Object

The objective of this project is to utilize Arduino UNO to create a hardware system that can detect and classify dry and wet waste, and subsequently segregate it into the appropriate bins for effective waste management.

Project description

The primary objective of this project is to develop a device that can automatically sort and categorize waste into two distinct categories: dry and wet waste. The device uses sensors to determine the type of waste material based on the readings of the moisture sensor. Once the system identifies the type of waste, it triggers a mechanism that separates the waste into separate bins for proper disposal. The segregation of waste into dry and wet categories allows for efficient and effective waste management, promoting sustainable waste practices. This project aims to provide an automated solution for waste segregation in households, commercial establishments, and public spaces. It will reduce the need for manual sorting, save time and energy, and ensure proper disposal of waste, contributing to a cleaner and healthier environment.

Hardware section

Arduino UNO

The primary control and processing unit of the Arduino UNO R3 board is the ATmega328P microcontroller. This microcontroller has a capacity of 32kB In-System Programmable Flash Memory, 1kB EEPROM, and 2kB internal SRAM. It has 14 digital input/output pins, six analog input pins, and a USB interface for programming and communication with a computer.
Arduino Uno is also open-source hardware, which means that the design files and software are freely available for modification and distribution. It can be programmed using the Arduino Integrated Development Environment (IDE), a simple and user-friendly software platform that allows users to write and upload code to the board. Arduino Uno is widely used in robotics, automation, and other electronic projects, and has a large and active community of users who share ideas and collaborate on projects.

Moisture sensor

A moisture sensor is an electronic device that measures the moisture level in a soil or other materials. Moisture sensors for Arduino usually work based on changes in

electrical conductivity due to moisture in the surrounding environment. The sensor provides an analog or digital output, which can be read by an Arduino board to determine the moisture level. These sensors are commonly used in agriculture for measuring soil moisture, as well as in various DIY projects that require monitoring moisture levels. The output of a moisture sensor can be used to trigger an action, such as turning on a pump to water plants when the soil becomes too dry. In this project, the moisture sensor is used to classify dry and wet waste.
The moisture sensor consists of 4 pins in which two pins, Vcc and Gnd are connected to supply voltage. The remaining two pins are digital (D0) and analog (A0) are the output pins.

Ultrasonic sensor

An ultrasonic sensor is a device designed to identify objects and determine their distance. It accomplishes this by emitting ultrasonic waves and subsequently receiving the reflected waves from the object, enabling the measurement of the distance. Ultrasonic sound operates at a frequency beyond the range of human hearing.By measuring the time delay between sending and receiving the ultrasonic pulses, the sensor is able to calculate the distance to the target.
The HC-RS04 Ultrasonic sensor module has 4 pins i.e. Vcc, Gnd, Trig (for sending ultrasonic sound waves), and Echo (for receiving ultrasonic sound waves).

Servo motor

Servos are motors that allow you to precisely control physical movement because they generally move to a position rather than continuously rotating. They are simple to connect and control because the motor driver is built right into them. Servo motors operate based on a feedback mechanism, where they continuously receive signals from a control system that directs the motor to rotate to a specific position. They are designed to provide accurate and repeatable movement, often with a rotation range of up to 180 degrees. Servo motors can be controlled with a variety of electronic devices, including microcontrollers like Arduino boards. They are often used in applications such as robotic arms, RC vehicles, and industrial automation systems.
Servo motors are controlled with a 3-pin input, with two pins being used for power (+ and -) and the third signal used for setting the angle.

9V battery

The board has the ability to function with an external power source ranging from 6 to 20 volts. Nevertheless, if the supplied voltage is less than 7V, the 5V pin may provide less

than 5 volts, and the board's stability may be affected. On the other hand, if the voltage supply is greater than 12V, there is a possibility that the voltage regulator may overheat and result in damage to the board. As a result, it is suggested to utilize a voltage range of 7 to 12 volts. We are using a 9V battery as an external power supply and it works well.

Jumper wires

Jumper wires are utilized to establish connections between components on a breadboard and the Arduino’s header pins. We are using Male to Male (M to M) jumper wires in this project.

