Group 3
Industrial Programming

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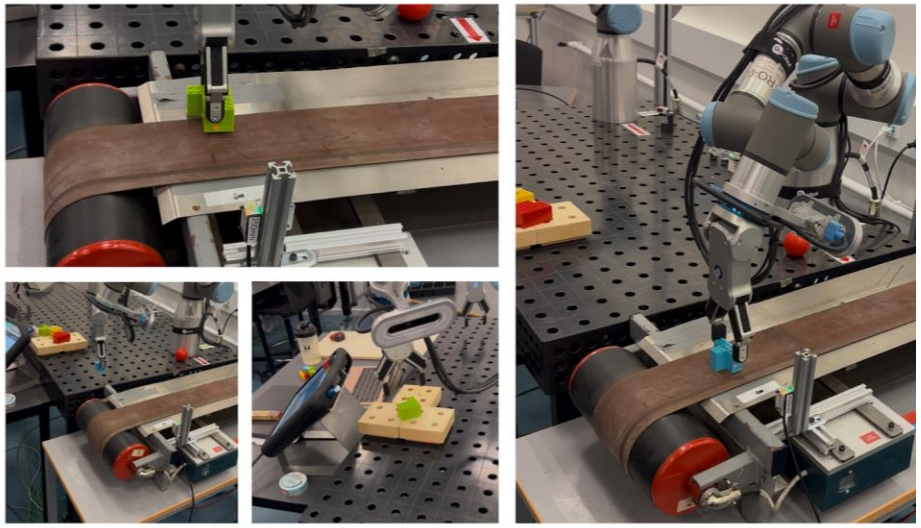
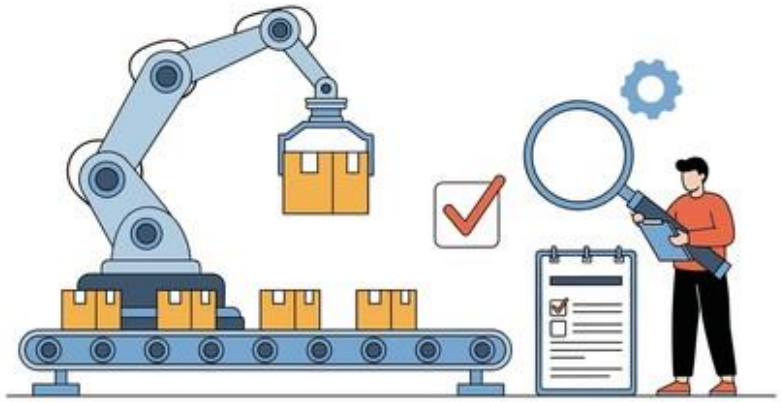
Project case:



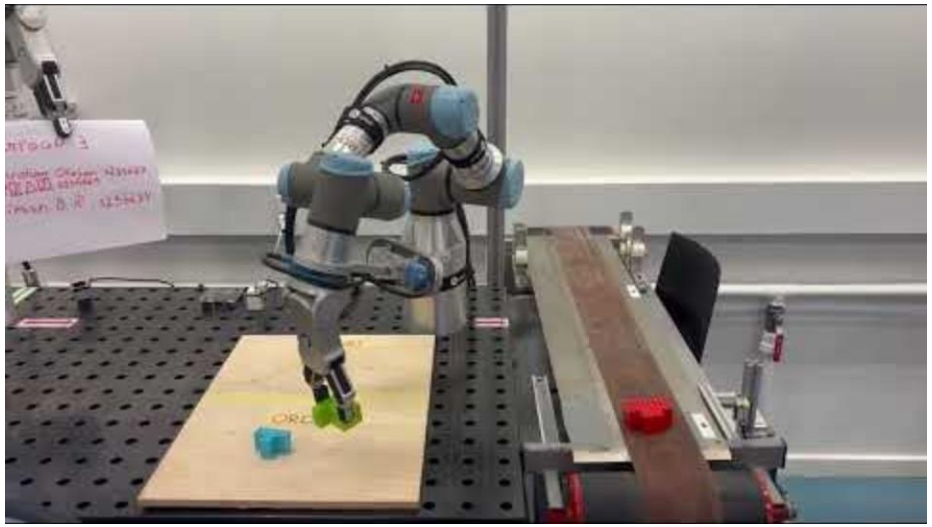
This project solves cases where production lines require automatic, reliable sorting of products for different customers. It replaces manual handling with a camera-guided robotic system that improves efficiency, accuracy, and scalability in industrial workflows.



