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IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Smart Dustbin

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Abstract: In this paper, a system of smart dustbin is proposed. The proposed smart dustbin can control the overflow of the waste through the ultrasonic sensors which are interfaced with arduino. A separate GSM module is incorporated which sends a message to the concerned authority of municipal council regarding the waste level in the dustbin. This smart dustbin is currently deployed after testing in the Shirpur Warwade Municipal Council, Shirpur in the state of Maharashtra under the Swachha Bharat Abhiyan 2018.
Keywords: Arduino, Ultrasonic Sensor, GSM module, Smart Dustbin.

I. INTRODUCTION

The world is in a stage of up-gradation, there is one stinking quandary. We have to deal with Garbage. In our quotidian life, we visually distinguish the pictures of garbage bins being overfull and all the garbage spills out. An astronomically immense 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 quandary or at least drop it to the minimum level. A society will get its waste dispatched felicitously only if the dustbins are placed well and amassed well. The main quandary in the current waste management system in most of the Indian cities is the insalubrious status of dustbins. Now with the elevate of technology, it is the correct time that we should utilize technology for waste management systems. As we have visually perceived that technology with analytics has made the world a better place to live by its application in the field of genetics, indemnification, marketing, engineering, banking etc. in past many years. So, in this Project, we have integrated analytics and electronics in order to create optimal vicissitudes in the conventional methodology of waste amassment. Most of the urban cities and town in India are not well designed to facilitate the felicitous garbage disposing and amassment mechanism. Adscititiously, the cities are expanding rapidly putting the pressure on subsisting infrastructure which is not expanding at the same pace that of urbanization. As the govt. of India has launched keenly intellective city project to utilize the IT-enabled solution so there is an implicit need to make the city cleaner.

In past few decades there is a rapid magnification in the rate of urbanization and thus there is a desideratum of sustainable urban development plans. Now utilizing early age technology and strategic approach, the concept of keenly intellective cities are coming up all around the world. While the noetic conception comes up form keenly intellective cities there is a requisite for keenly intellective waste management. The conception of smart dustbin is for the keenly intellective buildings, colleges, hospitals, and bus stands. The astute dustbin thus thought is an amendment of mundane dustbin by elevating it to be smart utilizing sensors and logic. The smart dustbin is an incipient conception of implementation which makes a mundane dustbin keenly intellective utilizing ultrasonic sensors for garbage level detection and sending the message to the utilizer updating the status of the bin utilizing GSM modem.

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II. LITERATURE SURVEY

A lot of technologies have been proposed for waste management, especially for the smart dustbin. In this section, we will discuss few of them. In [1], the level of the dustbin is detected and the data is stored in the database so that the data can be visualized or used for future requirement. In this, component used are, PIC, Ultrasonic Sensor, and GSM. The GSM is used to store the data in the database by using GPRS in GSM. The real-time data of level detection of garbage is analyzed and used for further analysis. The real-time data is developed in the excel file. The message is also notified in the excel file in the database. There is a color code used. The color code as an indicator such that how much dustbin is filled, this color code is also shown on Google Maps that how

