

Intelligent System for Garbage collection: IoT technology with Ultrasonic sensor and Arduino Mega

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Abstract

Piles of rubbish are one of the major problems faced by most people in our country. Many times, in our city we see that the garbage bins or dustbins placed at public places are overloaded. It creates unhygienic conditions for people as well as ugliness to that place leaving bad smell which may lead to sanitary issues and disease. To avoid all such situations we are going to implement a project called IoT Based Smart Garbage System. The proposed system is consisted by the ultrasonic sensor to measure the waste level, and an Arduino Mega which Control the system operations. It can be also generate warning message to the municipality via SMS when the garbage bin is full or almost full, so the garbage can be collected immediately. The main aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision. Furthermore, it is expected to contribute to improving the efficiency of the solid waste disposal management.

Key words:

Smart Garbage, IoT garbage system, intelligent system, Ultrasonic sensor

1. Introduction

In recent years, waste has been a problem to many environments whereas the use of different strategies has been put in place to solve the problem. The impacts of these wastes on the economy cannot be ignored and managing them has become a major problem. Waste management is the collection, transport or disposal, managing and monitoring of waste materials. Most waste management activities are decided upon and carried out in a public, semi-public area typically involving the waste management organization, one or more regulators and other stakeholders and members of the public.

The environment has a limited capacity for waste assimilation therefore this assimilative capacity of the environment may be exceeded or put under too much stress to handle the large quantity of waste and this may result in pollution and resource degradation. In the result of managing the waste we will decrease their effects on our health, our surroundings and the environment. Thousands of lives are lost every year to environmental-related diseases such as cholera, diarrhea, malaria fever, typhoid fever, river blindness and so on. It is generally recognize that there is a strong

relationship between the effective management of solid wastes and a good quality of life and a healthy environment. The attractiveness of the country to foreign visitors and investments is very much influenced by a clean and healthy environment. Majority of people live in filthy, cockroaches, rats and mosquitoes-infected environment. The air, which is an unavoidable source of life, has been polluted with. Chemicals, pathogens or offensive odour. Our system is a web application which helps the user

To find the real time level of garbage in the garbage bins. This project is related to the Smart City and based on Internet of Things (IOT). So for smart lifestyle, cleanliness is needed, and cleanliness is begins with Garbage Bin.

Internet and its applications have become an integral part of today's human lifestyle. The Internet of Things (IOT) is a concept in which surrounding objects are connected through wired and wireless networks without user intervention [8]. Internet of things (IOT) is the networking of physical objects with the help of sensors. In the field of IOT, the Objects communicate and exchange information to provide advanced intelligent services for users. The control room gets the information through sensor and objects surrounding the sensor. Our system is SGS (Smart Garbage System) the level of garbage detected in the dustbin with the help of sensor and communicates to the authorized control room. Sensor provide run time values of garbage level to authorized control room.

There are many steps being taken to avoid the overfilling of dustbins. Due to rapid population growth, disorganization of city governments, a lack of public awareness and limited funding for programs waste management is become a global problem.

The equipment we use in our day to day life can be controlled and monitored using the IoT. A majority of process is done with the help of sensors in IoT. Sensors are deployed everywhere and these sensors convert raw physical data into digital signals and transmits them to its control center. Smart garbage system works in the similar manner with the combination of sensors namely ultrasonic that indicates the different levels respectively. The ultrasonic sensors will show us the various levels of garbage in the garbage bins. Ultrasonic

sensor range from 2cm to 400cm measurement function of non-contact. The connecting wire such as 5v power supply trigger pulse input, 0v ground. The details are further given by the audrino and the controller gives the details to the transmitter module (Wi-Fi module). Ultrasonic sensors provide the level of garbage to web application through connecting (Wi-Fi module) working on 3.3v. Audrino provide 5v to Wi- Fi module but we use 3.3v converter that convert the 5v to 3.3v for Wi-Fi module. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins. For this the system uses ultrasonic sensors placed over the bins to detect the garbage level and compare it with the garbage bins depth. The system makes use of Arduino family microcontroller, LCD screen, Wi-Fi modem for sending data and a buzzer. The system is powered by a 12V transformer. The LCD screen is used to display the status of the level garbage collected in the bins.

