# Smart Parking Exploration System in Real Time Environment through IOT

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This study aims to propose a Technology network architecture and explain a new algorithm that boosts the effectiveness of the present smart parking cloud-based system. Finding open parking places is difficult for users to perform at busy times of the day, but the "SMART PARKING SYSTEM" project offers an algorithm-based technique to do so. The finest solution for the parking problem in big cities is provided by this initiative. The method proposed in the study helps users find a free place automatically by considering the size and overall availability of spaces in each parking IoT. We successfully implemented the proposed strategy as well. Additionally, customers can find vacant parking sites and reserve a spot that uses a smartphone application. Smart Parking might create more jobs by lowering gasoline carbon emissions and pollution in big cities.

**Keywords**: Internet of Things, Cloud Computing, Smart Parking, Arduino, Wireless Sensors, Raspberry PI

2023. In Deepak Bhatia & Himanshu Arora (eds.), *SCRS Proceedings of International Conference of Undergraduate Students 2023*, 85–95. Computing & Intelligent Systems, SCRS, India. https://doi.org/10.56155/978-81-955020-4-2-9

# 1 Introduction

The idea of the IOT devices and IOT originated with objects that identify communication equipment. This allows the item to be tracked, managed, or observed from any location in the world employing computers or even cellphones [1-2]. The IoT allows for the detection and remote command over objects using current network infrastructure (IoT) [3]. As a result, productivity rises and there is a closer connection between implementation carried out on computers and the real world. Smart parking is one use for the Internet of Things, a device that first appeared in 2006 [4]. To put it more precisely, the Internet of Things (IoT) is a concept that enables a variety of objects to interact with one another to offer new services or even functionalities. Both wireless broadband connections can be used to link these components [5-6]. Because of population growth and economic expansion, there are more cars on the road every day. Parking, which has become quite expensive, is one of the main issues that cities are currently facing. For instance, while working, it could be challenging to find a parking space. The users find it more bothersome while utilizing a parking IoT to find a spot [7-8].

If a lot is available or not, a response is delivered to the person who seeks a parking space. The parking attendant, who may check with the client, receives the same data updates. The fact that the data is kept in the cloud makes it simple to access, update, and modify the data [9- 10]. As a means of remedying issues and profiting from the tremendous technological improvement, Technology utilizing the Internet of Things (IoT) has transformed many facets of life, including technology for parking management systems (SPS). An efficient cloud-based SPS solution built on the Web of Things is proposed and developed in a current study. The information about each parking garage, such as the car Geo-location, the distance across car parks, and the number of spots available in each lot, will be transmitted to the data centre via our technology, which transforms each parking lot into an IOT infrastructure. Parking application costs are computed by the data centre acting as a cloud server; these rates are updated often and are always available to the network's cars [11-13]. Parking lots may be controlled and watched over automatically because the SPS is based on various cutting-edge technologies. The recommended system's parking lots can all run independently as regular parking lots [14]. In order to show the viability of the proposed system, this research also develops a wireless prototype of a system in an open-source physical computing system based on Uno with RFID technology [15]. The system uses a cell phone as the connection and a web browser. The web of things is composed of real items coupled with motors, sensors, and sensors as mentioned in Fig. 1.

