Towards Smart City through Virtualized and Computerized Car parking System using Arduino in the Internet of Things

M. Kannan
Department of Computer Science
Vels Institute of Science, Technology and Advanced Studies (VISTAS)
Chennai, India
kannanmuthusamy.research@gmail.com

Mrs. L. William Mary
Department of Computer Science and Applications
St. Peter's Institute of Higher Education and Research (SPIHER)
Chennai, India
william.mca2010@gmail.com

Dr. C. Priya
Department of Information Technology
Vels Institute of Science, Technology and Advanced Studies (VISTAS)
Chennai, India
drcpriya.research@gmail.com

Dr. R. Manikandan
Department of Computer Science
Quaid-e-Millath College for Men
Chennai, India
manisankar27@gmail.com

Abstract—**Nowadays, IoT offering many smart systems to internet users. This smart system has played a vital role in many real-time applications like medicine, cultivation, and security. This paper proposes a new architecture with an algorithm for better to park the vehicle further in this document, examine the parking availability status of the registered and / or reserved vehicle to park the vehicle and examine the sensor-based intelligent parking system. Using mobile applications, the system will help the user detect the parking space in the user's current arena. The IoT-based smart car hosts heterogeneous sensors, each of which has unique assiduously. The smart parking system requires an Arduino microcontroller, a cloud server, an ultrasonic sensor, and an IR sensor, enough to efficiently park a vehicle in the assigned slot. The ultrasonic sensor can check the availability of the slot in the parking area. Similarly, the IR sensor is used to control the entry and exit of the vehicle. The main intention of the car parking system is to distribute the slot in the vehicle (user) in the parking area without becoming rigid for vehicle parking. At last, this paper explains and also shows a general description of the intelligent system.**

Keywords—Arduino microcontroller, Cloud servers, Internet of Things, IR sensor, Parking application, Ultrasonic sensor, Vehicle

I. INTRODUCTION

Internet of Things has many innovations; although autonomous vehicles are elegant and eccentric. The key point of this paper is to share the capabilities of IoT-based autonomous cars with their computer-based applications, including how the system is efficient in the industry. Today, all middle classes, as well as the rich, can buy a car. Transportation is a necessary source, for everyone to reach the destination very quickly. Due to the increase in motor vehicles, people face various vulnerabilities such as traffic jams, pollution, parking availability, road accidents and various consequences, in particular. This document unquestionably discusses the vehicle parking system used to find precise parking space using the web-based objects (IoT). In an intelligent and computerized environment, everything is updated day by day. The cloud offers multiple customer benefits, especially the archiving system used to store data in our private cloud for future reference. A private cloud model is created for high-security purposes. Different combinations of cloud models reproduced in the IoT environment. This cloud-based Internet of things is one of the epochs and also efficient for the user and Internet users. Thanks to this advanced technology, people will feel comfortable in their lives without thinking about other problems. On the other hand, everyone has faced problems. The IoT helps the user to raise the life of humans as much as the reality.

In the current parking lot, the systems have no computerized system to store our car. Until now, the entire vehicle parking system is managed through the manual process. The main problem with this manual system is the loss of time and the search for optimal parking for the vehicle. Sometimes vehicle users can search in another parking area and the slot has no vehicle availability. Therefore, this causes a fuel management problem and traffic can also occur. But in recent intelligent parking systems, they are addressed using the cloud-based Internet of Things application. To search for a parking space for vehicles, then IoT uses different sensors for the automated parking system. In this intelligent system that contains, all processes are fully automated from the vehicle entrance door to the vehicle exit from the parking lot. Cloud technology is a surface technology and one of the Web applications offers data storage capacity with high security.

Cloud computing adopts various IT resources and stores this information as a separate file using different cloud models at the user's discretion, while Internet of Things (IoT) is a new era of technology that offers similar advantages based on cloud computing IoT devices come used to access and communicate with real objects and store data for future use. IoT uses servers in the cloud to

access the database from a different module in the cloud. This document contains a systematic survey on the intelligent parking system for finding the availability of slot space through the Internet of Things (IoT) cloud. To identify free parking, then IoT uses several sensors to track the distance to the place. We know very well that the network of things is intelligent, reduces the workload of the user and makes them feel free. In general, urban cities have at least one motor vehicle; they can easily pay for the vehicle. Therefore, mores parking problems have occurred in urban cities. The cloud-based IoT car parking system obtains slot information (data) from cloud servers using various sensors involved, such as parking availability, the last parking time and remaining vehicle time in the slot, etc. This information is collected and stored in the user's mobile application for future use.

