

Design and Fabrication of a Smart Bin

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Abstract

Dustbins are containers used for collecting household waste all around the world. In our day to day life, we dispose variety of waste materials categorized as industrial waste, sewage wastes, domestic wastes etc. Dustbins are used for collecting the domestic waste materials. Indoor dustbins are used to collect wastes from household, which are then disposed into the outdoor dustbins maintained by the Corporation or Municipality. Indoor dustbins are smaller in size, whereas municipal dustbins present outdoors are so big in size since it has to accommodate all the wastes from many household users in that area. Hence our main focus is on the dustbins placed outside every corner in the streets in order to keep the environment clean. Road side dustbins are not monitored and cleaned properly most of the times. In this paper we propose a new system for managing garbage within Smart Cities. This Efficient Waste disposal or Management System is considered as an essential for Modern Smart Cities (MSC). Internet of Things (IoT) can be implemented both in IS and MSC creating an highly developed proposal for future Operations. Special methods can be applied to enhance technology used for high Quality of Service (QoS) in our waste management system. Specifically, IoT components like sensors, detectors, and actuators are integrated into Intelligent System (IS) and Inspection systems for efficient waste management. We recommend a sophisticated IS for efficient waste management in Smart Cities. The proposed system is an automated alert based smart bin or garbage collection system and to alert the authorities like corporation or local waste disposal team. Using this, we can monitor the complete waste disposal in an efficient way.

Index Terms—Smart cities, Smart bin IOT Sensors, UV infra-red automated, Aurdino UNO, Ethernet module, alert buzzer, cost efficient, Rain detector, Ethernet, Html web page.

INTRODUCTION

RECENT advancements in communication technology using wireless sensor devices opened vast opportunities for developers and researchers of many intelligent smart systems developed for social relevant applications. Using this everyone is migrating to select only smart mobile phones, smart sensors, smart home automation, smart irrigation system etc. The IoT permits all individuals and things to be more smart and connected to the Internet world. Hence, we can call it as Internet of Everything. To facilitate new smart services and redesign the active devices in smart cities are very effective, when

we use IoT [1-6]. In this case garbage collection is reshaped to Waste Collection as a Service. Dynamic scheduling and collecting waste are the manual process, but done efficiently through online using IoT. There are two Issues connected to smart waste collection. First how frequently collect waste from bins and secondly how to inform this to the municipal authorities.

Smart Bin, is a garbage collecting dust bin, which is self-aware and detects the level of the waste in the dustbin, based on that it can send alert messages to the municipal authorities, so the authorities make the arrangements to replace the dustbin. This type of

dustbins will be very useful in places where the frequency of people using the dustbin varies because timely checks won't be sufficient [7]. Other features are also added, one is automated closing of the doors with the help of motors using Ultra-sonic Sensor, in case the dustbin is full, another is the detection of objects around the dustbin using IR Sensor, which in turn can help the dustbin from accumulating wastes around the dustbin. An Arduino board is used to send the information to a server. Power supply of 12V-2 Amps is used for the circuit. An IR Sensor is used for detecting objects and an ultra-sonic Sensor is used for detecting the height filled by the dustbin.[8] These Sensors are connected to the SPI Interface of the Arduino, and a buzzer is added with relays. Buzzer is used as an alarm in case people throw wastes around the dustbin. The board also consists of avoltage regulator, which is used to provide the required voltage to the Sensors and the Arduino. [9]. The Arduino consists of an Ethernet module, which is used for server client communication. Using this, information can be passed from the client to server, and vice versa. This is used for passing info about the current state of the dustbin.

The paper is framed as follows: Section II discusses Literature review in the area of IoT-enabled waste collection for Smart Cities. Section III describes the Problem definition of the system and some scenarios of usage. Section IV considers the scope and motivation for this work. Section V contains the proposed system which describes the complete system model and purpose. Section VI concludes the complete flow chart which describes the process. Implementation and Methodology are proposed in section VII. In section VIII, plans for future work is discussed and finally section IX has conclusion and references.

