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Smart Waste Management System using IoT

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Abstract— *With rapid increase in population, the issues related to sanitation with respect to garbage management are degrading immensely. It creates unhygienic conditions for the citizens in the nearby surrounding, leading to the spread of infectious diseases and illness. To avoid this problem, IoT based "Smart Waste Management" is the best and trending solution. In the proposed system, public dustbins will be provided with embedded device which helps in real time monitoring of level of garbage in garbage bins. The data regarding the garbage levels will be used to provide optimized route for garbage collecting vans, which will reduce cost associated with fuel. The load sensors will increase efficiency of data related to garbage level and moisture sensors will be used to provide data of waste segregation in a dust bin. The analysis of ceaseless data gathered will help municipality and government authorities to improve plans related to smart waste management with the help of various system generated reports.*

Keywords— Cloud, ESP8266, Raspberry pi, UV Sensor, Load Cell, Humidity Sensor, Garbage Collecting Vans.

I. INTRODUCTION

Worldwide interest in Smart Cities has aggrandized, fostered by the need to find effective remedies to the major challenges foreseen for the next years. As one of the application of Smart City, Waste Management in a city is a formidable challenge faced by the public administrations. Waste is defined as any material in which something valuable is not being used or is not usable and represents no economic value to its owner, the waste generator. Depending on the physical state of the waste, they are categorized as solid waste and wet waste.

With the proliferation of population, the scenario of cleanliness with respect to waste management has become crucial. Waste management includes planning, collection, transport, treatment, recycle and disposal of waste together with monitoring and regulation. The existing waste management system, where the garbage is collected from the streets, houses and other establishments on quotidian basis, is not able to effectively manage the waste generated.

Giraud village in Raipur district, the capital of Chhattisgarh have deployed garbage bins at every street to collect the garbage, engaged its laborers and vehicles to clear the trash. The amount of total solid waste generated by the village is 558 kg/day and liquid waste is 108040 lit./day, the garbage is collected daily and dumped into landfills. In case a villager observes illegal dumping of any kind of waste, he/she can complain regarding this to the concerned department. As improper disposal of waste causes serious impact on health, causing the spread of diseases and problems to the surrounding environment, the complete care is taken by the government for collecting and disposal of waste.

In this paper, a model has been proposed for real-time monitoring the garbage level of respective garbage bins and to detect the level when threshold value is reached using combination of Sensors and Raspberry pi. This data will be sent to the control unit and updated timely with the help of WiFi- module, depending on which optimized route have to be found for Garbage Collecting Van (GCV), depriving the fuel consumption, cost, time and labor. The data will be provided whether the waste is segregated completely or not by wet sensor and humidity sensor which will help for recycling, disposal and reuse of waste. Using data mining, qualitative analysis will be carried out to generate reports. The main objective of this system to be implemented is to supersede the tedious existing system which will aid city to become a Smart City.

The rest of the paper is organized as follows. Section II provides a general overview of the system architecture of smart waste management. Section III provides in detail the hardwares deployed in the proposed system. Section IV specifies how the system will be implemented to smartly manage the waste generated.

II. ARCHITECTURE

In the existing system, the sensors being placed at the topmost level in the bin, sense the level of the garbage in that bin. On reaching the threshold a command is generated and sent to the central office through the Zig-Bee technology notifying for the collection of garbage. The authority at the central office conveys this notification to the garbage collecting van through the GSM module. GSM is interfaced with ARM micro-controller through MAX232 chip that checks compatibility between the GSM modem and ARM micro-controller.

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Fig.2: Architecture

The proposed architecture will have a master slave configuration of dustbins. This would overcome the connectivity issues in remote areas. These slave dustbins communicate their information with their corresponding master dustbins. Each master dustbin shall be equipped with a micro-controller. Each of the dustbins has 3 types of sensors:

1) Level sensor: The level sensor will provide continuous information of level of dustbin filled. On reaching a threshold, an alert needs to be generated for the collection of garbage.
2) Humidity sensor: The humidity sensor will provide information related to the presence of wet waste in the dry waste bin.
3) Load cell: The load cell will provide information related to the weight of the garbage in the dustbin.
4) On checking for two of the parameters- level sensor and load cell, the error rate of false alarm will greatly reduce. The micro-controller used will be Raspberry-pi 3, which has an inbuilt Wi-Fi module. The information from master bins will be continuously streamed to the cloud using Wi-Fi module.

In the cloud, the real time analysis has to be carried out to generate various reports like- area generating maximum waste, seasonal or function reports on waste, segregation reports etc. which can help the Municipal corporation with better strategies for waste management. The proposed architecture assumes a backup server be provided by the cloud service provider. Along with the real time analysis, the optimized route for collecting the garbage will be found using Google maps. This will provide the advantage of saving fuel costs. Web based applications could be hosted using cloud. The authority at the central office would view all the reports, optimized routes and all the data related to the garbage bins. The person accordingly will direct the collecting vans for the collection of garbage and make efficient plans for the garbage management.

