SMART WASTE MANAGEMENT SYSTEM USING ARDUINO

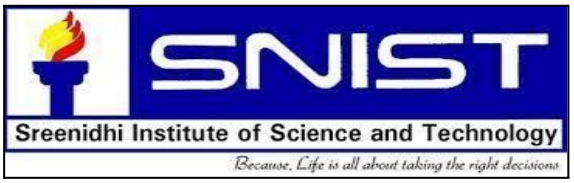
E.GANESH GOUD, P.MANIKANTA, R.VARSHITH

UNDER THE GUIDANCE OF

MR.B.BALAKRISHNA
ASSISTANT PROFESSOR ECE
INTERNAL GUIDE

DR.SHRUTHI BHARGAVA
DEAN-INNOVATION SNIST
ASSOCIATE PROFESSOR ECE
PROJECT COORDINATOR

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY
(Autonomous)
Yamnampet (V), Ghatkesar (M), Hyderabad – 501 301.



ABSTRACT

In this paper, a system is introduced to manage waste in big cities effectively without having to monitor the parts 24x7 manually. Here the problem of unorganized and non- systematic waste collection is solved by designing an embedded IoT system which will monitor each dumpster individually for waste deposited. Here an automated system is provided for segregating wet and dry waste. A mechanical setup can be used for separating wet and dry waste into separate containers here sensors can be used for separating wet and dry. For detecting the presence of any waste wetor dry can be detected using an IR sensor in the next step for detecting wet waste a moister sensor can be used. In this process, if only IR is detected motor will rotate in the direction of the dry waste container if both the sensor detects the waste then it will go to the wet container. Both these containers are embedded with ultrasonic sensors at the top, the ultrasonic sensor is used for measuring distance. This makes it possible to measure the amount of waste in the containers if one of the containers is full then alert message will be sent to the corresponding personal.

1. INTRODUCTION

Today big cities around the world are facing a common problem, managing the city waste effectively without making city unclean. Today's waste management systems involve a large number of employees being appointed to attend a certain number of dumpsters this is done every day periodically. This leads to a very inefficient and unclean system in which some dumpsters will be overflowing some dumpsters might not be even half full. This is caused by variation in population density in the city or some other random factor this makes it impossible to determine which part needs immediate attention. Here a waste management system is introduced in which each dumpster is embedded in a monitoring system which will notify the corresponding personal if the dumpster is full. In this system, it is also possible to separate wet and dry waste into two separate containers. This system provides an effective solution to waste management problem

1.1. EXISTING SYSTEM

- Manual systems in which employees clear the dumpsters periodic
- No systematic approach towards clearing the dumpsters.
- Unclear about the status of a particular location
- Employees are unaware of the need for a particular location
- Very less effective in cleaning city

2. ABOUT SMART WASTE MANAGEMENT

Module descriptionList of modules:

1. Processor
2. Sensors
3. Soft wares
4. DC Motor

2.1 Processor:

2.1.1 ARDUNIO UNO: The Arduino Uno is a microcontroller board is dependent on the ATmega328 (datasheet). The microcontroller in Arduino is Microchip ATmega328P and the Operating Voltage is 5 volts. TheInput Voltage range from 7 to 20 Volts and the Digital I/O Pins are 14 of which 6 provide PWM output. The analog Input Pins are 6, and DC Currentper I/O Pin is 20 mA.

Direct Current for 3.3V Pin is 50 mA. .The main part is the flashMemory contains 32 KB of which 0.5 KB used by bootloader SRAM for this Arduino has 2 KB and EEPROM of 1 KB with a Clock Speed of 16 MHz .TheLength of the Arduino is 68.6 mm With the Width of 53.4 mm having the weight of 25 g .

It contains everything expected to assist the microcontroller; essentially associate it to a laptop with a USB link or power it with associatedegree AC-to-DC instrumentality or battery to start.

The Uno varies from each single going before board in that itdoesn't utilize the FTDI USB-to-sequential driver chip. Rather, it includes the Atmega16U2 (Atmega8U2 up to make R2) modified as a USB-to-sequential device.

