IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 10, Issue 1, January 2021

DOI 10.17148/IJARCCE.2021.10125

Smart Parking System with Automatic Payment

Sneha George[1], Amal.V.S[2], Antony Pavu[3], Neeraj.V.N[4]

Assistant Professor, Department of Computer Science and Engineering, Universal Engineering College, Vallivattom, Thrissur, India.[1]

B.Tech Student, Department of Computer Science and Engineering, Universal Engineering College, Vallivattom, Thrissur, India.[2,3,4]

Abstract: The Internet of Things (Iot) is able to connect Millions of devices and services at any time, from anywhere in the world with the help of Internet. It also plays a major role in filling the gap between all the day to day things and the networking system, and thus creates a way to access all the non-internet objects from any distant location. With the growth of population and commercial development increasing day-by-day, the number of vehicles on the road is also increasing day-by-day. So that, spending too much time for searching a parking area/slot in the city will be a time waste process, which will lead to greater financial costs. Thus, it is very much important to develop an automated smart parking management system that would help the user to find a perfect parking space without wasting any time. In the proposed system, a user can search parking areas nearby the user's location, choose and book for a slot in a parking area from the smartphone. The system also comes with real-time detection of improper parking and automatic parking payment collection. The proposed system in future will surely help users to overcome the difficulty of parking and also saves much of the user's time.

Keywords: IoT, Cloud Computing, RFID Technology, Ultrasonic sensors

I. INTRODUCTION

In recent years, cities experiencing a massive growth in the number of cars used for transportation. So finding a parking area/slots is wastage of time and effort. And also parking fee is deducted manually in all parking areas in cash or card directly collected by staff. So here we introducing Smart parking system with automatic payment with help of internet of things (IOT). In this system user can see the nearest parking areas through mobile application. And user can see the real time parking slot status by the help of cloud computing. And also user can book a slot in that parking area in advance by the mobile application if the slot is free. Here we use RFID technology to deduct the parking fee automatically direct from the wallet. User can top up the wallet by online payment mode. Ultrasonic sensors are using for detecting the car in the parking slots. A RFID tag is attached in the windshield of the car. So before entering to the parking area RFID scanner scan the RFID tag and checking the booking in the database. If the booking is found then the entry gate is open. If it is non booked user a new slot will assign within seconds if they have enough balance in their wallet. If user parked in wrong slot user will get notification to their mobile application. In exit gate of parking area there is also RFID scanner for deducting the fee from wallet automatically. This paper will help to save too much time for searching the parking area and reduce carbon footprint.

II. THEORY

A. CLOUD COMPUTING

Cloud computing was popularized in Amazon.com releasing the Elastic Compute Cloud in 2006. Cloud computing is the on-demand availability of computer system resources, especially computing power and data storage. Cloud computing is the delivery of different services like data storage, servers, databases, networking, and software. Rather than keeping files on a local storage device, save them to a remote database by the help of cloud-based storage. And also electronics devices has access the web, it can access to the data in the cloud. In cloud computing have two service, public and private. In public service are provided online for a fee. In private service are hosted by selected clients only.

B. ULTRASONIC SENSOR

It is an electric device it measures the distance of a target by emitting ultrasonic sound waves. After that reflected sound changes into electrical signal. Ultrasonic waves travel faster than the normal audible audio. Ultrasonic sensor have two components, transmitter and receiver. Ultrasonic sensor are used as a proximity sensor in cars, robots etc.

This work is licensed under a Creative Commons Attribution 4.0 International License

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 10, Issue 1, January 2021

DOI 10.17148/IJARCCE.2021.10125

C. INTERNET OF THINGS

The internet of things (IoT) provide a internet connection between devices. The Internet of Things (IoT) is the number of things that are connected to the internet. So they can able to collect and transfer data over a internet network without human intervention. Sensors and devices are connected to an IOT platform, it integrates data from the different devices and apply analytics to share the information with applications built to address specific needs. An IoT system consists of sensors/devices, their data send to the cloud by wireless network. After the data enters to the cloud, software process the data and then decide which action will be perform like An IoT system consists of sensors/devices which "talk" to the cloud through some kind of connectivity. If user input is needed then a user interface allow to do so.

