RECOMMENDATION OF SENSOR BASED SMART DUSTBINS USING IOT

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Abstract—This paper presents the design of smart dustbins for enhancement in waste management systems. There has been an increase in the garbage for urban areas due to drastic rise in population. Automatically operated Smart dustbins using IOT and sensor based technology are a boon to curb the problem of waste management. Traditional dustbins are manually handled by pressing foot against lever and throwing garbage. Trackers are needed to monitor on when it is full so that it can be emptied. Overflow of garbage results in land pollution, spread of diseases, and it creates unhealthy conditions for individuals and environment. Thus, there has to be a technology or system that must provide the vital signs of filling the bin that alerts the local municipality to clear the trash and protect our mother earth. In order to handle such problems, we proposed a system “Smart Dustbin using IOT and Sensors”. The proposed system provides an alert signals to inform the authorized individual by blink or buzzer. This system reduces labour effort with minimal resources. To support the smart city vision and to provide pollution free, green and healthy environment for a better lifestyle for mankind.

Keywords— Smart Dustbin, GSM module, Sensors, Internet of Things, Garbage Monitoring.

I. INTRODUCTION

In today's world, countries are developing both economically and technologically. There is a rapid increase in unwanted waste due to plastics, hardware, biodegradable and non-biodegradable waste. Waste management is the most pressing issues to be discussed in developing countries and important to address this problem. In city and urban areas, dispatching of waste is a hard task. Hence there is a necessity to adopt effective waste removal system to maintain a green environment. The development of such system to collect information and management of waste is a challenging task.

In urban and rural areas, we can see trash and garbage everywhere. The wastage is source of pollutants. The garbage overflowing out of trash bins is an increasing problem day by day. It causes an unhygienic, unhealthy condition. The pollution creates health diseases and health issues. People are facing many challenges related to environmental issues because of increasing population. One of which these challenges is in overflow of garbage. So it causes the various types of diseases and health problems. Nowadays collection and management of garbage waste is a very critical problem. In India on 2nd October 2014, our Prime Minister Mr. Narendra Modi declared “A clean India Mission”. The main objective of mission is to cover 4041 cities in India. Figure 1 shows dumped garbage in urban areas.
Waste increases exponentially in the next few years. To solve this problem we have to find the proper garbage collection management. Using a garbage collection management system may reduce impacts on the environment. The proper waste management system is necessary to avoid diseases which are caused due to this increasing garbage. So it is necessary to monitor the details of dust bins by respective authority. The wet waste can be decomposed by making use of motor and blades forms manure which can be used for growing crops. Sensors can be used for the closing and opening of lid avoiding rain water entry into the bins. Implementation of such system will reduce the unhygienic condition and health issues. The total number of trips by garbage collecting vehicles can be reduced to collect garbage. It helps to maintain cleanliness in our society and can minimize disease and pollution.

Smart systems with IoT technology should be developed and deployed. The main intention of such systems is to educate cities and people that provide a healthy, clean and sustainable environment. These systems should monitor the smart dustbin trash, control garbage clearance time and labor effort. Automated system of controlling the smart dustbins has to be adopted in our county.

II. LITERATURE SURVEY

Lakshmi Devi P et al.[1] implemented the smart garbage management system and discussed about its advantages. The system alerts authorized persons by sending a message whenever the dustbin was full. System used a servo meter to avoid the rain water entering into the dustbin to help opening and closing the lid of the dustbin. DC motors and blades were used to decompose the garbage, which was later used as manure for crops. Ambient sensors installed in street lights helped in detecting any obstacles. Muruganandam. S et al.[2] discussed about the smart dust bin which was user friendly and maintained a hygienic environment. They used an Infra-red sensor system to find objects thrown around the dustbin. If any garbage found around the dustbin, it signals with an alarm.

In [3] Ravi Gorli proposed a Smart Garbage Monitoring system with an ultrasonic sensor which finds the levels of wastage in the dust bin. A message indicating level of wastage is forwarded to Arduino board attached to a GSM module. Messages related to wastage level in the bin are sent to the central monitoring system (CMS) for further action to be taken. Implementation was done using android application to detect the waste level. Sensors indicating moisture level helped in waste segregation. Waleed Ejaz et al.[4] discussed two case studies. The objective of first case is to reduce the electronic cost and the second case is efficient usage of energy sources. Energy sources were utilized for providing energy to IOT devices and Smart cities.

T.Tamilveli et al.[5] implemented Smart Dustbin enabled with GPS and GSM. Using ‘Ultrasonic Sensor’ and ‘Gas sensor’ avoided overflow of garbage from the dustbin. Correspondingly these sensors sensed the presence of bad odor. Anilkumar C.S et al.[6] discussed...
waste management with Bluetooth enabled smart dustbin monitored using android application. In [7] Suresh et. al proposed a system which used IR sensor to detect person who throws the garbage to dustbins. Whenever it detects the person, the lid will automatically open, and close the lid when he/she moves away from the dustbin. Opening and closing of lid of dustbin is done using stepper motor. If the garbage level reaches the threshold value, it will send the message to authorized person through GSM module.

