# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

**Jnana Sangama, Belgaum-590018**



A PROJECT REPORT **(15CSP85)** ON

## "WASTE MANAGEMENT FOR SMART CITIES BASED ON IOT"

**Submitted in Partial fulfillment of the Requirements for the Degree of**

**Bachelor of Engineering in Computer Science & Engineering**

**By**

**SUNIL  K V (1CR13CS107)**

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## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

# CERTIFICATE

Certified that the project work entitled **"WASTE MANAGEMENT FOR SMART CITIES BASED ON IOT"** carried out by **Ms. SUNIL K V,** USN **1CR13CS107,** bonafide students of CMR Institute of Technology, in partial fulfillment for the award of **Bachelor of Engineering** in Computer Science and Engineering of the Visveswaraiah Technological University, Belgaum during the year 2019-2020. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report as been approved as it satisfies the academic requirements in respect to Project work prescribed for the said Degree.

| | | |
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Name of the examiners

1.

2.

Signature with date

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# DECLARATION

We, the students of Computer Science and Engineering, CMR Institute of Technology, Bangalore declare that the work entitled " **Waste Management For Smart Cities Based On IOT** " has been successfully completed under the guidance of **Asst Prof. Ms. Sagarika Behera ,** Computer Science and Engineering Department, CMR Institute of technology, Bangalore. This dissertation work is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Engineering in Computer Science and Engineering during the academic year 2019-2020. Further the matter embodied in the project report has not been submitted previously by anybody for the award of any degree or diploma to any university.

Place: Bengaluru

Date:

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# ABSTRACT

In the present day scenario, many times we see that the garbage bins or Dust bin are placed at public places in the cities are overflowing due to increase in the waste every day.

It creates unhygienic condition for the people and creates bad smell around the surroundings this leads in spreading some deadly diseases & human illness, to avoid such a situation we are planning to design "IoT Based Waste Management for Smart Cities".

In this proposed System there are multiple dustbins located throughout the city or the Campus,these dustbins are provided with low cost embedded device which helps in tracking the level of the garbage bins and an unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full.

When the level reaches the threshold limit, The device will transmit the level along with the unique ID provided. These details can be accessed by the concern authorities from their place with the help of Internet and an immediate action can be made to clean the dustbins.

# ACKNOWLEDGEMENT

I take this opportunity to express my sincere gratitude and respect to **CMR Institute of Technology, Bengaluru** for providing me a platform to pursue my studies and carry out my final year project

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# LIST OF ABBREVIATIONS

| ABBREVIATIONS | MEANING |
|---|---|
| SRS | Software Requirement Specification |
| JDK | Java Development Kit |
| IDE | Integrated Development enviornment |
| DFD | Data Flow Diagram |

# CHAPTER 1

# INTRODUCTION

A major environmental concern of our society today is proper management and disposal of solid waste, which is crucial to the cleanliness and overall health of our society. Traditional monitoring and disposal of waste is highly inefficient as it requires a lot of time and human effort. Using the power of IoT, we are therefore coming up with the idea of Smart Bin for efficient and smart waste monitoring. Things(Embedded devices) that are connected to Internet and sometimes these devices can be controlled from the internet is commonly called as Internet of Things. In our system, the Smart dust bins are connected to the internet to get the real time information of the smart dustbins.In the recent years, there was a rapid growth in population which leads to more waste disposal. So a proper waste management system is necessary to avoid spreading some deadly diseases. Managing the smart bins by monitoring the status of it and accordingly taking the decision. There are multiple dustbins are located throughout the city or the Campus (Educational Institutions, Companies, Hospitals etc.).

## 1.1 Existing System

As we have seen number of times the dustbins are getting overflown and concern person don't get the information within a time and due to which unsanitary condition formed in the surroundings, at the same time bad smell spread out due to waste, bad look of the city which paves the way for air pollution and to some harmful diseases around the locality which is easily spreadable.

## 1.2 Proposed System

In this proposed System there are multiple dustbins located throughout the city or the Campus,these dustbins are provided with low cost embedded device which helps in tracking the level of the garbage dustbin in the city so that it is easy to identify which garbage bin is full. When the level reaches the threshold limit, the device will transmit the level along with the unique ID provided. These details can be accessed by the concern authorities from their place with the help of Internet and an immediate

action can be made to clean the

## 1.3   PROBLEM STATEMENT

● As we have seen number of times the dustbins are getting overflown and concern person don't get the Information within a time.

● Bad smell spreads and may cause illness to human beings.

● Unhygienic Environment and look of the city.

## 1.4   Brief outline of the project

The works carried out at each project phase are outlined below:-

## 1.4.1 Learning and Analysis phase

This Phase includes :

● Gathering knowledge about existing communicating techniques.
● Well understanding of the project design review from the client.
● Learning tools,technologies &programming languages for coding purpose.

## 1.4.2 Design And Implementation

This Design And Implementation Phase includes:

● Designing the overall functional view i.e .system architecture  of the project.
● Describe the language,platform used in the project implementation .
● Identification and design of the modules for implementing.
● Implementing the applications for accessing  and controlling the different types of services.

## 1.4.3 Testing Phase

This Phase includes:

● Writing the test cases for the implemented modules.
● Executing test cases manually,comparing and evaluating the actual result with the expected result.

## 1.5   Summary

In this chapter we have discussed briefly about the overview of the project,that is the problem statement,the existing system,the proposed system ,the outline of the project,analysis ,design and implementation and finally the test cases of our project.

# CHAPTER 2

# LITERATURE SURVEY

Literature Survey is mainly carried out in order to to analyze the background of the current project which helps to find out flaws in the existing system & guides on which unsolved problems we can work out .So, following topics not only illustrate the background of the project but also uncover the problems and flaws which motivated to propose solutions and work on this project.A variety of research has been done on power aware scheduling.following section explores different references that discuss about several topics related to aware scheduling.

● **Kanchan Mahajan, "Waste Bin Monitoring System Using Integrated Technologies", International Journal of Innovative Research in Science,Engineering and Technology, Issue 3 ,Issue 7 , July 2014.[1]**

In [1], the Zig Bee, GSM (Global System for Mobile Communication) and ARM7 is used to form the Integrated system to monitor the waste bins remotely. The sensors are placed in the common garbage bins placed at the public places. When the garbage reaches the level of the sensor, then that indication will be given to ARM 7 Controller. The controller will give indication to the driver of garbage collection truck as to which garbage bin is completely filled and needs urgent attention. ARM 7 will give indication by sending SMS using GSM technology.

● **M. Al-Maaded, N. K. Madi, Ramazan Kahraman, A. Hodzic, N. G. Ozerkan , An Overview of Solid Waste Management and Plastic Recycling in Qatar, Springer Journal of Polymers and the Environment, March 2012, Volume 20, Issue 1, pp 186-194. [2]**

In [2], they came to a point It isimportant to understand the societal concerns over the increased rate of resource consumption and waste production  and therefore the policy makers have encouraged recycling and reuse strategies to reduce the demand for raw materials and to decrease the quantity of waste going to landfill.

- **Islam, M.S. Arebey, M. ; Hannan, M.A. ; Basri, H,"Overview for solid waste bin monitoring and collection system" Innovation Managementand Technology Research (ICIMTR), 2012 International Conference , Malacca, 258 – 262. [3]**

In [3],it is being proposed in this paper that introduction of an integrated system combined with an integrated system of Radio Frequency Identification, Global Position System, General Packet Radio Service , Geographic Information System and web camera will solve the problem of solid waste They also analyzed the actual performance of the system.

