Arduino-based Real Time Implementation of Smart Trash Collector using Internet of Things

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Abstract

Nowadays certain actions are taken to improve the level of cleanliness in the country. People are getting more active in doing all the things possible to clean their surroundings. When the garbage will reach the maximum level, a notification will be sent to the municipality office, and then the employees can take further actions to empty the bin. This system will help in cleaning the city in a better way. Garbage bins remain uncollected for long periods of time putting the lives of marketers at risk in an event that there is Cholera outbreak especially duringthe rainy season. In order to avoid such a situation, this project proposes the design and implementation of a GPS and IOT Based Garbage and Waste Collection Bin Overflow Management System using GPS and IOT technology in providing real time information on thestatus of the garbage bins, i.e. when they are full so that appropriate action can be carried out. The system notifies the person (Truck Driver) in charge of garbage collection by sending a short message (sms) and telling them where the full bin is exactly located. The proposed systemhaving IR sensor once human came to nearby bin, it automatically detects and open bin door using servo motor. At the top of the bin having ultrasonic sensor it measures the level of the bin and automatically send live location using GPS to municipal servers using IOT mode. All components are associated to micro controller Arduino. Arduino ATMEGA328 micro controller used to process input and produce output by using ARDUINO IDE with EmbeddedC programming and operated through Regulated power supply which gives 5v of DC voltage to all hardware modules.

Keywords: Trash collector, Arduino controller, Internet of Things, GPS module, Ultrasonic sensor.

1. Introduction

As the world's population grows at an unprecedented rate, more trash waste is being generatedon a daily basis and waste management and proper collection from trash bins is becoming more and more challenging and important. In extreme scenarios, littered garbage causes unhygienic and unhealthy conditions that risk the surrounding areas and communities. Such dangers are witnessed in the form of flooded and leaking dirty waste containers. The leakage causes overflow of trash waste all around the place making the area dirty and unhygienic. This results in wastage of vital resources used due to a lack of coordination and keeping an eye on data in clusters and poor infrastructure. With the latest advances in information technology,smart cities and smart infrastructures are prospering. Smart Cities is a small sustainable development model. It is based on the use of human capital and technology to improve urban integration with the growing popularity of Internet of Things (IoT) and the availability of actuators and low sensors, technological advantages can be pave the way to solve used to solvethe problem of current urban. IoT is the ecological unit of compatible objects available online. The 'object' in IoT may disablethe portable device with the ability to disseminate information via IP address and the ability tocommunicate data directly from the base station. IoT is able to interact with various online applications. In this project a new method has been introduced to integrate IoT green environment into automatic waste disposal and provide an efficient solution. The main functions of the Smart Trash

Collector are: The system having IR sensor once human comes closer to the dustbin, it will automatically detects and open the bin. If the person is far away, it will automatically close the bin.At the top of the bin having ultrasonic sensor it measures the level of the bin.Once the garbage attains the maximum level, It will alert with the buzzer indicating a state of overflow. The garbage level and the GPS location of the dustbin will be available in the IoT server. This project focuses on the Trash Monitoring System using an ultrasonic sensor as a distance measurement sensor, GPS will assist in sending a trash bins location and GSM will assist in sending a message to municipal authorities. Internet of Things is nothing but the applications performing with the help of internet access..IOT Communication over the internet has grown from user - user interaction to device interactions these days. The IOT concepts were proposed years back but still it's in the initial stage of commercial deployment. Home automation industry and transportation industries are seeing rapid growth with IoT. The basic project idea is to design a smart waste detection system which would automatically notify the officials about the current status of various garbage bins in the city, would have real-time monitoring capabilities, which would beremotely controlled using IOT systems. The motivation behind the real-time implementation of an IoT smart trash collector projectis to address the increasing issue of waste management and its environmental impact. Improper waste disposal and inefficient waste management practices can lead to numerous environmental problems, including pollution, health hazards, and climate change. By implementing an IoT smart trash collector, waste management can be streamlined andmade more efficient. The system can monitor and manage the waste collection process in real-time, ensuring that the trash is collected on time and disposed of in the proper manner. This can also help reduce the amount of waste that ends up in landfills, as the system can identify and sort recyclable materials. Additionally, the IoT smart trash collector can help reduce the cost of waste management by optimizing the collection route and reducing the need for manual labor. It can also provide valuable data on the amount and type of waste generated, which can help policymakers and waste management authorities make informed decisions. Overall, the implementation of an IoT smart trash collector can have a significant impacton waste management practices, leading to a cleaner and healthier environment.

