

# Waste Monitoring System using Internet of Things

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**Abstract** - In today's era, IoT (Internet of things) is considered as one of the trending topics across the globe. Still IOT is yet to be more exploited; it has already been manifested in almost every phase of life.

The proposed system explains garbage monitoring system using IoT. This system consists of microcontroller (brain of the system), Wi-Fi module, GSM, DC motor, ultrasonic sensors, and Telnet protocol used on the internet or local area network to provide bidirectional communication for storing as well as retrieving data over the internet. It explains how you can collect, store, analyze, visualize as well as finally retrieve data over the internet.

This project plays a vital role in designing a system which helps to promote waste management. Garbage Monitoring is one of the examples of this system but you can also modify the system as per individual need or requirements.

## 1. INTRODUCTION

Due to rapid population growth and lack of public awareness, garbage management has become an issue of National Concern. The Government of India has taken some commendable steps recently to combat the problem of waste management. Many initiatives like Swachh Bharat Abhiyan, The Odd Even Rule, and Clean Ganga Project have been carried out in order to keep the environment clean. But still one of the common issues in the over populated and residential urban areas are the overflowing garbage bins which cause environmental pollution and unhygienic living conditions in the surrounding. Regular monitoring of garbage bins is necessary, but the traditional system of manual checks of garbage bins is less effective and time consuming.

The IOT based garbage monitoring system is an innovative system which helps to keep the environment clean. Ultrasonic sensors placed over the garbage bins detect the garbage level and informs the microcontroller about the status of the bins. Thus, an efficient system has been designed which informs about the garbage level with the help of a message notification system and the level of bins can be remotely monitored via Telnet Protocol.

## 1.1 Objective

- The main objective of our project is to monitor the garbage level in dustbins.
- This system monitors the garbage bins to detect the garbage level and compare it with the garbage bins depth and informs the level of total garbage collected in the garbage bins to the monitoring person at the different place.
- It also prevents overflowing of garbage in dustbins as the dustbin lid automatically shuts down upon reaching a certain threshold level.

## 1.2 Overview of IOT

The Internet of things (IoT) is the internetworking of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure with minimum human intervention. IoT is a real time technology. In this project we are using IoT to monitor the output of the project on the screen of computers not only in the city where the dustbin is placed but also it can be monitored from anywhere. We have also developed a special provision for SMS notification system, which ensures bidirectional communication.

## 2. COMPONENTS

There are basically four components which are used for the designing of our garbage monitoring system, and they are:

1. ATmega16 Microcontroller
2. Wi-Fi Module – ESP8266
3. GSM Module
4. Ultrasonic Sensors

### 1) ATmega16 Microcontroller

ATmega16 is an 8-bit high performance 40 pin microcontroller. It is a member of Atmel's Mega AVR

family with low power consumption and is based on enhanced RISC architecture. Atmega16 operates on a maximum frequency of 16MHz. It has 16 KB programmable flash memory, static RAM of 1 KB and EPROM of 512 Bytes.

Atmega16 Microcontroller IC has been used in our garbage monitoring system. It gets information from the sensors and processes it accordingly to get the required output.



Fig - 1: ATmega16 Microcontroller

### 2) Wi-Fi Module – ESP8266

A complete inbuilt Wi-Fi networking solution is provided by ESP8266, which allows it to either host the application or to drop all Wi-Fi networking functions from another controller. This module offers good storage capability and powerful onboard processing allowing it to interface with the sensors.

The ESP8266 is a microcontroller, known as a Wi-Fi Module, has the ability to perform Wi-Fi related activities like Internet of things applications and home automation. ESP8266 Wi-Fi module is used for connecting the Microcontroller to the webserver. Here we have used Local web server to demonstrate the working of this Garbage Monitoring System.



Fig - 2: Wi-Fi Module – ESP8266

### 3) GSM Module

A Quad-band GSM/GPRS solution is provided by SIM800, with a SMT type customer application embedded system.

