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Automated Waste Segregator for Efficient Recycling Using IoT

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Abstract - *This paper proposes a prototype of waste segregator, which can segregate the different types of waste immediately. The various smart bins are used to collect these garbage and used to send information about the collective garbage, such that respective action can be taken. Various sensors, motors and GSM are interfaced with PIC microcontroller in this proposed system.*

Key Words: IR sensor, Metal sensor, Moisture sensor, Ultrasonic sensor, Smart Bin, GSM with Internet of Things.

1. INTRODUCTION

With economic developments the globally generated wastes are increasing. The current global Municipal solid waste generation levels are approximately 1.3 billion tons per year and are expected to increase to approximately 2.2 billion tons per year by 2025. India with a population of 1.35 billion has per capita waste generation ranging from 0.12 to 5.1 kg per person and an average of 0.45kg/ capita/ day [1].

According to a sanitation survey called ministry of urban development under the mission, it was found that about 50% people in India face the problem of improper waste collection and management [5]. According to center of science and environment, innovative disposal and recycling methods must be introduced instead of landfill sites.

Segregation of waste helps increase the recyclable materials and control unwanted degradation, which might result in emission of harmful gasses. In India the segregation of domestic waste is done at the municipal factories, where huge machinery are used for separating recyclable materials. Implementation of separate bins for collection of waste materials is done, but it does not yield its purpose due to lack of awareness, ignorance and negligence. The existing system for collection of municipal solid waste does have any means to verify the proper disposal or its timely maintenance.

Paper contaminated with food cannot be recycled, since the paper is mixed with water in a large churner, the oil eventually separates from the paper. The oil does not dissolve in water, instead it mixes in with the paper during the production, leading to formation of an oily layer over the paper, making unusable [1].

In [4], the proposed system consists of smart bins, such that each smart bin consists of fill out sensor and IoT unit. Such that the sensors detect the filling level of the bin and the IoT sends these reading to the cloud. In the control centre, the readings from the bins are analysed and the best route for the waste collecting truck is generated based on the bins locations and filling levels. And the route information is forwarded to the truck collection driver.

In this paper we have proposed the design of a waste management system that focuses on the social aspects of the waste management systems & the system uses IoT devices with sensors for a waste management process.

The overall paper is organized as follows: in section II methodology, section III system flow, section IV results, section V conclusion and in section VI recommendation.

