PROJECT REPORT

ON

”REVERSE VENDING MACHINE”

Submitted to

VASAVI COLLEGE OF ENGINEERING

In Partial Fulfilment of the Requirements
for BE IV sem mini project

BACHELOR’S DEGREE IN
COMPUT ER ENGINEERING

BY

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CERTIFICATE

This is certify that the project entitled

"REVERSE VENDING MACHINE"

submitted by

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Students of Electronics and Communication Engineering Department,Vasavi College of Engineering in partial fulfillment of the requirement for the award of the degree of Bachelor of Engineering in Electronics and Communication Engineering is a record of the Bonafide work carried out by them during the academic year 2022-2023

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INTRODUCTION

The global population is experiencing a significant increase, resulting in a rise in consumption and subsequent waste generation. The sheer amount of waste produced worldwide is immense. While some of it is reused, a substantial portion is simply discarded, causing problems for both individuals and the environment. A staggering 2.12 billion tons of waste is dumped annually, which, if loaded onto trucks, could encircle the Earth multiple times. Among the various types of waste, a significant proportion consists of bottles and cans from drinks and beverages. Every year, approximately 4,321,400 used drink bottles are dumped into the ocean, leading to water pollution. Moreover, over 100 million bottles are used globally on a daily basis. These plastic containers take an astonishing 700 years to begin decomposing, as they do not readily break down through the action of typical microorganisms that facilitate the decomposition of organic materials. Only one out of every five bottles or jars is recycled, while the rest end up as waste.

To address the issue of bottle waste management and preservation, a traditional system called the ”Bottle Return and Handling Machine” exists. This system can identify bottle types and refund money to consumers. How-

ever, an improved solution called the ”Arduino Based Recycling System” is proposed, which incorporates new features. This system introduces the capability to count bottles based on their material type, unlike the conventional system that only counts and calculates monetary refunds. The most notable feature of the Arduino system is the ability to separate bottles into predefined storage units, simplifying the recycling process by facilitating easy collection from the designated storage areas.

ABSTRACT

By 2030, India is projected to generate approximately 80-85 million tons (MT) of solid waste. Given this alarming quantity, it is crucial to implement methods that can address this issue, particularly in relation to plastic waste. One effective solution for plastic waste disposal is the Reverse Vending Machine (RVM). The RVM is a device that accepts plastic bottles with barcodes and provides digital cash or redeemable coupons in return.

However, studies indicate that the utilization of reverse vending machines is not widespread. This research aims to explore the challenges associated with the adoption of eco-friendly products like RVM. A conceptual model was developed based on variables identified through a review of existing literature. These variables include awareness, willingness, incentives, convenience, and involvement.

The findings strongly indicate that the willingness to adopt RVM is influenced primarily by factors such as involvement, convenience, awareness, and incentives, in that order. It is also evident that high levels of involvement prompt individuals to become more aware and adopt eco-friendly methods, as confirmed by the research results. Therefore, it is essential for citizens to actively engage with RVM usage, either driven by personal interest or through

the enforcement of legislation and policies.

In conclusion, this study recommends the implementation of additional policies and strategies, such as the ”bottle bill,” the ”European Union Plastic Strategy,” and Recycle Refund Systems, to be universally mandated. These measures aim to encourage citizens worldwide to adopt methods that contribute to a plastic-free environment.

PROBLEM STATEMENT

Before we delve into the proposed solution, let's address some common challenges that we need to take into account.

Firstly, the issue of people disregarding designated garbage cans and instead littering the ground, despite the presence of nearby bins. Many individuals are unaware of the detrimental effects of littering. Public waste bins are filling up at an accelerated rate, often resulting in overflowing bins before they can be collected. This not only leads to cluttered streets and unpleasant odors but also has negative implications for public health and the environment.

Secondly, door-to-door waste collection may seem like a viable solution, but the associated transportation costs and overall expenses would result in significant financial losses. Additionally, implementing such a system would require a considerable amount of manpower and time to collect plastic bottles from every household within a city. Furthermore, storage space becomes a challenge when collecting waste manually.

Thirdly, the practice of burning plastics in industrial areas is a major contributor to air pollution. The incineration of plastic waste in open fields emits unpleasant odors and releases toxic gases, including dioxins, furans, mercury, and polychlorinated biphenyls (PCBs), into the at-

mosphere. This poses a threat to vegetation, as well as the health of humans and animals. Dioxins settle on crops and enter waterways, eventually finding their way into the food chain and impacting our bodies. These dioxins are highly dangerous persistent organic pollutants that can cause cancer and disrupt the thyroid and respiratory systems.

