

AUTOMATIC MATERIAL SEGREGATION SYSTEM USING PLC

Bhagyashri¹, H. Prasanna Kumar²

PG Scholar(C&I)¹; Assistance Professor²

Dept. of EEE, University Visvesvaraya College of Engineering, Bangalore^{1,2}

bhagyahugge10@gmail.com¹; uvcehpk@gmail.com²

ABSTRACT: This project describes the scrap material segregation using automation system. This can be used to segregate waste in industries and domestic level. The advantage of scrap disposal reduce manufacturing cost and to minimize the raw material wastage. This paper proposes the separation of metal and nonmetal waste into respective bins; different sensors are incorporated for detecting the material along conveyor belt. Program is developed by Programmable logic controller (PLC).

Keyword: Allen Bradley PLC, DC motor, IR Proximity sensor, Relay, inductive proximity sensor, capacitive proximity sensor

I. INTRODUCTION

Automation plays an increasingly essential role in the international economic system. One of the critical software of automation in segregate the metal and nonmetal for domestic and commercial use because the charge of scrap technology continually main at the back of the price of scrap disposal. Segregation machine are better overall performance environmental, uncooked fabric wastage minimizes this outcomes is primary advantage of lowering the producing cost of cloth. Even though there are large scales industrial waste segregators present,

it's far always much better to segregate the waste at the supply itself. The benefits of doing so are that a higher excellent of the fabric is retained for recycling which means that more cost may be recovered from the waste. The occupational chance for waste workers is decreased. Also, the segregated waste can be at once dispatched to the recycling and processing plant rather than sending it to the

segregation plant then to the recycling plant. In this PLC used as automation gadget due to the fact it's far value powerful, very bendy, lessen complexity, area green. The PLC represents one of these regular controllers and it can be used for special applications and, through application is mounted in its reminiscence. Automation method is quicker, cleanser and does now not affect the ecosystem. The largest benefit of automation is that it saves exertions; it also used to save power and materials and to improve great, accuracy and precision.

The most important advantages of automation are:-

- Increased throughput or productiveness
- Increased consistency of output.
- Improved robustness (consistency), of processes or product.

II. Reduced direct human hard work prices and fees PLC SYSTEM (Allen Bradley)

A programmable logic controller, additionally called a PLC or programmable controller, is a laptop-kind tool this is used to manipulate equipment in an industrial facility. PLC's are real-time controllers with cyclic behavior. A PLC is a digitally working electronic tool which makes use of a programmable reminiscence for internal garage of instructions for implementing unique features, such as logic sequencing, timing, counting 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 controller 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 the photo

of the output variables is mapped to the real outputs. I/O interfaces:

An I/O module is a plug-in-type meeting containing circuitry that communicates among a PLC and field gadgets. These devices could be transmitting and/or accepting digital/or analog signals.

Programming languages:

Graphical languages:

- i. Ladder diagram (LD)-uses a standardized set of ladder programming symbols to put into effect control capabilities.
- ii. diagrammatic illustration of manipulate sequences in software

Text based language:

1. Instruction list – A low stage language much like the machine
 2. Structural Text- a excessive level language that allows structured programming, which means that many complex obligations can be damaged down into smaller ones or assembly language use with microprocessors.
- iii. 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.
 - iv. Sequential characteristic chart (SFC)-a graphical language that provide a

III. HARDWARE CONFIGURATION

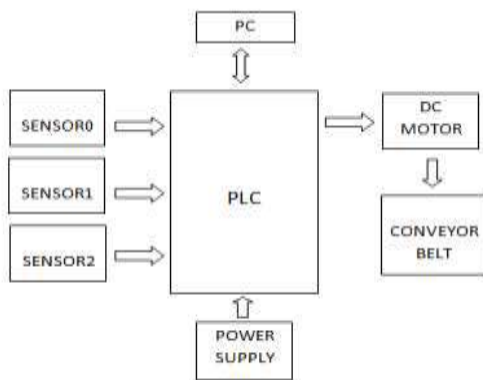


Fig.1 BLOCK DIAGRAM OF MATERIAL SEGREGATION USING PLC

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

1.1 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.

1.1.1 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, Schmitt trigger, 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 thru the loop these adjustments may be seen change in oscillation amplitude .As extra steel enters the sensing field oscillation amplitude shrinks and collapses subsequently.

