ISSN: 2395-1680 (ONLINE)
DOI: 10.21917/ijme.2019.0139

ARDUINO MICROCONTROLLER BASED SMART DUSTBINS FOR SMART CITIES

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Abstract

In this paper, a method is presented to make our surrounding's and environment to be clean. Recently the Government of India has launched a smart city project and for these smart cities to be smarter, it is necessary that the garbage collection and disposal system has to be smarter than the existing systems. The idea of Self-Monitoring Automated Route Trash (SMART) dustbin is for the smart buildings, Colleges, Hospitals and bus stands, etc. In this paper, we have used the Ultrasonic sensor and PIR sensor to sense the human presence, Servomotor to open the dustbin top, Ultrasonic sensor to sense the garbage level. A communication module is used to communicate signals between two dustbins and GSM module to send the message to operator. As soon as the dustbin is full it moves in the predefined path to reach the unnoticed place with the help of the Line follower robot using Arduino Microcontroller. We have designed a simple model to test the effectiveness of the proposed method. This paper gives an idea to be implemented in Swach Bharat dustbin in a real time model of various loads like full load, half load and empty load and for different weights.

Keywords:

Ultrasonic Sensor, PIR Sensor, Servo Motor, DC motor

1. INTRODUCTION

Dustbin is a common and a basic need everywhere. It is observed that often the garbage gets accumulated due to irregular removal of garbage present in the dustbin. Here we have proposed out a new model for the municipal dustbin which intimates the center of municipality for immediate cleaning of a dustbin. Most of the urban cities and town in India are not well designed to facilitate the proper garbage disposing and collection mechanism. Indian Prime Minister, Shri. Narendra Modi has introduced the concept of implementing 100 smartest cities in India (source: www.smartcities.gov.in). "Swachh Bharat Abhiyan" was initiated to ensure a clean environment. The majority of viruses and bacterial infections develop in a polluted environment (source: www.who.int). Safeguarding the environment using technology sources is needed at present. The majority of the public environment seems to be polluted with the waste materials. So, modernization is needed by impacting the smart technology.

Implementation of this smart dustbin can prevent lumping of the garbage for a long period of time, thereby preventing the widespread of diseases to a great extent and promising a clean environment in the city. The importance of the proposed model is to keep our environment clean by avoiding the improper collection and segregation, improper disposal of wastes and overflowing of dustbin in public areas. This proposed model is fully automated, so there is no need of manpower to collect and segregate the wastes in unnoticed place. The movement of this proposed model is also fully automated by using line a follower robot. In this proposed model the dustbin is fully closed, so at the time of movement there is no improper disposal of wastes in roadsides. The proposed model uses an ultrasonic sensor and PIR sensor to detect the human presence, if they are within the pre-defined range of sensors and after detecting the human presence, the dustbin top will be automatically open. So, it is very useful for physically challenged people to put their wastes into the dustbin and also overflowing of dustbin in public areas can be avoided.

Sinha et al. [1] introduced a system that makes a normal dustbin smart using sensors for garbage level detection and sending message to the user updating the status of the bin.

Singh and Kaur [2] proposed a system that has been divided into three layers. Dustbin Layer consists of internet and Wi-Fi enabled dustbins which contain a sensor which senses the fill up status of dustbins and sends the data to the server.

Narayan Sharma et al. [3] designed a system that makes a normal dustbin smart using sensors for garbage level detection and sending message to the user updating the status of the bin.

Monika et al. [4] proposed system that makes a normal dustbin smart using sensors for garbage level detection and sending message to the user updating the status of the bin.

Subho et al. [8] designed a system that has made a quantitative analysis between existing dustbins and their serving population. The study first analyses the spatial distribution of dustbins in some areas of Dhaka city using average nearest neighbor functions of Geographic Information System.

Hong, et al. [7] proposed a system to reduce the amount of food waste. In a smart garbage bin, battery-based smart garbage bins exchange information with each other using wireless mesh networks, and a router and server collect and analyze the information for service provisioning.

Sahu et al. [5] introduced a system that has built a framework in which a Camera will be set at each garbage collection point alongside load cell sensor at the base of the trash can. The camera will take continuous snapshots of the garbage can.

