A New Era of Waste Collection : IOT Based Smart Waste-Bin

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***Abstract*— The Internet of Things (IoT) allows linking devices that use the Internet with the ability to collect and market data. The object network refers to a type of network that links all the data based on specific protocols during the collection of information, replacement and communication tools to perform intelligent functions of detection, positioning, monitoring, monitoring and administration. The Internet of Things are affected in all areas of human life, work, health and the social area, which will significantly affect the possible development of the global financial community. Recent scientific advance have led to an increase in the carbon footprint. Energy efficiency in the IoT has been magnetize a lot of thought as of researchers & designers above the last pair of years, concrete the way for an emerging area called green IoT. In this paper we describe a system for smart waste bin with the help of some electronics devices, website or app notification system and real-time monitoring system that are interrelated to each other to perform as an efficient, cost-effective waste management system that yield to a green and healthy living environment. Wastage management involves not only the gathering of the trash in the garbage collector at particular place but also the transfer and removal to the suitable locations. In this paper, we presented the smart waste-bin that can manage the waste in a smart city project. The system consists of sensors to measure the level of waste, temperature, moisture, Hazard gas level inside the smart bin. The system also adapt with network environment, to manage all information from waste management. As the result we proposed a prototype of smart waste-bin that suitable for many kind of conventional waste-bin.**

Keywords*— *Internet of things; Android mobile; WiFi modual; GPS module; Termperature Sensor; Moisture Sensor;Buzzer;LCD; Infrared sensor; Ardunio;Power supply Adaptor;

I. INTRODUCTION

A smart solid waste bin operates to ensure the efficient measurement of its status while consuming minimum energy. At present, most of the cities around the world require challenging solutions for solid waste management, as there is rapid growth in residential areas and the economy. Solid waste management is a costly urban service that consumes around 30% of Municipal Corporation's annual budget in many developing nations. After various surveys and study done by numerous organizations it has been seen that factors affecting effective solid waste management are due to improper management and lack of cutting edge technology infrastructure. Municipal authorities have inadequate resources for waste management institutions to effectively collect the waste generated. It becomes an excessive wastage of resources when bins are collected that are filled up partially. By optimizing the quantity and deployment of smarter technology for waste collection and management activities can be carried out very efficiently to reduce operational cost. In today's connected devices era, Internet of things (IoT) technology is revolutionizing society in different domains like healthcare, industrial automation, automobile and smart cities.

In this paper, we have proposed IoT internet of things based smart waste management system which allows waste management authorities to continuously monitor status of dust bins placed at different locations and as per the status take appropriate actions to collect it immediately and efficiently. This is not a unique thought, for the usage of keen trash container; the thought has existed for a long time. Motivation for this work comes from " IoT based solid waste management system for smart city" [1] have already presented sensing system and algorithm for solid waste bin to automate the solid waste management process. Several sensing methods have been integrated and have combined their verdicts that offer the detection of bin condition and its parameter measurement. Though results and developed algorithms are efficient for automatic bin status monitoring work lacks remote monitoring of bin. So, in this paper we have proposed system which can be deployed in general purpose dust bins placed at public places and which allows us to monitor its status remotely over web browser for efficient waste management.

Waste management has been a crucial issue to be considered. This project is a way to achieve this good cause. Though the world is in a stage of up gradation, there is yet another problem that has to be dealt with. Garbage! Pictures of garbage bins being overfull and the garbage being spilled out from the bins can be seen all around. This leads to various diseases as large number of insects and mosquitoes breed on it. We have thus come up with an Automatic waste segregator that categorizes the waste as wet, dry and metal. [2]

Waste management is an uninterrupted fattening problem at universal as well as community levels. The household waste which gets accumulated in garbage bins are collected at a particular time of day even though the bins gets filled at any time. Therefore the existing technology is not fruitful as the arising technology IoT is considered. IoT is the co-dependent of distinctly recognizable enumerating appliances with network framework. Smart city reaches extensive diversity of operable events such as traffic management, garbage

management, metropolitan salvation and environment supervising. Smart city remedies assures the people to pacify the existent discomforts in towns these days like clearing traffic jam, minimising the sound and supporting the cities to become self-reliant. [3]