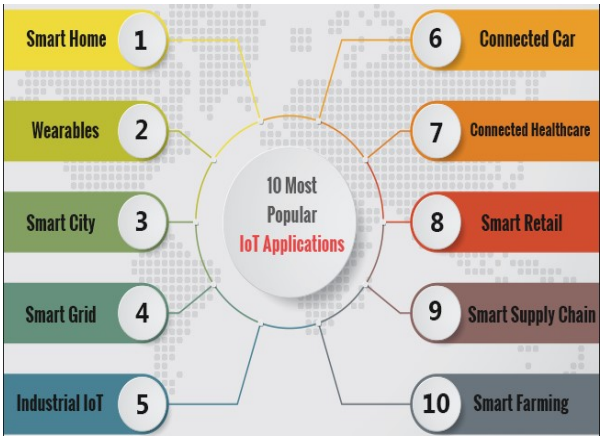


**Figure1.** Application Of IOT [16]

## 2 Literature Survey

For collecting the information from the climate and soil, an observing sensor of IoT is utilized in the farming field, it will help in Finding a decent parking spot is the main challenge for Indians who own cars in large cities owing to a scarcity of parking spaces. Over 40 million automobiles are owned by both businesses and private persons in India. And because of the low cost of automobiles and the increase in the economic standing of the middle class, the number is rising daily. Although there have been more cars on the road lately, the amount of parking space has not expanded in line with demand. As a result, parking takes up around 40% of available road space, which raises the risk of traffic accidents [16-17]. Real-time parking treatment planning has been approached in a novel way by the authors of several studies. They started off by using an algorithm to convert the online parking system challenge into an offline one. In the subsequent stage, the Statistical model was devised that classified the disconnected problem as a nonlinear problem. They developed a third strategy to deal with this linear issue. Furthermore, they evaluated the recommended technique using system simulation. The results of the research demonstrated that quick and efficient functioning was feasible. However, these articles do not cover the following important issues: the mechanism for resource bookings (all parked needs are instantly calculated and placed in the queue), the method for resource system evaluation, the method for directing vehicles to parking spaces, the mechanism for managing situations in which the request for service is rejected, nor do they compute both the average waiting time and the overall average time that each vehicle spends on the system [7, 14]. Using RFID, IEEE 802.15.4 Wireless Sensing Network, and HF frequency technologies in combination, the authors of another study propose an SPS. This system may employ a software application to gather data about the amount of parking lot occupancy and direct visitors to the next available parking spot. The authors of this work, however, do not provide a thorough parking system, and the system design does not have any mathematical calculations. The findings of this article only execute the proposed design; the efficiency of the parking management system is not addressed [18-19]. To guide the automobile to the given location, an inertial coordinate system (INS) is used. The system will routinely update the state of the parking spot in real-time to help ensure system correctness. GPS accuracy is utilized to assess the system's implementation, while the precision of inertial navigation technologies used indoors is applied to analyze system efficiency. The performance of the residential parking has not been evaluated, a mathematical model for the system has not been provided, and the waiting times for each car have not been considered by the authors of this work [20]. For smart cities, several academics have developed parking management architecture. In order to exceed the current public smart parking systems, they invented the automatic parking assistant (Pale Ale) design. This architecture enables vehicles to reserve the most practical parking spot at their location before arriving by informing them of the accessibility of on-street parking spaces. RFID technology is used in this system. When a car enters or quits an IPA parking spot, the electromagnetic loop and RFID reader recognize it and send it to the device controller to update the parking lot's status [15, 21].

## 3 Traditional Parking System

The number of vehicle owners has been continuously rising in recent years so that when someone looks for a spot to park after a long day at work, he is occasionally shocked by the lack of spots and witnesses the driver going past numerous locations until he finds one. Traditional parking has simply two access and exit points. The fact that some parking lots only have one access, have a small number of slots for small cars, and a significant number of spaces for huge vehicles only makes issues worse. In some parking lots, the vehicle may stand yet be unable to open the door (Zhou & Li, 2016). Because the parking spot is too short to provide enough room between automobiles for parking, you take your time getting out of the car out of concern that you will not hit any surrounding vehicles.

**Disadvantages**

- Waste of time forcitizens.
- Waste of fuel which is non-renewable.
- Increasing rush in peak traffic hours in metro cities.

To overcome these problems, we decided to create a smart solution for all these problems ultimately, we found a smart parking system with an algorithm.

