PHASE 05

SMART PARKING

USING IoT

SUBMITTED BY,

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Step 1: Defining the system requirements and objectives of the smart parking project

Objectives:

1. **Efficiency**: Minimizing the time it takes for drivers to find available parking spaces, reducing traffic congestion, and improving the overall flow of vehicles within the urban environment.
2. **Environmental Impact**: Reducing emissions and fuel consumption associated with circling for parking spaces, thus contributing to a greener and more sustainable urban environment.
3. **Customer Satisfaction**: Enhancing the parking experience for customers by providing real-time information on available parking spaces, convenient payment options, and user-friendly mobile applications.
4. **Revenue Optimization**: Maximizing parking facility revenue through improved occupancy management, dynamic pricing, and efficient space allocation.
5. **Data-Driven Insights**: Collecting and analyzing data to gain valuable insights into parking patterns, which can be used for future planning and decision-making.
6. **Safety**: Improving safety for both pedestrians and drivers by reducing traffic congestion and eliminating the need for risky maneuvers to find parking.
7. **Accessibility**: Ensuring that parking facilities are accessible to all, including those with disabilities, through the use of technology that assists in finding and reserving accessible parking spots.

8. **Smart Infrastructure**: Integrating with other smart city initiatives and infrastructure, such as traffic management and public transportation systems, to create a more cohesive and efficient urban environment.

Requirements:

Sensor Infrastructure:

- Vehicle detection sensors (e.g., ultrasonic, infrared, magnetic, or camerabased) to monitor parking space occupancy.
- Communication infrastructure to transmit sensor data to a central system.

Centralized Management System:

- A central server or cloud-based platform for processing and managing parking data.
- Real-time data processing capabilities.
- User authentication and access control.

Mobile App and User Interface:

- User-friendly mobile app for drivers to find, reserve, and pay for parking spaces.
- Web-based interface for administrators and parking operators to manage the system.

Data Storage and Analytics:

- Storage for historical parking data.
- Data analytics tools for insights into parking patterns and optimization.

Payment and Billing System:

- Integration with various payment methods (credit cards, mobile wallets, etc.).
- Billing and invoicing capabilities for users and operators.

Navigation and Guidance:

- GPS integration for accurate navigation to available parking spaces.
- Real-time guidance and notifications to drivers.

Security and Privacy:

- Robust security measures to protect user data and system integrity.
- Compliance with privacy regulations (e.g., GDPR) and data protection.

Integration with Existing Infrastructure:

- Integration with traffic management systems, public transportation, and other smart city initiatives.

- Compatibility with existing parking facilities andinfrastructure.

Space Management and Allocation:

- Dynamic allocation of parking spaces based on demand.
- Efficient use of space through intelligent allocationalgorithms.

1. **Availability and Redundancy: -** High availability toensure minimal downtime. - Redundancy and failover mechanisms to prevent system failures.
2. **User Support and Customer Service: -** 24/7 customersupport for user inquiries and issues.
3. **Accessibility:** - Provision for accessible parking spacesand user support for those with disabilities.
4. **Scalability:** - Ability to scale the system as the numberof users and parking facilities grows.
5. **Environmental Considerations:** - Integration with environmental and sustainability initiatives to reduce emissionsand promote eco-friendly transportation options.
6. **Regulatory Compliance:** - Compliance with localregulations and permits for smart parking implementation.
7. **Maintenance and Upkeep:** - Regular maintenanceschedules and procedures to ensure sensors and equipmentremain operational.

8. **User Education and Training:** - Training materials and resources for users and operators.

9. **Marketing and Promotion:** - Marketing strategies to encourage adoption and usage of the smart parking system.

10. **Data Backup and Recovery:** - Regular data backups and recovery plans in case of data loss or system failure.

11. **Feedback Mechanism:** - Mechanisms for users to provide feedback and suggestions for continuous improvement.

IOT SENSOR SETUP

IOT SENSORS plays a crucial role in detecting and relaying information about the occupancy status of parking spots in real time.

Sensor Types:

Ultrasonic Sensors: These sensors emit high-frequency sound waves to detect the presence of vehicles in parking spaces. Theyare cost-effective and work well in various weather conditions. However, they may require regular maintenance and calibration.

