Experimental Setup of Segregation of Industrial Waste using PLC

Nitika Ghosh, Piyush Kumar, Shivam Bhardwaj, Vijay Singh Rana, Nishchal Verma

Abstract: This paper is dedicated to solve the problem occurring at the time of segregation of the solid waste which is produced by the manufacturing process in the industry. As with the growing population, there is continuously increase in the number of Industries and each industry produces the goods in very high amount in order to fulfil the need of the society. And as with increase in the production rate there is also increase in the waste produced by the industries. And it is very important to manage these waste otherwise it creates the hazardous effect in our living environment. Therefore to keep this in mind we developed the system which deals with the segregation of solid waste which is generated by the industry during manufacturing process, in the section of metal and non-metal such that they treated separately. In this system we are using plc as the controller to control the whole task.

Keywords: Segregation of waste, industrial waste segregation, metal and non-metal segregation, PLC, segregation of metallic waste.

I. INTRODUCTION

Waste Management is very important for the healthy ecosystem. It prevents the birth of new bacteria and viruses which damages the living system. As by increasing population day by day there is vast increase in the setup of different types of industry and their production rate in order to fulfil the need of the growing number of population in society and as by increase in the production rate of the industries there will be also increase in the scrap (waste) which is generated during the manufacturing process in the industries [1, 2].Poor industrial waste management causes the improper handling and disposal of waste which causes the hazardous damage to the living being. Segregation of the waste is the first step of waste management plan that help the environment to exist in harmony state. Segregation is the one of the typical task of the waste management [3, 4]. In manual method segregation requires lots of worker and because of its unhygienic it's also hazardous for the health of the workers. So it is prefer to do this task with the automation method [5]. So, we decided to design a system that does effective separation in the level of solid industrial waste in the section of metal and non-metal. We are using programmable logic controller (PLC) as the automation controller of the whole system [6]. The main concept of this project is to achieve the effective segregation of waste material in the section of metal and non-metal which is the first process of waste segregation in order to achieve effective waste management.

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II. RELATED WORK

Solid waste management is the one of the important concern about the environmental problem. As the increase in the growth of population the amount of waste is rapidly increases day by day. Therefore the management of waste is also being complicated day by day [6]. Each group of societies approaches different approach to the waste management. The different method of solid waste management is not only varies between the countries but also in the locality of the different places in the same countries [7, 8].Each country continuously changes its policies towards waste management in order to increase the efficiency of the waste management [9]. But even after applying many continuous efforts, the efficiency of the waste management remains not up to the mark sufficient to achieve the effective waste management.
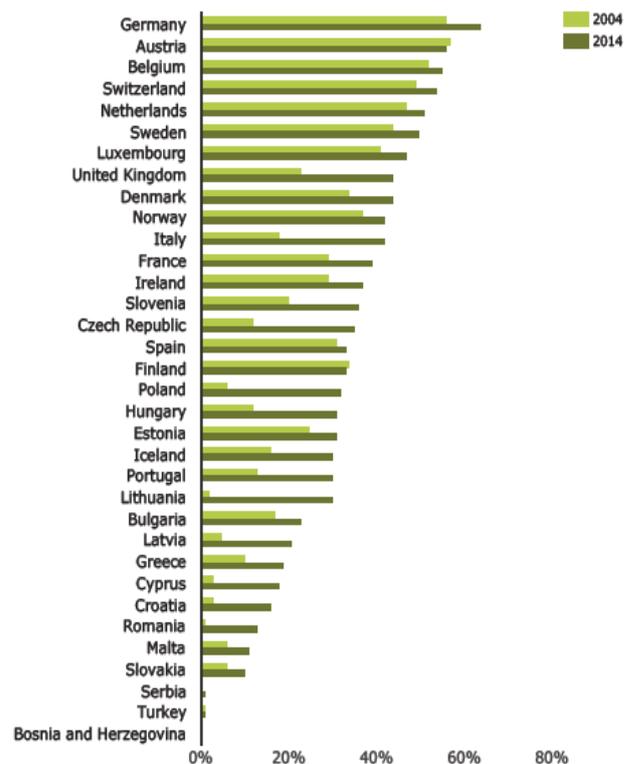

Fig. 1 Municipal Waste Recycling of 34 countries from 2004-2014

Due to insufficient waste management, the unmanaged waste damped in the landfill which causes the pollution area near the landfills which causes the decrease in the land area and also the air and water near the area of landfill is hazardously polluted such that the marine and land life near that landfill area is badly affected.

