An IOT Based Smart-City Waste Management System

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ABSTRACT: To make cities smarter the cities must be clean,green, Internet of Things (IoT) can play an important role. We present a waste collection management solution based on making waste bin smart using an IoT prototype with sensors. It can read, collect, and transmit very large volume of data over the Internet. Such system is based on the android mobile application and the sensor.We are using the different sensor for obtaining the realtime status of the dustbins and then update the information by sending it to the server or mobile application via wifi module. This paper represents the smart system for the smart cities which makes the peoples responsible to keep the city clean and healthy.This project will definitely make the waste management more reliable and smart for the big cities as well as for small towns to make their city a smart city. We use Raspberry pi microcontroller and sensor for making the hardware system working and an android application for displaying and tracking the data which is send by the dustbin module.

KEYWORDS:IOT, smart dustbin, Raspberry pi, iot enabled dustbin etc.

I. INTRODUCTION

As the population is increasing the solid waste is also increasing in a urban and rural areas and waste management has become a global concern. We need to take the right decision in order to manage this overflowing garbage. Mainly there are three types of sources where garbage isgenerated viz. residential, commercial and industrial. The garbage produced in the residential area can be collected directly from home or by making an arrangement for mass collection in that area and can be lifted using vehicles. In case of restaurants, malls and other commercial establishment garbage can be collected directly from the unit using vehicles. 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 mobile. 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 thecompletely full dustbin and dispose it. The authority will check the garbage for every two hours and it will give the alert message the garbage is not cleaned. After cleaning the trash can the ultrasonic sensor checks the trash can whether it is empty or full and if the trash can is empty then it sends the information to the Raspberry pi, then it initiates the cleaning process by switching on the centrifugal pump, it flows the water with a force to clean the trash. A smart solid waste bin operates to ensure the efficient measurement of its status while consuming minimum energy. At present, most of the cities around the world require challenging solutions for solid waste management, as there is rapid growth in residential areas and the economy. Solid waste management is a costly urban service that consumes around 30% of Municipal Corporation's annual budget in many developing nations. After various surveys and study done by numerous organizations it has been seen that factors affecting effective solid waste management are due to improper management and lack of cutting edge technology infrastructure. Municipal authorities have inadequate resources for waste management institutions to effectively collect the waste generated. It becomes an uncontrolled wastage of resources when bins are collected that are filled up partially. By optimizing the quantity and deployment of smarter technology for waste collection and management activities can be carried out very efficiently to reduce operational cost.

II. LITERATURE SURVEY

[1]Dynamic Solid Waste Collection and Management System Based On Sensors, Elevator and GSM "Trushali S. Vasagade, Shabanam S. Tamboli, Archana D. Shinde".
International Conference on Inventive Communication and Computational Technologies (ICICCT 2017)
Solid waste management is one of the major aspect which has to be considered in terms of making urban area environment healthier. The common dustbins are placed by the municipal corporation are leading no. of health, environmental and social issues. Various causes are there like improper dustbins placement in city, improper system of collecting waste by City Corporation, and more specifically people are not aware enough to use dustbins in proper way. These various major causes are leading a serious problems like, an unhygienic condition, air pollution, and unhealthy environment creating health disease. Up till now, research has been carried out by developing a Software Applications for indicating the dustbin status, another by Shortest path method for garbage collecting vehicles by integrating RFID, GSM, GIS system; but no any active efforts has been taken paying attention towards managing such waste in the atomized way. Considering all these major factors, a smart solid waste management system is designed that will check status and give alert of dustbin fullness and more remarkable system has a feature to educated people to use dustbin properly and to automatically sense and clean garbage present outside the dustbin. Thus presented solution achieves smart solid waste management satisfying goals of making Indian cities clean, healthy and hygienic. Keywords: Smart Solid Waste Collection, Monitoring and Management, IR Sensors, GSM, Alarming system, Mechanical Shaft and Elevator Assembly.

