

PROJECT REPORT

TEAM : 2

SHARKS

SMART TRASH CAN

SEGREGATOR

GUIDED BY:

Dr. Abhay Singh Gour

Mrs. Mamoni banerjee

TA Sumit kumar Chand

TEAM MEMBERS

Hrishikesh M V (21ME10038)

Aryan Poonia (21CH10010)

Rohit Reddy (21CS30011)

Shaiba Maji (21MT10050)

Sreejan Shivam (21CE10067) (Team Leader)

ACKNOWLEDGEMENT

We would like to express our special thanks to our teachers Dr. Abhay Singh Gour,Mrs. Mamoni banerjee TA Sumit Kumar Chand who gave us the golden opportunity to do this wonderful project on “SMART TRASH CAN SEGREGATOR”.

We are really thankful to them for making us learn numerous new things during this period.

Secondly, we would also like to thank our parents and our friends who helped us a lot in managing things and finalizing this project within the limited time frame.

By -
Aryan Poonia
Hrishikesh M V
Rohit Reddy
Shaiba Maji
Sreejan Shivam

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PURPOSE

1. Smart waste segregator provides us with the tools to implement more data-driven decision-making.
2. Helps in keeping the cities clean.
3. Positive impact on the environment with low carbon emissions.

WORKING

- Initial position of the rotatory body will be fixed.
- According to the waste material detected, the body will rotate up to fixed angle and direction in fixed speed pre-coded.
- That's how a particular type of dustbin will come up under the particular type of waste material detected.

FLOW CHART OF WHOLE SET UP

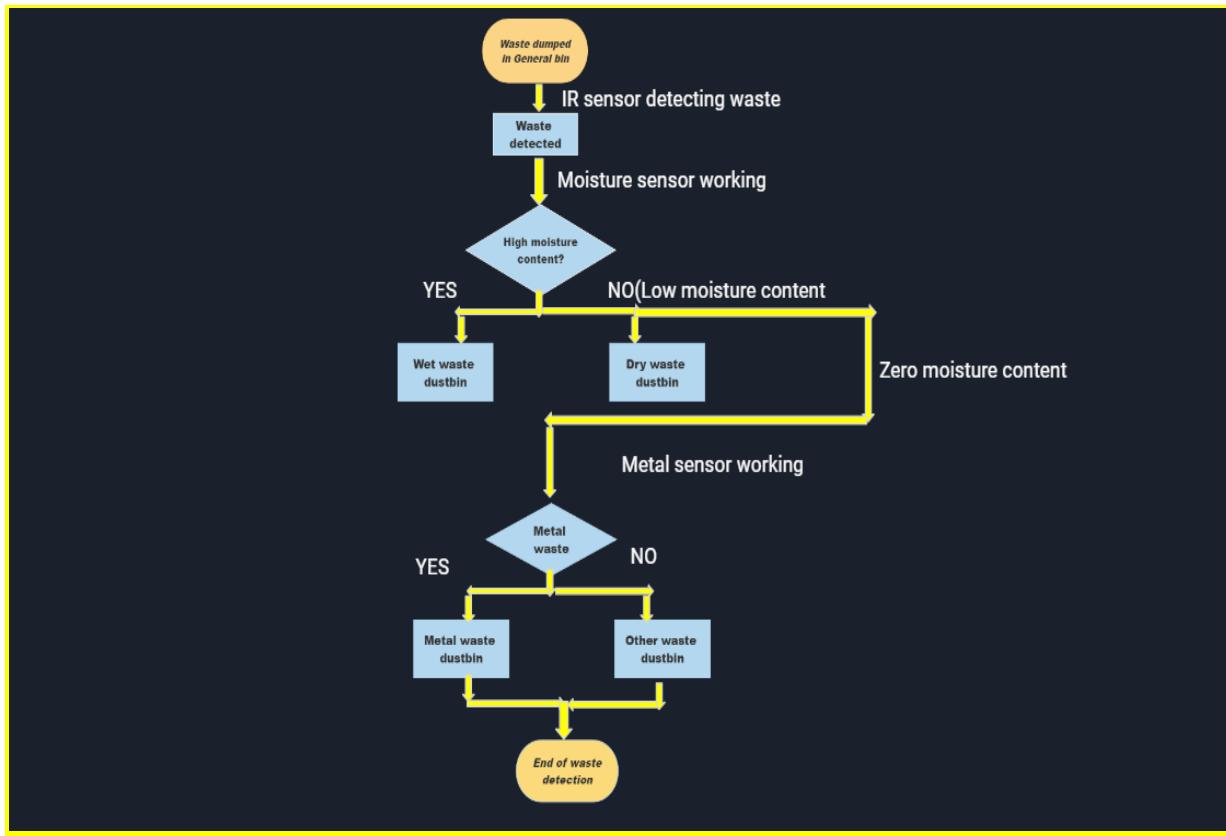
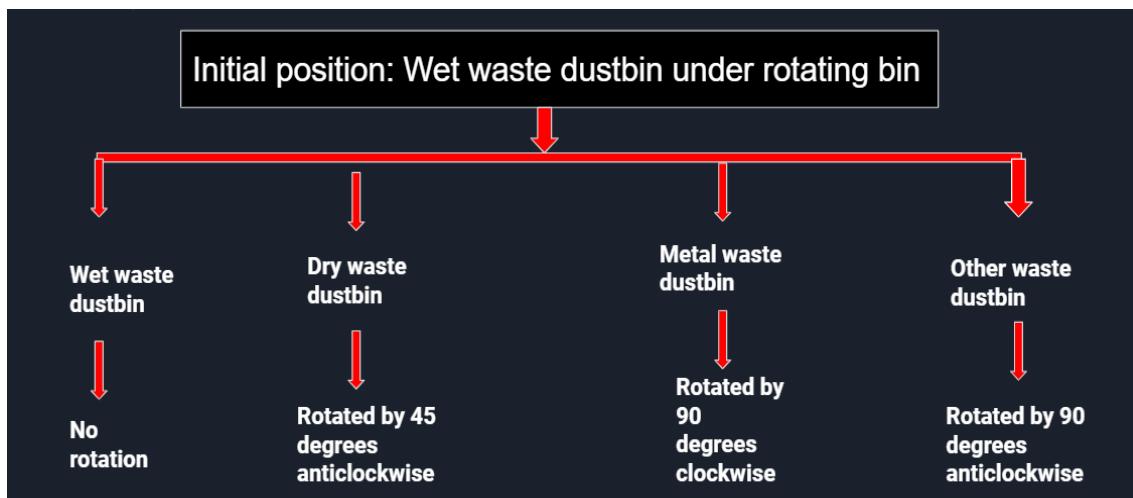


