IOT Based E-Tracking System for Waste Management

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Abstract: **In the present scenario, due to the increased population there is increase in amount of things consumed by this population. Due to which an extreme amount of waste is generated day by day. The garbage bins that are placed at public places overall the cities overflow due to increase in the waste which not only creates unhygienic conditions for the people but also generates bad odor in the surrounding which then leads in spreading some deadly diseases. Solutions have been provided but most of these are not feasible ones. So we are proposing a concept of "Intelligent Receptacle". This system would comprise of a completely wireless setup that would monitor the garbage bins and would track the level of bin. Each bin will be provided with a unique id and would be embedded with low cost devices. When the garbage in the bin reaches a particular level of the dustbin, the notification would be send on the mobile app as well as to the web portal that the garbage bins are completely filled and needs urgent attention.**

***Index Terms*— Firebase, GPS module, IFTTT, NodeMCU (esp8266), Ultrasonic sensor**

I. INTRODUCTION

"Smart System" the word describes it all. The System that provides convenient solution to the real life problems. It generally focuses on one of the problem which is nothing but the Waste Management which is now becoming the biggest problem across the globe. Already many solutions are provided but most of them are not the feasible ones [8]. As this system comprises of wireless setup which includes sensors and other IOT devices which would together be more feasible than the wired system [10].

The system provides the solution, where the garbage collection system is not optimized. The system enables various organizations to meet their needs of smart garbage management system. The system allows the user to know the level of each garbage bin in a locality timely, so that it's become cost effective and time saving for the Garbage Collector. The earlier system was completely designed as wired system; we provide the solution by making it wireless which is more feasible [1].

The system is designed using the concept IOT i.e. The Internet of Things in which surrounding objects are connected through wireless networks without user intervention. In the field of IoT, the objects communicate and share or exchange information to provide advanced intelligent services for users. The System makes use of Ultrasonic Sensors and the Communication device NodeMCU which is also refer as ESP8266 (v2) [4]. NodeMCU uses its Wi-Fi module to send the information over the network. To check whether which dustbin is full unique ID is provided to each dustbin. When the garbage reaches particular level of the sensor it is displayed or notified in the App as well as Web Portal [2].

II. METHODOLOGY

A. . *Hardware requirements*

1. NodeMCU

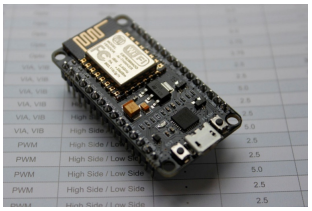

FIG 1: NodeMCU

NodeMCU is an open source IoT platform. It includes firmware that runs on the ESP8266 Wi-Fi SoC, and hardware which is based on the ESP-12E module [6]. The firmware is something in between hardware and software. The firmware uses the Lua scripting language or can be coded using Arduino IDE. The NodeMCU repository contains its own collection of elaborate code examples. It uses many open source projects, such as lua-cjson, and spiffs [15, 16].

2. Ultrasonic Sensor

FIG 2: Ultrasonic Sensor

Ultrasonic sensor also called as HC-SR04 uses sonar waves to detect distance to an object like bats do. An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It has four pins: TRIG, ECHO, GND, and VCC. When the sound waves transmitted in environment then waves are fetched by ECHO after striking an obstacle. Its operation is not affected by sunlight or black material (although acoustically soft materials like cloth can be difficult to detect). The sensor module consists of ultrasonic transmitter, receiver [5].

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3. GPS Module

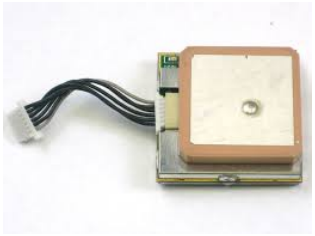


FIG 3: GPS Module

Global Positioning System is a device which is capable of receiving information from GPS satellites and to calculate the device's territory position. Using software, the device may display the position on a Google maps, and it may offer directions.