Procedure

Step 1) To begin with, we obtained a cardboard carton and removed its upper section. Following this, we securely mounted a servo motor onto one side of the cardboard, and proceeded to connect a rotating lid that would move in response to the servo's actions.

Step 2) Once the framework for our waste segregation device had been constructed, we proceeded to calibrate the ultrasonic sensor in order to enable it to detect the presence of waste on the lid.

Step 3) Subsequently, we adjusted the calibration of the moisture sensor and affixed it to the lid so that it could distinguish and categorize dry and wet waste.

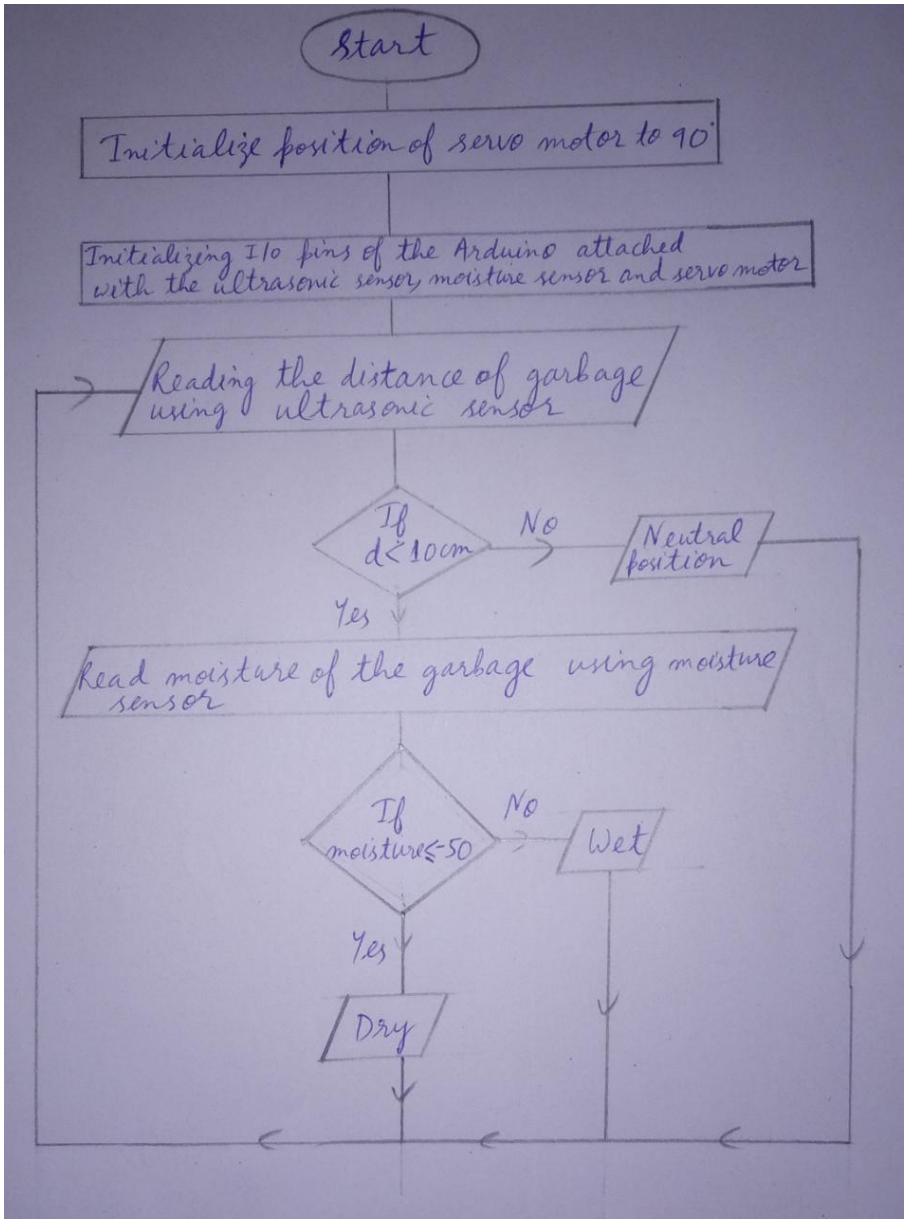
Step 4) Following that, it is necessary to make the required connections, which involves utilizing jumper wires to connect the servo motor, moisture sensor, and ultrasonic sensor to the Arduino board.

