Chapter 1 INTRODUCTION

This project will helps to eradicate or minimize the garbage disposal problem. The Internet of Things (IoT) is a recent communication paradigm that envisions near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet.

This project IOT Garbage Monitoring system is a very innovative system which will help to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via a web page. For this the system uses ultrasonic sensors placed over the bins to detect the garbage level and compare it with the garbage bins depth. The system makes use of Arduino uno, GPRS module for sending data and a buzzer. According to Ministry of Urban Wellbeing, Housing and Local Government shows that these waste are resulting in tremendous land and air pollution for the environment, health problems for communities and bottlenecks to the economic growth. Taken together, the problem of poor waste management in Malaysia is one of the nation's biggest issues to date.

Waste can be divided into two categories, liquid or solid waste, both can be hazardous. Both of these wastes can be group into organic, re-usable and recyclable waste. Mainly, liquid waste came from a point source or non-point source discharges such as wash water from homes, liquids used from cleaning in industries and waste detergents. Meanwhile, solid waste is any garbage, refuse or rubbish that make from home. These include old car tires, old newspapers, broken furniture and even food waste.

Though, the waste collection is consistent however the current collection does not allow the local municipal to know the status of the garbage bin either full or empty. This practice of garbage collection become irregular and not relevant, once the increasing of state's population. Whilst, it does not have a systematic schedule to collect every type of garbage, the overloaded garbage will attract animals and insects. So, it will create unhygienic condition for surrounding environment and creates bad small which can lead in spreading some deadly disease and human illness. Current garbage collection is inefficiencies, time waste and required a huge amount of human energy. This is because the garbage collectors need to check whether the garbage is full or not according to the fix schedule. The objectives of the project are to design a prototype of Internet-of-Thing (IoT) garbage monitoring system and alert the garbage collectors the fullness of the bin by identify the level of garbage based on the depth of the bin.

It is very important to clean all the dustbins as soon as they get filled. We will use ultrasonic sensors for this system. The sensor will be placed on top of bin which will help in sending the a Smart Dustbin proposed by, based on IoT in which the smart bin was built on a platform which was based on Aurdino Uno board which was interfaced with a GSM modem and an ultrasonic sensor. The sensor was placed on the top of the bin. A threshold level was set as 10cm. As the garbage reaches the level of threshold, the sensor triggers the GSM modem which alerts the associated authority till the garbage in the bin is emptied. At the end a conclusion was made that various issues like affordability, maintenance and durability were addressed when these smart bins were designed. It also contributed towards a hygienic and clean environment in the process of building a smart city.

Chapter 2 PROBLEM DEFINATION

A big challenge in the urban cities is solid waste management. The garbage collecting authority in traditional waste management system doesn't know about the level of garbage in dustbin, if the dust bins gets full by garbage then it gets overflowed as well as spelled out from the dustbin leading to unhygienic condition in cities. People throw garbage on that dustbin which is already overflowed. Sometimes due to unclean garbage bins bad smell arises also toxic and unhygienic gases are produced which is way to support to the air pollution and to some harmful diseases which are easily spreadable. It is very bad look of the city. Use of traditional system result in inefficient and time and money spending system.

This project combats the problem of overflowing solid waste bins which pollute the surroundings. The level of garbage present in any bin is determined by the ultrasonic distance measuring sensor. When the garbage level in any garbage bin exceeds a pre-defined level, then the microcontroller send an alert message to the e-monitoring station, and, the workstation then assigns the nearest garbage collecting truck to collect the garbage from such bins, which have sent an alert message. It informs when the container is at full capacity and when it needs to be emptied, thus allowing the sanitation specialists to work more efficiently and cut unnecessary costs.

Chapter 3 HARDWARE/METHODOLOGY

We will need the following hardware to accomplish our project.