# 4 System Architecture

## A. Smart Parking System Based on IOT

IoT, or the idea of tying all devices to one another over the internet is all the rage right now. Each internet-connected gadget has its own unique identity (UID). As per Fig. 2, these devices could be computational, mechanical, or digital in design. Without communicating with other people or machines, they may carry data. IoT technology is one of the most important technologies employed by SPS developers. In an IoT-based SPS, every sensor and computing device is connected to without the aid of a person, data may be sent through the Internet. Simultaneous wired and wireless connectivity can be used to link sensors, computing equipment, and storage containers to the Internet.

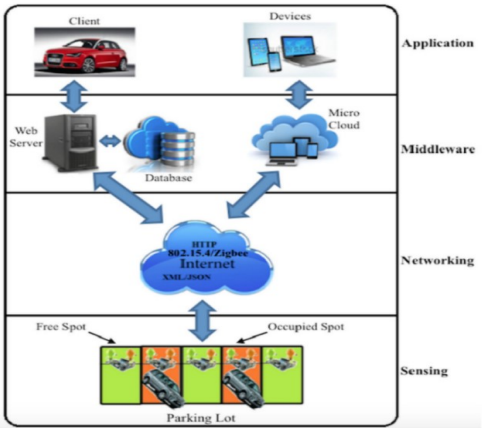


**Figure 2.** Working model & architecture of smart Parking System [22]

## B. IID Database

A smart auto park system using an IoT database. An intelligent parking database is necessary to run the car park efficiently and conveniently. The database connects the internal system and the wide area network that the application is a representation of. Every car reservation has information in the database, including the car's registration, color, and name of the driver, as well as the most recent time the parking spot was hired, and minutes were allotted. This method is used for all automobiles with allocated parking, which must all be paid for. Additionally, the database must include a backup copy of the information that may be used as a comparison in case any data is lost or corrupted as shown in Fig. 3.

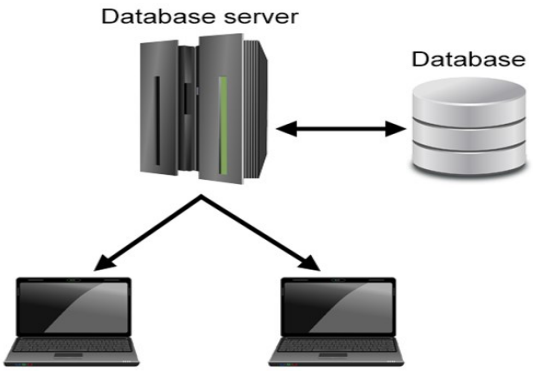


**Figure 3**.Database Server

## C. Sensor Technology

According to Fig. 4, a smart parking system's most important component is its sensors. By integrating every aspect of its structure, smart parking is an intelligent and sustainable method to operate. To maintain sustainability and efficiency, parking is monitored and controlled by infrastructure, services, and smart devices. The sensor that enables the automatic parking system to detect and function is the fourth Mideast University Student Research Conference, which took place in Muscat, Sultanate of Oman. In "smart" car parks, sensors are utilized to track automobile movement within and outside of the lot. A network supports the operation of sensors that are connected to one another. Devices placed at parking entrances or exits receive a signal from the sensor and transmit it to the database.


**Figure 4.** Some Examples of Sensor Technology [23]

### D. Cloud Processing

As per the Fig.5 shown below, the parking service processes and stores its data on the cloud. It keeps a lot of data on the time of entry and leaves, as well as the amount of parking that is available and occupied. Additionally, it gives the position of the parking and updates the cloud when a new car is parked or pulled out of one.

