

# A PRESENTATION OF SMART PARKING

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## **SMART PARKING SYSTEM USING IOT**

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### **ABSTRACT**

Smart Parking System is a giant stride towards smart cities. It is an intelligent system that takes care of finding a free parking slot for the user and reserving the chosen slot. It frees the user up from the task of locating a free parking slot, thus saving up a considerable amount of time for the user. Along with helping the users out, it also helps achieve the objectives of the smart city by reducing traffic congestion, fuel expenditure and the release of pollutants into the atmosphere. It increases traffic management. This system walks hand in hand with digitalization by maintaining transparency with users. A smart parking system delivers enriched and hassle-free parking experience to users.

**Keywords**—smart parking system; internet of things; android application; parking sensor; OpenALPR; firebase; node-red

### **INTRODUCTION**

Smart Cities are not the future anymore they are the present. With the evolution of smart cities come responsibilities to manage things more smartly. Smart Parking System is an automated way of searching for a free parking slot and reserving it for your car. This system is a step towards better traffic management and making the process of parking cars easy. The Smart Parking System involves parking your car through a mobile application, thereby reducing a considerable amount of searching time. The Internet of Things (IoT) may be a novel paradigm that's 39 rapidly gaining ground within the scenario of recent wireless 40 telecommunications. It involves sensing through various objects and creating wireless connectivity amongst them to realize a standard goal. Internet of things may be a novel paradigm that has shifted the entire curve of technological advancement many new technologies are often incorporated with the internet of things to return up with more creative solutions. These technologies involve cloud computing, machine learning, AI and lots of more. The usage of a combination of these technologies has truly sprung a replacement technological era. Cloud computing is on-demand availability of resources. These resources can range from infrastructure to network to software. Any technological resource you name it, and it's available on the cloud. Cloud computing has given certain advantages that create it hard to ignore. This system is developed by integrating the three modules 1) Android Application for booking parking slots, 2) Parking Sensor node, 3) License Plate Detection at the parking lot entry. The basic flow of this system is shown in the Fig. 1.



## ANDROID APPLICATION

From the user's point of view, we have developed an android application that is capable of showing the real-time status of parking slots to the user. This application allows users to select an available slot and proceed further with booking. For the authenticity of the user, we have provided an option to select who's driving the car. If the car is being driven by other than the user then, the application will ask for another person's mobile number and it will send an OTP to it. After verifying OTP the booking confirmation will appear. The booking receipt can be downloaded in PDF file format, which carries booked slot number, name of the user, vehicle number.

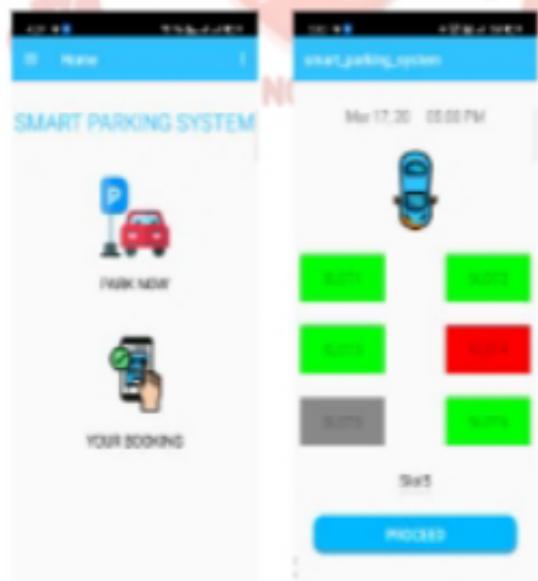


Fig. 2. Smart Parking System Android Application

## PARKING SENSOR

In the literature review we analyzed that many proposed Parking System[4][5] included the concept of having many sensors connected to one micro-controller unit, i.e. individual sensors for slots but only one micro-

controller. This reduces the portability and flexibility of the system. Thus, the Parking Sensor is an end device that will be installed in each parking slot.

It comprises of three devices which are:

1) Microcontroller Unit (MCU)

2) IR sensor (for detection)

3) Power Supply Unit

The micro-controller unit we have used for implementation is Node-MCU v1.0. Node-MCU will continuously read IR sensor value and also it will be updating values to Firebase in a real-time fashion. Then these values will be used to show the real-time status of parking slots via android application.

