A Project Report

on

IOT-BASED SMART CITIES:

INTELLIGENT GARBAGE COLLECTION

Submitted in partial fulfillment of the requirements

for the award of the degree of

BACHELOR OF TECHNOLOGY

in

Computer Science & Engineering

By

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(Affiliated to JNTUA, Accredited by NAAC with 'A' Grade, Approved by AICTE, New Delhi & Accredited by NBA (EEE, ECE & CSE))

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Certificate

This is to certify that the project report entitled **IOT-BASED SMART CITIES: INTELLIGENT GARBAGE COLLECTION** is the bonafide work carried out by **V. Poojasri** bearing Roll Number 174G1A0552, **P. Harshitha** bearing Roll Number 174G1A0522, **R. Vanaja** bearing Roll Number 184G5A0506, **S. Liyakath** bearing Roll Number 174G1A0532 in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science & Engineering** during the academic year 2020-2021.

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DECLARATION

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The results embodied in this project report have not been submitted to any other Universities of Institute for the award of Degree.

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ABSTRACT

Increasing population density in urban areas demands the necessity of intelligent services to meet the needs of the city's residents. An emerging solution to deal with this scenario is the convergence of information and communication technologies through the implementation of the concepts of smart cities and Internet of Things to provide solutions in diverse fields like infrastructure, transportation, and surveillance. The efficient management of these kinds of services has a significant impact on the quality of life of the citizens.

The garbage collection system is an important component of urban infrastructure. It is difficult to locate the exact garbage bin which is facing the problem. Therefore, it is essential to develop a system which can handle intelligent garbage collection without human intervention. Hence, this project aims to design intelligent garbage collection system using IoT.

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List of Abbreviations

ICT	Information and Communication Technologies
IoT	Internet of Things
GUI	Graphical User Interface
IR sensor	Infrared sensor

CHAPTER 1

INTRODUCTION

1.1 Internet of Things

Internet of Things (IoT) is the networking of physical objects that contain electronics embedded within their architecture in order to communicate and sense interactions amongst each other or with respect to the external environment. In the upcoming years, IoT-based technology will offer advanced levels of services and practically change the way people lead their daily lives. Advancements in medicine, power, gene therapies, agriculture, smart cities, and smart homes are just a very few of the categorical examples where IoT is strongly established.

Over 9 billion 'Things' (physical objects) are currently connected to the Internet, as of now. In the near future, this number is expected to rise to a whopping 20 billion.

There are four main components used in IoT:

1. **Low-power embedded systems**

   Less battery consumption, high performance are the inverse factors play a significant role during the design of electronic systems.

2. **Cloud computing**

   Data collected through IoT devices is massive and this data has to be stored on a reliable storage server. This is where cloud computing comes into play. The data is processed and learned, giving more room for us to discover where things like electrical faults/errors are within the system.

3. **Availability of big data**

   We know that IoT relies heavily on sensors, especially real-time. As these electronic devices spread throughout every field, their usage is going to trigger a massive flux of big data.

4. **Networking connection**

   In order to communicate, internet connectivity is a must where each physical object is represented by an IP address. However, there are only a limited number of addresses available according to the IP naming. Due to the growing number of devices, this naming system will not be feasible anymore. Therefore, researchers are looking for another alternative naming system to represent each physical object.

1.2 ABOUT INTELLIGENT GARBAGE COLLECTION:

In advanced technology, A smart city is an urban area that uses different types of electronic methods and sensors to collect data. Insights gained from that data are used to manage assets, resources and services efficiently. In other words, smart city is the one which has digital technology embedded across all the city functions. It also uses ICT (Information and Communication Technologies) to provide better quality and performance. The Proposed system assures the collection of garbage soon when the garbage level reaches its maximum level. The system will thus provide accurate reports, increasing the efficiency of the system. The real time monitoring of the garbage level with the help of sensors and wireless communication will reduce the number of trips required by the garbage collection vehicle and thus will reduce the total expenditure associated with the Garbage bin. Increasing population density in urban areas demands the necessity of intelligent services to meet the needs of the city's residents. An emerging solution to deal with this scenario is the convergence of information and communication technologies through the implementation of the concepts of smart cities and Internet of Things to provide solutions in diverse fields like infrastructure, transportation, and surveillance. The efficient management of these kinds of services has a significant impact on the quality of life of the citizens. The garbage collection system is an important component of urban infrastructure. It is difficult to locate the exact garbage bin which is facing the problem. Therefore, it is essential to develop a system which can handle intelligent garbage collection without human intervention. Hence, this project aims to design intelligent garbage collection system using IoT.

Most of the cities, towns and villages in India are notwell designed to facilitate the suitable garbage collection methods. Common Public dustbins are filling over with the garbage and no one is concerned to clear them up as and when they get completely packed with overflowing garbage. Keeping in view of this big problem, it will be a good suggestion to do something to deal with this unmanaged waste and from this, the concept of 'Smart Dustbin' came out.

1.3 Objective

In this project is to design and build a prototype for an automatic open dustbin that can automatically open the lid when it detects the people who want to throw out their trash. It also can detect the level of the trash that inside the dustbin. If

the dustbin is full of trash at the certain level, the lid will not open even when there are people who want to throw out their trash. dustbins are provided with a sensor which helps in tracking the level and weight of the garbage bins and a unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. In order to avoid the decaying smell around the bin harm-less chemical sprinkler is used which will sprinkle the chemical as soon as the smell sensors detect the decaying smell. Waste Management is all the activities and actions required to manage waste from inception to its final disposal. So this can be done by implementing IoT based waste management using smart dustbin.

1.4 PROBLEM DEFINITION

Nowadays, there are tons of flats and apartments which have been built in the rapid urbanization area. This is due to high housing demands which have been drastically risen as a result of migration from villages to cities to find work. In order to accommodate the growing population in the urban area, the government has also constructed more apartment complexes. There are several issues faced by the residents of the flats. One of them is disposal of solid waste. Unlike private houses, the residents of all the apartments use a common dustbin, which tends to fill up very quickly. This overflowing of garbage is a sanitary issue which might cause diseases like cholera and dengue. Moreover it is a waste of fuel to travel around a complex or an area to find that some of the garbage are filled and some are not. Also, on rare days, problems might arise that there is so much garbage that the truck doesn't have enough capacity. The idea struck us when we observed that the garbage truck use to go around the town to collect solid waste twice a day. Although this system was thorough it was very inefficient.