The intelligent IoT-based vehicle parking system is a close solution for high-population cities through this intelligent system, users do not have to waste money, time and fuel. When adopting an intelligent parking system, people do not have to worry about the safety of their vehicles due to the automated process.

II. RELATED WORKS

A. Implementing of an Image Processing based Smart Parking System using Haar-Cascade Method [1]

Imam Muhammad Hakim and his team carry out a temporary project to trace the parking area using the image processing system. This document implements a concept of image processing, as well as the cascade Haar method, this system will contain, and each parking space has its camera for protection. So far we can say that this is against thieves and one of the security systems. With this system, the driver will get all the information on the parking area and the status of the vehicle through the user's mobile application. Through this, data can also be displayed.

B. Smart Parking System Using IoT [3]

This document contains a KNN algorithm for slot security and availability. For this, a sensor module, a raspberry pi module, and the arduino module are used for reserved and non-reserved cars.

C. Internet of Things based Smart Vehicle Parking Access System [4]

This document proposes a new methodology to check parking availability using the raspberry pi module. The ultrasonic sensor is one of the main parts for tracing most of this document. Provide the result in 2 ways. If the slot is available, the monitor turns green; otherwise, it shows a red light, which means that the slot is not available. The results [4] are displayed using the inactive Python module environment.

D. Smart Parking Using IoT Technology[5]

This document proposed to increase vehicle safety by identifying the QR code and looking for parking spaces in the mall or a theatre. It provides information on the advanced parking reservation system.

E. IoT Based Smart Car Parking System[6]

This document proposes a new parking algorithm to search and park the car in the allotted space. This module is completed using combinations of hardware and software specifications. This module helps to exchange vehicle data between the mobile application and the sensor.

F. Smart City: IoT based Prototype for Parking Monitoring and Management System Commanded by Mobile App [9]

This document uses a new prototype to monitor the vehicle using the geographical location. The sensor observes the vehicle as when the vehicle leaves the parking slot. This document contains a parking management problem, monitors the vehicle using live streaming from the cloud- based server.

G. Smart Car Parking using Arduino Microcontroller [10]

This document helps the driver to park the vehicle flexibly and efficiently. This document uses two types of proposed buildings. One thing for the vehicle entry and another thing are the purposes of leaving the vehicle. Each of the functions is quite different, but some modules are the same. The input part contains an Arduino MEGA and the output part contains the UNO Arduino microcontroller. Both the input and output parts contain the IR sensor and the servo motor to detect the current vehicle. This complete circuit is designed using IC 555 and IC 4026.

H. Smart Car Parking System Using Arduino [11]

This document proposes and tracks the car's clever parking by using the arduino UNO and the ultrasonic sensor. For this proposed job, the driver can easily identify the parking area that is closed to the driver/user.

I. Intelligent Parking Management System based on Image Processing [17]

It has been discussed that using the technique of image processing, we can find a car parking place. Empty places have been identified with the help of RGB colors which are considered primary colors. The vacant lot is referred to as the red color, the entire vacant space is blue, and the green space when a car is not in its space.

J. Smart Parking Guidance on IoT [21]

Open CV and python have been used for video processing, and the implementation tasks are in python programming. [21] Proposed a new hybrid model to search for available space in the car parking slot.

K. Automated Parking System-Cloud and IoT based Technique [22]

Authors have proposed a new hybrid method for car parking (RFID) system. For this, three different mechanisms are proposed, such as client booking view, timeout, and also for the new android application.

III. WEB OF THINGS

The Internet of Things (WoT) is a bridge to establish the connection between the data and the device; the main ideology of the Internet of Things is to provide the customer with some vital data on the use of the Internet. The IoT concepts and modules are used for multiple intelligent business purposes. Today, this system is used in various applications such as health monitoring, energy management, smart devices, agriculture-oriented tests, transport, laboratories, industrial applications, etc. The Internet of things can be represented as,

> *IoT = physical objects (real world) + Internet source + Wi-Fi controller + sensors + microcontroller + actuators*

This document contains an intelligent search for the parking system. For this, cloud-based IoT sensors are used to search in the possible slot to park the vehicle. The main objective of this document is to address the problem of parking availability in the smart city.

