

SMART TRASH AND DUST COLLECTION- SEGREGATION ROBOT

Submitted in partial fulfillment of the requirements for
the award of
Bachelor of Engineering degree in Computer Science and Engineering

by

PRISCILLA CHELSEA R.K(Reg. No. 37111598)

K. PRIYANKA (Reg. No. 37110599)



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SCHOOL OF COMPUTING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade “A” by NAAC
JEPPIAAR NAGAR, RAJIV GANDHI SALAI,
CHENNAI – 600 119**

APRIL - 2021



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited with "A" grade by NAAC

Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119

www.sathyabama.ac.in



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this project report is the bonafide work of **PRISCILLA CHELSEA R.K (Reg. No. 37110598)** and **K. PRIYANKA (Reg. No. 37110599)** who carried out the project entitled "**SMART TRASH AND DUST COLLECTION-SEGREGATION ROBOT**" under my supervision from **August 2020 to March 2021**.

Internal Guide

Dr. K. Ashok Kumar M.E., Ph.D.,

Head of the Department

Submitted for Viva voce Examination held on _____

Internal Examiner

External Examiner

DECLARATION

I **PRISCILLA CHELSEA R.K** hereby declare that the Project Report entitled “**SMART TRASH AND DUST COLLECTION- SEGREGATION ROBOT**” is done by me under the guidance of **Dr. K. Ashok Kumar M.E., Ph.D.**, Department of Computer Science and Engineering at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Computer Science and Engineering.

DATE:

PLACE: CHENNAI

SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to **Board of Management** of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. T. Sasikala, M.E., Ph.D., Dean**, School of Computing, **Dr. S. Vigneswari, M.E., Ph.D.,** and **Dr. L. Lakshmanan, M.E., Ph.D., Heads of the Department** of Computer Science and Engineering for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Project Guide **Dr. K. Ashok Kumar M.E., Ph.D., Associate Professor**, for her valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Computer Science and Engineering** who were helpful in many ways for the completion of the project.

ABSTRACT

Waste generation, insufficient waste collection, transportation, treatment, and disposal are major environmental issues in India. In India, waste production ranges from 200 to 870 grammes per day, and the rate of increase is around 1.3 percent per capita once a year. To help solve this issue, we came up with a concept that uses IoT and CNN to help segregate waste. Smart Bins contribute to a healthier, safer, and more sanitary environment, as well as improved operational quality, all while lowering maintenance costs, energy, and roadside pollution. This paper introduces an Internet of Things interface for both autonomous and manual control modes. When the object is put in front of the camera, the camera determines whether it is a waste or not. The trash is retrieved by a robotic arm, which then positions it on a metal detector and moisture sensor to assess if it is metallic, nonmetallic, wet, or dry. A dust-collector is mounted at the rock bottom of the container, and an IR sensor is used to see the depth of the trash. The results of the designed prototype were sufficient to justify the tactic used. With this research, the waste management system is taking the first steps toward being a viable system that will result in a healthy climate for this and future years.

TABLE OF CONTENTS

CHAPTER No.	TITLE	PAGE No.
	ABSTRACT	v
	LIST OF ABBREVIATIONS	viii
	LIST OF FIGURES	ix
	LIST OF TABLES	x
1.	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Background	2
	1.3 Objective	2
	1.4 Problem statement	3
2.	LITERATURE SURVEY	4
	2.1 Literature survey	4
	2.2 Existing System	5
	2.2.1 Drawbacks	6
	2.3 Proposed system	6
	2.3.1 Advantages	7
	2.4. About the system	7
3.	AIM AND SCOPE OF THE PRESENT INVESTIGATION	9
	3.1 Aim and objective of the project	9
	3.1.1 Objective	9
	3.2 Project Scope	9
	3.3 Methodology	10
4.	MATERIALS AND METHOD	14
	4.1 Requirements of the system	14
	4.1.1 Hardware requirements	14
	4.1.1.1 Arduino Uno	15
	4.1.1.2 IR sensor	17
	4.1.1.3 L298D Motor Driver	18
	4.1.1.4 Bluetooth HC-05	20
	4.1.1.5 Servo motor gear 9G	21

4.1.1.6	12V battery	23
4.1.1.7	Jumper Wires	23
4.1.1.8	Moisture sensor	24
4.1.1.9	USB cable	25
4.1.1.10	Metal detector sensor	26
4.1.1.11	USB web camera	27
4.1.1.12	12V DC motor	28
4.1.1.13	ESP8266 Wifi module	29
4.1.2	Software requirements	32
4.1.2.1	Arduino IDE	32
4.1.2.2	Blynk app	33
4.2	Circuit design for Bluetooth connected with android app	34
4.2.1	Android app	34
4.2.2	Working of Bluetooth connected with android app	34
4.2.3	Limitations	35
4.2.4	Applications	35
4.3	Working Principle	35
5.	RESULT AND DISCUSSION	38
5.1	Simulation result of IR sensor and servo motor	38
5.2	Android app connected with Bluetooth	39
5.3	Level of the garbage using IR sensor	39
5.4	Robotic arm	40
5.5	Result	40
6.	CONCLUSION AND FUTURE SCOPE	42
6.1	Conclusion	42
6.2	Future scope	42
	REFERENCES	44

LIST OF ABBREVIATIONS

ABBREVIATIONS

IOT

RCV

AC

USB

IDE

ICSP

DC

IR

IORef

KB

SRAM

EEPROM

LED

GND

TTL

PAN

FHSS

EN

RM

AM

TCP

IP

EXPANSIONS

Internet Of Things

Remote Control Vehicle

Alternating Current

Universal Serial Bus

Integrated Development Environment

In Circuit Serial Programming

Direct Current

Infra Red

Input Output Reference

Kilo Byte

Static Random Access Memory

Electrically Erasable Programmable
Read Only Memory

Light Emitting Diode

Ground

Transistor-Transistor Logic

Personal Area Network

Frequency-Hopping Spread Spectra

Enable

Relative Moisture

Absolute Moisture

Transmission Control Protocol

Internet Protocol

LIST OF FIGURES

FIGURE NO.	NAME OF THE FIGURE	PAGE NO.
2.1	Existing system	6
3.1	Waterfall model	11
3.2	Modules of smart dustbin	12
3.3	Flowchart for smart dustbin controlled by BT	12
3.4	Block diagram for smart dustbin	13
4.1	Arduino Uno	16
4.2	IR sensor	17
4.3	L298N motor driver	19
4.4	Bluetooth HC-05 module	20
4.5	Motor gear 9G	21
4.6	12V battery	23
4.7	Jumper wire	23
4.8	Humidity sensor	25
4.9	USB cable	25
4.10	Inductive proximity sensor	26
4.11	USB web camera	28
4.12	12V DC motor	28
4.13	ESP8266 wifi module	31
4.14	Arduino IDE	33
4.15	Front view of the Smart trash and dust collection-segregation robot	37
4.16	Top view of the Smart robot	37
5.1	Distance vs Response time	39
5.2	Screenshot of the app	39
5.3	Level of the garbage using IR sensor	39
5.4	Structure of robotic arm	40

LIST OF TABLES

TABLE NO.	NAME OF THE TABLE	PAGE NO.
4.1	Specification of Arduino Uno	16
4.2	Specification of IR sensor	18
4.3	Specification of Humidity sensor	25
4.4	DC motor specification	29
4.5	Specification of ESP8266 wifi Module	31
5.1	Computed time from the acquired distance	38
5.2	Rotation of bin according to the type of waste	41

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The Internet of things, also called the Internet of objects, refers to a wireless network between objects. Usually, the network will be wireless and self-configuring, such as household appliances. Internet of things refers to concept that the Internet is no longer just a global network for the people to communicate with one another using computers, but it is also a platform for devices to communicate electronically with the world around them. The Internet of Things (IOT) is a network of the physical objects-device, vehicles, buildings and other items which are embedded with electronics, software, sensor and networks connectivity, which enables these objects to collect and exchange data. The Internet of things allows objects to be sensed and controlled remotely across existing networks infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems and resulting in improved efficiency, accuracy and economic benefit. Dustbins or Trash cans are small plastic or metal containers that are used to store trash or waste on a temporary basis. They are often used in homes ,office ,streets ,parks etc .To collect the waste. In some places, littering is a serious offence and hence Public Waste Containers are the only way to dispose small waste. Usually, it is common practice to use separate bins for collecting wet or dry, metallic or non- metallic waste. Dustbin have been important part of our life. But the major issue is we have to go in search of the dustbin to put garbage in it and it is difficult for the user to segregate the waste. In order to solve this issue, I have designed a simple system called “SMART TRASH AND DUST - COLLECTION SEGREGATION ROBOT”. This bin has an IOT interface with autonomous and manual mode (mobile/laptop) of control. Where the trash is picked up using robotic arm. The picked-up trash is segregated (metallic and non-metallic, wet and dry waste) and dumped into the bin attached to the robot which has separate partitions for metallic wet, non-metallic wet, metallic dry and non-metallic dry trashes. Along with this we have attached a dust collector at the bottom of the trash bin which

collects minute dust particles like hair, sand, dead bugs, etc. Also, we have used image processing for identifying the objects using CNN by camera module.