The garbage collections system is an important component of urban infrastructure. It is difficult to locate the exact garbage bin which is facing the problem. Therefore, it is essential to develop a system which can handle intelligent garbage collection without human intervention. Hence, this project aims to design intelligent garbage collection system using IoT. Increasing population density in urban areas demands the necessity of intelligent services to meet the needs of the city's residents. An emerging solution to deal with this scenario is the convergence of information and communication technologies through the implementation of the concepts of smart cities and Internet of Things to provide solutions in diverse fields

like infrastructure, transportation, and surveillance. The efficient management of these kinds of services has a significant impact on the quality of life of the citizens.

1.5 PROJECT PURPOSE

The Proposed system assures the collection of garbage soon when the garbage level reaches its maximum level. The system will thus provide accurate reports, increasing the efficiency of the system. The real time monitoring of the garbage level with the help of sensors and wireless communication will reduce the number of trips required by the garbage collection vehicle and thus will reduce the total expenditure associated with the Garbage bin. A smart city is an urban area that uses different types of electronic methods and sensors to collect data. Insights gained from that data are used to manage assets, resources and services efficiently. In other words, smart city is the one which has digital technology embedded across all the city functions. It also uses ICT (Information and Communication Technologies) to provide better quality and performance. Increasing population density in urban areas demands the necessity of intelligent services to meet the needs of the city's residents. An emerging solution to deal with this scenario is the convergence of information and communication technologies through the implementation of the concepts of smart cities and Internet of Things to provide solutions in diverse fields like infrastructure, transportation, and surveillance. The efficient management of these kinds of services has a significant impact on the quality of life of the citizens. The garbage collection system is an important component of urban infrastructure. Itis difficult to locate the exact garbage bin which is facing the problem. Therefore, it is essential to develop a system which can handle intelligent garbage collection without human intervention. Hence, this project aims to design intelligent garbage collection system using IoT Technology.

1.6 PROJECT FEATURES

This type of IoT implementation is only in its initial stages but is very promising. A basic example of an IoT smart city would be smart parking. This service automatically shows users where they could find free parking spaces in the neighborhood. Major Tasks involved in Proposed Project are:

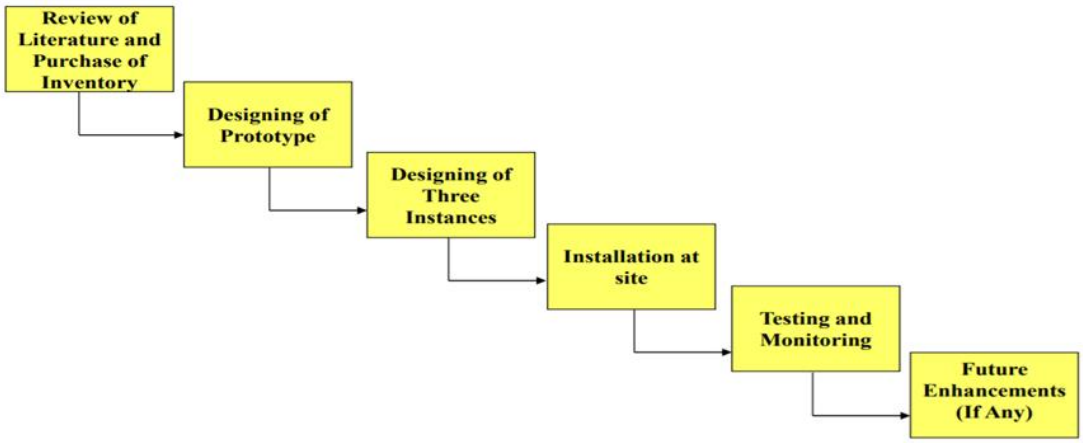


Fig. 1.6 Tasks involved in Proposed Project.

CHAPTER 2

LITERATURE SURVEY

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 H. Arasteh etal [1] discussed about 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 IR 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 todetect the level of the garbage in the dustbin. The output of level detector is given to microcontroller. Four IR sensors are used to indicate the different levels of the amount of the garbage collected in the dustbin which is placed in public area. When the dustbin is filled up to the highest level, the output of fourth IR receiver becomes active low. This output is given to microcontroller to send the message to the Control room via GSM module. At receiver, control room is present where all the activities are managing. At receiver, control room is present where all the activities are managing. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum. If the dustbin is not cleaned in specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor.

The Prakash etal [3] suggest the method for garbage management which is as follows. In this paper the bin was connected with a microcontroller based system which had an IR wireless system with a main central system that shows the current status of the garbage bin. The status was seen on a mobile based web browser with html page by using Wi-Fi. in this system to reduce the cost they used weight sensor and on the sender's side they used a Wi-Fi module to send and receive the data. In the end the weight sensor only detects the weight of the garbage in the bin but not the level of waste.

First is the traditional method or the normal use of Dustbin in our daily life. Each and every person in the world disposes of the waste in the dustbin and if the dustbin becomes full, he empties the waste inside the bin and again uses the same Dustbin. This is the basic use of a normal dustbin where no components are used, no coding is done and where everything is manual i.e. everything is done by hand. No batteries, electronic components such as Arduino, UNO are used. Only way of disposal is to open the lid of the dustbin and dispose of the waste in it and clean or empty it when it becomes full. When the same thing is applied in a neighborhood or in a colony, the waste becomes more to dispose of and if the dustbin is full people start throwing the waste around the dustbin which leads to different diseases. The official who should empty the bin will be irregular in emptying the bin and the waste will be lying in that street for weeks causing an unhealthy environment and leading to various diseases. The maintenance of the bin is also not proper where the lid is broken which leads to the overflowing of the waste from the bin. The advantages of using this method of disposal is the waste will be disposed of in the bin and emptying the bin is easy as there are no electronic components used. In this method a plastic container storage bin will be present for disposal of waste but this method leads to various disadvantages than being advantageous. The various disadvantages are If the maintenance of the bin is not proper then the bin gets a stinky smell. If the bin is not emptied immediately after it gets full then various flies, mosquitoes and other insects will be around it which leads to a cause of various diseases. If the bin does not have a lid then the waste overflows out of the bin causing damage to the environment.

The second method is the use of a dustbin with different segregations like green and blue bins which are placed together or the dustbin where only recyclable waste should be disposed. This method also has the same advantages and disadvantages as mentioned above because this method also does not use any hardware components or any electronic items like the above method. Only the bins are segregated in many types indicating which waste should be disposed of in a particular bin.

