Smart and Automatic System for Garbage Pickup

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***Abstract*—Frequently, we observe waste bins or dustbins put in public places in our city that are overflowing. It generates unsanitary conditions for humans as well as ugliness in the area, as well as a foul odour. Our primary aim is to deal with this problem by implementing IoT Based Smart Garbage Collection Bins. These bins are connected to a microcontroller-based system with ultrasonic sensor systems and a central system that displays the current garbage status on a mobile web browser with an html page through Wi-Fi. This system allows the user to know the fill level of each garbage bin in a locality or city at all times, to give a cost-effective and time-saving route to the truck drivers.**

***Index Terms*—Monitoring, Garbage Collection, IoT, Microcontroller, Sensor, HTML, Wi-Fi**

I. Introduction

The amount of waste produced on a daily basis appears to be unstoppable, expanding to huge scales. Every city is suffering with ever-growing trash. Every day, India generates 0.1 million tonnes of garbage. People also do not take it seriously because they are either unaware of it or refuse to accept responsibility for it. Uncontrolled garbage disposal on the edges of towns and cities has resulted in overflowing landfills that are not only impossible to reclaim due to their haphazard nature, but also have major environmental consequences. The standard garbage monitoring system employs a flat rate, there are no regulations on heavy waste producers and there are no benefits for small waste producers. We address this issue in cities with inefficient garbage collection systems. The administration can use this project to suit their needs for smart garbage management solutions. This system monitors garbage bins and tells truck drivers through web-application on the amount of garbage collected in the bins in order to provide a cost-effective and time-saving route.

II. Objectives

Using IoT, the suggested system would be able to automate the solid waste monitoring process as well as the complete collecting procedure.

- Smart Trash System (STS) and Smart Monitoring and Controlling Hut are the two key subsystems of the proposed system (SMCH).
- In the suggested system, whenever the garbage bin is filled, the circuit at the waste bin acknowledges this by transmitting it to the receiver at the desired location in the area or spot.
- The received signal in the proposed system indicates the status of the waste bin at the monitoring and regulating system.

III. Literature Survey

A. Smart Waste Collection and Disposal System [1]

An IoT based brilliant waste assortment and removal framework is proposed to distinguish and isolate the loss as dry, wet, and metallic waste at the family unit level. The framework identifies the appearance of flotsam and jetsam utilizing an ultrasonic sensor and after that checks for any metal substance in the loss by utilizing metallic sensor. When the rubbish is identified and isolated, the wipers help to move the refuse over the individual canisters, and afterward the stage flips. Furthermore, the framework can be used to the trash level of the dustbins on the LCD screen just as makes an impression on clean it if it's full by the utilization of ESP32.

Advantage: By using an android application one can view then bin location surrounded by his area. This will save both the time and effort of the human for tracking the location of the bin.

Disadvantage: People not having access to a smartphone cannot view the location and status of bins.

B. Garbage Management with Smart Trash using IoT [2]

An IR sensor is installed to detect obstructions, and if something moves in front of the IR sensor, it sends a signal to the DC motor to open the lid through the Arduino. After that, it will remain open until an obstruction is detected, and then it will close automatically if no obstacle is detected. An ultrasonic sensor Wi-Fi module ESP8266 is installed. Using the Wi-Fi module ESP8266, the sensor will detect the level of rubbish in the bin and transmit a message to the authority. If a garbage collection vehicle cannot be reached, the signal is sent to the authority again after a certain time period. The user tag that will utilise the bin will be authenticated using an RFID card and reader, and this user will be logged in the database. Users who use the garbage can be rewarded using this method. If the user does not have a valid tag, an invalid tag will be sent to the database.

Advantage: A reward system ensures user engagement. Garbage can lids are not kept open unnecessarily which promotes hygiene.

Disadvantage: Issuing RFID cards to all users is costly and requires employment of assistance personnel.

C. Smart Garbage Collection System in Residential Areas [3]

Automatic techniques are used to detect garbage level in garbage can. For that, an ID number is given to each can. As soon as the garbage can is full, the server is notified. Also They have a Load cell based weight sensor which will sense the weight of the garbage can and when the weight crosses the set point the SMS is sent to the garbage collection centre. After the message is sent, a garbage disposal vehicle will arrive at that location. In this project, it is demonstrated by a robot mechanism.

Advantage: This project leads to avoiding overflowing of garbage from the container. Also automatic loading saves time and increases the productivity of the vehicles and manpower deployed. Besides, manual handling of waste poses a threat to the health of the sanitation workers as the waste is highly contaminated.

Disadvantage: The project assumes availability of highly reliable and efficient power systems which might not be necessarily true for developing countries. Also, the proposed implementation requires heavy expenses which can again be a problem for implementing it even for a small society.

