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IOT Based Garbage Monitoring Using Arduino

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ABSTRACT
This paper attempt to IoT based garbage bin level monitoring system or simply IoT smart dustbin where real time garbage fill level can be monitored via internet. The proposed system uses non-contact method (Arduino based) for measuring garbage level and it can detect solid, semi-solid and liquid waste.Today, one of the challenges of most cities and towns are confronting is the decline in condition of cleanness of the environment regarding the garbage management. This occurs due to the mismanagement of the garbage collection. This mismanagement creates the spread of garbage in community which in turn creates unhealthy condition in the immediate area. It also stimulates several serious diseases amongst the people in close proximity and degrades the beauty of the area. To avoid mismanagement of the garbage and to improve the cleanness of the society, Garbage monitoring system is designed.
Key words: *Garbage, Monitoring System, Internet of Things and Arduino and Ultrasonic Sensor*

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I. INTRODUCTION

We are living in an age where tasks and systems are fusing together with the power of IOT to have a more efficient system of working and to execute jobs quickly! With all the power at our finger tips this is what we have come up with. The Internet of Things (IoT) shall be able to incorporate transparently and seamlessly a large number of different systems, while providing data for millions of people to use and capitalize. Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system. One of the main concerns with our environment has been solid waste management which impacts the health and environment of our society. The detection, monitoring and management of wastes is one of the primary problems of the present era. The traditional way of manually monitoring the wastes in waste bins is a cumbersome process and utilizes more human effort, time and cost which can easily be avoided with our present technologies. This is our solution, a method in which waste management is automated. This is our IoT Garbage Monitoring system, an innovative way that will help to keep the cities clean and healthy.

The problem

Nowadays, there are tons of flats and apartments which have been built in the rapid urbanization area. This is due to high housing demands which have been drastically risen as a result of migration from villages to cities to find work. In order to accommodate the growing population in the urban area, the government has also constructed more apartment complexes. There are several issues faced by the residents of the flats. One of them is disposal of solid waste. Unlike private houses, the residents of all the apartments use a common dustbin, which tends to fill up very quickly. This overflowing of garbage is a sanitary issue which might cause diseases like cholera and dengue. Moreover it is a waste of fuel to travel around a complex or an area to find that some of the garbage are filled and some are not. Also, on rare days, problems might arise that there is so much garbage that the truck doesn't have enough capacity. The idea struck us when we observed that the garbage truck use to go around the town to collect solid waste twice a day. Although this system was thorough it was very inefficient. For example let's say street A is a busy street and we see that the garbage fills up really fast whereas maybe street B even after two days the bin isn't even half full. This example is something that actually happens thus it lead us to the "Eureka" moment!