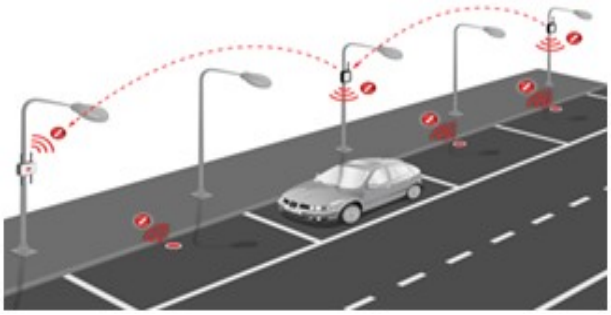

**Figure 5.**Working Process of a Cloud in Smart Parking System [24]

## 5 Implemented Sensors in Smart Parking System

### A. Cellular Sensor

The sensors that are housed inside a smartphone are called cellular sensors. The most often utilised sensors in a smartphone are the SPS, Accelerometer, Gyroscope, and Magnetometer. The sensors are used to track the movement, position, and direction of the user.

### B. Magneto-Resistive (MR) Sensor

As Fig.6 shows, without any electrical connection, MR sensors can detect the applied magnetic field. The MR sensor runs on a straightforward principle. Any important connection undergoes a penetration-related resistance change when a force is applied. The direction of the magnetic fields affects resistance fluctuations. IoT parking systems frequently employ MR for automobile detection.

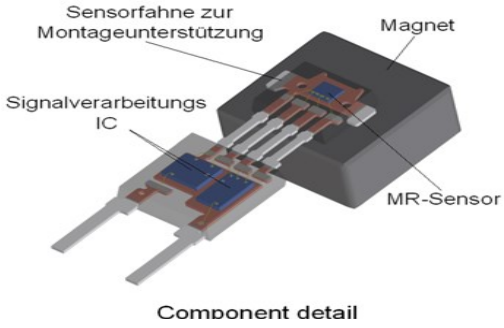


**Figure 6.**Magneto Resistive Sensor

## C. Acoustic Array Sensor

To locate and determine the direction of the noise waves or reflector, this acoustic array sensor detects sound or vibration at certain frequencies. The passive acoustic location technique is the name for this localisation method. In SPS, the usage of an acoustic array sensor for monitoring and parking vacancy detection is common.

## D. Ultrasonic Sensor

As per Fig. 7, a ultrasonic sensors seems that a nearby item that reflects an acoustic wave is detected by an ultrasonic sensor using acoustic waves in the 25–50 kHz range. This sensor is most suitable for indoor applications because of its vulnerability to breakdowns in changing weather conditions like snow and rain. Since they are often positioned on the ceiling, ultrasonic sensors are employed in enclosed and indoor parking facilities. Vehicles can be found using ultrasonic sensors. With proper implementation, this sort of sensor may also be able to tell a moving car from a bystander. Ultrasonic sensors are inexpensive and need little upkeep.


**Figure 7.**Ultrasonic Sensor [16]

## E. Light Detection and Ranging (LIDAR)

With Laser scanners, a laser is used to burn the target, and a sensor measures the light that is reflected to determine distance. By measuring the light's frequency and the time required to gather reflected light, a 3D representation of the item of interest may be created. LIDAR is mostly deployed in SPS for detection and tracking as shown in Fig. 8.

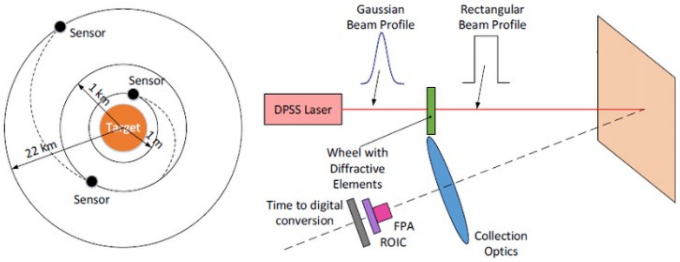


**Figure 8.**Schematic of LIDAR

# 6 Storage and Database Server

When a person wants to reserve a position for a specific amount of time, the server communicates with the cloud to get information about the open positions and those that are already taken, then it displays that information to the customer so he can find a position that works for him. The server updates the cloud to indicate that the customer has selected a position and entered and exited times, and it then sends a signal to the display screen to reserve the position. The server is linked to a database of all customers who have made mobile phone reservations, along with their entry and exit times.

