Design And Fabrication of Waste Segregating Smart-Bin

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Abstract- *In the current scenario, garbage disposal has become a huge cause for concern in the world. A voluminous amount of waste that is generated is disposed by means which have an adverse effect on the environment. The common method of disposal of waste is by unplanned and uncontrolled open dumping at the landfill sites. This method is injurious to human health, plants and animal life. When the waste is segregated into basic streams such as wet, dry and metallic waste it has a high potential of recovery and consequently, recycled and reused. In order to come out from this problem, the smart-bin is an effective solution for the segregation of the waste.*

Keywords- Dry, wet, metal, waste, segregation, sensor.

I. INTRODUCTION

In India, Waste management is an issue which causes a lot of havoc in the urban society. Improper disposal of waste by the citizens have led to mixing up of all kinds of waste which is difficult and costly to separate, which also has an adverse effect on the health of the people and the environment. Recently, the idea of keeping colour coded bins for different types of waste in every home was implemented, but the response has been quite dim. There is lack of awareness that is causing the people to dump the waste altogether in a common bin or incorrect bins.

We are implementing a Smart-Bin which can solve this issue at the source level, by this we could save a lot of money and valuable time. The rag-pickers that manually separates the waste could take a break from the unhygienic work for which they get absolute minimum wage. Also by properly separating waste at the source level we can avoid the entire process of separating waste in industry and directly carry on with the recycling process.

When the waste is segregated into basic streams such as wet, dry and metallic it has a higher potential of being procured by the recycling industries and reused. The wet waste is either converted into compost or methane-gas or both which can be used as fertilizers and biogas as a source of energy. The metallic waste can be reused or recycled. The dry waste can be incinerated and the heat generated by this can be used to run the turbine and thus electricity can be generated.

M.K. Pushpa et.al(2015)[1] Microcontroller based waste segregator which uses a funnel with permanent magnets to attract the metal waste, The leftover waste goes on to a conveyor belt which has a high speed blower to blow off the dry waste which falls into a bin.

H.N. Chaithanya das et.al(2017)[3] This system consists of a conveyor belt with sensors fixed closely to one end ,when the waste is put onto the conveyor the sensors detects the type of waste and accordingly the waste is segregated.

Shahrul Nizam(2014)[4] This mechatronic project consists of two proximity sensor with partially rotating lid.When the waste is thrown in the range of sensor, the lid open's up and the waste falls down due to gravity.

II. METHODOLOGY

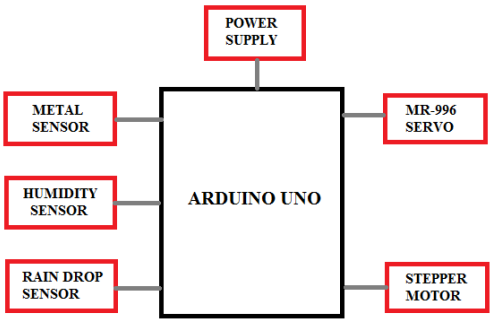

Fig 1: Block diagram of components used

When the waste is dumped into our Smart-Bin, the proximity sensor detects the entry of the waste, the sensitivity of the proximity sensor is tuned using the potentiometer. As soon as the microcontroller receives the signal from proximity sensor, it sends power to metal, humidity and rain drop sensor. The block diagram of components used is shown in Fig1.

Initially humidity and rain drop sensor are OR-ed together ie, it gives the value one if at least one operand has the value one, and otherwise gives a value of zero as shown in

table 1. Then microcontroller sends signal to rotate stepper motor which in turn rotates the inner cylinder to align the lid. Then the servo MR996 is powered so as to slide the waste to the bin.

HUMIDITY SENSOR	RAIN DROP SENSOR	OUTPUT
OFF	OFF	OFF
OFF	ON	ON
ON	OFF	ON
ON	ON	ON

Table 1: Truth table of OR-gate

If metal item is present, then the process remains the same as discussed in the wet separation. If it's not metal neither wet then the waste is thrown to dry bin.

Basic components required:

- Two cylindrical bins (Perforated)
- Lid (Acrylic made)
- Micro-controller (Arduino uno)
- Stepper motor
- Servo motor (MG996R)
- Ball bearings
- Sensors
  i) Metal sensor
  ii) Humidity sensor (DHT11)
  iii) Moisture sensor(Soil moisture sensor)
  iv) Proximity sensor

III. DESIGN

Fig 2: Assembled unit

The assembled unit is shown in fig 2. The software coding is provided in the annexure. The design and working is provided in the below section.

