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AUTOMATIC WASTE SEGREGATION AND MONITORING SYSTEM

Ankit Bhoir, Amaan Chaudhary, Aaditya Lokhande, Rayyan Shah

Electronics and Telecommunications & Manjara Charitable Trust's Rajiv Gandhi Institute of Technology

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Abstract - The process of collecting, sorting, moving, and discarding trash to the proper sites is known as waste management. The most crucial problem to address in the design of a waste segregation and monitoring system is the separation of various waste kinds. This means that the garbage must still be separated by hand, which is detrimental to the segregator itself. An automated segregator and monitoring system is reported in this project. Recycling plastic is one way to address this. The practice of recovering plastic that has been thrown away as garbage and repurposing it is known as plastic recycling. The primary controller of the segregating portion is an Arduino UNO. To detect the kind of waste, it has three sensors: a moisture sensor, a capacitive proximity sensor, and an inductive proximity sensor. Trash is categorized as plastic, dry, moist, and metallic. The monitoring portion keeps an eye on the garbage collecting procedure. An economical waste management solution for separating plastic, dry, moist, and metallic trash without requiring constant human attention is the automated waste segregator and monitoring system.

Key Words: Waste Management, Segregator, Monitoring, Garbage.

1. INTRODUCTION

In a world where environmental problems are becoming more and more prevalent, waste management needs to be a solution. An automated waste segregation and monitoring system will aid in the effective resolution of this issue. An automatic waste segregator categorizes the garbage. In contrast, a monitoring system aids in the observation of the garbage collecting procedure. Because the recycling system will already have a separated waste, this strategy improves recycling. Garbage segregation is the process of dividing and classifying garbage in order to make recycling easier. Sorted waste may be recycled more quickly, which can save you money and time. The goal is to create a system that separates garbage into three categories: dry, wet, and metallic waste. This will guarantee that a better quality of material is retained for recycling, meaning that more value may be extracted from the waste. To lessen the risk of occupational injury for those who handle and collect garbage. By delivering the garbage straight to the recycling and processing facility rather than first to the segregation plant and then to the recycling plant, the total amount of time needed for post-segregation processing can be shortened. An automatic garbage segregator sorts the waste into three categories: dry, wet and metallic waste. The usual practice for disposing of rubbish is to dump it carelessly and unintentionally in landfills. The health of people as well as plants and animals at risk from this practice. Waste has a better chance of being recovered, subsequently recycled, and reused if it is divided into basic streams like metal, plastic, and non-plastic

2. COMPONENTS USED

1. ARDUINO UNO

Figure 1: Arduino UNO

Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output. The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010. Arduino Uno is a microcontroller board that controls the whole system. It has 14 digital input/output pins and all the sensors and motors are connected through these pins.

2. Ultrasonic Sensor

Figure 2: Ultrasonic sensor

This is a HC-SR-04 ultrasonic sensor to detect the dry waste and segregate it. According the algorithm that we have applied, when the output of this sensor is high, it indicates that the waste is dry. An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity.

3. Inductive Sensor

Figure 3: Inductive sensor (NPN Type)

This is an NPN type inductive sensor to detect metallic waste. It has a range of about 8mm. So when the waste is dumped on the conveyer belt, the sensor detects if it is a metallic waste or not, and depending on that it generates the output as low or high. An inductive sensor is an electronic device that can detect ferrous metal targets without physical contact. Inductive sensors will also detect non-ferrous metal targets like aluminum, brass, and copper. An inductive sensor is a device that uses the principle of electromagnetic induction to detect or measure objects. An inductor develops a magnetic field when an electric current flows through it; alternatively, a current will flow through a circuit containing an inductor when the magnetic field through it changes.

4. Moisture Sensor

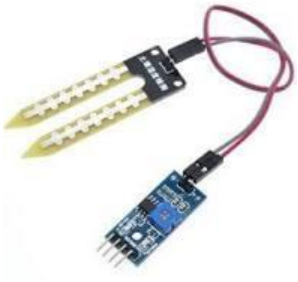

Figure 4: Moisture sensor

These sensors are used to detect the waste or moisture in a material. So, we are using this senor to detect the wet waste. So. When the waste is dumped on the conveyer belt, the sensor detects if it is a wet waste or not, and depending on that it generates the output as low or high.