Bhor et al. [5] proposed a system that describes that the level of garbage in the dustbins is detected with the help of Sensor systems, and communicated to the authorized control room through GSM system.

Sharma et al. [3] proposed system for Microcontroller based Smart dustbin management system that shows the status of the Dustbins in Mobile phones.

Gayanthika et al. [10] proposed a RFID based Smart Dustbin System is a prototype model of next generation dustbin which would be highly equipped with sensors. The system uses a cloud based monitoring system for garbage monitoring.

Tripathi et al. [11] proposed a model that uses RFID tags in the RFID reader. Then the system will open the lid of the dustbin by validating the user ID from the database in the server using the GSM module. Before the lid opens the ultrasonic sensor will check the garbage level and if the dustbin is full the system will

send a text message to the authority saying that dustbin is full and then opens the lid.

The main contribution of this paper is described as follows: In the existing system dustbin layer consists of internet and Wi-Fi enabled dustbins which contain a sensor which senses the fill up status of dustbins and sends the data to the server. It also sends its current GPS location to the server at regular intervals. There will not be any movement of the dustbins in the previously discussed methods. So there we need labors for taking the garbage. In this work, movement of dustbin is possible. But our proposed work will reduce the manpower. The proposed SMART dustbin is used to achieve following objective

- To keep our environment clean.
- To reduce the man power.
- To reduce the time consumption.
- Prevention of overflowing of garbage from a dustbin.

This paper is organized as follows, section 1 presents about the introduction of the garbage monitoring system and literature survey. Section 2 describes our proposed methodology to design the SMART Dustbin. Section 3 explains the components used to design SMART dustbin. Section 4 deals with the Arduino microcontrollers. Section 5 analyses about results and discussion of the proposed system. Finally, section 6 concludes the paper.

2. PROPOSED SMART DUSTBIN

This proposed model consists of three ultrasonic sensors fixed around it in all three sides at the top of the dustbin. This detects the obstacles in all three sides within a limit 50 cm as we already pre-determined this distance in the Arduino coding and gives a signal when obstacle presence is encountered. The signal from ultrasonic sensor sends to PIR sensor.

This PIR sensor is used to detect human presence whereas the ultrasonic sensor detects any object or obstacles. This PIR sensor sends signals when human body temperature is detected. There consists of two smart dustbins and each dustbin consists of ultrasonic sensor inside, it to detect the level of garbage value in it. If the dustbin is full the LED will be on and in that case if there is any human presence inside the ultrasonic sensor range, the beeper will be on.

The Fig.1 shows the flowchart of the proposed method, the functional block diagram of the proposed model is shown in the Fig.2. The proposed model has three nRF24L01+PA+LNA module, one is the MASTER and remaining two are SLAVE's and it is used for the communication purpose. It will help these two smart dustbins to communicate each other.

The SLAVE 1 is fixed in dustbin 1 and SLAVE 2 is fixed in dustbin 2. When the dustbin 1 gets full, it sends signal to MASTER via SLAVE 1, the MASTER sends message to the user through GSM modem which is connected to the MASTER and when the user responds positively (YES), the reverse action takes place.

The GSM modem sends signal to MASTER and then it sends signal to SLAVE 1 and SLAVE 2. The SLAVE 1 and SLAVE 2 are given the signal for line follower action. The SLAVE 1 goes to an unnoticed place and SLAVE 2, which is already in unnoticed place comes to noticed place through the pre-defined path with the help of line follower robot and so on. The proposed model has gas a sensor for sensing the smoke which is created from the fire. When there is any form of fire (like cigarettes, waste tyre, waste sticks) inside the smart dustbin, the gas sensor will sense the smoke and alert the operator.