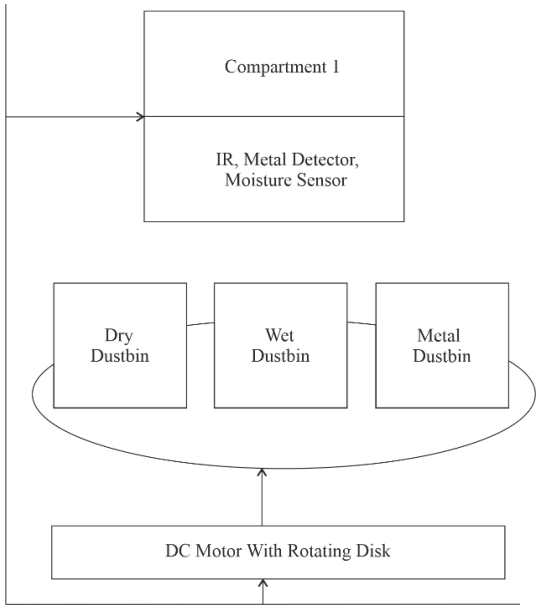

Fig.1 Waste Separation Process

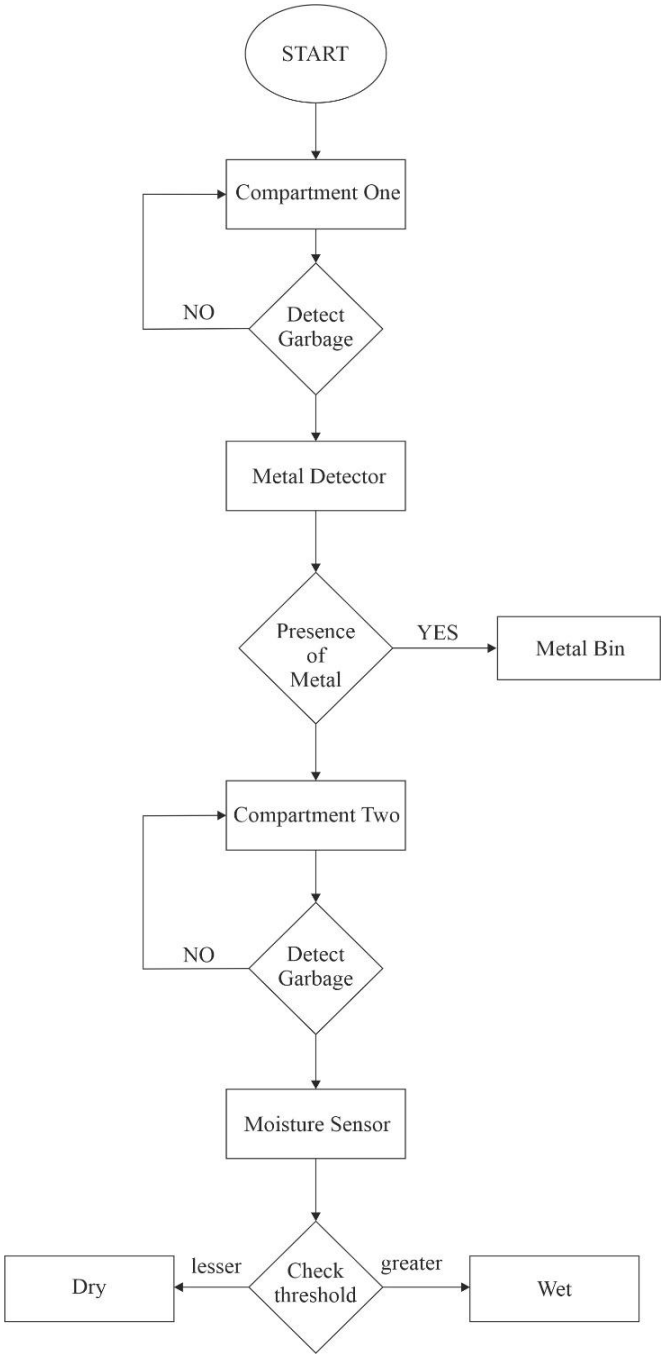

Fig.2 Flow Chart of Waste Separation into Different Bins

2. METHODOLOGY

A. System Design

The Smart bin is divided into two compartments. Each compartment has its own function, the first compartment consists of an IR sensor, metal detector and moisture sensor for detecting dry, wet and metallic waste, the second compartment is subdivided into three bins for collection of the segregated waste respectively. The whole system is controlled by PIC microcontroller board. The sensors and all the components are connected with this board.

The code for controlling the sensors and the motors is coded using embedded-C language, in which the inputs and the output ports can be defined easily. In this project IDE compiler is used to compile a code and burn it to the board using a serial communication. Liquid Crystal Display device is used to display the actions taken by the controller and the other components. GSM with internet of things is interfaced with controller board that can be used for providing real time updates by using a specific server, from where the status of the device or system can be monitored [1].

3. SYSTEM FLOW

The process of segregation begins with the detection of garbage in the first compartment, where an IR sensor and a metal detector and ultrasonic sensor are placed. The IR sensor is used for the detecting the presence of garbage in the compartment and the process of separation begins. Once garbage is detected by the IR sensor the metal detector becomes active and verifies if the garbage is of metal wastes.

When any metal object is present near the metal sensor the magnetic field around it induces current in the metal object, hence creating a loss and change in the electric field.

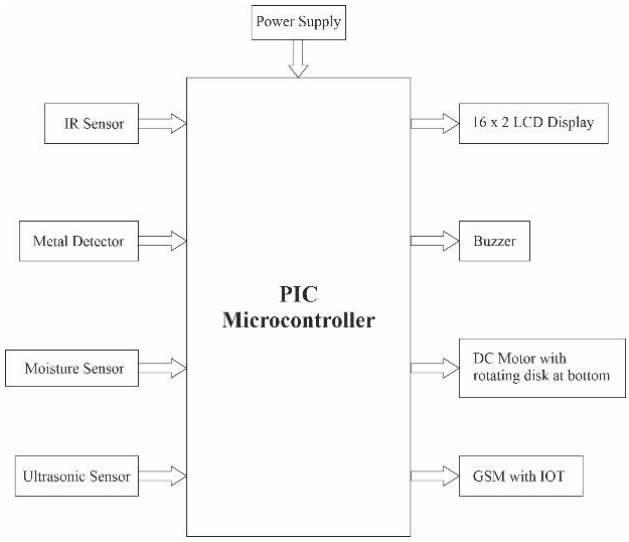

Fig. 3 Block Diagram of Waste Segregation Process Using IOT

Once metal is detected the contents in the first compartment are sent directly to the storage compartment, where three separate bins with a label are used for the storage of metal, dry and wet waste [1].