D. RFID TECHNOLOGY

RFID is a method of data collection that automatically recognizing the objects by radio waves. Data is sent and received to the system by the help of RFID reader and RFID tag Transmit data to RFID reader by an antenna and RFID tags, every tag contain an integrated circuit. After that the reader convert the radio waves to the data. Then this data are transferred to the host computer system by the communication interface. Every RFID tag have integrated circuit and an antenna. There are two types of RFID tags, passive and active. The passive tags are widely used RFID tag because of their cost and smaller in size. And also implementation cost of this RFID is very low. Every passive RFID tags will must powered up by the RFID scanner before data transmitting. But in active RFID tags have onboard power supply. So these tags are ready to transmit the data to reader.

III. RELATED WORK

Here we introduce each papers based on the technologies used in the smart car parking systems and these are arranged in technologies bases.

The aim of this paper [1] save time for finding the parking spot. Here user can book a parking slot by the mobile application. While car check in at parking area, system will do a validation process. User will scan a QR code by user's mobile application. After that the camera is scan the license plate and send to the system for checking the booking. After successful validation the entry gate will open. Here using image processing technology. In this technology the camera scan the license plate and send to database through internet. In car check out time pay the parking fee by automatic cashier machine by debit/ credit cards. User can see the real time parking slot status by IOT and send to user mobile application through internet. Drawback of this system is that Automatic Cashier machine is used for payment, and it is very time consuming.

In this paper [2] the UParking system will manage parking controlling booking, searching, and payment procedures. Users uses this application to book the parking slot. The ANPR camera scan the vehicle plate number when a user reached at the parking area. The entry gate will open only if the plate number has a registered booking in the database. The TCRT5000 sensor are provided all parking slot detecting the lots are free or not. Users can increase the booking time and view parking location. Also, users can cancel the parking slot bookings. There are few sub-modules in the system: monitoring and management module. The management module control the booking, managing users and parking information, and storing their information in database system. Users book parking slots by their mobile application. ANPR camera that monitors the entrance of the parking and control access by scanning the plate number image.

In this paper [3] user must register by providing the personal details including ADHAAR number details. user access the mobile application after registration and check the status of free parking slot. The status of free parking slots is understand through data base server that is updated by raspberry pi with sensors that are place in the every parking slots. The user books slot by entering user ID, Slot number after that this information is updated to cloud database. When user reaches parking area, the user and the vehicle is identified by using unique booking id that is generated at the time of booking and the booked slot is provided to the user to park their car. The algorithm validates the parking time and calculate the parking charges based on the presence of the car at the parking slot. When user click checkout button in the mobile application, the temporary charge is displayed in the application, the exact parking charge is calculated by taking car from parking slot.

The aim of this paper [4] reduce the traffic in the parking area. This paper the selection of the parking place is done based on priority of distance and traffic free path to reach the parking area ; for an identified slot; nearest path will be selected and check the traffic on the selected path. If the path is settled by other car then the path on lower priority and inform by glowing the LED's if it is traffic free. If all paths are busy, driver has to wait until LED's on any one path starts glowing, which is an inform that driver to follow that route. Selected path is indicated by glowing the LED's to direct the user. Nearest and least traffic path can accordingly selected. Here we use IR sensor to Arrival of car. And here using PIC Micro Controller (PIC16F887) to operate this system. if all slots are not free, gate will not open neither

This work is licensed under a Creative Commons Attribution 4.0 International License

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 10, Issue 1, January 2021

DOI 10.17148/IJARCCE.2021.10125

the path LED's going to glow. If there are more than one slot is free, the slot is selected based on distance as well as traffic on a path.

