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# Programmable Logic Controller Based Metal Segregation in Steel Industry

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**ABSTRACT:** Mostly the waste management is one of the most important things in day to day life. This waste disposal mostly disturbs the earth environment because of lack of segregation of the particular waste. The waste disposal mainly consists of plastic items, metal waste, and waste from industries like E-waste, etc. Here the metal waste can be recycled in a proper manner if the metal disposal is segregated separately. This metal segregation can be done by detecting the metals in the waste that is coming in through any source. Here we have done a simple conveyor based system which separates the metal from non-metals. This will be useful in the waste segregation process. This system will separate the metal using the Programmable Logic Controllers (PLC) and a simple conveyor system will help to segregate the metals.

**KEYWORDS:** Metal detection, Conveyor system, Programmable Logic Controller (PLC), Metal separation.

### I. INTRODUCTION

Waste management is one of the toughest processes in the current trend. The waste management can be done based on the particular products. The waste disposal consists of metals, non-metal, plastic, rubber, medical waste, etc. Metal is one of the most important components in all fields of industries. The metal must be first segregated in order to recycle the waste metals. The segregated metal is further getting sorted and the scrapped metal must then be processed in order to be reused. The exact reusing of metal is how it was previously used, and what it will be used for next purpose. In this paper the waste metal is segregated using a hopper system. The waste metal will be coming from the hopper in to the sensing area in which the metal gets sensed with the help of the metal sensor [1]. The waste disposal like dry metals, wet metals from the rural as well as urban area is get collected in a separate area by which the waste gets managed. This is done with the help of simple collectors which is used to segregate the dry metals as well as wet metals using Programmable Logic Controllers (PLC) [2]. The waste disposals from the households that is solid waste from the households will be separated using a kiln which will sort according to their and based on that further process will take place in the plants for reusing or any recycling process [3]. The process is to separate out the wet and dry waste into the separate bins with the help of the sensors which will detect the metals, non-metals, plastics, rubbers, etc. using the Programmable Logic Controllers (PLC). Here they have done a structural hardware which selects and positions the waste materials with the help of optical sensors and directs it to the tin which is used for the collection purpose. This is done with the help of the Programmable Logic Controllers (PLC) [4]. The metal detection is done in order to separate the non-defective metals in the industries using robots. Here they have automated using the PLC and SCADA. The metals have been detected and get separated using a robotic arm which has been interfaced using the Programmable Logic Controller (PLC) [5]. The non-ferrous waste from electric and electronic equipment (WEEE) is separated using the hyper spectral image analysis technique [6]. An automated waste segregator is used in order to separate the waste materials from the households, etc. the metals also get sorted with the help of these Automated Waste Segregator (AWS) [7]. The metals have been sensed using the sensors and then the overall process. Here the required metals are sensed using the sensor and the defected metals are get rejected. This process is get monitored using the SCADA

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[8]. The metal segregation using the hydraulic cylinder flaps, which is then further goes to the sensing section and this process is automated using the Programmable Logic Controller (PLC) [9].

## A. PLC (Programmable Logic Controller) system.

The main motive of the automation is to reduce the man power and also to do the work which the man cannot perform. The automation has been widely increased in the industries for the past decades. The main stream in which the automation has been used is as follows Electrical, Wirings, Communication, Mechanical, Instrumentation, and Robotics (Servo Mechanism). The basic automation has been used in PLC was Relay mechanism. The Relay mechanism is the basic version of the PLC. Relay mechanism plays an important role in the part of automation. PLC is known as Programmable Logic Controllers. Initially it was the advanced version of the Relay switching. PLC was found in 1969. The PLC is a solid state device that controls output devices based on input signals and a user developed program. The PLC device can be connected to both Input and Output devices.