2. Literature Survey

Kurre, Vishesh Kumar,(2016) [1] This implementation of Smart Garbage collection bin using IoT, IR sensor, microcontroller and GUI . This system assures the cleaning of dustbins soon when the garbage level reaches itsmaximum. If the dustbin is not cleaned in specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor. This system also helps to monitor the fake reports and hence can reduce the corruption in the overall management system. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. It ultimate helps to keep cleanness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient the use of solar panels in such systems may reduce the energyconsumption. In [2] the future IOT based smart waste management system which checks the waste altitude over the dustbins present in urban areas by using Sensor systems. To check and join together, an android application is developed with desired information which is related to the various level of waste dustbins which is in different locations. The waste bins send notifications with its location details to the drivers for the truck once it is filled up. The higher official will be notifiedand they can monitor and track the respective employees. This system is powered by a solar panel which is also a means of renewable energy resources. In this paper [3] author introduce IOT-enabled system architecture to achieve e client dynamic waste collection. They also propose a top-K query based dynamic scheduling model to face the demanding

nature of scheduling timing. Finally, an Android app along with a user-friendly GUI is presented in order to evaluate a waste collection scenario on synthetic and real experimental data. Author discuss about Smart Cities, are being designed and built for comfortable human habitation. These paper motivate and propose an Internet of Things (IOT)-enabled system architecture to achieve dynamic waste collection and delivery to processing plants or special garbage tips. The Internet of Things (IOT) enables dynamic solutions aimed at optimizing the garbage truck set size, collection routes and query based prioritized waste pick-up. It gave us the concept of dynamic scheduling required for the cleaning of dustbin and the Top-k query led us to priority based cleaning of dustbins. Ruhin et al. Dustbin level is calculated by the ultrasonic sensor and transmitted through server to particular authorities. At a time accessing the data from dustbin where all the computer terminals are connected to the same network. In these, eevery 5 seconds the data about the level of waste in the dustbin will update and transport waste to the dump yard to keep city clean. The waste in the dustbin is monitored using [4]. This research it explains about the smart bins have equipped with ultrasonic sensors. The level of the dustbin which being filled up will measure by these sensors. The container is divided into three levels. The sensors receive the relevant data regarding levels when every time the garbage crosses a level. Furthermore, by using GSM module, this data is sent to the garbage analyzer as instant message. According to the author there may be several disadvantages such as increasing cost of the dustbin. For example, if there are three different levels then three sensors has to be placed; one sensor for each level. Also rough action and usage of the user may cause damages to the sensors. But according to this paper the researchers have used only one level and one sensor's. Sinha et al. [5], explains about 'Smart Dustbin' which indicates directly that the dustbin is filled to a certain level by the garbage and cleaning or emptying them is a matter of immediate concern. This prevents lumping of garbage in the roadside dustbin which ends up giving foul smell and illness to people. The design of the smart dustbin includes a single directional cylinder and an Arduino Uno The circuit to power up the mechanical devices is also assembled to obtain the desired simulation. This dustbin is also designed to compress the garbage periodically thus preventing the unnecessary occupying of dustbin's space by light weighted but space occupying garbage particles like sponges, etc. The smart dustbin is an automated a mobile dustbin intended to reduce the human efforts and improve the cleaning [6]. The project contents automatic lid mechanism and garbage sensing. ATMEGA 328 based Arduino Uno microcontroller board has been used to interface and governing of electronics. The AVR microcontroller utilized is an altered Harvard architecture machine fabricate by Atmel in which program and information are put away independently in physical memory system that show up in various location spaces. Thus this IOT garbage monitoring system contributes towards clean and hygienic environment. Singh [7] developed a project to control the over filling of the dustbin by making the dustbin smart enough to notify itself for its cleaning. The smart dustbin management system is built around a microcontroller ATMEGA 328p, LCD, PIR sensor, ESP8266 Wi-Fi Module etc. This project typically use microcontroller based real time bin monitoring system, RFID technology, GPS, GSM, RF module, etc. Ardiuno UNO microcontroller based smart garbage monitoring system to ascertain the level of waste in the garbage bin in real time before there is overflow in garbage bin the system sense out and alert through SMS municipality for the bin to be emptied garbage to be collected immediately. In city areas, the clearance of waste management is one of the challenging tasks throughout the world [8]. There is a requirement of well organization in monitoring garbage system. Although there are many organizations, still we are facing waste management system problem. Since lack of co-ordination among authorities and people. Hence smart garbage monitoring system and clearing system using IoT paper emphases on clearing the waste proficiently by via wireless sensors system and GSM/GPRS. The ultrasonic sensor detects the level of the wastes in the dustbin. Force

