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Sorting Waste Machine

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Disclaimer

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Abstract

A sorting waste machine is a highly advanced technological solution that separates and sorts different types of waste materials, this machine use a combination of mechanical and sensor-based systems to accurately identify and sort various materials, such as plastics, metals, and anything else. This process not only improves the overall efficiency of waste management, but also helps to reduce the environmental impact of waste disposal by diverting recyclable materials from landfills. Additionally, the sorted materials can be sold to the recycling industry, which can generate revenue for waste management facilities. Overall, sorting waste machines play a crucial role in making waste management more sustainable and economically viable but also incorporates several additional features to enhance the overall user experience. The machine is equipped with an automatic freshener that activates every time waste is placed in the basket, ensuring that the surrounding area remains fresh and clean. Additionally, the machine has an automatic cover that opens when hands are close to it, making it easy and convenient to deposit waste. The machine also comes with an accompanying application that allows users to monitor the level of waste in the basket, keeping them informed and in control with an automatic door that opens using a card, providing a secure and controlled access to the waste sorting process. This machine not only improves the overall efficiency of waste management but also ensures a cleaner and more user-friendly experience for users. Furthermore, the machine can be integrated with a recycling industry to generate revenue for the facility.

1. Introduction

1.1 Statement of the problem

Not recycling waste that is useful to factories is a problem because it can have negative consequences for the environment, economy, and society. When we throw away materials that could be recycled or reused, we are wasting valuable resources that could be used to create new products. This can lead to a depletion of natural resources and a need to extract more raw materials from the earth, which can have negative environmental impacts, such as greenhouse gas emissions. In addition, recycling can be more cost-effective than producing new products from raw materials, so by not recycling, we may be wasting money and resources that could be used more efficiently. Finally, landfills are limited in size, and when they are full, we need to find new places to dispose of our waste. By recycling, we can help to reduce the amount of waste that ends up in landfills and delay the need to find new landfill sites. Therefore, it is important to recycle waste that is useful to factories in order to conserve resources, reduce environmental impacts, save money, and extend the life of landfills so from here our project is sorting waste machine.

1.2 Objectives

Using sorting waste machine to sort waste can be a very effective way to manage waste and improve the efficiency and cost-effectiveness of waste management. Our project can sort waste more quickly and accurately than humans, and they can work around the clock without getting tired. This means that waste can be sorted and processed more efficiently, reducing the overall time and cost of waste management. In addition, machines can help to reduce the risk of injuries or accidents for workers, as waste sorting can be a dirty and hazardous job. Machines can also sort waste consistently, without the variations that can occur when humans are performing the task, which can help to ensure that waste is sorted and processed correctly. Finally, in the long run, using machines to sort waste is likely to be more cost-effective than relying on manual labor, as the initial investment in the machinery may be higher but the cost per unit of waste sorted is likely to be lower.

2. Constraints Standards/ Codes and Earlier course work

2.1 Constraints:

While working, we have faced a series of problems and challenges.

- The inability to add large materials because the sensors are close to each other and if we want to add large materials we have to increase the size of the basket and this is not practical.

- Accuracy of sensors: Sensors are not always accurate, having limitations in their distance of measurement. This affects its accuracy in detection we solve it by make the tripper back a little bit so the sample touch the sensors so become more accurate.

- The capacitive sensor and inductive sensor are very sensitive in detecting waste, anything inside/around the sample affects.

- The motors take the voltage as high as possible at the start of the operation, and this causes noise on the voltage source, and therefore the ESP8266 module it turns off and restarts due to the decrease in voltage, and to solve this problem, we added an Arduino feeder to compensate for the shortage with ESP8266 module.

- The capacitive and inductive can only recognized a specific thickness but we can't solve it because those are the only sensors available.

2.2 Standards/ Codes:

The following list contains the hardware components that have been used in our project.

ESP8266MOD:

is a development board based on the ESP8266 Wi-Fi chip. It includes the ESP8266MOD module, as well as a microcontroller and a USB-to-Serial converter on a single board. This allows for easy programming and communication with the module via a USB connection. also includes a number of pins for connecting to sensors and other peripherals and therefore we used it to connect the IR sensor and send the data of IRs to the application.

Figure 1: ESP8266MOD

Arduino uno:

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.

Figure 2: Arduino uno

IR Sensor:

An infrared (IR) sensor module is a device that uses infrared technology to detect objects or changes in its environment. It consists of an IR transmitter and receiver, and it works by emitting a beam of IR light and detecting any reflections off nearby objects. When an object is detected, the sensor sends a signal to a microcontroller or other device to indicate that an object is present.

Figure 3: IR Sensor

Power Supply:

A power supply is a device that provides electrical power to an electrical load. It converts one form of electrical energy into another, typically from a source such as a battery or the electrical grid, into the form of electricity that is needed by the load. The load can be a device, such as a computer or a cell phone, or it can be a system, such as a lighting system or an industrial process

Figure 4: Power Supply

Relay Module:

A Relay module is a device or circuit that introduces a specific amount of delay to a signal.

