A Unique Technique for Solid Waste Segregation

Mahesh Kumar A S[1], Rajesh A S[2]

[1]Assistant Professor, PES College of Engineering, Mandya, Karnataka, India
[2]Assistant Professor, Department of Mechanical Engineering,
[2]Maharaja Institute of Technology, Mysore, Belavadi, Karnataka, India

ABSTRACT

The rising population of India poses serious threats with regard to the availability of living space, utilization of natural resources and raw materials, education and employment, another serious peril that follows is the escalating amount of waste generated each minute by an individual. One such problem is solid waste management which in addition to disturbing the balance of environment also has adverse effect on health of the society. Effective waste management is one of the major problems of the present era. The segregation, handling, transportation and disposal of waste are to be properly managed so as to minimize the risk to the environment. Waste segregator comprises of IR sensor to detect the waste or objects that are present on the conveyor belt. The IR sensor conveys the data to the micro controller, and then the microcontroller initiates the driver circuit. The function of the driver circuit is to convert the low current signal to high current signal. This high current signal is then given to the motor which makes the motor to rotate in clockwise and anticlockwise direction, resulting in the movement of conveyor belt. Conveyor belt start moving, when the waste on the conveyor belt reaches the blower section, the conveyor belt stop to a particular duration of time, during that time blower is turned on, which makes the dry waste to blow off and fall into the bin. Once the dry waste is removed, again when it reaches the metallic section, again conveyor belt is stops. Once the conveyor belt stops, the microcontroller initiates the motor to rotate in a particular angle and provides power supply to the electro- magnet. The electro-magnet attracts the metal particles/objects that are present in the mixed waste.

KEYWORDS: Microcontroller, Conveyor belt, Electro-magnet, Sensor

INTRODUCTION

The rising population of India poses serious threats with regard to the availability of living space, utilization of natural resources and raw materials, education and employment, another serious peril that follows is the escalating amount of waste generated each minute by an individual. One such problem is solid waste management which in addition to disturbing the balance of the environment also has an adverse effect on the health of the society. Effective waste management is one of the major problems of the present era. The segregation, handling, transportation and disposal of waste are to be properly managed so as to minimize the risk to the environment. Uncontrolled and unscientific dumping of waste in the outskirts of cities and towns leads to groundwater pollution and global warming. The economic value of waste is best realized when it segregated. The traditional way of manually segregating the waste utilizes more human effort, time and cost. It has been proposed an automatic waste segregator that aims at segregating the waste at the disposal level itself. It is designed to sort the waste into 3 major categories, namely metallic, wet and dry, thereby making waste management more effective. This paper despite about Economic Automated Waste Segregator (AWS) which is cheap and easy to use solution for a segregation system at households, so that it can be sent directly for processing. It is designed to sort the refuse into metallic waste, wet waste and dry waste. Segregate waste because when the waste is separated into streams such as wet, dry, and metallic. The waste has a higher potential of recovery and consequently, re-cycled and reuse. The wet waste fraction is often converted either into compost can replace the demand for chemical fertilizers and biogas can be used as a source of energy, the metallic waste could be reused or recycled. In recent times, garbage disposal has become a huge cause of condemning in the world. A voluminous amount of waste that is generated is disposed of by means which have an adverse effect on that environment.

The generation and disposal of waste in large quantities has created greater concern overtime for the world which is adversely affecting the human lives and environmental conditions. Wastes are the one which grows with the growth of the country. Segregation of waste is important for proper disposal of the vast amount of garbage modern society produces in an environmentally sensible mode. People became adapted to tossing things away and never realize the consequences of their action. The common method of disposal of the industrial waste is by uncontrolled and unplanned and exposed dumping at the river sites and open areas. Throwing of waste everywhere creates pollution and cause an impact on plants, human health and animal life. The common method of disposal of the waste is by unplanned and uncontrolled open dumping at the landfill sites. This

method is injurious to human health, plant and animal life. This harmful method of waste disposal can generate liquid leachate which contaminates surface and ground waters; can harbor disease vectors which spread harmful diseases, can degrade the aesthetic value of the natural environment and it is an unavailing use of land resources.

