PROJECT INNOVATION

SMART PARKING

TEAM DETAILS

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Problem description	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

Automatic Parking System Controlled by ESP32:

- An automatic parking system can be controlled by an ESP32 microcontroller, which can be programmed to activate the barrier arm when a vehicle approaches, lower it again once the vehicle has passed through, and control the access by various means. The ESP32 can be connected to various sensors, such as ultrasonic or infrared sensors, to detect the presence of a vehicle and trigger the barrier arm to open or close.
- To control the barrier arm, the ESP32 can be connected to an electric motor or a hydraulic actuator using a motor driver or an H-bridge. The ESP32 can be programmed to control the speed and direction of the motor, and to monitor the position of the barrier arm.
- The system can be configured to be activated by various means such as a RFID reader, a barcode scanner, a keypad, or a mobile application. The ESP32 can be programmed to read the data from these devices and determine whether the vehicle is authorized to enter the parking lot or not.
- Additionally, the system can be configured to work with other systems such as an access control system, cameras, or license plate recognition systems. The ESP32 can communicate with these systems using various protocols such as HTTP, MQTT, or Bluetooth.
- When using an ESP32 to control an automatic parking system, it’s important to ensure that the system is properly programmed, configured, and maintained to ensure proper operation and to prevent accidents.

OBJECTIVE

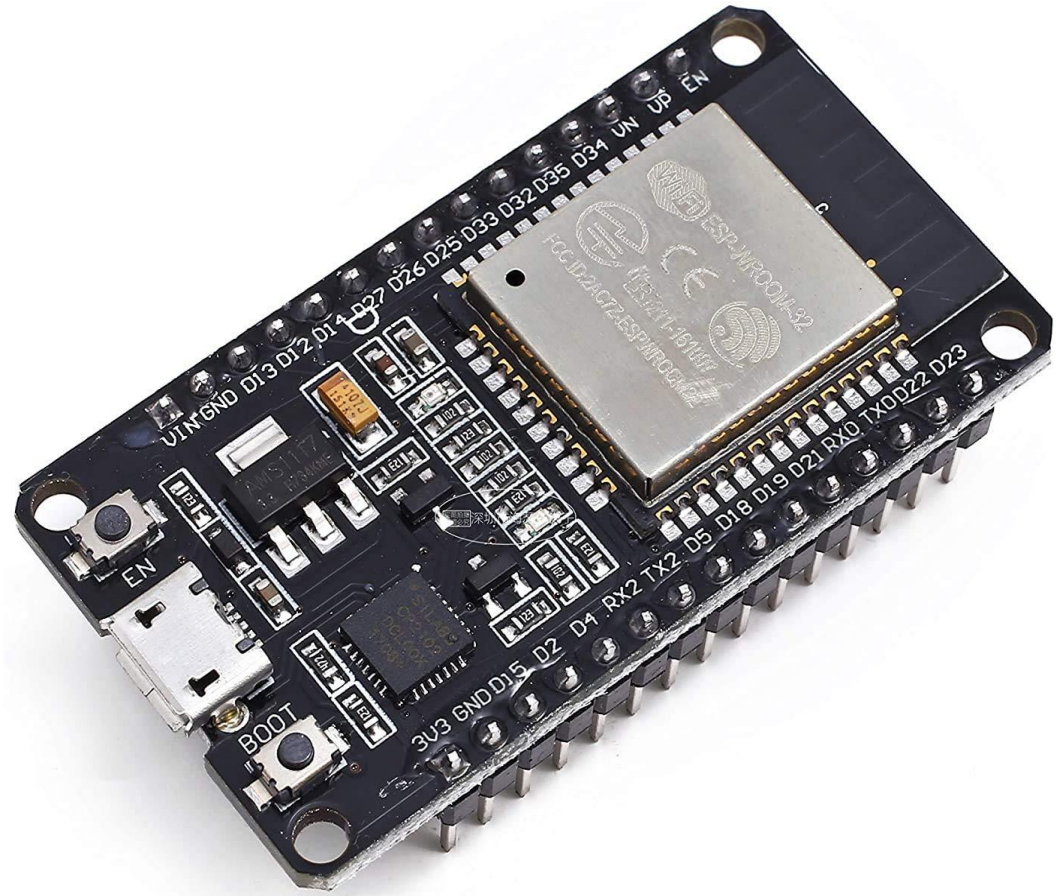
In this project we will simulate an automated parking system with the ESP32 card. This model shows the general operation of the automated systems that allow access to public parks found in stations, airports, cinemas, supermarkets, etc.
Our barrier opens using a servomotor when the HC-SR04 sensor detects a vehicle and closes automatically otherwise.

