IOT Based Garbage Monitoring System

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IN

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TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

CHAPTER 2

LITERATURE REVIEW

CHAPTER 3

PROPOSED MODEL

CHAPTER 4

IMPLEMENTATION AND WORKING

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ABBREVIATIONS	FULL FORM
IoT	Internet of Things
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCU	Microcontroller Unit
GPIO	General Purpose Input Output pins
MODEM	Modulator Demodulator
MiB	Mebi byte
Wi-Fi	Wireless Fidelity

DECLARATION BY THE SCHOLAR

We hereby state that the work presented in this report entitled **"IOT Based Garbage Monitoring System"** submitted at **Jaypee University of Information Technology, Waknaghat India,** is an authentic record of our work carried out under the supervision of **Dr. Neeru Sharma (Assistant Professor, Electronics and Communication)**. We have not presented or submitted this work elsewhere for any other degree or diploma.

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CERTIFICATE

This is to certify that the work reported in the B.Tech project report entitled **"IOT BASED GARBAGE MONITORING SYSTEM"** which is being submitted by Abhishek Sharma, Himani Bhardwaj and Paritosh Srivastava in fulfillment for the award of Bachelor of Technology in Electronics and Communication Engineering by the Jaypee University of Information Technology, is the record of candidate's own work carried out by him/her under my supervision. This work is original and has not been submitted partially or fully anywhere else for any other degree or diploma.

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ABSTRACT

In the present scenario, one of the main problems that our country is facing is that heaps and bounds of waste is getting segregated day by day. We see daily that our garbage bins are overloaded with trash which creates many problems and lead to unhygienic conditions. The waste from the bins and its foul smell often give invitation to a number of communicable diseases like diarrhoea, dengue, and many other water borne diseases. The detection, monitoring and efficient management of waste thus becomes the primary concern of the present era. The traditional way of manually monitoring the waste in waste bins is a complex, difficult and tedious process and takes more human effort, time and cost which is not compatible with the present day technologies in any way. The project IOT Garbage Monitoring system hence comes to the picture which is a very unique system to keep the mounding amount of waste under check and tackle the growing garbage in a more sustainable and time saving manner. This is an advanced method in which waste management has been made automated. This system monitors the garbage bins by measuring the depth of bins using ultrasonic sensors and sending that information to the microcontroller which in turn processes that information and displays the level of waste collected in the bins using a web page. This web page also sends all the information to garbage collection vehicles and the vehicle driver will go to that bin only in which the level of garbage has cleared the threshold level.

Chapter 1

Introduction

1.1 Motivation

Growing waste is one of the major problems faced by the rapidly transforming world today. Millions of tons of waste is being generated every day and most of the part of it is left untreated. More than 100000 metric tons of solid waste is generated by India alone every day, which is way too higher than total daily waste generation of many countries taken together.

Figure 1.1.1: Untreated Waste

The countries which are undergoing economic transformation or which are witnessing an economic shift have poorly managed waste collection methods and scarcely handled and unmanaged dumpsites. The problem is worsening. Problems due to lack of efficient governance in waste disposal is making the already deteriorating situation even more worsened. Waste management, in bigger cities, is a tough challenge to cater and many face problems due to weak institutional designs, scarcely available resources, which is a grave concern and rapid urbanization

adds to its woes. All these factors play a very important role in making the situation uncontrollable and unmanageable and hence the need arises to do something unique in order to bring this issue to the fore and do something for our and our future generations' survival.

Figure 1.1.2: Disposed Waste

Hence, the need of the hour is to monitor the waste generated and dispose it off in an efficient and time-preserving manner. This revolutionary idea of monitoring the garbage in a real time manner using the tools of technology and human brain is a very effective tool and would prove to be a huge success in the near future.

1.2 Introduction: Internet of Things (IoT)

With the steady advancements in the technical know-how and rapidly growing scientific potential, a new innovation IoT is catching the attention of many and coming down the road which is exploding as an omnipresent world computing network where everything is available to everyone by connecting to the internet.

IoT is evolving rapidly and making its indelible mark and is a hot recipe for research work where opportunities are infinite for everyone.

The amount of contraptions related with the web and benefitting web organizations is growing well beyond time and having each one of them related by wire or remote means will put a monster and intense wellspring of data readily available. The idea of empowering collaboration between intelligent machines is a forefront innovation however the advancements making the IoT are not something we are witnessing today and not new for us and have been continuously making leaps.


Figure 1.2.1: IoT Network

IoT, as you can figure by its name, is the approach of merging information got from various types of things to any virtual stage on existing Internet framework [1].

The IoT is a change in perspective in the IT field. The articulation "Web of Things" which is also in a matter of moments clearly comprehended as IoT is organized from the two words i.e. the main word is "Web" and the second word is "Things". The Internet is an overall course of action of interconnected PC sorts out that usage the standard Internet tradition suite (TCP/IP) to serve billions of customers around the world. It is an arrangement of frameworks that includes an expansive number of private, open, academic, business, and government frameworks, of close-by to overall degree, that are connected by a wide exhibit of electronic, remote and optical systems administration advances [2].

IoT term addresses a general thought for the limit of framework devices to identify and accumulate data from around the world, and after that offer that data over the Internet where it can be prepared and used for different fascinating purposes [3].