1.2 BACKGROUND

The world is in a stage of up-gradation, there is one stinking quandary. We have to deal with garbage. In our quotidian life, we visually distinguish the pictures of garbage bins being overfull and all the garbage spills out. An astronomically immense challenge in the urban cities is solid waste management not only in India but for most of the countries in the world. Hence, such a system has to be built which can eradicate this quandary or at least drop it to the minimum level. A society will get its waste dispatched felicitously only if the dustbins are placed well and amassed well. With increase in population, we have an increase in the garbage around urban areas. Here I propose a smart dustbin that operates automatically to help solve this issue using IOT and sensor-based circuitry. The main concept behind the Smart Dustbin using Arduino project is Object Detection. I have already used IR sensor in Object Avoiding Robot, the robot will change its courses of direction. A similar methodology is implemented here, where the IR sensor is placed on the front of the dustbin to check the level of the garbage. Apart from Arduino, which is main controlling module of the project, there are two other important modules in order to implement the Bluetooth Controlled Smart Dustbin. They are HC-05 Bluetooth Module and esp8266 Wifi Module which makes use of an Android mobile phone for robotic control with the help of HC-05 Bluetooth technology. Implementation is done using IOT concept.

1.3 OBJECTIVE

Smart Auto Trash Bin is a new automatic trash bin designed to be used by every community to remove the garbage. This automatic trash bin can start operating if the sensor located on the front of the trash will detect or identify an object that approached it within 10-80cm and automatically the robotic arm picks up the trash. The picked-up trash is segregated (metallic and non-metallic, wet and dry waste) and dumped into the bin attached to the robot which has separate partitions for

metallic wet, non-metallic wet, metallic dry and non-metallic dry trashes. Along with this we have attached a dust collector at the bottom of the trash bin which collects minute dust particles like (hair, sand, dead bugs, etc). Also we have used image processing for identifying the objects using CNN by camera module. The main aim of the project is to reduce human resources and efforts along with the enhancement of the smart city vision. In this project it can be controlled through Bluetooth connected with phone. Smart Dustbin as its name to describe. It works smart. It is a good device to make your surrounding clean and your home clean. Because of almost all children of home always make it dirty and spread garbage here and there by paper, rappers and many other things. The Smart Dustbin is also interesting and children make fun with it so they help to keep clean your home. They always will be used to throw all garbage and waste into this Smart bin. Smart dustbin helps us to reduce the pollution. These dustbin models can be applied to any smart cities around the world. This will improve our life style of living. This Smart Dustbin will help us reduce many resources and it is also easy and convenient to operate. The main of this Smart Bin is to give better and modern way of using the bin this will help us to be clean and hygiene and improve our surrounding to be clean.

1.4 PROBLEM STATEMENT

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 for this we should keep our surrounding clean to be away from many diseases, we should use dustbins for a easy way of using dustbin I have created "SMART TRASH AND DUST - COLLECTION SEGREGATION ROBOT" which make our life easy to use Dustbin. This idea stuck to us when we were thinking how to make use the Dustbin efficiently. To implement a Smart dustbin built on a microcontroller-based platform Arduino Uno board which is interfaced with Bluetooth module and esp8266 wifi module which is used to show the level of the garbage in our phone as a notification and also the robotic arm picks up the trash automatically.

CHAPTER 2

LITERATURE SURVEY

2.1 LITERATURE SURVEY

In [4] they used an ARDUINO UNO, as well as an ultrasonic sensor, a servo motor, and a battery jumper cable, to create a smart dustbin. In [1] they suggest IoT-based waste segregation, as well as a sensor device that will detect the amount of waste substances in it and send a warning to the municipal office. In [10] since there is no interaction with the bin, the automatic door opening mechanism confirms that human garbage disposal is fully hands-free and therefore very hygienic. Waste is separated into categories based on its capacitance. Wet waste has a slightly higher capacitance than dry waste and plastic, making it readily distinguishable. Some dry waste has different reflective properties than plastic, and as a result, the best method for distinguishing plastic from other dry waste is infrared spectroscopy. In [8] they mostly focused on home automation systems (which can also be used in malls and other public places) and hope that this can be applied on a wide scale in the future. The wastes are separated into categories so that they can be easily disposed of according to their form. In addition, the waste information is submitted directly to a cloud database in real time. As a result, the Smart Garbage Segregation & Management System would assist in garbage disposal by segregating it according to its form, thereby contributing to society and the environment in a green manner. In [6] they introduced an Internet of Things (IoT) framework that not only sends a warning to the company about the overflow and toxicity level of the dustbins, but also creates a website to track the data related to the dustbins. The message is sent to the mobile phone via the GSM module, and data about the dustbin status is updated on the website. People may also file concerns about trash cans or waste management on this website. The Arduino is used as a microcontroller in the recommended framework to communicate between the GSM/GPRS module and the Ultrasonic and gas sensors, which are used to determine level and toxicity, respectively. In [3], The basic idea is to introduce a smart way of handling garbage by using the IOT protocol to wirelessly relay dustbin status to the concerned individual via e-mail to inform them that the device is full of garbage and needs to be replaced. In [5] they've taken a more cost-effective approach to waste

management. Furthermore, the matter of waste spilling due to overcrowding of trucks has been resolved. In [7] they suggested a topic on waste management focused on the current issues that it is creating. This was exacerbated by irresponsible waste management, and as a result, it has been reported that it has a negative impact over time. Waste management is recommended not only for the common solution of a sanitary climate, but also for other economic, social, environmental, and intergenerational benefits. The study was expected due to their country's condition, in which it is required to segregate waste into wet and dry categories. But, due to a lack of time, waste is usually segregated without much thought; however, a suggested solution is to establish automated waste segregation using a moisture sensor. The sensor senses whether the waste is wet or dry and separates it accordingly. Furthermore, ultrasonic sensors detect the wet and dry waste bins, determining if they are full or not, and if so, how full they are. In [2] they defined how Solar Smart Bin can be used to handle an entire city's waste collection system. In [9] they suggested an IoT-based smart waste management system that uses sensor systems to control the waste level in the bins. As soon as it was detected, the device was changed to concern approved via GSM/GPRS.

2.2 EXISTING SYSTEM

In the existing system garbage is collected by corporation by weekly once or by 2 days once. Though the garbage shrinks and overflows the garbage bin and spread over the roads and pollutes the environment. The smell will be heavy and produces air pollution and spreads disease. The street dogs and animals eat the waste food and spreads over the area and creates dirty environment to avoid such situation we are planning to design IOT Based Garbage Management For Smart Cities.

2.2.1 DRAWBACKS

- Time consuming and less effective: trucks go and empty containers whether they are full or not.
- High costs.
- Unhygienic Environment and look of the city.
- Bad smell spreads and may cause illness to human beings.
- More traffic and Noise.



Fig 2.1 Existing system

2.3 PROPOSED SYSTEM

In this proposed system there are multiple dustbins located through the city or the campus, these dustbins are provided with low-cost embedded device which helps in tracking the motion near the IR sensor and an unique ID will be provided for every dustbin in the city and the important of the special feature of the dustbin is it can come to our place by us controlling the dustbin through Bluetooth. This can be implemented to our society and develop our living life style and this will help the garbage collector from keep track of the device. This is an environment friendly Smart Dustbin. This bin has an IOT interface with autonomous and manual mode (mobile/laptop) of control. Where the trash is picked up using robotic arm. The picked-up trash is segregated (metallic and non-metallic, wet and dry waste) and dumped into the bin attached to the robot which has separate partitions for metallic wet, non-metallic wet, metallic dry and non-metallic dry trashes. Along with this we have attached a dust collector at the bottom of the trash bin which collects minute dust particles like (hair, sand, dead bugs, etc).

Also, we have used image processing for identifying the objects using CNN by camera module.

2.3.1 ADVANTAGES

- Deployment of dustbin based on the actual needs.
- Cost Reduction and resource optimization.
- Improves Environment quality -Fewer smells - Cleaner cities.
- Effective usage of dustbins.
- Dust collector which collects minute dusts.
- Segregation of waste.
- Robotic arm.

