

# Automated Segregation of Physical Loads Using PLC

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**Abstract.** This paper presents an automatic load segregation using plc. Heavy loads are often transported and handled in various industrial applications, such as manufacturing, mining, construction, and logistics. However, different types of heavy loads may require different methods of processing, storage, or disposal. Therefore, it is important to segregate heavy loads according to their characteristics, such as size, shape, weight, material, or function. This proposes an automatic material segregation system using PLC (programmable logic controller) to achieve this task. The system consists of three main components: a sensor unit, a controller unit, a relay unit and a segregation unit. The segregation unit performs the output actions based on the commands from the controller unit and directs the heavy loads to the corresponding bins or conveyors using actuators, such as DC motors, relays, solenoids, etc. The system is designed and implemented using SELPRO Version 5.4.3 and we can also implement by using software's like Allen Bradley PLC and GX Works3 software. The system is tested and evaluated using different types of heavy loads and shows satisfactory performance in terms of accuracy, efficiency, and reliability. The system can be applied to various industrial scenarios where heavy load segregation is needed.

**Keywords:** PLC, SEGREGATION, SELPRO Version 5.4.3, ALLEN BRADELYPLC and GX Works3 Software.

## 1. INTRODUCTION

Automatic segregation of physical loads is the process of separating different types of materials or objects based on their physical properties or characteristics. This process can be useful for various applications, such as physical loads management, recycling, manufacturing, logistics, and more. By automating the segregation of physical loads, the efficiency, accuracy, and safety of the process can be improved, as well as the environmental and economic benefits. However, automating the segregation of physical loads also poses many challenges, such as the complexity of the materials, the diversity of the objects, the reliability of the sensors, and the adaptability of the system. In this introduction, we will review some of the existing methods and technologies for automatic segregation of physical loads related to daily basis, such as household physical loads, industrial scrap, and postal packages. We will also discuss some of the advantages and limitations of these methods and technologies, and suggest some possible directions for future research. One of the main aspects of automatic segregation of physical loads is the identification and classification of the materials or objects based on their physical properties or characteristics. These properties or characteristics can include color, shape, size, weight, density, magnetic susceptibility, electrical conductivity, thermal conductivity, optical reflectance, and more. Depending on the application and the type of material or object to be segregated, different sensors and techniques can be used to measure these properties or characteristics.

For example, optical sensors can be used to detect color and shape; weight sensors can be used to measure weight; magnetic separators can be used to separate ferrous



from non ferrous metals; eddy current separators can be used to separateconductive from non-conductive metals; air classifiers can be used to separate light from heavy materials; density separators can be used toseparate materials with different densities; and robotic arms can be used to pick and place objects based on their properties or characteristics.

## **2. REDUCED DIRECT HUMAN HARD WORK PRICES AND FEES PLC SYSTEM (SELPRO VERSION 3.4.5)**

A programmable logic controller, additionally called a PLC or programmablecontrol-ler, is alaptop-kind tool this is usedto manipulate equipment in an industrial facility. PLC's are realtime controllers with cyclic behavior. A PLCis a digitallyworking elec-tronic tool which makes use of aprogrammablereminiscence for internal garage of instructions for implementing unique features, such as logicsequencing,timing, count-ing and manipulate thru digital or analog enter/output modules. The first step scans the inputs to the controller and maps a image of the enter popularity into the control-ler reminiscence. After that software stored within the controller reminiscence is processed, taking into consideration the memory photo of the inputs. As a result, an photograph of the outputs is produced. In the third step thephoto of the output va-riables is mapped to the real outputs.

### **2.1 I/O interfaces:**

An I/O module is a plug-in-type meeting containingcircuitrythat communicates among a PLC and filed gadgets. Thesedevice could be transmitting and/oraccepting digital/or analog signals.

Programming languages:

Graphical languages:

1.Ladder diagram (LD)-uses a standardized set of ladder programming symbols to put into effect control capabilities.

2.diagrammatic illustration of manipulate sequences in software Text based language:

- Instruction list – A low stage language much like the machine
- Structural Text- a excessive level language that allows structured program-ming, which means that many complex obligations can be damaged down into smaller ones or assembly language use with microprocessors.

3. Function block diagram (FBD)-a graphical language that permits the person to application elements in this sort of manner that they appear like wired collectively like electric circuits.

