



## Multipurpose Street Smart Garbage bin based on Iot

Dharna Kaushik

Computer Science and Engineering  
Indira Gandhi Delhi Technical University For Women  
Delhi, India

Sumit Yadav

Computer Science and Engineering  
Indira Gandhi Technical University For Women  
Delhi, India

**Abstract:** The government of India aims at “Swachh Bharat Mission” and for that we need smart city with smart streets enabled with smart garbage monitoring system. We see garbage bins around us placed at public places overflowing with due to increase in waste and results into unhygienic conditions for people and leads to deadly diseases. Thus to improve this situation, we proposed this project. In our proposed system, there are multiple smart garbage trash bins on a microcontroller board platform (Arduino Board) located throughout any city or the campus or hospital. The Arduino Board is interfaced with GSM modem and ultrasonic sensor. Once the level of threshold is being crossed, then ultrasonic sensors will trigger the GSM module which in turn continuously alert the authorised person by sending SMS reminder after until the dustbin is cleaned. Beside this, we will also create the central system that will keep showing us the current status of garbage on mobile web browser with html page by wi-fi. With the help of this, we will create shortest path for garbage collection vehicles using Dijkstra Algorithm. This is real time waste management by using smart trash bins that can be accessed anytime anywhere by the concerned person.

**Keywords:** IoT; Smart city; Smart Garbage Bins; Arduino; Ultrasonic Sensors; GSM; Real time Analytics; Route Optimization

### I. INTRODUCTION

The “Smart City” concept is not a new concept in India, but it is not implemented as it is expected. When our respected Prime Minister gave so much importance on “Swachh Bharat Mission” and gave the idea of building 100 smart cities throughout India [1]. Smart City means smart lifestyle that comes up with cleanliness. There is a rapid growth in urbanization and modernization. With respect to urbanization, we must have sustainable urban development future plans. We must have street smart bins in all smart cities. In spite of the progress of smart buildings, upgradation, there is one stinking problem that we have to deal with. The biggest challenge in smart city Implementation is solid waste management. In the world of upgradation stage, we see pictures of garbage bins overfilled with trash. This leads to no. of diseases because mosquitoes breeds on it continuously. To handle management of trash and solid waste in urban cities is difficult to handle. Hence to solve this problem, a new approach of intelligent Trash bins or dustbins where automatic waste management system is done. This idea of smart garbage bins is not only for smart city but for smart buildings, Universities, Hospitals, Residential Complex, Malls, offices and bus stands etc. Here we are converting normal dustbins into intelligent trash bins by using sensors for garbage level detection and sending message to concerned person or authority. Our proposed project is based on IOT, refers to wireless network between objects. The internet of things make several objects for example dustbins can be easily sensed and remotely accessed and controlled from the internet. Here we get real time information of dustbins.

Due to growth in population rapidly, results in more disposal and causing deadly diseases. So to avoid all above all above menace, we must have system for proper waste management. For example, we have multiple dustbins in north zone, south zone, east zone and west zone located through the city or the college campus, educational institutes, companies (MNCs), hospitals etc. Interfacing of dustbins with Arduino board and ultrasonic sensors for detecting trash level.

The concept of smart cities is emerging without cleanliness is useless. Thus we need smart waste disposal system for the entire city. Sensors enabled bins connected through GSM module, generates a large amount of data which is further analyzed and visualized at real time to gain insights about the status of waste around the city using route optimization algorithm [2]. The main focus of our research paper is to create automatic waste management system across the whole city and monitoring by a single system efficiently. This can prove to be a new revolution in smart city implementation [7]. This problem not only exists in India but also in other parts of the world. Hence, we will build such a system that will eradicate the problem from its root. This project of Smart City Implementation with respect to smart garbage Bin will help us in keeping environment clean. As “Cleanliness is next to Godliness”. Thus we need to create healthy environment for healthy and happy people. The concept introduced in this research paper is helpful as it is not possible to check each and every place where garbage bin is full and where it is empty.

### II. LITERATURE SURVEY

[1] Nowadays cities face lots of challenges in terms of socio economic development phases. The “smart cities concept” is still a new concept in India due to lack of its implementation, it acts as response to above challenges. This research paper is exploration of how we can drive innovative experiments with “Smart Cities” and proved Internet enabled devices as boon for people. This elaborates the concept of innovative ecosystem using resource sharing techniques and deal with rapid urbanization with innovation.

In [2], the concept of smart cities is associated with smart waste management system. It is done with the help of using PIC microcontroller and network of sensors and complex electronic circuitry.

