IOT Garbage Monitoring System

Vishwachi[1], Manvandra Singh [2], Leena Sharma[3], Manaswini[4]
[1, 2, 3, 4] Dept of Information and Technology
[1, 2, 3, 4] ABES IT, Ghaziabad

Abstract- *In this work, we aim at implementing thesmart dustbin which has the special feature ofpreventing the overflow of dustbin so that the cleanliness is maintained. This works on the concept in which the Smart trash can is connected to smart phone by using a bluetooth module, and then a IR placed in the bin detectthe trash level and accordingly update the status in the android app of the smart phone of the person responsible for cleaning the trash. Evaluation shows that the system operates reliably in practical situations.*

Keywords- IR sensor, Bluetooth module, Arduino Uno

I. INTRODUCTION

Overflowing bins of garbage have been an important cause of concern for people in developing countries. As the population is increasing, the condition of cleanliness with respect to garbage management is degrading tremendously. With the already prevailing diseases, the open containers are proving to be a breeding place for germs. Traditionally, municipalities operate on weekly routes to pick up trash and recyclables on designated days, regardless of whether the containers are full or not.

Now here in this project,design a smart garbage dustbin with Arduino Uno board, IR sensor and Bluetooth module for transmission of data that will be providing the real time status of the dusbin level. Basically, an IR sensor that is fixed in the dustbin will shoot IR waves to know how much stuff is inside the container.

Data collected from the sensors are sent to Arduino Board and then sent to Bluetooth Module which is again connected to a smart phone and hence a message is displayed on customers phone using the smart bin application. . It will help to curb laziness of the people's garbage collectors. Basically, this project is about collecting the most amount of materials in the least amount of time to reduce costs, time and emissions along the way. Furthermore, this project is supposed to work with any type of container and any type of waste, including mixed materials, paper, glass, metals and fluids excluding gases.

II. LITERATURE REVIEW

In 2015, Barcelona government thought to implement the idea of smart dustbin systems [1]. This is one of the sources from where we got idea about this project.

Beside this IoT based Smart Garbage and Waste Collection Bin has been proposed [2]. Here, the implementation of garbage management system is done using IR sensor, micro controller and Bluetooth module. This system provides only the cleaning of dustbins when the garbage level reaches its maximum. This insinuated us the idea of using ultrasonic sensor over IR sensor as a level detector for our container to sense up to higher range.

Moreover a smart dustbin system has been implemented [3],

A threshold level is set which compares the output of IR sensor.

The comparison is done with help of microcontroller.

After analyzing the image we get an idea about levelof garbage in the bin and from the cell sensor we get to know weight of garbage. According to the information, the controller checks if the threshold level is exceeded or not. However, this project is convenient to use but it is not economically good.

III. SYSTEM DEVELOPMENT

Considering the need of modern technology the smartdustbin should be of low cost ,efficiently working and should meet the demand of society/authority hence considering all these points we are using a arduino uno board, IR sensor, and a Bluetoothmodule.

The system developed for smart dustbin is on twoways A) System Hardware B) System Software

A. System Hardware

Fig 1.shows the block diagram of smart trash dustbin system with IoT. Environment have been kept much more clean and fresh with the use of smart dustbinsystem as the

dustbin are now been cleaned at everyinterval of the time as soon as the garbage in it is at a overflow level since a alert message is send to the particular person as it gets full.

The android application is designed on java which is discussed in the next section of software.

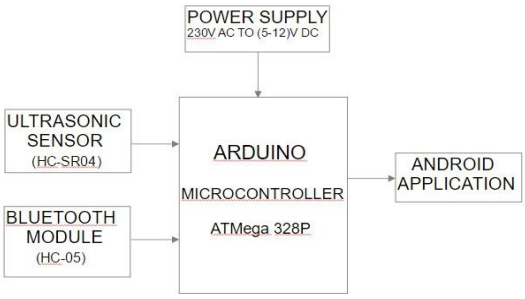

Fig 1. Block diagram of smart trash can

A.1 Sensor and Module

The module which we are using for connectivity between arduino and application for the transfer of data is a Bluetooth module HC-05 as shown in Fig 2. Bluetooth module is used to connect a system to the arduino microcontroller. There are different sensors used to measure the distance of an object, one which we are using in our system is IR sensor and that to a particular model HC-SR04 as shown in Fig3.