The IoT system shares the user's work using its module. IoT offers many advantages for creating a smart city using its sensor modules. The existing system provided information on the availability of parking spaces for parking the vehicle. This is an excellent method of innovation to learn about free parking spaces. For this, the ultrasonic and IR sensors will be used to detect free space. This document proposes a new algorithm to guarantee the registered position of another vehicle user.

A. Arduino-A Science Kit

The Arduino micro-controller is an electronic-based hardware and software device contains some scientific instruments, which is the brain of the system. It is an open-source, currently available in the various e-electronic stores such as Amazon, Electronics comp, viz. Generally, the board can read and process inputs through a light signal (LED). It is like a digital kit and also the cheapest in the market. Everyone can purchase the board and use it with the knowledge of basic physics principles and also Arduino program too. When compared with other programming, Arduino is much easy to understand and also easy to use. It will support different operating systems like Mac, Linux, and Windows.

Arduino is a simple tool that provides many resources to create various smart and new things. This program offers many advantages to the students to learn easily and much quite interest. The main intention of building Arduino boards is to give some creative throughput. The system allows connecting the microcontroller board with a computer by the use of a USB connection. To do this, the user will impress the result through the user's PC by the implementation of A-IDE (Arduino IDE). After all the connections were done, the system will interact with sensors and motors, etc.

B. Problem Description

In the current decade of the population and vehicle census report (2019), China has more quantities and India is approaching. According to the survey of the total population by country, over both countries, there are a billion people, it was also reported that the Indian motor vehicle had 28,860,000 units in December 2015. On the other days, it could increase considerably. For this reason, traffic congestion occurs.

Therefore, the population increases, traffic can also be increased vice versa. When declaring this problem, a vehicle could park in unassigned locations and then drive in traffic. This is one of the biggest emissions of metropolitan cities, where people have to face this complicated situation like every day. For the unbalanced situation, the intelligent and optimized parking system is used. Some of the important issues including,

- The availability of parking spaces/search for space is one of the problems that affect time management.

- May cause traffic.

- Parking research is a tedious process during peak or peak times.

- Sometimes, the availability of slots may be useless due to traffic congestion.

- Sometimes, searching for slots can be annoying for drivers.

- The availability of parking spaces during sunny and rainy seasons is a problem

IV. VIRTUAL CAR PARKING SYSTEM

The diagram of the intelligent parking architecture is shown in the following figure [3]. This figure contains the load balancing system to provide parking space for each driver required based on the sequence model. This system proposed and managed by the FCFS mode rule. The virtual car parking system (VCPS) is efficient and beautiful and alternates the normal city to the digital city (intelligent). This VCPS is automotive due to the influence of the Internet of things.
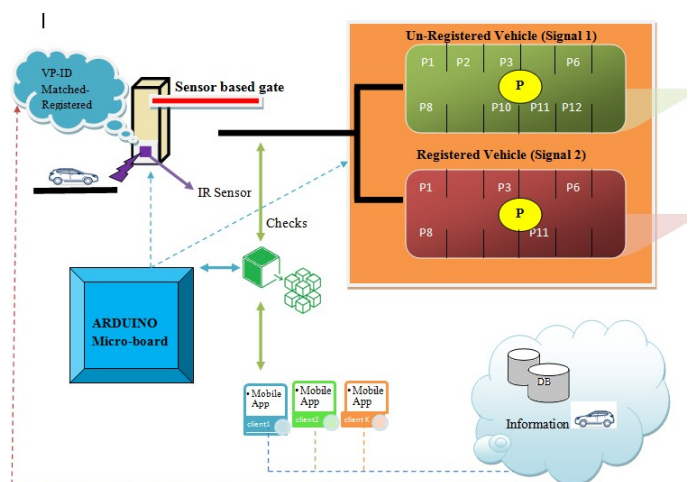

Fig. 1.   Architecture of IOTPS

IoT-based sensors and parking applications help the driver reserve vehicle parking. The proposed algorithm also helps to find the virtual parking lot to store the vehicle through a mobile application. This algorithm offers the

user the best result and reduces slot search times. Figure 3 is shown above, considering a smart car park. That will be divided into two signals which are signals 1 and 2.