In [3], they came a point that introduction of an integrated system in the form of RF Receivers, GPS (Global Position System), GPRS (Global Packet Radio Service), GIS (Geographic Information System) and web camera will collectively solve the problem of solid waste.

Here in Research paper [4], the dustbin is converted intelligent trash bins and by operating it through remote control unit and the completes the task according to our gestures. But in this research paper, it explains the hardware circuit design that is interaction is possible between humans and intelligent trash bins.

While in [5], dustbin monitoring project using smart GSM will help us in the proper smart management of cleaning in high class smart cities, shopping malls etc. to make the environment clean. It has been modified in the form of establishing connection of GSM module with trash bins. However these automated bins needs more improvements in this area.

[6] Waste Management Problem is tackled by developing a smart alert garbage system. This is based on RFID Tag which is a computing technology that is used for verification. This is an integration of RFID and IOT module. Hence reducing the manual process of monitoring and verification.

The use of pervasive computing technology is also involved here to improve waste Management system. We are associating physical objects (trash bins) with digital information. Here in research paper [9] waste material consists of RFID (Radio Frequency Identification) Tag. Here we are using RFID Waste Sorting System. But this system is distinguishing waste on the basis of their tag. Thus cost of the system increases.

### III. PROBLEM STATEMENT

Instead of using plenty of bins in an unordered fashion around the city, we can have minimal no. of smart bins that can be placed that are feasible and affordable. As we have seen all around us, the dustbins are getting overflowed and concerned municipal authorities usually don't get information within the stimulated time.

#### A. Disadvantages of Existing System

There are so many disadvantages of existing system that are as follows:

- High costs
- Complex circuitry.
- The above circuit system are less effective and wastes a lot of time.
- Garbage Collection vehicles go and empty containers when they are not even 50 % filled.
- No route optimization.
- No Centralized system for proper functioning and maintenance.
- Environment becomes become unhygienic and cause serious illness to human beings due to lack of implementation.

### IV. PROPOSED METHODOLOGY

While considering the need of technology and innovation, this is not an original idea. The idea has been proposed. But however, we need an original plan for designing a Smart Bins with ultrasonic sensors. Already existing system involves complex circuitry and high costs and features are also limited. In India, if we have a costly garbage bin that will not be a priority experiment for people [6]. Thus here we are deploying such kind of system that is not only cheaper but with extended

features that has never been implemented. For detection of trash in the bin, many sensors can be used like weight sensors, IR sensors, etc. But here we are using ultrasonic sensors which gives us directly information about percentage of trash in the dustbins. It is advantageous over weight sensors because weight sensors only tells us about the weight of the garbage, but this does not let us know the level of garbage in the bins. Dynamic Routing and Intelligent Transportation System is a novel solution to the problem arises with Waste Management [10]. The system will provide high QOS to the citizens of smart city.

### V. BLOCK DIAGRAM

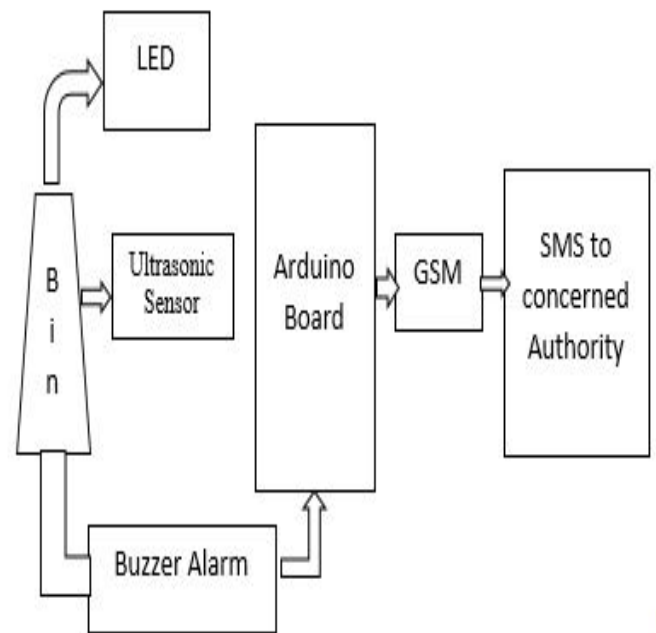


Figure 1. Example of a One-Column figure caption

#### A. Hardware and Software Requirements

The hardware requirements for the system are as following:

1) *Arduino ATMEGA 328 Microcontroller:* Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, 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. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.



Figure 2. Arduino Board

II) *Ultrasonic sensors*: It emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance. The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board.

