

# Smart Dustbins for Smart Cities

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## ABSTRACT

The govt. of India has launched various smart city projects and for these cities to be smarter it is necessary that the system which collects the garbage has to be smarter. In addition to that it is necessary that people need easy accessibility to the garbage disposing points as well as the garbage collection process. It has to be efficient in terms of time and fuel cost. Most of the urban cities and town in India are not well designed to facilitate the proper garbage disposing and collection mechanism. Also there are cities which are expanding rapidly and are putting the pressure on the current infrastructure which is not developing at the same pace as that of the current urbanization. In our propose system we are going to check garbage fill status of the dustbin by using Ultrasonic Sensor, Buzzer, Arduino Board, Moisture Sensor, Wifi Model this will check the status and send the message to cloud that Dustbin is full, then message is sent to collection van through Wifi Module then garbage collection is done, if the Dustbin is not cleaned in paticular time we will send message to higher authority and they will take appropriate action on it. Our proposed system is going to segregate Dry and Wet garbage. Therefore, the Automatic Garbage Fill Alerting system makes the garbage collection more efficient, which will ultimately make our dustbins and also cities smart at the same time.

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## 1. INTRODUCTION

From the total number of cities in India most of the towns and cities are not well designed and does not facilitate the proper garbage disposing and collection mechanism. Also there are cities which are expanding rapidly and are putting the pressure on the current infrastructure which is not developing at the same pace as that of the current urbanization. As the govt. of India has launched smart city project to utilize the IT enabled solution so there is an implicit need to make the city cleaner. Our proposed system solves Four related problems:

- We provide greater access to the garbage disposing points (public dustbin).
- System is efficient in terms of fuel and time cost.
- Provide data collection facility which shows that, how much a city generates garbage and accordingly plan disposing process.
- Detection of wet and dry garbage in dustbin.

## 2. Problem Definition

As there is rapid growth of population in many of the cities and states, There are lot of problems faced by the people, like environmental issues in which increasing garbage waste, increases various types of diseases and creates health problem and many more. In recent times garbage waste collection and its management is a very critical issue. To Overcome the drawbacks produced by previous systems and produce a system which gives greater access to the garbage disposing points (public dustbins), efficient in terms of time

and fuel cost, and provide data collection facility on how much a city generates garbage and accordingly plan disposing process, and to detect wet and dry garbage in dustbin.

## 3. Previous Work

Longhi s et al. had made a quantitative analysis between previous as well as existing dustbins and their serving population. They studied and analysed the spatial distribution of dustbins in the local areas of dhaka city using the average nearest neighboring function. Significantly , the spatial circulation of the current dustbins had appeared to be dominant in the clustered pattern. Next, an optimal number of additional dustbins were calculated. It was shown that the number of existing dustbins was insufficient in the studied area.[1]

D Alidori et al. studied the extent of pollution caused by the existing system. In this system, it was found that all the dustbins were burnt along with waste and causing pollution to the environment. The results thus obtained, helped to understand the situation of the waste management of dhaka city and than the dustbins were placed optimally.[2]

Thakker s and Narayanamoorthi r, used ultrasonic sensors in dustbins, which where used to determine its fill status. The dustbin was divided into three levels of garbage. The sensors, detects dustbins filled status. This data was sent using GSM module. They used three ultrasonic sensors at three different levels in the dustbin, this increases cost and

also the sensors could be damaged by harsh use by the users. In an Smart Garbage System(sgs), battery-based smart garbage bins (sgbs) they exchange information with each other using router and server collects this information and this information is analyzed for service provisioning. These includes various iot skills for user convenience and it increases the battery life with the help of two types of energy-efficient operations of the sgbs: standalone operation and cooperation-based operation. The proposed sgs had been experimented as a pilot project in the Gangnam district, Seoul, Republic of Korea, for a one-year period. This test demonstrated that the food waste could be decreased by 33%. [3]

Mamun m used a camera and placed load cell sensors at base of the dustbins, at each collection point . Camera took continuous snapshots of the dustbin. A threshold level was set which compares the snapshots and load sensor. A microcontroller did the comparison. After analyses, an idea about the level of garbage in dustbin and from the load cell sensors, weight of garbage could be estimated. The controller checks, if the threshold level is exceeded or not. This was convenient to use. but economically not reliable. [4]

#### 4. Proposed Work

In this system, there are 3 different types of layers viz Dustbin layer, Server layer and Client layer.