sensor is used to estimate waste of the dustbin. Microcontroller acts as interface between the sensor system and the GSM/GPRS system. Shashank, and Salvi [8] presented a Prototype of Remote Smart waste segregation and garbage level monitoring system", whichcan remotely monitor and is built at a very minimal cost. The design of the presented system considers the portability and ease of assembly of components as the essential factors during implementations. The demonstration shows the implemented system; its interaction with the user using the mobile along with the web application. To overcome the challenges in the environment such as inadequate waste collection, treatment, disposal. Due to flooding of the dustbin causes unhygienic conditions are created, the dustbin is placed in the entire city; it is delivered with minimum cost embedded method to assist in tracking of the garbage [9], therefore the "Blynk app" is used to get the immediate SMS as early as garbage bin reaches its peak level. Therefore, instant action will be taken by the alarmed authorities once the status of a bin is notified through the internet. Ultrasonic sensor, node MCU, blynk app, a servo motor is used to develop the proposed system. [10] uses AVR (Alf-Egil Bogen Vegard Wollan RISC) microcontroller for programming and Wi-Fi module for accessing data into the cloud. The data in the cloud is used to observe the dustbinstatus by the mentors as well as public in the city. These system keeps city clean, also people get awareness and maintains it more effectively.

3. Existing method

In the existing system garbage is collected by corporation by weekly once or by 2 days once.Though the garbage shrinks and overflows the garbage bin and spread over the roads and pollutes the environment. The smell will be heavy and produces air pollution and spreads disease. The street dogs and animals eat the waste food and spreads over the area and createsdirty environment to avoid such situation we are planning to design IOT Smart Trash Collector. When the dustbin is overflown, there will be heavy pollution in our environment. Due to this, the bad smell is spread, which causes various diseases to children. Smart Bin system helps to overcome these problems. These smart bins are connected with a microcontroller-based system with IR wireless sensors with a central system that shows the present status of garbage on mobile web browsers with HTML pages through WI-FI. Nowadays, IOT can control and monitor the equipment we use in daily life. These are donewith the help of sensors. Sensors are used to measure physical quantities such as temperature,light, pressure, sound, humidity. They send a signal to the processor. In this manner, we can monitor the environmental changes from anywhere through the internet. Smart bin also workssimilarly, with the help of weight sensors and IR sensors. They show different levels. Variouslevel of garbage in the bin is showed by IR sensors, and the weight sensors send its output whenthe threshold level is crossed. The microcontroller gives further details to the transmitter module. Our mobile should be connected to WI-FI So that the details of the smart bin could bedisplayed on the HTML page.

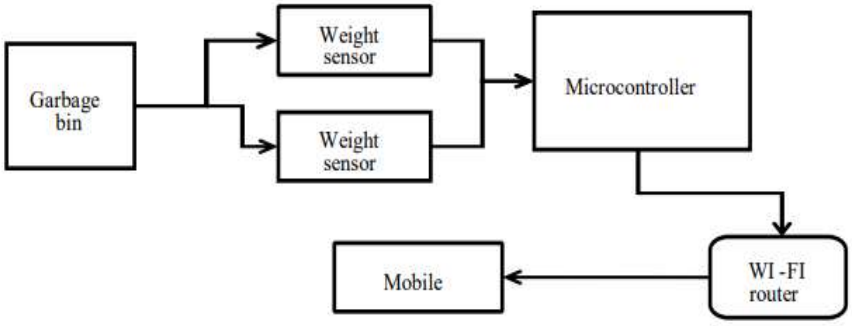

Fig. 1: Existing system.

4. Proposed method

The current scenario shows the enormous technological development in all fields, but still,India has got its rank in major garbage producers globally. Even though the smart bin system costs high, we might reduce the costs by using the sensors by a systematic approach. Based on the level of waste in the dustbin, we have proposed a smart waste collection system shown in figure. The sensors collect all the data and transmit it over the Internet server. The data are stored, and a processing mechanism takes place. It helps to monitor the daily selection of waste bins for the cleaning process based on the bins' level. The workers are provided with navigational devices that show the updated information about the routes and locations in which the dustbins must be cleaned. The important characteristics of this system are that it predicts the future bin technologies regarding the factors like traffic, overcrowding, cost efficiency, and also factors that are difficult for us to calculate. Based on the analysis, the future status of the dustbin is calculated. By using the weighing sensors, the quantity of garbage is analyzed. The collection of waste should be done properly by the labor as it may cause any public hindrance. As a result, the dustbin in the specific locations should be identified before the overflow of garbage in the dustbin. There are two sensors to detect the trashes and humans. If the person comes closer to the dustbin, it will automatically open the bin, and if the person is far away, it will close the bin. Once the garbage attains the maximum level, it readily sends the information to the server.

