ADM Unit 3 | Mission Brief 3.5

Automated Circuit Assembly Cell

Design a virtual workcell that transports, positions, and verifies components for circuit assembly.

Customer	Department	Difficulty	Time
Satellite Electronics Systems	Automation Integration	Advanced	3 class periods

Production Goal: Simulate a complete component assembly and inspection cell.

Background

A satellite electronics supplier wants to automate a simplified circuit-board assembly process. The cell must deliver parts in order, avoid collisions, and include a quality-verification step before the product exits.

Learning Objectives

- Integrate robot, conveyor, and sensor behavior
- Sequence a multi-step automated assembly
- Use simulation for system verification
- Document interfaces and production logic

Equipment

- Digital twin environment
- Virtual robot and conveyors
- Virtual sensors/inspection point
- Component models
- Python or simulation logic
- Engineering notebook

Student Instructions

1. Define a three-component assembly sequence.
2. Create a layout showing incoming parts, assembly position, inspection point, and exit.
3. Develop a state or flow diagram for the complete cycle.
4. Program the robot to retrieve and place components in the required order.
5. Add conveyor logic that prevents a new board from entering while assembly is active.
6. Add a simulated inspection decision with pass and reject routes.
7. Run ten simulated boards and record failures and cycle times.
8. Revise the layout or logic until ten consecutive boards pass the system test.
9. Prepare an interface diagram showing signals between devices.

Engineering Requirements

- Complete ten consecutive simulated assemblies
- Place all components in the correct order
- Prevent simultaneous use of an occupied zone
- Route failed inspection results to reject

- Provide a documented reset procedure

Constraints & Safety

- Use the provided virtual equipment set
- No overlapping robot/conveyor motion in unsafe zones
- All device interactions require a defined signal or condition
- Final program must include comments

Deliverables

- Workcell layout
- State/flow diagram
- Simulation program
- Ten-board test log
- Device interface diagram
- Reflection

Reflection Questions

1. Which interface was hardest to coordinate?
2. Where was a buffer needed?
3. What physical tolerance would matter most?
4. How would a real camera inspect the assembly?

Engineering Support

Engineering Tip
Define device ownership of each zone so two machines never command the same space at once.

Common Mistake
Programming each device separately without a shared state model often creates deadlocks or collisions.

Stretch Goal
Add a rework loop that returns one failed board for a second assembly attempt.

Career Connection
Systems integrators combine robots, conveyors, sensors, and inspection equipment into complete production cells.

Before You Submit

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