IOREF: This stick on the Arduino/Genuino board gives the voltage reference with that the microcontroller works. Associate in Nursing suitably organized defend will examine the IOREF pin voltage and choose the fitting

power source or empower voltage interpreters on the outputs to figure with the 5V or 3.3V.

VIN: The input voltage to the Arduino / Genuino board once it's utilizing an external power supply (instead of five volts from the USB association or alternative managed power source). We will be able to provide voltage through this pin, or, if providing voltage by means that of the power jack, get to that through this pin

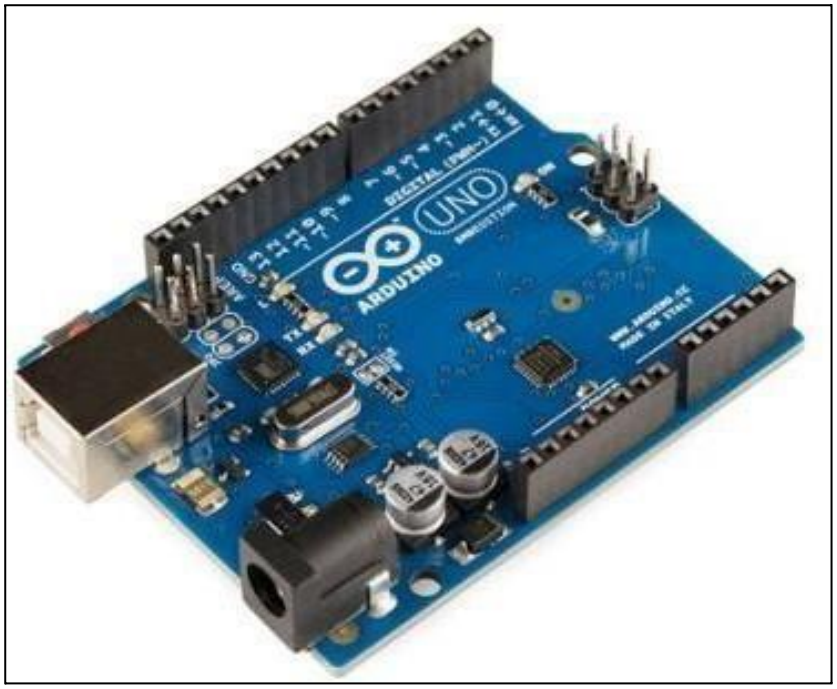
LED: there is a worked in crystal rectifier driven by advanced 13 pin. At the purpose once the pin is high in terms of value, the crystal rectifier is on, once the pin is low, it's off.

5V: This pin outputs a managed 5V from the controller on the board. The board is given power either from the DC power jack (7 - 20V), the USB connecter (5V), or the VIN stick of the board (7-20V). Providing voltage by means that of the 5V or 3.3V pins sidesteps the controller, and might damage the board.

Reset: generally wont to add a reset catch to shields that sq. the one onthe board

GND: This is a ground pin

3V3: 50mA of maximum current is drawn and on- board regulator generates 3.3 volts of supply



2.2 Sensors:

2.2.1 Ultrasonic Sensor:

Ultrasonic (US) sensor is a 4-pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This detector could be a very-about detector utilized This detector could be utilized in several applications wherever mensuration distance or sensing objects are needed. The module has 2 eyes like accompanies like robot at the front that frames the ultra- supersonic transmitter and recipient. The locator works with the simple secondary school recipe that

Distance = Speed × Time

The Ultrasonic transmitter broadcast a supersonic wave, this wave goes in air and whenit gets questioned by any material it gets reflected back toward the sensor this reflected wave is seen by the Ultrasonic beneficiary module as appeared in the image beneathNow, to figure the separation utilizing the above recipe, we should know Speed and time.Since we tend to utilize the supersonic wave, we as a whole know all inclusive speed of wave at region conditions that is 330m/s.

The hardware inbuilt on the module will compute the time taken for the US wave to return and turns on the reverberation stick high for that equivalent specific measure of your time; along these lines we can likewise realize the time taken. Presently just figure the separation utilizing a microcontroller or small scale chip. Likewise, this nondeterministic mapping case (i.e., one-to-many mapping) happens even after we normalize all parameter values to extract the structures of the web requests and queries.

