SMART WASTE MONITORING SYSTEM

Prof .Mayur Tiwari, Aboli Deshmukh, Kshitija Boke, Netra Deshmukh, Ashwini Dhurve

[1]*Prof. Dept. of Electronics and Telecommunication, Prof. Ram Meghe Institute of Technology and Research, Badnera, Amravati, Maharashtra, India*
[2,3,4,5]*Student, Dept. of Electronics and Telecommunication, Prof. Ram Meghe Institute of Technology and Research, Badnera, Amravati, Maharashtra, India*

Abstract: ***Environment is essential for everyone and present everywhere, that supply all natural needs in an abundant manner but also we have some responsibilities towards our environment India is the developing country with a huge population .This ever increasing population degrades the cleanliness of sustainable environment. To maintain splendor, the Indian government launched the campaigned of Swachha Bharat mission popularly known as clean India mission. Once these smart bins are implemented on a large scale, by replacing our traditional bins present today, waste can be managed efficiently as it avoids unnecessary lumping of wastes on roadside. Foul smell from these rotten wastes that remain untreated for a long time, due to negligence of authorities and carelessness of public may lead to long term problems. Breeding of insects and mosquitoes can create nuisance around promoting unclean environment. This may even cause dreadful diseases. People are more interested to use such technologies which can reduce their time and effort in efficient manner. Automation is the most demandable feature now a day. For this purpose smart dustbins are the much suitable approach. It will be helpful to develop green and smart city.***

1. INTRODUCTION

Nowadays, there are tons of flats and apartments which have been built in the rapid urbanization area. This is due to high hous- ing demands which have been drastically raised as a result of migration from villages to cities to find works. In order to ac- commodate the growing population in the urban area, the gov- ernment has built flats, apartments or condominiums, to provide shelter for them, there are several issues faced by the inhabitants of the flats. One of them is the issue of the domestic solid waste disposal, which cause pollutions. Unlike landed houses, the flats' waste disposal bins are shared among all residents which live in the same building, and thus, the bins tend to be filled very quick- ly. Thus, an unsystematic and inefficient disposal waste man- agement may cause the bins to be always full with of garbage, and further littering from the residents will cause the garbage piles to be scattered outside the bins. The waste collection pro- cess is a critical aspect for the service providers. The traditional way of manually monitoring the wastes in waste bins is complex, cumbersome process and utilizes more human effort, time and cost which is not compatible with the present day technologies. Irregular management of waste typical- ly domestic waste, industrial waste and environmental waste is a root cause for many of the human problems such as pollution, diseases and has adverse effects on the hygiene of living beings. In order to overcome all these problems, we are proposing the idea of smart waste management system which helps in auto- management of waste without human interaction in order to maintain a clean environment. At various locations it is observed that the garbage remains in the dumpster for number of days and it spreads nearby dumpster container. In today's garbage collecting system, there is no record of garbage collection. 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 automat- ed. This is our IoT Garbage Monitoring system, an innovative way that will help to keep the cities clean and healthy.

2. LITERATURE SURVEY

Several solutions for waste management equipped with IoT fa- ciliates have been proposed and invented in the literature to help solid waste management authorities improve the quality of ser- vice delivery. Designed a smart bin system uses a wifi based mi- crocontroller .This web developed application, a tool for local authority is used to monitor garbage status to ensure

waste collection services is deliver per contract by the service provider. The proposed system attempts to provide solution of problems like proper allocation and relocation of waste bin, check for un- suitability and proximity convenience to the users and future suggestions. Another work by provides a Smart Garbage Moni- toring System specifically to apartment, condominium or flat type residency that has trash. The concept system uses ultrasonic sensor to measure the waste level using wifi microcontroller. Ultrasonic sensor will continuously measure the waste level and notify the residence and garbage collector regarding the waste status. This system sends notification through SMS to collector whenever waste bin is almost or already full. Indicator can be put at each level of the resident to alert the residencies to minimize or stop dispose waste. We built an efficient garbage monitoring sys- tem which can be used to monitor the level of garbage in the dump. This data can be further used to plan garbage collection trips more efficiently, ultimately reducing overflowing bins and helping have better public sanitation.