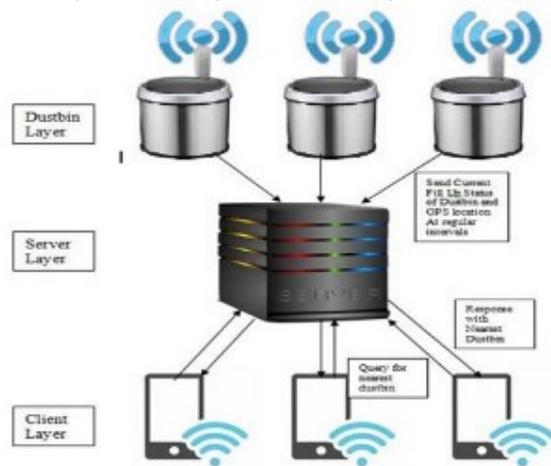


Fig.1 Different Layers

##### 4.1. Different Layers

1. Dustbin Layer: It consists of internet and Wi-Fi enabled dustbins. Ultrasonic sensor senses the fill up status of dustbin and sends it to server.
2. Server layer: Server gets the fill status of dustbin. It processes the clients query and responds with nearest dustbin location to the client and with direction to access dustbin.
3. Client layer: Clients request for the nearest location of the IoT enabled dustbin to the server using Mobile Application designed for this purpose.

##### 4.2 Scheduling

###### 1. Fixed Scheduling:

With fixed priority preemptive scheduling, the scheduler ensures that at any given time, the processor executes the highest priority task of all those tasks that are currently ready to execute. Fixed scheduling is a scheduling system commonly used in real-time systems. With fixed scheduling, the scheduler ensures that at any given time, the garbage

collection van follows its schedule. In this type of scheduling no matter how much the dustbin is fill after a fixed interval van comes and collect the garbage.

###### 2. Priority Scheduling:

Here based on Priority that means the fill up status of the dustbin is checked and accordingly garbage gets collected. This can be used for routine check of bins for saving resources. In this scheduling according to the status of the dustbins, their priority is decided and collection of garbage is carried out accordingly. In this method, the scheduler chooses the tasks to work as per the priority, which is different from other types of scheduling, for example, a simple round robin.

###### 3. Average Threshold Scheduling:

This type of scheduling has its own advantages and disadvantages. According to the average threshold value set by the authority, if the dustbin capacity reaches this value, only than the van will collect the garbage from it. There are some drawbacks in this scheduling, as if one of the dustbin in the area reaches to its full capacity while the average of all the dustbins in the area has not reached the threshold value, the dustbin will remain unattended. To overcome that drawback we can add one algorithm as while calculating average we will only consider the dustbins which are above 50 percent filled.

###### 4. Full Dustbin Capacity Utilization Scheduling:

This type of scheduling is most efficient in terms of cost because garbage is collected only when all the dustbins are filled.

Until all the dustbins in the area are filled to its full capacity, the garbage collection van will not come. Some dustbins which are filled to its full capacity will remain unattended. Thus, it refers to the relationship between actual output produced and potential output that could be produced with installed equipment, if capacity was fully used.

##### 4.3 Disadvantages of Other Scheduling

1. In fixed scheduling if one dustbin is filled early so it will be left unnoticed until the next interval of collection.
2. In average threshold scheduling Average is calculated so if one dustbin which is filled, will be emptied after the value exceeds the threshold value which will be late in some cases.
3. In Full capacity scheduling, unless and until all dustbin are filled no garbage collection will be done.

##### 4.4 Advantages of Priority Scheduling we will use this priority scheduling Mechanism because it has many advantages:

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

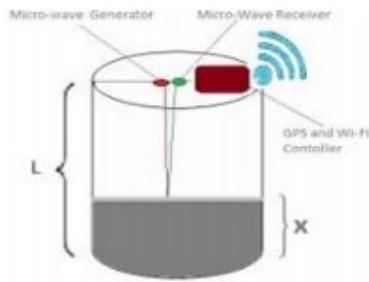
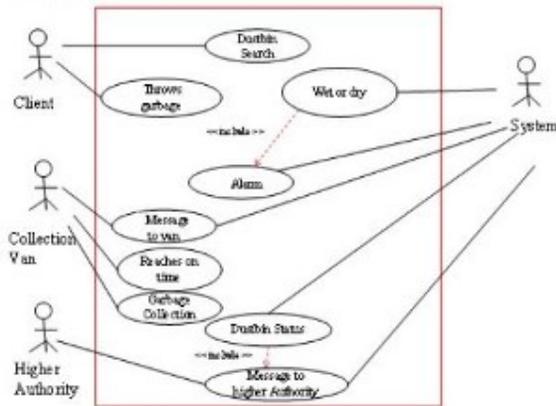


