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PLC APPROACH TO DESIGN COUNTER-BASED APPLICATIONS

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Abstract
Automation provides a solution for controlling any task or process using various electronic and electrical devices. Accurate detection, monitoring, and counting of products in various processes is important in industrial applications to maintain stock data records. Accurate counting provides the proper availability of stock to maintain overstock or understock situations. It prevents from the shortage of products and also help to minimize the financial losses based on that. Requirement of particular products and its management is the main purpose behind the process of product counting. The paper aims to build a PLC-based detection and counting system for various processes. It includes detailed information regarding PLC-based hardware wiring designed for multiple processes and the ladder logic programming of the respective process.

Keywords –
PLC, Hardware components, software-based up and down counter, Proximity sensor, Metal detector, Ladder diagram, System design process.

Introduction

A programmable logic controller is used to monitor and control the designed process. Quality control, cost management, product management, production efficiency, and requirements as per needs are some of the aspects of the industry behind the stock monitoring and counting process. Accurate data records prevent excess product orders or lack of stock availability. So, the paper included the process of product detection, monitoring, and counting process. Some application requires the detection of a particular type of product for example metal detection, some application requires product counting based on the size of the product, etc., so, the paper has attempted to cover all these processes.

System Design Process

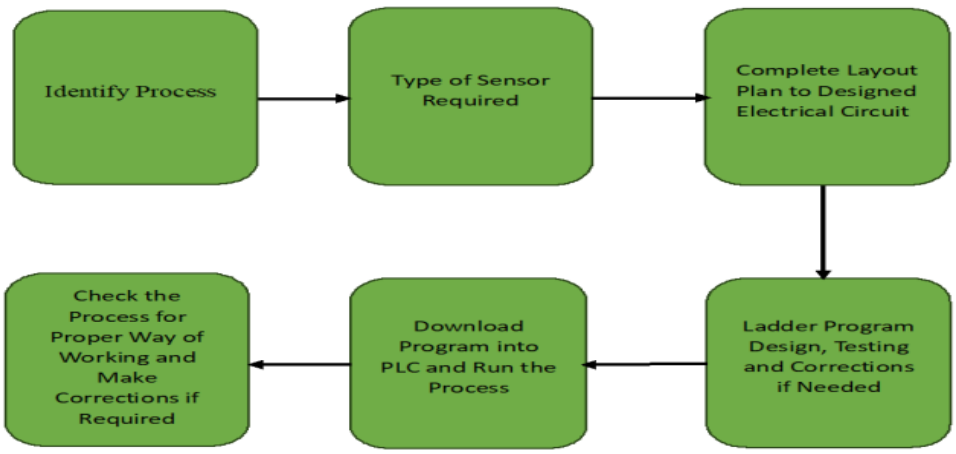

Figure – (A)

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Experimental Work

I. Incoming and Outgoing Stock Detection and Counting Process

Stock management is an important task in handling overstock and understock situations. It allows for identifying the requirements of incoming stock and recording outgoing data.