- **Raghumani  Singh, C. Dey, M. Solid waste management of Tubal Municipality, Manipur -  a case study Green Technology and Environmental Conservation (GTEC 2011), 2011 International Conference Chennai 21 – 24.[4]**

This paper objective of the study was to determine the characterization of the waste and the current system of management activities. The paper highlights an overview of the current municipal solid waste management (MSWM) system of Tubal Municipality and it concludes with a few suggestions, which may be beneficial to the authorities to work towards further improvement of the current management systems.

- **Vikrant Bhor, "Smart Garbage management System International Journal of Engineering Research & Technology (IJERT),Vol. 4 Issue 03, March-20152000.[5]**

In this work the proposed system describes that the level of garbage in the dustbins is detected with the help of Sensor systems, and communicated to the authorized control room through GSM system. Micro controller is used to interface the sensor system with GSM system. A GUI is also developed to monitor the desired information related to the garbage for different selected locations. This will help to manage the garbage collection efficiently

- **Narayan  Sharma,, "Smart Bin Implemented for Smart City",International Journal of Scientific & Engineering Research, Volume 6, Issue 9,September-2015.[6]**

This work describes the application of our model of "Smart Bin" in managing the waste collection

system of an entire city. The network of sensors enabled smart bins connected through the cellular network generates a large amount of data, which is further analyzed and visualized at real time to gain insights about the status of waste around the city. This paper also aims at encouraging further research in the topic of waste management.

## 2.1 Summary

This chapter mainly discuss about the papers,websites that are referred while making this dissertation report.All these papers and websites provide information related to learning of collective behaviour,their existing solutions,methods used and also their advantages &limitations.

# CHAPTER 3

# SYSTEM REQUIREMENTS SPECIFICATION

The chapter describes about the requirements. It specifies the hardware and software requirements that are in order to run the application properly. The Software Requirement Specification (SRS) is explained in detail, which includes the overview of functional and non-functional requirements.

An SRS document describes the functional and behavioural requirements of the software under development. SRS is a fundamental document which forms the foundation of the software development process. It is the complete description of the behaviour of a system to be developed it is not only the list of requirements of a system but also has a description of its major features. Requirement Analysis in system engineering and software engineering encompasses those tasks that go into determining the need or conditions to meet for a new or altered product.

The SRS functions as a blueprint for completing a project. It is important to note that an SRS contains functional and non- functional requirements.

Thus, the goal of preparing the SRS document is to

- To firm foundation for the design phase

- Support system testing facilities

- Support project management and control

- Controlling the Evolution of system

## 3.1 Functional Requirements

Functional Requirement defines a function of a software system and how the system must behave when presented with specific inputs/or conditions. These may include calculations, data manipulation and processing and other specific functionality. In these systems following are the functional requirements

- Input test case must not have compilation and runtime errors.

- The application must not stop working when kept running for even a longtime.

- The application should generate the output for a given input test case.

## 3.2 Non-Functional Requirements

Non-functional requirements are the requirements which are not directly concerned with the specific function delivered by the system. They specify the criteria that can be used to judge the operation of a system rather than specific behaviours.

Given below are the non-functional requirements:

- Product requirements
- Organizational requirements
- Basic operational requirements

## 3.3 Hardware Requirements

We need two platforms Embedded platform and Server Platform.

**Embedded platform requirements**

Controller     :     Arduino micro  controller

Battery         :     5V battery

Devices         :     Ultrasonic Sensor, Battery,

                             WIFI Module and LED.

**Server platform requirements**

We need 1 machine with following minimal needs

CPU             :       Intel 2 GHZ

Memory        :       2 GB

Disk             :       40 GB

Display         :       15 inch color

Network        :       Internet interface / Serial cable

WIFI Enabled

Input        :        Keyboard, Mouse

## 3.4 Software Requirements

The software requirements of Embedded platform is below

Coding     :            C++

Platform   :            Arduino 2.1

Dev Tool  :            Arduino Development Kit

OS            :            Windows

 The software requirements of the server platform is below

Coding         :            MAT LAB

 Platform       :            IOT

OS               :             Windows

Dev Tool      :            ThingSpeak .com

## 3.5 Hardware Description

### 3.5.1 Arduino Uno:

The Arduino Uno is a micro controller board is dependent on the ATmega328 (data sheet). The micro controller in Arduino is Microchip ATmega328P and the Operating Voltage is 5 volts. The Input 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 Current per I/O Pin is 20 mA. Direct Current for 3.3V Pin is 50 mA. The main part is the flash Memory 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 .The Length 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 micro controller; essentially associate it to a laptop with a USB link or power it with associate

degree AC-to-DC instrumentality or battery to start. The Uno varies from each single going before

board in that it doesn'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.
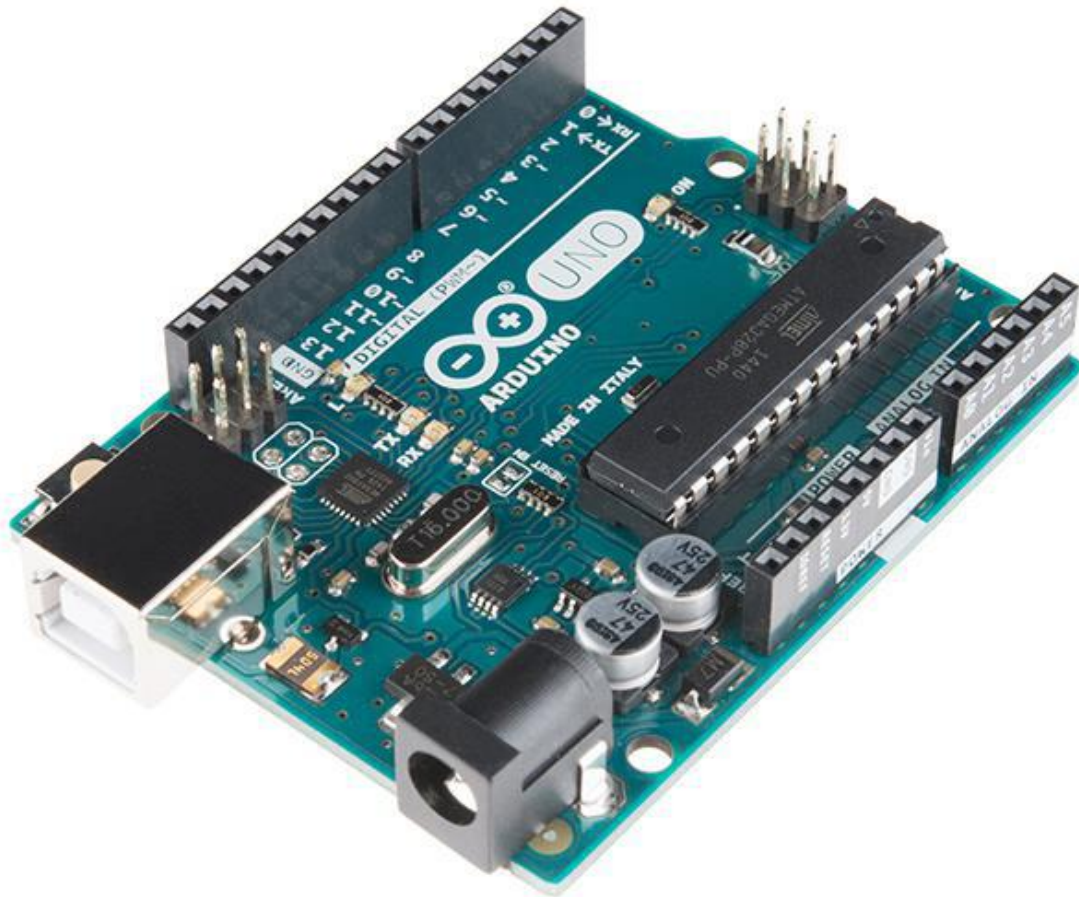


### 3.5.2 WIFI Module

ESP8266 is a Wi-Fi module which will give your projects **access to Wi-Fi or internet**. It is a very

cheap device but it will make your projects very powerful. It can communicate with any micro

controller and make the projects wireless. It is in the list of most leading devices in the IOT platform.