Solid waste generation report: The generation of the solid waste is also varying from the state of development of country. For example: Developed countries in Asia like Japan, Hong Kong in Asia is produce more waste as compare to the other developing countries in Asia.
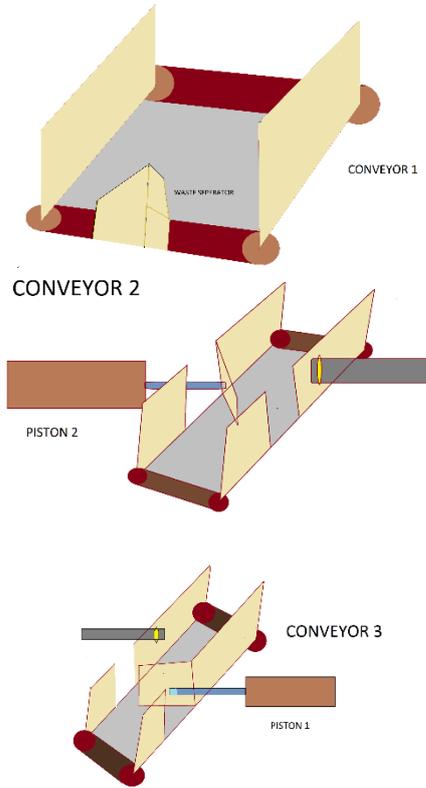
III. WORKING METHODOLOGY

Fig. 2 Working Model

The Working methodology of this system is that the whole scrap (waste) is placed on the conveyor 1.As the waste reaches the end of the conveyor 1 it get separated by the separator and go into respective next conveyor which is conveyor 2 and conveyor 3. Then the Metallic material from the waste is get sensed with the help of metal detector sensor and then it is dumped to the collector box with the help of piston. The remaining non-metal waste is move forward to the end of conveyor and dumped into non-metallic section for the further treatment.

IV. FLOW CHART OF PROPOSED MODEL

The flow chart of the Waste separation system shows the visualization of the working methodology of the system in the flow-wise steps of the working process of system.

The detailed of the working model is written in the form of steps.

Step 1: Start button turn on the system.

Step 2: Conveyor 1 is get started to carry the waste.

Step 3: In this step separator is separates out the waste into two sections for the respective conveyor.

Step 4: Conveyor 2 and Conveyor 3 start to carry the waste material for the further process.

Step 5: The metal sensor (Inductive proximity Sensor) is senses the metallic waste.

Step 6: The metallic waste is get placed in the metallic waste bin with the help of piston cylinder.

Step 7: The non-metallic waste is remain un-sensed and further automatically placed to the bin which is placed in the end of the conveyor belt.
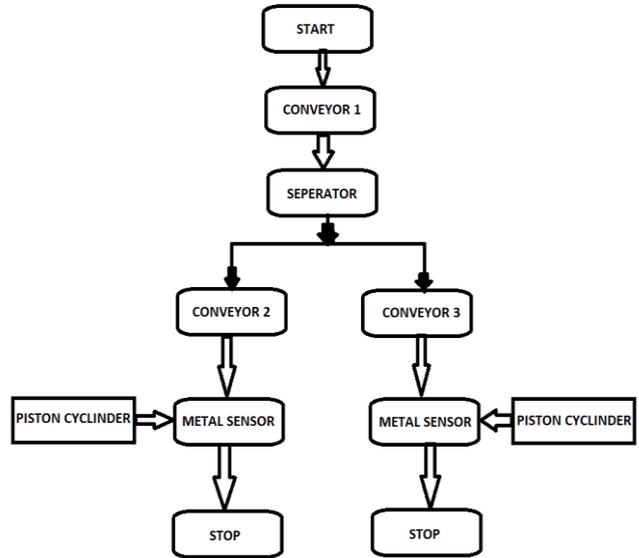
Step 8: Stop button turn off the system.

Fig. 3 Flow Chart of Proposed

V. COMPONENTS DESIGN OF MODEL

All the components are discussed below in details.

