SMART WASTE MANAGEMENT SYSTEM

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CHAPTER 1

INTRODUCTION

1.1OVERVIEW

Waste management is all the activities and actions required to manage waste from its inception to its final disposal [1]. This includes collection, transportation, treatment and disposal of waste together with monitoring and regulation. Waste collection methods vary widely among different countries and regions. Domestic waste collection services are often provided by local government authorities.

Curbside collection is the most common method of disposal in most countries, in which waste is collected at regular intervals by specialised trucks. Waste collected is then transported to an appropriate disposal area.

Nowdays, cities with developing economies experience exhausted waste collection services, inadequately managed and uncontrolled dumpsites and the problems are worsening [2]. Waste collection method in such countries is an on-going challenge and many struggle due to weak institutions and rapid urbanization.

1.2NEED FOR IMPROVEMENT IN WASTE MANAGEMENT SYSTEM

- By 2030, almost two-third of the world's population will be living in cities. This fact requires the development of sustainable solutions for urban life, managing waste is a key issue for the health.
- Efficient and energy-saving waste management, reducing CO_2,air pollution and vehicle exhaust emissions—these are just a few examples for the demands of future cities. In views of that, the efficient use and responsible handling of resources become more important.
- Effectively managing waste is important in developed countries. Waste management may swallow upto 50% of a city's budget, but only serve a small part of the population.
- Sometimes, upto 60%of waste is not being collected, it is often simply burned by the roadside. It can pollute drinking water, it can spread disease to people living nearby.
- Even with great route optimization, the worker must still physically go to the dustbin to check waste levels. Because of this, trucks often visit containers that do not need emptying, which wastes both time and fuel.
- Waste management prevents harm to human health and the environment by reducing the volume and hazardous character of residential and industrial waste.

- Improving proper waste management will reduce pollution, recycle useful materials and create more green energy.

1.3FEATURES OF SMART WASTE MANAGEMENT SYSTEM

- The smart, sensor based dustbin will judge the level of waste in it and send the messege directly to the municipal corporation.
- It can sense all the type of waste material either it is in the form of solid or liquid.
- According to the filled level of the dustbin, the vehicles from the municipal corporation will choose the shortest path with the help of the "TRANSPORTATION SOFTWARE", which will save their time.
- It emphasizes on "DIGITAL INDIA".
- The system is simple. If there is any problem with any equipment in the future, that part is easily replaceable with new one without any difficulty and delay.

1.4ADVANNTAGES OF SMART WASTE MANAGEMENT SYSTEM

- Less time and fuel consumption as the trucks go only to the filled containers.
- Decreased noise, traffic flow and air pollution as a result of less trucks on the roads.
- Our smart operating system enable two way communication between the dustbin deployed in the city and service operator. Therefore the focus is only on collection of route based fill level of the containers.
- The sensors installed in the containers provide real time information on the fill level. This information helps determine when and where to prioritise collection.
- In this way both service providers and citizens benefit from an optimized system which results in major cost savings and less urban pollution.
- Reduces the infrastructure (trucks, containers), operating (fuel) and maintenance costs of the service by upto 30%.
- Applying this technology to the city optimises management, resources and costs, and makes it a "SMART CITY".
- Historical information on collections helps adapt the deployment of containers to the actual needs of the city, therefore reducing the number of containers that clutter up the road and increasing public parking spaces.
- It keeps the surroundings clean and green, free from bad odour of wastes, emphasizes on healthy environment and keep cities more beautiful.
- Reducing manpower required to handle the garbage collection.

1.5APPLICATION OF SMART WASTE MANAGEMENT SYSTEM

- This can be best used by municipal corporation for their betterment of management regarding collection of wastes.
- With the help of proper technology (GPS & SOFTWARE APPLICATIONS) we can guide the trucks to choose the shortest path.
- It also favours the “SMART CITY” project and “DIGITAL INDIA”.

1.6MAIN EQUIPMENTS USED IN THE SMART WASTE MANAGEMENT SYSTEM

1.6.1 GARBAGE CONTAINER

A waste container is a container for temporarily storing waste, and is usually made out of metal or plastic.

The curbside dustbins usually consist of three types: trash cans (receptacles made of metal or plastic), dumpsters (large receptacles similar toskips) and wheelie bins (light, usually plastic bins that are mobile). All of these are emptied by collectors, who will load the contents into a garbage truck and drive it to a landfill, incinerator or consuming crush facility to be disposed of.

FIG 1.6.1 : DUSTBIN

1.6.2 ULTRASONIC SENSOR

A special sonic transducer is used for the ultrasonic proximity sensors, which allows for alternate transmission and reception of sound waves. The sonic waves emitted by the transducer are reflected by an object and received back in the transducer. After having emitted the sound waves, the ultrasonic sensor will switch to receive mode. The time elapsed between emitting and receiving is proportional to the distance of the object from the sensor.

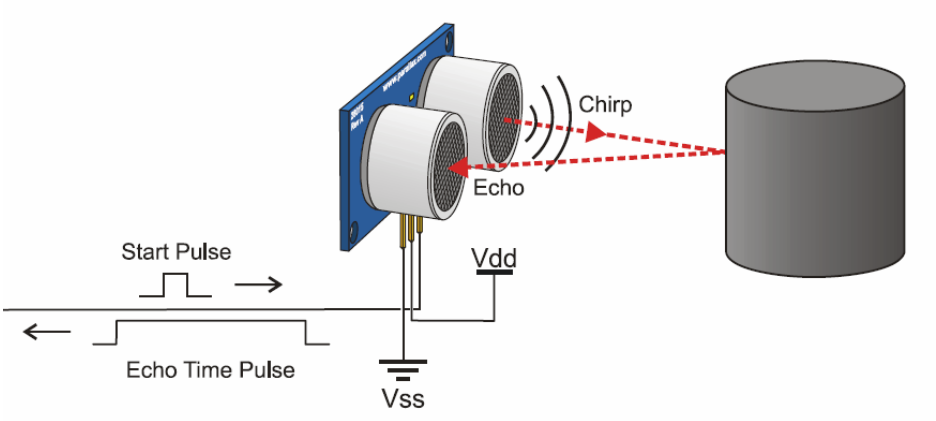

FIG 1.6.2 : WORKING OF SENSOR

Ultrasonic sensors generate high-frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object.

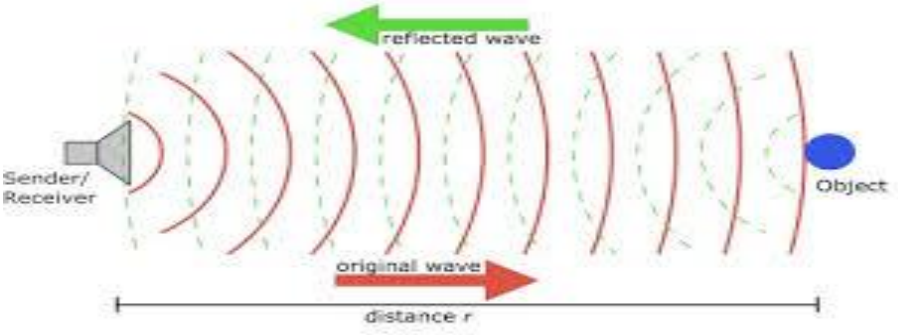

FIG 1.6.3 : PRINCIPLE OF SENSOR

1.6.3 ARDUINO BOARD

Arduino is a software company, project, and user community that designs and manufactures computer open-source hardware,open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices [3].