Since the mapping can appear differently in different cases, it becomes difficult to identify all the one-to-many mapping patterns for each web request. Moreover, when different operations occasionally overlap at their possible query set, it becomes even harder for us to extract the one-to-many mapping for each operation by comparing matched requests and queries across the sessions.

2.2.2 IR Sensor:

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detectsthe motion. These types of sensors measures only infrared radiation rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, allthe objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simplyan IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IRlight falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

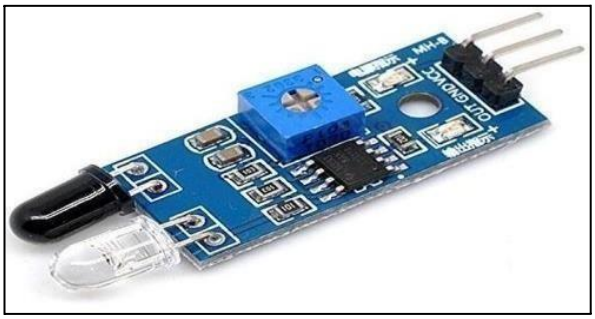


Figure:2.3 Module Diagram for IR Sensor

2.2.3 GSM module:

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRSsystem. The modem (modulator-demodulator) is a critical part here.

These modules consist of a GSM module or GPRS modem powered by a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for computer. A GSM modem can be a dedicated modem device with a serial, USB

or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities.

A GSM/GPRS modem is a class of wireless modem, designed for communication over the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also, they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for theiridentification.

A GSM module exposes an interface that allows applications such as NowSMS tosend and receive messages over the modem interface the mobile operator changes for message sending receiving as if it is performed directly on the mobile phone

To perform these modules a GSM module should support an “extended AT commandset”.for sending or receiving messages

One of the major application is the flood intimation project is designed to detect arise in the water level and convey the message to the concerned authorities by using GSM protocols. As the water level rises from a fixed level, (which can be sensed by usingany sensor) the microcontroller gets interrupted.

Figure 2.4: GSM module

2.2.4 Moisture sensor:

Moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

2.3 Soft wares:

2.3.1 Arduino IDE:

The Arduino integrated development environment (IDE) is a cross-stage application (for Windows, macOS, Linux) that is written in the programming language Java. It is utilized to compose and transfer programs to Arduino compatible boards, yet in addition, with the assistance of outsider centres, other seller advancement sheets.

The source code for the IDE is discharged under the GNU General Public License. The Arduino IDE underpins the dialects C and C++ utilizing uncommon guidelines of code organizing. The Arduino IDE supplies a product library from the Wiring venture, which gives numerous normal information and yield methodology.
Client composed code just requires two essential capacities, for beginning the sketch and the principle program circle, that are aggregated and connected with a program stub fundamental () into an executable cyclic official programwith the GNU toolchain, additionally included with the IDE distribution.
The Arduino IDE utilizes the program avrdude to change over the executable codeinto a book record in hexadecimal encoding that is stacked into the Arduino board by a loader program in the board's firmware

The primary code, otherwise called a sketch, made on the IDE platform will eventually produce a Hex File which is then moved and transferred in the controller on the board.

The IDE condition for the most part contains two essential parts: Editor and Compilerwhere previous is utilized

for composing the required code and later is utilized for assembling and transferring thecode into the given Arduino Module.

This environment supports both C and C++ Figure 2.6: Module Screenshot for Arduino IDE

2.3.2 ThingSpeak:

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB code in ThingSpeak you can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototypingand proof of concept IoT systems that require analytics.

