Smart Garbage Management System Using Internet of Things (IOT) For Urban Areas

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Abstract: This project manages the garbage collection done by Municipal Corporation with the help of an IOT based embedded device attached to dustbin of each area, this device continuously update the status of dustbins in each area to the website designed for this management. This device continuously detect the level of dustbin using ultrasonic sensor and as the dustbin gets full it will update its status of getting full on the website designed for garbage management along with date and time and will go to waiting state and remain in this state till dustbin gets empty. A timer is also set simultaneously in this state for a fixed duration within which dustbin must be cleaned by the Municipal Corporation. If this timer gets expired and dustbin is not cleaned by their employees on given time then device will sent a message to the higher authority that dustbin not cleaned on time and again set the timer for the same duration and remain in waiting state. Once the dustbin is cleaned by the employees the device will comes out of waiting state and will update its status of getting cleaned on the website along with date and time. Thus a record is maintained regarding dustbin status for each area in the website in tabular form using IOT technology along with embedded system which will efficiently manage the garbage collection by the Municipal Corporation and will resolve the major environmental issue of inefficient garbage collection leads to a clean and healthy environment.

Keywords: Internet of things, Ultrasonic sensor, SIM800 GPRS/GSM module, ATMega16 microcontroller, Garbage Management

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I. INTRODUCTION

IOT based Embedded system is the technology in which an embedded developer connects multiple embedded devices to the internet. IOT for embedded systems consist of many things like collecting and analyzing large amount of data from different perspectives and summarizing them into useful information to improve the way services and devices are used today and making the embedded devices more smarter than before. Major players in embedded hardware and software development are aiming to bring these transformations into their products to take advantage of growing IT market. Smart embedded systems need architecture and design elements to suit real time operations. With billions of devices expected to join in the coming years, analysts expect that IOT will have significant impact on device design [11].

In today's era as the population is growing day by day, in most of the cities the overflowed garbage bins results in unhygienic environment which will further leads to rise of different types of unknown diseases degrades the standard of living[9]. As solid waste management is one of the major issues in the urban cities hence introduction of smart dustbins is one of the major requirements to eradicate this problem or at least reduce it to the minimum level. Our present Prime Minister of India, Sri Narendra Modi has recently introduced the concept of implementing 100 smart cities in India and "Swachh Bharat Abhiyan" to ensure a clean environment is one of the major initiatives included in this implementation [6].

So in this paper we are going to propose a smart garbage management system based on IOT for urban areas acts as one of the innovative system to keep the cities clean. This system monitors the dustbins in different areas and update about their status on a website. For this, the system uses ultra sonic sensor placed over the bins to detect the garbage level, Advanced Virtual Reduced (AVR) instruction set microcontroller ATmega16 for controlling the whole system working, Global system for mobile communication (GSM) to send message to higher authority, GPRS (General Purpose Radio Service) for updating status on designed website. The website designed for this purpose gives a tabular view of the status of dustbin along with date and time and the 16X2 LCD display equipped with system will show the changing status of dustbin.

II. LITERATURE SURVEY

The employees of Municipal Corporation often shows irregularity in inspection of dustbins of different areas as it made them to do a lot of manual effort. Hence to reduce their manual effort technology of IOT based embedded devices is used to introduce the smart garbage collection systems is that majorly have two units one is master unit to undertake allocation of work to available truck drivers for respective area and slave unit that keep record of all the garbage collection in different areas [2]. However the task of allocation of work and keeping records is done with the help of a device equipped with these dustbins. These devices generally consist of sensors like weight sensor for getting level of dustbin, Arduino UNO board for controlling device functioning, and Wi-Fi module so that status of dustbin can be updated on government's web server [3].Further advancement is done in the system where the GSM module is used in addition, to above proposed system to introduce a feature according to which the device will send the message to the respective truck drivers when dustbin is full for collecting garbage from respective area as well as ultrasonic sensor used in place of weight sensor for level detection [4]. At some systems dustbin is equipped with RF transmitter which will send information regarding status of dustbin to central level having RF receiver at central level from where data is sent to cloud used further for presenting status of dustbin on respective server [5]. To show the status of device, LCD is also used [6] [7] [8] [9].The use of ATMega 16 is also possible as controller instead of Arduino [7]. Further advancement is done within system by interfacing more sensors with the dustbin like fire sensors used to detect fire in dustbin or nearby so that this information can also be reached to respective authority on time to prevent hazardous activities [9]. As per latest trend apps are also be used instead of web page for updating status of dustbin [10]. To make this device more efficient and smarter, dustbins are also be equipped with other type of sensors like using photoelectric sensors along with ultrasonic sensor in order to get the clear information regarding type of garbage inside the dustbin like presence of some electrical or electronic component inside it.[11].