In the recent decades, Urbanization has increased tremendously. At the same phase there is an increase in waste production. Waste management has been a crucial

issue to be considered. This paper is a way to achieve this good cause. In this paper, smart bin is built on a microcontroller-based platform Arduino Uno board which is interfaced with GSM modem and IR sensor. IR sensor is placed at the top of the dustbin which will measure the stature of the dustbin. The threshold stature is set as 10cm. Arduino will be programmed in such a way that when the dustbin is being filled, the remaining height from the threshold height will be displayed. Once the garbage reaches the threshold level IR sensor will trigger the GSM modem which will continuously alert the required authority until the garbage in the dustbin is squashed. Once the dustbin is squashed, people can reuse the dustbin. At regular intervals the dustbin will be squashed. Once these smart bins are implemented on a large scale, by replacing our traditional bins present today, waste can be managed efficiently as it avoids unnecessary lumping of wastes on the roadside. Foul smell from these rotten wastes that remain untreated for a long time, due to negligence of authorities and carelessness of the public may lead to long term problems. Breeding of insects and mosquitoes can create nuisance around promoting an unclean environment. This may even cause dreadful diseases.

2.1 EXISTING SYSTEM

A waste-bin system can be adapted into general waste-bin and it consists of the sensing units, a Bluetooth and GSM Module for data transmission, and a mobile application and web-based monitoring for interfacing and communication with the waste department for waste management. The smart bin is composed of a sensor node mounted on it for the data collection and transmission. The sensors are divided into two paths. One path is mounted with the bin cover and the other is in the bottom of the bin. The first path is a level sensor to monitoring the level of waste-bin. The other path is a smart load cell sensor to calculate the weight of waste

2.2 PROPOSED SYSTEM

The Proposed system assures the collection of garbage soon when the garbage level reaches its maximum level. The system will thus provide accurate reports, increasing the efficiency of the system. The real time monitoring of the garbage level with the help of sensors and wireless communication will reduce the number of trips required by the garbage collection vehicle and thus will reduce the total expenditure associated with the Garbage bin. This system consists of an single IR sensor to collect information on the level of garbage.

CHAPTER 3

REQUIREMENT ANALYSIS

3.1 Hardware Requirements

The Hardware Requirements for developing this project is as follows:

- Arduino uno
- IR sensor
- GSM module
- Servo motor

3.1.1 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 as shown in the figure 3.1.1.

- The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package. The Arduino is a microcontroller board based on the ATmega8. It has 14 digital -input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a ACto-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Revision 2 of the Uno board has a resistor pulling the 8U2HWB line to ground, making it easier to put into DFU mode. Revision of the board has the following new features

- Pin out: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.
- Stronger RESET circuit.
- AT mega 16U2 replace the 8U2.

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

Fig. 3.1.1 Aurdino uno.

3.1.2 IR sensor

The IR sensor module consists mainly of the IR Transmitter and Receiver, Opamp, Variable Resistor (Trimmer pot), output LED in as shown in the figure 3.1.2.

IR LED Transmitter

IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. IR LEDs have light emitting angle of approx. 20-60 degree and range of approx. few centimetres to several feet's, it depends upon the type of IR transmitter and the

manufacturer. Some transmitters have the range in kilometres. IR LED white or transparent in colour, so it can give out amount of maximum light.

Photodiode Receiver

Photodiode acts as the IR receiver as its conducts when light falls on it. Photodiode is a semiconductor which has a P-N junction, operated in Reverse Bias, means it start conducting the current in reverse direction when Light falls on it, and the amount of current flow is proportional to the amount of Light. This property makes it useful for IR detection. Photodiode looks like a LED, with a black colour coating on its outer side, Black colour absorbs the highest amount of light.

LM358 Opamp

LM358 is an Operational Amplifier (Op-Amp) is used as voltage comparator in the IR sensor. the comparator will compare the threshold voltage set using the preset (pin2) and the photodiode's series resistor voltage (pin3).

Photodiode's series resistor voltage drop > Threshold voltage = Opamp output is High

Photodiode's series resistor voltage drop < Threshold voltage = Opamp output is Low

When Opamp's output is high the LED at the Opamp output terminal turns ON (Indicating the detection of Object).

Variable Resistor

The variable resistor used here is a present. It is used to calibrate the distance range at which object should be detected.

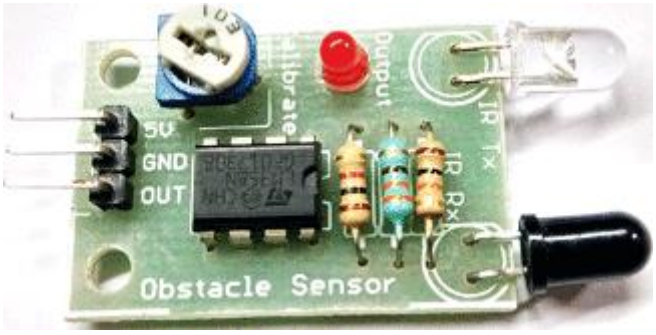


Fig. 3.1.2 IR sensor.

3.1.3 GSM module

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system as shown in the figure 3.1.3. 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:

- Receive, send or delete SMS messages in a SIM.
- Read, add, search phonebook entries of the SIM.
- 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

Fig. 3.1.3 GSM module.

3.1.4 Servo motor

The servo motor is usually a simple DC motor controlled for specific angular rotation with the help of additional servomechanism (a typical closed-loop feedback control system)is shown in the figure 3.1.4. Nowadays, servo systems are used widely in industrial applications.

Servo motor applications are also commonly seen in remote-controlled toy cars for controlling the direction of motion, and it is also very widely used as the motor which moves the tray of a CD or DVD player. Besides these, there are hundreds of servo motor applications we see in our daily life.

The main reason behind using a servo is that it provides angular precision, i.e. it will only rotate as much we want and then stop and wait for the next signal to take further action. The servo motor is unlike a standard electric motor which starts turning as when we apply

power to it, and the rotation continues until we switch off the power. We cannot control the rotational progress of electrical motor, but we can only control the speed of rotation and can turn it ON and OFF. Small servo motors are included many beginner Arduino starter kits, as they are easy to operate as part of a small electronics projects.

Fig. 3.1.4 Servo motor.