2.1 DESIGN METHODOLOGY FOR THE PROSED SYSTEM

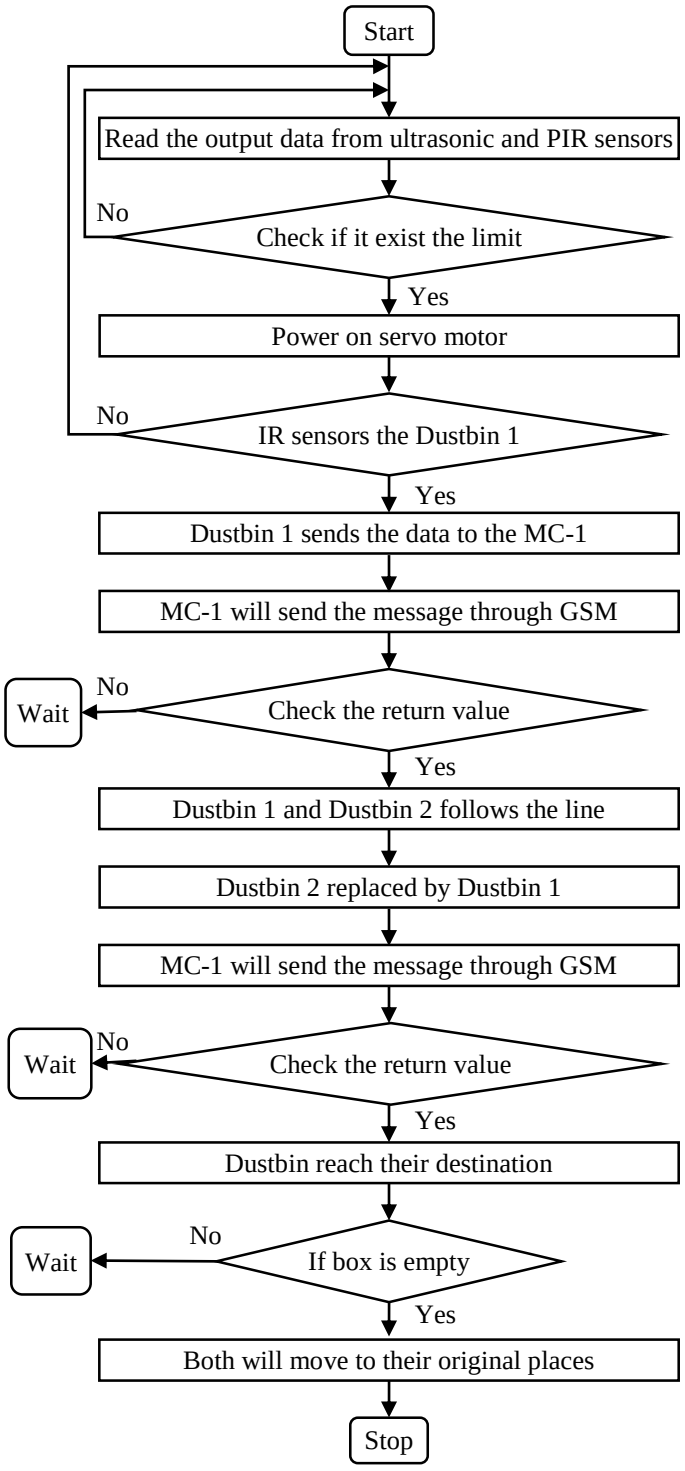

Fig.1. Flowchart of Self-Monitoring Automated Route Trash (SMART) Dustbin

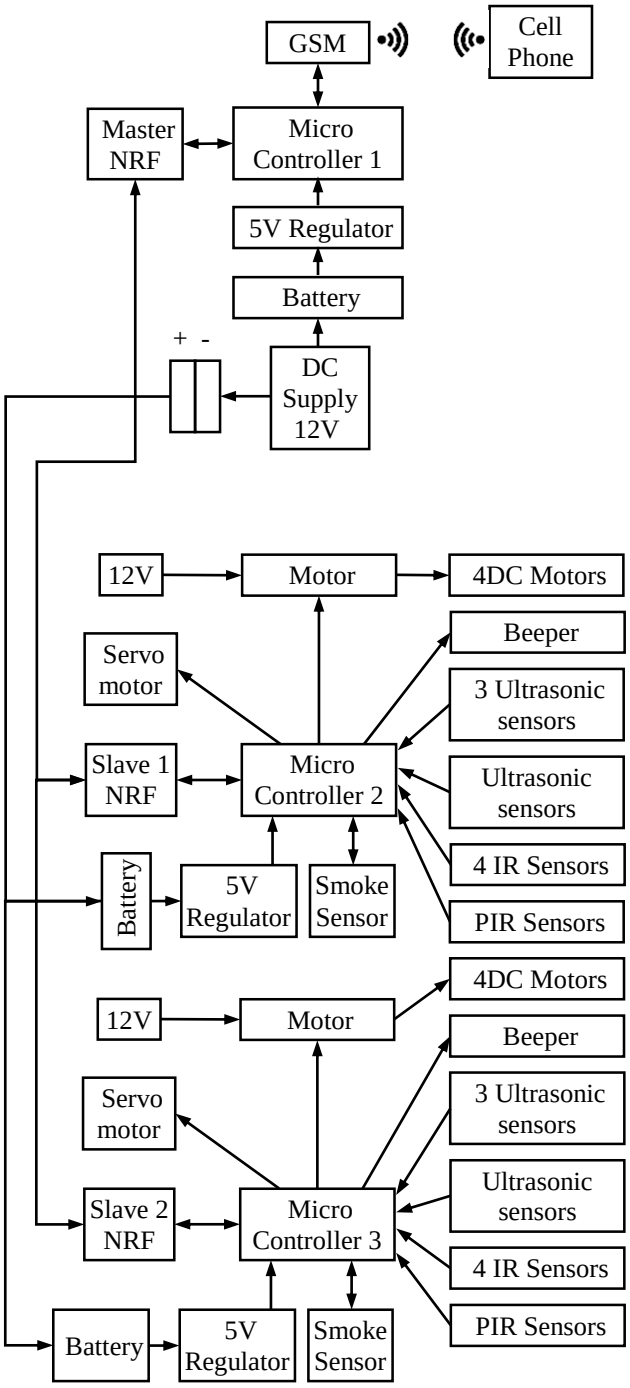

Fig.2. Block diagram of Self-Monitoring Automated Route Trash (SMART) Dustbin

Proposed model consists of three ultrasonic sensors that senses the obstacle and PIR motion sensor senses the human presence. The fourth ultrasonic sensor senses the garbage level. Once the sensor senses its condition a signal from the slave 1 nRF24L01+ will be sent to the master nRF24L01+.

The master microcontroller will send a message through GSM to the operator. Once, the operator sends a reply message as a favor. The master nRF24L01+ will send signals to both slave 1 nRF24L01+ and slave 2 nRF24L01+. Then the four DC motors and IR sensor will be triggered and it will make its operation in both the smart dustbin and again the smart dustbin 2will do the same operation as smart dustbin 1.

Ultra sonic sensors and PIR sensors read the data according to the collection of waste materials in the dustbin. Servomotor starts to operate, at the initial position of the servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. This output port of the potentiometer is connected with one of the input terminals of the error detector amplifier. Now an electrical signal is given to another input terminal of the error detector amplifier. Now the difference between these two signals, one comes from potentiometer and another comes from an external source, will be amplified in the error detector amplifier and feeds the DC motor. This amplified error signal acts as the input power of the DC motor and the motor starts rotating in desired direction. As the motor shaft progresses the potentiometer knob also rotates as it is coupled with motor shaft with the help of gear arrangement. Microcontroller sends the information message through GSM. If the dustbin 1 is full, it will be replaced by dustbin 2 automatically. This is the major contribution of this research work.

2.1.1 Structure of the Proposed Model:

The Fig.3 shows the Structure of Self-Monitoring Automated Route Trash (SMART) Dustbin.

Three ultrasonic sensors are connected to the digital pin of the Arduino. Similarly PIR motion sensor is also connected to the digital pin of the Arduino. The three ultrasonic sensors are used to sense the obstacle and PIR motion sensor are used to sense the human presence. Both will give a digital signal as the input to the Arduino. The fourth ultrasonic sensor is used to detect the garbage level, which is also connected to the digital pin of the Arduino. The smoke sensor which detects the colour difference is also connected to the analog pin of the Arduino. An alarm (Buzzer) and four DC motors will be operated from the digital pin of the Arduino. The nRF24L01+PA+LNA connect to the RX and TX pin of the Arduino.

