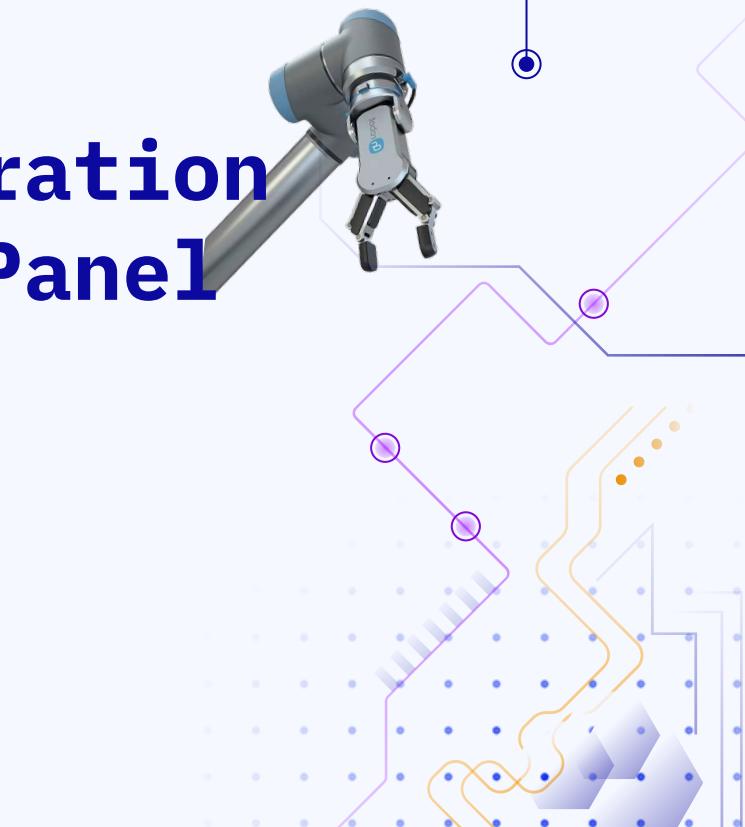


Human Robot Collaboration For Ergonomic Door Panel Assembly

Sofie, Sophie, Lærke og Ida



Agenda

01

Problem and solution

02

Design and implementation

03

GUI, database and tests

04

Goals and limits

Demonstration



01 Problem and solution

Lærke Holst

Problem and solution

Problem

- **Ergonomic Problem**

Manual handling of heavy door panels causes ergonomic strain.

- **Industrial Constraint**

High product variability limits the use of full automation.

