MODULE 2

DESIGN AND SIMULATION OF EMBEDDED CIRCUITS AND SYSTEM

Project Title

SMART DUSTBIN

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Abstract

The main objective of the project is to design a smart dustbin which will help in keeping our environment clean and also eco-friendly. This smart dustbin is built on the microcontroller-based system having ultrasonic sensors on the dustbin. After all hardware and software connection, now Smart Dustbin program will be run. Dustbin lid will when someone comes near at some range than wait for user to put garbage and close it. Seperating fdry and wet waste makes the task of recycling dry non-biodegradable waste easier. It also simplifies the conversion of wet waste like leftover food, used tea leaves, etc. to compost. Hence the bin alerts the user to put only the dry waste by beeping if wet waste is detected.

OBJECTIVE

The main objective of this project is to

- Design and build a prototype for an automatic open dustbin that can automatically open the lid when it detects the people who want to throw out their trash. It also can detect the level of the trash that inside the dustbin.
- To seperate the dry and wet waste for easy recycling processes
- To get familiar with the Arduino and the respective sensors how to use them for a cause.

COMPONENTS

Ultrasonic sensor

Fig 1.1 Ultrasonic Sensor

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.

It the measures the distance to an object approaching the dustbin

Servo motor

Fig 1.2 Servo Motor

A servomotor (or servo motor) is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

It is responsible for opening and closing the lid of the dustbin

LED

Fig. 1.3 LED

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it.

It indicates the level of garbage in the bin

Moisture Sensor

Fig. 1.4 Moisture sensor

Humidity sensors are electronic devices that measure and report the moisture and air temperature of the surrounding environment where they are deployed

Detects the wet waste

Buzzer

Fig. 1.5 Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short).

It Beeps when wet waste is detected and alert the person to not put inside the bin.

WORKING

This Smart Dustbin sense the person or object using Ultrasonic Sensor which send the message to Servo Motor using Arduino Uno. When the person Comes closer to Smart Dustbin then the Dustbin Cap will automatically open for your waste and after some time it will automatically Close. It also contains the Moisture sensor, which senses the moisture in waste and it alerts the user by beeping, indicating that the user must not throw the wet waste in dustbin. The ultrasonic sensor is placed beneath the lid, which keeps track of garbage level. Once the waste reaches the limit, the LED glows, indicating the dustbin is full.

CONTROLLER

Arduino UNO

Fig. 1.6 Arduino UNO Board

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on our computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board — we can simply use a USB cable

SOFTWARES

Arduino IDE

Fig. 1.7 Arduino Software

The Arduino Integrated Development Environment – or Arduino Software (IDE) – contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

SimulIDE

Fig. 1.8 SimulIDE Software

SimulIDE is a simple real time electronic circuit simulator, intended for students to learn and experiment with simple electronic circuits and microcontrollers, supporting PIC, AVR and Arduino.SimulIDE also features a code Editor and Debugger for GcBasic, Arduino, PIC asm and AVR asm.

4W'S 1-H

What

- Description of the problem
  - It's unhygienic to touch the dustbin lid while disposing waste
  - Mixture of dry and wet waste leads to pollution and recycling related issues
  - Improper dispoing of waste
  - Growth of micro-organisms if exposed to enviroment

Who

- The responsible parties
  - Human beings

Where

- The location of the problem
  - House, restaurants, Office
  - Streets
  - Airports, bus stand, railway station, etc

Why

- Motivation of the problem
  - To maintain environmental hygiene
  - To simplify the waste recycle process

How

- The effects of the problem
  - Causes unwanted disease if not treated well
  - Effects environmental hygiene

HIGH LEVEL REQUIREMENTS

ID	Requirements
HLR1	It should be contactless
HLR2	It should indicate the garbage level
HLR 3	The garbage should not exposed to environment
HLR4	Only dry waste should be disposed