It runs on 3.3V and if you will give it 5V then it will get damage.

The ESP8266 has 8 pins; the VCC and CH-PD will be connected to the 3.3V to enable the wifi. The

TX and RX pins will be responsible for the communication of ESP8266 with the Arduino. The RX pin

works on 3.3V so you will have to make a voltage divider for it as we made in our project.
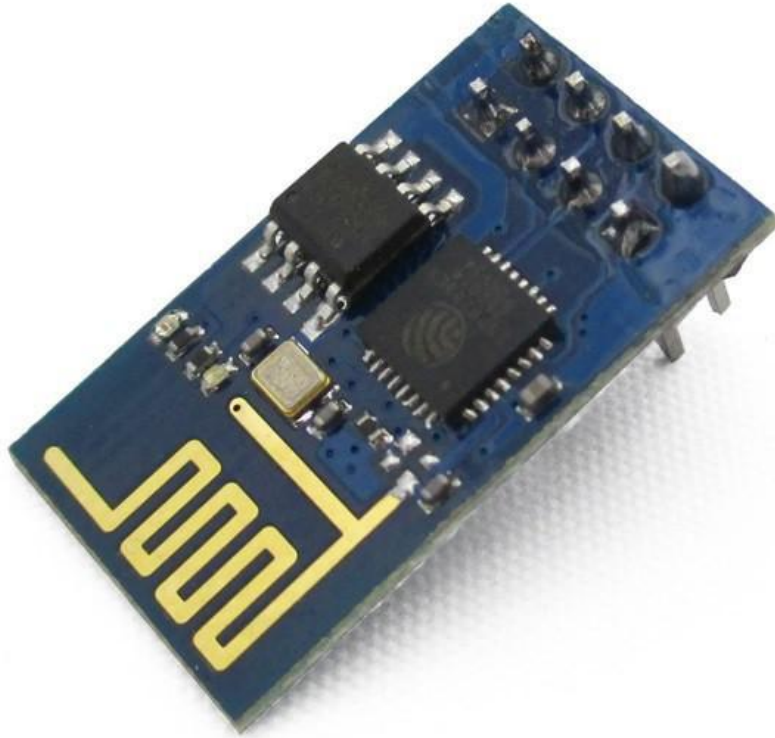
## 3.6 Software Description

● **ThingSpeak**

According to its developers, "**ThingSpeak** is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates".[2]

● **Arduino IDE**

The Arduino Software (IDE) is an open source software and it makes easy to the code and upload it to

the board. I t runs on the different plant from Windows, MAC OS, Linux. The environment is written in Java and before running the IDE Java software to be installed on the machine this software can be used with any Arduino board.

## 3.7 Summary

All the hardware and software requirements which relate to my project been mentioned here.the list of hardware requirements consists of two platforms  embedded platform and server platform specification .The list of software requirements of embedded platform and server platform also mentioned.

# CHAPTER 4

# SYSTEM ANALYSIS AND DESIGN

**System Analysis** is the process that decomposes a system into its component pieces for the purpose of defining how well those components interact to accomplish the set requirements. Systems design is the process of defining the architecture, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. There is some overlap with the disciplines of systems analysis, systems architecture and systems engineering. System design is the process of defining and developing systems to satisfy specified requirements of the user. The purpose of the System Design process is to provide sufficient detailed data and information about the system and its system elements to enable the implementation consistent with architecturalentitiesasdefinedinmodelsandviewsofthesystemarchitecture.

## 4.1.1 Input Design

System design takes the following inputs −Statement of work  Requirement determination plan Current situation analysis  Proposed system  requirements including a a conceptual data model, modified DFD s,  and Meta data (data about data).

## 4.1.2 Output Design

System design gives the following outputs − Infrastructure and or e and organizational changes for the proposed system. A data schema, often a schema, often a relational schema.Meta data to define the tables/files and columns/data-items. A function  hierarchy  diagram  or  web page map that graphically describes describes the program structure.Actual or pseudo code for each module in the in the program.  A prototype  for the proposed system.

## 4.1.3 MVC Design Method

Model–view–controller (usually known as MVC) is a software design pattern commonly used for developing user interfaces that divides the related program logic into three interconnected elements. This is done to separate internal representations of information from the ways information is presented

to and accepted from the user. ]This kind of pattern is used for designing the layout of the page.Traditionally used for desktop graphical user interfaces (GUI s), this pattern has become popular for designing web applications. Popular programming languages like JavaScript, Python, Ruby, PHP, Java, C#, and Swift have MVC frameworks that are used for web or mobile application development straight out of the box.
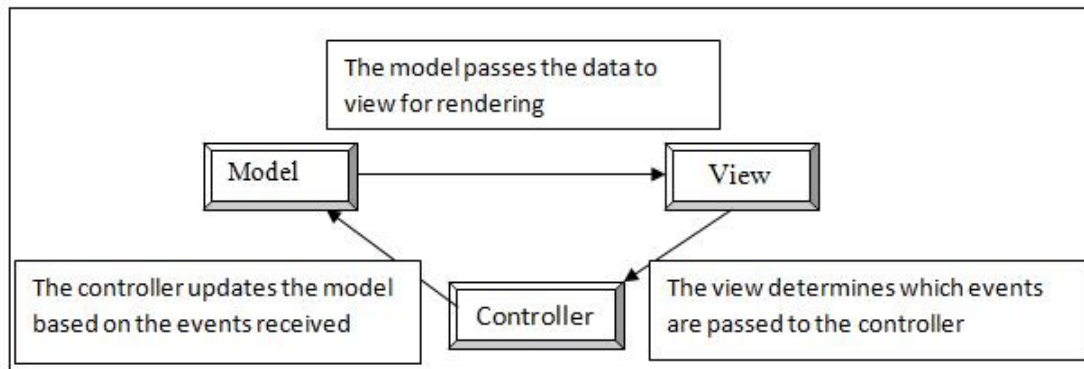


**Fig 4.1: Communication through the MVC Architecture**

**Model**
The central component of the pattern. It is the application's dynamic data structure, independent of the user interface. It directly manages the data, logic and rules of the application.

● **View**

Any representation of information such as a chart, diagram or table. Multiple views of the same information are possible, such as a bar chart for management and a tabular view for accountants.

● **Controller**

Accepts input and converts it to commands for the model or view.  In addition to dividing the application into these components, the model–view– controller design defines the interactions between them. The model is responsible for managing the data of the application. It receives user input from the controller.The view means presentation of the model in a particular format. The controller responds to the user input and performs interactions on the data model objects. The controller receives the input, optionally validates it and then passes the input to the model. As with other software patterns, MVC expresses the "core of the solution" to a problem while allowing it to be adapted for each system. Particular MVC designs can vary significantly from the traditional description here.