Infrared Sensors: Infrared sensors detect the heat emitted by vehicles. They are suitable for indoor parking facilities but maybe affected by temperature variations and direct sunlight.

Magnetic Sensors: Magnetic sensors use changes in the Earth'smagnetic field to detect vehicle presence. They are highly accurate and durable but can be more expensive to install.

Camera-Based Sensors: Cameras can provide visual data of parking spaces and can be used for license plate recognition and video analytics. They offer a higher level of accuracy but may bemore costly to implement and maintain.

Sensor Accuracy:

Choose sensors that provide high accuracy in detecting parking space occupancy. The accuracy of sensors and cameras is criticalto ensure reliable data for guiding users to available spaces and optimizing space allocation.

Environmental Considerations:

Consider the environmental conditions of the parking facility. Outdoor parking lots may require sensors that can withstand exposure to rain, snow, and extreme temperatures. Ensure that the chosen sensors are designed to function effectively in theseconditions.

Maintenance and Reliability:

Evaluate the maintenance requirements of the sensors and cameras. Some sensors may require more frequent calibrationand maintenance than others. Choose sensors that are reliableand robust, with a low risk of malfunctions.

Integration with Central System:

Ensure that the selected sensors and cameras can seamlessly integrate with the central management system of your smart parking solution. They should be able to transmit data in real-time for analysis and user guidance.

Camera Resolution:

For camera-based sensors, consider the resolution of the cameras. Higher resolution cameras can capture more detailed images and provide better accuracy in license plate recognitionand video analytics.

Scalability:

Select sensors and cameras that can be easily scaled as yourparking facility grows. The system should accommodate theaddition of more sensors or cameras without significant disruptions.

Cost Considerations:

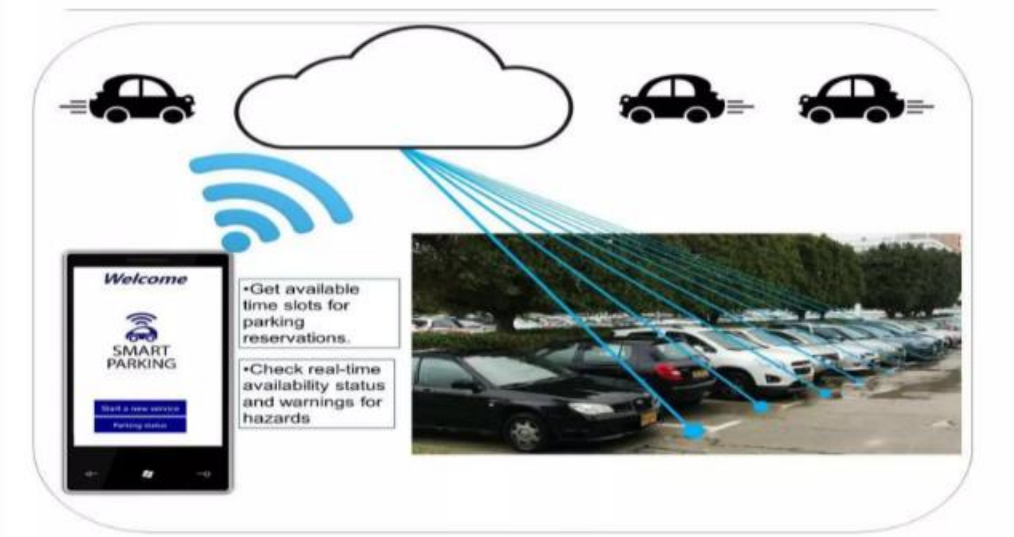
Budget constraints are a significant factor in sensor and cameraselection. Weigh the costs of installation, maintenance, and potential savings from improved parking efficiency.

