Smart Dustbin using Ultrasonic Sensor and Servo Motor

Objective

To design and develop a low-cost, intelligent dustbin system that automatically opens its lid when motion is detected near it and closes it after 4 seconds of inactivity. This project aims to promote contactless waste disposal, improving hygiene and preventing the spread of germs.

Components Required

- Arduino UNO / Nano - 1
- Ultrasonic Sensor (HC-SR04) - 1
- Servo Motor (SG90/Standard) - 1
- Jumper Wires - As required
- Breadboard (optional) - 1
- Power Source (USB or Battery) - 1
- Dustbin Lid (with hinge) - 1

Working Principle

The Ultrasonic Sensor constantly monitors the distance in front of the dustbin. When an object (like a hand) is detected within 20 cm, the system immediately rotates the servo motor to 120°, opening the lid. It remains open as long as the object is detected. If no object is detected for 4 seconds, the lid closes automatically by rotating the servo back to 0°.

Circuit Diagram Summary

- Ultrasonic Trigger -> Pin 7
- Ultrasonic Echo -> Pin 6
- Servo Signal -> Pin 9
- VCC (Sensor + Servo) -> 5V
- GND (All Components) -> GND

Code Explanation

pulseIn() measures the echo time to determine the distance of nearby objects. millis() function is used to track elapsed time without blocking the code. If the distance is less than 20 cm, the servo rotates to 120° to open the lid. A timer starts counting the time since last detection. If no motion is detected for 4 seconds, the lid closes automatically.

Testing & Results

When a hand approaches the bin, the lid opens instantly and remains open while the hand is nearby. After withdrawing the hand, the lid reliably closes after exactly 4 seconds. The servo operates smoothly without jitter. The system performs accurately within a detection range of 0-20 cm.

Improvements & Future Scope

- Add an IR sensor for more precise motion detection.
- Integrate a buzzer or LED indicator before closing the lid.
- Show countdown timer or messages on OLED display.
- Connect to Blynk or IoT platform to monitor usage data.
- Add solar power support for sustainable outdoor usage.

Conclusion

This Smart Dustbin project successfully demonstrates a basic automation concept using Arduino. It helps in promoting hygienic, contactless waste disposal. The integration of ultrasonic sensors and servo motors creates a responsive and intelligent system with potential for further IoT enhancements.