A. Details of Signals 1 and 2

Signal 1 is a normal parking space. Unregistered users can use the system. Signal 1 was created specifically for timed users. This area has a time limit for parking the vehicle. Signal 2 is created separately for long-term parking users / registered drivers. This means that the vehicle has all the right to interrupt the day's account. Here all the jobs are computerized, thanks to the intelligent parking system. For this reason, each user receives the unique VP ID after paying the parking fee. The cloud server provides this identification based on the hash code to guarantee. VP-ID automatically updated the data on the port based on the sensor through the Internet connection. This will help the user if the identification is lost. A virtual parking ID has some interconnections with the car number. Therefore, the IR sensor can easily identify the registered vehicle. Suppose that, if the vehicle is not registered, the system will allow the vehicle to park the signal 1.
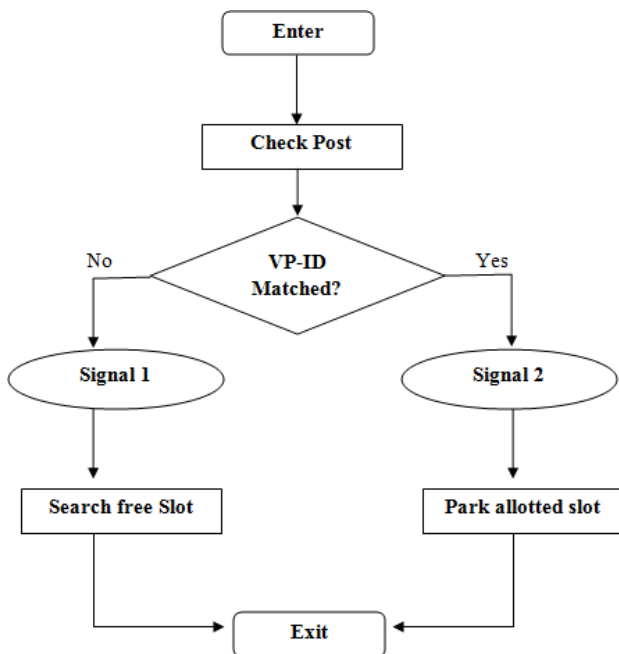

Fig. 1.   VCPS flowchart

B. Algorithm IOTPS

Step 1: register

It contains some personal information such as user name, vehicle name, vehicle number, email ID, etc.

Step 2: research area

According to the user's request (city location).

Step 3: the available parking space after tracing the requested search area and tabulating the searched parking area (positive result).

Step 4: book the place by hours or by day

If hourly-based, go to step 5, else go to step 6.

Step 5: search and occupy space

Open Door Signal 1 - Pay the parking amount while the vehicle is an exit.

Step 6: go to the payment page

Here the user must pay the fee for the selected slot. Otherwise, check the high acoustic alarm after production when the vehicle passes by the door, according to the sensor (daytime base vehicle only).

Step 7: VP_ID

Receive VP_ID after successful payment (car number ID)

Step 8: sensor port

Gate identifies the vehicle registered using VP_ID, while the vehicle is present.

Step 9: signal 2

The registered vehicle may be authorized to enter the 2-door signal if the ID matches, otherwise enter the signal 1.

Step 10: Exit or vacate the vehicle.

V.   DISCUSSION OF VEHICLE STATUS REPORT

Traffic is one of the globalized problems due to global warming. All countries face this traffic day by day. This page shows the annual essay traffic index. Because of the traffic, people waste precious time and have spent a lot of money on it. Traffic creates numerous problems for both humans and nature through the emission of CO_2. So, in this section, we fully know the traffic index in the Indian country.

