CHAPTER- 1

1.1 INTRODUCTION

Garbage(waste) segregation means dividing waste into dry and wet. Dry waste includes wood and related products, glass and metals. Wet waste typically refers to organic waste usually generated by eating establishments and are heavy in weight due to dampness. Waste can also be segregated on basis of biodegradable or non-biodegradable waste.

Landfills are an increasingly pressing problem. Less and less land is available to deposit refuse, but the volume of waste is growing all time. As a result, segregating waste is not just of environmental importance, but of economic concern too.

Wet Waste:

Rotten fruits, vegetable and their peels, left-over food, egg shells and rotten eggs, mango seeds, garden waste, rangoli colours, coconut shell, tea bags come under wet waste. Spoiled or expired food should be removed from its packet and discarded. Nails must be wrapped in a paper. Anything liquid amongst these must be drained and the remaining must be wrapped in a newspaper.

Dry Waste:

Mop stick and mop clothes should be handed over directly. Toilet cleaning brushes, other brushes, toothbrushes and scrubs must be dried first and then wrapped in newspapers. Doormats and containers of pesticides, various papers and stationery, razors and blades, various bottles should be kept separate. All the covers of various food/diary items like tetra packs etc must be cleaned, dried and handed over separately. Hair, waste pet food and Thermocol should be wrapped in paper.

1.2 LITERATURE REVIEW

Padmakshi Venkateshwara Rao, Pathan Mahammed Abdul Azeez, 2020[1] introduces the IoT based Waste Management for Smart cities to overcome the challenges in the environment such as inadequate waste collection, treatment, disposal. Due to flooding of the dustbin causes unhygienic conditions are created, the dustbin is placed in the entire city; it is delivered with minimum cost embedded method to assist in tracking of the garbage, therefore the Blynk app is used to get the immediate SMS as early as garbage bin reaches its peak level. Therefore, instant action will be taken by the alarmed authorities once the status of a bin is notified through the internet. Ultrasonic sensor, blynk app, servo motor is used to develop the proposed system.

Clude-Noel Tamakloe, Dr. Elena V.Rosca , introduces the Smart System and the Internet of Things (IOT) for waste management to provide an efficient and effective manner for waste disposal, improving the cities waste management. The proposed system is drawn and makeup a prototype of a solar powered, compact smart garbage bin whose monitoring is done with server side applications. The smart garbage bin is capable of monitoring internal garbage levels, compact them, and also free 25% of the space with each compactness. The bin detects and monitors the total weight and is capable of sending all the information to a secure server side application.

1.3 BLOCK DIAGRAM

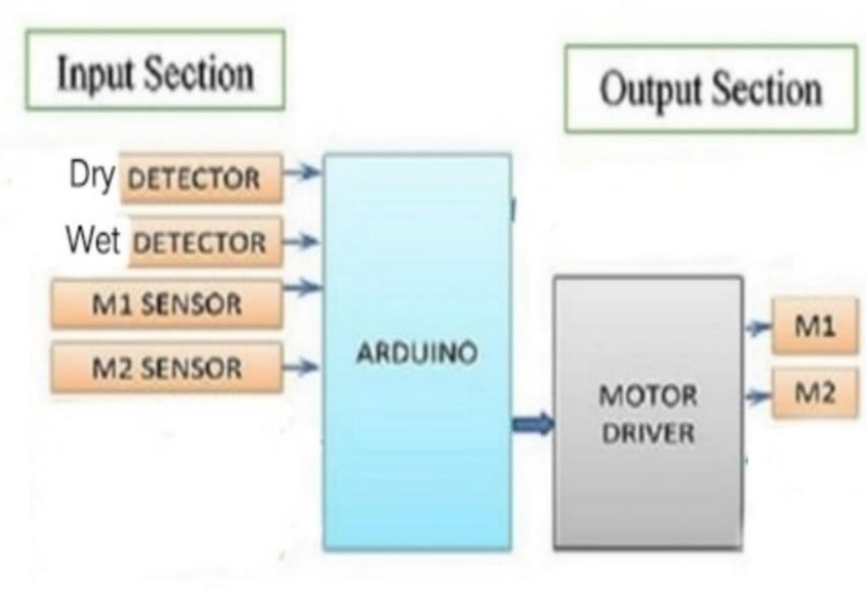


Fig. 1.3.1 Block Diagram

1.3.1 Description of block diagram

In this block diagram, we have used Arduino, moisture sensor, ultrasonic sensor, LCD & servo motor. There is also an IR sensor that will used to detect whether there is some garbage on the platform or not. The dustbin identifies the kind of material being thrown inside it and segregates it into wet and dry wastes separately, so that dry waste can be recycled and wet waste can be composted.