## 4.2 System Architecture
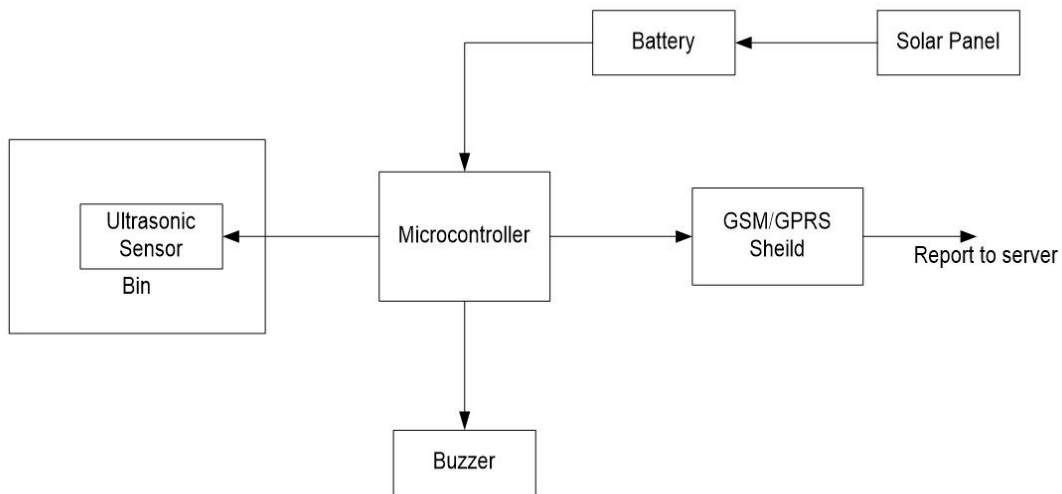


**Fig: 4.2 System Architecture At Bin side**

- **Micro controller :**The Arduino  Uno is a micro controller board is dependent on the ATmega328 (data sheet). The micro controller in Arduino is Microchip ATmega328P and the Operating Voltage is 5 volts.

- **LED:** there's a worked in crystal rectifier driven by advanced 13 pin.

- **Ultrasonic Sensor:**The Ultrasonic Sensor is used to measure the distance with high accuracy ad stable readings. It can measure distance from 2cm to 400cm or from 1 inch to 13 feet.

