International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2017 IJSRCSEIT | Volume 2 | Issue 1 | ISSN : 2456-3307

Smart Garbage Collection Monitoring Systems

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ABSTRACT

Solid Waste Management is a challenge for cities' authorities. As per the Municipal Solid Waste Management and Handling Rules of 2000 in India, waste collection and dumping is the responsibility of the Municipal Committees/Corporations. But unfortunately, the waste management is not paid enough attention and the duties are thus performed poorly by these local bodies. This leads to numerous problems related to sanitation, health and the environment. Keeping all this in mind innovative system is proposed which will help to keep the cities clean. This system monitors the level of waste in garbage bins and informs about the level of garbage collected in the garbage bins via a SMS.

Keywords: IoT, Waste Management, Garbage Collection

I. INTRODUCTION

With the ever increasing population, urbanization, migration issues, and change in lifestyle, municipal solid waste generation levels are increasing significantly. Hence, waste management becomes a challenge faced not only by the developing nations, but also the developed and advanced countries. The overall waste management involves three main types of entities: 1) Users who generate waste, 2) Waste collectors/city admin., 3) Stakeholders.

Waste management directly effects the lifestyle, healthcare, environment, recycling and disposal, and several other industries. 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, so that not only the waste status is notified in-time when to be collected, but also, all the stakeholders are made aware in timely fashion that what type of waste in what quantity is coming up at what particular time. This will not only help in attracting and identifying stakeholders, but also aids in creating more effective ways of recycling and minimizing waste also making the overall waste management more efficient and environment friendly.

City administrations and waste management organizations in different metropolises face the challenge to provide efficient and effective system to collect, dispose-off properly, and recycle the waste, keeping in view the health standards and environment friendliness. In waste management, collection, transfer, and transport practices are negatively influenced by improper bin collection systems, lack of information about collection schedule, inefficient route planning, insufficient resources, and other factors [1].

Moreover, waste facilities also significantly affect the way waste disposal is done. Inadequate supply insufficiently equipped waste containers, and longer distance to these containers increase the probability of dumping waste in open areas and roadsides [2]. Relative to recycling, social influences, altruistic, and regulatory factors are some of the key reasons of developing a robust recycling system. Enabling factors, which include technical, cultural, and financial, also affect waste management. Better technology and better ways of handling waste enables a systematic approach in this regard. Improvement in waste management methodology is required to provide effective, efficient, and sustainable solid waste services; which have an influence on many actors as well as are affected by some of them. Better technology will also help in identifying stakeholders [2].It is evident that a much

II. METHODS AND MATERIAL

In order to address the above-mentioned problems of waste management, several solutions have come up in the past years. Some of the commonly used solutions for waste collection are as follows:

A. Normal GPS based route optimization

This is one of the basic solutions adopted in United States and many European Countries by companies like Fleetmatics (http://www.fleetmatics.com). GPS systems are used to provide shortest routes. This solution helps in cost cutting by saving fuel.

B. GIS Based Waste Management Planning

GIS (Geographic Information System) based planning is yet another way of optimizing waste collection systems. The placement of bins and the collection routes is planned on a geographical map of the city. The population of a certain area and their economic status is considered for planning because the amount of waste generated also depends on the income levels of a family [3].

C. Item RFID based Collection, Detection and Segregation system

This is comparatively a new concept. Here the waste items are tagged with its category RFID [4]. The bins are provided RFID readers. These RFID readers notify the location of a particular waste category and help in segregation of the waste at the final disposal level.

D. Customer RFID based Collection system

Every waste generating entity is allotted a RFID. This system is in use for food waste collection [5]. This system is developed in the Korean context. Weight sensors fixed in the waste collection bin calculate the amount of food waste generated by a particular entity. The payment for each customer is then calculated based on that quantity. The lid of the bin does not open unless the RFID is scanned.

