Automated Packaging and Sorting Station with Quality Check

Based on Factory IO Simulation

Sina Javadi
Department of Electrical Engineering
School of Electrical and Computer Engineering, University of Tehran
Tehran, Iran
sinajavadi@ut.ac.ir/sinajavadiut@gmail.com

Abstract

This document presents a simulation-based project implemented in Factory IO, aimed at automating a packaging and sorting station with integrated quality control. The system identifies defective products, separates metallic parts from plastic ones, and counts each category efficiently. Using sensors, pushers, and programmable logic control (PLC), the project simulates a real-world manufacturing scenario with an emphasis on modularity and reliability. This setup offers a scalable model for automation learning and industrial prototyping.

I. Introduction

In modern manufacturing systems, automation plays a vital role in increasing efficiency and ensuring quality. One common challenge in such environments is the need to sort and filter different types of products based on their quality or material type. This project simulates a production line using Factory IO that addresses such needs by detecting defective products, separating metallic and plastic items, and tracking the number of each. The simulation leverages programmable logic controllers (PLCs) to implement intelligent control logic based on real-time sensor input and timing mechanisms. This report outlines the logic, architecture, and behavior of the system in detail.

II. System Assumptions

The project is designed under the following assumptions:

- The factory produces two main types of products: blue plastic doors and metal doors.
- Any defective product (bad box) is a cardboard box that should be removed early in the production line.
- Metal doors must be separated from plastic doors at a later stage of the conveyor.
- All sorting is done via sensors and actuators without manual intervention.

III. Production Line Workflow

The main conveyor transports products through different stages:

1) At the beginning of the line, a retroreflective sensor detects bad boxes. These boxes are taller than the doors, which allows detection based on height. When a bad box is detected, a pusher is activated (with delay) to transfer the defective item to a side conveyor.
2) After defective products are removed, a vision sensor checks for metal doors. When a metal object is detected, another pusher is triggered to remove it from the main conveyor.
3) Blue plastic doors continue to the end of the main conveyor without intervention, assuming any product not removed is valid and plastic.

IV. Control Logic and PLC Design

The system relies on PLC-based digital logic with the following components:

- Retroreflective Sensor: Constant high output (1) unless obstructed by a tall object (bad box), causing output to go low (0).
- NOT Gate: Used to invert sensor output for logical consistency.
- SR Latch: Holds the detection signal long enough for the pusher to be triggered accurately.
- TON Timer: Introduces delay after detection to synchronize actuator movement with object arrival.
- Pushers: Pneumatic or electric actuators used to divert defective or metallic items from the line.
- CTU Counters: Increment counters each time a product is detected and categorized, allowing real-time tracking of quantities.
- Reset Switches: Reset the counter values to 0 for a new production cycle.

A second TON is also used to retract the pushers after a delay once the item is successfully removed from the main conveyor.

V. Sensors and Devices

Three key sensors are used:

- Retroreflective Sensor: Detects tall bad boxes at the start of the line.

- Vision Sensor (1): Recognizes metallic objects and signals for removal.
- Vision Sensor (2): Located at the end of the line to count remaining plastic doors.

Additionally, curved belt conveyors are used to direct sorted products to their respective output lanes.

VI. Project Structure and Files

The project includes the following components:

- CA: Factory IO simulation file containing the production line model.
- Diagram1: System design and block diagram used for planning and documentation.
- Report: A Word-based document that includes screenshots and step-by-step documentation.
- Documentation: A PDF version of this LaTeX-based document for official submission or sharing.

VII. Conclusion and Future Work

This project showcases the integration of digital control systems with sensor-driven automation in a simulated environment. It highlights how different technologies can be combined to achieve a reliable and efficient sorting process.

For future enhancements:

- Add RFID or barcode systems for more specific product tracking.
- Implement feedback systems for closed-loop control and better fault handling.
- Include machine learning vision systems for defect detection beyond simple height or material type.

The current setup is fully modular and provides a strong foundation for advanced automation training and testing.