

SMART IoT BASED WASTE SEGREGATION AND MANAGEMENT SYSTEM

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Abstract: The rising population of India presents genuine dangers as to the accessibility of living space. Waste management (or waste disposal) are the activities and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process. In this proposal, we present IOT based waste management system by incorporating waste segregation and to create awareness by providing short time Internet facility. The proposed system consists of an IOT module that is used to monitor wet and dry waste, also depending on the weight of the waste Internet will be provided to the user. A LDR is used to detect the status of the dustbin and authenticate to the concerned authority about the status of the bin.

KEYWORDS: waste, clean city, waste management, waste segregation.

1. INTRODUCTION

A rage of notable inflation in municipal solid waste generation has been registered worldwide. Table 1 shows the statistics of waste generated. This has been found due to over population, industrialization, urbanization and economic growth and have caused immense effect on solid waste generation. Overflowing landfills are impossible to reclaim because of the unruly accumulation of wastes on outskirts of cities rooting vital environmental enlance in terms of water pollution and global warming. This has caused the average life time of the manual segregators to reduce [1].

In India, rag pickers play a crucial role in the recycling of urban solid waste. Rag pickers and conservancy staff have higher jejuneness due to infections of skin, respiratory system, gastrointestinal tract and other allergic disorders. Hinging on the rag-pickers can be diminished if segregation takes place at the source of municipal waste generation. The benefits of doing so are that a higher quality of the material is preserved for recycling which means that more value could be recaptured from the waste. The occupational hazard for rag pickers is reduced. Also, the segregated waste can be directly sent to the recycling and processing plant instead of sending it to the segregation plant and then to the recycling plant [2].

Place	Waste Generated
India	62 million tonnes per year
Karnataka	10000 tonnes per day
Bangaluru	6233 tonnes per day
Mangalore	226 tonnes per day

Table 1. statistics of waste generated

The economic value of the waste generated is not realized unless it is recycled completely and there are different techniques available to recycle and reuse the municipal solid waste [3], [4].

When the waste is segregated into basic categories such as wet, dry and metallic, it has an intense prospective of improvement, and accordingly, recycled and reused. The wet waste fraction is often converted either into compost or methane gas or both. Compost can replace demand for chemical fertilizers, and biogas can be used as a source of

energy. The metallic, plastic and paper waste can be reused or recycled [2]. A model is proposed to segregate E-waste by combining data mining process and knowledge management process is proposed in [5].

In [6] it shows the use of RFID for waste segregation. This system is not viable, as not all companies would add to their cost of applying RFID tags to their products thus implementation of such system is difficult and not economical. Also the use of RFID scanner like devices in harsh and non-suitable condition would only add to the difficulty. In [7] it shows the use of PLC for segregation. This again, has a drawback of complexity as it uses all the sensors to be clamped on a conveyor belt that is controlled by the PLC. It only shows the segregation of metal, glass and plastic wastes. This makes the system rambléd, huge and complicated. In [1] 8051 Microcontroller is used to interface the sensors used for waste segregation. This system is more time consuming and the expansion of the circuit is difficult. It also uses blower mechanism to separate dry and wet waste based on their density which is not feasible if both dry and wet has the same density. In this system, it segregates only dry, wet and metal wherein it dumps all the dry wastes together without segregating them. Here, all the wastes are thrown on a conveyor belt thus making the system large and complex. In [8] it only shows the segregation of glass and metal wastes.

In this proposal, we present IOT based waste management system by incorporating waste segregation and to create awareness by providing short time Internet facility. The proposed system consists of an IOT which is used to monitor wet and dry waste, also depending on the weight of the waste Internet will be provided to the user. A LDR is used to detect the status of the dustbin and authenticate to the concerned authority about the status of the bin. The paper will further continue as follows: proposed solution execution process and, then the experimental results.

2. PROPOSED SOLUTION

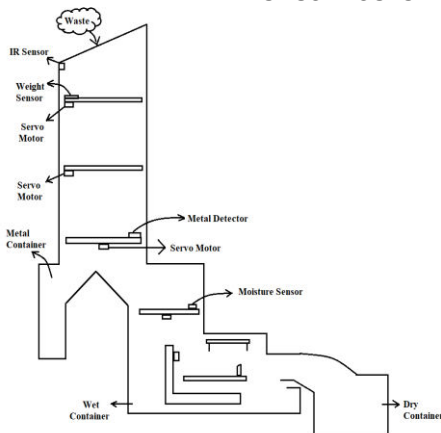


Figure 1. Structural bin design

Our proposed system includes the actual waste bin setup and also the control system with other peripheral devices. Figure

1 shows the longitudinal view of the bin. The main control system for the whole system is Arduino. Among the many available Arduino, we use Arduino uno for the system shown in figure 1. The Arduino is supplied by the power supply unit which provides constant 5 volt dc supply.