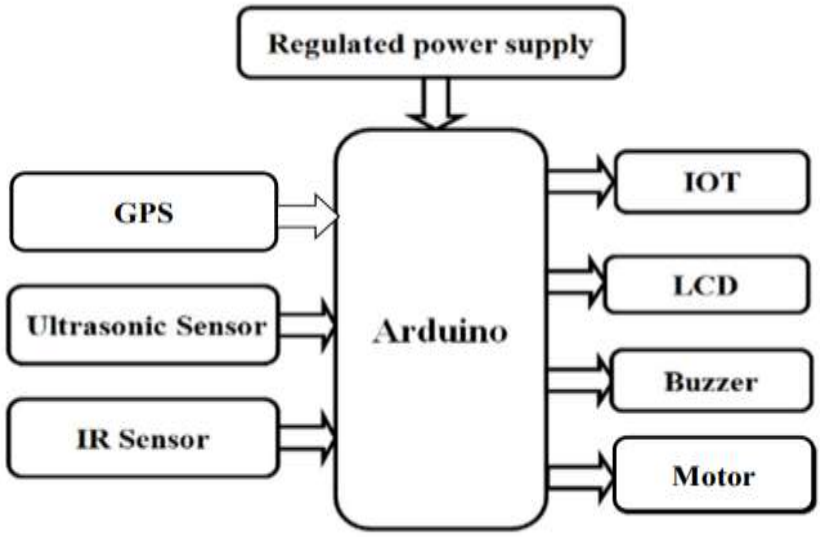

Fig. 2: Block diagram of proposed method.

4.1 WORKING

The complete working section contains five modules:

1. Regulated power supply
2. Input
3. Output
4. Arduino Microcontroller
5. Programming

The RPS module coverts the 230 ac volts into 5v dc. The 5v of power supply goes to all the components in the system which is indicated by LED. The input of the project is IR sensor, Ultrasonic sensor and GPS module. The IR sensor detects the object and opens the bin using motor there by Ultrasonic sensor checks the level of the garbage if it is up to a certain level sends an alert. The GPS modules collect the location from satellites and give it to the microcontroller. The output has LCD, Buzzer, dc motor and IOT module. In the Arduino microcontroller contains the software programming code Embedded C. The main purpose of the microcontroller is the data can be controlled. We should ON the kit first Reset the kit because to connect wifi to IOT server. By using mobile phone we can connect the wifi to IOT server. Once the wifi is on mobile data should be OFF. By using id: iot 198 and password we can check updates. At first the LCD shows Level 0 when the garbage is filled below 5% then LCD displays the level (95%) and sends the alert.

4.2 Schematic

In this project we are using Atmega328p Microcontroller. It has total 28 pins. In these 28 pinswe are using only 20 pins.D0-D13 are the Digital pins(14) and A0-A5 are the Analog pins(6).Here the D0, D1 are connected to the IOT, for transmitting and Receiving the data. D2-D7 pins are connected to 16*2 LCD display ,D8 pin is connected to GPS. D10,D11 pins are connected to ultrasonicsensor, D18 connected to IR sensor and D13 connected to Buzzer. A0,A1 connected to motor. The 230v Ac is converted into 5V of DC and that is given to the circuit through pin7. Reset isgiven to the pin 1 which is used to Reset the circuit for connecting to the IOT module. The oscillator is connected to the pin9 and pin10, the GND is connected to the pin8 and pin22.