2.4 ABOUT THE SYSTEM

Everything's getting smarter right? So why not your trash bin? This bin has an IOT interface with autonomous and manual mode (mobile/laptop) of control. A remote-control vehicle is defined as any mobile device that is controlled by a means that does not restrict its motion with an origin external to the device. This is often a radio control device, cable between control and wheel or an infrared or Bluetooth controller. A remote-control vehicle (Also known as RCV) is always controlled by a human and takes no positive action autonomously. It is viral that a vehicle should be capable of proceeding accurately to a target area: manoeuvring within that area to fulfil its mission and returning equally accurately and safely to base. In this project we are using Bluetooth wireless technology to control our robot car which is a very simple communication system. The remote in this project is an android device which has Bluetooth feature built in. The user has to install an application on the his/her mobile and turn on the Bluetooth in the mobile phone. User can perform various actions like moving like moving forward, backward, move left and move right using commands that are sent from android mobile. The Bluetooth is a serial communication medium through which we can connect two devices wirelessly. Here we have used Bluetooth module in

our robot car which gets connected to the phone's Bluetooth, that allows us to communicate and allows to take command over it. The task of controlling the car is done by Arduino UNO which houses the micro-controller ATMEGA32. Arduino has played a major role in robotic section and has made it easier to convert digital and analog signal to physical movements. We are using robotic arm which works similar to human hands. It has two motors for motion. one is used for gripping movement and another is used for ARM movement. The ARM is being used for picking and placing the waste. The robotic arm moves with respect to the command given by user. The picked-up trash is then kept in a palette which has Moisture sensor is used to detect garbage is either dry or wet and also Inductive proximity sensors which detects metal targets. They do not detect non-metal targets such as plastic, wood, paper, and ceramic. After sensing the waste the garbage is put into its respective bin using servo motor which rotates the bin. IR sensor which is kept at the top of each bin shows us the level of garbage by sending notification to our phones using esp8266 wifi module. The project is Bluetooth and Wifi based because it gives us wider range of the control and more efficiency. It also gives us the advantage of changing the remote anytime, meaning that we can use any android devices including phones, tablets, computers, physical barriers like walls, doors, etc. Do not affect in controlling the car.

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 AIM AND OBJECTIVE OF THE PROJECT

The main aim of the project is to design a smart dustbin which will help in keeping our environment clean and also eco-friendly. We are inspired from Swachh Bharat Mission. Nowadays, technologies are getting smarter day-to-day so as to clean the environment, we are designing a smart dustbin by using Arduino. This smart dustbin management system is built on the micro-controller based system having IR sensor and robotic arm.

3.1.1 OBJECTIVE

- Creates a configuration on the trash bin model in relation to Arduino and uses sensors to identify the waste.
- Using the IR sensor, it detects the level of the garbage.
- Uses Bluetooth to control the device.
- Install an application to control the Dustbin through robot.
- Using wifi module to send notification to the mobile.
- used to segregate the waste.
- dust collector to collect minute dust.

3.2 PROJECT SCOPE

The scope consists of three, the scope of the user, the scope of the location, and the scope of the system:

➤ **User Scope:**

The user's scope consists of people who are in need of help and for working people. It can be used in homes and office. It is a growing technology.

➤ Scope of Location:

The main aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision. This project involves people who need help. Although this project is just a prototype, it is developed almost identical to the actual situation.

➤ System scope:

Smart dustbin helps us to reduce the pollution. Many times garbage dustbin is overflow and many animals like dog or rat enters inside or near the dustbin. This creates a bad scene. Also, some birds are also trying to take out garbage from dustbin. This project can avoid such situations. And can be controlled with Bluetooth and Wi-Fi.

3.3 METHODOLOGY

In this project methodology model takes the fundamental process activities of Project Plan, specification, Analysis, Design, development, validation and evolution and represents them as separate process phases. Using a waterfall model as a project development methodology. Smart Dustbin has an IOT interface with autonomous and manual mode of control. The trash is picked up using robotic arm. The picked-up trash is segregated (metallic dry, metallic wet, non-metallic dry and non-metallic wet) and dumped into bin attached to the robot which has separate partitions for metallic and non-metallic trashes. If the trash bin gets filled it is notified to the person operating the robot as message in the IOT interface. The entire operation of waste collection can be viewed by the operator through internet using a web camera attached to the robot. The robot is operated using an android mobile phone and a laptop. 2 operating modes. Manual and Autonomous. In manual mode the robot locomotion and trash pickup is operated using an android phone through blynk app. The robot can be controlled from anywhere in the world by the use of Internet (IOT). The trash is picked up using robotic arm made using servos. The collected trash is transferred to a trash bin attached to the robot platform. The trash bin has separate partitions for metallic and non-metallic

trashes. Another Servo motor attached to the trash bin will rotate the bin so that the collected waste will fall into the corresponding partition of the bin. In autonomous mode the robot locomotion and waste pickup is done without human intervention. In autonomous mode the robot locomotion and waste pickup is done without human intervention. Other objects are considered as trash and are picked up by the robotic arm. Metal detectors placed in the arm check the trash picked to be metallic or non-metallic and are dumped its corresponding partition in the trash bin. IR sensor placed in the trash bin monitor the level of the waste in the bin. If the bin is full it is notified to the operator. A Dust collector is placed at the bottom of the trash bin which collects minute dust.

