IOT BASED GARBAGE MANAGEMENT SYSTEM

A Project Report of Capstone Project - 2

Submitted by

PREM SHARMA

(1613101514)

in partial fulfillment for the award of the

degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF COMPUTING SCIENCE AND ENGINEERING

Under the Supervision of
Indu Malik, M.Tech,

Assistant Professor

APRIL / MAY- 2020

SCHOOL OF COMPUTING AND SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

Certified that this project report **"IOT BASED GARBAGE MANAGEMENT SYSTEM"** is the bonafide work of **"PREM SHARMA (1613101514)"** who carried out the project work under my supervision.

SIGNATURE OF HEAD

Dr. MUNISH SHABARWAL,
PhD (Management), PhD (CS)
Professor & Dean,
School of Computing Science &
Engineering

SIGNATURE OF SUPERVISOR

Ms. INDU MALIK, M.Tech
Assistant Professor
School of Computing Science &
Engineering

ABSTRACT

The neat and clean surrounding is the main driving force for any city to be called a "smart city". Many modern cities are currently encumbered with various challenges such as smart transport system, smart grid, smart environment, and smart living. Now-a-days, proper waste management is the major concern for cities and urban areas. The traditional waste management approaches are not sophisticated enough to achieve a proficient and robust waste management. Smart Waste Management is on top priority in any smart city as it directly affects the lifestyle, healthcare and environment. This article deliberates a comprehensive survey of various proposed approaches for smart bin systems such as Smart Garbage Monitoring System, Wisely Waste Segregation System, and Smart Waste Collection System. In addition to this Survey, we propose a framework for a smart Garbage Management System.

One of the challenges most cities and towns are confronting is the decline in the cleanliness of the environment regarding the garbage management. This occurs due to the mismanagement of the garbage collection. This mismanagement creates the spread of garbage in the community which in turn creates unhealthy conditions in the immediate area. It also stimulates several serious diseases amongst the people in close proximity and degrades the beauty of the area. To avoid mismanagement of the garbage and to improve the cleanliness of the society, the Garbage monitoring system is designed.

TABLE OF CONTENTS

CHAPTER 1

1. INTRODUCTION

"Learn cleanliness from the cat" is said and appreciated in Ethiopian society. The scenario beyond this proverb is that keeping the environment clean is quite important and it is used to emphasize more on giving attention to cleanliness. Nonetheless, it is not as easy as to speak out the proverb to effectively and properly managing the garbage. We frequently observe garbage bins being filled over and additional waste materials being disposed and accumulated around the bin in different cities of Ethiopia. Because of this, severe and contagious disease is stimulated and also a bad smell comes out of it and may cause illness to human beings. The municipality of most cities in Ethiopia has strived its best to alleviate this problem by providing several garbage bins throughout the town. However,

It is a manual approach and a number of trucks from the municipal authority are sent to the waste bins to collect the waste. The wastes are loaded to the truck and conveyed to the pre-specified locations. Because of this the category of the people involved in collecting and transporting the wastes are usually not responsible enough to make the job well done. Very often the waste is not collected from each and every waste bin properly due to municipal authorities not having information about the garbage bin. The manual waste collection and management approach has problems such as lack of information about the collecting time and place. Because of this it is time consuming and less effective i.e. trucks go and may get empty garbage bin. management and lack of smart monitoring of the condition of the bin. This proposed paper shows an effective solution to manage the garbage. This garbage monitor is implemented using sensors and Arduino microcontroller.

1.1 PURPOSE

With an increase in population at an unprecedented rate, the scenario of cleanliness with respect to garbage management in terms of collection, sorting and finally disposal is facing an increasing number of challenges .The overflow of garbage in public areas creates the unhygienic condition in the nearby surrounding which may cause serious diseases. To avoid this and to automate the cleaning and ensure end to end efficient garbage disposal "IOT BASED GARBAGE MANAGEMENT SYSTEM" is proposed.

1.2 MOTIVATION AND SCOPE

The key motivation is in achieving efficiency in the waste management sector at the national level. Issues in the waste management Waste truck drivers need a navigation system and reporting problem system. Citizens want to have better service, lower cost and having easily accessible reports. In order to maintain a clean and hygienic environment in the area around us, we are using the technology for the better garbage monitoring system.

In big institutions or a city under a municipal corporation where there are extensive quantities of garbage bins deployed and workers are kept specifically for this task, the antiquated technique for physically hunting down filled garbage bins is wasteful and does not run well with the technological era we are in. Routine checks for cleaning the garbage bins which depend on time crevices are wasteful in light of the fact that a dustbin may get filled early or may get tampered and might require prompt consideration or there might not be any need of a routine check for a drawn out stretch of time. Likewise, to save fuel and time and make the entire process more effective and convenient, the workers going on routine check should know the shortest route consisting of all the filled garbage bins.