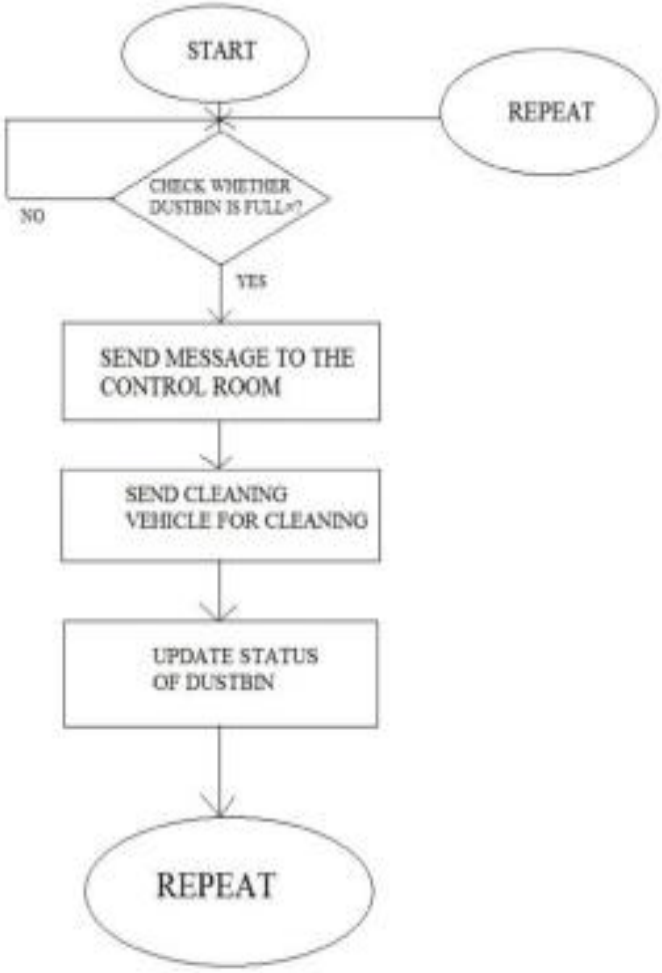


FIG: 1. Flow chart of project

What our system does is it gives a real time indicator of the garbage level in a trashcan at any given time. Using that data we can then optimize waste collection routes and ultimately reduce fuel consumption. It allows trash collectors to plan their daily/weekly pick up schedule. An Ultrasonic Sensor is used for detecting whether the trash can is filled with garbage or not. Here Ultrasonic Sensor is installed at the top of Trash Can and will measure the distance of garbage from the top of Trash can and we can set a threshold value according to the size of trash can. If the distance will be less than this threshold value, means that the Trash can is full of garbage and we will print the message "Basket is Full" on the message and if the distance will be more than this threshold value, then we will print the distance remaining for the garbage vat to be full.

HARDWARE REQUIREMENTS

We will need the following hardware to accomplish our project.

1. HC-SR04 ultrasonic sensor.
2. Arduino Uno.
3. GSM module
4. Connecting wires.

ARDUINO UNO

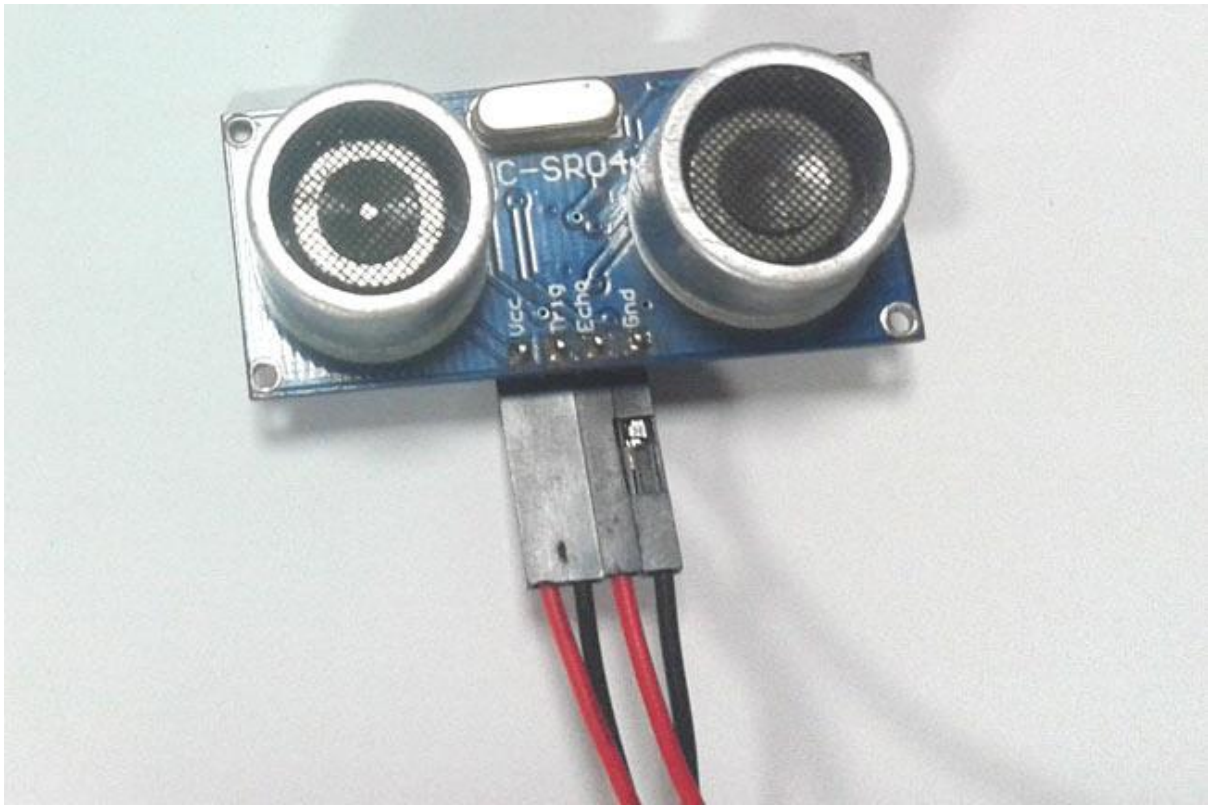
Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of

hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package. The Arduino is a microcontroller board based on the ATmega8. It has 14 digital - input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with aACto-DC adapter or battery to get started.