[2]Implementation of an Smart Waste Management system using IoT "P Haribabu1 , Sankit R Kassa1 , J Nagaraju1 , R Karthik1, N Shirisha2 , M Anila2"Proceedings of International Conference on Intelligent Sustainable Systems (ICISS 2017) IEEE Xplore Compliant - Part Number:CFP17M19-ART, ISBN:978-1-5386-1959-9
Waste collection services, today, are exhausted and unable to take the burden of rising cities. It is one of the biggest ongoing challenges, being faced by developing economies, where a large variety of goods ranging from cars to metal and hardware end up in inadequately managed and uncontrolled dumpsites, spreading diseases and increasing pollution. However, most of these plans have been able to manage waste once it has already been created. We, therefore, propose a system through a mobile application associated with a Smart Trash Bin .The main aim of this application is to reduce human resources and efforts along with the enhancements of a smart city vision. At regular intervals dustbin will be squashed. Once these smart bins are implemented on a large scale, by replacing our traditional bins present today, waste can be managed efficiently as it avoids unnecessary lumping of wastes on roadside. Procreation of insects and mosquitoes can create nuisance around promoting unclean environment. This may even cause dreadful diseases.

[3]Smart Garbage Monitoring and Clearance System using Internet of Things"S. Vinoth Kumar1, T. Senthil Kumaran2, A. Krishna Kumar3 and Mahantesh Mathapati4"
2017 IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM), Veltech Dr.RR & Dr.SR University, Chennai, T.N., India. 2 - 4 August 2017. pp.184-189.
The increase in population, has led to massive degradation in the state of affairs of hygiene with respect to waste management system. The spillover of waste in civic areas generates the polluted conditions in the neighboring areas. It may aggravates numerous severe diseases for the nearby people. This will humiliate the evaluation of the affected area. For eliminating or reducing the garbage's and maintains the cleanness, it requires 'smartness based waste management system. This paper is proposed the IOT based smart waste clean management system which checks the waste level over the dustbins by using Sensor systems. Once it detected immediately, this system altered to concern authorized through GSM/GPRS. For this system is used Microcontroller as an interface between the sensor system and GSM/GPRS system. To monitor and integrate an android application is developed for desired information which is related to the various level of waste in different locations. This is ensued the greenish in the environment and support for swachh bharat for cleanness.

[4]Design and Implementation of a Smart Solid Waste Monitoring and Collection System Based on Internet of Things"Aaditya Jain, Ranu Bagherwal"IEEE – 40222

Solid waste is generated is an ever growing problem at local regions or at global levels. There is proper disposal of solid wastes pollute all the components of the green environment (i.e., air, land and water) at regional and global levels. Since there is rapid increase in producing or consumptions, quantity of wastes generated by the urban society has increased. The problem is more faced in the developing countries than in developed countries, as the economic growth as well as urbanization is more rapid. The continuous flow of garbage in all places where public people move around creates the unhygienic situations. It may invoke several injurious diseases among the nearby people. To avoid such a situation and to improve the cleaning, 'smart waste management system' is proposed. In the proposed system, the completeness of waste in the dustbins is checked with the help of Sensors used in the system, and information is sent to the required control room through GSM/GPRS system. Renesas Microcontroller is used to communicate the sensor system with GSM system. An android application is been designed to monitor the information related to the waste for different selected locations. Through this the collection of garbage can be made efficiently.

[5]Optimizing routine collection efficiency in IoT based garbage collection monitoring systems"Sayan Tapadar ; Suhrid Krishna Chatterjee ; Robin Karlose ; Sudipta Saha ; Himadri Nath Saha".2018 IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC)