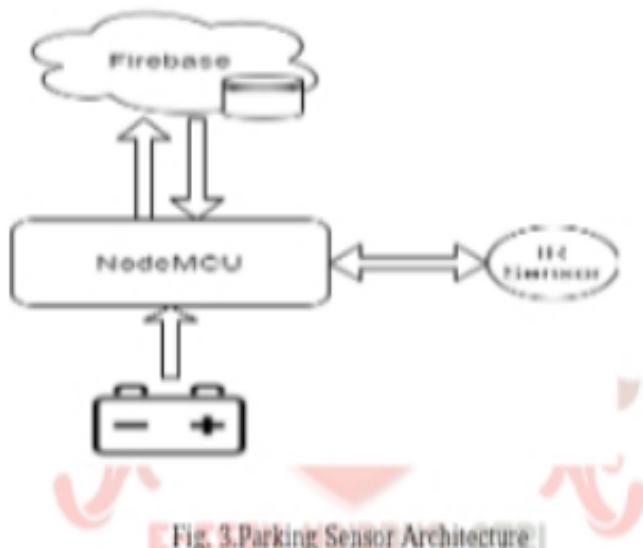


Fig. 3.Parking Sensor Architecture |

## LICENSE PLATE RECOGNITION

The third module of this project is the detection of the license plate number. For this we are using Raspberry Pi 4, Rpi Camera, Node-Red[2] and Open-ALPR[3] API. The process of detecting a car license plate is automated by a Node-Red flow which will open the entrance gate for cars having a license plate that is used while registering in our application. We have incorporated an IR sensor which will trigger Rpi Camera when a car is detected at the parking lot entrance. The purpose of using License plate detection is to allow valid cars into the parking lot. The Open-ALPR API will be called via a curl request, in response Open-ALPR will send a JSON object which will contain detected number plates with corresponding confidence. Then the msg.payload.plate (contains OpenALPR detected license plate number string) will be mapped with the registered number plates in firebase which is connected to our Android Application. Upon receiving the valid conditional mapping the entrance gate will be opened for 10 seconds to allow the car to enter into the parking lot.



Fig. 4. Node-Red flow for Automation of License Plate Recognition

## IMPLEMENTATION

We now have implemented the Smart Parking System by combining these three modules and now it is a workable demonstration of how current parking lots can be transformed into Smart Parking System. Fig. 5 shows the hardware setup of the system

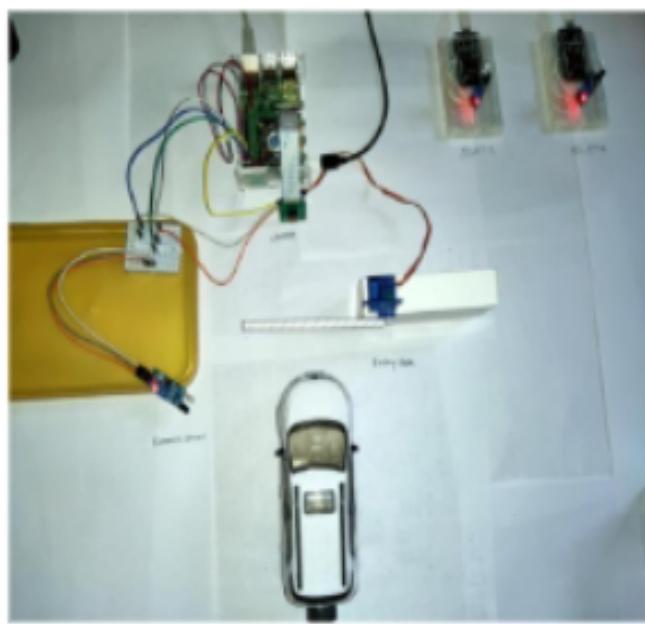


Fig. 5. Hardware Setup of Smart Parking System

## FEATURES OF SMART PARKING SYSTEM

- o Accurate Detection – the use of IR and camera module leaves no chance for blunder in detection of the slot.
- o Probability – the expectant time entered by the user can be used to predict when the slot will free up for other users.
- o Security – the camera module provides reliability and security to the vehicles.
- o Transparency – the whole system is quite transparent. This is because the whole system is digital with very less or no human intervention leaving no scope for mistakes. The transparency is maintained in every aspect with the user including payment.

- o Utility – the user has to pay only for the amount of time he/she is parking his/her vehicle. This helps in keeping the charges to minimum, leading to a pocket-friendly system.
- o User authentication – the camera module responsible for authentication is quite efficient. The users will be authenticated based on their booking and license plate recognition.

## CONCLUSION

After the implementation of this Parking System, traditional car parking can be transformed into smart parking systems. This helps to reduce traffic congestion and saves time searching for free parking space. With the real-time status of available parking slots users can stay relaxed about available parking wherever they go. The OpenALPR platform helps in authenticating valid license plates which increases security measures of this system. Thus Smart Parking System will reduce parking-related problems[1], time consumption and fuel wastage.

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With the development of road infrastructure, there is a significant increase in number of private vehicles which results in traffic congestion, directly effecting the flow of traffic, and life of citizens. Parking becomes a significant problem in the urban areas (Cao & Menendez, 2015). The research paper proposes a smart parking system to solve the current parking problem at affordable cost. Previously automatic car parking system were proposed to reduce the space or size required for parking especially in crowded places with few spaces, such as a multi-story car park providing cars with parking on multiple levels stacked vertically to increase the number of parking spaces (Ibrahim, 2017). The proposed system utilizes the latest advancement in the Information and Communication Technologies and consists of four layers: Application, Middleware, Networking, and sensor layer. It offers environmental friendly, reduces harmful emissions during parking, and is a computerized system pre-programmed without human intervention. The research paper highlights the comparison of traditional parking system with smart parking system using IoT. The paper also proposes a framework for smart parking system.

