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Automatic Waste Management System with RFID and Ultrasonic Sensors

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***Abstract*— Radio** Frequency Identification (RFID) is a technology that can be used to automate waste management by providing details about the waste and sending massage to the system about the collected bins. In this paper, we are proposing a smart bin application based on RFID tags which contain information of each waste item. The wastes are tracked by smart bins using a RFID-based system without requiring the support of an external information system. Because of this system, the user is helped in the application of selective sorting and smart waste management system will come to know the status of the bin using ultrasonic sensors. Automatic Waste Management System helps to keep track of empty bins and also will give information about the filled bins to collective vehicles which will help them to collect filled bins with proper management automatically reduce the human efforts. This system will surely keep society hygiene and reduce air pollution spread by waste.

***Keywords*—**Waste management, RFID, Ultrasonic Sensors, RFID tags

I. INTRODUCTION

Nowadays society hygiene and every kind of pollution is the major concern and the waste management is crucial part involve in this cycle. The waste collection process is a critical aspect for the service providers. The traditional way of manually monitoring the wastes in waste bins is a complex, cumbersome process and utilizes more human effort, time and cost which is not compatible with the present day technologies. Irregular management of waste typically domestic waste, industrial waste and environmental waste is a root cause for many of the human problems such as pollution, diseases and has adverse effects on the hygiene of living beings. In order to overcome all these problems, we propose the idea of automatic waste management system which helps in auto-management of waste without human interaction in order to maintain a clean environment.

Selective sorting is another approach, which is often implemented to improve recycling and reduce the environment impact. The sorting of wastes must be implemented as early as possible in the chain to increase the quantity of valuable recyclable materials. The use of pervasive computing technology such as Radio Frequency Identification (RFID), and sensor networks offer a new way to optimize the waste management systems [1].

The main objectives of our proposed system are as follows:

1. Monitoring the waste management.
2. Providing an automated technology for waste system.
3. Avoiding human intervention.
4. Reducing human time and effort
5. Resulting in healthy and waste ridden environment.

This paper proposes a method of sorting of the waste by using RFID technology. Each waste is detected by information properties stored in a RFID tag associated to it. At each step where wastes are to be processed the RFID tags are read in order to provide the relevant information. This process improves the sorting quality of recyclable products. We assume organic wastes products are not recycled and hence RFID tags are not attached to it [1].

Using the information stored in RFID tags user will get help to sort the waste and can analyze the content of a bin.

This paper is organized as follows. The Section II outlines the architecture used to process the waste flow in our automated waste management system. The Section III details out the RFID system to help the individual sorting of the wastes, while the Section IV discusses some related works. Finally, Section V concludes the paper.

II. ARCHITECTURE OF AUTOMATED WASTE MANAGEMENT SYSTEM

The Automated waste management architecture consists of several elements: waste items, dust bin, sensors, RFID Tags and collecting vehicles. The waste flow starts from the waste items and the dust bin to end in the collecting vehicles.
The bin with ultrasonic sensor, PIC controller, GSM and GPS will notify the coordinate and bin status to the database. Here GSM is user to communicate with the server, which will contain the SIM with the basic speed internet.

The ultrasonic sensor which uses ultrasonic waves will check the bin status. The PIC controller board is used to control ultrasonic sensor, GSM and GPS.

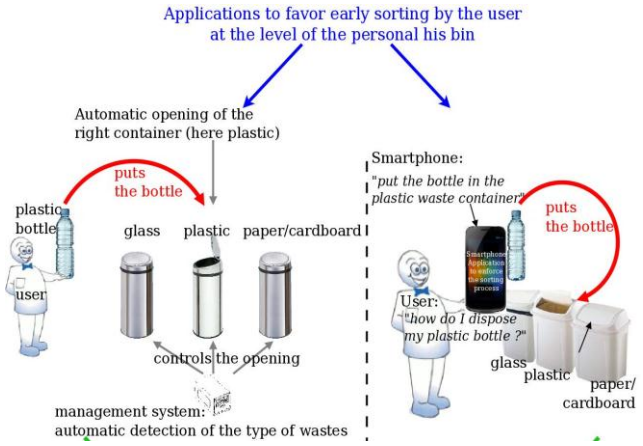

Figure 1 Waste management at user level

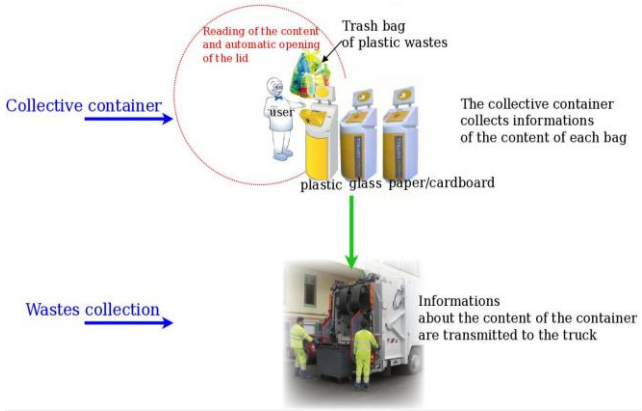

Figure 2 Waste collected by containers

In the sorting process of the waste, the waste item is identified by RFID tag associated with it. For example, a plastic bottle is identified as a plastic waste, and a cardboard box is identified as a cardboard waste. Other properties of the waste are also collected which will be useful for further processing. For example, the weight of each waste can be used to estimate if a bin is full, or empty. Sensors attached to bin are used to intimate the status of bin to the collective vehicles.

