



ISSN: 2350-0328

**International Journal of Advanced Research in Science,
Engineering and Technology**

Vol. 4, Issue 12 , December 2017

Intelligent Waste Collection System in IOT

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ABSTRACT: In India, every year tons of garbage is generated. In most cases, the garbage bins are overloaded which creates an unhygienic environment for neighbouring people. To address this issue intelligent waste collection system in IOT environment has been introduced. In this system, Internet of things establish communication between device-device, device-user, user-user with the help of sensors, microcontroller and communication protocols. Here input parameters are level, weight, and odour of the garbage detected with the help of Ultrasonic, IR, Weight and Gas sensor. The threshold value was set as 15cm for distance, 50kg for weight and 500ppm for gas. Arduino Uno board has been working as a microcontroller to process the data. If the garbage level exceeds particular threshold level the SMS alert send to authorized concern. To avoid data congestion problem the garbage bin nodes are classified as the master node and slave node. Master node sends information about the slave node to the server using GSM. While slave node passes its information to the master node through ZigBee. Using this approach the overflow of the garbage was eliminated and data traffic can be reduced.

KEYWORDS: :Arduino Uno, ultrasonic sensor, IR sensor, the Weight sensor, Gas sensor, ZigBee, GSM, IOT.

I. INTRODUCTION

Waste can be defined as the end of product life cycle which can be disposed to landfill. In India currently, the wastes are collected with the help of municipal workers periodically and dumped into a land. Nearly 62 million tons of waste are generated every year but only 43 million tons of waste were collected. If the waste cannot be collected at a right time it causes severe impact in human life, since its reaction among the garbage substances produces poisonous gases. For the better life of human being, the air should be clean to breathe and the environment should be properly maintained for the development of the nation.

The periodic collection of waste management can be done automatically with the help of Internet of Things (IOT). IOT is a very powerful technology that can be adapted to sort out various real-time problems. Through the internet, the communication between the devices can be made which can be used to provide the information to the municipal authorized people. Sensor or Transducer can receive and transmit the information. Sensors are a small device which can be fixed anywhere. The information from the devices can be retrieved and monitored in IOT environment. Further, the stored data can be used in future for knowledge extraction.

Using IoT, we can prevent the municipal parties to visit empty garbage bin and notify them to identify the bin which is about to overflow. In some cases, it is identified that even though bin is not full if the strong odour exits it create bad circumstances to the passer by or nearby living people. In this case, the notification needs to be sent to the municipal controller room. In this paper along with the highest filling level of the bin, odour level of garbage also considered as input, if that value exceeds the threshold value the notification will be sent to the municipal controller room.

II. LITERATURE SURVEY

In order make garbage collection process in an intelligent way, IOT technology has been adopted. Here the System made with Ultrasonic sensor, IR sensor, Weight Sensor and the Gas sensor has made communicated to the server through ZigBee and GSM module.

The authors in [2] use an ultrasonic sensor to detect the level of garbage and send the SMS to the concerned person through GSM, but they haven't yet considered that if there is a severe odor exists before the highest level reached it severely affect the health of the people. To measure the gas chemical level they have used Wi-Fi module for ease data

transmission [3]. The flow of transmission from detection to transmission and processing information has been addressed in [2].

The authors in [1] adopted the master-slave approach that is they have classified process into two parts first part slave it detects the garbage level and intimate to master, the second part master will alert the concern people. The weight has been considered as one of the parameters in a waste management system. The weight of the garbage is estimated with the help of weight sensor [6].

The authors in [4] describe data management, a single node has been considered as a head among the other nodes in a particular region, the head of the node collects information from other nodes within its region and send information to the server. This approach significantly reduces the data traffic. The sensor node deployment and device-device, device-user communication is used to create the smart environment which has been addressed in [7]. The authors in [8] have given the idea about the information collected from the sensor and the management of data; which separates the level of data in IOT environment.

III. PROPOSED SYSTEM

By considering the need for current environmental development and for the better growth of the country we achieved to use garbage system enhanced with IOT technology for the smart environment.

