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ABSTRACT

Nowadays, there are many flats and apartments which have been built in the rapid urbanization area. 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 of garbage that the truck doesn't have enough capacity. Many times, the garbage truck needs to go around the town to collect solid waste twice a day. Although this system was thorough it is very inefficient.

For example, let's say street 1 is a busy street and we see that the garbage fills up really fast whereas maybe street 2 even after two days the bin isn't even half full. So, this leads to the unnecessary wastage of time, fuel of the municipal department and also when they are not aware of a rapidly filling bin in some area, they might not come on a regular basis to collect the garbage leading to pollution and other consequences. All this could be because the municipal department might not have a real time monitoring system of the garbage bins across the area or city.

In this project garbage monitoring system, I tried to implement this idea in a small scale to show its efficiency. We can place 3 to 4 dustbins on the model and attach an ultrasonic sensor to each dustbin. When the garbage is full in a dustbin (known by the ultrasonic sensor) a signal is sent to the micro controller which in turn alerts the truck to go in that path to clear the trash. Ultrasonic sensor is used to detect level in the dustbin whether the dustbin is full or not. Here the Arduino is used to read the data from the sensor and process the data received from sensor, and the same data wirelessly transmitted to the channel using Wi-Fi module. Now this system can be used in certain areas but as soon as it proves its credibility it can be used in all the big areas. As this system also reduces manual work certain changes can be done in the system to take it to the next level and make it more useful for the employees and people who will be using it.

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1. INTRODUCTION

1.1 Introduction to IoT

IoT or Internet of Things refers to the network of connected physical objects that can communicate and exchange data among themselves without the need of any human intervention. It has been formally defined as an “Infrastructure of Information Society” because IoT sanctions us to amass information from all kind of mediums such as humans, animals, conveyances, kitchen appliances. Thus, any object in the physical world which can be provided with an IP address to enable data transmission over a network can be made part of IoT system by embedding them with electronic hardware such as sensors, software and networking gear. IoT is different than Internet as in a way it transcends Internet connectivity by enabling everyday objects that utilizes embedded circuits to interact and communicate with each other utilizing the current internet infrastructure.

Since then the scope of IoT has grown tremendously as currently it consists of more than 12 billion connected devices and according to the experts it will increase to 50 billion by the end of 2020. With the advent of IoT both manufacturers and consumers have benefited. Manufacturers have gained insight into how their products are used and how they perform out in the real world and increase their revenues by providing value added services which enhances and elongates the lifecycle of their products or services. Consumers on the other hand have the ability to integrate and control more than one device for a more customized and improved user experience.

1.2 Overview of the proposed system

In this project, we are going to propose a system for the immediate cleaning of the dustbins or garbage bins. As dustbin is considered as a basic need to maintain the level of cleanliness in the city, so it is very important to clean all the dustbins as soon as they get filled. We will use ultrasonic sensors for this system. The sensor will be placed on top of bin which will help in sending the information to the office that the level of garbage has reached its maximum level. After this the bin should be emptied as soon as possible. The concept of IoT when used in this field will result in a better environment for the people to live in. No more unsanitary conditions will be formed in the city. With the help of this

system minimal number of smart bins can be used around the whole city and the city will still be much cleaner.

There has been an unprecedented growth in the number of devices being connected to the internet since past few years. All these devices connected to the internet are part of the IoT infrastructure which can communicate with each other. The IoT network consists of embedded electronics, sensors and software that allows these devices to send and receive data among each other. This is why it is beneficial to use such an existing infrastructure for designing the proposed system.

The disadvantages of the existing system are that the employees have to go and check the bins daily whether they are filled or not, it results in high cost. If the bin doesn't get emptied on time then the environment becomes unhygienic and illness could be spread. The proposed system will help in removing all these disadvantages. The real-time information can be gained regarding the level of the dustbin filled on the system itself. It will also help in reducing the cost as the employees will have to go only at that time when the bin is full. This will also help in resource optimization and if the bins will be emptied at time then the environment will remain safe and free from all kinds of diseases. The cities will become more cleaner and the smells of the garbage will be much less.