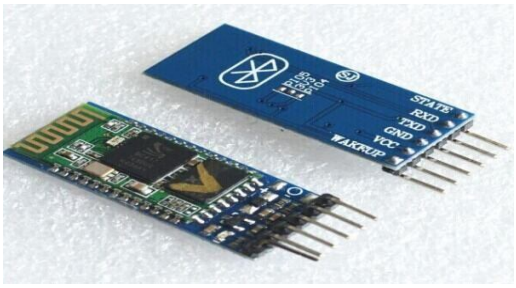

Fig 2. Bluetooth module (HC-05)

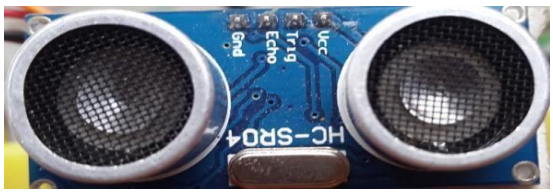

Fig 3. Ultrasonic Sensor (HC-SR04)

The Bluetooth module HC-05 is a master/slave module. By default, the factory setting is slave. The role of the module (master or slave) can be configured only by AT commands. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. We are using it in our smart trash can system to create a connection between microcontroller and mobile hone (android application) for the flow of data.

IR sensors are based on measuring theproperties of sound waves with frequency above thehuman audible range. They typically operate by generating a high-frequency pulse of sound, and then receiving and evaluating the properties of the echo pulse. In our smart trash can system we are using the IR sensor for the measurement of distance.

A.2 Arduino Controller

Arduino is an open-source computer hardware and software company, project and user community. The main reason for choosing this device arduino uno is that controller board based on the ATmega328 which have the following specification as shown in Table1.

Table 1. ATmega328P Datasheet

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	16 KB (ATmega16u2) of which 1 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz

Internet of Things (IOT), describes a world in which objects that form part of our everyday lives can communicate through various networks, including the Internet and server. The Server is a common database centre which has all data in it; from that we can update it from whatever devices you need to access it like android and etc.

The Internet of Things (IOT) is the network of physical objects that can be embedded with electronics, software, sensors, and network connectivity, which enables

these objects to collect and exchange data. It allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer- based systems, and resulting in improved efficiency, accuracy and economic benefit with continuous storage and retrieve.

In project smart trash dusdtbin we are using an arduinoboard on which IR sensor and Bluetooth module is connected, which is used to connect the

B. System Software

Software used for data reading and connecting theSmart dustbin is written in C and Java.

C is used in Arduino IDE to get data from smart dustbin and Java and XML is used to connect dustbinto Android app named (Smart Can) and display real time status of Trash

Can to the Connected Smart phone.Initially, using the (Smart Can) app dustbin isconnected to the smartphone via Bluetooth. Once thestbin is connected the IR sensor sends the data tothe android app. If the distance between the dustbin and the sensor is less than threshold than status displayed hardware to the android app, where IoT is applied and on the screen is "No Need To clean Trash Can".

The correspondingly according to the distance measure by
ultrasonic sensor a message with notification is sent to the smart phone of the user.

All the hardware is connected to the arduino as shown in Fig 5(which shows the hardware connection of the smart trash can system). status remains in the same state till the distance send by trash can is more than threshold and when distance is more than threshold the status is updated on the screen as "Please clean the trash Can".

IV. IMPLIMENTATION OF HARDWARE AND SOFTWARE

Implementation is done in two ways

A. Distance measurement using IR sensor
B. Bluetooth connectivity

A. Measuring distance using IR sensor

Transmitter part of IR module emits IR
high frequency waves in the form of pulses. After collision of these waves with any object, these waves are detected by microphone. Time taken by these waves from transmitter to receiver is used to measuredistance from any object. This IR module weare using i.e.HC-SR04 is initiated with pulse of 10us.

