

# IoT Based Automated Waste Segregator for Efficient Recycling

T. Saminathan, Akash Musipatla, P. Manideep Varma, P. Shahid Khan, G. Mahesh Kumar

**Abstract:** This paper proposes a prototype of a municipal waste segregator, which can segregate the dumped waste immediately, leading to more recyclable paper. The Smart bin can be programmed to send information about the dumped garbage, such that respective action can be taken. Various sensors and motors are interfaced with Arduino board in this system.

**Index Terms:** Metal sensor, Moisture sensor, Smart Bin, Internet of Things

## I. INTRODUCTION

With economic developments the globally generated wastes are increasing. The current global Municipal solid waste generation levels are approximately 1.3 billion tonnes per year and are expected to increase to approximately 2.2 billion tonnes 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.

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 it's 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.

The present recovery and utilization of waste in paper mills in India is pretty low, at 20 percent of the total paper and paper board consumed. India currently imports waste paper as raw materials for paper production.

**Revised Manuscript Received on April 14, 2019.**

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The solution needed for increasing the utilizable resources is through setting up automated bins which can identify the type of garbage dumped into the bin. This helps negate the effects of human negligence and also reduce the chances of available recyclable materials getting contaminated.

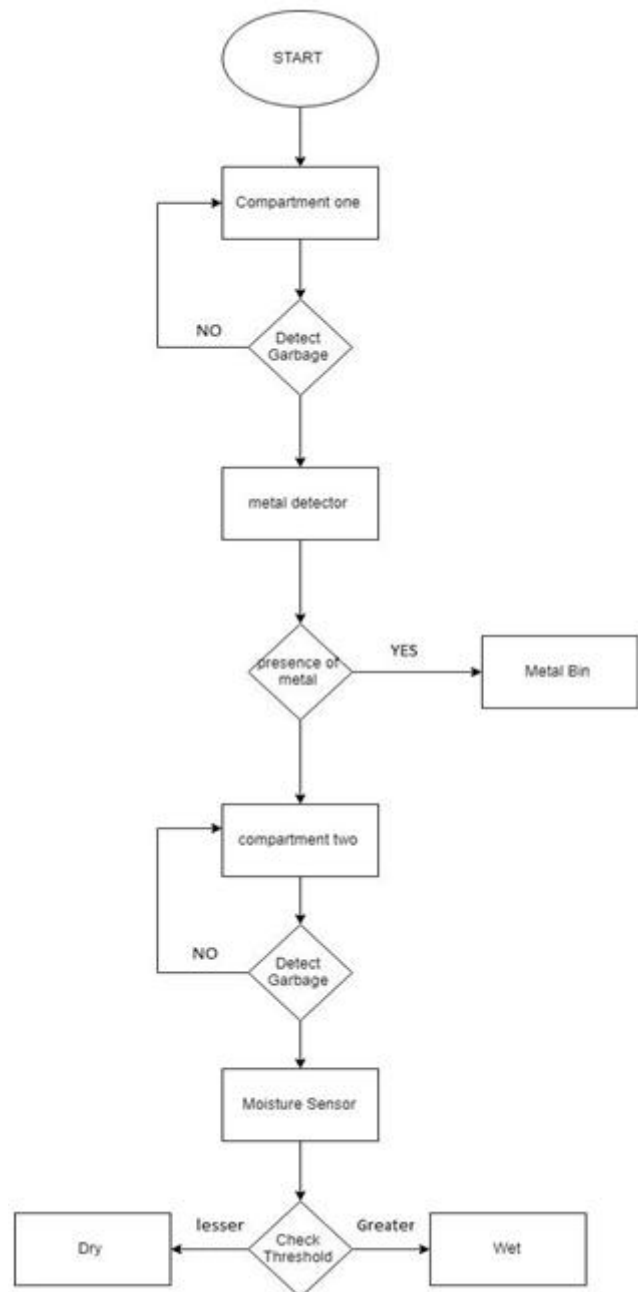
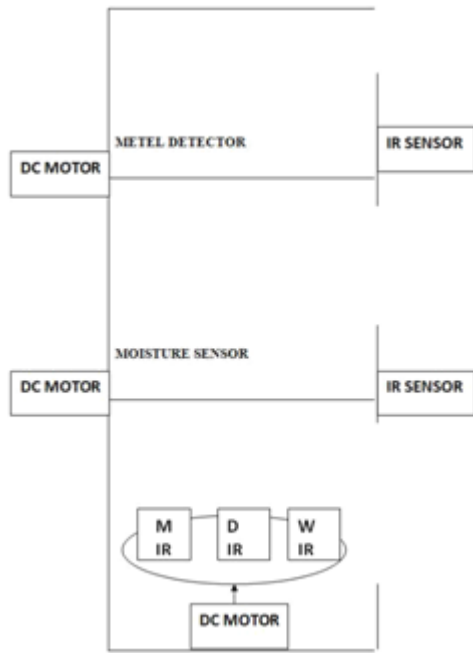