The Internet of Things (IoT) is a recent communication pattern that will visualize the near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol that will make them able to convey with one another and with the users, becoming an essential part of the Internet. [4]

Connecting embedded electronic devices through a medium Internet is called Internet of things. It can be implemented with four steps Computing, Programming, Interfacing, and Networking. In Computing We can Use either Microcontrollers or Microprocessors such as Microcontrollers (8051,AVR,Arduino) and Microprocessors (Raspberry Pi) Both Using will be depend on the User Requirement and Programming also related to the device using Embedded C Programming for Microcontrollers and Python programming for Microprocessors i,e raspberry In Interfacing user can use any type of electronic devices or sensors either analog or digital sensors and last Networking will Play Vital role in IOT(Internet of things) they are two types LAN and WAN[5].

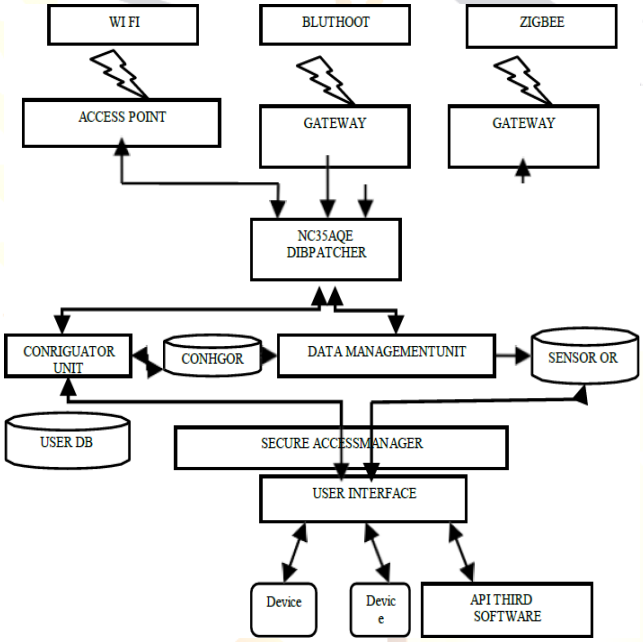

Figure 1. Internet of Things

It is a fundamental trouble in various progressed urban networks, in light of equally the charge of the association and the issue of the breaking point of waste in landfills. A huger path of ICT designs in this space, regardless, may achieve gigantic assets and efficient and environmental favorable circumstances.

II. PROPOSE METHOD FOR SMART WASTE BIN

As we have seen quantity of times the dustbins are receiving flood and concern individual don't get the information inside a period and due to which unsanitary condition confined in the environment in the meantime awful stench spread out because of waste, awful look of the city which makes ready of air contamination and to some unsafe infections around the territory which is effectively spreadable. In this paper, we available the smart waste-bin that can manage the misfortune in a smart city venture. The framework likewise adjust with arrange condition, to deal with all data from waste management.

In previous time, for throwing the garbage people have to wait for dustbin van. If dustbin van not come on proper time and there is no dustbin near to the location of that area. Then there was problem with citizens how they can track the position of dustbin and where they decompose the garbage. If want to complaint for that then they have to go in the dept. for these reasons, public wears a lot of problem.

To reduce these problems, we have to made a mobile application, but we are using an open source website for student and researchers that is www.thingspeak.com. by this we can track the proper dustbin location and find out dustbin are placed in local area. Also for complaining about this, we use a mobile number of care. Through this we can complaint to the higher authority. So we can try to solve the problem of people. Citizens provide to have better service, and very easy process through this care service.