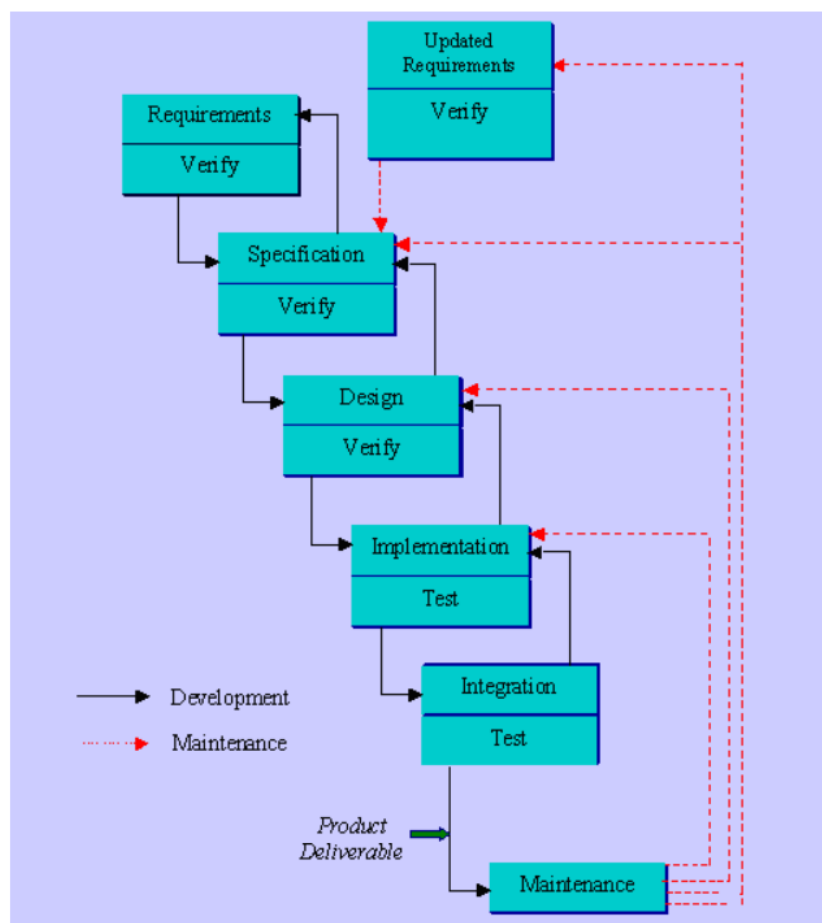


Fig 3.1 Waterfall model

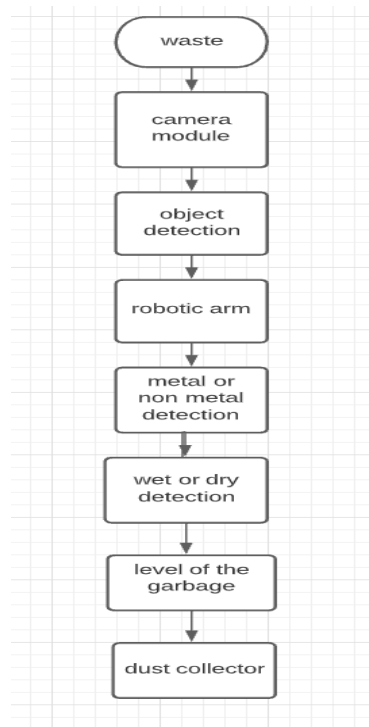


Fig 3.2 Modules of smart dustbin

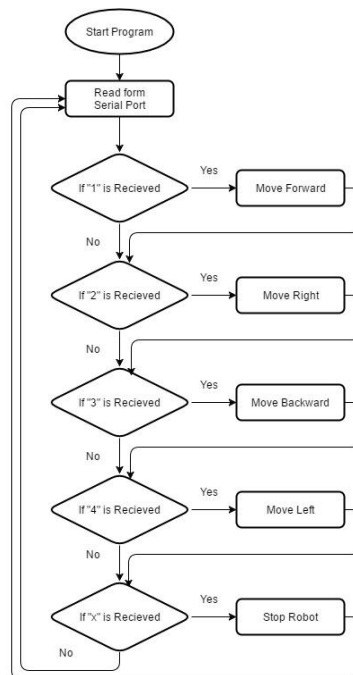


Fig 3.3 Flowchart for dustbin controlled by Bluetooth

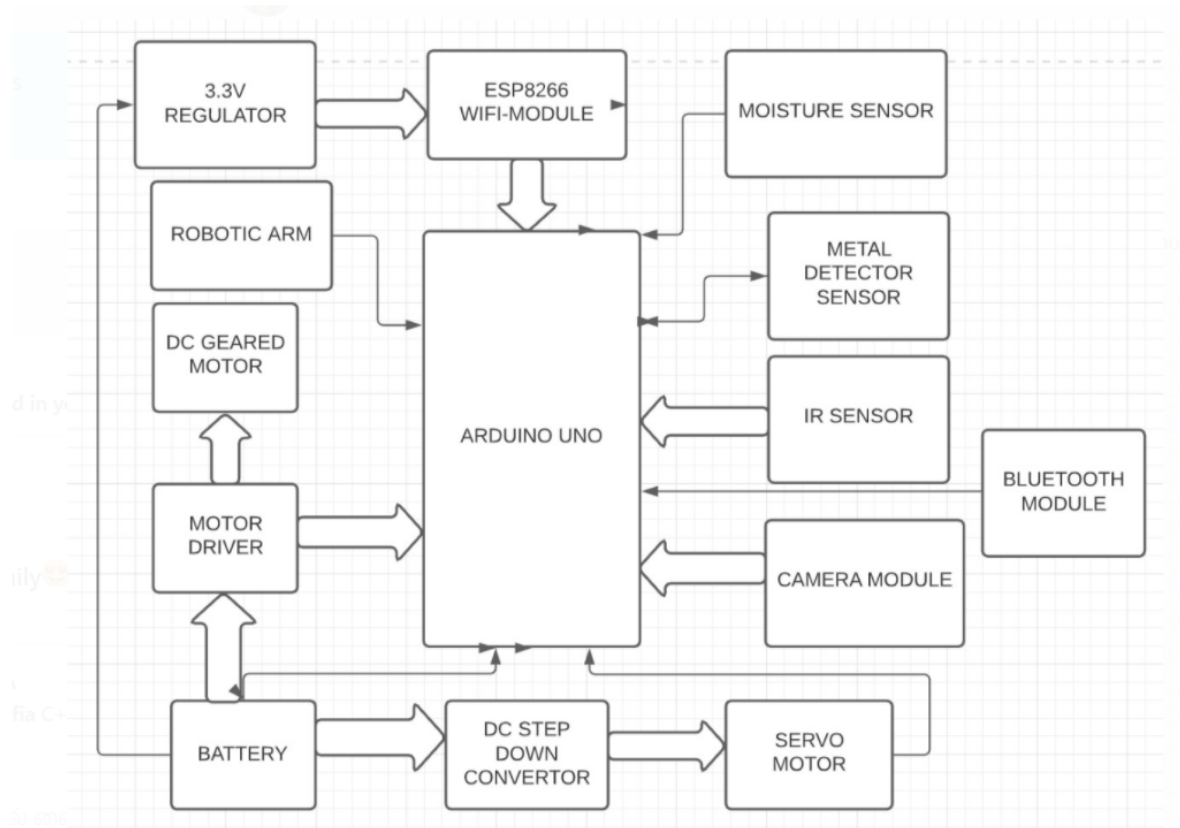


Fig 3.4 Block diagram for smart dustbin

CHAPTER 4

MATERIALS AND METHOD

4.1 REQUIREMENTS OF THE SYSTEM

The system needs two types of requirement. They are

- Hardware requirements
- Software requirements

4.1.1 HARDWARE REQUIREMENTS

I have used the following hardwares to accomplish my project:

1. Arduino Uno
2. IR sensor
3. L298N Motor Driver
4. Bluetooth HC-05
5. Servo motor gear 9G
6. 12V Battery
7. Jumper wires
8. Moisture sensor
9. USB cable
10. Metal detector sensor
11. USB web camera
12. 12V DC Motor
13. ESP8266 Wifi module

4.1.1.1 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. 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 microcontroller 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, a 16 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 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 4.1 Arduino Uno

Parameters for Arduino UNO Description

Microcontroller	ATmega 328
Operating voltage	5V
Input voltage(recommended)	7-12 V
Input Voltage (Limits)	6-20 V
Digital I/O pins	14
Analog Input pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3v Pin	50 mA
Flash Memory	32 KB (ATmega 3280) of which 0.5kb used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

Table 4.1 Specification of Arduino Uno

4.1.1.2 IR SENSOR

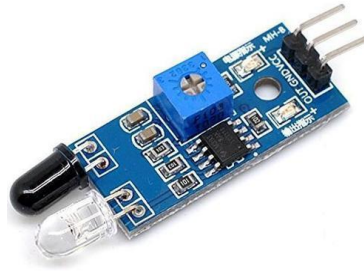


Fig 4.2 IR sensor

The IR sensor module consists mainly of the IR Transmitter and Receiver, OP amp, Variable Resistor (Trimmer pot), output LED in brief.

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. It depends upon the type of IR transmitter and the manufacturer. Some transmitters have the range in kilometers. 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 it conducts when light falls on it. Photodiode is a semiconductor which has a P-N junction, operated in Reverse Bias, means it starts 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 OP amp

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 pre-set (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 the object).

Variable Resistor

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

IR Sensor Module Features:

- 5VDC Operating voltage
- I/O pins are 5V and 3.3V compliant
- Range: Up to 20cm
- Adjustable Sensing range
- Built-in Ambient Light Sensor
- 20mA supply current
- Mounting hole

Pin Configuration

Pin Name	Description
VCC	Power Supply Input
GND	Power Supply Ground
OUT	Active High Output

Table 4.2 Specification of IR sensor

4.1.1.3 L298N MOTOR DRIVER

The L298N is an integrated monolithic circuit in a 15- lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver de-signed to accept standard TTL logic level sand drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device

independently of the in-put signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional Supply input is provided so that the logic works at a lower voltage.

Features

- 1) High operating voltage, which can be up to 40 volts;
- 2) Large output current, the instantaneous peak current can be up to 3A
- 3) Two built in H-bridge, high voltage, large current, full bridge driver, which can be used to drive DC motors, stepper motors, relay coils and other inductive loads.
- 4) Able to drive a two-phase stepper motor or four-phase stepper motor
- 5) Adopt a high-capacity filter capacitor and a freewheeling diode that protects devices in the circuit from being damaged by the reverse current of an inductive load, enhancing reliability.
- 6) The module can utilize the built-in stabilivolt tube 78M05 to obtain 5v from the power supply. But to protect the chip of the 78M05 from damage, when the drive voltage is greater than 12v, an external 5v logic supply should be used.

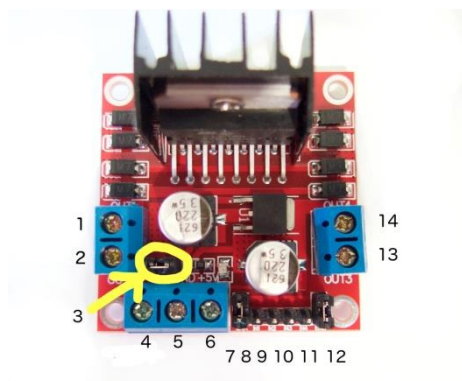


Fig 4.3 L298N Motor Driver

1. DC motor 1 "+" or stepper motor A+
2. DC motor 1 "-" or stepper motor A-
3. 12V jumper - remove this if using a supply voltage greater than 12V DC. This enables power to the onboard 5V regulator
4. Connect your motor supply voltage here, maximum of 35V DC. Remove 12V jumper if >12V DC
5. GND
6. 5V output if 12V jumper in place, ideal for powering your Arduino (etc)
7. DC motor 1 enable jumper. Leave this in place when using a stepper motor. Connect to PWM output for DC motor speed control.
8. IN1
9. IN2

- 10.IN3
- 11.IN4
- 12.DC motor 2 enable jumper. Leave this in place when using a stepper motor.
Connect to PWM output for DC motor speed control.
- 13.DC motor 2 "+" or stepper motor B+
- 14.DC motor 2 "-" or stepper motor B-

4.1.1.4 BLUETOOTH HC-05

- It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard and many more consumer applications.
- It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions.
- It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air.
- It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).
- HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration.