CHAPTER- 2

2.1 CIRCUIT DIAGRAM

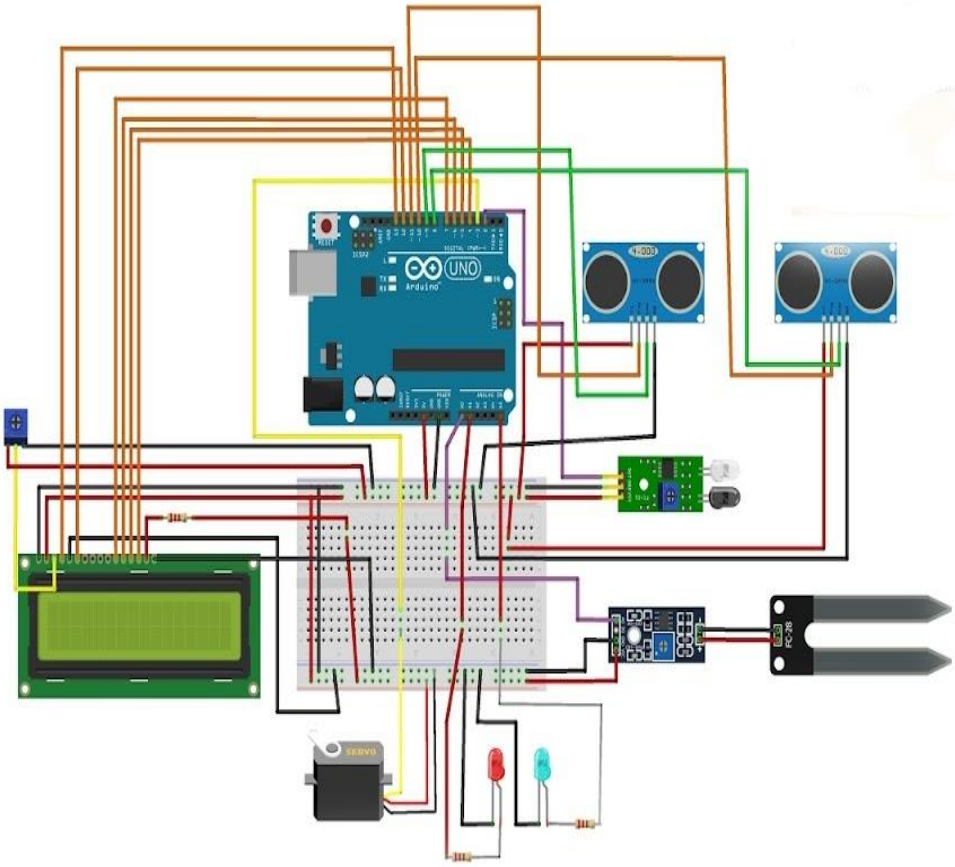


Fig. 2.1.1 Circuit Diagram

2.1.1 Description of circuit diagram

Firstly, the garbage is placed on the platform.

A Servo Motor is attached to the platform, that will be used to rotate it.

There's an IR Sensor that will be used to detect whether there is some garbage on the platform or not.

If the IR sensor detects that there is some garbage then it would give a signal to the Arduino board.

The Arduino Board will then give a signal to the Moisture sensor that will detect if the garbage is DRY or WET.

As per our code, if the garbage detected is DRY then the Servo motor would rotate left which would also rotate the platform and the garbage would go inside the DRY Dustbin.

If the garbage is WET, then the platform would rotate right and the garbage would go inside the WET Dustbin.

Two ultrasonic sensors are used to check if both the dustbins are full or not.

If one/both of the Dustbin is/are full, then it would give us a message on the LCD screen that the dustbin is full.

2.2 Working Principle

- **Step 1:** It is composed of three stages; the waste is fed into the inlet basket & lands on moisture sensor.
- **Step 2:** Depending upon the Threshold set Moisture sensor classifies it as dry or wet.
- **Step 3:** As soon step 2 is done Servo Motor runs to either direction depending upon the type of waste and the waste goes in the appropriate compartment.
- **Step 4:** The whole process is autonomous and continuous.

CHAPTER- 3

3.1 Circuit Components

The following components are used in this garbage segregation system:

- Arduino UNO
- IR Sensor
- Moisture Sensor
- Ultrasonic sensor
- LCD
- Servo Motor
- Connecting Wires

