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Waste Management using Smartbin

Dr. N.Suba Rani AP (SG)
Computer Science and Engineering
Dr. Mahalingam College of Engineering and Technology
(Affliated to Anna University)
Pollachi,India

Kowsik S
Computer Science and Engineering
Dr.Mahalingam College of Engineering and Technology
(Affliated to Anna University)
Pollachi,India

Krishni V
Computer Science and Engineering
Dr. Mahalingam College of Engineering and Technology
(Affliated to Anna University)
Pollachi,India

Arun I
Computer Science and Engineering
Dr.Mahalingam College of Engineering and Technology
(Affliated to Anna University)
Pollachi,India

***Abstract*— In Smart Cities generation of waste is increasing due to rapid growth of population, industries in urban areas and the biggest problem to authorities is collection of wastage from different locations. Due to the lack of proper information about 85% of the total municipal solid waste budget is spent on waste collection and transportation. To tackle this problem, we need an intelligent system to monitor waste and to give the complete information to authorities to solve the waste management problem in well-organized manner.**

Our proposed smart bin uses ultrasonic sensor and temperature sensor DS18B20 to identify the status of the bin and update it to the database in a regular interval. The truck driver is notified through the mobile application and reaches the corresponding bin which needs attention. This minimize the usage of man power and other resources, moreover the bin uses image processing technique to identify the plastic bottles in the waste. This helps to segregate the biodegradable from non biodegradable waste. It also helps to identify any suspicious material being placed in the bin.

I. INTRODUCTION

The smart city concept is still new in India, although it has received a lot of attention in few years when our present prime minister gave the idea of building 100 smart cities throughout India. Now, with the upcoming large number of smart cities, large numbers of responsibilities are also required to be fulfilled. The prime need of a smart lifestyle begins with cleanliness and cleanliness begins with dustbin. A society will get its waste dispatched properly only if the dustbins are placed well and collected well. The main problem in the current waste management system in most of the Indian cities is the unhealthy status of dustbins. One of the conditions is overflow of garbage, this is the main reason of many disease and many type of pollutions which affects our health as well as our environment. Some metropolitan's cities are overcrowded and it is not able to monitor all the garbage bins which are available in different area.

This project waste management using smart bin is a very innovative system which will help us to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via mobile application. Through the mobile application we can monitor the status of the bin from anywhere and anytime. This helps to minimize the usage of man power and other resource; moreover the bin uses image processing technique to identify the plastic bottles in the waste. This helps to separate the biodegradable from non biodegradable waste. This project helps us to save time. It is more efficient over manual process. It is little bit expensive but it saves continuous labor costs and human efforts.

II. RELATED WORK

Waste Management in a city is a formidable challenge faced by the public administrations. Waste is defined as any material in which something valuable is not being used or is not usable and represents no economic value to its owner, the waste generator. In this paper, a model has been proposed for real-time monitoring the garbage level of respective garbage bins and to detect the level when threshold value is reached using combination of Sensors and Raspberry pi. This data will be sent to the control unit.

- To initimate the workers by sending message notification when the trash bin is filled and also when it fire.
- To detect the plastic bottle if it is found in the dustbin.

This project helps us to develop a clean environment by using sensors and microcontroller. The ultrasonic sensor and temperature sensor are used to identify the status of the bin and update it to the database in a regular interval and also the bin uses image processing technique to identify the plastic bottles in the waste. This image processing technique helps to separate the biodegradable from non biodegradable waste. The truck driver is notified about the status of each bin through the mobile application and so that the driver can

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reach the corresponding bin which needs the attention. This will reduce the usage of man power and other resource.

III. LITERATURE SURVEY

A. Design a Smart Waste Bin

The existing system consists of the sensing units, a Bluetooth and GSM Module for data transmission, and a mobile application and web-based monitoring for interfacing and communication with the waste department for waste management. The smart bin is composed of sensor node mounted on it for the data collection and transmission. Load cell is a measuring device used either directly or indirectly.

The ultrasonic sensor is used to measure the level of the waste bin and placed at the top of the bin. A GSM module is used to communicate with server. It will send periodically the information of waste weight and bin capacity. When waste-bin is full it will send the message notification automatically for worker to pick the waste.

Bluetooth is attached for short range communication. It is used by the workers for maintenance when there is a system fault. A mobile application is also made to help worker picking and managing the waste bin. The notification sent from GSM module also came up in mobile application. Web-based monitoring shows the graphic daily, weekly, monthly, and yearly about the number of waste in the entire city.