In this paper [5] the user queries about the free slots and the system checks the Database for the free slots. The system displays the number of free slots and the user is select a slot and proceed the payment to book the free slot. After the confirmation of payment, the database is updated, and a barcode is generated. At the entry of parking areas contains a Barcode scanner, DC Motor, and Display. When a user enters the parking area, user scans the barcode in the barcode scanner. The display shows the slot number, and then the DC Motor opens the entry gate. The system provide to book slot in offline. Then offline user must be manually pays the cash to book free parking slot, and the paper barcode is generated. Each parking slots have an ultrasonic sensor which checks the parking slot free or engaged. After that send the data from ultrasonic sensor to NodeMcu. The Raspberry Pi3 collects data from all the NodeMcu's and send data to the database with the available free slots. Mobile application are developed to display the free parking slots by the data from the database. A user book a parking slot online is also provided to the another users. The disadvantage of this system is Time consuming because of the bar code scanning process in the entry gate of the parking area.

The main aim of this paper [6] is to develop an automated smart parking management system that would help the driver to find some suitable parking space for his/her vehicle very quickly. In this paper presents an internet-of-thing (IoT) based E-parking system that employs an integrated component called parking meter (PM) to address inquiry on availability of parking space and reservation of parking lot, Real-time parking navigation and route guidance, Vehicle occupancy detection and management of parking lots, Real-time detection of improper parking using PM, Estimation of each vehicle's duration of parking lot usage. The proposed E-parking system uses an integrated component called parking meter to address the above mentioned issues as well as to provide smart parking management throughout the city. The proposed PM-EP presented in this paper consists of four different modules. They are parking lot monitoring system (PLMS), local parking management system (LPMS), central parking management system (CPMS) and lastly parking availability information and reservation GUI. The drawback of this paper is that accuracy of vehicle detection at the entrance is in very low, there is no proper booking system so that real-time detection of improper parking can't find the vehicles who violate and park in another user's parking lot and also here the payment system is based on duration of reservation and the payment should be done during reservation too so that the entire system not have a user-friendly approach in duration of reservation. i.e., if the user spends least time for parking than his paid duration, there is no refunding system and also when the user used more time than his specified time limit, it would effect the entire system and there is no proper system to control this.

The main aim of this paper [7] is to develop a smart parking system using vision system for disable drivers (OKU). To accomplish this recognized image undergoes several pre-processing phases. Pre-processing phases includes RGB to grey filter technology, Gaussian filter technique and then the image undergoes background correction algorithm and then to centroid algorithm. All these things are used to get a clear capture of the vehicle when it arrives at the parking area. After obtaining pre-processed image it has to be recognized to perform certain functions such as the system is using K-Nearest-Neighbour algorithm (KNN). The main purpose of this algorithm is to stores all the provided spaces and allocates new cases on the basis of similarity measure for example distance functions. KNN has been used excessively for pattern recognition and statistical estimation. Here it recognizes OKU sticker which is placed on the disabled vehicles and checks whether the user is a disabled driver or not and then only it allocates parking lot. The main drawback of this system is that here the system is using vision based technology so that climate change is a major problem and also the system requires high cost for initial investment and also for maintenance.

The main aim of this paper [8] is to a parking management system using mobile application to address the parking problems in malls. This paper contribution can be split in to two. The hardware part which consists of custom-made sensor units based on a phototransistor with an infrared transmitter that is responsible for determining if a certain parking space is occupied or free. The units connect to a central controller wirelessly using Arduino microcontrollers with Ethernet shields. The central controller is a server hosting a database that is accessible through the developed mobile application. There is mobile application in this system which is developed using the Eclipse IDE and runs on the Android platform. It connects to the database using JSON (JavaScript Object Notation) format. The users can use this application when they enter in to the mall and also they can locate free parking spaces, check the parking fees, locate their cars, and even pay using the mobile application. The main drawback of this system is that the entire system features spends a lot of time even in the payment section too. This system can be used only to solve the parking problems in malls which says the system limit which is also a disadvantage.