Chart for rotation of Rotating Bin



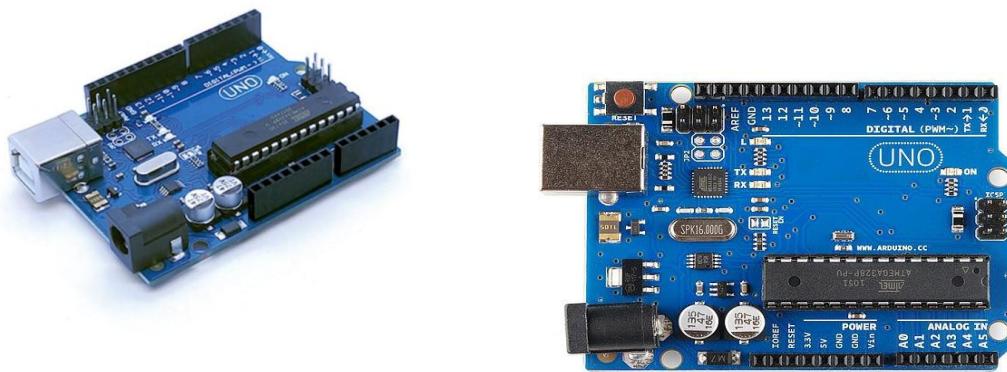
COMPONENTS WITH COST

1. Arduino Uno+Cable	Rs.620
2. BreadBoard	Rs.65
3. Jumper Cable	Rs.40
4. Wires	Rs.10
5. Resistors	Rs.6
6. IR sensor	Rs.80
7. Rain sensor	Rs.113
8. Inductive proximity sensor	Rs.384
9. Servo Motors *2	Rs.370
10. Stepper Motor *2	Rs.450
11. 9V battery	Rs.90
12. Thermocol sheet	Rs.30
13. Woods	Rs.40
14. Bins	Rs.100
15. M-seal	Rs.30
16. Cello Tape, gums,cardboards	Rs.100
TOTAL COST	Rs.2538

SOME COMPONENTS' WORKING

1. Arduino UNO:

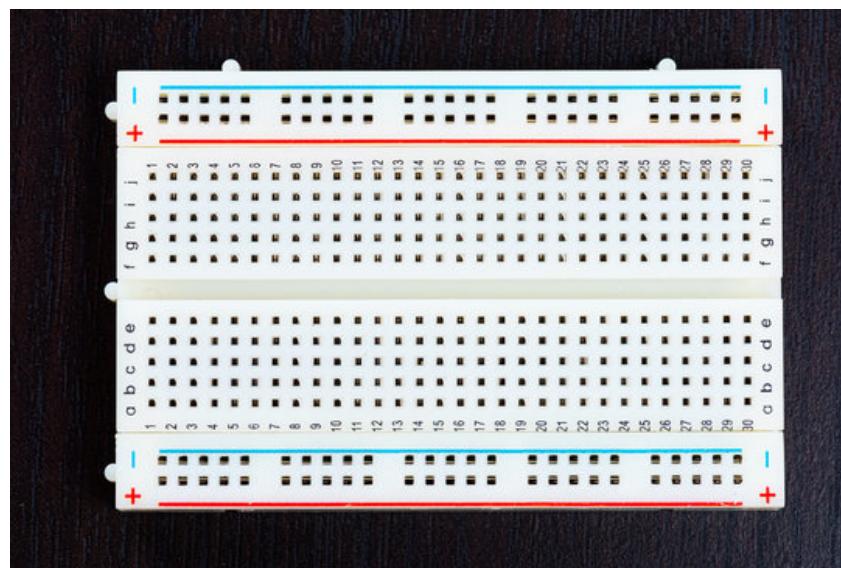
- The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards(shields) and other circuits.



- The board has 14 digital I/O pins ,6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery.

2. Breadboard

- A breadboard, or protoboard, is a construction base for prototyping of electronics. Because the solderless breadboard does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experiment with circuit design.