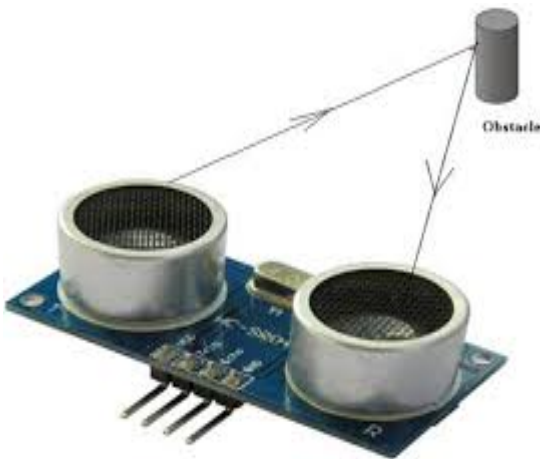


Figure 3. Ultrasonic Sensors.

III) *Buzzer*: Buzzer is a device that gives audio signal as an output. Buzzer receives the feedback send by both the sensor to the control unit and responds according to the code that burnt into the microcontroller.



Figure 4. Buzzer.

IV) *GSM Module*: GSM module is used to establish communication between a computer and a GSM system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc.) for computer. The MODEM is the soul of such modules.



Figure 5. GSM Module.

### B) Software Requirements

The software specifications are basically software system that should be developed.

I) *Arduino IDE*: The Arduino IDE (Integrated Development Environment) is text editor for writing code, a message area, a tool bar with buttons for common functions and a service of menus as shown in fig.

It connects the Arduino and hardware and then we upload the required programs and start communicating.

Programs that are written using Arduino Software IDE are called sketches and they are written in the Text editor. The Editor has basic features including cutting, pasting, searching and replacing text. The file extension is .ino.

II) *Arduino Language*: The language used for programming in Arduino IDE is a set of C/C++. The sketch automatically generates function prototype and then passed to a C/C++ compiler.

## VI. DESIGN AND IMPLEMENTATION

The design methodology of the proposed system is divided into three modules. The one in which detection of garbage level is carried out. Then in the second in which we create centralized system to keep the track of all dustbins with their respective ID's using web page. Then finally we will create optimized for collection of garbage using some kind of algorithm.



**A. Phase 1**

The proposed work aims at implementing dustbins enabled in 4 zones i.e. north zone, south zone east zone and west zone. We will do connections of all above mentioned components ATMEGA 328 microcontroller, buzzers, led, power supply on PCB board. The garbage bins are fitted with ultrasonic sensors which senses the garbage level in the bin and sends it to the ATMEGA 328 microcontroller. Arduino uses the information received from sensors and check whether it is above or below the threshold level and if it is above the threshold then the buzzer will start sounding [5]. The LED's will blink depending upon the level of trash in the bin. SMS is sent to authorities no. of municipal staff using GSM Module. The number presents at waste Management Centre receives information from microcontroller and display it on phone screen.

**B. Phase 2**

The HTML page is created with individual dustbins and their unique ID's. GUI is created in order to provide friendly environment, so creation of GUI (Graphical User Interface) for Smart Garbage Monitoring. The Centralized System will display the different parameters that is Dustbin ID, location of dustbin and status of bin [11].

GUI Interface at Control Room

Location	Dustbin Level	Date	Time	Worker Mobile No	Message to cleaner	
MALAD	25 %	13-03-2015	15:00	98153 24611	Text1	Send SMS
GOREGAON	50 %	13-03-2015	15:00	98253 24612	Text2	Send SMS
DADAR	50 %	13-03-2015	15:00	98353 24613	Text3	Send SMS
Matunga	100 %	13-0-2015	15:00	98453 24614	Text4	Send SMS

Figure 6. HTML page of dustbins

**C. Phase 3**

The data acquired by above can be used to systematically plan route map to collect garbage [12]. The information from Trash bin is collected via HTML page and help in creating the optimized route using Dijkstra algorithm.

For the optimal collection of waste from dustbins all around us, we are having various Scheduling Mechanism or algorithm.

**I) Fixed Scheduling**

In this scheduling Mechanism, we fixed the time interval for collection of garbage. This is what we generally used to do in conventional garbage collection system. For example, after every 3 days the garbage collection vehicle will go and collect the garbage. In this, we can apply Traveling Salesman Algorithm for route planning.

**II) Average Scheduling using Threshold**

In this Scheduling mechanism, just calculate the average of all fill up status of all bins.