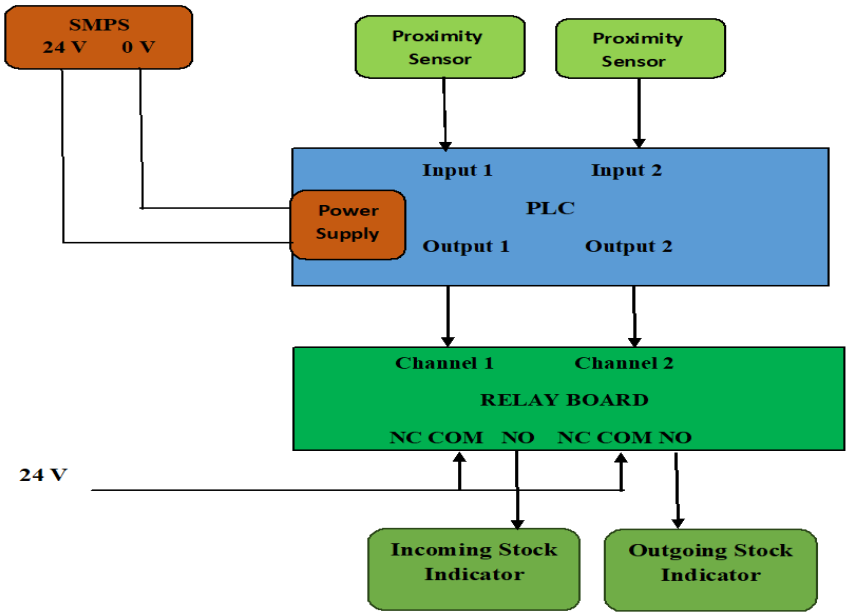

Figure 1.1

Here one proximity sensor is connected at the entry point of the place where products are stored and one proximity sensor at the exit point of the place from where products are delivered. As per the detection by the particular sensor, the up or down counter of the ladder program updates its counting process. Two indicator lamps are provided, one for incoming product indication and the other for outgoing product indication. If the sensor at Input 1 used at the entry point of the place detects the presence of the product, the indicator lamp at the relay output of channel 1 glows to indicate the presence of an incoming product. If the sensor at Input 2 used at the exit point of the place detects the presence of the product, the indicator lamp at the relay output of channel 2 glows to indicate the presence of the outgoing product, and the counters (up counter and down counter) works according to its mode of operation.

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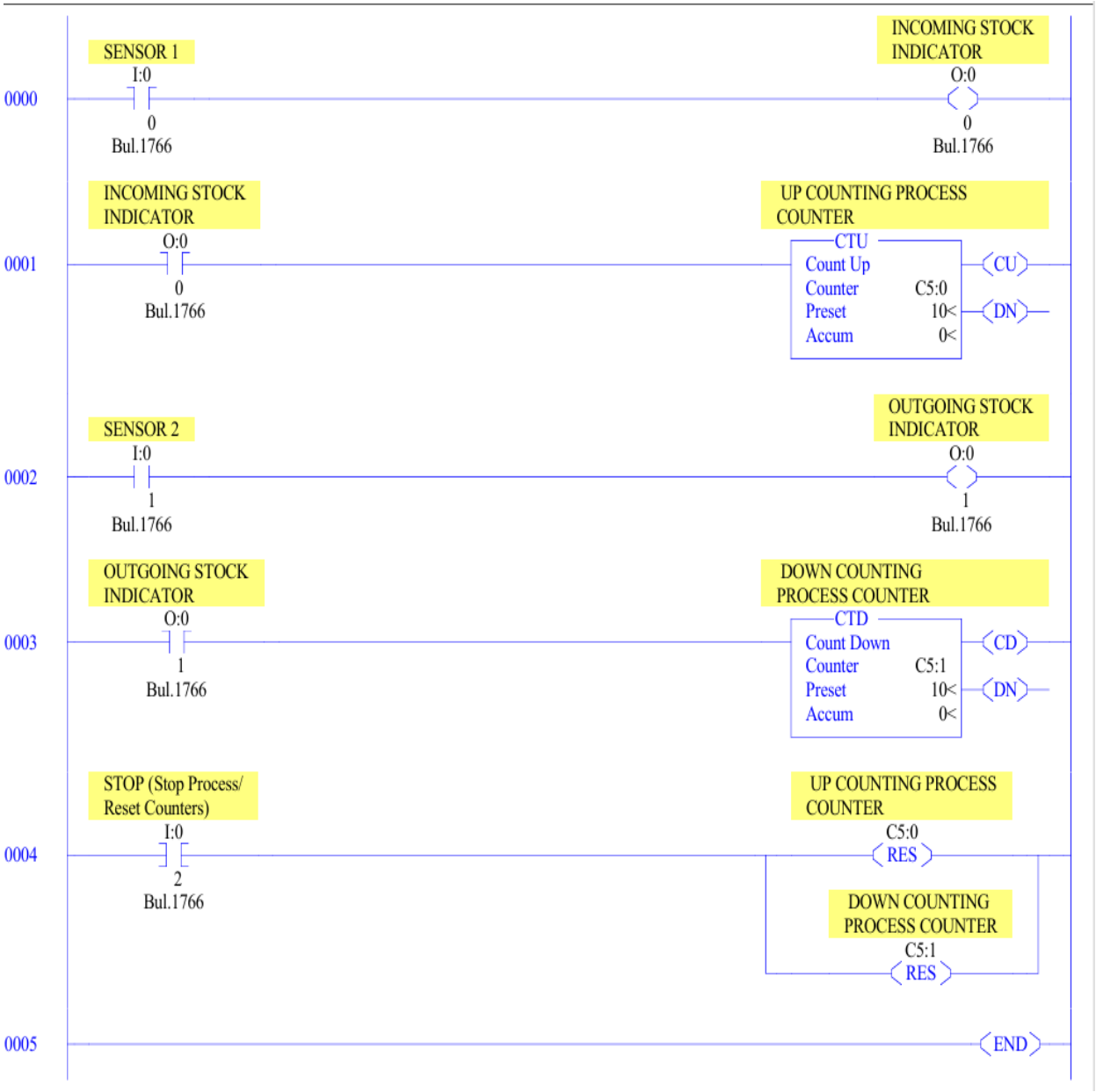