3. DESIGN OF SMART BIN

Node MCU provides a way to connect different sensors to their controllers wirelessly via wifi. Since, it is an improved version of the ESP8266 it has better and easier programming, with better voltage stability and more reliability. It get information from sen- sor and process on it. It compares the received data with the threshold level set and accordingly output is generated.
The HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are VCC, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed × Time

Power the Sensor using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly powered by the on board 5V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trig- ger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor. Using this information the distance is measured as explained in the above heading. The time between the transmission and reception of the signal allows us to know the distance to an object. This is possi- ble because we know the sound's velocity in the air. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 openings on its front. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

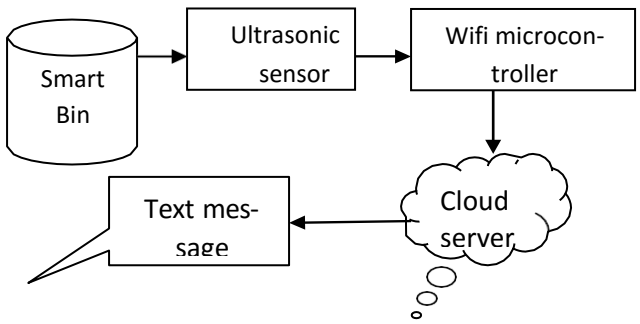

Fig 3.1: Block Diagram of Smart Bin

In this section we design structure of the system before imple- mentation of circuit. We use advanced microcontroller called WeMOS. In this project we put the ultrasonic sensor on top of the garbage bin. The output of the ultrasonic sensor is processed by the microcontroller and the output is then sent to the cloud server which sends a text message to the concerned person. We have a threshold value of 10cm which means that if the distance of the sensor from the top of the garbage is less than 10cm, the output will come with a message that the basket is full. We have created our web developed application which will continuously monitor the graphical status of smart bin. Connections of the ultrasonic sensor with the WeMOS are very simple. Connect the VCC and the ground of the ultrasonic sensor to the 5V and the ground of the WeMOS. Then connect the TRIG and ECHO pin of ultrason- ic sensor to the pin D5 and D6 of the WeMOS respectively.

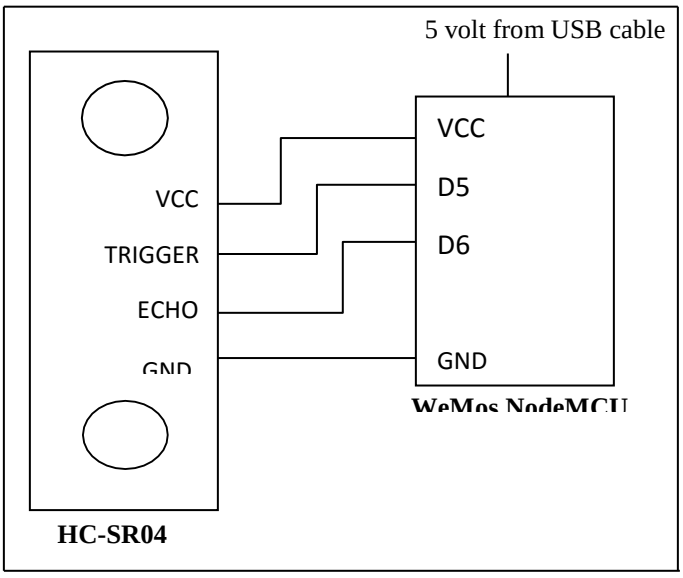

Fig3.2: Connection between WeMos and HC-SR04

Mathematical Analysis

- Total dustbin length=30 cm
- The sensing distance of UV sensor=10cm

Calculation

Time taken by pulse is actually for to and from travel of ultrason- ic signals, while we need only half of this. Therefore time is tak- en as time/2.