The GPS system information can be retrieved by the GPS device in all kind of weather condition and anywhere on the planet.GPS devices may be able to indicate: the roads or paths available, traffic congestion and alternative routes, roads or paths that might be taken to get to the destination, if some roads are busy or crowded then the alternative solution can be given to the user [9].

B. Software Requirements

1. Arduino IDE

It includes a code editor which provides simple one-click mechanisms to compile and upload programs to an Arduino board. The Arduino IDE supports the languages C and C++ using special rules of code structuring. It connects to the Arduino and Genuino hardware to upload programs and communicate with them [12, 14].

2. SQLite

SQLite is a database which is used to store the data mostly gathered from the android application. It has features such as self-contained, server less, no configuration, transactional SQL database engine. The SQLite engine does not have any standalone processes like client-server database management systems with which the application program communicates. Instead, SQLite library becomes integral part of the application program as it is linked in. This can be called dynamically. The data stored in the SQLite can be viewed using DB browser for SQLite application.

3. Firebase

In 2011, Firebase Inc. developed a mobile and web application development platform which is then taken over by Google in 2014. The Firebase Realtime Database is a cloud-hosted database. Data is stored as JSON and synchronized in realtime to every connected client. Firebase provides the facility to create cross-platform applications with iOS, Android, and even web application. All the clients of this application then share the one Realtime database which automatically updates with new data [11, 13].

4. IFTTT

If This Then That, also known as IFTTT, is a free web-based service to create chains of simple conditional statements, called *applets*.

In addition to the web-based application, the service runs on iOS and Android. The IFTTT was renamed as IF in February 2015. It also released new patch of application which is called as Do used for creating shortcut applications and actions. As of 2015, IFTTT users created about 20 million recipes each day. IFTTT provides SMS, email, Gmail etc. notification facilities.

C. Mathematical Model

S = {s, e, X, Y, Function, DD, NDD, Success, Failure}

Where,

s = Start state: Sensors are inactive.

e =End state: Required automated action is performed.

X =Input=Data obtained from sensor.

Y =Output= {y1, y2} Where,

y1=Correct Garbage level displayed.

y2=Location of Dustbin through GPS tracking, which will be displayed on Web page of central authority.

Functions:

- StartEvent() - This function will start the sensing through ultrasonic sensors.
- Controllerdata() - This function will pass the sensed values to the controller, which will be forwarded to the server after computation.
- SMSsend() - This function will send the SMS's to required drivers.
- EndEvent() - This function will verify the garbage is collected or not.

DD: Deterministic Data: Sensors will sense the signals.

NDD: Power Failure, Loss of connectivity.

Success=Time and Cost efficient smart waste management system.

Failure=Impact of environmental conditions of sensors.

III. IMPLEMENTATION

One of the major issue arises in the college campus is that the garbage collector needs to check the dustbins each and every time manually (i.e. going towards the dustbin). As it becomes very hectic and time consuming for garbage collector our system focuses on providing a feasible solution for this.

In the System, the collector gets the email notification on his/her android app through IFTTT about the waste bin that gets filled. A circuit that is placed on the bin contains the Ultrasonic sensor, Node MCU and battery (to provide the power supply).Sensor senses the amount of garbage and finds up to what level the bin is filled. When the level of bin goes above the certain threshold value, the value is stored in the database as well as it displayed in android application. All the actions take place in real time. Web portal also work as a central authority and provide the Administrative support [7].

By using this system it reduces the man power required to collect the garbage and also its time saving because there is no need to check dustbin again and again manually [3].

