

# A COMPARITIVE ANALYSIS OF DIFFERENT ALGORITHMS USED IN IOT BASED SMART CAR PARKING SYSTEMS

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**Abstract** -Internet of Things (IoT) is an ecosystem of connected physical objects that are accessible through the internet. The 'thing' in IoT could be a person with a heart monitor or an automobile with built-in-sensors, i.e. objects that have been assigned an IP address and have the ability to collect and transfer data over a network without any human interaction. Using IoT we can developed a smart parking system that automatically handle the parking and traffic using many techniques, algorithms and sensors. There are many algorithms are used for handle traffic and parking related situation. This paper contains the overview of different algorithms that are used in smart car parking. First Come First Serve (FCFS) is used for the car allocation in queue. Priority (PR) is used for priority base queue assigning to the car. Distance Geometry Problem (DGP) is used to determine absolute position of car in space. Vehicle-2-vehicle (V2V) and Vehicle-2-infrastructure (V2I) technologies allow vehicles to communicate via wireless to issue security warnings and to share traffic information now a days it's mostly used for self-driving cars. Round Robin (RR) algorithm used for load balancing in smart parking system for reduce traffic problem. Study State Evolutionary Algorithm (SSEA) used for optimal allocation of parking lots. Dijkstra and Ant Colony (ACO) Algorithm are used for the finding nearest empty parking lot for car. This paper shows analysis of algorithms or combination of algorithms (Hybrid Algorithm) is best suitable for smart car parking system.

**Key Words:** IoT, Smart Parking System (SPS), Hybrid Algorithm, Traffic Handling, Load Balancing (RR), shortest path finding (ACO), Dijkstra Algorithm, V2V-V2I technologies.

## 1. INTRODUCTION

The parking drawback in massive cities, particularly the mega-cities, has become one among the key causes of the town traffic congestion, driver frustration and pollution. thus researchers are recently turned to applying technologies for management of lot by coming up with and implementation of a prototype system of good parking that enables vehicle drivers to effectively notice the free parking places. Within the future the demand for the intelligent parking service can increase because the rise within the automotive industries. An effective resolution to the present service will be provided by several new technologies. Good parking, permitting drivers to access parking data through their smart phones. several cities

have been launching their good parking comes and apps, yet still only a few drivers will very take pleasure in them. That is because this technology still needs to be improved from completely different perspectives: the strength of device devices, the steadiness and timeliness of device networks, the standard and legerity of urban service.

Firstly we tend to provide an summary regarding the conception of smart parking system, their classes and totally different functionalists. Then we tend to build a survey of the sensible parking research and implementations. we tend to describe the technologies around parking availableness watching, parking reservation and dynamic rating and see however they're utilized in several settings. Finally a theoretical comparison is given to point out advantages and drawbacks of every totally different sensible parking systems and a comparison of technologies and algorithms employed in each system.

### 1.1 Different technologies used in Smart car parking system

Different methodologies and looks into are made to defeat the challenges of parking Area. Thus, numerous frameworks and innovations are produced for parking.

The creator in introduce the plan and execution of a savvy parking framework in light of remote sensor arranges that enable vehicle drivers to locate the free parking places. The plan depends on WSNs, Embedded Web-Server, Central Web-Server and Mobile telephone application. The driver can identify the condition of the parking space utilizing cell phones because of sensor hub in each parking opening which recognize the condition of this one and report it to implanted web-server lastly the data is sent to focal web-server utilizing Wi-Fi organizes progressively.

This paper exhibit an innovation that could be connected to screen and oversee vehicles in a parking structure by illuminating drivers about the quantity of accessible parking spots and in which region should they be coordinated to. The plan depends on the change of the first WSN and utilization of RFID and ZigBee innovation. To assess other significant measurements, for example, time and so on. The data got from each detecting hub is handled cooperatively in two conduct either in conveyed or brought together way.

The target in is to plan a smart parking direction and data framework with ARM8 micro controller which can keep

running on an installed framework. The creator likewise present a critical element like getting the above said status of the parking space on the web or web and status can refresh specific time. The webcam finds the free openings for parking. It can catch openings at once and show it on touch screen LCD. It will show red shading box on LCD if any car is available in the space. On the off chance that the space is free it will show purge opening number on the LCD. In the event that any individual needs to book the space, send opening number through SMS. The controller gets the space number data through GSM. In the wake of getting the data the controller keeps the opening free.

The executed model depends on picture handling procedure The framework catches and forms the picture of parking area and produces the data of the unfilled car parking spots.