The same power is used to power other peripherals as well. The system uses NodeMCU to control the provision of Internet. An IR sensor is used to sense the waste and to calculate the weight of the waste put. The metallic, dry and wet waste detection is done by the metal detector sensor and moisture sensor. Arduino takes the analog input from the metal detector and moisture sensor, to controls the rotation of servo motor towards different compartment. Conveyor belt arrangement is made to cut the plastic into two half with the help of blade arrangement. A blower is associated to blow the lighter particle. A LDR is used to detect the quantity of waste collected, and GSM module is used to send the SMS to the concerned authority for cleaning the place.

3. EXECUTION PROCESS

The above setup gives the clear idea as how the arrangement has to be made so that, the waste slides properly from compartment to compartment. The head of the bin is attached with the infrared sensor to detect the waste put by the user. The infrared sensor will detect the waste put by the user. When the infrared sensor detects the waste put, it gives a positive signal to the micro-controller. The micro-controller triggers the Node MCU to turn on the Wi-Fi module. The Wi-Fi access will be enabled and the user gets the data for short duration, the duration can be varied with respect to size of the waste put. Figure 2 shows the functional block diagram of the proposed system.

When a small piece of waste has been put in the bin the Infrared sensor detects waste as an object and in accordance to that the system gives the acknowledgement in terms of voice message. So that the user doesn't get disappointed. The voice assistant module attached along with it gets turned on to produce the voice message.

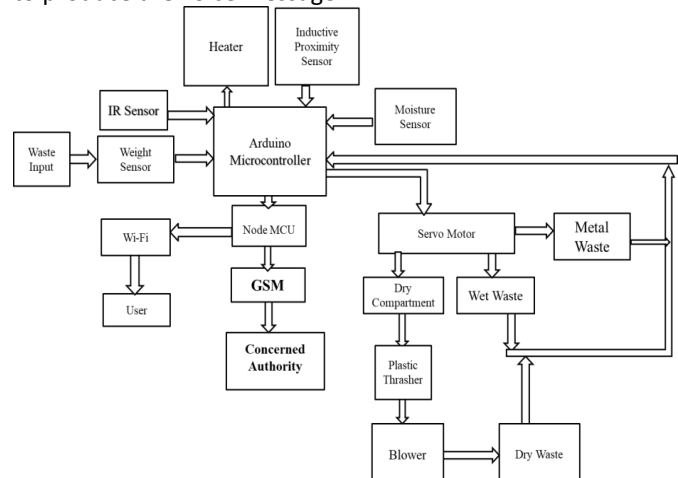


Figure 2. Block diagram

Further the waste is pushed on to the heating compartment to remove the mild moisture content which is present on the surface of the waste. Once the mild moisture is removed except the wet content say banana peel, and many other will retain the moisture and the metal cans, plastics will lose its moisture content and then slides to another compartment, where in metal is detected by the metallic sensor and put into the metallic bin and the remaining slides over the next compartment. In this compartment a servo motor is fixed which rotates 180 degrees. The wet waste is detected by moisture sensor and put in the wet bin and the remaining waste is dry waste which is to be processed further.

Now in the dry waste if there is wet waste inside the plastic? So the dry waste is put on to the conveyor belt which is having sharp edged blades on one end. In this compartment again an infrared sensor is fixed to detect the waste, once detected conveyor belt starts moving and the waste is torn into pieces. So that all the content from the inside will come out and gets separated. A blower is used to blow the air so that light plastic materials will fall apart and gets collected in the separate bin and the heavy materials will fall nearby and this gets separated.

When the concerned dustbin gets filled a LDR module which is fit in the bin activates and sends signal to the controller, automatic request to the concerned authority will be sent by the system using a GSM module. In response to it concerned authority will visit the place and clean the dustbin.

4. RESULT

All the components including sensors were neatly interfaced with the Arduino board. Figure 3 shows the practical setup of the bin. The IR sensor detected the waste put by the user. The signal was sent to the Arduino to trigger the ESP8266 Wi-Fi to provide network to the user. Further the moisture was tested to detect wet or dry waste and was put into separate compartment.

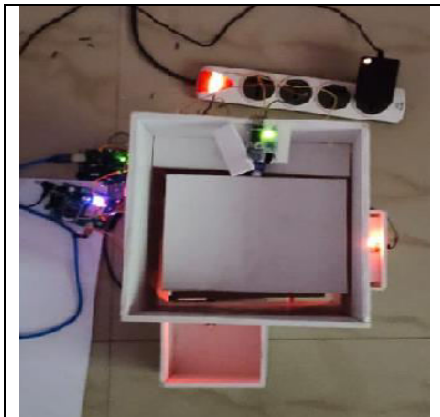


Figure 3. practical setup of the bin

Dry waste was put into the thrasher to open up the plastic covers and, hence separating the wet waste put inside the plastic. Blower blew the plastic into a separate bin. The LDR module in each bin detected that the dustbin was full and, sent the signal to the controller. The SMS was sent to the authority sing GSM module to clean up the place. The experimental observations are tabulated in the Table 2 and Table 3.