# 4. 3 PIN Diagram of WIFI Module
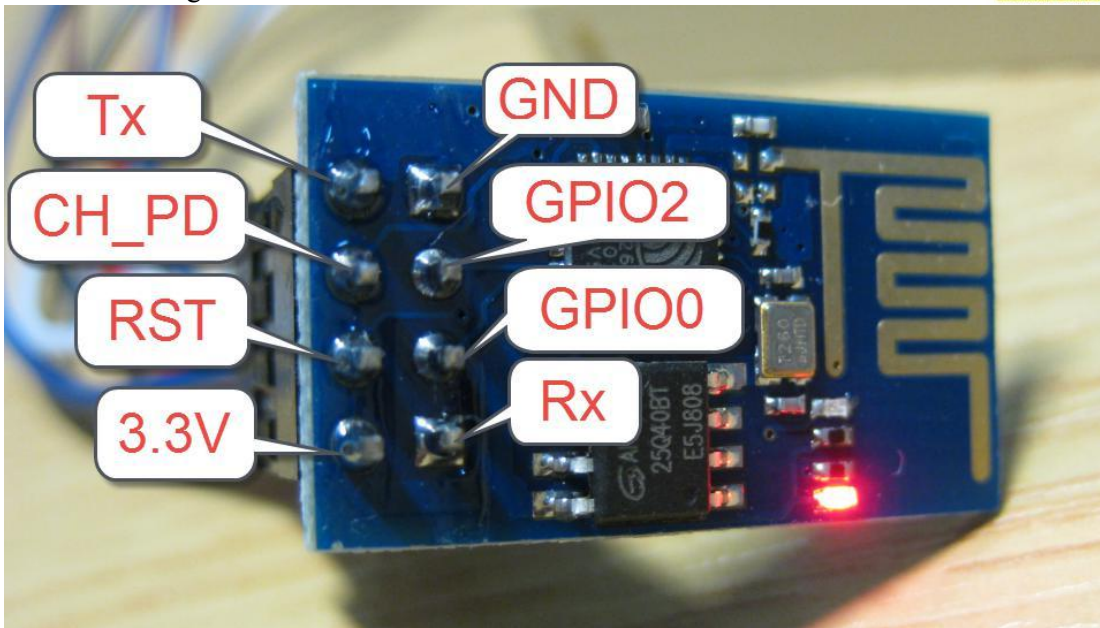
**Fig.4.3:Pin Diagram OF WIFI Module**

## 4.4 PIN Diagram of Arduino



**Fig.4.4:Pin Diagram of ARDUINO**

## 4.5 PIN Diagram of Ultra Sonic Sensor



**Fig.4.5:Pin Diagram of Ultra Sonic Sensor**
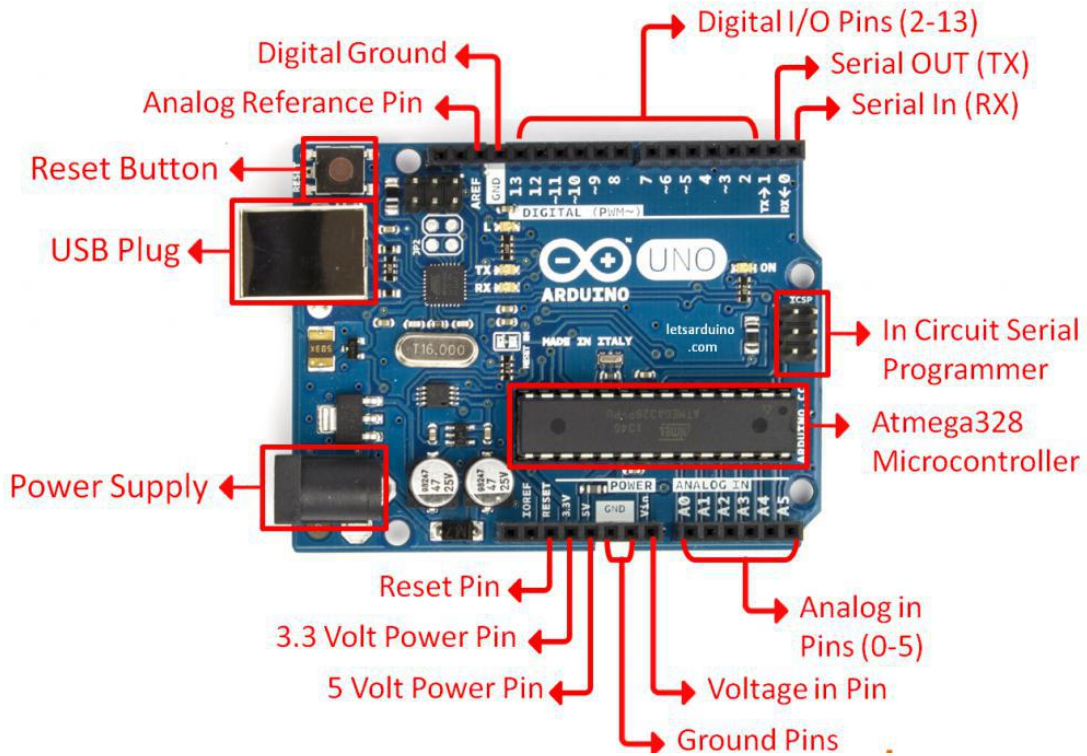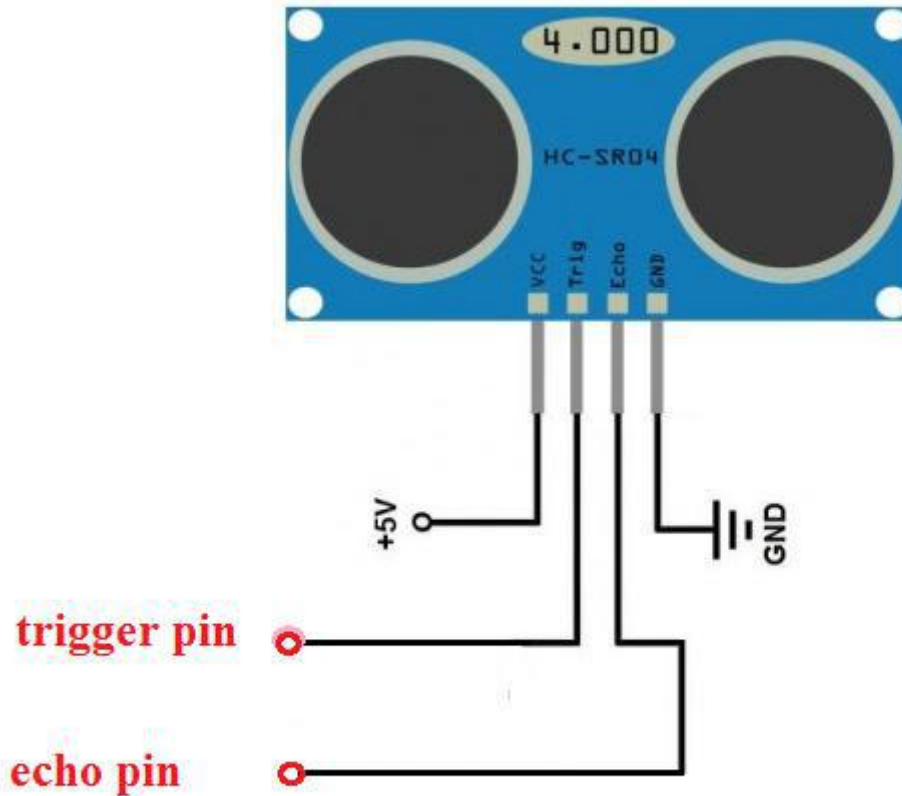
# 4.6 Circuit Diagram
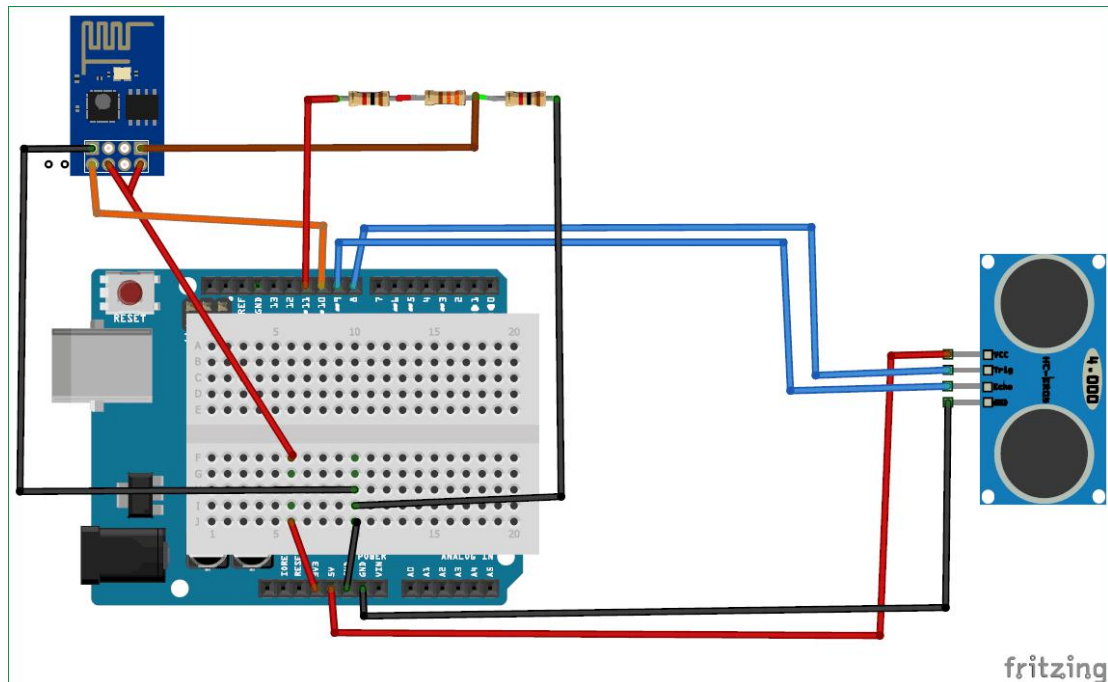


**Fig.4.6:Circuit  Diagram**

First of all we will connect the ESP8266 with the Arduino. ESP8266 runs on 3.3V and if you will give it 5V from the Arduino then it won't work properly and it may get damage. Connect the VCC and the CH_PD to the 3.3V pin of Arduino. The RX pin of ESP8266 works on 3.3V and it will not communicate with the Arduino when we will connect it directly to the Arduino. So, we will have to make a voltage divider for it. Three 1k     resistors connected in series will do the work for us. Connect the RX to the pin 11 of the Arduino through the resistors as shown in the figure below and also the TX of the Arduino to the pin 10 of the Arduino. Now it's time to connect the HC-SR04 ultrasonic sensor with the Arduino. 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 8 and 9 of the Arduino respectively.

## 4.7 Class Diagram of the system

- A class diagram in the Unified Modeling Language is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, and the relationships between the classes.
- The class diagram has the following classes.
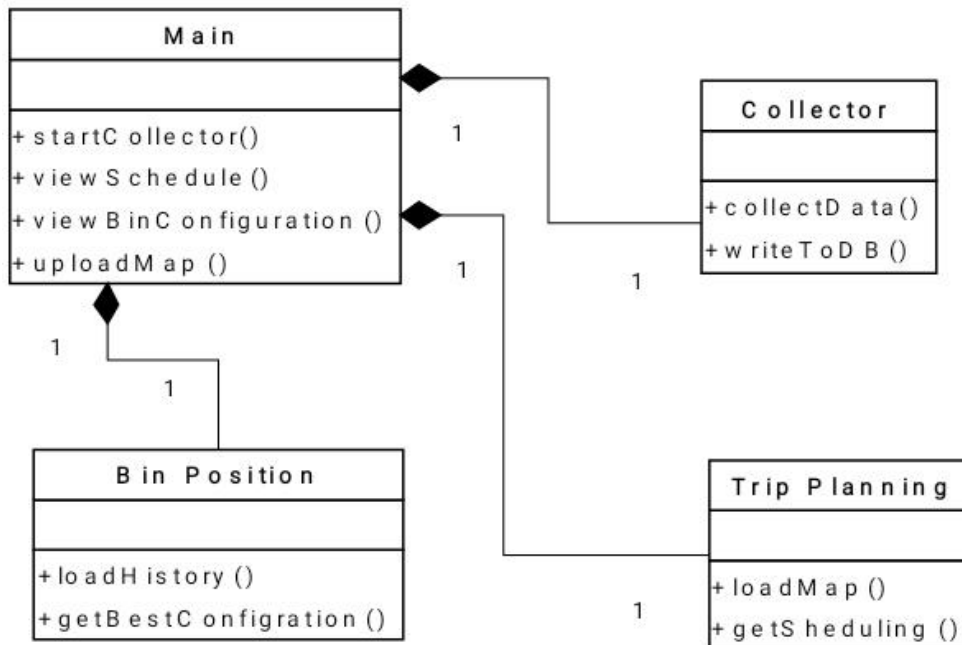


**Fig 4.7:class diagram**

Here we mentioned main class composed with the other classes like collector Bin Position.Main class has the operations such as start collector,view scheduler,view bin configuration .Collector class has the operations such as collect data and writes to DB .Bin Position class has the operations such as load history and get best configuration

## 4.8 Data Flow Diagram of the  System

A data flow diagram is a graphical representation of the "flow" of data through an  informed system.DFD 'scan also used for the visualization of data processing structured design .On a DFD,data items flow from an external data source or internal data store to an internal data or external data sink,via an internal process.