LOW LEVEL REQUIREMENTS

ID	Requirements
LLR1.1	It shall sense the objects approaching to it
LLR1.2	It shall have a automatic movable lid
LLR2.1	It shall have a proximity sensor to detect the garbage level
LLR2.2	It shall have a LED which glows once the maximum limit has reached
LLR2.3	It shall beep one time after reaching the limit
LLR3.1	It shall have a sliding lid to open and close
LLR3.2	It is closed when no object is detected
LLR4.1	It shall alert the user if moisture is detected
LLR4.2	It Shal close the lid within a sec if moisture is detected

BLACK BOX

Black box testing refers to any type of software test that examines an application without knowledge of the internal design, structure, or implementation of the software project.
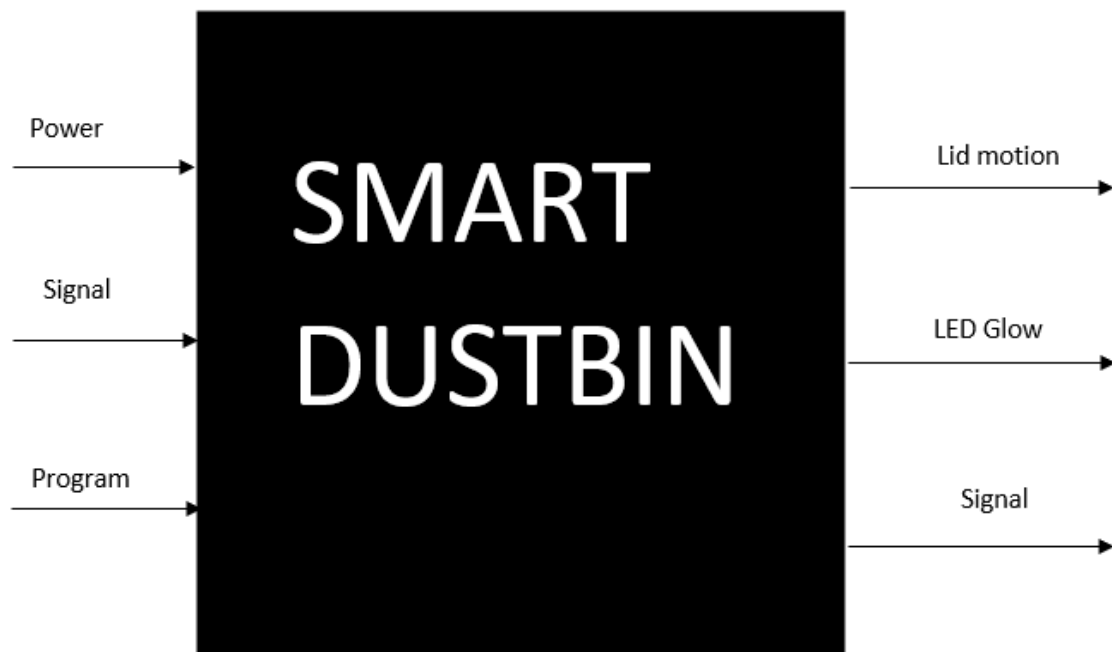