3.2 ARDUINO UNO

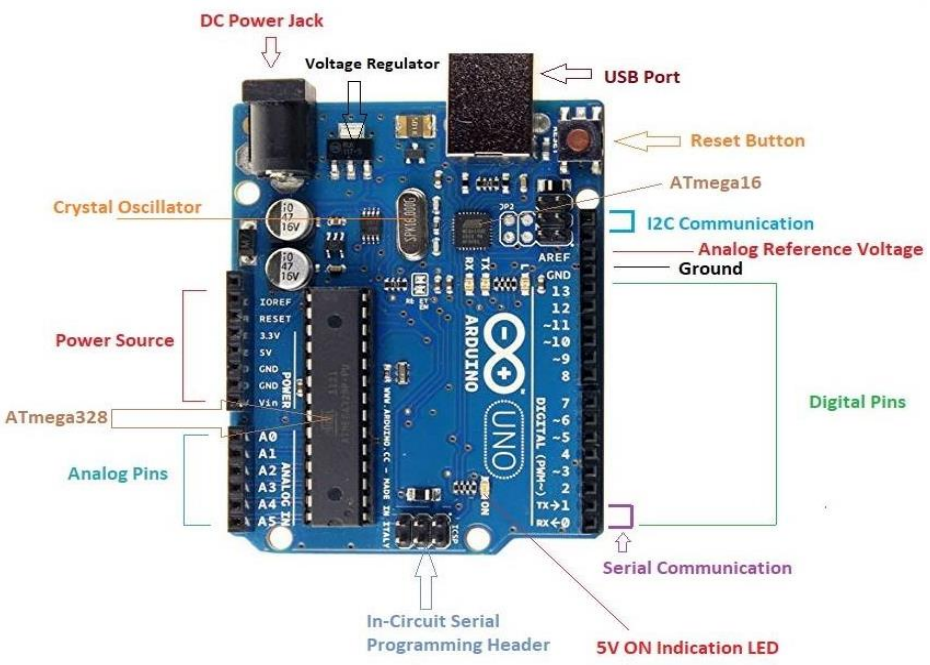


Fig. 3.2.1 Arduino UNO

It is a microcontroller board developed by Arduino.cc and based on Atmega328. ARDUINO UNO is a valuable addition in the electronics that consists of USB interface, 14 digital input/output pins, 6analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins.

It is an open-source platform, means the boards and software are readily available and anyone can modify and optimize the boards for better functionality. The software used for ARDUINO devices is called IDE (Integrated Development Environment) which is free to use and required some basic skills to learn it. It can be programmed using C and C++ language.

3.2.1 Features of ARDUINO UNO

- ARDUINO UNO comes with USB interface i.e. USB port is added on the board to develop serial communication with the computer.
- Atmega328 microcontroller is placed on the board that comes with a number of features like timers, counters, interrupts, PWM, CPU, I/O pins and based on a 16MHz clock that helps in producing more frequency and number of instructions per cycle.
- There are 14 I/O digital and 6analog pins incorporated in the board that allows the external connection with any circuit with the board. These pins provide the flexibility and ease of use to the external devices that can be connected through these pins.
- The 6analog pins are marked as A0 to A5 and with a resolution of 10 bits. These pins measure from 0 to 5v, however, they can be configured to the high range using analog reference function and AREF pin.

3.2.2 ARDUINO UNO pin out

ARDUINO UNO is based on AVR microcontroller called Atmega328. This controller comes with 2KB SRAM, 32KB of flash memory, 1KB of EEPROM, ARDUINO board comes with 14 digital pins and 6analog pins. ON-chip ADC is used to sample these pins. A 16MHz frequency crystal oscillator is equipped on the board. Following figure shows the pin out of the ARDUINO UNO board.

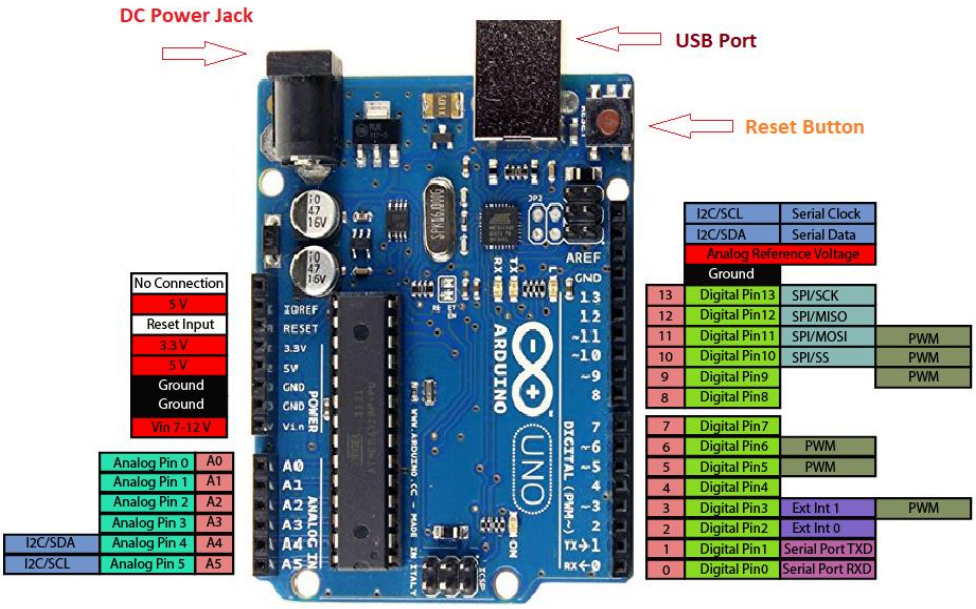


Fig. 3.2.2 ARDUINO UNO pin out

3.2.3 PIN description

LED- ARDUINO UNO comes with built in LED which is connected through pin 13. Providing high value to the pin will turn it ON and LOW will turn it OFF.