The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can interface to various expansion boards (termed *shields*) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment(IDE) based on a programming language named *Processing*, which also supports the languages C and C++.

The first Arduino was introduced in 2005, aiming to provide a low cost, easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

FIG 1.6.4 : ARDUINO BOARD

SOFTWARE OF ARDUINO :

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the

programming language Java. It originated from the IDE for the languages Processing and Wiring. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such assyntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch" [4].

The Arduino IDE supports the languages C and C++ using special rules to organize code.

1.6.4 GSM MODULE

GSM (Global System for Mobile Communications, originally *Groupe Spécial Mobile*), is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used bymobile phones, first deployed in Finland in July 1991 [5]. As of 2014 it has become the default global standard for mobile communications - with over 90% market share, operating in over 219 countries and territories [6].

FIG 1.6.5 : GSM MODULE

GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS

frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead (for example in Canada and the United States). In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems.

1.6.5 BREAD BOARD

A breadboard is a construction base for prototyping of electronics. Originally it was literally a bread board, a polished piece of wood used for slicing bread. In the 1970s the solderless breadboard (AKA plugboard, a terminal array board) became available and nowadays the term "breadboard" is commonly used to refer to these. "Breadboard" is also a synonym for "prototype".

Because the solderless breadboard does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design. For this reason, solderless breadboards are also extremely popular with students and in technological education. Older breadboard types did not have this property. A stripboard (veroboard) and similar prototyping printed circuit boards, which are used to build semi-permanent soldered prototypes or one-offs, cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

FIG 1.6.6 : BREAD BOARD

A modern solderless breadboard consists of a perforated block of plastic with numerous tin plated phosphor bronze or nickel silver alloy spring clips under the perforations. The clips are often called *tie points* or *contact points*. The number of tie points is often given in the specification of the breadboard.

The spacing between the clips (lead pitch) is typically 0.1 in (2.54 mm). Integrated circuits (ICs) in dual in-line packages (DIPs) can be inserted to straddle the centerline of the block. Interconnecting wires and the leads of discrete components (such as capacitors, resistors, and inductors) can be inserted into the remaining free holes to complete the circuit. Where ICs are not used, discrete components and connecting wires may use any of the holes.

1.6.6 JUMP WIRES

Jump wires (also called jumper wires) for solderless breadboarding can be obtained in ready-to-use jump wire sets or can be manually manufactured. The latter can become tedious work for larger circuits. Ready-to-use jump wires come in different qualities, some even with tiny plugs attached to the wire ends. Jump wire material for ready-made or homemade wires should usually be 22 AWG (0.33 mm^2) solid copper, tin-plated wire - assuming no tiny plugs are to be attached to the wire ends. The wire ends should be stripped $^3\!/_{16}$ to $^5\!/_{16}$ in (4.8 to 7.9 mm). Shorter stripped wires might result in bad contact with the board's spring clips (insulation being caught in the springs). Longer stripped wires increase the likelihood of short-circuits on the board. Needle-nose pliers and tweezers are helpful when inserting or removing wires, particularly on crowded boards.

FIG 1.6.7 : JUMP WIRES

Differently colored wires and color-coding discipline are often adhered to for consistency. However, the number of available colors is typically far fewer than the number of signal types or paths. Typically, a few wire colors are reserved for the supply voltages and ground (e.g., red, blue, black), some are reserved for main signals, and the rest are simply used where convenient.

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

An inevitable consequence of development and industrial progress is generation of waste. Therefore, efficient waste management is a matter of international concern and countries have setup robust regulatory waste management regimes for balancing the objectives of development and environment sustainability. In India, the national environment policy, 2006 while suggesting measures for collection of wastes and safe disposal of residues [7].

The metro cities and major economic hubs generate the maximum volume of waste, but a survey of 20 smaller cities selected to be developed as smart cities show that most are struggling to manage waste. So, there should be an improvement in the waste management techniques.

2.2 HISTORY

Following the onset of industrialisation and the sustained urban growth of large population centres, the build-up of waste in the cities caused a rapid deterioration in levels of sanitation and the general quality of urban life. The streets became choked with filth due to the lack of waste clearance regulations [8].

In the UK, London, The Metropolitan Board of Works was the first city-wide authority that centralized sanitation regulation for the rapidly expanding city and the Public Health Act 1875 made it compulsory for every household to deposit their weekly waste in "moveable receptacles: for disposal—the first concept for a dust-bin [9].

Early garbage removal trucks were simply open bodied dump trucks pulled by a team of horses. They became motorized in the early part of the 20th century and the first close body trucks to eliminate odours with a dumping lever mechanism were introduced in the 1920s in Britain [5].

2.3 ABOUT BELGAVI CITY

- POPULATION : OVER 5 LAKHS
- AREA : 94 SQ. KM.
- NO. OF WARDS : 58
- TOTAL QUANTITY OF SOLID WASTE GENERATED : 200-220 TONS PER DAY
- METHOD OF COLLECTION :
  - PRIMARY COLLECTION : DOOR TO DOOR COLLECTION
  - PROVIDED METALLIC CONTAINER IN DESIGNATED PLACES ALL OVER THE CITY.
- MODE OD TRANSPORTAYION (SECONDARY TRANSPORTATION):
  - TIPPERS AND LORRIES COVERED WITH PLASTIC
  - DUMPER PLACERS
  - COMPACTERS

CHAPTER 3

VARIOUS PROGRAMS USED IN THE SYSYTEM

3.1 PROGRAM FOR WASTE LEVEL SENSING

```
#define trigPin 12

#define echoPin 13


void setup()
{

        Serial.begin (9600);

        pinMode(trigPin, OUTPUT);

        pinMode(echoPin, INPUT);

}



void loop()
{

        long duration, distance;


        int max = 80;   // Let consider as Height of the Garbage Bin is = 80 cm.
        float diff, perc;

        digitalWrite(trigPin, LOW);

        delayMicroseconds(2);


        digitalWrite(trigPin, HIGH);

        delayMicroseconds(10);
```

```
	digitalWrite(trigPin, LOW);

	duration = pulseIn(echoPin, HIGH);

	distance = (duration/2) / 29.1;



	diff = max - distance;  // 'diff' variable tells u that, how much the Garbage Bin is Left to fill.
	perc = (diff/max)*100;		// 'perc' variable tells u that, how much percentage the Garbage Bin is filled.

	if (perc>=90)
	{
		Serial.println("Garbage Bin is FULL.");			// When the Garbage Bin is filled more than 90%, then this Error Message will Displayed.
	}
	else
	{
		Serial.print("Garbage Bin is Filled ");
		Serial.print(perc);
		Serial.println("  %.");				// These 3 Lines are print, that how much the Garbage Bin is Filled...Ex. "Garbage Bin is Filled 70%.".
	}

	/*
	if (distance >= 400 || distance <= 2)
	{

		Serial.println("Out of range");

	}

	else
	{

		Serial.print(distance);
		Serial.println(" cm");

	}

	*/

	delay(500);

}
```