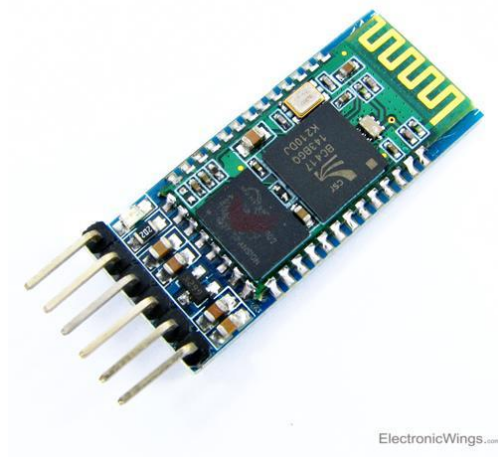


Fig 4.4 Bluetooth HC-05 module

Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth.

It has 6 pins,

1. Key/EN: It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

HC-05 module has two modes,

- Data mode: Exchange of data between devices.
- Command mode: It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.

2. VCC: Connect 5 V or 3.3 V to this Pin.

3. GND: Ground Pin of module.

4. TXD: Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)

5. RXD: Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

6. State: It tells whether module is connected or not.

4.1.1.5 SERVO MOTOR GEAR 9G



Fig 4.5 Motor gear 9G

Servo implies an error sensing feedback control which is utilized to correct the performance of a system. It also requires a generally sophisticated controller, often a dedicated module designed particularly for use with servomotors. Servo motors are DC motors that allows for precise control of angular position. They are actually DC motors whose speed is slowly lowered by the gears. The servo motors usually have a revolution cutoff from 90° to 180°. A few servo motors also have revolution

cutoff of 360° or more. But servo motors do not rotate constantly. Their rotation is limited in between the fixed angles. The servo motor is actually an assembly of four things: a normal DC motor, a gear reduction unit, a position-sensing device and a control circuit. The DC motor is connected with a gear mechanism which provides feedback to a position sensor which is mostly a potentiometer. From the gear box, the output of the motor is delivered via servo spline to the servo arm. For standard servo motors, the gear is normally made up of plastic whereas for high power servos, the gear is made up of metal. A servo motor consists of three wires- a black wire connected to ground, a white/yellow wire connected to control unit and a red wire connected to power supply. The function of the servo motor is to receive a control signal that represents a desired output position of the servo shaft and apply power to its DC motor until its shaft turns to that position. It uses the position sensing device to figure out the rotational position of the shaft, so it knows which way the motor must turn to move the shaft to the instructed position. The shaft commonly does not rotate freely around similar to a DC motor, however rather can just turn 200 degrees. From the position of the rotor, a rotating magnetic field is created to efficiently generate torque. Current flows in the winding to create a rotating magnetic field. The shaft transmits the motor output power. The load is driven through the transfer mechanism. A high-function rare earth or other permanent magnet is positioned externally to the shaft. The optical encoder always watches the number of rotations.

Advantages

- If a heavy load is placed on the motor, the driver will increase the current to the motor coil as it attempts to rotate the motor. Basically, there is no out-of-step condition.
- High-speed operation is possible.

Disadvantages

- Since the servomotor tries to rotate according to the command pulses, but lags behind, it is not suitable for precision control of rotation.
- Higher cost.
- When stopped, the motor's rotor continues to move back and forth one pulse, so that it is not suitable if you need to prevent vibration.

4.1.1.6 12V BATTERY



Fig 4.6 12V Battery

A 12-volt motorcycle battery is made up of a plastic case containing six cells. Each cell is made up of a set of positive and negative plates immersed in a dilute sulfuric acid solution known as electrolyte, and each cell has a voltage of around 2.1 volts when fully charged. The six cells are connected together to produce a fully charged battery of about 12.6 volts. That's great, but how does sticking lead plates into sulfuric acid produce electricity? A battery uses an electrochemical reaction to convert chemical energy into electrical energy. Let's have a look. Each cell contains plates resembling tiny square tennis rackets made either of lead antimony or lead calcium. A paste of what's referred to as "active material" is then bonded to the plates; sponge lead for the negative plates, and lead dioxide for the positive. This active material is where the chemical reaction with the sulfuric acid takes place when an electrical load is placed across the battery terminals.

4.1.1.7 JUMPER WIRES



Fig 4.7 Jumper wires

Jump wires (also called jumper wires) for solderless breadboarding can be obtained in ready-to-use jump wire sets or can be manually manufactured. The latter can become tedious work for larger circuits. Ready-to-use jump wires come in different qualities, some even with tiny plugs attached to the wire ends. Jump wire material for ready-made or homemade wires should usually be 22 AWG (0.33 mm²) solid copper, tin-plated wire - assuming no tiny plugs are to be attached to the wire ends. The wire ends should be stripped 3/16 to 5/16 in (4.8 to 7.9 mm). Shorter stripped wires might result in bad contact with the board's spring clips (insulation being caught in the springs). Longer stripped wires increase the likelihood of short-circuits on the board. Needle-nose pliers and tweezers are helpful when inserting or removing wires, particularly on crowded boards.

4.1.1.8 MOISTURE SENSOR

A moisture sensor is an electronic device that measures the humidity in its environment and converts its findings into a corresponding electrical signal. Moisture sensors vary widely in size and functionality; some humidity sensors can be found in handheld devices (such as smart phones), while others are integrated into larger embedded systems (such as air quality monitoring systems). Moisture sensors are commonly used in the meteorology, medical, automobile, HVAC and manufacturing industries. Moisture sensors can be divided into two groups, as each category uses a different method to calculate moisture: relative moisture (RM) sensors and absolute moisture (AM) sensors. Relative moisture is calculated by comparing the live moisture reading at a given temperature to the maximum amount of moisture for air at the same temperature. RM sensors must therefore measure temperature in order to determine relative moisture. In contrast, absolute moisture is measured without reference to temperature. The two most common RM sensors are the capacitive and resistive moisture sensors. Capacitive sensors use two electrodes to monitor the capacitance (i.e., the ability to store an electric charge) of a thin metal strip placed between them. The metal's capacitance increases or decreases at a rate that is directly proportional to the change of moisture in the sensor's environment. The difference in charge (voltage) generated by an increase in moisture is then amplified and sent to

the embedded computer for processing. Resistive moisture sensors operate on a different principle. These sensors utilize a small polymer comb that increases and decreases in size as the moisture changes, which directly affects the system's ability to store charge. Thermal moisture sensors are used to measure absolute moisture. Unlike RM sensors, thermal moisture sensors utilize two probes, one to measure dry nitrogen and one to measure the air of its surrounding environment. When moisture is collected on the exposed probe, the difference in thermal conductivity is perceived by the sensor, and AM is calculated.



Fig 4.8 Moisture sensor

PIN NAME	DESCRIPTION
VCC	The VCC pin powers the module, typically with +5V
GND	Power Supply Ground
D0	Digital Out Pin for Digital Output
A0	Analog Out for Analog Output

Table 4.3 Specification of humidity sensor

4.1.1.9 USB CABLE

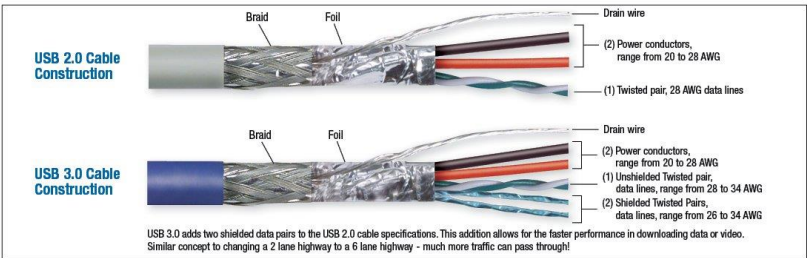


Fig 4.9 USB cable

The term USB stands for "Universal Serial Bus". USB cable assemblies are some of the most popular cable types available, used mostly to connect computers to peripheral devices such as cameras, camcorders, printers, scanners, and more. Devices manufactured to the current USB Revision 3.0 specification are backward compatible with version 1.1.