Whereas a web page is built to show the status to the user monitoring it. The web page gives a graphical view of the garbage bins and highlights the garbage collected in color in order to show the level of garbage collected. The LCD screen shows the status of the garbage level. The system puts on the buzzer when the level of garbage collected crosses the set limit. Thus this system helps to keep the city clean by informing about the garbage levels of the bins by providing graphical image of the bins via a web page.

We used Twilio allows software developers to program- matically make and receive phone calls and send and receive text messages using its web service APIs. Twilio's services are accessed over HTTP and are billed based on usage. Twilio supports 98 languages.

In recent years the android mobile has become the valuable part of the human beings. It is necessary for human begins to have a powerful device which will provide all the facilities other than basic facility available in mobile phones. We used android application for finding shortest path if more than one garbage bins generate alert. Application of proposed system is shortest path is going to provide the service to user by mining the shortest distance between source and destination. Alarm of proposed system will provide the notification to the user of arrival of its specified destination while traveling in the form of alarm [1].

2. Background Related Work

Challenges and state-of-the-art solutions in Internet-scale Sensor Information Management and Mobile analytics by Arkady Zaslavsky. This paper gave us the details about mobile analysis and sensor information

management that will help in data segregation of various dustbins. It gave us the concept of dynamic scheduling required for the cleaning of dustbin and the Top-k query led us to priority based cleaning of dustbins [2].

In this paper Infrared sensor (IR sensor) is used which is a multipurpose sensor, which can detect the level of garbage. IR sensor emits the light, which is invisible to naked eye but the electronic components can detect it. It consists of IR transmitter and IR receiver. The output of IR sensor is acquired by The National Instruments myRIO-1900. It is an input output device which is portable and reconfigurable. USB acts as a connector between the NI myRIO-1900 and host computer. It has connectors A and B that acts as an expansion port and a connector C that act as a mini-system port, they carry the signals and these signals are distinguished by different connector names. Sensor senses level of the bin. The GUI gives the output of what level of garbage is filled. Sensor senses level of the bin. The graphical representation to access the output of the sensor is as shown below. It gives the output of what level of garbage is filled. When the level in a bin is reached the threshold, the LED placed at the location of the bin starts blinking. When the blinking LED is clicked, a display opens showing the location of the bin, status of the bin, data and time when the bin gets filled, mobile number and the text to send to the concerned person. But this system does not ensure whether garbage is cleaned or not and transportation cost is another issue. [3]

An efficient method to monitor the waste has been designed with some sensors and the output will display on the monitor- ing screen of municipality office. Level sensor detects the level of the garbage inside the bin and thus we get information about the level of garbage in the bins. The weight sensor is mounted at the bottom of dust bin and continuously monitors weight of garbage in to dustbin [7]. On the receiver side continuously monitor garbage in to dustbin. The system proposed by Vishesh Kumar Kurrel assures the cleaning of dustbins soon when the garbage level reaches its maximum. In this management system IOT as the working in the field for networked radio-frequency identification (RFID), tracking the collection vehicle, Dustbin monitoring and other emerging sensing technologies. The IR sensor is act as level detector. The assures a low budget by changing all light traffic servers into Raspberry Pi. The sensor senses the content of the dustbin and sends the signals or the data to the ARM microcontroller then the microcontroller reads the data from the sensor and process the data received from sensor, and the same data will send to Dashboard section and this section send mail/message to respective Municipal Government authority person or collection vehicle. If the dustbin is

not cleaned in specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor. This system also helps to monitor the fake reports and hence can reduce the corruption in the overall management system. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection [4].

The Smart Garbage Management in Smart Cities using IoT proposed a method as follows. The level of garbage in the dustbins is detected with the help of ultrasonic sensors system, and communicated to the authorized control room through GSM system. Arduino micro-controller is used to interface the sensor system with GSM system. A GUI is also developed to monitor the desired information related to the garbage for different selected locations. This will help to manage the garbage collection efficiently. Level detector consists of IR sensors which is used to detect the level of the garbage in the dustbin. The output of level detector is given to micro-controller. Four IR sensors are used to indicate the different levels of the amount of the garbage collected in the dustbin which is placed in public area. When the dustbin is filled up to the highest level, the output of fourth IR receiver becomes active low. This output is given to micro-controller to send the message to the Control room via GSM module. At receiver, control room is present where all the activities are managing. At receiver, control room is present where all the activities are managing. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum. If the dustbin is not cleaned in specific time, then the record is sent to the higher authority who can take appropriate action against the concerned contractor. System also helps to monitor the fake reports and hence can reduce the corruption in the overall management system. This reduce the total number of trips of garbage collection vehicle and hence reduce the overall expenditure associated with the garbage collection. It ultimate helps to keep cleanness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient [5].