2. BACKGROUND OF THE WORK

2.1 Literature review

A Smart Dustbin proposed by [1], based on IoT in which the smart bin was built on a platform which was based on Arduino Uno board which was interfaced with a GSM modem and an ultrasonic sensor. The sensor was placed on the top of the bin. A threshold level was set as 10cm. As the garbage reaches the level of threshold, the sensor triggers the GSM modem which alerts the associated authority till the garbage in the bin is emptied. At the end a conclusion was made that various issues like affordability, maintenance and durability were addressed when these smart bins were designed. It also contributed towards a hygienic and clean environment in the process of building a smart city. The researchers [2] suggests the method for garbage management which is as follows. The bin was interfaced with a system based on microcontroller which had IR wireless systems with a central system that showed the current status of the garbage in the bin. The status was seen on a mobile based web browser with a html page by using Wi-Fi.

To reduce the cost, they only used weight-based sensors and on the sender's side they only used a Wi-Fi module to send and receive the data. In the end the sensor could only detect the weight of waste present in the bin but not the level of waste. The author proposed a method for organizing the collection of the garbage in the commercial and residential areas of the cities [3]. In this system, the level of garbage in the bin was detected by the ultrasonic sensor which will send the data to the control room using the GSM module. A GUI was also developed to check the information that was related to the garbage for different locations, GUI was based on MATLAB so it was different. Two units were present in the system, slave unit was in the bin whereas the master unit was there in the control room. The sensor will check the level of garbage and send it to the slave unit which will further send the data to master unit which at last will inform the authorities to clean the bin. This paper proposed Decision Support System which would be used for garbage collection in the cities [4]. This system handled the ineffective waste collection in the inaccessible areas of the city. The cameras were placed in those parts of the cities which were facing the most problems. The system worked in two parts, the first part was to find the companies that were involved in collecting the waste and owned trucks and who could also organize some drivers for collecting the garbage from various parts of the city in the truck and pass on the city dumps or the recycling organizations. The second part was to make a system which could handle all the communications of all the people involved and could also maintain the data which will be collected while working around in the city. Various bins were placed around the city which were provided with an embedded device which was low in price and helped in tracking the garbage level in the bins [5]. A different ID was provided to each bin so that it could be easier to detect that which is bin is full and ready to be emptied. The project is divided into two sections one being the transmitter section and other the receiver section. The transmitter section consists of a microcontroller and sensors which check the level of the garbage and the data is passed onto the system with the help of the RF Transmitter, then RF Receiver receives the data and sends it to the client associated so that the bin can be emptied quickly. Anitha et al (2016) proposed a home automation system using IOT uses raspberry for the implementation [6]. Also proposed a model for cyber security systems using artificial system to have secured transactions [7].

3. OVERVIEW OF THE WORK

3.1 Problem description

Nowadays, there are many flats and apartments which have been built in the rapid urbanization area. 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.

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For example, let's say street 1 is a busy street and we see that the garbage fills up really fast whereas maybe street 2 even after two days the bin isn't even half full. So, this leads to the unnecessary wastage of time, fuel of the municipal department and also when they are not aware of a rapidly filling bin in some area, they might not come on a regular basis to collect the garbage leading to pollution and other consequences. All this could be because the municipal department might not have a real time monitoring system of the garbage bins across the area or city.

In this project, we tried to bring out a feasible and an efficient solution to this problem.

3.2 Working model

3.2.1 Connecting components

The existing system has the limitations as time consuming, trucks go and empty the containers, even they are empty. The cost is high with unhygienic environment. Even the bad odour causes the unhealthy environment. So, proposed model talks about how to make use of the recent advancements in technology to make our place clean and tidy. The implementation starts by setup ESP8266 by flashing the latest version of the firmware. This enables the Blynk libraries efficiently communicate and avoid producing error. To flash the latest firmware, download the ESP8266 flasher tool and

the latest firmware from the internet which would be in the bin format and flash the ESP8266 with it. Once the ESP8266 flashing done, other components can be added to the configuration. we need a breadboard to connect the microcontroller, ultra sonic sensor, buzzer and the ESP8266 using the jumper wires. The breadboard is used to interface between the various components available. It also makes it easy to connect multiple inputs to a single pin on the Arduino board. The connection of hardware parts is shown in figure 1.



Figure-1: Hardware components connection.

Following circuit diagram as shown in Figure 2, shows how the components are supposed to be connected together using the breadboard and the jumper wires. The architecture diagram is shown in figure 3.