HC-SR04 Ultrasonic Sensor

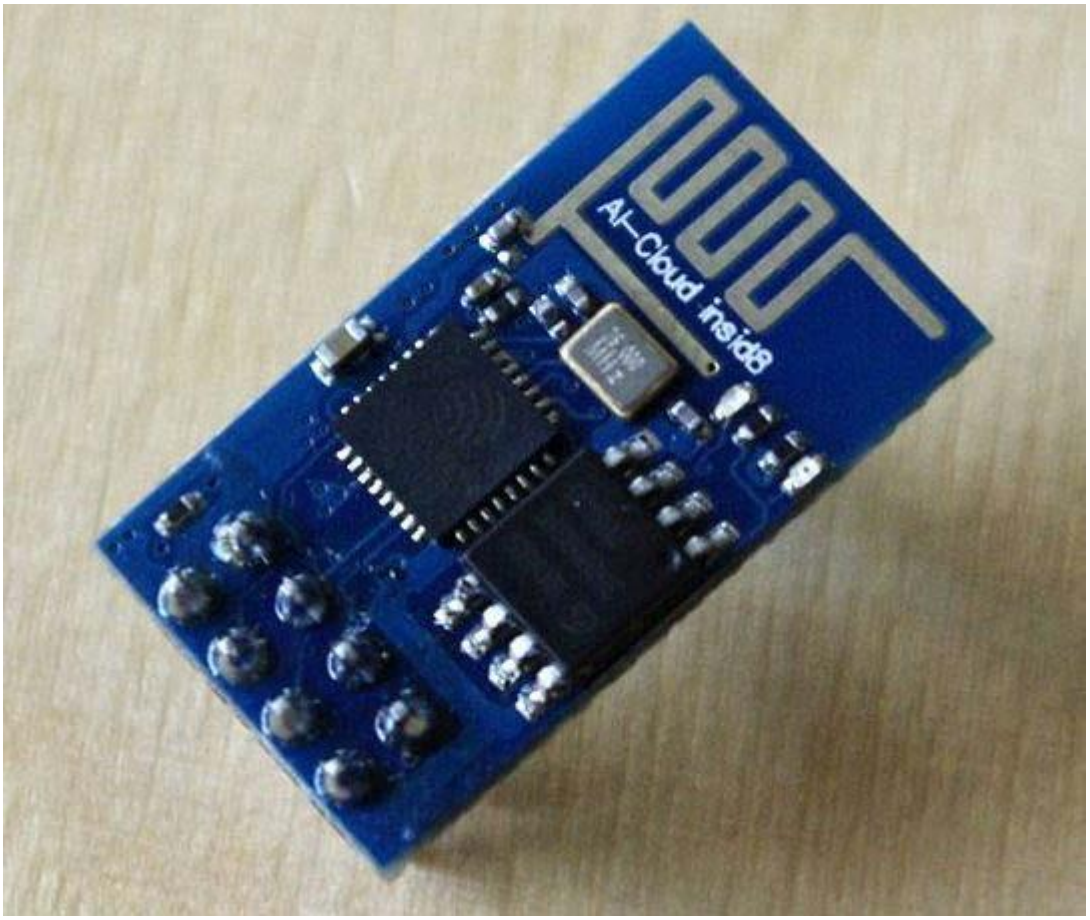
The Ultrasonic Sensor is used to measure the distance with high accuracy and stable readings. It can measure distance from 2cm to 400cm or from 1 inch to 13 feet. It emits an ultrasound wave at the frequency of 40KHz in the air and if the object will come in its way then it will bounce back to the sensor. By using that time which it takes to strike the object and comes back, you can calculate the distance.



