An Effective Real Time Solid Waste Management

Sujitha S [1], Akash Bhardwaj [2], Shraddha Kiran [3], Soumyashree C Javali [4]

[1]- *Assistant Professor, Department of Electronics and Communication, New Horizon College of Engineering*

[2,3,4] *Student,B.E. , Department of Electronics and Communication, New Horizon College of Engineering*

Outer ring road, Marathahalli, Bengaluru- 560103 India

Abstract : Pollution in any form is hazardous to the environment. Today, Indian government aims for a "Swachh Bharat" to make it a more cleaner and greener country and improper waste management poses a major obstacle in achieving this agenda. The focus here is on solid waste management which could lead to serious health issues if not managed effectively. It was observed that the municipality vehicles were irregular at public bins to collect trash which led to overflow of these bins causing environmental pollution. This paper proposes a solution to manage the solid waste effectively and in real time with the help of technologies like zigbee, wifi module. The dustbins ae interfaced with ultrasonic sensors to know the status of the dustbins. This data is then sent to the ARM processor through zigbee transceiver and a message is sent to the concerned person via GSM about the level of filling of the bin. Also the sensor values are stored in cloud through thingspeak portal that acts as a database for future use.

IndexTerms **-** solid waste management, zigbee, ARM, WiFi module

I. INTRODUCTION

Solid waste is defined from households refusals, industrials, commercials and institutional establishments like hospitals,market waste, yard waste and street sweepings. Municipal waste and certain industrial waste have comparatively significant impact on environment. Hence, solid waste management has become a major talk worldwide. To overcome this problem, effective solid waste management must be implemented.

In past few years, waste management has become major talk worldwide. Also, one of the issues in the waste management is that the garbage bin at public places gets overflowed in advance before the commencement of the next cleaning process by the municipalities. Improper management of waste collection and disposal leads to unhygienic environments resulting in various diseases in localities. To tackle this issue we are presenting this paper about which deals with waste management with low investments. Our system can be incorporated in the already existing bins which measures the level of filling of the bin and inform the municipal about the status of bin through wifi .The proposed system consists of ultrasonic sensor to sense the level of bin whose value is sent through Zigbee and processed by ARM 7 processor .This value is sent to main Municipal office through Wifi so actions will be taken accordingly. This solution is also helpful in building a Smart city which is the main criteria of many countries that are being developed .

The source for the below table was taken from planning commission report which showed the following observations.

Table 3. Change in composition of municipal solid waste with time (in %)

Year	Biodegradables	Paper	Plastic/rubber	Metal	Glass	Rags	Others	Inert
1996	42.21	3.63	0.60	0.49	0.60	-	-	45.13
2005	47.43	8.13	9.22	0.50	1.01	4.49	4.02	25.16
2011	42.51	9.63	10.11	0.63	0.96	-	-	17.00

Table 1: change in composition of municipal solid waste with time (in %)

II. RESEARCH METHODOLOGY

The existing system consists of various technologies like RFID, GIS, and GSM. It aimed at supervising the collection process of solid waste. This was achieved using a web based solution wherein the clients were able to see and receive the trucks and their trash bin information through a web based server. GIS and GSM were used for communication purpose between the tracking unit and server. GPS collected the location information and stored it in a central database. RFID reader is attached with GSM module. When truck driver enters or leaves the solid waste collection place, the RFID reader communicates with the tag that is attached to the bin and all the information is sent to control station via SMS. It provides greater range for but the battery gets drained very quickly. Apart from all these technologies there was an integration of camera and GPRS technologies. It aimed at estimating the amount of solid waste without involving any truck driver. Here , RFID tag was mounted on the bin and RFID reader acted as truck module. Since there is no involvement of any truck driver a camera is fitted along with RFID reader. Both the RFID data and images is sent to the designated server via GPRS. However, if the images are not taken in fixed positions then it will not give good results. Another solution proposed a model which focussed on monitoring the overall waste produced, measuring the quantity of the waste at each collecting location and identifying the type of materials present using a sensorized technology. This included humidity sensor, ultrasonic ranger and temperature transducer. Using the container data they would optimize the routing and scheduling of the vehicles. But this could not provide an early detection of hazardous materials in the waste. Also collection and deployment issues were also faced that affected the cost. Arduino was used as the main processor but it was difficult to

support a few extra features like addition of gas sensor for bad odour detection along with sensing the level of the bin infrared sensors were also used which could not give the accurate results about the level of the bin.