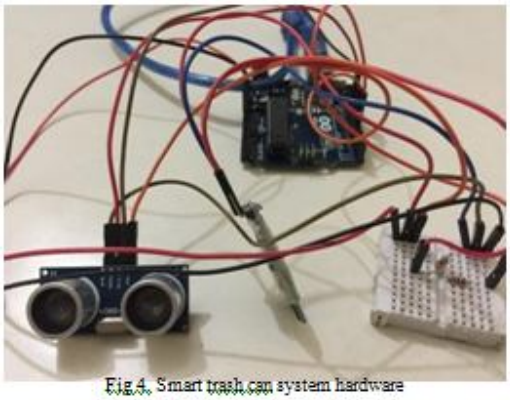

Fig.4. Smart trash can system hardware

The distance from any object is calculated using formula:

$$\text{distance} = p \times \text{speed} \quad (1)$$

We know that the speed of sound in air is 20C which is equal to 344 meter per second. The time given in above formula should also be divided by two, because ultrasonic waves travel from transmitter and then go back to receiver by travelling same distance. So the formula to calculate distance becomes:

$$\text{distance}(\text{cm}) = 344 \times \frac{i}{2} \quad (2)$$

B. Bluetooth connectivity

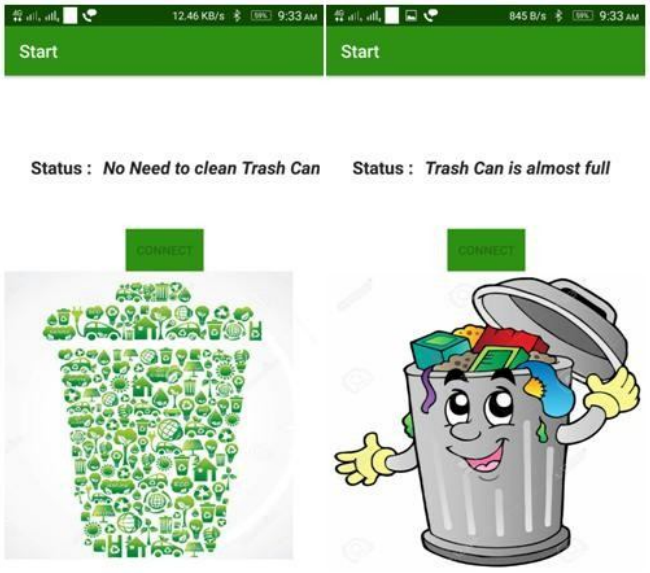

Fig 5. Android app view of smart trash can.

Bluetooth is a technology for wireless communication. It is designed to replace cable connections. Usually, it connects small devices like mobile phones, PDAs and TVs using a short-range wireless connection. And it uses the 2.45 Ghz frequency band. The connection can be point-to-point or multipoint where the maximum range is 10 meters. The transfer rate of the data is 1Mbps (or a maximum 2Mbps).

In our smart dustbin system, we are creating an Arduino-model where we fetch data from Arduino and send using Bluetooth commands. And we will get that data using our android phone application. Inshort, we are getting real time data of dustbin on aphone via Bluetooth(HC-05).

V. WORKING

Initially, when all hardware is setup properly as shown in fig. 6 and Android app is installed in the Smartphone. Switch ON the button to give power supply to the board and open the android app. When Android app is open, message appears on the screen which asks to open the Bluetooth network and connect the mobile Bluetooth to the Bluetooth module connected to the Arduino Board. After proper connections established between Board and the phone, ultrasonic sensor starts detecting the level of the garbage inside dustbin , if the distance between garbage and sensor placed top of the dustbin is more than 8cm than screen shows “NO NEED TO CLEAN TRASH CAN” as shown in fig. 7 and when it is less than 8cm than it shows “TRASH CAN IS ALMOST

Fig 8. App view of “Trash Can is almost full”

FULL”

as shown in fig. 8. IR sensors continuously detect the garbage in the smart dustbin as long as power is on. The flow diagram of working model of trash can is depicted in fig. 9.

