

# IoT based Smartbins for a Smart City

Patil Ankita Mohandas, Bhat Aditi Kodandarama, Anusha K, Anusha Bhat, Prof. Shiva Kumar

**Abstract**— Waste management is one of the primary problem that the world faces irrespective of the case of developed or developing country. The key issue in the waste management is that the garbage bin at public places gets overflowed well in advance before the commencement of the next cleaning processes. It causes bad odor and ugliness in the surrounding and in turn spreads diseases. The cleanliness and hygiene of the region is maintained by mounting these smart dustbins. The main theme of the project is to develop an intelligent garbage system for efficient garbage disposal. This paper proposes an alert system to the municipal corporation by checking the level of garbage and making its disposal method easier. This process has an ultrasonic sensor which is connected to Arduino UNO to check the level of garbage in the dustbin and sends the alert to the municipal web server if garbage is filled or when it reaches the threshold level. After cleaning the dustbin, the driver confirms the task of emptying the garbage.

**Index Terms**— Arduino Uno, garbage system, ultrasonic sensor, waste management, disposal, threshold level.

## 1 INTRODUCTION

The ultimate need of the hour for a developing nation is the key for "Smart City". We have often seen garbage spilling over from dustbins on to streets and this was an issue that required immediate attention. The proverb "Cleanliness is next to god and clean city is next to heaven" has inspired us to conceptualize the project. Smart dustbin helps us to reduce the pollution. The influential ecological factor that poses to be a threat to this may include: hazardous pollution and its subsequent effects on health of humanity, alarming global warming and depletion of ozone layer etc. Mostly Environmental pollution may be owing to the Municipal Solid Left-overs (MSL).

A Proper maintenance becomes mandatory for an efficient and effective removal of the generated Municipal Solid Leftover. Swatch Bharat Abhiyan (English: Clean India Mission and abbreviated as SBA or SBM for "Swatch Bharat Mission") is a national campaign by the Government of India, covering 4,041 statutory cities and towns, to clean the streets, roads and have a better infrastructure of the country. In our system, the dustbins are connected to the sensors which via internet (IoT) records the level of garbage and sends an alert. In the recent years, there was a rapid growth in population which leads to more waste disposal. One of the main problems has been solid waste management which in addition is disturbing the balance of the nature and spreading diseases. This in turn affects the health of humans and animals.

and keeping and track of the garbage being disposed to provide a better environment to stay in. All such problems can be solved by implementing smart dustbins based. This will solve most of the problems faced related to garbage disposal and make the work easier.

The system should collect the garbage and the bin should be emptied as per the defined schedule and networked path. It is perceived that often the waste space gets too much occupied due to irregular removal of garbage occupancy in the dustbin. Using the anticipated system, monitoring of the waste collection status could be monitored effectively. The undesirable overflow of the dustbins can be avoided by this proposed method. In addition to this it also has facilitation to intimate the authority to clean up in case of any overflows. The ultrasonic sensors detect the original garbage level and the filling level of the garbage. Programming in the Arduino UNO is done in such a way that once a level of filling is sensed information message is sent requesting a clean-up.

## 2 LITERATURE SURVEY

In paper [3] the authors have given approach for the trucks that are used to collect waste and if trucks are overloaded then these trucks discard their further route of waste collection, hence no waste collection in some areas. Due to this we have seen people emptying out their overloaded dustbins in open spaces.

In paper [5] the authors have proposed the city's greener, safer, and more efficient cleaning system, Internet of Things (IoT) can play an important role. Improvement in safety and quality of life can be achieved by connecting devices, vehicles and infrastructure all around in a city. Best technological solutions can be achieved in smart cities by making different stakehold-

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The main problem of the era is detecting, monitoring

ers to work together. System integrators, network operators and technology providers have a role to play in working with governments to enable smart solutions. Building such solutions is open, but standard based communications platform that can be continuously used is a challenge.

In paper [2] the authors have proposed that the collection of waste is currently a door to door collection system which is available. In this approach waste collector knocks on each door or rings doorbell and waits for waste to be brought out by resident. Disadvantage of this system is residents may not be available to hand the waste over. Not suitable for apartment buildings because of the amount of walking required.

In paper [8] the authors have presented a waste collection management solution based on providing intelligence to waste bins, using an IoT prototype with sensors. It can read, collect, and transmit huge volume of data over the Internet. Such data, when put into a spatial-temporal context and it processes an intelligent and optimized algorithm and can be used dynamically to manage waste collection mechanism. Simulations for several cases are carried out to investigate the benefits of such system over a traditional system.

In paper [9] the authors have tried to replicate the scenario using Open Data from the city of Pune, India stressing on the opportunities created by this type of initiatives for several parties to innovate and contribute to the development of Smart waste management solutions.