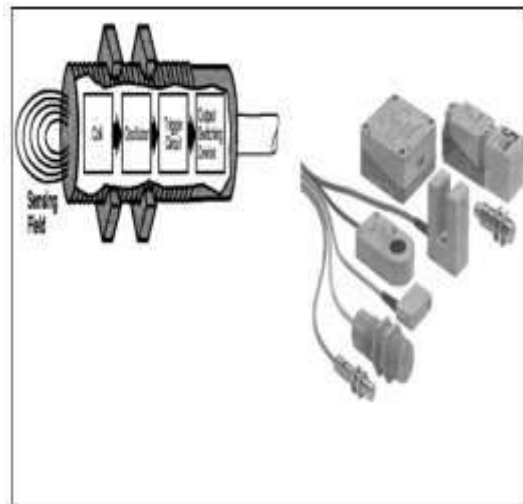


Fig1.1.2 Inductive proximity sensor

1.1.2 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 electrodes 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 oscillators 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.

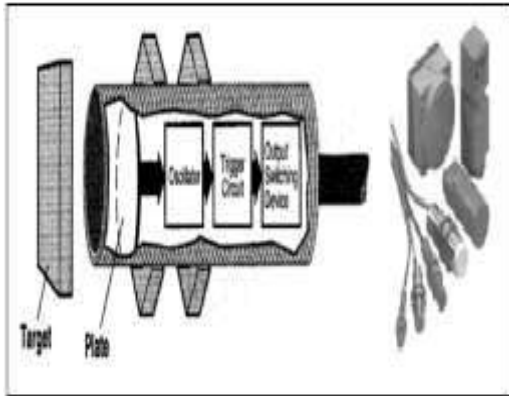


Fig1.1.3 Capacitive proximity sensor

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.

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.

IV. PROPOSED METHOD AND SIMULATION

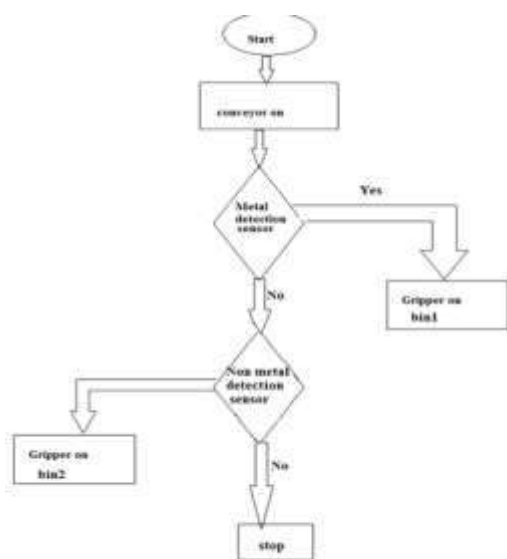


Fig 4.1 flowchart

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 the external controller (PLC) that will show 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 bin1. 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 bin 2. Cycle repeats till IR sensor goes low.

SIMULATION: Ladder diagram is used to execute the above proposed system.