Video Link

https://www.youtube.com/watch?v=uZIzbW6h2qI’

Group 3 - Industrial Programming Robot sorter



How did we solve it ?

Day 1-3 “Rookie Mistakes”

- Day 1-3 was about figuring out how we wanted to go about the project.

Day 1:

- Initial Camera setup
- Integration of Hardware components

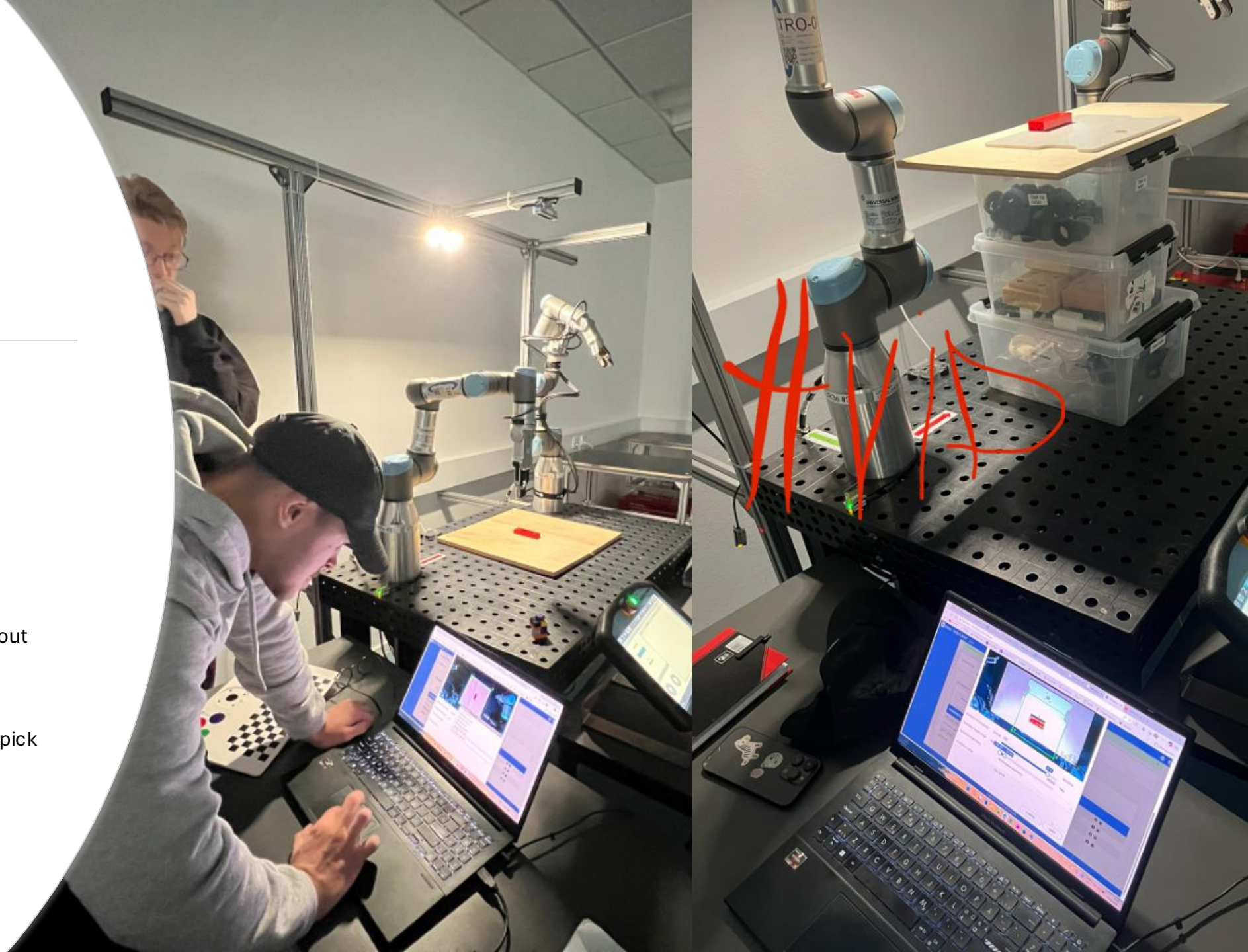
Day 2:

- Camera on arm
- Pendent programming
- Time not wasted; Lessons learned about surroundings and environment

Day 3:

Once we were setup:

- Inverse kinematics error – alternative pick paths
- Consistency is key



Day 4-6 ”Progress”

Day 4:

- Trying to make sense of exported file from pendant
- Fewer waypoints

Day 5:

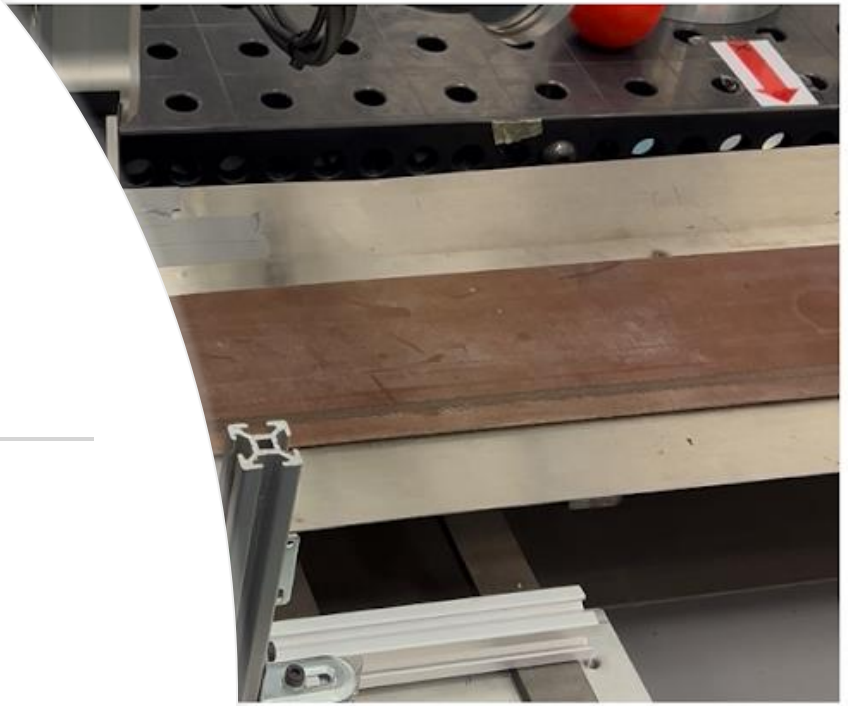
- Choosing to be pragmatic
  - A lot of redundent code left

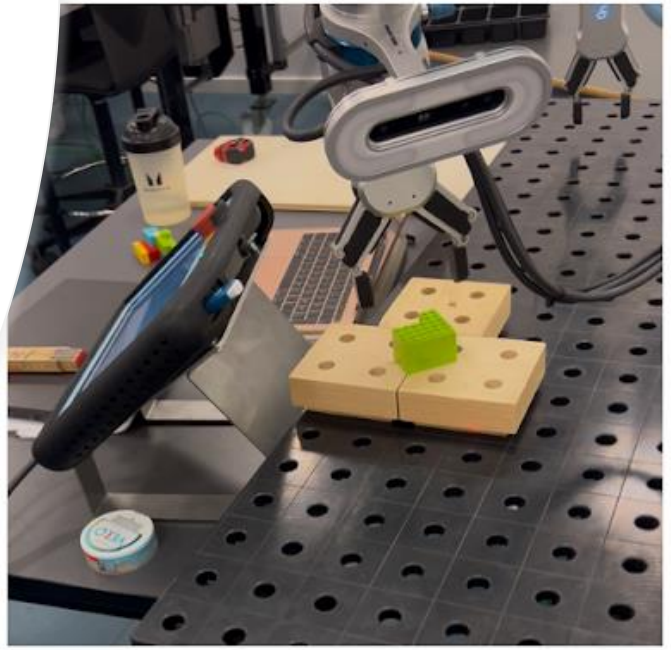
Day 5:

- Extension of Database
  - Customer profiles
  - Orders
- GUI Customization

Day 6:

- Eyes Locate: 15 seconds
- Multiple quantities of the same brick
- Automatic Log out