3.2 PROGRAM FOR MESSAGE SENDING

```
SoftwareSerial mySerial(9, 10);

#define trigPin 12

#define echoPin 13



void setup()
{

mySerial.begin(9600);   // Setting the baud rate of GSM Module
Serial.begin (9600);

pinMode(trigPin, OUTPUT);

pinMode(echoPin, INPUT);

delay(100);
}



void loop()
{

long duration, distance;


int max = 80;   // Let consider as Height of the Garbage Bin is = 80 cm.
float diff, perc;

digitalWrite(trigPin, LOW);

delayMicroseconds(2);


digitalWrite(trigPin, HIGH);

delayMicroseconds(10);


digitalWrite(trigPin, LOW);
```

```
duration = pulseIn(echoPin, HIGH);

distance = (duration/2) / 29.1;



diff = max - distance;  // 'diff' variable tells u that, how much the Garbage Bin is Left to fill.
perc = (diff/max)*100;          // 'perc' variable tells u that, how much percentage the Garbage Bin is filled.

if (perc>=90)
{
//Serial.println("Garbage Bin is FULL.");                  // When the Garbage Bin is filled more than 90%, then this Error Message will Displayed.

// Call the Function of Send SMS.
SendMessage();                  // Send Message Function Call.


}
/*
else
{
Serial.print("Garbage Bin is Filled ");
Serial.print(perc);
Serial.print("  %.");                          // These 3 Lines are print, that how much the Garbage Bin is Filled...Ex. "Garbage Bin is Filled 70%.".
}
*/



/*
if (distance >= 400 || distance <= 2)
{

Serial.println("Out of range");

}

else
{

Serial.print(distance);
Serial.println(" cm");

}
```

```
*/

delay(500);

}



void SendMessage()
{
mySerial.println("AT+CMGF=1");                    //Sets the GSM Module in Text Mode
delay(1000);                                  // Delay of 1000 milli seconds or 1 second
mySerial.println("AT+CMGS=\"+918792574742\"\r");        // Replace x with mobile number
delay(1000);
mySerial.println("Garbage Bin is Full.");                // The SMS text you want to send
delay(100);
mySerial.println((char)26);                    // ASCII code of CTRL+Z
delay(1000);
}
```

3.3 PROGRAM FOR SHORT ROUTE OPTIMIZATION

```
#include<stdio.h>
#include<stdlib.h>
#define infinity 999
int nd,n=26,v,a[50];
float dist[50];
float
cost[26][26]={999,3.55,4.35,5.85,7.3,7.5,9.45,7.45,6.05,3.45,4.65,6.35,8.8,8.95,10.1,9.55,9.1
5,8.1,6.85,3.3,2.2,3.4,3.7,5.65,6.35,5.1,3.55,999,8.35,2.3,3.7,4.25,5.95,3.75,2.55,2.1,3.33,3.
55,5.1,5.75,6.9,6.75,6.35,5.3,4.05,4.8,3.7,2.7,2.35,4.3,5,4.4,4.35,0.85,999,1.5,2.95,3.4,5.1,2.
9,1.7,2.9,4.1,2.7,4.25,4.9,6.05,5.9,5.5,4.45,3.2,5.6,4.5,3.5,3.15,5.1,5.8,5.45,5.85,3.2,1.5,999,
1.45,1.9,3.6,1.6,2.8,4.4,5.4,3.7,2.95,3.6,4.75,6.9,6.5,5.45,4.2,7.1,6,5,4.65,6.6,7.3,6.95,7.3,3.
7,2.95,1.45,999,3.35,5.05,3.05,4.25,5.85,6.85,5.15,4.4,5.05,5.2,8.33,7.95,6.9,5.65,8.55,7.45,
6.45,6.1,8.05,8.75,8.4,7.5,4.25,3.4,1.9,3.35,999,1.7,3.5,4.7,6.3,7.3,5.6,3.75,3.8,4.95,6.35,6.7
5,7.35,6.1,9,7.9,6.9,6.55,8.5,9.2,8.85,9.45,5.95,5.1,3.6,5.05,1.7,999,3.4,4.6,8,7,5.3,2.05,2.7,
2.85,5.25,5.65,9.05,7.8,10.7,9.6,8.6,8.25,10.2,10.9,10.55,7.45,3.75,2.9,1.6,3.05,3.5,3.4,999,
1.2,5,3.8,2.1,1.35,2,3.15,4.55,4.9,3.85,2.6,8.5,7.4,6.4,6.05,7.2,7.9,8.35,6.05,2.55,1.7,2.8,4.2
5,4.7,4.6,1.2,999,3.8,2.6,0.9,2.55,3.2,4.35,4.1,3.7,2.65,1.4,7.3,6.2,5.2,4.35,6,6.7,7.15,3.45,2.
1,2.9,4.4,5.85,6.3,8,5,3.8,999,1.2,2.9,6.15,6.8,7.95,6.1,5.7,4.65,3.4,4.7,3.6,2.6,2.25,2.2,2.9,4
.55,4.65,3.3,4.1,5.4,6.85,7.3,7,3.8,2.6,1.2,999,1.7,4.95,4.3,5.45,4.9,4.5,3.45,2.2,5.9,4.8,3.8,3
.45,3.4,4.1,5.75,6.35,3.55,2.7,3.7,5.15,5.6,5.3,2.1,0.9,2.9,1.7,999,3.25,2.6,3.75,3.2,2.8,1.75,
0.5,7.6,6.5,5.5,5.15,5.1,5.8,7.45,8.8,5.1,4.25,2.95,4.4,3.75,2.05,1.35,2.55,6.15,4.95,3.25,999
,0.65,1.8,3.2,3.6,4.65,3.75,9.85,8.75,7.75,6.9,8.35,9.05,9.7,8.95,5.75,4.9,3.6,5.05,3.8,2.7,2,3
```

```
.2,6.8,4.3,2.6,0.65,999,1.15,2.55,2.95,4,3.1,10.2,9.1,8.1,7.75,7.7,8.4,10.5,10.1,6.9,6.05,4.75,
6.2,4.95,3.85,3.15,4.35,7.95,5.45,3.75,1.8,1.15,999,1.4,1.8,2.85,4.1,11.35,10.25,9.25,8.9,8.8
5,9.26,11.2,9.55,6.75,5.9,6.9,8.35,6.35,5.25,4.5,4.1,6.1,4.9,3.2,3.2,2.55,1.4,999,0.4,1.45,2.7,
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,0.4,999,1.05,2.3,10.4,9.3,8.3,7.75,7.9,8.6,10.25,8.1,5.3,4.45,5.45,6.9,7.35,9.05,8.85,2.65,4.
65,3.45,1.75,4.65,4,2.85,1.45,1.05,999,1.25,9.35,8.25,7.25,6.9,6.85,7.55,9.2,6.85,4.05,3.2,4.
2,5.65,6.1,7.8,2.6,1.4,3.4,2.2,0.5,3.75,3.1,4.1,2.7,2.3,1.25,999,8.1,7,6,5.65,5.6,6.3,7.95,3.3,4
.8,5.6,7.1,8.55,9,10.7,8.5,7.3,4.7,5.9,7.6,9.85,10.2,11.35,10.8,10.4,9.35,8.1,999,1.1,2.3,2.8,4
.8,5.5,4,2.2,3.7,4.5,6,7.45,7.9,9.6,7.4,6.2,3.6,4.8,6.5,8.75,9.1,10.25,9.7,9.3,8.25,7,1.1,999,1.
2,1.7,3.7,4.4,2.9,3.4,2.7,3.5,5,6.45,6.9,8.6,6.4,5.2,2.6,3.8,5.5,7.75,8.1,9.25,8.7,8.3,7.25,6,2.3
,1.2,999,0.5,2.5,3.2,1.7,3.7,2.35,3.15,4.65,6.1,6.55,8.25,6.05,4.35,2.25,3.45,5.15,6.9,7.75,8.
9,8.35,7.95,6.9,6.65,2.8,1.7,0.5,999,2,2.7,2.3,5.65,4.3,5.1,6.6,8.05,8.5,10.2,7.2,6,2.2,3.4,5.1,
8.35,7.7,8.85,8.3,7.9,6.85,5.6,4.8,3.7,2.5,2,999,0.7,3.2,6.35,5,5.8,7.3,8.75,9.2,10.9,7.9,6.7,2.
9,4.1,5.8,9.05,8.4,9.26,9,8.6,7.55,6.3,5.5,4.4,3.2,2.7,0.7,999,2.5,5.1,4.4,5.45,6.95,8.4,8.85,1
0.55,8.35,7.15,4.55,5.75,7.45,9.7,10.05,11.2,10.65,10.25,9.2,7.45,4,2.9,1.7,2.3,3.2,2.5,999};

void dij()
{
        int i,u,count,w,flag[26];
float min;
        for(i=0;i<n;i++)
      {


                flag[i]=0;
dist[i]=cost[v][i];

}
        count=2;
        while(count<=n)
        {
                min=99;
                for(w=0;w<n;w++)
                        if(dist[w]<min && !flag[w])
                                {
min=dist[w];
u=w;
}
                        flag[u]=1;
                        count++;
                        for(w=0;w<n;w++)
                                if((dist[u]+cost[u][w]<dist[w]) && !flag[w])
                                        dist[w]=dist[u]+cost[u][w];
        }
for(i=0;i<n;i++)
if(i==v)
dist[i]=999;
```

```
}
int sort()
{
int i,j,flag,temp;
for(i=0;i<nd;i++)
for(j=0;j<nd-i-1;j++)
{
if(dist[a[j+1]]<dist[a[j]])
{
temp=a[j];
a[j]=a[j+1];
a[j+1]=temp;
}
}
flag=a[0];
for(i=0;i<nd;i++)
a[i]=a[i+1];
nd--;
printf("%d ",flag);
return flag;
}
void main()
{
        int count,i,j;


        printf("\n Enter the source vertex: \n");
        scanf("%d",&v);

printf("\n Enter the number of  active nodes: \n");
      scanf("%d",&count);
      printf("\n Enter the active nodes \n");
 for(i=0;i<count;i++)
{
      scanf("%d",&a[i]);
}

nd=count;
for(i=0;i<count-1;i++)
{
        dij(n,v);
      v=sort();
}
printf("%d",a[0]);
}
```

