

IOT based Garbage Monitoring And Waste Management system for Smart Cities

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ABSTRACT

Waste is an important issue, which needs to be tackled smartly. The main purpose of this paper is to develop the system which uses the information collected from sensors to manage the waste collection. In proposed system, Smart waste bins are located in several areas of city are connected to Internet wirelessly, they equipped with sensors which collects the data about level of collected waste in waste bin. Then Smart waste bin sends this information to central web portal using WIFI module. If the waste bin is filled up to its threshold value then the message is displayed on web portal and the responsible authority take proper action and it will shows the all information on to the Smart waste bin Application on the users mobile phone.

Keywords

IOT, Ultrasonic sensors, Arduino, Android application, GUI.

1. INTRODUCTION

Today waste is a problem on which huge sums of money is spent each year for its collection and segregation process. India particularly generates approximately 133 760 tons of MSW per day, of which approximately 91 152 tones is collected, and a huge sum of money is spent on collection. World waste production is expected to be approximately 27 billion tons per year by 2050, one-third of which will come from Asia, with major contributions from China and India. Waste generation in urban areas of India will be 0.7 kg per person per day in 2025, approximately four to six times higher than in 1999. Mostly Environmental pollution may be owing to the Municipal Solid Leftovers (MSL). A Proper maintenance becomes mandatory for an efficient and effective removal of the generated Municipal Solid Leftover. 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 process. In present scenario of digitalizing world everything in our surroundings have been equipped with modern technology and internet to ease our work and gain more efficiency. But the systems existing today for waste management are the same as they were before in most of the countries. Currently, for collection of waste in some countries, we have door to door collection systems that require a lot of efforts and money. A waste collector has to visit everybodys place, knocking the doors, and has to wait till each resident brings the waste to them [1]. Moreover, residents have to be available in order to get their waste collected at that particular time which brings in a major disadvantage of this system. Also in some countries, systems do exist in which waste is collected from the trash bins of each colony, but this system also brings a disadvantage that many a times dustbins are overfilled and waste isn't collected from it. This also makes dustbins, a place facilitating bacterial growth, feeding animals and a breeding place for insects. Also at times it happens that dustbin collection is done in prior resulting in waste of fuel and increasing costs of waste collection. So, at each step a lot of fuel and money is invested unnecessary for the process.

2.PROBLEM DEFINITION

Waste management is one of the major environmental problems of Indian cities. The problem is over flowing of wastages on the roads. Several efforts have been invested in tackling

3. GOALS & OBJECTIVES

- Sensor based smart waste bin will judge the level of waste in it and send the message directly to the municipal corporation.

- It can sense all the type of waste material either it is in the form of solid or liquid.
- According to the filled level of the smart waste bin, the vehicles from the municipal corporation will choose the shortest path with the help of the “Transportation Software”, which will save their time.
- It emphasizes on “Digital India”.
- The system is simple. If there is any problem with any equipment in the future, that part is easily replaceable with new one without any difficulty and delay.

4. LITERATURE SURVEY

- [1] Ashiya Malak, Pallavi Bhojar, “Garbage Collection System Using IOT- A Review”, 2017. In the present day scenario, many times we see that the garbage bins or Dust bin are placed at public places in the cities are overflowing due to increase in the waste every day. It creates unhygienic condition for the people and creates bad smell around the surroundings this leads in spreading some deadly diseases & human illness; to avoid such a situation we are planning to design “IOT Based Waste Management for Smart Cities”. In this proposed System there are multiple dustbins located throughout the city or the Campus, these dustbins are provided with low cost embedded device which helps in tracking the level of the garbage bins and an unique ID will be provided for every dust bin in the city so that it is easy to identify which garbage bin is full. When the level reaches the threshold limit, the device will transmit the level along with the unique ID provided. These details can be accessed by the concern authorities from their place with the help of Internet and an immediate action can be made to clean the dustbins.
- [2] Prof. Indu Anoop, Ayush Jain, “IOT based Smart Waste Management”, 2017. Many times, in our city we see that the garbage bins or dustbins placed at public places are overloaded. It creates unhygienic conditions for people as well as ugliness to that place leaving bad smell. To avoid such situations the proposed project will be implemented for efficient waste management using IOT. These dustbins are interfaced with Arduino based system having ultrasonic wireless systems along with central system showing current status of garbage, on mobile web application with Android app by Wi-Fi. Hence the status will be updated on to the App. Major part of the proposed project depends upon the working of the Wi-Fi module; essential for its implementation. The main aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision.
- [3] . Raffaele Carli, Mariagrazia Dotoli “Measuring and Managing the Smartness of Cities: a Framework for Classifying Performance Indicators”, 2013. Due to the continuous increase of the world population living in cities, it is crucial to identify strategic plans and perform associated actions to make cities smarter, i.e., more operationally efficient, socially friendly, and environmentally sustainable, in a cost effective manner. To achieve these goals, emerging