B. Garbage Monitoring System

Garbage consists of the unwanted materials left over from city, urban areas, Educational Institutions, Business organizations, home etc. This project will help to understand the developments of research on Internet of things. Internet of things is a recent communication technology; this becomes the digital communication that makes to communicate with one another and with the users easily.

The garbage bin are set in all around the city and fixed with closed circuit camera at the top of the bin that will capture the images of garbage continuously and RFID, GPS and GIS send these images for work station.
When the truck come closer to the bins, the RFID starts communicating with RFID tag and send all the information. This information process uses of controlling the Hut (S.M.S Technology). A buzzer is used to alert the surrounding for showing the percentage level of the garbage.

The ultrasonic sensor compares the depth of the level of the garbage with the bin depth and alert the person who throws trash into the bin, about the status of the dustbin through a buzzer device .

C. Garbage Management System

The weight sensor is used for the garbage detection that gives only the weight of the garbage in the dustbin. But that doesn't provide any of information about the level of the garbage wastes. To overcome that, Infrared (IR) sensor used for garbage detection. The IR sensor arrangement is act as level detector. The output of level detector is given to the microcontroller

GUI is a graphical user interface which provides a user friendly environment that easy to use. The GUI developed using MATLAB software, used to display the different parameters and information regarding the garbage i.e. location of the dustbin, status of the dustbin, date and time of garbage collection and also has the provision to display the name and mobile number of the worker, who is responsible for cleaning the dustbin of the particular location .

D. Waste Management

IoT is a concept of which the objects are connected through wired and wireless networks without user intervention. The smart dustbin contains motor-driver, 16*2 LCD Display, Aurdino UNO, Load cell, Playback IC, Speaker, IR Sensors, Smell Sensors ,Bread Board, Power Supply and Raspberry pi.

The dustbins are provided with a sensor which helps in tracking the level and weight of the garbage bins and a unique ID will be provided that helps easily to identify the garbage bin is full. To avoid the decaying smell around the bin harm-less chemical sprinkler is used which will sprinkle the chemical as soon as the smell sensors detect the decaying smell.

Once the bins are full then the user can't access the bins. On that such circumstances the bin displays the direction of available nearby bins on LCD display also generate the voice messages if the user places the waste on the floor. The status of the level shows to their corresponding authorities with the help of Internet and an immediate action will be taken to replace the full bins with the empty bins.

D. Garbage Notification System

The existing system provides the immediate cleaning the dustbins. As dustbin is considered as a basic need to maintain the level of cleanliness in the city, it is important to clean all the dustbins as soon as they get filled.

The ultrasonic sensor placed at the top of the bin which will help in sending the information to the office that the garbage level has reached the maximum level. After this the bin should be emptied as soon as possible. A threshold level was set as 10cm. As the garbage reaches the level of threshold, the sensor triggers the GSM modem which alerts the workers to clean that wastes present in the garbage.

This will reduce the cost as the employees will have to go and check the dustbin is full or not. This will also help in resource optimization and if the bins will be emptied at time then the environment will remain safe and free from all kinds of diseases. The cities will become cleaner and the smells of the garbage will be much less.

E. SmartBin Monitoring System

Waste management is the activities and actions required to manage waste from its origin to its final disposal. This

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incorporates in addition to other things, collection, transport, treatment and disposal of waste together with monitoring and regulation. It also includes the legal and regulatory framework that relates to waste management encompassing guidance on recycling.
Smart Garbage System (SGS) is proposed to reduce the amount of waste. The system exchange information with each other using wireless mesh networks, and a router and server collect and analyze the information for service provisioning and been operated as pilot project. The results showed that the average amount of waste could be reduced by 33%. Smart Bin by was designed to manage the waste collection system based on smart city.

On the other hand, IoT components such as RFIDs, sensors, cameras and actuators for efficient waste collection by proposed DSS for efficient waste collection in Smart Cities. The system handles ineffective waste collection by incorporates a model for data staring between truck drivers on real time and dynamic route optimization.

F. SmartBin For Smaller cities
The Smart Bin unlike any ordinary Bin is equipped with a network of sensors each capable of providing a specific information to monitor waste in real time. To achieve automation the entire system uses an ARDUINO UNO board. The board acts as the central processing Unit and controls the interaction and synchronization of the sensors.

A small device called the Ethernet shield/Wi-Fi shield is used along with the Arduino to provide internet connectivity and help in transmission of real time data. When a person approaches the bin the PIR detects movement and sends a signal to the Arduino which in turn instructs the servo motor to rotate a few degrees as a result of which the Lid of the bin opens up. Once the Lid opens a person gets approximately 20-30 sec to dump the garbage and then the Lid of the bin automatically closes.