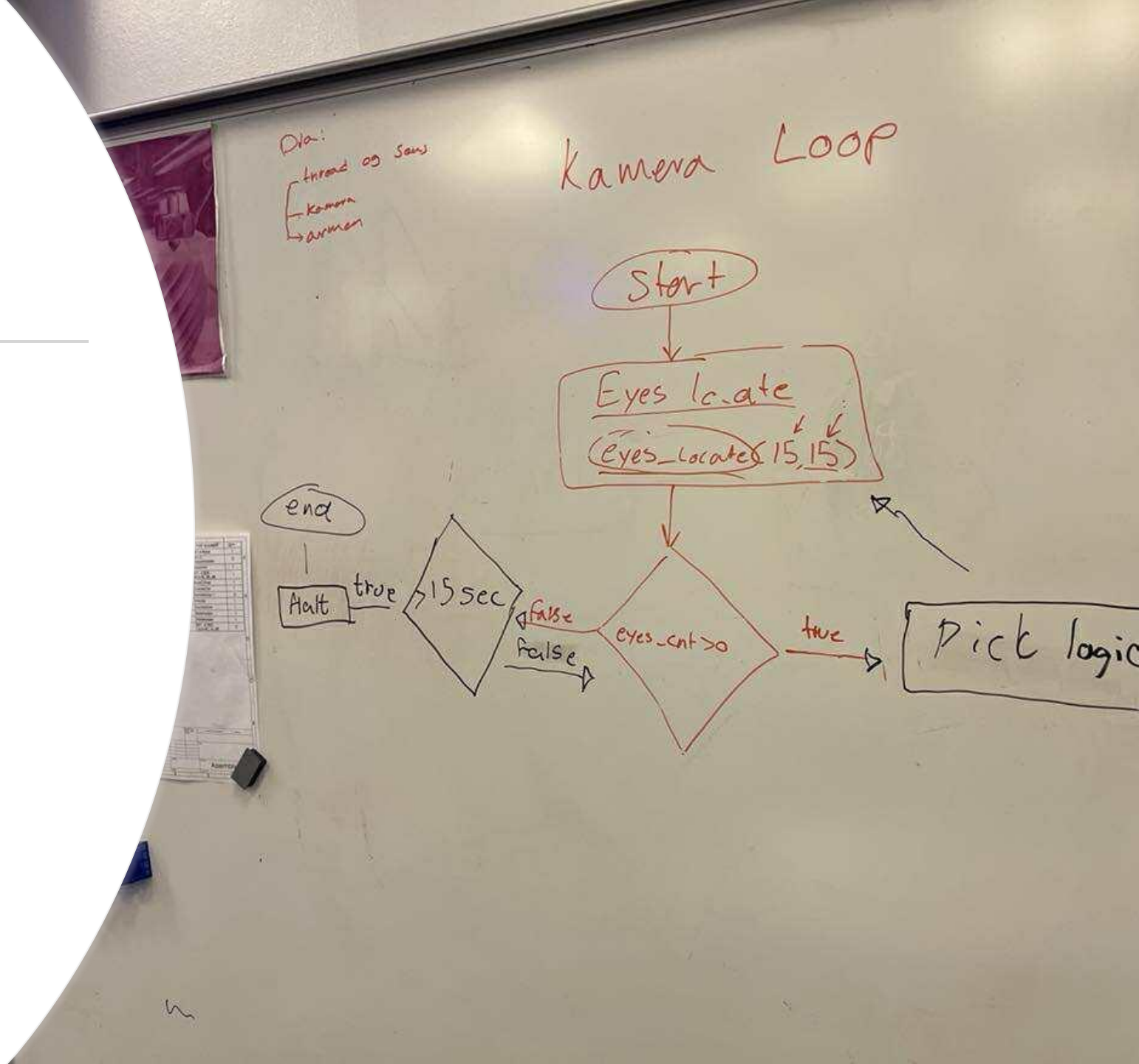
Day 7-8 ”KISS”

Day 7:

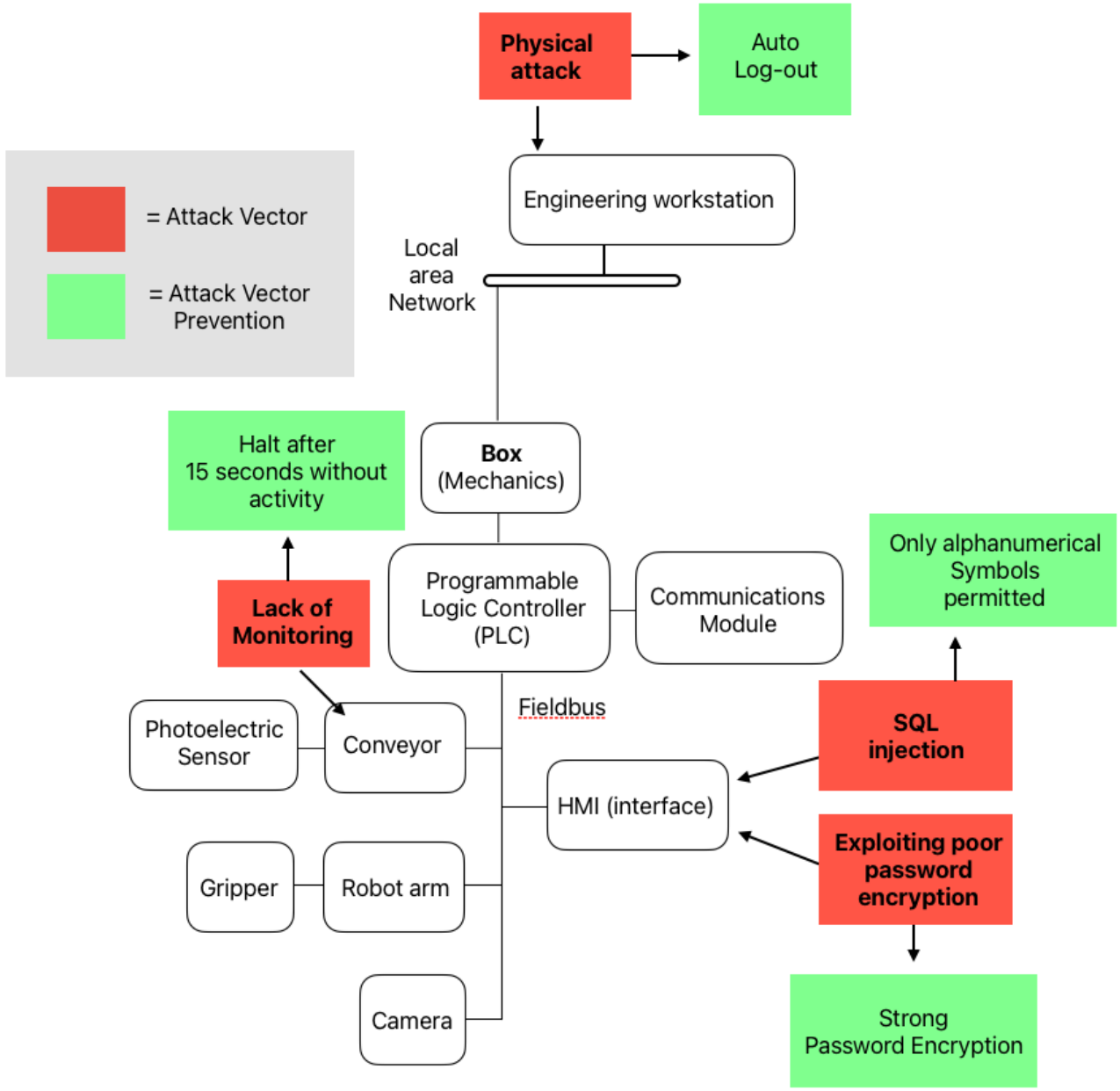
- Details (KISS); halt
  - No need for restart button
  - UI cleanup for better UX
  - Removed old .cs test files

Day 8:

- Flow charts and video – Final product

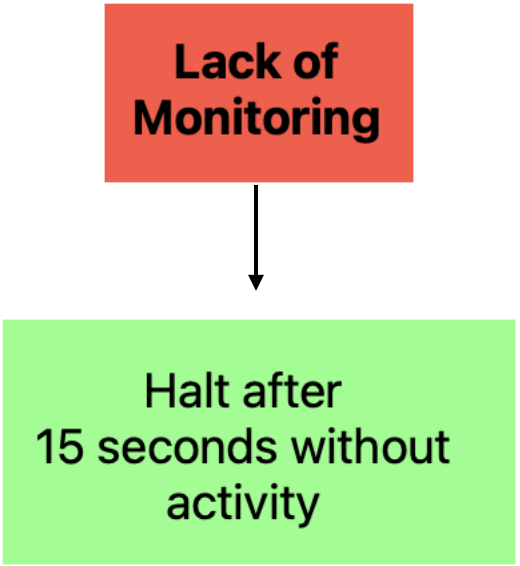


Program Diagram



Attack Vector and Prevention #1

```
1730        $ 6 "Eyes Locate"
1731        eyes_cnt = 0
1732    eyes_cnt = eyes_locate(15, 15)
1733    if (eyes_cnt > 0):
1734      eyes_workp_cnt = eyes_cnt
1735      # existing pick logic continues
1736    else:
1737      set_standard_digital_out(7, False)  # stop conveyor
1738      halt
1739      end
```



Attack Vector and Prevention #2

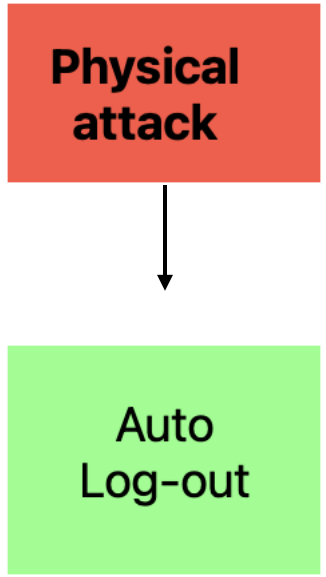
Timer

```
_inactivityLogoutTimer = new InactivityLogoutTimer(TimeSpan.FromMinutes(5), HandleInactivityTimeout);
```