Vin- It is the input voltage provided to the ARDUINO board. It is different than 5v supplied through a USB port. This pin is used to supply voltage. If a voltage is provided through power jack, it can be accessed through this pin.

5v- This board comes with the ability to provide voltage regulation. 5v pin is used to provide output regulated voltage. The board is powered up using three ways i.e. USB. Vin pin of the board or DC power jack.

GND- These are ground pins. More than one ground pins are provided on the board which can be used as per requirement.

RESET- This pin is incorporated on the board which resets the program running on the board. Instead of physical rest on the board, IDE comes with a feature of resetting the board through programming.

IOREF- This pin is very useful for providing voltage reference to the board. A shield is used to read the voltage across this pin which then selects the proper power source.

PWM- PWM is provided 3,5,6,9,10,11 pins. These pins are configured to provide 8-bit output PWM.

SPI- It is known as Serial Peripheral Interface. Four pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) provide SPI communication with the help of SPI library.

AREF- It is called Two-wire Interface. TWI communication is accessed through wire library. A4 and A5 pins are used for this purpose.

Serial Communication- Serial communication is carried out through two pins called PIN 0 (Rx) and PIN 1 (Tx).

External Interrupts- Pin 2 and 3 are used for providing external interrupts. An interrupt is called by providing LOW or changing value.

3.2.4 Applications

- Embedded system
- Security and defence system
- Digital electronics and robotics
- Parking lot counter
- Weighing machines
- Traffic light countdown timer
- Medical instrument
- Industrial automation

3.3 IR SENSOR

The IR sensor or infrared sensor is one kind of electronic component, used to detect specific characteristics in its surroundings through emitting or detecting IR radiation. These sensors can also be used to detect or measure the heat of a target and its motion. In many electronic devices, the IR sensor circuit is a very essential module. This kind of sensor is similar to human's visionary senses to detect obstacles.

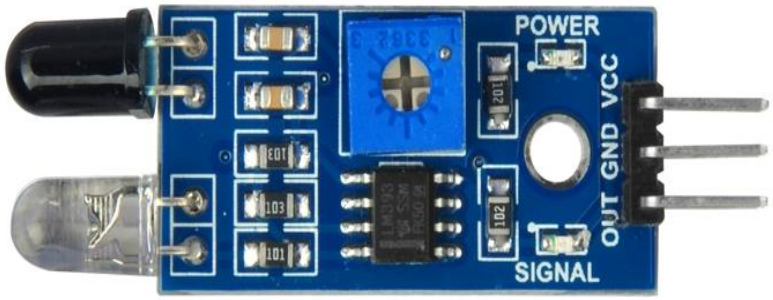


Fig. 3.3.1 IR Sensor

The sensor which simply measures IR radiation instead of emitting is called PIR or passive infrared. Generally in the IR spectrum, the radiation of all the targets radiation and some kind of thermal radiation are not visible to the eyes but can be sensed through IR sensors.

In this sensor, an IR LED is used as an emitter whereas the photodiode is used as a detector. Once an infrared light drops on the photodiode, the output voltage and resistance will be changed in proportion to the received IR light magnitude.

3.3.1 Types of IR Sensor

- **Active IR Sensor**- This type of IR Sensor includes both the emitter and the receiver which are also known as transmitter and receiver. In most situations, a laser diode or LED is used as a source. For non-imaging infrared sensors, LED is used whereas laser diode is used for imaging infrared sensors.
  The best examples of active infrared sensors are reflectance and break beam sensors.
- **Passive IR Sensor**- Passive Infrared Sensor (PIR) includes detectors only and this kind of sensor uses targets like infrared transmitters or sources. Here, the object will radiate the energy and detects it through infrared receivers.
  The best examples of PIR sensors are bolometer, Pyro-Electric Detector, Thermocouple-Thermopile etc.

3.3.2 Features of IR Sensor

- The operating voltage is 5VDC
- I/O pins -3.3V and 5V
- Mounting hole
- The range is up to 20cm
- The supply current is 20mA
- The range of sensing is adjustable
- Fixed ambient light sensor

3.3.3 Applications

- Rail Safety
- IR Imaging Devices
- Climatology
- Remote Sensing
- Water Analysis
- Night Vision Devices
- Flame Monitors
- Exploration of Petroleum
- Gas Detectors
- Infrared Astronomy

3.4 MOISTURE SENSOR

A moisture sensor is an instrument used for measuring the moisture content in the environmental air or powders. Most measurement devices usually rely on measurements of some other quantity such as temperature, pressure, mass or a mechanical or electrical change in a substance as moisture is absorbed. From calculations based on physical principles, or especially by calibration with a reference standard, these measured quantities can lead to a measurement of moisture. Modern electronic devices use temperature of condensation, or changes in electrical capacitance or resistance to measure moisture changes.