much dustbin is filled in a Specific area. In [3], the level is detected in the dustbin, the status of dustbins is stored to the server and also sends the GPS location with the status of dustbins to the server. It process to the query and response to nearer dustbin locations with showing the direction on Google Maps to reach the dustbin. The person can enable server using a mobile app to replace the dustbin. Similarly, in [2], the free space is occupied by wrappers, which takes more space in the dustbin. So the dustbin will fill immediately. When the cylindrical dustbin filled 2/3rd of total area, the compressor of the dustbin will be activated by some circuitry. The waste in the dustbin will be compressed periodically as the 2/3rd level is detected. The relay in the circuit operates the timers, actuators, and compressors. When an A+ level is detected then compressors starts compressing the waste, and when A- level is detected compressor stops compressing and goes to its original position. The level in the dustbin is stored in the database through the central hub. The location of the dustbin is shown on the Google Maps by the indication of different Led's. In [5], the similar work is done as the as discussed above. The level of dustbin is detected continuously. The continuous detection is done and the level data is continuously stored on the server. The Ethernet Shield is used to store data to the server. The IP address and URL get the dustbins levels. The web page is created in HTML. If internet connection is not available then also the data can be used or stored. In [6], the author discussed similar work as [1 – 5]. The level is detected of the dustbins and stores the data to the server. This data is analyzed and wherever the dustbin is full the coordinates are sent to the mobile and it is shown on Google Maps to replace the dustbin. Many people have the nearly same methodology that they store data on the server for further analysis of the level of a dustbin and apply appropriate action on it or use the compressor in the dustbin for more waste to be occupied in the dustbin. In [7] the data is stored on the server. In [8], the dustbin is full then the level of the is dustbin is stored on the internet. The data from internet server is received then the van owner to replace the dustbin. In [9][15][21][24], when the person comes near to the dustbin then the RFID card is read by RFID reader. If the person is authenticated then the servo motor opens the door of the dustbin to throw the waste in the dustbin. The process is displayed on the LCD display. In [10], the level is detected and if the level is detected then it sends the message. The person must log in to a website in [11], if the user is valid then it enters the website. Then it checks that is their citizen or official user got access to it. Then the dustbin level is checked and accordingly complaint is posted by citizen user or vehicle is deployed and a report is generated. The raspberry pi is used to store data on the server using Wi-Fi in [12] and with only Wi-Fi, the data is stored on a server in [16]. In [13], the garbage weight is measured and displayed on display and on the server using Wi-Fi. The weight of garbage is measured in [14], then the motor is driven using a webcam. In [15], the metal detector is used detect metal and the moisture is detected using moisture sensor. The level is detected in 0%, 50%, & 90% level is stored on server using lpc2148 in [17]. The servo opens the LID when the desired level is detected. In [18][19], the Bluetooth module is used to know about the level of the dustbin. Also, weight is measured. In [20][21], the components used are a microcontroller, motor, LDR, GPS, ultrasonic sensor, GSM, LCD & force sensor. LDR is used to detect light, ultrasonic sensor opens the door of the dustbin when the person comes near the dustbin, GPS gives coordinates, LCD displays the data and GSM stores the data to the server. The level is detected using two ultrasonic sensor in [23] and stores the data on the server in [22]. Fire is detected and store the data on the server and display on LCD in [23]. In [25], the RF transmitter is used to transmit the data of level of the dustbin and weight of the garbage. The RF receiver connected to Arduino modem and Ethernet shield to store the data to the computer. The GSM is used to send the message to an authority to send a cleaning vehicle to clean the dustbin.

Table 1: Comparative Study.

References	Type of sensors	Description	Cost
10	Ultrasonic	Detects level and send message.	High
13	IR	Detects level using MCU & store data on server.	High
22	Two Ultrasonic	Detects level & store data on server.	Medium
Our system	Two Ultrasonic	Detects level in Tank type dustbin & sends message.	High

The comparative table shows that in [10][13][22] and in our system, the level of the dustbin is detected. The level is detected using IR sensor in [13] and in other ultrasonic sensor is used. Our system uses two ultrasonic sensors for a tank type dustbin. Another system the dustbin is normal, so the cost of the system becomes very high. In our system, the cost is negligible as compared to another system. So our system is cost-effective and sufficient for tank type dustbin.

III. HARDWARE

A. Component used

Table 2: Hardware Components used in project.

Component	Type
Arduino	Arduino UNO
Ultrasonic Sensor	HC-SR04
GSM module	SIM900A
Relimate Connector	4 Pin Connector
Battery	9V 1A

1) *Arduino:* Arduino is an open-source physical computing device based on a simple I/O operations and used to implement the program written in Arduino IDE. The open-source IDE can be downloaded for free to write a program to implement a project. It has 14 digital IO pins with 6 PWM pin multiplexed on it, 6 analog inputs, a 16 MHz quartz crystal oscillator to provide clock to microcontroller, a USB connection, a power jack for power supply and a reset button and operates on 5V 1A supply. It's simply a trainer learning kit, with open source software.
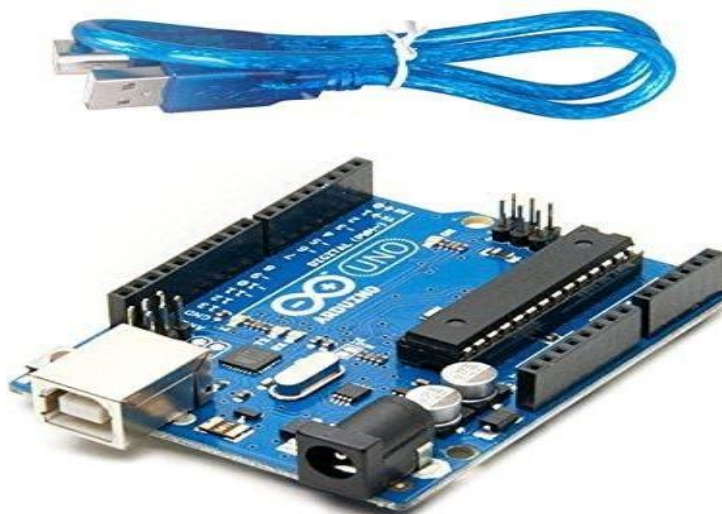