NECESSARY COMPONENTS:

- ESP32
- HC-SR04 sensor
- Servomotor
- Breadboard
- Jumper wires
- Wokwi virtual simulator
- Arduino uno

DESCRIPTION OF COMPONENTS:

1. ESP32:



- The ESP32 is a low-cost, low-power microcontroller with built-in Wi-Fi and Bluetooth capabilities. It is a popular choice for IoT projects and is commonly used for a variety of

applications such as home automation, wireless control, and sensor data logging.

- The ESP32 features a dual-core processor, a rich set of peripherals, and support for a wide range of protocols. It can be programmed using the Arduino IDE and various other programming languages such as C, C++, and Micro Python.

- The ESP32 has a wide range of features including:

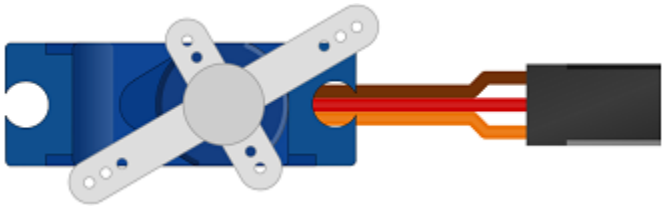
    a) A high-performance processor with a clock speed of up to 240 MHz
    b) Support for various types of wireless connectivity such as Wi-Fi, Bluetooth, and Bluetooth Low Energy (BLE)
    c) Multiple communication interfaces such as I2C, SPI, UART, and I2S
    d) A large number of GPIO pins to connect to external devices and sensors
    e) A built-in security module for secure communication

- The ESP32 is often used in projects where a low-cost, low-power device with Wi-Fi and Bluetooth capabilities is needed, and it is commonly used with other sensors and devices to build IoT projects, home automation systems, wireless control systems, and data logging systems.

2. HC-SR04 SENSOR:

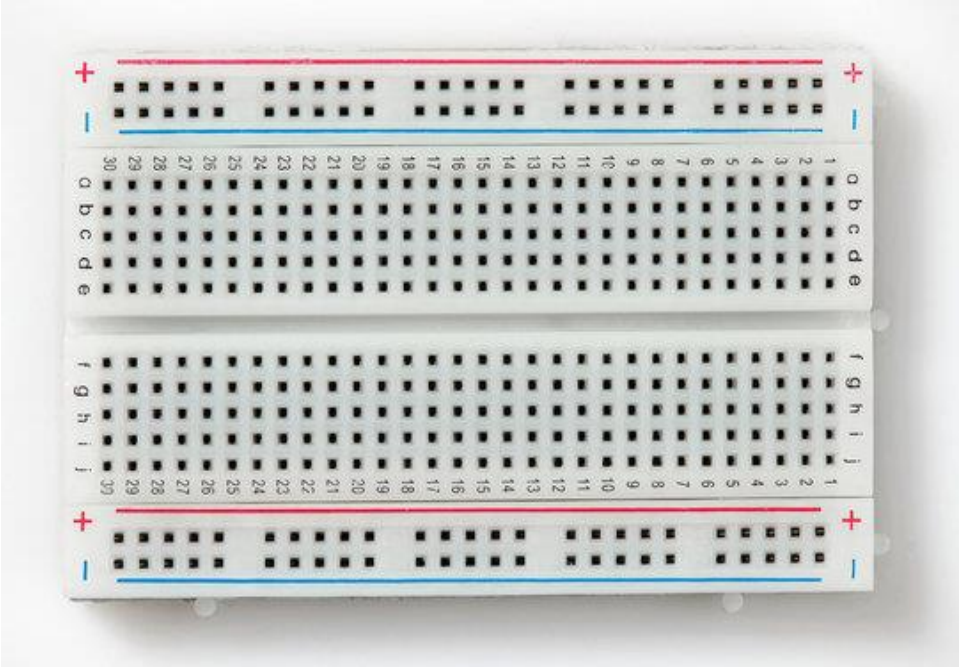
- The HC-SR04 sensor is an ultrasonic sensor that can be used in an automatic parking system to detect the presence of a vehicle.
- This sensor works by emitting a high-frequency sound wave and measuring the time it takes for the sound wave to bounce back.
- By measuring the time it takes for the sound wave to return, the sensor can determine the distance to an object.
- When used in an automatic parking system, the HC-SR04 sensor can be positioned to detect a vehicle as it approaches the barrier.
- The sensor can be connected to the ESP32 microcontroller and programmed to trigger the barrier arm to open when a vehicle is detected and to close again when the vehicle has passed through.