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## Introduction

Smart parking system using IoT to identify vacant positions and occupied positions without the need to waste time in finding a suitable position for the cars. The status of the parking slot detected by the wireless sensor is sent to the database via a gateway and car information is transferred to a database to save and store (Fraifer & Fernström, 2016). The system allows the date and time of entry to the parking area, the date and time of exit from the parking space (LeBeau, Contreras Albuja, Altavilla, & Li, 2018).

Proper and balanced planning based on automatic and intelligent system to organize parking and provide it with sensor system to detect available, occupied, and reserved parking slots. Streamlined entry and exit of parking, no need to lose time and fuel in order to get parking, smart parking feature and the presence of surveillance cameras. To ensure the safety of the vehicle and passengers and the presence of fire extinguishers throughout the parking. Smart parking does not cause traffic jams as the time is not wasted to find the available parking space in the parking area and the driver of the vehicle is aware about the location of available parking slot and.

## Problems Statement

The number of cars is increasing day by day (Guerra, 2016). The main problem is to find a parking slot, whether in the shopping mall or companies or at the airport or in hospitals. An average, people spent 20 minutes to find a suitable parking for the car (Litman, 2018). Most of the people park their cars in places not designated for parking, and parking in places not reserved for parking slots. This results in the disruption of the traffic and sometimes in the movement of people. Usually, there are reasons to park people in places not reserved for parking such as the area designated for parking is not enough to cater the needs. This is due to the weak planning and not thinking of solutions to keep pace with the large increase in the number of cars, and most people park the car for long times without thinking. Drives looking for parking space is a major cause of traffic congestion and accounts for 30% (Tsakalidis, Julea, & Thiel, 2019).

## **Traditional parking System**

In recent years, number of car owners are increasing day by day, when someone tries to find a position to stop his car after a long day of work surprised by the lack of parking to stop his car and see the driver passes positions more than once to find him a position. Traditional parking consists of only two passages to enter and exit port. In some parking only one entrance to enter and out of space, while parking spaces are small for a small car, while the big vehicle takes more than one position, which makes things worse, sometimes the car stands but when it is not possible to open the door (Zhou & Li, 2016). The car is scratched with the next car because the parking is too small and cannot take up enough space between cars for the parking, but when you exit take a lot of time to get out of the car for fear of bumping any car near-by.

## **Smart parking system**

The traditional parking has been developed to a parking system that helps the driver to know the occupied and available positions through a display that contains the number of available parking spaces and where they are located (Pham, Tsai, Nguyen, Dow, & Deng, 2015). Vacancy in a car cannot take this position, and in the case of the car out of the position goes light green and gives an update of the screen the presence of a vacant position can any car stand in that position (Fraifer & Fernström, 2017), this system is used in many places and solve the problem of random parking and not to stand in places not available to stand up (Pham et al., 2015).

Smart parking consists of two networks, an external network and an internal network, the external network is that the user connects to the Internet and enter the application of smart parking to reserve a position and be booking anywhere available in a data network, and the user enters the server of smart parking to be able to reserve the desired position without the need to access parking Through the application the user can know any vacant positions and available and places parking , The internal network of parking is the process of connecting all devices smart parking When the server is sending a signal to the cloud and the role of the cloud send this signal to the display screen and from the display screen to the sensor and the sensor to the top of the position and vice versa and this communication is done internally without the intervention of any employee or user.

	Traditional parking system	Smart parking system
Planning	Without planning	With planning
Right parking	Parking any where	Parking in right area
Using IOT	NO	YES
Secure	No	Yes
Comfortable	No	Yes

**Table 1.** Comparison of Traditional and Smart Parking System

## **Smart parking in UAE**

The United Arab Emirates is one of the Gulf countries faced the problem of finding parking. this problem was associated with the exceptional growth in the large number of cars, buses and trucks, before a period is finding a parking for the car was a real challenge because of the lack of sufficient parking (Gossling, 2017), and the random planning in the management of parking. The reasons that resulted in the problem of parking, has been a new application of parking and regulating the movement of parking and exit. The UAE is the forerunner in the field of smart parking, and the Emirate of Dubai and Abu Dhabi more than interested in smart parking.

## **Advantage of smart parking system**

- Accommodating many cars
- Car parking is organized and easy
- Easy access to vacant positions
- Prevent vehicle theft and vandalism

## **Smart parking in Japan**

It is considered one of the developed countries in the field of smart parking, where in the early nineties was established more than 40,000 parking attributable to the fact that Japan suffers from narrow areas and estimated only 20% of its land is suitable for housing and population and living and the rest mountains and volcanoes (Axhausen, Chikaraishi, & Seya, 2015). The 20% were exploited creatively and wonderful Problems arising from the lack of parking spaces are becoming more susceptible to traffic congestion, particularly in densely populated areas. Therefore, urges the government to use other means Such as trains and bicycles minimize the use of cars to preserve the environment from pollution.