smart cities need to be optimally and intelligently measured, monitored, and managed. In this context the paper proposes the development of a framework for classifying performance indicators of a smart city. It is based on two dimensions: the degree of objectivity of observed variables and the level of technological advancement for data collection. The paper shows an application of the presented framework to the case of the Bari municipality (Italy).

- [4] M. Fazio, M. Paone “Heterogeneous Sensors Become Homogeneous Things in Smart Cities”. Smart Cities offer a new approach for optimizing services, reducing costs, simplifying the management of Future Cities, enabling new services for citizens. In the Future Internet initiatives, Sensors Networks assume even more a crucial role, especially for making smarter cities. Sensors, becoming smart, will represent the peripheral elements of a complex future ICT world. However, due to the specific application field, smart sensors are very heterogeneous in terms of communication technologies, sensing features and elaboration capabilities. To overcome issues due to the high heterogeneity in this paper we present a new architecture able to make a dual abstraction of complex sensing infrastructures along with data they collect. An important key of this work is to provide a service at worldwide level that is scalable and flexible. The architecture implementation is based on Sensor Web Enablement standard specifications and makes use of the Contiki Operating System for accomplishing the Internet of Things.
- [5] Samir Atkar, Abhishek Aryan, “Garbage Collection System Using IOT”, 2017. The method of connecting the objects or things through wireless connectivity, Internet called Internet of Things. Nowadays a variety of tasks are based on IOT. Cities in the world are becoming smarter by implementing the things around using IOT. This is a new trend in technology. One of the objectives of smart cities is keeping the environment clean and neat. This aim is not fulfilled without the garbage bin management system. Hence the paper “IOT Based Intelligent Bin for Smart Cities” has been developed. Bin management is one of the major applications of IOT. Here sensors are connected to the all the bins at different areas. It senses the level of garbage in bin. When it reaches threshold a message is sent via GSM to the concerned person to clean it as soon as possible.
- [6] . Chitra Balakrishna, “Enabling Technologies for Smart City Services and Applications”, 2012. Smart mobile devices are fast becoming the epicenter of people’s lives. Most smart phones are currently embedded with powerful and programmable sensors such as GPS, gyroscope, microphone, camera, accelerometer etc. These sensor-enabled smart-phones would form an important element of the future networked-infrastructure. A new wave of services is bound to erupt from such connected infrastructure and smart devices that will influence all aspects of our social ecosystem. In the context of Smart Cities, this position paper and the associated invited talk presents the Mobile Technology perspective of the Smart-city architecture by presenting a conceptualized framework and highlights the open and emerging research challenges in this landscape.
- [7] Theodoros Anagnostopoulos, “Assessing Dynamic Models for High Priority Waste Collection in Smart Cities”, 2015.

Based on research pertaining test beds and smart cities, it is possible to notice that there is a great demand for testing smart city solutions, and that most of the existing testing strategies are based on the use of sensors and IOTs.