Figure 1.2 - Ladder Diagram

In this ladder program (Figure 1.2), two different counters (C5:0 and C5:1) are used. The up counter C5:0 is used for incoming stock counting while the down C5:1 is for outgoing stock counting. Counter C5:0 increases its value as the incoming stock is detected and shows as +1, +2, +3, +4, etc., and maintains the record of incoming stock. The counter C5:1 increases its value as the outgoing stock is detected and shows as -1. -2, -3. -4 etc. and maintained the record of outgoing stock. So, by observing two counters' data, the exact available stock can be determined.

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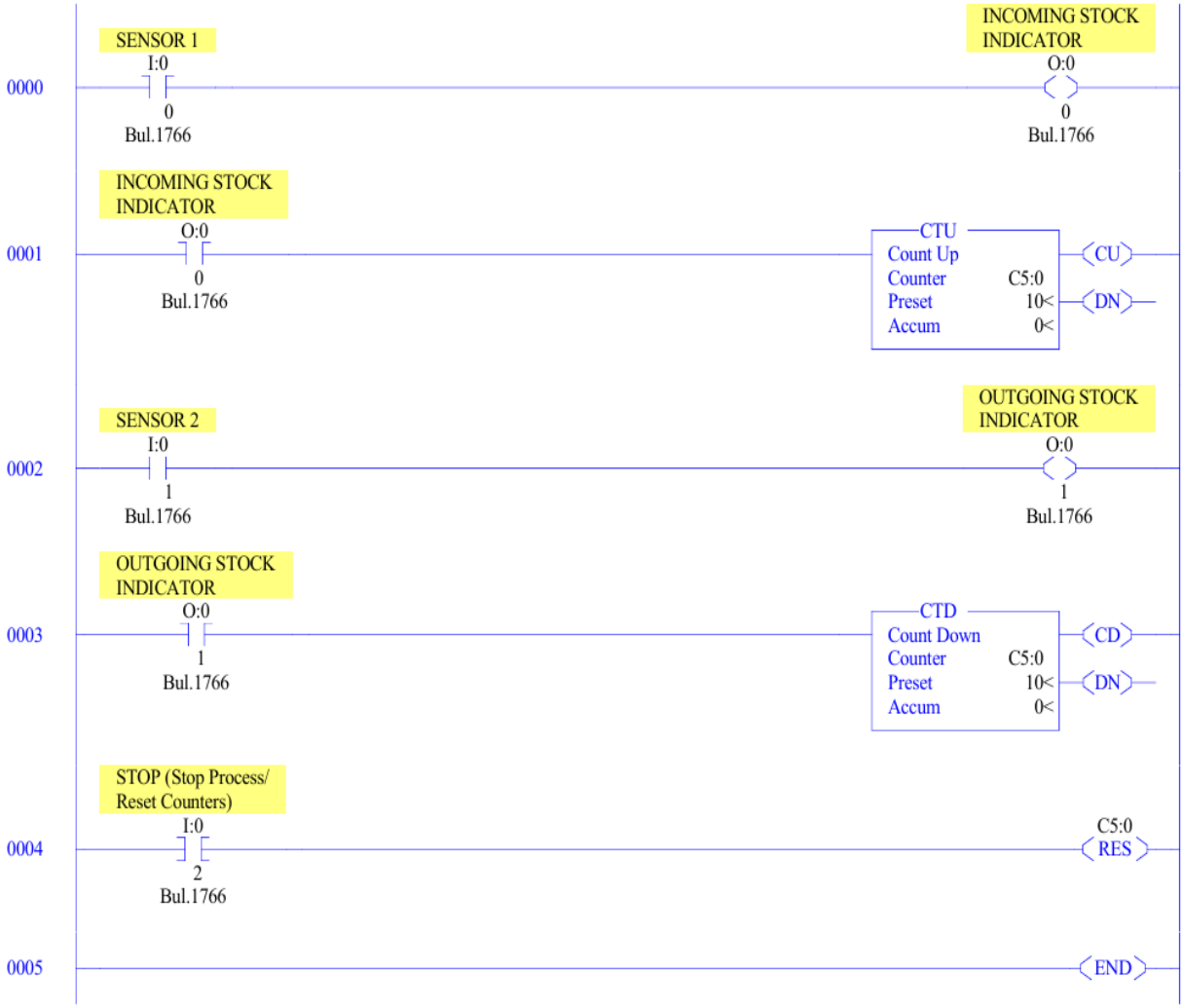

Figure 1.3 - Ladder Diagram

In this ladder program (Figure 1.3), the same counter C5:0 is used in up counter (CTU) and down counter (CTD) mode. Counter C5:0 (CTU) increases its value as the incoming stock is detected, and counter C5:0 (CTD) also increases its value at the same time.

