IoT-Based Smart Garbage System for Efficient Waste Management

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Abstract: Now-a-days, many cities have placed public dustbins are overflowing due to increase the waste regularly. The bin collector does not clean the dustbins on-time. So, it makes unclean city, polluted environment and unhygienic atmosphere. It spreads bad smell in that waste this may cause illness to our human being's health. To avoid this problem and maintain the surroundings clean and creates healthy atmosphere. The ultrasonic sensor detects the level of waste in dustbin. We designed a low-cost embedded device to city cleanliness which helps to tracking the location from the web server at each and every street. It is easy to identify which dustbin is full or not. Once level reaches the particular limit, automatically sends the information to bin collector. The bin collector will be accessing the mobile phone with the help of internet and they will be taking immediate actions to clean the city.

I. INTRODUCTION

The wastage of anything is harmful for the society. the last word got to developing nation is that the key for "smart city" the influential ecological factor this might include hazardous pollution, effects on human health so Internet of things (IOT) Provides new opportunities for creating cities smarter by introducing the smart waste management system, we are taking key step towards becoming a sensible city we've few garbage bins placed in cites which is overflowing and it checked by local authorities there are all kinds of garbage all disposed in bins and it all dumped together [1, 2]. So, we designed the new concept of waste management disposal using automatic garbage level detecting from ultrasonic sensor and it'll provide real time information about dustbin which is situated city.

The garbage bin is filled this information can be send to the concerned authority person to clean the dustbin for real time information, we use PIC microcontroller [3, 4]. PIC microcontroller is the back bone of communication system which is low cost and high-performance device and straightforward to implementation. PIC microcontroller gives message signal when the dustbin is filled. The main aim of this project is to keep the surrounding clean, healthy and harmless [5-8].

Prakash et.al, 2019 discussed that this system can detect waste level in dustbin and avoid the overflow of dustbin. Chandra N et.al, 2017 highlighted IoT module which is used to control waste & data will be sent to the Organization. Vinoth Kumar et.al, 2017 said that the IoT based Smart waste management System checks the waste level over the dustbins by using sensor systems. Bikramjit Singh et.al, 2016 highlighted that this system to garbage collection providing greater accessibility, planning proper for disposing process [9-11].

II.   PREVAILING SYSTEM

The ESP8266 Wi-Fi module may be a low-cost component with which manufacturers are making wirelessly networkable microcontroller module. ESP 8266 Wi-Fi module may be a system-on-a-chip with capabilities for two .4GHz range. It has 32-bit RISC CPU running at 80 MHz. It is supported the TCP/IP (Transfer control protocol) [12].

It is the foremost important component within the system because it performs the IOT operation. It has 64 kb ROM, 64 kb instruction RAM, 96 kb data RAM. Wi-Fi unit performs IOT operation by sending data to webpage which may be accessed through IP address. The TX, RX pins are connected to the seven and eight pins of the Arduino microcontroller [13, 14].

A waste container is container for temporarily storing waste and typically made out metal or plastic. It contains three types:
1. Trash cans
2. Dumpsters
3. Wheelie bin.

III. SUGGESTED SYSTEM

In this System there are many dustbins located in whole city. These dustbins were designed with low cost embedded device and it helps to tracking the level of the dustbin in the street. The ultrasonic sensor is used to detect the level of waste in the dustbin.

When the level reaches the threshold limit, the LCD will display how much percentage is not yet to fill in the dustbin. When the dustbin is full, the LED is indicating red in colour and the dustbin is not full, the LED is indicating green in color. It is easy to identify which dustbin is full.
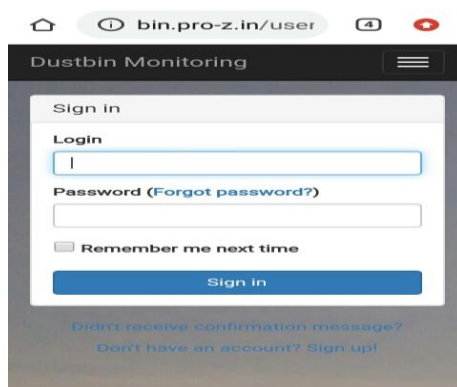
Figure 1. Login page

Figure 2. Information in web browser

The login and web browser information's are shown in Figure. 1 & 2. The web server has sent the data to the web browser link. The web browser in our desktop or mobile phone shows the location and how much waste filled in the dustbins in that street. All these details can be accessed by the bin collector from their place with the help of Internet and they take immediate action can be made to clean the dustbins. The percentage of waste monitoring template is shown in Figure 3.