### INPUT DEVICES:

1. Push button.
2. Selector switches.
3. Limit switch.
4. Level switch.
5. Photo detecting sensor.
6. Motors.
7. Relays.

### OUTPUT DEVICES:

1. Valves.
2. Motor starters.
3. Solenoid.
4. Control Relays.
5. Alarms.
6. Lights.

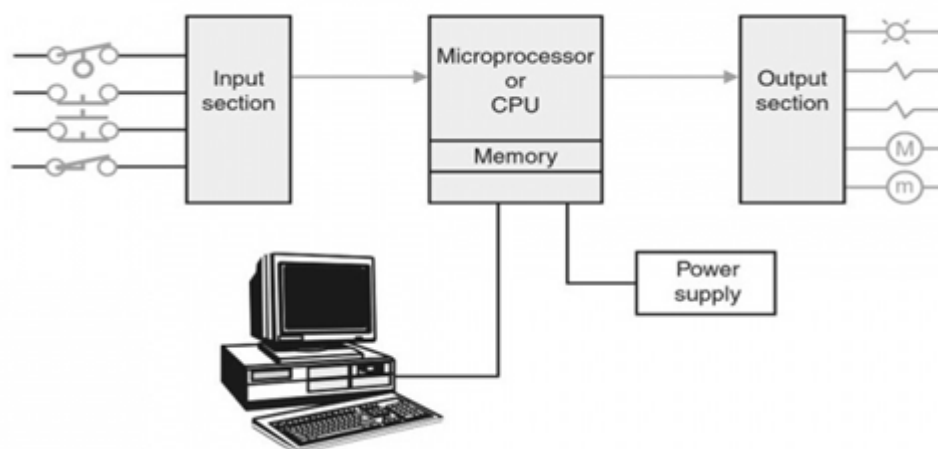


Fig1. Block Diagram of PLC

Fig 1 shows the basic block diagram of Programmable Logic Controller (PLC). The PLC consists of input sections, memory unit, and output section. They were first developed in the automobile industry to provide flexible, ruggedized and easily programmable controllers to replace hard-wired relays, timers and sequencers. When digital computers

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became available, being general-purpose programmable devices, they were soon applied to control sequential and combinatorial logic in industrial processes.

## B. The PLC Processor

It stores the control program and data in its memory. It reads the status of connected input devices and executes the control program. Commands connected outputs to change state based on program execution For example: Turn a light on, start a fan, adjust a speed, or temperature and Comes in various physical forms.

## C. I/O Modules

They physically connect to field devices. Input modules convert electrical signals coming in from input field devices such as pushbuttons, to electrical signals that the PLC can understand. Output modules take information coming from the PLC and convert it to electrical signals the output field devices can understand, such as a motor starter, or a hydraulic solenoid valve. I/O comes in various forms.

## D. Power Supply

The function of the power supply is to provide the DC power required to operate the PLC system. It is supplied by single-phase 120 or 240V AC line power that powers the PLC system.

## II. BLOCK DIAGRAM OF METAL SEPARATION PROCESS.

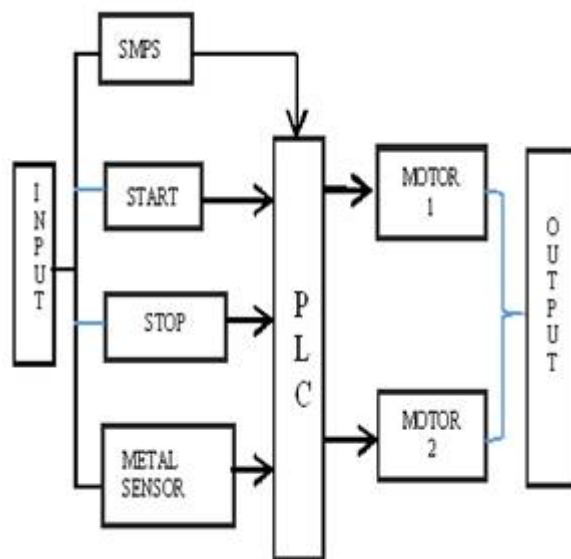


Fig2. Block diagram of separation Process

Fig2 represents the overall block diagram of the metal segregation process. This process consists of input section, main PLC section and output section. The input section is connected to the Switch mode power supply (SMPS), start button, start button, and metal sensor. These inputs are interfaced to the PLC system. Then the conveyor motor is been interfaced to the PLC system. The conveyor system will be divided into two sections. One section is the primary conveyor section and the other section is the secondary conveyor section. The sensing action will takes place in the primary conveyor section. Based on the sensing process the secondary conveyor will start to run. Here the motor 1 will be the primary conveyor and the motor 2 will be the secondary conveyor. These two motors are connected to the outputs of the system. The Switch Mode Power Supply (SMPS) is used in order to minimize the incoming 230v to 24v. The operating range of the PLC system and the motor of the conveyor is 24v. The SMPS consists of the regulatory circuit, filter circuits, etc. The metal sensor is used in order to detect the metal particles in the conveyor. The motor, sensor and the conveyor system are interfaced to the Programmable Logic System (PLC).