Figure 5: Relay Module

Inductive Sensor:

Inductive proximity sensors have been used to detect metal objects. We have used a larger sensor, based on our requirement of having a larger sensing range

Figure 6: Inductive Sensor

Capacitive Sensor:

Capacitive sensors can sense any object within their sensing range. When the target approaches the face of the sensor, the capacitance increases, resulting in an increase in amplitude of the oscillator. Then the solid-state output switch detects the increase in amplitude and based on that it is turned on or off.

Figure 7: Capacitive Sensor

l7805cv:

The L7805CV is a linear voltage regulator that is commonly used to convert a higher input voltage to a lower output voltage

Figure 8: l7805cv

Limit Switch:

A limit switch is an electromechanical device that is used to detect the physical position of an object or machine. It typically consists of a switch mechanism and an actuator that is connected to a machine or moving object. When the actuator comes into contact with a fixed object or reaches a certain position, it causes the switch mechanism to activate, changing the state of an electrical circuit.

Figure 9: Limit Switch

Lathe Gear Metal Cutting Gear:

Lathe gears are mechanical components that are used in metal cutting lathes to control the speed and feed of the cutting tool

Figure 10: Lathe Gear Metal Cutting Gear

AC/DC Adapter:

An AC/DC adapter with a 100–240-volt input and 12-volt,4-amp output is a type of power supply that converts alternating current (AC) electricity from a wall outlet into direct current (DC) electricity that can be used to power devices that require DC power.

Figure 11: AC/DC Adapter

Servo motor :

A servo motor is a type of motor that is used for precise control of angular position.

Figure 12: Servo motor

Dc Servo Motor:

is a type of direct current motor that is designed to rotate at a specific position or speed when a control signal is applied to it.

Figure 13: Dc Servo Motor

DC Motor:

A DC motor is an electric motor that runs on direct current (DC) power. It converts electrical energy into mechanical energy through the interaction of a magnetic field and an electric current flowing in the motor's windings

Figure 14: DC Motor

Capacitor 1000mf:

A capacitor is a passive electronic component that stores electrical energy in an electric field.

Figure 15: Capacitor 1000mf

Transistor:

A transistor is a semiconductor device that can be used as an amplifier or switch

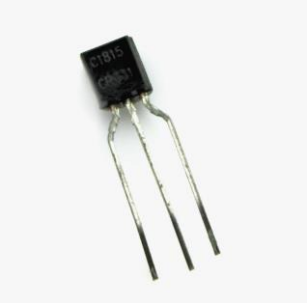

Figure 16: Transistor

Trimpot Potentiometer:

Trimpots are often used to adjust parameters such as gain, offset, and threshold levels in electronic circuits, especially in situations where the final value of the resistance is not known in advance. They are commonly used in circuits such as audio equipment, test and measurement equipment, and medical instruments.

Figure 17: Trimpot Potentiometer

DIP-Relay:

is a type of electrical relay that is packaged in a DIP package, which is a rectangular housing with two rows of electrical contacts.

Figure 18: DIP-Relay

Wires:

Using Male-Female and Male-Male

Figure 19: Wires

Board:

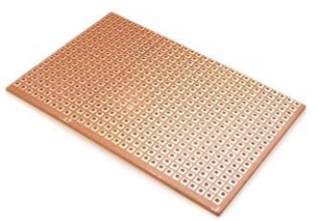

Figure 20: Board

DC Solenoid:

converts electrical energy into linear mechanical motion when an electric current flows through it.

Figure 21: DC Solenoid

Batteries (1.5v):

Figure 22: Batteries (1.5v)

RFID Tags:

tags are small devices that use radio waves to communicate with a reader, in order to identify and track items.

Figure 23: RFID Tags

Air Freshener:

Figure 24: Air Freshener

2.3 Earlier course work:

Working on our project depends on some courses we learned within the Computer Engineering such as:

1. Microcontroller:

The microcontroller provides basic information about understanding the PIC Microcontroller and how to program hardware components, also the lab of this course provides how-to download code on the PIC Microcontroller equipment and how to understand every pin and feature there. so, it is one of the most important materials that helped us understand how to deal with the Arduino parts in the project, through our knowledge of how to deal with the microcontroller, as the laboratory of this material contributed mainly to help us start working on the project.

2. Electronic circuits:

This course has mainly contributed to helping us deal with electrical circuits and related connections.as a result of this course that provides basic information about how to deal with many different circuits and how to wire their circuits.

3. Literature Review:

When we looked at the importance of sorting waste for recycling and reused it again, we found that this idea was implemented outside Palestine, and no one implemented it in Palestine.

