

Automatic Smart Parking and Reservation System Using IOT

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ABSTRACT

In recent years the number of vehicles increased drastically and many times the car owners struggle to find the proper parking space within the city. IoT has great potential in implementing many of the smart city infrastructure requirements. Traffic congestion and the scarcity of car parking space have given a lot of opportunity for the research scholars to work in this field. In this paper we have proposed a smart car parking and reservation system. The proposed system is being controlled by an android app so as to reduce human intervention. This system reduces the traffic congestion and hence fuel consumption. To book the free slot for parking in advance is being done with the help of web application either using PC or mobile phone. This system can be used to book a free car parking slot within city.

KEY WORDS: ANDROID, ARDUINO, INTERNET OF THINGS, RESERVATION SYSTEM, SMART PARKING.

INTRODUCTION

Internet of Things (IoT) is a technology where in all the smart nodes will be connected to each other with the help of internet. Accessing the parameters from the remote sensors became a reality because of IoT. Such connected nodes generate a huge amount of data which will be stored in the cloud. In this proposed design we have made use of concept of IoT to book a free car parking slot. The main aim of our design is to give the information related to the available free car parking slots on user fingertip. It will be more convenient to the car owners to reduce the effort in finding the free car parking slots within the city.

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We have made use of an optimal architecture for the proposed design. In this design the traffic congestion is reduced due to confirmed parking slot and pre booking option. Hence it will save fuel and hence the carbon footprint. Recently the Indian government has launched a proposal called as smart city, where in the whole city will be developed so as to make the life of the people living there more comfortable and flexible. In such conceptualization the smart parking system plays a vital role.

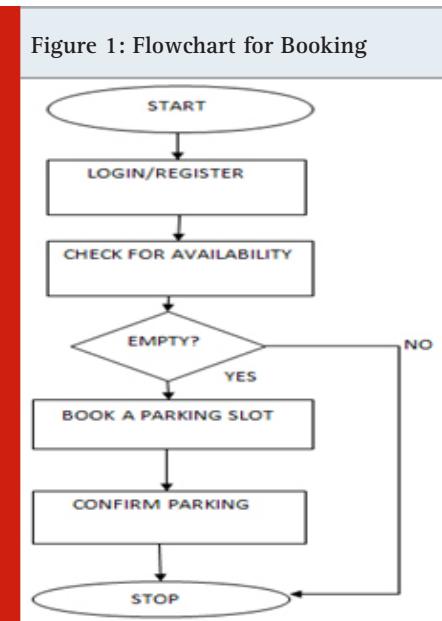
In large shopping complexes many times the vehicle owner struggle to find the parking place and end up wasting a lot of their valuable time. Now to avoid such situations we have come up with a solution where in the whole parking problem can be solved. Even this system has a pre booking and cancellation option. We can book a parking slot in advance and save traffic congestion which reduces fuel consumption of the vehicle. The whole work has been divided into multiple sub sections. The description starts with literature review, where a brief description about the work already done in this domain has been discussed. Followed by methodology in terms of a simple flowchart has been explained.

Then the preceding part of the paper explains about its implementation and functional working.

Literature Survey: (Mendiratta et al., 2017), (Krasner and Katz, 2016), (Suhr and Jung, 2016) have proposed work is using ultrasonic sensor to detect the parking slot. The parking slot status is updated on internet using ESP8266 Wi-Fi module. (Khanna and Anand, 2016), (Zheng et al., 2015), have proposed mobile application for parking system and an on-site deployment of an IoT module. It is used to monitor and provide the availability of each single parking space. (Lambrinos and Dosis, 2013), (Polycarpou et al., 2013), (Geng and Cassandras, 2011), have proposed system called DisAssist. It will help people with disabilities for finding available parking slots. It uses wireless and mobile communication. It integrates sensors and smart phones. (Chinrungrueng et al., 2007) and (Chinrungrueng et al., 2006) proposed WSN for traffic monitoring. Observation was that this could be applied to monitor vehicles in parking garage. Then drivers are informed about available parking spaces. WSN modified for parking garage.

METHODOLOGY

A. Parking slot booking: Since the drivers keep on roaming around seeking out for decent parking, using this feature they can book the space for car parking in advance. They just need to install the app and can select the vacant slot. For this feature, they don't have to pay anything in advance. Once booking is done, the server will be updated accordingly. If the user is new, he/she has to register with his/her credentials and get access to the app. The old users can simply log in into the app by using the user id and password that was given by the user at the time of registration.