It is important to note that the design presented here has a closed Bin this is because in case of open bins there is high chance of littering as animals and unnatural weather conditions can litter waste all over the place. In case of a closed system there is very less probability of interference with external factors. Once the lid of the Bin closes the Ultrasound Range sensors get activated only once and it triggers a pulse which then reflects back containing the information regarding the filled level.

G. Smart Waste Management
Traditionally, litter bins are emptied at certain intervals by cleaners. This method has several drawbacks such as, some litter bins fill up much faster than the rate of emptying and they are full before the next scheduled time for collection. This leads to overflowing of rubbish bin and poses hygiene risks. There are special periods (e.g. festivals, weekends, and public holidays) when certain litter bins fill up very quickly and there is a need for increased collection intervals. It is a challenge to maintain a clean city. It involves several factors such as different stakeholders, financial/economical, collection & transport, etc.

The bin sub-system pushes information to the workstation. The workstation then shows meaningful information to users through a graphical user interface. Each bin will be visualized using an icon on a GIS (Geographic Information System) map on the operator terminal. The bin fullness level will also be visually displayed on the operator terminal.

From the litter bin daily seasonality information, 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.

IV. METHODOLOGY

A. Block Diagram for SmartBin
Smart bin uses ultrasonic sensor to identify the status of the bin and update it to the database in a regular interval and the temperature sensor DS18B20 is used to measure the temperature of the Smart Bin environment. The picam capture the image of garbage and detect the plastic in the garbage.

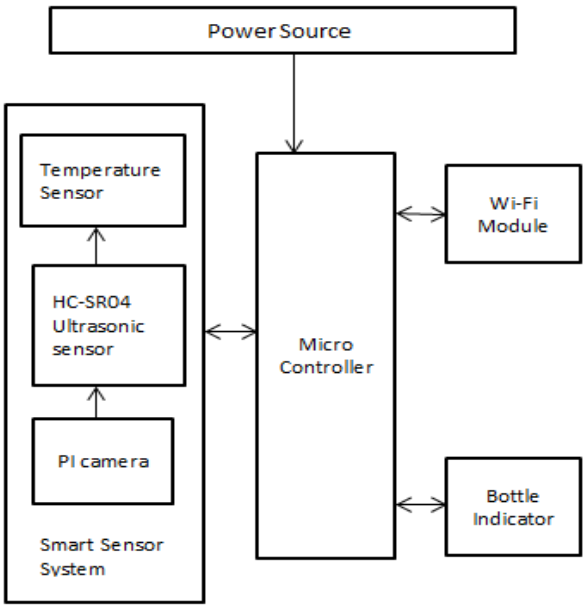

Figure 1 Block Diagram for Smart Bin

B. Micro Controller
Microcontroller receives information from sensors and processes on it. Here we are using Arduino ATmega2560. It operates on maximum +5 Volts. Input voltage range is (6-20) V. It has a number of facilities for communicating with a computer, another Arduino or other microcontrollers. Here the microcontroller raspberry pi is used. The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python.

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C. Ultrasonic Sensor

Ultrasonic sensors are a type of acoustic sensor divided into three broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals into ultrasound, receivers convert ultrasound into electrical signals, and transceivers can both transmit and receive ultrasound. Ultrasonic sensor transmits ultrasonic waves into the air and detects reflected waves from an object. It has two openings. One transmits ultrasonic waves and another receives them. The speed of sound is about 340 meters per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound pulse to determine the distance to an object.

D. Temperature Sensor

Ultrasonic sensors are a type of acoustic sensor divided into three broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals into ultrasound, receivers convert ultrasound into electrical signals, and transceivers can both transmit and receive ultrasound. Ultrasonic sensor transmits ultrasonic waves into the air and detects reflected waves from an object. It has two openings. One transmits ultrasonic waves and another receives them. The speed of sound is about 340 meters per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound pulse to determine the distance to an object.

E. PiCam

Camera is an optical instrument for recording or capturing images, which may be stored locally, transmitted to another location, or both. The images may be individual still photographs or sequences of images constituting videos or movies. The camera is a remote sensing device as it senses subjects without any contact using the camera object detection is performed. Object detection is a computer technology related to computer vision and image processing that deals with detecting instances of semantic objects of a certain class in digital images and videos. Well-researched domains of object detection include face detection and pedestrian detection. Object detection has applications in many areas of computer vision, including image retrieval and video surveillance.

F. FireBase

Firebase Auth is a service that can authenticate users using only client-side code. It supports social login providers Facebook, GitHub, Twitter and Google. Additionally, it includes a user management system whereby developers can enable user authentication with email and password login stored with Firebase.