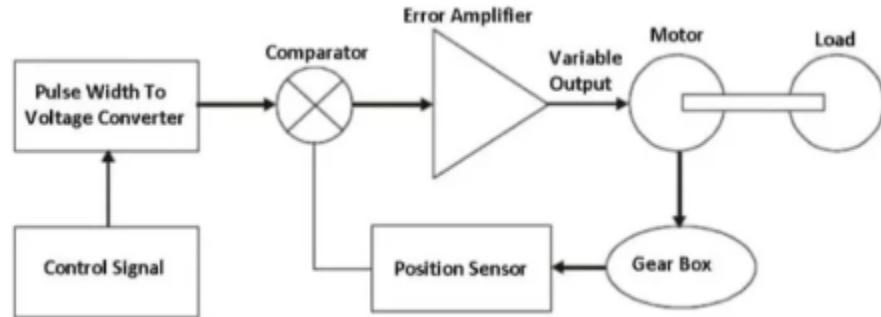


- A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

3. Servo Motor:

- A servo motor is a linear or rotary actuator that enables precise position control in closed-loop applications. These motors have a high-speed reaction and are constructed with tiny diameters and large rotor lengths.

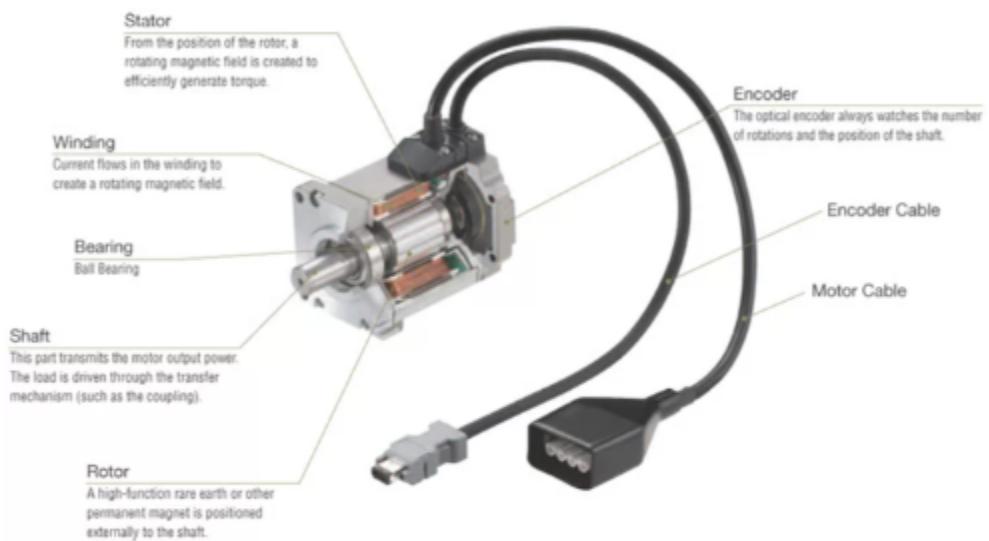
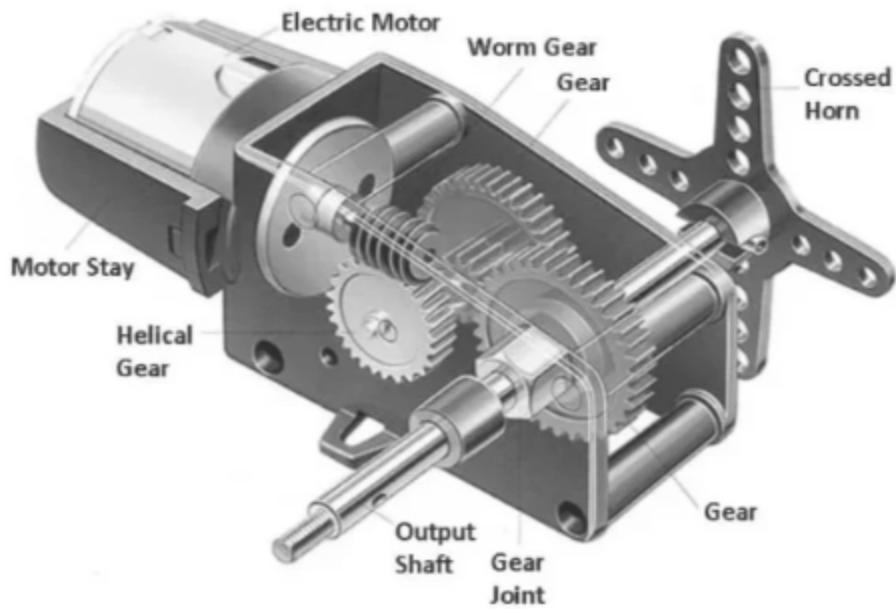
- The speed and ultimate position of servo motors are controlled by a mechanism that uses position feedback.



- Working Principle

A servo motor provides speed and location feedback via an encoder or speed sensor. The error signal is produced when the feedback signal is compared to the input command position.

The error signal provided at the error detector's output is insufficient to run the motor. As a result, the error detector, in conjunction with a servo amplifier, enhances the voltage and power level of the error signal before turning the motor shaft to the intended position.