Shikha Parashar et al.[8] discussed urbanization problems Srilanka. Smart dustbin with Arduino is used to prevent the waste management problems. the explained how to collect garbage from different places and be used for reusing and recycling. They introduced RF Module on the fixed dustbin part to make dustbins automatic. In[9] Krithika. S et al. projected the present system workers to work in two groups. One group is allotted for wastage monitoring and other is allotted for wastage cleaning. They implemented the system using it to solve the problem related to garbage overflow. Smart dustbin System using Open source micro-controller, Wireless communication, Sensors, Motors and Drives, Serial communication, Serial Peripheral interface was implemented by Priyam Parikh et al.[10]. Components to implement the system were easily available. The system used open source technology, consumed less power provided battery backup and user friendly.

Himadri Nath Saha et al.[11] have discussed about how Internet and Sensors can help to develop a smart city and also articulated about the two problems of Traffic management and water management. Saadia Kulsoom Memon et al.[12] explained about wastage monitoring system which detects level of wastage in the bin and sends the information using Wi-Fi. This model helps to identify the distance value in real time. Swati Sharma et al.[13] proposed a system using sensors. Four dustbins are placed in four locations( East, West, North and South). Ultrasonic sensors were used to find the height of the garbage inside the dustbins. PIR sensors detected motion. This system was more efficient to collect garbage by using solar panels which reduced energy consumption.

In [14], Shraddha Zavare et al. discussed a system which controlled wastage collection to maintain clean and green environment. This technique provided details about solid waste which can be disposed using shortcut route and minimal fuel consumption. The main objective is to provide an efficient and effective way to handle and segregate all the biodegradable and non-biodegradable wastes like plastics, electronic hardware. Various sensors are used in order to weigh and find the capacity of the smart dustbin. Ultrasonic sensors, PIR Sensors, microcontroller, GSM, GPS, Wifi and various other sensors are utilized to provide well equipped system to manage the dustbin which are overflowing, and provide secure transfer of information to the authority.

![Figure 2: Message To The Authority BY GSM](image-url)
Figure 2 depicts how messages can be sent to Authorities by GSM. Whenever the dustbin reaches the maximum level, it will send the message as “Dustbin is full”. It also gives latitude and longitude details of garbage in the dustbin. Implementation mobile applications can be utilized to provide information continuously.

III. PROPOSED WORK

IoT plays an important role in modern era which requires modern solutions to tackle the problems. Smart Dustbin is an IoT solution that helps people to manage the waste in an efficient way. The existing garbage collection requires a lot of time to collect and dispose it and also more labor force is required. Implementing such systems is expensive and requires continuous monitoring over the bins placed in different part of the cities. Figure 3 shows workflow of existing garbage collection system.

![Figure 3: Existing system for garbage collection](image)

3.1 General Design

The proposed Smart bin system should transmit data through GSM modules and Bluetooth. Sensors should sense the level of waste in the bin. Web interface and Mobile application should monitor and transmit data. Bins will have sensor nodes with two paths, one for waste level and another for the weight of the waste situated in bin cover and bottom of the bin. The prototype will be attached to the bin monitoring system. Collection of data about the bin waste level is continuously collected by sensors. If the waste level is above 80% then a notification will be sent to the management to collect the waste. It is a real time system which helps to monitor the waste effectively. It also records response time of communication and load sensor results of the test. Figure 4 shows the Flowchart of prototype waste-bin.

Waste in the smart garbage bin will be continuously evaluated and the notifications will be sent to the authorized person to handle the waste in a better way. Data collected in real-time helps to manage the waste in a smart way. The GMS module will send the message once the dustbin reaches level above 80% and collects the load from the dustbin, informing the database. The proposed system helps in keeping complete record of the waste-bin and monitors it continuously in a more effective way. Hardware requirements of the proposed system are
Figure 4: Flowchart of prototype waste-bin.

**Hardware A.ATmega328P**

It is an Atmel manufactured micro-controller. It has read while-write capability with non-volatile storing capacity. Twenty three input/output (I/O) lines for general purpose, thirty two operating registers for purpose of general function, three compare modes for versatile timer/counters, and internal and external interrupts.

**Ultrasonic Sensor**

Sound waves helps to find the distance from the object can be measured through the ultrasonic sensors. It sends signals with particular frequency and measures distance with the re-bounced one. The elapsed time recorder between the sending and receiving helps to find the required distance between the object and sensor. The formula used is Distance = \( \frac{1}{2} \times T \times C \). Where T is the time between the emission and reception, and C is the speed.

**ESP8266 Wi-Fi Module**

It is integrated with the TCP/IP protocol with self-controlled SOC which helps connecting to WiFi network. It has capability of hosting an application or offloading another application processor from Wi-Fi module. It is pre-programmed with commands that can be directly connected to the arduino board to access and function well. It is very cost effective one with growing demand to connect all other devices with the Wi-Fi module.