Figure 1. Arduino.

Features
Microcontroller: - ATmega328
Operating Voltage: - 5V
Input Voltage: - 5-12V
Digital I/O Pins: - 14 (of which 6 has PWM output) Analog Input Pins: - 6
DC Current on each I/O Pin: - 40 mA
DC Current for 3.3V Pin: - 50 mA
Flash Recollection: - 32 KB of which 0.5 KB utilized by boot- loader
SRAM: - 2 KB
EEPROM: - 1 KB

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B. Ultrasonic Sensor

An Ultrasonic sensor is a device which measures the distance to an object by using a sound wave. It measures distance by sending out a sound wave at a specific frequency and waiting for a sound wave to come back by striking the object. When the signal is received then the distance is calculated by the formulae given below

Speed = distance/time.

By using calculated distance we can perform many different tasks.

Figure 2. Ultrasonic Sensor.

Features:
Supply voltage: - 5V
Current Consumption: - 15ma
Ultrasonic Frequency: - 40 Khz
Maximum Range: - 400 cm
Minimum Range: - 3 cm
Resolution: - 1 cm
Trigger Pulse Width: - 10 s
Dimension: - 43x20x15 mm

C. GSM

The main objectives of GSM module are to utilize it as a communication contrivance. It can connected computer through serial (RS232) connector. A GSM modem is a standard GSM mobile phone with a congruous cable and a software driver to connect to a serial connector on your computer. The GSM uses AT Commands for its operation.
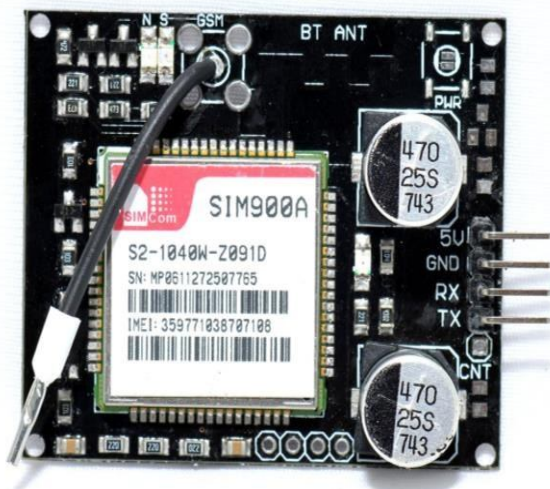

Figure 3. GSM SIM900A.

Features
SIM900A fortifies Dual-band 900/1800 MHz

Supply voltage range is 3.4 to 12V Low power consumption Operation temperature:-
〚40〛 ^0 to 〚85〛 ^0.

Control AT commands (3GPP TS 27.007, 27.005 and SIMCom enhanced AT Commands)

IV. BLOCK DIAGRAM

Block diagram shows the overview of a smart dustbin. In this block diagram is Arduino, which controls the function of the system. The level detectors used is the ultrasonic sensor. It detects the level by formulae

Speed = distance/time.