CHAPTER 4

WORKING PRINCIPLE

4.1 INTRODUCTION

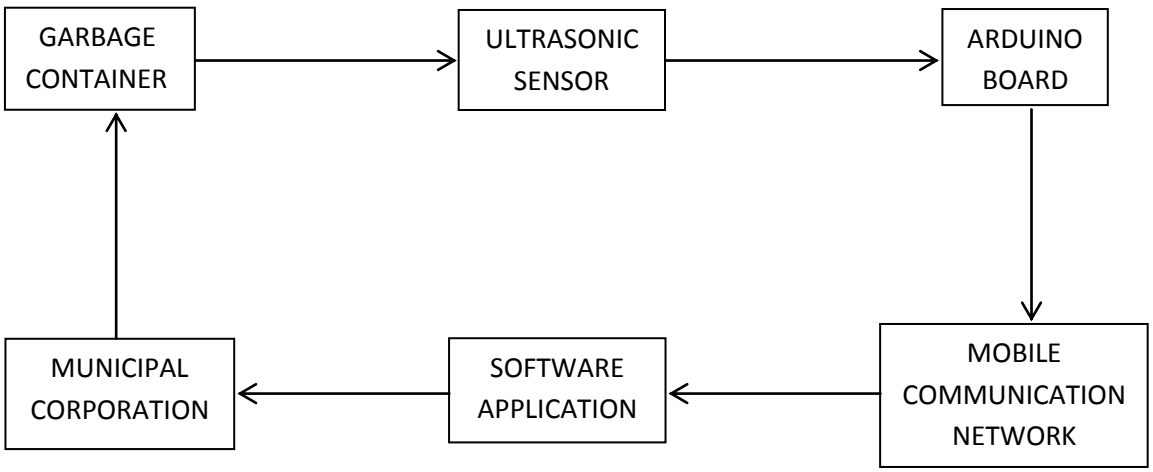
The garbage containers transmit signals to indicate that they are over 80% or 90% full and should be emptied. Via the mobile communications network, the signals are sent to a web based software application used by the waste management company.

In the software, the capacity of the container is indicated, which is taken as a basis to plan the best route for waste collection garbage trucks travel only to those containers that actually need to be emptied.

A robust ultrasonic sensor is installed in the garbage container and detects the fill level regardless of what has been deposited inside. The whole system contains **ULTRASONIC SENSOR, ARDUINO BOARD, GSM MODULE, BREAD BOARD, POWER SUPPLY (BATTERY).**

The sensor is fixed on to the bread board. the connection between the arduino board and sensor is made with the help of connecting wires. The working program is fed into the arduino board. The gsm module is also connected to the same arduino board with the help of wires. The power supply to the system is given with the help of a battery.