A. ULTRASONIC SENSOR

An **Ultrasonic sensor**is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.The main component of the system is ultrasonic module HC-SR04 used for non-contact measuring from 2cm up to 400cm with 3mm precision. It consists of ultrasonic transmitter, receiver and circuit. The function is based on sharing 8 signals of 40 KHz and checking if there is a returning pulse. After that if we have returning pulse while the I/O port is opened, we get the period from sending until receiving of the signal. Thus in our system design ultrasonic sensor plays the major role of sensing the level of bin and sends the data respectively through Zigbee module. It gives a very accurate value even to the tiniest objects sensed.

FIGURE 1: HC-SR04

B. ARM 7

Arm , Advanced RISC Machine is a family of reduced instruction set computing architectures for computer processors configured for various environments. British company ARM Holdings develops the architecture and licenses it to other companies, who design their own products that implement one of those architectures including system on chips that incorporates memory, interfaces, radio etc. Here we use the LPC2148 ARM board which is a 32 bit microcontroller. There are various registers used like IODR for input output assignment. It consists of four capture and match channels which works on the basis of event action it compares if the action is the same as capture time and accordingly value is taken down Thus here the processor processes the data obtained from ultrasonic sensor and gives a final conclusion about the bin filling level.

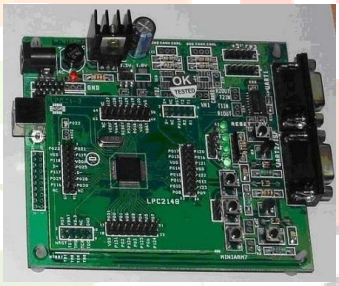


FIGURE 2: LPC2148

C. ZIGBEE

Zigbee is a low cost, wireless, high-level communication protocol that quickly transmit small amounts of data. It is used to create personal area networks with low-power digital radios and is designed for point to point, star etc. communication over the air based on the IEEE 802.15.4 Standard. It forms an ad-hoc mesh network to transmit data over long distances and has a data rate of 250kbps. Due to its low power consumption, it allows a longer battery life. Xbee module is being used for our application and tera-term software is used to configure this module.

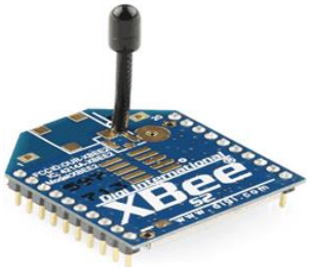


FIGURE 3: XBEE MODULE

D. WIFI MODULE

We are using a ESP-12E WiFi module which is developed by Ai-thinker Team. Core processor ESP8266 in smaller sizes of the module encapsulates Tensilica L106 integrates industry-leading ultra low power 32-bit MCU micro, with the 16-bit short mode, Clock speed support 80 MHz, 160 MHz, supports the RTOS, integrated Wi-Fi MAC, on-board antenna. The module supports

standard IEEE 802.11 b/g/n agreement, complete TCP/IP protocol stack. It gives +20 dBm output power in 802.11b mode. Users can use the add modules to an existing device networking, or building a separate network controller. In the current proposed model it is used to send the data values of the sensor to a cloud and store it in Thingspeak database.

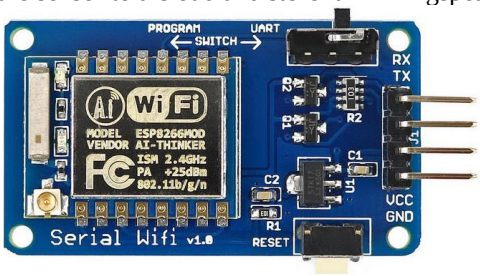
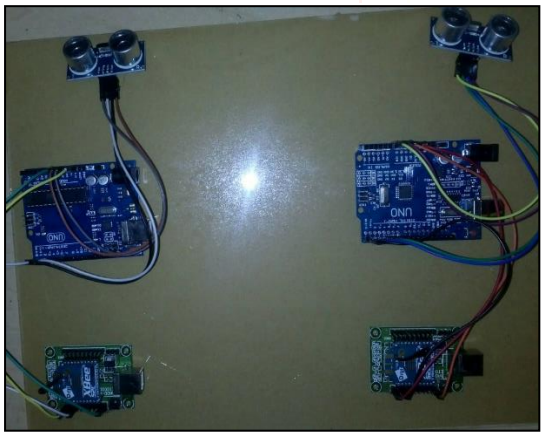