Hardware contains many sensors and one microcontroller that are described in the requirement specification section. The microcontroller programmed through the software Arduino IDE 1.8.5. The sensors collect all the data and send it to Arduino microcontroller. Then, microcontroller display the data on lcd and with the help of wi- fi module the data is sent on the server of “things speak”. The administration can see all the data through “www.thingspeak.com” and truck driver show the status level of bin through its app.

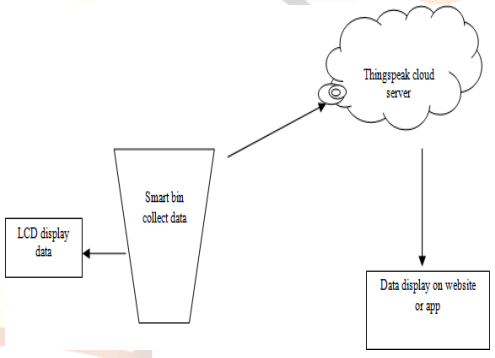

Figure.2 Process of propose methodology

1. SMART BIN MODULE

Level detector comprises of infrared sensor which is used to recognize the level of the waste in the dustbin. The give way of stage pointer is specified to Arduino. At the point when the dustbin is topped off to the most elevated amount, the yield of infrared sensor beneficiary winds up dynamic low.

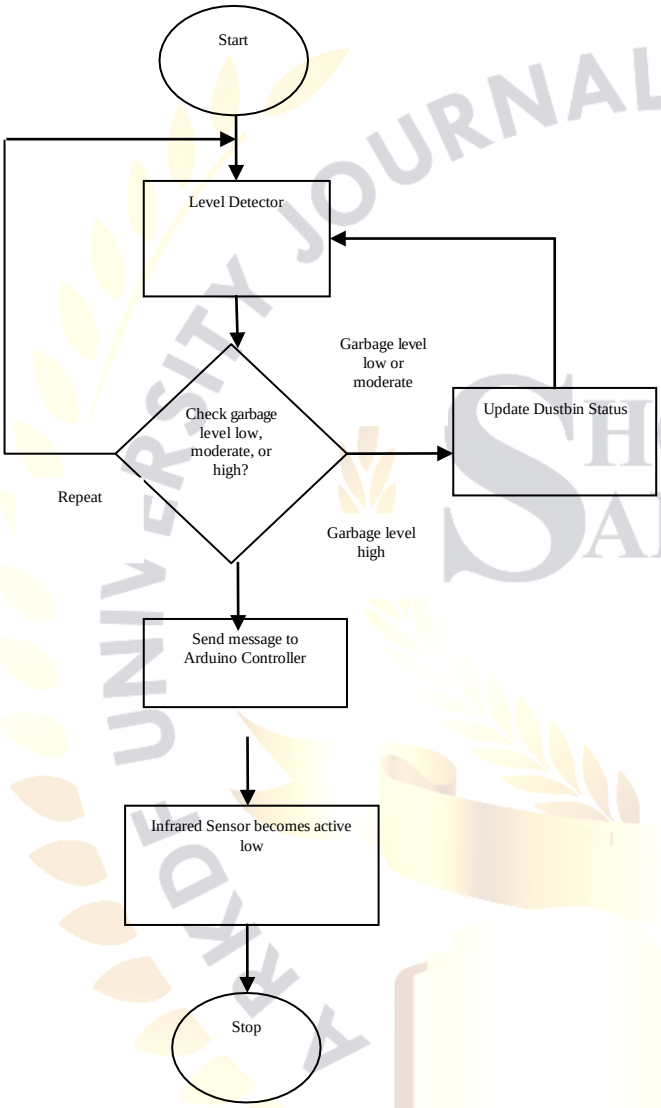

Figure. 3. Smart bin Module process

2. IOT MODULE

This outcome is given to Arduino to send the communication to the admin module via IoT module.