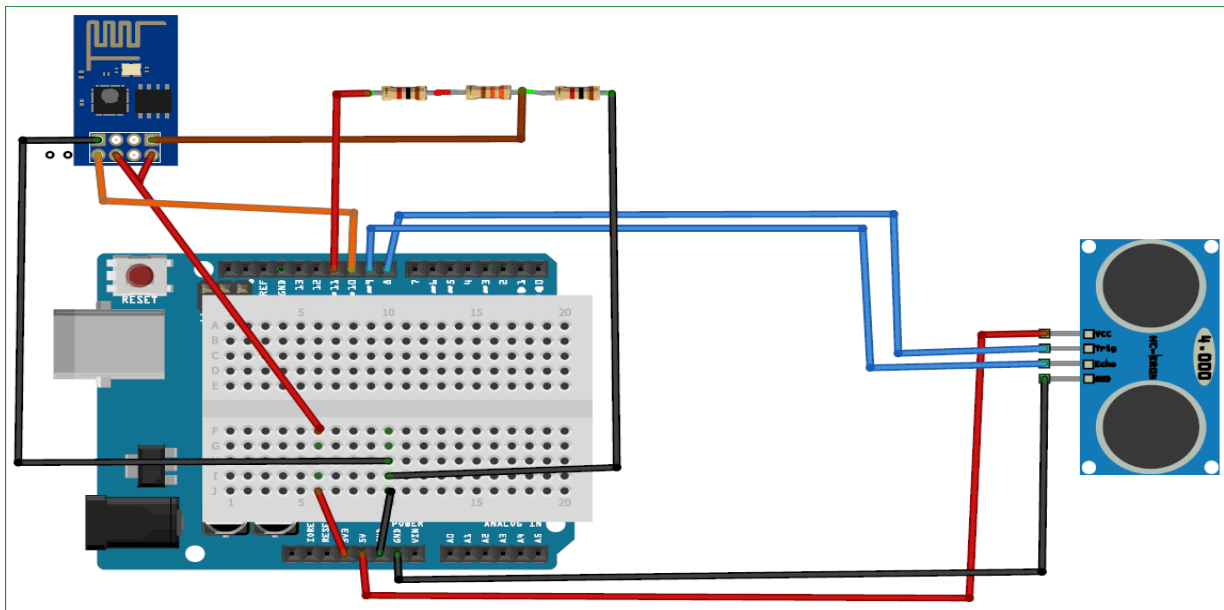


Figure-2: Circuit Diagram.

The below diagram is the architecture diagram of this system.

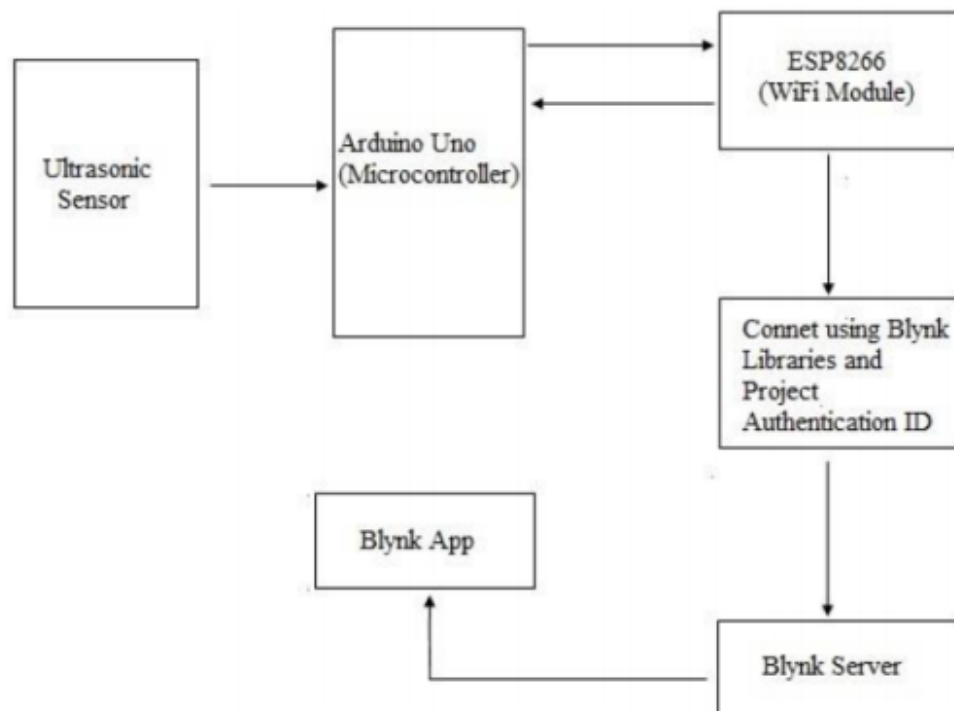


Figure-3: Proposed model - Architecture Diagram

3.2.2. Configuring Blynk app

To connect to the internet, we make use of a prebuilt platform called Blynk app. After the user installs the Blynk app on the smartphone, an account to be created in the app to access its services. The services are enabled for the signed users. Let us create an account and add a new project to get started. A unique authentication code is used by the code to communicate with the project. The Blynk needs to be running in the background for the user to get real time notifications. The working process of the proposed model can be clearly seen in the following figure 4. The configuration of Blynk app and account creation is shown in figure 5.

