IOT Based Dustbin for Smart City

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Abstract—*This paper presents IOT based dustbin for smart city with real time monitoring system and notification which integrates multiple technologies. The purpose of this project is to provide an efficient and cost-effective waste management system, hence providing clean and healthy environment. This study proposed a new framework that enables remote monitoring of solid waste bin in real-time via GSM Module, to assist the waste management activity. Short messaging service [SMS] notification system and real-time monitoring system that are interrelated to each other to perform as an efficient, cost-effective waste management system that yield to a green and healthy living environment.*

INTRODUCTION

Due to the fast pace of urbanization, waste management is becoming a bigger issue each day in each developed and developing countries. In Malaysia, rapid urbanization and industrialization transition have changed the solid waste characteristics. The generation of municipal solid waste [MSW] over the past 10 years has increased by 95 per cent due to rapid development in the urban areas. The waste created from various sources will be lead to environmental pollution arising without an effective and well-organized solid waste management. Besides, this can also bring to serious health hazard and lead to the spread of infectious diseases. An effective solid waste management practices need to be updated to suit the current waste quantity and composition. Municipal waste management in Malaysia has gone through several transitions. This proved that, Malaysia is striving in improving the solid waste management practices towards sustainability. In the approach of smart city, the objective is to provide a city with basic infrastructure to give a decent quality of life, a clean and sustainable environment through application of some smart solutions. One of the basic infrastructure is sanitation and solid waste management.Ease of Use.

Internet of Thing [IoT] can play an important role in providing a smart solution for waste management that will reduce costs and increase efficiency. In Malaysia, many companies concentrates on remote sensing system in waste management system. Rather than traversing all the route to clean the waste bin, it is more efficient if the waste management system able to alert the collector only the waste bin requires to be emptied.

Thus, this able to optimize collection routing and save time and fuel. A system that able to collect and analyze data are important as a decision support tool to help the local authority or waste management contractor to improve their service. Many researches in waste management focus on the solution implementation rather than how to deliver a product with competitive price with less maintenance cost.

LITERATURE REVIEW

A smart dustbin proposed earlier[1] based on IOT in which the smart was built on a platform which was based on Arduino Uno Board which was interfaced with a GSM Modem and an ultrasonic sensor. pThe Sensor was placed on the top of the bin. A threshold level was set at 10cm.As the garbage reaches the level of threshold, the sensor triggers the GSM modem which alerts the associated authority.The second researcher[2] suggest the method for garbage management as follows. The bin was interfaced with a system based on microcontroller which had IR wireless system with a central system. The status was seen on a mobile based web and browser with a home page by using a Wi-Fi.The author proposed a method for organizing the collection of garbage in the residential and commercial areas of the cities. In this system the level of garbage in the bin was detected by the ultrasonic sensor for solid or dry waste, where as for the wet waste, the author proposed to use a load cell as it. Wet waste is more harmful so we cannot wait for it to reach a certain level by using ultrasonic sensor. So, for wet waste load cell is used.

The paper proposes priority sequence which would be used for garbage collection in smart city. This system will generate a SMS or email-based alert, for the high priority place like schools.

The system works in two parts, the first part was to reach the companies that had the government contracts for collecting the waste from various parts of the city in the trucks and pass on the city domes or the recycling organization. The second part was to make a system which could handle all the communications involved and could also maintain the data which will be collect while working around the city.

Various bins were placed around the city. A different ID was provided to each bin so that each bin would be easier to detect that which bin is full and ready to be emptied. the system generates a priority SMS or email for the bins placed near a school or a hospital, thus truly emphasizing on the need of a smart city.

The project is divided into two sections, one being the transmitter section and other the receiver section. As soon as ultrasonic sensor or load cell detect that the saturation level has occurred, it will send an alert via gsm module and the alert will be transmitted on a web page.

METHODOLOGY

As a guideline for proposing the new framework for waste management system, several problems in waste management will be considered:

1) Lack of information about the collecting time and area.

2) Lack of proper system to monitor the trucks and trash sbins that have been collected in real time.

3) There is no estimation to the amount of solid waste inside the bin and the surrounding area due to the scattering of waste.

4) There is no quick response to urgent cases like truck accident, breakdown, longtime idling.

5) There is no quick way to response to client's complaints about uncollected waste.

6) There is no information to the management whether the dustbin is emptied or not.

MATERIALS

Arduino

Fig.1 Arduino Uno

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits.

The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers.The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. The Arduino project provides an integrated development environment (IDE) based on the Processing language project. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IOT applications, wearable, 3D printing, and embedded environments.