Solution

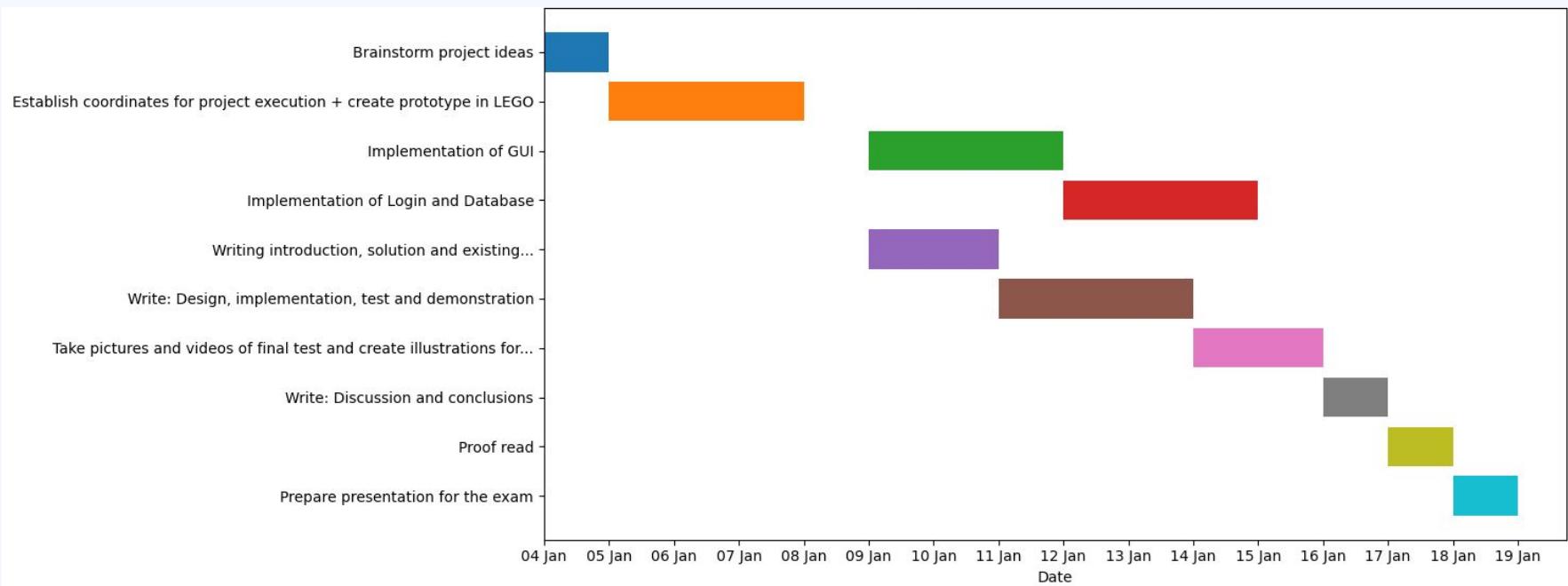
- **Proposed Solution**

A collaborative robot supports lifting and positioning.

- **Expected Benefits**

Improved ergonomics, stability, and assembly quality.