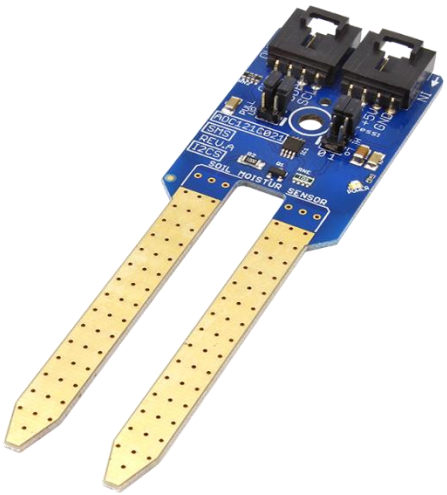


Fig. 3.4.1 Moisture Sensor

3.4.1 Features of MOISTURE SENSOR

- The probe does not corrode over time
- Not conductivity based
- Rugged design for long term use
- Small size
- Precise measurement
- Insensitive to salinity
- Consumes less than 7mA for very low power operation
- Output Voltage is proportional to moisture level

3.4.2 Applications

- Fluid level measurements
- Rain and weather monitoring
- Environmental monitoring
- Irrigation and sprinkler systems

- Water conservation application
- Moisture monitoring of bulk foods

3.5 ULTRASONIC SENSOR (HC-SR04)

HC-SR04 ultrasonic sensor is also known as ultrasonic transducer that is based on a transmitter and receiver and mainly used to determine the distance from the target object. The amount of time it takes to send and receive waves will determine how far the object is placed from the sensor. It mainly depends on the sound waves working on non-contact technology. The sensor comes with a range between 2cm to 400cm and is used in a wide range of applications including speed and direction measurement, wireless charging, sonar, burglar alarms and non-destructive testing.

Fig. 3.5.1 Ultrasonic Sensor

3.5.1 Features of HC-SR04 SENSOR

- Operating voltage: +5V
- Measuring distance: 2cm to 450cm
- Operating frequency: 40Hz
- Accuracy: 3mm

- Operating current: 15mA
- Practical measuring distance: 2cm to 80cm
- Measuring angle covered: 15 degree

3.5.2 Working of HC-SR04 Sensor

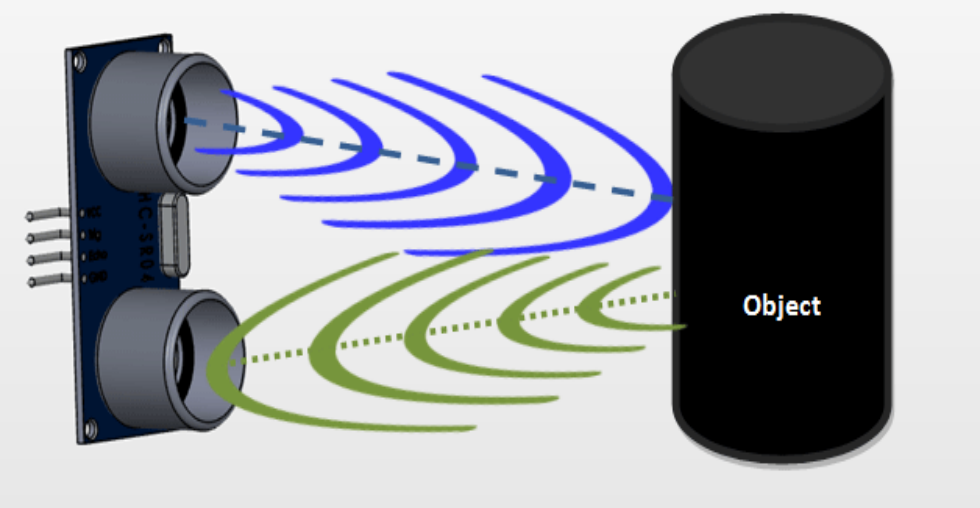


Fig. 3.5.2 HC-SR04 Sensor

As shown in the above figure, the HC-SR04 ultrasonic sensor is a 4pin module, whose pin names are VCC, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. It is very useful accurate distance measurement of the target object and mainly works on the sound waves. The sensor works with the simple high school formula that

Distance= Speed x **Time**

As we connect the module to 5v and initialize the input pin, it starts transmitting the sound waves which then travel through the air and hit the required object. These waves hit and bounce back from the object and then collected by the receiver of the module. The ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back towards the sensor, this reflected wave is observed by the ultrasonic receiver module as shown in the above figure.

3.5.3 Applications

- Used to avoid and detect obstacles with robots like biped robot, obstacles avoider robot, path finding robot etc.
- Used to measure the distance within a wide range of 2cm to 400cm.
- Can be used to map the objects surrounding the sensor by rotating it.
- Depth of certain places like wells, pits etc can be measured since the waves can penetrate through water.

3.6 LCD

A liquid crystal display (LCD) is a flat panel display or other electronically modulated optical device that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven segment displays, as in a digital clock. LCDs can either be normally on or off, depending on the polarizer arrangement.