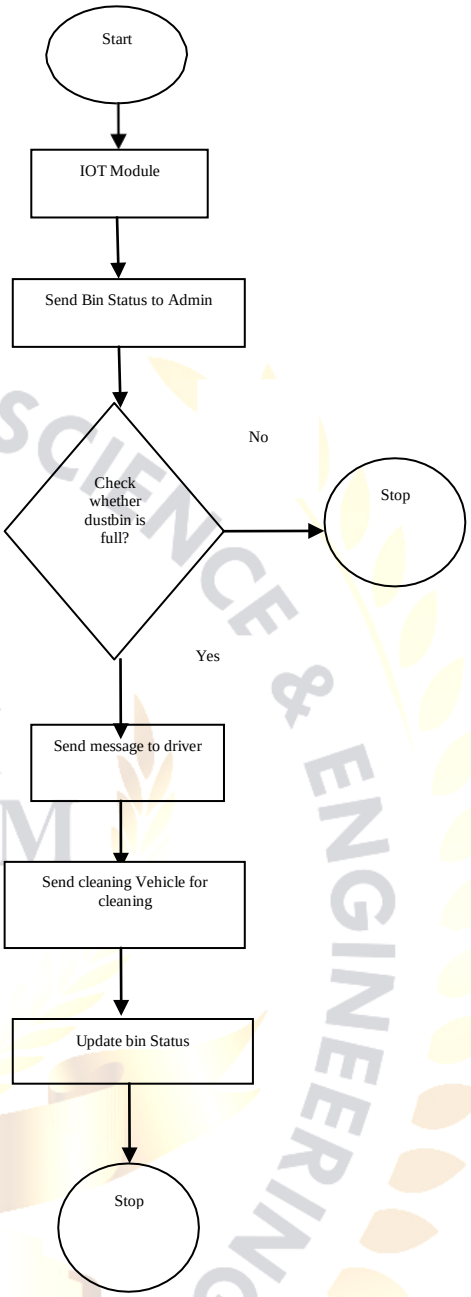

Figure. 4. IoT Module process

3. ADMIN MODULE

Admin module is present where all the activities are manage. Scheduling, Routing, Update status and Send Notification

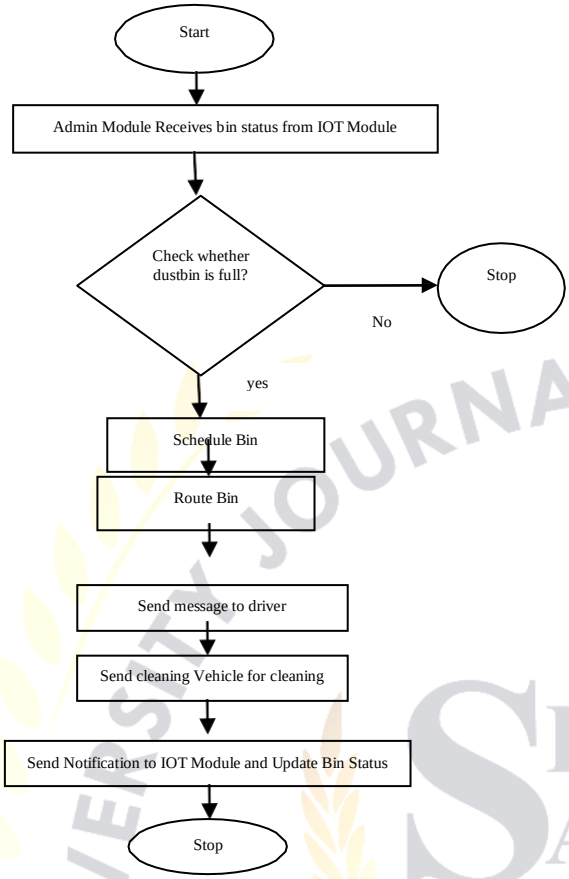

Figure. 5. Admin Module process

4. DRIVER MODULE

- Receive notification
- Clean bin
- Send notification

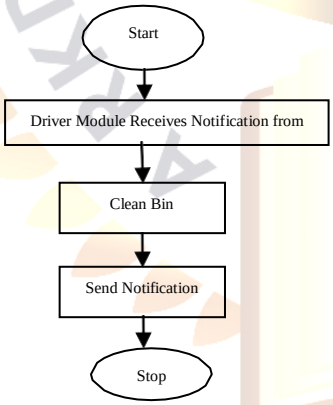

Figure. 6. Driver Module process

5. USER MODULE

- User can register complaint
- He/She can search nearby dustbin.

