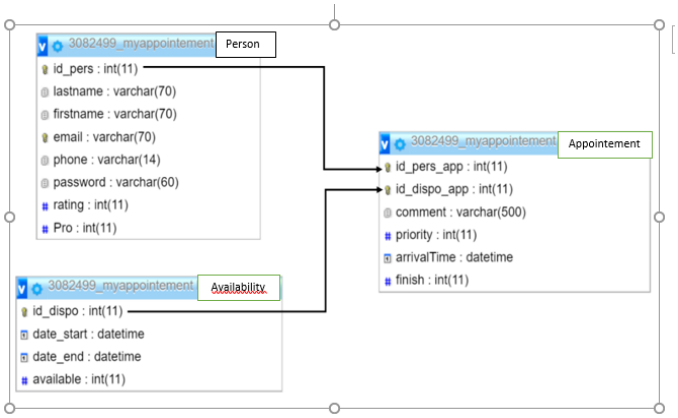

Fig. 4.Database design

For an application to be adopted, it is important to provide a good user experience. In our case, user interface is an activity containing a large space for fragments as well as a bottom navigation to easily access the different services of the application. Fig.5 represents the access path to the different visible parts of the application.

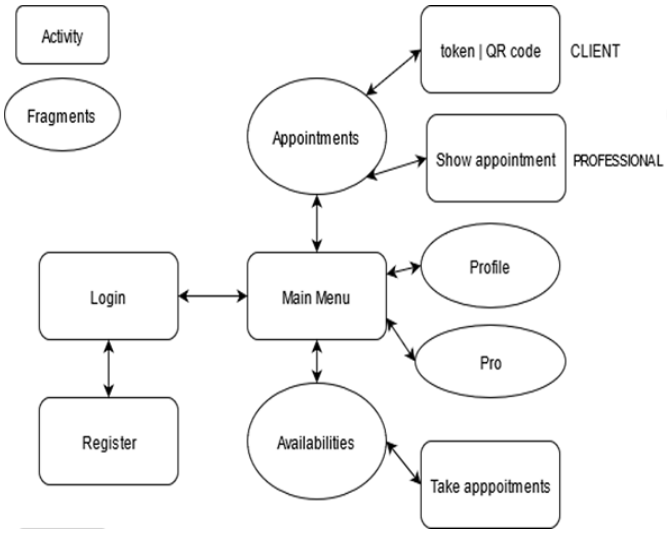

Fig. 5.Access path to various parts of the Application

An activity is a single, focused thing that the user can do. The Activity class takes care of creating a window in which we place the user interface. A fragment represents a behavior or a portion of user interface. We can think of a fragment as a modular section of an activity.

A service is an application component that can perform long-running operations in the background so that the professional is informed about the arrival of a customer. An android service runs in the background to ask for the list of people who have arrived. This period depends on the value of interval Millis (1200 milliseconds by default). As depicted in Fig.6, the service starts and asks the server for the list of people who have arrived in the waiting room. It compares this list with the list of people kept in its memory and sends a notification to the professional if the new list contains new clients. Finally, the service sets up its next restart and stops.

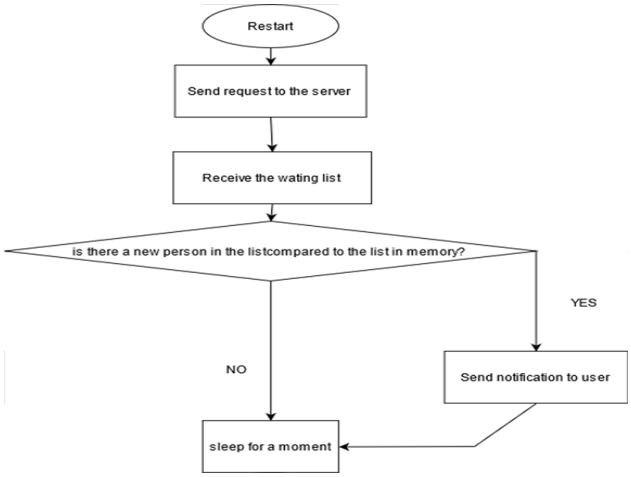

Fig. 6.Service Life Cycle

QR code is a method of representing data in a visual, machine-readable form like a barcode. Each appointment is defined by the person ID and the availability ID. For this reason, the data on the QR code is structured as:

id_person ==; XX; id_availability ==; YY;

where XX & YY are integers.

The QR code image is generated by the smartphone from the reservation information. Fig. 7 depicts the process of scanning the QR code by the Raspberry Pi camera.

Fig. 7.QR code scanning using Raspberry Pi camera

After decoding the QR code, the Raspberry Pi sends a request to the server to define the action to be performed. It uses the OpenCV library [8] to obtain the image and the Zbar library [8] to decode the QR code. QR code playback is performed on each image of the video stream coming from the camera. In order not to send an untimely request to the server, the Raspberry Pi only makes a request if the QR code read is different from the previous QR code detected. When several people are in the waiting room at the same time, it is important to define a sequence for each client. To decide who has the priority, a score is associated for each client entering the office. The score is calculated based on the order of arrival in the waiting room, the order in which appointments are made, the priority given by the user and the score assigned to him by the professional.