1. System Integration

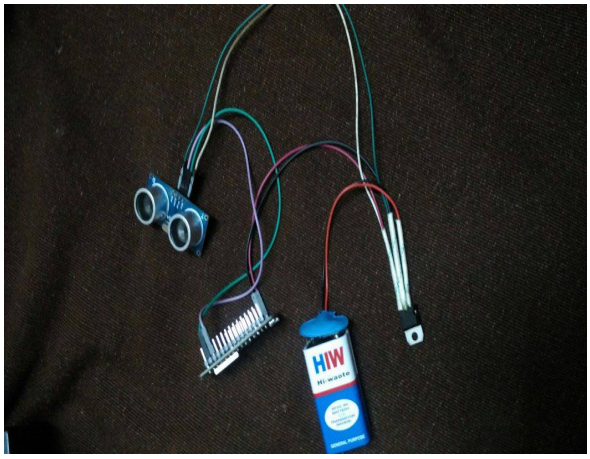


FIG 4: System Components

2. Hardware Kit

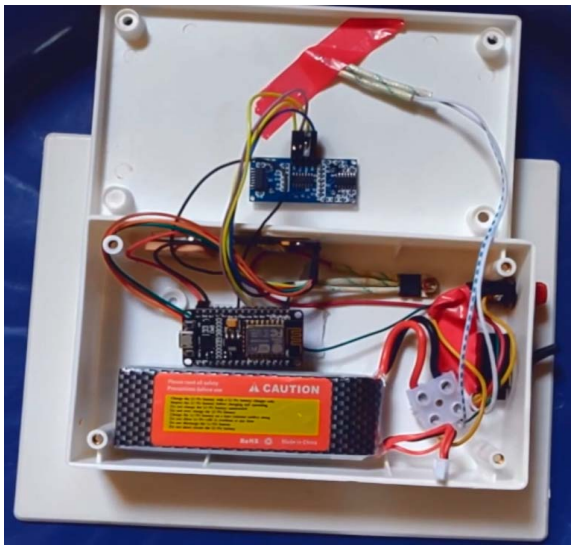


FIG 5: Hardware Kit

3. System Flow

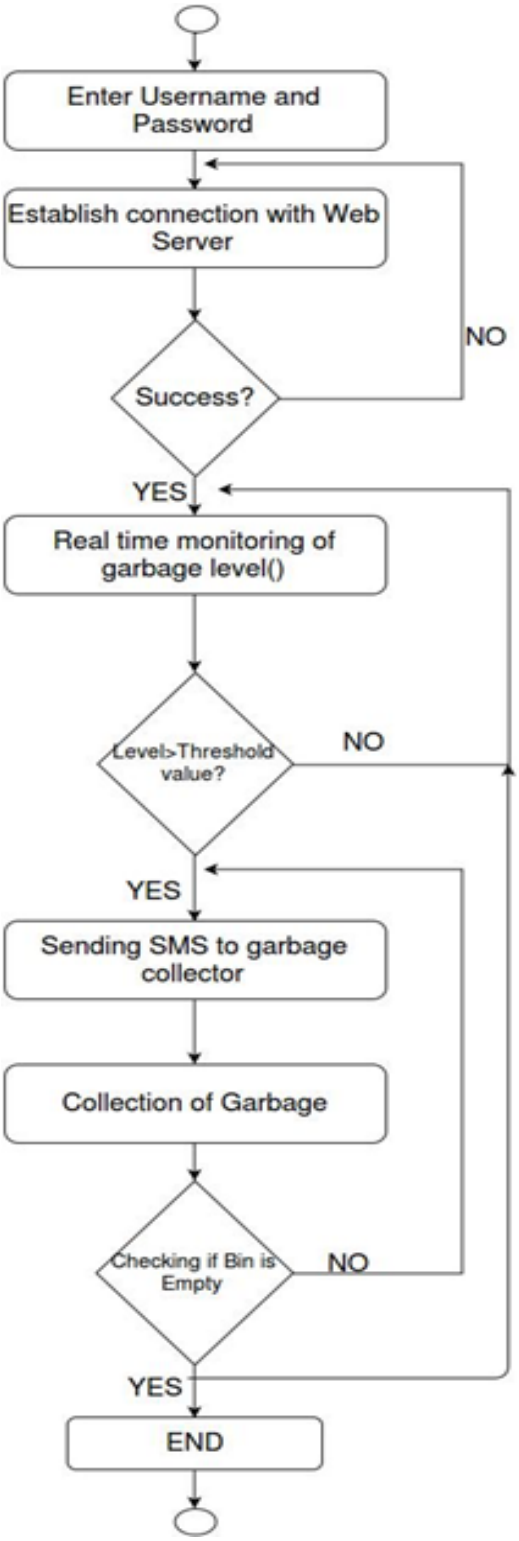


FIG 6: Flow Chart

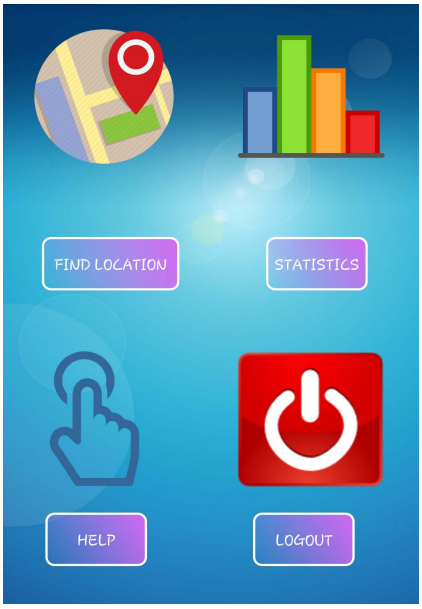
IV. RESULT SET

Android App

A Login facility is provided to the user. Access to the android application is permitted after the input of correct user name and password. The App provides access to different sections of the system. Location provides the current location of the dustbin so that the user can locate the bin as soon as it gets filled.