The ultrasonic sensor has four pins. Two are VCC and GND which will be connected to the 5V and the GND of the Arduino while the other two pins are Trig and Echo pins which will be connected to any digital pins of the Arduino. The trig pin will send the signal and the Echo pin will be used to receive the signal. To generate an ultrasound signal, you will have to make the Trig pin high for about 10us which will send a 8 cycle sonic burst at the speed of sound and after striking the object, it will be received by the Echo pin.

ESP8266 Wi-Fi Module:

ESP8266 is a Wi-Fi module which will give your projects access to Wi-Fi or internet. It is a very cheap device but it will make your projects very powerful. It can communicate with any microcontroller and make the projects wireless. It is in the list of most leading devices in the IOT platform. It runs on 3.3V and if you will give it 5V then it will get damage.

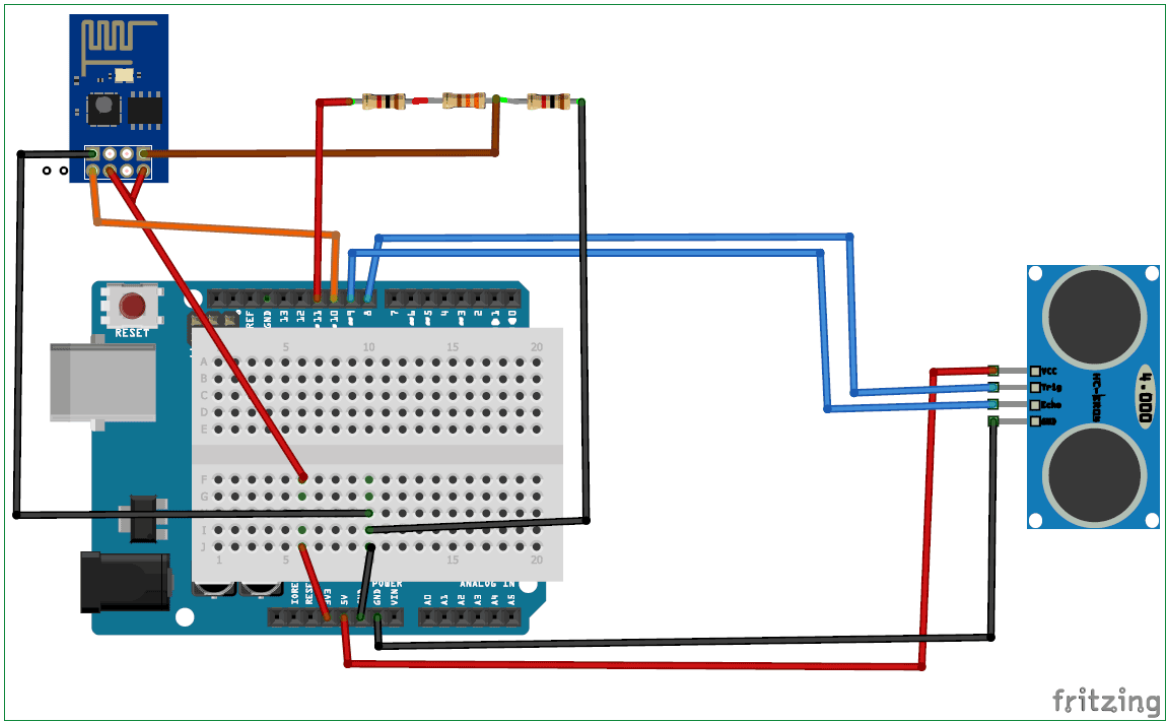


The ESP8266 has 8 pins; the VCC and CH-PD will be connected to the 3.3V to enable the wifi. The TX and RX pins will be responsible for the communication of ESP8266 with the Arduino. The RX pin works on 3.3V so you will have to make a voltage divider for it as we made in our project.

Circuit Diagram and Explanation

First of all we will connect the ESP8266 with the Arduino. ESP8266 runs on 3.3V and if you will give it 5V from the Arduino then it won't work properly and it may get damage. Connect the VCC and the CH_PD to the 3.3V pin of Arduino. The RX pin of ESP8266 works on 3.3V and it will not communicate with the Arduino when we will connect it directly to the Arduino. So, we will have to make a voltage divider for it. Three 1k resistors connected in series will do the work for us. Connect the RX to the pin 11 of the Arduino through the resistors as shown in the figure below and also the TX of the Arduino to the pin 10 of the Arduino.