Fig. 1 Flowchart



**Fig. 2 System Figure**

## II. METHODOLOGY

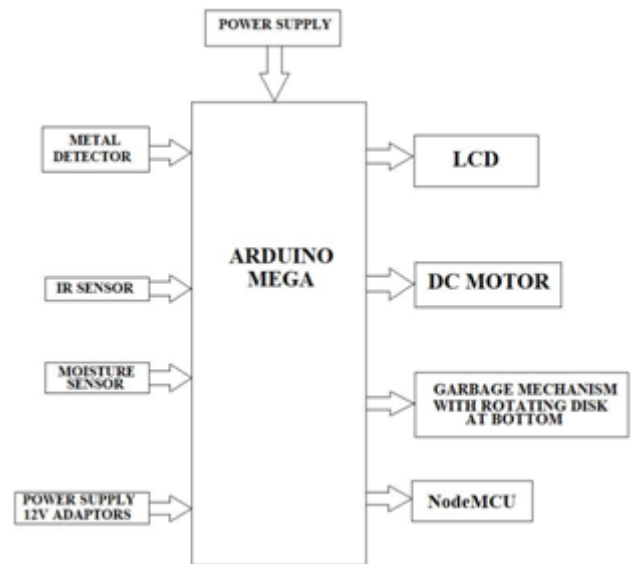
### A. System Design

The Smart bin is divided into three compartments. Each compartment has their own function, the first compartment consists of an IR sensor and a metal detector and the second compartment consists of another IR sensor and a moisture sensor for detecting dry and wet waste, the last compartment is subdivided into three bins for collection of the segregated waste respectively. The whole system is controlled by ARDUINO MEGA Board. Each and every component is interfaced to the arduino board.

The necessary 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 we have used IDE compiler to compile the code and upload it to the board using an A-B wire. To provide details of every decision we have used an Liquid Crystal Display device to display the decisions made by the arduino processor. NodeMCU is a component which can be used to connect to a wifi hotspot using the 802.11 protocol. NodeMCU when interfaced with ARDUINO MEGA can be used for providing real time updates, through updating the decisions made by the device on to the specific server, from where the status of the device can be monitored.

### III. SYSTEM FLOW

The automated process of segregation starts with the detection of garbage in the first compartment, where an IR sensor and a metal detector [4] 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.



**Fig. 3 Block Diagram**

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. Once metal is detected the contents in the first compartment are sent directly to the storage compartment, where three separate bins are used for metal, dry and wet waste.

When the contents of the first compartment are deemed to be non-metallic, they are sent to the second compartment where an IR sensor is used to verify the presence of the garbage. Depending on the output given by the IR sensor the moisture sensor [4] gets activated or stays inactive. When the garbage is detected in the second compartment, the 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 (solid bulk permittivity). Higher permittivity suggests that the garbage contains water content and hence is deemed to be wet waste. Depending on the decision made by the moisture sensor the contents are sent to their respective bin.

