A Novel and Cost Effective IoT Based System for Handling Garbage using Smart Bin

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Abstract: Waste Management Using Smart Bins is a very innovative system which will help to keep the cities clean. This system monitors the garbage bins 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 compare it with the garbage bins depth. The system makes use of AVR family microcontroller, LCD screen, Wi-Fi modem for sending data and a buzzer. As the scope of IoT is developing day by day effective methods can be found out easily. The LCD screen is used to display the status of the level of garbage collected in the bins, whereas a web page is built to show the status to the user monitoring it. The web page gives a graphical view of the garbage bins and highlights the garbage collected in colour in order to show the level of garbage collected. The LCD screen shows the status of the garbage level. The system puts on the buzzer 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 providing graphical image of the bins via a web page

Keywords: Ultrasonic Sensors, AVR family microcontroller, LCD screen, Wi-Fi modem

1. Introduction

In the present days, the garbage bins or Dust bin are placed at public places which are overflowing due to increase in the waste every day. Because of this an unhygienic condition of environment and also creates bad smell around the surroundings which leads in spreading some deadly diseases and human illness.It also has various impacts on the environment like (i) Water contamination which is detrimental to general health, it negatively impacts local wildlife and ecosystems (ii) due to process of anaerobic biodegradation which can result in methane being released into the air which is 21 times more potent than carbon dioxide which causes air pollution. (iii) Overflowing waste is linked to malaria, cholera, typhoid, gastroenteritis as well as causing chronic diarrhoea, vomiting and stomach pains [1]-[3].

An advanced method in which waste management is automated using Radio frequency identification (RFID) is proposed. The system makes use of radio frequency (RF) tags and web support in an efficient and easy way. The system consists of four main subsystems namely Smart Trash System (STS), Local Base Station (LBS), Smart Vehicle System (SVS) and Smart Monitoring and Controlling Hut (SMCH). The technologies that would be used in the proposed system are good enough to ensure the practical and perfect for solid waste collection process monitoring and management for green environment.[5]

The Internet of Things (IoT) is a trending concept in which objects are connected through wired and wireless networks without human intervention. The objects communicate and exchange information to provide advanced intelligent services for users. Due to the recent advances in smart mobile devices which are equipped with various sensors and communication modules, together with network technologies such as Wi-Fi, the IoT has gained considerable interest of the researchers. The initial realization of IoT was achieved by using RFID technology for the identification and tracking of devices and storing device information. But it was limited to object tracking and extracting information of specific objects only. The current IoT performs sensing, actuating, data gathering, storing, and processing by connecting physical or virtual devices to the Internet. Because of these merits of IoT, waste management has become a significant issue. To handle these problems, various researches into waste management based on IoT technology have been conducted, from studies on RFID technology to studies on waste management platforms and systems [4–12]. However, there remains a lack of research into waste management based on IoT technology

This paper proposes an IoT-based System there are multiple dustbins located throughout the city or the Campus, these dustbins are provided with low cost embedded device which helps in tracking the level of the garbage bins and an unique ID will be provided for every dustbin in the city so that it is easy to identify which

garbage bin is full. When the level reaches the threshold limit, the device will transmit the level along with the unique ID provided. These details can be accessed by the concern authorities from their place with the help of Internet and an immediate action can be made to clean the dustbins.

The paper is organized as follows. In Section 2existing method will be described in detail. Section 3 gives the proposed system and its block diagram. Section 4 and 5 describes the hardware components used and the advantages and disadvantages of the system. Section 6 and 7 discusses on the result and display system. The paper concludes with a brief summary in section 8.

2. Existing System

The present system is a manual method to know about the bin level which is inefficient. Also there is always an increased workload on the municipal workers. Figure 1 is therepresentation of garbage bins in which overflowing wastes are not monitored. The workers have to reach every garbage bin for emptying.

Figure 1: Existing System

3. Proposed System and Block Diagram

This system monitors the garbage bins and informs about the level of garbage in the bins via a web page. Ultrasonic sensors are placed over the bins to detect the garbage level and compare it with the bin's depth. Thelevel of garbage in the bins that are located at various areas monitored at the same time. The bins can be of various sizes and can be of various shapes.
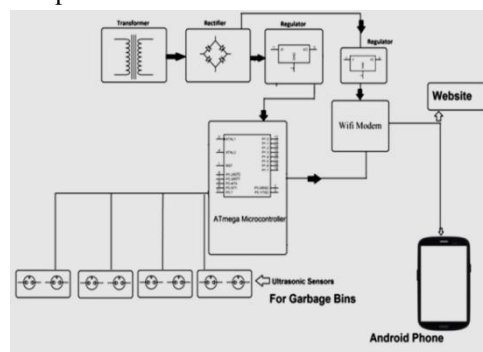

Figure 2: Bock Diagram

Implementation of the above mentioned system requires a block diagram to understand the flow of process easily. Figure 2 shows the Block Diagram of the Proposed System which comprises of Transformer, Rectifier, Regulators, Microcontroller, Ultrasonic Sensors, Wi-Fi module and a Mobile phone or Computer monitor to see the garbage level.The block diagram is having four sub –modules which are (i) power supply module to provide 5V DC supply. (ii) sensing module which has Ultrasonic sensors placed over the bins measures the level of garbage (iii)Wi-Fi Module in which a web page is built to receive the data sent via Wi-Fi module for monitoring the garbage bins status.(iv) Controller Module which has LCD screen to show the status of the garbage level and a Buzzer to indicate when the level of the garbage exceeds the set level

4. Hardware components used

Microcontroller: To get information from sensor and process on it. It compares the received data with the threshold level set and accordingly output is generated.The Atmel ATmega328P is a 32K 8-bit microcontroller based on the AVR architecture. Many instructions are executed in a single clock cycle providing

a throughput of almost 20 MIPS at 20MHz. The ATMEGA328-PU comes in an PDIP 28 pin package and is suitable for use on our 28 pin AVR Development Board or Arduino UNO Board.