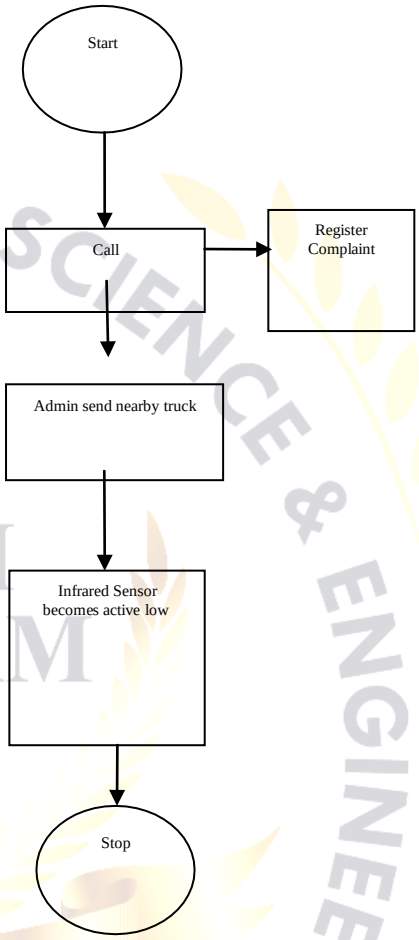

Figure. 7. User Module process

III. EXPERIMENTAL SETUP & IMPLIMENTATION

Assembling smart waste bin we use a group of sensor and one microcontroller that is Arduino pro mini 328. A proto type of dustbin is made with two boxes one is for wet waste and other one is for dry waste. The dry bin contains embedded wet sensor. The LCD 16*2 (HD44780) displays all the data collected by sensor. Voltage regulator IC 7805 is fixed to provide 5V regulated power supply. Both waste bin contains Ultrasonic Sensor (HC-SR04) to measure garbage level of bin. Gas Sensor (MQ-135) provides safety from harmful gases. GPS module GY-NEO6MV2 fixed to detect bin location. A fire alarm system is made by the help of Temperature sensor IC LM 35 and Buzzer. Wi-Fi module (ESP8266-01) help for data connection by which data can be sent to the server of "thing speak".

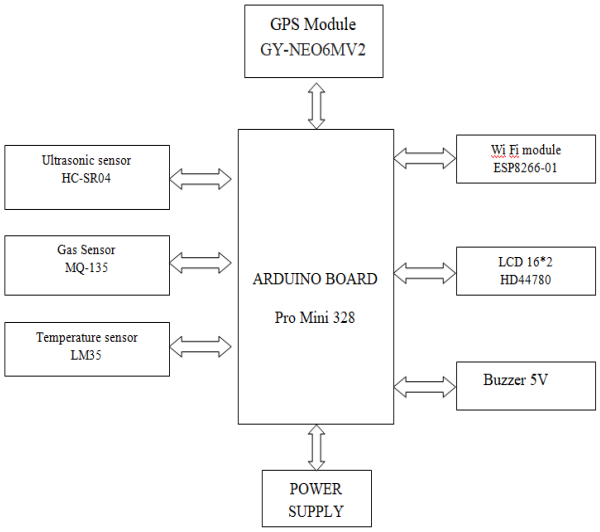

Figure 8 Block diagram of Experimental Setup

1. Software Requirement

1. Arduino IDE 1.8.5-The Arduino integrated development environment is used to write and upload programs to Arduino board. It supports the languages and c++. It is designed for Windows, Mac OS and Linux.