The IoT consists of smart and intelligent machines interacting and communicating with other machines, objects, environments and infrastructures. Nowadays, every person is connected to the other using a number of ways of means of communication, where the most popular communication way being internet is used widely and hence is most important in today's world.
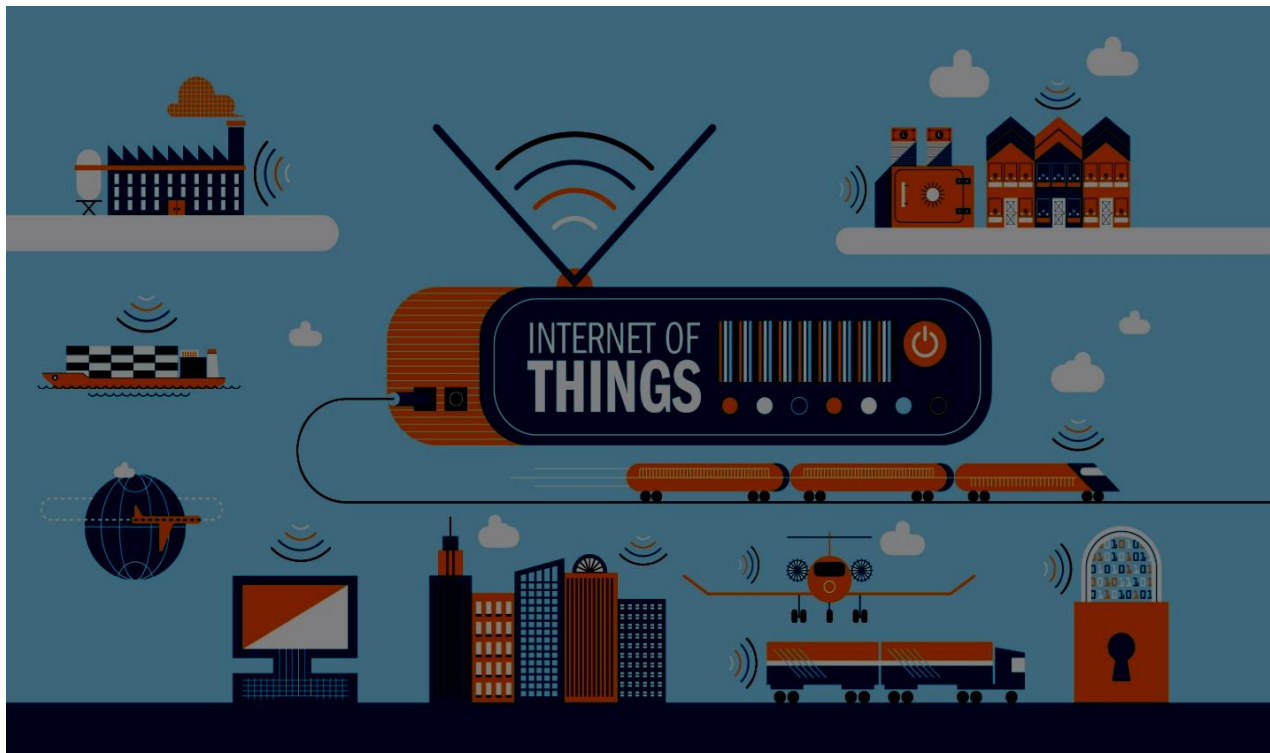
Figure 1.2.2: Representation of IoT

IoT has many benefits for the general public in many domains

- In the field of defence manufacturing
- In the field of transportation

- In the field of Education
- In the field of Telemedicine
- In Research and Development

Splendid things expect a key part in IoT vision, since embedded correspondence and information development would can change the utility of these inquiry. Utilizing sensors they can see their specific situation, and by means of implicit systems administration capacity they would have the capacity to speak with each other, get to Internet benefits and associate with individuals [3].

IOT is a view that was came into existence in 2009. This view encompasses the idea of connecting all gadgets and devices to the internet. The concept of IoT is actually trying to change our world. It is augmenting our health, life as a whole, and businesses, society by developing products which would prove to be comfortable in our life.
This is projected that by around 2020, about 50 billion equipment's would be linked to the Internet and the market would be worth around 14 trillion USD.

In other application spaces, Internet availability of regular articles can be utilized to remotely decide their state with the goal that data frameworks can gather forward data on physical questions and procedures. This empowers numerous parts of this present reality to be seen at a formerly unattained level of detail and at immaterial cost. This would not take into consideration a superior comprehension of the fundamental procedures, yet additionally for more proficient control and administration. The capacity to respond to occasions in the physical world in a programmed, fast and educated way not just opens up new open doors for managing perplexing or basic circumstances, yet in addition empowers a wide assortment of business procedures to be advance.

The utilization of "Web" in the basic setting "Web of Things" which remains for the vision plot above can be viewed as either just a representation – similarly that individuals utilize Web today, things will soon likewise speak with each other, utilize administrations, give information and in this manner create included esteem – or it can be deciphered in a stricter specific sense, conjecturing that an IP tradition stack will be used by astute things.
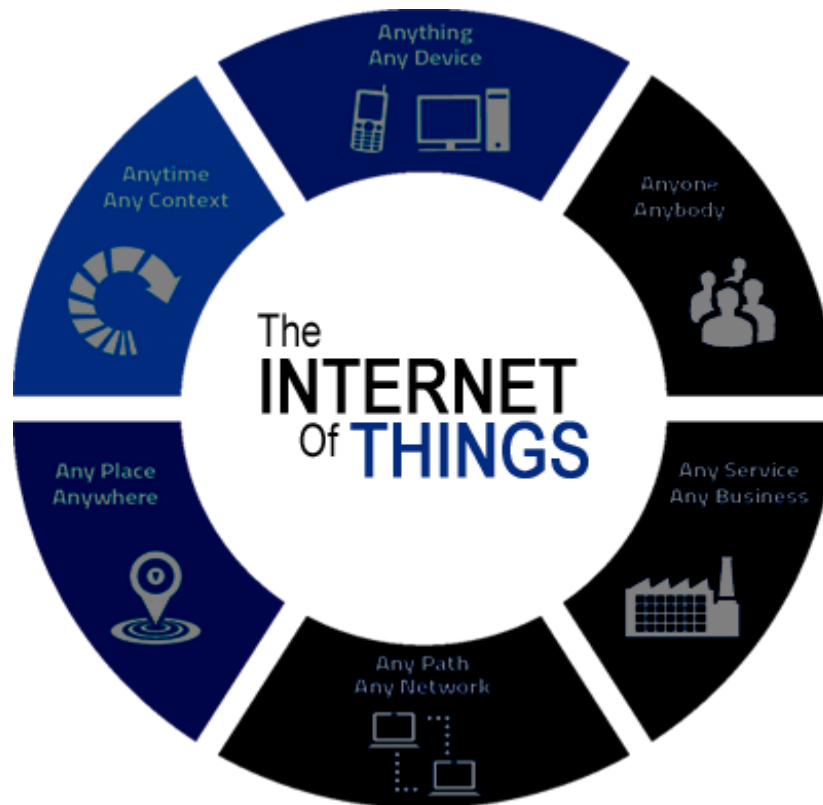
Figure 1.2.3: Benefits of IoT

1.3   Internet of Things in Garbage Monitoring

IoT can be defined as internetworking of different physical entities, vehicles, buildings, and other items— embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic

IoT is useful in building a robust system that can measure the level of garbage in the dustbins and help to reduce it and to decrease human interference in monitoring the garbage to reduce waste and provide a healthy environment. IoT can be used in making the garbage monitoring a wireless system. It can protect the environment from pollution generated due to untreated waste.

