**PHASE 2: INNOVATION**

**1. Mobile App for Vacant Spot Display:**

Design and develop a user-friendly mobile app for both Android and iOS platforms.

The app should have a user-friendly interface that displays real-time information about available parking spots.

Include features such as a map view with color-coded indicators (green for available spots, red for occupied spots) to help users quickly identify vacant spaces.

Implement a search feature that allows users to find the nearest available parking spots based on their current location.

Provide the ability for users to reserve a parking spot in advance via the app.

**2. Vacancy Detection Sensors:**

Use infrared (IR) sensors and magnetic sensors for indoor parking areas. These sensors are typically reliable for detecting the presence of vehicles in confined spaces.

Install these sensors at each parking space to monitor occupancy. When a vehicle is present, the sensors trigger a signal indicating that the space is occupied.

In outdoor areas, use ultrasonic sensors. Ultrasonic sensors are well-suited for detecting vehicles in open-air environments, as they are less affected by weather conditions.

Ensure the sensors are calibrated and maintained regularly to ensure accurate detection.

**3. Automatic Debit of Parking Charges with FASTag:**

Integrate a payment gateway, which includes support for FASTag or similar electronic toll collection systems.

Users can link their FASTag accounts to the parking app for seamless payment processing.

When a user enters the parking area, the sensors detect the vehicle's entry and record the entry time.

Upon exit, the system calculates the parking duration and automatically deducts the parking charges from the user's FASTag account.

Users can receive digital receipts of the parking charges through the app.

**Additional Considerations:**

* Implement a user registration and authentication system to secure user accounts and payment details.
* Ensure data security and encryption to protect sensitive user information.
* Offer customer support channels within the app to assist users with any issues or inquiries.
* Regularly update the app and the sensor infrastructure to improve system performance and user experience.
* Consider compliance with local regulations and data privacy laws, especially regarding payment processing and user data.
* This integrated system provides users with a convenient and efficient way to find and pay for parking, streamlines parking management, and enhances the overall parking experience. It also contributes to reducing traffic congestion and optimizing parking space utilization.
* Wireless sensors can be placed in parking spaces and are often battery-powered. They communicate data to a central server or gateway using technologies like LoRaWAN or Zigbee..
* Implement data processing algorithms to analyze parking data and provide real-time availability information to users.
* Use data analytics tools to gain insights into parking usage patterns and optimize space allocation.