Fig. 3.6.1 LCD

3.6.1 Working of LCD

We always use devices made up of Liquid Crystal Displays (LCDs) like computers, digital watches and also DVD and CD players. The have become very common and have taken a giant leap in the screen industry by clearly replacing the use of Cathode Ray Tubes (CRT). CRT draws more power than LCD and are also bigger and heavier. LCD's have made displays thinner than CRT's. Even while comparing the LCD screen to an LED screen, the power consumption is lesser as it works on the basic principle of blocking light rather than dissipating. All of us have seen an LCD, but no one knows the exact working of it. Let us take a look at the working of an LCD.

3.6.2 Applications

- Liquid crystal thermometer
- Optical imaging
- LCD technique is also applicable in visualization of the radio frequency waves in the waveguide
- Used in medical applications

3.6.3 Features

- Operating voltage: 5v
- Backlight colour: Green
- Horizontal characters: 16

3.7 SERVO MOTOR

A 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 also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Fig. 3.7.1 Servo Motor

3.7.1 Working of SERVO MOTOR

Servo motors are used to control position and speed very precisely, but in a simple case, only position may be controlled. Mechanical position of the shaft can be sensed by using a potentiometer, which is coupled with the motor shaft through gears. The current position of the shaft is converted into electrical signal by the potentiometer, and the compared with the command input signal. In modern servo motors, electronic encoders or sensors are used to sense the position of the shaft.

Command input is given according to the required position of the shaft. If the feedback signal differs from the given input, an error signal is generated. This error signal is then amplified and applied as the input to the motor, which causes the motor to rotate. And when the shaft reaches to the required position, error signal becomes zero, and hence the motor stays standstill holding the position.

The command input is given in the form of electrical pulses. The amount of power required by the motor is proportional to the distance it needs to travel.

3.7.2 Features of SERVO MOTOR

- Linear torque speed characteristics i.e. torque for any control voltage decreases at a definite uniform rate with speed.
- The output torque of the servo motor at any speed is roughly proportional to the applied control voltage. This is true more particularly in respect of starting torque (also called stall torque or locked-rotor torque)
- The servo motor operates stably i.e. it does not oscillate or overshoot.

3.7.3 Applications

- This motor is used to activate movements in robotics for giving the arm to its exact angle.
- This motor can be used in the camera to set a lens of the camera to enhance the focus of images.
- This motor is built into the camera to correct a lens of the camera to improve out of focus images.
- This motor is used to start, move and also stop conveyor belts carrying the product along with many stages. For example, bottling, packaging and product labelling.

CHAPTER-4

4.1 PROGRAM

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

//-------------------------------------------------

// Setting up LCD

const int rs = 13, en = 12, d4 = 7, d5 = 6, d6 = 5, d7 = 4;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

//-------------------------------------------------

// Setting Values

int moistValue = 0;

int irValue = 0;

int distanceDry;

long durationDry;

int distanceWet;
```

```
long durationWet;

int distance;

int duration;


//--------------------------------------------------

// Indicate pins for Components

int servoPin = 3;  // Servo

int trig1Pin = 11; // Dry Garbage Utrasonic Sensor
int echo1Pin = 9;
int trig2Pin = 10; // Wet Garbage Utrasonic Sensor
int echo2Pin = 8;

int Rled = A1;     // Dry Garbage Red LED
int Bled = A5;     // Wet Garbage Blue LED

int redPin= A4;    // Dustbin full or not LED

//--------------------------------------------------
```

```
// Initiate Servo



Servo servo1;

//--------------------------------------------------

void setup()
{
  pinMode(2, INPUT);
  pinMode(A0, INPUT);

  pinMode(Rled, OUTPUT);
  pinMode(Bled, OUTPUT);

  pinMode(redPin,OUTPUT);


//For Dry Garbage Ultrasonic Sensor

  pinMode(trig1Pin,OUTPUT);
  pinMode(echo1Pin,INPUT);

//For Wet Garbage Ultrasonic Sensor
```

```
  pinMode(trig2Pin,OUTPUT);
  pinMode(echo2Pin,INPUT);



  servo1.attach(servoPin); // Attaching the Servo

// LCD Starting

  lcd.begin(16, 2);     // LCD setup
  lcd.setCursor(0, 0);

  lcd.print("Welcome to");
  lcd.setCursor(0, 1);
  lcd.print("our Project");
  delay(2000);
  lcd.clear();
  lcd.print("Garbage");
  lcd.setCursor(0, 1);
  lcd.print("Segregation");
  delay(2000);
  lcd.clear();

//LCD Credits

  lcd.print("By:");
  lcd.setCursor(0, 1);
```

```
  lcd.print("Shayan Bhowmik");
  delay(2000);
  lcd.clear();


  lcd.print("Joyeeta Das");
  delay(2000);
  lcd.clear();



  lcd.print("Our Guide:");
  lcd.print("Mrs.");
  lcd.setCursor(0, 1);
  lcd.print("Tandra Sutradhar");
  delay(2000);
  lcd.clear();