Fig. 1.9 Black Box of Smart Dustbin
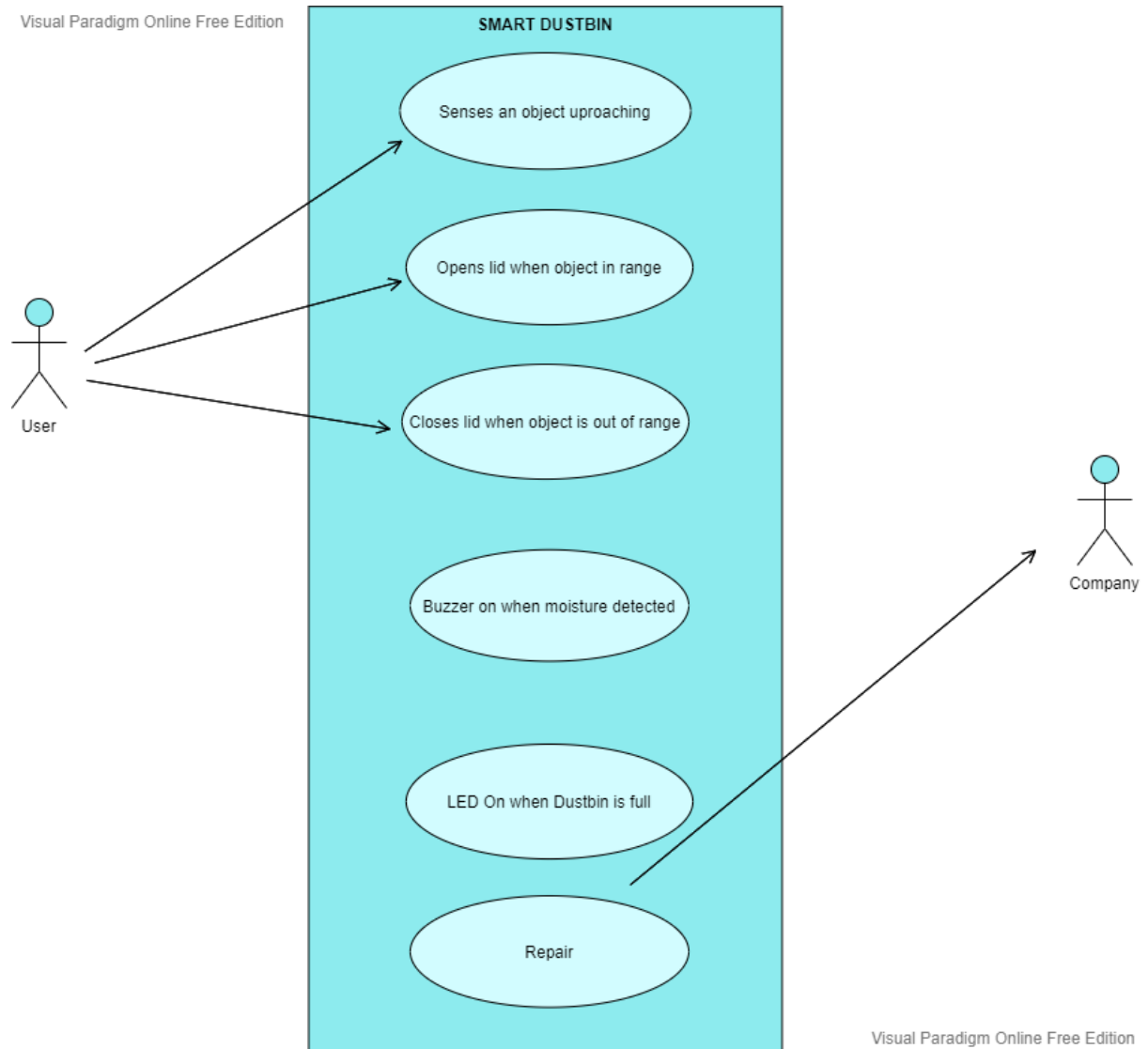
BEHAVIORAL DIAGRAM