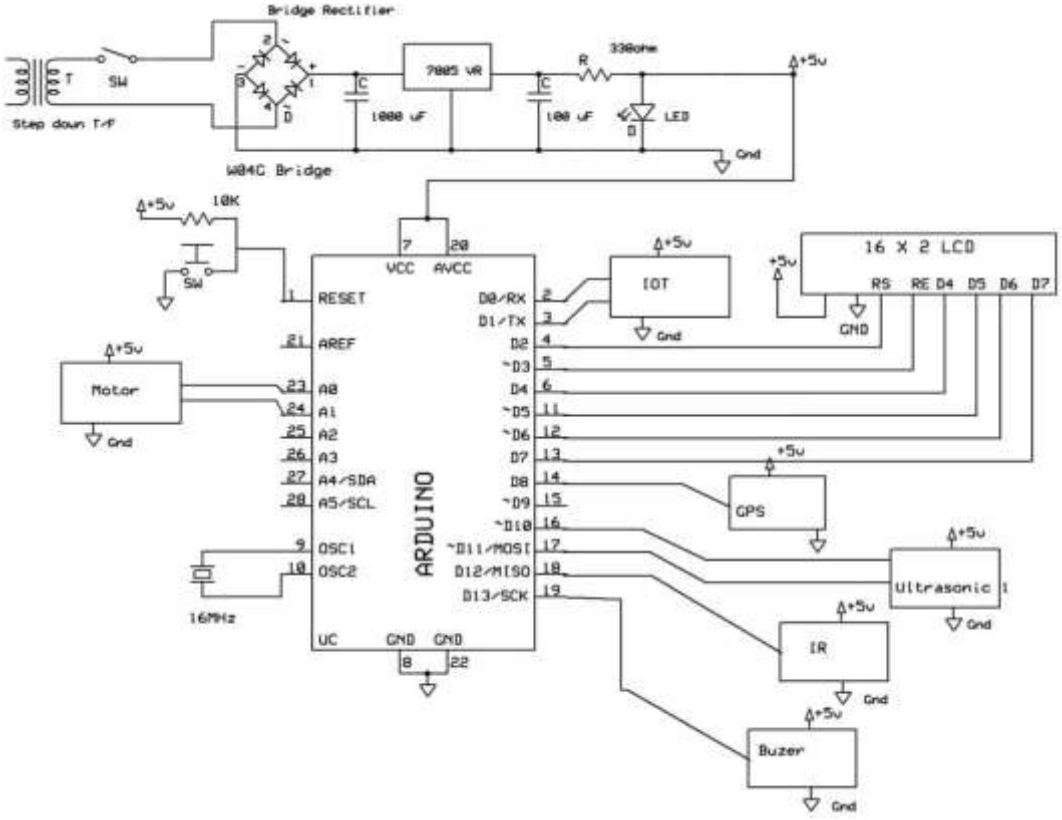

Fig. 3: Schematic diagram

5. Results and Discussion

Here the circuit is turned ON by giving the regulated power supply of 12v which is then converted to 5v dc current. The LED is the indication for 5v current so, if there is 5v current then automatically the LED glows. The generated 5v dc current passes to every hardware component in the circuit. When we hit the reset button after providing the regulated power supply, the LCD displayed the Smart Garbage Monitoring. The output may be seen in the following image after we have connected the IoT module via a WIFI connection. The level of the garbage in the dustbin is displayed on the LCD screen once the Wi-Fi has connected to the IOT server. Connect to the IOT server using id: iot198 and password. When connected, the LCD shows the garbage level of the dustbin.