3.1.5 Breadboard

A breadboard is a construction base for prototyping of electronics. It is shown in the figure 3.1.5. Originally it was literally a bread board, a polished piece of wood used for slicing bread. Because the solder less breadboard does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design. For this reason, solder less breadboards are also extremely popular with students and in technological education. Older breadboard types did not have this property. A strip board (Vero board) and similar prototyping printed circuit boards, which are used to build semi-permanent soldered prototypes or one-offs, cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

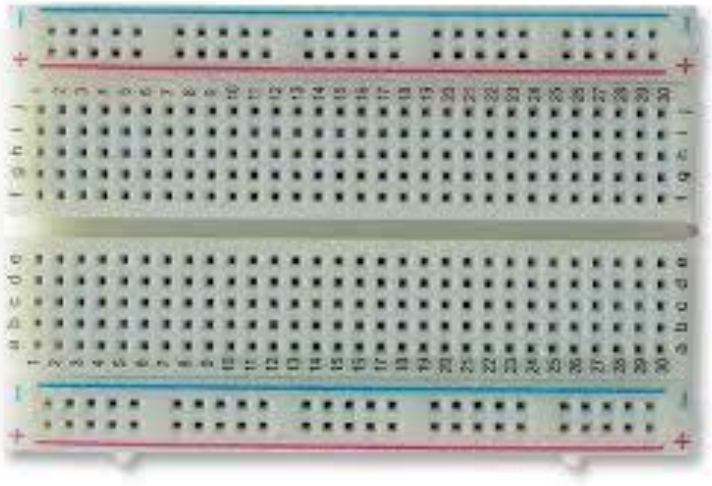


Fig.3.1.5 Breadboard.

3.2 Software Requirements

The software requirements for this project are Arduino IDE. Arduino IDE: The Arduino Integrated Development Environment is a cross platform application that is used to upload programs into Arduino Compatible boards. The Arduino IDE supports C and C++ using special rules of code structuring. The Arduino IDE employs the program AVRDUDE to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino Board by a loader program in the board's firmware. This IDE when selected opens a default sketch file where the part of the code is divided into two parts the void setup() and the void loop ( ). Above these two statements the header files and the variable declarations should be done so that the actual code logic can be mentioned in those methods. The setup method has the different variables that are needed to perform the specific operation and the loop method consists of the actual logic code. After the code has been written it should be verified and should be compatible with the board that the code needs to be uploaded

3.2.1 Dev C++

Dev C++ is a free full-featured integrated development environment (IDE) distributed under the GNU General Public License for programming in C and C++. It was originally developed by Colin Laplace and first released in 1998. Dev-C++ can also be used in combination with Cygwin or any other GCC-based compiler. An additional aspect of Dev-C++ is its use of DevPaks: packaged extensions on the programming environment with additional libraries, templates, and utilities. DevPaks often contain, but are not limited to, GUI utilities, including popular toolkits such as GTK+, wxWidgets, and FLTK. Other DevPaks include libraries for more advanced function use. Users of Dev-C++ can download additional libraries, or packages of code that increase the scope and functionality of Dev-C++, such as graphics, compression, animation, sound support and many more. Users can create DevPaks and host them for free on the site. Also, they are not limited to use with Dev-C++ - the site says "A typical devpak will work with any MinGW distribution (with any IDE for MinGW)".From February 22, 2005 the project was not noticeably active, with no news posted nor any updated versions released. In a 2006 forum post, lead developer Colin Laplace stated that he was busy with real-life issues and did not have time to continue development of Dev-C++.In a 2020 forum post, Orwell lead developer Johan Mes stated that he "will probably still not have any time to work on this

project".There are three forks of Dev-C++ since then: wxDev-C++, the Orwell version, and the Embarcadero-maintained fork version. On June 30, 2011 an unofficial version 4.9.9.3 of Dev-C++ was released by Orwell (Johan Mes), an independent programmer, featuring the more recent GCC 4.5.2 compiler, Windows' SDK resources (Win32 and D3D), numerous bug fixes, and improved stability. On August 27, after five years of officially being in a beta stage, version 5.0 was released. This version also has its own separate Source Forge page since version 5.0.0.5, because the old developer isn't responding to combining requests. In July 2014, Orwell Dev-C++ 5.7.1 was released featuring the then recent GCC 4.8.1 which supports C++11.Compile & run your code with the CodeChef online IDE. Our online compiler supports multiple programming languages like Python, C++, C, Kotlin, NodeJS, and many more. Code Chef was created as a platform to help programmers make it big in the world of algorithms, computer programming, and programming contests.

CHAPTER 4

DESIGN AND IMPLEMENTATION

4.1 DESIGN GOALS

This smart bin system is very useful in preventing overflow of dustbins and accumulation of wastes around the dustbin. This prototype model monitors the bins and provides details about the level of garbage collected in the garbage bins via sensors & Internet. This system uses an Arduino device with a power supply.

IR Sensors placed over the bins lid to detect the garbage outside bin. IR Sensor is used to sense near garbage if any Sensors are used to lock the bin automatically, when rain is detected. The system makes use of Arduino board. Connections of the IR sensor with the Arduino are very simple. Connect the VCC and the ground of the IR sensor to the 5V and the ground of the Arduino. Then connect the TRIG and ECHO pin of IR 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.

After setting up the Smart Dustbin and making all the necessary connections, upload the code to Arduino and provide 5V power supply to the circuit. Once the system is powered ON, Arduino keeps monitoring for any object near the IR Sensor.

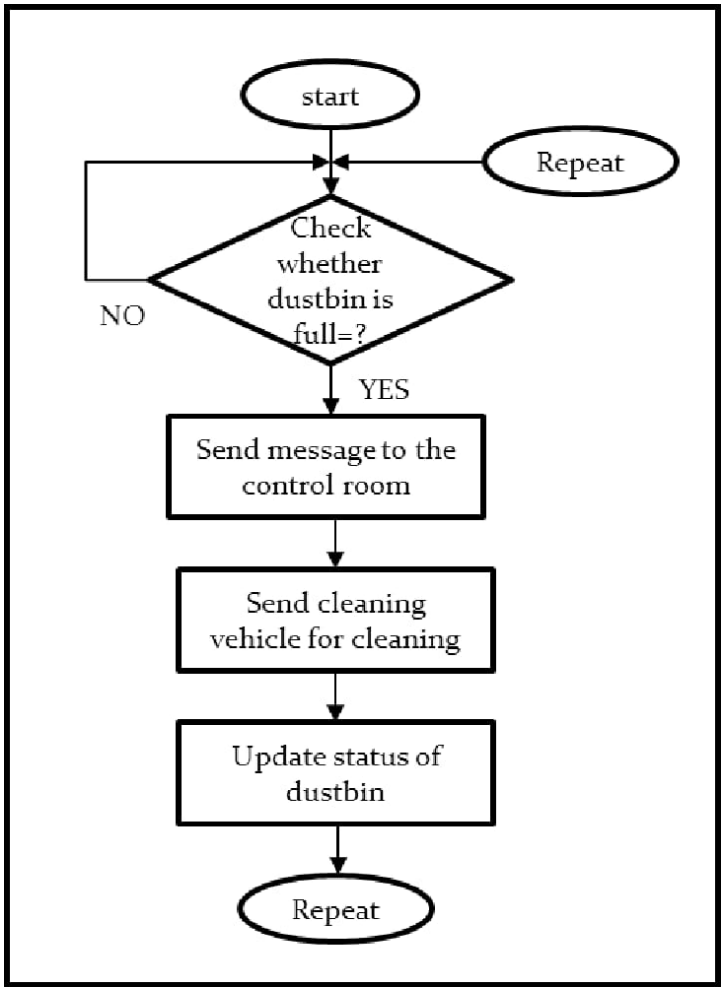


Fig. 4.1 The cycle of the first part of dustbin.