## **Smart Parking System Using IOT**

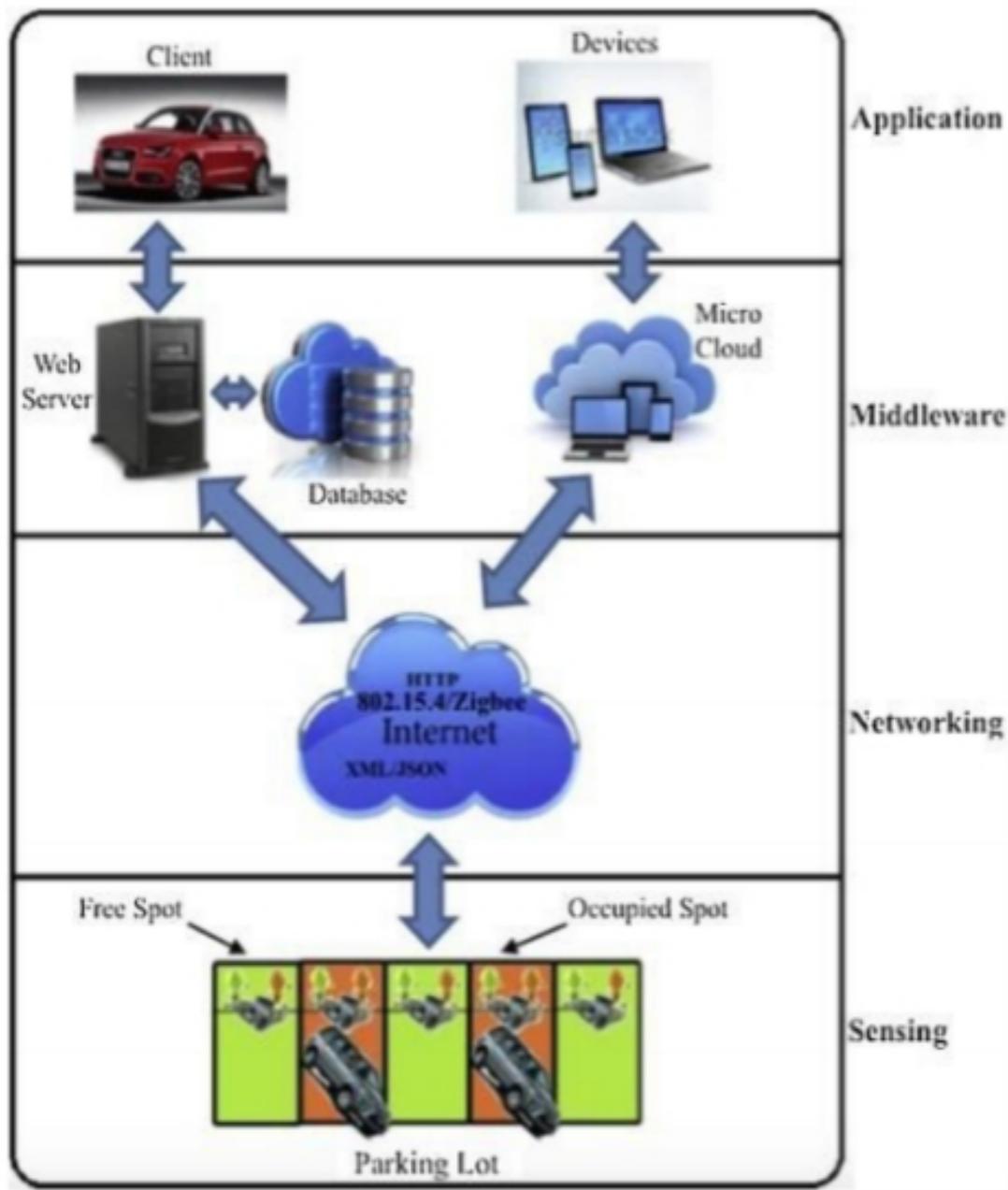
With the growth of smart cities, there is a constant demand for smart solutions to the problem of attitudes

Internet of Things has witnessed a significant and significant development in many sectors. Internet of Things addressed technological constraints such as storage, processing and energy. Internet of Things is able to use devices heterogeneous in nature and allows different devices to communicate and exchange data in an acceptable format. The Internet of Things consists of a large number of information sources.

The proposed system consists of smart parking using the Internet of things to monitor any nearby parking and reference to parking. There will be an application for phones allows the user to search and check the availability of parking and reserve parking for a limited time without loss of time and effort.

Smart Parking system will combine technology and human innovation to minimize the use of resources such as space, time and fuel. The goal of this research is to achieve faster and easier parking and organize less time in finding a position.

In each position there are two of the red and green. Red light indicate that the position is not vacant while green position represent vacant parking slot. In each position there is a sensor and a horizontal range of a meter to send the signal to the server that this position is not available. The position is reserved and one number is decreased from the total number. The users can use the mobile application for free and can reserve any parking space. Reserve any position of choice by the day and by hour and the amount is deducted from the credit/debit card and the discount is immediately upon parking in the specified position.



