# SMART GARBAGE MONITORING SYSTEM USING IOT

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**Abstract**

**In the recent years, there was a rapid growth in population which leads to more waste disposal. So, a proper waste management system is necessary to avoid spreading some deadly diseases. But due to lack of resources, ineffective groundwork, some waste is not collected which poses serious health hazard to the surrounding environment. The government of India announced smart cities and the key to smart cities is cleanliness. In support of clean city we design a dustbin which can interact with the cloud (free cloud for demonstration) and push its filling percent at regular intervals (say every 1 hour or its status set to full). If the status of the dustbin is filled, a message is pushed to the municipal person who is responsible to empty the bin. The filling percent monitored by weight sensor and ultrasonic sensor continuously. The status of the bin set to full when either the threshold weight reached (may be some space available in the bin) or it is filled up to a threshold level (may be the weight less than the threshold) and by using analysis of statistics to estimate area wise quantity of waste which in turn used to rank areas which helpful in cities clean.**

**INDEX TERMS**: **Internet of things (IOT)**

## I. INTRODUCTION

Owing to the characteristics and merits of IoT services, waste management has also become a significant issue in academia, industry, and government as major IoT application fields.

Our Aim towards the designed proposal are

- Dustbins can be emptied before they filled completely.
- Save the time and efforts to view overall the process.
- Helps in maintaining the surrounding of dustbins clean.
- The statistics can be used to estimate area wise quantity of waste which in turn used to rank areas.

In our system, the Smart dust bins are connected to the internet to get the real time information of the smart dustbins. These dustbins are interfaced with Arduino based system with ultrasonic sensors and weight sensors and Node MCU. Where the ultrasonic sensor detects the level of the dust in dustbin and sends the signals to Node MCU the same signal is encoded and send to the application and it is received. The data has been received, analyzed and processed in the database, which displays the status of the Garbage in the dustbin on the application of authorized person system through web application. The concerned authority get alert about dustbin is full and informs person whoever is responsible for collecting garbage from the particular areas. The garbage trucks collect the garbage from the completely full dustbin and dispose.

## II METHODOLOGY

The whole proposal contains the following modules

- Collecting data from sensors.
- Pushing the statistics onto cloud at specified intervals.
- Accessing statistical data using web/mobile application.

### 2.1 Collecting data from sensors:

Ultrasonic and weight Sensors to be placed on garbage bins. Data is collected from the ultrasonic sensor information and weight sensor information. The ultrasonic sensor sends triggering pulses on the garbage and according to it receives an echo signal to calculate level. The weight sensor converts the load into an electrical

signal which is given to A/D converter for the weight information

**2.2 Pushing the statistics onto cloud at specified intervals:**

The whole data is collected and is pushed into the IOT cloud platform and the statistics are observed. This data is given to the cloud database and it is given at specific intervals.

**2.3 Accessing statistical data using web/mobile application:**

Each bin is given a tag id and each id information is in the web application developed. In the web application the area cards are displayed where the status of each bins in that area is determined. From there it can be known the bin levels of different areas and if the bin is filled then an alert can be sent to the municipal driver.

## III.DETAILED DESIGN

The system is designed in such a way that it avoids the overflow of the dustbin and keeps the environment dust free and pollution free. Making the environment clean and tidy. By sending alerts to the municipal department with help of a microcontroller linked with a web server using IoT.

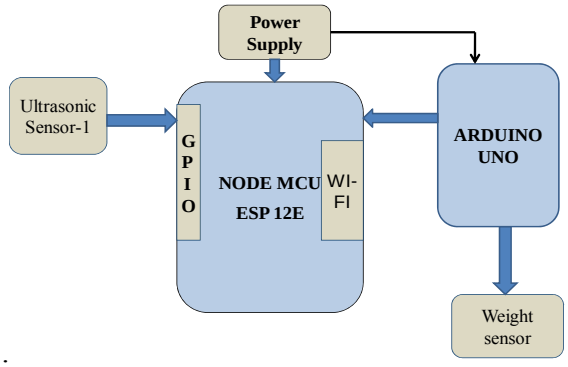


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Fig 3.1: proposed block diagram