Call on resets C-operation

```
4 references
private void ResetInactivityTimer()
{
    if (_currentUser == null)
        return;

    _inactivityLogoutTimer.Reset();
}
```



Attack Vector and Prevention #3

IsLetterOrDigit == true if alphanumeric string

```
4 references
public static bool IsCredentialValid(string? value) =>
    !string.IsNullOrWhiteSpace(value) && value.All(char.IsLetterOrDigit);
```

SQL injection

↓

Only alphanumerical Symbols permitted

Attack Vector and Prevention #4

Password = Password +  + 

```
2 usages
public class Authentication(AppDbContext db, PasswordHasher hasher)
{
    3 usages
    public async Task CreateUserAsync(string username, string password, bool isAdmin = false)
    {
        var (salt :byte[] , saltedPasswordHash :byte[] ) = hasher.Hash(password);
        db.Users.Add(new User
        {
            Username = username,
            Salt = salt,
            SaltedPasswordHash = saltedPasswordHash,
            IsAdmin = isAdmin
        });
        await db.SaveChangesAsync();
    }

```

Exploiting poor password encryption

↓

Strong Password Encryption

Attack Vector and Prevention #5?

Forcing password to be beyond 8 alphanumeric characters.

```
public static bool IsPasswordValid(string? value) =>
    IsCredentialValid(value) && value!.Length > 8;
```

Total possible passwords

4-character alphanumeric

$$62^4 = 14{,}776{,}336 \quad (\approx 1.5 \times 10^7)$$

8-character alphanumeric

$$62^8 = 218{,}340{,}105{,}584{,}896 \quad (\approx 2.18 \times 10^{14})$$

How much harder is 8 characters than 4?

$$\frac{62^8}{62^4} = 62^4 = 14{,}776{,}336$$

➡️ **An 8-character password is ~14.8 million times harder to brute-force than a 4-character one.**

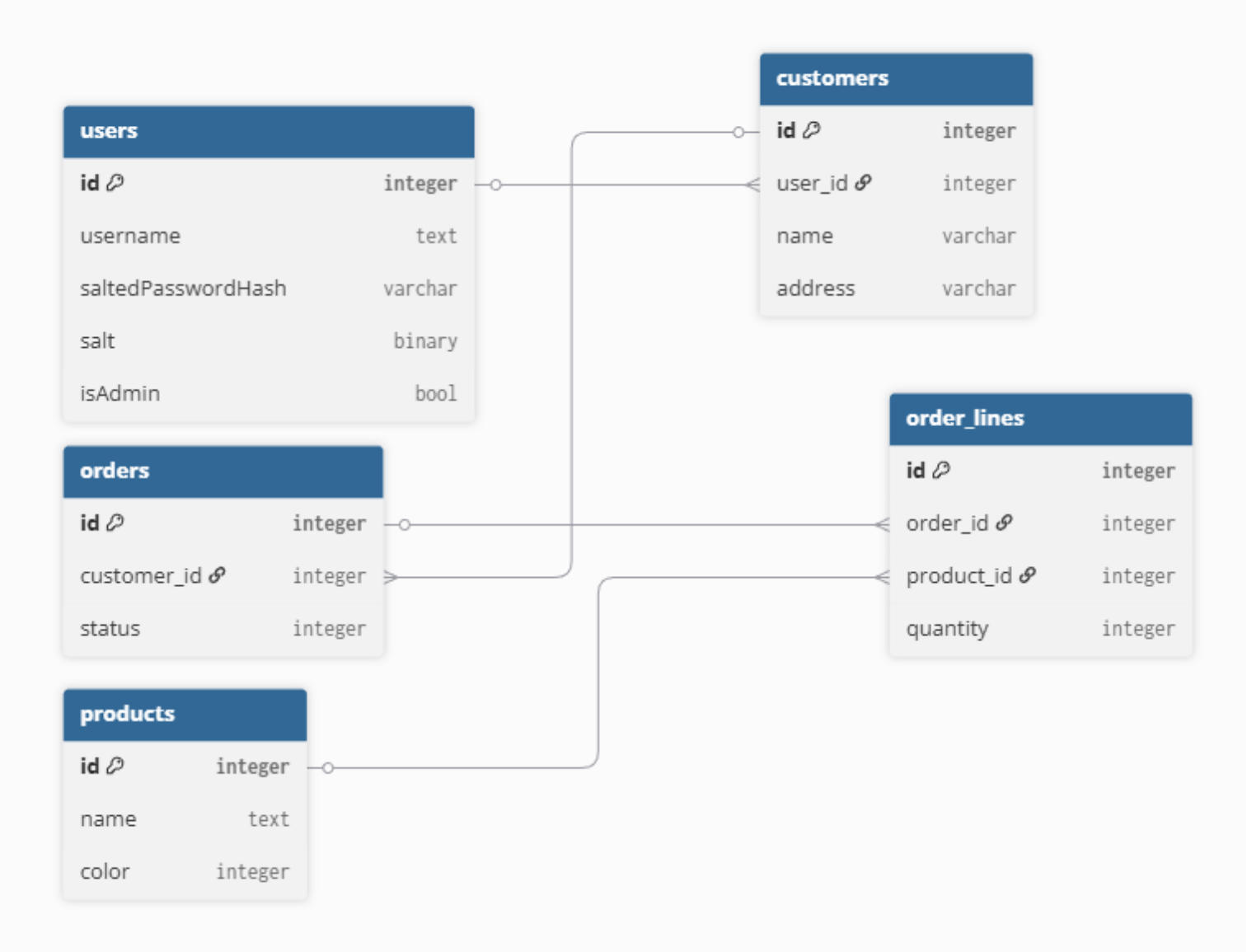
That's the key takeaway.