However, as a graduation project idea, it was repeated, but with a different principle. We developed it by adding Wi-Fi using Esp8266 and an air freshener that works when turning the piece in the basket and adding a lock to the door so that only the official who has the card can take out the contents of the baskets.

4. Methodology:

This is a report on a project in which a sorting waste was implemented to sort waste to plastic also metal and default this project includes 2 parts:

4.1 Design the shape:

Figure 25: Design the shape

The design consists of a hole from the top to put the sample through, and there is a wooden piece with a Conveyor belt on it to move the sample towards the sensors, then the wooden piece turns towards the baskets, and inside the design there are pieces and wires.

Used component:

1.Inductive Sensor: used to detect metal, we put a fixed thickness by the potentiometer that are in the back of the sensor if the sample is the same thickness, it sends 1 to the Relay and the tipper will move down.

2.Capacitive Sensor: used to detect plastic used to detect plastic, we put a fixed thickness by the potentiometer that are in the back of the sensor if the sample is the same thickness, it sends 1 to the Relay and the tipper will move down.

3.11 IR sensors: 9 IR's that are connected to ESP8266 to view the level of waste in basket also 1 IR used to allow the sample to enter inside to detect it later, the last IR are used to detect the default waste and the position for this sensor at the wooden piece.

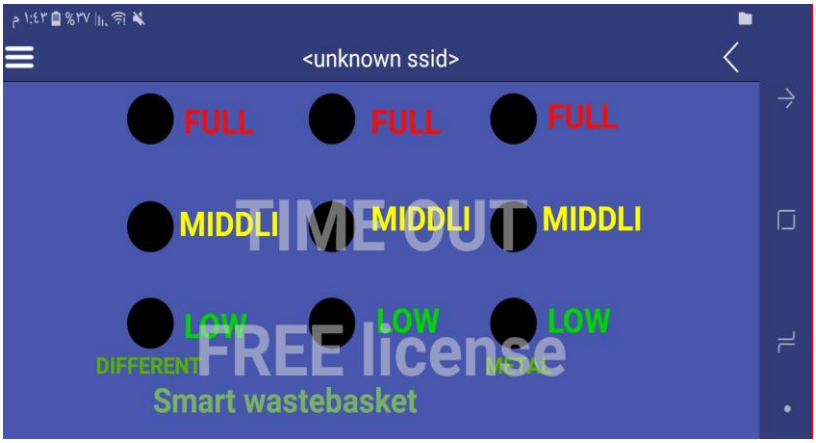

Figure 26: Design the application

3.Power Supply: we used it to convert the 220v to 12v, 2amp.

4.AC/DC Adapter: we used it to convert the 220v to 12v, 4amp.

5.Dc Servo motor: we used 2 servo motors the first one it to move the Lathe Gear Metal Cutting Gear and this will make scraping and move the sample through the sensors but to make it work we have to press a button to make it works and the other one used to open the hole cover 90 degrees when the IR sensor detect a sample then it back again slowly to 0 degree.

6.DC Motor: this motor moves the tipper 90 degrees down on the direction of baskets

7.DC Solenoid: this Solenoid works when the tipper moves down.

8.Limit Switch: we have 2 limiting switches the first one is normally closed when the sensor detect sample so Dc motor move from limit switch1 to limit switch2 and the second one when tripper arrived switch2 it will make it closed so the DIP Relay will reverse the direction of the motor therefor the tripper will change to Home (were limit switch1 are closed).

9.DIP Relay: we have 2 DIP Relay The first relay works if limit switch1 is closed and limit switch2 is open. When the sensors identify a sample, the tipper moves down and the sample goes down and the limit switch2 becomes closed, and to return to the home mode, the function of DIP Relay2 comes so that it reverses the polarity of the DC motor and thus it moves in the other direction, and so the tipper returns to the home mode.

10.Relay module: we used 2 Relays those Relays takes the output of the sensors then to DIP Relay

4.2 Implementation:

To Sorting waste (metal, plastic and default) and to move tripper. And this is the map for the project