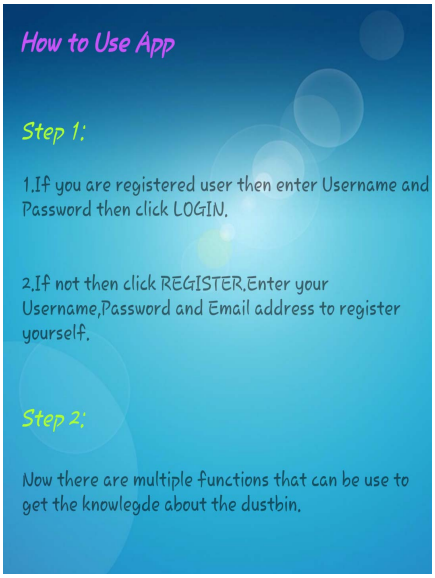
The following figure shows the dashboard of the android application. It provides the options for statistics as well to show a weekly summary about the rate with which the dustbin gets filled and most frequently filled dustbins are shown. The specific location of the dustbins is obtained with the help of the GPS kit attached to each dustbin.

Menu



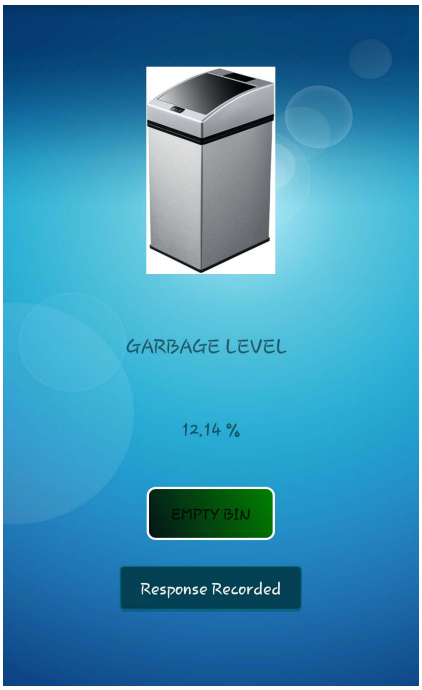
Help

A list of instructions is provided to provide a user friendly access to the user. This makes the Android Application easy to use and understand.