1. Arduino Uno.
2. HC-SR04 ultrasonic sensor.
3. Connecting wires**.**
4. GSM/GPRS module

3.1 Arduino Uno

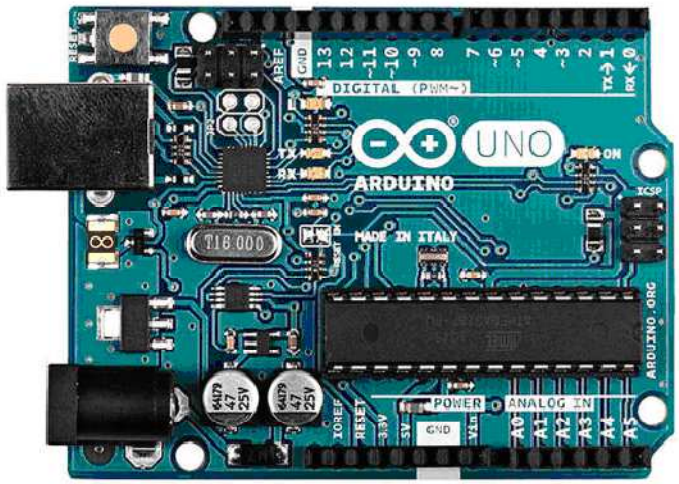

Figure 3.1 Arduino Uno

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 – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package. The Arduino is a microcontroller board based on the ATmega8.

It has 14 digital -input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a ACto-DC adapter or battery to get started .The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter .Revision 2 of the Uno board has a resistor pulling the 8U2HWB line to ground, making it easier to put into DFU mode. Revision of the board has the following new features:

Pin out: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.

Stronger RESET circuit. AT mega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform. Arduino Uno is shown in figure 1.

3.2 Ultrasonic Sensor

The Ultrasonic Sensor is used to measure the distance with high accuracy and stable readings. It can measure distance from 2cm to 400cm or from 1 inch to 13 feet. It emits an ultrasound wave at the frequency of 40KHz in the air and if the object will come in its way then it will bounce back to the sensor. By using that time which it takes to strike the object and comes back, you can calculate the distance. Distance can be measured by equation 1.

$$\text{Distance} = \text{Time} * \text{sound speed} / 2. \qquad (3.1.1)$$

Where Time = the time between an ultrasonic wave is received and transmitted. It has four pins. Two are VCC and GND which will be connected to the 5V and the GND of the Arduino while the other two pins are Trig and Echo pins which will be connected to any digital pins of the Arduino. The trig pin will send the signal and the Echo pin will be used to receive the signal. To generate an ultrasound signal, you will have to make the Trig pin high for about 10us which will send a 8 cycle sonic burst at the speed of sound and after striking the object, it will be received by the Echo pin. Ultrasonic sensor as shown in figure 3.2.

Figure 3.2.Ultrasonic Sensor.

3.3 Jump wires

Jump wires are generally used to establish connectivity with bread board as shown in figure 3.3.

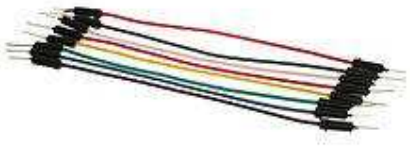

Figure 3.3. Jump Wires.

3.4 GSM Module:

GSM/GPRS module is used to establish communication between a computer and a GSMGPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with 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 their identification. A GSM/GPRS

MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

A SIM card contains the following information:

- Subscriber telephone number (MSISDN)
- International subscriber number (IMSI, International Mobile Subscriber Identity)
- State of the SIM card
- Service code (operator)
- Authentication key
- PIN (Personal Identification Code)
- PUK (Personal Unlock Code) Computers use AT commands to control modems.
- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Reading, writing and searching phone book entries.

Figure 3.4 GSM module.