Detail of USB Cable Construction

The USB cable standard allows for these advantages over serial cable types:

- USB cables are "Hot Pluggable", in other words you can connect and disconnect the cables while the computer is running without fear of freezing the computer
- USB cables are fast, transferring up to 480Mbps. Compare that to serial communication which transfers data at about 20Kbps
- USB cables carry power as well as signals. This allows for "USB powered" gadgets as well as recharging batteries in cameras and other USB peripherals
- USB cables are designed with several distinct connector types, making it easy to identify which plug goes into the computer and which plug goes into the peripheral device
- USB cables are a universal standard and are fairly easy to find and to afford

4.1.1.10 METAL DETECTOR SENSOR

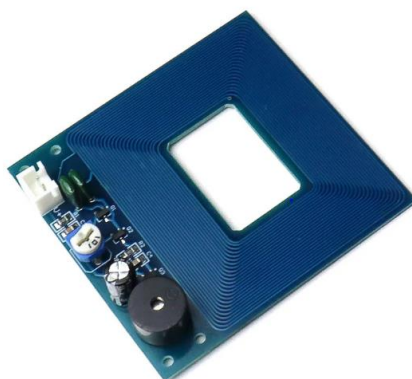


Fig 4.10 Metal detector sensor

Metal detector or Proximity sensors are commonly used in many automation applications. They're used to sense the presence of objects and don't require physical contact with the target or object being sensed, which is why they're often referred to as non-contact sensors. Common proximity sensor types include photoelectric, capacitive, and inductive sensors. Inductive sensors operate on the basis of Faraday's Law. One way to state Faraday's Law is that a change in magnetic flux in a coil of wire will induce a voltage in a nearby coil. This is applied in inductive proximity sensors in the following way: The sensor itself contains an oscillator circuit and a coil from which an electromagnetic field radiates out and induces eddy currents in any nearby metallic objects. The eddy currents have the effect of attenuating the oscillations from the amplifier. This reduction in oscillations is registered as the presence of a metallic object. Because only metallic objects have inductive properties, inductive sensors can't be used to detect plastic or cardboard or other non-metallic objects. However, different metals have different inductive properties and the type of metal being sensed will influence the sensing distance. For instance, ferromagnetic materials like steel generally have the longest sensing distance, while non-ferrous metals such as aluminum or copper have much shorter sensing distances. In general, inductive proximity sensors are well suited to shorter-range applications as the inductive effect wears off with growing distance between the sensor and object to be detected. Inductive proximity sensors hold up well in dirty environments where contaminants don't interfere with the sensor's ability to detect metallic objects. For example, they're resistant to dirt, dust, and smoke in the environment between the sensor and the object to be detected. As for build-up of contaminants on the sensor face such as dirt and dust, oil, grease or soot, these don't affect the inductive sensing. However, metallic contaminants such as metal chips in machining applications will impact sensor operation. The key is to be sure to understand what type of contaminants an application contains in order to select the correct type of sensor that can handle them and operate effectively.

4.1.1.11 USB WEB CAMERA

A USB webcam is a camera that connects to a computer, usually through plugging it in to a USB port on the machine. The video is fed to the computer where a software application lets you view the pictures and also transfer them to the Internet. The software you choose can be set to upload images on a time interval using FTP

(file transfer protocol) to a website, or it can be set to provide a live feed for displaying on a remote machine or again in a website. When FTP is used the picture on the website is a static one which is updated regularly at intervals minute by minute, hour by hour or even longer. This is very easy to set up but the image delay means they are nowhere near as interesting to watch as a live feed. USB webcam software can also be used to provide a live feed directly from the computer to your website or even fed to the Camsecure streaming service to allow large numbers of visitors to your website to see the feed at the same time. USB webcams can be the small internal type you usually see for web conferencing and personal use etc. right up to professional quality out door weather proof webcams. The downside to any USB type of webcam is the fact that you must have a PC switched on at the location of the camera to enable the images or video feed to be sent to a website.



Fig 4.11 USB web camera

4.1.1.12 12V DC MOTOR



Fig 4.12 12V DC motor

Motor1 is a 12V DC geared motor with a .25" motor output shaft and a 2mm rear encoder shaft. The 2mm shaft works with our ENC300 quadrature encoder to allow the motor to be used in position control applications. Motor controllers that are rated for 12V@2A are ideal for controlling this motor. However, motor controllers with lower current ratings can also be used if they have over-current and overtemperature protection.

Features

1. 12V – 200RPM –
2. 3.6KG•CM torque DC gearhead motor
3. 30:1 Gear Ratio
4. 2mm rear encoder shaft
5. Good compromise between speed and torque for small robotic designs.

CHARACTERISTIC	VALUE	UNIT
Operating voltage	4.5-18	V
Startup torque (kilogram-force centimeter)	3.6	KG.CM
Startup torque (inch-pound)	3.1	INCH.LBF
Gear ratio	30:1	
No-Load current (12V)	0.053	A
Stall Current	1.5	A
No-Load Speed (12V)	200	RPM

Table 4.4 DC motor specification

4.1.1.13 ESP8266 WIFI MODULE

The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers

(and that's just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever growing, community. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, and is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth coexistence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts. There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the below you will find many resources to aid you in using the ESP8266, even instructions on how to transform this module into an IoT (Internet of Things) solution! Note: The ESP8266 Module is not capable of 5-3V logic shifting and will require an external Logic Level Converter. Please do not power it directly from your 5V dev board. This ESP8266 WiFi Module Adaptor comes with an on-board logic level converter and 3.3V LDO regulator for easy interfacing to Arduino boards.

Features:

- 802.11 b/g/n
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- Integrated TR switch, balun, LNA, power amplifier and matching network
- Integrated PLLs, regulators, DCXO and power management units
- +19.5dBm output power in 802.11b mode
- Power down leakage current of <10Ua

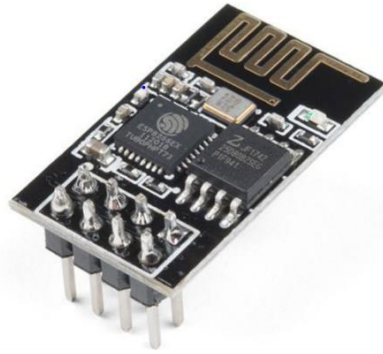


Fig 4.13 ESP8266 Wifi module

NO.	PIN NAME	FUNCTION
1	GND	GND
2	GPIO2	GPIO, Internal pull-up
3	GPIO0	GPIO, Internal pull-up
4	RXD	UART0, data received pin RXD
5	VCC	3.3 V power supply (VDD)
6	RST	1) External reset pin, active low 2) Can loft or External MCU
7	CH_PD	Chip enable pin. Active high
8	TXD	UART0, data send pin RXD

Table 4.5 Specification of ESP8266 wifi module

4.1.2 SOFTWARE REQUIREMENTS

I used the following software to accomplish my project

1.Arduino IDE

2.Blynk app

4.1.2.1 ARDUINO IDE

Arduino software is used to put the instruction of whole functions of this system to the microcontroller. Here we use programming language 'C' for coding. The program for executing this project has been written in C language. The program is burnt in the microcontroller using burner software. The program is stored in the EEPROM of the microcontroller, which is present in the Arduino board. By this software we put the data and instruction for forward, backward, left, right operation of this system. In android application when we press a button, a corresponding signal is sent through the Bluetooth-to-Bluetooth module (HC-05) which is connected with the Arduino board. When signal data arrives the Arduino the pin which corresponds to the particular input is set to high. Now that pin gives the output to the motor driver section. Motor driver switches accordingly the data bit, if the data bit is low then the corresponding pin of the motor driver doesn't work else high bit then the corresponding pin of the motor driver is on. We have used Arduino IDE version 1.8.1 for writing program for Arduino. There are two steps of the programming. First set up section where we define all the variables. Second loop part where the program runs continuously.

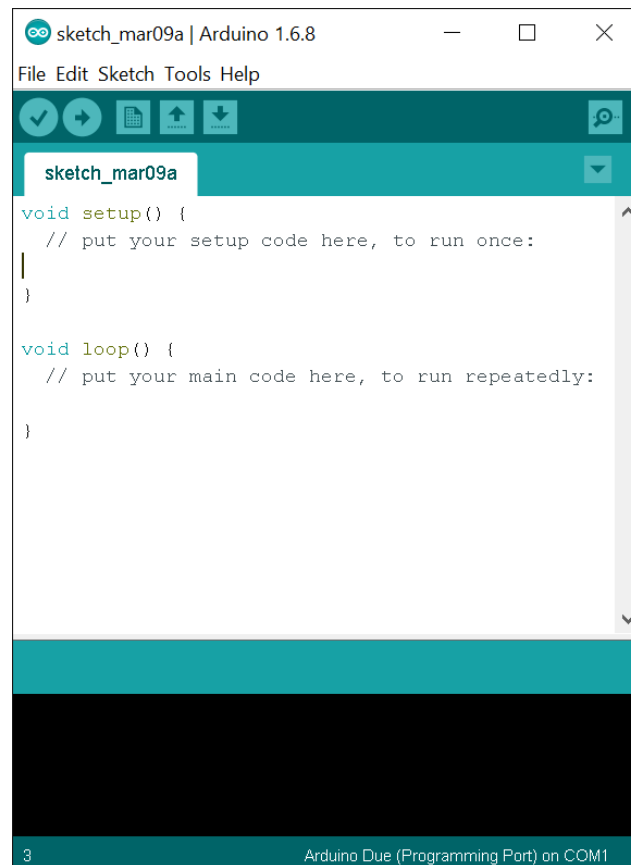


Fig 4.14 Arduino IDE

4.1.2.2 BLYNK APP

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 smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. It's 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 outcoming commands.