During the empathy phase, we engaged with individuals in various locations and discovered that public places, such as bus stands in junction areas, are particularly susceptible to passengers discarding plastic bottles. After extensive discussions with our team, considering the challenges at hand, we concluded that placing vending machines in public areas and incentivizing people with rewards for recycling their PET bottles could attract them towards this system.

In the definition phase, our team formulated the problem statement with the following objectives:

Reduce plastic waste from bottles Promote clean and green technology Facilitate efficient collection of recyclable materials Boost recycling activities and, consequently, improve waste management Reward individuals for responsibly disposing of their waste plastic bottles.

Literature survey

A Reverse Vending Machine (RVM) is a device that allows individuals to return empty drink containers such as bottles and jars for recycling purposes. Typically, the machine provides a deposit refund or store credit to the end user. This is what distinguishes it as a ”reverse” vending machine: instead of the customer inserting money and receiving a product (like with a typical snack vending machine), the customer deposits an item and receives a monetary value in return. These machines are particularly popular in locations with mandatory recycling laws or container deposit legislation. The basic operation involves several steps: the recycler places the empty bottle or can into the receiving opening, and the horizontal in-feed system allows one container to be inserted at a time. The container is then automatically rotated. The plastic is identified using an inductive proximity sensor and an infrared sensor. As for the reward system, the RVM dispenses valuable coins as the refund.

0.1 HARDWARE REQUIREMENTS

0.1.1 Arduino Uno (ATmega328P):

The Arduino UNO employs an ATmega328P microcontroller and is simpler to operate than comparable boards like the Arduino Mega board. It includes various features such as digital and analog Input/Output pins (I/O), shields, and other circuits. Additionally, it contains 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. Moreover, it operates based on IDE (Integrated Development Environment) and can function on both online and offline platforms.

0.1.2 Proximity Inductive Sensor(NPN):

An inductive proximity sensor is a sensor that does not require physical contact and is designed to identify if metallic objects are present or not within a specific range. It functions by utilizing electromagnetic induction as its underlying principle.

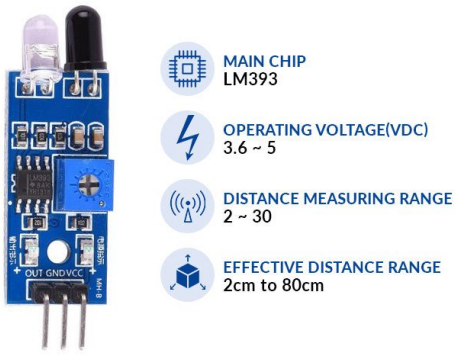
The inductive proximity sensor identifies the alteration in the magnetic field created by the metallic object, which is then transformed into an electric signal, signifying the object's presence.

The sensor generates a digital output signal, typically represented as voltage or current, to indicate whether the detected object is present or not. The output state can be either "ON" or "OFF" based on the sensor's setup and the existence of the metallic object.

They are commonly used in industrial automation to detect the presence or absence of metallic components on assembly lines.

0.1.3 IR Sensor:

An IR (Infrared) sensor, also known as an IR detector or IR receiver, is a device that detects and responds to infrared radiation. It is commonly used in a wide range of applications, from consumer electronics to industrial automation. IR sensors can be categorized into two main types: active and passive.



An active infrared (IR) sensor emits infrared radiation and assesses the reflection or absorption of the emitted radiation in order to identify objects or proximity.

Active IR sensors typically comprise an IR transmitter and an IR receiver. The IR transmitter emits infrared light within a particular frequency range, while the IR receiver detects the reflected or absorbed light.

0.1.4 Servo Motors:

The SG90 is a frequently used micro servo motor among hobbyists and those who enjoy doing DIY projects.It is compact and affordable, able to rotate up to 180 degrees while producing a maximum torque of 1.8 kg-cm.
The motor functions at 4.8-6V and only weighs about 9 grams, which is great for small robotics and models requiring control.

0.1.5 I2C LCD display:

The components of an I2C LCD display typically include a character LCD display based on HD44780 and an I2C LCD adapter. It is worth noting that these LCDs are best suited for displaying textual characters. For instance, a 16×2 character LCD.