A storage server has additional storage capacity, storage access interfaces, and specialized data retrieval and administration tools but is often less capable than a conventional server. In most cases, a storage server acts as the main access point for data storage and access. The storage server is accessible to neighbouring client nodes and remote computers via a graphical user interface control panel, FTP, or programmatic API access by software and applications. It can be used for regular or frequent data storage and access, or as a backup server to store backup data. All storage networking solutions, including direct attached storage (DAS), network attached storage (NAS), and others, require the use of a storage server.
A database server is a computer that runs database software. With the use of database software, individuals and companies can store, manage, retrieve, update, or alter files, information logs, and other sorts of digital data. Back-end operations and client-facing services are the two main components of database servers. All digital data and files are kept in the backend of a database server. Client-facing services make it easy for people or businesses who use the database to access, alter, contribute to, or monitor the data stored on the server.

Database servers simplify the storage, organization, and maintenance of vast amounts of digital data. Nowadays, most businesses save a large amount of data on their computers or networks, including information about their clientele, operations, and money.

# 7 Applications

Using a mobile application, you may reserve a parking space or look for spaces near the destination of your visit. Most applications need the Internet to operate effectively, and in order to find the best spots to stand, users may book using a computer, laptop, or mobile phone. The user receives a notification from the program informing them of the position's location, parking restrictions, and cost details.

The characteristics of smart cities that improve quality of life include better space use, reduced traffic, cleaner air, and more effective public services. Smart cities also provide a plethora of job options, strong economic prospects, and strong social relationships.

The IoT project for smart parking will aid in:

### A. The Traffic Flows Without Interruption

Real-time route adjustments for public transportation are possible, and smart traffic light systems can reduce congestion.

### B. Energy Usage Might be Increased

By continuously monitoring, one may quickly identify their power and energy usage.

### C. Safe Cities were Feasible

With the increasing usage of Wi-Fi communications and IoT technology, cities can leverage technology to enhance resident safety and response times.

### D. Encouraging Increased Participation for Citizens

To help their neighbours connect and share resources to better their communities and neighbourhoods, citizens can respond to everyday issues.

## 8 Proposed Methodology

The proposed methodology as we discussed in the whole paragraph is shown in Fig. 9 as a blueprint of it. characteristics of smart cities that improve quality of life include better space use, reduced traffic, cleaner air, and more effective public services. Smart cities also provide a plethora of job options, strong economic prospects, and strong social relationships. This proposed intelligent parking system is made up of an on-site fitted IOT device (IoT) unit and monitors the movement of cars into and out of that specific parking lot. The technique offers the parking spaces an ideal answer. One can determine the space for parking the car using this technique.

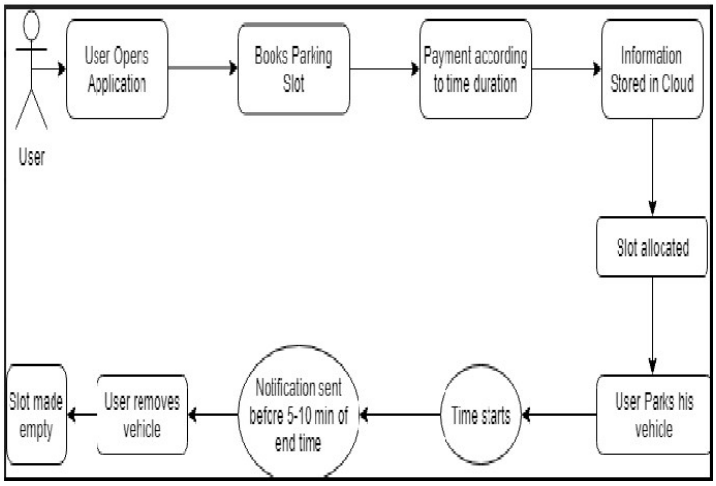


**Figure 9.** Planned Cellular Smart Parking System Technique

## 9 Solution for the Existing Systems

Accordingly, the solution for the existing parking system has to be changed as I have mentioned in Fig. 10. The different parking options mentioned in this work, together with their benefits and drawbacks, can be used to solve the parking problem.