● **Level 1data flow diagram**

The Level 1 DFD shows the how the system is divided into sub systems each of which deals with one or more of the data  flows to or from an external agent, and which together provide full all functionality of system as a whole
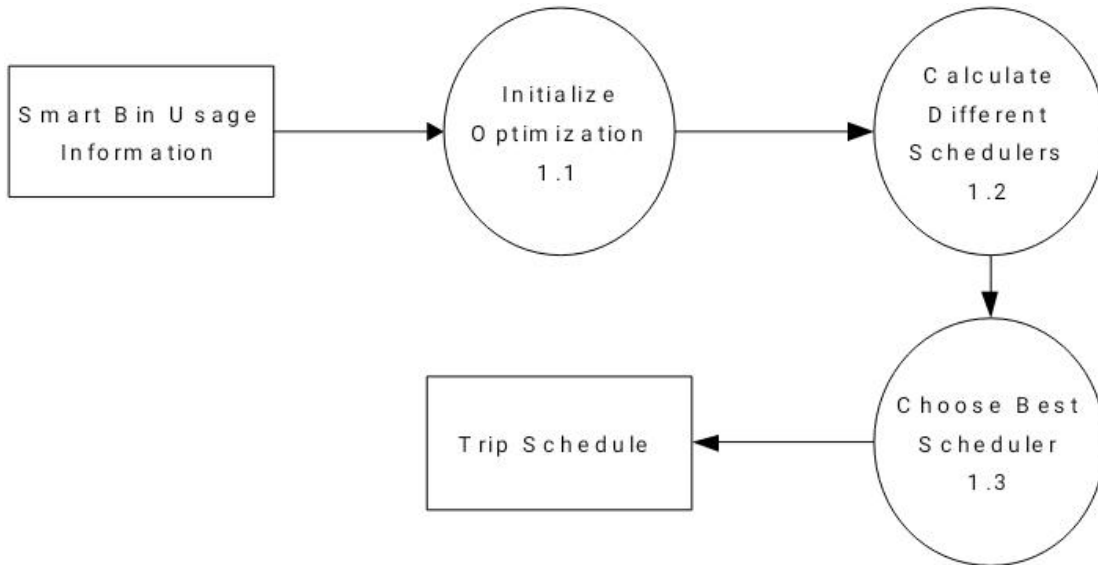


**Fig 4.8: Level 0 data flow diagram shows how system is divided into sub system**
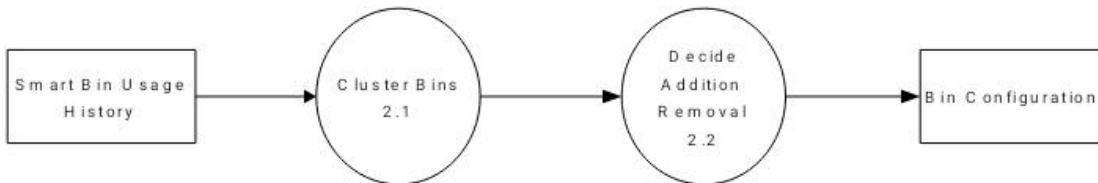


**Fig 4.8 Level 1 data flow diagram shows the sub process of first main process**

Here the sub process of first main process were showed they are initialize optimization calculate different schedulers and choose best schedulers

## 4.9 Summary

This chapter mainly concentrates on system architecture ,class diagram ,data flow diagram etc.

# CHAPTER 5

# IMPLEMENTATION

Implementation is the realization of an application, or execution of a plan, idea, This article needs additional citations for verification. Learn more model, design, specification, standard, algorithm, or policy. Industry specific definitions Role of end users System implementation generally benefits from high levels of user involvement and management support. User participation in the design and operation of information systems has several positive results.First, if users are heavily involved in systems design, they move opportunities to mold the system according to their priorities and business requirements, and more opportunities to control the outcome. Second, they are more likely to react positively to the change process. Incorporating user knowledge and expertise leads to better solutions. The relationship between users and information systems specialists has traditionally been a problem area for information systems implementation efforts. Users and information systems specialists tend to have different backgrounds, interests, and priorities. This is referred to as the user-designer communications gap. These differences lead to divergent organizational loyalties, approaches to problem solving, and vocabularies.

## 5.1 Languages used for Implementation

- **Platform Independence**: Java is a platform-independent language. In other words, you can write your code once and then run it anywhere, on any platform that provides the environment to run it. This environment is the Java Virtual Machine (JVM). The JVM should be present to execute the code. The JVM is different for each platform. In the case of Java, platform independence does not mean that you can run the code anywhere; you can run it wherever the environment is provided. This is the key point of platform independence in Java.

- **Object-oriented programming** :Object-oriented programming (OOP) is a programming paradigm

based on the concept of "objects", which can contain data, in the form of fields (often known as *attributes* or *properties*), and code, in the form of procedures (often known as *methods*).

● **Applet:**An applet is a Java program that runs runs in a Web browser . An applet can be a a fully functional Java application because it has the entire a Java API at its disposal.

**Garbage Collection:**In C/C++, programmer is responsible for both creation and destruction of

objects. Usually programmer neglects destruction of useless objects. Due to this negligence, at certain point, for creation of new objects, sufficient memory may not be available and entire program will terminate abnormally causing Out Of Memory Errors.

# 5.2 Platform used for implementation

Platform is a crucial element in software development.A platform is a might be simply defined as "a place to launch software".in this project for implementation purpose windows XP platform is used &reasons for choosing this platform are Integrated networking support,More stable and secure than previous version contain remote reduced reboot scenarios Improved code protection side by side DLL support Windows file protection ,File Protection,Preemptive multitasking architecture, Scalable memory and processor support ,Smart card support,Internet Explorer Add-on manager Windows Firewall,Windows Security center Fresh Visual design.

# 5.3  Pseudo code

● Randomly create the initial population of individual string of the given TSP problem and create a matrix representation of the cost of the path between two cities.

Assign the fitness to each chromosome in the population using fitness measure.

| F(x)= | 1/x |
|---|---|
| Where, | |
| X represents the total cost of the string | |

The selection criteria depends upon the value of string if its close to the some threshold value 3.Create new off string population from two existing chromosomes in the parent population by applying crossover operator.