**Figure 1.** Smart Car Parking System Using IoT

## Database

In smart parking database is necessary to work the parking easily and conveniently. The database acts as an intermediary between the internal network and the external network represented in the application. The database includes the data of each car booked position such as the car number, color and driver name and the last time the parking was reserved and the number of hours reserved. Payment is also done, and this method is done with all cars that have reserved parking, the database must also have a reference copy of the data be a reference in case of damage or loss of data. The database will be available individually in case someone wanted to see his data when entering the parking.

## Sensing

Sensors are a critical component of smart parking system. Smart parking is a sustainable and intelligent way of working, by integrating all of its structure. Infrastructure, services and smart devices to monitor and control the parking to ensure sustainability and efficiency. The sensor is

located at the heart of smart parking system to monitor and work smartly. Sensors deployed in smart parking to monitor the movement of cars inside and outside the parking. Sensors are interconnected with each other and operate through a network. Sensor sends the signal to the devices deployed in the parking enters or exits, which sends a signal to the database. The display updates the data of the vacant positions and the occupied positions. It is red and green based on the signal that the green light is available and the red color is occupied. Arduino is an electronic piece to connect the sensors with each other and used with Arduino piece called Node mcu This widget helps to connect to Wi-Fi, real time clock connected to the sensors to see the time reserved by the user and the hour of exit from positions and be linked to the application to give an alarm near the end of the specified position reserved, the display screen of reserved positions and available positions and be connected with the Arduino to know the status of positions and work continuously update For positions.

## Using cloud

The cloud provides the processing and storage of data for the parking service. It stores a lot of information about the available and occupied parking, and the time of entry and exit. It also provides the location of the parking, and give the cloud update in the case of entering a new car in the parking or exit the car from the parking.

## Server and database

The server works with the database as a bridge between mobile applications and the cloud, where if a person wants to reserve a position in a certain period of time, the server asks the cloud information about the available positions and positions occupied and presented to the consumer to search for a position that suits him. The server sends an update to the cloud that this consumer has chosen a position and set the time of entry and exit, and then sends a signal to the display screen to reserve the position, and the server is connected to a database of all consumers who have booked by mobile phone and entry and exit times.

## Application

Mobile application can be used to reserve a parking position or search for positions that are close to the intended location of the visit. Most applications require an Internet to work efficiently and explore the best places to stand, the user can book by computer or laptop or mobile phone (Kahn, Kinsolving, Vogel, & Christensen, 2018). The application sends a message to the user about the location of the position, the hours of parking, and billing information.

## Conclusion

IoT based Smart parking system has been proposed in this paper to avoid traffic congestion, random parking, and obstruction of traffic in the parking area as well as to search and wait for a parking space. The proposed system described in this paper is built with four layers: Application, Middleware, Networking, and sensor layer. The research paper highlights the comparison of traditional parking system with smart parking system using IoT. The paper also proposes a framework for smart parking system.