Distance = Speed * Time/2

Speed of sound at sea level = 343 m/s or 34300 cm/s

Thus, **Distance = 17150 * Time (unit cm)**

Analysis of the accuracy of determination of the intensity **E** of UV radiation for a specified wavelength λ was made on the basis of the uncertainty theory. The inaccuracy of intensity measurement, charac- terizing the scatter of the values attributed to the quantity being measured, is described by a complex uncertainty:

$$U(E)=kuc(E)$$

where: **k** – the coverage factor (**k**=2 for confidence level 0.95); $u_C(E)$ – the combined standard uncertainty of estimate **E**.
The equation from which the estimate **E** of the true value of UV radiation intensity is calculated.

To calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = cen- timeters or uS / 148 =inch; or: the range = high level time * ve- locity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.

Fig.3.3:Radiated and Received signal

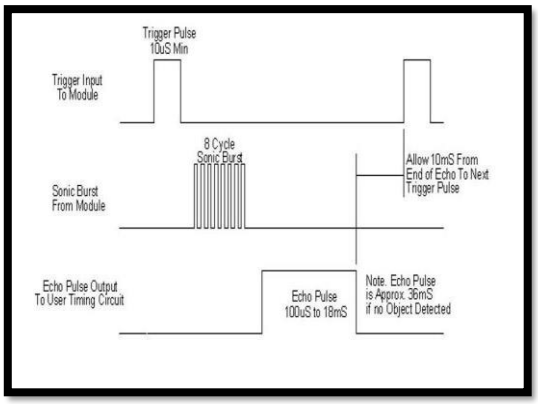

Fig.3.4: Waveform of UV sensor

Distance Measurement formula is expressed as: L = C X T

In the formula, L is the measured distance, and C is the ultrason- ic spreading velocity in air, also, T represents time (T is half the time value from transmitting to receiving).

Table 1: Waste bin fill-level indicators.

Indicator	Threshold	Value	Description
Status	0%	0	Empty/Not full
	>= 80%	1	Full

Table 2: Waste bin SMS notification indicators.

Indicator	Value	Description
sms	NS	SMS not sent
	S	SMS is sent

Table 3: Waste bin conditions.

Condition	Indicator		Description
	status	sms	
1	0	S	Initial or empty
2	1	NS	Full and notified
3	1	S	Full and not notified

