Design and Implementation of Waste Management in Iot-Enabled Smart Cities

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Abstract- *In this project, we present the Smart bin system that identifies fullness of wastage bin by collecting data and deliver the data through wireless mesh network. The system also employs duty cycle technique to reduce power consumption and to maximize operational time. The Smart bin system was tested in an outdoor environment. Through the tested, we collected data and applied sense-making methods to obtain litter bin utilization and litter bin daily seasonality information. With such information, wastage bin providers and cleaning contractors are able to make better decision to increase productivity. finally we will see the all the results in web page using web application*

Keywords- Gas Sensor, Ultrasonic Sensor, Arduino UNO, IoT (Internet of Things), UART (Universal Asynchronous Receiver Transmitter)

I. INTRODUCTION

The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators and network connectivity which enable these objects to collect and exchange data. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

Visualizing a world where several objects can sense, communicate and share information over a Private Internet Protocol (IP) or Public Networks. The interconnected objects collect the data at regular intervals, analyze and used to initiate required action, providing an intelligent network for analyzing, planning and decision making. This is the world of the **Internet of Things (IoT).** The IoT is generally considered as connecting objects to the Internet and using that connection for control of those objects or remote monitoring. But this definition was referred only to part of IoT evolution considering the machine to machine market today. But actual definition of IoT is creating a brilliant, invisible network which can be sensed, controlled and programmed. The products developed based on IoT include embedded technology which allows them to exchange information, with each other or the Internet and it is assessed that about 8 to 50 billion devices will be connected by 2020. Since these devices come online, they provide better life style, create safer and more engaged communities and revolutionized healthcare. The entire concept of IoT stands on sensors, gateway and wireless network which enable users to communicate and access the application/information.

Swachh Bharat Abhiyan (English: Clean India Mission and abbreviated as SBA or SBM for "Swachh 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 more waste disposal. So a proper waste management system is necessary to avoid spreading some deadly diseases. Managing the smart bins by monitoring the status of it and accordingly taking the decision. There are number of dustbins are located throughout the city or the Campus (Educational Institutions, Companies, Hospitals etc.). The aim of the mission is to cover all the rural and urban areas of the country to present this country as an ideal country before the world. With the proliferation of Mobile network devices such as smart phones, sensors, cameras. It is possible to collect massive amount of garbage. In the metropolitan cities it is not possible to check each and every place where the garbage dump yard is full or not. So we have introduced a new concept using ultrasonic sensor. This is a sensor which intimates about the load placed on it. So that the garbage can also be checked in this way. Many times, in our city we see that the garbage bins or dustbins placed at public places are overloaded. It creates unhygienic conditions for people as well as ugliness to that place leaving bad smell. To avoid all such situations we are going to implement a project called IoT Based Smart Garbage and Waste Collection bins. This system also helps to monitor the fake reports and hence can reduce the corruption in the

overall management system. If the dustbin is not cleaned in specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. It ultimate helps to keep cleanness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient the use of solar panels in such systems may reduce the energy consumption. These dust bin model can be applied to any of the smart cities around the world. A waste collecting and monitoring team which is deployed for collection of garbage from the city can be guided in a well manner for collection.

II. ARCHITECTURE DIAGRAM

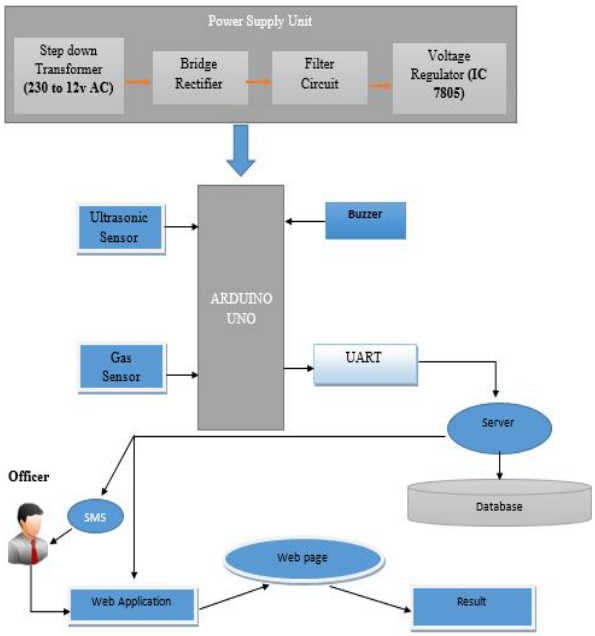


Fig 1: Overall Architecture

III. HARDWARE AND SOFTWARE DESCRIPTION

This system consists of two major parts:

1. Hardware Module
2. Software Application

Hardware module consists of the following components:

- Arduino UNO
- Gas Sensor
- Ultrasonic Sensor
- Buzzer

Software application is implemented as a web page built using NetBeans IDE.