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

We have interfaced a NODEMCU module [1] [3] [5] which gives us a feedback on the filling of bins. This module also helps us to send information about the filling of bins to municipal corporation [3] so that they can come and collect the waste.

### IV. 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.

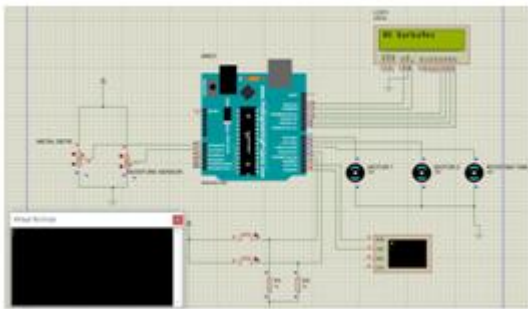


Fig. 4 No Garbage

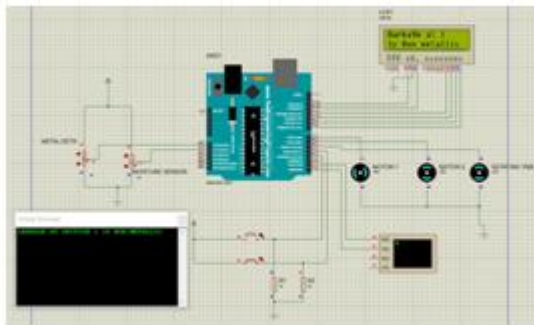


Fig. 5 Non Metallic

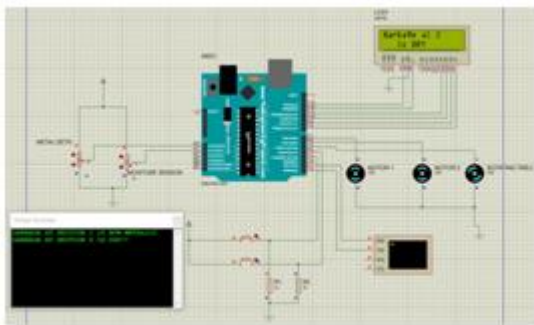


Fig. 6 Dry Waste

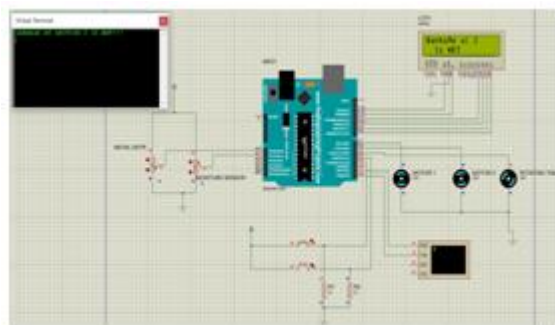


Fig. 7 Wet Waste

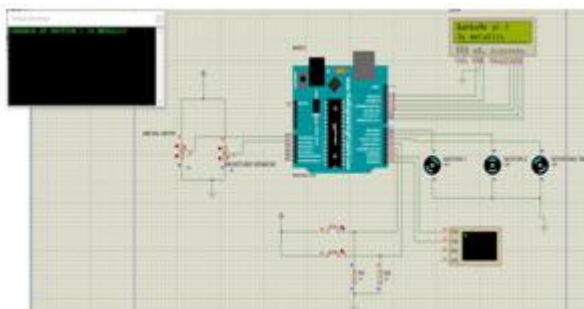


Fig. 8 Metallic Waste

Each step is displayed in the lcd and the process output is uploaded on to the server for further usage by the municipal organizations.

## V. CONCLUSION

The project when implemented will help create more resources for recycling as it decreases the probability of contamination, hence increasing the resources usable for recycling.

## VI. 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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