Ubiquitous objects are getting a "smarter" and more "connected", every day. With this ever-growing Internet of Things, every object can be uniquely identified and made to communicate with each other. This approach has been applied to a dustbins too, to monitor garbage collection, throwing light on numerous valuable insights. Our project too employs a similar approach, to not only monitor garbage collection but also optimize it, using machine learning. The method of unsupervised learning we utilized K Means Clustering, widely used in data mining and analytics. Our physical device uses an ultrasonic sensor to be aware of a dustbin's current content level. If the level reaches or exceeds a threshold percentage of the total capacity of the dustbin, it informs our servers, via an online application programming interface (API) developed for this purpose. The API also stores the related data - fill time, cleanup time, and location, to name a few. This dynamic dataset generated is analyzed by our algorithm, to determine the times of the day, when a regular cleanup should be performed, such that the dustbins are clean, for the maximum possible portion of the day. The algorithm also shows the locations, where another dustbin should be installed, for further optimization. This is found out by inspecting each cluster individually and scanning out - items which are the furthest away from its closest centroid; and multiple items related to the same dustbin. In either case, a new dustbin installation is advised at such locations. Data henceforth generated revealed that the installation has a positive effect on the optimization.

[6]IoT enabled dustbins " Sagar Wadhwa ; Preeti Wadhwa ; Richard Joseph;sahil Mirchandani" 2017 International Conference on Big Data, IoT and Data Science (BID)

Nowadays, waste management is one of the problems on which millions of dollars are spent worldwide. The key issue in the waste management is waste collection and sorting. Also, one of the issues in the waste management is that garbage bin at public places gets overflowed in advance before the commencement of the next cleaning process. This, in turn, leads to various hazards such as a bad odor & ugliness to that place which may be the root cause for the spread of various diseases. To tackle this problem, we proposed the IOT enabled dustbins in this paper. These bins, use RFID tags for tracking of the waste's linked with web-based online system and according to the weight of waste added, host server calculates the points and updates in the database of virtual wallet. Also, it measures the fullness of the dustbins and updates the status of each dustbins on the municipal server. It notifies them when the dustbin is full and provides the shortest route to empty all the dustbins based on the capacity of the municipal waste loading vehicles. The Capacity of trucks is calculated and updated each time according to the number of dustbins serviced by the trucks, as soon as it completes a route assigned to it. Furthermore, the user is assisted in material waste classification through our application and also the smart bin knows its content and can report back to the rest of the recycling chain about its contents. Our system, target two crucial problems, cost efficiency in waste sorting and waste collection processes.

[7]Automation of Smart waste management using IoT to support "Swachh Bharat Abhiyan" - a practical approach "Bharadwaj B; M Kumudha; Gowri Chandra N; Chaithra G"
 2017 2nd International Conference on the Computing and Communications Technologies (ICCCT)
"Swachh Bharat Abhiyaan" is a national campaign initiated by the Government of India, which covers 4,041 cities and towns, to clean the streets, roads and infrastructure of the country. The main motto of the mission is to covers all the rural and urban areas of the country. With growing of Internet of Things (IoT) devices such as Smartphone & sensors, this paper describes the effective dry and wet dirt collection using Embedded System. The main motto of the application is collection of dry and wet waste separately which is placed in conveyor belt on which the dry waste collected dust bins are placed left side and wet waste collected bins are on right side. The system will gets the input through the dust collecting person through switches and sends signal to the Micro controller unit using RF technology and that makes the H-bridge to rotate conveyor belt. When the belt starts rotating in clockwise the dust bin's lid is automatically closed, simultaneously the waste is dumped into the underground garbage container placed at the ground floor. Here IoT module is used to control and monitor the waste and the information will be sent to the particular organizations and the common man. The mobile app shows the collection of waste and the particular date and arrival time of vehicle.

III. RELATED WORK

3.1 Problem Definition
Nowadays, waste management is one of the problems on which million of dollars are spent worldwide. The key issue in the waste management is waste collection and sorting. Also, one of the issue in the waste management is that the garbage bin at public places gets overflowed in advance before the commencement of the next cleaning process. This, in turn, leads to the various hazards such as bad odor & ugliness to that place which may be the root cause for the spread of various diseases. To tackle this problem, we propose the Smart dustbins.