A. HARDWARE ARCHITECTURE

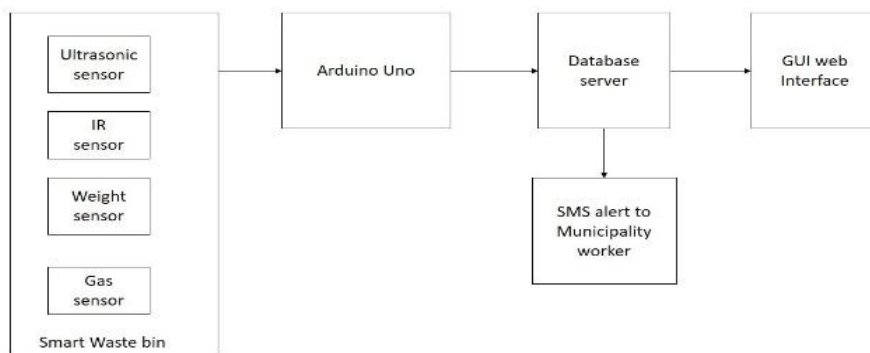
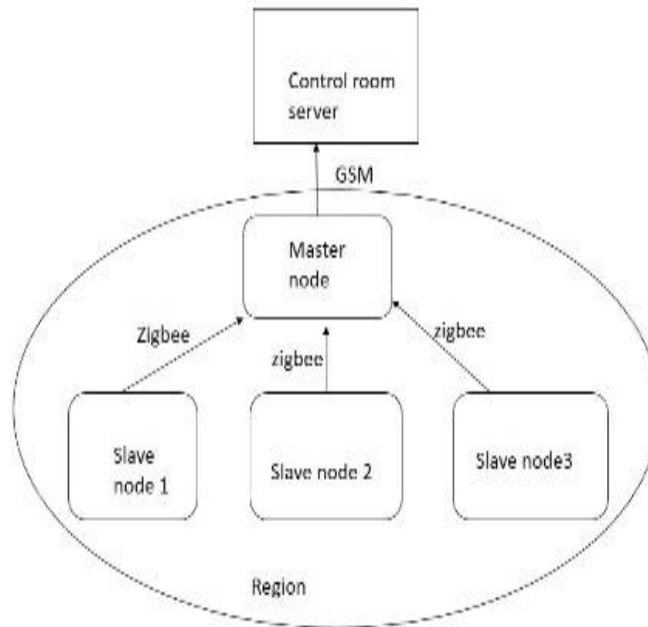


Figure 1- System workflow architecture

Figure 1 shows the workflow of the system. In our system, the smart bins are considered as nodes which can be classified as the master node and slave node. The area has been divided into a region; each region has a single master node and multiple slave nodes. Figure 2 show that the master node sends information to the controller room server through GSM module. The slave node communicates with its master node through ZigBee module. The sensors have been used to detect the status of garbage and send the information to the microcontroller along with the dustbin id which has been stored on the server. The server identifies the corresponding person with these ids and sends SMS alert to collect the garbage.

**Figure 2- Master-Slave nodes communication in a region****a) ULTRASONIC SENSOR**

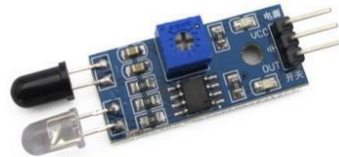
An ultrasonic sensor is used to detect the distance of the object. This sensor has an ultrasonic transducer that is of 2 types. A piezoelectric transducer which uses ceramic or crystal which has to be simulated by a signal to produce a pulse, the other one is an electrostatic transducer which has been used in this paper which produce sonic impulse by moving plates that are made up of Kapton. The sensor sends a high-frequency sound pulse and detects how long time it takes to reflect that pulse through which it can detect the distance of the object. It has 2 pins one sends the signal and the other pin receives the signal back. The speed of the sound travels in the air is approximately 341 meters. It works on the principle of time distance between sending and receiving signal.