Concept behind Smart Dustbin using Arduino

In this project we put the IR sensor on top of the garbage bin/ dump. The output of the IR sensor is processed by the Arduino and the output is then sent to the GSM module which sends a text message to the concerned person. We have a threshold value of 5cm.Which means that if the distance of the sensor from the top of the garbage is less than 5cm, the output will come with a message that the basket is full.

A similar methodology is implemented here, where the IR Sensor is placed on top of the dustbin's lid and when the sensor detects any object like a human hand, it will trigger Arduino to open the lid.

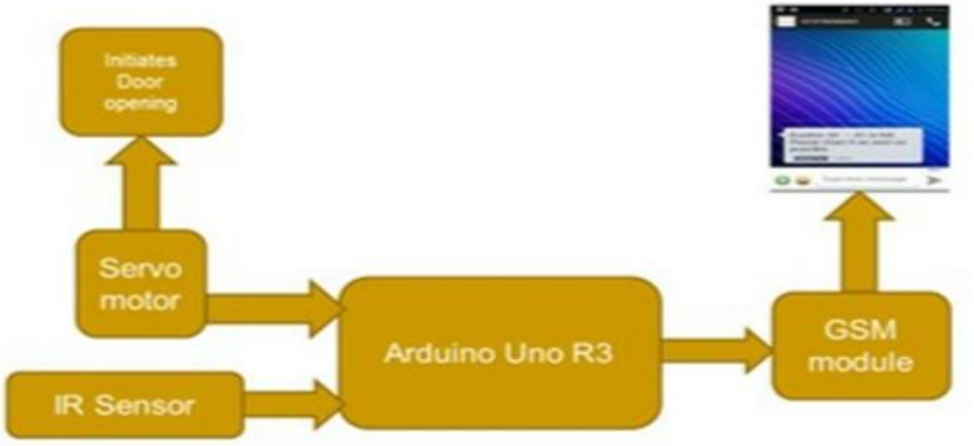


Fig. 4.1.1 Design.

The IR sensor will observe a person nearby dustbin. If motion is detected the lid of dustbin is opened, the servo motor activates and as GSM connected it will send an alert message to user if dustbin is filled. Dustbin placed in public place, people throw garbage in dustbin, place the ultrasonic sensor in top of the garbage bin. If dustbin reach in 75% then arduino send message through GSM module.

4.2 Hardware implementation

Connections of the IR sensor with the Arduino are very simple. Connect the VCC and the ground of the IR sensor to the 5V and the ground of the Arduino. Then connect the TRIG and ECHO pin of IR 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.

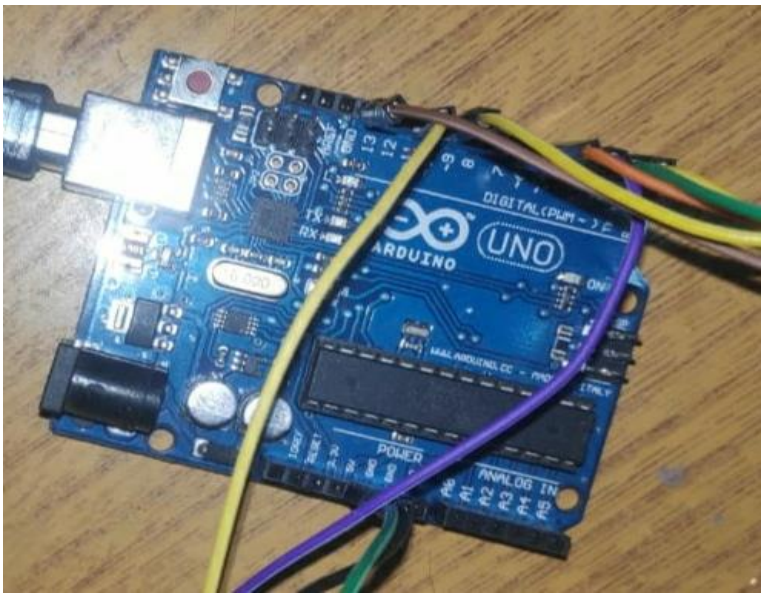


Fig. 4.2.1 Hardware implementation.

4.3 Software implementation

The software required for it is the Arduino IDE. 4.2.1 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/pastingand for searching/replacing text. The message area gives feedback while saving and exportingand also displays errors. The console displays text output by the Arduino environmentincluding complete error messages and other information. The bottom right-hand corner ofthe window displays the current board and serial port.

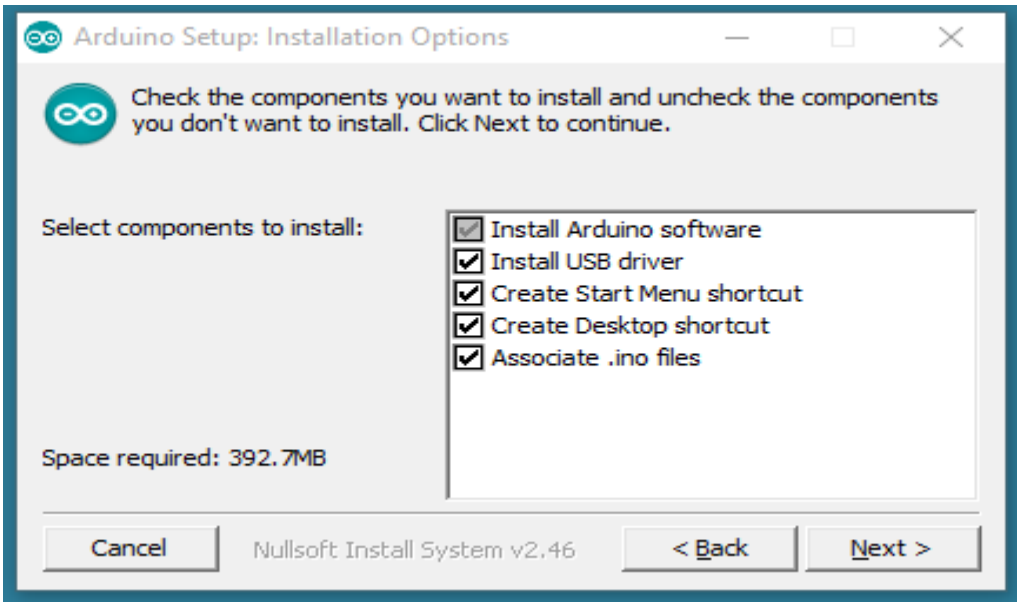
Arduino code:

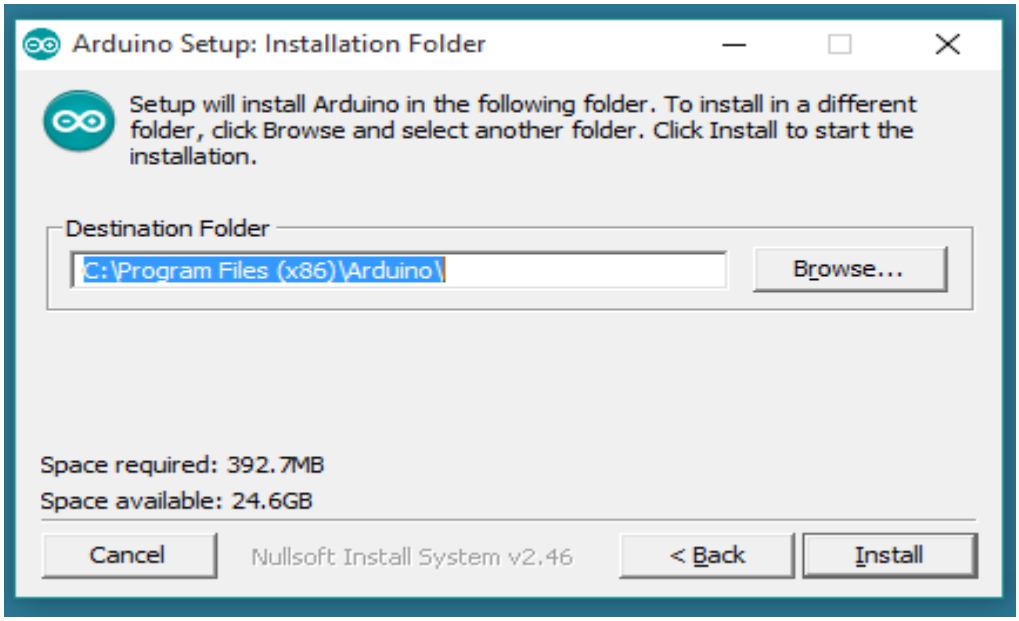
```
#include <Servo.h>
Servo tap_servo;
int sensor_pin = 4;
int tap_servo_pin =5;//PWM PIN
int val;
const int IR_Sensor1 = 10;
const int IR_Sensor2 = 11;
void setup()
{
  mySerial.begin(9600);
     // Setting the baud rate of GSM Module
  pinMode(sensor_pin,INPUT);
  tap_servo.attach(tap_servo_pin);
  pinMode(IR_Sensor1, INPUT);
  pinMode(IR_Sensor2, INPUT);
 }
void loop()
{
val = digitalRead(sensor_pin);
        if (val==0)
  {
    tap_servo.write(88);
  }
  if (val==1)
  {
    tap_servo.write(180);
  }
if (digitalRead(IR_Sensor1) == 0)
  {
    SendMessage1();
  }
if (digitalRead(IR_Sensor2) == 0)
  {
    SendMessage2();
```

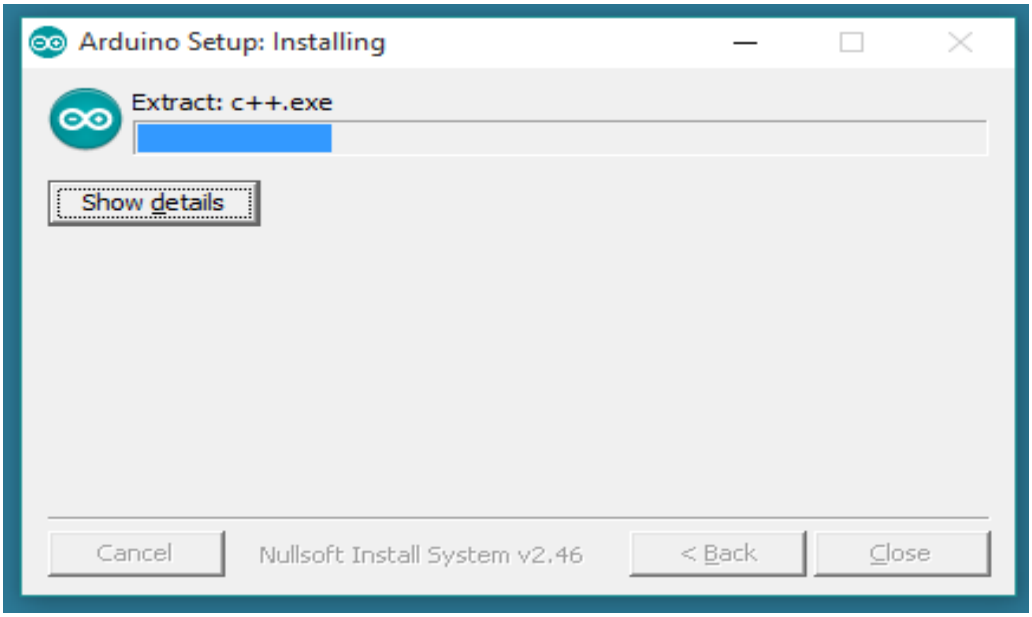
```
  }
}
void SendMessage1()
{
  mySerial.println("AT+CMGF=1");
 //Sets the GSM Module in Text Mode
  delay(1000);
 // Delay of 1000 milli seconds or 1 second
  mySerial.println("AT+CMGS=\"+919346524441\"\r");
// Replace x with mobile number
  delay(1000);
  mySerial.println("75% DUSTBIN FILLED at SRIT!!!");
// The SMS text you want to send
  delay(100);
  mySerial.println((char)26);
// ASCII code of CTRL+Z
  delay(1000);
  while(1)
  {
    if (digitalRead(IR_Sensor1) == 1)
    {
      return digitalRead(IR_Sensor1);
    }
  }
}
void SendMessage2()
{
  mySerial.println("AT+CMGF=1");
    //Sets the GSM Module in Text Mode
  delay(1000);
    // Delay of 1000 milli seconds or 1 second
  mySerial.println("AT+CMGS=\"+919346524441\"\r");
    // Replace x with mobile number
  delay(1000);
```

```
  mySerial.println("100% DUSTBIN FILLED at SRIT! please clean the dustbin!!!");
    // The SMS text you want to send
  delay(100);
  mySerial.println((char)26);
    // ASCII code of CTRL+Z
  delay(1000);
  while(1)
  {
   if (digitalRead(IR_Sensor1) == 1)
    {
     return digitalRead(IR_Sensor2);
    }
  }
}
```

