Project Name: Automatic Hand Sanitizer - DIY

Components Used:

- Arduino UNO R3
- Ultrasonic Sensor
- Servo Motor

Ultrasonic Sensor

An **ultrasonic sensor** is a device that measures distance by emitting ultrasonic waves and detecting the time it takes for the waves to reflect back from an object. It typically consists of a **transmitter** (which emits the waves) and a **receiver** (which detects the reflected waves). The most commonly used sensor is the **HC-SR04**, which operates at a frequency of **40 kHz**.

Applications:

- Obstacle detection in robotics
- Distance measurement
- Automatic parking systems
- Liquid level detection

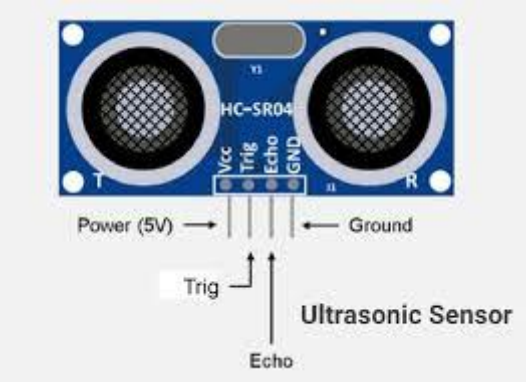

Fig14.1: Ultrasonic Sensor

Servo Motor

A **servo motor** is a precise, controlled motor used in applications requiring accurate angular positioning. It consists of a **DC motor**, **gear system**, and a **control circuit**. The angle of rotation is controlled by a **PWM (Pulse Width Modulation) signal**, where the pulse width determines the motor's position. Common servo motors include **SG90** and **MG995**.

Applications:

- Robotics and automation
- RC cars and planes
- Robotic arms
- Camera gimbals

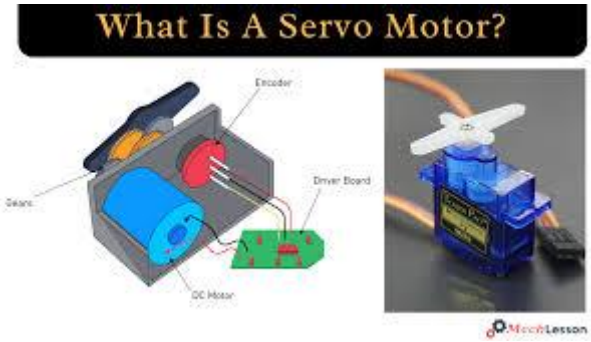

Fig14.2: Servo Motor

Project:

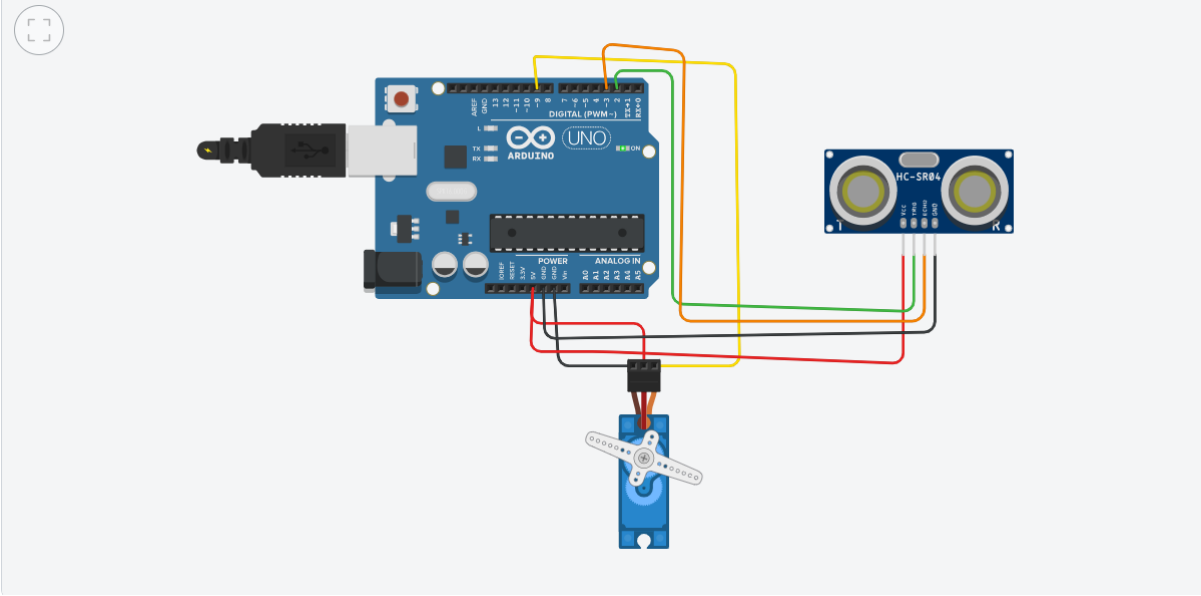

Fig14.3: Circuit Diagram for Automatic Hand-sanitizer

using Ultrasonic sensor and Servo Motor

Explanation:

The system detects the presence of a hand using an **ultrasonic sensor (HC-SR04)** and activates a **servo motor** to push the sanitizer nozzle. When the Arduino runs the program, the ultrasonic sensor first measures the distance of an object in front of it. It does this by sending an ultrasonic pulse from the **trigger pin (TRIG_PIN = 9)**, which travels outward and reflects off an object (such as a hand). The **echo pin (ECHO_PIN = 10)** then receives the reflected signal, and the Arduino calculates the distance using the time taken by the pulse to return. The formula used is:

$$\text{Distance} = \text{Time} \times 0.0342$$

where **0.034 cm/µs** is the speed of sound in air, and division by **2** accounts for the round-trip travel of the pulse.

Once the distance is calculated, the Arduino decides whether to activate the servo. If the measured distance is **≤ 5 cm**, it indicates that a hand is detected. The Arduino then sends a **PWM (Pulse Width Modulation) signal** to the servo motor on **pin 6**, commanding it to rotate to **90 degrees**, which pushes the sanitizer nozzle and dispenses the liquid. If the distance is greater than **5 cm**, the servo returns to **0 degrees**, bringing the system back to its idle state.

This process ensures an **automatic and touch-free sanitizer dispensing system**. The ultrasonic sensor continuously monitors for any approaching hands, and the servo operates accordingly. This automation improves hygiene by minimizing physical contact, making it ideal for public use.