CHAPTER 2

2. LITERATURE REVIEW

"International Journal of Scientific & Engineering Research"

The characteristics and composition of the urban waste i.e. sewage and municipal solid waste was studied by various workers in the world. Literature shows evidence of the work carried out on the health risk assessment due to urban waste. The impact of urbanization on the water quality as well as soil quality was also studied by various researchers in the different parts of the world.

At International level, there are various organizations including private and government which are working in the field of environment and are engaged in research and development in the field of waste management. The international agencies like World Health Organization (WHO), Environmental Protection Agency (EPA) and United Nations Environment Program (UNEP) are engaged in developing new technologies for waste management and its disposal including its characterization.

Management of Municipal Solid Waste for various cities and towns has been widely studied throughout the world. As the huge quantities of solid waste generated in the urban areas is the major problem, the majority of researchers concentrated on this issue. Numbers of researchers have tried to find out new techniques for solid waste management. Mahar et.al., 2007[1] reported the review and analysis of solid waste management situations in urban areas of Pakistan. According to him poor solid waste management is one of the major causes for environmental degradation in Pakistan. According to Rajput et.al., 2009[2], municipal firm squander production displayed divergent fashion and a beneficial

parallel with monetary development in expression of kg/capita/day firm waste production at humanity weighing machine.

"International Journal Of Engineering And Computer Science"

The garbage management in cities has to be effectively and efficiently implemented. The various proposals were put forward and some of them already implemented. But it cannot be considered as an effective one. So a survey was done among different proposals and this survey paper includes survey among different methods for smart garbage management in cities using IoT.

The paper [1] Smart Garbage Management in Smart Cities using IoT proposed a method as follows. The level of garbage in the dustbins is detected with the help of ultrasonic sensors system, and communicated to the authorized control room through GSM system. Arduino microcontroller 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. Level detector consists of IR sensors which is used to detect the level of the garbage in the dustbin. The output of the level detector is given to the microcontroller.

The idea of smart garbage bins and systems have been in discussion for quite a long time. The technologies used at disposal to develop this smart system have also evolved, Internet of Things (IoT). Each idea seems to be similar but is slightly different at its core and our proposed work is no exception from the same. After the IoT field, finding its hold in our lives, this is our original plan for designing a smart garbage collection system which has provision for citizen participation and analysis of data for better decision making. At hardware level, the smart system is a garbage bin with ultrasonic sensor, a micro-controller and Wi-Fi module for transmission of data. The worldwide implementation of Internet of Things is possible with a Cloud centric vision.

CHAPTER 3

3. Hardware Requirements

1. Arduino Uno

2. HC-SR04 Ultrasonic sensor

3. ESP8266 Wi-Fi module

4. GSM module

5. Breadboard

6. Connecting wires

3.1 ARDUINO UNO

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

- 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 AC to-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.

Fig.1: ARDUINO UNO BOARD

Parameters For Arduino Uno Description

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14
Analog Input Pins	6
DC Current per I/O Pin	40mA
DC Current for 3.3V Pin	50mA
Flash Memory	32Kb(ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16MHz
Length	68.6 mm
Width	53.4 mm
Weight	53gm

Table 1: Specifications of Arduino

3.2 HC-SR04 ULTRASONIC SENSOR

HC-SR04 is an ultrasonic sensor which is used for measuring the distance between the top of the lid to the top of the garbage.

PIN NO.	PIN NAME	DESCRIPTION
1.	VCC	The VCC pin powers the sensor, typically with +5V
2.	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3.	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4.	GND	This pin is connected to the Ground of the system.

Table 2: Pin Number and Function of Ultrasonic sensor

3.2.1 HC-SR04 SENSOR FEATURES

- Operating voltage: +5V

- Theoretical Measuring Distance: 2cm to 450cm

- Accuracy: 3mm

- Measuring angle covered: <15°

- Operating Current: <15ma

- Operating Frequency: 40Hz

3.2.2 ULTRASONIC SENSOR WORKING

The HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

$$\text{Distance} = \text{Speed} \times \text{Time}$$

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module. Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

Fig.2: HCSR04 ULTRASONIC SENSOR

3.3 ESP8266 Wi-Fi MODULE

Fig.3: ESP8266 Wi-Fi 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 microcontroller 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 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.

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.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the

processor/controller/computer to interact with the GSM and GPRS cellular network.

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. 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. Both GSM modems and dial-up modems support a common set of standard AT commands. In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, the following operations can be performed:

Fig.4: GSM MODULE

- Reading, writing and deleting SMS messages.