### 3 PROPOSED SYSTEM

One of the main concerns with our environment has been solid waste management which in addition to disturbing the balance of the environment also has adverse effects on the health of the society. The detection, monitoring and management of waste are one of the primary problems of the present era.

The overflowing garbage spreads unhygienic conditions along with dirty odor, deadly diseases, and a breeding ground for insects and flies which disturb the environmental conditions. To avoid all such situations, we are going to implement a project called IoT Based waste management using smart dustbin. Implementation is done with the help of IoT concept.

The system should collect the garbage and the bin should be emptied as per the defined schedule and networked path. The IOT Garbage Monitoring system is a very innovative system which will help to keep the cities clean. This system also monitors the garbage bins and provides notification about the level of garbage filled in these bins via a web page to the authorized user. This system uses ultrasonic sensors placed over the bins to detect the garbage level and compare it with

the garbage bins depth.

The smart dustbins that are being fixed by the sensors are placed at the different location. All of these are emptied by collectors, who will load the contents into a garbage truck and drive it to a landfill, incinerator or consuming crush facility to be disposed of.

The formal description and the representation of the managed system is organized in a way that supports reasoning about the structures and behaviors of the system.

An ultrasonic sensor (also known as a distance sensor) will be placed on the interior side of the lid, the one facing the solid waste. As the trash raises in the bin, the distance between the ultrasonic sensor and the trash will be reduced. This live data will be sent to our micro-controller. Our micro-controller then processes the data and through the help of Wi-Fi sends it to an app. The web page has a task of visually representing the amount of trash in the bin with a small animation to the authority. The information about the garbage level is stored into the database and then it can be accessed by the admin. The admin will then notify the garbage collector about the dustbin status. Once the garbage is emptied from the respective bin the garbage collector needs to send this data to the admin and this data is then updated into the database. The admin can access the data through web page as well as android application while the garbage collector will have an android interface. The real time status of how waste collection is being done could be monitored and followed up by the municipality authority with the aid of this system. In addition to this the necessary remedial / alternate measures could be adapted. An Android application is developed and linked to a web server to intimate the alerts from the microcontroller to the urban office and to perform the remote monitoring of the cleaning process, done by the workers, thereby reducing the manual process of monitoring and verification. The notifications are sent to the Android application using Wi-Fi module. The figure (Fig.1) shows the complete flow diagram of the system.

#### Ultrasonic sensor (HC-SR04):

A special sonic transducer is used for the ultrasonic proximity sensors, which allows for alternate transmission and reception of sound waves.

#### Arduino Board:

It consists of analog and digital used for input and output and microcontroller for building digital devices and IDE that helps in writing and uploading the computer code to the physical board.

#### Jump wires:

Jump wires (also called jumper wires) for solder less bread boarding can be obtained in ready-to-use jump wire sets or can be manually manufactured.

**Load sensor:**

It is used to calculate the weight of the total waste percentage in the bin and sends the information to the authorities. Utilizing load cells helps monitor the container’s capacity increase.

**Wi-Fi module:**

It stores data in the server using internet.

the different sensors managing the bin status.

