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# Sorting Mechanism Using Plc and HMI

Roshan Agarwal, Shrutika Sathe, Prof. Mrs. Rajani Hardas

Department of Electrical, PES's Modern college of Engineering, Mandya, India

**ABSTRACT:** Sorting of products in an industry is a tedious industrial process, which is generally carried out manually. Continuous manual sorting creates quality consistency issues. Segregation based on different characteristics like weight, colour, type require different equipment for weighing and then separating. The proposed of the project is an efficient method which uses load cell, inductive sensor and TCS 230 colour sensor for identifying and segregating on the basis of weight, colour and type (metal or non-metal) of object and PLC to control the overall process of sorting two types of objects. The system rejects and discards objects that are not of required characteristics by pushing them out of conveyor line using a flipper mechanism. A circular container, having three partitions is used to collect objects of three different colours. Two conveyor belts were used, each controlled by separate DC motors. The first belt is for placing the product to be analysed by the load cell and inductive sensor, which also contains a colour sensor at the end for one type of segregated object and the second belt also has a colour sensor for the components separated by the load cell and inductive sensor.

## I. INTRODUCTION

Automation is the use of control systems for handling different processes and machineries to replace human efforts. Automated systems generally use complex algorithms which increase the cost of the design and the power consumed. But this not only reduces manual efforts, time consumed, but gives more time to work on factors like aesthetics. Using automation also prevents danger which might occur when humans are made to work in hazardous environments. Thus, use of automation is effective in manufacturing industry. Sorting based on colour, weight and type is done in many industries to ensure the quality of the object is consistent and up to the mark. Automated sorting also reduces the labour cost and the production time. The error caused due to human negligence are avoided by the use.

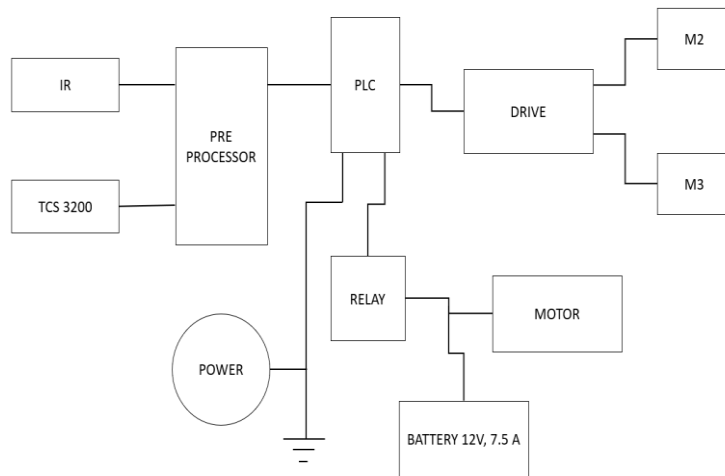
## II. METHODOLOGY

According to national electrical manufacturers association, programmable controller is a digitally operated electronic system, designed for use in industrial environment, which uses a programmable memory for the internal storage of user oriented instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic to control, through digital or analog inputs and outputs, various types of machines or processes. This section, describes the block diagram of the proposed system. Figure 1 shows the proposed block diagram based on which the interfacing of various inputs and outputs are done with the PLC.

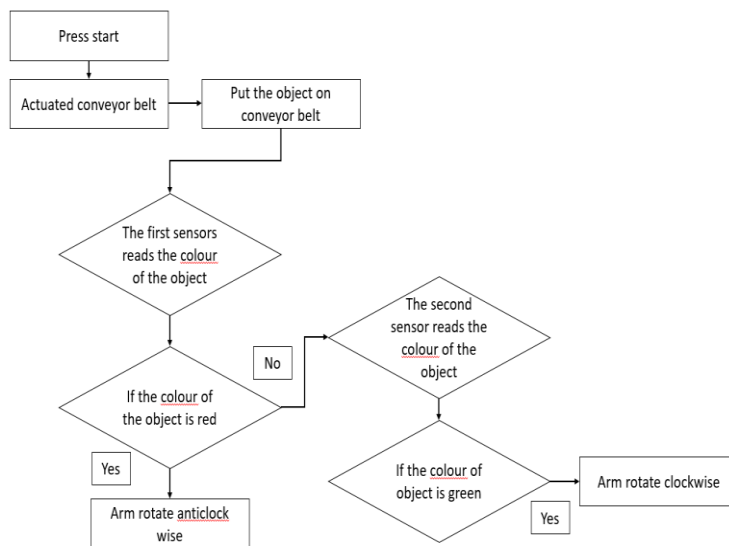
According to the previous mentioned figure, there are three main systems involved. One is the input module to which the object detecting, metal, wood, and size detecting sensors are interfaced. Second one which is the heart of whole system is PLC which processes the signals from input modules and performs actions according to the logic diagram written for it. The last one is the output module interfaced with the output giving devices.