The main aim of this paper [9] is to develop a secure and reliable cloud-based intelligent car parking system based on Internet-of-Things (IoT) technology for smart cities. Here the system uses WSNs to monitor each parking space. This real-time status of each parking space is transferred to an integrated server through the wireless router. By using this wireless router, a large-scale parking area can be monitored at low cost. The user can choose suitable parking spaces by logging into the system. Information on the selected parking spaces should be confirmed to the drivers via different notifications and also this system prevents multiple reservations by the other drivers. The system updates the statuses of all the parking spaces from the WSN nodes when new cars enter the parking area so that the statuses of parking spots updates in a real-time manner. Reliable operation and work in case of power shortage (working in the offline mode) can

This work is licensed under a Creative Commons Attribution 4.0 International License

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 10, Issue 1, January 2021

DOI 10.17148/IJARCCE.2021.10125

be guaranteed by using a battery bank which can supply enough power to the proposed intelligent car parking system. The main drawback of this system is that here the payment section is at the booking stage so that the system's payment scheme is not based on duration of each parking lot and also the system is missing some important features like there is no refunding scheme, payment system and time-up limit to pay parking fee is not in a user friendly approach and also the entire system is in a time consuming approach.

The main aim of this paper [10] is to develop a reservation-based Smart Parking System to avoid traffic congestion. Here this system have a mobile application to the users for reserving parking lots. Here the system using GPS technology to track the user's location and also this system is using some sensing technology in the parking area to update the parking lot update information to the database. Here this system using colour based approach to indicate whether the parking lot is occupied or free. This would help the user to reserve the parking lot in more easier way. The main disadvantage of this system is that the system is missing some important features to make parking area more comfortable and also the system requires some manual works like checking whether the vehicle is a booked user or not, fake user detection, checking improper parking etc.., and also the system required manual work in payment section too which leads that the entire system is in a time consuming approach.

The main aim of this paper [11] is to develop a smart parking system which enables a user of find a parking location and a free slot in that parking space inside a city and also this system focuses on reducing time wastage while finding parking space nearby and on-going through the filled parking slots. Here the system using hardware components such as raspberry pi, Arduino pre-assembled microcontroller, Ultrasonic sensors (HC-SR04) and RFID (RC522) and also the system is using software such as Node.js, Socket.i-Client and Pigpio in Raspberry pi, Node.js, Express, Socket.io, AWS-EC2, MongoDB, Nodemailer and Google Distance Matrix API in cloud application and the system is using React and Redux in client application. Cloud Application reads the data sent by Raspberry Pi application and stores it in the MongoDB. It also reads the triggers sent by Raspberry Pi application when a user enters the parking using RFID, it maintains the logs such as entering time, exit time, parking id, billed amount for the parking and emails the user invoice for a parking session. Client Application is a progressive-web-app using which user can access our services. Raspberry Pi and Cloud application are connected using web socket protocol. The main drawback of this system is that the system is not focusing to reduce time wastage while in payment section.

The main aim of this paper [12] is to develop a prototype of smart parking system using wireless sensor technology and networks. Using a Wireless Sensor Network (WSN), parking spot statuses (occupied or idle) are detected and transmitted to a database. This information then be accessed by users through website or mobile app (application) to receive real-time updates. This system should provide users with near instantaneous updates of available parking spots while the WSN allows for flexibility of sensor placement. Here the smart parking system consist of two fundamental parts: parking detection and user notification. Parking Detection is responsible for detecting if a vehicle is in a parking spot. This can be done with many different types of sensors. This information should then be sent to the User Notification system. User Notification will relay the status of each parking spot to the end user. The main drawback of this system is that there is no proper methods to control improper parking and also payment scheme is not in an automated approach.

The main aim of this paper [13] is to a new solution for parking management and control that can be used along with the actual parking system. Here the system uses a Web Service as a data controller, a database for data storage and three client applications targeting a better user experience. Web Service's role is to process data received from clients and works as a link between clients and database. Also, Web Service role is to validate requested data and send a proper response to client according with validation result. Clients splits into Web Client (Web Application), Mobile Client (Android Application) and an Admin Client (Desktop Application). Web and Mobile clients are used by drivers to reserve, pay the parking ticket or to make a subscription. Admin Client is used by an admin to add new cities, new parking in system, edit actual data or just view actual data. All the algorithms and results obtained in this paper are developed and tested using the C# and JavaScript programming languages and SQL query language. The main disadvantage of this system is that the entire process in the system makes time consuming and also the payment scheme is in a manual way.