D. IoT-Based Smart Garbage System for Efficient Food Waste Management [4]

An IoT-based Smart Garbage System (SGS) replaces existing RFID-based garbage collection. A resident will use his/her RFID card to open the lid and the SGS will measure the weight of discharged waste and send data to the server. The resident is charged based on an adaptive scheme and garbage bins are battery powered for mobility.

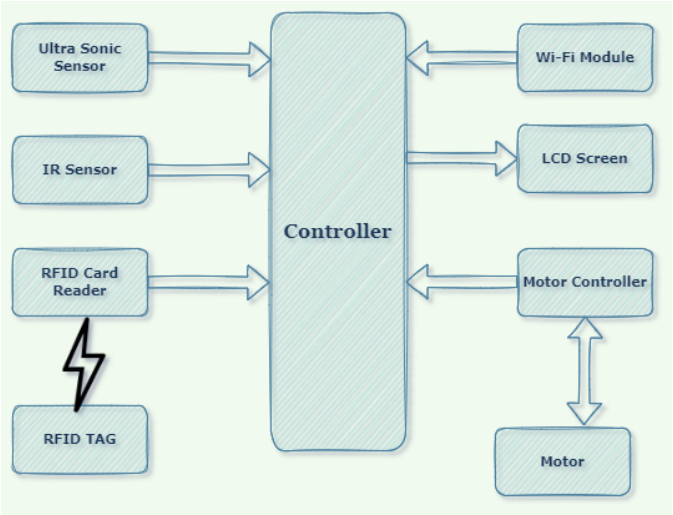


Fig. 1: Board and components

Advantage: Work distribution is energy efficient, smart and is based on remaining power and previous use. Waste pickup scheme can be devised using collected data.

Disadvantage: Upfront cost of creating such SGS and maintenance cost are large. Due to unfavourable pricing scheme, residents may keep using conventional ways of waste disposal rather than using SGS.

E. Automation of Smart Waste Management using IoT [5]

Based on the key requirements to be addressed while dealing with waste management process and keeping in mind operation efficiency, scholars have proposed a cloud based, IoT sensors driven smart solution called as iSmartWMS for managing end to end waste management process. The major components of their solution are: Smart Trash bin, Smart Waste Truck, iSmartWMS Server, iSmartWMS database, Recycling Plant Controller and Landfill Station Controller.

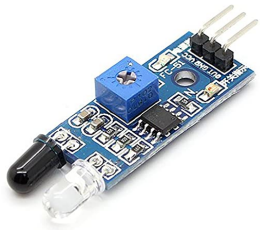
Advantage: Smart Waste Management System facilitates waste collection from waste bins only when required, efficient waste collection and transportation, automated process operations, optimised resource utilisation and helps in maintaining the healthy environment. Also, By using the Waste Collection Vehicles running on Natural Gases instead of Petrol or Diesel, the overall transportation is quieter as well as cost effective.

Disadvantage: Due to their personal reasons, authors have accepted that the paper mainly discusses ideas at a concept level and hence there is little proof of success in the practical world. Also, the major components are very difficult to align and work in sync perfectly as proposed in a non perfect real world.

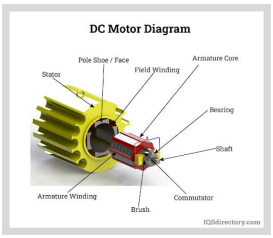
IV. BOARD COMPONENTS

In the proposed methodology, we have explained which components are connected with one another as shown in Fig. 1. The whole system is divided into four parts:

1) **For controlling Dustbin Lid**
   IR Sensor is installed for the detection of obstacle, if

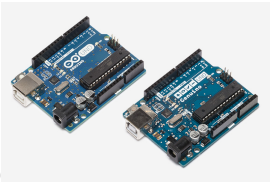


(a)

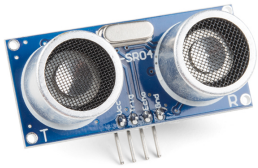


(b)

Fig. 2: (a) IR Sensor (b) DC Motor



(a)



(b)

Fig. 3: (a) Arduino Uno (b) Ultrasonic Sensor

something comes in front of IR sensor it will send signal through Arduino to DC motor for opening of the lid. After that it will be kept open till the obstacle is detected and when no obstacle is detected it will get automatically closed.