Arduino UNO:

Fig 2: Arduino UNO board

The Arduino Uno is a microcontroller board based on the ATmega328. It can be connected to computer via USB cable. Batteries or AC-to-DC adapter can also be used to get started. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It has maximum of 12V power supply and minimum of 2.3V, but the recommended is 5V of supply. Arduino UNO IDE can be used to program the board for any device.

Ultrasonic Sensor:

Fig 3: Ultrasonic Sensor

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. It is important to understand that some objects might not be detected by ultrasonic sensors.

Gas Sensor:

Fig 4: Gas Sensor

A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and can interface with a control system so a process can be automatically shut down.

Buzzer:

Fig 5: Buzzer

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke..

Arduino IDE:

Fig 7: Arduino Software

The Arduino IDE is an Open-Source software used to provide instructions to microcontroller. It provides an environment where you can write code and upload it to your microcontroller. It is available for Windows, Linux and MAC operating system based computers.

NetBeans IDE:

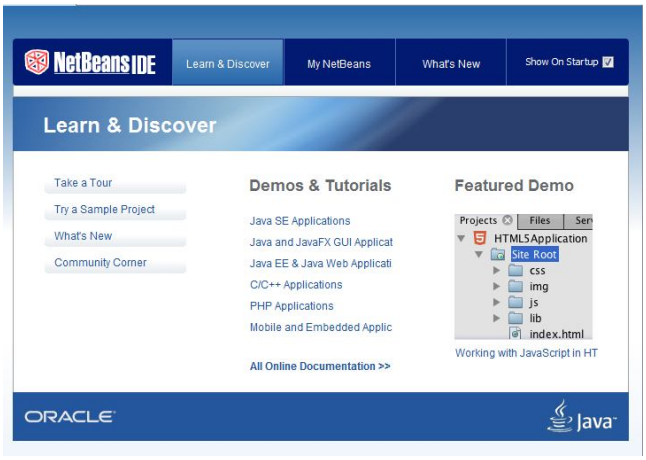
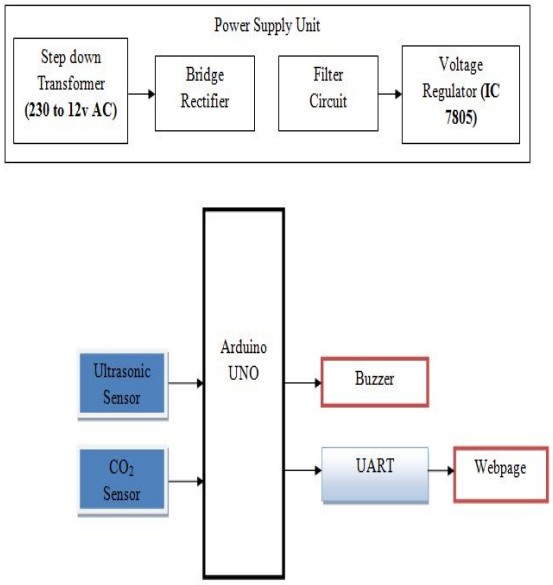


Fig 8: NetBeans IDE

NetBeans is an Integrated Development Environment (IDE) for developing primarily with Java, but also with other languages, in particular PHP, C/C++, and HTML5. It is also an application platform framework for Java desktop applications and others. The Net Beans IDE is written in Java and can run on Windows, OS X, Linux, Solaris and other platforms supporting a compatible JVM. The Net Beans Platform allows applications to be developed from a set of modular software components called modules.

BLOCKDIAGRAM



IV. METHODOLOGY USED

In this system, the arduino board is used to interface various sensors which is used for reading parameters like gas and load. The users are registered with the server side so that only registered users will be able to access the system. The arduino which is interfaced with the sensors acts as a remote device which senses the data stores them into the server database. The system is designed in such a way to monitor server that notifies the user during excess garbage load and gas through UART automatically. The user is notified with the measure of gas and ultrasonic units in the dustbin .

The hardware and the software interface are connected to each other to monitor the level of garbage and gas level of the dustbin and further, this will be monitored by sensors and will be uploaded to server from where the user can log on to the webpage in computer. The web page will display the level of garbage, gas in the dustbin.

