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Analysis of Waste Management For Smart Cities

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***Abstract* – Current waste management trends are not sophisticated enough to achieve a robust and efficient waste management mechanism. It is very important to have a smart way of managing waste. This project introduces an innovative way of integrated sensing system that will help to automate the waste management process which includes the collection of waste. We proposed an IOT based waste collection system based on level of wastes present in the waste bins. The data obtained from waste bins equipped with Ultrasonic sensors is transmitted over the Internet to a server for storage and processing mechanisms. It is used for monitoring the daily status of waste bins. Based on which, the routes to take up several waste bins from different locations are decided. This information can be linked with municipality web server for immediate action. Every day, the workers receive the updated status of bins and routes in their Android application by integrating Google Maps application. The significant feature of this system is that it is designed to update from the previous experience and decide not only on the daily waste level status but also the predict future state with respect to factors like traffic congestion in an area where the waste bins are placed, cost-efficiency balance, and other factors that is difficult for humans to observe and analyze. Based on this historical data, the rate at which waste bins gets filled is easily analyzed. As a result, it can be predicted before the overflow of wastes occurs in the waste bins that are placed in a specific location.**

***Keywords* – ultrasonic sensor, Arduino, Webapplication, Mobile application.**

I. INTRODUCTION

Internet of Things (IoT) has taken priority in research among the technical communities due to the advances and popularity in sensing, propulsion, exchange of information and control. IoT is a broad domain providing many services, such as smart waste collection system for making a city smart, healthcare observation, transportation facility, logistics department to find vehicles or packages, etc.

IoT comprises very large number of devices interconnected to the internet. IoT is an integrated system comprising different physical entities such as various components, transportation system, constructions and other things fixed with electronics, software, detectors, and network connectivity that make them capable to gather the information and exchange data.

It allows to operate remotely through network framework, generating new opening for more direct incorporation of the physical world into computer-based systems, and enhances perfection, accurateness and financial benefits. With IoT, the technology (sensors and actuators) has become sophisticated to create smart and intelligent systems. Every object is separately identified is capable to work within the existing internet architecture. It is estimated that by 2020 nearly 50 billion components will be integrated into IoT.

IoT makes our live easier as the objects are having brain (sensors help in making decisions) and communicate using wireless networks for helping us make better choices. Currently, popularity of smart city development has made researchers to work along with engineers, urban developers and architects to improve efficiency of municipal services. This efficiency of the system depends on quality of life, maintenance, economy and sustainability.

To make the city smarter, the waste management is an important aspect. Garbage monitoring system using IOT can decrease a large amount of human labour required for garbage monitoring in different area. In some areas where the population is less, the garbage storage is also less but in places where there is more number of inhabitant, the garbage is generally more. If the garbage collector can able to keep a online tracking of where the garbage is required immediate clearance, then it will follow the route by maps, without on spot monitoring by the garbage collector. So to overcome this problem, the implementation of this project may be useful.

This project also proposes the route tracking system by integrating Google maps which will provide route, the garbage collector will follow while collecting the garbage and visit the bins which is more filled. The advantages of this system, in comparison to a conventional waste collection approaches are economic and efficiency factors. As the condition of all waste bins is known to the

authority they can collect waste so that minimum fuel and vehicles are required to collect the waste and the garbage collector does not have to travel to all location of the bins.

II. RELATED WORKS

Design A Smart Waste Bin For Smart Waste Management (2017)

Aksan Surya Wijaya, Muhammad Niswar, Zahir Zainuddin In this paper, Smart Waste Collection Routing Problem and the algorithm developed considers the use of real-time information on the bins fill-level to define dynamic routes. Genetic Algorithm is used to solve the travelling salesman problem for waste collection. Ultrasonic sensor which is placed on the top of bin collects the data and transmit to server side through GSM/GPRS shield. At sever end, all information is stored on database. Based on the database plan, the optimized path is calculated using genetic algorithm.