ERD: Entity Relation Diagram

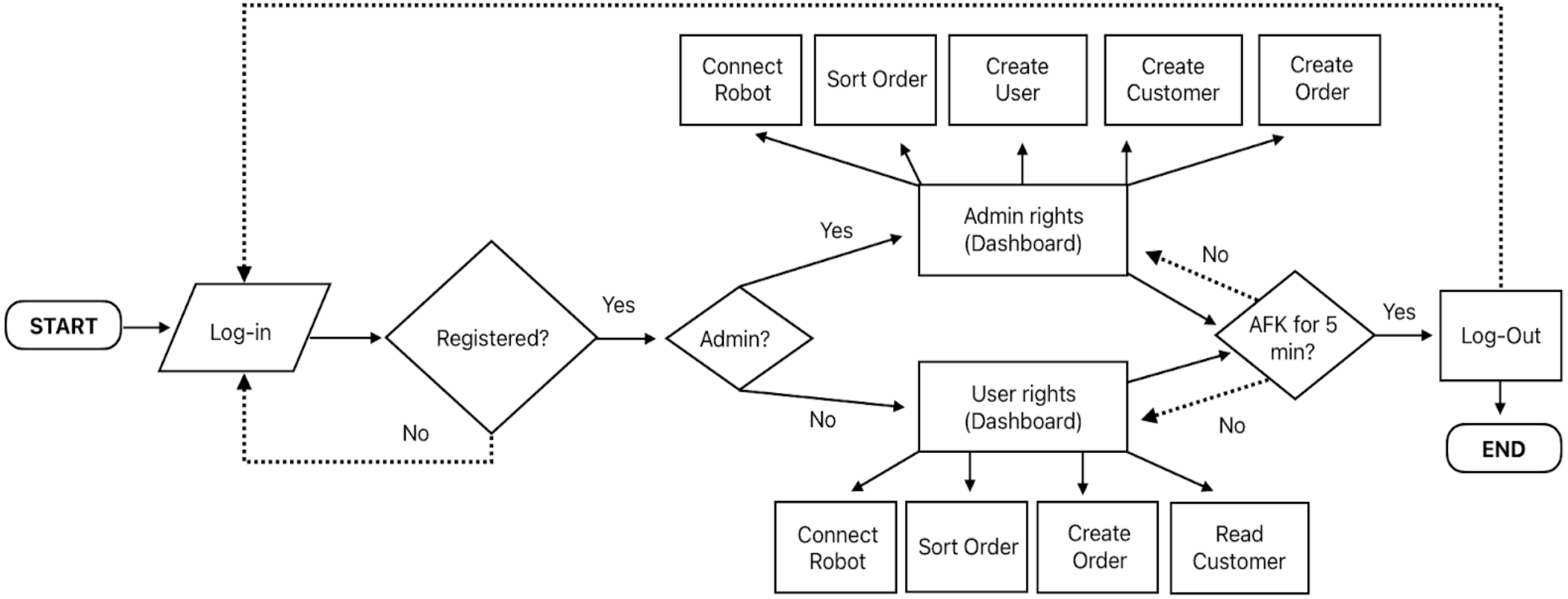
One-to-Many:
User => Customers
Customers => Orders
Orders => Order_lines
Product => Order_lines