Now imagine: every time you press a Button in the Blynk app, the message travels to space the Blynk Cloud, where it magically finds its way to your hardware. It works the same in the opposite direction and everything happens in a blink of an eye.

4.2 CIRCUIT DESIGN FOR BLUETOOTH CONNECTED WITH ANDROID APP

Coming to the design of the circuit, first is the HC-05 Bluetooth Module. The +5V and GND pins of the Bluetooth Module are connected to +5V and GND of Arduino.

Since I will be only transmitting data related to the Robot's movement from Android Phone to Bluetooth Module and do not intend to receive any data from Arduino, I will connect only the TX pin of the Bluetooth Module to RX Pin of Arduino.

This RX pin of Arduino is based on Software Serial library (Pin 2 and Pin 3 are configured as RX and TX on Arduino). The RX pin of the Bluetooth is left open.

4.2.1 ANDROID APP

If you remember the HC-05 Bluetooth Module tutorial, I have used a simple app called Bluetooth Controller, which is installed on an Android Phone to communicate with the Bluetooth Module. In this project, I have used the app with modifications in the data to be transmitted. The above given Arduino code is written to synchronize with the data configured in the Bluetooth Controller App.

4.2.2 WORKING OF BLUETOOTH CONNECTED WITH ANDROID APP

Assemble the robot, make the necessary connections and upload the code to Arduino. Then understanding the Bluetooth Controlled Robot project is very easy. First, in the Android App, I have used 5 keys as Forward, Reverse, Left, Right and Stop. The corresponding data associated with each key is as follows:

- Forward – 1
- Reverse – 2
- Left – 3
- Right – 4
- Stop – 5

When a key is pressed, the corresponding data is transmitted to the Bluetooth Module from the Phone over Bluetooth Communication. The Arduino code, the Arduino UNO receives any of this data from the Bluetooth Module (as per the key pressed) and performs a simple switch case operation, where each case associated with appropriate instructions to the Motor Driver Input Pins. For example, if 'Forward' key is pressed in the Android Phone, then '1' is transmitted. Arduino will then make IN1 and IN3 as HIGH and IN2 and IN4 as LOW to achieve a forward motion. Similarly, other keys correspond to appropriate setting of IN1-IN4 pins.

4.2.3 LIMITATIONS

- As the range of the Bluetooth Communication is limited (a maximum of 10 meters for class 2 devices for example) the control range of Bluetooth Controlled Robot is also limited.
- Make sure that sufficient power is provided to all the modules especially the Bluetooth Module. If the power is not sufficient, even though the Bluetooth Module powers on, it cannot transmit data or cannot be paired with other Bluetooth devices.

4.2.4 APPLICATIONS

- Low range Mobile Surveillance Devices
- Military Applications (no human intervention)
- Assistive devices (like wheelchairs)
- Home automation

4.3 WORKING PRINCIPLE

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. If the IR Sensor detects any object like a hand for example, Arduino calculates its distance and if it less than a certain predefined value, Arduino will activate the Servo Motor and with the support of the extended arm, it will lift the lid open. After certain time, the lid is automatically closed. The working principle is kept as simple as possible. The working principle of the circuit has been elaborated with the help of a block

diagram, of the system interconnection. A DC power supply is required to run the system. The DC power supply feeds the Microcontroller and the Bluetooth module. The Bluetooth module receives the signal sent from an android smart-phone, where the application software coded in C language is installed. The microcontroller, thereby, sends instructions, which when executed, helps in functioning of the motor driver. The movement and functioning of the motor can be controlled by using the android based application software. Hardware of this project consists of Arduino UNO, Bluetooth module and a motor driver IC. The Bluetooth module is connected with the Arduino UNO board for the connection with the user. Through the Bluetooth module for monitoring and controlling the particular motor reaches the board and process accordingly and the output of the Arduino goes to the motor driver IC and it controls the particular motor. Our proposed project consists of the following three sections:

- a) Input section
- b) Microcontroller section
- c) Output section

In our android application base Bluetooth controlled robotic car, the user interacts with the system with a smart phone. In this method user must be present within in range (< 15 meters) to control the system. In future we would try to extend the range using Internet of Things (IoT) [12]. When user sends any data to the Arduino board then the corresponding pin of Arduino goes to high state and switches the motor driver in the on mode. The corresponding motor moves as per the input data. Here in this project the user (android application) is the input section. This device is connected with the Arduino board (microcontroller section) by the means wirelessly i.e., Bluetooth module. The system can now be connected with the motors (output section) to be controlled via wireless connectivity. Here at first we construct the circuit. Then through the data cable we insert the commands in the microcontroller ATMEGA 328P. These commands help the microcontroller to interface with the Bluetooth module HC05 and also with the motor driver IC L293D. Here the Bluetooth module act as a receiver which receives the instruction from the smart phone (remote or transmitter). Then the microcontroller decides the operation for the instruction which is coming from the smart phone. The functions of the given

instructions are operated by the microcontroller. The instructions are sent by the smart phone. We can easily control the movements of the dc motor. The Bluetooth module can operate below the 10 m range, which we would try to extend in future. Here we are using four 12 V, 200 R.P.M DC motors and a 9 V DC battery as main power supply of this system. Until we send any instruction to the microcontroller the motors remain stop. When any input is given then the motors move as per the preloaded functions in the microcontroller. Figure 8 shows the snapshot of the whole Bluetooth Based Smart Phone Control Robot Project.

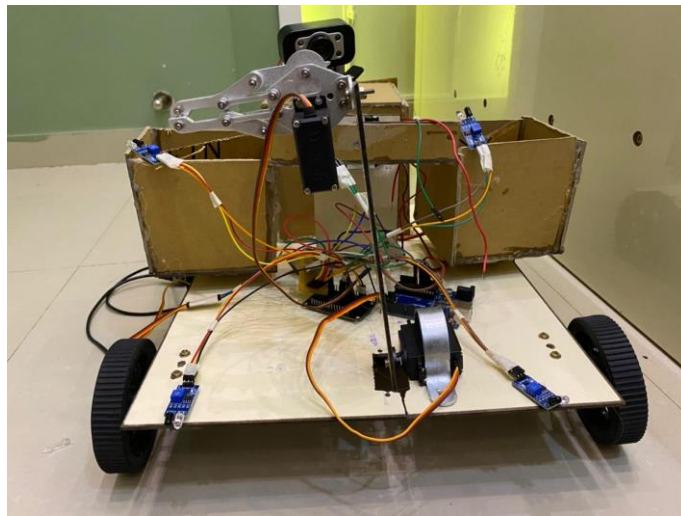


Fig 4.15 Front view of Smart trash and dust collection – segregation robot

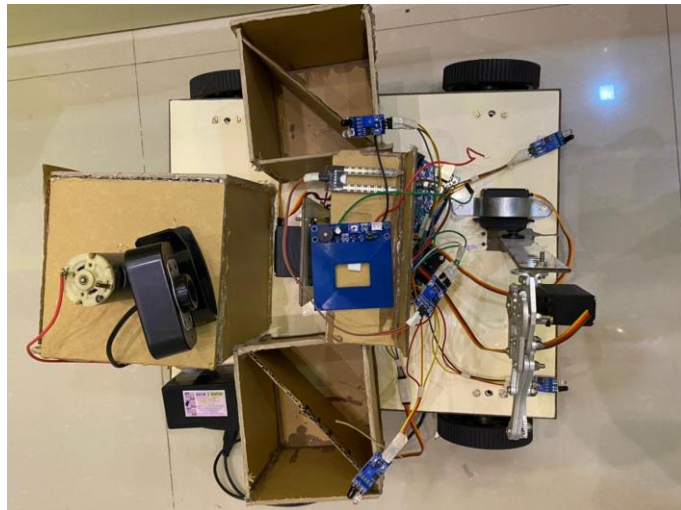


Fig 4.16 Top view of Smart trash and dust collection – segregation robot

CHAPTER 5

RESULT AND DISCUSSION

5.1 SIMULATION RESULT OF IR SENSOR AND SERVO MOTOR

The Distance of the user's hand was measured using Arduino IDE serial monitor. It was computed using formula for the distance of the electromagnetic waves emitted by IR sensor.

$$\text{Distance(cm)} = (\text{time} / 2) / 29.1$$

Equation 1. Distance formula

Manipulating the formula, the response time can be obtained shown in Equation 2

$$\text{Time} = 2(\text{distance(cm)}) / 29.1$$

Equation 2. Time formula

DISTANCE (CM)	TIME (μS)
2	116.4
4	232.8
6	349.2
8	465.6
10	582
12	698.4
14	814.8
16	931.2
18	1047.6
20	1164

Table 5.1 Computed time from the acquired distance

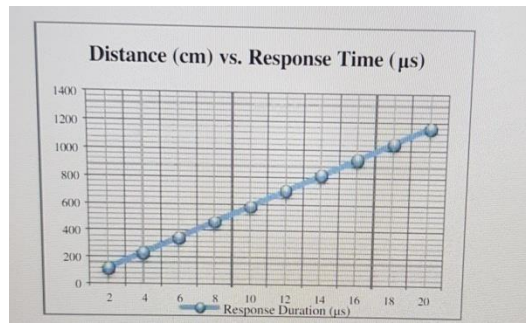


Fig 5.1 Distance vs Response time

5.2 ANDROID APP CONNECTED WITH BLUETOOTH

Below is the screenshot of Android application which is used in this project to control the Robot. This application has 10 keys / commands. I have used 5 commands. Remaining Command are not used and are reserved for future scope. User can even rename these key text as Forward / Reverse using the Set Keys option [3]. User needs to turn on the Bluetooth on his/her mobile and press scan button as shown below. Then connect to the Bluetooth receiver on robot [4]. Once the connection is established then the application will show connected status.