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## III. DESIGN AND WORKING

The conveyor system has been imparted in our system to separate the metals and non-metals for the segregation process. We have chosen the conveyor system because it will be one of the simplest processes in order we can easily separate the incoming process through the conveyor belt. We can also use hopper like system in order for segregation process. But when compared to that the conveyor system will be easiest and also it can be easily interfaced through the Programmable Logic Controller (PLC) system. Here we have shown you the simple conveyor system with two motors.

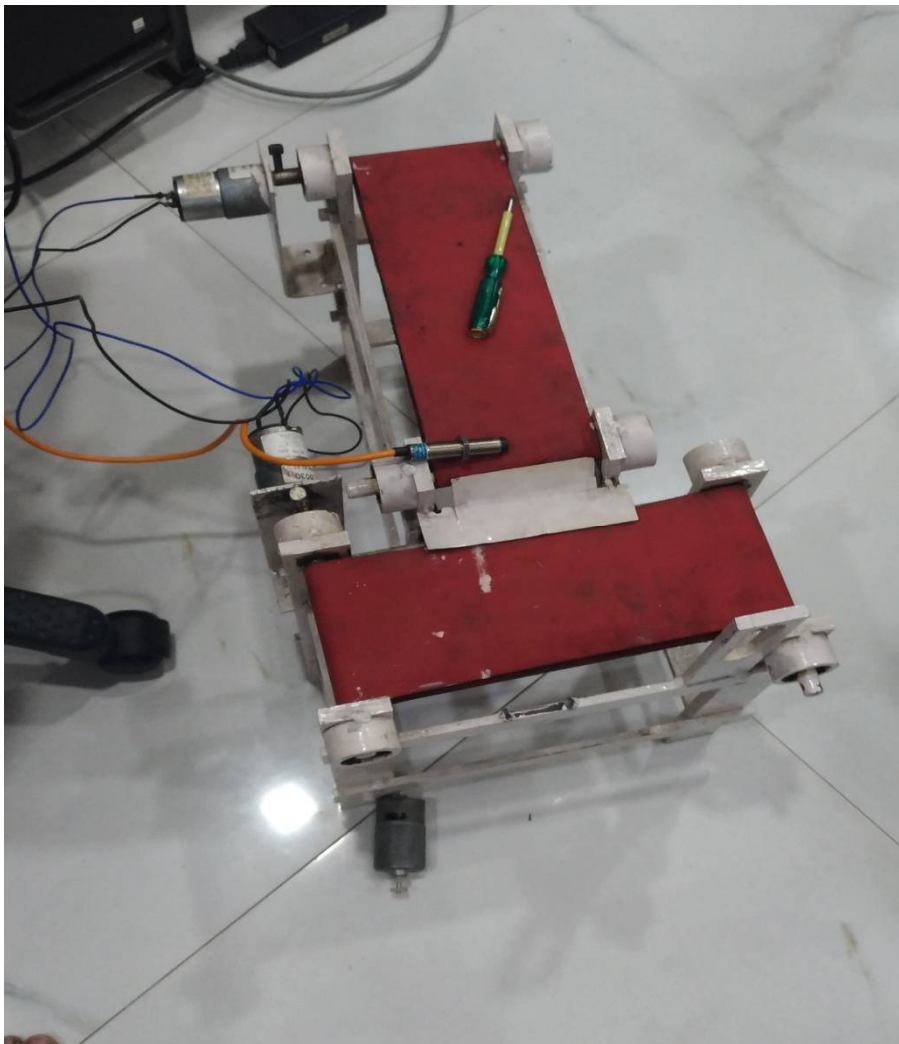


Fig3. Conveyor system

Fig3 shows the simple conveyor system which consists of two conveyor sections. The two sections are primary sections and secondary sections. In this the incoming product will come through the primary section of the conveyor. In the primary conveyor the metal sensor will be imparted, so that the product will be sensed for whether it is metal or not. Based on the sensing action the secondary conveyor will move to the required direction. The secondary conveyor will be in a stationary position until the sensing action takes place. After that the secondary conveyor will start to move



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based on the sensed product. If the product sensed is metal means then the secondary conveyor will move in the right direction. If it is a non-metal then the conveyor will move in the left side direction.