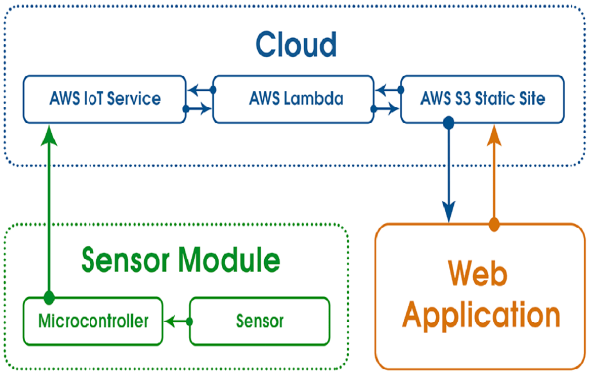


**Figure 10.** Solution to Parking System

## 10 Conclusion

This study suggests an IoT-based smart parking system to reduce parking area traffic blockage, random parking, and congestion, as well as the need to seek and wait for a parking spot. Application, Middleware, Networking, and Sensor Layer make up the four levels of the proposed system presented in this study. The issues that might emerge when using the smart parking system and their remedies have been discussed, providing a solid foundation for all users. Smart parking system deployment ensures the comfort of life for those who struggle with regular tasks in day-to-day living. The method we propose provides real-time data on the number of parking spaces that are open in a parking IoT. By using our smartphone application, users may reserve a parking space for themselves. As a result, consumers may save spending time looking for parking spaces.

## References

[1] M. Assim and A. Al-Omary, "A survey of IoT-based smart parking systems in smart cities", IEEE 3rd Smart Cities Symposium (SCS 2020), pp. 35-38, 2020.

[2] A. Rawat, G. K. Soni, D. Yadav, M. Tiwari, “High Gain Multiband Microstrip Patch Antenna for mmWave 5G Communication”, Optical and Wireless Technologies. OWT 2021, Springer Lecture Notes in Electrical Engineering, vol 892, pp. 299-305, 2023.

[3] Zaid Ahmed, Akash Rawat and Pankaj Kumari, "An Analysis of IoT Based Smart Cities", International Journal of Engineering Trends and Applications (IJETA), vol. 8, pp. 30-35, 2021.

[4] C. Ajchariyavanich et al., "Park King: An IoT-based Smart Parking System", IEEE International Smart Cities Conference (ISC2), pp. 729-734, 2019.

[5] M. Assim and A. Al-Omary, "A survey of IoT-based smart parking systems in smart cities", 3rd Smart Cities Symposium (SCS 2020), pp. 35-38, 2020.

[6] G. . Shankar, V. . Gupta, G. K. . Soni, B. B. . Jain, and P. K. . Jangid, “OTA for WLAN WiFi Application Using CMOS 90nm Technology”, International Journal of Intelligent Systems and Applications in Engineering, vol. 10, no. 1s, pp. 230 –233, Oct. 2022.

[7] D. -h. Kim, S. -h. Park, S. Lee and B. -h. Roh, "IoT Platform Based Smart Parking Navigation System with Shortest Route and Anti-Collision", IEEE 2018 18th International Symposium on Communications and Information Technologies (ISCIT), pp. 433-437, 2018.

[8] I. Aydin, M. Karakose and E. Karakose, "A navigation and reservation based smart parking platform using genetic optimization for smart cities", IEEE 2017 5th International Istanbul Smart Grid and Cities Congress and Fair (ICSG), pp. 120-124, 2017.

[9] N. B. A. Warif, M. I. S. S. Azman, N. -S. N. Ismail and M. A. Remli, "IoT-based Smart Parking System using Android Application", IEEE Emerging Technology in Computing, Communication and Electronics (ETCCE), pp. 1-6, 2020.