E. Ultrasonic sensor based smart bins

This is an advanced solution in comparison to the above. This system provides a scheduled collection route based on the real time status of the bin [6]. The real time data is collected using ultrasonic sensors. These ultrasonic sensors are placed under the lid of the bin. This solution is used by Enevo (http://www.enevo.com) and UrBiotica (http://www.urbiotica.com/en smart-solutions/ intelligentwaste-management/). Enevo is currently using the system in the United States and many countries in Europe. Although the above-mentioned solutions have been tried at many places by various waste managing authorities, yet some shortcomings have been observed.

III. REVIEW ON PRIOR SOLUTIONS

This section describes the survey of the previous technology used by various authors for solid waste management.

Yang [7] state that with the complex situation of rapidly growing population, increase in migration, instable situations in various countries, unavoidable change in the climate, energy and resource limitations, etc. pose a challenge in addressing diverse interests, values, and objectives, inherent among stakeholders. Therefore, a more efficient and effective mechanism is required, such that the stakeholders are aware of what is relevant to them and in what measure. Stakeholders can there after prepare and effectively handle the waste

Guerrero et al. [1] provide a review of several research papers on waste management also including their outcome of visiting 22 countries in 3 continents. The authors come to a conclusion that all the stakeholders and factors impacting waste management systems are affected by the way waste is collected, separated, and transported for recycling and other disposal. The authors emphasize on the importance of an efficient and smarter way of reporting the waste and creating means for the recycling agencies to analyze the quantity and timing of the generated relevant waste material.

Moh and Manaf [8] provide an overview of the solid waste recycling policy in Malaysia. The authors state that even being an Emerging Economy, Malaysia still heavily relies on land filling as a disposal of waste. This has resulted in space limitation, health issues, and environmental problems. One of the best ways to tackle the recycling issue in Malaysia and other such nations

is to have a proper notification and data availability, so that the type and quantity of recycling material is known and stakeholders are involved in the process in an effective way.

Caniato et al.[9] provide a method of surveying solid waste management through the integration of Social Network Analysis (SNA) and Stakeholder Analysis (SA). The outcome of the survey suggests that stakeholders are more concerned about the communication in the waste management and seek improvement in that regard. Moreover, stakeholders' involvement should be more in system development planning and waste management should be redesigned to identify stakeholders as well. Service beneficiaries should directly be made part in order to attain sustainability of the solid waste services. This is possible with more advanced technologies in this area.

Zhang et al. [10] mention in their work that one of the important IoT applicability in cities is food industry. It is very important to monitor, analyze, and manage the food industry and it is possible by keeping track of the organic waste. Provenance of waste also plays an important role in managing food industry and other related processes.

Greene and Tonjes [11] provide an analysis of waste management in NewYork State, USA. The authors state that in the USA, from 19thcentury till 1960s, public health was a key driver of waste practices. However, the drivers have shifted to environmental concerns now. This shows the importance of a more sophisticated waste management mechanism.

Al-Jarallah and Aleisa [12] provide a study on characterizing municipal solid waste in Kuwait. The authors mention that the daily average of waste generation is 1.01kg/person. Most of the waste is of organic matter, comprising44.4%. Rest is composed of 11.2% film and 8.6% of corrugated fibres as the noteworthy types of waste. In order to have a complete waste management mechanism, it is very important to have a smart way of notifying the quantity of each type of waste and involve the stakeholders effectively.

S. No	Paper Title	Methodology	Accuracy	Limitations	Ref
1	Quality of service ensuring in urban solid waste management	geographic information system, modular development approach	identify the optimum solutions in waste management	Does not support for the synchronization of all activities related to urban waste management	13
2	Notice of Retraction Research on logistics operations management system of urban solid waste	logistics operation management system	Provides the establishment of the market-oriented, industry-based mechanism of urban solid waste logistics	Poor performance in management of solid waste logistics operation	14
3	An approach of Geographic Information System (GIS) for Good Urban Governance	GIS across cross-cutting municipal themes	achieving good urban governance at municipal levels	focused on select areas at local level like mapping, utility management	15
4	ALMANAC: Internet of Things for Smart Cities	federated smart city platform (SCP)in the context of the ALMANAC FP7 EU project	supports end-to-end security and privacy	services and data management quality is low	16
5	Using genetic algorithm for advanced municipal waste collection in Smart City	Internet of Things , genetic algorithm	provides calculation of more efficient garbage-truck routes	Accuracy in providing garbage-truck routes has to improved	17
6	An approch for monitoring and smart	Smart-M3 platform, decisional algorithms	advantages for both service	Performance in updating the fulness	18