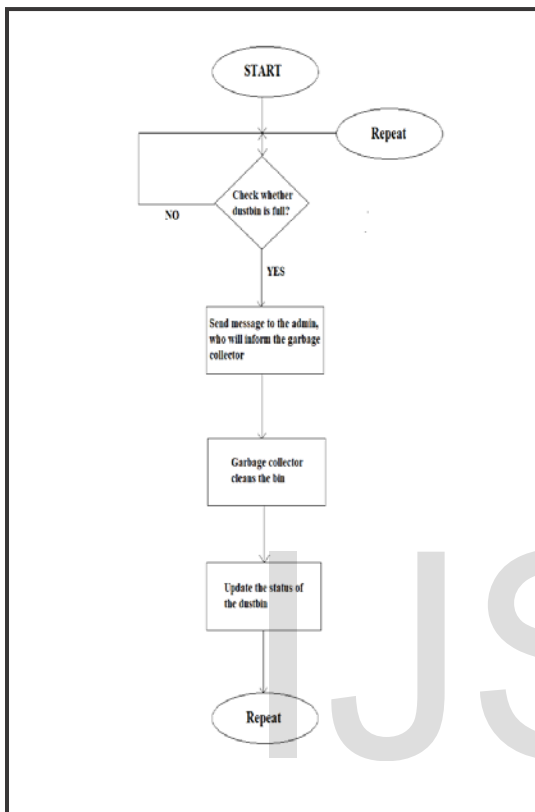


Fig. 1: Complete System Flow Diagram

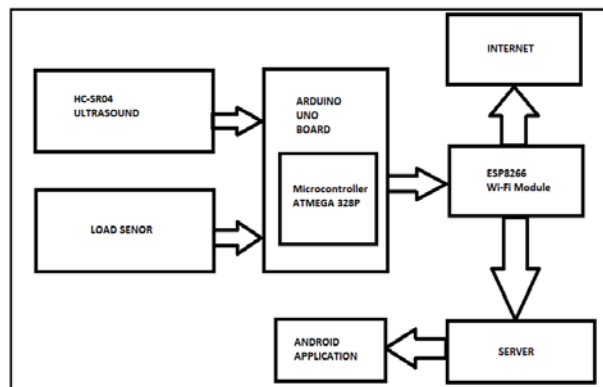


Fig. 2: Architectural Design

**4 IMPLEMENTATIONS**

The system makes use of Arduino family microcontroller (ATMEGA 328P) and a Wi-Fi modem for sending data. The system is powered by a 12V transformer. The ultrasound sensor (HC-SR04) sends the sound waves, which reflects to the sensor. It helps us to find the level of the garbage in the bin. The officer (administrator) checks the web page which gives a graphical view of the garbage bins and highlights the garbage collected, on the other hand the mobile app is built to show the status of the garbage bin and helps the garbage collector monitor it. The android app screen shows the status of the garbage level to the garbage collector. The system helps the officer to connect with the garbage collector and update the status of the bin once emptied. This system thus helps in saving time, by picking the waste up only when the bin is full. The figure (Fig.2) shows the architecture of the system with

**USER INTERFACES:**

**Arduino ide interface:**

The Arduino is programmed based on the 4 levels set in the dustbin:

1. Level 1 (>75 cm) - Garbage Full send alert
2. Level 2 (50 cm to 75 cm) -- 25% -50%
3. Level 3 (25 cm to 50 cm) --Above 50%
4. Level 4 (<25 cm) - Garbage Empty send alert

**Android app output:**

- It consists of an optimized user interface for the easier access.
- There are two buttons for the monitoring process.
- Each button has a specific operation.
- “Alerts” button is used to view the information of the alerts from the dustbin and the “Status”.

**SOFTWARE INTERFACES:**

**Android Application Interface:**

We use this to connect the server information to the app and the website. Java may be combined with C/C++, together with a choice of non-default runtimes that allow better C++ support. The Go programming language is also supported, although with a limited set of application programming interfaces (API).

In our project an android application displays the data, updates the data and helps in effective user interface. It shows the details about the dustbin to be cleared, by which garbage collector, the region etc.

### Microsoft Azure:

This system uses Microsoft azure a paid online server that contains the databases and helps us store information of the bin status and login details of the officer and the garbage collector.

### PhpMyAdmin:

The databases contain the information on bin-status, admin and garbage collector. All the values detected by the hardware systems are stored in the database. The admin cannot access the webpage unless registered or the admin's data is already saved in the database. The garbage collectors will be registered by the admin and will keep getting the notifications about the bin status in the different area.

### HARDWARE INTERFACES:

#### Wi-Fi module (ESP8266):

This is a Wi-Fi module which helps the project with **access to Wi-Fi or internet**. The data from the sensors is processed to the Arduino board and will be passed to the server via the Wi-Fi module. This Wi-Fi module can communicate with Arduino Uno microcontroller and makes wireless communication easier, cheaper and faster.

#### Arduino Uno:

It is a microcontroller board based on the ATmega328P (datasheet). This has 14 digital input/output pins of which 6 are analog inputs, 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 an AC-to-DC adapter or battery to get started.

### REQUIREMENTS:

#### Hardware Requirements:

- Arduino Uno
- Wi-Fi Module
- Load Sensor
- HC-SR04 Ultra Sound Sensor
- 12V Supply

#### Software Requirements:

- System: Android
- Languages Used: Java, HTML, CSS, Arduino C, PHP, Bootstrap
- IDE: Android Studio

## 5 RESULTS

The propagation at ultra sound sensor is carried out through the air at the velocity of sound. If they strike on object and it reflected as echo signal to the sensor. It then self-calculates the distance to the target based on time interval between the transmitting signal and receiving the echo. This ultra-sonic sensor will be placed on the interior side of the lid, the one facing the solid waste. As the amount of waste increases in the bin, the distance between the ultra-sonic and the waste decreases. This live data will be sent to our micro-controller.

The micro-controller, the Arduino Uno then processes the data and through the help of the Wi-Fi module sends it to an app. The officer manages the information and the details through the website. The screenshot of the dustbin status is inserted below.

## 6 CONCLUSIONS

The propagation at ultra sound sensor is carried out through the air at the velocity of sound. If they strike on object and it must reflect as echo signal to the sensor. It then self-calculates the distance to the target based on time interval between the transmitting signal and receiving the echo. This ultra-sonic sensor will be placed on the interior side of the lid, the one facing the solid waste. As the amount of waste increases in the bin, the distance between the ultra-sonic and the waste decreases. This live data will be sent to our micro-controller.

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Fig.3: Screenshot of Dustbin Status

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