  Serial.begin(9600);

}

//--------------------------------------------------

// This is for indicating if the dustbin is full or not
```

```
void ultrasensor(int trigPin,int echoPin)
 {
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);


  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);

  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);  //Checks the Duration

  distance = (duration * 0.034 / 2);  //Calculates the distance
 }

//-------------------------------------------------


void RGB_color(int redvalue)
{

  analogWrite(redPin, redvalue);

}
```

```
//-------------------------------------------------


void loop()
{


  irValue = digitalRead(2);

  moistValue = analogRead(A0);

    servo1.write(35);


 delay (1000);
//Ultrasonic Sensor Part

  ultrasensor(trig1Pin, echo1Pin);
  distanceDry = distance;

  ultrasensor(trig2Pin, echo2Pin);
  distanceWet = distance;

  lcd.print("DRY        WET");
  lcd.setCursor(2,1);
  lcd.print(distanceDry);
```

```
  lcd.setCursor(11,1);
  lcd.print(distanceWet);
  delay(1000);
  lcd.clear();
  lcd.setCursor(0, 1);
  lcd.clear();


//---------------Dustbin Full or NOT Part-------------------


  if (distanceDry >= 150 || distanceWet >= 150)
  {
   RGB_color(255);
   delay(300);
   RGB_color(0);
   delay(300);

  }


  if (distanceDry >= 150 && distanceWet >= 150)
    {
     lcd.print("Both Bins are ");
     lcd.setCursor(0, 1);
```

```
 lcd.print(" Full");
 delay(2000);
 lcd.clear();
 RGB_color(255);
 delay(450);
 RGB_color(0);
 delay(450);
}


else if (distanceDry >= 150)
{
 lcd.print("Dry Bin is Full");
 delay(2000);
 lcd.clear();
 RGB_color(255);
 delay(450);
 RGB_color(0);
 delay(450);
}

else if (distanceWet >= 150)
{
 lcd.print("Wet Bin is Full");
 delay(2000);
 lcd.clear();
```

```
  RGB_color(255);
  delay(450);
  RGB_color(0);
  delay(450);
 }

else if (irValue == 1)
{
 Serial.println(moistValue);


 lcd.clear();

 lcd.setCursor(0, 0);
 lcd.print("Moisture = ");
 lcd.print(moistValue);

 delay(2000);

 if (moistValue > 500)
 {
  lcd.setCursor(0, 1);
  lcd.print("Its Dry Garbage");
  digitalWrite(Rled, HIGH);
  servo1.write(0);
  delay(3000);
```

```
    lcd.clear();
    servo1.write(35);
    digitalWrite(Rled, LOW);


  }
  else
  {
    lcd.setCursor(0, 1);
    lcd.print("Its Wet Garbage");


    digitalWrite(Bled, HIGH);
    servo1.write(180);
    delay(3000);
    servo1.write(35);
    digitalWrite(Bled, LOW);
    lcd.clear();
  }