It also provides the verification process after cleaning the dustbin. The level of the dustbin is calculated by measuring the distance of the nearest obstacle using an ultrasonic sensor. Here not only the level by the weight also we can determine the filling of the bin as in bulk it cannot be emptied. NodeMCU is used as the Wi-Fi module to read the data from the ultrasonic sensor and the Arduino is interfaced with weight sensor and through serial transmission the data is sent to the NodeMCU. It is programmed to send an alert to the Thing Speak web server once the garbage reaches a certain distance and weight

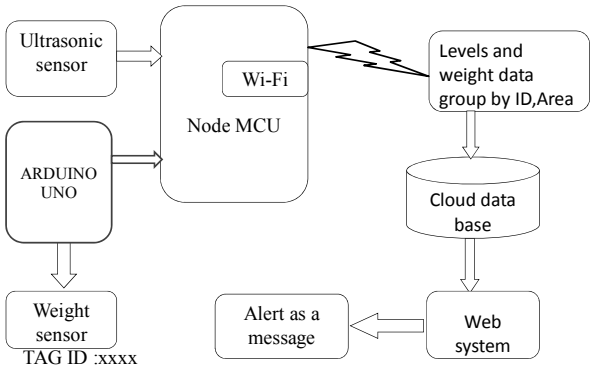



Fig 3.2: Detailed Design

## IV SENSORS

**Ultrasonic sensor**:

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. It is important to understand that some objects might not be detected by a ultrasonic sensor.

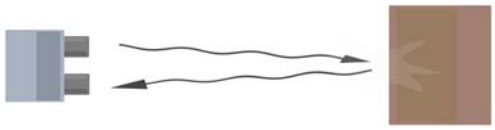


Fig 4.1Diagram of basic ultra sonic sensor

$$\boldsymbol{distance} = \frac{\boldsymbol{speed\ of\ sound \times time\ taken}}{\boldsymbol{2}}$$

**Weight sensor:**

Weight Sensor Module is based on HX711, which is a precision 24-bit analog-to-digital convertor designed for weigh scale and industrial control applications to interface directly with a bridge sensor.

Load cell is transducer which transforms force or pressure into electrical output. Magnitude of this electrical output is directly proportion to the force being applied. Load cells have strain gauge, which deforms when pressure is applied on it. Now the electrical signals generated by Load cell is in few millivolts, so they need to be further amplify by some amplifier and hence HX711 Weighing Sensor comes into picture. HX711Weighing Sensor Module has HX711 chip, which is a 24 high precision A/D converter (Analog to digital converter). so HX711 module amplifies the low electric output of Load cells and then this amplified &

digitally converted signal is fed into the Arduino to derive the weight.

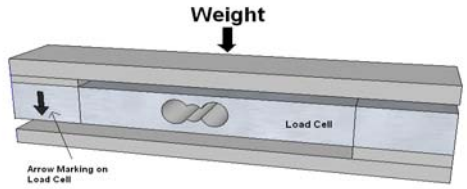



Fig 4.2 Load Cell

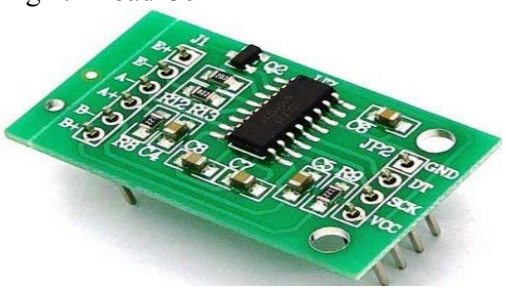


Fig 4.3 HX711 balance module

## V FLOWCHART

Detailed Flowchart listed in figure 4.4

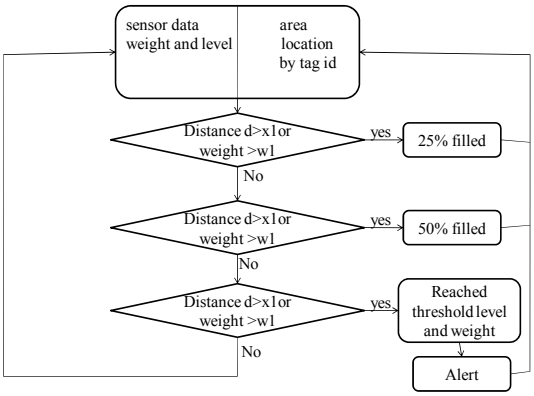



Fig 4.4 Flowchart

## VI . RESULTS

For developing the web application we just need the data from the thingspeak API feed which is used for the development of web application and WIN Forms ,C#.Net, Cloud, Thingspeak, Gateways are the important modules in the development of web application.