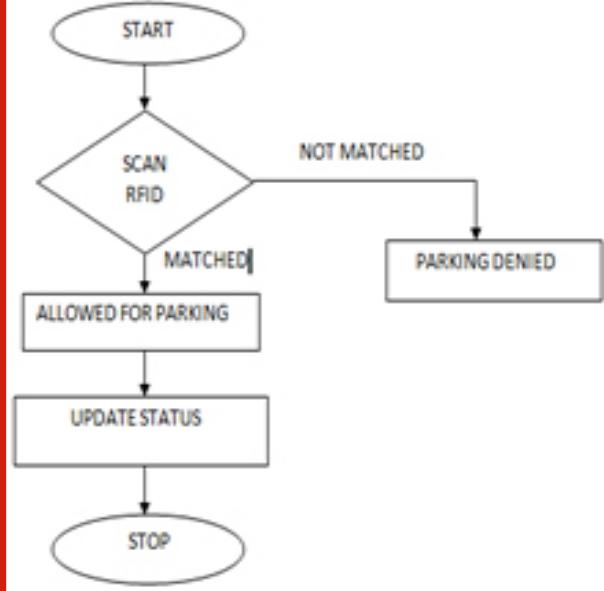


After the user has logged in into the app, he/she checks for the availability of the parking slots and if a slot is empty then the user books the particular slot. The

status is updated in the app and the user will receive a confirmation message on successful booking. As shown in the (Figure 1) is the simple flow chart for booking. Where in we verify for the registered user and then check for the availability of the parking slot. If slot is empty then a confirmation will be displayed on the app.

B. Vehicle Entry: (Figure 2) shows the flow chart for Vehicle Entry.

Figure 2: Flowchart for Vehicle Entry



C. Pseudo Code for Vehicle Entry

Input: the RFID code C;
Output: Parking Slot Status S;
Initialization: Parking Slot S=0;

1: for each vehicle entry scan RFID code C do
2: if C matches in C 1 then
3: S to 1;
4: end if
5: end for
6: return S 1;

As shown above is the Pseudo code for the vehicle entry. The QR code generated after booking the parking slot is taken as variable C. This code will be varied at the entry of the parking. The variable S is used to indicate the availability of the slots. If S=0 indicates a particular slot is free. Once after booking happens by a user the S immediately gets updated to S=1. This information will be available to the user in the app and to the app admin at the background.

Whenever, the registered user books a parking a slot, a unique RFID tag will be generated as shown in (Figure 3) and sent to the user. When the vehicle enters the parking space, it checks for the same. If the tag generated and the tags scanned by the user are same, then the vehicle is allowed for parking. If the tags do not match, then

parking is denied for that vehicle. After parking a vehicle in the parking slot, parking slot details will be updated i.e slot is occupied, as shown in (Figure 4). In (Figure 4), occupied column '1' indicates that vehicle is present in the slot and '0' indicates slot is empty. And this updated information will be shown to the user with the help of mobile application.

Figure 3: php Status Updation

	M.	username	password	address	contact	rfid	created
1	Edt	Copy	Delete	user1	anand	Volu	2019-04-19 06:07:41
2	Edt	Copy	Delete	user2	anand	Volu	2019-04-19 06:07:41
3	Edt	Copy	Delete	Sana	134	mmmm	2019-05-21 04:23:23
4	Edt	Copy	Delete	Vinay	dhruv	NULL	2019-05-21 11:11:40
5	Edt	Copy	Delete	Akash	0000	NULL	2019-05-21 12:14:12
6	Edt	Copy	Delete	Poonam	12345	NULL	2019-05-21 15:42:42
	Check all	With selected	Edit	Copy	Delete	Export	
	Show all	Number of rows:	25	Filter rows	Search this table	Sort by key:	None

Figure 4: php Parking Status

	M.	user_id	parking_number	confirmed	occupied	
1	Edt	Copy	Delete	1	0	
2	Edt	Copy	Delete	2	0	
3	Edt	Copy	Delete	3	1	
4	Edt	Copy	Delete	4	1	
	Check all	With selected	Edit	Copy	Delete	Export
	Show all	Number of rows:	25	Filter rows	Search this table	Sort by key:

Figure 5: php Booking Orders

	M.	parkinglot_id	user_id	amount	created	
1	Edt	Copy	Delete	4	0	
2	Edt	Copy	Delete	4	0	
3	Edt	Copy	Delete	4	0	
4	Edt	Copy	Delete	4	0	
5	Edt	Copy	Delete	4	0	
6	Edt	Copy	Delete	4	0	
7	Edt	Copy	Delete	4	0	
8	Edt	Copy	Delete	4	0	
9	Edt	Copy	Delete	4	0	
10	Edt	Copy	Delete	4	0	
11	Edt	Copy	Delete	4	0	
12	Edt	Copy	Delete	4	0	
13	Edt	Copy	Delete	2	0	
14	Edt	Copy	Delete	5	35	
15	Edt	Copy	Delete	5	0	
16	Edt	Copy	Delete	5	0	
17	Edt	Copy	Delete	5	0	
18	Edt	Copy	Delete	1	27	
19	Edt	Copy	Delete	1	27	
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130	Edt	Copy	Delete	1	27	
131	Edt	Copy	Delete	1	27	
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The app admin will get the detailed consolidated information as shown in the below (Figure 5) consisting of user ids, parking slots booked, available, date and time.

D. Vehicle Exit: (Figure 6) shows the flow chart for Vehicle Exit.

E. Pseudo Code for Vehicle Exit

Input: the Sensor Output C;
Output: Parking Slot Status S;
Initialization: Parking Slot S=1;

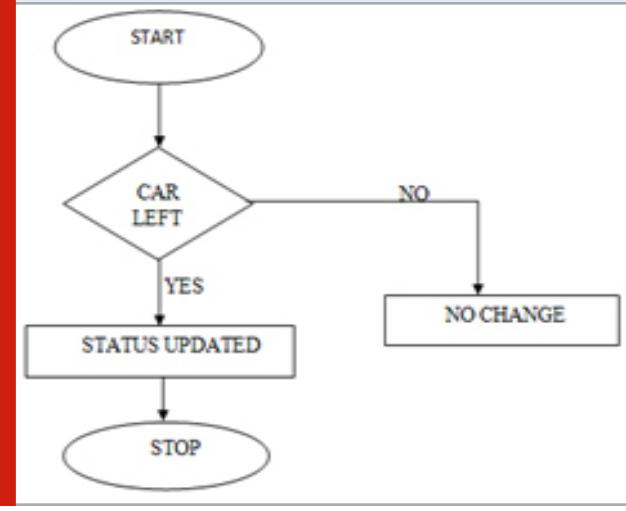
1: if C = 1 then

2: S to 0;

3: end if

4: return S 0;

Figure 6: Vehicle Exit



At the time of exit, the user is required to scan the RFID tag of the vehicle. Upon successful payment, that particular slot will be available as vacant again and the database will be updated accordingly i.e S=0, so that next user can use the same. This parking system is useful for parks, street side and malls parking. The entire parking system information will be stored on the server. This information consists of number of empty slots, number of occupied slots etc. The secured gateways are used to access the system information. The parking spaces present in the city is stored on the main server database.

F. Registration system: Initially, the user has to register the details. It stores his necessary details into the server. Once the user is registered, he is allowed to sign in to his account and allowed to book a parking slot. Once user vehicle reaches the parking lot, the RFID tag is verified. This is done using a RFID reader module. After the verification, the vehicle is permitted to enter the parking lot. The nearest available slot number is given. Then at the exit barricade the RFID card is again verified while exiting from the parking lot.

Features of Hardware Architecuture:

Below are the hardware details.

i. Arduino UNO

ii. ESP Module

iii. LDR(Light Dependent Resistor) Sensor

iv. RF ID Reader Module

v. XAMPP SERVER

vi. NOTEPAD++ EDITOR

vii. MySQL

viii. PhpMyAdmin

A. ARDUINO UNO (ATmega328p): The Microcontroller ATmega328p is used for the system. This microcontroller has input and output pins. These pins will help to interface with external world. There are 14 I/O pins for digital data. And 6 pins are for analog data. This microcontroller will be able to read input from sensor. For internet connectivity this board is connected to an Ethernet cable (standard RJ-45).