Literature review

Pushpa, M. K et al [1] has proposed an idea of implementing waste segregator using a microcontroller, proximity sensor, electromagnetic plates, ultrasonic sensor, open-close mechanism, conveyor belt, slider section. The open and close mechanism acts as a regulator to control the waste that falls on the belt to move in the linear or vertical or horizontal direction. Slider section is where the slider is used to dump the metallic particles which are attached to the electromagnetic plates to the bin. Mohammed Rafeeq et al [2] has proposed an Automation of Waste material Segregation in the scrap industry. It is designed to sort the trash into metallic waste, plastic waste and glass waste ready to be processed separately for the next process of operation. The Method uses inductive sensors, metallic sensor and capacitive sensors to distinguish between wet and dry waste. Experimental results show that the segregation of waste into metallic, plastic and glass waste has been successfully implemented using the Automation of material segregation (AMS) method. Ranjitha C et al [3] has given information, in order to reduce the risk to the health of the public and to ensure the safety of the environment. The economic value of waste is best realized when it is segregated properly. Mohammad Aazam et al [4] describes the ever-increasing population, urbanization, migration issues and change in lifestyle, municipal solid waste generation levels are increasing significantly. S Dwivedi et al [5] has stated automated waste segregation, developing a prototype for separating plastic, glass bottles and metal cans from solid waste material using the programmable logic controller (PLC) S7-300. VJ, Aleena, et al [6] has proposed an automatic waste segregator (AWS) which is a cheap, easy to use solution for a segregation system at households so that the wastes can be sent directly for processing. Automatic waste segregator is designed to sort the waste into three main categories namely; metallic, organic and plastic, thereby making the waste management more effective. Amrutha Chandramohan, et al [7] has proposed an Automated Waste Segregator (AWS) which is a cheap, easy to use solution for a segregation system for household use only. Yamazaki, S et al [8] gives an idea about Metal detectors, are extensively used to find undesirable metal objects in processed food. In such a typical metal detector, the coils are coaxially arranged with the transmitting coil in the center and two receiving coils on the sides. Vicentini, F, et al [9] describe the effects of a fast national growth rate, of a large and dense residential area. Jayachitra, A. et al [10] describes methods for waste management. Waste Management involves several steps to manage waste and to convert it to its final disposal.

From the above relative literature, it is clear that it is very difficult to segregate different wide variety of mixed waste in a single platform. This paper describes when the mixed waste is deposited on the conveyor belt for segregation. The IR sensor detects the waste or objects that are present on the conveyor belt. The IR sensor conveys the data to the microcontroller, and then the microcontroller initiates the driver circuit. The function of the driver circuit is to convert

the low current signal to the high current signal. This high current signal is then given to the motor which makes the motor to rotate in the clockwise and anticlockwise direction, resulting in the movement of the conveyor belt.

Methodology Waste segregator comprises of IR sensor to detect the waste or objects that are present on the conveyor belt.
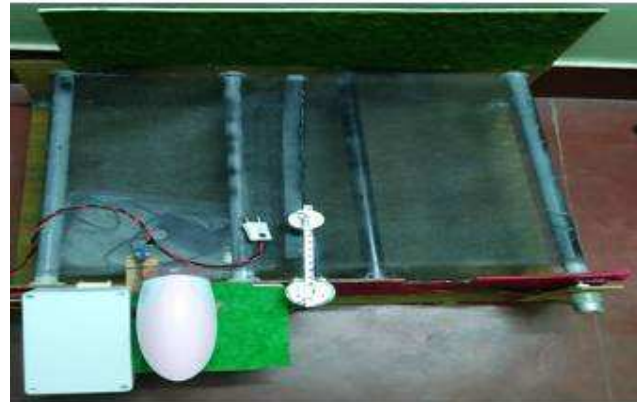

Figure 3.1 Microcontroller Based Waste Segregator

When it reaches the metallic section, again conveyor belt is stopped. Once the conveyor belt stops, the microcontroller initiates the motor to rotate in a particular angle and provides power supply to the electromagnet. The electro-magnet attracts the metal particles/objects that are present in the mixed waste. When the power supply is not given to the electromagnet, it loses its magnetic property which results from the metal waste fall into the bin. Once this mechanism is finished, the conveyor belt starts moving due to gravity, the wet waste falls into the bin.