Quad-band 850/900/1800/1900MHz are supported by SIM800. Transmission of voice, SMS and data information is done with low power consumption using the GSM Module. The module size is 24\*24\*3 mm, featuring Bluetooth and embedded AT.



Fig - 3: GSM Module

### 4) Ultrasonic sensors

The identification whether the dustbin is filled with garbage or not is done with the use of ultrasonic sensors. It uses IO trigger for at least 10usec high level signal. The eight 40 kHz signals are sent by the module automatically and it detects whether there is a pulse signal back. A 10usec pulse is needed for triggering the input to start the ranging, and now the module sends out an 8-cycle burst of ultrasound at 40 kHz and echo pin is raised high. The range can be calculated through the time interval between sending and receiving echo signal as shown:

$$\text{Range} = \frac{\text{High level time} * \text{Velocity} (340\text{m/s})}{2}$$

$$\text{uS} / 58 = \text{centimeters or uS} / 148 = \text{inch}$$



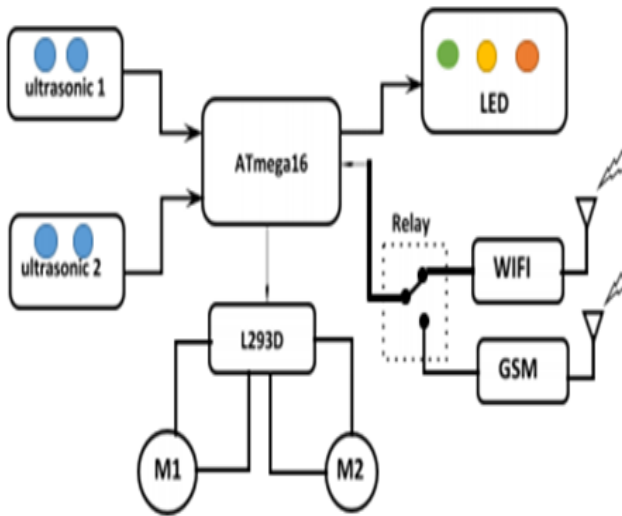
Fig - 4: Ultrasonic sensors

## 3. WORKING

### 3.1 Overview of Project

In this project, we are trying to make a smart system which continuously monitors different levels of garbage in dustbins and sends the real time data using ESP8266 Wi-Fi module. User can see the real time data either at smart phone or PC using Telnet. Telnet is a protocol used on the internet or local area network to provide bidirectional communication for storing as well as retrieving data over the internet. Once the garbage reaches the threshold, Microcontroller triggers the DC motor for automatically shutting down of lid to prevent overflowing of garbage. Further, Ultrasonic sensor sends the real time data to GSM modem through microcontroller which alerts the required authority with the help of a message notification system. The complete circuit is

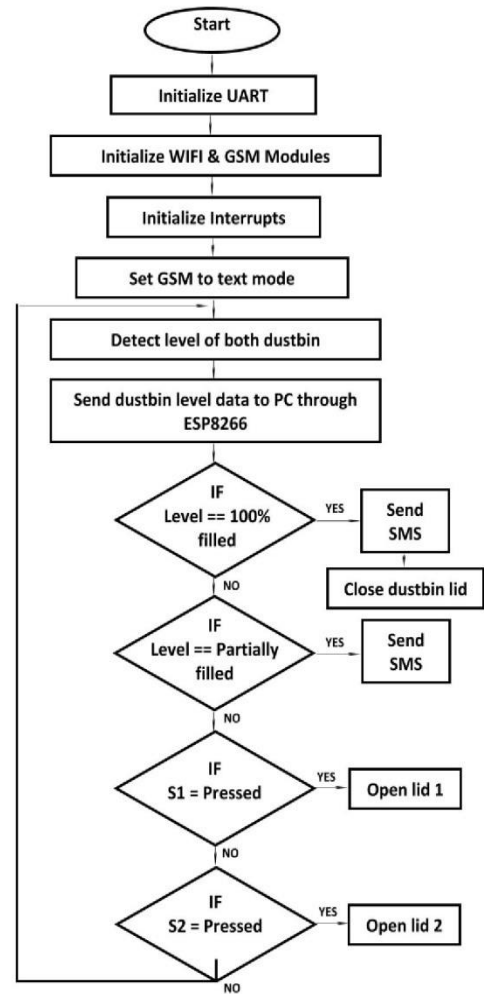
designed around the microcontroller which is the heart of the whole system.