3.2 Motivation
Issues in the waste management, Waste truck drivers need navigation system and reporting problem system. Citizens want to have better service, lower costs and having easy accessible reports. Citizens as well as the government have a feasible and flexible system for waste management so that the citizens will be healthy and city clean and the government will avail this services at low cost and on time.
The motivation to Empowered Swachh Bharat mission and E-governance based on digital India. It also Reduce environmental pollution. The main goal of this project is to develop system a target twocrucial problems, cost efficiency and timely wastecollection processes
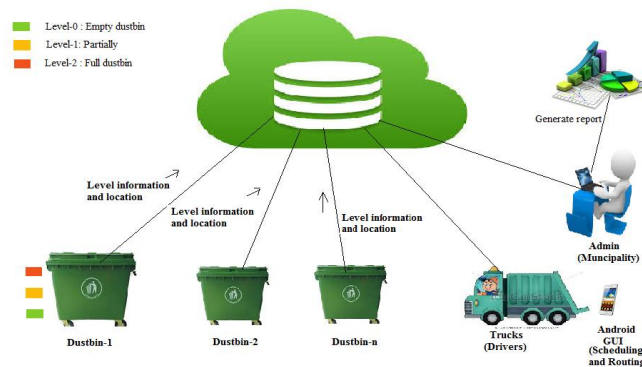
IV. PROPOSED SYTEM

Fig 4.1 : Proposed System Architecture

Fig System Architecture Shows the architecture of our proposed system in which the iot enabled dustbin are sending their status like level and location to the server of the system.

The status information from the server can be accessed by the administrator, public and truck driver to monitor the dustbin status.

The truck driver is get known about the dustbin status with the help of an Android application so that he knows the level and location of the dustbin which is full now. Administrator can take the decision and action against the truck driver.

The proposed system is divided into three module
1. Administrator
2. Truck Driver
3. Public

This system that we have proposed improves the currentscenario, by bringing all the data on the internet so thatsystems operate more efficiently. Primarily, there is levelsensor and toxicity sensor that will be sending the datacollected at intervals of 15 minutes each. With the followingdata, we have a decision taking system that will decidewhether to include the dustbin in the list of collection andmark it on the map of the municipal application. This will infact save a lot of efforts and fuel wasted in collection processas real-time monitoring of bins is done. As well as theparameters of the dustbin is used to notify the user about thestatus of the dustbin so that user can dump their wasteaccordingly. All the municipal waste collection trucks would be registered with Some more information like their capacities and registration numbers, etc. If a citizen or user wants to add the waste to the dustbin, they can scan their RFID which will trigger the lid of the bin to open, and user can then add waste. The amount of waste added is monitored using weight sensors integrated in the dustbin, according to the amount of waste our system will calculate points which will be rewarded to the user in an Android application consisting of a virtual wallet.

1.2 Algorithm/Protocol/Technology Used
Divide and Conquer, shortest path (Dijkstra Algorithm)
1.3 Mathematical Model

$S= \{I, P, O, R\}$
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

V. OTHER SPECIFICATIONS

5.1 Advantages:

1) Waste collection is done on timely basis which also avoid the fuel wastage and give notification about overflowing of the wastes from the bins.
2) Ecological pollution decreases.
3) Inefficiency of the waste collection and sortingprocesses increases.
4) It reduces environmental pollution.
5) It provides Real time solution for cleaning our cities.

5.2 Applications

- Empowered swach bharat mission.
- E-governance based on digital India.
- Reduce environmental pollution.
- Real time based cleaning of our cities.
- It makes our system transparent between the Municipal Corporation, workers and public.

VI. CONCLUSION

We have implemented garbage management system by using smart dustbins to check the level of smart dustbins whether the dustbin are full or not. In this system when garbage is full the information is send to the authorized person. By implementing this proposed system we can develop the smart city concept and cost is reduced. By the effective usage of smart dustbins can the resource is optimized. This system reduces the traffic in the smart city, so that environment will be cleaned. The existed system will inform the status of the garbage in each and every dust bin, so that the concerned authority can send the garbage collection vehicle only when the dustbin is full.

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