2. Functional Requirement

1. Smart bin:

Level detector comprises of infrared sensor which is used to recognize the level of the deny in the dustbin. The yield of level locator is given to Arduino. Right when the dustbin is finished off to the most unusual sum, the yield of infrared sensor authority winds up powerful low. This yield is given to Arduino to send the message to the administrator module by means of IoT module.

2. Admin module:

It is accessible where each one of the activities is managed. The amount of the control room is depends upon the dustbins appear in the region. The overseer sitting in the control room screens the entire structure. The IoT Module is related with the PC of the Admin module through Arduino. The entire structure is screen by the chairman sitting in the control room. The similar IoT Module is used to send the communication to the officially required laborer for cleaning the dustbin.

IV. RESULT AND ANALYSIS

In this paper, we collect all the results from the website of thing speak and it's mobile App. The result contains real time data sheet and graphs. The graphs are showing the position, level, temperature & harmful gas level with respect to time and date. The Table 1is generated by the thing speak website in the form of '.csv file' that can be open from Microsoft excel. The fields 1,2,3,4,5 represent dry bin level, wet bin level, harmful gas level, bin temperature and positional value respectively. 'Created at' shown the time and date of data collection.

Table.1 Data table From Thingspeak website.

Created_at	Entry_id	Field 1	Field 2	Field 3	Field 4	Field5
2019-04-06 14:22:56 UTC	1	16	17	343	25.35	2613.173
2019-04-06 14:23:25 UTC	2	16	16	340	27.5	2613.172
2019-04-06 14:23:54 UTC	3	16	17	339	25.35	2613.173
2019-04-06 14:24:23 UTC	4	16	16	344	27.5	2613.177
2019-04-06 14:24:52 UTC	5	16	16	348	25.78	2613.174
2019-04-06 14:25:21 UTC	6	17	16	352	25.78	2613.175
2019-04-06 14:25:50 UTC	7	17	16	355	25.35	2613.173
2019-04-06 14:26:19 UTC	8	16	16	358	25.78	2613.175
2019-04-06 14:26:48 UTC	9	16	16	357	27.5	2613.176
2019-04-06 14:27:17 UTC	10	16	16	354	26.64	2613.176
2019-04-06 14:27:46 UTC	11	16	16	350	27.5	2613.174
2019-04-06 14:28:15 UTC	12	16	16	346	26.21	2613.175
2019-04-06 14:28:45 UTC	13	1	1	343	26.21	
2019-04-06 14:29:14 UTC	14	1	16	340	26.21	2613.17494$ GPRMC
2019-04-06 14:29:43 UTC	15	1	1	340	27.5	
2019-04-06 14:30:12 UTC	16	1	1	346	27.5	2613.17582$ GPRMC
2019-04-06 14:31:10 UTC	17	1	16	353	25.35	2613.17718$ GPRMC

(Field 1 – wet bin, field 2-dry bin, field 3- hazardous gas level, field 4- bin temperature, field 5-gps position)

In Fig 9, the line of the graph is showing the positional value of latitude of bin with respect to time. As we moving the

dustbin the positional value is changing otherwise it will stable.

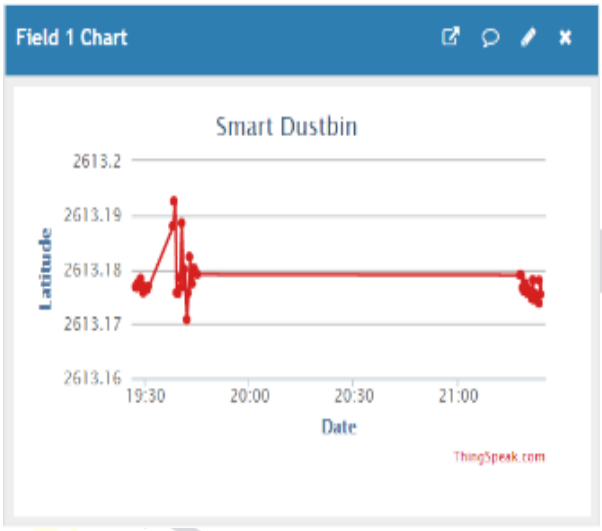

Fig. 9 latitude graph- the graph is showing latitude position of bin

In fig 10, the line of the graph is showing the positional value of longitude of bin with respect to time. As we moving the dustbin the positional value is changing otherwise it will stable.