Chapter 4 HARDWARE IMPLEMENTATION

Connections of the ultrasonic sensor with the Arduino are very simple. Connect the VCC and the ground of the ultrasonic sensor to the 5V and the ground of the Arduino. Then connect the TRIG and ECHO pin of ultrasonic sensor to the pin 07 and 08 of the Arduino respectively(you can use any other pin as well).Than buzzer pin are connected to 11 pin Connect the RX pin of the arduino with the TX pin of the GSM module and the TX pin of the arduino in 02 pin with the RX pin of the arduino in 03 pin GSM module. Connect the GND of the arduino to the ground of the module. Also, the GSM module needs an external 12v

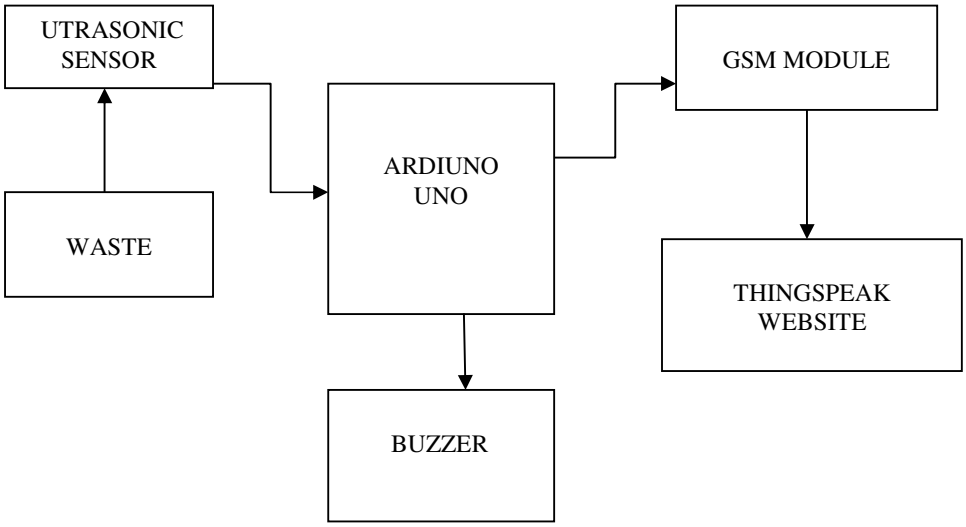

Figure 4.1 Block diagram of process system.

The propose system through a block diagram. The proposed system is using ultrasonic sensor as input and placed at the maximum level of the garbage bin. The system consist the ultrasonic sensor which measure the garbage level and an Arduino which controls system operation whereas everything will be connected to ThingSpeak. At the same time, the level of garbage also will display on allow user to know the level of garbage in the dustbin without open it. The four ultrasonic sensors connect to Ardiuno

to detect the level of garbage of each bin based on the depth of the bin. At the same, these four ultrasonic sensors connect to GSM MODULE to make sure the data transfer and display on ThingSpeak. In this work, the system will try to monitor the depth of the garbage based on garbage type. The domestic waste does not to wait the bin to be 100% full as the longer it will be in the bin; the longer the domestic waste will be rotten and create unpleasant environment.

Figure 4.2 Hardware components connection.

Chapter 5 CIRCUIT DIAGRAM

The circuit diagram and each component connect each other. Here, ultrasonic sensors are connected to Ardiuno UNO and GSM module using logic level converter. The function of logic level converter is to reduce the voltage from ultrasonic sensor 5V to 3.3V. This is because every PIN in GSM module can accept 12 V only. In this system, the ultrasonic sensor need at least 5V to generate the data and. To make connect ultrasonic sensor to GSM module. The date than been collected then send to ThinkSpeak to analyse and visualise uploaded data.