BLOCK DIAGRAM OF MICROCONTROLLER BASED WASTE SEGREGATOR

In Automatic Waste Segregator, automatic sorter machine is developed which can sort out the wastes in various categories to make waste management more efficient. It can be possible to sort out metal, dry and wet wastes by developing a system using microcontroller 8051 and sensor.

Description of waste segregation using a microcontroller

The Microcontroller based waste segregator has two modules first one is the sensing module, the second one is the segregating module. The sensing module consists of a sensor which is used to detect the waste and a motor which is used to start a conveyor belt. The segregating unit consists of the bin and a bin used to collect the waste segregated.

The IR sensor is used to detect the waste put in the sensing module. If any waste is detected then waste segregation process start, first blower mechanism start which segregates the "**Dry Waste**". Electro-Magnet is used to segregate the **"Metal Waste"** and **"Wet Waste"** segregated through rolling (gravity) action of the conveyor belt. The IR sensor conveys the data to the microcontroller, and then the microcontroller initiates the driver circuit. The function of the driver circuit is to convert the low current signal to the high current signal. This high current signal is then given to the motor which makes the motor to rotate in the clockwise and anticlockwise direction, resulting in the movement of the

conveyor belt. Conveyor belt start moving, when the waste on the conveyor belt reaches the blower section, the conveyor belt stop to a particular duration of time, during that time blower is turned on, which makes the dry waste to blow-off and fall into the bin. Once the **dry waste** is removed, again conveyor belt starts to move. When it reaches the metallic section, again conveyor belt is stopped. Once the conveyor belt stops, the microcontroller initiates the motor to rotate in a particular angle and provides power supply to the electro-magnet. The electro-magnet attracts the metal particles/objects that are present in the mixed waste. When the power supply is not given to the electromagnet, it loses its magnetic property which results from the **metal waste** fall into the bin. Once this mechanism is finished, the conveyor belt starts moving due to the rolling action of the conveyor belt, the **wet waste** falls into the bin.
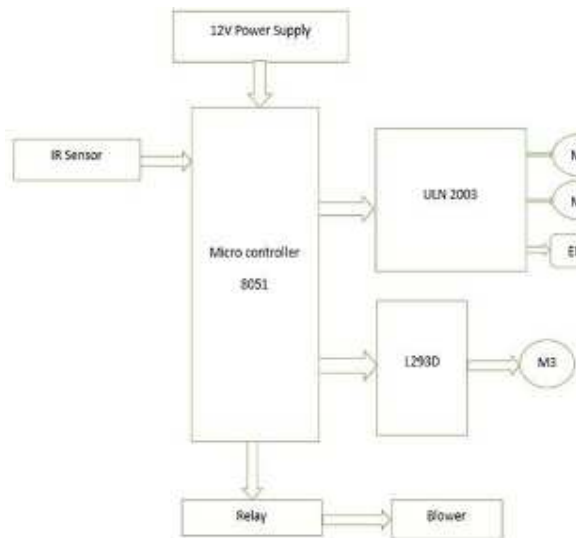

Figure: 3.2 Block diagram of Microcontroller based waste segregator

Pin description with connection
➢ In this circuit diagram, we are using W78E052D NUVOTON Microcontroller. The NUVOTON W78E052D is 40-pin microcontroller and it consists of 4-bidirectional ports.
➢ Each port are 8-bit length namely as port1, port2, port3 and port4 and every port can as input and output port we can send or receive the data.
➢ From the pin number, 1 to 8 are initialized for the port 0 and pin number 9For rest operation, and pin number 10 to 17 is assigned to the port 3.
➢ And pin number 18 and19 is assigned for xtal1and xtal2 to provide clock frequency of range 11.0592MHz, pin number 20 is used for the ground connection.
➢ The pin number 21 to 28 is assigned for the port 2 and pin number 32 to 39 for port 0. Pin number 40 is used for the VCC connection.
➢ We are using IR sensor which are connected to input/output lines of the microcontroller. The IR Sensor, in which all the +VCC are tied together and given to +5 VVCC/DC Supply and all the ground terminals are connected together and connected to common ground.
➢ The IR sensors output pin is connected to microcontroller Port p2.0
➢ ULN2003 is a 16-pin IC. It is the external voltage circuit drivers carrying 12V which can be used to drive the motors thus the 12v DC motors.

