Smart Garbage Monitoring System using Internet of Things (IOT)

[1]Supriya Patil, [2]Amruta Patil, [3]Srushti Shah, [4]Samrudhi Yadav, [5]Prof. N.C.Yadav,

[1]Student, [2]Student, [3]Student, , [4]Student, [5]Professor
[1]Department of Electronic And Telecommunication Engineering,
[1]Jaywant College of Engineering And Polytechnic, K.M Gad , Imdia

Abstract: The Internet of Things (IoT) must be able to include a huge number of various and heterogeneous end systems transparently and smoothly, while also allowing open access to specified subsets of data for the development of a plethora of digital services. Building a generic architecture for the Internet of Things is thus a very hard endeavour, owing to the incredibly wide range of devices, connection layer technologies, and services that may be included in such a system. One of our key environmental issues has been solid waste management, which, in addition to disrupting the environment's equilibrium, has negative consequences on society's health. One of the most pressing issues of our day is the identification, monitoring, and management of trash. The conventional method of physically monitoring rubbish in waste bins is a complex, time-consuming procedure that requires more human effort, time, and money and is in no way compatible with modern technology. This is a sophisticated way of trash management that is automated. This IoT Garbage Monitoring Technology idea is an extremely unique system that will assist to keep cities clean. This system monitors the garbage bins and provides information on the amount of waste collected in the bins via a web page. All information is also sent to waste collection vehicles via this website.

Index Terms - **Wi-Fi modem, Arduino microcontroller, Application Resource Manager (ARM), Solids Waste management.**

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.

Internet and its applications have become an integral part of today's human lifestyle. It has become an essential tool in every aspect. Due to the tremendous demand and necessity, researchers went beyond connecting just computers into the web. These researches led to the birth of a sensational gizmo, Internet of Things (IoT). Communication over the internet is grown from user-user interaction to device - device interactions these days. Typically, IOT offers advanced connectivity of devices, systems, and services that go beyond machine to machine communications (M2M) and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is implemented in nearly all fields of automation enabling advanced applications like a Smart Grid. The term-things in the IoT refers to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field operation devices that assist fire-fighters in search and rescue. Current market examples include smart home and smart cities [2-4].

The world is in a stage of upgradation, there is one stinking problem we have to deal with. Garbage! In our daily life, we see the pictures of garbage bins being overfull and all the garbage spills out. This leads to the number of diseases and insects and mosquitoes breed on it. A big challenge in the urban cities is solid waste management not only in India but for most of the countries in the world. Hence, such a system has to be build which can eradicate this problem or at least reduce it to the minimum level [7].

The waste collection process is a critical aspect for the service providers. The traditional way of manually monitoring the wastes in waste bins is a complex, cumbersome process and utilizes more human effort, time and cost which is not compatible with the present day technologies. In order to overcome all these problems, we are proposing the idea of a waste management system which helps in the management of waste with the least human interaction in order to maintain a clean environment.

The people who need dust bins near their location can request it through logging onto our website. IoT Garbage Monitoring System monitors the garbage bins and informs about the level of garbage collected in the garbage bins via an SMS. We are making use of various sensors to scan type of garbage and then categorize them to different bins by automatically opening the door. It also uses ultrasonic sensors placed over the bins to detect the garbage level. Our system works on solar energy. If the dustbin is not cleaned

in a specific time, then the record is sent to the higher authority who can take appropriate action. This system also helps to monitor the fake reports and hence can reduce corruption in the overall management system. It will stop overflowing of dustbins along roadsides and localities as smart bins are managed at real time. The filling and cleaning time of smart bin will also be reduced thus making empty and clean dustbins available to common people [1].

II. PROBLEM DESCRIPTION

In recent decades, Urbanization has increased tremendously. There is an increase in waste production. Hence, the role of waste management services remains integral in India. Waste management or waste disposal are all the activities and actions required to manage waste from its inception to its final disposal. This includes amongst other things collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling.

Waste can take any form that is solid, liquid, or gas and each has different methods of disposal and management. Waste management normally deals with all types of waste whether it was created in forms that are industrial, biological, household, and special cases where it may pose a threat to human health. It is produced due to human activity such as when factories extract and process raw materials. Waste management is intended to reduce the adverse effects of waste on health, the environment or aesthetics.

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 !

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.