If average is greater than the set threshold (70% or 80%) then schedule the collection of garbage using Travelling Salesman Algorithm

**III) Priority Scheduling**

In this scheduling Mechanism, the dustbins are cleaned up according to their filled level. For example, if we have 4 dustbins and their fill up status is 30%, 80%, 90%, and 30 %. The collection of garbage also must happen according to the level of trash. This can be used for routine check of bins for saving resources[8].

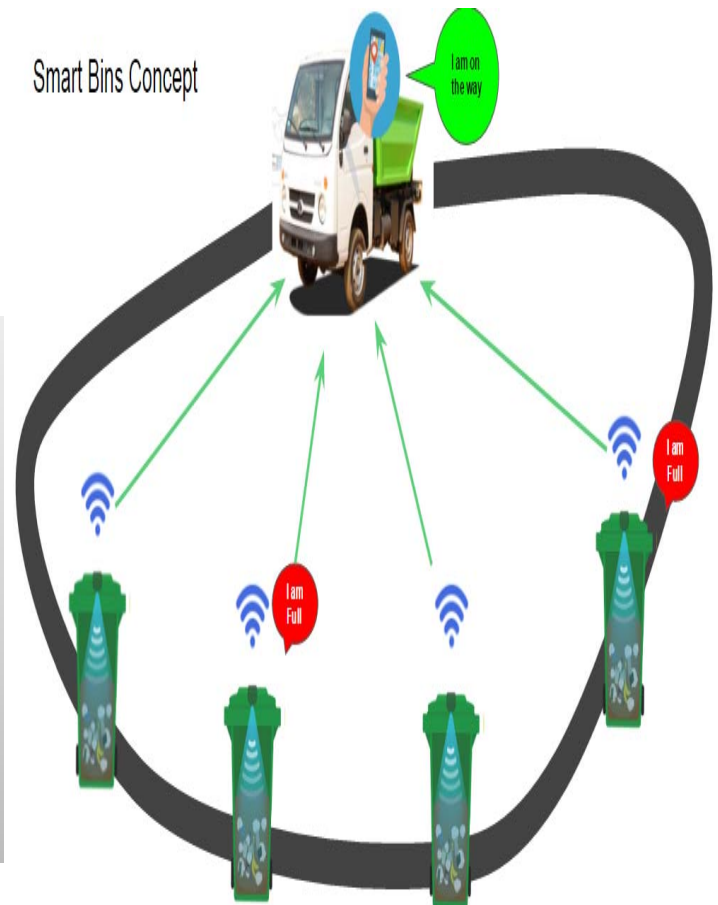


Figure 7. Route Optimization.

We will use this priority scheduling Mechanism because it has many advantages :

- Our system provides real time access to the dustbin.
- Save fuel with respect to priority route appropriate planning mechanism using Dijkstra Algorithm.
- It reduces the no. of trips of garbage collection vehicle and reduce expenditure associated with garbage collection.

**VII. FLOW CHART**

The flow chart of the project is shown in fig. It basically provides the idea of this project. The flow of the project of smart Waste Management System begins with option start.

Ultrasonic sensors are deployed that senses the level of trash in the bins and when it crosses the threshold level, message is send to the concerned authority via GSM so that the concerned authority can clean the dustbin as soon as possible. The process gets repeat itself again and again until the dustbin is not cleaned.