Firebase provides a real-time database and backend as a service. The service provides application developers an API that allows application data to be synchronized across clients and stored on Firebase's cloud. The company provides client libraries that enable integration with Android, iOS, JavaScript, Java, Objective-C, Swift and Node.js applications.

In our proposed system the firebase is used to store users information (Truck Driver) and bin related details. The details gets updated in real time.

G. Tensor Flow

Tensor Flow is an open-source software library for dataflow programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks. It is used for both research and production at Google. While the reference implementation runs on single devices, Tensor Flow can run on multiple CPUs and Tensor Flow is available on 64-bit Linux, MacOS, Windows, and mobile computing platforms including Android and iOS.

Its flexible architecture allows for the easy deployment of computation across a variety of platforms and from desktops to clusters of servers to mobile and edge devices. Tensor Flow computations are expressed as statesful dataflow graphs. The name Tensor Flow derives from the operations that such neural networks perform on multidimensional data arrays. These arrays are referred to as "tensors".

Tensor Flow used to detect various objects. In our proposed system we trained to detect the plastic bottles. If the bottle is detected, then the pin-13 will be enabled, and the buzzer connected to that pin will alert.

H. Mobile Application

A mobile application is made to help worker picking and managing the waste bin. The data sent from the microcontroller is stored in the database and made available in the mobile application. This application consists of signup and login facility, the user can login using their registered email id and password the user can monitor the status of the bin using the mobile application at any time. This mobile application shows the status of the bin whether the bin is empty, half filled or completely filled and also it updates any fire in the dustbin.

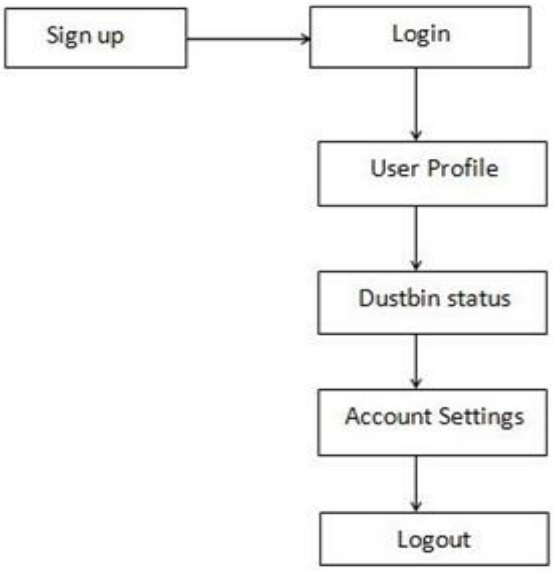

Figure 2 Flow Chart for SmartBin Mobile Application

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V. EVALUATION

A. *Results*

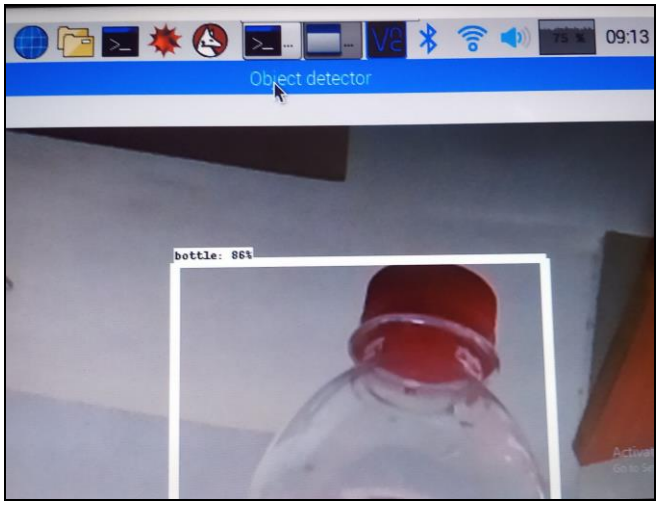

Figure 3 Plastic Bottle Detection

The Raspberry pi captures the video of the collection bin using Pi cam and it alerts the user when it detects the plastic bottle. The above figure 3 shows the image of plastic bottle when it is detected.