Install the Arduino Software (IDE)




Arduino Setup: Installation Folder
Setup will install Arduino in the following folder. To install in a different folder, click Browse and select another folder. Click Install to start the installation.
Destination Folder
C:\Program Files (x86)\Arduino\
Browse...
Space required: 392.7MB
Space available: 24.6GB
Cancel
Nullsoft Install System v2.46
< Back
Install


Arduino Setup: Installing
Extract: c++.exe
Show details
Cancel
Nullsoft Install System v2.46
< Back
Close


Blink | Arduino 1.6.12
File Edit Sketch Tools Help
How to make
Arduino IDE
work better with QHD+ Screen


sketch_may08a | Arduino 1.6.4
File Edit Sketch Tools Help
sketch_may08a
1.6.4
ARDUINO
AN OPEN PROJECT WRITTEN, DEBUGGED,
AND SUPPORTED BY ARDUINO.CC AND
THE ARDUINO COMMUNITY WORLDWIDE
LEARN MORE ABOUT THE CONTRIBUTORS
OF ARDUINO.CC on arduino.cc/credits

File Edit Sketch Tools Help

srit_project

```
#include <SoftwareSerial.h>
SoftwareSerial mySerial(2, 3);

#include <Servo.h>

Servo tap_servo;

int sensor_pin = 4;
int tap_servo_pin =6; //PWM PIN
int val;
const int IR_Sensor1 = 10;
const int IR_Sensor2 = 11;
void setup()
{
  mySerial.begin(9600);   // Setting the baud rate of GSM Module
  pinMode(sensor_pin,INPUT);
  tap_servo.attach(tap_servo_pin);
  pinMode(IR_Sensor1, INPUT);
  pinMode(IR_Sensor2, INPUT);

}
void loop()
{
val = digitalRead(sensor_pin);

  if (val==0)
  {
    tap_servo.write(88);
  }
  if (val==1)
  {
    tap_servo.write(180);
  }

  if (digitalRead(IR_Sensor1) == 0)
```

File Edit Sketch Tools Help

srit_project

```
  if (digitalRead(IR_Sensor1) == 0)
  {
    SendMessage1();
  }

  if (digitalRead(IR_Sensor2) == 0)
  {
    SendMessage2();
  }

}

void SendMessage1()
{
  mySerial.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
  delay(1000);  // Delay of 1000 milli seconds or 1 second
  mySerial.println("AT+CMGS=\"+918328192377\"\r"); // Replace x with mobile number
  delay(1000);
  mySerial.println("75% DUSTBIN IS FILLED at SRIT! !!!");// The SMS text you want to send
  delay(100);
  mySerial.println((char)26);// ASCII code of CTRL+Z
  delay(1000);

  while(1)
  {
    if (digitalRead(IR_Sensor1) == 1)
    {
      return digitalRead(IR_Sensor1);
    }
  }
}
void SendMessage2()
{
  mySerial.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
```

Done uploading

srit_project

```
  mySerial.println("AT+CMGS=\"+918328192377\"\r"); // Replace x with mobile number
  delay(1000);
  mySerial.println("75% DUSTBIN IS FILLED at SRIT! !!!");// The SMS text you want to send
  delay(100);
  mySerial.println((char)26);// ASCII code of CTRL+Z
  delay(1000);

  while(1)
  {
    if (digitalRead(IR_Sensor1) == 1)
    {
      return digitalRead(IR_Sensor1);
    }
  }
}
void SendMessage2()
{
  mySerial.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
  delay(1000);  // Delay of 1000 milli seconds or 1 second
  mySerial.println("AT+CMGS=\"+918328192377\"\r"); // Replace x with mobile number
  delay(1000);
  mySerial.println("100% DUSTBIN IS FILLED at SRIT! please clean the dustbin!!!");// The SMS text you want to send
  delay(100);
  mySerial.println((char)26);// ASCII code of CTRL+Z
  delay(1000);

  while(1)
  {
    if (digitalRead(IR_Sensor1) == 1)
    {
      return digitalRead(IR_Sensor2);
    }
  }
}
```

CHAPTER 5

TESTING

5.1 Test approach

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

5.2 Features to be tested

After building the whole circuit we test it, This project should satisfy some features. Features to be tested as follows:

- The IR sensor should give proper output. To check whether the output is accurate or not, the output of the sensor will be checked against a meter tape.
- The GSM module should send messages after the specified delay. If the text messages are reaching the phone, that means the GSM module is working. It should make a small ringing sound, when it sends messages.
- Check the working of servo motor.

5.3 Testing tools and environment

For testing of the project we require some tools, like to test Arduino program we require a software called Arduino IDE. Using this we can check the program that program is working properly or not. For hardware checking we require power supply and proper range of measurements and a meter tape. The garbage dump should have only solid waste.

5.4 Test cases

In this section we discuss about the inputs, expected output, testing procedure.

5.4.1 Inputs

This project requires two inputs:

1. Power supply: Power supply is the basic need of any electronic circuit. Here we use 5v dc battery to give power Arduino and sometimes we can give power directly from the computer. We also need a 12V power supply for the GSM module.
2. We can also power these circuits via two 9v batteries using a circuit divider. Distance, The distance will be the input of the Arduino circuit and will be

gotten from the IR sensor.

5.3.2 Expected output

The expected output of this project should be a text message showing the distance to full. The output should also be seen on the serial monitor of the Arduino IDE.