Figure 7: IoT System block diagram

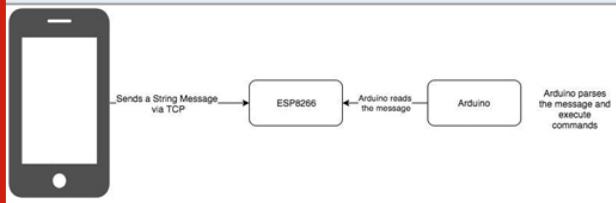


Table 1. System parameters

Categories	Items	Parameters
Wi-Fi (ESP8266)	Certification	Wi-Fi Alliance
	Protocols	802.11 b/g/n (HT20)
	Frequency Range	2.4G ~ 2.5G (2400M ~ 2483.5M)
	TX Power	802.11 b: +20 dBm
		802.11 g: +17 dBm
		802.11 n: +14 dBm
	RX Sensitivity	802.11b: -91 dBm(11Mbps)
		802.11g: -75 dBm(54Mbps)
		802.11 n: -75 dBm(MCS7)
	Antenna	PCB Trace, External, IPEX Connector, Ceramic Chip
Hardware	CPU	Tensilica L106 32-bit processor
	Peripheral Interface	UART/SDIO/SPI/I2C/I2S/IR Remote Control GPIO/ADC/PWM/LED Light & Button
	Operating Voltage	2.5V~3.6V
	Operating current	Average value: 80 mA
	Operating Temperature Range	-40°C ~ 125°C
	Package Size	QFN32-pin (5 mm x 5 mm)
	External Interface	-
Software	Wi-Fi Mode	Station/SoftAP/SoftAP+Station
	Firmware Upgrade	UART Download/OTA (via network)
	User Configuration	AT Instruction Set, Cloud Server, Android/iOS App

Figure 8: Sensor Stands

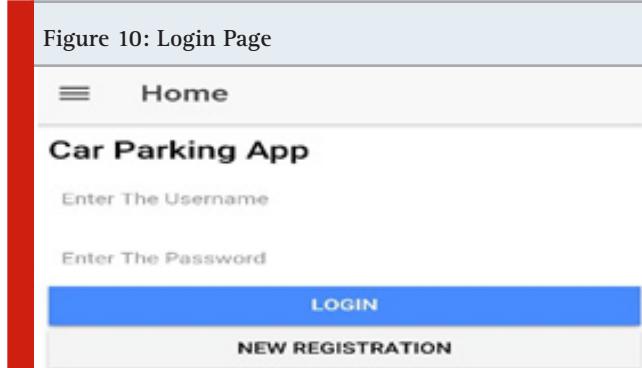


Figure 9: Circuit diagram for smart parking



B. XAMPP SERVER: The local web server is developed by XAMPP server. It is light weight Apache distribution. XAMPP stands for Cross-Platform (X), Apache (A), MariaDB (M), PHP (P)and Perl(P).it is developed for deployment and testing. XAMPP acts as a local host. A server scripting language used is PHP. Web application is developed by Perl language. The web browser can be used to enter local host address. (Figure 7) represents the block diagram of the System. The NodeMCU (ESP8266)is used for wireless communication. It will send and receive data on internet remotely. The NodeMCU (ESP8266) will provide access to WiFi network. So it is working as Access Point (AP Mode) for other devices. Then further it connects to a wired network. We can use Android phone to send command/message to ESP8266. (Table 1) shows the System parameters.

Figure 10: Login Page



Model Working

A. Sensor Stands: (Figure 8) shows sensor stand for parking system. Which has been used as a prototype to sense the presence of vehicle. Each stand has the facility for the placement of Ultrasonic sensor. Here each stand will be placed in each of the parking slots. As Ultrasonic sensor detects obstacle within the programmed range. Now the vehicle which enters within the range of the sensor will be detected and the information will be sent to the controller. Then the respective information about the availability of the parking slot will be updated.