IoT Based Waste Management:An Application To Smart City (2017)

B. S. Malapur, Vani R. Pattanshett In this paper, there is a need of collecting waste in smarter way applying optimistic and also applied on demand for collection of trips. In this bin end and server end, where bin end consists of devices like ultrasonic sensor, microcontroller, GSM/GPRS shield. Ultrasonic sensor which is placed on the top of bin collects the data and transmit to server side through GSM/GPRS shield. At sever end all information is stored on to database plan for optimized path using Genetic Algorithm.

Survey On Municipal Waste Collection Management In Smart City (2018)
Maya Chavan, T. R. Pattanshetti In this paper, waste collection and garbage-truck allocation problem could be solved by traditional mathematical linear methods that shows insufficient efficiency in some more difficult cases of waste collection. The large amount of variables was the reason for large computation time. The recent research works mostly uses the heuristic solutions and methods dealing with the municipal waste collection with a Travelling Salesman Problem (TSP). Their survey introduces various things on how to approach the waste collection algorithm.

Volunteer Gis (VGIS) Based Waste Management (2017)
Labib S M
In this paper, "Volunteer GIS (VGIS) Based Waste Management" provides a common platform for citizens active participation in waste management, and also help to bridge the gap between citizens and local government, thus would open opportunities for active e-governance. Geo-location of Dhaka city is studied, and the areas are divided into several wards based in city corporations numbers and the wards are differentiated based on their jurisdiction areas. The boundary of each words are collected as GIS shapefile from Dhaka city corporation office, later on these are converted in JSON format for overlaying with the Google map interfaces. Based on the report from an volunteer the admin and update the collection schedule. A full functional interactive GeoWeb, for the volunteers who want to contribute in the waste management system provides real time data about waste related problems that allows people to get general waste management related information like collection schedule.

An IoT-Based Waste Management System Monitored By Cloud (2018)

Debajyoti Misra, Gautam Das, Triankur Chakrabortty, Debaprasad Das

In this paper, cloud predicts the chance of overflow of the waste bin before it occurs so the environment is maintained clean from stink. Ultrasonic- level sensors takes to sense the level of waste in a waste bin. This system can sense the waste level and intensity of bio-gas generated in the municipal area. The information collected by sensors is sent over the internet to a server where it is stored and processed. This information is then used for monitoring the waste bins and decision to pick up the bin is made. The essential characteristics of this scheme are that it is planned to learn from experience and to make conclusion not only on the daily waste level status but also forecast future state. This helped to understand the efficient collection process which saves money, manpower and time.

IoT Based Solid Waste Management System (2016) Abhay Shankar Bharadwaj, Rainer Rego

The bins will be fitted with IR sensors to detect the level of garbage collected. A gas sensor will be used to detect the presence of any harmful gases, a load cell will be used to measure the weight of the bin, and indicators like LEDs and LCD will be used for notifications. The sensors and actuators will be interfaced to a microcontroller that will collect the sensor data and send it to a gateway using LoRa transceiver module. A gateway module with a LoRa transceiver will be used to receive the sensor data from several garbage bins.

Local processing of the data will be done here and the processed data will be sent to the cloud over TCP/IP using the MQTT protocol. An MQTT broker will be running in the cloud that collects the data and a MYSQL database will be implemented to store those data. Rule engines will be used for analytics, and the collected data will be displayed on a dashboard / UI. Based on the data collected, the garbage trucks can be alerted to collect the garbage, and by integrating Google maps and suitable algorithms, the trucks can be given efficient routes to

collect the garbage and reach the dump yard. Separate trucks can be used to collect only the bio-degradable waste and be sent to bio-gas generation units to dispose of the collected garbage. Using data analytics, reports will be generated and using the admin panel, the concerned authorities can monitor the entire process.

Smart Waste Management Using Internet-of-Things (IoT) (2017)
Gopal Kirshna Shyam, Sunilkumar S. Manvi
In this paper, smart waste collection system on the basis of level of wastes present in the waste bins, the data obtained through sensors is transmitted over the Internet to a server for storage and processing mechanisms. It is used for monitoring the daily selection of waste bins, based on which the routes to pick, several of the waste bins from different locations are decided. Every day, the workers receive the updated optimized routes in their navigational devices.

