IoT Based Dumpster Monitoring System

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ABSTRACT:

In today's fast and materialistic world, it is very much likely for someone to ignore small details of the society. Specifically when it comes to pollution and global warming, the planet has seen its worst downfall in the last 10-15 years. Detection, monitoring and management of wastes is one of the major problems in today's busy era. The traditional way of manually checking the wastes in dumpsters is an inconvenient way and requires more human effort, time and cost. This can be easily avoided by the Dumpster Monitoring System. This system will tell us whether the trash can is empty or full through the web server and you can know the status of your 'Trash Can' or 'Dumspters' from anywhere in the world over the Internet. It will be very useful and can be installed in the trash cans in public places as well as at home. This IoT based waste management system uses an ultrasonic sensor to check whether a certain trash can is filled to its brim or is empty. It will automatically measure the distance of the garbage present in the dumpster from the top of the trash can and with the help of the threshold value set up by the user(based on the height of the dumpster) it will notify us of the presence of garbage in the can.

If the distance detected will be lesser than the default threshold value, it implies that the dumpster is filled with garbage. With the help of code, we can display the message "Your dumpster is full!" on the webpage. Whereas, if the distance is more than the default threshold value, then the message "Your dumpster is empty!" will be printed out. In this dumpster monitoring system, we will use ESP8266 Wi-fi module for connecting the Arduino to the web server.

KEYWORDS:

Detection, Monitoring, Dumpster, Management, waste management, IOT, Embedded Systems

INTRODUCTION:

Iot based dumpster management system is an upcoming and efficient technology which will be successful in monitoring the pollution level and controlling it to some extent. Hence, it can be used for almost all the public places where we can get a stable and reliable access to the Internet or Wi-Fi. It can also be used in industrial garbage bins and also large-scale dumping grounds that will ultimately result in the reduction of air pollution. So, what has always happened is that Garbage vans or trucks come to our premises so as to pick the garbage and dump which also requires manual effort and expenses and maintenance of the vehicles to be taken care of. What if the area's garbage bins are empty or less filled? Extra effort of human beings are required also for other costs. So as to prevent this kind of situation we have come up with this project where the garbage bins will be continuously monitored and the garbage will only be picked when necessary.

An advanced and deeply researched form of this management system can also help in segregating the dry and wet waste and also detect the toxic substances present in the dumpster. Installation of such IoT based dumpsters will also help the government bodies to manage and recycle the waste in an effective as well as fruitful manner. This system is also cost-effective and small-sized.

HARDWARE DISCRIPTION:

1) Arduino Uno:

A Microcontroller board which is based on ATmega328p data. The basic structure of Arduino Uno consists of USB connection jack, Digital pins,

reset switch, TX RX leds, Microcontroller, analog input pins, power port, voltage regulator, crystal oscillator, USB interface chip. The TX RX pins are Receiving and Transmitting pins of Arduino used for Serial communication and the leds are connected in arduino fabrication. When the leds blink we get the data flowing direction. Arduino Uno has 14 digital input/output pins in which 6 of the pins are used for PWM outputs and has 6 analog inputs. An ICSP header is present and a 16 MHz ceramic resonator (CSTCE16M0V53-R0).

There are benefits of Arduino Uno in terms of its low cost, it is an open source hardware, easy programming, open source in software as well, the IDE software can operate on any Operating System. The major three parts of the Arduino Uno are its functions, values (variables and constants), as well as its structure. Arduino Uno is used or preferred over any other Arduino products because the board can be easily connected to other systems using the USB connectors. It can also be used for supplying the power to the board and can also act as a serial device to connect the board to the computer system.

2)HC-SR04 Ultrasonic Sensor:

The HC-SR04 Ultrasonic Sensor is used to detect the distance of an object using sonar technology. Its prime objective is to avoid any kind of obstacle that occurs due to the inaccuracy in measuring the distance. It basically uses a non-contact ultrasound sonar for measuring the distance.