3. SERVO MOTOR:



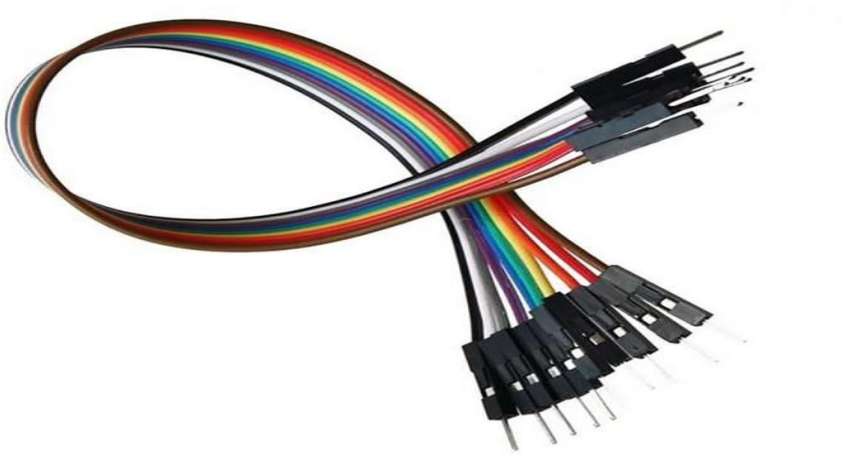
- A servomotor can be used in an automatic parking system to control the movement of the barrier arm.
- A servomotor is a type of motor that can be controlled to rotate to a specific position, making it well suited for precise control of the barrier arm.
- When used in an automatic parking system, the servomotor can be connected to the ESP32 microcontroller and programmed to rotate to a specific position to open or close the barrier arm.
- The ESP32 can be programmed to control the speed and position of the servomotor, and to monitor the position of the barrier arm.

4. BREADBOARD



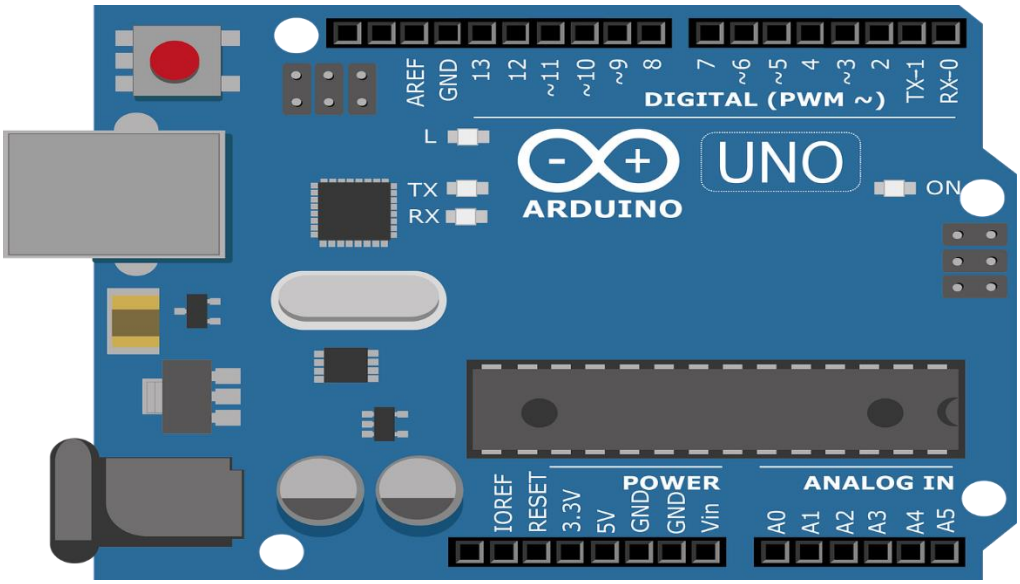
- A breadboard is a type of circuit board that is used to test electronic components.
- It typically consists of a flat board made of a non-conductive material, such as plastic or fiberglass, with a number of holes or pads that are used to connect electronic components.
- The breadboard allows you to connect electronic components and test them easily.