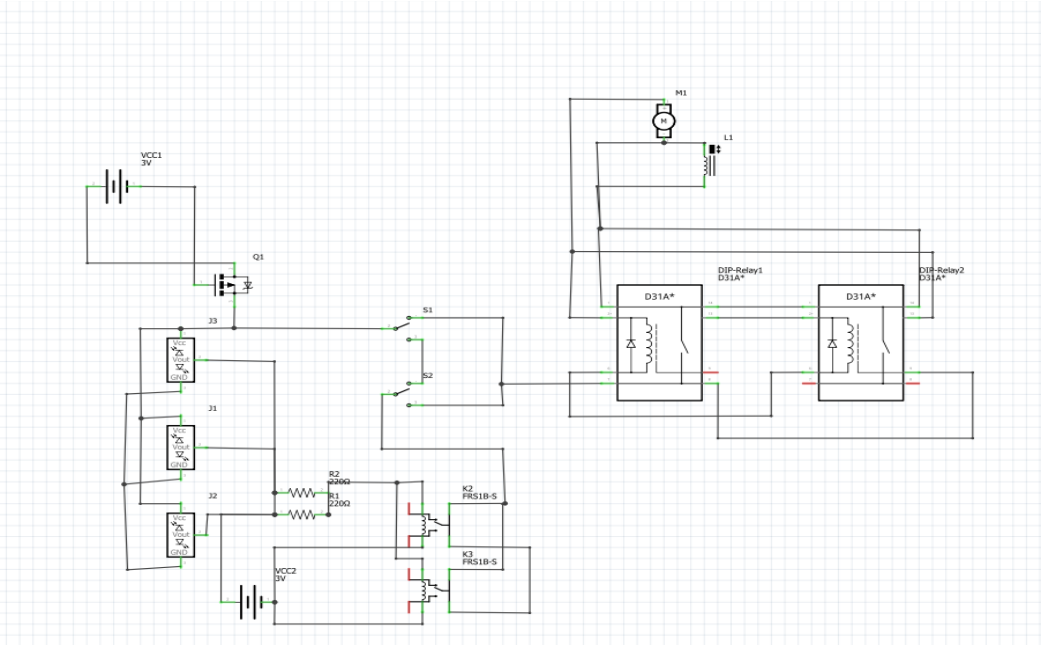

Figure 27: Sorting process1

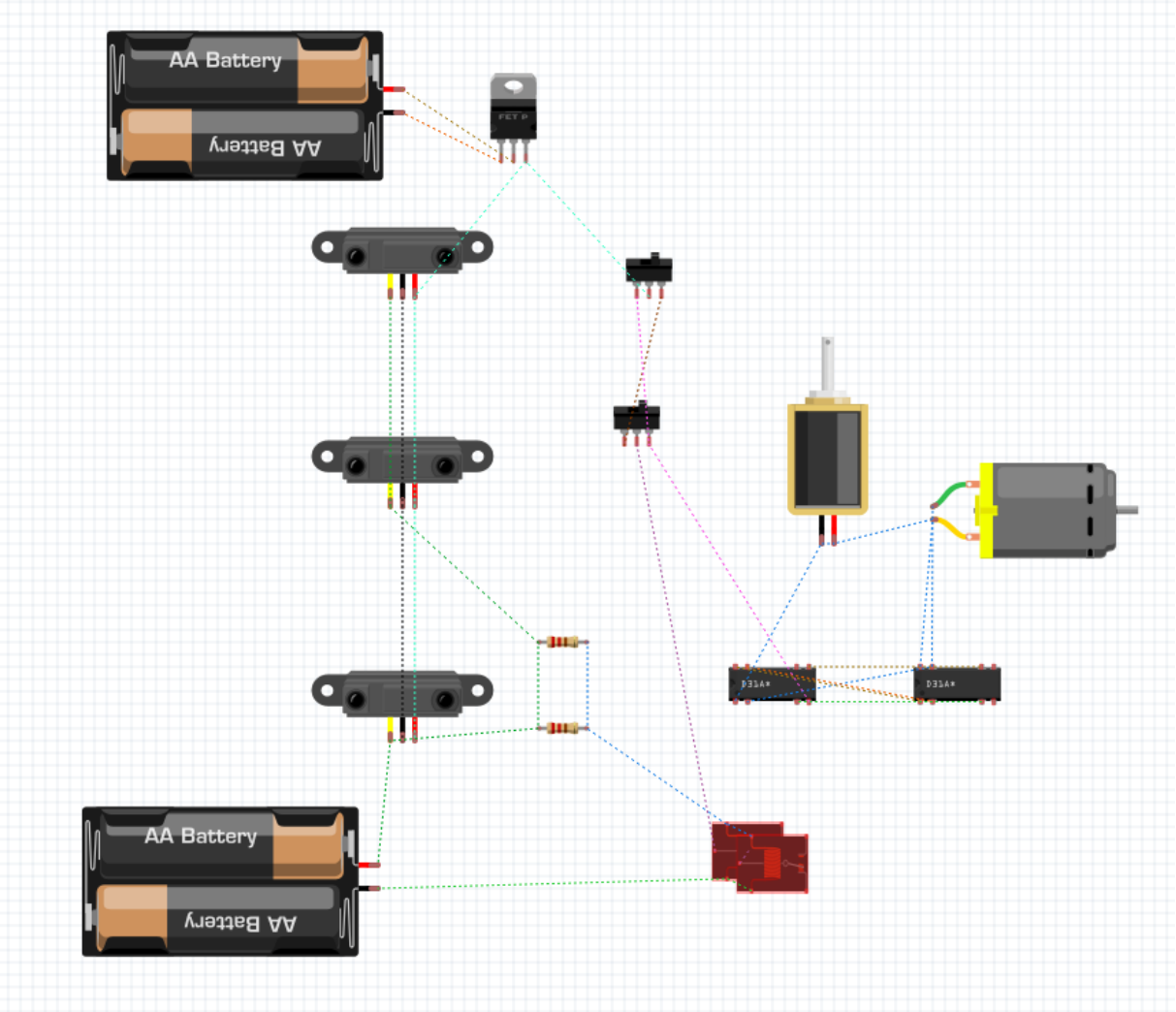

Figure 28: Sorting process2

4.2.1 The operating time of the conveyor belt:

When we press the button, there will be a charge in the capacitor, and according to the following law τ(time constant)=RC , we can control the duration of the stripping operation. There is a variable resistance, if we move it to the right, the