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Smart Dustbin for Smart City

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Abstract - *The 21st century known as the era of technological development and is estimated by Cisco that, by 2050 more than 50 billion devices will be connected to the internet. As more devices are connected to the internet it will change the way people live, work and play. Things will tend to become "SMART" and influence the lives of humans. With technological advancement and growth in industrialization, urbanization and population governments across the globe will need to devise sustainable development plans and hence in the recent year, the notion of Smart City has been trending across the globe and governments are investing huge sums of money towards establishing smarter cities. A smart city is incomplete without a Smart Waste Management System. In this paper, we have presented an Integrated Platform for Waste Management where smart bins are equipped with a network of sensors and they transmit real time data indicating the fill percentage of the bin. Depending on the status of the bin route optimization can be performed which indeed increases efficiency of fuel and time. The large amount of data collected can be helpful to gain insights about the waste generated across cities. The ultimate motive behind this paper is to encourage and inspire people to do further research related to Smart Waste Management.*

This paper presents the architecture and implementation of an Internet of Things based mobile application for a Smart Waste Management for Smart City on a low cost of the system. The implementation of this system initially includes a dustbin and a mobile application both connected to the internet using Wi-Fi module. The Arduino UNO microcontroller communicates to the internet via Wi-Fi module to provide the information about the areas dustbin to the personnel responsible to clean the trash of that particular area. Smart dustbin will help to keep the surrounding clean and garbage free.

Key Words: Smart bin, Smart City, Internet of Things, Arduino, Wi-Fi module, garbage free, low cost.

1. INTRODUCTION

Population has been increasing at an exponential rate. Migration is on its peak. The lifestyle of the people, throughout the world, has undergone a drastic change. Population explosion, increasing levels of urbanisation and the changing lifestyle of the people have resulted in problems aplenty. One of the primary problems it has caused is the increasing levels of waste generation. Disease causing germs, insects, bacteria and viruses breed on these garbage and can result in the spread of various diseases. In the traditional waste management schemes, cleaners are assigned to empty the waste bins at a particular time of the day. Such a strategy has lot of disadvantages. It is inefficient and time consuming. At a particular time of the day, the cleaners visit the bins and empty them. The waste management strategy is not at all a suitable one and there is much scope for improvement. With the concept of smart cities gaining ground throughout the world, a large number of responsibilities need to be fulfilled.

A smart city needs its habitants to have a smart lifestyle, and for a smart lifestyle, cleanliness is a basic need. Thus, it is necessary to develop smart waste management strategies throughout the world with the aid of technology in order to make cities cleaner, greener, healthier and smarter. This paper illustrates an alternative waste management strategy to tackle the problem of ever-increasing amount of waste generation due to population explosion and increased urbanization.

For implementation of this alternative strategy, a new waste bin design, fitted with several sensors are propose for real-time monitoring of the garbage level in the bin. Whenever the garbage level in the bin would cross a certain predetermined threshold, a notification would be send to the authority to schedule to clean the bin. Thus, this alternative waste management strategy using real-time monitoring solves not only the problem of underutilization of the waste bin, but also the problem of overfilling of the waste bin leading to overflowing of garbage in the vicinity. Therefore, the alternative strategy can pave the way for a cleaner, greener and healthier city.

2. SCOPE AND MOTIVATION

The main aim of this project is to reduce human resources and efforts along with the enhancement of a Smart City Vision with Low Cost for manufacturing. The proverb "Cleanliness is next to god and clean city is next to heaven" inspired us to conceptualized the project. Swatch Bharat Abhiyan (English: Clean India Mission and abbreviated as SBA or SBM for "Swatch Bharat Mission") is a national campaign by the Government of India, covering 4,041 statutory cities and towns, to clean the streets, roads and infrastructure of the country. In our system, the Smart dustbins are connected to the internet to get the real time information of the smart dustbins. In the recent years, there was a rapid growth in population, which leads to waste disposal. Therefore, a proper waste management system is necessary to avoid spreading some deadly diseases.