Use Case Diagram

Fig. 1.10 Use Case Diagram Of Smart Dustbin
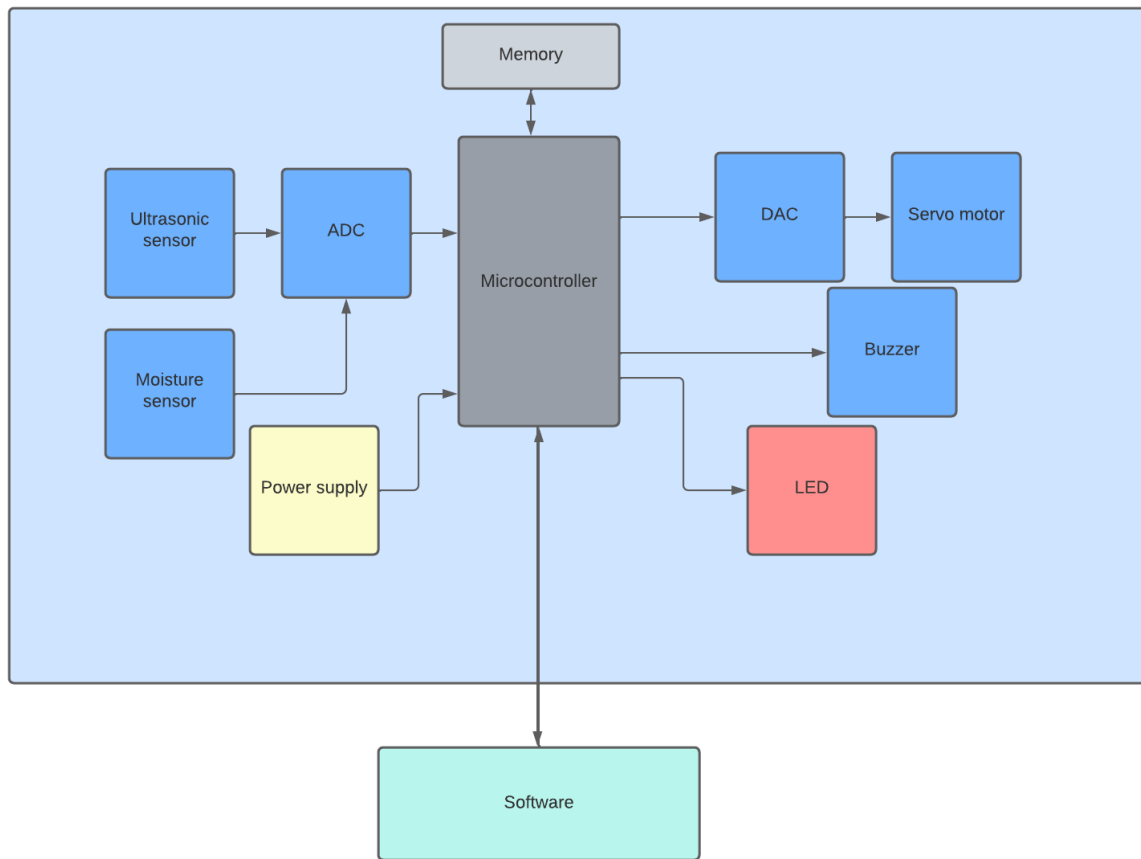
STRUCTURAL DIAGRAM

BLOCK DIAGRAM

Fig 1.11 Block Diagram Of Smart Dustbin

- Ultrasonic sensor: It the measures the distance to an object approching the dustbin
- Servo Motor: It is responsible for opening and closing the lid of the dustbin
- LED: It indicates the level of garbage in the bin
- Power supply: It supplies the appropriate volatge to the controller
- ADC & DAC: They are responsible in converting the signals according to the requirements.
- Moisture sensor: detects the wet waste
- Buzzer: It Beeps when wet waste is detected and alert the person to not put inside the bin.