When the outgoing stock is detected, the counter C5:0 (CTD) decreases its value while the C5:0 (CTU) also decreases its value. So, by observing data of any counter, the availability of stock can be determined.

II. Size Based Product Counting

Here the two proximity sensors are used and mounted in such a way that, sensor 1 only detects thepresence of small-size products while both sensors (sensor 1 and sensor 2) detect the presence of large-size products. The ladder programming is done, so that when only sensor 1 detects the product, the indicator lamp at output 1 of PLC glows to indicate the presence of small-size product detection.

When sensor 1 and sensor 2 both detect the product, the indicator lamp at the output 2 of PLC glows and indicates the presence of large-size products. The two counters are used in programming, one to count the number of small-size products and another for large-size products.

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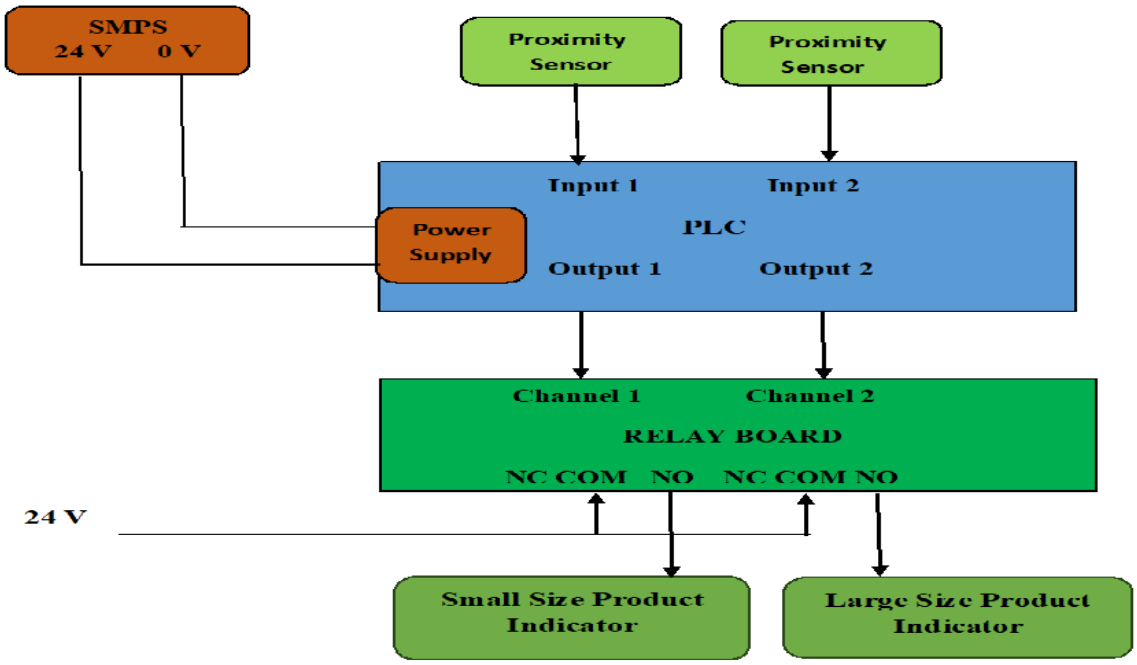