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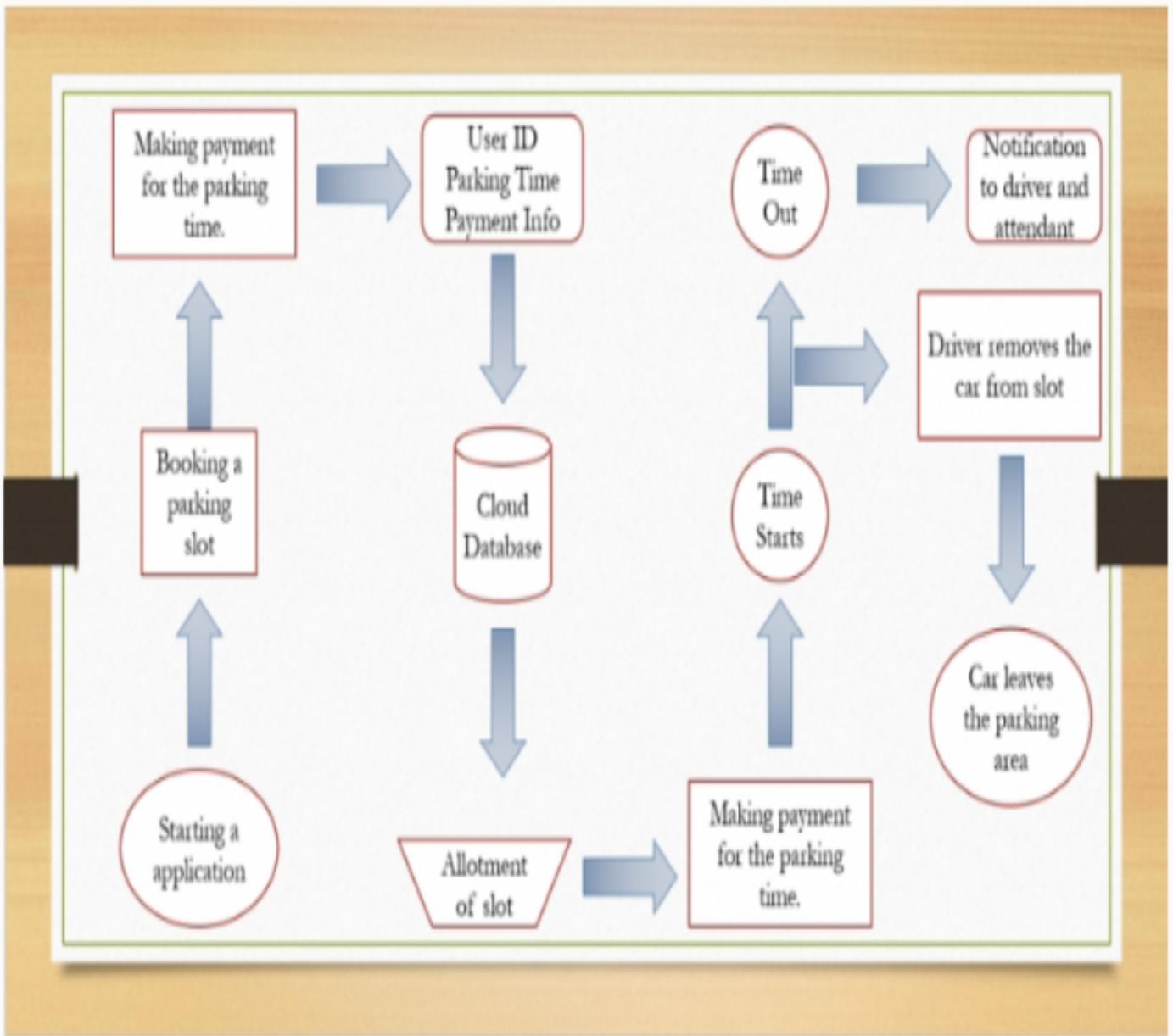
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**Abstract-**Smart Parking is a parking strategy that combines technology and human innovation in an effort to use as few resources as possible—such as fuel, time and space—to achieve faster, easier and denser parking of vehicles for the majority of time they remain idle. The Smart Parking system consists of an on-site deployment of an IoT module that is used to monitor and signalize the state of availability of each single parking space which enables the user to find the nearest parking area and gives availability of parking slots in that respective parking area. These systems use effective sensors in the parking areas and by tracking information from various sources and also deployed active data processing units. Here our proposed idea is implemented using django web framework and creating a web application so the drivers or end users could get their parking information via Wi-Fi or Internet. It mainly focuses on reducing the time in finding the parking lots and also it avoids the unnecessary travelling through filled parking lots in a parking area. Thus, it reduces the fuel consumption which in turn reduces carbon footprints in an atmosphere.

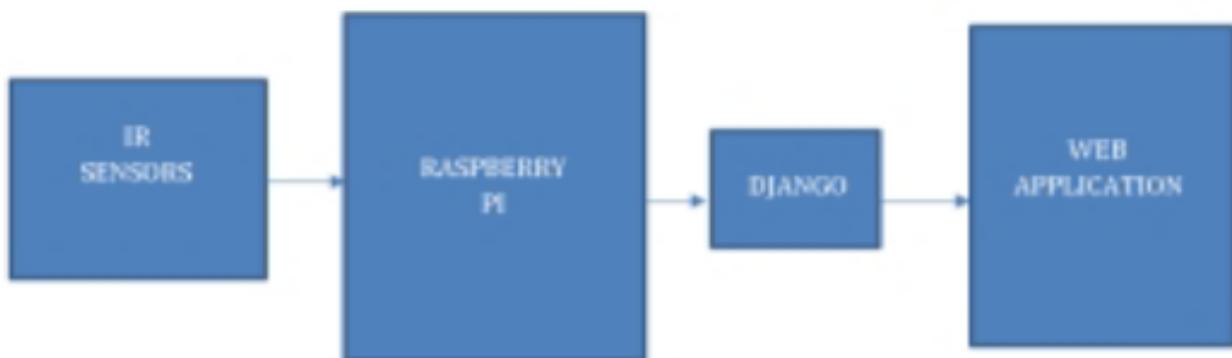
**Key Words:** Smart Parking, Internet of things(IOT),Web Framework, Web Application, Django, Wi-Fi, Carbon Footprint

## 1. INTRODUCTION

IOT technology grows in various fields of smart applications but we have not yet found boundary constraints of this technology. Some smart applications which it has implementing currently such as on smart grids, smart lighting, smart energy, smart city, smart health etc. [4]. Problems such as, traffic congestion, limited car parking facilities and road safety are being addressed by IoT. A smart city is an urban area that uses different types of electronic data collection sensors to supply information which is used to manage

