

IoT Based Smart Trash Bins – A Step Toward Smart City

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Abstract - Waste management is one of the primary problem that the world faces irrespective of the case of developed or developing country. The key issue in the waste management is that the garbage bin at public places gets overflowed well in advance before the commencement of the next cleaning process. It in turn leads to various hazards such as bad odor & ugliness to that place which may be the root cause for spread of various diseases. To avoid all such hazardous scenario and maintain public cleanliness and health our work is mounted on a smart garbage system. The main idea of proposed work is to develop a smart intelligent garbage alert system for a proper garbage management. A smart alert system is designed for garbage clearance by giving an alert signal to the municipal web server for instant cleaning of dustbin with proper verification based on level of garbage filling. This process is aided by the ultrasonic sensor which is interfaced with Arduino UNO to check the level of garbage filled in the garbage bin and sends the alert to the municipal web server once if garbage is 90% filled via IoT. Once the alert is received, Municipal Corporation takes initiative to clean the same. After cleaning the garbage bin, municipal web server gets updated about the garbage bin been cleaned. This system provides information regarding status of how waste collection is being done and followed up by the municipality authority.

Key Words: Smart Bin, Arduino, Waste management, IoT.

1. INTRODUCTION

Waste management is the action required to manage waste from its inception to its final disposal [1]. This includes collection, transportation, treatment and disposal of waste together with monitoring and regulation. Waste collection methods vary widely among different countries and regions. Domestic waste collection services are often provided by local government authorities.

Curbside collection is the most common method of disposal in most countries, in which waste is collected at regular intervals by specialized trucks. Waste collected is then transported to an appropriate disposal area. Nowadays, cities with developing economies experience exhausted waste collection services, inadequately managed and uncontrolled dumpsites and the problems are worsening [2]. Waste collection method in such countries is an on-going challenge and many struggle due to weak institutions and rapid urbanization.

The following is the need for improvement in waste management system

- ❖ By 2030, almost two-third of the world's population will be living in cities. This fact requires the development of sustainable solutions for urban life, managing waste is a key issue for the health [2].
- ❖ Efficient and energy-saving waste management, reducing CO₂, air pollution and vehicle exhaust emissions—these are just a few examples for the demands of future cities. In views of that, the efficient use and responsible handling of resources become more important.
- ❖ Effectively managing waste is important in developed countries. Waste management may swallow up to 50% of a city's budget, but only serve a small part of the population.
- ❖ Sometimes, up to 60% of waste is not being collected; it is often simply burned by the roadside. It can pollute drinking water; it can spread disease to people living nearby.
- ❖ Even with great route optimization, the worker must still physically go to the dustbin to check waste levels. Because of this, trucks often visit containers that do not need emptying, which wastes both time and fuel.
- ❖ Waste management prevents harm to human health and the environment by reducing the volume and hazardous character of residential and industrial waste.

2. MOTIVATION

Hubli city's current waste collection logistics is carried out by emptying containers according to predefined schedules and routes which are repeated at a set frequency. Such a System has major disadvantages:

- ❖ Time consuming
- ❖ High costs
- ❖ Greater traffic and congestion.
- ❖ Unnecessary fuel consumption.
- ❖ Increased noise and air pollution as a result of more trucks on the road.

All the above disadvantages are a result of lack of real time information resulting in unsuccessful collection of waste. The Hubli Municipal itself finds this as a big problem and a big hurdle in between Hubli Smart City initiative. There is an urgent need to optimize the management of this service to reduce infrastructure, operating and maintenance costs, as well as reduce contamination directly associated with waste collection.



Fig. 1 Conditions in the city

3. PROBLEM STATEMENT

As we have seen number of times the trash cans are getting over flow and concern person don't get the information within a time and due to which unsanitary condition formed in the surroundings, at the same time bad odor spread out due to waste, bad look of the city which paves the way for air pollution and to some harmful diseases around the locality which is easily spreadable.

4. LITERATURE SURVEY

The idea of smart trash bins and systems have been in discussion for quite a long time. The technologies used at disposal to develop this smart system have also evolved, i.e. from WSNs to RFIDs to now the most popular Internet of Things (IoT). Each idea seems to be similar but is slightly different at its core and our proposed work is no exception from the same. After the IoT field, finding its hold in our lives, this is our original plan for designing a smart garbage collection system which has provision for citizen participation and analysis of data for better decision making. At hardware level, the smart system is a garbage bin