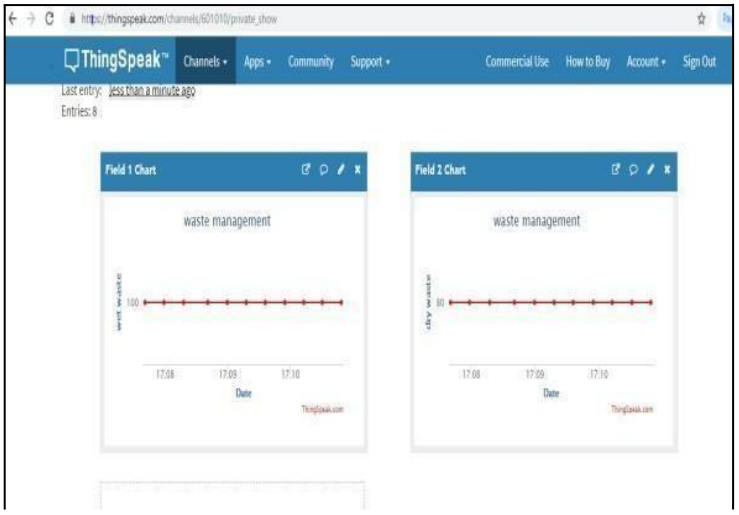


Figure 2.7 : Module Screenshot for BLYNK App

2.3.3 Servo Motor:

A servomotor is a linear actuator or rotary actuator that allows for precisecontrol of linear or angular position, acceleration, and velocity. It consists of a 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.

There are some special types of applications of an electric motor where the rotation of themotor is required for just a certain angle.

For these applications, we require some special types of motor with some specialarrangement which makes the motor rotate a certain angle for a given electrical input (signal). For this purpose, servo motor comes into the picture.

A servo motor is a self-contained electrical device, that rotate parts of a machinewith high efficiency and with great precision.

The output shaft of this motor can be moved to a particular angle, position and velocitythat a regular motor does not have.

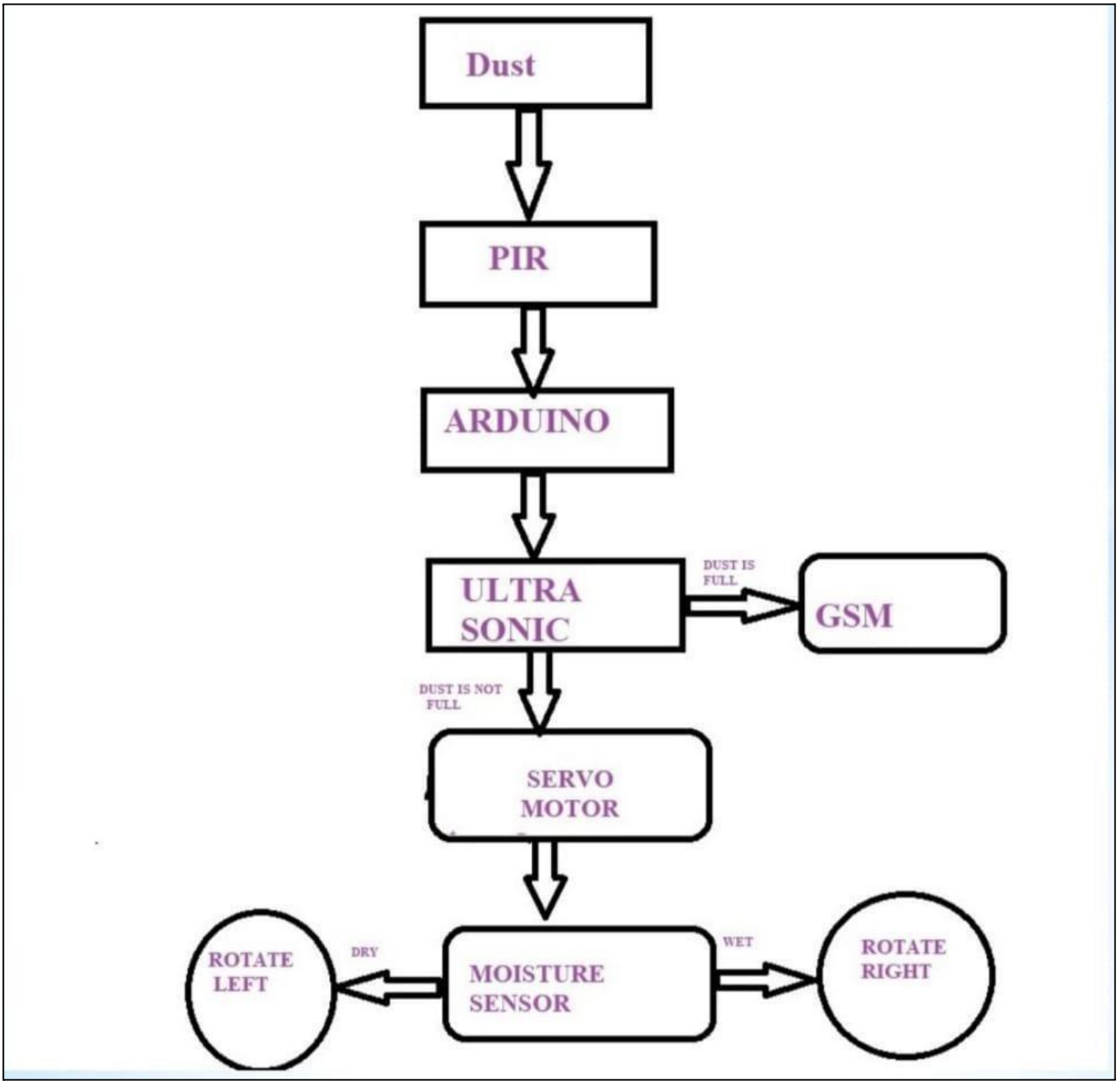
The Servo Motor utilizes a regular motor and couples it with a sensor for positionalfeedback.The controller is the most important part of the Servo Motor designed and usedspecifically for this purpose.