4.2 BLOCK DIAGRAM



CHAPTER 5

IMAGES OF MODEL

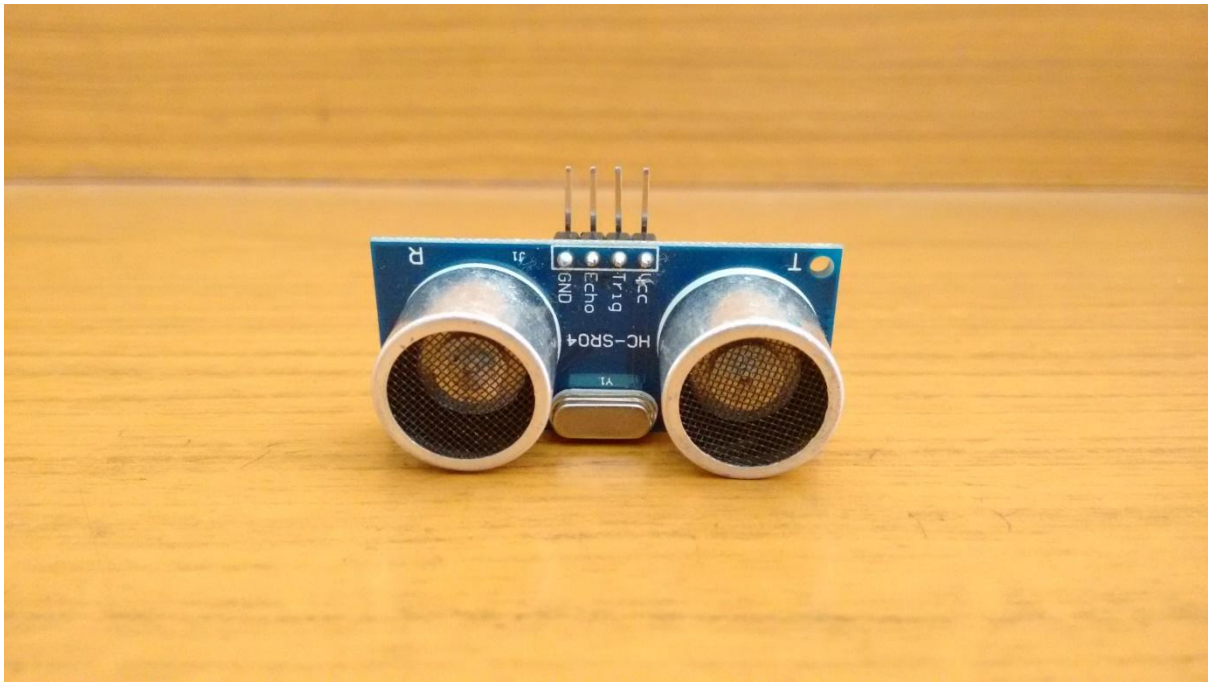


FIG 5.1 : ULTRASONIC SENSOR

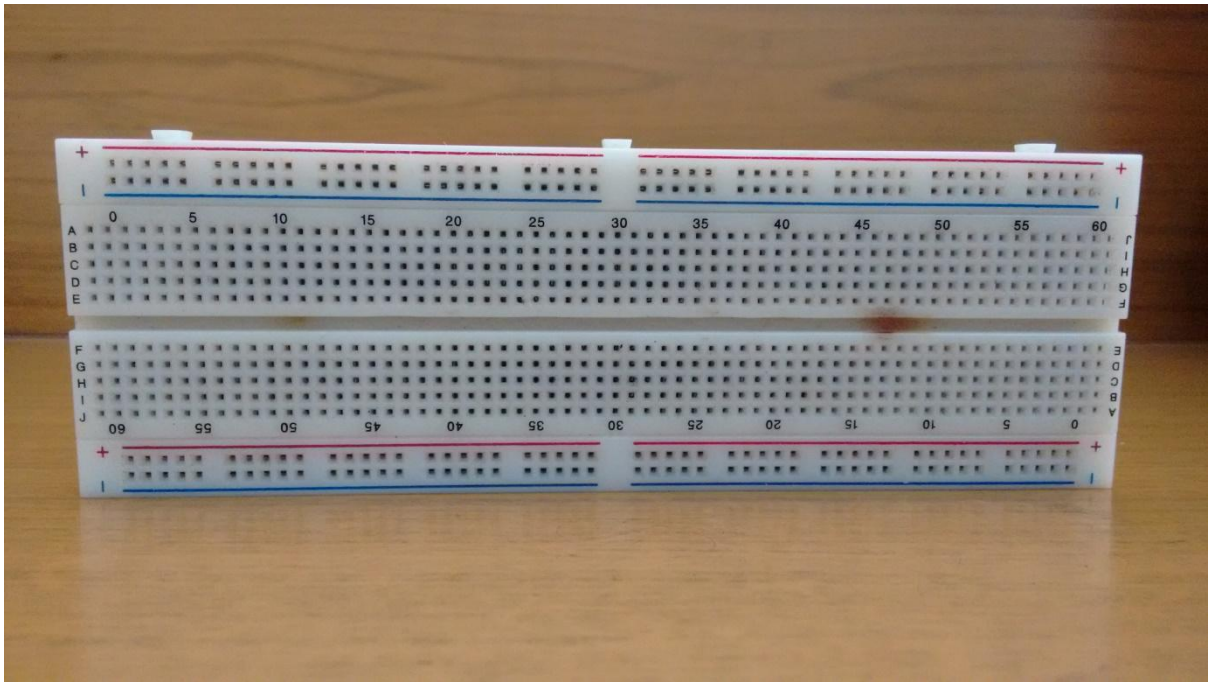


FIG 5.2 : BREAD BOARD

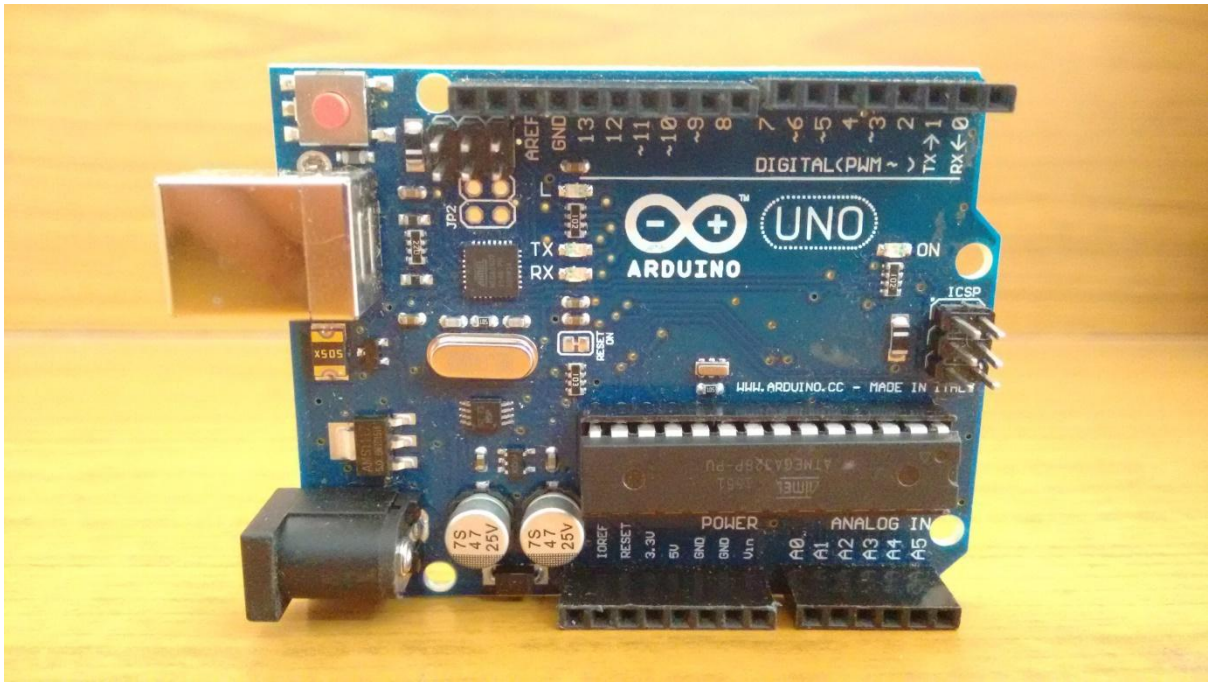


FIG 5.3 : ARDUINO BOARD