Milestone

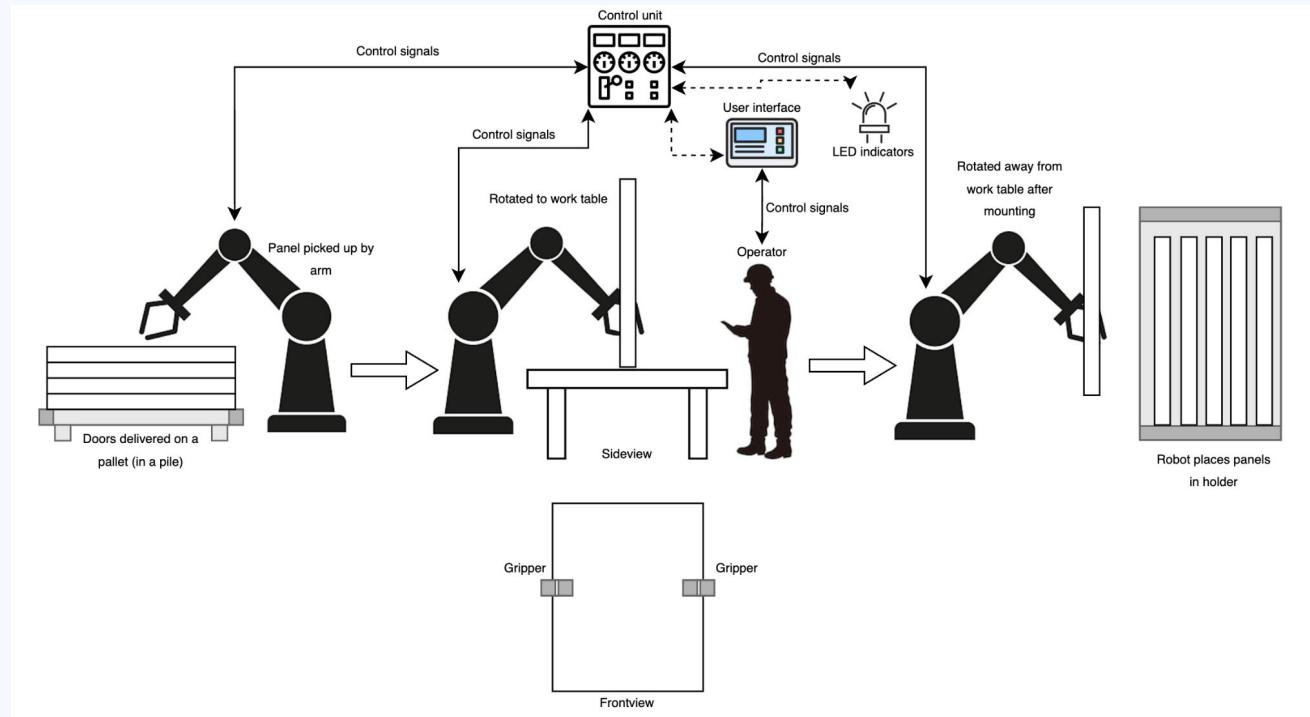


02

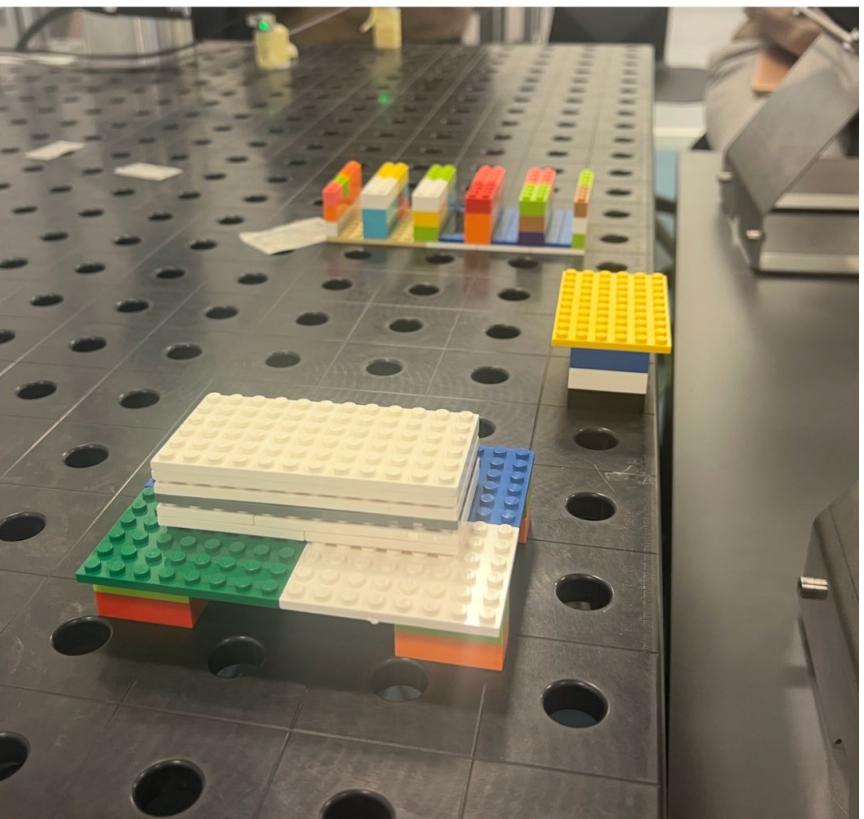
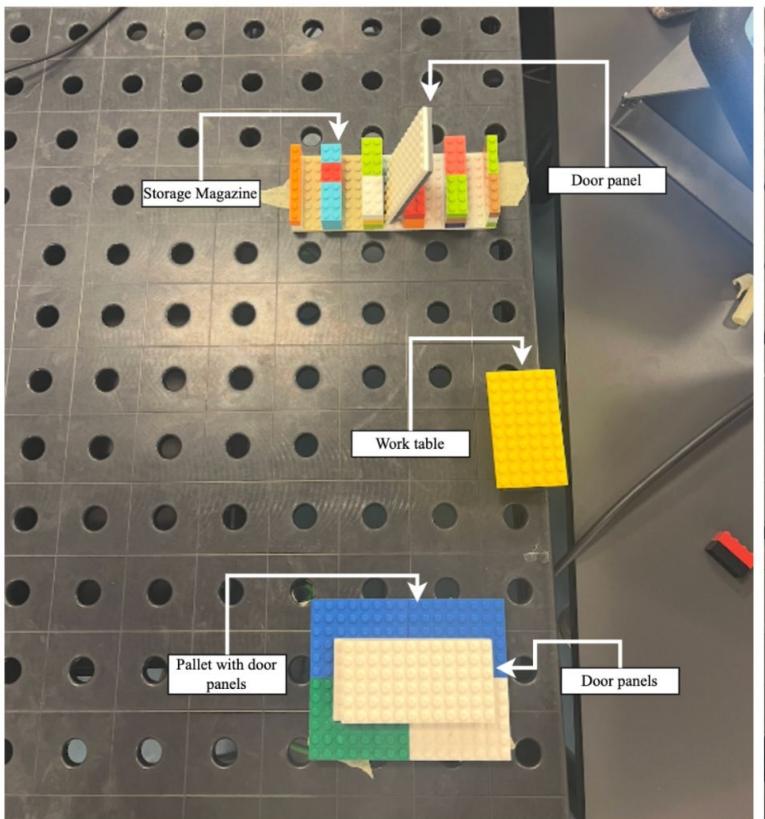
Design and implementation