5.3.3 Testing procedure

For testing first connect the circuit to the power supply is given to the Arduino using computer and it can be done by using battery. In this way the whole testing circuit is built. Now we give input to the HC-SR04 by changing the level of solid garbage. Change in garbage levels should be messaged using GSM Module. Summary of testing procedure:-

- Connect the circuit according to the diagram
- Give power to the system.
- Vary garbage level for the IR sensor to give output.
- Get the output from the IR sensor.
- Send message via the GSM module

CHAPTER 6

RESULT

In the wake of setting up the Dustbin and making all the crucial affiliations, move the code to Arduino. At the point when the system is energized ON, Arduino keeps checking for any article near the IR Sensor. If the IR sensor perceives any article like a hand for example, Arduino figures its detachment and if it not actually a certain predefined regard, The Motor of Servo of Arduino Uno will be instigated with the help of broad arm, it will list the top open.

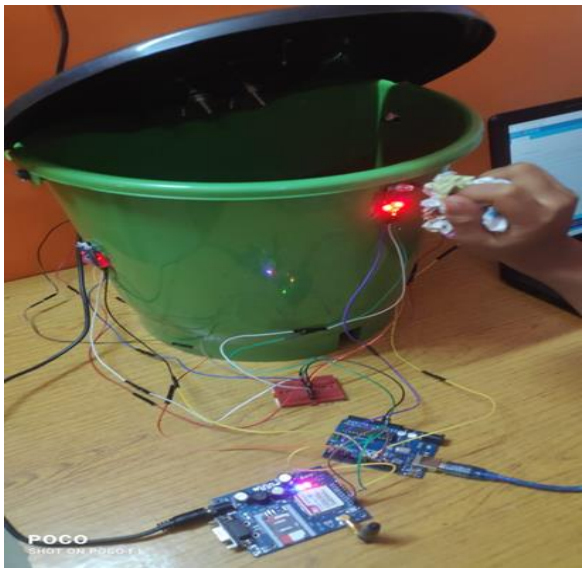


Fig . 6.1 Servo motor working.

This implementation of smart garbage Bin indicator receptacle, gives a solution for unsanitary environmental condition in a city. This implementation of Smart Garbage collection bin using IR sensor.. This system assures to send msg notification and status on dashboard of dustbins when the garbage level reaches its maximum. If the dustbin is not cleaned in specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor. This system also helps to monitor the fake reports and hence can reduce the corruption in the overall management system. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. It ultimate helps to keep cleanness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient the use of solar panels in such systems may reduce the energy consumption.

Such systems are vulnerable to plundering of components in the system in different ways which needs to be worked on. These dust bin model can be applied to any of the smart cities around the world. A waste collecting and monitoring team which is deployed for collection of garbage from the city can be guided in a well manner for collection.

Fig. 6.2 Dustbin is full.

A simple but useful project called Smart Dustbin using Arduino is designed and developed here. Using this project, the lid of the dustbin stays closed, so that waste is not exposed (to avoid flies and mosquitoes) and when you want dispose any waste, it will automatically be opened.

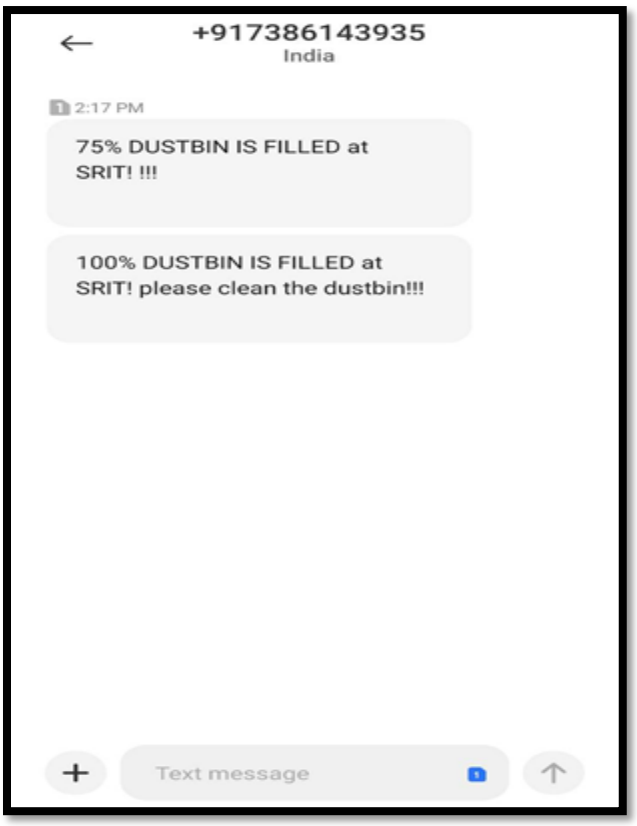


Fig. 6.3 Alert SMS messages.

The output of this project should have been the values of the distance, temperature and humidity, which we were supposed to get via a text message. For, the GSM Module to send data, the sensors must be working perfectly which can be seen in figure. This brings us to figure 6.3 alert SMS messages. In which we see the text messages sent from the GSM Module.

CHAPTER 7

CONCLUSION AND FUTURE ENHANCEMENT

7.1 CONCLUSION

We built an efficient garbage monitoring system which can be used to monitor the level of garbage in the dump. This data can be further used to plan garbage collection trips more efficiently, ultimately reducing overflowing bins and helping have better public sanitation And time to avoid damage to the public health.

A simple but useful project called Smart Dustbin using Arduino is designed and developed here. Using project, the lid of the dustbin stays closed, so that waste is not exposed and when you want dispose any waste, it will automatically open the lid.

7.2 FUTURE ENHANCEMENT

This is a prototype developed for two bins. This system can be easily extended to any number of bins. All dustbins present in a city can be connected together through a system for totally automating the process of the wastage collection once the bins are full. Additional controls like closing the lid when the bin is full and closing the bin when it rains. Facility for modifying and project. More interactive interface. Facilities for Backup creation. Can be done as stand alone. Can be done as Mobile Application. Implemented for colleges. Implemented for the universities and small villages.

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[5] IOT Based Smart Garbage alert system using Arduino UNO, By Dr.N.Sathish Kumar, B.Vijayalakshmi, R. Jenifer Prarthana, A .Shankar 2016 IEEE Region 10 Conference (TENCON) — Proceedings of the International Conference.

[6] International Journal of Advanced Research in Computer and Communication Engineering ISO 3297:2007 Certified Vol. 7, Issue 4, April 2018 Copyright to IJARCCE DOI 10.17148/IJARCCE.2018.7434 177 GSM based Garbage Monitoring System S.Kale, P.Alane, K. Gaikwad.