3. HARDWARE COMPENENTS

Various components which are used for designing the SMART dustbin is discussed in this section.

3.1 COMMUNICATION SYSTEMS

The nRF24L01 is a single chip radio transceiver for the worldwide 2.4 - 2.5GHz ISM band. The transceiver consists of a fully integrated frequency synthesizer, a power amplifier, a crystal oscillator, a demodulator, modulator and Enhanced Shock Burst protocol engine. Output power, frequency channels, and protocol setup are easily programmable through a SPI interface. Current consumption is very low, only 9mA at an output power of -6dBm and 12.3mA in RX mode. This transceiver IC operates in the 2.4GHz band and has many new features.

3.2 OVERVIEW OF GSM

A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any other processor communicate over a network. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator.

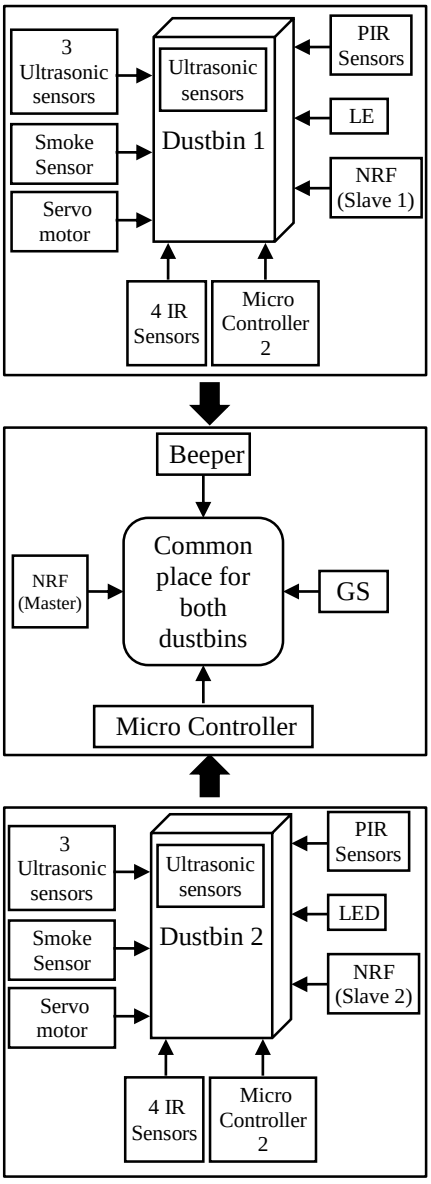

Fig.3. Structure of Self-Monitoring Automated Route Trash (SMART) Dustbin

3.3 VARIOUS SENSOR

Different types of sensors which are used in this model are discussed in this section.

3.3.1 IR Sensor:

An infrared sensor is an electronic device that emits rays in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations.

3.3.2 Ultrasonic Sensor:

Ultrasound is a technique of measuring distance from objects/obstacles. It contains a transmitter and a receiver. The transmitter transmits a short Ultrasound pulse periodically. If there is an object in front, the pulse hit the object can come back. The receiver then measures the round trip time and can estimate the distance based on the round trip time.

3.3.3 PIR Sensor:

IR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m.PIR are fundamentally made by a pyro electric sensor, which can detect levels of infrared radiation.

3.3.4 GAS Sensor:

This sensor module utilizes an MQ-2 as the sensitive component and has a protection resistor and an adjustable resistor on board. The MQ-2 gas sensor is sensitive to LPG, i-butane, propane, methane, alcohol, Hydrogen and smoke. It could be used in gas leakage detecting equipment's. A gas detector can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave.

3.4 MOTOR

3.4.1 Overview of DC Motor:

A DC motor converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic to periodically change the direction of current flow in part of the motor. By adjusting the voltage of the DC motor, speed is controlled. In DC motor voltage is proportional to the speed. As the speed increases, voltage increases.

