Involuntary Method for Separating Wastes by Using Regional Sensors

S. Sharma[1], K. Suriyan[2], K. Prem Kumar[3], S. Thambi Prabhakaran[4], S. Emimal[5]

Department of Electronics and communication engineering
Anand institute of higher technology,
Chennai, Tamil Nadu, India.

ABSTRACT

"Wastes are not always waste unless it is separated as it was". Wastes are the one which grows with the growth of the country. In order to use the waste in a very precious manner we have done the project of Involuntary Method for separating wastes by using regional sensors (IMS). Generally wastes are classified into three main categories. They are organic, inorganic and reusable wastes. In the involuntary method for separating wastes, different set of sensors is embedded with the help of microcontroller [7].

IMS bin consist of three slots in order to segregate the waste respectively depending on whether it is organic, inorganic or else reusable. However the waste will be belongs to one among the three categories. With the help of sensor the organic and inorganic wastes are sensed and segregated. If the waste which doesn't fall under any of these mentioned, the things will be sensed by electromagnet and consider that as a reusable. Finally the things which is remained will be blow off by using air blower [7].

Keywords: sensors; micro controller

1. INTRODUCTION

Waste items have to be separated efficiently, so that it can make as a reusable one. Hence we have done a project of involuntary method for separating wastes based on regional sensor as we suggest. Sensor plays the vital role in the separation of wastes involved. The main aspects behind the use of this process are, it is less expensive and ease of handling. The IMS is an initial stage process i.e., separation can be performed at the earlier stage of waste product [4].

A. Existing technology

Sorting technology for the treatment of waste particles have been well established and constitutes of the major components. The objectives of the sorting technology is the concentration i.e., produce one or more finished product or pre-concentration i.e., to upgrade or to produce smaller bulk for

further process. The sorting technology considers many technical parameters like deposits size, particle size, crushing and milling [19].

List of Existing Sorting Technology

- Black polymer sorting
- Saturn
- Inductive Sorting System
- Sapphire
- Aladdin
- Eagle Vizion
- Multisort IR System
- MultiSort ES System [19]

B.limitations of existing technology

There are certain limitations in these existing sorting technologies. Since many processes are involved in sorting the specific waste from its cluster.

- High capital costs for installing sorter.
- High operation costs.
- Low throughputs for sorting narrow size waste.
- Using high energy X-rays radiations.
- Size of the sorting machines is huge. [13,14]

II. IMS system model

There are three subsystems in IMS. They are:-
- Singling
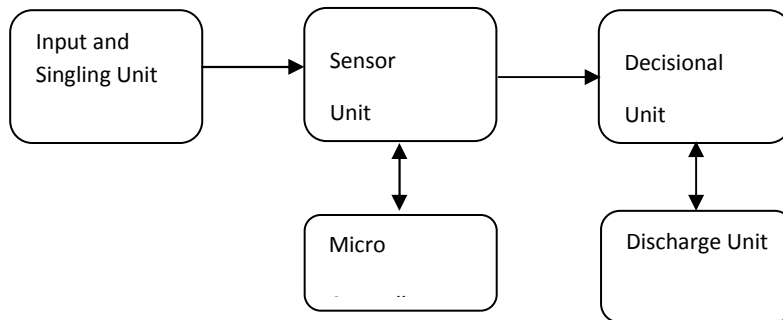- Sensor
- Discharge Unit

Fig 1. System Model

The singling unit consists of vibration feeder driven by a vibrating motor by which the mass flow of pre-processed waste particles has been isolated from rebounding and passes vibration feeder. So that it comes to lie on the bifurcated sheet in a controlled way which leads directly to the sensor unit [6].

The sensor unit contains one or more sensors to detect specific attributes of all particles in the mass flow. The particles have to stay in a fixed position relatively to the surface of bifurcation tray; apparently their position is predictable in order to detect the waste particles by using regional sensors which is placed in a bifurcation tray. Once the waste materials have been sensed by the sensor unit, a specific signal is transmitted to the microcontroller unit [6].