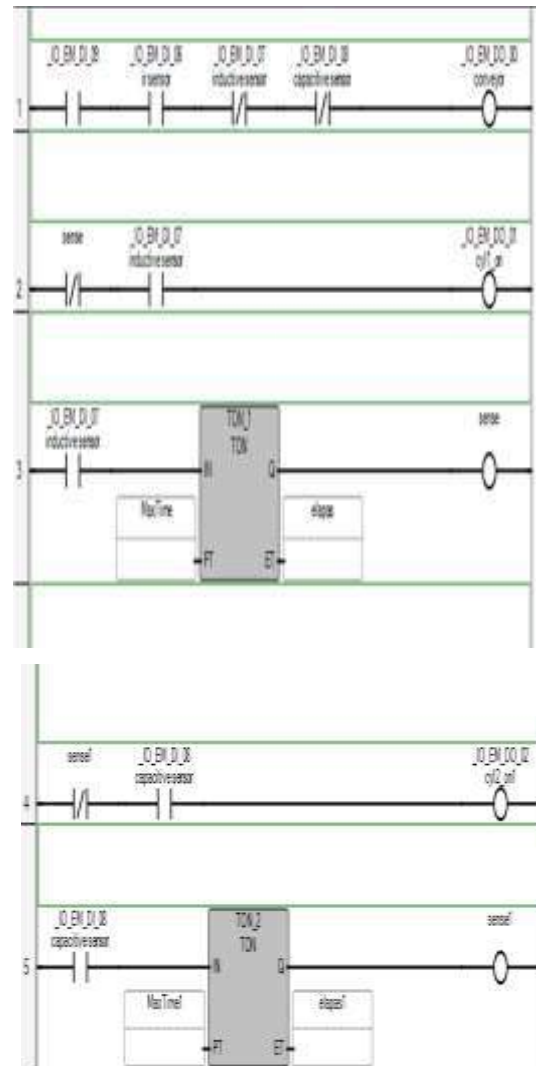


Fig4.2 Ladder diagram

V. 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

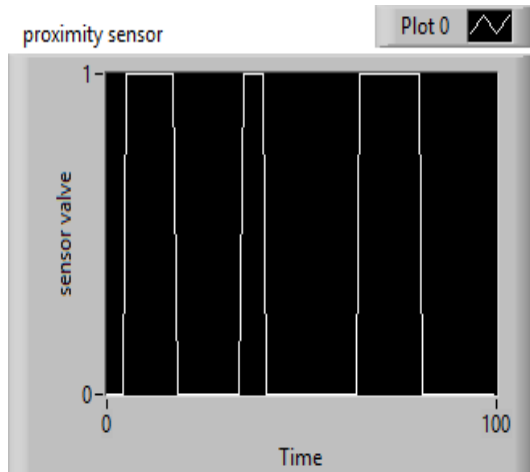


Figure 5.1 Inductive proximity sensors characteristic

This is used to detect the metallic object on the conveyor in this project .its detection range is 8mm. Above graph indicate 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 its gives logic state LOW this is show in graph as low. Generalized characteristic of inductive proximity sensor show in figure 5.2 which indicate the sensor detection is depend on size, shape of the object and depend upon the different material.

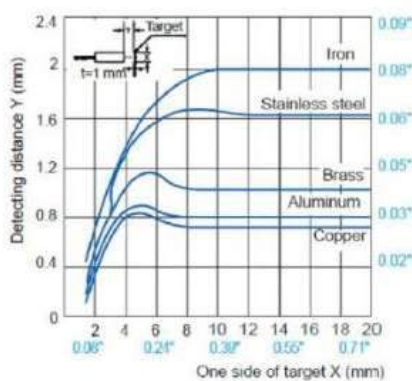


Figure 5.2 inductive proximity sensor generalized characteristic

(Different material)

In figure 5.2 detection distances via different material like iron, stainless steel, brass, Aluminum, copper. In this by considering a Square material and it dimensions are area $3.6 \times 10 \text{ mm}^{2.2}$ length (6x6) mm and height.

2. Capacitive proximity sensor

characteristic:

This characteristic is same as inductive proximity sensor but it detection range is within 10mm. and it detect the metallic and non metallic object.

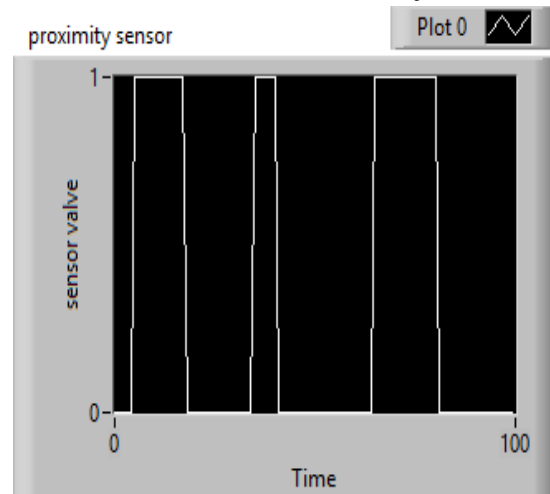


Figure 5.3 Capacitive proximity sensors characteristic

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.

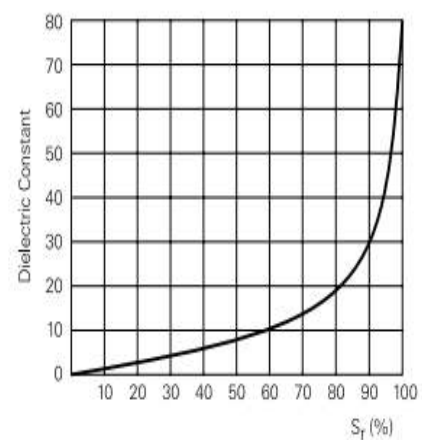


Figure 5.4 capacitive proximity sensors characteristic (considering liquid)

In figure5.4 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.

As entire setup is show below figure



Fig 5.1. Automatic material segregation system

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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