

Creating a Smart Parking project for ESP32 on the Wokwi platform involves using the ESP32 microcontroller to detect and manage parking spaces, and then visualizing the data on a virtual interface provided by Wokwi. Here's a step-by-step guide on how to create such a project:

**\*\*Components Needed:\*\***

1. ESP32 development board
2. Ultrasonic distance sensors (HC-SR04) for each parking space
3. Breadboard and jumper wires
4. Wokwi virtual simulator (<https://wokwi.com/>)

**\*\*Project Steps:\*\***

1. **\*\*Hardware Setup:\*\***

a. Connect the HC-SR04 ultrasonic sensors to your ESP32 board. You will need one sensor per parking space.

b. Wire the HC-SR04 sensors as follows:

- VCC to 5V on ESP32
- GND to GND on ESP32
- Trig to a digital GPIO pin on ESP32 (e.g., GPIO2)
- Echo to another digital GPIO pin on ESP32 (e.g., GPIO4)

c. Connect all the sensors in the same way, one for each parking space you want to monitor.

2. **\*\*Programming:\*\***

a. Write an Arduino sketch for the ESP32 that reads the distance data from the ultrasonic sensors.

```
```cpp
#include <Ultrasonic.h>

Ultrasonic sensor1(GPIO_TRIGGER1, GPIO_ECHO1);
Ultrasonic sensor2(GPIO_TRIGGER2, GPIO_ECHO2);
// Add more sensors if needed

void setup() {
  Serial.begin(115200);
}

void loop() {
  long distance1 = sensor1.read();
  long distance2 = sensor2.read();
  // Read distances from more sensors if needed

  // Process distance data and manage parking spaces here

  delay(1000); // Delay for better readability
}
```
```

b. In the loop function, process the distance data from each sensor to determine whether a parking space is occupied or vacant. You can set a threshold distance to decide when a space is occupied.

c. You may want to use a data structure to keep track of the parking space status, e.g., an array of boolean values.

3. **\*\*Visualization:\*\***

- a. Go to the Wokwi platform (<https://wokwi.com/>) and create an account if you haven't already.
- b. Create a new project and select the ESP32 as your target board.
- c. Import the Arduino sketch you created earlier into the Wokwi editor.
- d. Use the virtual interface provided by Wokwi to display the parking space status. You can use LEDs or any other graphical elements to represent the parking spaces.

#### 4. **Testing:**

- a. Simulate the project on Wokwi and observe how the parking space status changes based on the simulated distance measurements.
- b. Fine-tune your code and interface as needed to ensure it works correctly.

#### 5. **Deployment:**

- a. Once your Smart Parking project works as expected in the virtual simulator, you can deploy it to a physical ESP32 board and connect it to real sensors in a parking area.

#### 6. **Enhancements:**

Depending on your project's requirements, you can add features such as mobile app integration for real-time parking updates, data logging, and alerts when parking spaces are full or vacant.

Remember to refer to the ESP32 and HC-SR04 datasheets and the Wokwi documentation for detailed information on programming and using these components in your project.