WI-FI Modem: The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to Wi-Fi network. The ESP8266 is capable of eitherhosting an application or offloading all Wi-Fi networking functions from another application processor.

The working of module can be seen from the blinking lights of the module. If the blue light blinks, it can understood that the module is sending data to the webpage

Ultrasonic Sensor: Ultrasonic sensor provides a very low-cost and easy method of distance measurement. The sensors placed over the bins measures the level of garbage by comparing it with bin's depth. The ultrasonic sensor measures distance using sonar; an ultrasonic (well above human hearing) pulse is transmitted from the unit and distance-to-target is determined by measuring the time required for the echo

return. Output from the ultrasonic sensor is a variable-width pulse that corresponds to the distance to the target.

LCD (Liquid Crystal Display): LCD screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. GSM Module: It is used to send message to the garbage depot if the Garbage Can exceeds the set threshold level. With the help of GSM module interfaced, we can send short text messages to the required municipal office. GSM module is provided by sim uses the mobile service provider and send sms to the respective authorities as per programmed. It operates at either the 900 MHz or 1800 MHz frequency band

Piezo electric buzzer: A buzzer or beeper is an audio signaling device. A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep. A piezo buzzer which gives a beep whenever any of the Bins is Full.

5. Advantages and Disadvantages

The proposed system possess various advantages which are listed below.

(i) The authorized person can monitor the level of bins from anywhere.

(ii) Optimized route can be found to collect wastes which reduces fuel consumption and energy

(iii) Overflowing of garbage can be eliminated.

(iv) Reduces the workload on municipal workers

The system also has a major disadvantage since Ultrasonic sensors are used to monitor the bins the wastes should be thrown evenly in the bins.

6. Result and discussion

Initially when the Sensors are placed over the Bins the Depth of the Bins is found. Then the level of garbage is calculated every time when wastes are thrown. Sensor values are represented in integer range min 0 to max 5. Figure 3 shows the output observed formthe webpage in which Bin 1 is half filled, Bin 2 is partially filled, Bin3 is empty and Bin 4 is Completely Filled.

Figure 3. Output observed in the web page

Table 1 represents the Various Bins with Various Depth and Garbage level in the Respective Bins. In the monitor, the garbage level is represented in green color which varies as the wastes are thrown in the

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respective bins. The values obtained from the sensor are converted proportionally in the range of 0 to 5 in which 0 represents that the bin is Empty and 5 represents the bin is Full.

Table 1 Depth and Garbage Level observed

Bin	Depth of the Bin (cm)	Garbage Level (cm)
Bin 1	14	3
Bin 2	14	2
Bin 3	10	0
Bin 4	8	5

7. Output from the LCD

The output can also be observed in the LCD. The Figure 4 is the output when Bins are empty. Hence it displays the values as zero which indicates all the four bins namely B1, B2, B3, and B4. Bin 1, Bin 2, Bin 3 and Bin 4 are represented as B1, B2, B3 and B4 respectively
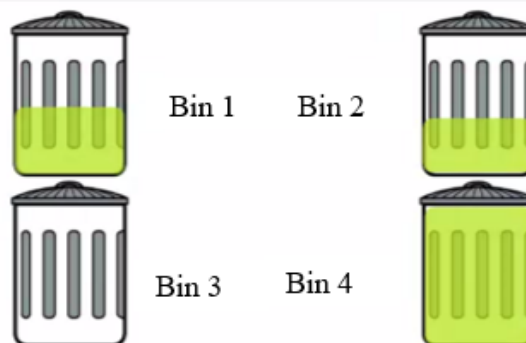

Figure 4 Bins When Empty

Figure 5 shows the condition when the bins are either partially filled or half filled.
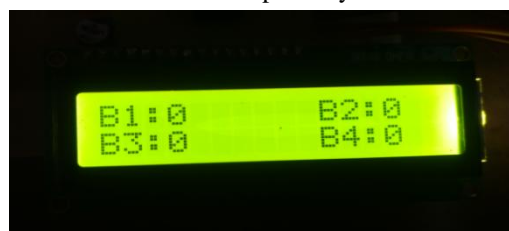

Figure 5: Bins when partially filled

Figure 6 presents the condition in which bin 1 is completely filled, bin2 is partially filled and bin3 and bin4 are empty

Figure 6: Bin When Full

8. Conclusion

This proposal for the management of wastes is efficient and time saving process than the currently employing method in which concerned municipal employee has to look for the filled waste bins manually across different spots in an area/street for checking regularly whether the waste bin is filled or not, which is complex and time consuming process. This system can be implemented at any place with ease and within reasonable amount of time. Thus it helps to keep the cities clean. The authorized person canmonitor the level of bins from anywhere. This system assures emptying of dustbins soon when the garbage level reaches its maximum.

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