2) **Message System for delay in Garbage Collection**
Installation of the Ultrasonic Sensor is assured with Wi-Fi module ESP8266. The ultrasonic sensor will detect level of the garbage in the bin and communicate message to respective authority by using Wi-Fi module ESP8266. In case if garbage collecting vehicle is not reached, message is again send to the respective authority after some delay of time.
3) **User Authentication for Using Dustbin**
We use an RFID card and reader which will authenticate the user tag who is going to use the bin and this user will be registered in the database. Using this reward can be given to user who use the trash. In case if user has not a valid tag it will send the message to database: "Not a valid tag".
4) **Information Display**
Use of LED screen where video can be played for the advertisement and revenue generation. Here when advertisement is shown on display screen then revenue is generated for the advertisement played. This revenue is distributed among users and authority. Here LED screen also shows the real time status of trash filled and location of other nearby trash.

The hardware components are listed below:

1) **Arduino Uno** Fig. 3a
Arduino Uno is a microcontroller board. It has 14 digital input/ output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller.
2) **Ultrasonic Sensor** Fig. 3b
The Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back.
3) **Wi-Fi Module – ESP8266** Fig. 4a
The ESP8266 WiFi Module is a self-contained SOC with an integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.
4) **RFID System** Fig. 4b
Radio Frequency Identification (RFID) is the wireless non-contact use of radio frequency waves to transfer data. RFID systems usually comprise an RFID reader, RFID tags, and antennas.Tagging items with RFID tags allows users to automatically and uniquely identify and track inventory and assets. RFID takes auto-ID technology to the next level by allowing tags to be read without line of sight and, depending on the type of RFID, having a read range between a few centimeters to over 20+ meters.
5) **IR Sensor** Fig. 2a
An infrared sensor is a type of sensor which detects an object when there is any obstacle in the front path of it. The infrared sensor always emits infrared rays for detecting an object. It has wavelength of 750nm-1mm. IR sensor is good for detecting an object from 10cm - 50cm.

The software components and interfaces are listed below:

1) **Arduino IDE**
It contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus.
2) **Web Server**
A Web server is a program that uses Hypertext Transfer Protocol to serve the files that form Web pages to users, in response to their requests, which are forwarded by their computers' HTTP clients. Dedicated computers and appliances may be referred to as Web servers as well.

V. CHALLENGES AND CONSTRAINTS

Due to lack of budget, the ideas discussed and proposed are mainly at concept level and thus have low practical reliability at the current moment. However, Seeing success of ideas during literature surveys which might seem "doubtful" is encouraging.Due to the lack of regulatory pressures, organisations tend to continue the status quo of waste management,

(a) (b)

Fig. 4: (a) Wi-Fi Module – ESP8266 (b) RFID System

which is often a neglected part of supply chain operations management. Organisation leaders need enough capacity to innovate to successfully implement these technologies in waste management and to upgrade them when necessary, possibly in collaboration with technology providers. Another difficulty lies in the short life cycle of technological products. Due to the rapid pace of innovation in the technology sector, it is difficult for users to keep up with the never-ending product upgrades. Furthermore, an organization often produces many types of waste, which make it difficult to treat each of them properly for value recovery. Partly due to the lack of scale economy in waste treatment, it is prohibitively costly for individual organizations.

VI. CONCLUSION

The system is used for monitoring the waste in different locations by using the IoT and web application. To take full advantage of the benefits offered by the proposed approach, it is highly recommended to develop the full-fledged system as per stated objectives and board components justification. An alert message is sent to the collectors at the point when the trash level arrives at the greatest amount. If the dustbin isn't cleaned, the message is sent off to the higher city authorities. A large number of questions are raised against the current garbage collecting system and for that most of the problems are resolved by using the latest technology and sensors. Moreover, this proposed methodology would help the municipal department for collecting and dumping the garbage effectively and efficiently.

VII. ACKNOWLEDGMENT

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CSPE65: Embedded System

Assignment – 1

My Contribution

106119100 - Rajneesh Pandey

Rajneesh Pandey (106119100). (30%)

1. Did Literature survey of one latest journal paper.
   - Smart Waste Collection and Disposal System.
   Analyse the paper and then give the conclusive literature survey

2. Structured and framed the Board components to implement the proposed model .

3. Made the Diagrams in Paper of the Proposed frame model and various components

4. Contributed to the Challenges and constraints in developing such system of the Proposed Methods

5. Also helped in converting the document to IEEE format as given in requirements.

Satyarth Pandey (**24 %**)

1. Did Literature survey of two latest journal paper.
2. Contributed in Challenges and Constraints
3. Conclusion.

Anurag Goyal (26 %)
1. Did Literature survey of one latest journal paper.
2. Contributed in Problem definition and objectives,
3. Scope of the system and beneficiaries/end user.

4. Making of IEEE format Paper.

Kartikey (20%)

1. Did Literature survey of one latest journal paper.
2. Contributed in Challenges and Constraints.
3. Diagrams in Paper