III. RESULTS AND DISCUSSION

First and foremost, requirement for the user to access the features of the application is to register by giving the information such as name, user name, email, phone number and password. The user logs in by entering email id as user name and password.

Now a window opens as depicted in Fig.8 with 3 buttons at the bottom of the page which are used to navigate between the activities. Availability button is used to show the availabilities of the professional. Profile is used to show the user profile. Pro button is only for the professional to the add availability. The window also shows the appointments already taken by the client. If an appointment is clicked, then an activity is started to show QR code and token.

Fig. 8. List of apppintments already taken by the client

Now the user can click the Availability button to see the availability of the professional on the specific date. The availabilities of the professional are listed under the calendar as depicted in Fig.9. Whenever the client clicks on an available slot, the take appointment activity will be started.

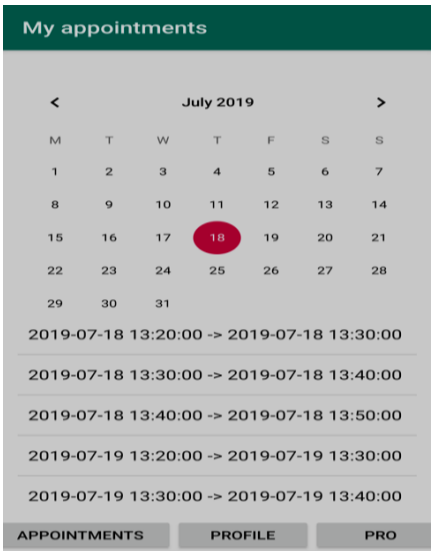

Fig. 9.List of availabilities of the professional

Using the take appointment activity window depicted in Fig.10, client can enter the purpose of visit and its priority on a scale from 0 to 10.

Fig. 10. Take appointment activity

Whenever the client clicks on an appointment, the QR code associated with the appointment is displayed. The current token number of the client is displayed upon clicking the Refresh Token button as depicted in Fig.11.

Fig. 11. Display QR code and current token number

A professional can specify his available slots by clicking the Availability button. He must choose a day on the calendar, the start time and end time to specify his availability as depicted in Fig.12.

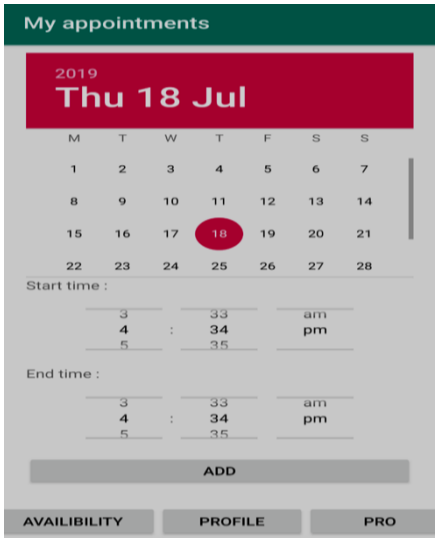

Fig. 12. Adding an appointment by the professional

The view appointment activity will be started whenever the Professional clicks on an appointment. As depicted in Fig.13, he can see all the data given by the client. He then assigns a rate and clicks on the Finish button to complete the appointment.

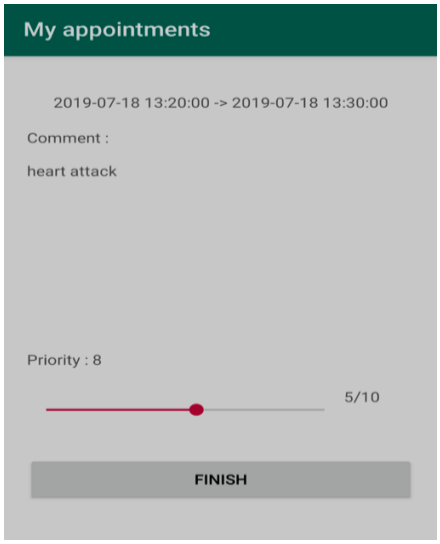

Fig. 13. View activity

IV. CONCLUSION

The proposed QR code based visitor management system provides a cost effective technological solution to the smart offices by exploiting the capabilities of the android smart phones along with a Raspberry Pi equipped with a camera. The system not only helps in improving the efficiency of the receptionists by reducing the load on them but also helps in assisting the professionals in receptionist's absence.

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Santhosha Rao is currently working as Associate Professor in the Department of Information and Communication Technology, Manipal Institute of Technology, MAHE, Manipal, India. His research areas are Cross Layer Design, Energy Constrained Wireless Networks, Internet of Things. He has around 20 years of teaching experience.

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