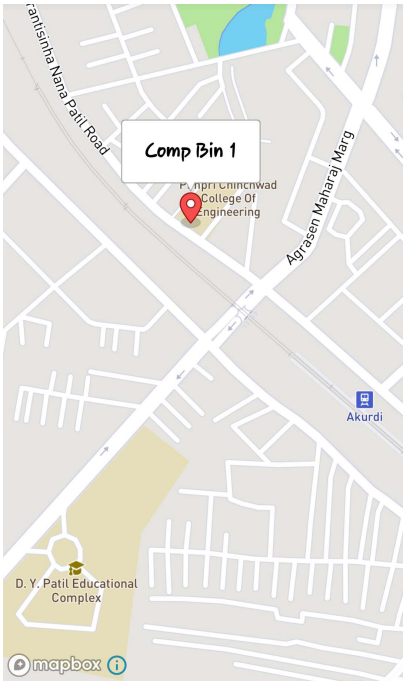
Statistics

The statistics provide a general idea about the amount of waste that the dustbin contains. The dustbin is monitored over a time interval and the value of the dustbin waste is shown in terms of percentage.



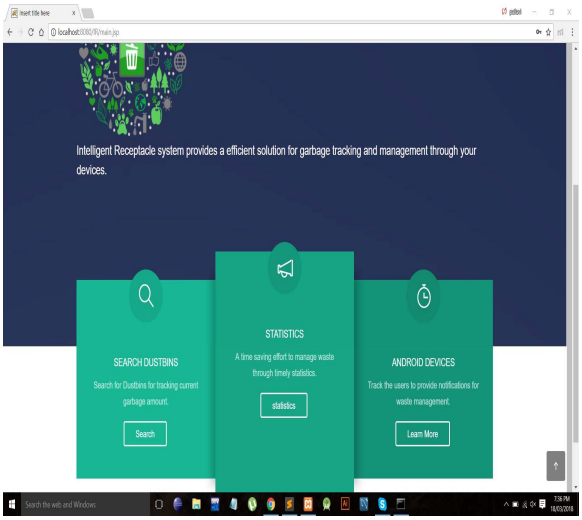
Location on Map

Each dustbin is assigned with a label and displayed on map. It will be helpful to track the location of each bin.

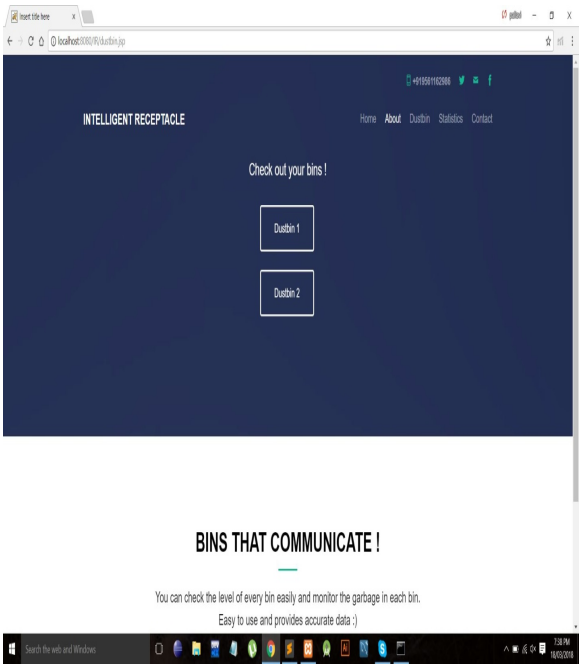


Web Portal

The Web Application is used to provide a centralized support to the administrator. The administrator logs in with the help of a secured password. Through portal he can watch the status of each and every dustbin as well as the statistics and the no. of android users connected to the system.



The no. of dustbins are listed for the convenience of the admin where he can simply click and view status of that particular dustbin.



Dustbin Status

Here the dustbin status is provided to the admin in terms of percentage. The actual value of the dustbin filled with waste is gathered by the sensor and converted into percentage for user convenience.

V. CONCLUSION

The proposed automated garbage monitoring system provides real time data analysis through android app and web portal. Through Android application, system will send the notification to the garbage collector about garbage level along with its ID and location using GPS Module. Thus, route optimization can be achieved. This will result in time and cost efficient system.

VI. FUTURE SCOPE

The system can be implemented at city level for monitoring the garbage level of bins automatically. Also instead of batteries the solar panels can be used for the power supply.

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