In city, there are many public places where we see that garbage bins or dustbins are kept but are overflowing. This creates unhygienic conditions in the nearby surrounding. Also creates ugliness and some serious disease, at the same time bad smell is also degrades the valuation of that area. Our main motivation behind this project is the ongoing campaign Swachh Bharat Abhiyan (Clean India Movement, 2014) Launched on October 02,2014at Rajghat, New Delhi , by the

prime minister of India Narendra Modi which is India's largest ever cleanliness drive to clean the streets ,roads and infrastructure of the country's 4,014satutaory cities and towns.

3. LITERATURE REVIEW

A. Literature Paper Survey:

However, large numbers of researches have done previously on such waste management techniques. In Efficient Waste Collection System by authors Saurabh Dugdhe, Pooja Shelar, Sajuli Jire and Anuja Apte have considered dustbins equipped with RFID, ultrasonic sensors, gas sensors working on Wi-Fi based communication with the central server [1]. The server calculates the shortest route for the collection of the wastes from the dustbins and escalates it to the further collection process. The major disadvantage here is the use of Wi-Fi sensors limit the application of such system to a small area and Moreover, gas sensor is used to detect level of carbon monoxides in the dustbins which itself is not sufficient to measure the quality of the air in the dustbins. In Smart Recycle Bin[2] by authors Mohd Helmy Abd Wahab, Aeslina Abdul Kadir, Mohd Razali Tomari, Mohamad Hairol Jabbar have proposed a system that rewards the users by calculating points on the basis of weight and the type of wastes inserted in them using a waste type detection system. This system eliminates the problem of waste sorting as user's points is deducted if the type of waste inserted does not match with the type of dustbin, but detecting the type of the waste is not yet figured and remains conceptual. In addition, nothing have done to eliminate the problem of the collection of waste. In Smarting: Smart Waste Management System [3], the proposed system presented, and the methodology is quite well, but if they use clusters in their system, efficiency would been maximized. Moreover, no attention are made on the toxicity as it can still cause harm to their environments even if they are not full.

B. Proposed System:

This system consist of interaction between the dustbin module and the authority. The main aim is to reduce the work of managing the dustbin around the city by making them traceable, which makes the work easier. To make the use of "A*" algorithm to provide the shortest distance between all the filled dustbin's and driver. The user/authority will be able to start and know the data of each dustbin. The dustbin will collect the waste and inform the authority when it is filled, so that the dustbin can be emptied regularly and the surrounding is kept clean. This in result keeps deadly diseases away from growing. This system can be upgraded gradually making it more reliable. Smarter the system smarter the city. Each dustbin has the ability to close the lid when it is filled to its maximum level lid can be opened by the driver collecting the bin. Influence the Smart City project in cheaper price.

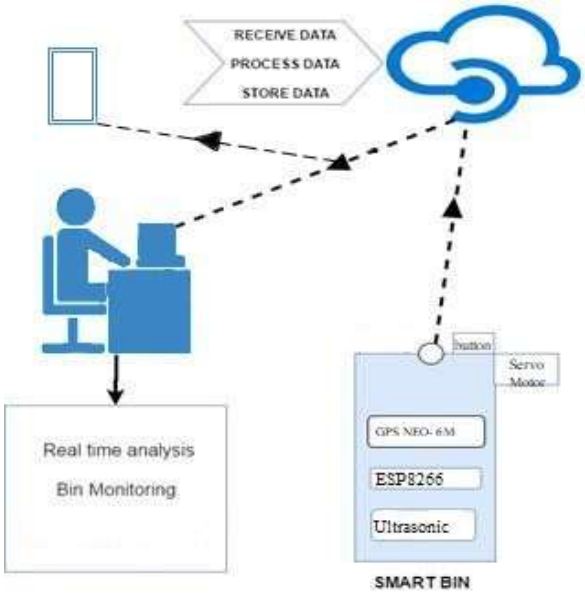

FIG-1: Basic Conceptual Diagram [2]

4. EXPERIMENTATION

The experimental setup of the smart bin is shown in figure 2. The components used for the model are as described below:

A. Arduino UNO:

Arduino UNO comes with 6 analog pins and 13 GPIO pins. It is a basic microcontroller with less features but it is cost efficient.