### 3. HARDWARE CONFIGURATION

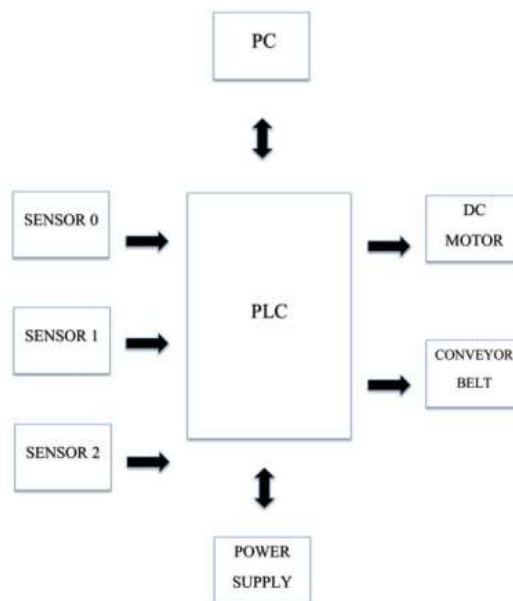


Fig. 3.1 BLOCK DIAGRAM OF MATERIAL SEGREGATION USING PLC

Fig1 shows above contain three units-sensor unit, controller unit and segregation unit.

#### 3.1 Sensors:

A sensor is a device used to detect the object that measures physical quantity and convert it into a signal. Most sensors are electronics, returning a voltage sign that may be converted into useful engineering unit.

#### 3.2 Inductive proximity sensor:

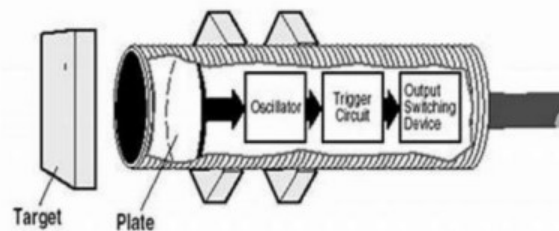
This sensor is a non-contact proximity sensor that's used to come across the metallic item. And its sensing variety relies upon on the form of metallic being detected together with iron or metallic, ferrous metal. They contain four-major components: inductive coil, oscillator, Schmitttrigger, output switching circuit. When metal is near to it induces a current around it through electric circuit generates magnetic field. This induce current is collapse to generating current than it fall to zero. When it is electrically stop and its inductance of the loop modifications consistent with the material inside it and considering that metals are a great deal powerful conductors that other material is presence of steel increases the modern flowing through the loop, these adjustments may be seen change in oscillation amplitude. As extra steel enters the sensing field oscillation amplitude shrinks and collapses subsequently.



Fig. 3.2 Inductive proximity sensor

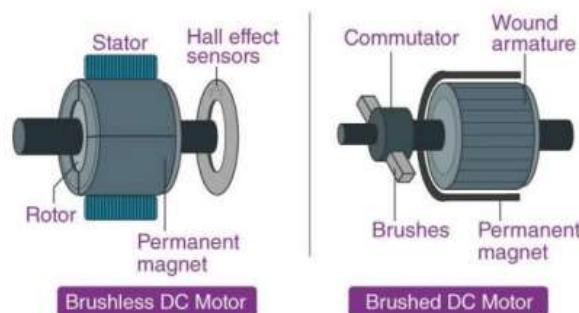
### 3.3 Capacitive proximity sensor:

This is non-touch proximity sensor that's used to hit upon the steel and non metal item. In this capacitive proximity sensor produces electrostatic discipline of the electrode and changes the capacitance in an oscillator circuit whilst object is near to it. As a result, the oscillator begins oscillating. The cause circuit reads the oscillator's amplitude and whilst it reaches a particular stage (electrically price) then output nation of the sensor changes. As the target actions far away from the sensor the oscillator's amplitude decrease (discharges), switching the sensor output back to its unique country. Inside the sensor is a circuit that uses dc power to generate ac strength and to switch the output circuit while the amount of ac modern-day adjustments, that is tries to charge a capacitor. The sensor could be able to flow widespread present day into and out of its internal plate.



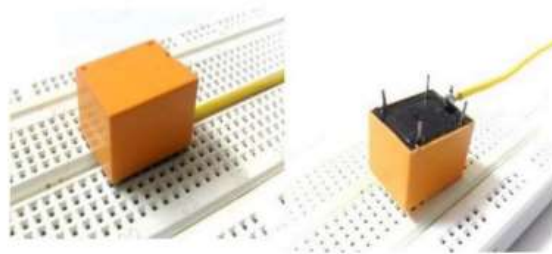
### 3.4 DC Motor:

DC motors were utilized in business applications. When a contemporary sporting conductor is located in a magnetic subject, it reviews a mechanical pressure. Dc is used with conveyor belt and elevator, material dealing with.



### 3.5 Relay:

It acts as a switch, switch is generally used to close or open the circuit manually. This is also connects and disconnects the two circuits. Relay can be different types like electromechanical, solid state.