- Mutate the resultant off springs if required

- Repeat step3 and step 4 until we get an optimal solution
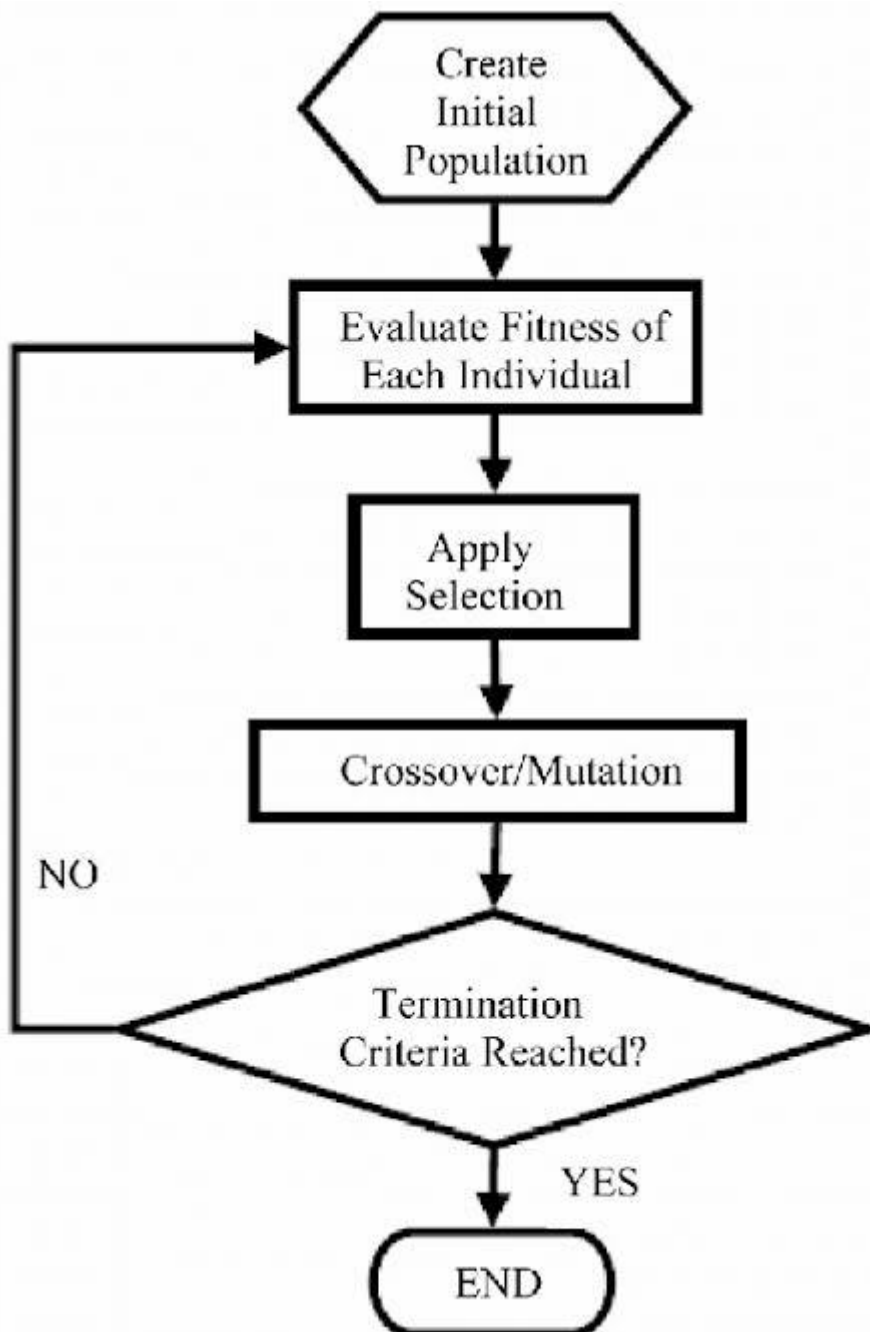
# 5.4 Summary

This chapter gives implementation details of the two major subsystems which are developed of this project.With the help of data flow diagram of data diagram it also specifies the logic of implementation fir the different modules that have been specified during the system design.Along with these this chapter also highlights some of the important features of the platform and language used for implementation purpose.

# CHAPTER 6

# RESULTS AND DISCUSSION

## 6.1 Snapshots

The following are the results which obtained from this work, Waste Level detection inside the dustbin

Transmit the information wirelessly to concerned The data can be accessed anytime and from anywhere

The real-time data transmission and access Avoids the overflows of Dustbins.



**Fig 6.1 Shows that smart bin in which the UR Sensor is deployed to detect**
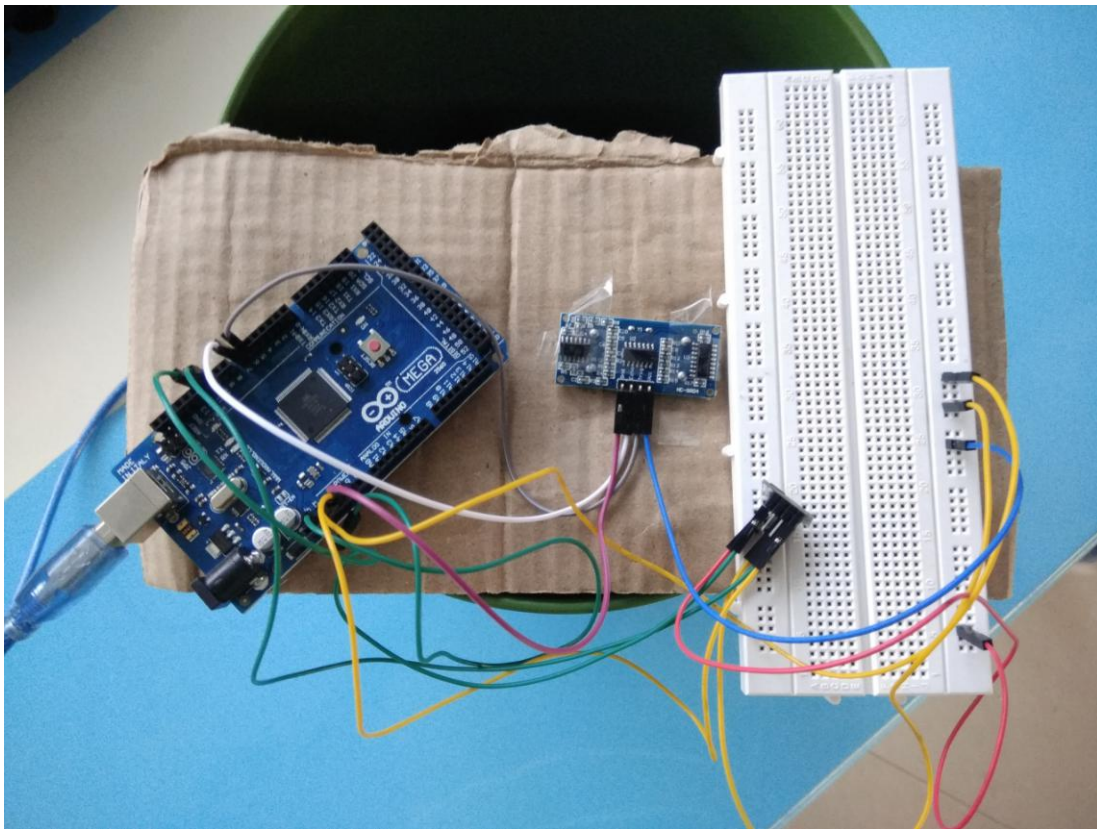
**Fig 6.1.2 shows that the central server system**

where the web server is running and processing the information received from the smart dustbins and

WiFI module to receive the data from the smart dustbins.