5. IR Sensor

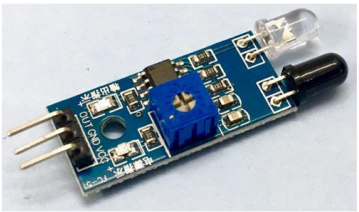

Figure 5: IR Sensor

This electronic device measures and detects infrared radiation in its surrounding environment. An infrared sensor (IR sensor) is a radiation-sensitive optoelectronic component with a spectral sensitivity in the infrared wavelength range 780 nm … 50 µm. IR sensors are now widely used in motion detectors, which are used in building services to switch on lamps or in alarm systems to detect unwelcome guests. The purpose of using this sensor is to monitor the level of sensor in the waste bins, and if the waste bins are full then pass a high signal to the Arduino once any of the bin is full. It has a range of about 2-30 cm, which can be adjusted.

6. LCD 16x2

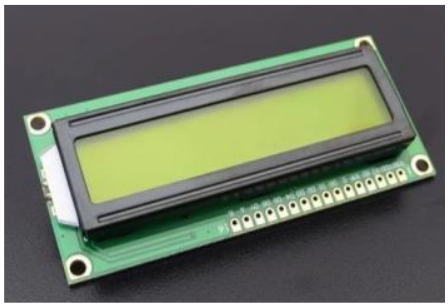

Figure 6: LCD 16 x 2

This LCD screen is a 16x2-character LCD display with an I2C interface. It features two rows for displaying text, with each row capable of displaying up to 16 characters. The white characters will be displayed on a blue background, providing a clear and visually appealing display. In this LCD, each character is displayed in 5×7 pixel matrix. This is great yellow backlight LCD display. It is fantastic for Arduino based project. Therefore, as we segregate the waste there should a monitoring system that will monitor the type of waste that is detected. As here the waste is detected, it is automatically displayed on the display that which type of waste it is. As well as it will also display a notification when the dustbin will be full.

7. Stepper Motor

Figure 7: Stepper Motor

This is a stepper motor, also known as a step motor or stepping motor. The motor is used to rotate the compartment that holds the collecting bins (the bins in which the segregate waste will be collected). As we want to rotate the

compartment according to the type of waste that has been detected. Therefore, once the waste is detected the Stepper motor will rotate and the waste will be dumped in the particular bin.

8. DC Motor

Figure 8: DC Motor

This DC Motor converts the received direct current or DC current into mechanical form of energy. We need a motor to rotate the conveyer belt, so we are using a 12V DC motor with 30 RPM. This conveyer belt will be rotating continuously so we will be powering it through a separate power supply of 12V.

9. Jumper Wires

Figure 9: Jumper Wires

Jumper wires are simply wires that have connector pins at each end, allowing them to use to connect two points to each other without soldering. Jumper wires typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