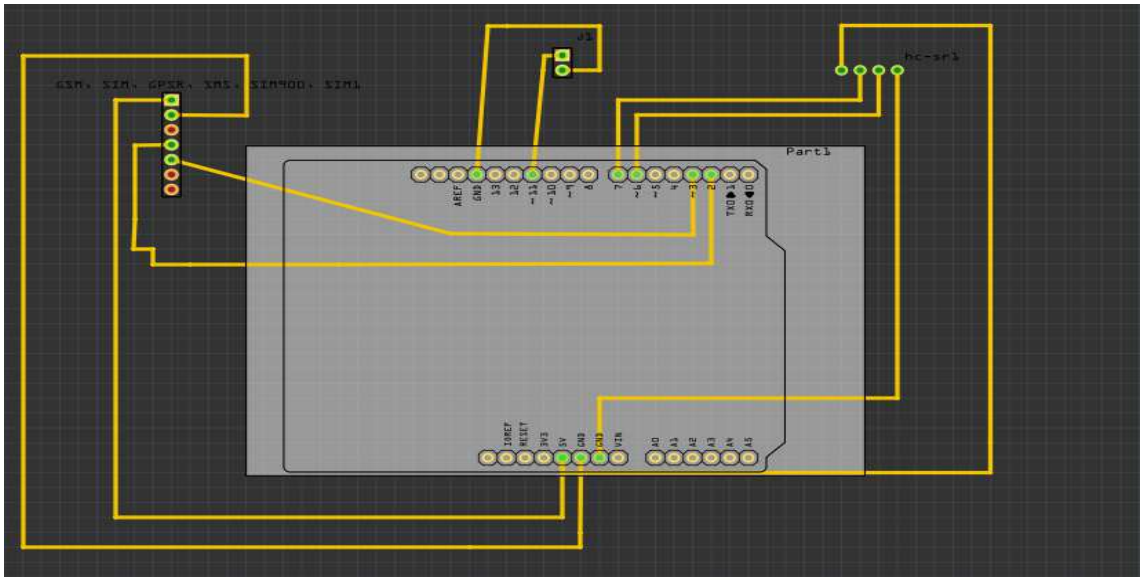

Figure 5.1 Circuit diagram .