3.4.2 Servo Motor:

Servo motors are available as AC or DC motors. Early servo motors were generally DC motors because the only type of control for large currents was through SCRs for many years. As transistors became capable of controlling larger currents and switching the large currents at higher frequencies, the AC servo motor became used more often.

3.5 ARDUINO

The Arduino UNO is a micro-controller board based on the ATmega328pu. It has 14 digital input/output pins of which 5 can be used as PWM outputs, 6 analog inputs, 4 UART's (hardware serial ports), a 16 MHz crystal oscillator, 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 an AC-to-DC adapter or battery to get started. The Arduino UNO can be programmed with the Arduino software.

4. CASE STUDY RESULTS AND DISCUSSION

We have considered two case studies. Case study I consider a small system. Our proposed model can be implemented in swach bharat dustbins on a large scale. Microcontroller programming code is written to control entire activities of the system.

- **Case Study 1**

In this proposed model, we have placed three ultrasonic sensors on the outer surface of this smart dustbin to detect the obstacle, which is present within the pre-determined range of ultrasonic sensor and we have placed one more ultrasonic sensor inside the smart dustbin to detect the garbage level. The PIR

sensor is fixed on the top of the smart dustbin to sense the human presence and the gas sensor is fixed inside the smart dustbin to detect the smoke.

The servo motor is placed at the bottom of the smart dustbin, which is used to open the top of the smart dustbin and three nRF24L01+PA+LNA module is used in this smart dustbin, in this module 1 is fixed in the common place of these two smart dustbins then module 2 and module 3 is fixed besides the dustbin 1 and dustbin 2.

The IR sensor is placed at the bottom of the line follower bot to sense the pre-defined path and the GSM module are connected to the Arduino UNO board to send the message to the operator. The DC motor is fixed at the line follower bot and it is used for moving action. The L293D motor driver is placed at the line follower bot to give actual supply to the DC motor. The required torque is calculated

The Table.1 shows the output characteristics of DC motor with a voltage supply of 12V and 24V. The speed of the motor to bring the setup out is also varies according to the voltage supply.

Table.1. Characteristics output of DC motor

Weight (Kg)	Voltage (V)	Speed (rpm)
20	12	10
	15	20
	20	40
	25	60

The Table.2 shows the output characteristics of servo motor with a voltage supply of 5V and which shows the speed and torque of servo motor. The speed of the motor to bring the setup out is also varies according to the voltage supply. The necessary torque is calculated for the servomotor.

Table.2. Characteristics output of servo motor

Weight (Kg)	Voltage (V)	Torque (Kgf Cm)	Speed (RPM)	Current (A)	Power (W)
0.5	5	1	30.58	0.6	3
1	5	2	15.29	0.6	3
1.5	5	3	10.19	0.6	3

Fig.4. Proposed Self-Monitoring Automated Route Trash (SMART) Dustbin

The Fig.4 shows the proposed Self-Monitoring Automated Route Trash (SMART) Dustbin. In this proposed model we have placed three ultrasonic sensors on the outer surface of this smart dustbin to detect the obstacle, which is present within the pre-determined range of ultrasonic sensor and we have placed one more ultrasonic sensor inside the smart dustbin to detect the garbage level.

- **Case Study 2:**

Our proposed model can be suitable for swach bharat dustbin of various loads like full load, half load and empty load and for different weights and the characteristics output and speed Vs voltage characteristic of DC motor has been discussed below.

4.1 CHARACTERISTICS OUTPUT OF DC MOTOR

The Table.3 shows the output characteristics of DC motor of empty load swachh bharat dustbin with a voltage supply of 12V, 100 Kg of weight and the speed of the DC motor is 50 rpm.

Table.3. Characteristics output of DC motor of empty load swachh bharat dustbin

Weight (Kg)	Voltage (V)	Speed (rpm)
100	12	50

4.1.1 Half Load Swachh Bharat Dustbin:

The Table.4 shows the output characteristics of DC motor of half load swachh bharat dustbin with a voltage supply of 24V, 150 Kg of weight and the speed of the DC motor is 100 rpm.