## 4. FIGURES AND TABLES

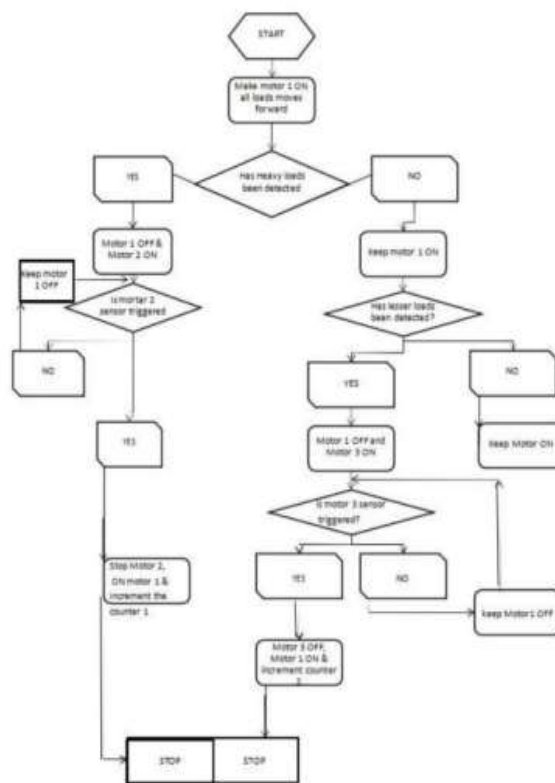


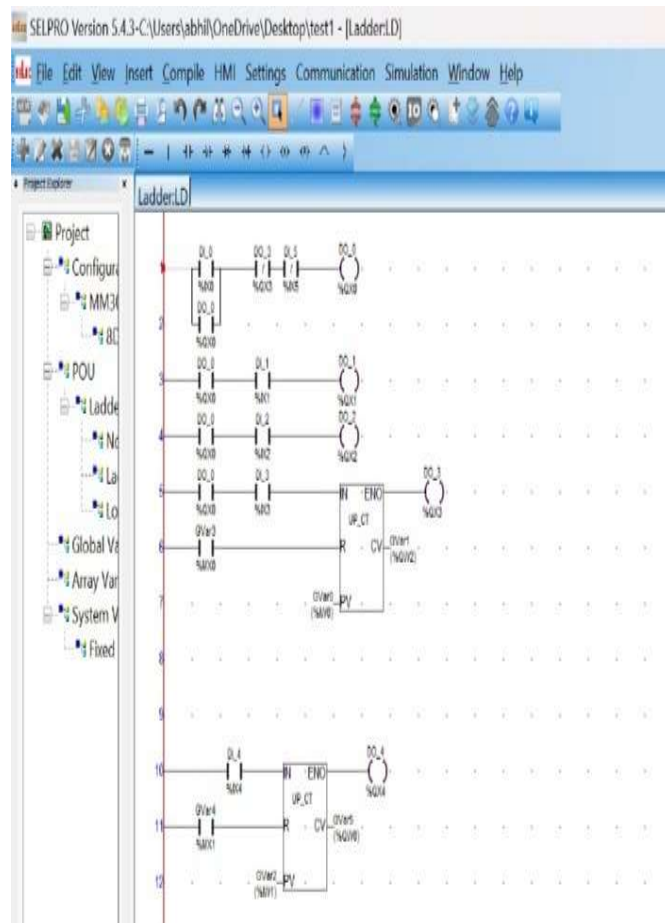
Fig 4.1 flowchart

This describes the working of the system through flowchart.

The process begins with when materials fall on the conveyor belt. The sensor output is read by the external controller (PLC) that shows the sensor is in high/low level state into useable information. Once the object is detected the conveyor turns on. When material reaches inductive sensor, it detects only if the object is metal. Then conveyor stops up to given time and gripper will push the material into chamber 1. Then conveyor

starts. If the material reaches capacitive proximity sensor it will sense the object then conveyor stops for specified time and gripper2 will push that material into the chamber 2. Cycle repeats till IR sensor goes low.

**4.1 Simulation:** Ladder diagram is used to execute the above proposed system.



## 5. RESULT

### 1. Inductive proximity sensor characteristic:

The proximity sensor is one type of inductive proximity sensor. The below graph shows the characteristic of the inductive proximity sensor.