III. LITERATURE REVIEW

Adil Bashir, Shoaib Amin Banday, Ab.Rouf Khan and Mohammad Shafi, "Concept, Design and Implementation of Automatic Waste Management System", [1] in this paper authors integrated to use as Smart Trash System embodies an electronic device known as Smart Trash Bin which consists of Sensors (Load sensor and IR proximity sensor) and a Radio Frequency (RF) transmitter. An automated GSM module, Load sensor, Microcontroller, DC motor, LCD, Web Camera, and Power supply are the essentials for collection, monitoring, and management of garbage. Implementation of this project helps in avoiding overflow of garbage from the container in a residential area which is previously either loaded manually or with the help of loader in traditional trucks. It reduces the productivity of the vehicles and manpower deployed and thereby helps in minimizing the threat to the health of the sanitation workers as the waste is highly contaminated.

B. Chowdhury and M. U. Chowdhury, "RFID-based real-time smart waste management system," [2] in this paper, some smart trash research consider "pay as you throw"' weight-based billing for residential collection, which could motivate residents to reduce their waste. It uses the load sensor.

F achmin F olianto, Y ong Sheng Low and Wai Leong Yeow, "Smartbin: Smart Waste Management System",[3] This paper presents a system which is designed to collect data using the ultrasonic sensor and to deliver the data through the wireless mesh network. The system also employs a duty cycle technique to reduce power consumption and to maximize operational time. The Smart bin system was tested in an outdoor environment. Through the testbed, we collected data and applied sense-making methods to obtain litter bin utilization and litter bin daily seasonality information. With such information, litter bin providers and cleaning contractors are able to make better decision to increase productivity.

Dr. K. R. Nataraj and Meghana K. C, "IOT Based Intelligent Bin for Smart Cities",[4] The proposed system concentrates on eradicating the issue of ignorance of cleanliness which is spoiling our environment and then reduce it. The smart trash consists of two sensors namely IR and gas sensors. The IR sensor placed inside the trash to sense the level of trash and gas sensor will sense the toxic gases. Once the trash is filled, alarm rings.

S.Navghane, M.S.Killedar, Dr.V.M.Rohokale, "IoT Based Smart Garbage and Waste Collection Bin",[5] this is not an original idea, for the implementation of smart garbage bin; the idea has existed for many years, After the IoT field finding its grip in ou lives. This is an original plan for designing a smart garbage bin with a weight sensor, IR sensor and Wi-Fi module for transmission of data. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum. If the dustbin is not cleaned in a specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection.

Gaikwad Prajakta, Jadhav Kalyani, Machale Snehal, "Smart Garbage Collection System in Residential Area",[6] automatic garbage collection and information gathering system which is based on Image processing as well as on GSM module. The main concept is that a Camera will be placed at every garbage collection point along with the load cell sensor at the bottom of the garbage can. The camera will take continuous snapshots of the garbage can. A threshold level is set which compares the output of the camera and load sensor. The comparison is done with the help of microcontroller. After analyzing the image, we get an idea about the level

of garbage in the can and from the load cell sensor we get to know the weight of garbage. Accordingly, information is processed and checks if the threshold level is exceeded or not. The controller sends a message with the help of a GSM module to Garbage collection local central office to notify that garbage can be exceeded its capacity and disposal of waste is required. Accordingly, the authority sends the garbage collecting vehicle to collect the garbage, which is done with the help of a robot mechanism which tilts the can.

Vishesh Kumar Kurre, "Smart Garbage Collection Bin Overflows Indicator using IOT",[7] in this a sensor (Infrared sensor/proximity sensor) Is placed under the dustbin. When the sensor signal reaches the threshold value, a mail notification (like email, twitter, WhatsApp message) will be sent to the respective Municipal / Government authority person. We can also see the density of the Dustbin through the internet on a Dashboard, this is a GUI (Graphical User Interface) dashboard so any of the authenticate person will easily check the present condition of the dustbin. So then that person can send the collection vehicle to collect the full garbage bins or dustbins.

IV. SYSTEM METHODOLOGY

A system consists of an inductive proximity sensor on the conveyor belt and ultrasonic sensors at the top of the dustbin, a smoke sensor to detect fire. Each smart bin is assigned with GPS(Global Positioning System) to provide the location and a GSM(Global System for Mobile) to send the message to the workers. All the sensors and modules are connected directly to Arduino and they are controlled by the Arduino board. Arduino's program monitors sensors and issues action based on the status of the bin.
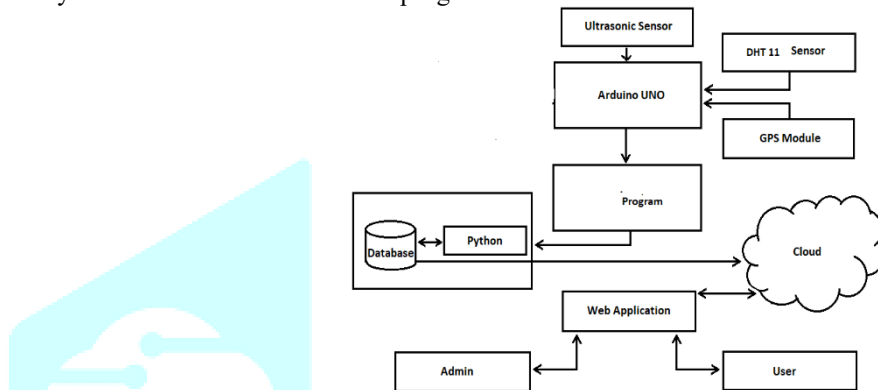