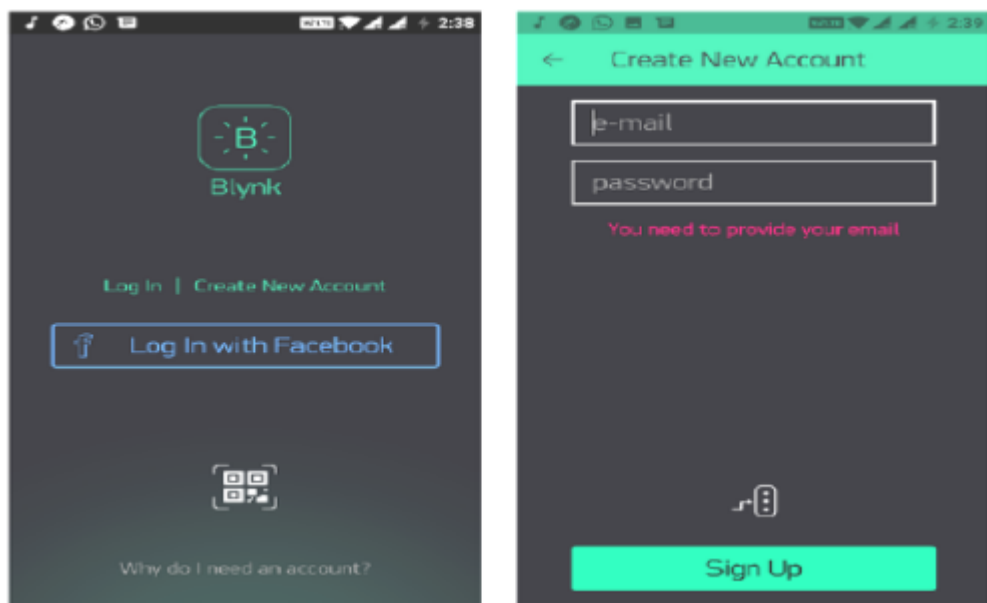


Figure-4 Configuration with Blynk app and account creation

The below figure depicts the working process of the proposed system.

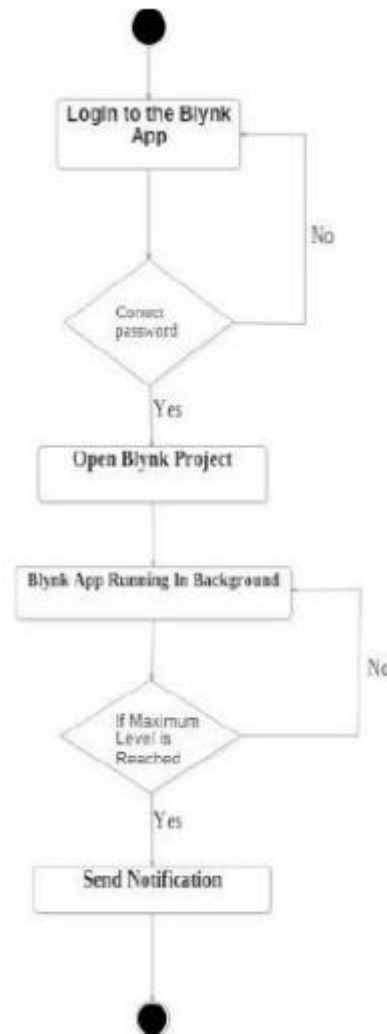


Figure-5 Working process of the proposed model

3.3 Design description

3.3.1 Materials used

(i) Arduino Uno

Arduino is an open source, PC paraphernalia and programming organization, endeavour, and client group that plans and produce microcontroller packs for constructing programmed devices and intelligent object that can detect and control questions in the real world. The inception of the Arduino began at the Interaction Design Institute in Ivrea, Italy. The equipment reference plans are appropriated under a Creative Commons Attribution Share. Arduino Uno is shown in figure 6.



Figure-6 Arduino Uno

(ii) 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 it used for implementation. ESP8266 is shown in figure 7.



Figure-7 ESP8266.