Fig.2 shows the Working principle of dustbin

#### 4.5 Modeling

##### A. Use Case Diagram

###### L Diagrams



Use case diagrams are valuable for visualizing the functional requirements of a system that will translate into design choices and development priorities.

Use case diagrams are usually referred to as behavior diagrams used to describe a set of actions that some system can perform in collaboration with one or more external users of the system (actors). Each use case should provide some observable and valuable result to the actors or other stakeholders of the system.

- **Actors:** Actors refer to a type of users, users are people who use the system. In this case student, teacher developer are the users of the framework and application.
- **Use cases:** A use case defines behavioral features of a system. Each use case is named using a verb phrase that express a goal of the system. The name may appear inside or outside the ellipse.
- **Associations:** An association is a relationship between an actor and a use case. The relationship is represented by a line between an actor and a use case.
- **The include relationship:** It is analogous to a call between objects. One use case requires some type of behavior which is fully defined in another use case.

##### B. Sequence Diagram

A sequence diagram simply depicts interaction between objects in a sequential order i.e. the order in which these interactions take place. We can also use the terms event diagrams or event scenarios to refer to a sequence diagram. Sequence diagrams describe how and in what order the objects in a system function. These diagrams are widely used by businessmen and software developers to document and understand requirements for new and existing systems.

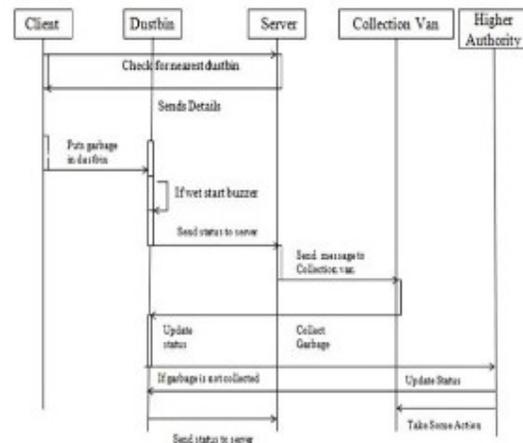


Fig.3.2 Sequence Diagram

##### Uses of sequence diagrams -

Used to model and visualise the logic behind a sophisticated function, operation or procedure.

They are also used to show details of UML use case diagrams. Used to understand the detailed functionality of current or future systems. Visualise how messages and tasks move between objects or components in a system.

##### 5. Advantages

- Proposed system provides greater accessibility to the dustbin.
- In proposed system if position of dustbin is changed from one place to another place its position will automatically get changed in server with the help of GPS module.
- It will save our fuel and time using appropriate route planning algorithm. Here we are using traveling salesman problem.
- Less pollution is generated as we are saving fuel which is mainly petrol and diesel.
- We can plan and design the collection mechanism based on the garbage collected in previous month by using the previous data available on cloud and analyzing the data.

##### 6. Limitation

- IOT Devices are costly.
- Sustainability of IOT Device

##### 7. Conclusion

This project work is the implementation of Automatic Garbage Fill Alerting system using Ultrasonic sensor, Arduino Uno, Buzzer and Wi-Fi module. Cleaning of dustbin is done as the garbage level of dustbin reaches upto the maximum level. Alarms when wet garbage is poured in dry dustbin. If dustbin is not cleaned in fixed time then the message will be send to higher authority and they will take appropriate action on sweeper or concerned contractor. Fake reports cannot be generated as previous data is always available when dustbin is cleaned in this way corruption is reduced in management. By using appropriate algorithm we can reduce the no of trips of collection van and hence we can save expenditure and resources. It ultimately helps to keep city and country clean. Therefore, the Smart dustbin makes garbage collection mechanism more efficient, which will ultimately make our dustbins and also cities smart at the same time.

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