III. SYSTEM ARCHITECTURE

This system makes use of general purpose board of ATMega16 microcontroller, SIM800 (GPRS/GSM) module and ultrasonic sensor. It is powered by a 12V DC adapter via 7805 regulator IC. A 16X2 LCD display is used to show the mode in which device working. An ultrasonic sensor used to detect level of dustbin. Along with this a website is built to show the status to the user monitoring it.
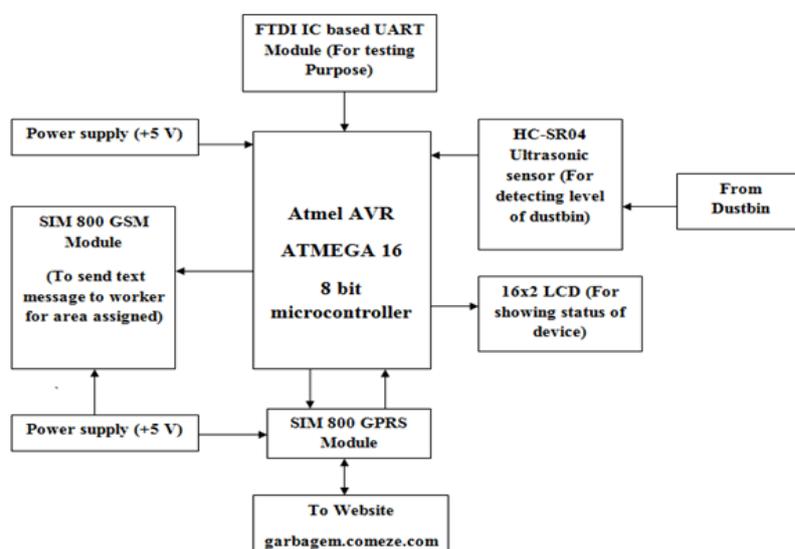
Fig 1: Block diagram of IOT based garbage management system

IV. HARDWARE USED

A. General purpose board of ATMega 16

A general purpose board of ATMega 16 is used. Its role is to get information from sensor and process on it. It will take the information about level of dustbin from the sensor and then according to it activate GPRS module to send on website and GSM module to send the message accordingly.
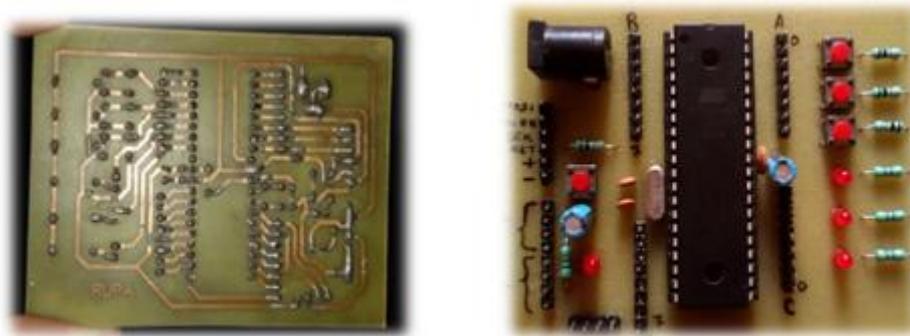
Fig 2: General purpose ATMega 16 board

B. 16x2 LCD Modules

A **liquid crystal display** is a thin, flat panel used for electronically displaying information such as text, images, and moving pictures. Hence used here for displaying the status of dustbin and modes in which device is running.

C. SIM800 GPRS/GSM Module:

The SIM800 modem has receiver and transmitter pins to connect the SIM800 modem with microcontroller using the UART at 9600 baud rate, which is the default baud rate of this modem. Once a serial connection is open through your microcontroller you can start sending the AT commands. When you send AT commands for example: "AT\r" you should receive back a reply from the SIM800 modem saying "OK" or other response depending on the command send.

D. Ultrasonic sensor

This sensor is used to measure distance of system with any obstacle and have four pins, VCC pin to be connected with +5V power supply, GND-: to be connected with ground Trig pin to provide a trigger pulse to sensor through controller. Echo pin controller converts the analog signal from this pin to the digital value ranging from 0-256 by connecting this pin with ADC pin.