FIGURE 4: ESP- 12E

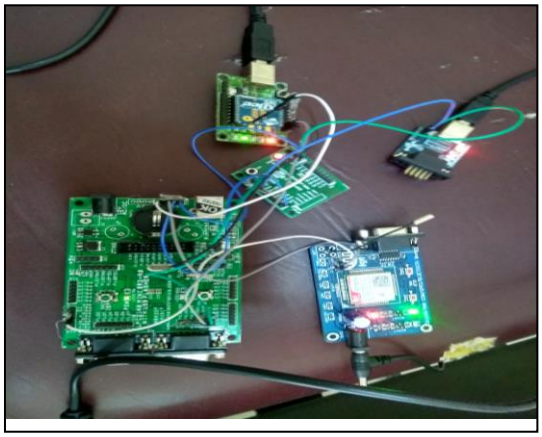
S.No	Components	Model	Range	Data Rate/baud Rate	Operating Frequency
1.	ultrasonic sensor	HC-SR04	2cm- 400cm	9600	40Hz
2.	ARM 7	LPC2148	-	9600	60Mhz (max)
3.	zigbee	CC2500	20m	250kbps	2.4GHz
4.	wifi module	ESP8266	250-500m	9600	160MHz

TABLE 2: COMPARISON OF HARDWARE COMPONENTS

The operational principle of the system is such that, normally it remains in idle mode and the sensor nodes are consuming the least power. It responds as soon as someone throw waste inside the bin. When waste has been thrown inside a bin, the sensor node installed within it will wake up and measure the parameters that give enough information about the bin status when garbage is added to the bin. After collecting the values with Zig Bee, WIFI connected of all the variables, the mote sends the data to the gateway through the Zig Bee radio module. The data contains information about the bin and its status. To acquire, manage and transmit sensors data and UART, a custom application has been built using the KEIL Integrated Development Environment (IDE). Using the XBee-ZB RF module, the gateway receives the data sent by the mote and store it in its database (THINGSPEAK). In things speak after login the user is provided with channel ID, Read key, Write key. Using this the information is uploaded to the things speak webpage. Concurrently, the gateway send the data to the control station through the WIFI communication module. A multi-threaded background process called daemon tools is always running on the server which receives the connections requests and listens for incoming data from the gateways. The gateways make connection request and opens the transmission channel using TCP/IP through the WIFI connection. Thus, the control station store the received data to the database. Using these data and web application, the user can monitor the status of the bins



Transmitter Section



Receiver Section

IV. RESULTS AND DISCUSSION

There are 3 levels set 0,1 and 2. When the distance is more than 40cm, the bin is empty and the value '0' is sent to thingspeak. When the distance is between 20cm-30cm , the bin is half-filled and the value '1' is sent to thingspeak. When the distance is less than 20cm, the bin is full and the value '2' is sent to thingspeak. When the bin gets filled, a text message is also forwaded to the registered phone number. This message is sent via the GSM module, and the nearby municipality vehicle can do the needful ASAP.The status of the bins is reflected by the different levels in the thingspeak as shown below