Table.4. Characteristics output of DC motor of half load swachh bharat dustbin

Weight (Kg)	Voltage (V)	Speed (rpm)
150	24	100

4.1.2 Full Load Swachh Bharat Dustbin:

The Table.5 shows the output characteristics of DC motor of full load swachh bharat dustbin with voltage supply of 48V, 200 Kg of weight and the speed of the DC motor is 150 RPM. The speed of the motor to bring the setup out is also varies according to the voltage supply.

Table.5. Characteristics output of DC motor of full load swachh bharat dustbin

Weight (Kg)	Voltage (V)	Speed (rpm)
200	48	150

4.2 CHARACTERISTICS OUTPUT OF SERVO MOTOR

Our proposed model can be implemented in swach bharat dustbin for different weights and the characteristic output and speed vs. voltage characteristics of servo motor has been discussed. The Table.6 shows the output characteristics of servo motors with a voltage supply of 5V and which shows the speed and torque of servo motor for different weights.

In section 3, the hardware components discussed in section 3 helps to make proposed model. Design calculations and test results of Hardware components are discussed.

Table.6. Characteristics output of servo motor of swachh bharat dustbin

Weight (Kg)	Voltage (V)	Torque (Kgf Cm)	Speed (rpm)	Current (A)	Power (W)
5	5	10.01	16.30	3.2	16
10	5	20.02	10.19	4	20
15	5	30.03	12.74	7.5	37.5

4.2.1 Test Results of IR Sensor:

An infrared sensor circuit is one of the basic and popular sensor modules in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time.

In this project, the transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. The Table.7 shows the output characteristics of the IR sensor.

Table.7. Characteristics of IR sensor

Input Voltage (V)	Distance (cm)	Colour (Black/White)	Output Voltage (V)
5	4	Black	4.5
		White	1.7
5	5	Black	4.39
		White	1.46
5	6	Black	4.07
		White	1.09

4.2.2 Design Calculation of Ultrasonic Sensor:

For distance calculation Eq.(1) is used. The obstacle distance from the subject, repeated information sampling and averaging is performed. As ambient light conditions do not affect ultrasonic sensors, object detection and distance calculation can be performed accurately. The Table.8 shows the output characteristics of the ultrasonic sensor.

$$D = [(T_t)*(S_v/2)] \quad (1)$$

where,

D - Distance in m

T_t - Travel time of sound wave in ms

S_v - Sound Velocity in m/s (340 m/s)

S_v = 340 m/s

D = 50 cm

$$0.5 = [(T_t) * (340 / 2)]$$

$$0.5 = [(T_t) * 170]$$

$$0.0029\text{s} = T_t$$

$$T_t = 2.9\text{ms}$$

Table.8. Characteristics of Ultrasonic Sensor

Sound Velocity (S_v) (m/s)	Distance (m)	Travel time (T_t) (ms)
340	0.5	2.9
	1	5.8
	1.5	8.8

4.2.3 Test Results of PIR Sensor:

In the presence of human IR radiations, the sensor detects the radiations and converts it directly to electrical pulses, which is fed to the inverter circuit. A PIR sensor detects the infrared light radiated by a warm object.

It consists of pyro electric sensors which introduce changes in their temperature (due to incident infrared radiation) into electric signals. When infrared light strikes a crystal, it generates an electrical charge. The Table.9 shows the output characteristics of the PIR sensor.

Table.9. Characteristics of PIR sensor

Input Voltage (V)	Human presence	Digital output
5	Yes	1
5	No	0

4.2.4 Test Results of Gas Sensor:

In the current technology scenario, monitoring of gases produced is very important. Small like a nose, gas sensors spontaneously react to the gas present, thus keeping the system updated about any alterations that occur in the concentration of molecules at gaseous state. The Table.10 gives the output characteristics of gas sensor.

