# IoT Based Waste Management System for Smart Cities

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*Abstract*- In present day scenario, many times we see that the garbage bins placed at various public places in cities are over flowing due to increase in the waste every day. It creates unhygienic condition for the people and creates bad odour around the surroundings thus leads  in spreading some deadly diseases and human illness. To avoid such situation, we are planning to design "IoT based Waste Management System for Smart Cities". In this proposed system, there will be multiple  garbage bins located throughout the city or campus, these garbage bins will be equipped with low cost embedded device which will helps in tracking the level of garbage in particular bin along with location tracking module to get real time location of bin. All the real time information including garbage level as well as location of that bin will be send frequently to concern authority and garbage collector truck driver as well. The truck driver will have android application which will  show real time information about all bins to driver that which bin is how much full and which location in graphical form. So he can go directly to place where actually need to empty the garbage bin to achieve Resource optimization, cost reduction, time management and active participation of truck driver.

**Keywords-** IOT, Smart Cities, IoT-GSI,  RFID

## I.  INTRODUCTION

The Internet of things (stylised Internet of Things or IoT) is the internetworking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings and other items embedded with electronics

**Disadvantages of current Waste Management system**
- Time  consuming and less  effective:Trucks go and empty containers whether they are full or not.
- High cost.
- Unhygienic Environment and look of the city.
- Bad  smell  spreads  and   may cause illness to human beings.
- More traffic and Noise.

**Disadvantages of existing system**
- Deployment  point  of  view,  this  system  is  not feasible.
- Infrared  sensor  is  used  to  check  the  level  of garbage which is not that much powerful.
- Intel  Galileo  Gen2  Motherboard  increase  the development cost of project.
- RFID  technology  is  not  capable  for sending data over a long distance.
- Garbage collector truck is no participated actively.

**Possible advantages of proposed system**

- Real time information on the fill level of the dustbin.
- Deployment of dustbin based  on the actual needs.
- Cost Reduction and resource optimization.

Software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data.[1] In 2013 the Global Standards Initiative on Internet of Things(IoT-GSI) defined the IoT as "the infrastructure of the information society."The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit [2].

Waste management is all the activities and actions required to manage waste from its inception to its final disposal. This includes amongst other things, collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling etc. The term normally relates to all kinds of waste, whether generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, or other human activities, including municipal (residential, institutional, commercial), agricultural, and social (health care, household hazardous wastes, sewage sludge). Waste management is intended to reduce adverse

effects of waste on health, the environment or aesthetics. 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. An indiscriminate and illegal discharge of waste, an absence of waste disposal and management systems, and inefficient waste management policies have caused serious environmental problems and have incurred considerable cost of waste disposal. To handle these problems, Internet of Things can be best solution which will enables you to gather real time information about level of garbage bins filled at which location throughout the city or public places.

## II. RELATED WORK

Plethora of work has been done regarding "IoT Based Waste Management System". Many authors proposed their system. But some systems are not feasible with respect to efficiency that should achieve by system and are not cost effective. Authors in [3] developed a system, in that, they used IR Sensor, 8051 microcontroller, Power Supply, RF Transmitter, RF Receiver, Intel Galileo microcontroller and the web browser. The project module is divided into two parts, Transmitter section and here in the transmitter section we are using 8051 microcontroller, RF Transmitter and sensors these are attached to the dustbin. Where sensor are used to detect the level in the dustbin whether the dustbin is full or empty. The sensor senses the content of the dustbin and sends the signals or the data to the 8051

## IV. PROPOSED SYSTEM

Considering all the drawbacks of existing system, proposed system will be more efficient by replacing existing system components which are not feasible. We would like to develop an mobile application for garbage collector truck driver on which he will get real time information about which bin is full at which location. Garbage bin will be equipped with low cost Arduino Uno Board which will consist of Ultrasonic sensor and GPS module as well as Wifi Module with Battery power supply. Ultrasonic sensor will sense the depth of bin in terms of garbage level

That sensed information along with figures of longitude and altitude given by GPS module will be collected by Arduino uno board. That controller will send that real time in formation by WiFi Module through Internet over a long distance at cloud storage. At cloud, collected data will be analyzed and it will help to carry out task. Truck driver will have one Map-based android application, in that he will be shown real time information of bins garbage level along with location. Application will have consisted of shortest path routing algorithm which will

help truck driver to find shortest path to the destination.