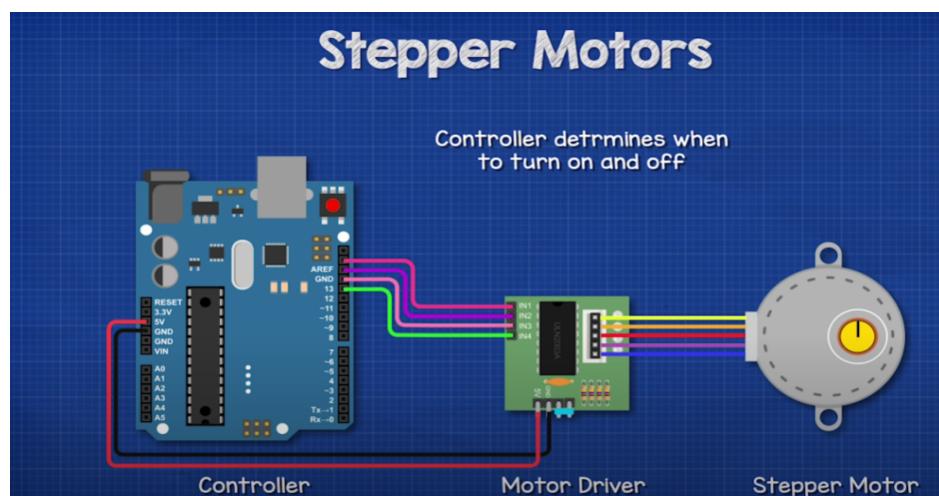


4. Stepper Motor:



- Stepper motor is an encoded dc motor which takes dc supply in a certain controlled sequence to cause rotation. It converts electrical energy to form mechanical movement.
- Every pulse received causes the motor to move one step.
We have a motor which can make 2048 steps for one complete 360 degree rotation.

For each step it moves 0.176 degree ($360/2048=0.176$)



- Internal Structure explanation:

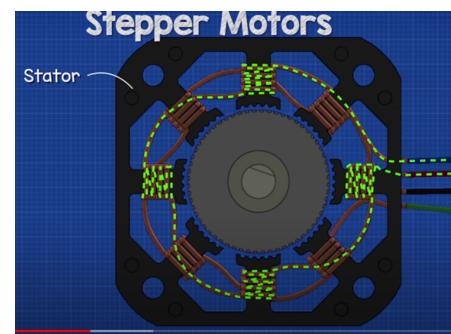
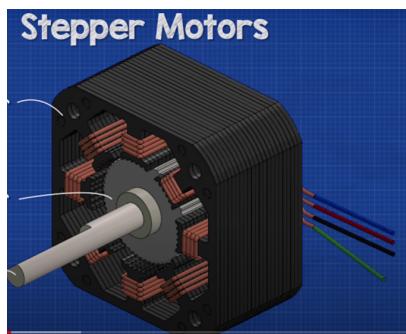
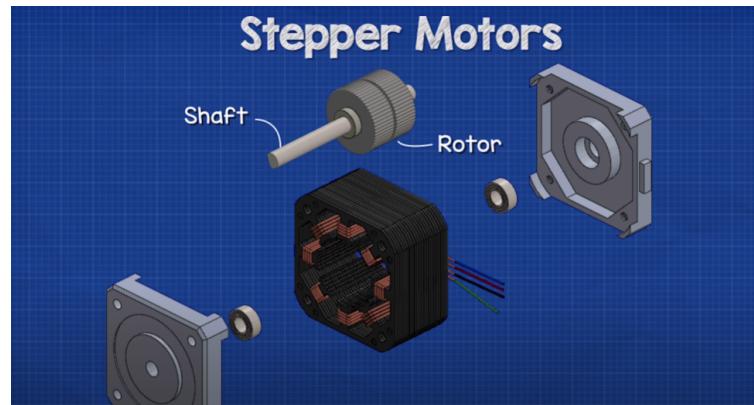
Stator remains stationary and does not rotate, it consists of coils of copper wire.

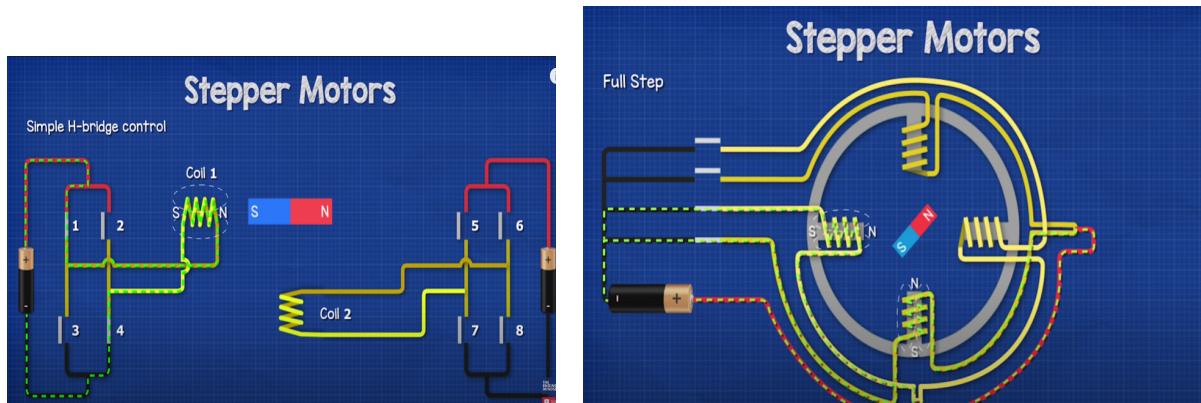
There are 8 coils which are connected in two groups of 4.