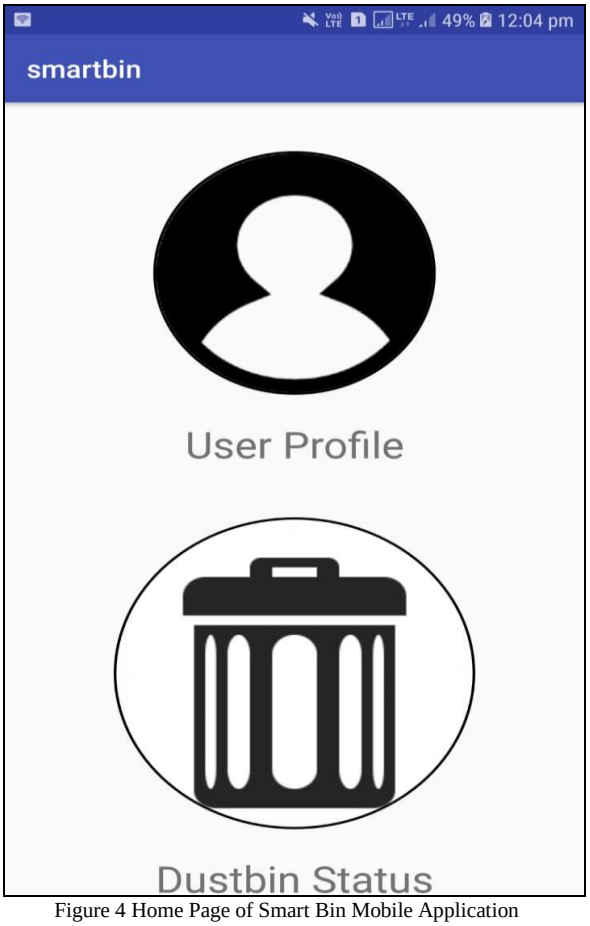

Figure 4 Home Page of Smart Bin Mobile Application

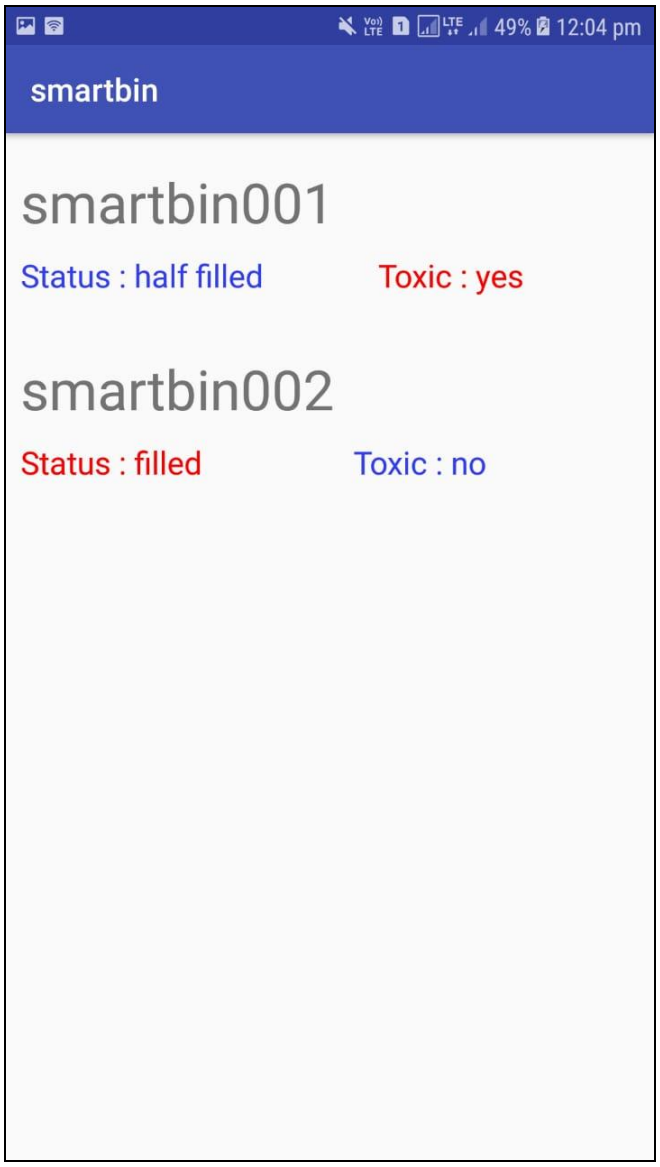

Figure 6 Smart Bin Status on Mobile Application

This shows the smart bin status where bin is filled or half filled or empty.

VI. CONCLUSION

This proposed work is implemented for smart garbage management system using ultrasonic sensor, microcontroller. This system assures to clear the dustbin as soon as the bin fill to maximum level and also alerts us when any inflammable products are dropped inside. Moreover the object detection helps us to segregates plastic bottles in the garbage. This improves the garbage monitoring management system and also reduces the total number of trips of garbage collection vehicle. This system also helps to monitor online current status of the bin and reports, hence to manage the system.

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