

Two-Station Manufacturing Handshake

Create a safe request-ready-transfer-confirm handshake between two connected workstations.

Customer Orion Robotics	Department Systems Integration	Difficulty Advanced	Time 2-3 class periods
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Production Goal: Exchange parts safely between two automated stations.

Background

Orion Robotics is connecting two manufacturing cells. Station A must never release a part until Station B is ready, and Station B must confirm receipt before Station A begins the next cycle. A failed signal could damage equipment or lose a product.

Learning Objectives

- Design machine-to-machine communication logic
- Represent a process with states and flowcharts
- Program confirmation and timeout behavior
- Validate communication under normal and fault conditions

Equipment

- Two connected VEX CTE workcells or a simulated two-station setup
- Object sensors
- Conveyors
- Signal tower
- Python projects
- Engineering notebook

Student Instructions

- 1 Define four signals: request, ready, transfer complete, and receipt confirmed.
- 2 Create a sequence diagram showing which station sends each signal.
- 3 Program Station B to announce ready only when its receiving zone is clear.
- 4 Program Station A to wait for ready before releasing a part.
- 5 Program Station B to confirm receipt after its sensor detects the part.
- 6 Add a timeout that stops both stations if confirmation does not arrive.
- 7 Run five normal transfers.
- 8 Simulate a blocked receiving zone and a missing confirmation; verify safe response.

Engineering Requirements

- Complete five consecutive normal transfers
- Never release into an occupied receiving zone
- Stop safely after a communication timeout
- Provide visible fault indication on the signal tower

Constraints & Safety

- No assumptions based only on elapsed time
- Each transfer requires positive confirmation
- Stations must start from a documented reset state
- Fault testing must use approved simulations only

Deliverables

- Handshake state/sequence diagram
- Station A and B code
- Normal and fault test log
- Reset procedure
- Reflection

Reflection Questions

- 1 Why are both ready and receipt signals needed?
- 2 What could happen if one station resets unexpectedly?
- 3 How did the timeout improve safety?
- 4 How would a PLC implement this handshake?

Engineering Support

Engineering Tip

Name signals by meaning and state, such as `receive_zone_clear`, rather than vague names like `flag1`.

Common Mistake

A single ready signal is not enough if the sending station never verifies that the product arrived.

Stretch Goal

Coordinate three stations and include a line-wide stop and reset procedure.

Career Connection

Controls engineers design handshaking logic between robots, PLCs, conveyors, and inspection machines.

Before You Submit

- Notebook evidence included
- Requirements checked
- Testing documented
- Reflection completed