1. **Open-Close Mechanism**: This consists of a platform of 120 degree with a MG-996R servo motor attached. When the waste is put on the platform, the proximity sensor detects the waste and sends the signal to the servo motor which rotates and causes the waste to drop in the bin.
2. **Metal Waste Detection:** In this part of metal waste segregation, A metal sensor of non-contact type is used in order to detect the presence of metallic items. When the waste is thrown into the bin, If their exists any metal items then the metal sensor detects it and sends the signal to the Arduino which powers the stepper motor at the bottom to align the metal compartment of the bin with the opening of the lid. Once done, the lid opens and the metallic waste falls into the metal compartment.
3. **Wet Waste Detection:** In this part of wet waste segregation, Two types of sensors are installed namely Humidity and Rain drop sensor. When waste is dropped onto the platform, if wet waste is present, these sensors detect it and send signals to the microcontroller, which in turn sends signals to the stepper motor at the bottom and aligns the wet compartment of the bin with the opening of the lid. Once done, the lid opens and the wet waste falls into the wet compartment.
4. **Dry Waste Detection:** When the waste is neither wet nor metal, which is determined by the detection through sensors, the waste is considered to be dry and signal is sent to the microcontroller to rotate and align the dry compartment.

IV. CONCLUSION

The waste segregator as the name suggests, segregates the waste into three major classes: dry, wet, metallic. By segregating waste at root source, not only can waste be recycled but beauty of the surroundings can be maintained. Automated Waste Segregator has been successfully implemented for the segregation of waste into metallic, dry and wet waste at a domestic level. The system can segregate only one type of waste at a time with an assigned priority for metal, wet and dry waste. Thus, improvements can be made to segregate mixed type of waste by the use of buffer spaces. The project proposed here aims to design a system which collects and segregates the wastes.

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ANNEXURE

Arduino Uno Coding:

```
#include <dht.h>
#include <Servo.h>
#include <Stepper.h>
const int stepsPerRevolution = 200;
int angle = 0;
Servo ser;
int rotWet=67;
int rotMetal=134;
dht DHT;
int obs1;
int obs2;
int moisture_val;
int mVal=1;
#define prox1 2
#define prox2 4
#define moist A1
#define humid A0
#define wet_led 7
#define dry_led 3
#define ser_pin 6
#define metal 12
int stepCount = 0;         // number of steps the motor has taken
int dirStep = 1;
Stepper myStepper(stepsPerRevolution, 8, 9, 10, 11);
void setup() {
  pinMode(prox1,INPUT);
  pinMode(prox2,INPUT);
  pinMode(13, OUTPUT);
  pinMode(wet_led,OUTPUT);
  pinMode(dry_led,OUTPUT);
  ser.attach(ser_pin);
  myStepper.setSpeed(25);
  Serial.begin(9600);
}

void loop() {
  ser.write(0);
  obs1 = digitalRead(prox1);
  obs2 = digitalRead(prox2);
  if(obs1 == LOW && obs2 == LOW)
  {
    digitalWrite(13,HIGH);
    delay(6000);
    DHT.read11(humid);
    moisture_val=analogRead(moist);
    moisture_val=map(moisture_val,1023,0,0,100);
    mVal=digitalRead(metal);
    Serial.print("Current humidity = ");
    Serial.print(DHT.humidity);
    //Serial.print("temperature = ");
    //Serial.print(DHT.temperature);
    Serial.println();
    Serial.print("Current Moisture = ");
    Serial.println(moisture_val);
    Serial.print("Metal ? : ");
    Serial.println(mVal);
    if(( DHT.humidity >96 ) || (moisture_val > 0 )){
      Serial.println("Waste Type : Wet waste");
      Serial.println("-")
      ser.write(110);
      digitalWrite(wet_led,HIGH);
      delay(4000);
      digitalWrite(wet_led,LOW);
    }
    else if(mVal==0){
      for(stepCount=0;stepCount<rotMetal;stepCount++)
      {
        myStepper.step(dirStep);
        //Serial.println(stepCount);
        delayMicroseconds(50);
      }
      delay(1000);
      Serial.println("Waste type : Metal waste");
      Serial.println("-");
      ser.write(110);
      delay(4000);
      dirStep=-1;
      ser.write(0);
      delay(2000);
      for(stepCount=0;stepCount<rotMetal;stepCount++)
      {
      myStepper.step(dirStep);
      //Serial.println(stepCount);
      delayMicroseconds(50);
      }
      dirStep=1;
      delay(2000);
    }
    else{
```

```
    for(stepCount=0;stepCount<rotWet;stepCount++)
    {
    myStepper.step(dirStep);
    //Serial.println(stepCount);
    delayMicroseconds(50);
    }
    delay(1000);
    Serial.println("Waste type : Dry waste");
    Serial.println("-------------------------------------------");
    ser.write(110);
    digitalWrite(dry_led,HIGH);
    delay(4000);
    digitalWrite(dry_led,LOW);
    dirStep=-1;
    ser.write(0);
    delay(2000);
    for(stepCount=0;stepCount<rotWet;stepCount++)
    {
    myStepper.step(dirStep);
    //Serial.println(stepCount);
    delayMicroseconds(50);
    }
    dirStep=1;
    delay(2000);
   }
  }
  else
  {
   digitalWrite(13,LOW);
  }
delay(1100);
}
```