For this discussion, all traffic-based data from [13] and [14] are collected.
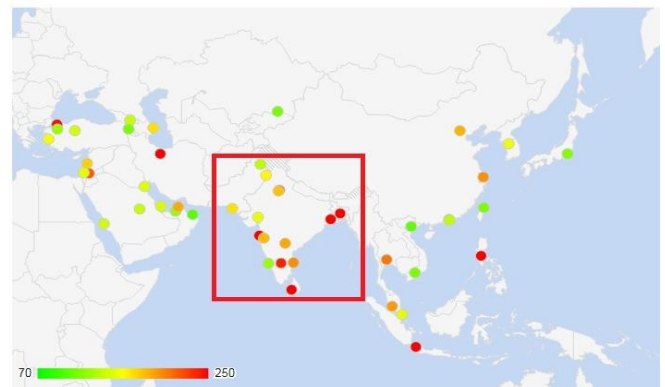

Fig. 2.   Traffic Index Rate in India

TABLE I.   VEHICLE USAGE INDEX

Name of the Vehicle	Peoples Used (in Percentage
Car	40.08
Bike	19.79
Bus	11.39
Motor Bike	8.25

In all the worlds, people have commonly used motor vehicles to move from one place to another

simultaneously. Here we will take an example of an Indian country, how many groups of people have used types of vehicles to change the place. This will be shown in the previous table 1. The graphic representation of the vehicle's uses is shown in Figure 4 below.

Tables 2 and 3 contain traffic data from the Indian country. From these two reports, Delhi and the city of Calcutta (India) have an index of similarity in terms of scope, many people have there and use a car - table 1 (vehicle).

TABLE II.   Traffic Index Report 2018-India

City	Traffic Index	Time Index (in Minutes)	CO_2 Emission Index
Dhaka	309.63	63.94	6466.67
Kolkata	299.43	62.8	6217.27
Jakarta	286.43	58.09	8865.62
Manila	283.77	58.33	8865.7
Delhi	282.53	56.69	9655.35

TABLE III.   Traffic Index Report 2019 -India

City	Traffic Index	Time Index (in Minutes)	CO_2 Emission Index
Delhi	279.84	56.56	9289.27
Kolkata	279.74	61.01	5012.65
Mumbai	266.95	56.43	7251.32
Bangalore	245.48	52.44	7401.62
Chennai	203.55	47.64	5041.38

For the excess of population, both cities (Delhi and Kolkata) affected by traffic and CO_2 emissions were also exchanged. In table 1, about 40% of people know and pay for a car. Worldwide, India has a lot of traffic compared to other countries. To increase car use, we must provide an efficient place to park the vehicle without distracting others. Finding a parking space is also another tedious task to position the vehicle.

IoT offers many innovative systems; Smart parking is one of the most efficient and important. An intelligent parking system has elevated the city and reduces the workload of the driver.
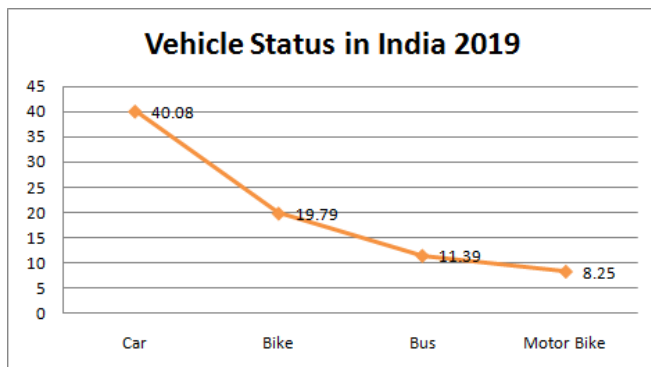

Fig. 3.   Report 2019-Vehicle Usage Status

CONCLUSION

Today vehicles are an essential part of everyone. However, traffic is so prevalent that everyone uses vehicles. Nowadays, finding a parking space is a tedious process to park the vehicle while the user is outside. And providing parking space for the vehicle is also an essential source. This document provides an overview of the smart, intelligent parking agenda for the smart city. Therefore, it is one of the efficient sources, according to the current population survey.

This system approaches VP_ID for each user while the user is registered for identification purposes, will be useful for the sensor port. Furthermore, this document proposed a new algorithm called IOTPS to search for vacancies and record the place to park the vehicle. The main key to this proposed work is to help reduce fuel costs and find an optimized vacancy.

In the future, we will have to implement this architectural system to develop our city as an intelligent and beautiful style. This intelligent and innovative technology will help to reduce the bottleneck.

REFERENCES

[1]   Imam Muhammad Hakim, David Christover and Adi Mahmud Jaya Marindra, "Implementation of an Image Processing based Smart Parking System using Haar-Cascade Method", IEEE, pp. 222-227, 2019.