4. FLOWCHART OF SMART BIN

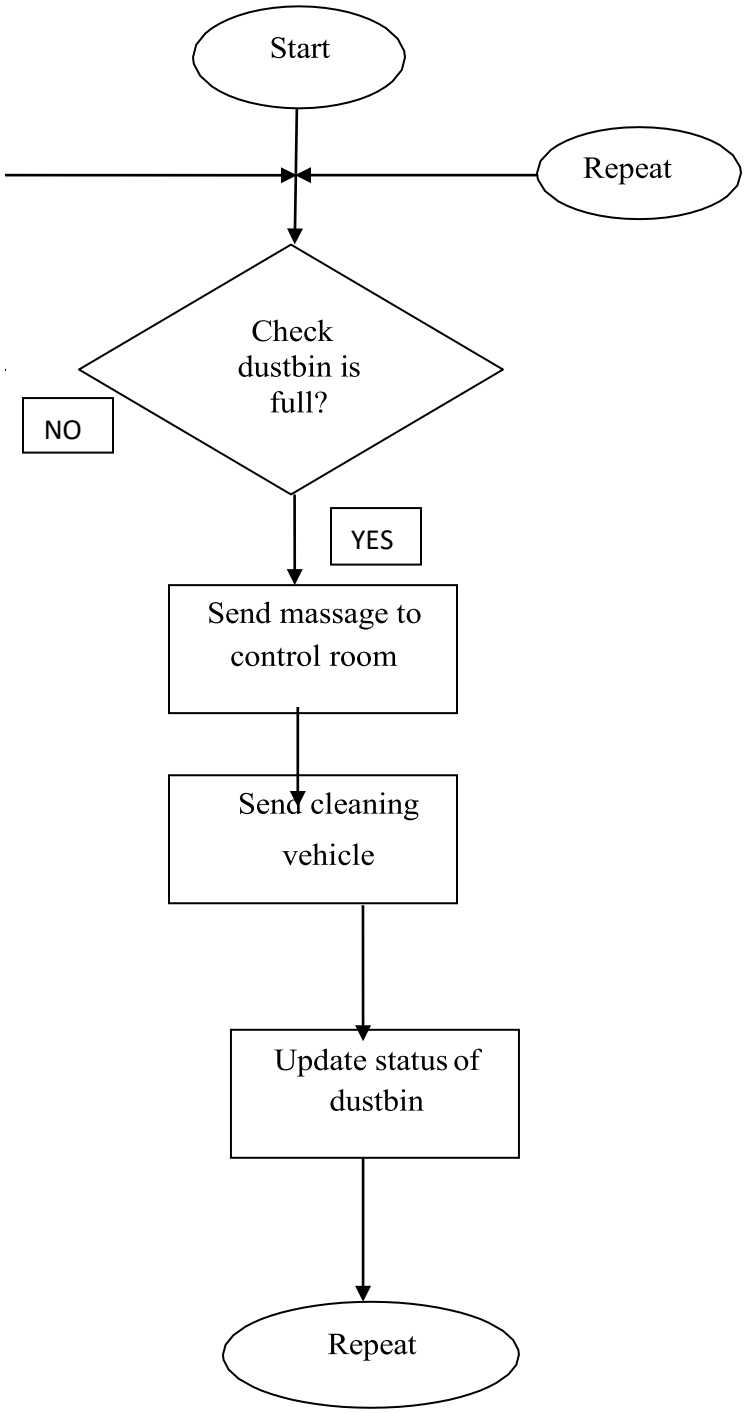

Fig4: Flowchart of Smart Bin

6. RESULT

This section preset a real time plot of the fill percentage of the bi ad the real time plot inside the bin this is the graphical representa- tion of design of smart bin. The test cases for the smart bin are as follows,

1) Dustbin when empty - 0 % (At first level UV Sensor gives output)
2) Dustbin full – 90% (At last level UV sensors gives output)