This paper [14] introduces the concept of using smart technology in car parking services in particular commercial area in cities. This design makes the traditional concept of parking system smarter by leveraging the power of IoT and embedding it with the latest innovation of electronic sensors & computers. It mainly focuses on reducing the time involved in finding parking lots and also on avoiding unnecessary travel through filled parking lots in a parking area. Many software applications and mobile apps have been proposed to provide a good parking experience to the users but there are many limitations like proper time usage in pre-booking through apps, traffic clearance, valet parking and allocation of slots near to the user required area. This proposed paper have a smart parking system for commercial stretch in cities (SPSCSC) which can be implemented using different database storage systems like Cloud, MySQL, Python wherein the vehicle is guided to the parking lot using the data, which is collected by sensors and image detectors, which is then processed and the necessary instructions are sent to the mobile of the user. The main disadvantage of this system is that the project is missing some important features which will help the user to find

This work is licensed under a Creative Commons Attribution 4.0 International License

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 10, Issue 1, January 2021

DOI 10.17148/IJARCCE.2021.10125

parking lot more easier and also there is no proper methods to control time wastage in finding the parking lot and in the payment scheme.

The aim of this paper [15] is to reduce the time involved in finding a parking area for the user and also to eliminate the unwanted travelling through the occupied slots in a parking area for finding a free parking slot. This will also help to reduce the consumption of fuel, thus reducing carbon footprints in our environment. There are some hardware components used in this paper, such as IR sensor, Arduino Uno, Wifi module. In the parking area, the slots are occupied with IR sensors for detecting any presence of vehicle in the slot. Arduino microcontroller will update the slot information in the data base. The slot information will be available in the user's smartphone in a mobile application with the help of Internet. The user can view and can book any available slot from the smartphone. The drawback of this paper is that there is no automated way for collecting parking charge, in this system parking charge can only be collected manually by a worker at parking area.

The aim of this paper [16] is to implement a smart parking system for a large parking area which will efficiently manage the parking area and also provide information on the nearest parking slot available through the mobile application, which will results in reducing the traffic congestion made by users. The hardware components used in this paper are Ultrasonic sensors, servo motors, Wifi module, Arduino Uno. The ultrasonic sensors will detect the occupancy of a car in a slot. The slot information in taken from ultrasonic sensors and updated in cloud by Arduino. In this paper, Thing Speak open IoT platform is used to store all the data related to the parking space availability and all the information is send to mobile application. So, the user is able to see which all slots are available. The major drawback of this paper is that there is no option for booking a parking slot.

The purpose of this paper [17] is to implement a smart car parking system based on NB-IOT controlled by a software application. This paper also aims to implement the smart car parking system at low cost with wide area coverage and lower power consumption with higher connectivity speeds. All these features are provided by NB-IOT. The hardware used in this paper are NB-IOT, S200 sensors, Arduino, QR Code scanner. The slot detection is done by S200 sensors, and the data of whether the slot is occupied or not is transferred to database by Arduino with the help of NB-IOT. In this paper, user is able to view the available slots in mobile application and book any specified slot. Then a QR code will be generated for the user. This QR code is scanned at the entrance of the parking area. Thus, system verify the booked user and allow user to enter parking area. The drawback of this system is that non-booked users cannot park in the parking area where this system is implemented.

The paper [18] proposes a smart car parking system that will help users to solve the issue of finding a parking space and to minimize the amount of time spent in finding a nearest available car parking area. This system also provides user the information of roads traffic congestion. Also the system collects the raw data locally and extracts essential data by applying data filtering and fusion techniques in order to reduce the amount of transmitted data over the network. After this process, the transformed data is then sent to cloud for processing and evaluating the data by using some machine learning algorithms. The system provides an easy way to save energy and minimize the transmitted data over network.