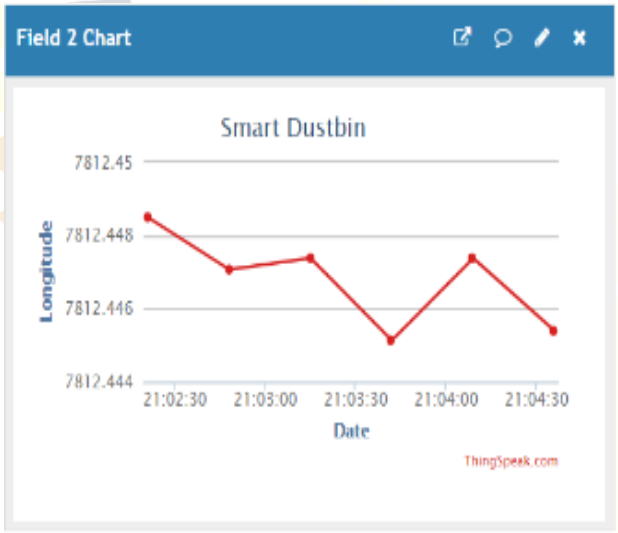

Fig. 10 longitude graph-the graph is showing longitude position of bin.

In Fig 11, the line of the graph represents the level of harmful gas with respect to time. The maximize level is 400 at which the buzzer start alarming.

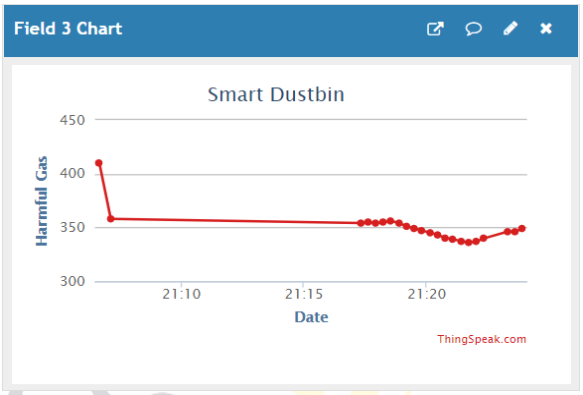

Fig.11 harmful gas level graph-the graph is showing harmful gas level.

In Fig 12, the line of graph represents the bin temperature with respect to time. The maximum level is 50 at which buzzer start alarming.

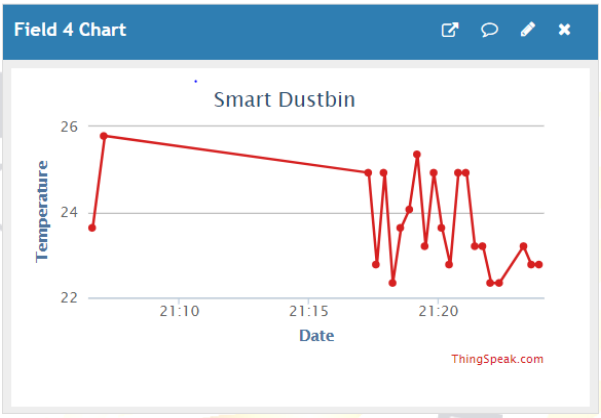

Fig. 12 temperature level graph-the graph is showing temperature level.

In Fig. 13, the line of graph represents the garbage level of dry bin with respect to time. The numeric values on Y-axis are in millimeter (mm).