The system is developed for easy management of the garbage and gas respectively in the dustbin. With the report of the gathered parameters, corporation workers will check the dustbin and removes the garbage from the dustbin. A multi-parameter continuous condition monitoring approach gives valuable data to detect abnormal situations like full level of garbage inside dustbin and indicates the officers to clear the garbage from the dustbin in the respective location. This data is stored in the Database server and accordingly, the data is sent to the registered user. So that the user can monitor the level of garbage from any location.

The proposed method uses the gas sensor as a extra advantage. It is programmed using Arduino IDE, which is a platform specifically designed for coding the projects run by Arduino UNO. This software can be downloaded for no cost from the official website of Arduino. After download is complete, connect your board to laptop via USB cable. Select **Tools -> Board** menu according to the microcontroller being used. The ATmega328 on the Arduino Uno comes pre-burned with a boot loader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. ICSP (In-Circuit Serial Programming) header can also be used to bypass the boot loader and program the microcontroller.

Ultrasonic sensor is connected with the Arduino UNO microcontroller to measure the level of garbage. Arduino analog inputs can be used to measure level in the garbage in the units of cm. It has the measurement of 1 cm to 30cm. 1cm to 10 cm will be mentioned as low level. 11cm to 20cm will be noted as medium. 20cm to 30cm is high level. when it reaches the highest level it indicates with the buzzer.
Gas sensor is connected with the Arduino UNO microcontroller to measure the Gas level around the environment. It has the values from 0 to 1000.when it hits more than 750 it will indicates as high and buzzer will also indicate.

Each and every value will stored in a server. It will working through the website.