Now it's time to connect the HC-SR04 ultrasonic sensor with the Arduino. Connections of the ultrasonic sensor with the Arduino are very simple. Connect the VCC and the ground of the ultrasonic sensor to the 5V and the ground of the Arduino. Then connect the TRIG and ECHO pin of ultrasonic sensor to the pin 8 and 9 of the Arduino respectively.



Code Explanation:
Before uploading the code, make sure that you are connected to the Wi-Fi of your ESP8266 device. You can check the full code in Code section below, code has been well explained by the comments, further we have also explained some important functions below.

The Arduino will first read the Ultrasonic Sensor. It will send a ultrasonic signal at the speed of sound when we will make the TRIG pin high for 10us. The signal will comeback after striking the object and we will store the travel time duration in the variable named *duration*. Then we will calculate the distance of object (garbage in our case) by applying a formula and will store it in the variable named *distance*.

```
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);
intconnectionId = 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, constint timeout, boolean debug)
{
    String response = "";
esp8266.print(command);
longint time = millis();
while( (time+timeout) >millis())
    {
while(esp8266.available())
      {
char c = esp8266.read();
response+=c;
      }
    }
if(debug)
    {
Serial.print(response);
    }
return response;
}
```

For printing the output on the webpage in web browser, we will have to use HTML programming. So, we have created a string named *webpage* and stored the output in it. To tell whether the trash can is empty or not, we have applied a condition there**.** If the distance will be less than 5cm then it will show "Basket is full" on the webpage and if the distance will be greater than 5cm then it will show the message "Basket is Empty" on webpage.

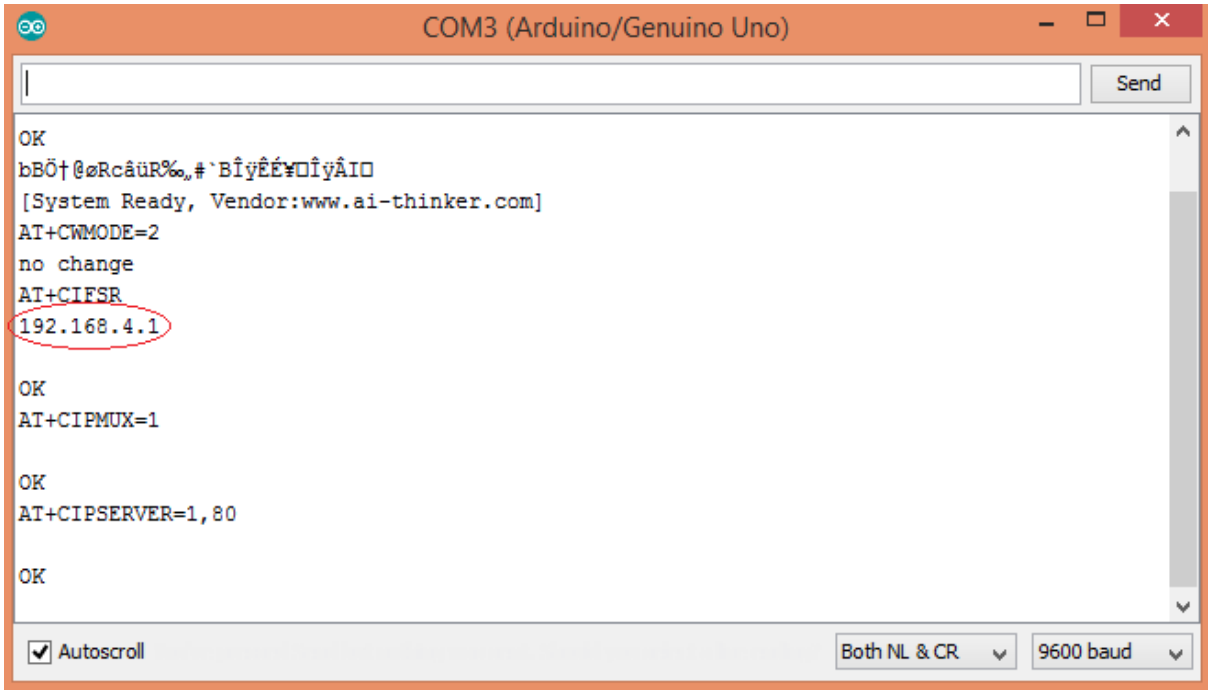
The following code will send and show the data on the webpage. The data, we stored in string named *'webpage',* will be saved in string named *'command'*. The ESP8266 will then read the character one by one from the *'command'* and will print it on the

webpage.