Step 5) Once the connections had been made, our hardware assembly and linking process was finished. We proceeded to program the Arduino UNO using the Arduino IDE. It's noteworthy that servo motors have the ability to move up to 180 degrees.

Step 6) Prior to implementing our code on the physical hardware, we tested it using Tinkercad, a simulation software.

Software section

Flowchart:-

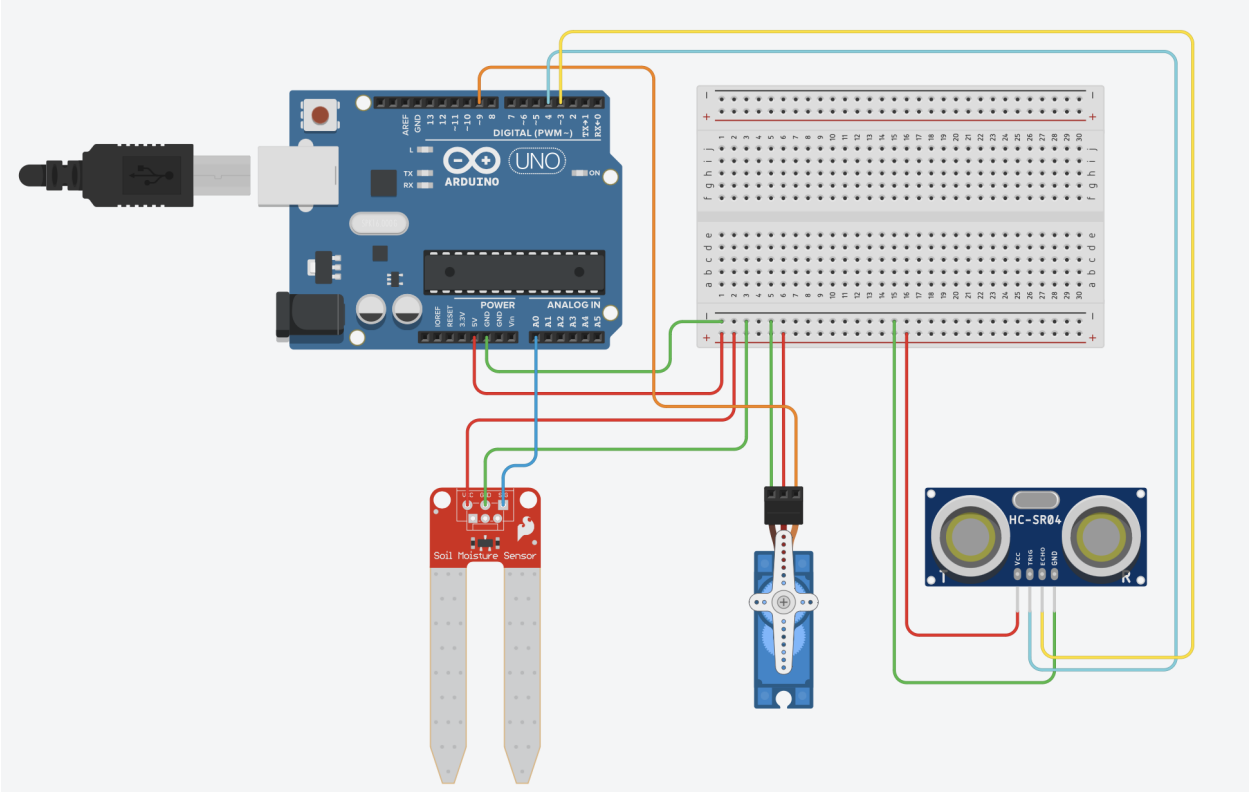


Code

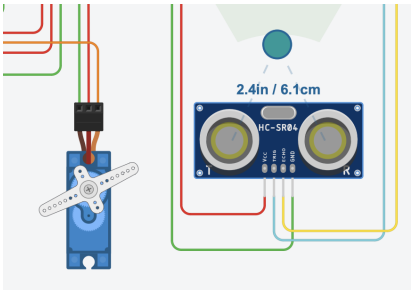
```
// Servo
#include <Servo.h>
Servo servo;
int pos = 90;

// Moisture sensor
int sensor_pin = A0;
int output_value;

// Ultrasonic sensor
const int trigPin = 4;
const int echoPin = 3;
// Defines variables
long duration;
int distance;

void setup()
{
  Serial.println("Reading from the sensor...");
  delay(2000);
  servo.attach(9);
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT);  // Sets the echoPin as an Input
  Serial.begin(9600);       // Starts the serial communication
}

void garbage_classifier()
{
  output_value = analogRead(sensor_pin);
  output_value = map(output_value, 550, 0, 0, 100);
  Serial.print("Mositure: ");
  Serial.println(output_value);

  delay(15000);

  if (output_value > -50)
  {
    servo.write(120);
    Serial.println("Wet");
```

```
  }
  else if (output_value <= -50)
  {
    servo.write(60);
    Serial.println("Dry");
  }
  else
  {
    servo.write(90);
    Serial.println("Neutral");
  }

  delay(2000);
}

void loop()
{
  // Clears the trigPin
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  // Calculating the distance
  distance = duration * 0.034 / 2;
  // Prints the distance on the Serial Monitor
  Serial.print("Distance: ");
  Serial.println(distance);

  if (distance < 10)
  {
    garbage_classifier();
  }
  else
  {
    servo.write(90);
  }
```

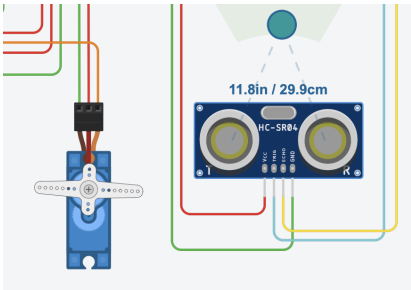
Simulation using Tinkercad



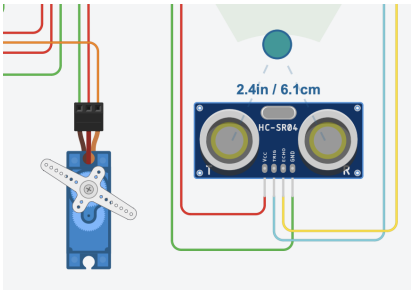
Circuit Diagram



a) Dry waste



b) Neutral position



c) Wet waste

Result

The outcome of this project is a dry and wet waste segregator device that utilizes an Arduino UNO board to detect and categorize waste. We have successfully segregated dry and wet waste using our smart segregator.