6. METHODOLOGY

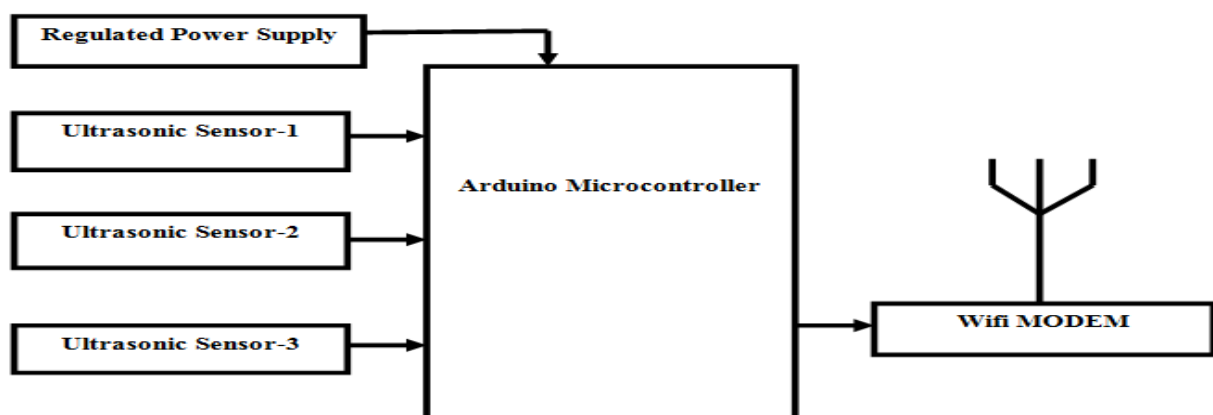


Fig.2 Block diagram of the proposed concept

with ultrasonic sensor, a micro-controller and Wi-Fi module for transmission of data.

The worldwide implementation of Internet of Things is possible with a cloud centric vision [1]. This work exploits the future possibilities, key technologies and application that are likely to drive IoT research. But a strong foundation to our work is provided, where the basics and applications of Arduino board is explained [5].

It is quite interesting as it implements a GAYT (Get As You Throw) system concept as a way to encourage recycling among citizens [6]. As we would discuss further, the citizen participation part of our system is quite influenced by their work.

The following defines the survey of Hubli area,

Population : over 10 lakhs

Area : 665.66 km².

No. of wards : 58

Total quantity of solid waste generated: 380-400 tons per day

❖ Method of collection :

- Primary collection : door to door collection
- Provided metallic container in designated places all over the city.

❖ Mode of transportation (secondary transportation):

- Tippers and lorries covered with plastic
- Dumper placers
- Compacters

5. OBJECTIVE

The main objective of the project is to involve IoT technology to the current urban waste management scenario and enable a two way communication between the infrastructures deployed in the city and the Operators/administrators. A centralized system for real-time monitoring is our goal to achieve. In this way both the municipal and citizens benefit from an optimized system which results in major cost savings and less urban pollution

As shown in Fig. 2, the proposed system consists of three ultra sonic sensors, an Arduino microcontroller and an WiFi modem. ESP8266Wi-Fi module is used for connecting the Arduino to the web server.

The ultra sonic sensors so used in this project, are used for detecting whether the trash can is filled with garbage or not. When the distance measured by the ultra sonic sensors is less than the threshold value programmed in microcontroller it depicts that the thrash can is filled. The same is intimated to the municipal corporation via WiFi modem (IoT) by displaying the message on server as "Basket is Full" and if the distance will be more than the threshold value set, then the message on server is displayed as "Basket is Empty". To avoid false triggering of the message to municipal corporation three sensors are installed in the system.

The above Fig. 3 represents the circuit diagram of the proposed concept. The ESP8266 is interfaced with the Arduino as ESP8266 operates at 3.3V, the VCC and the CH_PD pin were connected to the 3.3V pin of Arduino. The RX pin of ESP8266 operates at 3.3V hence a voltage divider was designed where in three 1k resistors were connected in series and further the RX was connected to the pin 11 of the Arduino through the resistors and also the TX was connected to the pin 10 of the Arduino.

Further the HC-SR04 ultrasonic sensor was interfaced to the Arduino. Further VCC and the ground of the ultrasonic sensor were connected to the 5V and the ground of the Arduino respectively. Lastly the TRIG and ECHO pin of ultrasonic sensor were connected to the pin 8 and pin 9 of the Arduino respectively.