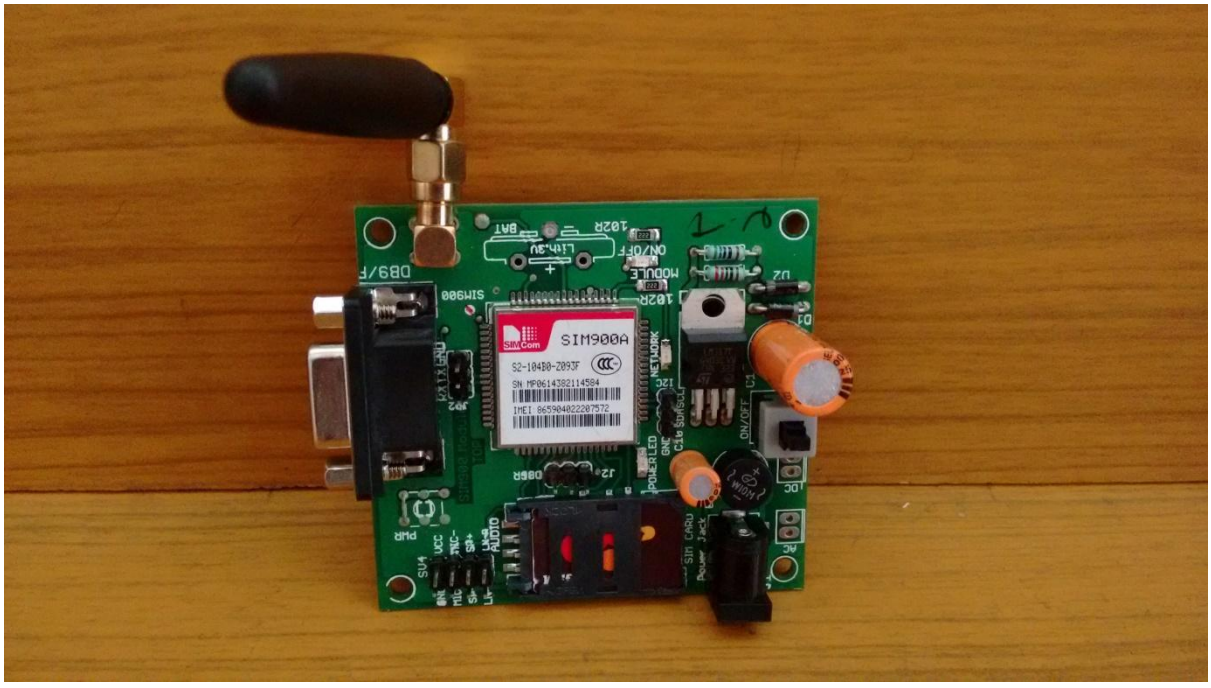


FIG 5.4 : GSM MODULE

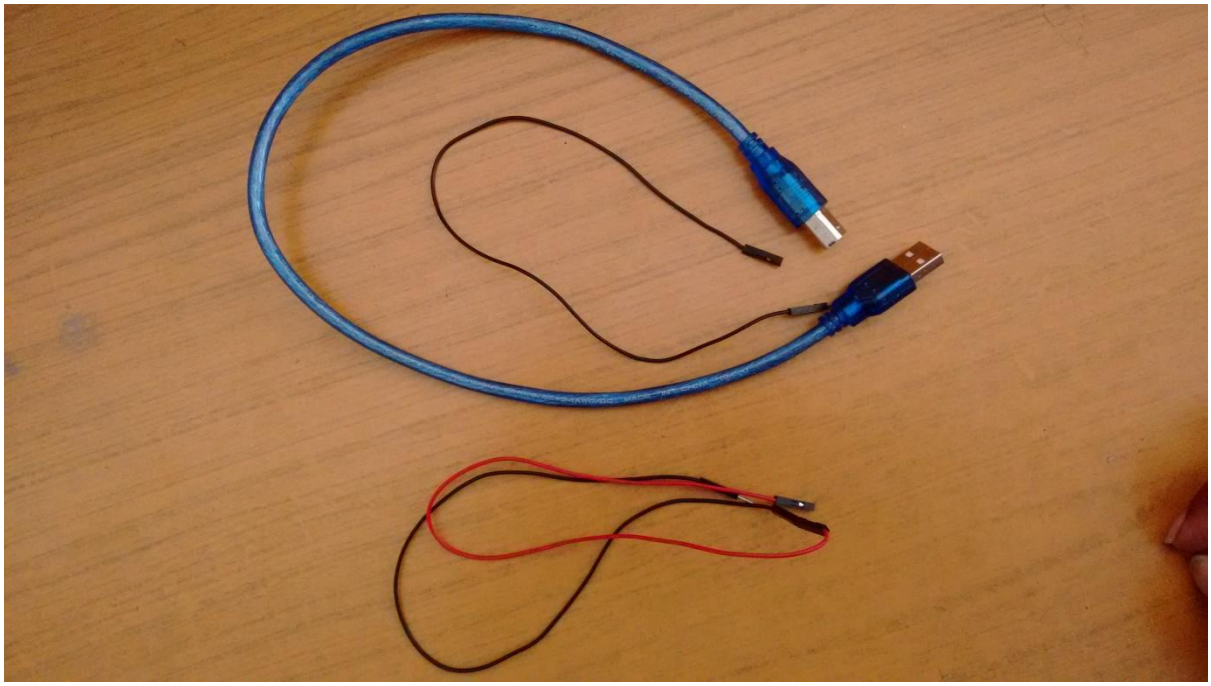


FIG 5.5 : JUMP WIRES (IN RED AND BLACK COLOUR) FOR CONNECTION OF THE EQUIPMENTS AND DATA CABLE (IN BLUE COLOUR) FOR DUMPING OF PROGRAM IN ARDUINO BOARD