A. PLC(Programmable Logic Controller)

PLC stands for programmable logic controller. It is basically a digital computer which helps to control the automated manufacturing process in the industry. It provides high reliability on automation process.
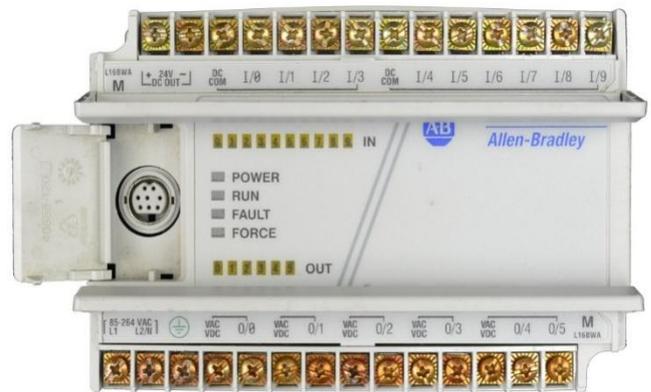

Fig. 4 Programmable logic controller

Specification:

No. of Input: 10

No. of output: 6

It is initially developed to replace the hard-wired relay in automobile industry.

PLC is categories in different module according to the different task will go to perform by them. It is depend on the number of input and output ports.

In our project PLC work as the core of the working of the project. It gets the signal from the metal detector sensor which is attach in the system and send the output signal to the piston which segregate the metallic waste in order for their suitable treatment. The programming language is used to control the plc is the ladder logic.

B. Conveyor

Conveyor is the main medium to carry the waste material for the segregation process. The waste materials are placed in this conveyor in move into respective bins by the sensing mechanism and with the help of piston cylinders. There are three conveyor is used in our working system. The first conveyor is use to carry and separate the waste material and the remaining two is use to carry and segregate the material.
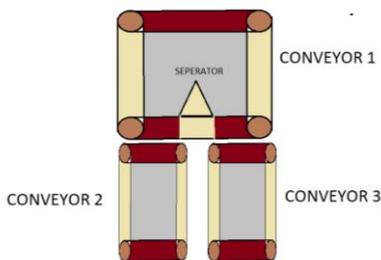

Fig. 5 Conveyor Design

Specification:
Length of Conveyor 1: 45 cm
Width of Conveyor 1: 40 cm
Length of Conveyor 2: 45 cm
Width of Conveyor 2: 16 cm
Length of Conveyor 3: 45 cm
Width of Conveyor3: 16 cm

C. Metal Detector sensor

In this project inductive proximity sensor is used as the metal detector sensor. It detects any metallic waste material without any contact with it.

Fig. 6 Inductive Proximity Sensor

Specification:
No. of wire: 3
Range: 6 cm

Operating Voltage: 24V

D. *Pneumatic cylinder*

Pneumatic cylinder is the mechanical device which is used to produce linear reciprocating motion with power of compressed gas.

Fig. 7 Piston Cylinder

Specification:
Bore Size: 12mm
Stroke: 40mm
Ensured Pressure Resistance: 13.5 Bar

VI. PROGRAMMING SOFTWARE

RX Logix is used as the programming software in this project in order to control the whole automation process with the help of PLC.
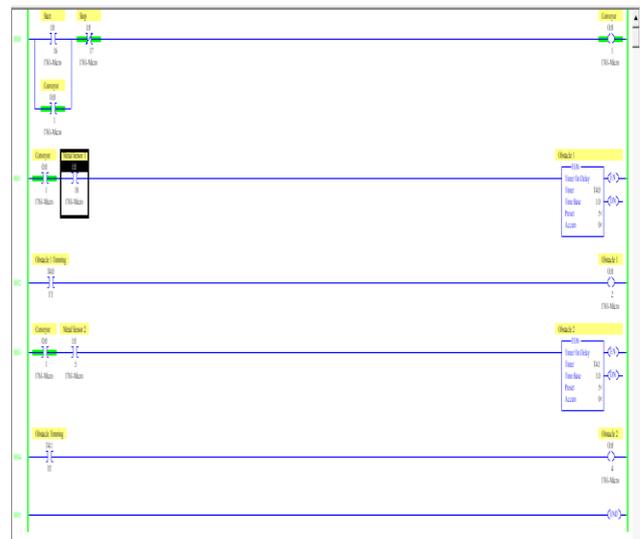

Fig. 8 Ladder logic program

The programming of the project is written in the ladder logic form. Timer tools is use to set the working time for the obstacles to place the metallic waste in dustbin.

VII. RESULT AND DISCUSSION

The output of this system is the segregated waste material in the section of metal and non-metal for the further treatment process.

The segregation of the waste is the first stage of the process of waste management and the segregation of waste material in the section of metal and non-metal is the first stage of the waste segregation process which is achieved by this project in the effective manner.

VIII. CONCLUSION

The proposed method is the efficient way for the industrial waste management which effectively segregates the metallic and non-metallic waste and then placed them for the further treatment. This paper meets the demand of the waste management in efficient way in such a way that the society is not get suffer from any hazardous effect which generated from the unmanaged waste.

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