Figure 11: Parking Slot Information

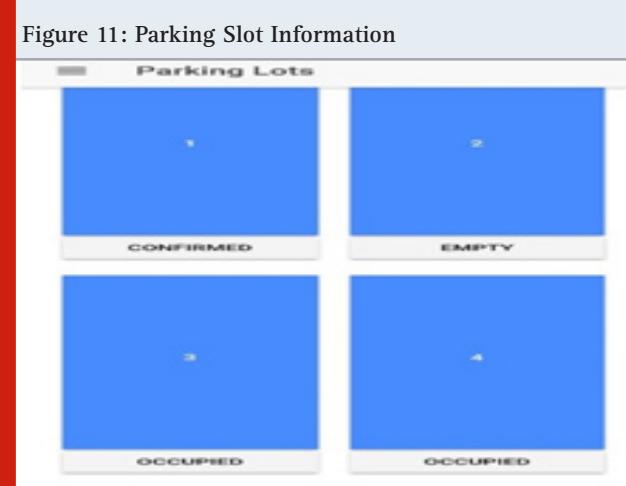
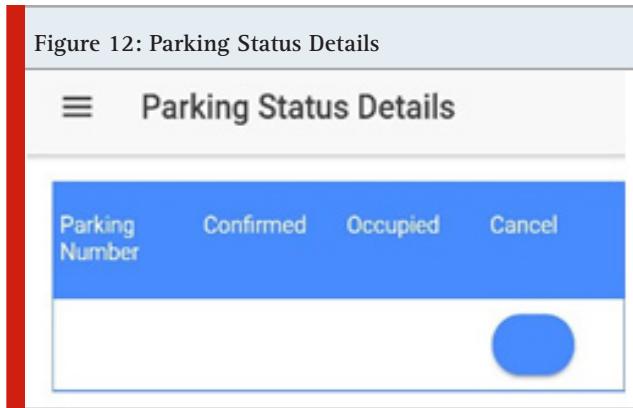


Table 2. Comparision of different vehicle parking systems

	Modules used and its features
(Mendiratta et al., 2017) "Automatic car parking system with visual indicator along with IoT"	Automatic car parking system makes use of IoT with Arduino, Wi-Fi Module (ESP8266), and Ultrasonic sensor for its implementation. Feature provided: Provides feature for checking the availability of the parking slot at the parking place using IoT. Scope for improvement: But the module does not provide feature for booking the parking slot using online mode and also does not provide the cancellation feature.
(Khanna and Anand, 2016) "IoT based Smart Parking System"	The Model for smart parking system uses IoT along with Raspberry Pi and Wi-Fi module. Feature provided: The model provides feature for online booking of the parking slot. Scope for improvement: The model does not provide feature for cancellation of the booked parking slot.
Our proposed model	The model uses IoT platform with Arduino, Ultrasonic sensor and WiFi Module (ESP8266). Feature provided: The model proposed features for online booking and cancellation of the booked parking slot. These features are added to improve the previous models features. These are the enhanced features as compared to the previous models discussed above.

B. Circuit Diagram for Smart Parking: (Figure 9) shows the circuit diagram for controller, display unit, switch and RFID reader module. This RFID reader is used at the

entry point to read the QR code generated by the user and validate. On LCD display will get the information about the entry of the vehicle.



C. App Interface: (Figure 10) shows the login page of app interface used for our system. On this page new user can register. The already registered person can login here and proceed with checking the parking slot availability.

After the registration he will be able to login and check availability of parking slot as shown in (Figure 11). It consists of parking slot number and the parking slot is confirmed or not. After parking slot is occupied it will be displayed as occupied with that slot number else empty. Parking status details will be displayed as shown in (Figure 12). The customer has option to cancel his parking slot and it will update the status of parking slot.

Tables 3. Latency features of models	
	Latency features
(Mendiratta et al., 2017) "Automatic car parking system with visual indicator along with IoT"	Bandwidth: 7Mbps Online booking timing delay: - Cancellation timing delay: -
(Khanna and Anand, 2016) "IoT based Smart Parking System"	Bandwidth: - Online booking timing delay: 125ms Cancellation timing delay: -
Our proposed model	Bandwidth: 7Mbps Online booking timing delay: 120ms Cancellation timing delay: 118ms

RESULT AND DISCUSSION

(Mendiratta et al., 2017), the authors have proposed the information of availability of free car parking slots but there was no scope to have option of booking a slot in advance. (Khanna and Anand, 2016), in this second work the authors have implemented the booking option but there is no scope for cancellation. In our work we overcome both the drawbacks; our system gives free car parking slot option to book as well as to cancel the slot.

(Table 3) shows the latency features of the our model and the other previously implemented models.

CONCLUSION

In this proposed design of smart parking and reservation system, the concept of unique ID for each of the user with a RFID has been implemented. Once the user registers himself in the system then the system will store the user information in its data base and try to find the availability of space for the newly registered user. Using this concept of user registration the proposed design can be used to inform the user about the free slot of the parking place and also allows him to reserve the slot well in advance. And this system provides option of cancellation of booking. This makes the life of the vehicle user a lot more comfortable and intern saves his valuable time and fuel consumption. As we save the

fuel we are reducing the whole carbon footprint which is the need of the hour.

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