SWOT Analysis of Smart Dustbin

SWOT (strengths, weaknesses, opportunities, and threats) analysis is a method for identifying and analyzing internal strengths and weaknesses and external opportunities and threats that shape current and future operations and help develop strategic goals.
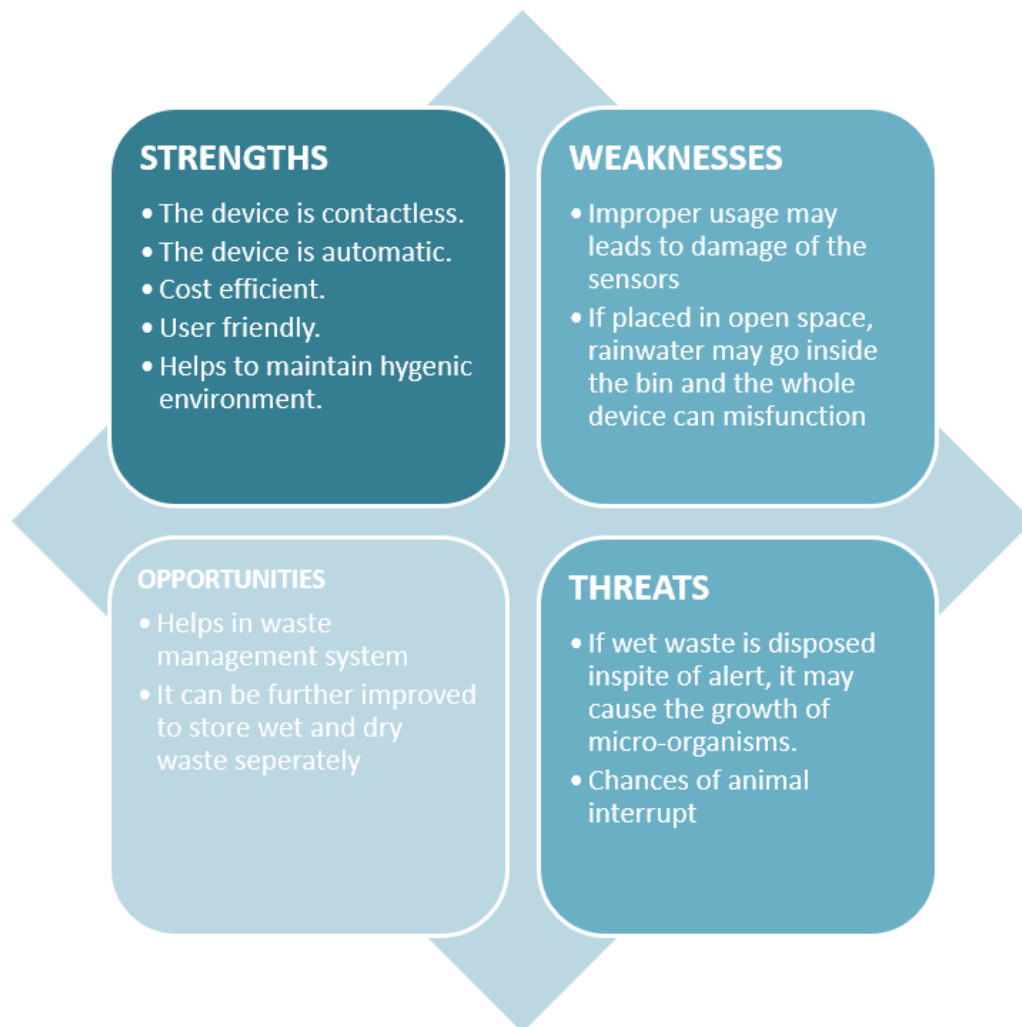
STRENGTHS
- The device is contactless.
- The device is automatic.
- Cost efficient.
- User friendly.
- Helps to maintain hygenic environment.

WEAKNESSES
- Improper usage may leads to damage of the sensors
- If placed in open space, rainwater may go inside the bin and the whole device can misfunction

OPPORTUNITIES
- Helps in waste management system
- It can be further improved to store wet and dry waste seperately

THREATS
- If wet waste is disposed inspite of alert, it may cause the growth of micro-organisms.
- Chances of animal interrupt