5. JUMPER WIRES:



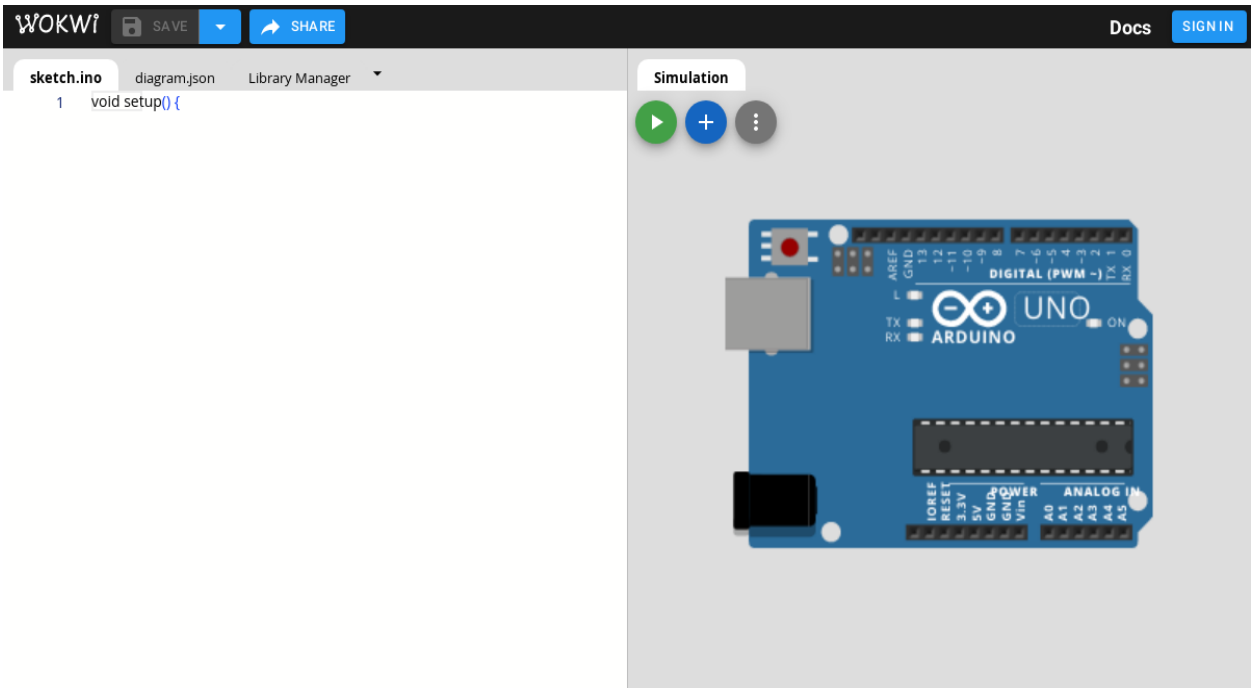
- Jumper wires refers to the process of physically connecting wires or cables to a device or circuit in order to establish an electrical connection.
- This can be done by using various connectors such as plugs, sockets, or terminal blocks.
- The wires are typically color-coded to indicate their function, such as red for power, black for ground, and yellow for signals.

6. ARDUINO UNO:



- Arduino UNO is a microcontroller board based on the ATmega328P.
- It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.
- It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

7.WOKWI SIMULATOR:



- Wokwi is an online Electronics simulator. We can use it to simulate Arduino, ESP32, STM32, and many other popular boards, parts and sensors.
- Wokwi is an embedded systems and IoT simulator supporting ESP32, Arduino, and the Raspberry Pi Pico.
- Wokwi compiles your code into a binary firmware, and then executes the binary firmware one instruction at a time, as a real microcontroller .