Fig 6.1: Design of Smart bin

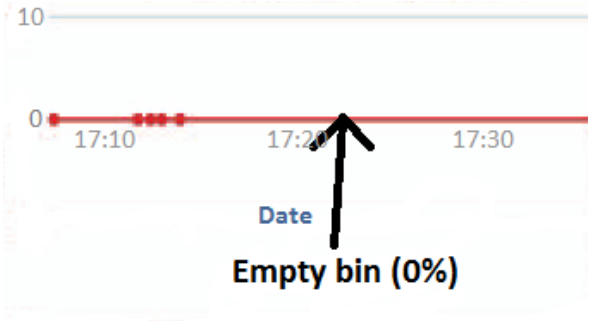

Fig 6.2: Garbage level at 0%

Fig 6.3: Garbage level at 25%

Fig 6.4: Garbage level at 50%

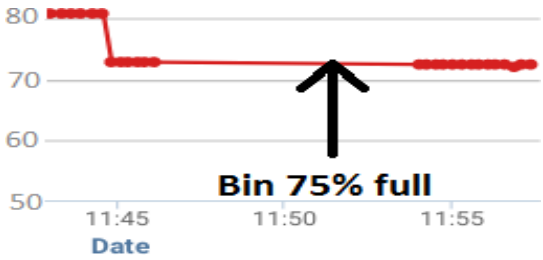

Fig 6.5: Garbage level at 75%

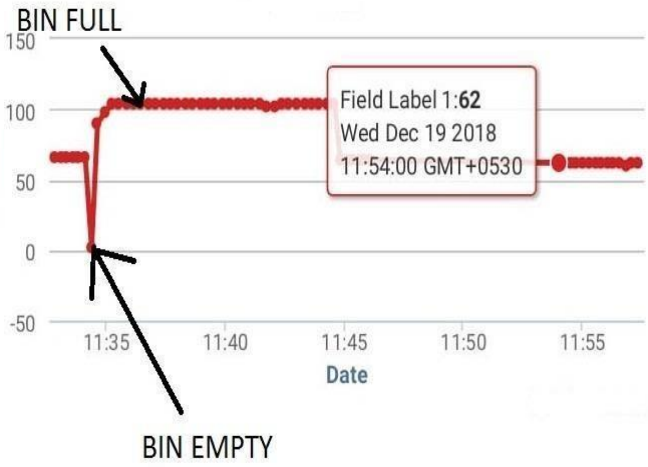

Fig 6.6: Graphical representation of level of garbage.

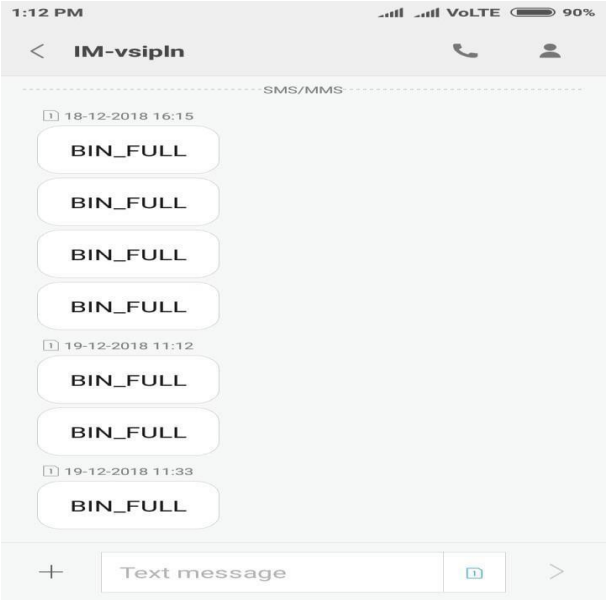

Fig 6.3: Message received from server

7. CONCLUSION

One of the utility of our system is that the Govt. can use the gar- bage generations statistics for policy and program design. If the system is implemented properly it will really make the cities cleaner and greener and makes the smart city. The real-time monitoring of the garbage level with the help of sensors and wireless communication will reduce the total number of trips required and thus, will reduce the total expenditure associated with the garbage collection. Thus, the dustbins will be cleared as and when filled, giving way to cleaner city, better infrastructure and increased hygiene. The proposed idea can be implemented for smart cities where the residents would be busy enough with their hectic schedule and wouldn't have enough time for managing waste. The bins can be implemented in a city if desired where there would be a large bin that can have the capacity to accumulate the waste of solid type for a single apartment. The cost could be dis- tributed among the residents leading to cheaperprovision.

ACKNOWLEDGMENT

We would like to thanks M. V. Tiwari, PRMITR Badnera for his continuous support and motivation which has help us in success- fully designing the system.

REFERECES

[1]. Ghose, M.K., Dikshit, A.K., Sharma, S.K. A GIS based transportation model for solid waste disposal – A case study on Asansol municipality. Journal of Waste Management‖.

[2] Guerrero, L.A., Maas, G., Hogland, W.: Solid waste man- agement challenges for cities in developing countries. Journal of Waste Management.

[3] Alexey Medvedev, PetrFedchenkov, ArkadyZaslavsky, Theodoros, Anagnostopoulos Sergey Khoruzhnikov,‖Waste Management -Enabled Service in Smart Cities‖.

[4]. Meghana K C, Dr. K R Nataraj, GSM Based Intelligent Bin for Smart Cities‖.