The driver will control when electric current will flow in which one then it creates an electromagnetic field which causes the rotation.

Teeths are present to enhance the precision of the motor and create magnetic alignment.

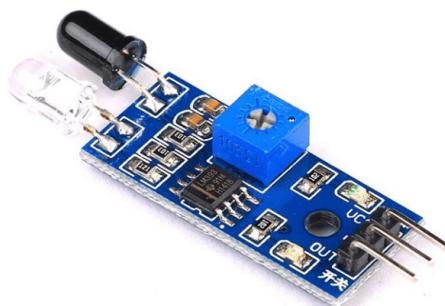
- Frequency of switching the coil increases then it will rotate faster.
We can change the direction of rotation by changing the way of switch.





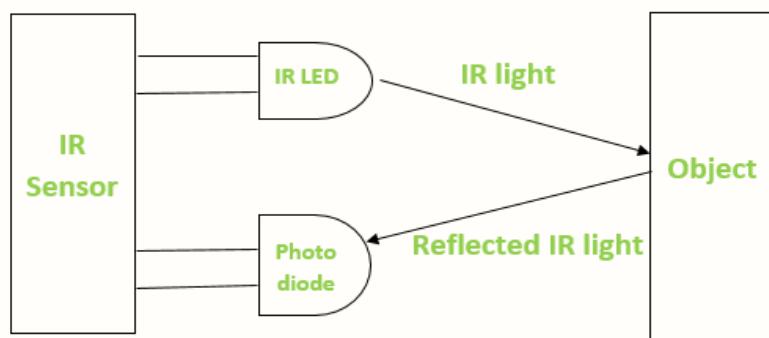
5. IR Sensor:

- IR sensor is an electronic device that emits light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detect the motion.



- Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiation are invisible to our eyes, but infrared sensors can detect these radiations.

- The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode . Photodiodes are sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

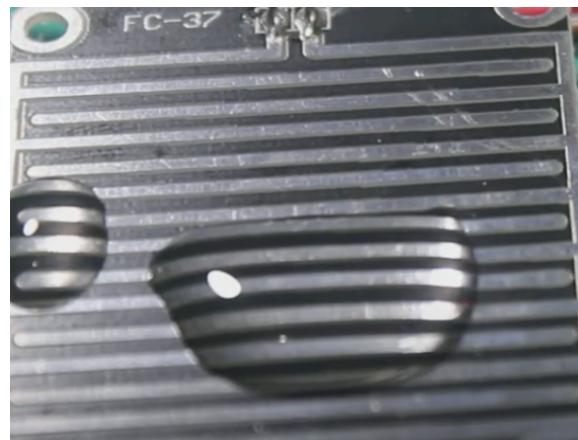


6. Rain detection Sensor:

- The driver has 4 pins :
 - VCC ,GND
 - A0 and D0 for analog and digital reading respectively



- Has a metal frame made of nickel exposed on its surface: Also called the PCB



- A LM393 component on the IC which gives out the digital output.

(The gray part is the metal) whose resistivity decreases based on the amount of water present on the panel;
- The panel is connected to a driver which has both analog and digital output and the output is in terms of the voltage based on the resistance ;
- When rain falls there is a change in resistance and depending upon the change in resistance we can determine the amount of rainfall
- More water implies more conductivity which means less resistance so less voltage so the value of the analog output will be less compared to the case in which no water is present

- The sensor is a resistive dipole, Less resistance when wet and more resistance when dry.

When raindrops are present it reduces the resistance as water conducts electricity and now some of the nickel lines can be assumed to be parallel instead of series so it also reduces the resistance and which further infers that the voltage drop across the nodes is reduced

- We can change the LOW and HIGH rating of the Rain sensor by turning the potentiometer present on the driver

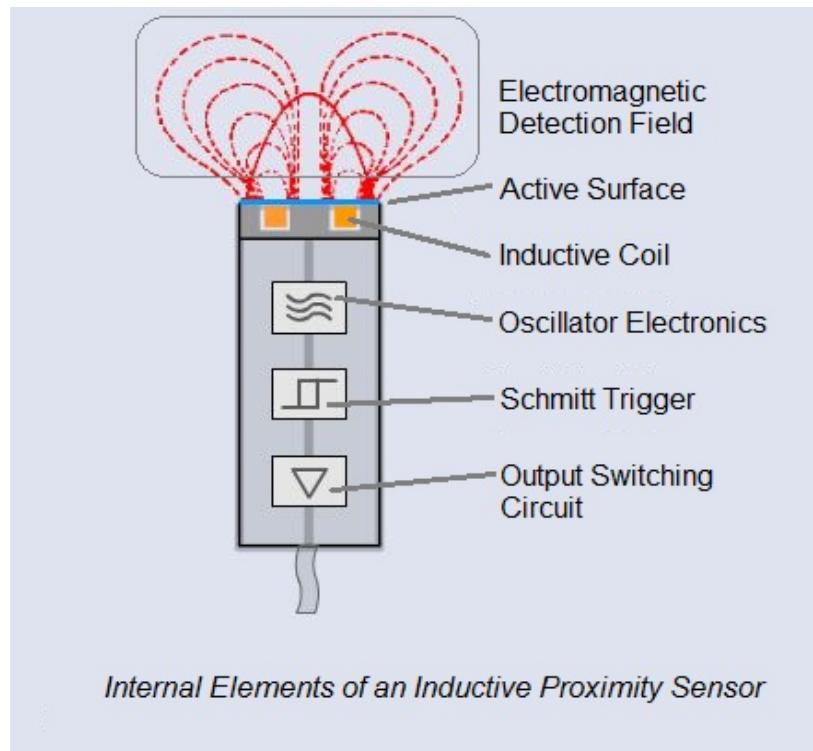
7. Inductive proximity sensor:

- Proximity sensors are used to detect objects near it without actual contact with the object.