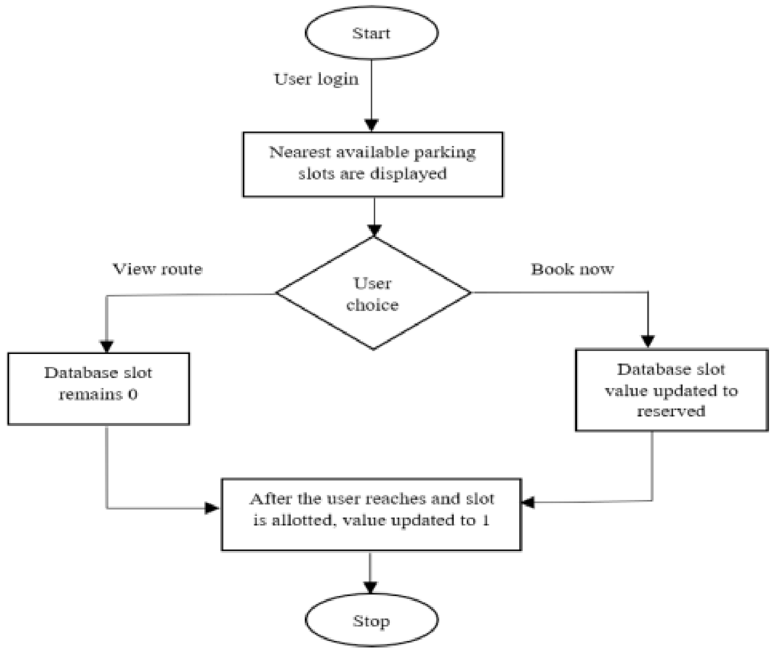
Sensor Placement:
Strategically position the sensors within each parking space for accurate detection of vehicle presence. Consider these points:

- Optimal Location: Install sensors to cover the most effective area in the parking space to detect the presence or absence of vehicles.
- Sturdy Installation: Ensure the sensors are securely mounted to withstand environmental conditions and the weight of vehicles.
- Wiring and Connectivity: Establish connections for power and data transmission, considering a wired or wireless setup based on the sensor type and location.

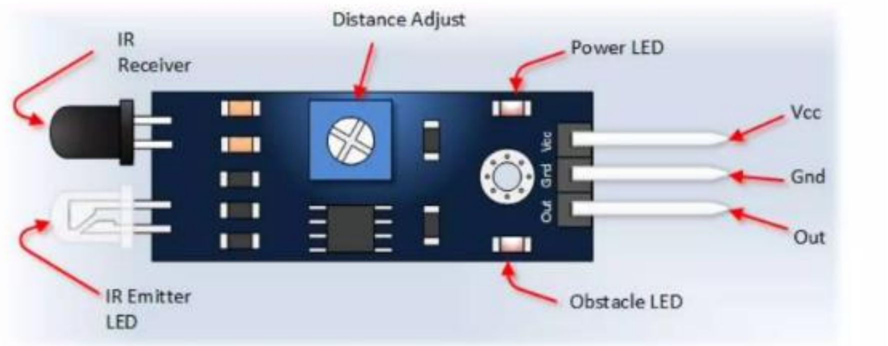
MOBILE APP DEVELOPMENT:

To find the parking space from any where by using the mobile application.