Another method for garbage management is introduced as follows. A dustbin is interfaced with micro-controller based system having IR wireless systems along with central system showing current status of garbage, on mobile web browser with HTML page by WiFi. Hence the status will be updated on to the HTML page. There by to reduce human resources and efforts along with the enhancement of a smart city vision. Considering the need of modern technology, the smart garbage bin can expensive but considering the amount of dustbin needed in India, there for they used based sensors to reduce its cost and also make it efficient in

applications. And at the sender side they used only a Wi-Fi module to send and receive data. But because of the use of weight sensor for detection of amount of garbage in dustbin. It will only detect the weight of waste; not how much level it is of. The message can be sent directly to the cleaning vehicle instead of the contractors office. Thus garbage bins are managed [6].

3. Existing Methodology

The manual method of tracking out the trash bins is tedious because sometimes a few bin will fast and some other late. There are many steps being taken to avoid the excessive fill of dustbins. Waste management beaming tougher and tougher these days.

A. Issues in Existing Methodology

- Excessive dump of waste on the garbage bin.
- Disposal unit may increase load of organic carbon that reaches the water level plant, which in turn increase the consumption of oxygen.
- Environment pollution is happened due to improper disposal and improper maintenance of waste.

4. Proposed Methodology

In "Smart Garbage System", the level of garbage in the dustbins is detected from ultrasonic sensor and the ultrasonic sensor provide the real time results with using ESP8266 Wifi Module send it to the web application. The Web Application show the sensor results in graphical form. In case if the dustbin fill with garbage like 80 to 100 % then Web Application automatic send the SMS to specific mobile number and show the location of specific dustbin and also provide the optimize route for reduce the time and fuel cost. Acknowledgments

Insert acknowledgment, if any.

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. Ultrasonic sensors are based on the measurement of the properties of acoustic waves with frequencies above the human audible range, often at roughly 40 kHz [1]. They typically operate by generating a high-frequency pulse of sound, and then receiving and evaluating the properties of the echo pulse.

1) Usability: HC-SR04 Ultra Sonic sensor used to detect the level of garbage in dustbins. This shows real time result on our web page through other hardware connections.



Fig. 1 HC-SR04 Ultrasonic Sensor

B. ESP8266 12E Wi-Fi Module

ESP-12E/F is designed and developed by Shenzhen Doc-tors of Intelligence and Technology (SZDOIT) based on the Ultra-low power consumption. ESP-12E/F is especially for mo- bile devices and application of IoT (Internet of Things). Now, ESP-12E/F is widely applied to internet, communication in local area, intelligent home, industrial control, handed-devices, and etc.

The ESP8266 chip requires 3.3V power supply voltage. It should not be powered with 5 volts like other Arduino boards. Node MCU ESP-12E dev board can be connected to 5V using micro USB connector or VIN pin available on board. The I/O pins of ESP8266 communicate or input/output max 3.3V only i.e. the pins are NOT 5V tolerant inputs.

1) Usability: This esp826612e is being used for the pur- pose of connecting ultrasonic sensor with web application through WI-FI module esp8266. This sensor is placed on the board at which ultrasonic sensor and esp8266 is connected.



Fig. 2 HC-SR04 Ultrasonic Sensor

C. Advantages of Proposed Methodology

- The garbage is collected only from the filled containers.
- Only the real time information of filled level id provided by the sensor.
- Reducing man power required to handle the garbage level.
- Applying this technology to the city optimizes management, resources and cost, and make it a "SMART CITY".

5. Result and Discussions

Fig 3. Show the hardware connection setup for the sys- tem. An ESP8266 12E board is connected to the HC-SR04

Ultrasonic Sensor via digital input/output pins. The Ultrasonic sensor is attached with dustbin and detect the garbage on the dustbin.

The ESP8266 WiFi Module take the data from Ultrasonic sensor and send the data to the server for web application and show the garbage data in real time results.