Chapter 6 FLOW CHART

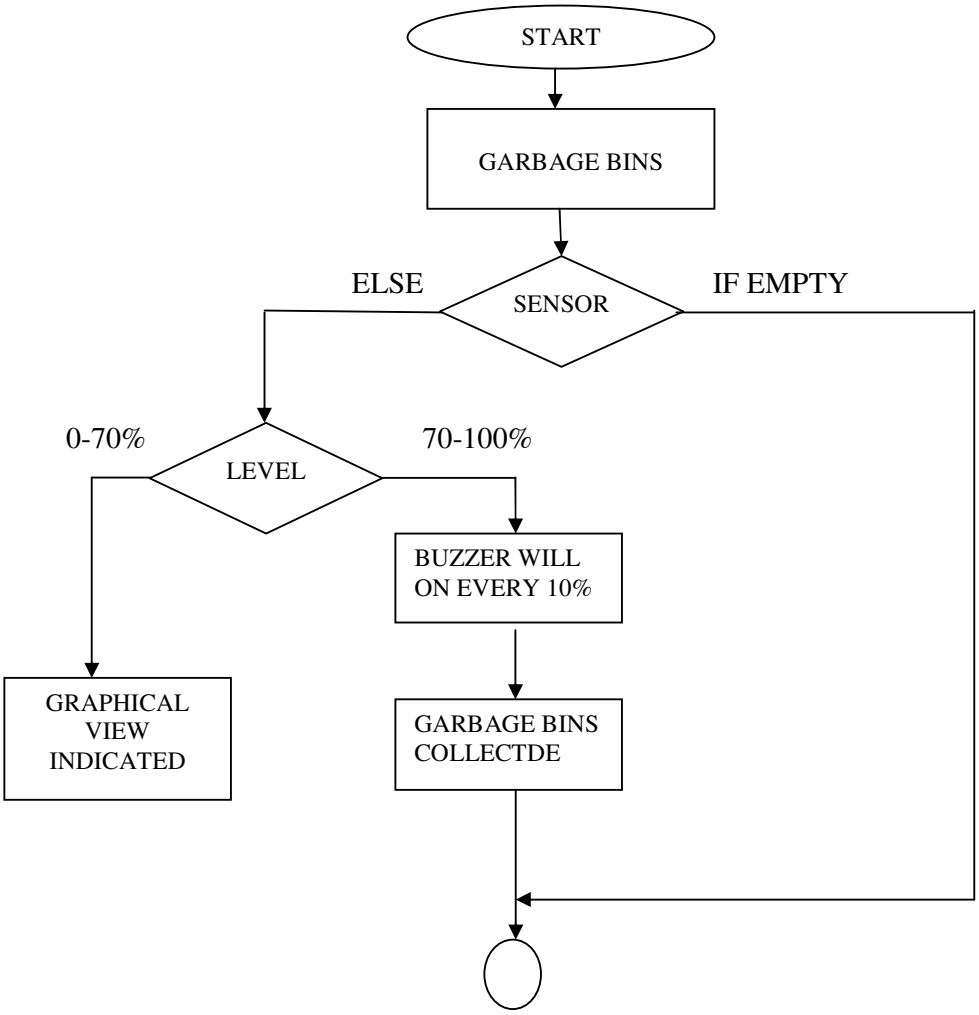

Figure 6.1 Flow chart.

6.1 Working Process

After the account creation, the arduino will first read the ultrasonic sensor, It will send the signal with the speed of sound. It revert back after striking the object and the travel time is store based on equation1. Thus the distance of the object is calculated. Based on the distance we can identify the garbage level to be low or high. We used the term “overflow” to indicate the necessary for cleaning process.

Chapter 7 SYSTEM TESTING

7.1 Test

We will test the project in two stages: software and hardware. The software part is to be tested via the Arduino UNO, whereas the hardware part has to be tested physically. It is necessary to check whether the system is working properly or not. To check whether the readings are accurate, we will check the distance pointed out by the sensor by a meter tape and buzzer are working or not.

7.2 Testing Strategies

Testing strategies are referred as test cases. The functioning and outcomes of the smart garbage bin.

TEST CASE DECSRIPTION	TEST CASE NOTATION	INPUT	REQUIREMENTS	TESTCASE STATUS	BUZZER
The garbage bin found to be 'EMPTY'.	T1	Null	Garbage bin should not have waste in it.	Pass	NO
The garbage bin found to be 'MEDIUM'.	T2	Garbage filling	Garbage bin should be filled to its intermediated level	Pass	NO
The garbage bin found to be 'NEARLY FULL'.	T3	Garbage filling	Garbage bin should be filled to an above intermediate level	Pass	YES
The garbage bin found to be 'FULL.'	T4	Filled	Garbage bin should be filled to its maximum level	Pass	YES
The garbage bin found to be 'THRESHOLD CROSSED'.	T5	Spillover	Garbage bin should be filled to a level that crosses the threshold limit	Pass	YES

Table 7.1 Smart Garbage Bin status identification and evaluation results.

7.3 Result

The system is evaluated by testing the emptiness and fullness of the garbage bin. Fig 7.2 shows that the garbage bin is empty thus level of garbage is empty. The fullness of the bin on Buzzer that attach at the bin to alert the users percentage of the fullness of the bin.