Fig 9. Working assembly model of smart trash can

VI. TEST CASES AND RESULTS

Fig 6. Working model of smart trash can

Fig 7. App view of "No need to clean trash can"

1) Dustbin is empty: "No Need to Clean TrashCan". When IR sensor sense the distancebetween the sensor and trash is more than 8cm(dustbin is empty) than this message is shown on the screen.
2) Dustbin is half empty: "No Need to Clean Trash Can". Similar to the case 1 i.e. distance is more than 8cm (Half-filled trash can), above messageis shown.
3) When Dustbin Crossed the threshold – "Trash can is almost full" When Trash Can crosses the threshold(8cm) than above message is shown on the Smartphone.
4) When Dustbin is Full – "Trash can is almost full" When Trash Level in Trash Can is full i.e. distance between the Sensor and Trash is zero, above message is shown on the smartphone.

VII. CONCLUSION

In this paper, we have shown the design and features of Smart Trash Can. This project work is the implementation of smart dustbin system usingIR sensor, microcontroller and Bluetoothmodule. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum.

The smart dustbin using Internet of things has been experimentally proven to work satisfactory by connecting Trash Can with the users Smart Phone.

Android based Smart dustbin provides a cost efficient, eco-friendly solution for the implementation of a smart dustbin using simple circuits andprovides a user friendly interface through the androidapp, as Android is most widely used Operating
System of the world.

VIII. FUTURE WORK

Smart dustbin helps us to reduce the pollution. Many times garbage dustbin overflow and many animals like dog or rat enters inside or near the dustbin. This project can avoid such situations. WIFI Module can be used to increase the range of Smart dustbin andserver can also be developed to maintain the data ofmany dustbins. Sensors can also be installed which can use to detect foul smell in the dustbins irrespective of the level of trash inside the trash can. GPS can also be installed to locate the position of trashcan if many trashcans are connected to the server.

REFERENCES

[1] http://datasmart.ash.harvard.edu/news/article/how- smart-city-barcelona-brought-the-internet-of-things-to- life-789
[2] S.S.Navghane,M.S.Killedar,Dr.V.M.Rohokale,"IOT based Smart Garbage andWaste Collection",International Journal of Advanced Research in Elec- tronics and Communication Engineering (IJARECE)Volume 5, Issue 5, May 2016
[3] Narendra Kumar G., Chandrika Swamy, and K. N.Nagadarshini, "Efficient Garbage Disposal Management in Metropolitan",Cities Using VANETs Journal of Clean Energy Technologies, Vol. 2, No. 3, July 2014
[4] Vikrant Bhor, Pankaj Morajkar,Maheshwar Gurav, Dishant Pandya "Smart Garbage Management System using Arduino uno,IR sensor and GSM" in Proceedings of the 2015 International Journal of Engineering Research & Technology (IJERT 2015)
[5] Parkash, Prabu "IoT Based Waste Management for Smart City using 8051 microcontroller, RF module, IR Sensors, RF Transmitters, Intel Galileo Gen2, RF Receiver" in Proceedings of the International Journal of Innovative Research in Computer and Communication Engineering(IJIRCCE 2016)
[6] http://www.instructables.com/id/Arduino-Smart-Trash-Can
[7] https://www.hackster.io/alpha007/smart-trash-can-iot-system-0f9160
[8] https://www.arduino.cc/
[9] Subrata Ghoshal, 8051 Microcontroller-Internals, Instructions, Programming & Interfacing. India:Pearson
[10] Muhammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems using Assembly and C. India: Pearson
[11] Krishna Kant, MICROPROCESSORS AND MICROCONTROLLERS: ARCHITECTURE, PROGRAMMING AND SYSTEM DESIGN 8085, 8086, 8051, 8096. India: PHL Learning Pvt. Ltd.