Figure 2.1

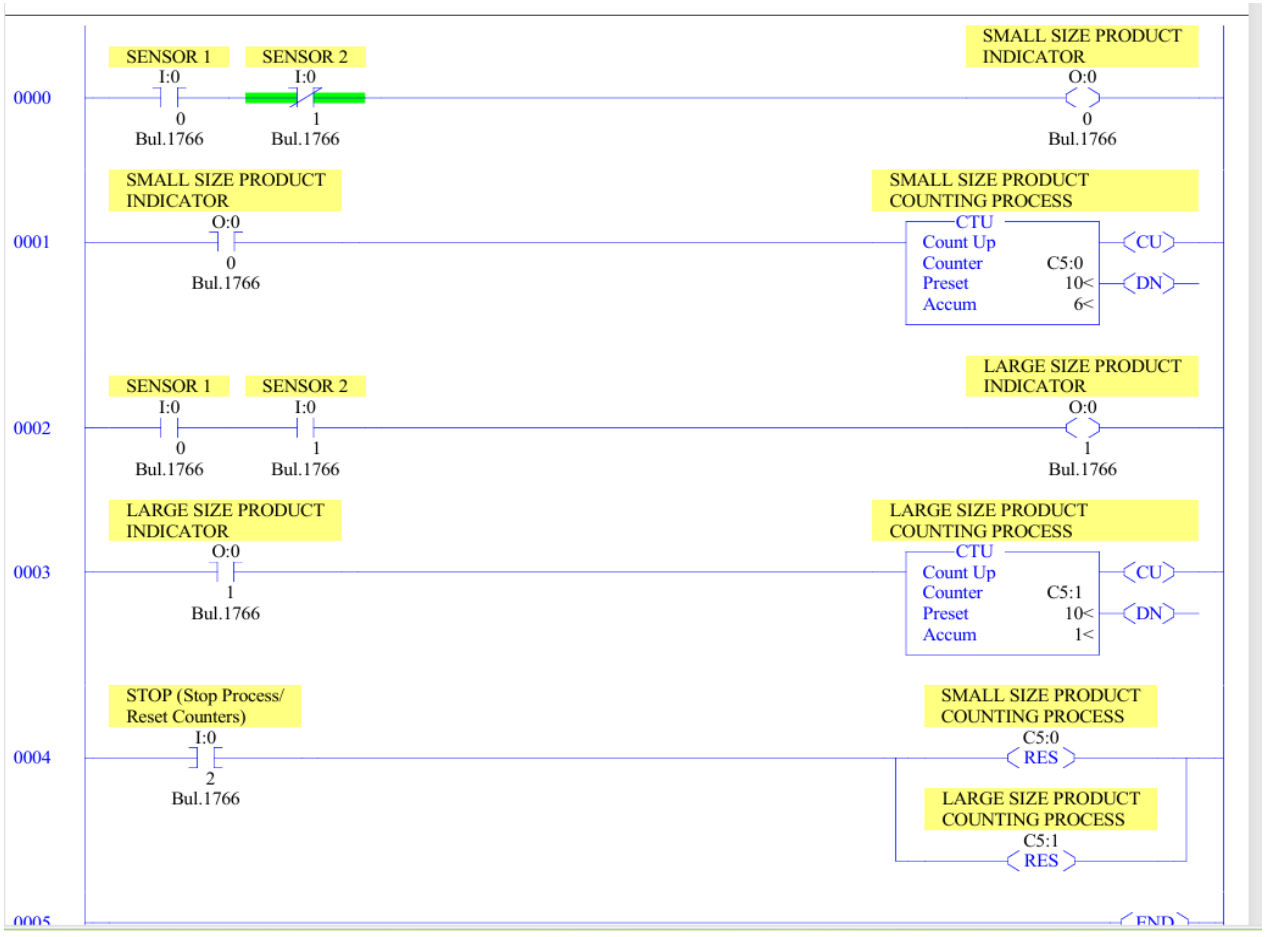

Figure 2.2 - Ladder Diagram

III. Metal Detection and Counting Process

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Metal detection is an important task in many industries for security or safety purposes. This task aims to build a PLC-based metal detection and counting system that can detect the presence of metals coming into contact. The basic objective of a metal detection system is to find the presence of metal. The various reasons for the metal detection process, include protecting machinery, protecting consumers, ensuring food safety, and achieving security, etc.