LITERATURE REVIEW

This is a unique idea, for the implementation of smart garbage bin. This is our plan for designing smart garbage bin with Ultrasonic Sensor, IR Sensor and Ethernet module for transferring of data. We

reviewed the papers which deal with the smart bin concepts. The review consists of different methods which are proposed for waste disposal and management. In paper [1] discusses the different methodologies used to manage internet of things and describes the detailed functionality of IoT, and gives an overall idea of preparing application related to information management over internet. An overview of the concept for combining user application with IOT [2] and deals with detailed description about mobile analysis and Sensor information management. They outlined recent advancements by world foremost innovators in developing IoT Standards, big data management and mobile analytics, as well as standards and open source platforms for developing IoT applications. To realize the IoT vision we must address a number of IoT challenges we have outlined in this paper. Addressing these significant challenges requires both international collaboration and high impact killer-applications. All major successes in IoT research. A new technique was introduced in this paper and implement for smart city waste management connected with IOT [3], The dynamic scheduling concept required for the cleaning of dustbin periodically and the Top-k query lead us to priority based cleaning of dustbins. City Garbage Collection Indicator using RF (Zigbee) and GSM technology [4]. In the proposed system uses a RFID to identify a particular dustbin. It detects the dustbin fillings using Sensors, and uses GSM to alert the authorities. Notable disadvantages are usage of RFID for identification and absence of log to record the data for each overflow. A Graphical user Interface GUI proposed in [5], which is able to show the current state of the dustbins. No efficient alert system is present since it sends all the alerts to the same person.

PROBLEM DEFINITION

People dispose domestic wastes in the dustbins placed at the roadside. This public dustbin gets filled up randomly. Continuous human monitoring is required to control the overflow level of the dustbin, because sometimes the dustbins fill up faster than

usual. When dustbins overflow people can't dispose their wastes in the dustbin, so they dispose it outside the bin. In rainy season, the situation gets worse when rain water enters the dustbin, releasing bad odours. In order to prevent the overflow and to avoid people disposing their wastes outside the bin, we are proposing a smart bin system, which can detect overflow and alert the authorities and also detect the wastes being placed around the bin, and send a buzzer to stop the people from disposing the wastes outside. Moreover a water Sensor is present which detects water and automatically closes the door in case of rain.

SCOPE AND MOTIVATION

Scope

Our proposed system identifies the status of smart bin and detects whether it is empty or filled to customize the waste collection schedule. Accordingly it alerts the authorities, thereby reducing the cost and saving time [10]. In Real time waste management system using smart dustbin the level of the dustbin is checked to find whether the dustbin is filled or not. This system provides the information status of the dustbins and can be accessed from any where you are and any point of time by the concerned authorities. It will inform the status of each dustbin to the concerned authority. So, the garbage collection vehicle can be sent only when it is needed. By implementing this resource optimization, cost reduction and effective waste management can be done.

Motivation

Cleanliness is one of the most important things which any human being would cherish. In order to be clean, we must preserve unclean places and make them tidy and neat. Dustbins are often seen as filthy since it is filled with wastes and spreads foul smell around it. Hence we chose this project which maintains a Fresh and untarnished environment around the dustbin. This also goes well in protecting the serenity of the environment.

PROPOSED SYSTEM

In the proposed method, a Sensor node is installed in every Smart-bin with a power supply unit (It consists of a Step down transformer, Bridge Rectifier, a filter circuit and a Voltage Regulator). The Sensor node senses bin fullness, reports readings and Sensor statuses by using Ethernet modem from Arduino UNO. It also has a function to locks the bin door when it is full and also at rainy period. The following hardware components are fixed to the bin. Ultrasonic Sensor is used to check the level of the dust bin. It can also update the status of the bin and sends this information to its nearest corporation office. An effective HTML based webpage is used to get the status in the office. It works by sending a sound wave, and it is received back from the other end. By calculating the time of travel of sound wave we can figure out the distance by,

$$\text{Distance} = [\text{Speed} * \text{Time}];$$

Where Time = Time taken by the sound wave to reach the bin and return back

Speed of travel is the Velocity of Sound which is equal to 330m/s. So, Distance = [Total distance travelled i.e., required distance * 2].