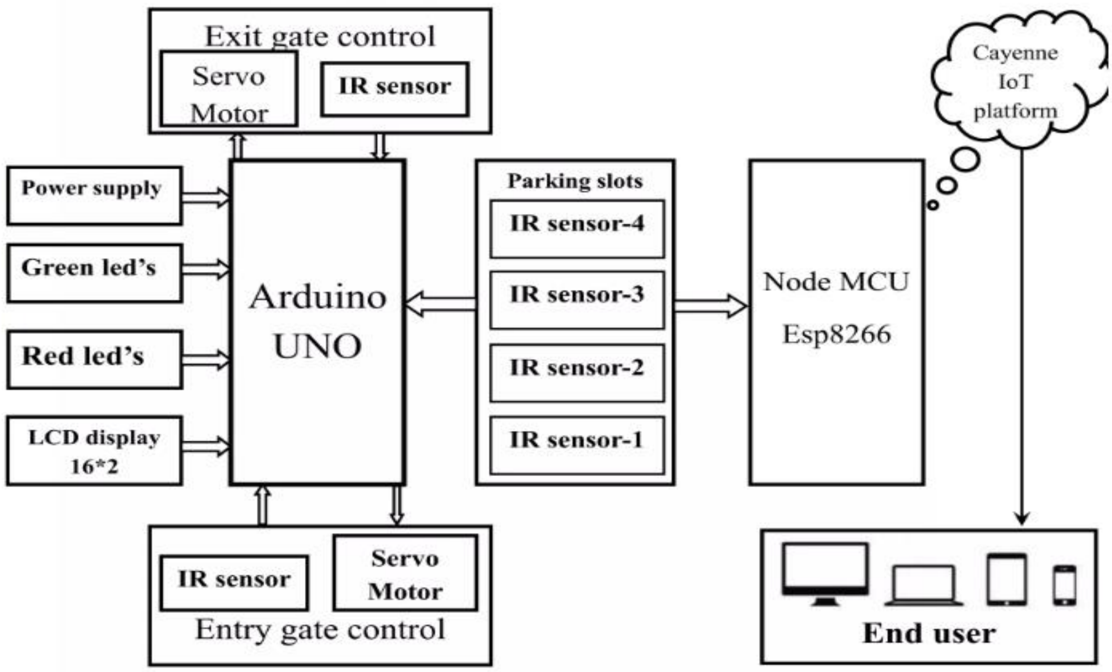




PROCESS FLOW OF APP



IR SENSOR



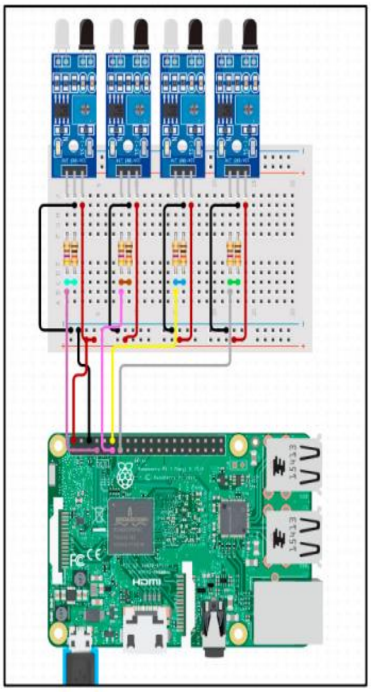
ARCHITECTUTRE DIAGRAM

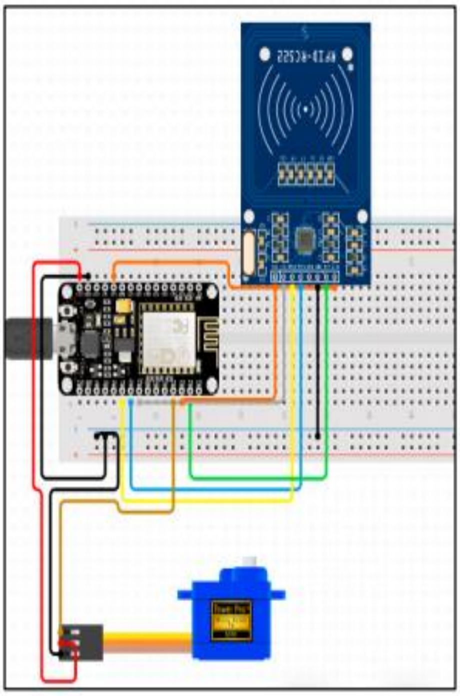
Raspberry Pi Integration

Role of Raspberry Pi

The Raspberry Pi 3 Model B is a third-generation Raspberry Pi. It has an added LAN and Bluetooth connectivity. It has 1GB RAM and it has 40 GPIO pins which help us to enhance the proposed work. The free Firebase real-time database, which has a little amount of data, is essential for interacting with the information on the slots' availability. AWS RDS is used to store the data regarding the process like user details, previous records, and time booked. The proposed work consists of two circuits having controllers as NodeMCU and Raspberry Pi. The connections are made accordingly to the schematic diagram mentioned in Fig. 4 and Fig. 5. The Raspberry-pi circuit consists of IR sensors and these sensors are connected to common VCC and GND through the breadboard and their input pins are connected to the GPIO pins of the board. Raspberry-Pi retrieves the values from firebase and checks the readings of the sensors. If there is any change in the real-time value of the sensors, the raspberry pi updates the firebase real-time database values so that every module in the project can be accessing a unique and correct value from the database. The 3.3V pin of the MFRC522 RFID module is linked to the 3.3V pin of the NodeMCU module in the second circuit shown in Fig. 5. The NodeMCU ESP8266's D1 pin and the RFID module's reset pin are connected. The MFRC522 Module's IRQ pin is not connected. The NodeMCU module's D6 pin and the RFID module's MISO and MOSI pins are connected. D5 and D2 are the respective connections for SCK and SDA. A servo motor is also attached to the NodeMCU