time increases, and if we move to the left, the time decreases, the resistance passes through the charge and the charge is discharged into the base of the capacitor Discharging time = operating time of the skimmer.

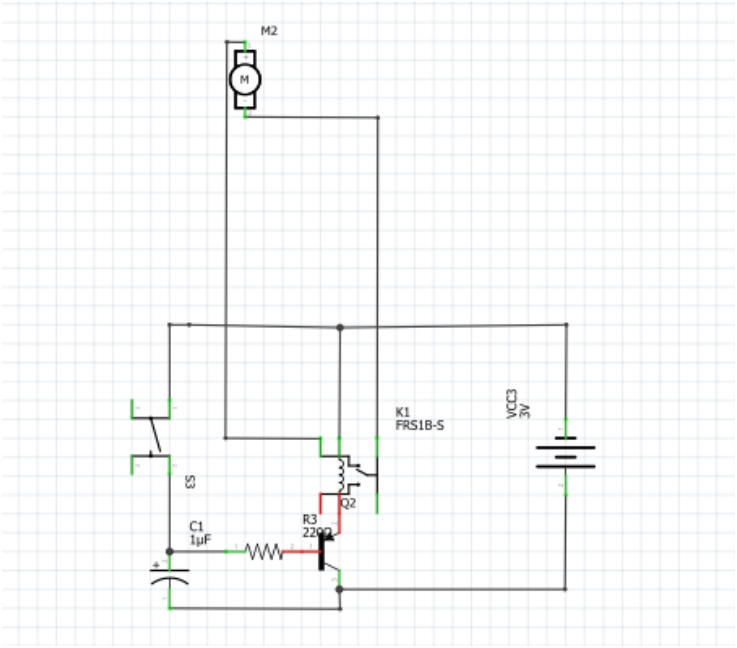

Figure 29: The operating time of the conveyor belt1

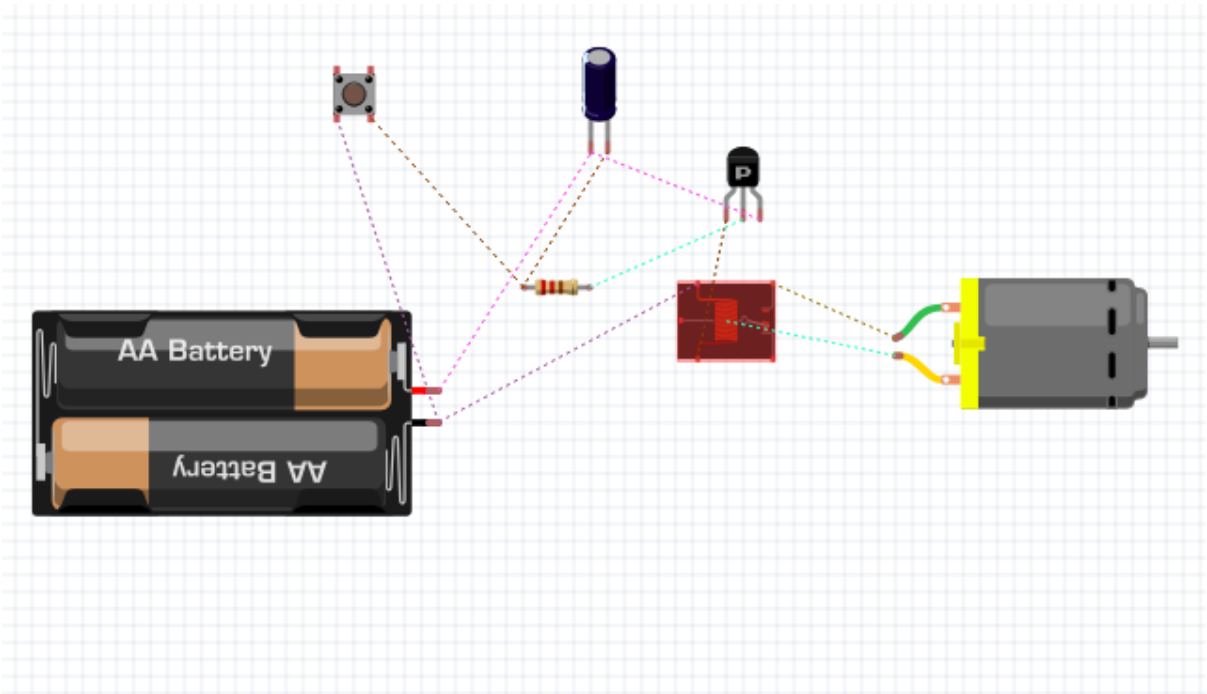

Figure 30: The operating time of the conveyor beltr2

4.2.2 open the hole cover:

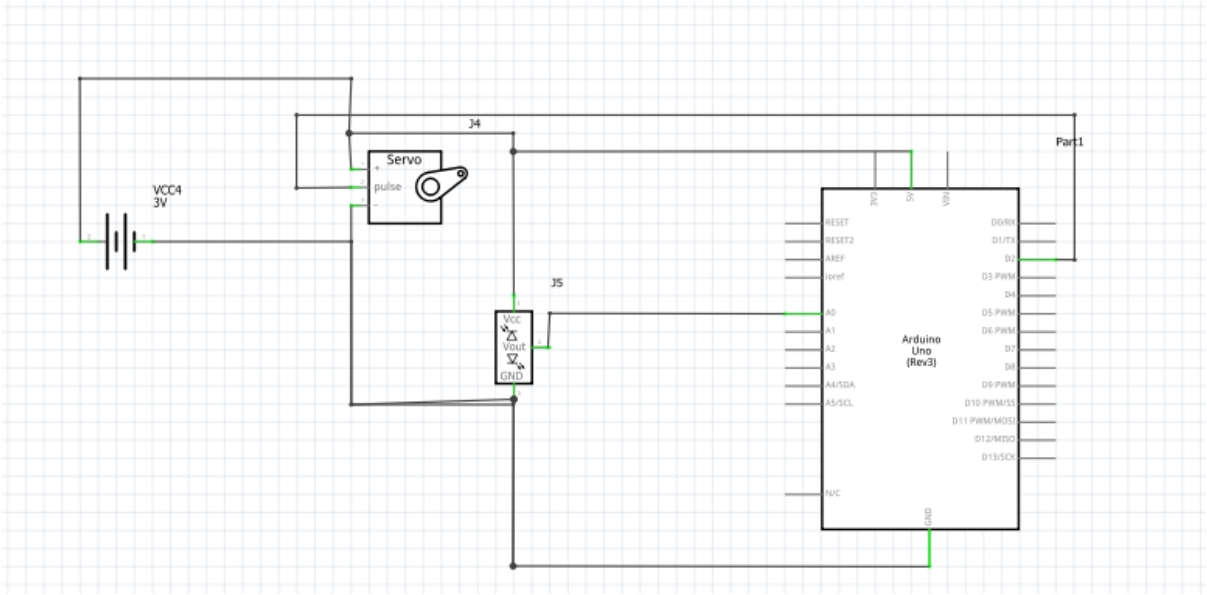

Figure 31: open the hole cover1

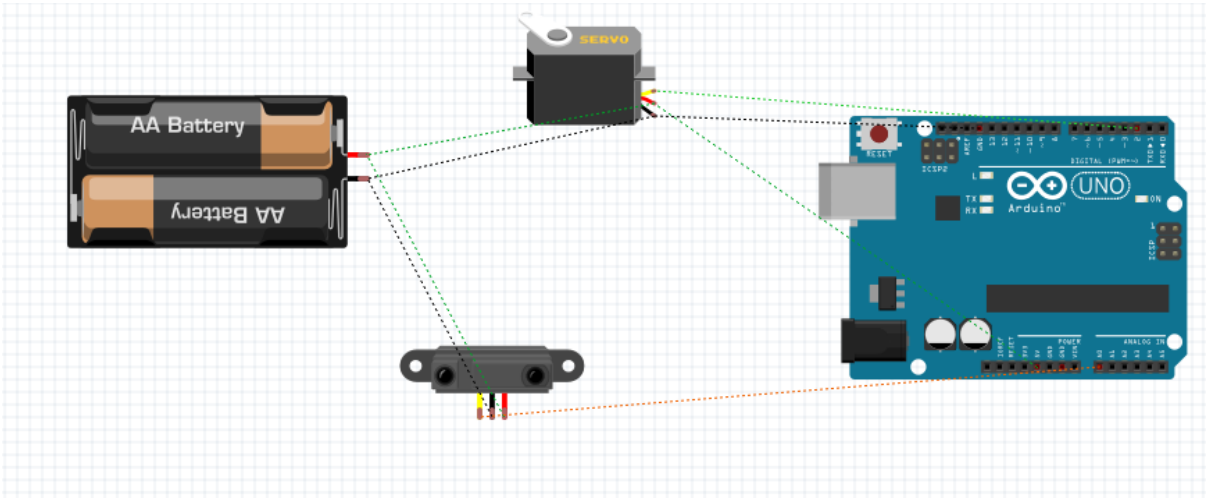

Figure 32: open the hole cover2

- **Code**

```
#include <Servo.h>
const int analogInPin = A0;
int sensorValue = 0;
int servoPin = 2;
int i = 0;
Servo servo;
void setup() {
servo.attach(servoPin); }
void loop() {
sensorValue = analogRead(analogInPin);
if(sensorValue < 600){
for (int i = 0; i<=90; i++){
servo.write(i);
delay(10); } }
servo.write(i);     }
```

4.2.3 For wi-fi:

9 IR’s that are connected to ESP8266 to view the level of waste in basket therefor each basket have 3 IR’s sensors each sensor represent the level of basket if it is low(empty) , medium or full.

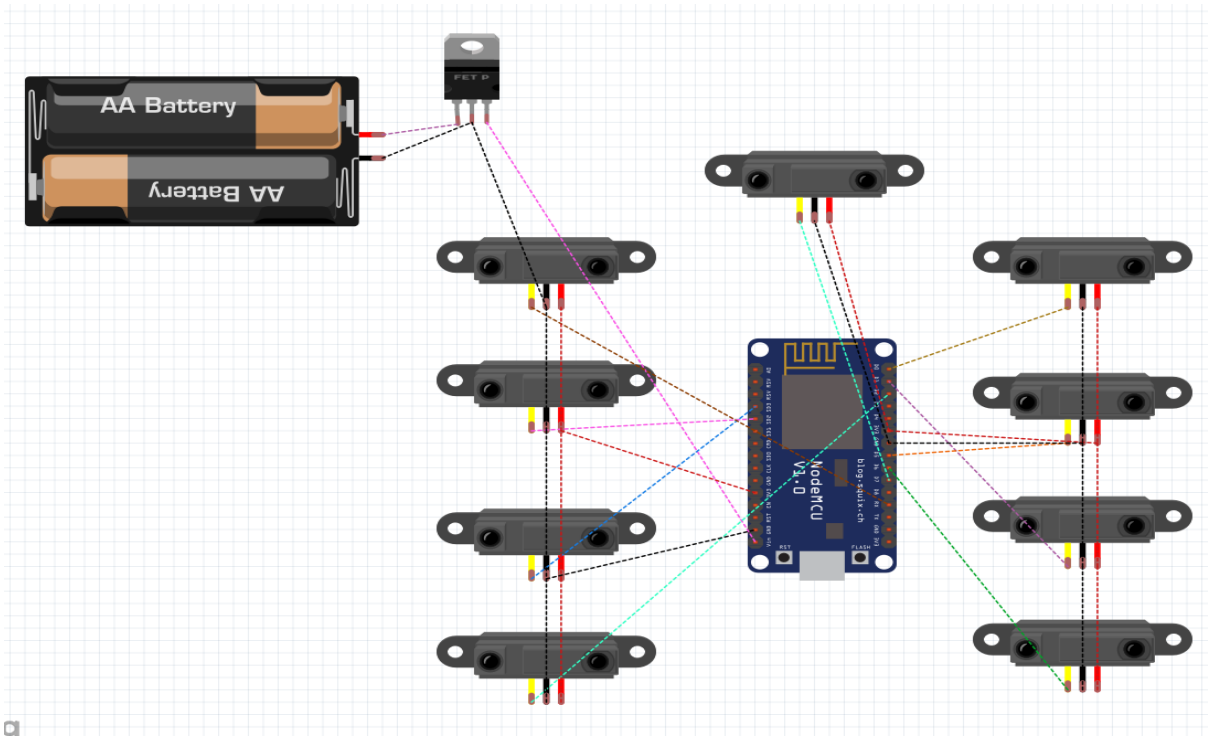

Figure 33: For wi-fi

The libraries we used:

#include <ESP8266WiFi.h>

#include <RemoteXY.h>

definitions on the code:

// RemoteXY connection settings

#define REMOTEXY_MODE__ESP8266WIFI_LIB_POINT

#define REMOTEXY_WIFI_SSID "pic"

#define REMOTEXY_WIFI_PASSWORD "12345678"