- Sending SMS messages.

- Monitoring the signal strength.

- Monitoring the charging status and charge level of the battery.

- Reading, writing and searching phone book entries.

3.5 BREADBOARD

A breadboard is a plastic board of rectangular shape having lot of tiny holes in it. These holes let us easily insert electronic parts to prototype (to build and test an early version of) an electronic circuit, like this one with a switch, battery, LED (light-emitting diode), and resistor. Figure.7 shows the breadboard.
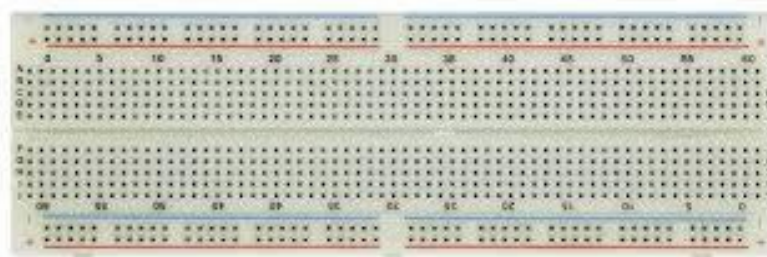

Fig.5: BREADBOARD

3.6 CONNECTING WIRES

Copper wire is often used as a connecting wire. It is very common in ethernet cable as copper is one of the best conductors based on cost and ability to work with it.

Solid pure copper is often used in bulk network cables and you will find the copper wires twisted together to form pairs. Figure.8 shows Connecting Wires.
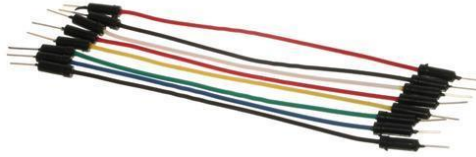

Fig.6: CONNECTING WIRES

CHAPTER 4
4. METHODOLOGY
4.1 PROBLEM STATEMENT

A big challenge in the urban cities is solid waste management. The garbage collecting authority in the traditional waste management system doesn't know about the level of garbage in dustbin, if the dust bins get 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 overflowing. Sometimes due to unclean garbage bins bad smell arises also toxic and unhygienic gases are produced which is a way to support air pollution and to some harmful diseases which are easily spreadable. Use of traditional systems results in inefficient and time and money spending systems.
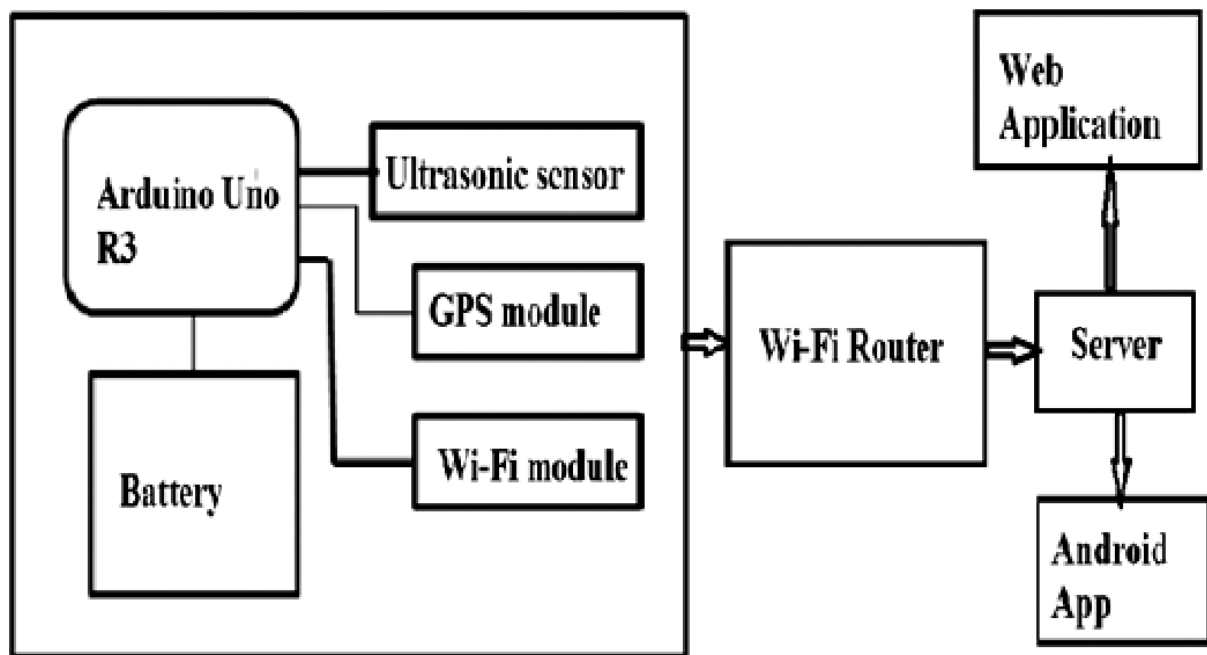
4.2 PROPOSED MODEL