- **Collection:** relies on sensors to collect the real-time parking.
- **Processing:** concerns technologies used to process data sensors and which type of data.
- **Deployment:** deals with the communication methods.
- **Urban Services:** can be provided to the user once the data storage and information monitoring are done.
- **Connection:** concerns the IOT layer which maintains the database of the parked vehicles through a shared server.
- **IHM:** means the technologies used as interface between human and the parking system.

The combination of networked sensors and RFID advancements is considered in a programmed auto stop administration. Creators proposed a versatile and minimal effort Car Parking Framework (CPF). These incorporate driver direction, programmed installment, parking lot recovery, security and vandalism recognition. In this paper the creator proposes the grouping of a bundle of sensors and the utilization of cross breed remote correspondences rather than bit in each spot which have a great deal of downsides as far as cost and vitality utilization. The usage of CPF incorporates 3 sections: stopping administrator, entryway chief and parking spaces director plans a programmed savvy stopping utilizing web of things which empowers the client to discover the closest stopping region and the accessible opening around there. The engineering of the stopping framework comprises of a few segments: brought together server, Raspberry PI, picture catch, route framework, display gadget and client gadget.

The cloud based IOT design contains cloud administration to store data about status of stopping openings and the concentrated server which stores keen stopping framework data. The driver can access and guide the

status of stopping openings from any remote area through web program. Be that as it may, in the creator presented a shrewd stopping framework utilizing cloud-based stages as an administration (Paas). The (Paas) gives the devices and administrations expected to make keen stopping arrangement. We recognize two sorts of Paas: IOT middleware stage as back-end information stage and front-end dashboard stage for virtualization and announcing. The IOT middleware contains 3 modules: information stockpiling module, gadget administration module and handling module. The use of Paas has brought about the production of speedier savvy stopping framework which has a considerable measure of advantages.

### 1.2 Different Algorithms & Sensors used in Smart car parking system

- In car parking system, the algorithms play a very vital role for giving the nearest empty parking lot, traffic management at a time of entry and exit, Load balancing at each entrance of very large and complex parking area. And many more thing that handled by algorithm / program. It's totally back end process that user never face. But it must for best output of system.
- There are many algorithms are used in smart car parking system are :

#### I. ALGORITHMS :

- ✓ FCFS (Queue Allocation for car)
- ✓ PR (Priority based allocation of car in queue)
- ✓ RR (Round Robin for Load Balancing)
- ✓ SSEA (for optimal parking lot allocation)
- ✓ DGP (Use for finding exact location of car in space)
- ✓ Dijkstra and ACO (finding Shortest path) Etc...

#### II. SENSORS :

- ✓ LED
- ✓ LDR
- ✓ Weight Sensor
- ✓ Image Sensor
- ✓ Infrared Sensor
- ✓ RFID
- ✓ CMOS / Motion Camera
- ✓ Motion Sensor
- ✓ Magneto Meter
- ✓ Etc...

## 2. LITERATURE SURVEY

There are many technologies are used in smart parking system. There are listed below with some short description of each techniques.

### 2.1 Wireless sensor networks-based systems

These types of systems have generated increased interest in researchers since 2005. They are the most popular technique in the last decade with researchers, as wireless sensor networks have various advantages, such as flexibility, intelligence, reasonable cost, rapid deployment, and sensing, as it usually consists of sensor nodes. The following papers discuss WSN-based parking systems, This type of system, which utilizes sensors to monitor environmental conditions, is widely used, especially in academia, due to the ease of installation and configuration, and the reasonable price. developed a system using crossbow products, which have a low unit cost. This system enables a car to detect entry to the car park, and it efficiently guides the driver to an empty parking space through signs displayed to the driver presented a new smart parking system using an ultrasonic detector. [1]

For each individual car park, one sensor is fixed on the ceiling above each parking space. Ultrasonic sensors operate based on echolocation. The sensor transmits a sound, which hits a solid object (car or ground) and is reflected back to the sensor. discussed the research challenges relating to parking technology and proposed some possible solutions. In the centralized solution, some cars are equipped with ultrasonic sensors as well, which drive past the parking spaces to collect occupancy data and upload the data to the centralized database. The cars that need to park simply query the centralized database. proposed the use of a combination of magnetic and ultrasonic sensors for the accurate and reliable detection of vehicles in a parking lot, and described a modified version of the min max algorithm for the detection of vehicles using magnetometers.[3]