Figure 3. Waste monitoring in percentage

- This system takes less time to reach particular streets and to use low fuel consumption as the trucks go only to the filled containers.
- To reduce noise, traffic flow and to avoids the overflow of dustbins.
- It is better effective usage of dustbins and makes pollution free.
- It makes surroundings clean, hygienic and healthy atmosphere.
- It reduces the man's power.
- The sensor attached in the container to provide the real time information on the fill level in the dustbin.
- This system has highest accuracy rate and its analysis was too quick.

IV. CONSTITUENTS PORTRAYAL

1. Ultrasonic Sensor

The ultrasonic sensor is used to detect the level of waste in the dustbin which is shown in Figure 4. This sensor has transmitter and receiver. The transmitter sends the ultrasonic signals to the controller. When the obstacles is in-front of the transmitter and it produces ultrasound waves and it get back the reflection from the module. The receiver detects the reflections and sends the signal to the output of the module. It takes 5V for input module.

Figure 4. Ultrasonic sensor

2. ESP8266

The ESP8266 is a powerful Wi-Fi module which will accessing Wi-Fi or internet. It is a low cost, compact and cheap device. It can communicate with any microcontroller. It is a wireless device and most leading devices in the IOT platform. It has 8 pins. There are GND, GPIO 2, GPIO 0, RX, VCC, RST,

CH_PD, TX. The mobile phone must opens the hotspot.ESP8266 has to connect with mobile phone's hotspot. The mobile phone's hotspot is accessed by ESP8266 Wi-Fi module as shown in Figure 5.

Figure 5. ESP8266 Wi-Fi module

3. Liquid Crystal Display (LCD)

Liquid Crystal Display is used to display the status of the waste level in the dustbin as shown in Figure 6. The ultrasonic sensor can calculate the level of waste in the dustbin and sends the data to the LCD. It will display the remaining blank space percentage from the waste in the dustbin. It runs on 4.7V to 5.3V.
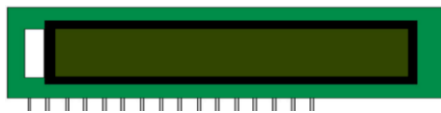

Figure 6. LCD

4. PIC Microcontroller

PIC microcontroller which is shown in Figure 7 is a low cost, easy to handle and flexible. It has EEPROM which makes to store the information permanently and some other related data. There are 40 pins and the input/output pins are 33 pins in pic microcontroller.

Figure 7. PIC Microcontroller

5. Buzzer

Buzzer is a very small, low cost and compact two pin structure is shown in Figure 8. It gives a continuous beep sound for alert. When the waste is full in the dustbin, it indicates the buzzer sound.