When the waste in the first compartment is non-metallic, then IR sensor verify the presence of the garbage. Depending on the output given by the IR sensor the moisture sensor gets activated or stays inactive. When the garbage is detected then moisture sensor becomes active and is used to decide if the contents to be dry or wet waste. The decision is made using the change in the dielectric constant (Permittivity). Higher permittivity suggests that the garbage contains water content and hence it is wet

waste. Depending on the decision made by the moisture sensor the contents are sent to their respective bin. The pair ultrasonic sensors are used on the top of the bins for the checking the level of the garbage i.e. full or empty.

The storage compartment consists of a rotating disk with three bins namely dry, wet and metal. The rotating table rotates according to the type of garbage detected in the first compartments, for collecting the respective waste and after collection of garbage resets to a default position. The placement of the bin for collection of waste is programmed using delay/time taken for the table to rotate.

We have interfaced a GSM with an internet of things for giving the status on the three bins on the thing speak platform. This will helps us to send status about the filling of bins to Municipal Corporation so that they can come and collect the waste.

4. RESULTS

We have simulated the practical situations in which the smart bin is to be operated. The results show the functioning of the bin undergoing the segregation process. Each step is displayed on LCD and the process output is uploaded on the IOT Platform (Thing Speak) for further usage by the municipal organization.

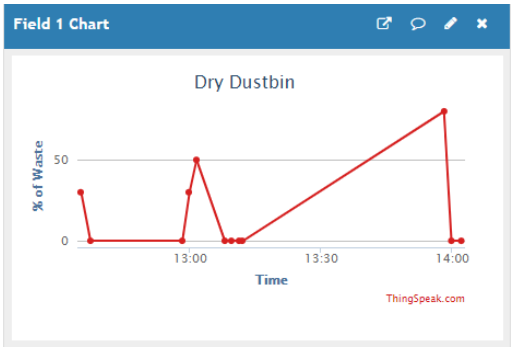

Fig. 4 Status of Dry Dustbin

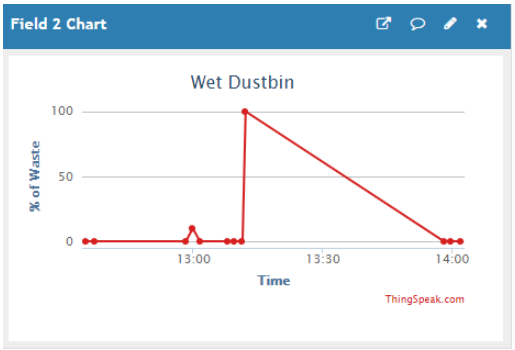

Fig. 5 Status of Wet Dustbin

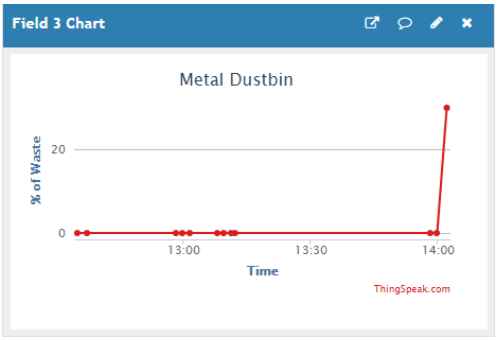

Fig. 6 Status of Metal Dustbin

The above three graphs shows the changes in the amount of collective waste according to the time.

1) Chart 1 shows the status of dry dustbin according to the threshold values of IR Sensor.

2) Chart 2 defines the graphical view of wet dustbin. Which is detected by the moisture sensor in the system. As the time changes the amount of collection of waste is changes.

3) The chart 3 shows the metallic waste. Which is sense by the metallic sensor. According to that a real time data is sent to IOT platform for a monitoring.

5. CONCLUSION

The waste segregator as the name suggest, segregates the waste into three major classes: dry, wet & metallic. The proposed system would be able to monitor the waste collection process and management of the overall collection process. The project when implemented will help create more resources for recycling as it decreases the probability of contamination. The real time & continuous reporting of waste level status from the smart bins by using an IOT platform ensures the clean green environment and wellbeing of the citizen in the city.

6. RECOMMENDATION

The project when implemented can cause errors due to improper alignment and calibration of sensors. Further research up regarding optimized calibration and better methods for detection can help reduce the problems faced during implementation.

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