Fig.7: BLOCK DIAGRAM

The block diagram shows the complete system which contains the bins installed with a sensor unit. The Arduino will get the level of the garbage from the ultrasonic sensor and send the information to the server via Wi-Fi module i.e. ESP 8266.In the service section, residents will throw the waste in a bin and that information with the sensors is collected and transferred to the administration section. The server will check for the threshold level and if the level is high it will send the notification. The web Server displays the details and status of the bin, at real time. The same information is transferred to concerned authority so that accordingly the filled bins are timely evacuated.

After the IOT field finding its grip in our lives. This is, however an original plan for designing a smart garbage bin with ultrasonic sensor, Arduino and Wi-Fi module for transmission of data.

CHAPTER 5

5. IMPLEMETATION

5.1 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 11 and 12 of the Arduino respectively(you can use any other pin as well).Connect the RX pin of the arduino with the TX pin of the GSM module and the TX pin of the arduino with the RX pin of the GSM module. Connect the GND of the arduino to the ground of the module. Also, the GSM module needs an external 12v supply.

5.2 SOFTWARE IMPLEMENTATION

The software required for it is the Arduino IDE.

5.2.1 ARDUINO IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. The Arduino development environment contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Software written using Arduino are called sketches. These sketches are written in thetext editor. Sketches are saved with the file extension .ino. It has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino environment including complete error messages and other information. The bottom right-hand corner of the window displays the current

board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

5.2.2 BLYNK APP

Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your Arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the Internet Of Your Things. Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

There are three major components in the platform:

- **Blynk App** - allows to you create amazing interfaces for your projects using various widgets we provide.
- **Blynk Server** - responsible for all the communications between the smart phone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. Its open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- **Blynk Libraries** - for all the popular hardware platforms - enable communication with the server and process all the incoming and out coming commands.

CHAPTER 6

6. CONCLUSION

The IOT-Garbage monitoring system pays a lot towards clean and disinfected pollution less environment in building a smart city. As these technology is new in India there should be appropriate consciousness and alertness among the public before the operation of this technology. Otherwise, sensitive devices like sensors might be spoiled due to rough action of the users. It is an automatic dust bin monitoring system in order to sense the full condition of the garbage bins. This provides the authorized users appropriate updates of the location of the garbage bins and thus eliminates the need of intermittent manual checks and overflowing garbage bins. This method finally helps in keeping the environment clean. Thus, the garbage collection is made more efficient, effective and operative.

The system can be used as a benchmark by the people who are willing to take one step further for increasing the cleanliness in their respected areas. Ultrasonic sensor is being used in this system to check the level of garbage in the dustbins but in future various other types of sensors can be used with the ultrasonic sensor to get more precise output and to take this system to another level. Now this system can be used in certain areas but as soon as it proves its credibility it can be used in all the big areas. As this system also reduces manual work certain changes can be done in the system to take it to another level and make it more useful for the employees and people who are using it. In future, a team can be made which will be in charge for handling and maintaining this system and also to take care of its maintenances.

REFERENCES

1. Monika K A, Rao N, Prapulla S B and Shobha G 2016 Smart Dustbin-An Efficient Garbage Monitoring System International Journal of Engineering Science and Computing 6 7113-16.

2. Kasliwal Manasi H and Suryawanshi Smithkumar B 2016 A Novel approach to Garbage Management Using Internet of Things for smart cities International Journal of Current Trends in Engineering & Research 2 348-53.

3. Medvedev A, Fedchenkov P, Zaslavsky A, Anagnostopoulos T and Koh Ruzhnikov S 2015 Waste management as an IoT-enabled service in smart cities In Conference on Smart Spaces Springer International Publishing 104-15.

4. Kanchan Mahajan, "Waste Bin Monitoring System Using Integrated Technologies", International Journal of Innovativ.

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

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

7. Research in Science, Engineering and Technology, Issue 3 , Issue 7 , July 2014.

8. "Smart Dustbin" National Conference on Product Design (NCPD 2016), July 2016.

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

10. N. Sharma, N. Singha, and T. Dutta, "Smart Bin Implementation for Smart Cities," International. Journal. Science Engineering. Research vol. 6, no. 9, pp. 787–791, 2015.

11. Rajput "Scenario of Solid Waste Management," IEEE Journal on Emerging and Selected Topics in Circuits and Systems, vol. 3, no. 1, pp. 45–54, 2009.