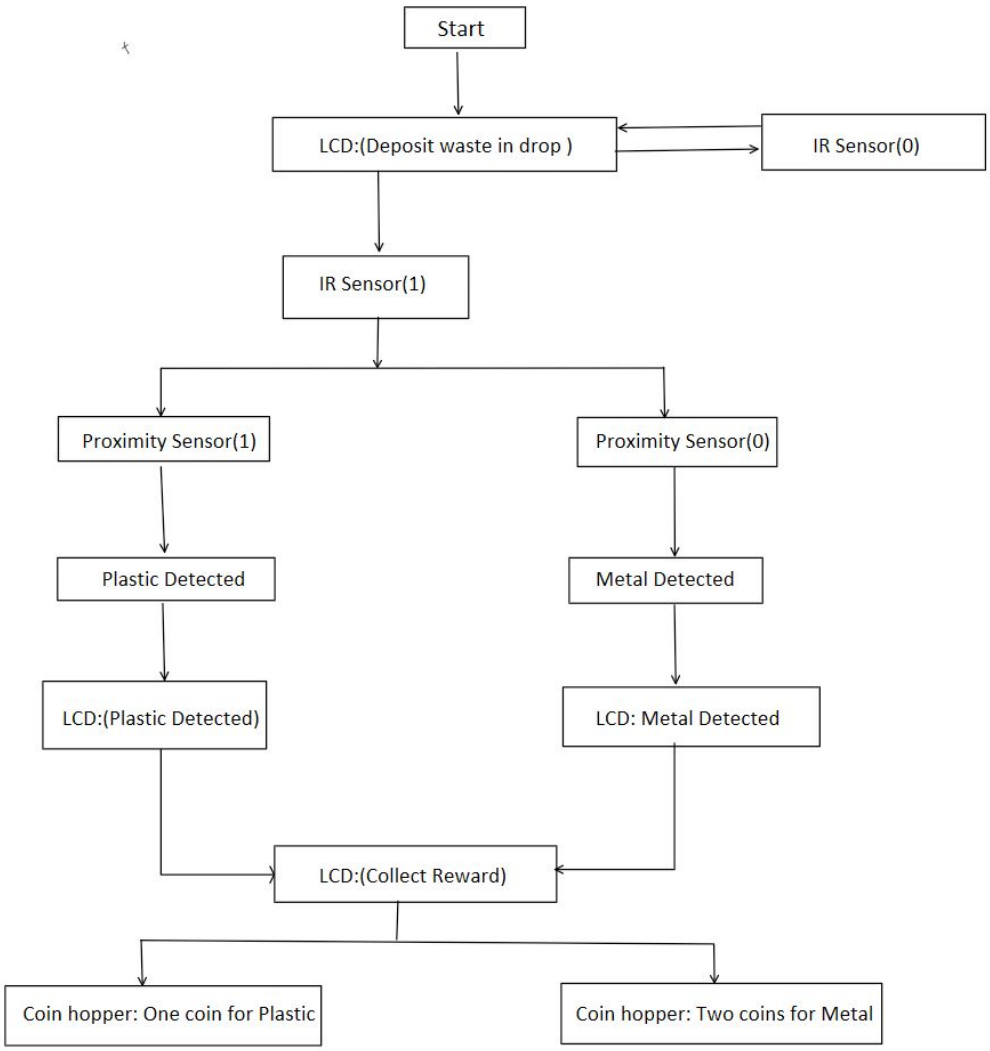
0.2 SOFTWARE REQUIREMENTS

0.2.1 Arduino IDE:

The Arduino IDE (Integrated Development Environment) is a software application used to write, compile, and upload code to Arduino boards. It provides a user-friendly interface and a set of tools for programming and working with Arduino microcontrollers.

0.3 WORKING:

FLOW CHART:



Firstly, an empty bottle or a pop can is placed in the chamber.

LCD display: Place object.

IR Sensor:

It detects the outside motion of any object in the chamber.

If motion is detected then the proximity sensor starts working.

Inductive Proximity Sensor:
If the sensor is low the detected object is metal object.
If the sensor is high the detected object is plastic.

It sends a signal to the first servo motor.

Servo motor(1):
As per the detected object if tilt its position to a certain angle.

The bottle is stored in its respective storage box.

Coin Hopper: As per the detected object it reward some coins.

Plastic detected: It rewards 1 coin.

Metal detected:It rewards 2 coins.