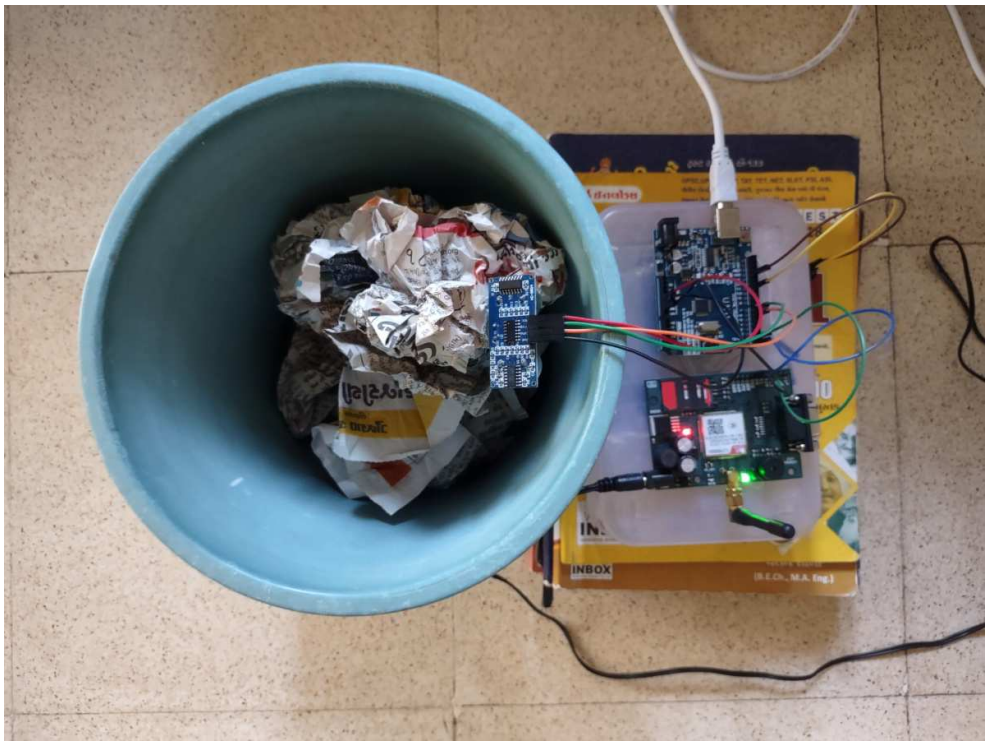

Figure 7.2 Project model

At the same time, data from sensor will send to ThingSpeak via GSM module. The ThingSpeak will shown the data in the real time as shown in Fig 7.2. The data on the ThingSpeak show the zero value because no garbage in the bin. So, the waste management can monitor based on the level of garbage depth inside the dustbin in ThingSpeak.

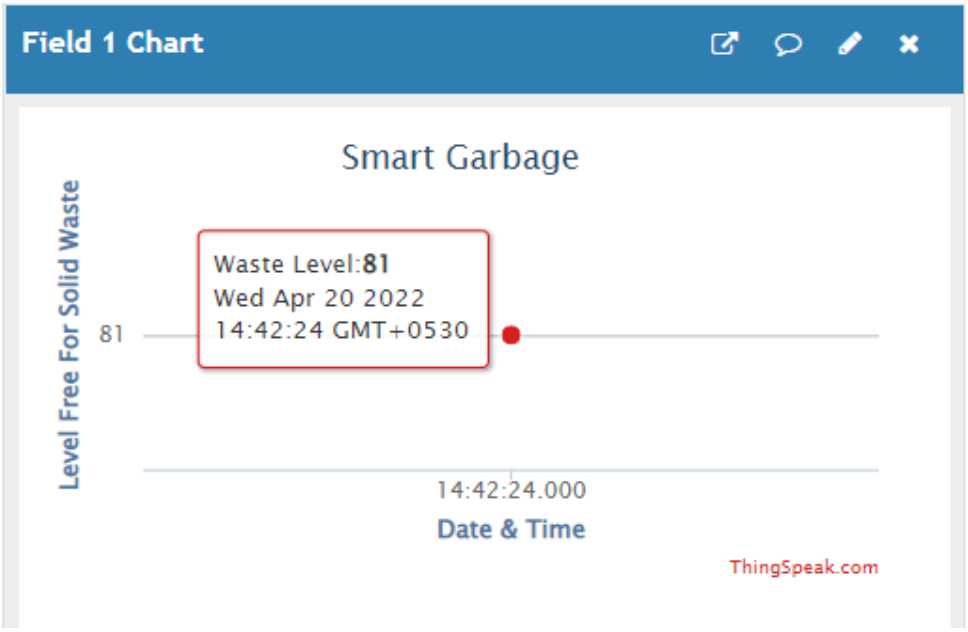

Figure 7.3 The data on ThingSpeak for each bin

The data on the ThingSpeak will shows the percentage for each bins to make sure the waste management can monitor it as shown in Fig 9. If the bin is full, the waste management can inform to collector to collect the garbage. So, collector can do their duties without any problem. .