The discharge unit consists of three ports such as organic, inorganic and reusable it is regulates by the microcontroller with the reference of received signal.
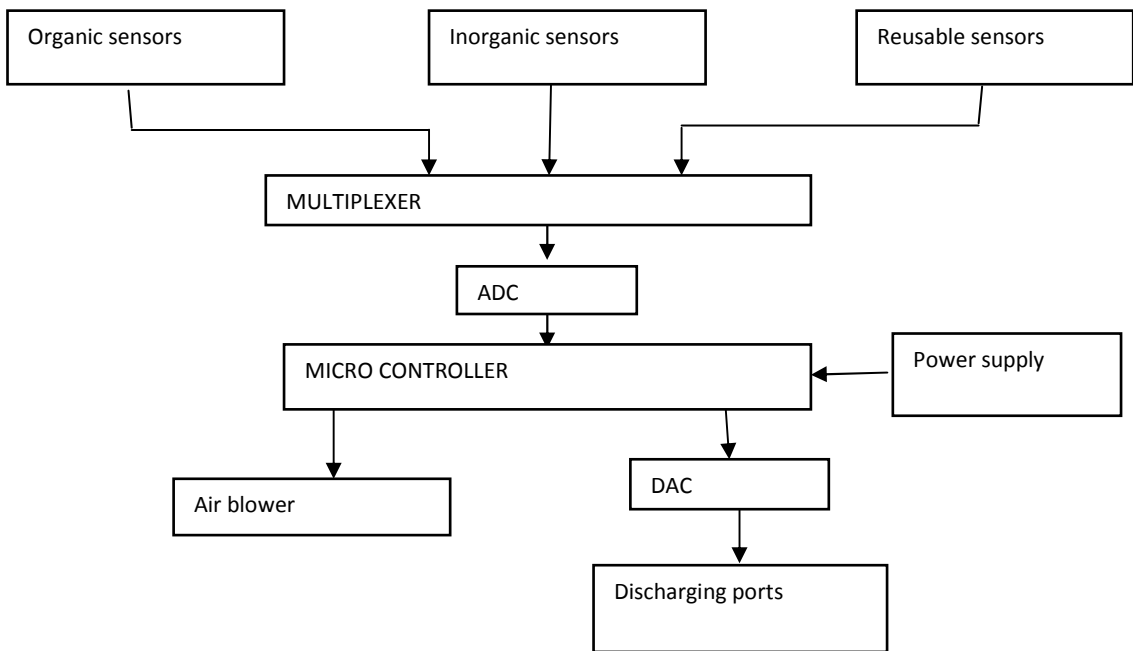
operational setup and working

Fig.2. Operational setup

Fig.2.shown above which describes the sensing process involved in the IMS method. As we know that how the sensor detects the waste material based on its intensity and wavelength.

Once the material is sensed a specific signal is passed towards the microcontroller for the analysis. The signal will be converted into digital signal by analog to digital converter (ADC). The digital signal is then passed to the microcontroller for certain diagnosis. A micro controller analyses the sensor data in a split of a second. After interpretation, the received spectrum of specific radiation of materials is classified to be separated [15].

The analyzed signal being a digital signal is converted into analog using DAC. The analog signal makes the discharging doors to recognize the corresponding waste and thrashes it into their respective slots. The air blower makes the use of discharging the waste that have not sensed.

The IMS bin is a multi sensor system which might be necessary to perform a successful classification of different type of materials.

TYPES OF SENSOR USED	APPLICATION
Inductive proximity sensor	Metallic object
Electro-magnet	Fero magnetic material
Air blower	Paper, carton
Photo electric sensor	Plastic materials
Capacitive sensors	Glass materials
Clear object detector	PET bottles

Table 1. sensors used algorithm

Step 1: In the time 't_o'
"SWITCH ON" Vibrating motor in both feeder and tray
Step 2: In the time 't_2'
"SWITCH ON" the air blower in the bin
Step 3: In the time 't_3'
"SWITCH ON" the electromagnet for detecting reusable materials
In the time 't_4'
Open the door corresponding to reusable
In the time 't_5'
Materials demagnetize from the door
In the time 't_6'
Close the door
Step 4: In the time 't_7'
        "SWITCH ON" all the Sensors in the bifurcation tray
If (organic sensors detect the material)

Open the corresponding organic door
Else if (inorganic sensors detect the materials)
Open the corresponding inorganic door
In the time 't_8'
Close all the doors
Step 5: In the time 't_9'
System "SHUT DOWN"

2. EXPERIMENTAL OBSERVATION

In IMS method, the Entire process can be done within duration of 6 minutes. When the power supply is given to the IMS bin, the vibrating motors in both the feeder and bifurcation tray get switched on in the time period of first 60 seconds ('t_0'). In the next minute ('t_1'), the air blower in the bin for blow off the light weight materials like paper, carton. And the blower will switch off within 60seconds. And the electromagnet will be switched on for the next 30seconds (t_3) to segregate the Ferro magnetic materials from the cluster of waste. It is demagnetized while the electromagnet door opens in the time period of 't_4'.

In the consecutive time period, the sensor in the IMS bin gets switched on and starts sensing the waste particles. If the waste particle is identified by the moisture sensor or humidity sensor in the particular time span it is said to be organic. In either case it is identified by the photo electric sensor in the same time period, said to be inorganic. Finally it will be discharged. Within the time span of 5 to 6 minutes the waste materials are sorted out hence it saves the environment.

3. IMS BIN

Fig.3. Front view of IMS bin   **Fig.4. Internal view of IMS bin**

Fig.5.Rear view of IMS bin

4. CONCLUSION

In IMS, we able to separate wastes in three steps without much complex process involved in a mean time energy consumption and operation costs are very low. As a result, we are making this process one or the other way to avoid the environmental degradation. In future the transportation cost can be reduced by implementing IMS bin in domestic and commercial buildings.