CODE:

Arduino Uno

finalproject2.ino

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);

#include <Servo.h>
Servo myservo1;
Servo myservo2;

int pos1=95;
int pos2=70;
int pos3=105;
int servopin1=7;
int servopin2=8;

int irsensor=6;
int metalsensor=A0;
int plastic=0;
int metal=0;

void setup()
{
  Serial.begin(9600);
   lcd.init();
   lcd.begin(16,2);
   lcd.clear();
   lcd.backlight();
   lcd.setCursor(2,0);
   lcd.print("Hello world!");
    delay(1000);
   pinMode(irsensor, INPUT);
   pinMode(metalsensor,INPUT_PULLUP);

  // pinMode(ledpin1,OUTPUT);
```

Output

Ln 152, Col 15 Arduino Uno [not connected]

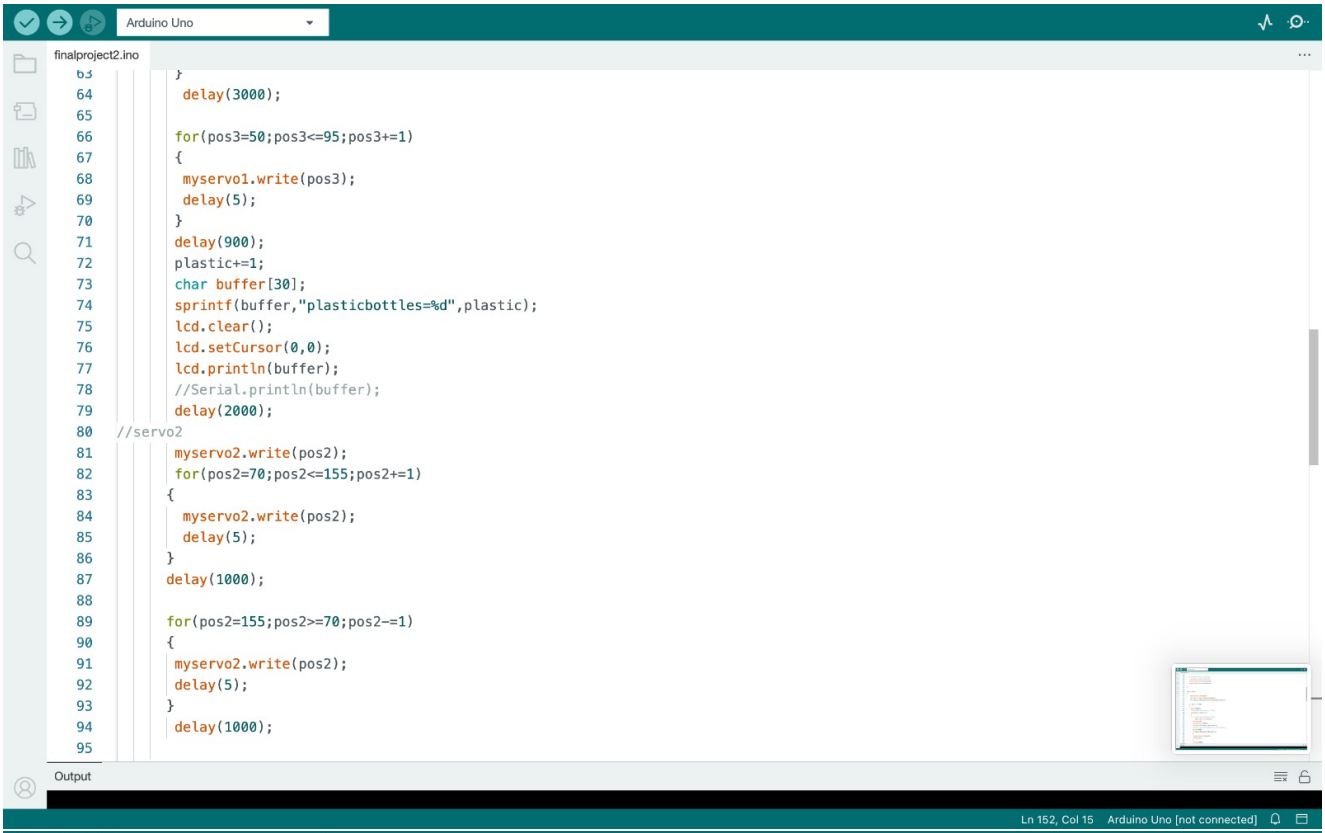
Arduino Uno

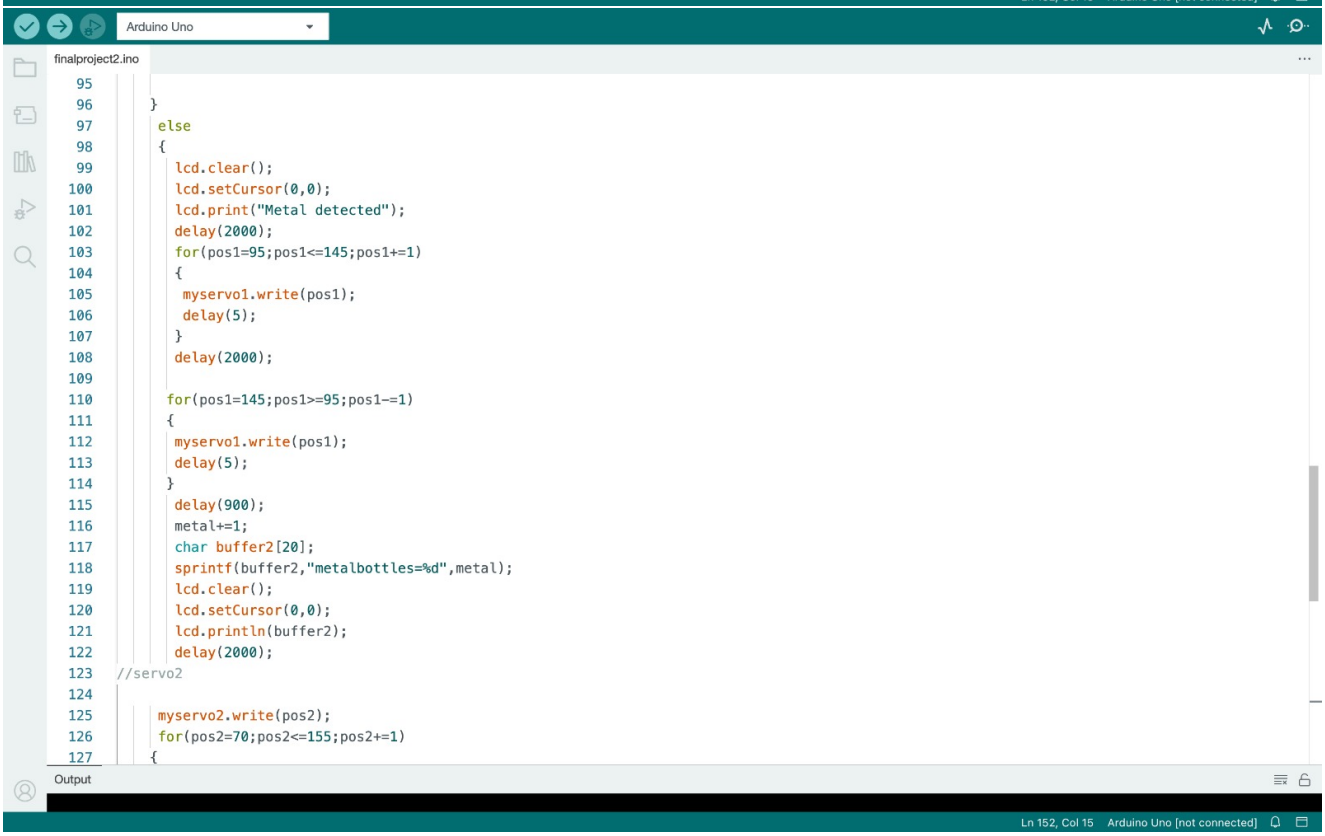
finalproject2.ino

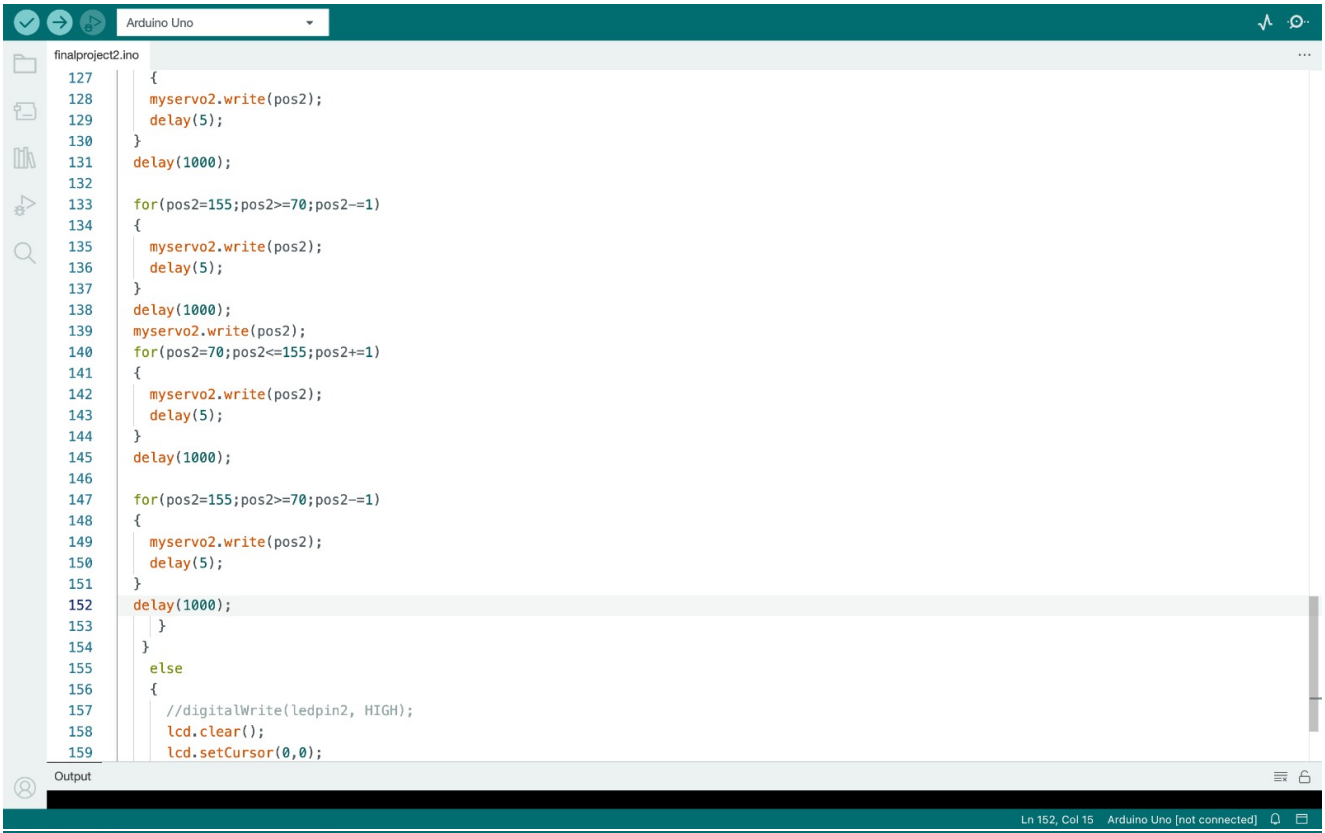
```
  // pinMode(ledpin1,OUTPUT);
   //pinMode(ledpin2,OUTPUT);
   myservo1.attach(servopin1);
   myservo2.attach(servopin2);