IoT can help build a unique system that evaluates the garbage continuously and indicates when there is an increase in the level of garbage in the bins and takes action to control it using wireless technology.

These improvements can be used to develop and implement a new environmental policy and manage the waste in a time efficient manner.
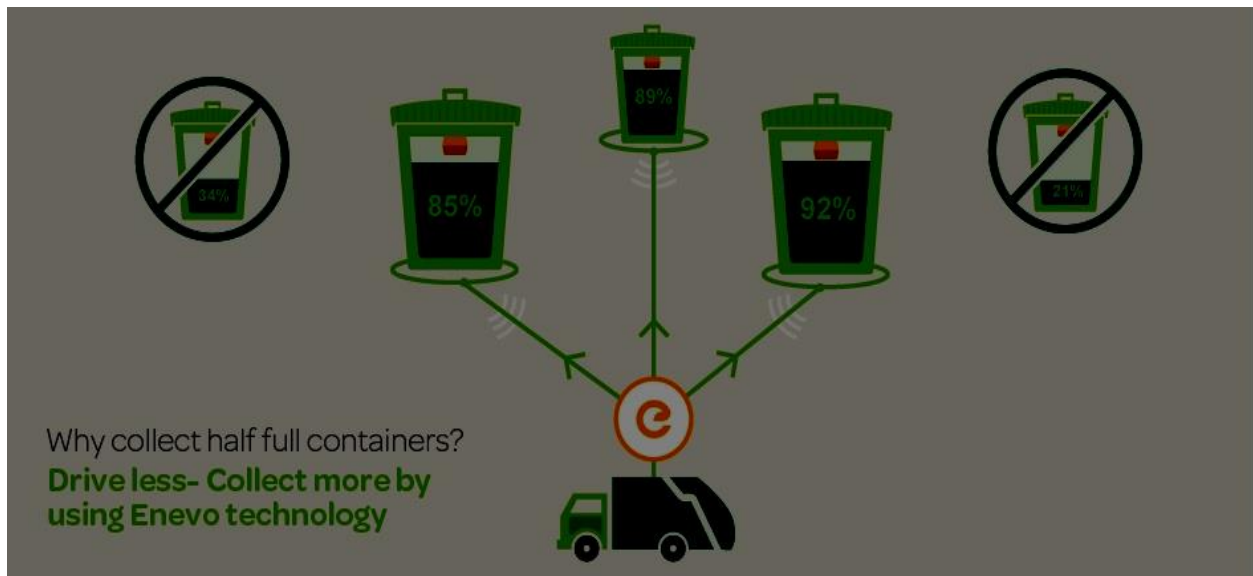
Figure 1.3: Waste Management System

IoT can help connect different components and devices used in the garbage monitoring wirelessly and monitor the increasing waste sitting at a place. There is no need to go to each and every bin to check how much it is filled. Using IoT, it would be a very easy task to monitor the garbage.

Chapter 2

Literature Review

Parkash,Prabu [4] have discussed about things (Embedded gadgets) that are associated with web and some of the time these gadgets can be controlled through the web which is usually called as Internet of Things.

Execution of ongoing waste administration framework is done by utilizing savvy dustbins to check the amount of garbage that is filled in the dustbin or whether the bin is empty.

Creators have examined how the data of every single smart dustbin can be accessed from anywhere and anytime by the concerned individual and he/she can make a choice as he/she deems to be fit. By actualizing this proposed framework the cost lessening, asset enhancement, powerful utilization of shrewd dustbins is possible to a great extent.

Traffic problem in the city can be greatly reduced by implementing this system effectively. In big and small cities and town areas the junk keeps on accumulating and the waste collection vehicle visits a particular dustbin twice or more number of times depending on the population density of the area in which the bin is placed. This framework will illuminate the status of every last tidy canister continuously with the goal that the concerned expert can send the junk accumulation vehicle the information about the status of the bin immediately after the dustbin gets full.

This framework can likewise be executed with time display in which constant clock will be available to the concerned individual showing at what time the bin is getting filled and at what time it needs to be cleaned and waste is carried out.

S.S.Navghane , M.S.Killedar [5] talks about how the waste administration is worked around a few components. Trash items, household waste, junk sacks, collecting containers and waste collection vehicles all shape an essential piece of this framework. These smart bins are directly connected and interfaced with microcontroller based framework demonstrating current status of junk, on portable web program with html page by Wi-Fi connection.

The pollution can be greatly reduced by using these smart dustbins. Commonly, the dustbins gets flooded with large amount of junk and numerous creatures like puppies or rats enter inside or close to the dustbin. This makes an awful scene causing numerous ailments. Likewise a few birds additionally try to take out the trash from dustbin. This innovative venture can keep away such unavoidable situations from happening. Moreover, the message can be sent straightforwardly to the waste collecting vehicle rather than the temporary worker's office.

Abhishek Dev, Maneesh Jasrotial [6] talks about the real application field of IoT. Absence of waste management causes a serious environmental problem. One possible solution provided by the authors in this paper is the application of IoT to tackle this problem.

IoT is simply the interconnection of different physical devices present through a common platform, possibly web. It is a propelled area of innovation in which every bit of information related to an individual is put away on the cloud with ongoing speedy access to information and additionally data mining can be carried out. While the information is put away on the cloud and individuals having the internet access, will give them an edge to access that information sitting anywhere in any corner of the world. Such headway likewise prepares sensors, switches and routers for sending and receiving data across the internet for different purposes.

A unified and centralized framework for constant evaluation is our prime objective to accomplish. Along these lines both the metropolitan cities and subjects can take advantage from a streamlined framework which brings about significant cost reduction and reduction in environmental pollution.

9

The basic objective of the project is to assure the cleanliness and hygiene of the areas where the bins are placed and the management and administration that it carries away with it. It goes for cutting edge administration of the entire waste gathering framework.

Different hardware components are used for implementing this system which includes ultrasonic sensors, a microcontroller and Wi-Fi module for processing and sending the necessary data to the authorities concerned.