7. IMPLEMENTATION OF THE PROPOSED CONCEPT

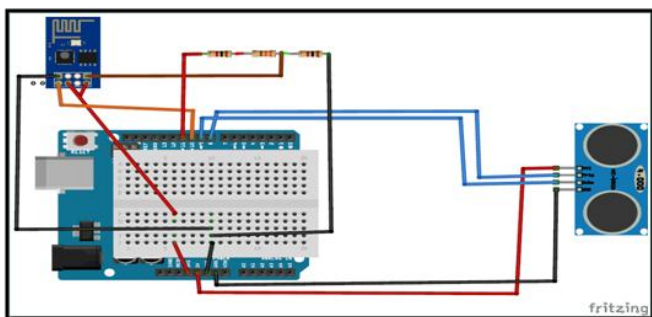


Fig. 3 Implemented circuit

8. FLOWCHART OF THE IMPLEMENTED CODE

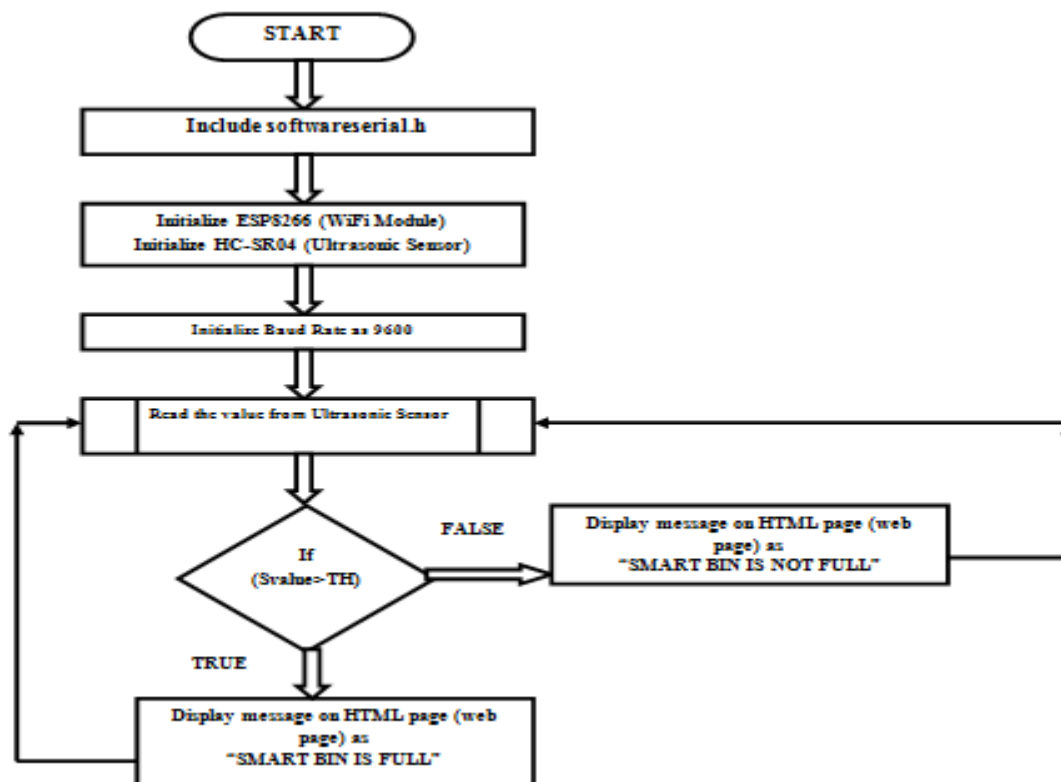


Fig. 4 Flowchart of the implemented code

9. IMPLEMENTED SYSTEM



Fig.5 Image of Implemented circuit

The above Fig.5 depicts the proposed concept been implemented. As we can observe the system is designed to indicate us that whether the trash can is empty or full through the web server and we can know the status of the 'Trash Can' or 'Dumpsters' from anywhere in the world over the Internet. It will be very useful and can be installed in the Trash Cans at public places as well as at home.

To test the system, after uploading the code; open the Serial Monitor and it will show you an IP address as shown below.

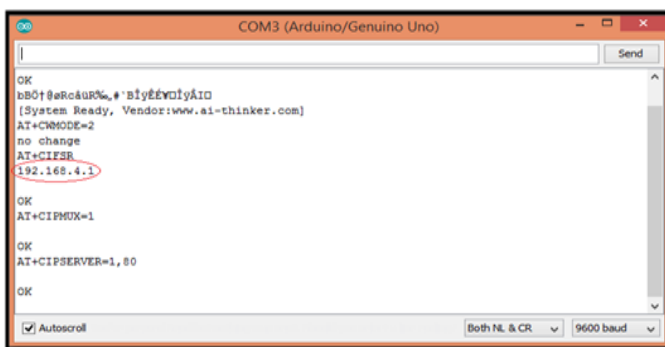


Fig.6 Screenshot of Serial Monitor

Type this IP address in the browser, it will direct to the server of municipal corporation. If the sensor value read by the Arduino is higher than the threshold value set in the controller the following message is shown on the server (Municipal Corporation) else it displays the message as "Basket is Full"



Fig. 7 Screenshot of Web Page

10. CONCLUSION

The implemented system assures the cleaning of trash cans once the garbage level reaches its maximum limit. 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. It ultimately helps to keep cleanliness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient. The implemented system was tested with five iteration of alternative trash in the bins the system was found 100% accurate as it depicted exact result of the trash can under test.

11. FUTURE SCOPE

With the help of proper technology (GPS & software applications) the lorry can be guided in selecting the shortest path for garbage collection. This project can add an edge to the cities aiming to get smart and eco-friendly.

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