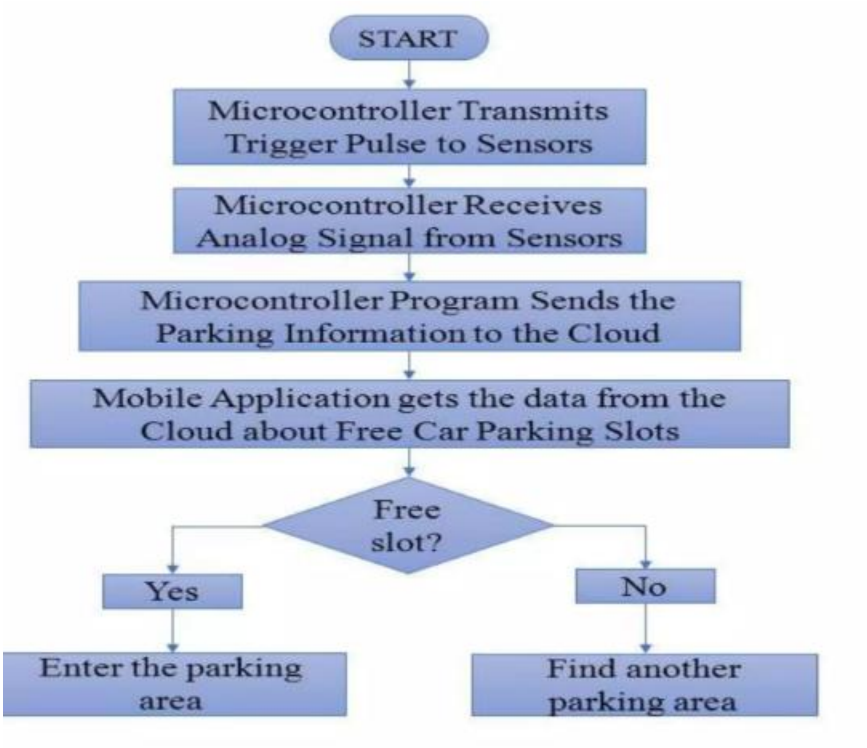
for the controlling of the gate. This module helps us to detect the vehicle using their fast-tags and updates the values in the firebase so that the remaining modules would be alerted and works in synchronization.





PI WITH FOUR IR SENSORS

FLOWCHART:



CODE:

```
const int TRIG_PIN_1 = 4;
const int ECHO_PIN_1 = 12;
const int TRIG_PIN_2= 2;
const int ECHO_PIN_2 = 5;

const int RED_PIN_1 = 27; const int
GREEN_PIN_1 = 26;


const int RED_PIN_2 = 33; const int
GREEN_PIN_2 = 32;

int counter = 0; float duration_us_1, duration_us_2, distance_cm_1,
distance_cm_2;
void setup()



{
Serial.begin(9600); pinMode(TRIG_PIN_1,
OUTPUT);
```

```
pinMode(ECHO_PIN_1, INPUT);
pinMode(TRIG_PIN_2, OUTPUT);
pinMode(ECHO_PIN_2, INPUT);

pinMode(RED_PIN_1, OUTPUT);

pinMode(GREEN_PIN_1, OUTPUT);

pinMode(RED_PIN_2, OUTPUT);
pinMode(GREEN_PIN_2, OUTPUT);

}
 void loop()

{
counter = 0;

ultrasonic_1(); ultrasonic_2(); Serial.print("1: ");

Serial.println(distance_cm_1); Serial.print("2: ");

Serial.println(distance_cm_2);
Serial.print("Counter: ");

Serial.println(counter); Serial.println("");
}
 void ultrasonic_1(){ digitalWrite(TRIG_PIN_1, HIGH);
delayMicroseconds(10); digitalWrite(TRIG_PIN_1, LOW);

// measure duration of pulse from ECHO pin duration_us_1 = pulseIn(ECHO_PIN_1,
HIGH);
// calculate the distance distance_cm_1 = 0.017 * duration_us_1;

if(distance_cm_1 < 50) {
red_1();
Serial.println("Slot 1 Terisi"); counter++;

}
else { green_1();

}

}
```

```
void ultrasonic_2(){
digitalWrite(TRIG_PIN_2, HIGH);
delayMicroseconds(10);
digitalWrite(TRIG_PIN_2, LOW);


// measure duration of pulse from ECHO pin duration_us_2 = pulseIn(ECHO_PIN_2,
HIGH);

// calculate the distance distance_cm_2 = 0.017 * duration_us_2;

if(distance_cm_2 < 50) {
red_2();
Serial.println("Slot 2 Terisi"); counter++;    }
 else {
green_2();

}

}
void red_1(){ digitalWrite(RED_PIN_1, HIGH);
digitalWrite(GREEN_PIN_1, LOW);
delay(1000)
}
void  red_2(){ digitalWrite(RED_PIN_2, HIGH);
digitalWrite(GREEN_PIN_2, LOW);delay(1000);

}
voidgreen_1(){ digitalWrite(RED_PIN_1, LOW);
digitalWrite(GREEN_PIN_1, HIGH);
delay(1000);

}
voidgreen_2(){ digitalWrite(RED_PIN_2, LOW);
digitalWrite(GREEN_PIN_2, HIGH);
delay(1000);
```