Discussion

The dry and wet waste segregator using Arduino UNO is a device that offers a cost-effective solution to the issue of waste management. The device uses sensors and an Arduino UNO board to segregate dry and wet waste, which is crucial for effective waste management and environmental sustainability.

One significant advantage of this device is that it facilitates easy segregation of waste into different categories. This makes the recycling process easier and more effective, as each type of waste can be dealt with separately. The device is also easy to use and maintain, making it a viable option for households, schools, and other small-scale waste management systems.

Another advantage of the device is its low cost. The components used in the device are readily available and affordable, making it an excellent option.
However, the device has some limitations. For instance, the device can only detect waste on the lid. Additionally, the moisture sensor may not work correctly in high humidity conditions, leading to inaccurate waste classification. It takes more time to sense the moisture content of the wet waste. Despite its limitations, the device offers a promising approach to promoting sustainable waste management practices.

Conclusion

In conclusion, the dry and wet waste segregator using Arduino UNO is an excellent example of how technology can be harnessed to address environmental challenges. The device provides a practical solution to waste management, making it easier to segregate waste into different categories, which promotes recycling and sustainable waste management practices.

Although the device has some limitations, its advantages far outweigh its shortcomings. The device is affordable, easy to use and maintain, making it a promising solution for small-scale waste management systems, households, and schools.

Going forward, it is crucial to continue exploring and developing innovative solutions to address the global waste management problem. The dry and wet waste segregator using Arduino UNO is an excellent step in the right direction and demonstrates the potential for technology to support sustainable development.