The paper [19] focuses on implementing a smart car parking system using IOT and cloud based technologies, for changing the traditional car parking area into a new automated car parking system. The hardware used in this paper are IR sensor, Image detection cameras, Arduino. The cloud technology is used in this system to connect with parking area and mobile application. If a booked user arrives the parking area, the image detection cameras are used to identify the booked user and allow to enter inside the parking area. The drawback of this paper is that, it does not consider about non-booked users as non-booked users cannot park in this parking area.

The aim of this paper [20] is to develop an IoT based cloud integrated smart parking system, for the purpose of reducing traffic congestion, tackle the problems with limited car parking facilities and to improve road safety. The hard wares used in this system are IR sensor, Raspberry Pi, Wifi module. The cloud computing technology is included in the system to implement the system efficiently and real time. The user can view and book a particular slot through a mobile application. After parking in the booked slot, the user must mark the slot as parked in order to specify the presence of a car. The drawback of this paper is that the system does not incorporate non-booked users.

IV. CONCLUSION

In all well-developed cities it is very difficult to create more parking spaces for car since those cities have almost reached its exhaustive occupancy. So, need for a smart car parking System is very essential. By using IoT and sensors with the help of user friendly mobile application, the identification of the parking area will turn to be easier. The smart parking management system will reduces stress and anxiety experienced by the user while searching for an available parking slot. Already an ample of research work on the topic smart parking is exist in literature. These systems can reduce the traffic cause by the vehicles in looking out for parking slots. The amount of carbon emission by the vehicle can also be reduced as this saves the unwanted time spent so the car will be turned off. These systems can make visible, an array of information around real-time car park usage and trends for future planning. Thus these papers ideology is to provide low cost, low power consumption, more accurate solution which is well suited for real time implementation. With all such benefits, leveraging IoT and its concepts in today's world our system will be a step towards an advanced

This work is licensed under a Creative Commons Attribution 4.0 International License

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 10, Issue 1, January 2021

DOI 10.17148/IJARCCE.2021.10125

future. Thus these systems should be built over with courage and moreover they can strictly reduce traffic related issues and also can save our valuable time for spending parking in various places.

ACKNOWLEDGMENT

We utilize this opportunity to convey our gratitude towards all those who have helped us directly or indirectly for the completion of our work. We deeply and whole heartedly thank **Mr. Sreeraj R** -HOD, Computer Science and Engineering for his extreme valuable advice and encouragement. We especially thankful to our guide and supervisor **Ms. Sneha George** -Assistant Professor ,Computer Science and Engineering for giving us valuable suggestions and critical inputs in the preparation of this paper. We would like to extend our sincere gratitude to all faculty of Computer Science and Engineering department for the support and suggestions that helped us in the development of our work to what it is now. We thank our parents and friends for the mental support provided during the course of our work at the times when our energies were the lowest.