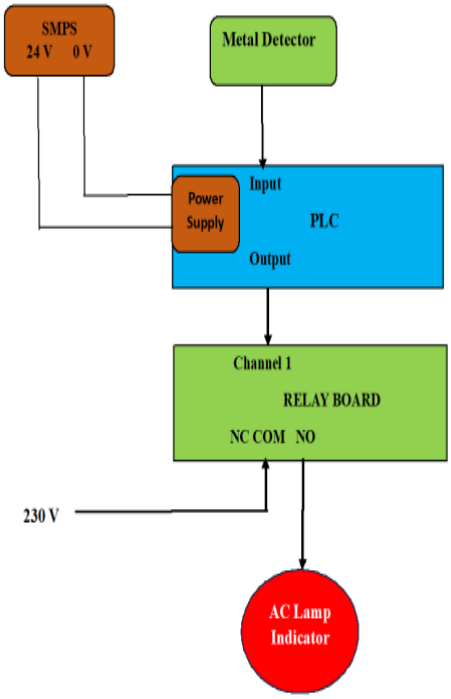

Figure 3.1 - Metal Detection and Indication With AC Lamp

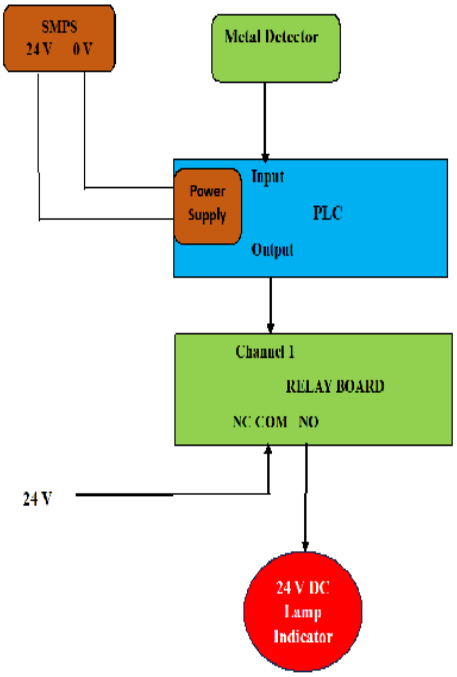

Figure 3.2 - Metal Detection and Indication with 24 V DC Lamp

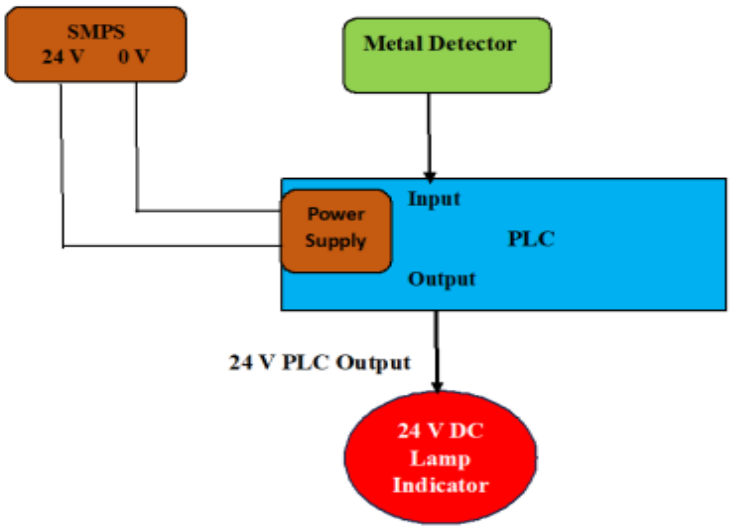

Figure 3.3 Metal Detection and Indication with 24 V DC Lamp without using a Relay

Industrial Engineering Journal
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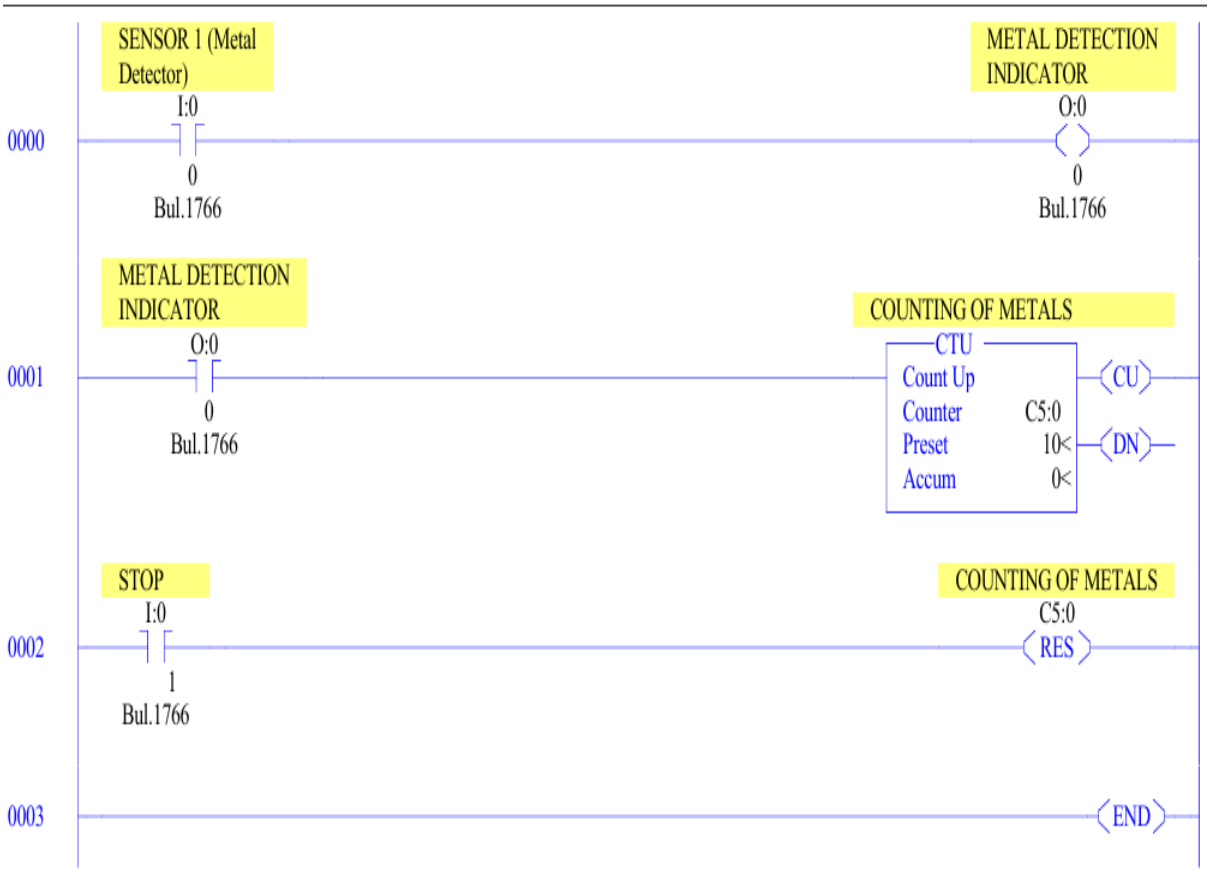