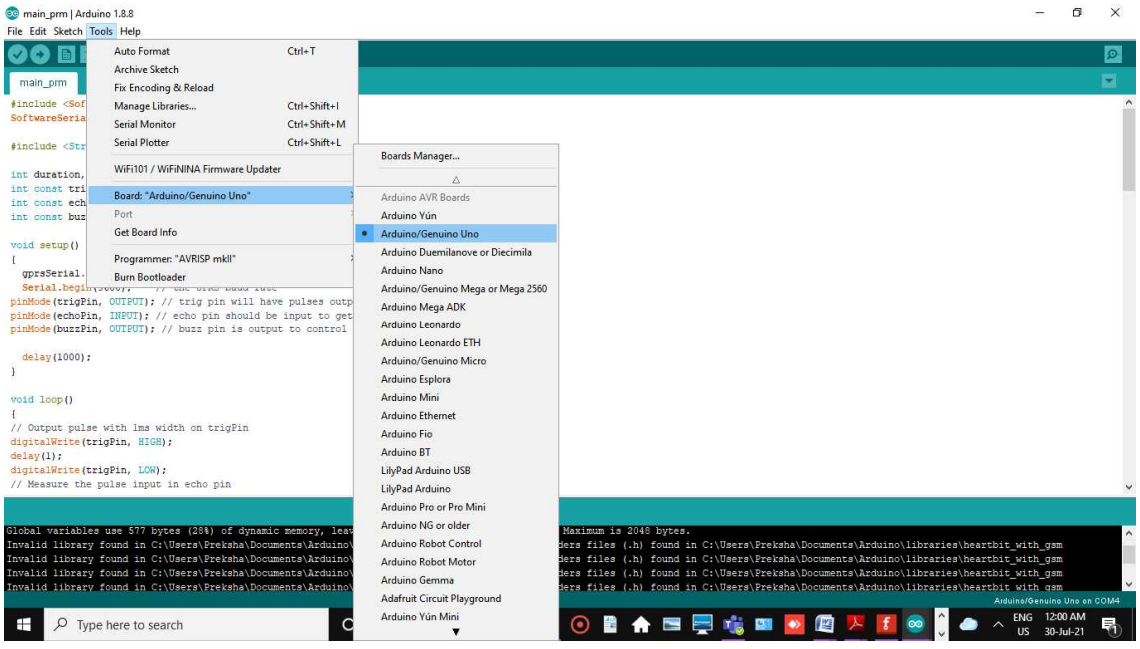

Figure 7.4 Ardiuno setup.