Fig.no 1 General Architecture

3.1 Ultrasonic Sensor

The suggested system with the help of sonar sensor can be used to identify the depth of the dustbin. A sonic transducer used for the ultrasonic sensor, which allows alternate transmission and reception of sound waves. The sonic waves emitted by the transducer are reflected by, an object and received back in the transducer after having emitted the sound waves, the ultrasonic sensor will switch to receive mode the time elapsed between emitting and receiving is proportional to the distance of the object from the sensor. Let T be the time elapsed between emitting and receiving ultrasonic waves and D be the distance between the sensor and the obstacle, given by The ultrasonic sensor consists of four pins ECHO pulse output, TRIG pulse input, ground, 5v supply.

3.2 Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is some signal, either analog or digital, representing the position commanded for the output shaft The motor is paired with some type of encoder to provide the position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either in direction, as needed to bring the output shaft to the appropriate position. As the position approach, the error signal reduced to zero and the motor stops.

3.3 GPS Module

GPS stands for Global Positioning System, in the proposed system GPS is used to keep track of the location of the smart bin.

Working: The Global Positioning System consists of a network of 24 broadcasting satellites orbiting the earth at a height of 20,200km. GPS also consists of receivers on the ground, which listen to and interpret the transmissions of the satellite. Stations on the earth carefully monitor the orbit of each satellite, maintaining a highly accurate record if the satellites instantaneous position. The knowledge of the precise position of the satellites allows them to use as reference points, from which GPS receivers on earth can determine their position. This technique of determining the position of an object is called ranging.

IV. RESULTS AND DISCUSSION

Software testing is the process of checking whether the developed system is working according to the original objectives and requirements. Software testing process commences once the program is created and the documentation and related data structures are designed. Software testing is essential for correcting errors. Otherwise, the project is not aid to be complete. The system should be tested experimentally with test data so as to ensure that the system works according to their required specification. When the system is found working, test it with actual data and check performance. Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design, and coding. Hardware testing is a process of testing the hardware products developed by hardware developers. The most commonly used testings are unit testing and system testing.
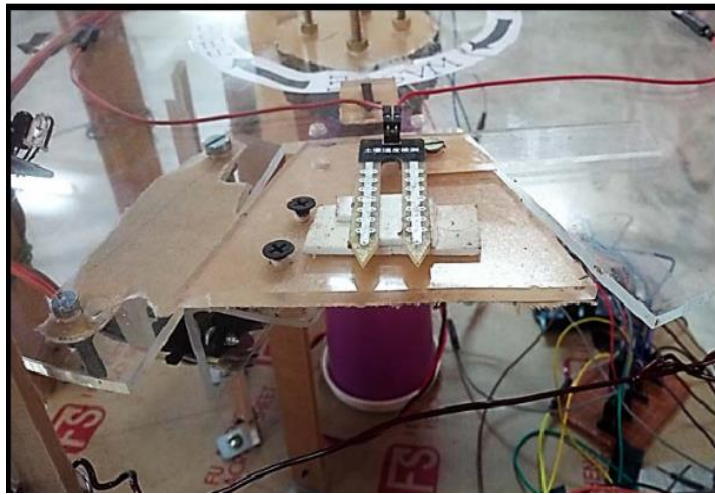
Fig.no 2 Hardware Implementation

Results basically refer to any particular output that comes as a result of the completion of the activities that have been performed as part of the project or a particular project component.
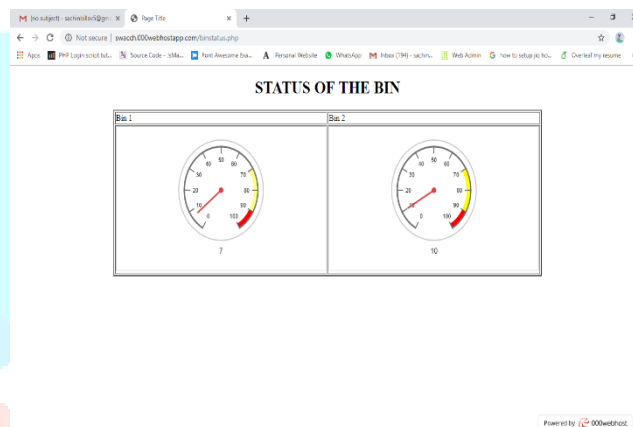