And it can update the status of bin to corporation office by using SPI Ethernet shield through html pages. (The SPI Interface is used as the input output interface for the Arduino. Ethernet module is the additional module attached to the board which is to be used to connect with other computers/servers. It can provide basic LAN based internet connection.) This is provided in recent advanced IOT methods to identify the bin by its ID. Rain Sensors are connected to detect rainfall, to avoid entering of rain water into the bin. It is a group of water Sensors clustered with an AND gate. So, it detects rain by placing three sensors around the bin. IR Sensor is used to detect the nearby objects which are placed closer to the bin ($I = 0$ or 1). If any object is placed closer to the bin, the buzzer will be turned ON to give an alert to the user and update the status in IOT. Relays and Motors are used to close the door automatically when it

receives bin full indication of ultrasonic Sensor and rain or water detection by rain Sensor.

Software and Hardware Components used are,

- 1) Arduino IDE,
- 2) HTML and embedded C language.

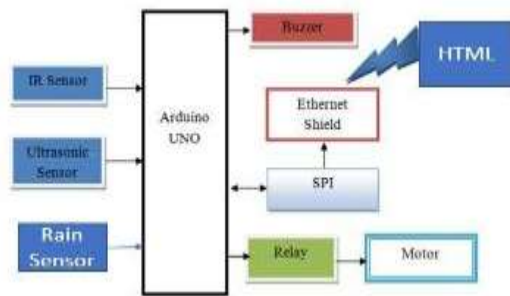


Fig. 1. Proposed Architecture

The proposed architecture, ultrasonic sensor and infrared sensor are shown in Fig. 1, Fig. 2 and Fig. 3 respectively.

Sensors are embedded to detect the distances between various bins.



Fig. 2. Ultra-sonic sensor

Infrared Sensor

Infra-red is connected to detect wastes placed around the dustbin. When an object is thrown near the bin, the infra-red sensor detects it and switches ON the buzzer.



Fig.3. Infra Red sensor

Rain sensor

Rain sensors shown in Fig. 4 are connected to detect rainfall, Rain sensors are a group of water sensors clustered with an AND gate. So, a rain sensor detects rain by placing water sensors on the various sides, and by using the data on all the water sensors, a rain is detected.



Fig. 4. Rain Sensor

C. Advantages

1. System is used to indicate the level of wastages filled.
2. System is used to identify the waste thrown around the bin and warn the person who has done it.
3. Entering of Rain water in to the bin is prevented.
4. Dust bin can be Easily Monitored through Webpages.
5. From the E-Waste Management details of daily seasonality information are obtained. Cleaning operators are able to better plan when they should send their cleaners to empty the bins, and they are also able to plan which routes their cleaners need to take for minimal travel.
6. Day to Day monitoring and cleaning can be o keep the pollution minimal.
7. Reduce human monitoring process
8. The system can be used to minimize the Cost and Time.

9. System Database can be accessed at anytime from anywhere.
10. The bin which is full can be easily identified by its ID using Ethernet Module.
11. The system makes the environment Eco friendly.

FLOW CHART

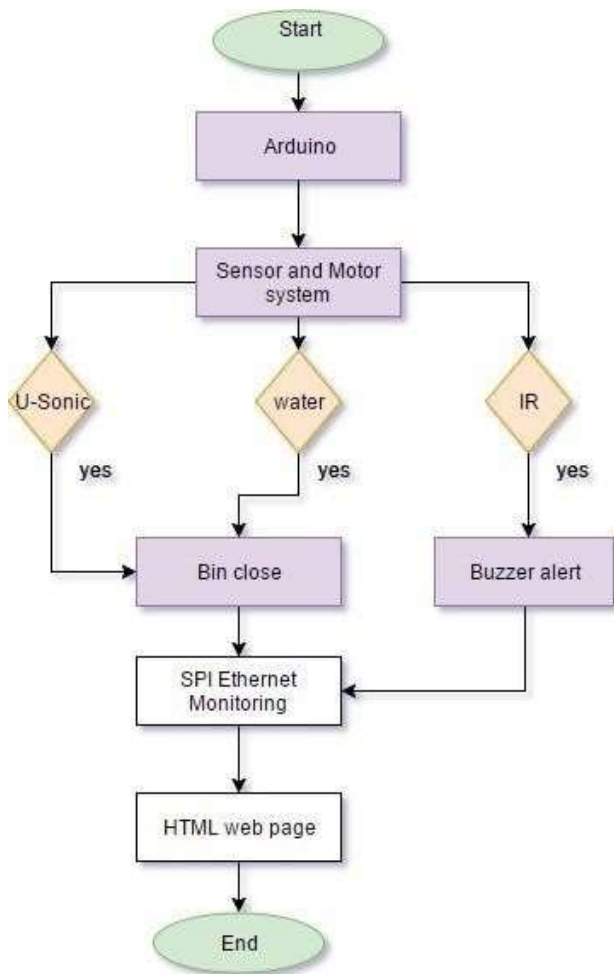


Fig. 5. Flow Chart

The Flow chart is shown in Fig. 5.