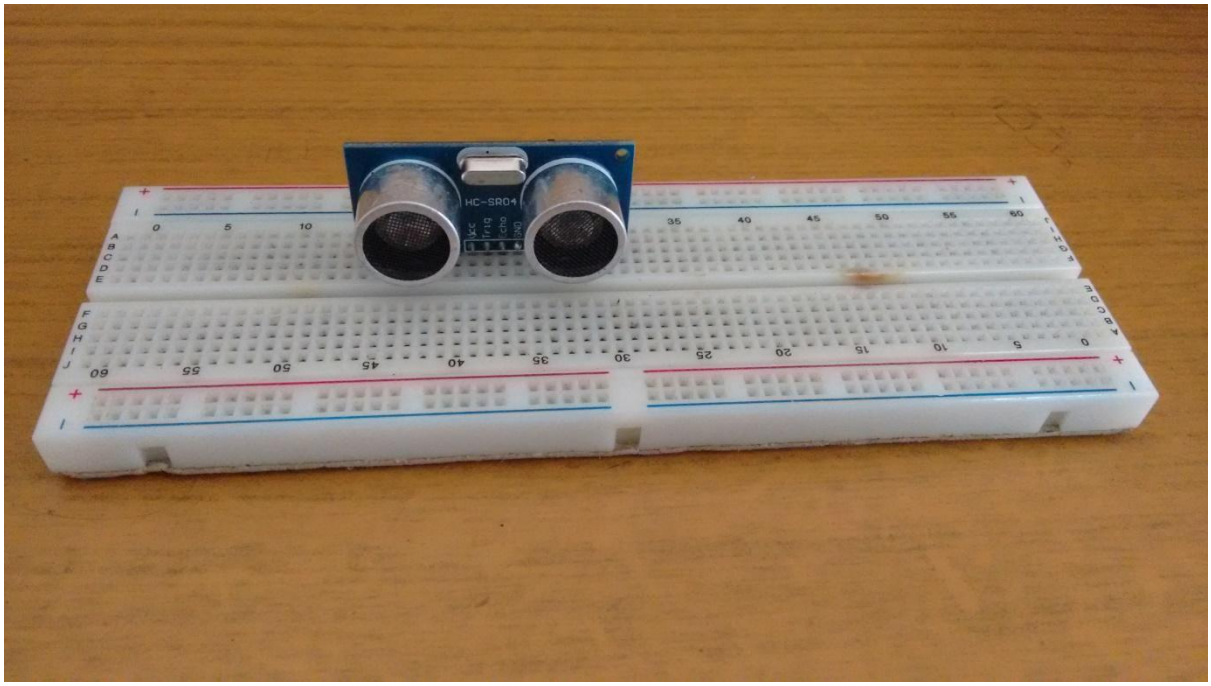


FIG 5.6 : ULTRASONIC SENSOR IS INSERTED IN BREAD BOARD

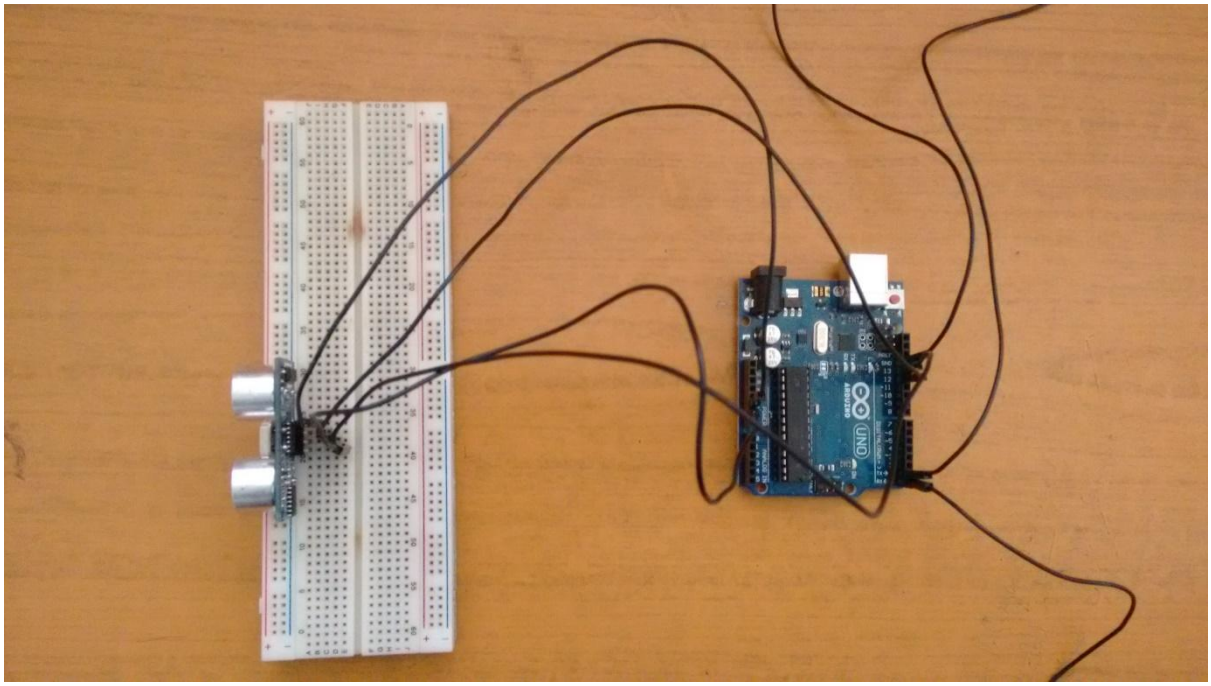


FIG 5.7 : ULTRASONIC SENSOR IS CONNECTED WITH ARDUINO BOARD THROUGH JUMP WIRES (THIS SETUP WILL HELP IN SENSING OF THE GARBAGE LEVEL)

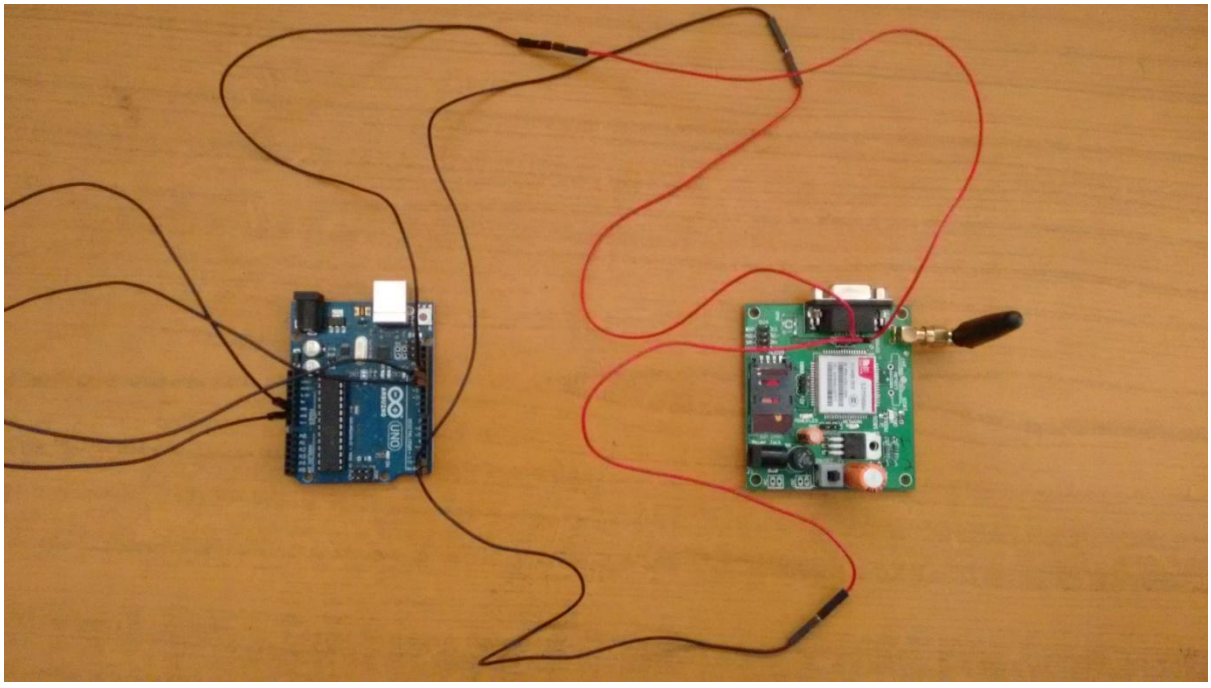


FIG 5.8 : GSM MODULE IS CONNECTED WITH ARDUINO BOARD THROUGH JUMP WIRES (THIS SETUP WILL HELP IN SENDING OF THE MESSEGE FROM DUSTBIN TO MUNICIPAL CORPORATION)