ThingSpeak is an Internet of Things (IoT) platform that lets you collect and store sensor data in the cloud and develop IoT applications. The ThingSpeak IoT platform provides apps that let us to analyze and visualize your data and then act on the data. Sensor data can be sent to ThingSpeak from the NodeMCU. Here an account to be created and it gives us a channel feed in which the data can be extracted and the data used in the web application for analyzing and act according to it that is we sending the message.

The gateway is used to send the message to the particular driver in those locations that are present in order to collect the garbagebins.SMS Messaging Server is an SMS messaging framework to send, receive and automate SMS mobile messages, low and high volume. Support for GSM/GPRS modems, SMPP and HTTP service providers and e-mail.

The overview of the entire proposed one having all the different modules connected together is shown in fig.5.1.

Fig 6.1 Modules connected to Dustbin

The proposed one contains the following components connected to the dustbin.It mainly consisting of two boards Arduino and NodeMCU which is used as a serial data transfer to the NodeMCU by the Arduino while the NodeMCU acts as wifi module and the data is pushed to thingspeak. The sensors are weight sensor and the ultrasonic sensors and the weight sensor must be connected to the HX-711 which is a analog to digital converter . load cell which is a metallic bar in which a one side pressure is applied to get the results. ultrasonic sensor which is connected to the NodeMCU and it is placed in such a height so that based on different heights it transmits and receives the signal and determines the results.

The data that came from the weight sensor and ultrasonic sensor is pushed into thingspeak IoT platform and data is displayed at regular intervals and is visualized in the form of graph and from here the data is taken and uploaded into the web application that we developed.

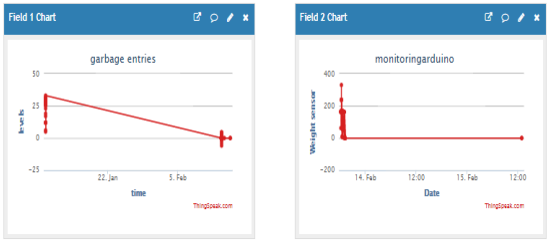



Fig 6.2: Plotted Graph for Garbage Entries.

The final results can be taken from the channel feed that are available in the thingspeak platform in which it contains the processed data which are used to plot the graph.

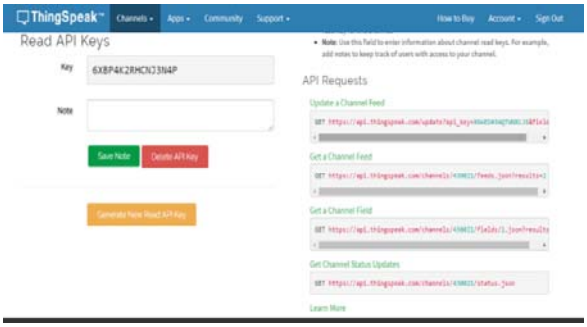



Fig 6.3: Thingspeak API Key

channel feed url is taken and is placed in the web application program and the results are stored and plotted in the form of graph and are used to analyze the whole data and we can see the graph data with maximum percentage and minimum percentage of the sensor data information which is shown below.