GSM MODULE

Fig. 2 GSM Module SIM800

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate.GSM/GPRS MODEM is a class of wireless. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.

2. Read, add, search phonebook entries of the SIM.

3. Make, Receive, or reject a voice call.

Load Cell

Fig. 3 Load Cell

A load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. The various load cell types include hydraulic, pneumatic, and strain gauge.tables may span across both columns..
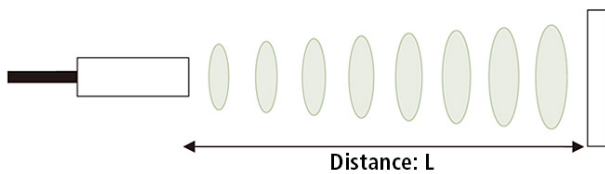
Ultrasonic Sensor

Fig. 4 Working of Ultrasonic Sensor

Ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception (A/m)" or "Magnetization $\{A[m(1)]\}$",

CONTROL SYSTEM

The control station contains the central server which hosts the web server, database, SMS notification system and a web-based waste bin real time monitoring system .The data sent by the smart waste bin is received by the control station and stored in the database server. Control station runs two systems which handle different jobs.

PRIORITY BASED SYSTEM

This project has a priority based system i.e if dustbin at different location got filled at the same time then the dustbin with the priority based will show its notification at the top.

For example: Dustbins at the hospitals are to emptied first as compared to dustbins at the bus stop or any other area

SMS NOTIFICATION SYSTEM

This project has a sms based notification which will alert the management or sweepers on their phone which dustbin are filled.This will be easier for them as they will have all the information related to dustbin on their mobile phones.

REAL TIME MONITORING SYSTEM

The web-based real time monitoring system provides a GUI for displaying the waste bin data so that user can monitor the waste bin status and collection activities using web browser from any devices. The location of waste bin [latitude and longitude] is retrieved from database server and marked on the map by using Google Map API.
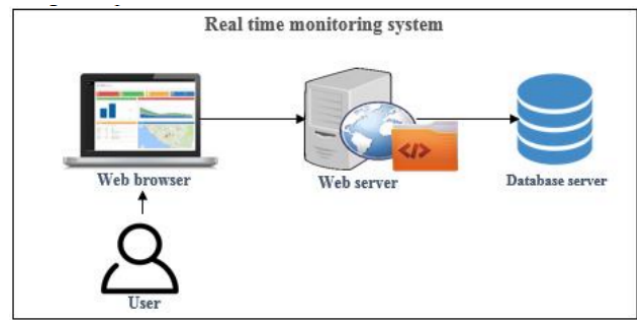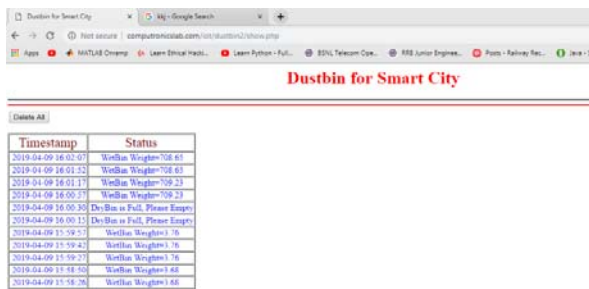

Fig. 5 Architecture of Real Time Monitoring System

Result

SMS Result

Webpage Result

CONCLUSION

This paper presents a framework of IoT innovation project for waste management system. This novel solution able to enrich the efficiency of waste bin collection activities and cost reduction. The implemented system on top of this framework can be further improve to perform real-time, reliable and efficient waste management system. For future works, a customer complaints module will be added and integrates with the SMS notification system to perform fast response. The map showing the waste bin actual coordinates stored in the database can be further leverage by integration with GPS technology to give the current waste bin location. Alert message can be produced if the waste bin has been reposition to other place or fall down. Other than that, the map can be used to show only full waste bin together with shortest route to help reduce operation costs and GhG emission. We also found several limitations in this implemented system. Firstly, the smart waste bin should work more intelligently to detect the waste bin lid is in close or open position. Due to that, in the future a hall effect sensor can be implemented so that the ultrasonic sensor can give correct reading at any time required. This implemented system also requires strong Wi-Fi connection to make it functioning. External Wifi-Extender device could be used to improve the Wi-Fi signal. Local authority can use this type of system and monitor the waste collection status in real-time and based on the recorded information they able to measure their operational performance, predict future paper.

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