#define REMOTEXY_SERVER_PORT 6377

```
// RemoteXY configurate
#pragma pack(push, 1)
uint8_t RemoteXY_CONF[] =   // 230 bytes
  {255,0,0,9,0,223,0,16,14,0,129,0,6,53,18,6,4,83,109,97,
  114,116,32,119,97,115,116,101,98,97,115,107,101,116,0,129,0,12,4,15,
  6,1,70,85,76,76,0,129,0,11,22,20,6,94,77,73,68,68,76,73,
  0,129,0,12,40,13,6,134,76,79,87,0,129,0,48,4,15,6,1,70,
  85,76,76,0,129,0,48,21,20,6,94,77,73,68,68,76,73,0,129,0,
  49,39,13,6,134,76,79,87,0,129,0,82,3,15,6,1,70,85,76,76,
  0,129,0,81,21,20,6,94,77,73,68,68,76,73,0,129,0,82,39,13,
  6,134,76,79,87,0,129,0,70,48,13,4,119,77,69,84,65,76,0,129,
  0,251,48,22,4,119,68,73,70,70,69,82,69,78,84,0,65,64,1,2,
  9,9,65,16,1,21,9,9,65,32,1,38,9,9,65,64,36,2,9,9,
  65,16,36,21,9,9,65,32,36,38,9,9,65,64,71,2,9,9,65,16,
  71,21,9,9,65,32,71,38,9,9};
// this structure defines all the variables and events of your control interface
struct {
  // output variables
  uint8_t led_1_r; // =0..255 LED Red brightness
  uint8_t led_2_b; // =0..255 LED Blue brightness
  uint8_t led_3_g; // =0..255 LED Green brightness
  uint8_t led_4_r; // =0..255 LED Red brightness
  uint8_t led_5_b; // =0..255 LED Blue brightness
  uint8_t led_6_g; // =0..255 LED Green brightness
  uint8_t led_7_r; // =0..255 LED Red brightness
  uint8_t led_8_b; // =0..255 LED Blue brightness
  uint8_t led_9_g; // =0..255 LED Green brightness
   // other variable
  uint8_t connect_flag;  // =1 if wire connected, else =0
  } RemoteXY;
#pragma pack(pop)
```

```
void setup() {
  RemoteXY_Init ();
  pinMode (16,INPUT);
  pinMode (4,INPUT);
  pinMode (5,INPUT);
  pinMode (3,INPUT);
  pinMode (9,INPUT);
  pinMode (10,INPUT);
  pinMode (12,INPUT);
  pinMode (13,INPUT);
  pinMode (14,INPUT);
  // TODO you setup code}
void loop() {
  RemoteXY_Handler ();
 if (digitalRead(16) == HIGH) // if pin 5 enjoyed a high level voltage
  RemoteXY.led_1_r = 255;   // then turn on red light
  else  // else
  RemoteXY.led_1_r = 0;
  if (digitalRead(4) == HIGH) // if pin 5 enjoyed a high level voltage
   RemoteXY.led_1_r = 0;   // then turn on red light
   else       // else
   RemoteXY.led_1_r = 255;
   if (digitalRead(5) == HIGH) // if pin 5 enjoyed a high level voltage
   RemoteXY.led_2_b = 0;   // then turn on red light
    else        // else
    RemoteXY.led_2_b = 255;
     if (digitalRead(3) == HIGH) // if pin 5 enjoyed a high level voltage
    RemoteXY.led_3_g = 0;   // then turn on red light
    else         // else
```

```
    RemoteXY.led_3_g = 255;
    if (digitalRead(9) == HIGH) // if pin 5 enjoyed a high level voltage
    RemoteXY.led_4_r = 0;   // then turn on red light
    else          // else
    RemoteXY.led_4_r = 255;
   if (digitalRead(10) == HIGH) // if pin 5 enjoyed a high level voltage
    RemoteXY.led_6_g = 0;   // then turn on red light
,   else          // else
    RemoteXY.led_6_g = 255;
    if (digitalRead(12) == HIGH) // if pin 5 enjoyed a high level voltage
    RemoteXY.led_7_r = 0;   // then turn on red light
  else          // else
 RemoteXY.led_7_r = 255;
if (digitalRead(13) == HIGH) // if pin 5 enjoyed a high level voltage
RemoteXY.led_8_b = 0;   // then turn on red light
else          // else
RemoteXY.led_8_b = 255;
if (digitalRead(14) == HIGH) // if pin 5 enjoyed a high level voltage
RemoteXY.led_9_g = 0;   // then turn on red light
else       // else
RemoteXY.led_9_g = 255;  }
```

5.Discussion:

Our project identifies a specific type of material, whether plastic or iron, but what is the benefit of the project if it identifies a specific type only? We can benefit from the idea that a specific company is designated to recycle the products it exports, and therefore it does not need to know the thickness of all types of plastic or iron, only it needs to know the thickness of the products it exports

6. Conclusions and Future work:

At the end of the project, we were able to sort minimum three different types of wastes: Plastic, Metal and default.

The potential for further development in this project includes incorporating a moisture sensor to detect organic waste, or wet waste.

Additionally, by incorporating additional sensors, the capability for segregation of a wider variety of waste streams can be achieved.

By implementing design modifications, the system can be made more versatile to detect different sizes of waste.

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