### 2.2 Smart parking systems based on Vehicular to infrastructure communication (V2I)

Other studies proposed using the term (CVT) to refer to Connected Vehicle Technology which depends on wireless data transmission between vehicle and infrastructure (V2I). This promising technology emerged recently.[2] It proposes a new smart parking technique that depends on developing a new VANET-based smart parking to be used for smart steering and smart parking. It refers to Vehicular Communication Systems, in which vehicles and roadside units are the communicating nodes, that is, they communicate and exchange information with each other, such as safety warnings or supplying the traffic congestion information and even for finding vacant parking spaces. Basically, vehicular networks are considered to contain two types of nodes: vehicles and roadside stations. Both

are categorized under the term 'Dedicated Short Range Communications' (DSRC) devices. DSRC works in 5.9 GHz bands with a bandwidth of 75 MHz and a range of about 1000 m. This is a two-way method of communication including Vehicle-to-Infrastructure (V2I) and Infrastructure-to-Vehicle (I2V) communication. In the "smart parking" system, usually, V2I communication includes drivers sending their parking requests, providing driver information, and confirming that reservation to the system. I2V communication involves the DRPC sending allocation results, driving directions, payment details, and more, back to vehicles. It is worth mentioning that cellular networks are usually applied in V2I and I2V solutions. proposed a novel parking system called SPARK, which consists of four parts: system setting, real-time parking navigation, intelligent anti-theft protection, and friendly parking information dissemination.[4] In, the SPARK scheme is characterized by employing a parking lot's RSUs to provide surveillance and manage the whole parking lot using VANET communication technology. The system uses light sensors, and in the proposed SPARK scheme, the whole parking lot is under the surveillance of the three parking lot RSUs described a parking system in VANET which locates any available parking spaces. This system depends on roadside units deployed to relay parking messages and GPS to locate parking positions.

### 2.3 Smart parking systems based on Global Positioning Systems GPS

Global Positioning Systems (GPS) technology is used to determine and track a vehicle's precise location. In this domain, it is used to offer information about the location and availability of parking spaces at the destination. This technique proposed for presented a location-based system called NAPA.

The server in the system associates buildings on the campus with parking lots in the order of distances to the building. After locating the nearest available parking lot, the user sends the NAPA server a message that he/she has parked. Then the server updates the information about the lot accordingly. When the user leaves the parking lot, the NAPA server can automatically charge the appropriate parking fee if necessary. proposed a new smart parking system using SMS services. This system is capable of finding parking spaces in specific car park areas. A parking reservation system is developed in such a way that users can book their parking spots over short message services (SMS) using the GPS [5].

The SMS is processed by a wireless communication instrumentation device called a micro-RTU (Remote Terminal Unit). The proposed prototype have the following specification; the circuit has a simple design, the reliability level is high, and the system accuracy is excellent.

## 2.4 Smart parking systems based on Computer vision

Recently, many researchers have focused on these methods. This field of study includes methods for acquiring, processing, and analyzing images. It uses computers to emulate human vision, including learning and being able to make inferences and take actions based on visual inputs, also called computer vision. The goal of computer vision is to make computers efficiently perceive and process visual data, such as images and videos, and act upon changes in these images. Usually, the technique involves analyzing a few frames per second and then sending the data to a central database, after which, the user can retrieve information about the changes at the parking lot.

In, their system utilized CCTV in a vehicle detection stream to detect the presence of a car or vehicle in a particular parking lot. Pixel detection is used to detect the presence of a vehicle in each parking lot. A certain number of pixels in the grayscale are used as the threshold to differentiate pixels from the vehicle and from the unoccupied lot. Another parking system, called CCTV, uses images to detect parking spaces.[6] CCTV cameras are fitted in car parks to automatically detect car parking spaces. However, these methods may incorrectly detect parked vehicles. The system is targeted on cases where occupancy values are required.

The reliability is high and the system is very accurate; however, all other parameters are unclear in the paper proposed a system that uses CCTV cameras that are fitted in car-parks to automatically detect car parking spaces. However, these methods are not always accurate in cases where occupancy values are required. (Bong et al 2008) proposed a research project which was developed to acquire car-park occupancy information using an integrated approach of image processing algorithms. Motivation for developing this system came from the fact that minimum cost is involved because image processing techniques are used rather than sensor-based techniques. This project is called the Car-Park Occupancy Information System (COINS).

## 2.5 Smart parking systems based on RFID technology

This technology (RFID) is proposed in the following selected systems. In many academic papers, smart parking's RFID solutions make it possible to manage permit parking easily, especially in the prototype stages. The main mechanism of RFID technology depends on an electromagnetic field to identify and track tags attached to objects automatically. used RFID technology in automation. Their system uses a software program for controlling and reporting changes in the status of the parking space, and for the operation of tasks such as choosing the closest vacant parking space, and it then sends the report to the driver.[7] Meanwhile, proposed a system containing Gate-PC Controller and Embedded Gate Hardware, an RFID System, and a Modular Parking

Management Platform: "Most systems in the Modular RFID Parking Management System are modulated and can be substituted for any other similar system or hardware".