In our project we have conveyor belt. Function of the conveyor belt is just to feed different colour objects to a will take these objects in Front of metal identification station. Main conveyor is run by phase AC induction motor controlled by Variable Frequency Drive interfaced with PLC. The system Assembly consist of two to three racks or holing stands.

According to the requirement, 1<sup>st</sup> one holds start sensor Which will start the conveyor and 2<sup>nd</sup> and 3<sup>rd</sup> stands hold 1 sensor each which are arranged to measure object's Colour. If place two sensors at a particular distance in such a Way, if object's front and back edges cut the sensor lines at A same time, then we can also measure the object's width. The push assembly consists of DC geared motor energized. By manipulated power supply.



**Block Diagram**



**Description of block diagram :**

- According to the PLC module , there are three main systems involved. One is the input module to which the object detecting, metal and non metal and colour detecting sensors are interfaced.
- Second one which is the main part of the system is PLC which processes the signals from input modules and performs actions according to the logic diagram written for it.
- The last one is the output module interfaced with the output giving devices.
- In this prototype the object will first come on conveyer belt and then it will pass through the inductive sensor. the conveyar belt is driven by 1ph ac induction motor.
- The inductive sensor will give the input to the plc then the object will move to the tcs-3200(colour sensor).the colour sensor will sence the colour of object and then send the input to the plc.
- If the object is red then the arm will pick the object to the box 1. If the object is green and it will sorted by box 2.
- This whole process is controlled by ladder diagram in PLC software.
- The power supply needed for plc is 24 V AC
- The length of conveyor belt is around 60 to 70 cm
- The whole process of sorting is mounted on the conveyor chassis which gives the stabily to the system.

### III. HARDWARE AND SOFTWARE

- INFRARED SENSORS
- WIPER MOTOR
- HMI PORT
- DC SOCKET
- LM 7812
- RELAY
- SUPPLY
- WIRES
- LED
- OBJECT DETECTOR
- COLOR SENSORS
- PREPROCESSOR
- PICKER
- DC MOTOR

Software – Window Based Select software for ladder programming.

Applications:

Robots can be used in numerous industries and hazardous environment, where it is risky for humans to work. It has application in material handling systems and manufacturing industries like.

- Food industry
- Agricultural products scaling and grading
- Sorting
- Pharmaceutical
- Handling biomedical waste bags
- Airport

### IV. FUTURE SCOPE

- Integration of Machine Learning: Incorporating machine learning algorithms into the sorting machine can enhance its object recognition capabilities. By training the system with a large dataset of different objects, it can learn to classify items more accurately, even when faced with variations in shape, size, or appearance.
- Advanced Sorting Algorithms: You can explore the development and implementation of more sophisticated sorting algorithms. These algorithms can optimize the sorting process by considering multiple criteria simultaneously, such as colour, size, weight, or material composition. This can lead to further improvements in efficiency and accuracy
- Conveyor System Optimization: Evaluate and optimize the conveyor system to maximize throughput and minimize jams or bottlenecks. This could involve implementing intelligent conveyor control mechanisms, such as variable speed control or automated diversion systems, to ensure smooth and efficient movement of objects.
- Expansion of Sorting Criteria: Consider expanding the sorting criteria to accommodate a wider range of parameters. For example, you could incorporate additional sensors or vision systems to sort objects based on attributes like texture, transparency, or barcode/QR code recognition.
- Integration with Centralized Control Systems: If applicable, explore integrating the sorting machine with centralized control systems, such as Manufacturing Execution Systems (MES) or Enterprise Resource Planning (ERP) systems. This integration can enable real-time data exchange, production monitoring, and better coordination with other processes within the organization.
- Remote Monitoring and Maintenance: Implement remote monitoring and maintenance capabilities for the sorting machine. This could involve integrating remote access and diagnostic features, allowing technicians to monitor performance, troubleshoot issues, and perform maintenance tasks remotely, reducing downtime and improving overall equipment effectiveness.

## V. CONCLUSION

- **Successful Automation:** The project demonstrates the successful implementation of automation using a PLC. The sorting machine is able to efficiently and accurately sort objects based on specified criteria, reducing the need for manual intervention and improving productivity.
- **Improved Efficiency:** The PLC-based automatic sorting machine has significantly improved the efficiency of the sorting process. It can handle a larger volume of items compared to manual sorting methods, reducing labour costs and increasing overall throughput.
- **Enhanced Accuracy:** By using sensors, actuators, and precise programming, the sorting machine achieves a high level of accuracy in classifying objects. This reduces errors and inconsistencies that can occur with manual sorting, leading to improved quality control.
- **Flexibility and Adaptability:** PLC-based systems offer flexibility in terms of reprogramming and reconfiguring the sorting machine for different sorting criteria or object types.
- **Cost Savings:** The automated sorting machine project could have resulted in cost savings for the organization. By reducing labour requirements, minimizing errors, and streamlining the sorting process, the project may have contributed to overall cost reduction and improved operational efficiency.

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