Figure 2.8 :SERVO MOTOR

The servo motor is a closed-loop mechanism that incorporates positional feedback in order to control the rotational or linear speed and position.The motor is controlled withan electric signal, either analog or digital, which determines the amount of movement which represents the final command position for the shaft.

There are three main considerations to evaluate servos motors. First basedon their current type – AC or DC, and secondly on the type of Commutation used, whether the motor uses brushes and the third type of consideration is the motors rotating field, the rotor, whether the rotation is synchronous or asynchronous.

3. BLOCK DIAGRAM:



3.1: Architecture Diagram A:

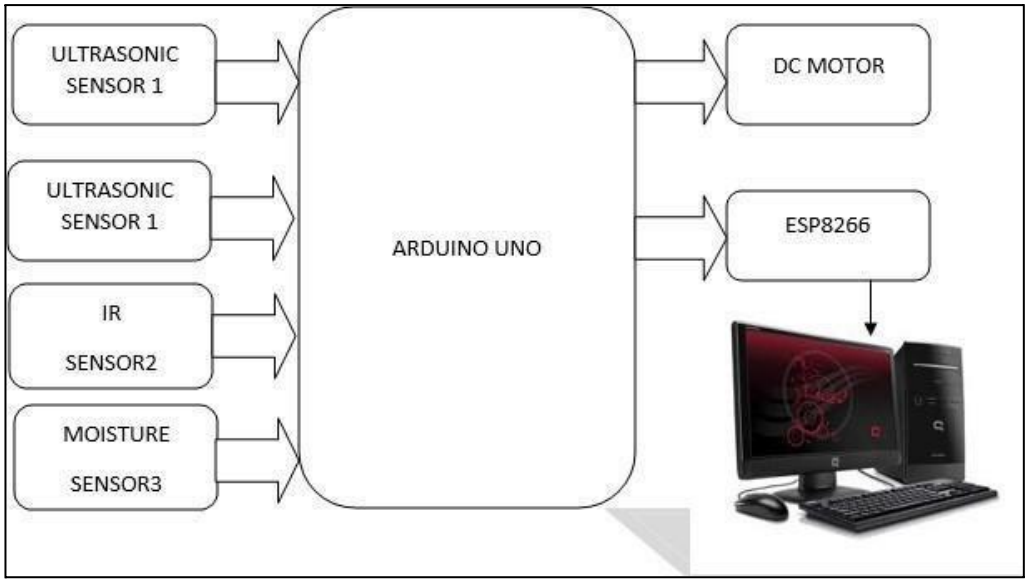


Figure 3.1:Architecture Diagram for Smart Waste Management System

Here, the figure represents an integration of Smart Waste Management System with a3-tier sensor processor device system.

Ultrasonic sensor measure distances by using ultrasonic waves. The sensor emits an ultrasonic wave and receives the reflected wave back from the target.

IR Sensor emits in order to sense some aspects of the surroundings.