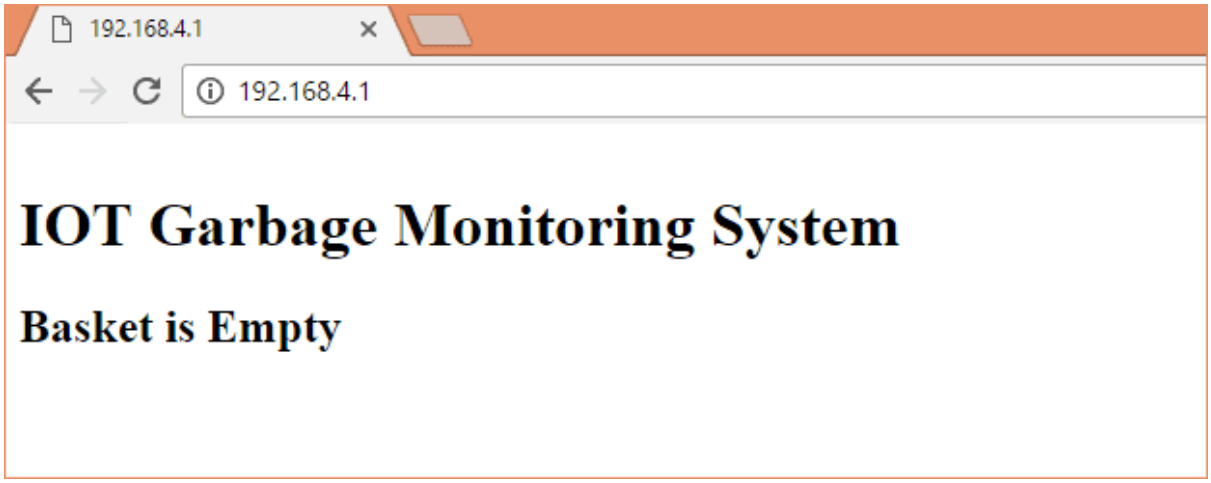
```
String sendData(String command, constint timeout, boolean debug)
{
    String response = "";
esp8266.print(command);
longint time = millis();
while( (time+timeout) >millis())
    {
while(esp8266.available())
      {
char c = esp8266.read();
response+=c;
      }
    }
if(debug)
    {
Serial.print(response);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

Testing and Output of the Project:

After uploading the code, open the Serial Monitor and it will show you an IP address as shown below.



Type this IP address in your browser, it will show you the output as shown below. You will have to refresh the page again if you want to see again that the trash can is empty or not.



So this how this Garbage Monitoring System works, this project can be further enhanced by adding few more features in it like we can set one more message when the Trash Can is half filled or we can trigger a Email/SMS to alert the user when Trash Basket is full.

II. CONCLUSION

In this paper an Arduino sensor based automated garbage monitoring system is developed to monitor the garbage through the city. The system is more effective in informing the municipalities about the status of the garbage at garbage bin location when the status of the garbage becomes full. Measuring the level of the garbage and informing the society and municipalities about at which level the garbage is and informing the driver to collect the garbage is the main feature that is developed in the project which makes the system more reliable and efficient. The motion detection mechanism is done by PIR sensor to that makes use of infrared waves to find the presence of an object towards the bin while the garbage is full. The interface and software can be modified and redeveloped according to the requirement of the system for different city municipals with further research to boost its efficiency and performance. Although the development of the automated garbage monitoring system is

good, there are things to be recommended to work on it in the future. First of all it is recommended to add camera to the system to capture the image of the surrounding while the people try to drop the garbage outside the bin which we will be used for penalty and to add smell sensor and moisture sensor to sense the environment and bin moisture so that it will have more efficiency and simple usability.

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