### 3.2 ARCHITECTURE DESCRIPTION

The system acquires real time data from ultrasonic sensor. This real time data can be sent easily using Wi-Fi module named as ESP8266 which is a low cost Wi-Fi module. In addition to this, user can see the status of the dustbins either at PC or smart phone using Telnet. The proposed method is further divided into following 5 sub-parts:

1. Capturing live data from the sensor.
2. Processing the real time data from step 1 using microcontroller.
3. Send all live data using ESP8266 Wi-Fi module.
4. Automatically Shutting down of dustbin lid when garbage reaches the threshold level
5. GSM module alert the required authority until the garbage is squashed.



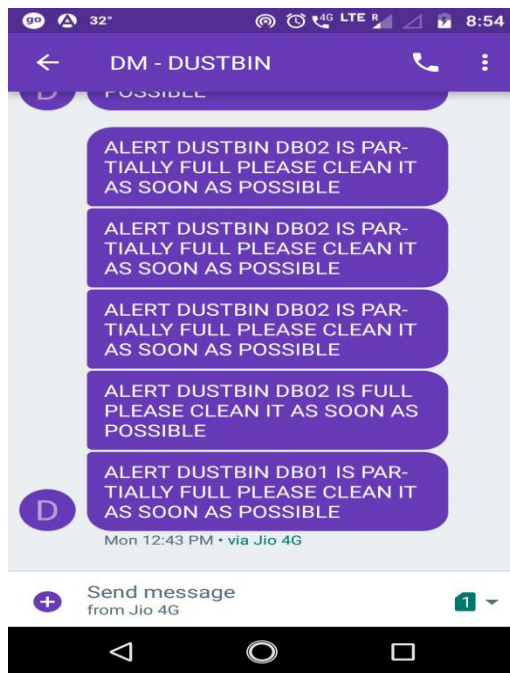
### 4. ADVANTAGES

The monitoring of garbage bins is done by the system to detect the garbage level and compare it with the garbage bins depth. The system notifies about the level of garbage collected in the garbage bins and the level of various dustbins can be monitored remotely. If the level of garbage in the bins exceeds the threshold level, the dustbin lid automatically shuts down with the use of DC motors, which prevents overflow of garbage. The feature of SMS notification for partially full and completely full garbage level is present, which continuously alerts the concerned authorities. Making of Smart Cities and real time based cleaning of cities can be attained by this system.

### 5. APPLICATIONS

- This project supports the campaign Swachh Bharat Abhiyan started by our Prime Minister Shri Narendra Modi.
- This project helps to reduce environmental pollution and keeps the cities clean.

## 6. RESULT



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## 7. CONCLUSION

The IOT based Garbage monitoring system pays a lot towards clean and pollution less environment in building a smart city. In this system the statistics of all dustbins can be acquired from anywhere and anytime by the authenticated person and hence the authorities can take a decision accordingly. By implementing this system, cost Reduction, resource optimization and effective usage of dustbins can be done. The system will inform the status of each dustbin in real time located throughout the city, so that the garbage collection vehicle can be dispatched only when the dustbin is completely full or is about to be full. The traditional garbage collection system is changed into a smart and intelligent system. The integrated IOT system is very useful to remotely monitor the garbage levels of the dustbins in the cities. This system reduces cost and human efforts, saves time and proves to be a user-friendly system. Thus, garbage collection is made more efficient, effective and operative.

## FUTURE SCOPE

Research can be done further to segregate solid and wet waste. It can further be expanded to maintain the monthly database with the location of each dustbin which will be useful for us to keep the city clean.

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