WORKING AND IMPLEMENTATION

Stage-1:

When car enters the parking area IR sensor that is present before IN gate will detects the passing vehicle and the gate will be opened automatically.

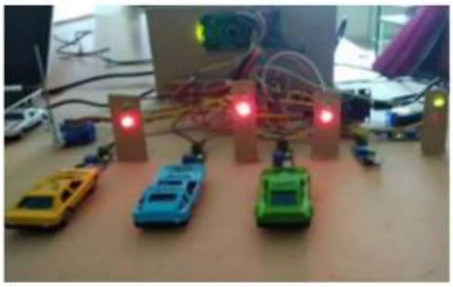
Before reaching to IN gate

After reaching to IN gate

Stage-2:

The car will enter into the parking area at that time person doesn't know which slot is empty, for this there will be an indication of LED's for every slot when the Green light glows the slot is empty when the red light glows the slot was filled. By this the person easily know which slot is empty.

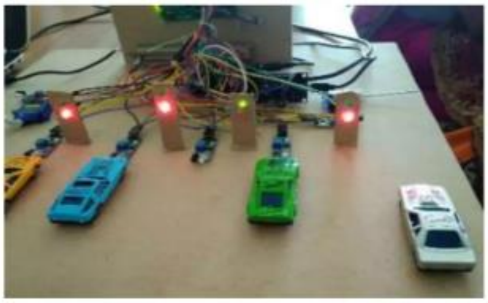
Before reaching to slot



After reaching to slot

Stage-3

The operation of exit side will be same as that of the entrance. When the car is leaving the parking area, the IR sensor that is present before the OUT gate will detect the passing vehicle and the gate will be opened automatically.