10. Connecting Wires

Figure 10: Connecting Wires

3. BLOCK DIAGRAM OF AUTOMATIC WASTE SEGREGATOR AND MONITORING SYSTEM

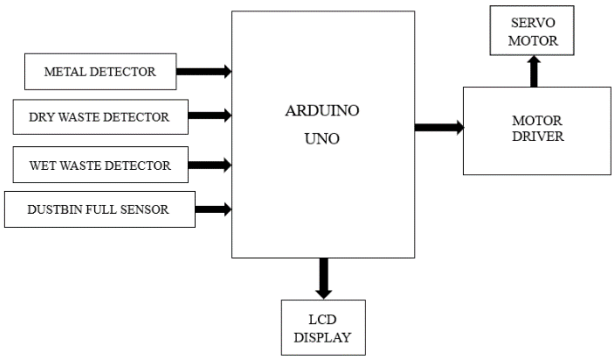

Figure 10: Block Diagram of Automatic Waste Segregator and Monitoring System

The Arduino UNO microcontroller powers the system. The Arduino IDE is used to program every component that is attached to the Arduino UNO. The application reads the input/output pins of the components and is developed in the Embedded C programming language. In addition, there is a conveyer belt that is powered through a DC motor, this belt rotates continuously. Over this conveyer belt, we deploy the waste. Now, since we need to detect and segregate, so to detect the metallic trash, an inductive proximity sensor is used. The moisture sensor and ultrasonic sensor are used to distinguish between the dry and wet trash. To direct the dry, wet and metallic trash into the appropriate bins, a Stepper motor is installed that holds the compartment of the bins. When both the inductive and ultrasonic sensors are high, indicating that the material detected is metal, and when both the moisture and ultrasonic sensors are high, indicating that the material detected is dry trash, the circular spinning model turns to the right. It gathers in the trashcan. Only when the ultrasonic sensor is high and the inductive sensor is low, indicating that the material is dry or wet trash, thus this model spin to the left. The model keeps moving left until the output from the rain sensor becomes high, indicating that wet material is present and should be gathered in the bin. The object is regarded as dry and gathered in the bin if the moisture sensor signal is not high. The dustbin level is measured using an ultrasonic sensor that is attached to the edge of the bin. A notification stating "BIN IS FULL" is forwarded to the cleaning authority when the dustbin is filled. Initially the conveyer belt will be continuously rotating, which is connected to the DC motor. And the Stepper motors and the sensors in the segregator, which were previously configured to operate at their default settings, are triggered when a waste item is dumped on the conveyer belt. These sensors assist in detecting the garbage. The waste bin compartment spins from 0 or 360-degree angle, if the moisture sensor detects waste.

The bin compartment turns at a ninety-degree angle if an inductive proximity sensor picks up garbage. Moreover, bin compartment at an angle of 180 degrees if the capacitive proximity sensor detects garbage.

4. CODE

```
#include<Servo.h>
#include <AccelStepper.h>
Servo flap;
#define trigPin 7
#define echoPin 6
int rain_pin = 3;
int inductive_pin = 4;
int flap_pin = 5;
const int buzzer = 12;
int homing_pin=13;
int homing;
int rain;
int inductive;
int sound = 250;
int i;
#define FULLSTEP 4
AccelStepper myStepper(FULLSTEP,8,10,9,11);
void setup()
{
 Serial.begin (9600);
 pinMode(trigPin, OUTPUT);
 pinMode(echoPin, INPUT);
 pinMode(rain_pin,INPUT);
 pinMode(inductive_pin,INPUT);
 pinMode(buzzer, OUTPUT);
 pinMode(homing_pin,INPUT);
 flap.attach(flap_pin);
 homing=digitalRead(homing_pin);
 myStepper.setMaxSpeed(1000.0);
 myStepper.setAcceleration(100.0);
 myStepper.setSpeed(1000);
 for(i=0;homing==LOW;i++){
 myStepper.moveTo(i);
 myStepper.runToPosition();
  homing=digitalRead(homing_pin);
}
 myStepper.moveTo(i-2);
myStepper.runToPosition();
 myStepper.setCurrentPosition(0);
 }
void loop() {
 long duration, distance;
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = (duration/2) / 29.1;
Serial.println(distance);
inductive=digitalRead(inductive_pin);
rain=digitalRead(rain_pin);
if(inductive==HIGH)//metallic waste
{
 tone(buzzer, 1000);
 delay(300);
 noTone(buzzer);
 delay(300);
 tone(buzzer, 1000);
 delay(300);
 noTone(buzzer);
 myStepper.moveTo(982);
 myStepper.runToPosition();
delay(2000);
 flap.write(179);
 delay(1500);
 flap.write(0);
```

```
 delay(500);
 myStepper.moveTo(0);
 myStepper.runToPosition();
}
if(rain==LOW)//wet waste
{
 tone(buzzer, 1000);
 delay(300);
 noTone(buzzer);
 delay(300);
 tone(buzzer, 1000);
 delay(300);
 noTone(buzzer);
 delay(300);
 tone(buzzer, 1000);
 delay(300);
 noTone(buzzer);
 myStepper.moveTo(1485);
 myStepper.runToPosition();
delay(2000);
 flap.write(179);
 delay(1500);
 flap.write(0);
 delay(500);
 myStepper.moveTo(0);
 myStepper.runToPosition();
}
if(distance <=8)//dry waste
{
//delay(500);
if(rain==HIGH);
{
if(inductive==LOW);
{
 tone(buzzer, 1000);
 delay(500);
 noTone(buzzer);
 myStepper.moveTo(510);
 myStepper.runToPosition();
delay(2000);
 flap.write(179);
 delay(1500);
 flap.write(0);
 delay(500);
 myStepper.moveTo(0);
 myStepper.runToPosition();
}}}
if(distance>=9&&inductive==LOW&&rain==HIGH) //No waste
{
 myStepper.moveTo(0);
 myStepper.runToPosition();
 flap.write(0);
}
delay(4000);
}
```

5. CONCLUSION

An Automatic Waste Segregation and Monitoring System represents a significant leap forward in waste management technology. By seamlessly integrating automation with waste segregation processes, this model offers an efficient and sustainable solution to the growing challenges of waste management.

6. REFERENCES

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