CONNECTIVITY:

- The entire smart system process is carried out using Wi-Fi as the wireless technology.
- They are controlled by ESP32 modules, and the data was sent wirelessly by using MQTT protocol. Quantitatively, the ultrasonic sensors are set to have 100 cm of distance as the threshold to differentiate vacant and occupied slots.

PROTOCOLS:

- proposed a system of parking management application that functions to monitor and control the location of parking slot that can be used by the parking management and parking users.
- The web application connected to ultrasonic sensor and GPS using MQTT protocol and real-time database. The research used modify algorithm of the SSGA, to optimize the allocation of empty parking slot and MQTT protocol to obtain the faster response time of the system when many users are accessing the website application.

MQTT PROTOCOL:

- Message queue telemetry transport (MQTT) protocol to communication of the data of the smart parking system, it is a broker-based messaging protocol for publish or subscribe information .
- MQTT is a lightweight messaging protocol, simple designed and straightforward to implementation.
- MQTT protocol is used to more rapidly obtain the response of the system time when many users are accessing the application website with a low power consumption and low bandwidth usage. The advantage of the proposed system is that it uses a real-time database via a global positioning system (GPS) module connected to the Raspberry Pi.
- MQTT protocol was used as a controller in managing the smart parking application using a star topology whose advantage was that if one client was disconnected, it would not interfere with other clients to connect with the broker.
- This research proposed an application of smart parking management system using MQTT protocol with the real-time database with steady state genetic algorithm (SSGA).
- The system provided the detailed information related to monitoring and controlling of parking location and empty parking slot, SSGA used to optimize the allocation of the empty parking slot.

STEADY STATE GENETIC ALGORITHM (SSGA):

- The research on the smart parking contains several algorithms that can be used for optimization, one of the algorithms is the schedule of round Robin implementing the preemptive strategy based upon the processing schedule called as quantum.
- The algorithm of a hybrid genetic assignment search procedure (HGASP) is used to seek the nearest route to the parking area. The time taken to seek the route is relatively short in comparison to Dijkstra algorithm.
- This algorithm is to guide the parking by considering the factors of distance and route time, traffic and parking cost.
- To optimize the information for both the parking management and the users about the allocation of empty parking slot.
- This research used an algorithm that can optimize the issue of multi-objectives, one of which is modify algorithm of SSGA for get the empty parking slot.

FEATURES OF SMART PARKING SYSTEM:

1. Real-time monitoring:

- One of the main features of smart and automated car parking systems is real-time monitoring. These systems use sensors and cameras to monitor the occupancy of parking spaces in real-time.
- Real-time monitoring also helps parking managers to identify when a parking spot has been occupied for too long, allowing them to enforce parking rules and prevent abuse of parking spaces.

2. Parking guidance systems:

- These systems use sensors and cameras to guide drivers to available parking spots, reducing the time it takes to find a spot and minimizing traffic congestion.
- Parking guidance systems also make it easier for drivers to park their cars, as they can be directed to spots that are appropriately sized for their vehicles.

3. Automated vehicle retrieval:

- These systems use robotics and automation to retrieve parked vehicles and bring them to a designated pickup location.
- Automated vehicle retrieval eliminates the need for drivers to search for their cars in crowded parking lots, saving time and reducing frustration.

- This feature is especially useful for extensive airports and shopping mall parking facilities.

4. Integration with other systems:

- Smart and automated car parking systems can be integrated with other systems to provide a seamless parking experience.
- For example, these systems can be integrated with traffic management systems to help reduce traffic congestion around parking facilities.

5. Environmental sustainability:

- Finally, smart and automated car parking systems can contribute to environmental sustainability. These systems can be designed to reduce the amount of energy consumed by parking facilities by using energy-efficient lighting, heating, and cooling systems.
- These systems can be designed to encourage the use of alternative transportation options, such as bicycles and public transit, reducing the number of cars on the road and lowering greenhouse gas emissions.