Web portal or the online platform on which the level of garbage is being displayed is also a very important aspect of this system. It should be ensured that the portal is user friendly so that the person concerned to monitor and citizens both can well understand the whole system without any difficulty.

Monika K A1 , Nikitha Rao [7] have examined about the waste administration which is an essential issue to be considered. In this paper, compartment relies upon a microcontroller based stage Arduino Uno board which is made to interface with GSM modem and Ultrasonic sensor. Ultrasonic sensor is put at the most elevated part of the dustbin which will evaluate how much deep the bin actually is.

The range of the ultrasonic sensor measuring the depth of the bin will be 2-400 cm. Let us assume the total bin depth is 15cm, then threshold depth is set as 10cm.Programming is done in such a way that microcontroller will evaluate the total depth of the bin and then checks how much the bin is filled and then accordingly compare it with the threshold set to show the level of bin that is filled or empty. Until the bin is not cleared of waste, the GSM modem which will help to alert the concerned authorities will be continuously triggered by the sensors once the threshold has been reached. Once this project is implemented on an expansive scale, by replacing our customary traditional dustbins, waste can be managed effectively as it will keep a check on the unnecessary accumulation of waste on the roadside.

Puspendra Singh, Ram Bilas Nagar [8] have talked about the project based on IoT to avoid the problem of waste.

The main motive of implementing the project is to reduce human resources, environment pollution and efforts with the enhancement of a smart city vision. The project is to promote **Swachh Bharat Abhiyan.**

This is an arrangement for planning a savvy junk container with Ultrasonic sensor and Wi-Fi module for transmission of information. Though every proposed idea may look similar but every new proposition has got something new in its core and in its approach.

The discussed project work is the execution of smart garbage bin monitoring system using sensors, Microcontroller and Wi-Fi modem. This proposed model assures the clearing of waste from garbage bin as soon as it crosses the threshold limit. By implementing this system, total number of rounds the collection vehicle has to make gets reduced and the total expense spent on garbage collection gets minimized.

Prof. Dr. Sandeep M. Chaware, Shriram Dighe [9] talks about the propelled technique in which management of waste is computerized.

This system screens the waste repositories and tells about the level of garbage assembled in bins by making use of a web page. This website page likewise send all data to waste collecting lorry.

For efficient, timely as well as cost saving disposal of the waste, different components are integrated to get the maximum and best output. The created framework provides an enhanced and improved database for junk accumulation time and waste sum at every area.

By executing this project sustainably, issue of over streaming of trash from the bins in local location which is beforehand either stacked physically or with the assistance of loaders in conventional trucks is decreased. It can consequently screen the junk level and send the data to gathering truck.

The advancements which are utilized as a part of the proposed framework are sufficient to guarantee the reasonable and ideal for strong waste accumulation process observing and administration for green condition.

[Benish I. Shaikh , Prachi P. Pawade [10] have proposed a system which is a cost effective and time saving bin monitoring system. Using some sensors and some other devices, an effective method to tackle the waste can be devised and the level of waste is to be shown on the municipality office screen. Level sensor detects the amount of waste in the bin and we will get to know to what level the bin is filled with garbage. This project is using a weight sensor which would be placed at the bottom of the bin and it would continuously monitor the weight of the garbage to detect the amount of garbage.

The creating framework will have an entire checking framework which is IoT based. Also the information will be directly sent to the internet from system; no need of computer for transmission purpose which reduces the cost.

# CHAPTER 3
PROPOSED MODEL

3.1 Introduction

The proposed model is a very innovative system which will help to handle the waste efficiently and without putting too much pressure on the resources. The proposed model evaluates the waste in the bins and a web page is developed to display the level of trash placed in the bins. Ultrasonic sensors also form an important part of this model which are placed on the top of the bins which checks the depth of the bins and ultimately the level of trash present in the bins.

The system has different components which includes ultrasonic sensors, a microcontroller, a LCD panel to display the data, a buzzer to alert the person, number of LED's, and a Wi-Fi Modem for sending and receiving the information processed by the microcontroller.. A 12V transformer feds the whole system. The status of the level of garbage collected in the bins is displayed with the help of LCD screen. The user monitors the level of garbage in the bins using a web page.

The level of garbage present in the bins is represented in a graphical manner and different colours are used to show the fill or empty level of the bins. The buzzer produces the sound whenever the amount of garbage in the bins crosses the set threshold level.

The web page used here is the IoT gecko online platform which would help the user evaluate the performance of different dustbins. In this way, a very efficient and profound method is devised to tackle the mounding heaps of waste in a time saving manner.

Model:

Dustbin	**Base station**	**Vehicle**
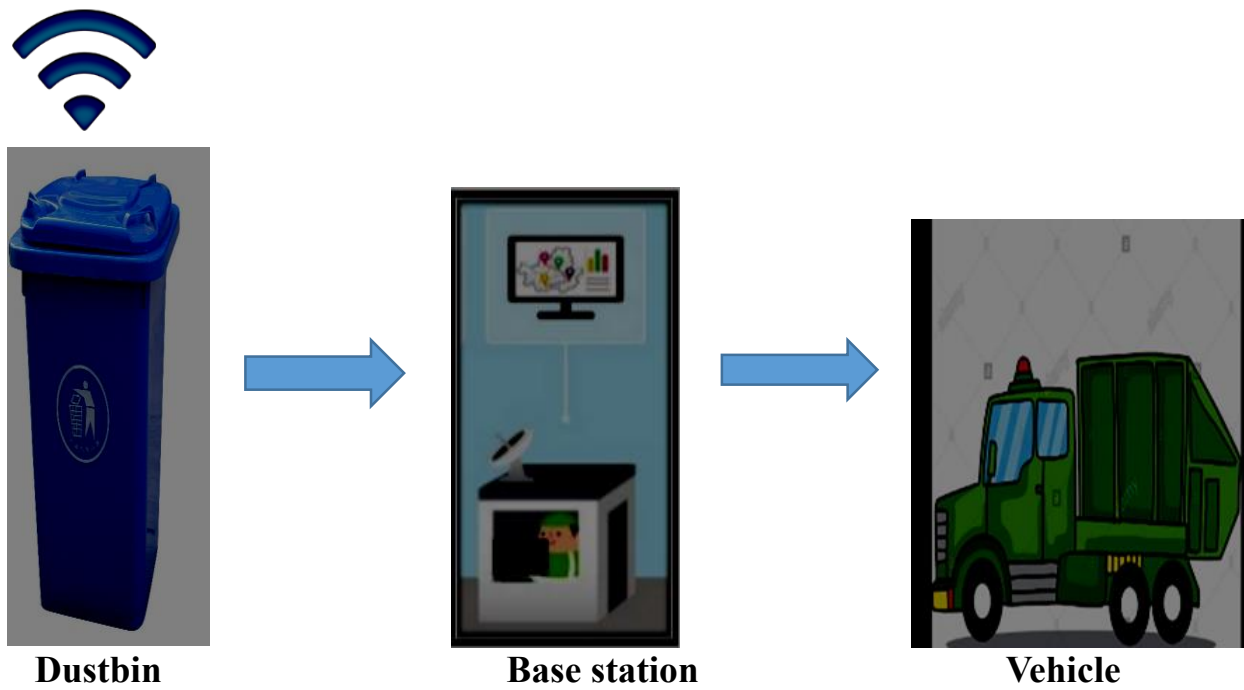
Figure 3.1.1: A practical model of smart garbage monitoring system