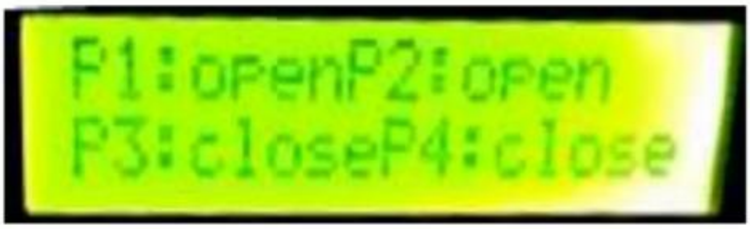


Before reaching to OUT gate

After reaching to OUT gate

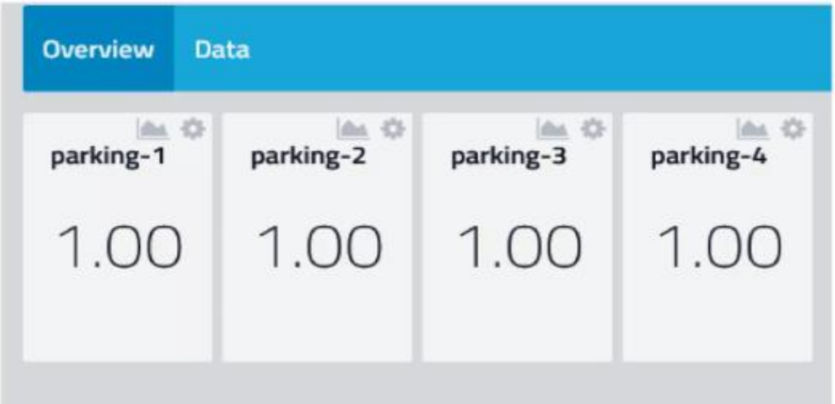
Stage-4

In front of the parking area, there will be an LCD display that is used to show the status of the parking slots, whether the parking is available or not.



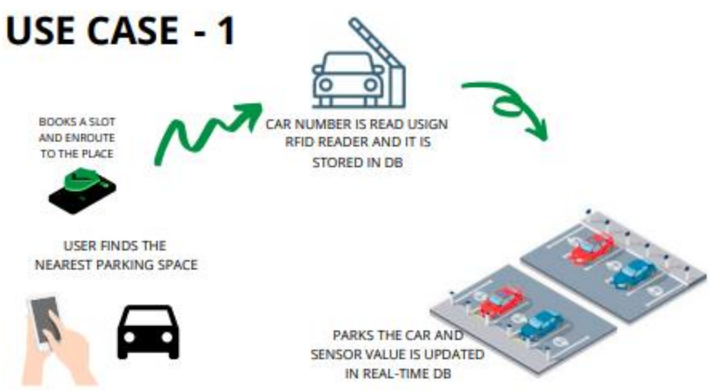
Stage-5

The main advantage of the current system is the user will register in CAYENNE application/website. From this application/website also the user can see the status of parking area. In this application it will show the information of parking slots individually.



<u>HOW THE REALTIME PARKING SYSTEM AND BENEFITS FOR DRIVERS</u>

Use-Cases for Intelligent Parking System (IPS) Parking space allocation in a smart city can be implemented in two ways. Initially, for high parking spaces, we can use parking lots for parking more cars with proper identification, and secondarily, we can do it by having home slots at houses. Both use-cases are explained



The nearest parking space with available slots is displayed to the user and through the app, the user reserves a slot ahead of reaching the space. Once the user enters the parking space, the car number is read using the RFID reader at the gate and it is then stored in the database. The user then goes ahead and parks the car in the available slot. The sensors installed at the slots detect this change and the firebase values are updated. At this stage, a verification is done to check if the user has parked in the reserved slot. If the car is parked in a different slot, the reserved slot is freed, and the parked slot value is updated. The details of the duration, vehicle type, etc., are stored in the database. Upon exit, payment is calculated, and the user can pay through the payment page in the app.

Fig. 3. Parking lots near home consisting some slots for nearby people

A specific space for parking might seem as under usage of the available space and thus an alternative, at least to some extent will be the use of home slots for this purpose. In this, people can register the parking slot in their home for the duration of time for which they know the slot will be unused. Multiple such slots are registered and then the sensors are deployed over there and the information is entered into the database. Similar to the above approach the nearest one to the user is suggested. However, since there is a higher difficulty in locating the parking spots since they are lesser in number, an additional check is done to ensure the right user has reached the right slot. The location of the user and the location of the slot in the system are compared and a confirmation message is given to the user. The payment and other details storage are the same as in the above approach

Payment is done to the owners on a monthly or weekly basis as per the government's guidelines.

SIMULATION AND RESULT:

User details are checked in the dynamo database and then the user is allowed entry into the app. On the second page, the nearest available slots are displayed to the user and the user makes a selection. On page three, the real-time view of the parking slot is updated. Its values are based on the firebase database and based on the changes; the colors of the slots are changed to indicate occupancy. The final page is the proceed to payment option displayed to the user at the time of exit from the slot.

BENEFITS:

- SHORTER WAITING TIME AT PARKING PLACE.
- IT SAVES FUEL,MONEY ,SPACE AND TIME.
- REDUCED POLLUTION.
- REDUCED TRAFFIC.
- EFFICIENCY
- CARBON EMISSION IS REDUCED.