Moisture Sensor measures the volumetric water content in the soil. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing hydrology and agriculture.

DC motor which is connected to the digital pins of ArduinoWe are using serial monitor for the display.

4. WORKING:

1. When we put dust on the thermocol,the PIR sensor will sense the motion of thedust.And gives them to the ARDUINO.

2. The ultrasonic sensor will check whether the dustbin is full or dustbin is to befilled.

3. If the Dustbin is full ,then it will send instructions to the GCM module which willsend the alerts to the authorities.

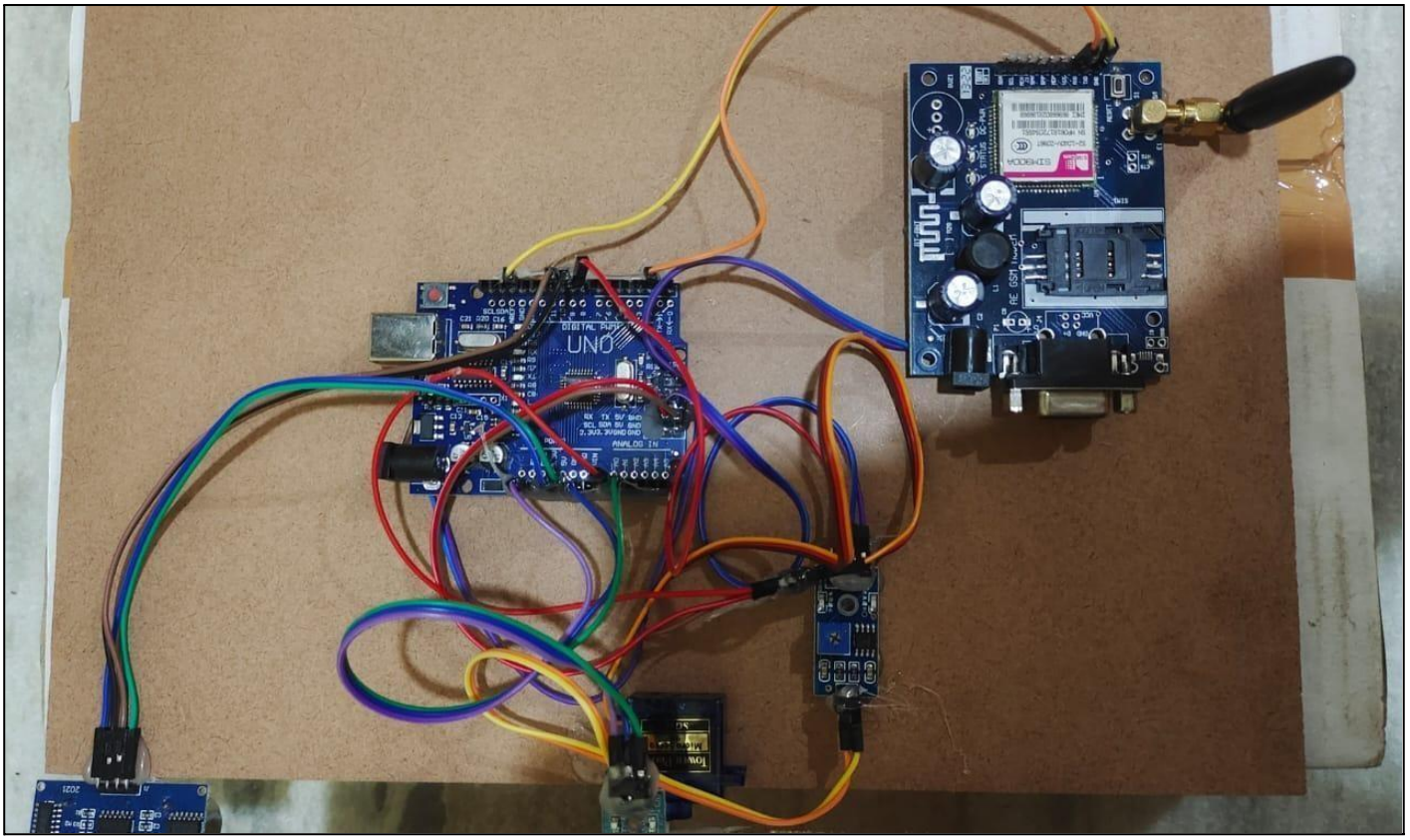
4. If the Dustbin is not fill ,then the soil moisture sensor will come into play. 5.The soil moisture sensor will check whether the dust is dry dust or wet dust.