The ultrasonic sensor can feasibly measure distance from 2cm to 400cm or from 1inch to 13feet. Further, the sensor emits an ultrasound wave at the frequency of 40kHz. Now, if the object comes in its way, it will be bouncing back to the sensor as it comes across as a

form of an obstacle. During the time(the time difference between the strike time and the response time) the distance will be calculated by using some clever math and a significant formula.

The Ultrasonic sensor has four pins. Out of these 4 pins, two are the VCC and GND that will be connected to the 5V and the Ground(GND) of the Arduino respectively. The remaining two i.e. the Trig and Echo pins will be connected to any of the digital pins of the Arduino. This trig pin will transmit the signal whereas the Echo pin will be used to receive the transmitted signal. In order to generate an ultrasound signal, we have to make the Trig pin high about 10μs which will send 8 cycle sonic bursts at the speed of sound. After it strikes the object, it will be received by the Echo pin.
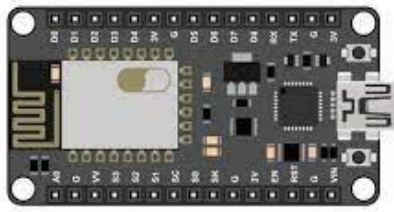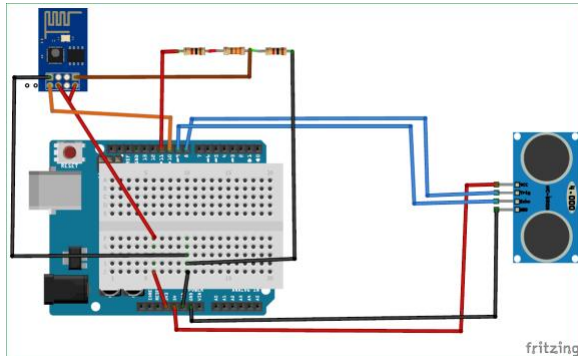
3)ESP8266 Wi-Fi Module:

Any kind of simulation project will surely need a stable access to the Internet. Similarly, the dumpster management system needs to connect with the Wi-Fi or the Internet to send prompt messages to the user via the database. Here, the ESP8266 is a Wi-Fi module that will be used to access the Wi-Fi or the Internet. It can effectively communicate with any nearby microcontroller hence making the project wireless. It runs on 3.3V. It should not exceed the limit of 5V or else it will get damaged.

The ESP8266 includes 8 pins. Out of these pins the VCC and CH-PD will be connected to the 3.3V to enable the Wi-Fi. Further, the TX and RX pins are responsible for the communication of ESP8266 and the Arduino Uno.

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CIRCUIT DIAGRAM:

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Circuit Diagram Explanation:

After collecting and studying all the components we have to assemble and understand the circuit diagram. The Wi-Fi module ESP8266 should be first connected to the Ardunio Uno board. The Wi-Fi module is temperature sensitive so the voltage suppy should be if 3.3V. If 5V supply is provided from the Arduino then the ESP8266 Wi-Fi module will get damaged. Now, connect the VCC and the CH_PD to the 3.3V pin of Arduino. At receiver - The RX which is the pin of ESP8266 that works on 3.3V and thus it will not communicate with the Arduino if we will connect it directly to the Arduino. Thus, here the voltage divider will be implemented. So, connecting three 1k ohm resistors in series for a small scale circuit will do. Now, connecting RX to the pin 11 of our Arduino board connecting through the resistors connected. And the TX of the Arduino to the pin 10 of Arduino.

The connections of the ultrasonic sensor with the Arduino are very simple. We have to connect the HC-SR04 ultrasonic sensor with the Arduino Uno board. Connect the VCC pin and the ground pin of the HC-SR04 Ultrasonic Sensor to the 5V and the ground of the Arduino. Lastly, we have to connect the TRIG and

ECHO pin of Ultrasonic Sensor to the pin 8 and pin 9 of our Arduino Uno respectively.