3.2 Hardware Requirements

3.2.1 Microcontroller :

A **microcontroller** (**MCU** for microcontroller unit) generally referred to as soc (system on a chip) is a small computer mounted on a single integrated circuit. It is composed of one or more CPUs (processor cores) along with memory and programmable input/output peripherals and other links. They are designed for different embedded applications like automobile engine control systems, medical devices, remote controls, office machines, toys, in defence sector, education and banking etc.

Figure 3.2.1: 8051 microcontroller

It has many advantages like reduced size and cost, flexible as compared to a microprocessor thus making it economical to digitally control even more devices and processes. These are considered as self-contained systems with a processor memory and peripherals with many general purpose input pins (GPIOs) that are used to read sensors' signals or external signals.

3.2.2   Wi-Fi Modem :

A **Wi-Fi Modem** is a specialized type of modem, which can give your microcontroller access to the Wi-Fi network. The Wi-Fi module is a link between the ultrasonic sensors, the microcontroller and the online web page.

Figure 3.2.2: Wi-Fi Module ESP8266

ESP8266 has 1 MiB of in built flash memory and it allows single chip devices to connect to the Wi-Fi. This module comes preprogramed initially with an AT command set firmware.

The Wi-Fi module acts as a channel which sends the information processed by the microcontroller to the web page on which the level of garbage will be displayed.

3.2.3   LCD display :

It is a flat-panel display which uses light modulating properties of liquid crystals to display the content.

Figure 3.2.3: 16*2 LCD display

It has many advantages:

- It is compact

- It is thin and light

- It has low power consumption

- Little heat is emitted by it.

Chemicals used are pair of aromatic benzene rings with a non-polar moiety on one side and polar on other.

3.2.4   Ultrasonic sensors :

These are the objects which measures the distance to an object by making use of the ultrasonic waves.

17

Figure 3.2.4: Ultrasonic sensor

One end of the sensor is transmitter which sends high frequency ultrasonic waves towards the object and the other end is the receiving end which catches the reflected wave back. The time in which the reflected wave comes back is calculated by the sensor and the speed of sound is known to be 332m/s. Using the formula

Speed=distance*time

We can calculate the distance to which the garbage is filled in the bin.

Its features include:

- Power consumption of 20mA.
- Precise distance measurement in the range 2cm-400cm.

Its accuracy can get affected by the temperature and humidity of the air.

3.2.5 Transformer :

It is an electrical device that is responsible for the transfer of electrical energy between two circuits by the virtue of electromagnetic induction. A changing electric current in one side of the coil (primary) induces magnetic field in other side of the coil (secondary) which in turn produces current in the secondary winding of the coil.
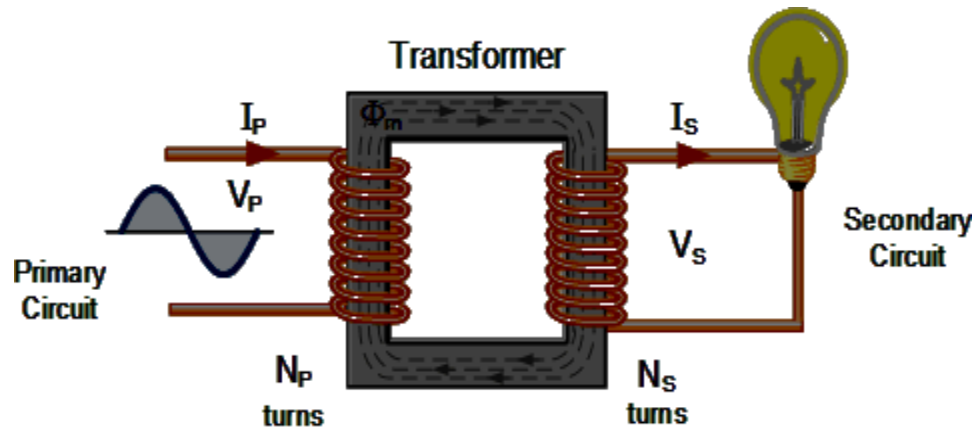

Figure 3.2.5: Transformer

3.2.6 LED :

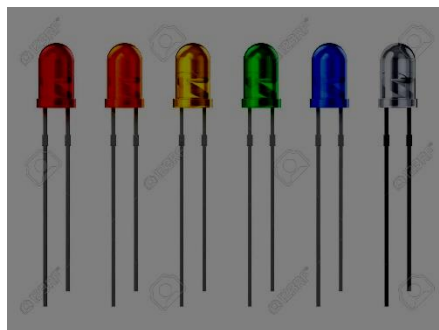It's a two lead semiconductor source that emits light when activated.

Figure 3.2.6: LED's

Each colour has a different wavelength which is responsible for the varying colours of LEDs.

3.2.7   Resistors :

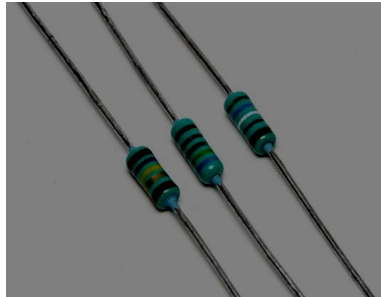It's a passive two terminal electrical component that implements resistance as a circuit element.