Table.10. Characteristics of gas sensor

Input Voltage (V)	Smoke presence	Output Voltage (V)
5	No	0.73
5	Yes	1.708

4.2.5 Design Calculation of DC Motor:

For torque calculation the Eq.(2) is used and for speed calculation the Eq.(3) is used. The Eq.(4) is used to calculate required torque for the proposed model.

$$P = 2\pi NT/60 \quad (2)$$

To find speed of DC motor:

$$V = (2\pi*r*60)1000*N \quad (3)$$

Let,

V = 2.826 Km/hr

r = 0.015m

$$2.826 = (6.28*0.015*60) / 1000*N$$

N = 10 rpm

where,

V – Velocity in Km/hr

r – radius in m

N – Speed in rpm

Required torque for proposed model:

$$T = \text{weight to be carried radius / gravity} \quad (4)$$

$$T = (7*0.003) / 9.81$$

$$T = 0.007645 \text{ Nm}$$

Torque required for a 12V DC motor:

For 3.6W DC motor,

$$P = 2\pi NT/60$$

$$P = (6.28*10*0.007645*T)/60$$

$$T = (3.6)/0.40$$

$$T = 8.9 \text{ Nm}$$

4.2.6 Design Calculation of Servo Motor:

Torque calculation is done using Eq.(5). For speed calculation Eq.(6) is used, Eq.(7) is used to calculate power.

$$\text{Torque } (T) = F \times D \quad (5)$$

$$T = (g*W) \times D$$

$$T = (9.81*0.5) \times 0.02 \text{ m}$$

$$T = 4.905 \times 0.02 \text{ m}$$

$$T = 0.0981 \text{ Nm}$$

Voltage (V) = 5 V

Current (I) = 0.6 A

$$\text{Power } (P) = VI \quad (6)$$

$$P = (5\text{V} \times 0.6\text{A})$$

$$P = 3\text{W}$$

$$\text{Speed } (N) = \text{Power/Torque} \quad (7)$$

$$N = (3\text{W} / 0.0981\text{Nm})$$

$$N = 30.58 \text{ rpm}$$

where,

F - Force in Newton

D - Diameter in m

g - Gravitational Force in m/s^2

W - Weight in Kg

In the existing system, there is no closing plate for the dustbin because of this problem there is overflowing of garbage in public areas and improper of collection of segregation of wastes. But, in this proposed model these problems can be avoided and in the existing system they used only one smart dustbin but in this proposed model two smart dustbins are used. So, on account of using two smart dustbins there is no need to time delay for disposing the garbage. The main advantages of our proposed model are easier collection of waste, less labor work for a municipality to maintain cleanliness. Our proposed model can be applicable for "Swachh Bharat Abhiyan" system in India to keep our environment clean and it may be used for Industries, Residential places like houses, flats, apartments, etc., and Commercial places like hotels, hospitals, bus stands etc., It is easily accessible by people and motivation of people to dump waste properly. By implementing this proposed model can avoid the majority of viruses and bacterial infections develop in a polluted environment. It will reduce the work for municipality workers to maintain cleanliness and here we are using two smart dustbins suppose if one dustbin is full, it will automatically move to unnoticed place and at the same time another dustbin which is already in unnoticed place comes to noticed the place.

According to the UN, between 2016 and 2025, the world population will increase by 20% to reach 8 billion inhabitants (from 6.5 today). With this increase in population, the responsibilities towards waste management also increase. Our waste administration frameworks and our economic situations, even taking care of business, are unequipped for taking care of the developing measures of waste universally [13]. So unless a new paradigm of global cooperation and governance is adopted, a tidal wave of uncontrolled dumpsites will be the principal waste management method, especially in Asia. There is a great scope for the modification of the proposed Smart Dustbin in future. Dumping of the waste was manual in Smart dustbin this can be automated by fixing a robot arm to lift or pick the garbage's.

5. CONCLUSION

This smart dustbin can contribute a lot towards a clean and hygienic environment in building a smart city. Two case studies are considered in this paper. Since the technology is new in India, proper awareness should be created among the public before it is implemented on a large scale. Otherwise, the sensitive devices like sensors might be damaged due to the irregular action of the users. There is a great scope for the modification of the Smart Dustbin in future. Dumping of the waste was manual in Smart dustbin this can be automated by fixing a robot arm to lift or pick the garbage. The Smart dustbins can be widely used in the Smart buildings of Smart Cities.

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