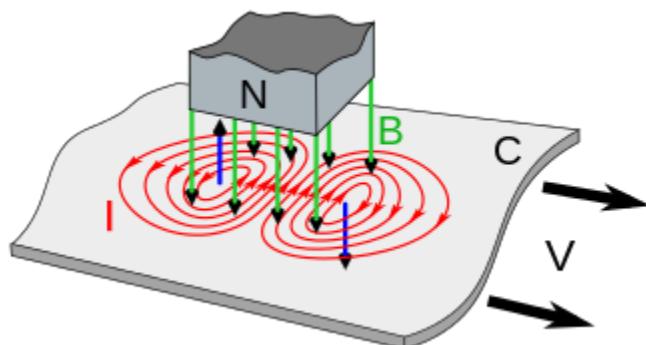


- Inductive proximity sensor: It uses the concept of Lenz law at its core

- Lenz law: Produces a Current in the opposite direction to oppose the change in the magnetic field caused near it.

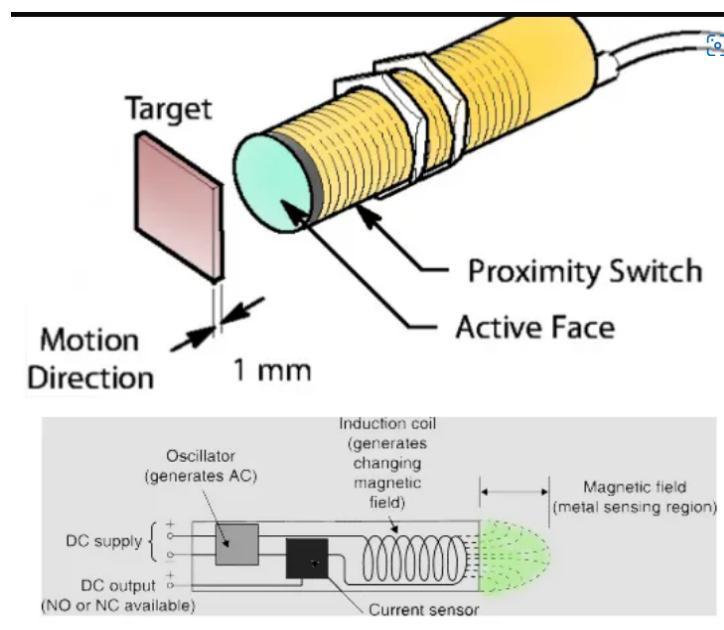


- The oscillator element in the sensor generates a magnetic field through the inductive coil present on the detecting side of the sensor; When a metal object is placed near it.



- Then there are eddy currents generated in it because of the external magnetic field created by the active surface of the proximity sensor

These eddy currents produced in turn generate a magnetic field in the direction opposite to the one caused by the proximity sensor's coil.



The change in the amplitude of oscillation is used to detect the object

- Inductive sensor works best when the source object is completely made of iron as the eddy currents produced will be maximum in that case
- NOTE:** When objects other than pure iron are placed then the object needs to be placed closer than in the case of iron for the eddy current value to be considerable.

MATHEMATICAL CALCULATIONS

1. General Bin specifications:

Height of cylinder: 12.5cm

Radius of cylinder base: 4.5cm

Material used: hard plastic

Linear Speed of lid: 0.1 m/s

2. Rotating Bin specifications:

Height of cylinder: 10cm

Radius of cylinder base: 3.75cm

Material used: cardboard

Linear Speed of lid: 0.5 m/s

Speed of bin: 0.1m/s

2. Dustbins specifications:

Height of cylinder: 8cm

Radius of cylinder base: 2.75cm

Material used: hard plastic

SOME CALCULATION

Torque of servo motor: 2 Kg-cm

Max speed servo rotates: 1m/s

Motors attached so maximum 4 kg load if motor attached 1 cm apart and Will use cogs to rotate it to prevent toppling. We used a square base of enough dimensions to counter the torque produced by the rotating bin.