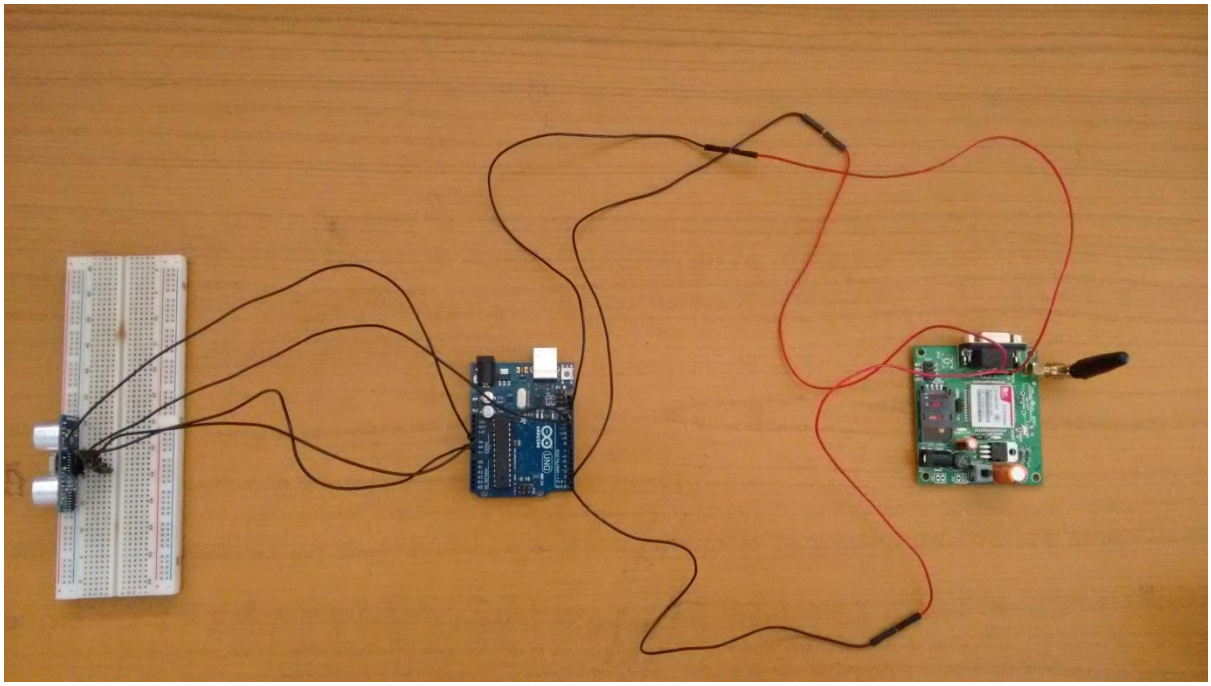


FIG 5.9 : COMBINED SETUP OF ULTRASONIC SENSOR, ARDUINO BOARD, BRAED BOARD AND GSM MODULE CONNECTED WITH JUMP WIRES

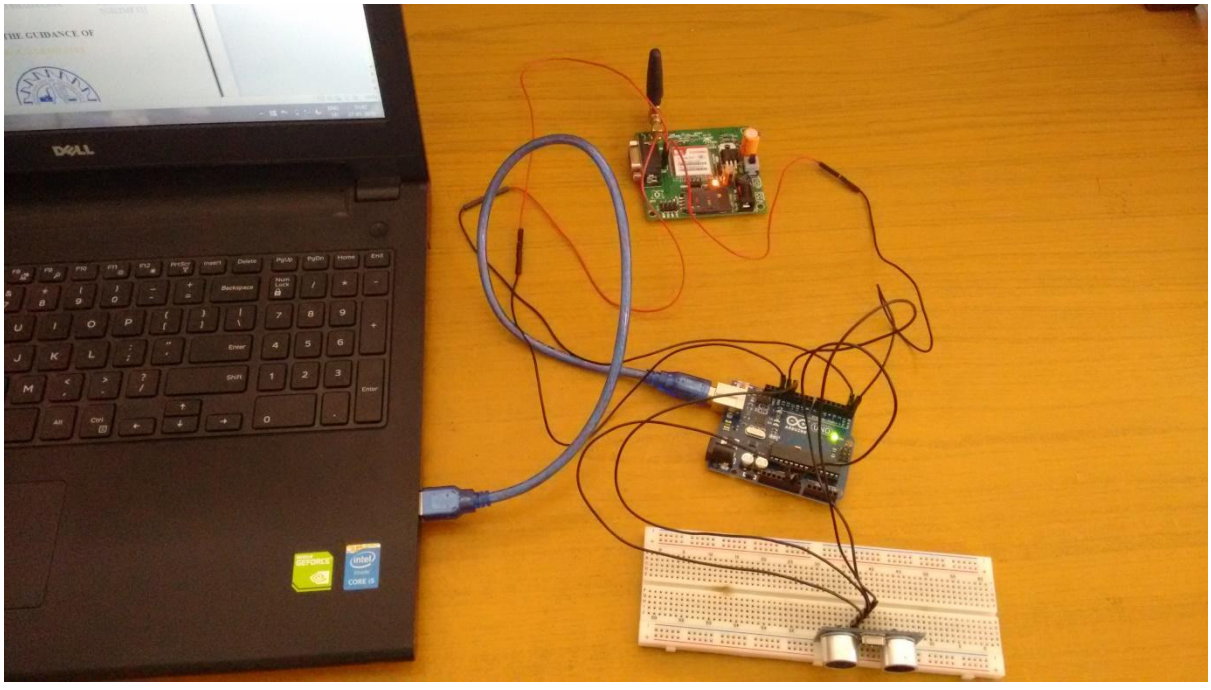


FIG 5.10 : ARDUINO BOARD IS CONNECTED WITH LAPTOP THROUGH DATA CABLE FOR DUMPING OF PROGRAM

FIG 5.11 : DUSTBIN

CHAPTER 6

LIST OF THE EQUIPMENTS WITH SPECIFICATIONS AND ITS COST (TABLE 6.1)

SERIAL NO.	ITEM	QUANTITY	COST
1	ARDUINO BOARD	1	595
2	ULTRASONIC SENSOR	1	150
3	GSM MODULE	1	1050
4	GSM CABLE	1	320
5	BREAD BOARD	1	340
6	JUMP WIRES	10	60
7	DUSTBIN	1	1500
8	STATIONARY ITEMS	5	500
9	TOTAL		4515

CHAPTER 7

CONCLUSION

- By using this method the collection of waste in the city becomes more easier. It helps in reducing air pollution, traffic flow, man power, time andmoney. With the help of proper technology (GPS & SOFTWARE APPLICATIONS) we can guide the trucks in selecting the shortest path for garbage collection. This project can add an edge to the cities aiming to get smart and people-friendly.

CHAPTER 8

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