E. Power supply

We give 5V power supply to our project using 12V DC adapter via 7805 IC. It is mainly used to provide DC voltage to the components on board for general purpose board ATMega 16 and for SIM800 module.

V. FLOW CHART
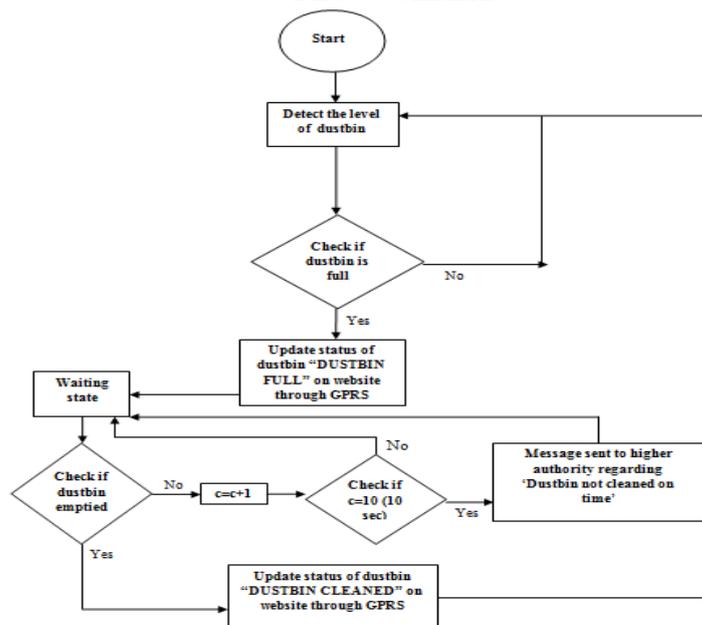
Fig 2: Flow chart of IOT based garbage management system

VI. RESULT AND SIMULATION

Here is the complete working of IOT based garbage management system.
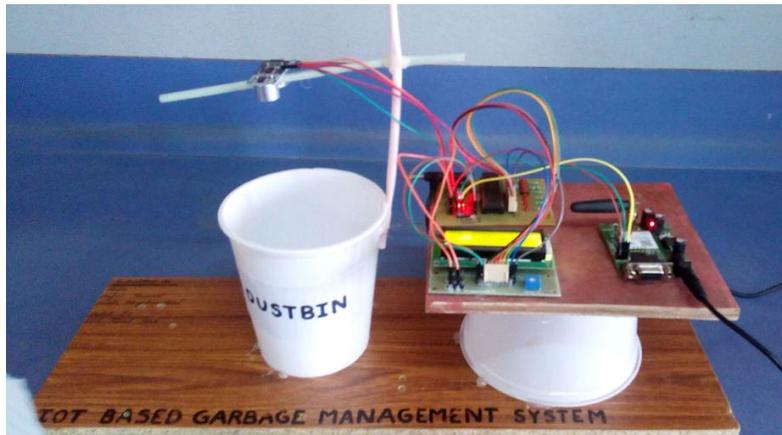
Fig 3: Complete setup of IOT based garbage management

Steps of Operation

Step 1: First of all when we start the device name of project is displayed on LCD that is "**Garbage**

management system" and then device comes in **event detection state**.

Now it will remain in this state till the dustbin is not completely filled. In this state the ultrasonic sensor continuously detect the level of dustbin.
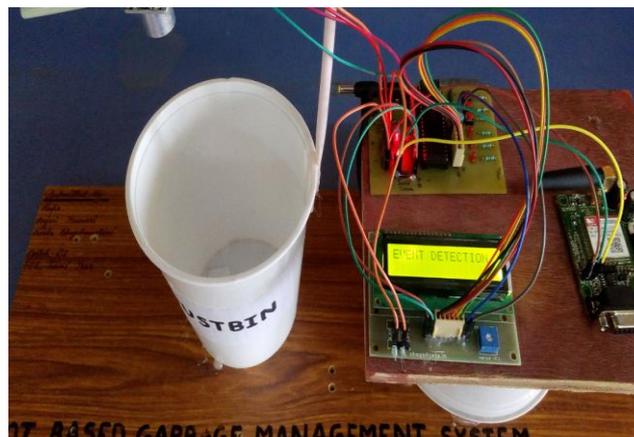
Fig 4: Event detection mode

Step 2: As sensor detects that dustbin is full the message is displayed on LCD that **dustbin is full** and the GPRS module is activated to update this status on our website.