Figure 3.4 Ladder Diagram

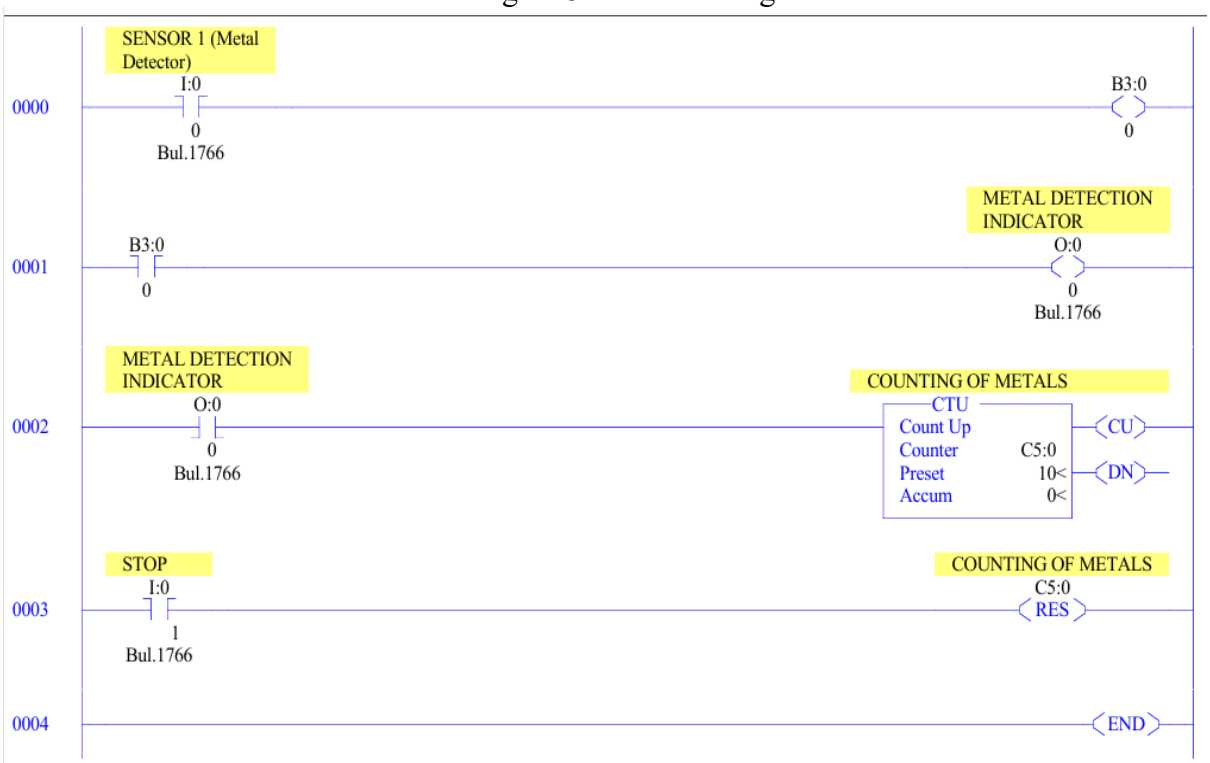

Figure 3.5 - Ladder Program (Using Memory Bit)