OBSERVATION TABLE

SL. No.	Type of waste	Dustbin	Angle & direction of rotation of Bin
1	Wet (cotton soaked in water)	Wet waste bin	0 degree
2	Dry waste(dry cotton)	Dry waste bin	45 degree anticlockwise
3	Metal waste(small metal nails)	Metal waste bin	90 degree clockwise
4	Other waste(non detectable)	Common bin	90 degree anticlockwise

CODE

```
#include <Stepper.h>
#include <Servo.h>

int stepsPerRevolution= 2048; // number of steps motor will
take in one revolution (constant)
int motSpeed=10; //speed of motor in rpm
int dt=500; //in ms
Stepper myStepper(stepsPerRevolution,9,11,10,12);

Servo flaptop,flapbottom;
int pos=0; // We use pos to define the position of the
servo at any point during its motion using Servo.Write(pos)

int rain_pin=3;
int rain; // We are using an Analog pin for the Rain
Sensor to get a much better and accurate result as compared
to a digital sensor

int inductive_pin = 2;
int inductive; // The inductive pin is connected to a
digital pin and it gives a value of low when no metal is
placed and high when a metal is near it

void setup()
{
    Serial.begin(9600); // Initializing the Serial monitor
to see the digitized output in each case

    myStepper.setSpeed(motSpeed);
    flaptop.attach(13); // flap is like servo wherever it
is used
    flapbottom.attach(3);
```

```
pinMode(rain_pin,INPUT); // pinMode(3,INPUT) ,  
Connecting Rain Sensor to the Analog pin number 4 of the  
arduino and intializing it  
pinMode(inductive_pin,INPUT); // pinMode(4,INPUT) ,  
Connecting the Inductive sensor to the digital pin number 4  
and initilizing it  
  
}  
  
void loop()  
{  
    // Read  
  
    rain=analogRead(A3); // Reading the output of the Rain  
Sensor  
    inductive=digitalRead(inductive_pin); // Reading the  
output of the Inductive Proximity sensor  
  
    // Case 1: If it is wet waste:  
  
    if(rain<500) // If there is water then the resistance  
of the metal will decrease and so will the reading  
    {  
        // First the top flap will open up for the waste  
to fall in the second bin  
  
        for (pos = 0; pos <= 90; pos += 5) { //  
Servo.write defines the angle position of the servo  
        flaptop.write(pos);  
        delay(10); // whenever u see time variables in  
arduino ? delay(time) the time is in ms  
    }  
  
    delay(1000);
```

```
// Closing of the top flap

for (pos = 180; pos >= 0; pos -= 5) {
flaptop.write(pos);
delay(10); }

delay(1000);

// Then the bottom bin will go directly below the
bin in which the waste is to be recycled

myStepper.step(-stepsPerRevolution/6); // '+' in
forward and '-' in backward rotation
delay(dt);
delay(2000);

// Once it is exactly below it the bottom flap
will open and the waste will fall down

for (pos = 0; pos <= 180; pos += 5) // 
Servo.write defines the angle position of the servo
flapbottom.write(pos);
delay(10); // whenever u see time variables in
arduino ? delay(time) the time is in ms
} delay(1000);
for (pos = 180; pos >= 0; pos -= 5) {
flapbottom.write(pos);
delay(10);

myStepper.step(stepsPerRevolution/6); //the
number given in bracket is number of steps it will take
delay(dt);

delay(1000);
}
```

```
else if(inductive==HIGH) // If there is metal then  
the emf of the system will decrease and so will the reading  
{  
    // First the top flap will open up for the waste  
to fall in the second bin  
  
    for (pos = 0; pos <= 180; pos += 1) { //  

```

```
// Once it is exactly below it the bottom flap  
will open and the waste will fall down  
  
for (pos = 0; pos <= 180; pos += 5) { //  
Servo.write defines the angle position of the servo  
flapbottom.write(pos);  
delay(10); // whenever u see time variables in  
arduino ? delay(time) the time is in ms  
}  
  
delay(1000);  
  
for (pos = 180; pos >= 0; pos -= 5) {  
flapbottom.write(pos);  
delay(10);  
  
delay(1000);  
}  
  
}  
  
else // In the case when the waste is neither wet/ Nor  
a metal then it will fall in the Dry bin container  
{  
    // First the top flap will open up for  
the waste to fall in the second bin  
  
    for (pos = 0; pos <= 90; pos += 5) { //  
Servo.write defines the angle position of the servo  
flaptop.write(pos);  
delay(10); // whenever u see time variables in  
arduino ? delay(time) the time is in ms  
}  
  
delay(1000);  
  
// Closing of the top flap
```

```
for (pos = 180; pos >= 0; pos -= 5) {
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    delay(10); }

delay(1000);

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bin in which the waste is to be recycled

myStepper.step(-stepsPerRevolution/6); //the
number given in bracket is number of steps it will take
delay(dt);
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for (pos = 0; pos <= 180; pos += 5) // 
Servo.write defines the angle position of the servo
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delay(10); // whenever u see time variables in
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} delay(1000);
for (pos = 180; pos >= 0; pos -= 5) {
flapbottom.write(pos);
delay(10);

myStepper.step(+stepsPerRevolution/6); // '+' in
forward and '-' in backward rotation
delay(dt);

delay(1000);
}

}
```

BENEFITS

1. Reduction in Collection Costs:

The solution reduces waste collection frequency dramatically, enabling you to save on fuel, labor, and fleet maintenance costs.

It has been seen that the solution has reduced the operational cost of municipalities up to 80%.

2. Reduced Overflows:

Overflow of garbage produces many problems like generation of disease causing microbes, waste dumping in water bodies causing water pollution, some of the waste causing air pollution.

Another malicious effect is on the waste collection staff and it is the risk of picking up and handling overflowing garbage which can cause them infections or chronic diseases.

3. CO₂ Emission Reduction:

The solution decreases the fuel consumption which ultimately reduces carbon emission by up to 70%. This is indeed a huge reduction both in terms of finance and environmental impact.