[2]   Anuradha G, et al., "IoT based Smart Parking System", in International Journal of Computer Science and Engineering, Vol-7, pp. 288-292, E- ISSN: 2347-2693, May 2019.

[3]   Ashutosh Kumar Singh, Mohit Prakash et al., "Smart Parking System using IoT", in International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 04, pp. 2970- 2972, Apr 2019.

[4]   Gontla Sucharitanjani, Peddinti Naresh Kumar, Bhupathi, "Internet of Things Based Smart vehicle Parking Access System", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-6, pp. 732-434, April 2019.

[5]   Kalekar Nikita U, Wani Renuka B, Tanpure Swapnali B, "SMART PARKING USING IOT TECHNOLOGY", in International Journal of Science Technology Management and Research, ISSN (online): 2456- 0006, Volume 4, Issue 4, pp. 34-37, April 2019.

[6]   Shruthi Mudaliar et al., "IoT Based Smart Car Parking System", IJSART- Volume 5 Issue 1, ISSN [ONLINE]: 2395-1052, pp. 270-272, JANUARY 2019.

[7]   Saidur Rahman and Poly Bhoumik, "IoT Based Smart Parking System", in International Journal of Advances in Computer and Electronics Engineering Volume 4, Issue 1, ISSN: 2456 – 3935, pp. 11–16, Jan 2019.

[8]   P B Natarajan, Samit Kumar Ghosh, "Design and Implementation of Smart Car Parking System Using Lab VIEW", in International Journal of Pure and Applied Mathematics Volume 120 No. 6 2018, pp. 329-338 ISSN: 1314-3395, 2018.

[9]   Durga Devi TJB, Dr.A.Subramani, Dr. Vijender Kumar Solanki, "Smart City: IOT Based Prototype for Parking Monitoring and Management System Commanded by Mobile App", in Proceedings of the Second International Conference on Research in Intelligent and Computing in Engineering pp. 341–343 DOI: 10.15439/2017R23 ACSIS, Vol. 10 ISSN 2300-5963, 2017.

[10]   Mr. Vedant Chikhale, Mr. Raviraj Gharat, Ms. Shamika Gogate, et al., "Smart Car Parking Using Arduino Microcontroller", in International Journal of New Technology and Research (IJNTR) ISSN: 2454-4116, Volume-3, Issue-6, pp. 28-31, June 2017.

[11]   Sabiya Sultana, Sadaf Anjum et al., "Smart Car Parking System using Arduino UNO", in International Journal of Computer Applications (0975 – 8887) Volume 169 – No.1, pp. 13-18, July 2017.

[12] Faheem, S.A. Mahmud, G.M. Khan et al., "A Survey of Intelligent Car Parking System", in Journal of Applied Research and Technology, Vol. 11, pp. 714-726, October 2013.

[13] https://www.numbeo.com/traffic/gmaps_rankings.jsp

[14] https://www.numbeo.com/traffic/region_rankings.jsp?title=2019-mid&region=142

[15] http://www.arduino.cc

[16] http://www.circuito.io

[17] Hilal Al-Kharusi, Ibrahim Al-Bahadly, "Intelligent Parking Management System Based on Image Processing", World Journal of Engineering and Technology, Scientific Research, 2, 55-67, 2014. http://dx.doi.org/10.4236/wjet.2014.22006

[18] Yousun Kim et al., "Proof of concept of Home IoT connected vehicles", Sensors, MDPI, pp. 1-13, 2017. DOI:10.3390/s17061289

[19] https://reolink.com/best-security-cameras-for-watching-your-car/

[20] Jhonattan J. Barriga, Juan Sulca, Alejandro Ulloa, Diego Portero et al., "Smart Parking: A Literature Review from the Technological Perspective", Applied Sciences, MDPI, 9, 4569, doi:10.3390/app9214569

[21] Salma, Rashidah, and Morshidi, "Smart Parking Guidance System on IoT", International Journal of Recent Technology and Engineering (IJRTE), Volume 8, Issue-2S11,pp.2793-2798, 2019. DOI: 10.35940/ijrte.B1344.0982S1119.

[22] Rajeev Tiwari, Hitesh Kumar Sharma, Ayush Sharma, et al., "Automated Parking System-Cloud and IoT based Technique", International Journal of Engineering and Advanced Technology (IJEAT), Volume 8, Isuue-4C, pp. 116-123, 2019.