}

void loop()
{
    myservo1.write(pos1);
    int val = digitalRead(irsensor);
    int sensor_read_m=digitalRead(metalsensor);

   if (val == LOW)
   {
     delay(2000);
     //digitalWrite(ledpin2, LOW);
     if(sensor_read_m==1)
     {
     //  digitalWrite(ledpin1,LOW);
          myservo1.write(pos3);
       lcd.clear();
       lcd.setCursor(0,0);
       lcd.print("plastic detected");
       //Serial.println("plastic is detected");
       delay(1000);
       for(pos3=95;pos3>=50;pos3-=1)
       {
        myservo1.write(pos3);
        delay(15);
       }
        delay(3000);
```

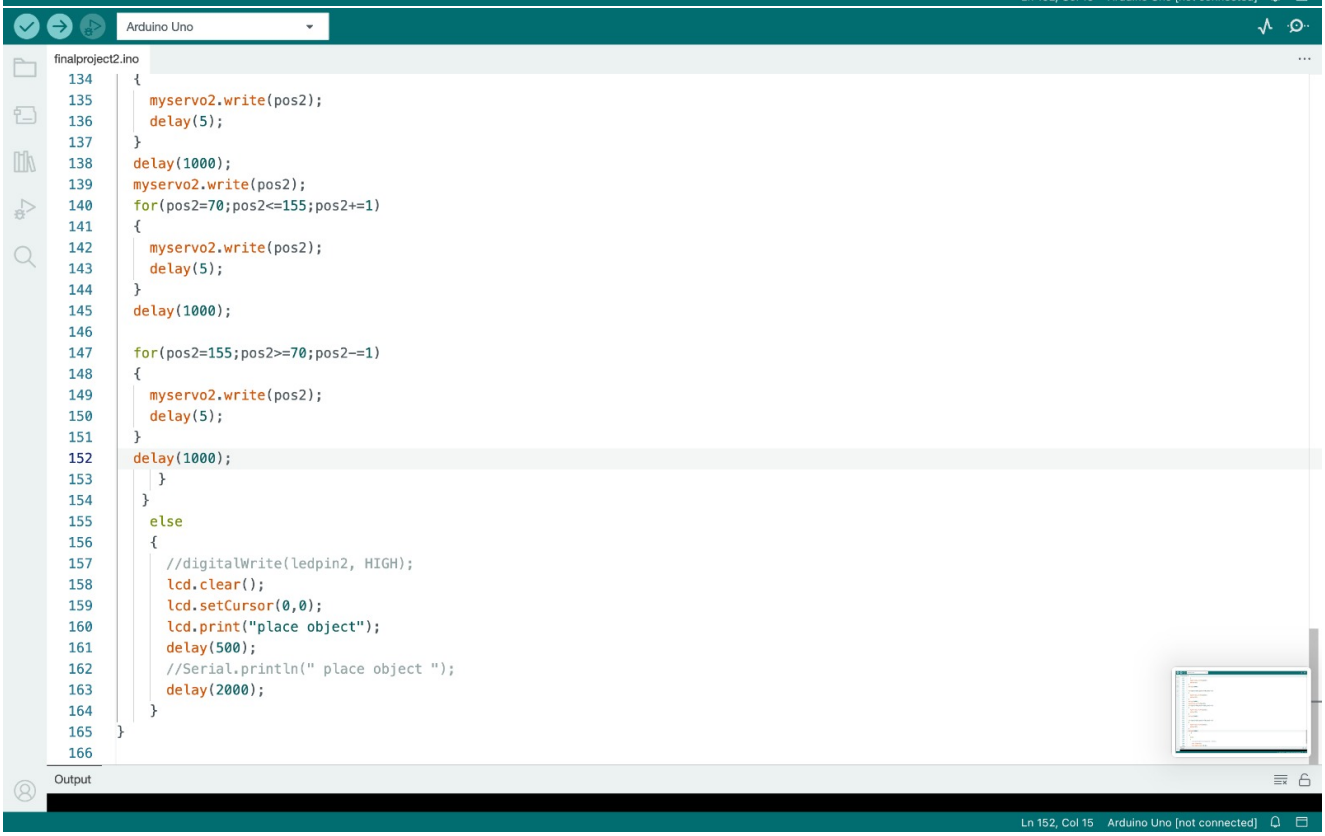
Output

Ln 152, Col 15 Arduino Uno [not connected]


Arduino Uno
finalproject2.ino
}
delay(3000);
for(pos3=50;pos3<=95;pos3+=1)
{
myservo1.write(pos3);
delay(5);
}
delay(900);
plastic+=1;
char buffer[30];
sprintf(buffer,"plasticbottles=%d",plastic);
lcd.clear();
lcd.setCursor(0,0);
lcd.println(buffer);
//Serial.println(buffer);
delay(2000);
//servo2
myservo2.write(pos2);
for(pos2=70;pos2<=155;pos2+=1)
{
myservo2.write(pos2);
delay(5);
}
delay(1000);
for(pos2=155;pos2>=70;pos2-=1)
{
myservo2.write(pos2);
delay(5);
}
delay(1000);
Output
Ln 152, Col 15 Arduino Uno [not connected]


Arduino Uno
finalproject2.ino
}
else
{
lcd.clear();
lcd.setCursor(0,0);
lcd.print("Metal detected");
delay(2000);
for(pos1=95;pos1<=145;pos1+=1)
{
myservo1.write(pos1);
delay(5);
}
delay(2000);
for(pos1=145;pos1>=95;pos1-=1)
{
myservo1.write(pos1);
delay(5);
}
delay(900);
metal+=1;
char buffer2[20];
sprintf(buffer2,"metalbottles=%d",metal);
lcd.clear();
lcd.setCursor(0,0);
lcd.println(buffer2);
delay(2000);
//servo2
myservo2.write(pos2);
for(pos2=70;pos2<=155;pos2+=1)
{
Output
Ln 152, Col 15 Arduino Uno [not connected]


Arduino Uno
finalproject2.ino
127 {
128 myservo2.write(pos2);
129 delay(5);
130 }
131 delay(1000);
132
133 for(pos2=155;pos2>=70;pos2-=1)
134 {
135 myservo2.write(pos2);
136 delay(5);
137 }
138 delay(1000);
139 myservo2.write(pos2);
140 for(pos2=70;pos2<=155;pos2+=1)
141 {
142 myservo2.write(pos2);
143 delay(5);
144 }
145 delay(1000);
146
147 for(pos2=155;pos2>=70;pos2-=1)
148 {
149 myservo2.write(pos2);
150 delay(5);
151 }
152 delay(1000);
153 }
154 }
155 else
156 {
157 //digitalWrite(ledpin2, HIGH);
158 lcd.clear();
159 lcd.setCursor(0,0);
Output
Ln 152, Col 15 Arduino Uno [not connected]


Arduino Uno
finalproject2.ino
134 {
135 myservo2.write(pos2);
136 delay(5);
137 }
138 delay(1000);
139 myservo2.write(pos2);
140 for(pos2=70;pos2<=155;pos2+=1)
141 {
142 myservo2.write(pos2);
143 delay(5);
144 }
145 delay(1000);
146
147 for(pos2=155;pos2>=70;pos2-=1)
148 {
149 myservo2.write(pos2);
150 delay(5);
151 }
152 delay(1000);
153 }
154 }
155 else
156 {
157 //digitalWrite(ledpin2, HIGH);
158 lcd.clear();
159 lcd.setCursor(0,0);
160 lcd.print("place object");
161 delay(500);
162 //Serial.println(" place object ");
163 delay(2000);
164 }
165 }
166
Output
Ln 152, Col 15 Arduino Uno [not connected]

PROBLEM'S FACED

1.We began the project at a basic level and acquired a proximity sensor. However, upon purchasing it, we discovered that its range was very low. In order to address this issue, we dedicated considerable effort to designing a bottle holder.

2.One day, while uploading the program to the Arduino board, an error message appeared as follows:

"avrdude: $\text{stk500}_{r}ecv() : programmerisnotresponding$
$avrdude : stk500_{g}etsync()attempt1of10 : notinsync : resp = 0x00$
$avrdude : stk500_{r}ecv() : programmerisnotresponding$
$avrdude : stk500_{g}etsync()attempt2of10 : notinsync : resp = 0x00$
..."

To troubleshoot this error, we faced a challenging situation that required intense problem-solving.

CONCLUSION

In the present era, plastic pollution has emerged as one of the most significant environmental threats worldwide. Dustbins are frequently overflowing due to the accumulation of used bottles, and a considerable portion of this waste ends up in landfills where it is buried. Since plastic is non-biodegradable, it takes a long time to decompose.

This project introduces a proposed solution, an IoT-based vending machine for recycling plastic bottles, Reverse Vending Machine (RVM). By implementing this system, it indirectly encourages the public to recycle small quantities of plastic bottles at conveniently accessible locations, while also offering rewards as an incentive.
It is highly recommended to introduce and maintain this system through a private vendor.

FUTURE SCOPE

Reverse vending machines have been the subject of ongoing research and development, but their widespread adoption is hindered in many countries due to the high initial implementation costs, which make them financially unfeasible. Therefore, this project aims to design a low-cost vending machine.

The remaining challenges and the objectives of this work are outlined below:

1. Enhancing the accuracy of the sensor system for improved detection.
2. Implementing diverse classification systems for different materials.
3. Introducing a points redemption mechanism.
4. Incorporating Internet of Things (IoT) technology into the vending machine.
5. Minimizing energy consumption for more efficient operation.
6. Installing a barcode reader for enhanced functionality.
7. Implementing image recognition procedures within the reverse vending machine (RVM).

REFERENCES

1. Abreo, N. A. S., Macusi, E. D., Cuenca, G. C., Ranara, C. T. B., Andam, M. B., Cardona, L. C., Arabejo, G. F. P., "Nutrient enrichment, sedimentation, heavy metals and plastic pollution in the marine environment and its implications on Philippine marine biodiversity: A Review". IAMURE International Journal of Ecology and Conservation, 15(1), 111-167, 2015.

2. Gaur, Aditya Priyadarshini, Rashmi. (2018). A Simple Approach to Design Reverse Vending Machine.

3. "What a Waste: An Updated Look into the Future of Solid Waste Management," The World Bank, Sept 20, 2018. [Online]. Available: https://www.worldbank.org/en/news/immersive story /2018/09/20/ what-a-waste-an- updated-look-into-the-future-of-solid-waste-management. [Accessed May 1, 2020]

4. Abdel-Shafy Hussein, S. M. Mansour Mona, "Solid waste issue: Sources,composition, disposal, recycling, and valorization," Egyptian Journal of Petroleum, vol. 27, no. 4, pp. 1275–1290, 2018, doi: 10.1016/j.ejpe.2018.07.003.

5. Ahmad, Irfana Mukhlisin, Muhammad Basri,Hassan.(2016). Application of Capacitance Proximity Sensor for the Identification of Paper and Plastic from Recycling Materials. Research Journal of Applied Sciences, Engineering and Technology. 12. 1221-1228. 10.19026/rjaset.12.2880.