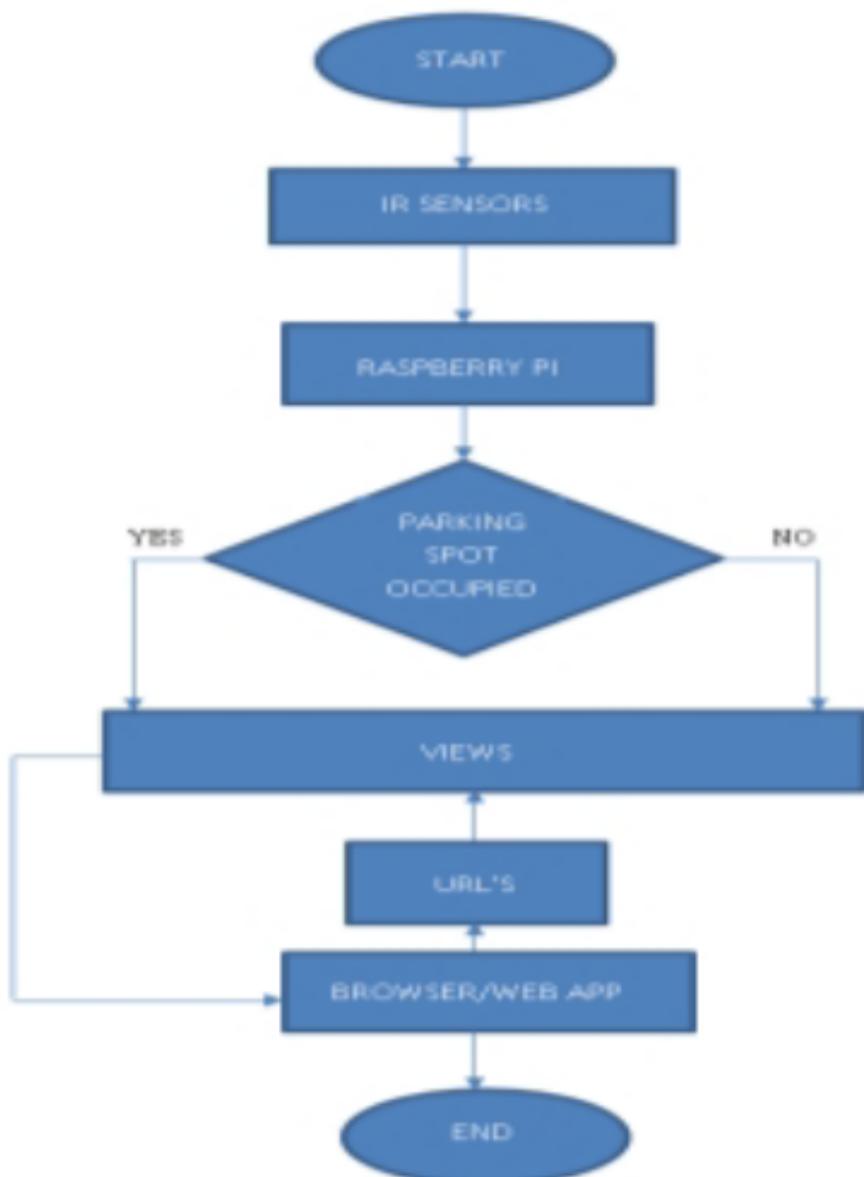
## 4. SYSTEM DESIGN

### 4.1. BLOCK DIAGRAM



**Fig 1:** Block Diagram

### 4.2. FLOW CHART



## **2. IR sensors**

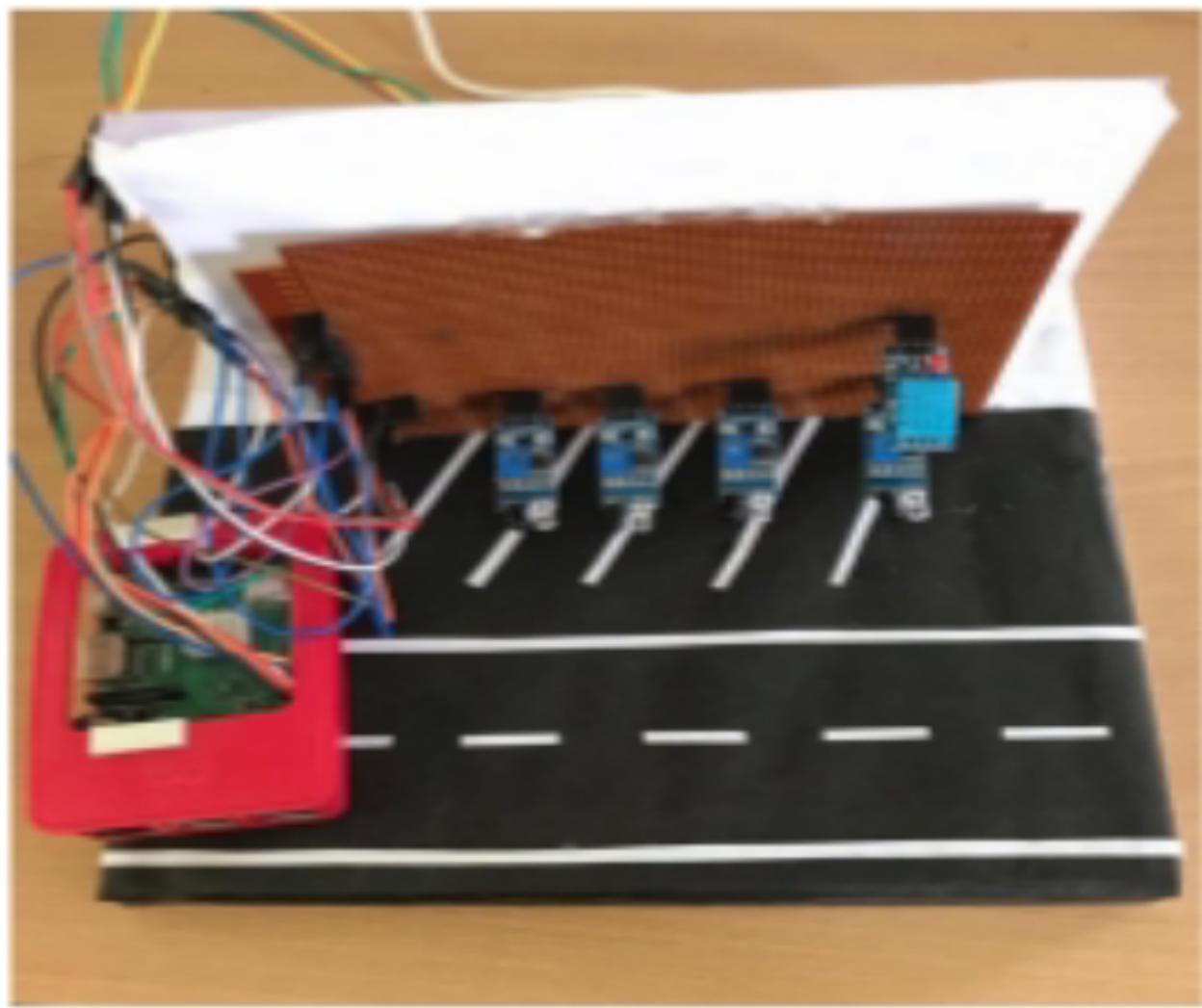
IR sensors are used to detect the presence of a vehicle. The radiations are not visible to naked eye IR sensors detect the heat and motion of an object or person. Thermal radiations are detected by passive IR sensors. The resistances and the output voltages, change in proportion to the magnitude of the IR light received [1]. The IR transmitter sends an infrared signal that, in the presence of a reflecting surface (especially if it is white), "bounces" in various directions, including the one along which the radiation hits the IR receiver, which captures the signal by detecting the object, and signaling it through one of its pins.