(iii) 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. Distance can

be measured by equation 1. $\text{Distance} = \text{Time} * \text{sound speed} / 2$. (1) Where Time = the time between an ultrasonic wave is received and transmitted. It 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 an 8-cycle sonic burst at the speed of sound and after striking the object, it will be received by the Echo pin. Ultra sonic sensor as shown in figure 8.



Figure-8 Ultrasonic Sensor.

(iv) Bread board and Jump wires

A modern solderless breadboard consists of a perforated block of plastic with numerous tin-plated phosphor bronze or nickel silver alloy spring clips under the perforations. The clips are often called tie points or contact points. The number of tie points is often given in the specification of the breadboard. The spacing between the clips (lead pitch) is typically 0.1 in (2.54 mm). Integrated circuits (ICs) in dual in-line packages (DIPs) can be inserted to straddle the centerline of the block. Interconnecting wires and the leads of discrete components (such as capacitors, resistors, and inductors) can be inserted into the remaining free holes to complete the circuit. Where ICs are not used, discrete components and connecting wires may use any of the holes. A breadboard is utilized to build and test circuits expeditiously afore finalizing any circuit design. The breadboard has many apertures into which route components like ICs and resistors can be connected. A typical breadboard that includes top and bottom power distribution rails is shown below figure 9. Jump wires are generally used to establish connectivity with bread board as shown in figure 10.



Figure-9 Bread board.



Figure-10 Jump Wires.

4. IMPLEMENTATION

4.1. Description of Modules/Programs

To describe about the program, we first defined few very important libraries of ESP8266 (WIFI module) and Blynk app. The character array “auth” in the program is the authentication key for connecting the Blynk app with this Arduino code in the IDE. The next two-character arrays “ssid” and “pass” are used to define the WIFI connection. SSid holds the WIFI name and pass holds the password for WIFI authentication access. The function “myTimerEvent()” is used to declare any interrupts in the working. Like if there are any particular events that needs to be performed at regular intervals, then this function helps achieve it by interrupting the procedure in “loop” function. The next function “CheckDistance()” is used to check the distance of the garbage stack in the garbage bin from the ultrasonic sensor which then verifies if the stack height is above or below the threshold height and if the distance is greater than the threshold height, then it writes a notification through the Blynk app. Else, it waits for another minute. In the “setup()” function, it just declares the BAUD rate which is the rate at which information can be transferred through the channel per seconds. The default value for the component we used is 9600BPS. In the “loop()” function we just call the Blynk method.

4.2. Source Code

```
#define BLYNK_PRINT Serial
#include <ESP8266_Lib.h>
```

```

#include <BlynkSimpleShieldEsp8266.h>
#include <SimpleTimer.h>
char auth[] = "MFidRmlFa2wBWnbYXuSmligC-BrEYfN7";
char ssid[] = "Dinesh";
char pass[] = "53038382";
#include <SoftwareSerial.h>
SoftwareSerial EspSerial(11, 10); // RX, TX
#define ESP8266_BAUD 9600
ESP8266 wifi(&EspSerial);
#define trigPin 8
#define echoPin 9
BlynkTimer timer;

void myTimerEvent()
{
}

void CheckDistance()
{
  long cm,duration, inches;
  pinMode(trigPin, OUTPUT);
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  pinMode(echoPin, INPUT);
  duration = pulseIn(echoPin, HIGH);
  inches = microsecondsToInches(duration);
  cm = microsecondsToCentimeters(duration);
  Serial.print(inches);
  Serial.print("in ");
  Serial.println(cm);
  Blynk.virtualWrite(V5, inches);
}

```

```

//Check whether Bin is full or not
if(inches < 2)
{
  Blynk.virtualWrite(V3, 255);
  Blynk.notify(" Overflow!!");
}
delay(1000);
}

long microsecondsToCentimeters(long microseconds) {

  return microseconds / 29 / 2;
}

long microsecondsToInches(long microseconds) {

  return microseconds / 74 / 2;
}

void setup()
{
  // Debug console
  Serial.begin(9600);
  EspSerial.begin(ESP8266_BAUD);
  delay(10);

  Blynk.begin(auth, wifi, ssid, pass);

  timer.setInterval(3000, CheckDistance);
}

void loop()
{
  Blynk.run();
  timer.run();
}

```


}

4.3. Test cases

The system was checked repeatedly by increasing and decreasing the level of garbage in the bin. Notification was sent each time the level got changed. The user checked the notification on the Blynk app, so it can be said that the system has worked in the way we planned. Proper security was also given to the hardware components so that the output which comes is accurate because further actions have to be taken based on the output. The result of the notification is provided in the below figure.