IMPLEMENTATION AND METHODOLOGY

This smart bin system is very useful in preventing overflow of dustbins and accumulation of wastes around the dustbin. This prototype model monitors the bins and provides details about the level of garbage collected in the garbage bins via sensors Internet. This system uses an Arduino device with a power supply. Ultrasonic Sensors placed over the bins lid to detect the garbage outside bin. IR Sensor is used to sense near garbage if any.

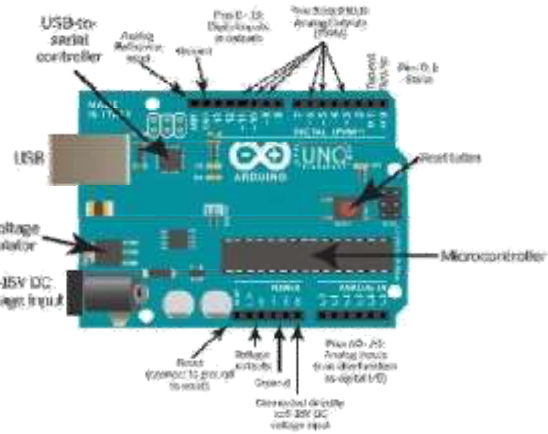


Fig. 6. Arduino Board

Sensors are used to lock the bin automatically, when rain is detected. The system makes use of Arduino board shown in Fig. 6 with microcontroller connected to the SPI using an Ethernet to the web page. Table I shows the sample statuses of two bins located at different places.

STATUS TABLE- 1

Area	Java canteen	Tech Park	UB
Bin-1	Empty	Full	Full
Bin-2	Full	Empty	Full

TABLE II- COMPARISON TABLE

Name	Bin Measurement	Technology used	Object detection around the bin	Technology Used	Web UI	Alert Messages	Technology used	Scheduling
"IOT Based Intelligent Bin for Smart Cities"	Yes	Infra-red	No	No	No	Yes	GSM	No
"Efficient Garbage Disposal Management in Metropolitan"	Yes	laser, Photo diode	No	No	No	Yes	AD-HOC	Yes
"SMART DUSTBIN"	Yes	Ultrasonic	No	No	Yes	Yes	GSM	No
'smart garbage collection system in residential area'	Yes	Webcam, Weight sensor	No	No	LCD	No	GSM	No
"Waste Bin Monitoring System Using Integrated Technologies"	Yes	Ultrasonic	No	No	No	Yes	Zigbee GSM	No
"Smart Bin Implemented for Smart City"	Yes	Infrared	No	No	No	Yes	RFID	No
Basic Feature, "Solid waste Management project"	Yes	Webcam	Yes	Infra-red	No	Yes	GSM	No

FUTURE WORKS

This is a prototype developed for two bins. This system can be easily extended to any number of bins. All dustbins present in a city can be connected together through a system for totally automating the process of the wastage collection once the bins are full. Additional controls like closing the lid when the bin is full and closing the bin when it rains.

CONCLUSION

Many works have been going on to reduce amount of waste accumulation and to maintain and dispose the waste present in the bin. Thus, by implementing these smart bins all around the world, the bins will be user friendly, and there will be hygienic environment around the bin. It will also be useful for the authorities who can inform the concerned to prevent the dustbin from getting overflow hence human monitoring is reduced. Using this, we can monitor the complete waste disposal in an efficient

way. An Infra-red Sensor system is present in the bin to detect objects placed around the dustbin.

This system will give alarm sound signals when we keep garbage's around the dust bin. This in turn will reduce the time the dustbin is overfilled, and hence will serve very useful for the society and the environment and surroundings where we live for the betterment of our future.

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