Ida Ankerstjerne

Concepts



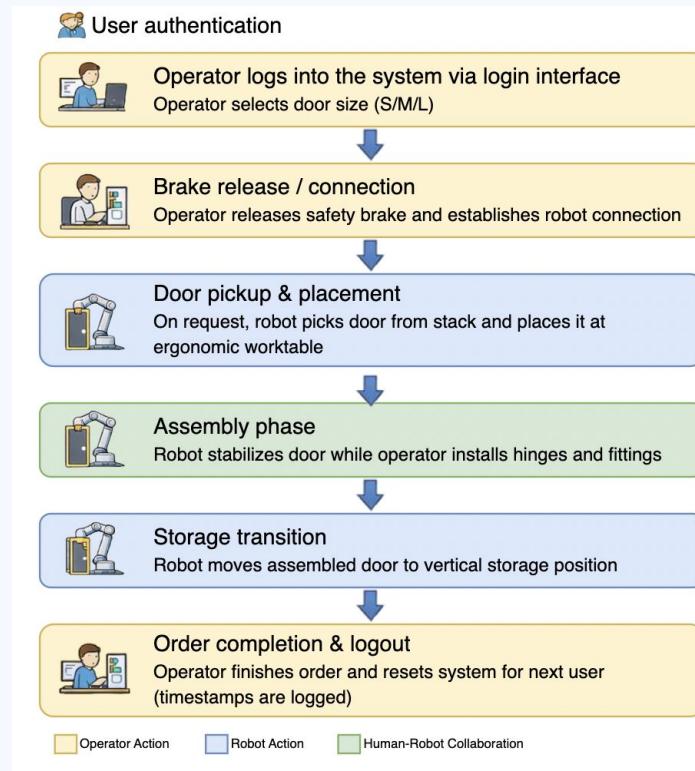
Setup



Control and flow logic



The overall process follows the main steps:

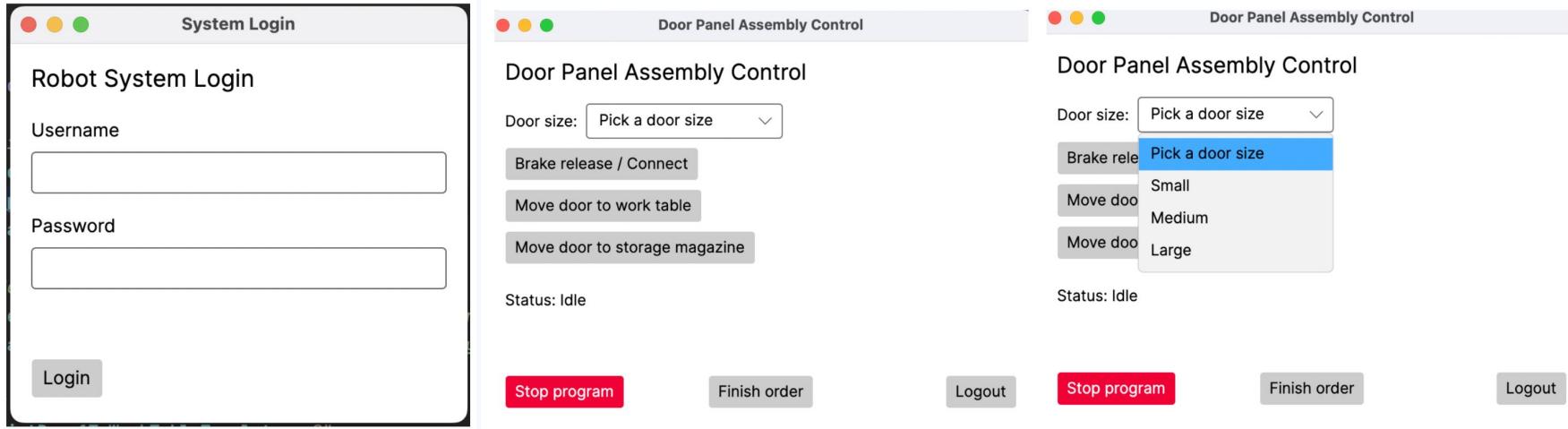


03

GUI, database and test

Sophie Hauritz

Graphical User Interface (GUI)



Purpose

- The GUI acts as the Operator control panel for the robot.
- Enables collaboration instead of full automation. Prevents unintended motion via confirmation buttons.
- Login restricts access to authorized users.
- Door size affects robot gripper settings.

User Flow

- Login with username + password.
- Select door size (S/M/L).
- Trigger robot actions step-by-step.
- Stop button for safety interruptions.
- Status text shows current system state.

Tech

- Built in Avalonia (.NET).
- XAML for layout, C# for logic.
- Event handlers send URScript TCP.
- Door size maps to grip width/force.
- Login validated against salted password hashes.
- SQLite used for logging orders/users.

Safety & Trace

- Identifies operator.
- Logs timestamps for each order.
- Supports accountability + documentation.
- Operator stays in charge, robot handles physical strain.

Database (SQLite)

Authentication

- Stores users + roles (admin/user)
- Login restricts access to system
- Passwords stored as salted + hashed
- Prevents unauthorized robot control

Table: Accounts

| | Username | Salt | SaltedPasswordHash | isAdmin |
|---|----------|--------|--------------------|---------|
| | Filter | Filter | Filter | Filter |
| 1 | Laerke | BLOB | BLOB | 1 |
| 2 | Sophie | BLOB | BLOB | 1 |
| 3 | Sofie | BLOB | BLOB | 0 |
| 4 | Ida | BLOB | BLOB | 0 |

Order Logging

- Logs start + finish timestamps
- Triggered via GUI buttons
- Links actions to specific operator
- Measures cycle time for each order

Table: OrderLogs

| | Id | Username | DoorSize | StartedAt | FinishedAt |
|---|-----|----------|----------|----------------------------|----------------------------|
| | ... | Filter | Filter | Filter | Filter |
| 1 | 1 | Sophie | Small | 2026-01-15 11:01:55.349606 | 2026-01-15 11:02:26.776203 |
| 2 | 4 | Ida | Medium | 2026-01-15 11:09:19.427963 | 2026-01-15 11:09:43.173335 |
| 3 | 5 | Laerke | Large | 2026-01-15 11:10:23.25267 | 2026-01-15 11:10:44.580694 |
| 4 | 6 | Sofie | Small | 2026-01-15 11:10:59.054394 | 2026-01-15 11:11:20.427787 |