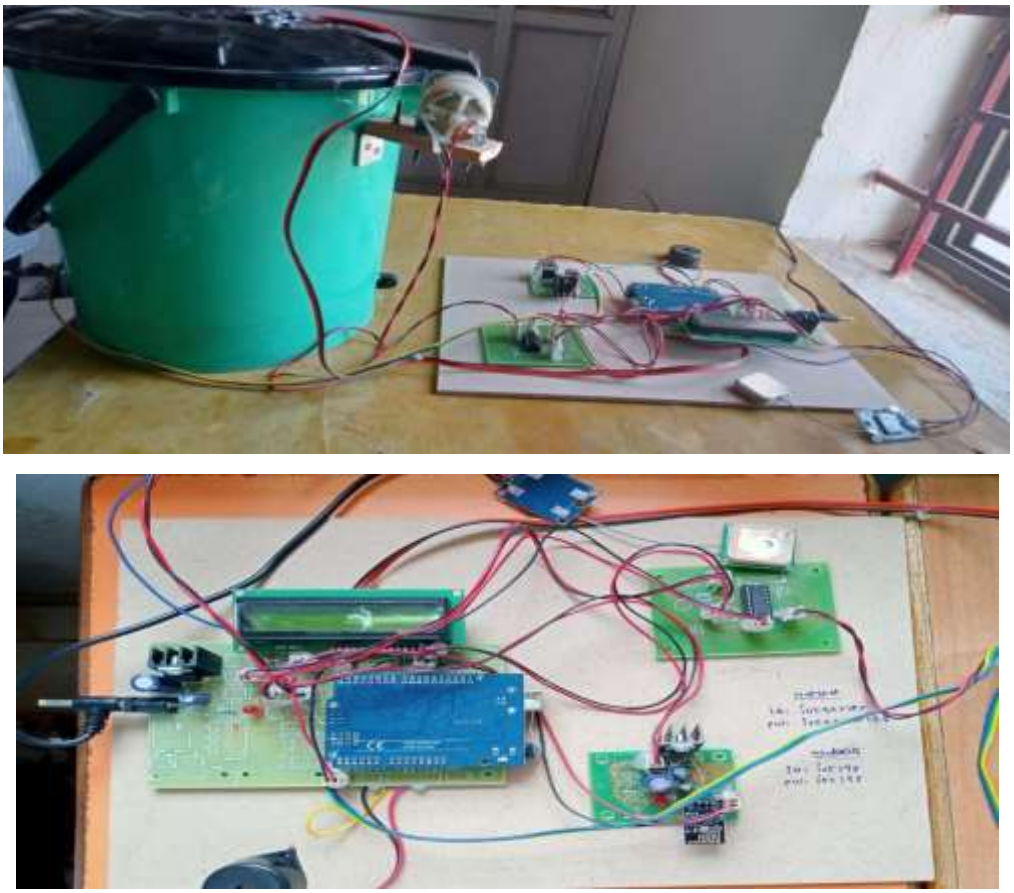

Figure 4: IoT Smart Trash Collector Kit

Figure 5 Lcd displaying the title.

Figure 6 Lcd displaying the level of the bin.

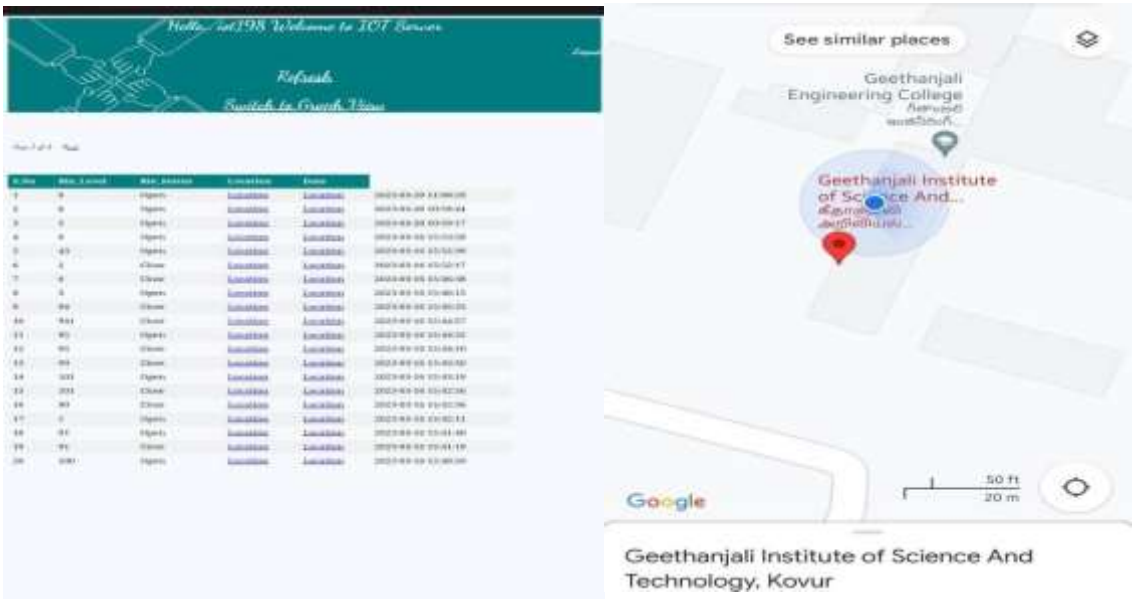

Figure 7 Information & location of the bin showing in the server.

When the level of the garbage in the dustbin reaches to a certain level i.e., more than 80% the gps module sends alert to their respective management by uploading the location with time and date in the website http://projectsfactoryserver.in/.

6. CONCLUSION

Overview of the project is "Real Time Implementation of IOT Smart Trash Collector" the main aim of the project make works simpler and smarter by automating the things without involving human intervention. In this we have used IoT module for transmittingthe data. And the data can be controlled by Microcontroller. The Wi-fi modem is used to send the data. The garbage status shown on the

webpage. The level of the garbage in the bins will be display on the LCD display. If it reaches the maximum level it alerts and send the location of the dustbin the IoT server.

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