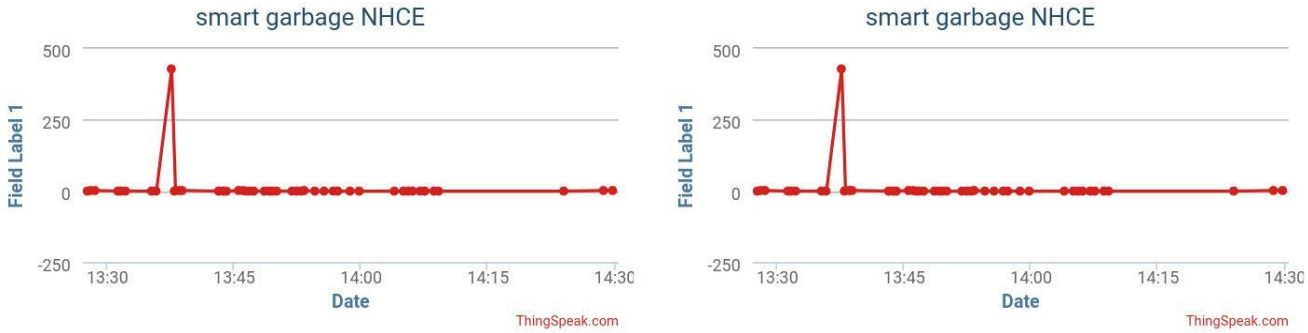


FIGURE: Graphical representation of the status of each bin

This project work is the implementation of digital dustbin through sensors and microcontrollers. The system assures the collecting of waste from the bins. As soon as the dustbin is full the information is sent to the ARM via ZIgbee transceiver and is then stored onto a web portal which is monitored by the concerned person through internet. This method ultimately helps to keep cleanliness in the society. As soon as the dustbin is full we can get to know and inform the concerned authorities

V. FUTURE SCOPE:

In future, an android based application for the citizens could be developed which would notify the user if there are any nearby dustbins/ municipal vehicle to collect the waste. In this way its disposal can be managed effectively. Also an efficient graphical user interface of the system and controlling action can be made for easy communication purpose for the municipality officials. Central servers can store all the necessary data like number of dispatched waste collecting vehicles etc and based on this information optimization of number of vehicles can be done. This would in turn reduce the cost comparatively and make the entire system work in a much smoother manner. Treatment of the foul smell from waste can be treated using ozone treatment. The management of solid waste is an important aspect in which everyone needs to put their effort. Using these technologies in an integrated manner could lead to reduction in amount of garbage and cost of transportation hence leading to a cleaner and convenient environment

REFERENCES

[1] **Yang Kai, Zhang Junmei, Li Wenbin, Yang Liu, GaoLin,XueHuixia,"Weighing System of Fruit-Transportation Gyrocar Based on ARM" IEEE computer society,2011 DOI 10.1109/ICMTMA.2011.253.**

[2] **[2]. Arebey M.,Hannan, M.A. ; Basri, H. , Abdullah, H. "Solid waste monitoring and management using RFID, GISand GSM "IEEE Student Conference on Research and Development (SCOReD), 2009.**

[3] **[3]. Arebey, M. ; Hannan, M.A. ; Basri, H. ; Begum, R.A., "Solid waste monitoring system integration based on RFID, GPS and camera", IEEE International Conference on Intelligent and Advanced Systems (ICIAS), 2010.**

[4] **Islam, M.S. ; Arebey, M. ; Hannan, M.A. ; Basri, H., "Overview for solid waste bin monitoring and collection system",IEEE International Conference on Innovation Management and Technology Research (ICIMTR), 2012.**

[5] **Alberto Rovettaa, Fan Xiuminb, c, Federico Vicentinia, , , Zhu Minghuab, c, Alessandro Giustia, He Qichang "Early detection and evaluation of waste through sensorized containers for a collection monitoring application" Science Direct Journal.**

[6] **Issac, R;Akshai,M."An effective solid waste management system for Thiruvalla Municipality in Android OS" IEEE Conference Publications , 2013.**

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

[8] **Belal Chowdhury, Morshed U. Chowdhury, "RFID-based Real-time Smart Waste Management System," 2007 Australasian Telecommunication Networks and Applications Conference December 2nd – 5th 2007, Christchurch, New Zealand**

[9] **Shubham Thakker, R.Narayanamoorthi, "Smart and Wireless Waste Management", IEEE Sponsored 2nd International Conference on Innovations in Information Embedded and Communication Systems ICIIECS'15**

[10] **Ahmed Imteaj, Mahfuzulhoq Chowdhury and Md. Arafin Mahamud, "Dissipation of Waste using Dynamic Perception and Alarming System: A Smart City Application" , 2nd Int'l Conf on Electrical Engineering and Information & Communication Technology (ICEEICT) 2015 Jahangirnagar University, Dhaka-1342, Bangladesh, 21-23 May 2015**

IJCRT