## 6.2 Results

```
fullcode | Arduino 1.6.9
File Edit Sketch Tools Help

fullcode

#include <SoftwareSerial.h>

SoftwareSerial mySerial(7, 8);

// defines pins numbers
int trigPin = 9;
int echoPin = 10;

int lastsend=0;

// defines variables
long duration;
float distance;

float lastfilled=0;          //initiallizing to zero
int fullbindistance=19.7;  //  setting the distance of bin accordingly
int ledpin = 13;

void setup() {
  mySerial.begin(9600);
pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
pinMode(ledpin, OUTPUT);// Sets the ledbulb as an Ouput
pinMode(echoPin, INPUT); // Sets the echoPin as an Input
Serial.begin(9600); // Starts the serial communication

 delay(100);
}

void loop() {          /* this loop is to send signal from ultrasonic sensor  which send signals by settings given for trigpin with high ,
                          low and delay seconds & calculates distance & percentage whichis placed inside bin */

// Clears the trigPin

digitalWrite(trigPin, LOW);                // setting trigpin to low and wait for 2microsec of delay
delayMicroseconds(2);

// Sets the trigPin on HIGH state for 10 micro seconds
digitalWrite(trigPin, HIGH);                  // again setting pin to high for trigpin and adding delay of 10microsec
```

**Fig 6.2.1 Snapshot of uploading data in the Arduino software**

The Figure shows the Arduino software code for specifying the distance and percentage calculation

```
COM3 (Arduino/Genuino Uno)                    —    □    ×

                                                   Sen

Distance: 0.00
Percent:100.00 %



        I



☑ Autoscroll                          No line ending ∨   9600 baud
```

**Fig 6.2.2 Snapshot of distance and percentage of garbage filled in dustbin**

## 6.2 Summary

This Chapter deals with the result and result analysis,which shows the output procedure in the form of snapshots and also work flow.

## CHAPTER 7

# TESTING

## 7.1 System Testing

System testing is a level of testing that validates the complete and fully integrated software product. The purpose of a system test is to evaluate the end-to- end system specifications. Usually, the software is only one element of a larger computer-based system. Ultimately, the software is interfaced with other software/hardware systems. System Testing is actually a series of different tests whose sole purpose is to exercise the full computer-based system.

## 7.2  Testing Objective

System Testing involves testing the software code for following Testing the fully integrated applications including external peripherals in order to check how components interact with one another and with the system as a whole. This is also called End to End testing scenario. Verify thorough testing of every input in the application to check for desired outputs. Testing of the user's experience with the application.

1. Testing is a process of executing a program with the intent of finding an error.

2. A good test case is one that has a high probability of finding an as yet undiscovered error.

3. A successful test is one that uncovers an as yet undiscovered error.

## 7.3 TYPES OF TESTING:

- White Box Testing
- Black Box Testing
- Grey box testing

### 7.3.1 White Box Testing

White box testing as the name suggests gives the internal view of the software. This type of testing is also known as structural testing or glass box testing as well, as the interest lies in what lies inside the box.

### 7.3.2 Black Box Testing

Its also called as behavioral testing. It focuses on the functional requirements of the software. Testing either functional or non functional without reference to the internal structure of the component or system is called black box testing.

### 7.3.3 Grey Box Testing

Grey box testing is the combination of black box and white box testing. Intention of this testing is to find out defects related to bad design or bad implementation of the system.

## 7.4 LEVEL OF TESTING USED IN PROJECT

### 7.4.1 Unit testing

Unit testing performed on each module or block of code during development. Unit Testing is normally done by the programmer who writes the code.

| Class | Function | Tests Done | Expected Output | Actual Output | Remarks |
|-------|----------|------------|-----------------|---------------|---------|
| Main | Start Collector view Schedule view Bin configuration | Start the Smart Bin and collect the information | Bin configuration viewed | Success | Pass |
| Collector | Collect Data write to DB | Receive the data from Device and store it in the DB | Data write into DB | Success | Pass |
| Bin Positioning | Load history get Best Configuration | Load Smart Bin History details | Best Path is configured | Success | Pass |

**Table 7.4.1:Unit testing table**

Table 7.4.1 shows the functions that were tested at the time programming.

### 7.4.2 Integration testing

Integration testing done before, during and after integration of a new module into the main software package. This involves testing of each individual code module. One piece of software can contain several modules which are often created by several different programmers. It is crucial to test each module's effect on the entire program model.

| TEST CASE ID | ITC-1 |
|---|---|
| Input | connect ultrasonic sensor to the Arduino. |
| Description | calculate the distance in the bin. |
| Expected Output | distance values got and send it through SMS. |
| Actual Output | Success |
| Remarks | Pass |

**Table 7.4.2 Integration Test Case-1**

The Above table describes that the connection of ultrasonic sensors with arduino to find the percentage filled in bin.Input is connected to ultra sonic sensor to the Arduino.Action of this is Calculated the distance in the bin the expected output is same as the actual output.

| TEST CASE ID | ITC-2 |
|---|---|
| Input | connect wifi module8266 to the Arduino. |
| Description | Send the received values to the server through wifimodule8266 |
| Expected Output | Values received by the server wifimodule8266 |
| Actual Output | Success |
| Remarks | Pass |

**Table 7.4.2 Integration Test Case-2**

The Above table describes that the connection of arduino with wifimodule8266 to get the values from the wifimodule8266. connect wifimodule8266 to the Arduino.Action is send the received values to the

server through wifimodule8266 expected output is same as the actual output.

| TEST CASE ID | ITC-3 |
|---|---|
| Input | View the bin filled percentage retrieve Filled percentage data from the history |
| Description | Retrieve the distance values and percentage of filled |
| Expected Output | Displayed Percentage |
| Actual Output | View percentage |
| Remarks | Success |

**Table 7.4.3Integration Test Case-3**

The Table 6.3 specifies the percentage filled in the dustbin in a particular area based on the retrieval distance values.input is View the bin filled percentage retrieve filled data from the history.the expected output is displayed with percentage filled and the output is to view

# 7.5  System Testing

System Testing is a level of testing that validates the complete and fully integrated software product. The purpose of a system test is to evaluate the end-to- end system specifications. Usually, the software is only one element of a larger computer-based system. Ultimately, the software is interfaced with other software/hardware systems. System Testing is actually a series of different tests whose sole purpose is to exercise the full computer-based system.

| TEST CASE ID | STC-1 |
|---|---|
| Input | Test whether the system as whole executes successfully |
| Description | Testing of Applications |
| Expected Output | Applications run successfully without any error in any of the modules |
| Actual Output | Success |
| Remarks | Pass |

**Table 7.5 System  Test Case-1**

The table 7 shows the main aim that is to sense the garbage based on the ultra sonic sensor and prevent the over filling of bin so that we can prevent from many disorders

# 7.6 Summary

This chapter deals with several kinds of testing such as unit testing which is a methods of testing the accurate functioning of a particular module of the source code.It is also gives a brief detail about different kinds of integration testing in which individual software modules are combined and tested as group.

# CHAPTER 8

# CONCLUSION AND FUTURE SCOPE

## 8.1 Conclusion

We have implemented real time waste management system by using smart dustbins to check the fill level of smart dustbins whether the dustbin are full or not.In this system the information of all smart dustbins can be accessed from anywhere and anytime by the concern person and he/she can take a decision accordingly.

## 8.2 Contribution

By implementing this proposed system the cost reduction, resource optimization, effective usage of smart dustbins can be done.This system indirectly reducing traffic in the city. In major cities the garbage collection vehicle visit the area's everyday twice or thrice depends on the population of the particular area and sometimes these dustbins may not be full. Our System will inform the status of each and every dust bin in real time so that the concerned authority can send the garbage collection vehicle only when the dustbin is full.

## 8.3 Future Scope

The scope for the future work is this system can be implemented with time stamp in which real-time clock shown to the concern person at what time dust bin is full and at what time the waste is collected from the smart dustbins.

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