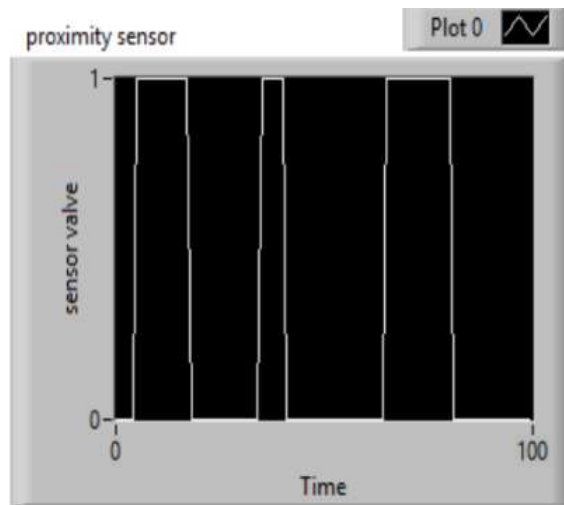


Fig. 5.1 Inductive proximity sensors characteristic

This is used to detect the metallic object on the conveyor in this project. Its detection range is 8mm. Above graph indicates sensor characteristic which give logic state as HIGH when object is within the range of 8mm then sensor detect. This is shown in graph. In graph pulses is 1. That indicate object is detected and more the pulses more the object detected. If object is not within the 8mm then it gives logic state LOW this is shown in graph as low. Generalized characteristic of inductive proximity sensors show in figure 5.2 which indicate the sensor detection is depend on size, shape of the object and depend upon the different material.

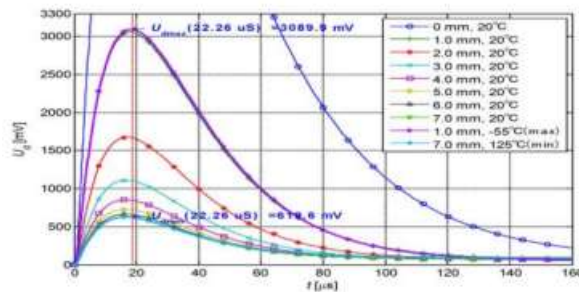


Fig. 5.2 inductive proximity sensor generalized characteristic

In figure 5.2 detection distances via different material like iron, stainless steel, brass, Aluminum, copper. In this by considering a Square material and its dimensions are area

$3.6 \times 10 \text{ mm}^2$  length (6x6) mm and height.

## 2. Capacitive proximity sensor characteristic:

This characteristic is same as inductive proximity sensor but its detection range is within 10mm. and it detects metallic and non-metallic objects.

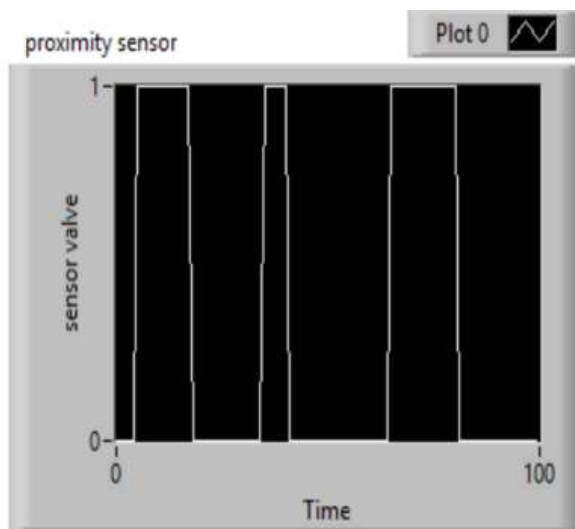


Fig. 5.3 Capacitive proximity sensors characteristic

In this sensor detection of object also depend on the dielectric strength of the material which indicate sensor characteristic of sensor with respect to material and dielectric constant for example glass is 5, paper 2.3, liquid 80 etc.

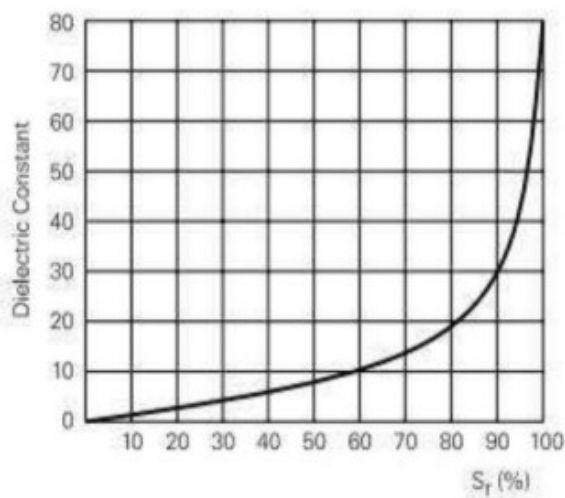


Fig.5.4 Capacitive proximity sensors characteristic (considering liquid)

In figure 5.4 as indicates the dielectric regular of a target and sensor capability to discover the material based on powerful distance of it in percentage. If sensor detection is 10mm and effective detection distance is 80% that is 8mm.





## 6. CONCLUSION

PLC controlled automatic material segregation system has been built. The system is capable of segregating materials like metal, wood, plastic successfully. The proposed system is such that it saves both time and cost. The system is suitable for small scale industries where an initial investment is low.

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