Figure 3.2.7: Resistors

It is used primarily to reduce current flow, balance signal levels and to divide voltage. There are two types of resistors – fixed and variable resistors.

Resistors can vary depending on its use.

3.2.8   Capacitors :

It is a passive two terminal electrical component that stores electrical energy in an electric field. It implements capacitance between two electrical conductors of a circuit
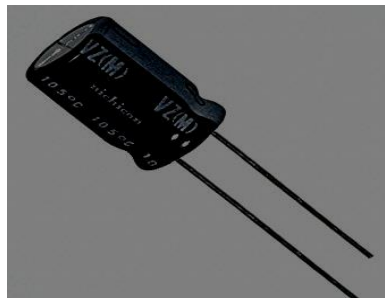

Figure 3.2.8: capacitor

3.2.9   Diodes :

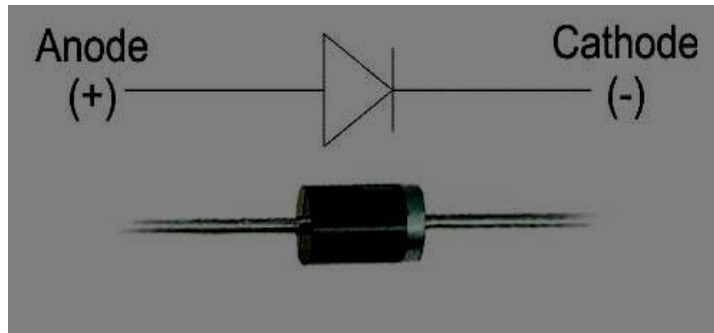It's a two terminal electronic component that conducts in one direction.

Figure 3.2.9: Diode

It has low resistance to current in one direction and high in other.

3.2.10   Regulator :

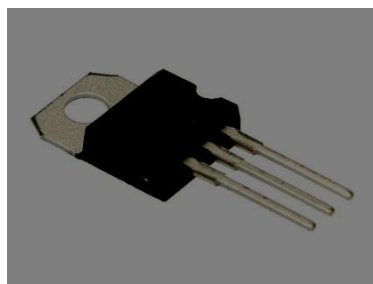It's a device or mechanism that automatically controls something such as temperature etc.

Figure 3.2.10: 3.3V regulator

Automatic voltage regulator ensures a constant output from the generator.

3.2.11   Rectifier :

It's a device that converts ac signal to dc signal. There are two types of rectifier – half wave and full wave.

Figure 3.2.11: 400V – 25A Bridge rectifier

3.3 Software Requirements

3.3.1 Arduino Software:

- It is an easy to use hardware and software which is primarily an open source electronics platform used for many purposes. They can make use of different set of inputs like a finger on button, light on any sensor etc.
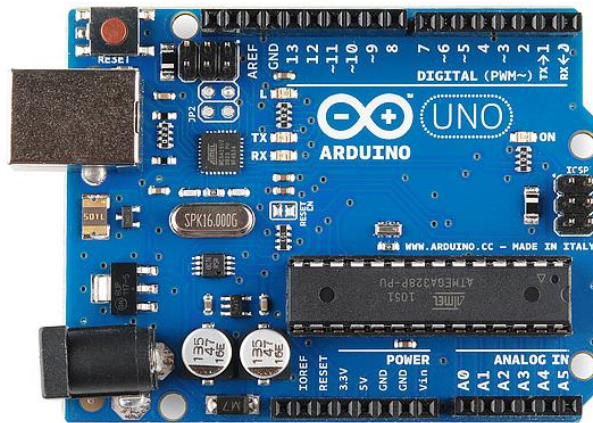

Figure 3.3.1: Arduino board

- The Arduino project provides an Integrated Development Environment (IDE) based on the Processing language project.

- The Arduino IDE supports the languages **C** and **C++** using special rules of code structuring.

- A text editor for writing codes, a message, a text console, a toolbar with different buttons for functions and series of menus all form a part of the IDE.

- The arduino uses the concept of sketchbook – a standard place to store program the first time use of the arduino software will automatically create a directory for our sketchbook.

3.3.2   MC Programming Language: Embedded C :

- Each processor is in turn somehow connected to an embedded software. It is the embedded software that decides and is responsible for the functioning of embedded system. Microcontroller is most significantly programmed using embedded C language.

- Two most important features of Embedded Programming are code speed and code size. Processing power and timing constraints determine the code speed and program memory available and which programming language is used determines the code size in embedded system. Maximum features in minimum space and minimum time are the aims of the embedded system programming.

- It has several advantages like low power consumption, rugged operating ranges and low per unit cost. These systems are based on a microcontroller.

- Embedded c programming requires non-standard extensions to the c language in order to support features such as fixed-point arithmetic, multiple distinct memory banks and input/output operations.

- Embedded C is a generic term given to a programming language written in C, which is associated with a particular hardware architecture. Embedded C is an extension to the C language with some additional header files. These header files change from controller to controller.

✓ Four types of data types are used in embedded C

Char or signed char	1 byte	-128 to +127
Unsigned char	1 byte	0 to 255
Int or signed int	2 byte	-32768 to +32767
Unsigned int	2 byte	0 to 65535

Table 3.3.2: data types and their ranges

3.3.3 IOT Gecko :

- The role of IOT development grows day by day. First is that the IOT allows us to control more than just digital objects and puts forward a new dimension on the internet. IOT based systems are used to read sensor values, operate monitored machines, monitor stuff and do lot more using IOT Gecko platform.
- Gecko is a web browser engine (developed as part of Firefox) used in many applications as well as in many other open source software project.
- Open source software is a computer software with its source code made available with a license in which the copyright holder provides the right to study, change and distribute the software to anyone and for any purpose.
- It is designed to support open Internet standards, and is used by different applications to display web pages and, in some cases, an application's user interface itself. Gecko offers a rich programming API that makes it suitable for a wide variety of roles in Internet-enabled applications, such as web browsers, content presentation, and client/server.

- Gecko is written in C++ and JavaScript, and, since 2016, additionally in Rust. It is made to work for Android , Linux , mac OS, and Windows.
- The device itself is packed with a microcontroller, removable coin cell battery, as well as a buzzer and LED light for alerts.
- The Gecko comes with four available gestures, including turning it to the left and right and shaking it once or twice. Meanwhile, the Gecko can also be used as a tracking or monitoring devices.