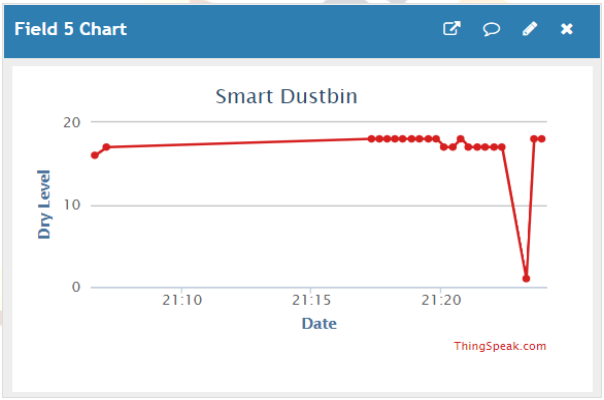

Fig.13 dry bin level – this graph is showing dry bin level

In Fig 14, the line of graph represents the garbage level of wet bin with respect to time. The numeric values on Y-axis are in millimeter (mm).

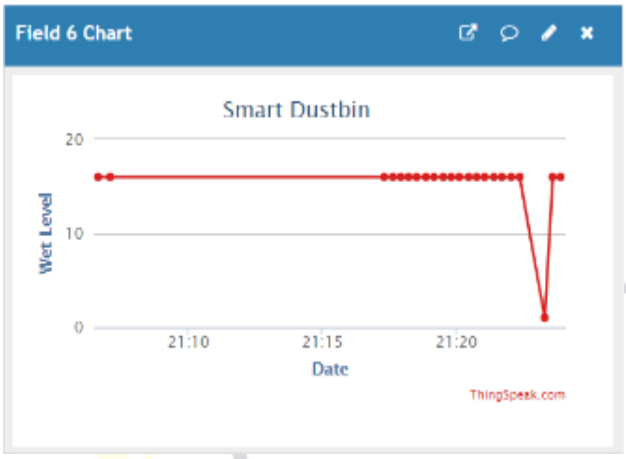

Fig.14 wet bin level-this graph is showing wet bin level

In Fig 15, App notification for truck driver is showing. This is the 'thing speak' widget app in which the status of dry and wet bin can be seen.

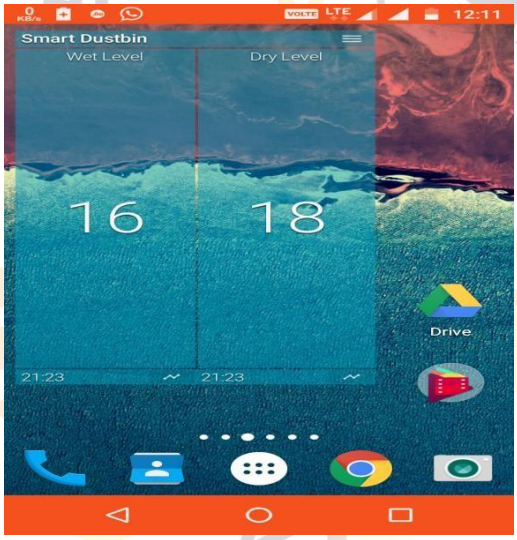

Fig. 15 App notification for truck driver

V. Conclusion

This paper presents a framework of IoT innovation project for waste management system. This novel solution able to enrich the efficiency of waste bin collection activities and cost reduction. The implemented system on top of this framework can be further improved to perform real-time, reliable and efficient waste management system. This work improves practicality of IoT based Bin to Track Dustbin and Public Complaint Management System for smart city. To reduce these problems we made a system, by using this we can track the proper dustbin location and find out how many dustbin are placed in local area when public living. Also for complaining about this, we use this android app. Through this , we can complaint to the higher authority. So we can try to solve the problem of people. Citizens provide to have better service, and very easy process. From the result analysis we find the smart waste bin works with Internet connection in order to send waste bin data to the control station. Local authority can use this type of system and monitor the waste collection status in real-time and based on the recorded information they able to measure their operational performance, predict future operation requirements and plan for better service to deliver. To solve problem of wastage collection in short duration, the map can be used to show only full waste bin together with shortest route to help reduce operation costs.

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