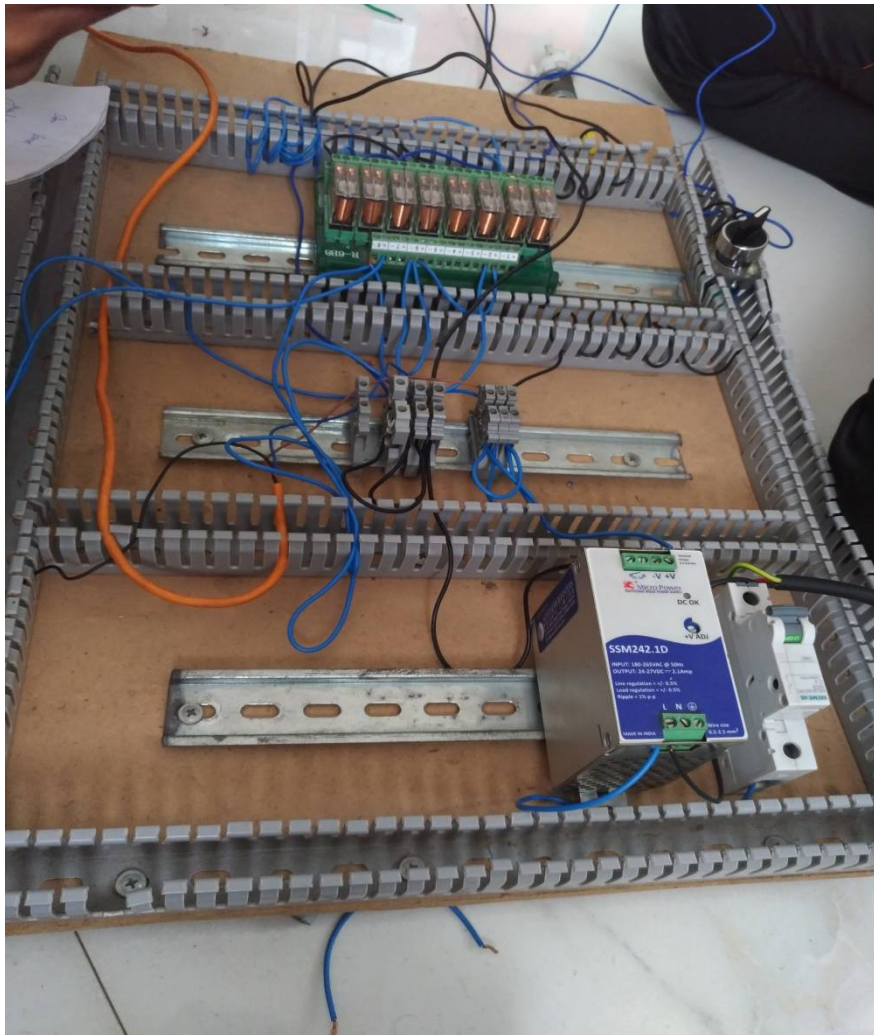


Fig4. PLC connections

Fig4 represents the initial stage connections of the Programmable Logic Controller (PLC) and also the connections of the Relay system. In this the 8 pin double change over relay has been used as the relay system. The terminal blocks are introduced because the output from the SMPS will be of two terminals one positive and one negative. This one positive and one negative terminal cannot be connected to the other systems like motors of conveyor, etc. So the terminal blocks are used in order to enhance the positive and negative terminal of the SMPS so that more number of connections can be given through it. This terminal blocks has to be interconnected to each other in a loop manner.

## IV. RESULTS AND DISCUSSIONS

The above system is to separate the metals and non-metals using a simple conveyor system by using the Programmable Logic Controllers (PLC). Here by separating the metal products, the waste disposal can be easily managed and also the metals from the waste can be easily separated. Metal sensing and separation is one of the most important things in the



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waste management process. We can also do this for the non-metallic product like plastics, rubber, or any other products based on the requirements. We can also further make a improvements by making a combined detection process in which the metals as well as non-metals can be segregated at a time.

## V. CONCLUSIONS

From our work, we have concluded that the metal segregation is one of the easiest ways to reduce the waste disposal in the nearby areas. This metal segregation work is done in a simple conveyor process in which the metal products alone gets sensed and has been segregated. This metal segregation is mostly used in the garbage disposal process and also in industries in which the metallic products need to be separated. The above work done the metal separation is made one of the easiest ways to remove the metal products. Mainly the waste management industry can use the metal segregation process which will be much helpful for their disposal purpose.

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