The fossil fuels needed to power the trucks, the trucks' emissions, the discarded auto parts, and the hulks of abandoned garbage collection vehicles all cause trouble for mother nature.

4. No Missed Pickups:

Using the solution, the managers, as well as the garbage truck drivers, can see which garbage containers are not picked up and need to be picked.

So, there will be no missed pickups, keeping the residents away from the disease which occurs due to bacteria, vermin and insects prospering from the garbage.

5. Increased Recycling Rates:

Once segregated recycling of wastes will be easier and efficient that will eventually result in resource sustainability.

FUTURE SCOPES

1. Use of Computer Vision:

Better efficiency in detection of waste using image and video processing technologies.

2. Waste Generation Analysis:

Features Advanced Data Analytics through which the waste collection managers can know the future waste generation and can plan the resources accordingly.

3. Complete IoT based system:

IoT usage will be highly helpful in smart waste management of cities, that eventually positively affects the growth of a country in various forms like cost saving, better working environment of staff, cleaner cities, tourists' good impressions, etc.

4. More Data driven system:

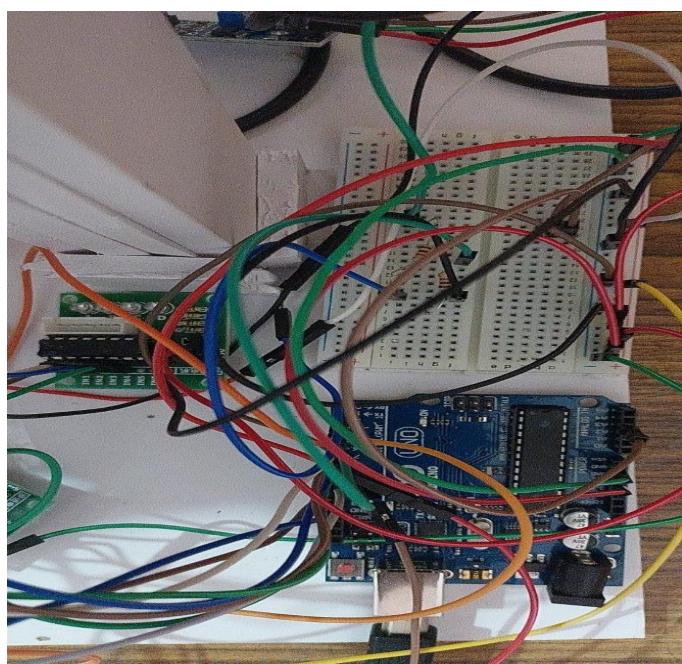
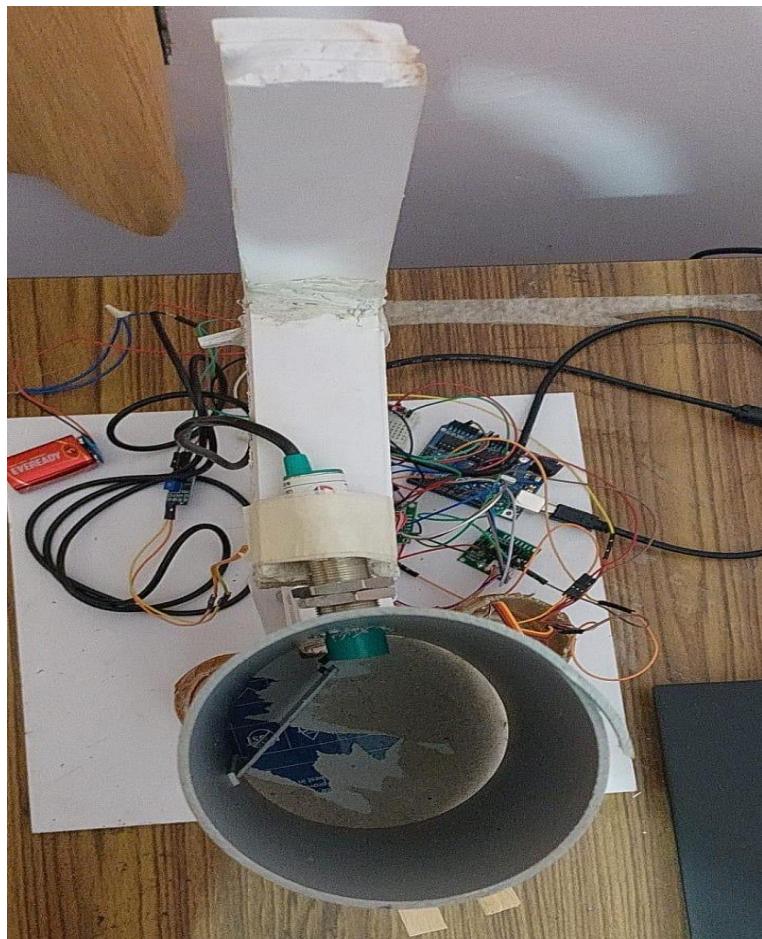
Data management technologies to be used for storing the data efficiently for further uses like analytics that in itself is inclusive.

5. Innovation in materials sciences:

Having data of analysis of the wastes, further it can be used to study the materials of the wastes dumped, for various purposes like to reduce the bad impact of the waste material on environment, humans or animals, to find a replacive better material.

MODEL VIEW





THANK YOU