## 2.6 Other hybrid Algorithm based, M2M, IoT Systems

Use certain kinds of hybrid techniques and mixed methods. As mentioned earlier, it is difficult to classify each type with a certain group, but it is useful to do so for the sake of clarity. proposed a smart system that detects and finds the parked location though systems based on IoT, smart sensors, and actuators, with the middleware connecting clients with terminal devices. The system is dependent on Bluetooth communication between the smart phone and wireless sensor nodes. proposed a smart car parking prototype using camera nodes and an Open CV algorithm to detect the vacant parking space to facilitate the parking service to the users presented and discussed the design and implementation of an M2M application in the field of road traffic management.

This study used an integrated IoT retractable bollard management system to allow vehicular access to restricted city areas, based on standard infrastructure and software components; the authors have invented an intelligent parallel technique which involves using RFID technology with fuzzy logic controllers and two ultrasound range sensors. This system contains a Gate-PC Controller and Embedded Gate Hardware, an RFID System, and a Modular Parking Management Platform. As mentioned previously, most systems in a Modular RFID Parking Management System are modulated and can be substituted for any other similar system or hardware. Finally, check-ins and checkouts of the parking lots are under the control of RFID, reader, labels, and barriers modeled a parking lot as a continuous-time Markov chain.

The parking area is modeled as a grid, and schemes for information aggregation and dissemination over the grid are proposed. Moreover, in, M2M system technology has recently emerged as a promising enabler for the development of new solutions in a plethora of IoT application domains including transportation, health care, smart energy, smart utility metering, supply and provisioning, city automation, manufacturing, and others.

M2M enables highly scalable direct communications among wireless enabled heterogeneous terminals, called M2M devices.[8] Basically, the principal of M2M applications that realize M2M communication involves four stages: 1) data collection, 2) transmission of specific data over a communication network, 3) assessment of the data, and 4) response to the available information. All these specifications make the involvement of the M2M desirable in smart parking systems.

The M2M networking architecture for IoT connectivity uses aggregator devices to serve multiple end nodes.[9] A gateway connects to a cellular network for eventual Internet attachment. Specifically, the end M2M nodes

contain one or more sensors that report physical conditions to a remote site or that are used with local embedded intelligence.

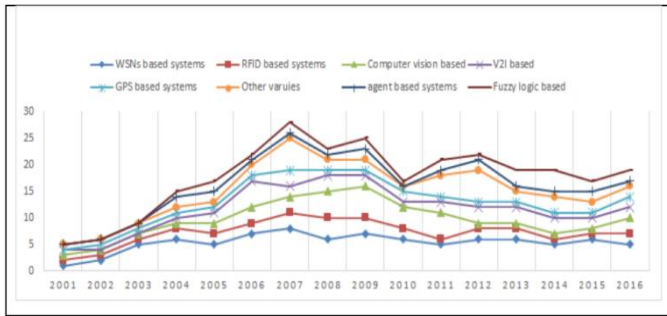


Fig. 1 "Analysis of different smart parking system"

Table-1. "Different technologies that used in smart parking"[1]

Ref	Collection	Deployment		Services							Connection		Processing		IHM		
	Type of sensor	NetS	NetU	GT	PV	LR	SE	RE	GM	AC	PM	IOT	BD	CC	SP	WA	VICS
[4]	Light sensor	WiFi	WiFi-3G			+					+	+				+	+
[5]	Reflection sensor+RFID	ZigBee		+						+							
[6]	CMOS Camera		GSM	+	+	+	+										
[7]	Camera			+	+	+											
[8]			GSM			+	+	+	+	+							+
[9]	digital infrared sensor	ZigBee		+		+					+						+
[10]	Infrared Sensor	ZigBee	GSM		+	+	+	+			+						+
[11]			Bluetooth		+	+	+				+						+
[12]	ultrasonic sensor,+RFID	ZigBee	WiFi-3G		+	+	+	+	+	+	+						+
[13]	Sensor+RFID				+	+		+			+						+
[14]	agent	Contract net			+	+	+	+									+
[15]	Pi camera	WiFi					+				+				+		+
[16]	ferromagnetic sensor	ZigBee					+				+				+		+
[17]	Infrared sensor+RFID				+	+			+	+	+				+	+	+

### 3. CONCLUSION

After Reviewing and analyzing the different techniques of smart parking system, found that the Hybrid approach is the best technique to implement a new system design. Hybrid method means combining different sensors, algorithms, and deployment of smart parking system we can developed a best system that are more efficient and more satisfied the user like:

- i. Assigning Nearest parking lot.
- ii. Reducing the traffic / conjunction at a time of Entry and exit of car parking.
- iii. Balance load to each entrance equally for reduce the conjunction at same entrance.

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