Many-to-Many:
Orders => products by order_lines

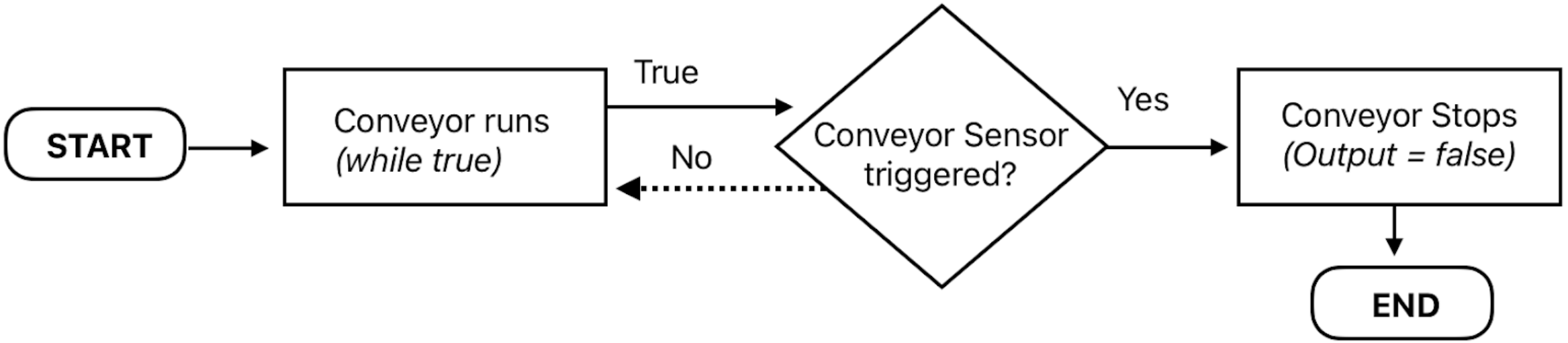
Qty makes it complex



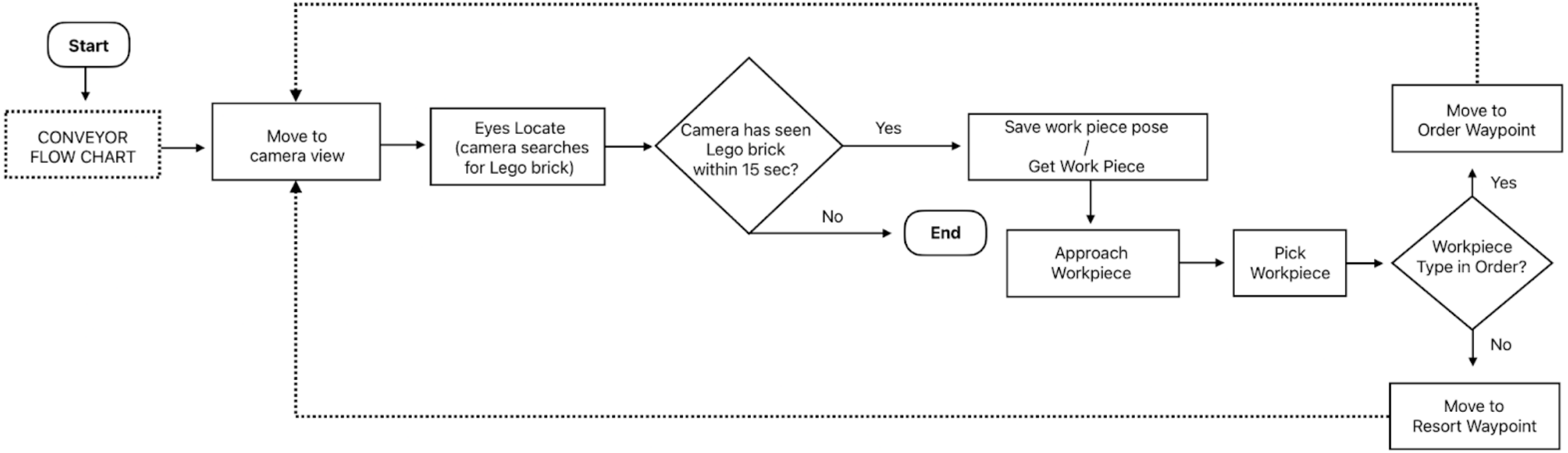
GUI Interaction Flow Chart



Conveyor Flow Chart



Camera and Robot Arm Flow Chart



Robot Tab Flow Chart