| | created_at | entry_id | field1 | field2 |
|---|---|---|---|---|
| | 02-Mar-18 3:44 PM | 105 | 8 | 2.80 |
| | 02-Mar-18 3:44 PM | 106 | 8 | 3.66 |
| | 02-Mar-18 3:45 PM | 107 | 8 | 3.96 |
| | 02-Mar-18 3:45 PM | 108 | 8 | 3.92 |
| | 02-Mar-18 3:46 PM | 109 | 8 | 4.42 |
| | 02-Mar-18 3:46 PM | 110 | 8 | 4.39 |
| | 02-Mar-18 3:46 PM | 111 | 8 | 4.44 |
| | 02-Mar-18 3:47 PM | 112 | 8 | 3.63 |
| | 02-Mar-18 3:47 PM | 113 | 8 | 3.31 |
| | 02-Mar-18 3:48 PM | 114 | 8 | 4.01 |
| | 02-Mar-18 3:48 PM | 115 | 8 | 4.07 |
| | 03-Mar-18 9:29 AM | 116 | 0 | 0.37 |

Table 6.1: filed entries table

Everyday data at regular intervals collected and data can be viewed as fields are displayed in the table 6.1. The individual graphs of field 1 and field 2 are displayed in below figures.

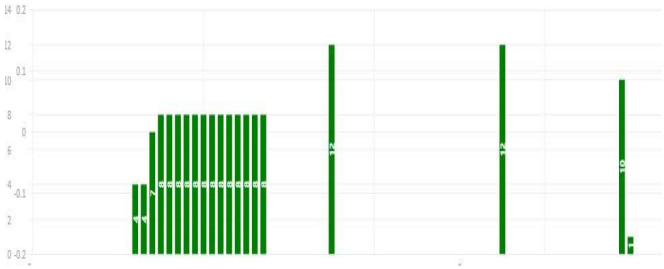


Fig 6.4: Field 1 ultrasonic Data i.e Garbage entries

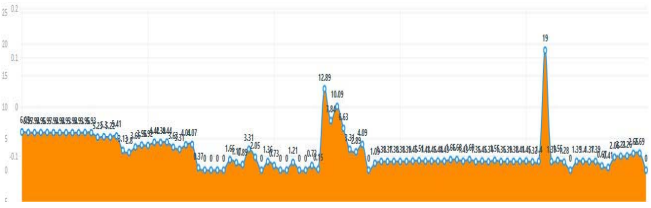


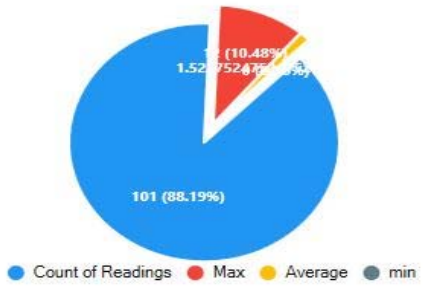
Fig 6.5 Field 2 weight sensor data

These are the data from the location of particular area and the area can be displayed in the map where the garbage bin is located.The user can view the location of the bin located where it is pinpointed so that its maximum and minimum values can be displayed.


Fig 6.6: Bin location

And the overall pie graph showing the percentage of levels of the fields that we are specified here.

6.7: Max and Min levels




When the bin reaches the threshold level it sends a message specifying that the garbage is filled in that particular location where it to be emptied. This is the message they will receive so that they can know the exact location of the bin.

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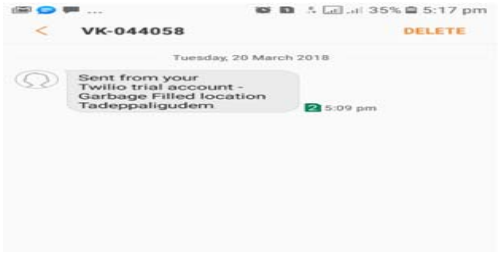


Fig 6.8: SMS send to Municipal Authorities

## CONCLUSION:

An integrated system of Wi-Fi modem, IoT, GSM, Ultrasonic Sensor and weight sensor is introduced for efficient and economic garbage collection. The developed system provides improved database for garbage collection time and waste amount at each location. We analysed the solutions currently available for the implementation of IoT. By implementing this project we will avoid over flowing of garbage from the container in residential area which is previously either loaded manually or with the help of loaders in traditional trucks. It can automatically monitor the garbage level & send the information to collection truck. The technologies which are used in the proposed system are good enough to ensure the practical and perfect for solid garbage collection process monitoring and management for green environment.

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