The significant feature of this system is that it is designed to update from the previous experience and decide not only on the daily waste level status but also the predict future state with respect to factors like traffic congestion in an area where the waste bins are placed, cost-efficiency balance, and other factors that is difficult for humans to observe and analyze. Based on this historical data, the rate at which waste bins gets filled is easily analyzed. As a result, it can be predicted before the overflow of wastes occurs in the waste bins that are placed in a specific location. Depending on economic requirements specified at early stages, the optimized selection of waste bins to be collected is expected to improve collection efficiency.

An IoT-Based Smart Cities Infrastructure Architecture Applied To A Waste Management Scenario (2019)
Patric Marques, Diogo Manfroi, Eduardo Deitos, Jonatan Cegoni, Rodrigo Castilho

In this paper, sensors collect the data that will feed the smart city architecture with information used to offer services to the population. After the sensors collect data, a communication device, which can implement different technologies, such as RFID, Bluetooth and Zigbee, is used to collects sensor data. The data is processed by a node MCU, which communicates with a local processing unit, responsible for gathering information used by the application which is providing a service. The cloud platform designed to provide three kinds of services: processing, data queries and data storage. Each of the service can be allocated dynamically to meet the requirements of different kinds of applications in the context of smart cities service provisioning.

A Waste City Management System for Smart Cities Applications (2017)
Dung D. Vu, Georges Kaddoum

In this paper, number of working clusters in each city are clustered and the location of new trash bins are classified automatically. A regression algorithm is applied to predict the situation of waste which can avoid the overload trash phenomenon while the garbage truck is coming to gather the trash bins. The priority weight of each bin is considered to conduct the optimal garbage truck routes algorithm more efficiently. By considering a large number of routes, Genetic Algorithm (GA) is used that is relatively fast in providing near optimal solutions. Since the garbage truck needs time to collect every trash bin, it is very delightful if a status of a trash bin can be predicted.

An Automated Trash Monitoring System for Waste Management Using IoT– (I- Bin) (2019)
Krithika. S, Kaja Maideen J, Madan T K C
In this paper, A real-time monitoring of the civic body's garbage vehicles using RFID can be incorporated, So that who and when and at what time garbage bin were emptied is all recorded and stored in the RFID tag, which in turn curbs laziness of the municipality's garbage collectors. Essentially, this paper is about collecting the most amount of materials in the least amount of time to reduce costs and emissions along the way. Furthermore, the bin supports any type of container and any type of waste, including mixed materials, paper, glass, metals and fluids using protocols for communication via LAN for local areas. In case of failure in the internet connectivity the location and level of the trash bin can be intimated to the mobile phones using API services like Twilio. Thus, there will be saving in fossil fuel due to optimized route for collecting garbage and also enhances cleanliness in and around the surrounding.

III. EXISTING SYSTEM

In the Existing 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 dustbin 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 to Web page along with the unique ID provided. A Web page is developed on internet which permits for remote monitoring of the real time status of dustbin. It offers the data considering the place of dustbin and its status in that respective area. The real time status of dustbin is shown on Web page and if the dustbin is full then an SMS is sent through GSM module to the worker to collect the garbage.

IV.CONCLUSION

This project work presents a smart garbage collection system for a smart city. This model is based on an Internet of Things sensing trashcan which measures the waste level and sends this information to a server for storage and processing over the internet. These data help to create an efficient collection process which saves money, manpower and time. It reduces overflow, as data are uploaded for every two seconds a day in web page and it helps municipal authority to be aware of dustbin's physical condition. In addition to this, Android application can also be developed for the drivers to update the bin status after take up and help them with easy navigation. The optimal scheduling and routing of vehicles optimizes the total cost in planning and scheduling of vehicles by reducing the number of required vehicles and determining the optimal routes by Google Maps. As an extension to this project work, predictive analysis can be used on how quick the bin will fill and plan the routing for the bin take up accordingly so that more efficiency in fuel and time is achieved.

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