Chapter 4

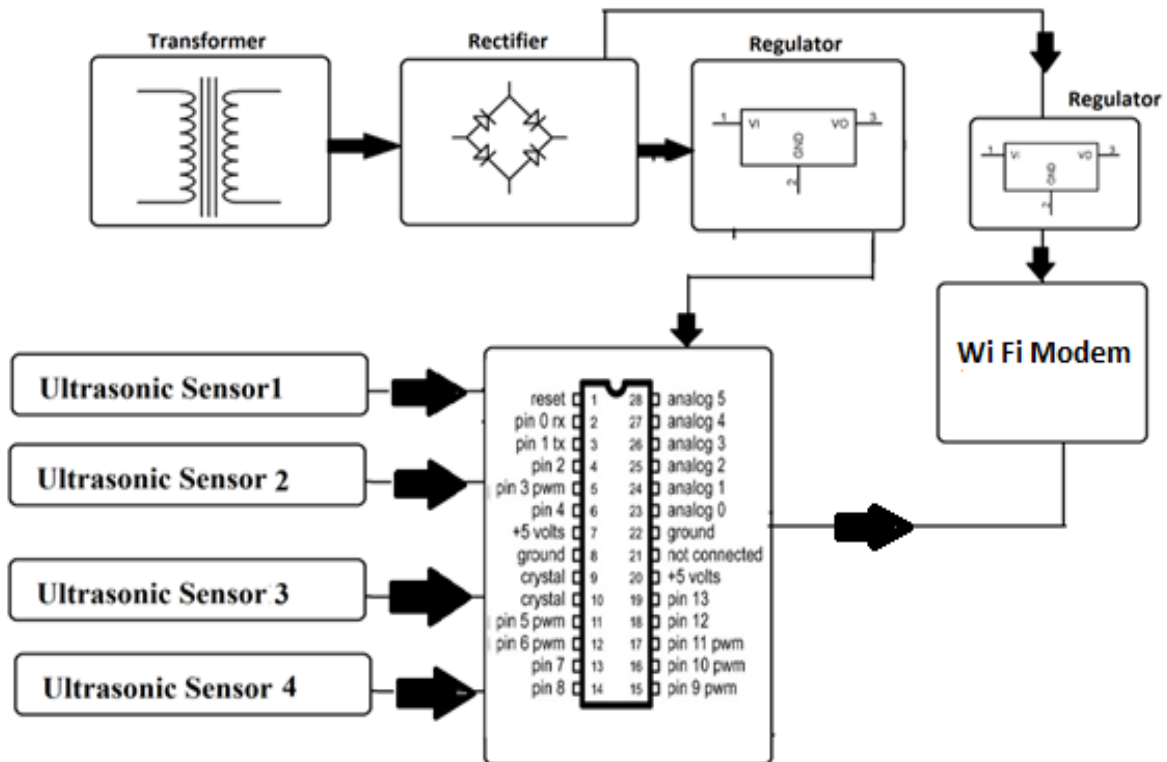## Implementation and working

4.1 Block Diagram

Figure 4.1: Block Diagram

The block diagram above shows a step down transformer connected to a rectifier which converts ac supply to dc voltage. The dc voltage is then fed to the regulator which regulates the level of dc and supplies the regulated voltage to Wi-Fi modem and microcontroller.

The ultrasonic sensors are connected to the microcontroller.

4.2 Working

The system starts with an ac supply of 220 volts being fed to a step down transformer which converts the high voltage of 220 volts to a low voltage i.e.12 volts. The small ac voltage is then supplied to the rectifier which converts the ac voltage to constant dc voltage and then to regulator which regulated the dc level and supplies 3.3 to 5 volts to microcontroller and GSM MODEM. The power supply switches the GSM modem on and we have inserted a SIM card in the GSM modem for internet accessibility. The power supply also switches on the microcontroller which is connected to ultrasonic sensors as well.

The microcontroller is connected to the LCD display which displays the level of garbage in the bins.

The Ultrasonic sensors placed over the garbage bins send ultrasonic waves into the bins to detect the depth of the bins. The distance at which the garbage is placed in the bin is measured using the time in which the ultrasonic waves come back to the sensor. An ultrasonic sensor can normally measure from 2 cm to 400 cm of depth.

The information from the ultrasonic sensors is transferred to the microcontroller which already has a threshold set. The data of the depth of the garbage in the bin is compared with the threshold level already set by the user and if the level of bin is greater than the threshold, then the LCD display shows the status of the garbage bin full.

Then, the user monitoring the LCD screen will know that which garbage bin has filled and will instruct the waste collecting vehicle owner to go to that bin only where the threshold level has cleared.

We can make this system even more efficient and time saving by making more than one threshold levels. By doing so, we can save the fuel and time of the vehicle which is going to clear the garbage in the bins. Rather than going from one corner of the city to another, he can clear the bins in the way that are near the mark of being filled. By creating more than one threshold levels, we can send a warning signal to the vehicle owner to wait a particular amount of time before proceeding to the next location.