[10] S. Mishra, M. Kumar, N. Singh and S. Dwivedi, "A Survey on AWS Cloud Computing Security Challenges & Solutions", IEEE 2022 6th International Conference on Intelligent Computing and Control Systems (ICICCS), pp. 614-617, 2022.

[11] A. Z Nor Saradatul, "Smart Environment Monitoring System for Air Pollution Using Internet of Things (IoTs)", IOP Conference Series: Materials Science and Engineering, 2020.

[12] H. Adil et al., "Designing and Managing a Smart Parking System Using Wireless Sensor Networks", Journal of Sensor and Actuator Networks, pp. 7-24, 2018.

[13] P. Jha, R. Baranwal, Monika and N. K. Tiwari, "Protection of User's Data in IOT", IEEE Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), pp. 1292-1297, 2022.

[14] A. C. Elsie et al., "Real time car parking system: A novel taxonomy for integrated vehicular computing", 2017 International Conference on Computing Networking and Informatics (ICCNI), pp. 1-9, 2017.

[15] G. Soni, V. Poddar, Y. Sahu and P. Suryawanshi, "Hand Gesture Recognition Based Wheel Chair Direction Control Using AVR Microcontroller", International Journal of Advanced Research in Computer and Communication Engineering, vol. 5, no. 3, pp. 344-348, 2016.

[16] T. Manglani, A. Vaishnav, A. S. Solanki and R. Kaushik, "Smart Agriculture Monitoring System Using Internet of Things (IoT)", IEEE International Conference on Electronics and Renewable Systems (ICEARS), pp. 501-505, 2022.

[17] A. Badhoutiya and A. Saxena, "SPS: A framework Of Smart Parking System Using IoT Technology", IEEE 6th International Conference On Computing, Communication, Control And Automation (ICCUBEA), pp. 1-4, 2022.

[18] A. Rawat, G. K. Soni, D. Yadav, M. Tiwari, "60-GHz Millimeter Wave Antenna for 5G Wireless Communication", Optical and Wireless Technologies. OWT 2021, Springer Lecture Notes in Electrical Engineering, vol 892, pp. 291-297, 2023.

[19] M. A. Al Maruf, S. Ahmed, M. T. Ahmed, A. Roy and Z. F. Nitu, "A Proposed Model of Integrated Smart Parking Solution for a city", IEEE International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), pp. 340-345, 2019.

[20] U. Mittal, T. Shekher, K. Agarwal, S. K. Singh and H. Chaudhary, "Real-Time Smart Parking System", IEEE 8th Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), pp. 1-5, 2021.

[21] M. Meenaloshini, J. Ilakkiya, P. Sharmila, J. C. Sheffi Malar and S. Nithyasri, "Smart Car Parking System in Smart Cities using IR", IEEE 3rd International Conference on Computing and Communications Technologies (ICCCT), pp. 178-182, 2019.

[22] Biyik, C., Allam, Z, Pieri, G., Moroni, D., O'Fraifer M., O'Connell, E., Olariu, S., Khalid, M., "Smart Parking Systems: Reviewing the Literature, Architecture and Ways Forward", MDPI Journal of Smart Cities 4(2), 623-642, 2021.

[23] Kalsoom, Tahera, Naeem Ramzan, Shehzad Ahmed, and Masood Ur-Rehman, "Advances in Sensor Technologies in the Era of Smart Factory and Industry 4.0", MDPI Journal of Sensors 20, no. 23: 6783, 2020.

[24] M. C. V. S. Mary, G. P. Devaraj, T. A. Theepak, D. J. Pushparaj and J. M. Esther, "Intelligent Energy Efficient Street Light Controlling System based on IoT for Smart City", IEEE International Conference on Smart Systems and Inventive Technology (ICSSIT), pp. 551-554, 2018.