**Smart Parking**

**Phase 2: Innovation**

**Project Definition:**

The project involves integrating IOT sensors into public transportation vehicles to monitor ridership, track locations, and predict arrival times. The goal is to provide real-time transit information to the public through a public platform, enhancing the efficiency and quality of public transportation services. This project includes defining objectives, designing the IOT sensor system, developing the real-time transit information platform, and integrating them using IOT technology and Python.

Design:

**Ultrasonic Sensors:** These sensors measure the distance between the sensor and an object, helping to detect the presence of vehicles in parking spaces.

**Infrared Sensors:** Infrared sensors can detect the presence of a vehicle based on heat signatures or motion. They are often used in conjunction with ultrasonic sensors.

**Camera Systems:** CCTV cameras or specialized parking cameras can capture images and video footage of parking spaces to monitor occupancy and enforce parking regulations

**Lidar Sensors:** Lidar sensors use laser light to create a detailed 3D map of the parking area, helping in precise vehicle detection and monitoring

**Solar Panels:** Solar panels can be used to power sensors, cameras, and lighting in outdoor parking areas, making the system more sustainable

**Magnetic Sensors:** Magnetic sensors detect changes in the Earth's magnetic field caused by the presence of a vehicle. They are often embedded in the pavement.

**LED Displays**: LED displays can show real-time parking space availability, directions, and pricing information to drivers.

Workflow**:**

**Vehicle Arrival and Detection:**

* + When a vehicle approaches the parking facility, sensors at the entrance detect its presence.
  + These sensors can be ultrasonic, infrared, magnetic, or other types of technology.

**Space Availability Check:**

* + The system checks if there are available parking spaces.
  + This information is often displayed on LED displays near the entrance and sent to a central server.

**User Access Control:**

* + If there are available spaces, the system may grant access to the driver.
  + Access control can be managed through gate control systems or barriers.

**Parking Space Allocation:**

* + If the user has paid and registered, a parking space is allocated to the vehicle.
  + The system keeps track of the allocated space in real-time.

**Vehicle Parking and Occupancy Confirmation:**

* + The driver parks the vehicle in the allocated space.
  + Sensors in the parking space confirm the occupancy status.

**Monitoring and Enforcement:**

* + Surveillance cameras and license plate recognition cameras monitor the parking area.
  + The system can detect unauthorized parking or violations.

**Real-Time Data Collection:**

* + IOT sensors and cameras continuously collect data on parking space occupancy, vehicle movements, and environmental conditions.

**Data Processing and Central Control:**

* + Data from various IOT devices is sent to a central server for processing.
  + The server analyzes the data and updates the status of each parking space.

**User Information and Guidance:**

* + Real-time information, such as space availability, directions to open spots, and pricing details, is provided to users through LED displays and mobile apps.

**Data Analytics and Reporting:**

* + The system collects historical data for analysis.
  + This data can be used for optimizing parking operations and future planning.

**Maintenance and Remote Monitoring:**

* + IOT technology allows for remote monitoring of the system's health and performance.
  + Maintenance alerts are generated for any issues that arise.

**User Feedback and Customer Support:**

* + Users can provide feedback through the mobile app or other channels.
  + Customer support can address user inquiries and issues.

**Environmental Control and Security:**

* + IOT devices may manage lighting, HVAC systems, and security features based on occupancy and environmental sensor data.

**Emergency Response:**

* + Emergency call stations or intercoms can be used to request assistance if needed.

**Navigation and Wayfinding:**

* + IOT-based navigation systems guide users to available parking spaces within the facility.