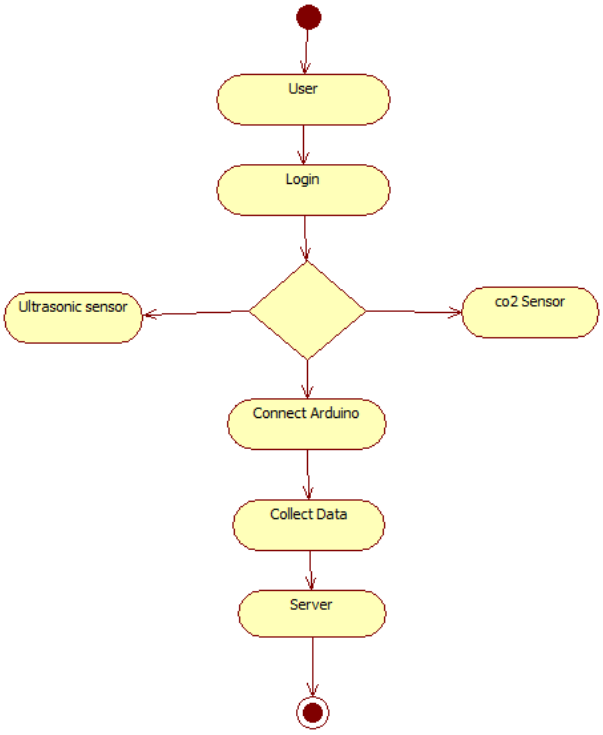


Fig 10: Overall Activity Diagram

V. IMPLEMENTATION

Fig 11: Home page

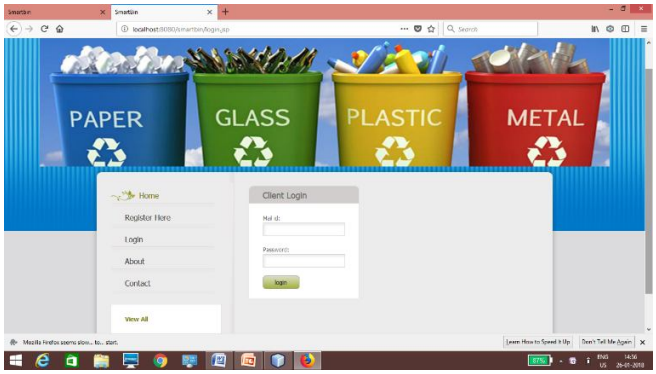


Fig 12: Login Page

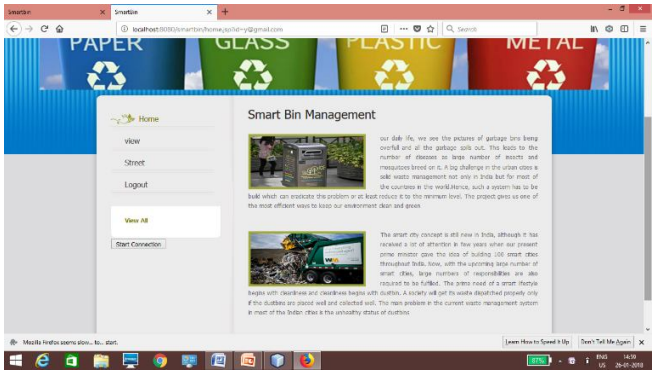


Fig 13:Connection page

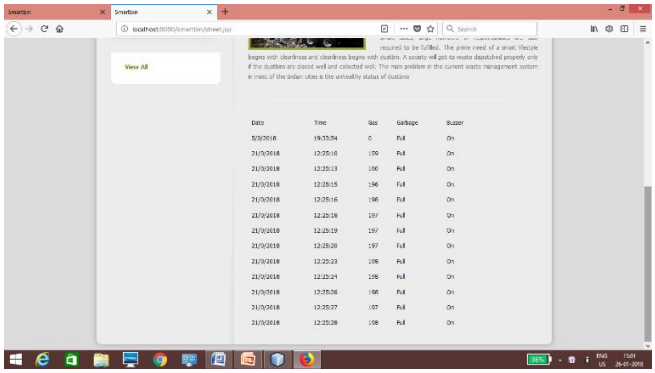


Fig 14: Reading values Display

VI. CONCLUSION

Monitoring the fullness of bins through the use of sensors, it is possible to achieve a more efficient system than the current existing. Our idea of "Smart waste management system", mainly concentrates on Monitoring the waste management, providing a smart technology for waste system, avoiding human intervention, reducing human time and effort and which results in healthy and waste ridden environment.The system is designed to collect data and to deliver the data through wireless mesh network. The system also employs duty cycle technique to reduce power consumption and to maximize operational time. The Smart bin system was tested in an outdoor environment. In our system, the Smart dustbins are connected to the internet to get the real time information of the smart dustbins.

REFERENCES

[1] T. Anagnostopoulos, A. Zaslavsky, "Robust Waste Collection exploiting Cost Efficiency of IoT potentiality in Smart Cities", IEEE 1st International Conference on Recent Advances in Internet of Things (RIoT), 2015, pp. 1-6.

[2] T. Anagnostopoulos, A. Zaslavsky, "Effective Waste Collection with Shortest Path Semi-Static and Dynamic

Routing", IEEE 14th International Conference on Next Generation Wired/Wireless Advanced Networks and Systems (NEW2AN) and 7th Conference on ruSMART, 2014, pp. 95-105.

[3] P. Muthukumaran, and S. B. Sarkar, "Solid waste disposal and water distribution system using the mobile adhoc network", IEEE International Conference on Emerging Trends in Communication, Control, Signal Processing & Computing Applications (C2SPCA), 2013, pp. 1-4.

[4] T. Gomes, N. Brito, J. Mendes, J. Cabral, and A. Tavares, "WECO: A wireless platform for monitoring recycling point spots", IEEE 16th Mediterranean Electro technical Conference (MELECON), 2012, pp. 468-472.

[5] H. Lingling, L. Haifeng, X. Xu, and L. Jian, "An Intelligent Vehicle Monitoring System Based on Internet of Things", IEEE 7th International Conference on Computational Intelligence and Security (CIS), 2011, pp. 231-233.

[6] P. P. Pereira, J. Eliasson, R. Kyusakov, J. Delsing, A. Raayatinezhad, and M. Johansson, "Enabling Cloud Connectivity for Mobile Internet of Things Applications", In the Proceedings of the IEEE 7th International Symposium on Service-Oriented System Engineering (SOSE), 2013, pp. 515-526.

[7] J. Li,Y. Zhang, Y. F. Chen, K. Nagaraja, S. Li, and D. Raychaudhuri, "A Mobile Phone Based WSN Infrastructure for IoT over Future Internet Architecture" ,IEEE International Conference onInternet of Things and Cyber, Physical and Social Computing (iThings/CPSCom), 2013, pp. 426-433.

[8] O. Zhou, and X. Xiaopeng, "Research on In-vehicle Bus Network Based on Internet of Things", IEEE 4th International Conference on Computational and Information Sciences (ICCIS), 2012, pp. 981-984.

[9] F. Reverter, M. Gasulla, and R. Pallas-Areny, "Capacitive level sensing for solid-waste collection", In the Proceedings of IEEE Conference on Sensors, vol. 1, 2003, pp. 7-11.

[10] A. Runka, B. Ombuki-Berman, and M. Ventresca, "Asearch space analysis for the waste collection vehicle routing problem with time windows", In the Proceedings of the 11th Annual ACM Conference on Genetic and Evolutionary Computation,