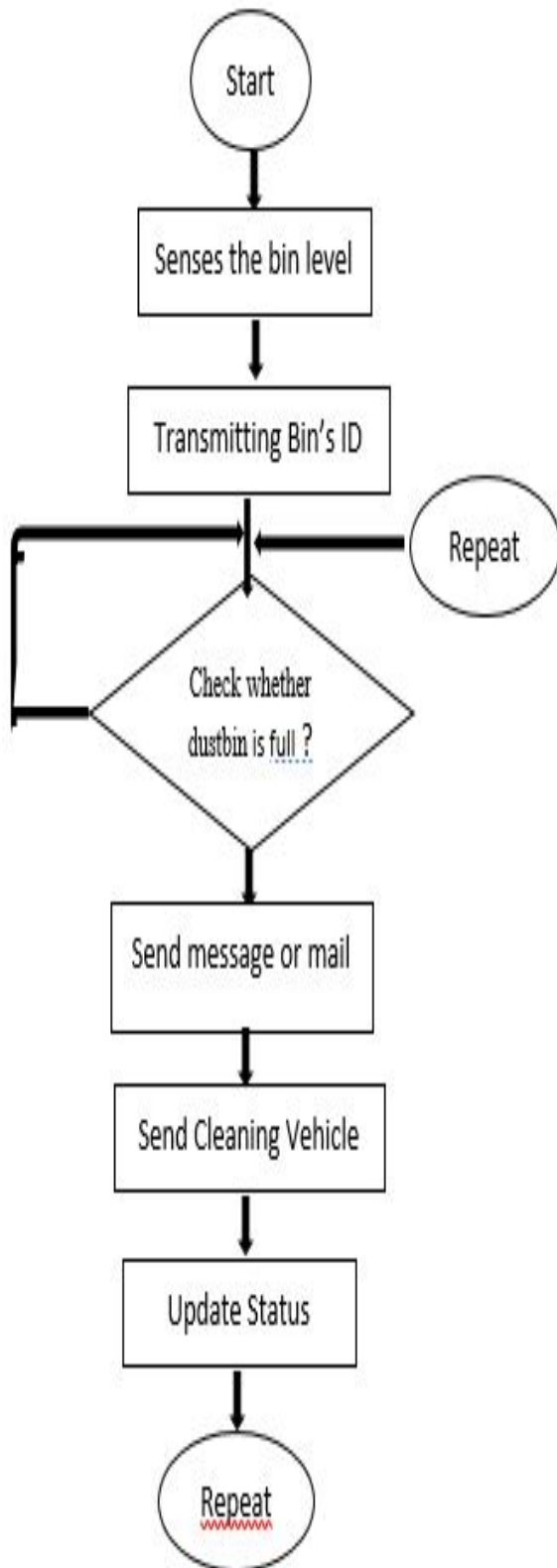


Figure 8. Example of a One-Column figure caption.

### VIII. CONCLUSION AND FUTURE WORK

The mission of smart city is accomplished by clean India. The Smart Trash Bin's Intelligent Monitoring enables waste management and our proposed methodology is using data Intelligence to drive operational efficiencies including optimized route by using Dijkstra Algorithm and effective cost analysis. We know the fill level of containers all times and send optimized routes directly to drivers. Our service cost cut by 50 % with respect to smart Decision Support System for efficient waste Collection in Smart Cities.

In future, by deploying smart bin wireless ultrasonic sensors and reduce the wired connectivity between the components and make this as wireless Smart garbage bin with so many advanced features and connect it with wi-fi. Automatic lock of trash bin, and we ca create cluster of dustbins in all zones with the help of cloud based system and providing SAAS (Software as a service) services to commercial waste management municipal corporations. This application is not limited here but can be extended further for city administration, municipal corporations, Recycling factories can be planned in near future.

### IX. REFERENCES

- [1] Schaffers. Hans. et al. "Smart cities and the future internet: Towards cooeration frameworks for open innovation." *The Future Internet Assembly*. Springer Berlin Heidelberg, 2011.
- [2] Sharma. Naravan. Nirman Singha. and Tanmov Dutta. "Smart Bin Implementation for Smart Cities." *International Journal of Scientific & Engineering Research* 6.9 (2015): 787-791.
- [3] Jasmi. Mohamad Azri Bin. and Irsvad Siddia Bin Ibrahim. "Development of Smart Dustbin." (2013).
- [4] Zhou. Hua Chun. "Circuit design for an intelligent dustbin controlled by gestures." *Applied Mechanics and Materials*. Vol. 644. Trans Tech Publications, 2014.
- [5] Fahiszrulzaki. Muhammad. and Md Yusof. "Smart Dustbin Monitoring Using GSM." (2015).
- [6] Kumar. N. Sathish. et al. "IOT based smart garbage alert svstem using Arduino UNO." *Region 10 Conference (TENCON), 2016 IEEE*. IEEE, 2016.
- [7] Karadimas. Dimitris. et al. "An integrated node for Smart-City applications based on active RFID tags: Use case on waste-bins." *Emerging Technologies and Factory Automation (ETFA), 2016 IEEE 21st International Conference on*. IEEE, 2016.
- [8] Joshi. Jetendra. et al. "SmartGarbage Monitoring System." *Proceedings of the 7th International Conference on Computing Communication and Networking Technologies*. ACM, 2016.
- [9] Glouche. Yann. and Paul Couderc. "A smart waste management with self-describing objects." *The Second International Conference on Smart Systems, Devices and Technologies (SMART'13)*. 2013.
- [10] Medvedev. Alexev. et al. "Waste management as an IoT-enabled service in smart cities." *Conference on*

*Smart Spaces*. Springer International Publishing, 2015.

Management Using Internet of Things for Smart Cities."

[11] Kasliwal Manasi. H.. and B. Survawanshi Smitkumar. "A Novel Approach to Garbage

[12] Dugdhei. Saurabh. et al. "Efficient waste collection svstem." *Internet of Things and Applications (IOTA). International Conference on. IEEE, 2016.*