Type of wet waste	Accept	Reject
Banana peel	Yes	-----
Cooked rice	Yes	-----
Tomato pieces	Yes	-----
Tissue	-----	Yes
Cardboard pieces	-----	Yes

Table 2. Acceptance of Wet Waste and Rejection of Dry Waste

Type of dry waste	Accept	Reject
Banana peel	-----	Yes
Tissue	Yes	-----
Plastic	Yes	-----
pin	-----	Yes
Cardboard pieces	yes	-----

Table 3. Acceptance of Dry Waste and Rejection of Wet Waste

The Figure 4 shows the status of the users cell phone before putting the waste into the bin. The status shows that the Wi-Fi named "clean+master" is disabled.

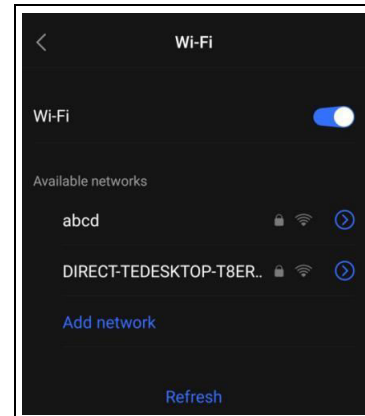


Figure 4. Wi-Fi disabled

The Wi-Fi “clean+master” gets enabled soon after the waste gets detected by the IR sensor. At this stage if it does not get detected the user will be acknowledged with a voice message saying “thank you for your concern, for keeping a step forward in keeping the city clean”. The Figure 5 shows the status of the users mobile phone where Wi-Fi is getting connected.

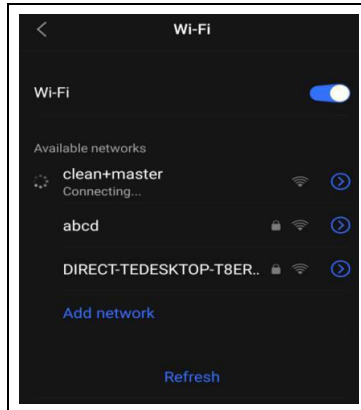


Figure 5. Wi-Fi connecting

The Wi-Fi “clean+master” gets connected to the users cellphone as shown in the Figure 6 for a duration of two minutes as detected by the IR sensor.

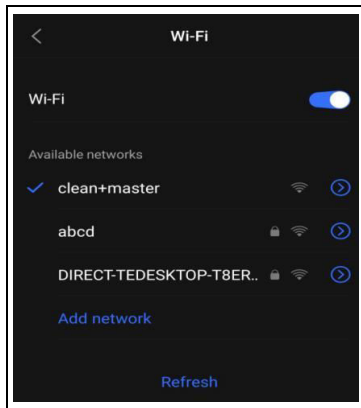


Figure 6. Wi-Fi connected

Once the waste segregation operation is completed it falls in its respective bins. The LDR module in each of the bins gets activated when the bin is filled and signals the controller to send the message to the concerned authority using global system for mobile communication(GSM) technology. The message saying “ kindly note dustbin is filled, please clean it soon” is sent as shown in the Figure 7.

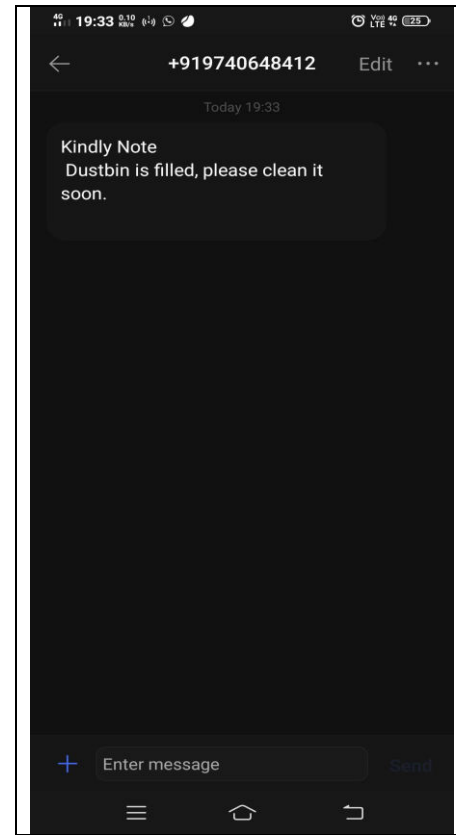


Figure 7. message arrived from the bin

5. CONCLUSION

One, who uses the dustbin, gets the facility of using the Internet for a short duration, which will motivate the people about the need of using the dustbin. It helps in creating social awareness and also fulfill the aim of the project. The waste put into the bin will be separated as metallic waste, wet waste and dry waste. Henceforth it can be called as robotic waste separator. Once the dustbin is filled information will be sent to the concerned authority for the purpose of removing the waste content. Hence forth maintains the cleanliness in the city.

6. REFERENCES

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