## V. METHODOLOGY

*Garbage Bin and Sensor Position Setup*
Garbage bin will be equipped with low cost embedded system which will consist of depth sensor such as ultrasonic sensor which will sense the depth of bin in terms of garbage level. sensor will be fix at center of garbage bins tin so it can cover maximum distance in straight top-bottom vertical direction.



Figure 1.Architecture of proposed system

*Sensing the data*
Ultrasonic sensor will be connected with Arduino Uno board. Arduino Open source software is going to use for coding. Basically C-programming approach will be use to write code. Along with Ultrasonic sensor, WiFi Module and GPS module is connected with arduino board. GPS module will collect location of bin in terms of longitude and altitude and WiFi module ESP8266 will be use to connect with internet.

*Transmission of data and collection at cloud*
Microcontroller, Power Supply +9V Battery power supply is given to the 8051 microcontroller to drive the system and the 8051 microcontroller reads the data from the sensor and process the data received from sensor, and the same data wirelessly transmitted to the Central system (Intel Galileo microcontroller) using RF Transmitted. RF Transmitter is to transmit the signal form 8051 microcontroller to the Intel Galileo microcontroller. The other section is receiver section in which RF Receiver, Intel Galileo, and Web Browser is used. Here RF Receiver is used to receive the data sent by RF transmitter to the Intel Galileo microcontroller. The Intel Galileo Gen2 Microcontroller is used to receive the data sent by the multiple transmitters and process the data and the same data transmitted to the Client i.e., Web Browser.

Authors in [4] Developed System using RFID, GIS and GPRS interfaced with low cost camera for solution of existing problems and streamline solid waste monitoring and management efficiencies as shown in Figure In this system,

there is a great deal of process intelligence to ensure the system capability and also justify its validity. This is not only in time-related factors such as time spent to, from and at locations, but more importantly, the accurate tracking of a solid waste bins serial number and location. The main goal involved in improving the overall efficiency is to estimate the waste content from bin. RFID tag is attached to each bin in order to monitor and track the bin during the collection process. Low cost camera attached to the truck in order to get images. Once the truck enters within the bin area, the camera takes images before and after the bin collection, to estimate the waste of the bin and its surrounding area. The system is developed to be as compact, robust, energetically efficient and reliable as possible. Data from the truck network are recorded and forwarded to a control server through GPS GPRS system. The control server monitors the information and optimizes truck routes and bins location according to the waste estimation.

### III. PROBLEM DEFINITION

As we have seen number of times the dustbins are getting over flown and concern person don't get the information within a time and due to which unsanitary condition formed in the surroundings, at the same time bad smell spread out due to waste, bad look of the city which paves the way for air pollution and to some harmful diseases around the locality which is easily spreadable. The sensed data along with location information will be sent over the internet through Wi-Fi Module ESP8266. Transmitted data will be collected at cloud so we will able to access data from anywhere using internet.

**a.** *Development of utility based software* Truck driver will have Map-based android application that will give real time information about all garbage bins located in particular region in graphical form.



Figure 2.

We are planning to give color signs for status of bins. Green color for that bin which is almost empty all slightly filled. Yellow color for bin which halfly filled and Red color for bin which is almost full. truck driver will able to track the bins which are need to empty fastly.
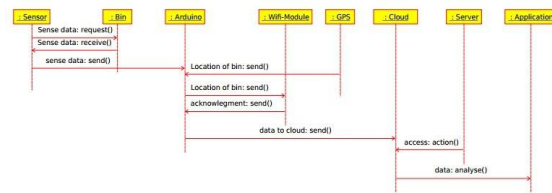


Figure 3.Sequence Diagram

### VI. SUMMARY AND FURTHER WORK

Waste collection in past years was treated in a rather static way. The proliferation of sensors and actuators enable dynamic models as well. In this paper, we have proposed more efficient waste management system based on Internet of Things concept, that will have intelligent management of all garbage bins located throughout city with proposed features like resource optimization, cost reduction and as well time management. The project is under development stage. As project is consist of hardware and software part, development team has developed the hardware part and simultaneously working on development of utility based android application which is important feature of entire project.

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