Source Code:

```
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance= duration*0.034/2;


if(esp8266.available())
 {
  if(esp8266.find("+IPD,"))
  {
   delay(1000);
   int connectionId = esp8266.read()-48;
   String webpage = "<h1>IOT Garbage Monitoring
System</h1>";
     webpage += "<p><h2>";
     if (distance<5)
     {
     webpage+= " Trash can is Full";
     }
     else{
       webpage+= " Trash can is Empty";
       }
     webpage += "</h2></p></body>";


String sendData(String command, const int timeout,
boolean debug)
{
  String response = "";
  esp8266.print(command);
  long int time = millis();
  while( (time+timeout) > millis())
  {
   while(esp8266.available())
   {
    char c = esp8266.read();
    response+=c;
   }
  }
  if(debug)
  {
```

```
    Serial.print(response);
    }
    return response;
}
```

Email SMS Prompt Code:

```
#include<SoftwareSerial.h> //including the library for the software serial
#define DEBUG true
SoftwareSerial esp8266(10,11); /*This will make the pin 10 of arduino as RX pin and pin 11 of arduino as the TX pin which means that you have to connect the TX from the esp8266 To the pin 10 of arduino and the RX from the esp to the pin 11 of the arduini*/
```

Code Explanation:

Before uploading the code, make sure that the Wi-Fi connectivity is present with the Wi-Fi of ESP8266. The full code is mentioned in the Code section below. The code is explained through the comments along with which we have also listed some important functions below.
So, initially the Arduino will first read the Ultrasonic Sensor. It will send an ultrasonic signal at the speed of sound when we make the TRIG pin high for 10us. The signal will come back after striking the object and we will store the travel time duration in the variable named duration. Then we will calculate the distance of the object (garbage in our case) by applying a formula and will store it in the variable named distance. For the output:

To print the output on a webpage in the web browser, we will use HTML language. Here, creating a string which is named as webpage which will store the output in it. Using a condition to tell whether our trash can is empty or not. If the distance is less than 5cm in the trash can it will show a message "Basket is full" on the webpage and if distance is greater than 5 cm it will show a message as "Basket is Empty" on the webpage.

TESTING AND RESULT::

After the setup and connections successfully done and code being uploaded, open the Serial Monitor which will show ip address as below
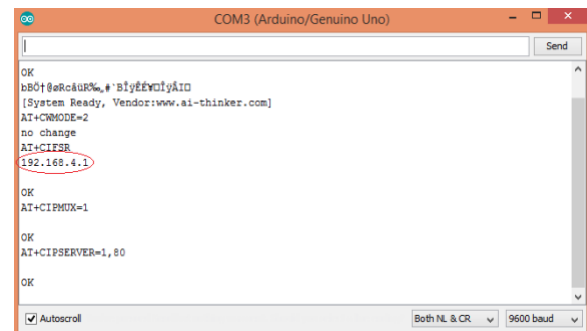
Thus, type this ip address in the browser and it will show output as below. And later on refresh the page if you have to see whether the trash can is now full or empty.

And the implementation email/sms code: The procedure goes the same only the difference is we will get an email or sms prompt when the trash is full.

CONCLUSION:

The main objective is to make our life easier and to maintain cleanliness around. In this fast moving world

one thing has always come into picture is the Garbage and its management. Nowadays, as per the population the generated garbage is simultaneously increasing, let it be wet garbage or dry or any other type of garbage. The most important thing to focus upon is the management of garbage. Thus, by implementing this project we focused upon how to continuously monitor the garbage bins of our area and thus will directly lessen the manual effort and vehicle expenses and maintenance too. We can implement this system anywhere in schools, companies or in certain areas when a person can too have an application where the garbage updates will appear. Thus, that individual can call the appropriate people. In future, a team can be created which will be in charge of handling and also to take care of its maintenance. Also people for application handling can be created as well. The system can be used as a benchmark by the people who are willing to take one step further for increasing the cleanliness in their respective areas.

ACKNOWLEDGMENT:

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