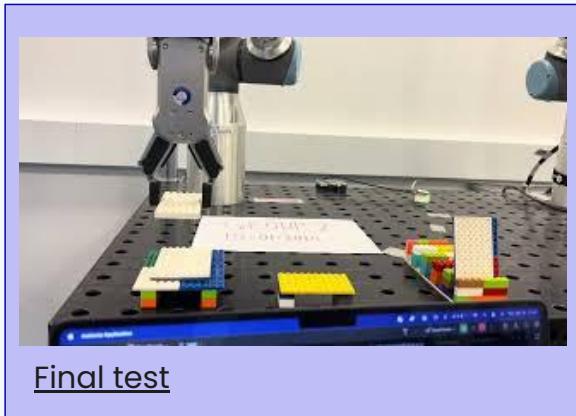
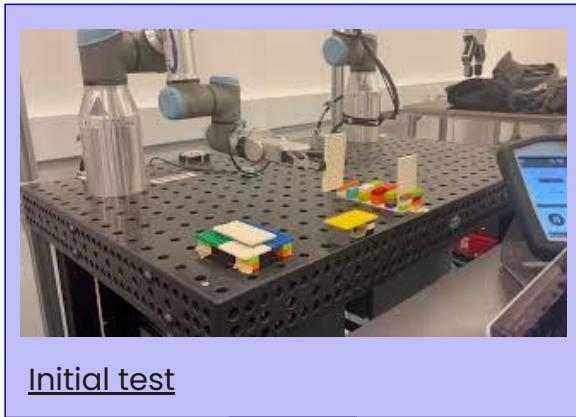
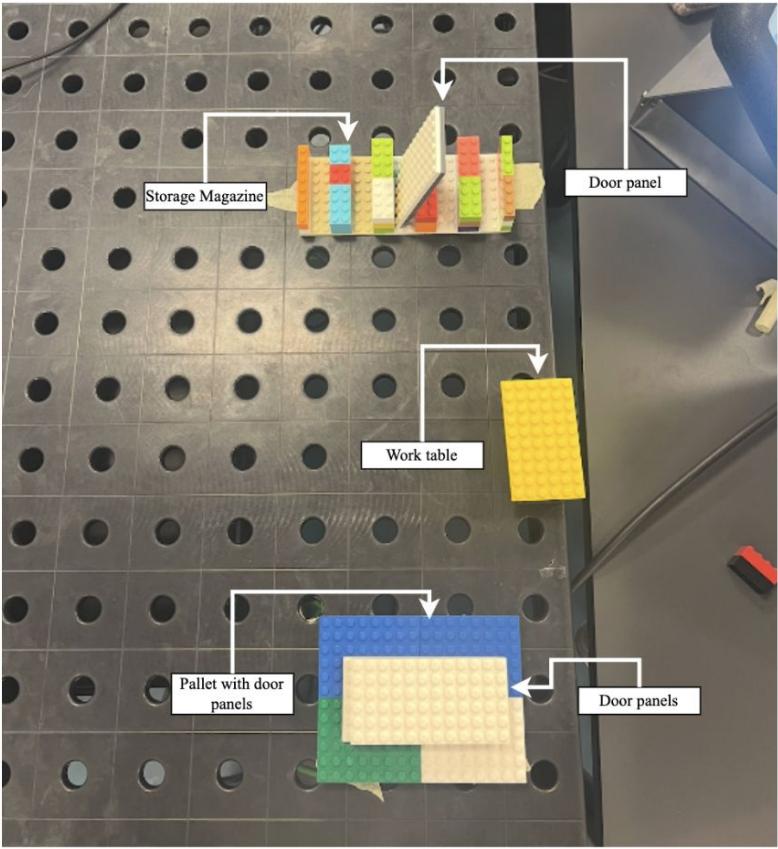
Traceability

- Tracks who did what and when
- Useful for quality + documentation
- Supports bottleneck analysis
- Enables future scheduling/delivery estimation

Tech

- SQLite used as local MVP DB
- EF Core maps objects to tables
- Simple to deploy (no server needed)
- Scalable toward MES/ERP in future

Test



04

Goals and limitations

Lærke Holst



Limitations & Future improvements

01

Restricted Automation

The workflow relies on predefined sequences and manual input, with limited adaptability to varying components.

Increased Automation

Introduce adaptive control logic to reduce reliance on predefined sequences and enable more autonomous operation.

02

Basic User Interface

The GUI contains a limited number of buttons and does not support advanced configuration or dynamic input.

Advanced User Interface

Expand the GUI with additional controls, dynamic input, and configurable workflows for improved usability.

03

Minimal Sensor Integration

The system lacks sensors for automatic detection, positioning, and state feedback.

Sensor & Vision Integration

Integrate sensors and camera-based recognition to enable automatic detection, positioning, and state feedback.

04

Simplified Hardware Setup

LEGO-based doors, factory layout, and workstation are used instead of real industrial components.

Industrial-Grade Setup

Replace the LEGO-based prototype with real components to increase realism, robustness, and scalability.



Thank you for your time!

Any further questions?