➢ The NUVOTON microcontroller port2 (p2.7 to p2.1) is connected to the pin number 1 to 7 of ULN2003 IC and pin number 8 is connected to +VCC.
➢ The ULN2003 IC pin number 12 and 13 is connected to the motor 1 and 2 and 16 for common ground.
➢ ULN2003 IC pin number 9 is connected to electro-magnet 12V.
➢ The L293D driver circuit is 16 pin IC. It is a two inbuilt H-Bridge driver circuit.
➢ L293D IC pin number 3 and 6 is connected to motor 3 and pin number 4, 5, 13, 12 for common ground.
➢ L293D IC pin number 8 and 16 is connected to VCC.
➢ Coil end 1 of the relay is connected to 12V and coil end 2 is connected to P2.5 of Microcontroller 8051. Common (COM) is connected to one end of the load (230V power supply) that is to be controlled.
➢ One port of blower is connected to the normally opened pin of the relay. Another port is connected to a negative point.
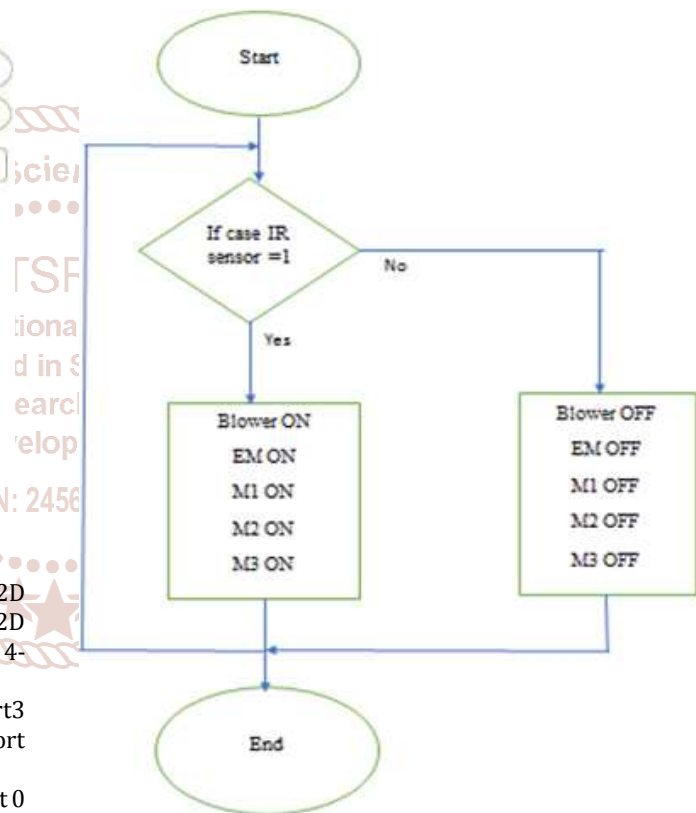
RESULTS AND DISCUSSION
The Automatic Waste Segregator sorts wastes into three different categories namely metal, dry and the wet waste. Waste segregation means a division of waste into dry waste and wet waste. Dry waste includes paper, cardboard, glass tin cans, etc. Wet waste on the other hand, refers to organic waste such as vegetable peels, left-over food etc. Separating our waste is essential as the amount of waste being generated today causes an immense problem. By keeping the household wastes which are generated in every home today and come up with the following result. The following tables show the tested sequel of the fate of the waste when exposed to Automatic Waste Segregator.

The experimentation consists of distinct categories of waste namely metal, dry and wet section. Each diverse category has been pigeonholed with the acceptance and the rejection

rate with our system. Here we have tabulated the list of the household waste that lives up to the system design of classification on the type of waste which will fall under true or false acceptance and rejection. Elaborating, True acceptance would mean a section that correctly identifies and sorts the waste. On the other hand, True Rejection will be a section which would recognize a wrong waste and reject it. Also, False Acceptance is one in which it would identify a wrong waste to be correct. Lastly a False Rejection is when it should have identified and accepted it but it ends up rejecting the waste.