III. HARDWARE DESCRIPTION

3.1 **Ultrasonic sensor:** Ultrasonic sensor will be used to detect the level of garbage filled in the dustbin. The level of garbage will be depicted in terms of distance between the sensor and garbage in dustbin. This module has 4 pins- VCC (5V), Trig, Echo and GND. Trig have to be used to send out an ultrasonic high level pulse for at least 10µs and the Echo pin will then automatically detect the returning pulse. Sensor will calculate the time interval between sending the signal and receiving the echo to determine the distance. Working frequency of ultrasonic sensor is 40Hz. Max range and min range is 4m and 2cm and measuring angle is 15 degree.

Fig. 3.1: HC-SR04 Ultrasonic Sensor

3.2 Humidity sensor: The temperature and humidity sensor have to be used to distinguish between dry and wet waste. For this purpose DHT11 sensor will be used. Depending upon the output temperature, dry and wet waste would be differentiated. The DHT11 is a high-precision digital humidity and temperature sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin. Sensor will only get new data from it once every 2 seconds. It will be good for 0-100% humidity readings with 2-5% accuracy and for -40 to 80°C temperature readings ±0.5°C accuracy.

Fig.3.2: DHT22 Humidity Sensor

3.3 Load Cell: The load cell needs to be used to weigh dustbin. A load cell is a transducer that creates an electrical signal whose magnitude is directly proportional to the force being measured. The load cell ranges from few grams to 200 kg. The electrical signal output will be typically in the order of a few millivolts and will require amplification before it can be used. The HX711 load cell amplifier has to be used to get measurable data out from a load cell.

3.4 Raspberry pi: The information collected by sensor will be processed by micro-controller. For this purpose raspberry pi 3 model B needs to be used. Raspberry-pi 3 is based on Broad-com BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512

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KB shared L2 cache. The allocated RAM will be of 1 GB. It will primarily use Raspbian, a Debian-based Linux operating system, but many other operating systems can also run on the Raspberry Pi such as RISC OS Pi,FreeBSD,NetBSD.

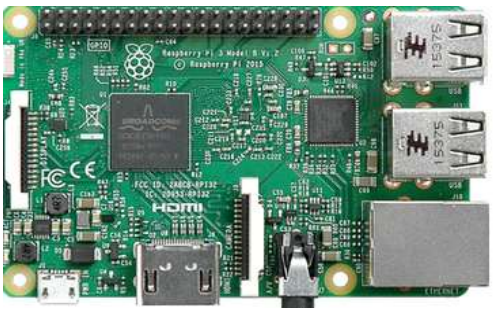

Fig.3.4: Raspberry Pi 3

3.5 Serial Wi-Fi wireless transceiver module: ESP8266 is a chip which is wireless network micro-controller module. It will be a system-on-a-chip (SoC) with capabilities for 2.4 GHz Wi-Fi, general-purpose input/output etc.

Fig. 3.5: ESP8266

IV. IMPLEMENTATION METHODOLOGY

In this scenario, garbage bins will be classified as master dustbins and slave dustbins. Master dustbins will be equipped with Raspberry Pi and slaves with IoT module. Every dustbin whether a master or a slave will have to be given a unique id. A database will be maintained containing the information about which dustbin to be placed in which area by their corresponding ids. The dustbin has UV sensor and load sensor for level detection, and humidity sensor for wet and dry garbage detection.

Every dustbin, slave or master will have to communicate with Raspberry-pi 3, where Raspberry-pi 3 will act as a broker. The work of Raspberry-pi 3 will be to collect the data from sensors attached to master and slave dustbins, apply noise removal algorithm and send data to server using Wi-Fi. The message has to be sent to server by raspberry-pi 3 about levels of garbage in a bin, wet and dry waste segregation levels along with dustbin id. Server matches ids with database of dustbins, and will find levels of dustbins located in different areas of city. Different IoT protocols can be used for data transmission like MQTT or COaP.

The collected data in cloud will be analyzed by using analytic tool like Hadoop or Storm, and useful information regarding waste management will be extracted. From the collected the data, user will get to know about real-time garbage level, and the garbage collection van can find optimized route for collection of garbage. Whenever the garbage level crosses threshold level, the alert will be generated for urgent collection of garbage. The data of wet and dry segregation level will help in evaluating the current garbage management plans and also to refine the plans for increasing the efficiency. The simple Web GUI will help the user to use this system efficiently.

V. CONCLUSION

This paper shows how the smart waste management using IoT can be implemented. This proposed system assures the collection of garbage soon when the garbage level reaches its maximum level. The system will thus provide accurate reports, increasing the efficiency of the system. The real-time monitoring of the garbage level with the help of sensors and wireless communication will reduce the total number of trips required of GCV and thus, will reduce the total expenditure associated with the garbage collection. Thus, the dustbins will be cleared as and when filled, giving way to cleaner city, better infrastructure and increased hygiene.

REFERENCES

[1] S.S.Navghane, M.S.Killedar, Dr.V.M.Rohokale, ”IoT based smart garbage and waste collection bin”, international journal of advance research in electronics and communication engineering, volume 5, Issue 5, May 2016

[2] Andrea Zanella, Nicola But, Angelo Castellani,Lorenzo Vangelista,Michele Zorzi, “Internet of Things for Smart Cities”, IEEE Internet of Things Journal (Volume: 1, Issue: 1, Feb. 2014)

[3] Kanchan Mahajan, Prof J.S. Chitode, ”Waste bin monitoring system using integrated technology”, International Journal of Innovative Research in Science, Engineering and Technology.