REFERENCES

[1]. Agustina Ampuni, Adi Fitrianto, Gunawan Wang, Sopater Fonataba ,"Smart Parking System with Automatic Cashier Machine Utilize the IoT Technology", in 2019 IEEE International Conference on Internet of Things
[2]. Norah farooqi, Shroug Alshehri, Sahar Nollily, Lama Najmi, Ghaidaa Alqurashi, Abeer Alrashedi ,"Uparking : Developing a Smart Parking Management System Using the Internet of Things(IoT)", in 2019 IEEE International Conference on Internet of Things
[3]. Mahendra B.M, Dr. Savitha Sonoli, Nagaraj Bhatt, Raghu T, Raju ,"IoT based sensor enabled Smart Car parking for Advanced Driver assistance System", in 2017 IEEE International Conference on Internet of Things
[4]. Balwant K. Patil, Avinash Deshpande, Sonal Suryavanshi ,Rudresh Magdum, Manjunath B. "Smart Parking System for Cars" in 2020
[5]. D. Vakula, Yeshwanth Krishna kolli ,"Low cost smart parking system for Smart cities", in 2017 IEEE International Conference on Internet of Things
[6]. Pamba Sadhukhan. AN IOT BASED E-PARKING SYSTEM FOR SMART CITIES. IEEE transaction on Intelligent Transportation System Application 2017.
[7]. K. Yousaf, V. Durairajah, S. Gobee. SMART PARKING SYSTEM USING VISION SYSTEM FOR DISABLE DRIVERS (OKU). ARPN Journal of Engineering and Applied Sciences VOL. 11, NO. 5, MARCH 2016
[8]. Michel Owayjan1, Bahaa Sleem, Elio Saad, Amer Maroun. PARKING MANAGEMENT SYSTEM USING MOBILE APPLICATION. Intelligent Transportation Systems, IEEE transactions on 2017.
[9]. Fazel Mohammadi, Gholam-Abbas, Nazri, Mehrdad Saif. A REAL-TIME CLOUD BASED INTELLIGENT CAR PARKING SYSTEM FOR SMART CITIES. 2019 2nd IEEE International Conference on Information Communication and Signal Processing.
[10]. Sanam Kazi, Shirgaonkar Nuzhat, Ansari Nashrah, Qureshi Rameesa. SMART PARKING SYSTEM TO REDUCE TRAFFIC CONGESTION. . IEEE transaction on Intelligent Transportation System Application 2018.
[11]. Akash Gupta, Priyanash Rastogi, Shourya Jain. SMART PARKING SYSTEM USING CLOUD BASED COMPUTATION AND RASPBERRY PI. Proceedings of the Second International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2018) IEEE Xplore Part Number:CFP18OZV-ART; ISBN:978-1-5386-1442-6.
[12]. Robin Grodi, Danda B. Rawat, Fernando Rios-Gutierrez. SMART PARKING: PARKING OCCUPANCY MONITORING AND VISUALISATION SYSTEM FOR SMART CITIES. IEEE transaction on Intelligent Transportation System Application 2016.
[13]. Petre Anghelescu, Ioan Adrian Stefan. PARKING MANAGEMENT AND CONTROL SYSTEM. ECAI 2017 - International Conference – 9th Edition Electronics, Computers and Artificial Intelligence 29 June – 01 July, 2017, Targoviste, ROMÂNIA
[14]. Dharmini Kanteti, D V S Srikar, T K Ramesh. SMART PARKING SYSTEM FOR COMMERCIAL STRETCH IN CITIES. International Conference on Communication and Signal Processing, April 6-8, 2017, India
[15]. Meenaloshini.M, Ilakkiya.J, Sharmila.P, Sheffi Malar.J.C, Nithyasri.S, "SMART CAR PARKING SYSTEM IN SMART CITIES USING IR", 3rd International Conferenceon Computing and Communication Technologies ICCCT 2019, pg. 178-182. IEEE
[16]. Manickam Ramasamy, Sunil Govinda Solanki, Elango Natarajan, Tham Mun Keat, "IoT Based Smart Parking System for Large Parking Lot", 2018 IEEE 4th International Symposium in Robotics and Manufacturing Automation (ROMA).
[17]. M.Praveen, V.Harini, "NB-IOT based smart car parking system", IEEE 6th International Conference on smart structures and systems ICSSS 2019.
[18]. Wael Alsafery, Badraddin Alturki, Stephan Reiff-Marganiec, Kamal Jambi, "Smart Car Parking System Solution for the Internet of Things in Smart Cities", 2018, IEEE.
[19]. Vaibhav Hans, Parminder Singh Sethi, Jatin Kinra, "An Approach to IoT based Car Parking and Reservation system on Cloud", 2015 InternationalConference on Green Computing and Internet of Things (ICGCIoT), pg. 352-354, IEEE
[20]. Abhirup Khanna, Rishi Anand, "IoT based Smart parking System", 2016 International Conference on Internet of Things and Applications (IOTA) Maharashtra Institute of Technology, Pune, India 22 Jan-24 Jan, 2016, pg. 266-270, IEEE

This work is licensed under a Creative Commons Attribution 4.0 International License