Industrial Engineering Journal
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In this program (Figure 3.4 / Figure 3.5), a sensor detects metals coming in contact, and metal detection is indicated by an indicator lamp, and starts the counting process using the up counter in the ladder program. The STOP button is used to reset the counter.

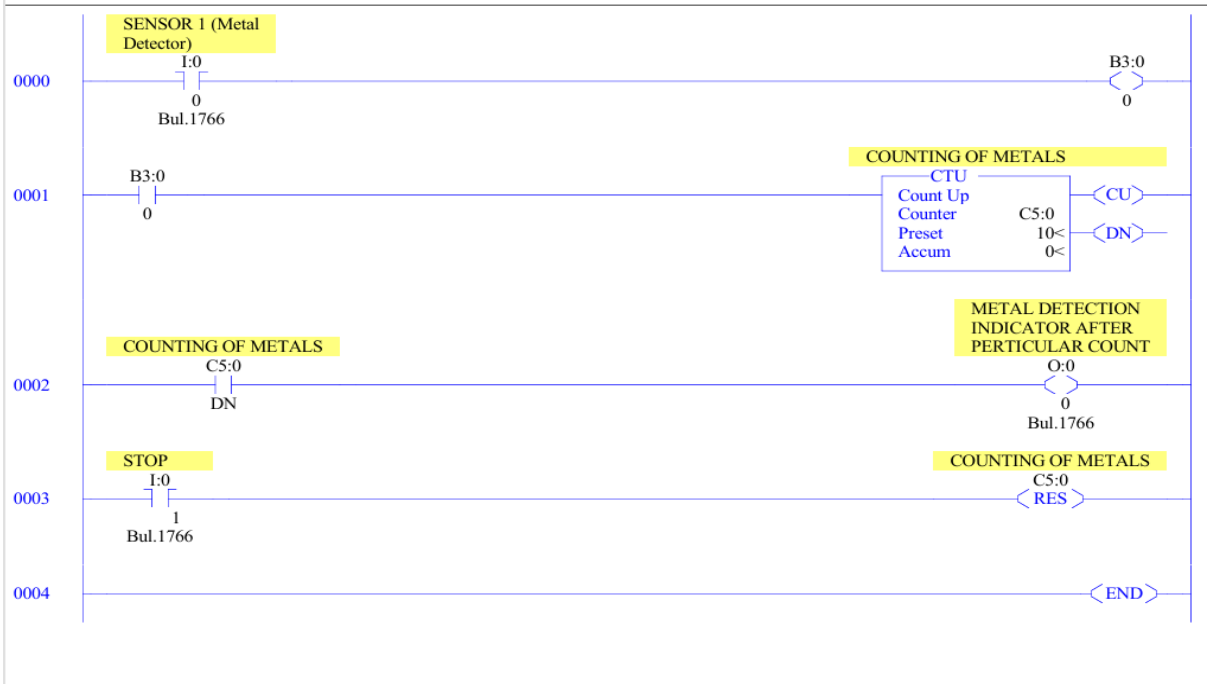

Figure 3.6 – Ladder Diagram

In this program (Figure 3.6), a sensor detects the metals coming in contact, and the up-counter used in the ladder program starts counting. A counting limit is provided for the counter, as the desired count is reached, the NO DN bit of the counter becomes the NC bit and it will ON the output in the form of an indicator lamp.

The STOP button resets the counter and restarts the process after the desired quantities are counted. This program is useful if anyone wants to make groups of particular quantities. Due to this the counting process is easy for the working environment.

IV. Designed PLC Based Control Panel to perform Various Processes or Operations

Outcome

- Low-cost designing of various operations using PLC is possible.
- Monitoring, counting, and controlling various processes are possible by changing the ladder logic program.
- Provide automatic monitoring of the process.

- A consistency in processing is possible.

Conclusion

The hardware designs for various PLC-based processes are constructed and tested by running a respective ladder logic program using RSLogix 500 and RSLinx Classic programming and communication software.

The designed PLC-based circuits for particular processes are run successfully, and errorless operation is possible.

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