- [8] Danilo Silva, Felipe Ferraz, “Smart City Applications TestBed”, 2015. Cities are facing a new challenge related to their population; it is the first time in history that most part of human population is now living in metropolis. Within this scenario, a city needs to deploy new solutions, presenting systems that answers to demands related to Security, Health, Resources, Government, Education and other urban daily systems to its citizens. In order to keep the creation of such solutions, it is vital to present developers with means to validate their projects. Focusing on this situation, this paper proposes the creation of a configurable test bed, where web services represent different systems of a smart city that could be consumed by applications in order to validate its implementation and features.
- [9] Akshay Bandal, Pranay Nate, Rohan Manakar, Rahul Powar “Smart WiFi Dustbin System,” 2016. We realize that Garbage causes damage to local ecosystems, and it is a threat to plant and human life. To avoid all such situations we are going to implement a project called IOT Based Smart Garbage.”When somebody dumps trash into a dustbin the bin ashes a unique code, which can be used to gain access to free Wi-Fi”. Sensor check garbage fills in dustbin or not and Router provides Wi-Fi to user. Major part of our project depends upon the working of the Wi-Fi module; essential for its implementation. The main aim of this project is to enhancement of a smart city vision.
- [10] Fachmin Foliato, “Smart-Bin: Smart Waste Management System”, 2015. In this paper, we present the Smart bin system that identifies fullness of litter bin. The system is designed to collect data and to deliver the data through wireless mesh network. The system also employs duty cycle technique to reduce power consumption and to maximize operational time. The Smart bin system was tested in an outdoor environment. Through the test bed, we collected data and applied sense-making methods to obtain litter bin utilization and litter bin daily seasonality information. With such information, litter bin providers and cleaning contractors are able to make better decision to increase productivity.

5. MOTIVATION

IOT Based Garbage Monitoring And Waste Management System For Smart Cities bringing all the data on the internet so that systems operate more efficiently. We have a decision taking system that will decide whether to include the dustbin in the list of collection and mark it on the map of the municipal application. This will in fact save a lot of efforts and fuel wasted in collection process as real-time monitoring of bins is done. As well as the parameters of the dustbin is used to notify the user about the status of the dustbin so that user can dump their waste accordingly. The motivation to Empowered swachh bharat mission and E-governance based on digital India. It also Reduce environmental pollution.

6. PROPOSED SYSTEM

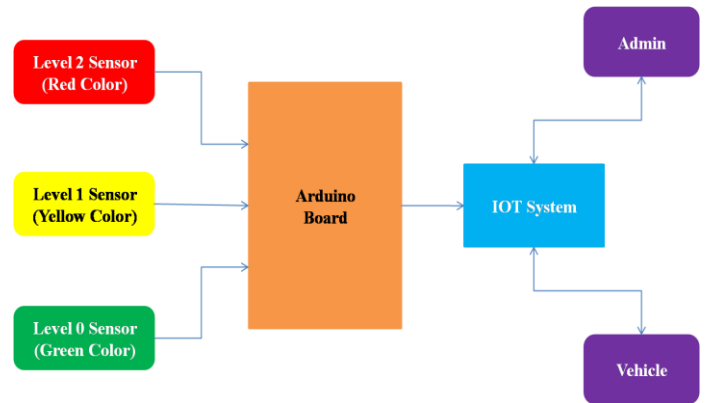


Fig 1: Block diagram

In proposed system, Smart waste bins are located in several areas of city are connected to Internet wirelessly, they equipped with sensors which collects the data about level of collected waste in Smart waste bin. Then Smart waste bin sends this information to central web portal using WIFI module. If the Smart waste bin is filled up to its threshold value then the message is displayed on web portal and the responsible authority take proper action and it will shows the all information on to the Smart waste bin Application on the users mobile phone.

7.SYSTEM DESIGN

To design system for waste collector which will show the information about level of waste in waste collector to user and on android application and also show the all available waste collector in nearby area and path to nearest waste collector.



Fig 2: System Architecture

8. IMPLEMENTATION MODULE

1. Smart bin module:

- a. Level detector consists of infrared sensor which is used to detect the level of the garbage in the dustbin.
- b. The output of level detector is given to arduino.
- c. When the dustbin is filled up to the highest level, the output of infrared sensor receiver becomes active low

2. IoT Module

- a. This output is given to arduino to send the message to the admin module via IoT module.