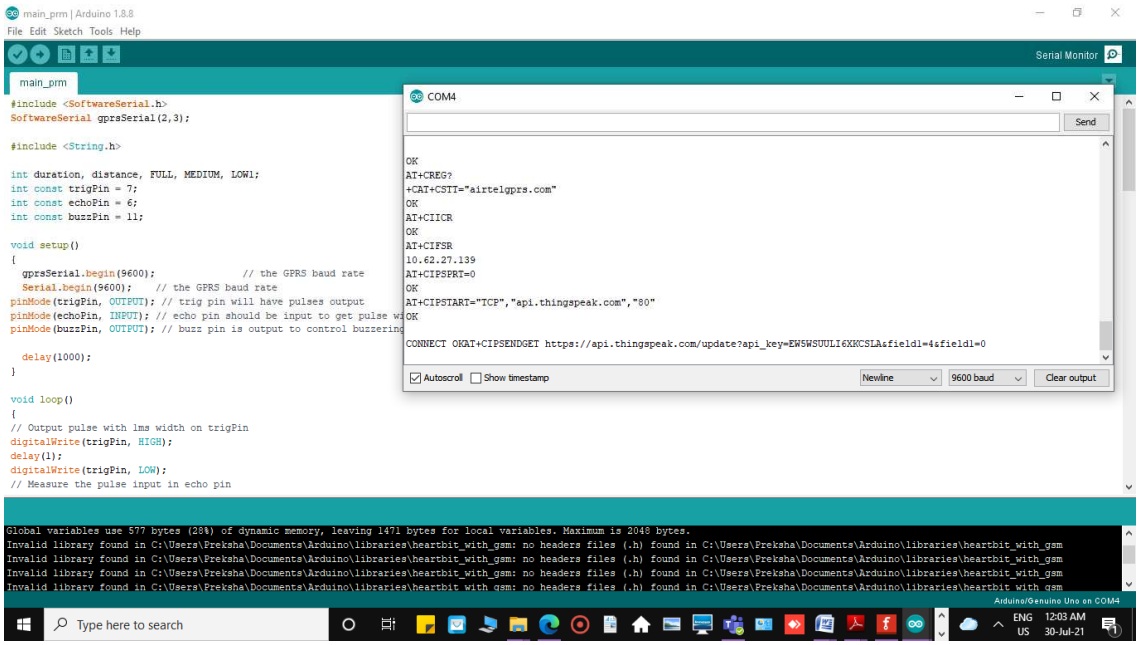

Figure 7.5 upload the coding and result are available.

7.4 Future Scope

This proposed system, integrates different sensing and communication technologies to monitor real time bin information. This system is good enough to carry out practically as it helps to collect the garbage from the garbage bins on time before the garbage overflows from that bin which can possess threat to the health of the people leaving in nearby area. This project can avoid such situations of overflowed dustbin and the message can be sent directly to the cleaning vehicle instead of the contractor's office (Authority). In Smart system design main is Development of web portal and applications for city administration, municipal staff and public.

Chapter 8

ADVANATAGES, APPLICATION & CONCLUSION

8.1 ADVANTAGES

- Very simple circuit.
- The HCSR04 sensor is very rugged.
- Helps monitor garbage levels.
- Uses very small amount of electricity.
- Ultimately helps in better planning of garbage pickups.
- Can help in reducing overflowing bins.
- Reduces trips to areas where the bins still have a lot of capacity.

8.2 APPLICATIONS

- This project can also be used in the" SMART CITY".
- This project is also helpful in the government project of "SWACHH BHARAT ABHIYAN".

8.3 CONCLUSION

A practical system for monitor the level of garbage is being presented in this paper. This project implementing real time waste management system by using sensors to check the level of garbage in the dustbin. In this system, the information of the dustbin can have accessed from anywhere and anytime. This system will help inform the status of each dustbins in real time. So, waste management can send the garbage collector to pick up the garbage when the dustbin is full. The range of ultrasonic sensor can detect distance is between 2cm until 400cm and buzzer are work.This sensor will compare the depth of the dustbin to show the level of garbage in the bin. At the same time, this sensor will send data to ThingSpeak via GSM module. The data in ThingSpeak will show the data in real time. Therefore, waste management can be monitor.

REFERSNCES

[1] Parkash and V. Prabu, "IOT based waste management for smart city," International Journal Research Compututer and Communciation Engineering., vol. 4, no. 2, 2016.

[2] A. Omran, A. Mahmood, and H. a Aziz, "Current practice of solid waste management in Malaysia and its disposal," Environmental Engineering Management Journal, vol. 6, no. 4, pp. 295–300, 2007.

[3] Kumar, S., Smith, S.R., Fowler, G., Velis, C., Kumar, S.J., Arya, S., Kumar, R. and Cheeseman, C., 2017. Challenges and opportunities associated with waste management in

India. Royal Society open science, 4(3), p.160764.

[4] A clean city in the waiting? But our garbage is spilling over.

https://www.todaygh.com/clean-city-waiting-garbage-spilling/

[5] Medvedev, A., Fedchenkov, P., Zaslavsky, A., Anagnostopoulos, T. and Khoruzhnikov, S.,2015, August. Waste management as an IoT-enabled service in smart cities. In Conference on Smart Spaces (pp. 104-115). Springer, Cham.

[6] Nallapaneni Manoj Kumar, Karthik Atluri, Sriteja Palaparthi, "Internet of Things (IoT) in

Photovoltaic Systems", 2018 IEEE National Power Engineering Conference (NPEC), 9th and [7]10th March 2018, Madurai, India. Manoj and Kannan E.P, "Data Acquaisition and Basic Feature,

"Solid waste Management Project by MCGM.