The waste flow shown in Figure 1 begins at the user level where the trash is generated. As it is shown on the top of Figure 1, we propose to favor a behavior of the users: by indicating the appropriate bin for a waste, or more directly, by opening the lid of the bin corresponding to the type of the waste [1]. When the bin is full of waste and it reaches to a threshold value it will indicate the status of the bin to the system so that it will send message to the driver of the collective vehicle as shown in Figure 2.

Considering this flow of the system, we now present a system based on RFID technology and ultrasonic sensors to implement this waste management process.

III. PROPOSED WORK

A. *Waste Sorting using RFID*

In this paper, we propose that information associated to a waste can be stored in a RFID tag. The RFID tags can be read from a small distance without any preferred position for reading purpose. The RFID tag is not used to store an identifier of the waste in an external database, but the information describing the associated waste is directly stored in the associated tag. Through our Smartphone RFID tag and indirectly the information of a smart waste is read. Using the information stored in RFID tags user will get help to sort the waste and can analyze the content of a bin.

Figure 3 presents a smart waste composed of a plastic bottle associated to a RFID tag which stores the data describing the bottle as a plastic object.

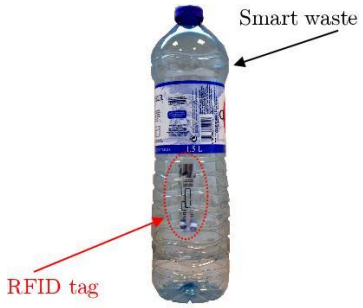

Figure 3 Smart Wastes with RFID Tag

B. *Smart Bin with Sensor Node*

A sensor node is installed in every Smart bin. It is powered by a battery. It senses bin fullness and report readings and sensor statuses. The bin capacity is measured using ultrasonic sensor. When waste reaches to threshold value sensor triggers to the GSM module. Upon receiving the trigger GSM sends the status to Waste Management System.

The Waste Management System 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 [2][3].

IV. METHODOLOGY

Figure 4 shows litter bin with sensor node which triggers GSM module on reaching to threshold value. GSM then sends signal to workstation. Workstation upon receiving this calculates longitude and latitude of the location from saved information of the bin and sends it to the waste collector contractor.

Figure 5 shows the whole working of the system. The user end will contain the android app which works on android compatible phone.

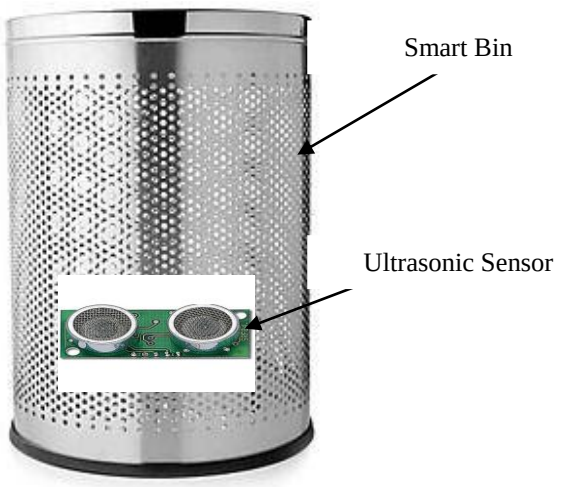

Figure 4 Sensor node deployments in Waste Bin

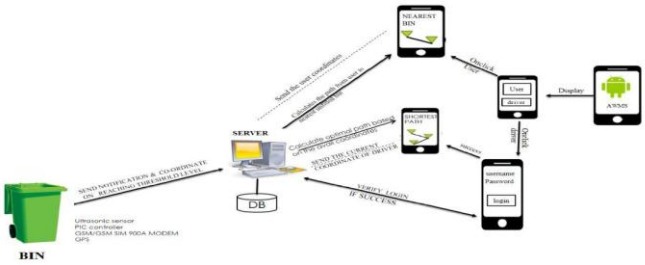

Figure 5 Working of Waste Management System

There will be two separate buttons for user and authority. The user will notify the unfilled nearest bin with path and contractor will be notified by the filled bins with path. Contractor then assign the work of waste collection. The collector then collects the waste by following the path given by the app. When he comes to collect the waste he has to read the tag associated with bin. The bin if emptied by the vehicle, a notification is sent by it to Control centre. This helps in easy monitoring.

V. CONCLUSION AND FUTURE SCOPE

In this paper, we propose a new solution to enhance waste collection efficiency using the RFID technology fully relying on digital information attached to waste items. The presented system helps the user in correctly sorting and disposing wastes.

Monitoring the fullness of bins through the use of sensors, it is possible to achieve a more efficient system than the current existing. Our idea of "Automated waste management system", mainly concentrates on Monitoring the waste management, providing a smart technology for waste system, avoiding human intervention, reducing human time and effort and which results in healthy and waste ridden environment.

The proposed idea can be implemented for smart cities where the residents would be busy enough with their hectic schedule and wouldn't have enough time for managing waste.

The bins can be implemented in a city if desired where there would be a large bin that can have the capacity to accumulate the waste of solid type for a single apartment. The cost could be distributed among the residents leading to cheaper service provision.

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Mrs. Manjusha Amritkar pursued Batchelor of Computer Engineering from North Maharashtra University of Jalgaon, India in 2003 and Master of Computer Engineering from Savitribai Phule Pune University, Pune, India in 2011. She is currently working as Assistant professor in Department of Information Technology in International Institute of Information Technology, Pune, India since 2015. She is a life member of ISTE. She has published 3-4 research papers in reputed jornals. Her main reserch work focuses on Data mining, IoT, Machine Learning etc. she has 10 years of teaching expreince.