Fig. 1.12 SWOT Analysis

FLOW CHART

A Flow Chart is a diagram that shows step–by–step progression through a procedure or system especially using connecting lines and a set of conventional symbols.
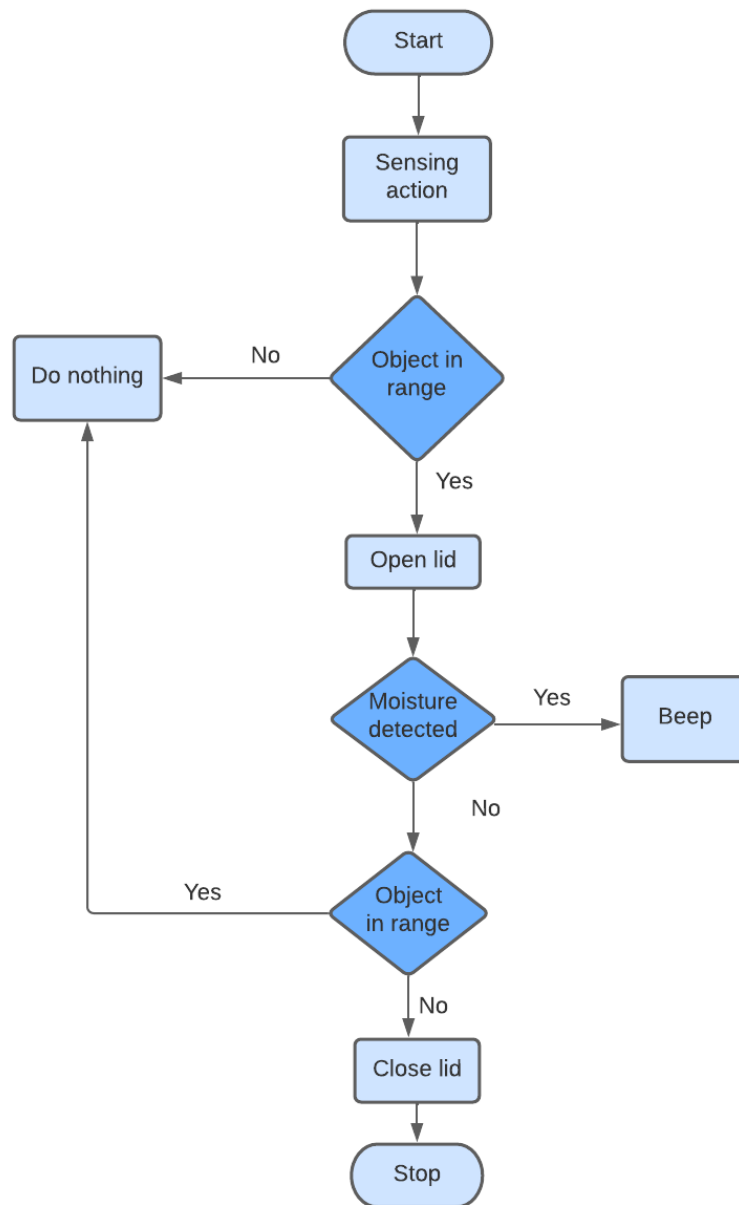
Fig. 1.13 Flow Chart of Smart Dustbin

Applications

- House, Office, restaurants
- Streets, etc

Test Plan and Output

| Sl.No	Requirements	Expected output	Actual Output	Status
1	It should be contactless	Object range within 30 cm, Servo rotates	object = 25cm, servo rotates 90 deg	PASS
2	Alert if dustbins full	Object range within 20 cm, LED glows	Object = 10cm, LED = ON	PASS
3	Alert if dustbins full	Object range within 20 cm, LED glows	Object = 45cm, LED = OFF	PASS
4	Only dry waste should be disposed	Moisture detects, Buzzer beeps	Moisture = 1, Buzzer = ON	PASS
5	Only dry waste should be disposed	Moisture detects, Buzzer beeps	Moisture = 0, Buzzer = OFF	PASS
6	Should not be exposed to environment	distance>=30, Servo = 00 deg	distance = 45, Servo = 0 deg, lid is closed	PASS