REFERENCES

[1] Malima Isabelle Wolf, Marcello Colledani, Stanley B. Gershwin and Timothy G. Gutowski "*A Network Flow Model for the Performance Evaluation and Design of Material Separation Systems For Recycling*" IEEE transactions on automation science and engineering, vol. 10, no. 1, January 2013 pp 65-75

[2] Mihai Bilici, Lucian Dascalescu, Ciprian Dragan and Ovidiu Fati, Alexandru Iuga, Adrian Samuila "*Tribocharging and Electrostatic Separation of Mixed Granular Solids in Fluidized Bed Devices*" IEEE Transactions on Dielectrics and Electrical Insulation Vol. 18, No. 5; October 2011 pp 1476-1483

[3] Mohammad Osiur Rahman, Aini Hussain, Edgar Scavino M A Hannan and Hassan Basri "*Real Time Waste Paper Grading Using CBR Approach*" international journal of innovative computing, information and control vol. 8, no. 1 January 2012 pp 471-488

[4] Mohamed Fodil Boukhoulda Mohamed Miloudi, Karim Medles, Mohamed Rezoug, Amar Tilmatine and Lucian Dascalescu "*Experimental Modelling of a New Tribo-electrostatic Separation Process for Mixed Granular Polymers*" Industry Applications, IEEE Transactions on Issue: 99 May 2013

[5] Hartmut Lucht, Lutz Kreuchwig, Arnold Uhl *"Plastic separation of automotive waste by superfast near-infrared sensors"*

[6] Killmann D., Pretz T *" possibilities of sensor based sorting regarding recycling of waste"* Acta Metallurgica Slovaca, 12, 2006, (188 - 193).

[7] Terrence Slonecker, Gary B. Fisher, Danielle P. Aiello and Barry Haack " *Visible and Infrared Remote Imaging of Hazardous Waste"* Remote Sens. 2010, 2, 2474-2508;doi:10.3390/rs2112474.

[8] Mohammad Osiur Rahman, M A Hannan, Edgar Scavino, Aini Hussain and Hassan Basri " *An Efficient Paper Grade Identification Method for Automatic Recyclable Waste Paper Sorting"* European Journal of Scientific Research, ISSN 1450-216X Vol.25 No.1 (2009), pp.96-103.

[9] Uwe Habich "*Sensor-Based Sorting Systems in Waste Processing*" International Symposium MBT 2007, pp 308-315

[10] Martha S. Petrovick, James D. Harper, Frances E. Nargi, Eric D. Schwoebel, Mark C. Hennessy, Todd H. Rider, and Mark A. Hollis " *Rapid Sensors for Biological-Agent Identification*" lincoln laboratory journal volume 17, number 1, 2007 pp no 63-84

[11] T. M. Libish, J. Linesh, M. C. Bobby, P. Biswas, S. Bandyopadhyay, K. Dasgupta, P. Radhakrishnan *"Fiber optic sensor for the adulteration detection of edible oils"* optoelectronics and advanced materials – rapid communications Vol. 5, No. 1, January 2011, p. 68 - 72

[12] LIU Xian-xing, PAN Quan, ZHANG Hong-cai and DAI Guan-zhong "*study on algorithm of sensor management based on functions of efficiency and waste*" chinese journal of aeronautics, feb 2000 vol no 13 article id: 1000-9 361(2000) 01-0039-06 pp no 39-44.

[13] Wyman, R.A., 1985, "Sorting by electronic selection" *SME-Handbook on Mineral Processing*, N.L., Wiess (ed.), SME, New York, pp. 7-5 – 7-35.

[14] Salter, J.D., and Wyatt, N.P.G., 1991, "Sorting in the minerals industry: past, present and future"Minerals Engineering, Vol. 4, No. 7-11, pp. 779-796

[15] Salter, J.D., and Wyatt, N.P.G., 1991, "Sorting machines in the minerals industry: problems or opportunities?" *Proc. XVII IMPC*, Dresden, Polygraphischer Bereich / Bergakaemie Freiberg, Vol. 5, pp. 183-193.

[16] Chadwick, J., 1989, "World's richest gold mine" Int. Min., Sept., pp. 12-16.

[17] Arvidson, B., 2002, "Photometric ore sorting" *Mineral Processing Plant Design, Practice, and Control*, A.L. Mular, A.N. Halbe, and D.J., Barratt (eds.), SME, New York., pp. 1033-1048.

[18] Stone, A.M., "Selection and sizing of ore sorting equipment" Design and Installation of Concentration and Dewatering Circuits, A.L. Mular (ed.), SME, New York, pp 261-267

[19] "*a review of optical technology to sort plastics and other containers*" December 2008.the Environment and Plastics Industry Council (EPIC).