**LCD**

*It is a display module with lot of applications. It is used in different circuits to display the message electronically. It is widely used when compared to seven segments.*

**IR Sensors**

*It is an electronic compound used to detect both the motion and heat of the objects. It helps in measuring the factors of the surrounding environment. Infra-red radiation is emitted by every*
object in the thermal radiation which helps to record the light emitted and used for the detection of the object. The light from the LED bounces whenever the IR sensor senses an object close enough to it, and hence it can detect it.

3.2 Waste Management Components

**GSM module**

It is a method through which one can communicate to the servers attached. The amount of waste the bin and the capacity will be sent to it periodically to record the information. When the bin reaches its threshold value a signal is send in the form of notification to empty the bins.

**Bluetooth**

Short range communications can be done through this module. The workers use it to maintain the system and to check whether there are any faults in it. It can also help in retrieving the data if GSM working fails. Also used to connect to the mobile application and to send the required notification to the user about the bin.

**Mobile app**

It is used for more efficient waste management through the mobile where the important messages are sent to the workers to empty the bin in case it has filled. The GSM module based information is sent to the application to help the workers to empty it on time and avoid the nonsense.

**Web based application**

Web-based monitoring help to store the data sent from bin through the GSM module. It can be used to show the data graphically about waste management and also about picking up of waste. Development of the website use code igniter, while php and mysql are used for the database. The data helps to estimate the amount of waste produced and time required emptying the bins along with peak hours of waste collection.

3.3 Advantages Of The Proposed System

Real time information about fill level of the dustbin: Whenever dustbins reach the maximum level, it will send the message that “Bin is full” to the authorized person. Deployment of dustbins based on the actual needs: We have to apply these smart dustbin concepts to several areas where the people with knowledge of how to use this system, because this system is very delicate.

Cost Reduction and resource optimization: Smart bin reduces number of trips used to collect the garbage. So it will reduce the petrol cost, carbon emission, less labours and air pollution. Improves Environment quality: a) Fewer smells-Smart dustbins sends message to authorized people whenever the dustbin is full. So it will lead to less smell. b) Cleaner cities- Smart dustbins sends message to authorized people whenever the dustbin is full. Hence, less carbon emission and reduction in diseases caused due this garbage.

Multi -purpose smart street bin concept gives details about how to manage the collection of wastage in the entire city by using smart bins. Smart bins with sensors networks which are connected through the cellular network gives a large amount of data. Data collected are realized with level of waste around the city. Figure 4 represents a Multi-purpose smart street bin concept. Proposed system can be installed in various places like Bus stops, Railway stations, education systems, companies etc. Table 1 depicts the comparison between different proposed systems implemented to manage waste.
Figure 4: Multi-purpose smart Street Bin Concept

Table 1: Comparison between different proposed systems implemented to manage the waste.

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<tr>
<th>Name/Title Of references</th>
<th>Bin Measurement</th>
<th>Technology used</th>
<th>Object Detection Around the bin</th>
<th>Technology Used</th>
<th>Web UI</th>
<th>Alert Messages</th>
<th>Technology Used</th>
<th>Scheduling</th>
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<tbody>
<tr>
<td>Lakshmi Devi P et al. “IOT Based Waste Management System for Smart City”</td>
<td>Yes</td>
<td>Ultrasonic</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>GSM</td>
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<td>Muruganandam et al. “Efficient IOT Based Smart Bin for Clean Environment”</td>
<td>Yes</td>
<td>Laser, Photo Diode</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>AD-HOC</td>
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<td>B. Rajapandian et al. “Smart DUSTBIN”</td>
<td>Yes</td>
<td>Ultrasonic</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>GSM</td>
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<td>Ravi Gorli “A New Model for Smart Garbage Monitoring”</td>
<td>Yes</td>
<td>Webcam, Weight sensor</td>
<td>No</td>
<td>No</td>
<td>LCD</td>
<td>No</td>
<td>GSM</td>
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<tr>
<td>Anilkumar C et al. “A Smart Dustbin using Mobile Application”</td>
<td>Yes</td>
<td>Ultrasonic</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Zigbee, GSM</td>
<td>No</td>
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<tr>
<td>W. A. L. Gayanthika et al. “Smart Dustbin for Waste Management”</td>
<td>Yes</td>
<td>Infrared</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>RFID</td>
<td>No</td>
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<tr>
<td>Ravi Kishore Koduri et al. “Smart solid waste management”</td>
<td>Yes</td>
<td>Webcam</td>
<td>Yes</td>
<td>Infra-red</td>
<td>No</td>
<td>Yes</td>
<td>GSM</td>
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IV. CONCLUSION

Smart Dustbin Management System will have significant impact on the standard of living of each individual. Our paper aims to provide a method for waste collection and hence, reduce the utilization of resources. Smart dustbin technology can be improved in an area, which includes automatic segregation of dry and wet waste product; hence we can reduce the problem of solid wastes. The system provides optimal solution for Municipal council and other government organizations to handle waste and segregation in a systematic way.
The system will influence each individual to segregate their waste on a proper way and municipal councils can collect the waste with notifications from smart dustbins when they are full. Hence, the government can incorporate the system to overcome several issues and find a proper way to segregate the bio and non-biodegradable wastes and recycle these products.

REFERENCES

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