3. Admin module

- a. Admin module is present where all the activities are manage.
- b. Scheduling
- c. Routing
- d. Update status
- e. Send Notification

4. Driver module

- a. Receive notification
- b. Clean bin
- c. Send notification

9. METHODOLOGY

S = I, P, O, R

S = System

I = Input

P = Process

O = Output

- I = I0, I1, I2

I0 = Bin details

I1 = Admin details

I2 = Driver details

- P = P0, P1, P2, P3

P0 = Receive message from bin to admin

P1 = Schedule and Route

P2 = Send message to the driver

P3 = Receive message from admin

- O = O1, O1, O2

O0 = Schedule which first bin clean

O1 = Route to which bin is close to garbage collector

truck

O2 = Clean bin

10. ALGORITHM

Input: K- the number of clusters

D: A data set containing n objects

Output: A set of k clusters

Steps 1: Randomly select k data objects from dataset D as initial cluster center.

Steps 2: Repeat.

Steps 3: Calculate the distance between each data object d_i ($1 \leq i \leq n$) and all k cluster center c_j ($1 \leq j \leq k$) and assign data object d_i to the nearest cluster.

Steps 4: For each cluster j ($1 \leq j \leq k$), recalculate the cluster center.

Steps 5: Until no changing in the center of clusters.

The computational complexity of the algorithm is $O(nkt)$

Where, n: the total number of objects

k: the number of clusters

t: the number of iterations

11. ADVANTAGES

- The garbage will be collected on time-to-time basis.
- There would not be any bad smell around the bin.
- Real time notification to collect the garbage.
- Saving on fuel consumption, thus reducing the threat to the environment.

12. APPLICATIONS

There are many applications that help users to monitor their running activities.

- Empowered 'Swatch Bharat Mission'.
- E-governance based on digital India.
- Reduce environmental pollution.
- Real time based cleaning of our cities.
- It makes our system transparent between Municipal Corporation, workers and public.

13. RESULT

- **Location of Dust Bins:** Figure 2 showing location of Dust bins on Map.

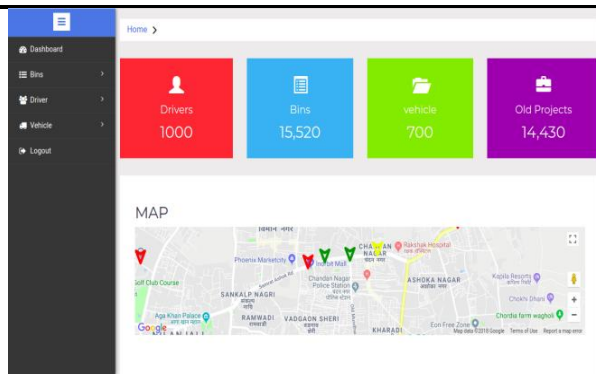


Figure 3: Dust Bin Location

14. CONCLUSION AND FUTURE SCOPE

1. Conclusion

This proposed approach can be used to keep our city clean. We started from smart waste bin. By using network environment, the real time accurate data from the implemented system could be used for the efficient solid waste management system. The system can collect accurate data on real time which can be used further as an input to a management system. With load cell calibration approach, it simplifies the calibration process so it can be attached to commonly used waste-bin without changed or modification. The level sensors also can be attached to common waste-bin. So the prototype is suitable for using in conventional waste management infrastructure.

2. Future Work

- For future, instead of person in the vehicle we can make use of a line follower robot which does not require a man power to move the vehicle.
- This path follower robot is able to follow line marked on contrasting background usually black line on a white surface or white line on a black surface.
- So using line follower robot technology vehicle moves to the particular trash bin area based on the information sent from the LoRa Gateway. So this makes the system more reliable.
- In future, some additional features will add to this project to crush and recycling plastics and other materials automatically.

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