6. This soil moisture sensor is connected to the servo motor ,If the dust is dry it willrotate on 90 degrees left.

7. If the Dust is wet then servo motor will rotate on 90 degrees right and throws thedust in right side.

8. This process continues till the dustbin is full.

5. CONNECTIONS:



6. PROGRAM CODE:

include <Servo.h>#define trigPin1 9

#define echoPin1 10

#define buzzer 11Servo myservo1; int pos = 0;

void setup()

{

Serial.begin(9600); pinMode(trigPin1, OUTPUT); pinMode(echoPin1, INPUT); pinMode(8, INPUT); pinMode(15, INPUT); pinMode(buzzer, OUTPUT); myservo1.attach(14); digitalWrite(buzzer, LOW); delay(50);

}

void loop()

{

long duration1, distance1; digitalWrite(trigPin1, LOW); delayMicroseconds(2); digitalWrite(trigPin1, HIGH); delayMicroseconds(10);

```
digitalWrite(trigPin1,  LOW); duration1 = pulseIn(echoPin1, HIGH);distance1 = ((duration1)/2) / 29.1;


//Serial.print("D1:");
//Serial.print(distance1);
//Serial.print("\n"); delay(20); if(distance1<=20)
Serial.print("Dust bin filled\n");
Serial.println("AT+CMGF=1");              //To send SMS in Text Modedelay(1000);
Serial.println("AT+CMGS=\"+919949274257\"\r"); // change to the phone numberyou using
delay(1000);
Serial.println("Alert! Dust bin filled\n");//the content of the messagedelay(200);
Serial.println((char)26);//the stopping characterdelay(1000);
Serial.println((char)26);//the message stopping characterdelay(1000);
}
if(digitalRead(15)==LOW)
{
//Serial.print("Checking dust..... \n");
delay(5000); if(digitalRead(8)==LOW)
{
//Serial.print("Wet dust\n");
for (pos = 100; pos >= 40; pos -= 1)
{ // goes from 0 degrees to 180 degrees
// in steps of 1 degree
```

```
myservo1.write(pos);                    // tell servo to go to position in variable 'pos'delay(5);
}
delay(5000);

for (pos = 40; pos <= 100; pos += 1)
{ // goes from 180 degrees to 0 degrees
myservo1.write(pos);                    // tell servo to go to position in variable 'pos'delay(5);
}
delay(1000);
}
else
{
//Serial.print("Dry dust\n");
for (pos = 100; pos <= 160; pos += 1)
{ // goes from 180 degrees to 0 degrees



myservo1.write(pos);                    // tell servo to go to position in variable 'pos'delay(5);
}
delay(5000);
for (pos = 160; pos >= 100; pos -= 1)
{ // goes from 0 degrees to 180 degrees
// in steps of 1 degree
myservo1.write(pos);                    // tell servo to go to position in variable 'pos'delay(5);
}
delay(1000);
}
```