Fig.no 3 Result window

When bin contents are above the threshold level administrator receives the real-time notification. The administrator can view the status of a particular smart bin which includes the current level of garbage in the bin, date and time of the last update and its location. The administrator receives the text message when contents in the bin cross the threshold level. The received message has the location details as well as a link to the map where the smart bin is located. When the administrator clicks on the URL received via SMS, it directs him to the bin location of the map.
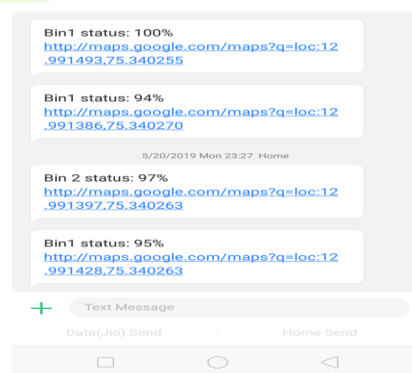

Fig no.4 Output

Testing of each module of a system is called the unit testing. The main purpose of Testing is Software quality checking. In this work, unit tests are conducted on all modules and obtained the expected results. Later, component testing is conducted on each module obtained the expected results and modules in the system worked properly. Once the implementation of the system has been completed then the entire system is tested to check whether the developed system satisfies the requirements. The process of testing the entire system is called system testing. On the other hand, the system is developed by the integration of different modules.

V. CONCLUSION

Rapid population and the increasing industrialization are considered to be the major causes of pollution. Garbage left in the streets and overflowing dustbins pose extreme health hazards to the surrounding people. Advancement in technology can be utilized to overcome these problems.

This project is initialized to aid smart city concept and swatch Bharat Abhiyan. It uses cheap and reliable Raspberry pi as central control board and is interfaced with Arduino and sensors for smoke detection, Dustbin status, GPS module for identifying location and all the sensors data are stored in online database in real time, it also makes use of web and SMS notification in order to make the system more efficient and reliable. Waste disposal is a burning issue and there is a sample potential in future development for various aspect of this research projects. The receptacle designed for segregation at source can be further developed in terms of materials and design for use in different waste situation and characteristics.

Cost and portability aspects can be taken up for further development through research which would enable its use for a larger and varied audience. The efficiency of the model has plenty of potential for research. The design of the waste management model has been carried out to cater to the current waste situation and optimized to meet the objective of providing an affordable waste solution.

In future system can be upgraded with many sensors which may be feasible, and maybe some advancement of technology new sensors will be added to the system to meet requirements and to perform more different segregation. Adding the shortest route to reach the location of the bin along with the SMS notification. A smartphone application can be developed to make it more user-friendly, ease of use and efficient.

REFERENCES

[1]   Adil Bashir, Shoaib Amin Banday, Ab. Rouf Khan and Mohammad Shafi, "Design and implementation of Automatic Waste Management System" International Journal on Recent and Innovation Trends in Computing and Communication, ISSN 2321-8169, Volume: 1, Issue: 7, pp. 604-609, IJRITCC, JULY 2013.

[2]   B. Chowdhury and M. U. Chowdhury, "RFID-based real-time smart waste management system" in Telecommunication Networks and Application Conference, 2007. ATNAC 2007. Australasian. IEEE, 2007.

[3]   F achmin F olianto, Y ong Sheng Low and Wai Leong Yeow, "Smartbin: Smart Waste Management System", IEEE Tenth International Conference on Intelligent Sensors, Sensor Networks and Information processing(ISSNIP) Demo and Singapore, 7-9 April 2015.

[4]   Dr.K.R. Nataraj and Meghana K.C, "IOT Based Intelligent Bin for Smart Cities", International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169, Volume: 4, Issues: %, pp.225-229 IJRITCC, May 2016.

[5]   S.S.Navghane, M.S.Killedar and Dr.V.M.Rohokale," IOT Based Garbage and Waste Collection Bin" International Journal of Advanced Research in Electronics and Communication Engineering, ISSN: 2278-909X, Volume 5, Issue 5, May 2016.

[6]   Gaikwad Prajakta Jadhav Kalyani and Machale Snehal, "SMART GARBAGE COLLECTION SYSTEM IN RESIDENTIAL AREA" International journal;=l of Research in Engineering and Technology, ISSN: 2319-1163 | ISSN: 2321-7308.

[7]   Vishesh Kumar Kurre, "Smart Garbage Collection Bin Overflow Indicator using IOT", International Research Journal of Engineering and Technolog e ISSN:2395-0056| p-ISSN 2395-0072, Volume : 03 Issue : 05-May-2016.