 }

}

//-------------------------------------------------
```

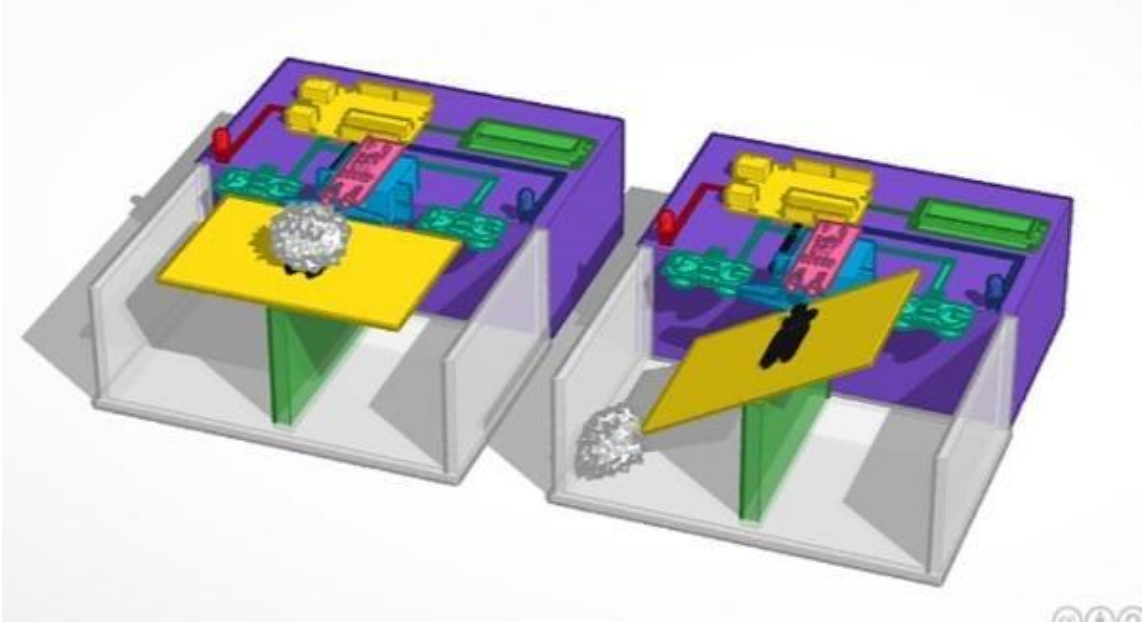
CHAPTER- 5

5.1 MERITS OF GARBAGE SEGREGATION

- Reduces environmental pollution.
- Reduce the land occupation.
- Turning waste to treasure.
- Less labour required.
- Makes recycling easier**.**
- More Efficient Waste Processing.

5.2 APPLICATIONS OF GARBAGE SEGREGATION

The Waste Segregator has a lot of applications in the management of the waste. The system separates the waste in 2 different bins under the category of wet and dry. Different sensors are used for the detection of the type of waste. The level of the garbage in the bins is monitored continuously so that the bins don't overflow and they are emptied timely. The notification is sent to the concerned authority with the location at which the bin is placed.

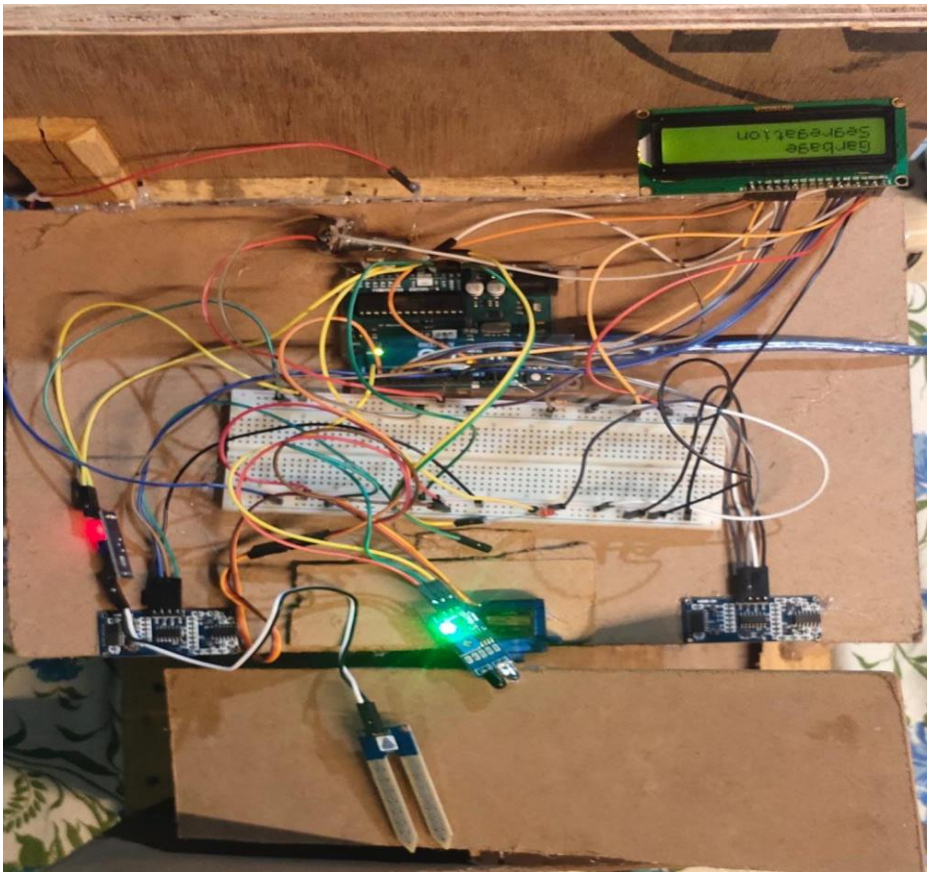


5.3 RESULTS AND DISCUSSIONS

- This project can be used in our day-to day life, which will be able to segregate the dry and wet waste.

- It avoids overflow of bins which in turn reduces the environmental pollution and hazards to human health.

The proposed system can be implemented everywhere in the cities and also in urban areas to which pollution free and creates an environment friendly atmosphere which helps to lead healthy, hazardous free life. It saves the life of the people without causing hazards to life by avoiding the overflow of bins.



5.4 FUTURE SCOPE OF GARBAGE SEGREGATION

- Smart dustbin is an innovative step in the direction of bringing a change in the current garbage disposal system.

- Further the self changing technology can be implemented so that the battery of the smart bin is low on power then using solar tracker the smart bin.

5.5 CONCLUSION

With growing urbanization and increasing population, effective waste disposal is a major concern. Manual waste segregation is very expensive, time consuming and inefficient. This paper presents a smart and cost effective solution for waste segregation. The proposed Smart Bin is an efficient waste segregation system that requires no human intervention to separate dry and wet waste and paves the path for timely collection and disposal. The proposed system can be deployed on a domestic scale in households or on a large scale in public places.

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