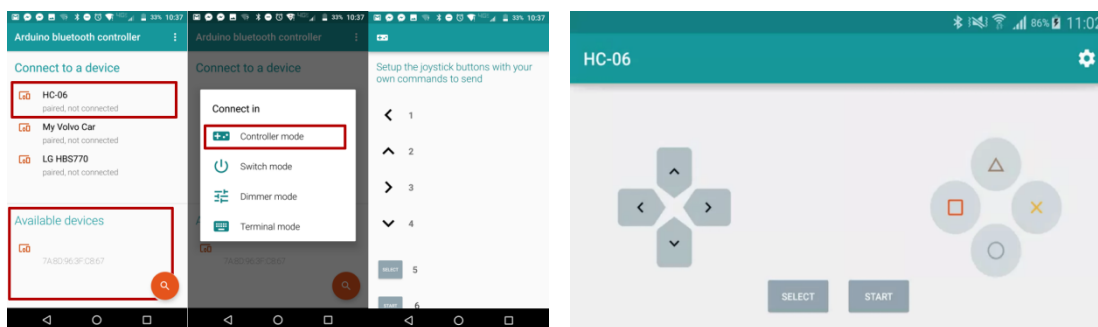


Fig 5.2 Screenshot of the app

5.3 LEVEL OF THE GARABGE USING IR SENSOR

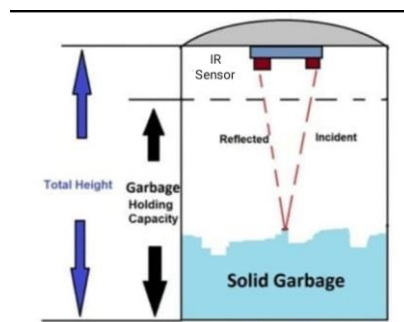


Fig 5.3 Level of the garbage using IR sensor

Here, IR sensor is placed on the top of the garbage bin which emits infrared waves at 40 KHz (which is far beyond human hearing range) the waves hit the trash and reflects back to the sensor. The time taken between emitted and received is used to measure the garbage fill level. A public or industrial garbage bin has a maximum waste holding capacity beyond which overflow may occur, the IR sensor is placed well above this limit. Notification about the level of the garbage is send to the mobile using Esp8266 wifi module.

5.4 ROBOTIC ARM

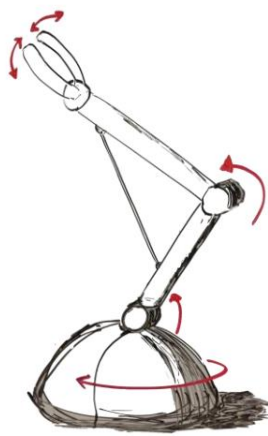


Fig 5.4 Structure of robotic arm

In this robotic arm we are going to use servo motors as servo motors gives good accuracy than any other motors. To look like a human arm we are going to connect this using servo clamps. The servo clamps are of different types, by the help of this various clamps a robotic arm is built. To pick and object and to put it from one place to another we are going to use a gripper. This gripper is also known as an end effector.

5.5 RESULT

After simulating the circuit connections, it will be used to pick up the garbage using robotic arm, segregates trash into its corresponding bins which can be controlled by Android application. Minute dusts are automatically collected using dust collector. The file of the code of Arduino was attached to Arduino uno and Arduino nano.

TYPE OF WASTE MATERIAL	ROTATION OF THE BIN
Metallic wet	180-0
Metallic dry	0-180
Non-metallic wet	180-0
Non-metallic dry	0-180

Table 5.2 Rotation of bin according to the type of waste

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

The reliability and accuracy of the prototype will always depend on the hardware and software components of the system. The results obtained by testing shows that the system has high level of accuracy and reliability when applied in real-life assembly. It can be observed that step response of the system is fast and accurate. It is believed that by repeated testing and simulation that all objectives are met precisely with a programmable controller (Arduino-uno) which was able to achieve, monitor, control, and maintain the desired output constantly. This is indeed a cost-effective and efficient project. The novelty lies in the fact that it is a cost-effective project with a simple and easy to use interface compared to existing ones. Also, the Bluetooth RC Controller and wifi application is more user friendly. With few additions and modifications, this robot can be used in army for detecting and disposing hidden land mines. The robot can be used for surveillance. In future we can interface sensors to this robot so that it can monitor some parameters and we can improve the efficiency using Internet of Things (IoT) technology. Since segregation of waste is done by the robot less time is consumed. The collected waste materials are also monitored using web camera. Also, minute dusts are collected using dust collector which is attached at the bottom of the bin.

6.2 FUTURE SCOPE

Smart dustbin helps us to reduce the pollution. Many times, garbage dustbin is overflow and many animals like dog or rat enters inside or near the dustbin. This creates a bad scene. Also, some birds are also trying to take out garbage from dustbin. This project can avoid such situations. And the message can be sent directly to the cleaning vehicle instead of the contractor's office. A wireless camera is mounted on the robot vehicle for spying and surveillance purpose even in night time by using infrared lighting. Future modifications can be made to perform different tasks with precise control such as:

- A Robot Mounted with camera.
- A headset, with a full-color display.
- We can interface sensors to this robot so that it can monitor some parameters.
- We can add wireless camera to this robot.
- Lifting of heavy weight by the robotic arm can be improved.

REFERENCES

- [1] Chaitali Bhangale, Sinh Viralkumar Ganesh, Punetkar Ronak Vijaybhai, Patel Ronak Shaileshbhai, Dr. R. Anjana, 2020, Smart Garbage Segregation & Handling System Using IoT, International Journal of Creative Research Thoughts (IJCRT)
- [2] Chandradeep Tiwari, Smt. Nagarathna. K, Waste Management using Solar Smart Bin, 2017, International Conference on Energy, communication, data analytics and soft computing (ICECDS).
- [3] Chinmay Kolhatkar, Prachi Choudhari, Bhavesh Joshi, Dhruvin Bhuvall Smart E-dustbin, 2018, International Conference on Smart city and emerging technology (ICSCET).
- [4] Mamta Pandey, Anamika Gowala Mrinal Jyoti Goswami, Chinmoy Saikia And Dr. Dibyajyoti Bora, 2020, Smart Dustbin Using Arduino, International Journal of Scientific Research in Engineering and Management (IJSREM)
- [5] Murugaanandam. S, Ganapathy. V and Balaji. R—Efficient IOT Based Smart Bin for Clean Environment, 2018, International Conference on Communication and Signal Processing.
- [6] Rishabh Kumar Singhvi, Roshan Lal Lohar, Ashok Kumar, Ranjeet Sharma, Lakhan Dev Sharma, Ritesh Kumar Saraswat, 2019, IoT Based Smart Waste Management System: India prospective, Internet of Things: Smart Innovation and Usages 2019 4th International Conference on, pp. 1-6.
- [7] R Ramya, G Pooja, D Ranjitha, 2019, Smart bins using dry and wet waste detectors, International Journal of Advanced Research in Computer Science, 9(Special Issue 3), 164.
- [8] Shamin. N, P. Mohamed Fathimal, Raghavendran. R, Kamallesh Prakash, 2019, Smart Garbage Segregation & Management System Using Internet of Things (IoT) & Machine Learning (ML), IEEE 1st International Conference on Innovations in Information and Communication Technology (ICIICT)
- [9] S. Vinoth Kumar, T. Senthil Kumaran, A. Krishna Kumar and Mahantesh Mathapati, 2017, Smart Garbage Monitoring and Clearance System using Internet of things, IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM).

[10] Wesley Pereira, Saurabh Parulekar, Sopan Phaltankar, Vijaya Kamble, 2019, Smart Bin (Waste Segregation and Optimisation), IEEE Amity International Conference on Artificial Intelligence (AICAI)