The above formulae are used to determine the distance traveled by the signal. Then the level is detected by the controller. This gives the signal to the GSM used in the system, GSM uses the AT commands to send a message. In this, the GSM is used to send a message to a concerned authority of the municipal council Arduino.
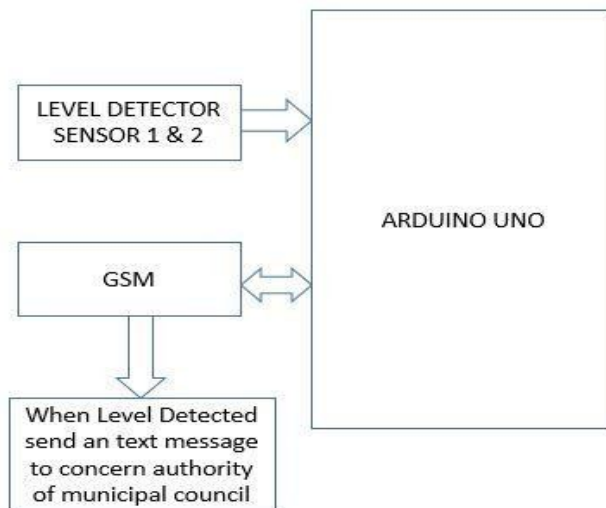

Figure 4. Block Diagram.

V. SIMULATION TOOL

Arduino IDE is an open source software to simulate the program. It is freely available on its home website. Anyone can download Arduino IDE from www.arduino.cc. It compiles the arduino program in it and then by using USB cable we can dump program to arduino connected to arduino.

VI. CIRCUIT DIAGRAM

Circuit diagram shows the Smart Dustbin. It consists of Components as shown in the Hardware Table. The Arduino is used as a Controller. The ultrasonic sensor detects the level of the dustbin. If any of the sensors don't detect the level then it doesn't
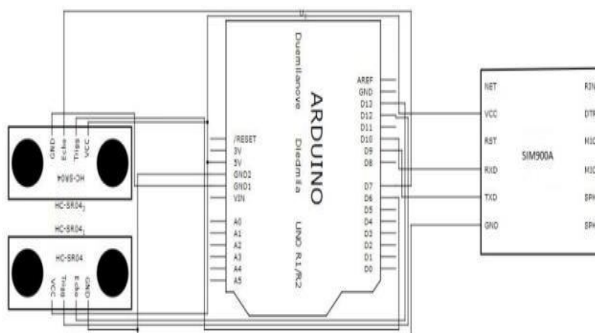

Figure 5. Circuit Diagram works as the description.

Send the text message to the concerned authority of the Municipal Council is sent. When the level is detected by both the ultrasonic sensor then it sends the signal to the Arduino Controller for further process. As the Signal is received by Arduino then it activates the GSM module. As GSM is activated then GSM (SIM900A) sends a text message to the concerned authority of the Municipal Council is sent. Then the authority will send a van by informing the van driver to replace the fully filled dustbin by a blank dustbin. When the blank dustbin is kept at that place then it's utilized by the general people go through the waste in that dustbin.

A. Interfacing Arduino to ultrasonic

The ultrasonic sensor detects the level by calculating the distance. The distance is calculated when the transmitter transmits the pulse and receiver receive the signal and calculate the time period. Then the distance is calculated by using formula as below.

Speed = Distance/Time

The ultrasonic transmit the signal with the speed of 340 m/s.

B. Interfacing Arduino to GSM

The GSM used is SIM900A in this circuit. The GSM uses the AT commands to send a text message to a concerned authority as discussed in the description of the circuit diagram.

C. Interfacing of final process

Both Sensor & GSM is finally interfaced with the Arduino. This project works according to the circuit diagram discussed in this paper.

VII. IMPLEMENTED SYSTEM

This system is deployed in Shirpur Warwade Municipal Council (Tal: - Shirpur, Dist.: - Dhule, Maharashtra) under the mission of Swachha Bharat Abhiyan, 2018.

Figure 6. Final Kit.

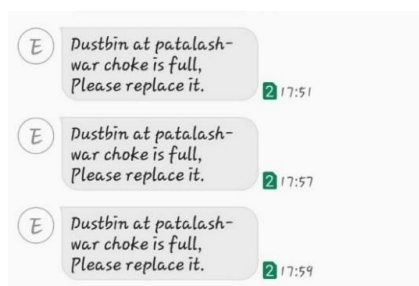Figure 7. Dustbin.

Figure 8. Kit in Dustbin.

Figure 9. Message on mobile.

VIII.   CONCLUSION

This system is cost-effective & maintenance is much less as compared to another project. This will reduce the overflow of waste in the dustbin and also can keep the environment clean & waste free.

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