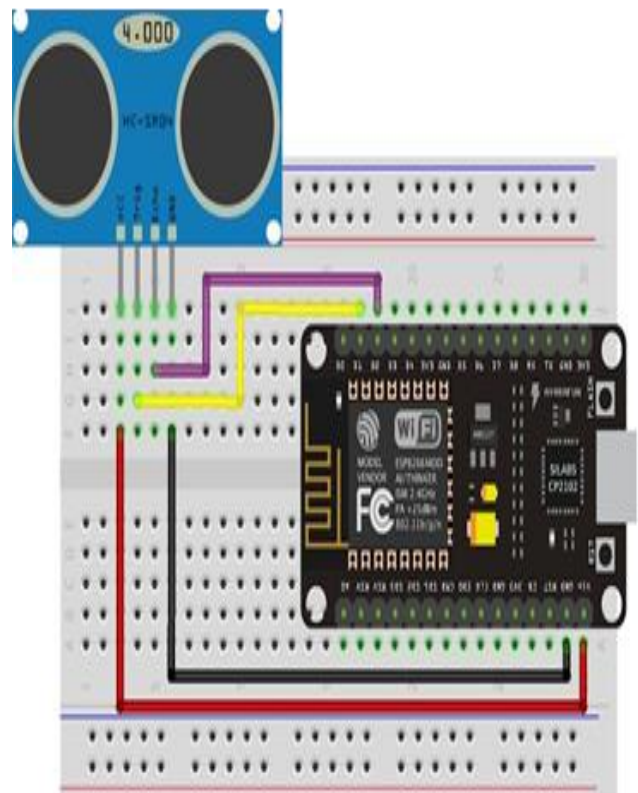


Fig. 3 The overview component of hardware system

The first test conducted is the situation where the garbage bin is empty. As shown in fig 4. Dustbin when empty - 0 % and Ultrasonic sensor show the output to dustbin.

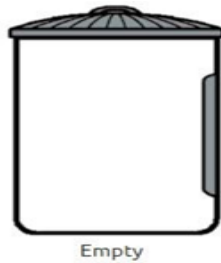


Fig. 4 Empty Garbage Level

In the second test conducted is the situation where the garbage level in low or has some garbage in the dustbin. As shown in the fig 5. Dustbin when some garbage - 20 to 30 % and Ultra-sonic sensor show the output to dustbin.



Fig. 5. Some Garbage Level

In the third test conducted is the situation where the garbage Mid level in the dustbin. As shown in the fig 6. Dustbin when Mid garbage - 50 to 60 % and Ultra-sonic sensor show the output to dustbin.

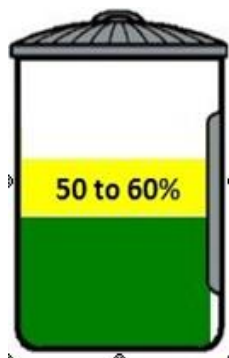


Fig. 6 Mid Garbage Level.

In the fourth test conducted is the situation where the garbage Full level in the dustbin. As shown in the fig 7. Dustbin when Full garbage - 80 to 100 % and Ultra-sonic sensor show the output to dustbin.



Fig. 7. Full Garbage Level

6. Conclusion

This system make our environment clean and ensure hygienic surrounding. Improper disposal and improper maintenance of the domestic garbage creates issues in public health and environmental pollution. This project attempts to provide practical solution to help the local municipal administrator in garbage management system i.e. monitoring of domestic garbage clearance at proper time to avoid damage to public health. By reducing the trend of fake reports generation it can be great act against corruption. This system can control the investment of resources for garbage collection. In real sense, it is great help for society cleanliness. Therefore, it is more efficient and cost effective system. Its branches can be merged into different smart systems. Technology demand "To be smart" possible only if we adopt intelligent systems for our problem solving needs.

7. Future Work

The development team, after complementing the development of project, they set some aims and goals to achieve in future, which is known as future plan. This part includes all the expected modifications and changing in the project are to be done in future according to the feedback given by users and we also have some future plans which are as follow:

- Use of shortest path algorithm to provide.
- Directions of any place from current location.
- We will launch this application in different cities.
- Adding share places on social media feature.
- Adding setting options into application.
- We will provide services to different garbage companies through our application.

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