Fig 5: Dustbin full mode

Step 3: After this device will comes in waiting state till the dustbin is not emptied and **waiting** is displayed on LCD in this state.
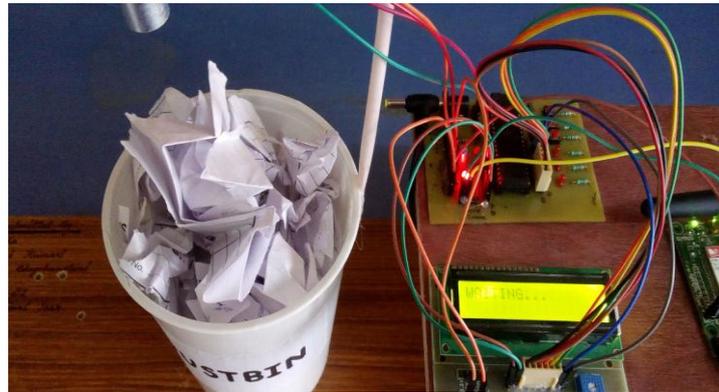
Fig 6: Waiting mode

Step 4: If dustbin is remain in full state for more than a fixed time interval GSM module is activated and message is sent to a higher authority regarding the carelessness of their employee of not cleaning the dustbin on time and **bin not cleaned** is displayed on LCD. After sending message device again returned to waiting mode and remain as it is till dustbin not cleaned.
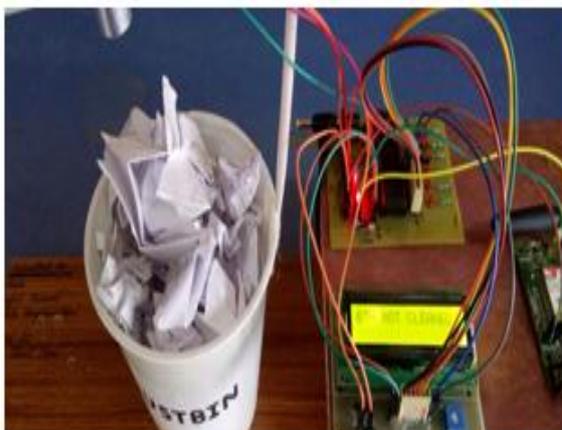
Fig 7: Bin not cleaned mode
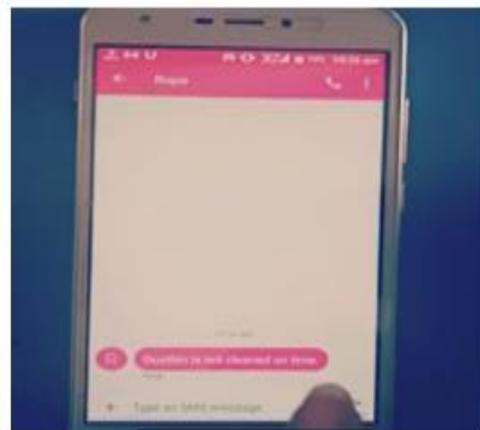
Fig 8: Message sent through GSM

Step 5: As dustbin is cleaned thoroughly the message is displayed on the LCD that **Dustbin is cleaned** and again GPRS module is update status on the website that dustbin cleaned along with time and dustbin's ID.

Fig 9: Dustbin cleaned mode

Fig 10: Status updated on website "garbagem.comeze.com"

After that device goes to **event detection state** in which it was initially and same process is repeated according to the level of dustbin.

VII. CONCLUSION

Hence overall we conclude that the main objective is to maintain the level of cleanliness in the city and form an environment which is better for living. By using this system we can constantly check the level of the garbage in the dustbins which are placed in various parts of the city. If a particular dustbin has reached the maximum level then the employees can be informed and they can immediately take certain actions to empty it as soon as possible. The employees can check the status of these bins anytime on their mobile phones by visiting corresponding website. This can prove to be a very useful system if used properly. The system can be used as a benchmark by the people who are willing to take one step further for increasing the cleanliness in their respected areas. Ultrasonic sensor is being used in this system to check the level of garbage in the dustbins but in future various other types of sensors can be used with the ultrasonic sensor to get more precise output and to take this system to another level. One of important advantage of this system is it is really helpful in improving the quality of environment and is a step towards fulfilling goal of SWACH BHARAT ABHIYAN a government initiative for environment cleanliness.

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