	planning of urban solid waste management using smart-M3 platform		providers and consumers	state of the nearest bins has poor performance	
7	Across-layer framework for sensor data aggregation for IoT applications in smart cities	Internet of Things, distributed cross-layer commit protocol (CLCP) for data aggregations	Provides the efficient management of solid urban waste	there has not been enough contribution to efficiently retrieve the sensor data for decision making	19

IV. RESULTS AND DISCUSSION

Proposed System

Today solid waste management is one of the most important challenges in urban areas and cities throughout the world and where a rapid increase in population has been observed it becoming a critical issue in developing countries. The proposed system is a very innovative system which will help to keep the cities clean. This system monitors the level of waste in garbage bin and informs about the level of garbage collected in the garbage bins via a web page. For this the system uses ultrasonic sensors placed over the bins to detect the garbage level and compute the garbage bin depth. The system makes use of AVR family micro controller, LCD screen, Wi-Fi modem for sending data. The system is powered by a 12V transformer. Using LCD screen to display the status of the level of garbage collected in the bins. Whereas cloud is used to store the bin level and show the status to the corporation employee monitoring it. The LCD screen shows the status of the garbage level. The systems send the SMS to corporation office when the level of garbage collected crosses the set limit. Thus this system helps to keep the city clean by informing about the garbage levels of the bins by SMS via IOT.

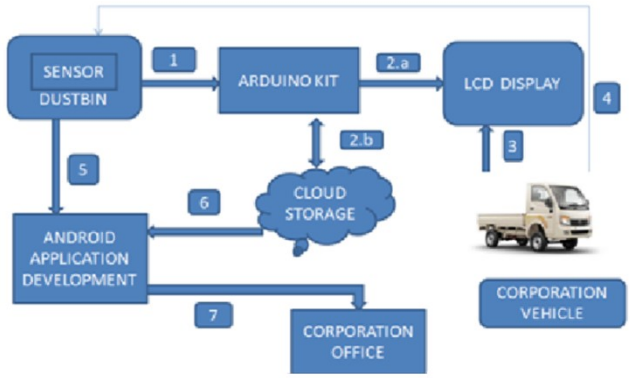

Figure 1. System Architecture

Figure 1 shown graphically the system architecture used. The sensor senses the solid waste level in the dustbin. Then, the sense data are transmitting to Arduino Uno micro controller device as well as the LCD connected into Arduino device. Then, LCD display is connected into Arduino Uno Micro Controller device and it's placed on street light pole or above dustbin. It will display the Information about bin containing. Then, it stores that information and the status of corporation vehicle in Cloud. Then, the corporation vehicle driver will clean the dustbin. If does not clean the dustbin to developed an android application for intimate to the corporation Office. Then the officer alert to appropriate corporation vehicle driver for cleaning the dustbin.

V. CONCLUSION

In this project work had done two modules. They are Sensor connected with Arduino Uno Micro controller and display the data in LCD. This work to monitored the dustbin whether if is full/semi full/empty for developed city as a Smart. By using sensor, it had been sensed the data of level of the bin contained solid waste. Then, the data are transferred to Arduino Uno device and also displayed in LCD Successfully. For phase two, to stores the data about bin and corporation vehicle in Cloud. Then Developed an Android Application for intimate to the appropriate corporation vehicle and also corporation office like bin is full and location of bin. smart system described focuses on two aspects: first of all, it is addressed to governments and private companies in order to plan a better management of resources to be deployed in cities and an optimal planning of waste collection; secondly, it is aimed at giving citizens the opportunity to know the position and conditions of the nearest bins and encourage them to recycling.

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