B. ESP8266:

ESP 8266 module is a Wi-Fi enable chip with built in TCP protocol. It connects the Arduino to internet, specifically cloud service (ThingSpeak)

C. GPS:

GPS NEO-6M is a cheap gps module available in the market. It is the perfect module to work with as it gives accurate location outside environment. GPS will give the location of the bin 24x7.

D. Ultrasonic Sensor:

The HC-SR04 ultrasonic sensor will calculate the distance vacant inside the bin.

E. Servo Motor:

Servo motor is used to close the lid when the bin has reached its threshold value, this lid can be opened by the collector to prevent overspill of garbage.

F. Cloud:

Cloud is the main interfacing platform to visualize the real time data. Thingspeak is a cloud service provider that's well secured and has a premium to control up to 1000+ devices and huge database storage.

G. Android Application:

Android application will be handy to view the real time data with the help of Cloud connectivity. Send short distance map guidance to the driver/collector.

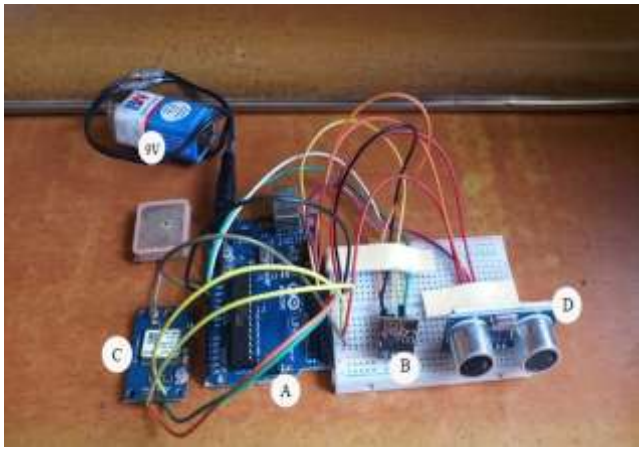

Fig-2: Connectivity of the component

H. Activity Diagram:

The below diagram (figure 3) shows the activity that our system will do in a proper manner. It has a 'Start' stage from where the system reboots and 'Stop' stage in the system halts some time. It defines the whole process of the system.

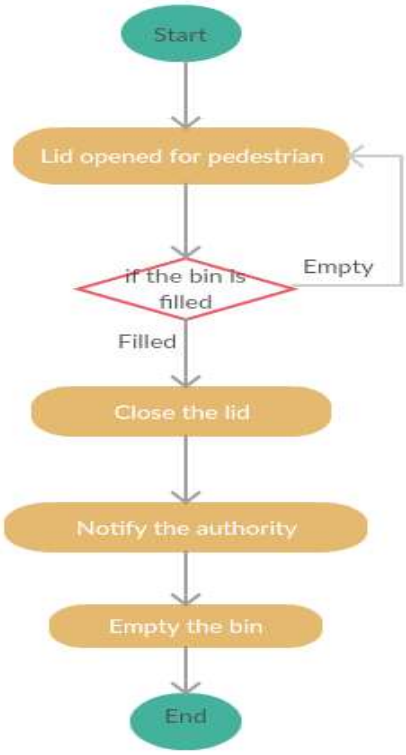

Fig-3: Activity diagram

5. CONCLUSIONS

Technological advancements have affected people in almost every aspect of their lives. It has gone a long way in improving the living conditions of the people. With each passing day, more and more emphasis is been given to work related to the development of smart cities throughout the world. The traditional waste management schemes are not efficient enough to handle such large amounts of waste. They are not at all, in line with how the waste management scheme of a smart city should be. It is time that application of technology is built in this sector to make waste management schemes worthy of a smart city and efficient enough to handle the ever increasing levels of waste. The alternative waste management strategy proposed effectively uses technology to develop a strategy much smarter and far more efficient than the existing one.

This paper would serve as an encouragement to others to further explore the sector of waste management and develop more robust and efficient strategies in the future with the aid of technology. This, in turn would make the cities cleaner, and the world a healthier place to live in. A prototype of the proposed design of a smart waste bin required for the suggested alternative waste management strategy was implemented successfully. With proper support and encouragement from the right people, it is highly possible to develop this prototype into a fully functional project.

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