

AUTOMATIC DOOR OPEN USING ULTRASONIC SENSOR AND SERVO MOTOR

1. Introduction

Automation has become an important part of modern life, reducing human effort and increasing efficiency. One common example of automation is the automatic door opening system. Traditional doors require manual operation, which can be inconvenient, especially in crowded places or for elderly and disabled people. Automatic doors solve this problem by opening and closing automatically when a person approaches.

An ultrasonic sensor-based automatic door system works by detecting objects using sound waves. When a person comes within a certain distance, the sensor sends a signal to a controller, which activates a motor to open the door. After the person passes through, the door closes automatically. This system is simple, cost-effective, and reliable, making it suitable for many real-world applications.

2. Components Used

2.1 Ultrasonic Sensor

The ultrasonic sensor is the key component of the system. It consists of a transmitter and a receiver. The transmitter emits high-frequency sound waves (ultrasonic waves), and the receiver detects the reflected waves. The time taken for the echo to return is used to calculate the distance of the object.

2.2 Microcontroller

A microcontroller (such as Arduino) is used to process the signal from the ultrasonic sensor. It compares the measured distance with a predefined value and decides whether to open or close the door.

2.3 Motor and Motor Driver

A DC motor or servo motor is used to physically open and close the door. A motor driver is required to control the motor's direction and speed because the microcontroller cannot supply enough current directly.

2.4 Power Supply

The power supply provides the required voltage to the sensor, microcontroller, and motor. It can be a battery or an external power adapter.

2.5 Door Mechanism

The door mechanism includes gears, belts, or sliding rails that convert motor rotation into door movement.

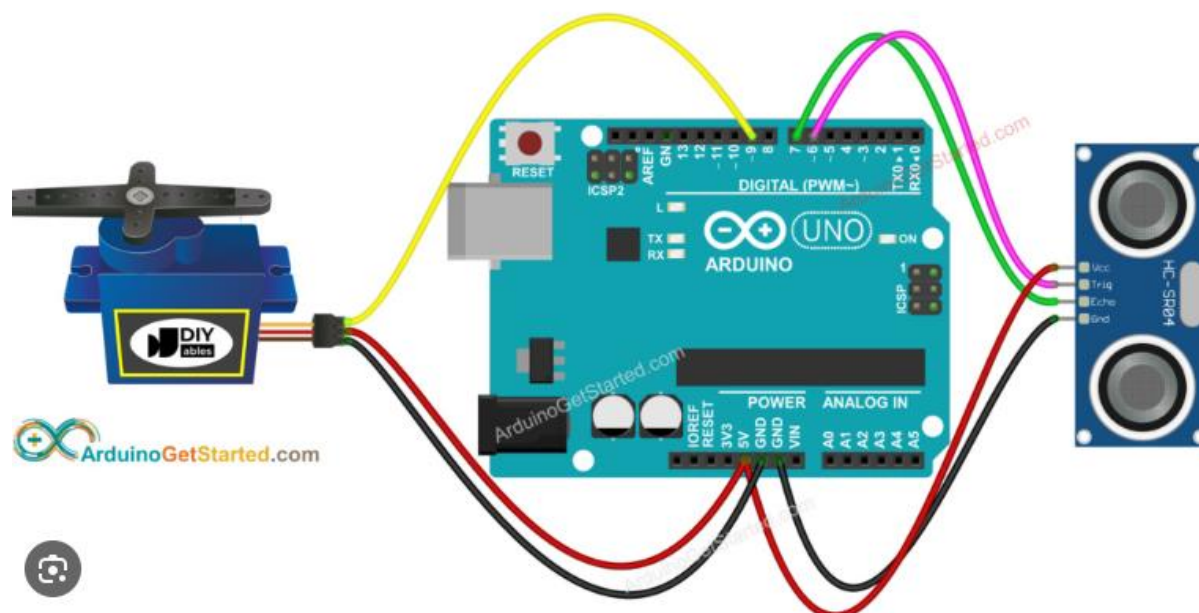
3. Working Principle

The automatic door opening system works on the principle of **distance measurement using ultrasonic waves**.

1. The ultrasonic sensor continuously emits ultrasonic pulses.
2. When a person comes in front of the door, the sound waves hit the person and are reflected back.
3. The sensor calculates the distance based on the time delay between sending and receiving the pulse.
4. If the detected distance is less than a preset value (for example, 50 cm), the microcontroller sends a signal to the motor driver.
5. The motor rotates and opens the door.
6. After the person moves away, the sensor no longer detects an object within range.
7. The microcontroller then signals the motor to close the door.

This process happens automatically without any human intervention.

4. Block Diagram Explanation



The system consists of the following blocks:

- **Ultrasonic Sensor Block:** Detects the presence of a person.
- **Control Unit (Microcontroller):** Processes sensor data and makes decisions.
- **Motor Driver Block:** Amplifies control signals to drive the motor.
- **Motor and Door Mechanism:** Opens and closes the door.

Each block works together to ensure smooth and reliable operation.

5. Advantages

- Reduces physical contact, improving hygiene
- Convenient and user-friendly
- Saves energy by closing automatically
- Helpful for elderly and disabled people
- Low cost and easy to implement

6. Applications

- Shopping malls and supermarkets
- Hospitals and clinics
- Office buildings
- Airports and railway stations
- Smart homes

7. Limitations

- May be affected by environmental noise
- Limited detection range
- False triggering due to pets or objects
- Requires regular power supply

8. Future Improvements

The system can be enhanced by integrating additional sensors such as infrared or camera modules to improve accuracy. Adding IoT connectivity would allow remote monitoring and control. Advanced algorithms can also be used to distinguish between humans and objects, reducing false detection.

9. Conclusion

The automatic door opening system using an ultrasonic sensor is an effective and practical solution for modern automation needs. It improves convenience, accessibility, and hygiene while reducing manual effort. The system is simple, affordable, and easy to implement, making it suitable for both educational projects and real-world applications. With further improvements, this technology can become even more reliable and intelligent.