CIRCUIT
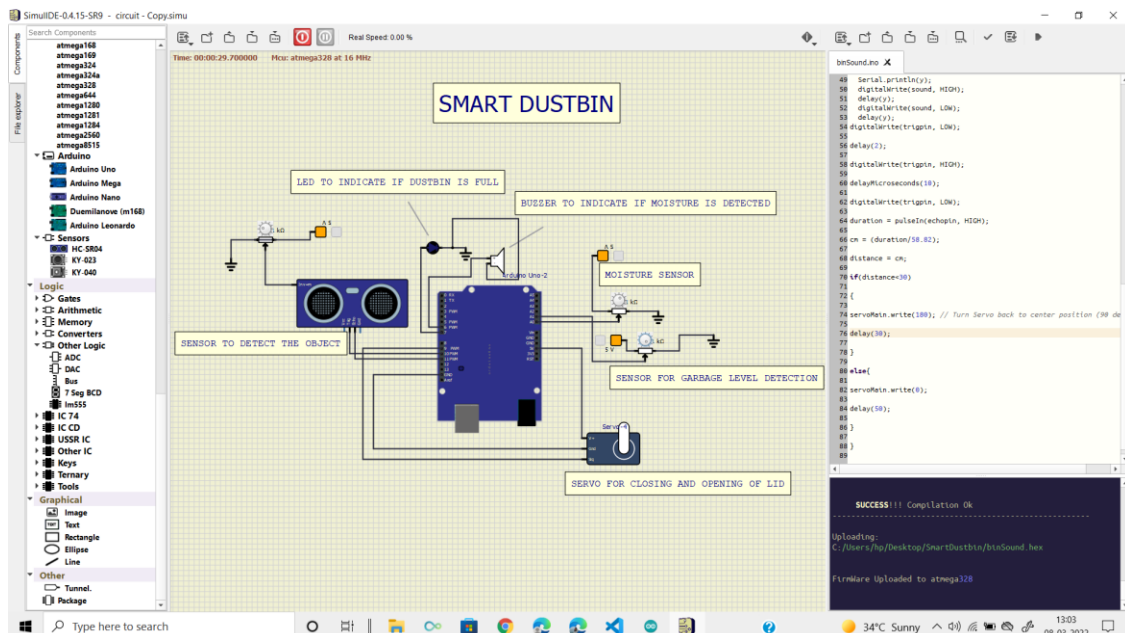
Fig. 1.14 Circuit of Smart Dustbin

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Smart Dustbin

ARDUINO CODE

```
#include <Servo.h>

Servo servoMain; // Define our Servo
int buzzer = 7;
int sound = 6;
int pot = A0;
int pot1 = A1;
int x;
int y;

int trigpin = 10;

int echopin = 11;

int distance;

float duration;

float cm;

void setup()

{
  pinMode(buzzer,OUTPUT);
  pinMode(sound,OUTPUT);

  Serial.begin(9600);

servoMain.attach(9); // servo on digital pin 10

pinMode(trigpin, OUTPUT);

pinMode(echopin, INPUT);

}
```

Smart Dustbin

```
void loop()

{
  x = analogRead(pot) / 102,4;

  Serial.println(x);
  digitalWrite(buzzer, HIGH);
  delay(x);
  digitalWrite(buzzer, LOW);
  delay(x);
 y = analogRead(pot1) / 102,4;

  Serial.println(y);
  digitalWrite(sound, HIGH);
  delay(y);
  digitalWrite(sound, LOW);
  delay(y);
digitalWrite(trigpin, LOW);

delay(2);

digitalWrite(trigpin, HIGH);

delayMicroseconds(10);

digitalWrite(trigpin, LOW);

duration = pulseIn(echopin, HIGH);

cm = (duration/58.82);

distance = cm;

if(distance<30)

{
```

```
servoMain.write(180); // Turn Servo back to center position (90 degrees)

delay(30);

}

else{

servoMain.write(0);

delay(50);

}

}
```

CONCLUSION

A simple but useful project called Smart Dustbin using Arduino is designed and developed here. Using this project, the lid of the dustbin stays closed, so that waste is not exposed (to avoid flies and mosquitos) and when you want dispose any waste, it will automatically open the lid. The buzzer will beep if moisture detected, hence separating the wet waste from dry waste, thus making the waste treatment easy.