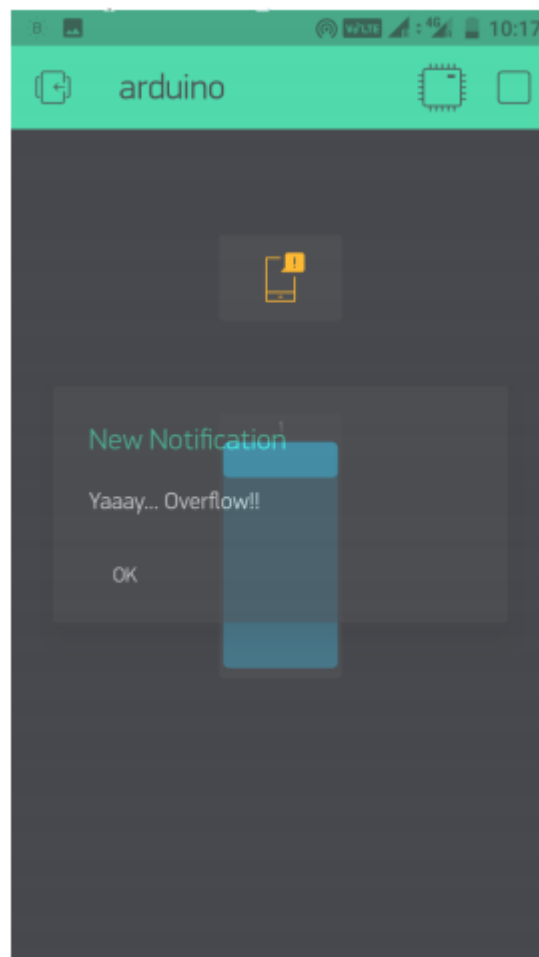


Figure-11 Experimental result.

4.4 Execution snapshots

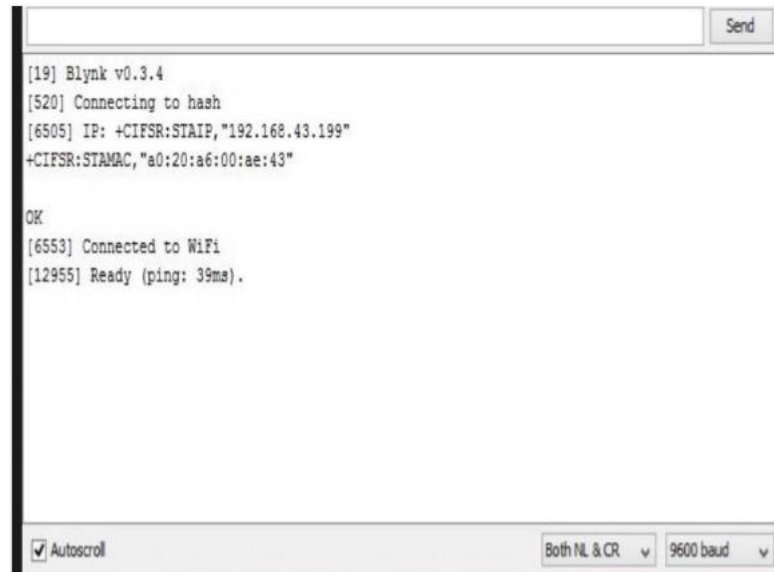


Figure-12 Connecting to WIFI



Figure-13 Output in serial monitor

5. CONCLUSION AND FUTURE DIRECTIONS

The main objective is to maintain the level of cleanliness in the city and form an environment which is better for living. By using this system we can constantly check the level of the garbage in the dustbins which are placed in various parts of the city. If a particular dustbin has reached the maximum level then the employees can be informed and they can immediately take certain actions to empty it as soon as possible. The employees can check

the status of these bins anytime on their mobile phones. This can prove to be a very useful system if used properly. 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 respected areas. Ultrasonic sensor is being used in this system to check the level of garbage in the dustbins but in future various other types of sensors can be used with the ultrasonic sensor to get more precise output and to take this system to another level. Now this system can be used in certain areas but as soon as it proves its credibility it can be used in all the big areas. As this system also reduces manual work certain changes can be done in the system to take it to another level and make it more useful for the employees and people who are using it. In future, a team can be made which will be in charge for handling and maintaining this system and also to take care of its maintenances.

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