In this project, we are using an online platform IoT Gecko to monitor the status of the bins that will be filled with garbage. IoT Gecko platform provides the webpage that can be put to use to display the dynamic situation of the level of garbage. We can also use the LCD display instead of this.
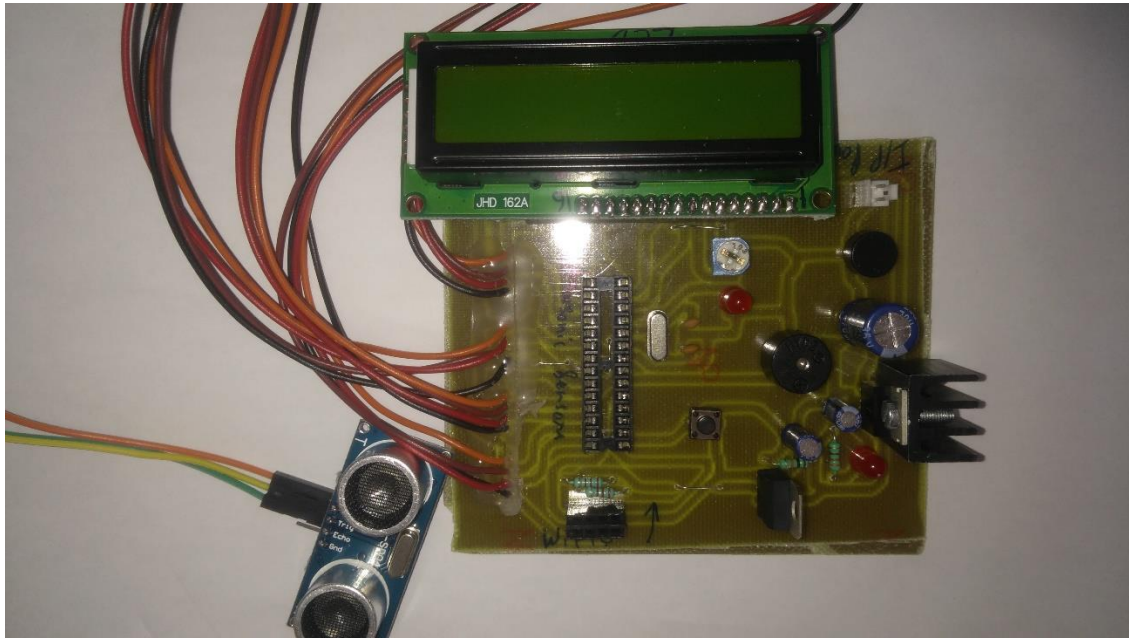
CHAPTER 5

CONCLUSION AND RESULTS

We have executed this project on bread board first and then we mounted the circuit on a PCB (Printed Circuit Board) using different components.
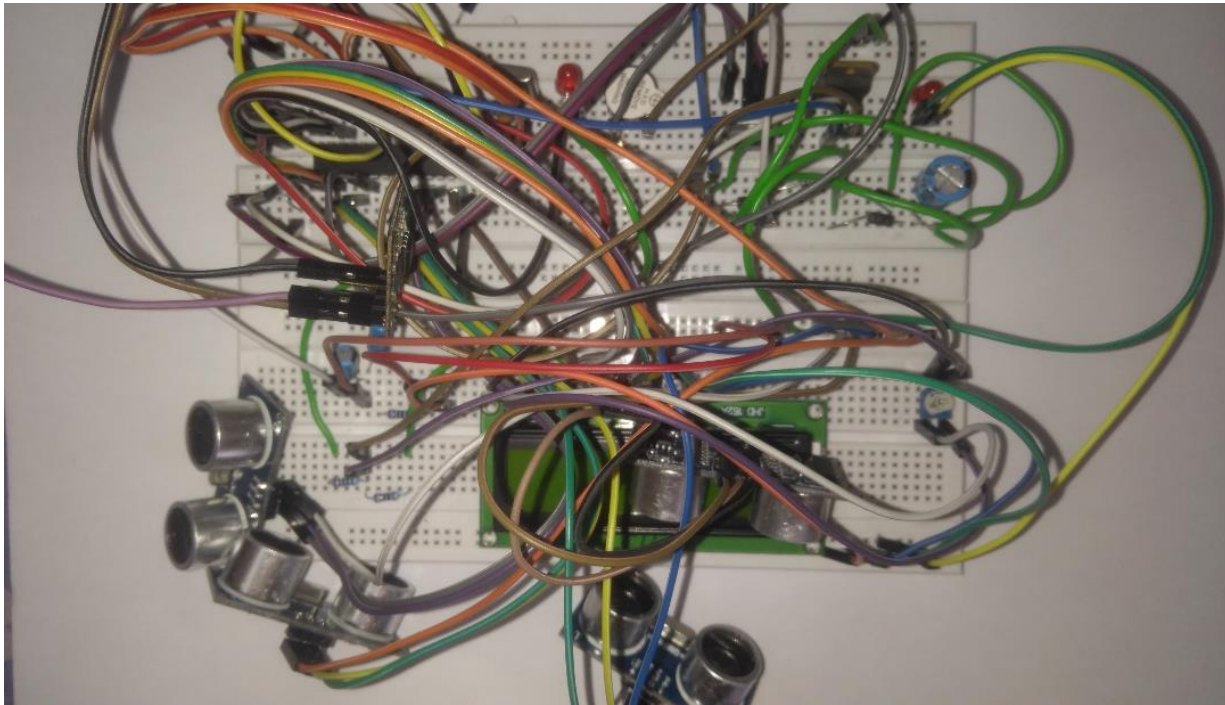
Figure 5.1:Bread board circuit

Figure5.2: Circuit mounted on PCB

Figure 5.3: Working of the Monitoring system

31

Figure 5.4: LCD Display showing Bin status and depth of the bin

A new value addition or innovative idea in this project will be to handle and dispose of the waste in an efficient and time saving way.

A more efficient way to dispose of the waste can be implemented. Suppose there are different bins placed at the different corners of the city and let us assume that the vehicle owner gets a message that the bin at location 'a' has been filled and the vehicle goes to 'a' to collect the waste.

At the same time, the vehicle owner gets an intimidation that a bin placed at the opposite corner of the city at location 'b' has got filled and the vehicle proceeds to clear that bin. In midway, the owner gets a message that the bin in the path of that way at location 'c' has got filled. So according to the protocol, the owner will go to firstly bin 'b' and then traverse the whole path back to get back to the bin 'c'.
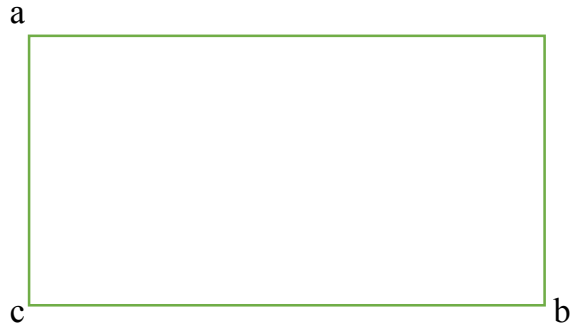
Figure 5.1: Scheme of a city

In this way, the whole system which was actually devised to make it efficient has gone wrong. The time saving approach which should have been followed is violated.

Hence, this problem needs to be tackled and it can be resolved by setting multiple threshold levels to issue an alert to vehicle owner to be alert about a bin getting filled shortly.

This could be one of the proposed modifications in our project to make it more efficient and effective.

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