[5]. Monika K A, NikithaRao, Prapulla S B, Shobha G, Smart Dustbin-An Efficient Garbage Monitoring System.

[6] Michael Batty , Kay Axhausen, et al., "Smart Cities of the Future,"UCL centre for advanced spatial analysis on working paper series, ISSN 1467-1298, Paper 188 - Oct 12.

[7]. S.S. Navghane, M.S. Killedar, Dr.V.M. Rohokale,|| IoT Based Garbage and Waste Collection Bin||, May 2016.

[8]. P. Sukholthaman, K. Shirahada, Proceedings of PICMET '14 Conference: Portland International Center for Management of Engineering and Technology; Infrastructure and Service Integra- tion, (2014)

[9]. C. K.M. Lee, T. Wu, International Conference on Industrial Engineering and Engineering Management, 798 (2014)

[10]. A.F. Thompson, A.H. Afolayan, E.O. Ibidunmoye, Infor- mation Science, Computing and Telecommunications, 206 (2013)

[11] Daniel V., Puglia P.A., and M. Puglia (2007). "RFID-A Guide to Radio Frequency Identification", Technology Research Corporation.

[12] Flora, A. (2009). "Towards a clean environment: A proposal on sustainable and integrated solid waste management system for university Kebangsaan Malaysia". Report from Alam Flora.

[13] Gogoi.L (2012). "Solid Waste Disposal and its Health Im- plications in Guwahati City: A Study in Medical Geography", Lambert Academic Publishing, Germany, ISBN 978-3-8454- 0149-2.

[14] Hannan, M., A., Arebey, M., Basri, H. (2010). "Intelligent Solid Waste Bin monitoring and Management System", Australi- an Journal of Basic and Applied Sciences, 4(10): 5314-5319, 2010, ISSN 1991-8178.

[15] Md. Liakot Ali, Mahbubul Alam, Md. Abu Nayeem Red- wanur Rahaman, (2012). "RFID based E-monitoring System for Municipal Solid Waste Management", International Conference on Electrical and Computer Engineering, Pg 474-477.

[16] Rahman, H., Al-Muyeed, A. (2010). "Solid and Hazardous Waste Management", ITN-BUET, Center for Water Supply and Waste Management

[17] Twinkle Sinha, K.Mugesh Kumar, P.Saisharan, (2015). "SMART DUSTBIN", International Journal of Industrial Electronics and Electrical Engineering, ISSN: 2347-6982, Volume-3, Issue-5.

[18] Visvanathan, C., Ulrich, G., (2006). "Domestic Solid Waste Management in South Asian Countries – A Comparative Analysis", 3 R South Asia Expert Workshop, Kathmandu, Nepal. (all reference are very old New latest reference may be added after year 2014) 1034

[19]P.Suresh1J. Vijay Daniel2, Dr.V.Parthasarathy4" A state of the art review on the Internet of Things (IoT)" International Co ference on Science, Engineering and Management Research (ICSEMR 2014)

[20] Arkady Zaslavsky, Dimitrios Georgakopoulos" Internet of Things: Challenges and State-of-the-art solutions in Internet-scale Sensor Information Management and Mobile Analytics" 2015 16th IEEE International Conference on Mobile Data Managment

[21]Theodoros.Anagnostopoulos1,Arkady.Zaslavsky2,1, Alexey Medvedev1, Sergei Khoruzhnicov1" Top–*k* Query based Dynam- ic Scheduling for IoT-enabled Smart City Waste Collection" 2015 16th IEEE International Conference on Mobile Data Man- agement.

[22] "City Garbage collection indicator using RF (Zigbee) and GSM technology"

[23] Vikrant Bhor, Pankaj Morajkar, Maheshwar Gurav, Dishant Pandya4 "Smart Garbage Management System" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 IJERTV4IS031175 Vol. 4 Issue 03, March-2015