It is works based on the formula of

$$\text{Distance} = \text{Time} * \text{speed of light} / 2$$

**b) IR SENSOR**

IR sensor works based on triangulation. The light emitted from the sensor hits the object and return back with changes in the angle. If the light didn't return back then there is no object. The deviation in the angle of light reception used to calculate the level of the object. While the light reflects from the object, it returns to the receiver and creates a triangle between the transmitter which emitted the light, the receiver and the reflection point of the object. IR sensor used to detect the level of the object.



c) WEIGHT SENSOR

Load cell transducer has strain gauge that is attached to the elastic material which will deform when a load was applied to it. The strain gauge an electrical signal based on the deformation. This additional parameter used to detect the weight of the garbage. It detects weight up to 50kg.



d) GAS SENSOR

The gas sensor used to detect leakage or presence of harmful gas or odour in the waste. If the waste is prolonged together, then it will react with one another and the chemical reaction will happen that will emit the hazardous gas. It supports concentration level of 200-10000ppm.



e) ZIGBEE / IEEE 802.15.4

ZigBee is a low power small circuit high-end communication protocol. It consumes low bandwidth. It is a personal area network communication module and it can be interoperable. Low power consumption coverage distance up to 100 m and it can also vary based on the power. The data rate is 250kbits/s.

f) GSM MODEM

GSM modem is used to communicate with other devices through the network. It requires a SIM card to operate. The network range it can communicate depends on the network operator. Using this modem communication, it can be computed through USB, serial or Bluetooth. It can be connected to the microcontroller using MAX 232 port, it can also send SMS alert, transmit/receive any data.

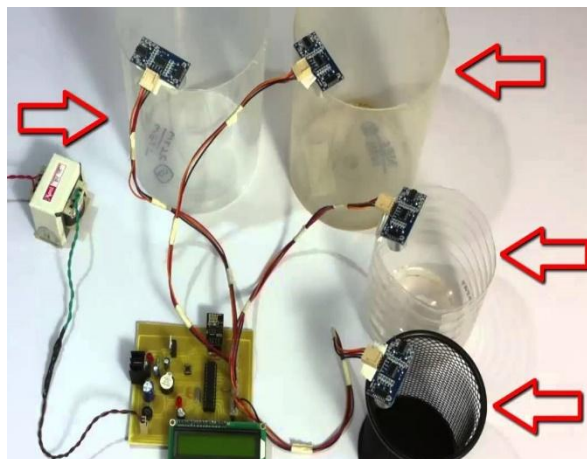
g) ARDUINO MICROCONTROLLER

Arduino Uno based on ATMEGE 238 microcontroller. It has 14 digital I/O pins, 6 analog input pin and then it has flash memory up to 32KB. SRAM, EEPROM, and clock speed are 2KB, 1KB and 16MHZ respectively. The board can be powered by USB or external power supply.



IV. EXPERIMENTAL RESULT

The device has been fixed in Garbage bin. The maximum distance level has been fixed as 15cm. the gas leakage level threshold set as 500ppm and weight of the garbage set as 50kg. If one of the parameters exceeds its threshold level, the SMS alert has been sent to concern people. This system produced an efficient result which reduces the overflow of garbage since odour also considered as a factor the hygienic environment was provided. By using Master –Slave node approaches the data traffic has been reduced by 31%.



V. CONCLUSION

This idea is implemented to develop an intelligent waste collection system for the better development of the environment. The inexpensive sensor has been used to detect the status of waste in the dustbin. The threshold level has been set based on level and the odour of garbage. This system can create a hygienic environment for the wellness of the people. ZigBee and GSM module used for communication purpose, since ZigBee is low power, high-efficiency module it can afford in IOT environment. Master-slave approach used in this system to reduce the data congestion, if a number of nodes communicate directly to the server, there might be a data traffic, in order to avoid this, the master node collects the data from slave node. So, the number of nodes communicate with the server can be reduced. The notification alert has been set for municipal cooperation based on threshold level.

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ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

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