Figure 8. Buzzer

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V. FUNCTIONAL BLOCK DIAGRAM

The block diagram as shown in Figure 9 has Pic Microcontroller, Ultrasonic sensor, ESP8266 wi-fi module, LED, Power supply, Web server, LCD and Buzzer. The ultrasonic sensor has transmitter and receiver. The input of this system has waste in the dustbin. The ultrasonic sensor detects the level of the waste in the dustbin. The transmitter from the sensor sends the ultrasonic signals to the PIC microcontroller. The PIC microcontroller receives the signal and reads the data from the sensor. The Power supply is using to drive the PIC microcontroller. The LED is used to identify the dustbins is full or not. ESP8266 wi-fi module receives the data from the controller and it sends the data to the web server. The ESP8266 wi-fi module collects the data from web server. This wi-fi module reads the data and process the signal and sends the signal to the controller. This PIC microcontroller receives the data from the wi-fi module. At the same time, the PIC microcontroller sends the data to the LCD and the buzzer. The LCD is to display how much space in above the waste in dustbin. The buzzer is using to detect the particular level in the dustbin whether the dustbin has filled or not. It gives beep sound to alert the concern authorities.
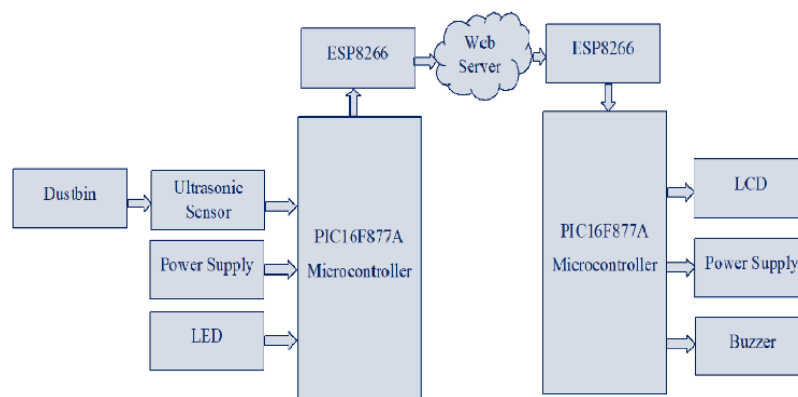

Figure 9. Block diagram

VI. OPERATION OF SUGGESTED SYSTEM

The hardware implementation of proposed technique is shown in Figure 10. The smart dustbin in which ultrasonic sensor is deployed to detect the level of the waste inside the dustbin. The pic microcontroller to read the data from the ultrasonic sensor and the transmitter transmits the dustbin level information to the pic microcontroller. Here, the power supply is used to drive the pic microcontroller and the single-phase supply is converting to 5V DC supply. We are using to connect the mobile hotspot to the two esp8266 wi-fi modules. One part of esp8266 wi-fi module sends the data to the web server. This server receives the data and analyse the information which send gathered information to the another esp8266 wi-fi module. The lcd screen shows the balance space in dustbin. The buzzer gives beep sound when the dustbin filled in 80 percent waste and it gives sound to alert the concern person. All smart dustbins information displayed on the web browser. We can easily access the information anytime and anywhere and the concern person take the immediate action accordingly.
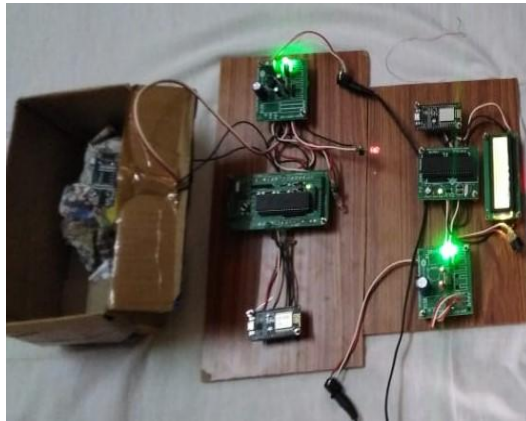
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Figure 10. Hardware implementation

VII. CONCLUSION

We have implemented real time waste management system by using smart dustbin container to see the fill level of smart container whether the dustbin is full or not. In this system the knowledge of all smart dustbins are often accessed from anywhere and anytime by the priority person and he/she can take a choice accordingly. By implementing this proposed system, the value reduction, resource optimization, effective usage of smart dustbins is often done.

In the future, small IoT gadget for waste monitoring are often develop and put inside the dust bin of every house to widening the implementation to the citizen. The appliance developed for this solution are often evolved by adding new facilities that can bring back the highest user more significant interactions with the management system besides integration with a platform, to calculate the only path in collection routes, seeking efficiency with a lower cost of operating the fleet of trucks. Additionally, the investment and operation costs of this solution are getting to be a very interesting study and should be performed.

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