7. ADVANTAGES:

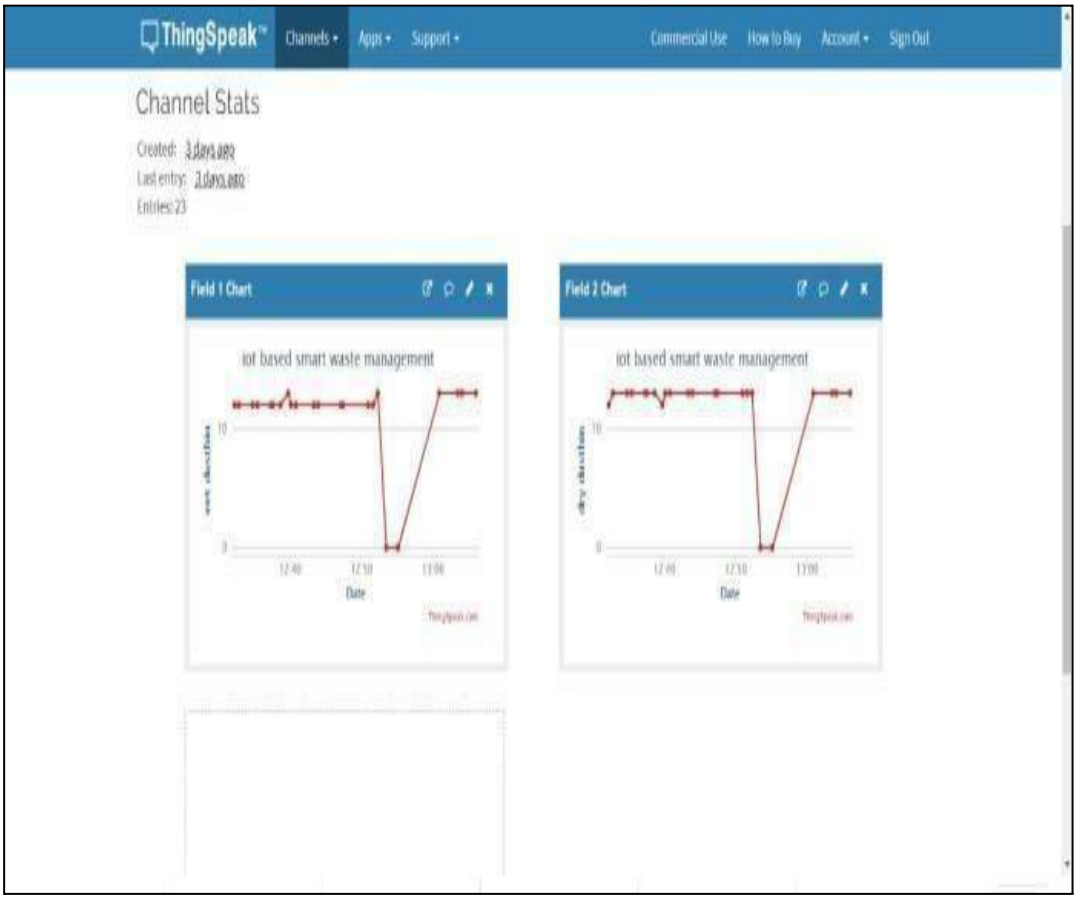
1. When we put dust on the thermocol,the PIR sensor will sense the motion of thedust.And gives them to the ARDUINO.
2. The ultrasonic sensor will check whether the dustbin is full or dustbin is to be filled. 3.If the Dustbin is full ,then it will send instructions to the GCM module which will sendthe alerts to the authorities.
4.If the Dustbin is not fill ,then the soil moisture sensor will come into play. 5.The soil moisture sensor will check whether the dust is dry dust or wet dust.
6. This soil moisture sensor is connected to the servo motor ,If the dust is dry it willrotate on 90 degrees left.
7. If the Dust is wet then servo motor will rotate on 90 degrees right and throws the dustin right side.
8. This process continues till the dustbin is full.

8.DISADVANTAGES:

1. When mixed waste is thrown on the dustbin ,moisture sensor fails to senseAnd throws dust either of sides.
2. When dustbin is full ,authorities cannot receive the message if their devices are out ofrange(either switched off or no signal).
3. In the process of detection of waste by soil moisture sensor ,there is delayIn time for the functioning of servo motor.

9. RESULT AND DISCUSSION

The below figure shows the graphical representation of levels of waste in both containers as uploaded to the ThingSpeak cloud. This page can be accessed by any person who has the username and password of the account.



10. FUTURE SCOPE:

Every project is always has scope for improvement, perhaps the most pressing issue ofseparation of waste is when their dispose simultaneously. The waste segregator can be improvised to include the separation of paper and plastic, safe segregation of biomedicalwaste generated at home, compact and aesthetic Mechanical design

11. APPLICATIONS:

1. When mixed waste is thrown on the dustbin ,moisture sensor fails to senseAnd throws dust either of sides.
2. When dustbin is full ,authorities cannot receive the message if their devices are out ofrange(either switched off or no signal).
3. In the process of detection of waste by soil moisture sensor ,there is delayIn time for the functioning of servo motor

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