## **3. Jumper Wires**

A jump wire is an electrical wire, or group of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Jumper wires are wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed [2].

## **4. Perforated PCB**

Perfboard is a material for prototyping electronic (also called DOT PCB). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually a square grid of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available. Inexpensive perfboard may have pads on only one side of the board, while better quality perfboard can have pads on both sides (plate-through holes). Since each pad is electrically isolated, the builder makes all connections with either wire wrap or miniature point to point wiring techniques. Discrete components are soldered to the prototype board such as resistors, capacitors, and integrated circuits. The substrate is typically made of paper laminated with phenolic resin (such as FR-2) or a fiberglass-reinforced epoxy laminate (FR-4).



**Fig 4: Hardware**

## **7. APPLICATION AND ADVANTAGES**

### **7.1 APPLICATIONS**

- It can be used in open spaces as well as in basement parking.
- It can be used in Smart Cities.

### **7.2 ADVANTAGES**

- Optimized parking
- Reduced traffic
- Reduced pollution
- Enhanced User Experience
- Increased Safety
- Real-Time Data and Trend Insight
- Decreased Management Costs

## **8. CONCLUSION AND FUTURE SCOPE**

### **8.1 CONCLUSION**

- Smart parking facilitates the problems of urban livability, transportation mobility and environment sustainability. Smart Parking technology is used for enhancing the productivity levels and the service levels in operations.
- It is well managed to access and map the status of parking slots from any remote location through web browser. It eliminates unnecessary travelling of vehicles across the filled parking slots in a city. So, it reduces time and it is cost effective.

### **8.2 FUTURE SCOPE**

- The automated parking fee system would allow people to travel without cash. It provides drivers with Also, as it would reduce the waiting time, long queues, tension, stress and increase the efficiency of the parking system.
- The smart parking management system can be applied for plane and ship and fleet management.
- For residential and domestic parking system the device can be interfaced with Home Automation system which can control the various home appliances by sensing whether the user is arriving or departing from the parking space.

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## *Program:*

```
d":"6c07042c.fe12b","type":"rpi-gpio in","z":  
"7d77b7e7.4c1f","name":"","pin":"7","  
intype":"down","debounce":25,"read":false,  
}],{"id":153,"yb":98,"x":336,"y":97,"wires":1,"type":  
"ui_led","z":"7d77b7e7.4c1f","name":"Parking Spot  
Control","func":"var status = msg.payload;\n\nif (status === 1) {\n    return { payload:  
        : \"occupied\" };\n} else {\n    return { payload: \"vacant\" };\n}\n","outputs":1,"  
noerr":0,"x":336,"y":98,"wires":[[{"id":4399d85c.  
273b7c"}]},{ "id": "4399d85c.273b7c", "type":  
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```

# Output:

In this example, ultrasonic sensors detect the presence of a vehicle, and the LED on the web dashboard indicates whether the parking spot is occupied (red) or vacant (green).

**THANK**  
**YOU**