Si. no	Types of metals	Discarded	Not discarded
1	Nails and nuts	Yes	
2	Paper clips	Yes	
3	**Safety pins**	**Yes**	

Table: 5.1 Result of Metallic waste separation

Si. No.	Types of metals	Discarded	Not discarded
1	Paper	Yes	
2	Dry leaves	Yes	
3	Thermal coal Bend	Yes	

Table: 5.2 Result of Dry waste separations

Dry waste separation happens with great accuracy in this system. The blower will blow all the dry waste that is discarded. As it is blown off, a simple collecting chamber is built just opposite the blower. The waste hits the chamber and falls down into the dry waste bin. Wet waste is successfully segregated from other types of waste in this system. They do not get blown off by the blower. Hence as the belt continues to rotate forward, the waste falls at the end, into the wet waste bin.

SL No.	Types of metals	Discarded	Not discarded
1	Banana peel	Yes	
2	Wet paper	Yes	
3	Tea Bags	Yes	

Table: 5.3 Result of Wet waste separation

CONCLUSION

The Smart Waste Management sorts wastes into three different categories, namely metal, dry and wet waste. Waste segregation means a division of waste into bio-degradable and degradable waste. It is a low cost, the most appropriate technological option for waste management. Through this system we can realize a compact, low cost and user-friendly separation system for urban house hold, college and offices to streamline the waste. Automated Waste Segregator has been successfully implemented for the segregation of waste into metallic, dry and wet waste at a domestic level. The system can segregate only one type of waste at a time with an assigned priority for metal, wet and dry waste. Thus, improvements can be made to segregate mixed type of waste by the use of buffer spaces.

Plastics can be segregated from the collected dry waste and also be processed based on their types, grades and colors. Thus further separation of dry waste can also be done. The work can be implemented by making use of a robotic arm to pick and place certain materials which can be re-used. GSM contraption to intimate to the nearest industry to use the metals collected.

References

[1] Pushpa, M. K., Aayushi Gupta, Shariq Mohammed Shaikh, Stuti Jha, and V. Suchitra. "Microcontroller Based Automatic Waste Segregator." International journal of innovative research in Electrical, Electronics, Instrumentation and Control Engineering 3, no. 5 (2015).

[2] Rafeeq, M., & Alam, S. (2016, October). Automation of plastic, metal and glass waste materials segregation using Arduino in the scrap industry. In 2016 International Conference on Communication and Electronics Systems *(ICCES)* (pp. 1-5). IEEE.

[3] Ranjitha, C., V. Sarga, P. K. Sreelakshmi, and Arya Paul Vishnu Suresh. "Real Time Waste Segregation." UG Scholars, Department of Electronics and Communication Engineering, Adishankara Institute of Engineering IJFRCSCE 2018.

[4] Aazam, M., St-Hilaire, M., Lung, C. H., & Lambadaris, I. (2016, October). Cloud-based smart waste management for smart cities. In 2016 IEEE 21st International Workshop on Computer-Aided Modelling and Design of Communication Links and Networks (CAMAD) (pp. 188-193). IEEE.

[5] Dwivedi, Subhasini, Michael Fernandes, Rohit D'souza, Anish A. Naik, Deeksha A. Naik, Shruti S. Naik, Shubham D. Naik, and Rolan G. Pereira. "A Review on PLC based Automatic Waste Segregator." International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)5, no. 2 (2016): 280-285.

[6] VJ, Aleena, Kavya Balakrishnan, T. B. Rosmi, K. J. Swathy Krishna, S. Sreejith, and T.D. Subha. "Automatic Waste Segregator and Monitoring System."

[7] Amrutha Chandramohan, et al. Automated Waste Segregator. National Level Analog System Design Contest, 2013–2014; Conducted by Texas Instruments, India.

[8] Yamazaki, S., Nakane, H., & Tanaka, A. (2002). Basic analysis of a metal detector. IEEE Transactions on instrumentation and measurement, 51(4), 810-814.

[9] Vicentini, F., Giusti, A., Rovetta, A., Fan, X., He, Q., Zhu, M., & Liu, B. (2009). Sensorized waste collection container for content estimation and collection optimization. Waste management, 29(5), 1467-1472.

[10] Jayachitra, A., & Kumar, R. J. Segregated waste management using Smart Dust Bin.