



DHL Smart Automated Warehouse System

JAVA based software simulation

Introduction

DHL operates advanced Smart Warehouses and Distribution Centers around the world, where autonomous robots, conveyor systems, and automated storage units handle parcel sorting, storage, and dispatch.

Our system will simulate a miniature DHL automated warehouse – a digital environment where robots move packages between storage zones, manage charging operations, and coordinate tasks such as loading, unloading, transferring, and dispatching.



Typical DHL workflow

01

Incoming Truck deliver
parcels

02

Robots collect parcels
from unloading dock

03

Storage Manger decides
where to store parcels

04

Order for dispatch
triggers.

05

Robots retrieve parcel &
deliver to loading dock.

When robots' battery levels drop below 10%,
they automatically navigate to the Charging
Station.

The HMI Dashboard shows live data about robot
status, task queue, and operational logs.

Key Components of the System

01

Task Management System

Prioritizes delivery and package handling

02

Storage Management System

Keeps track of package location & movement

03

Charging Station

For robot maintenance & charging

04

Human Machine Interface

To visualize, control & monitor operations

05

Storage Equipment

Racks & bins where packages are stored

06

Logging & Testing

Exception handling & unit tests for reliability

Requirements Document

Functional requirements and constraints are provided in a separate file in the capstone repository as a requirements document.

Requirements Document

1. System Overview

- The system simulates a DHL smart automated warehouse.
- Core components include robots, storage systems, task management, charging stations, HMI, and a centralized logging system.

2. Functional Requirements

2.1 Equipment

- All equipment must provide a unique ID and a status string.

2.2 Robots

- Robots must implement task assignment and charging functionality.
- Robots must maintain ID, battery level, current task, and operational status.
- Robots must move to locations, execute tasks, pick parcels, deliver parcels, and go to charging stations.
- Robot actions must be logged.

2.3 Storage System

- StorageManager manages racks and parcel locations.
- It must store and retrieve parcels and find available slots.
- StorageRack maintains slots and supports adding/removing parcels.
- StorageSlot tracks occupancy.

2.4 Task Management

- Supported task types: LOAD, UNLOAD, TRANSFER, CHARGE.
- Each task has ID, type, and status.
- TaskManager creates, assigns, and updates tasks; manages queue; creates dock tasks.
- Robots execute LoadTask, UnloadTask, ChargeTask.

2.5 Charging System

- ChargingStation has ID, availability, occupant.
- It must start/stop robot charging.
- Charging events must be logged.

2.6 DHL Warehouse System

- Maintains StorageManager, TaskManager, robots, and charging stations.
- Provides start, stop, and report generation.

2.7 HMI

- Builds UI, updates UI, refreshes system state, displays logs.

3. Logging Requirements

- Central LogManager logs system, robot, charging, and storage events.
- Must support listing, reading, deleting, moving, and archiving logs.
- Must close log writers on shutdown.

Task Distribution

**Muhammad
Mohsin Abbasi**

HMI, Log Management, Graphics of simulation and overall integration of the system

**Minhaj Jamraiz
Abbasi**

Task Management system

Implementing the classes and subclasses related to Task Management

Wajihah Kainat

Storage Management

Implementation of Storage Management class and its subclasses including integration into overall system

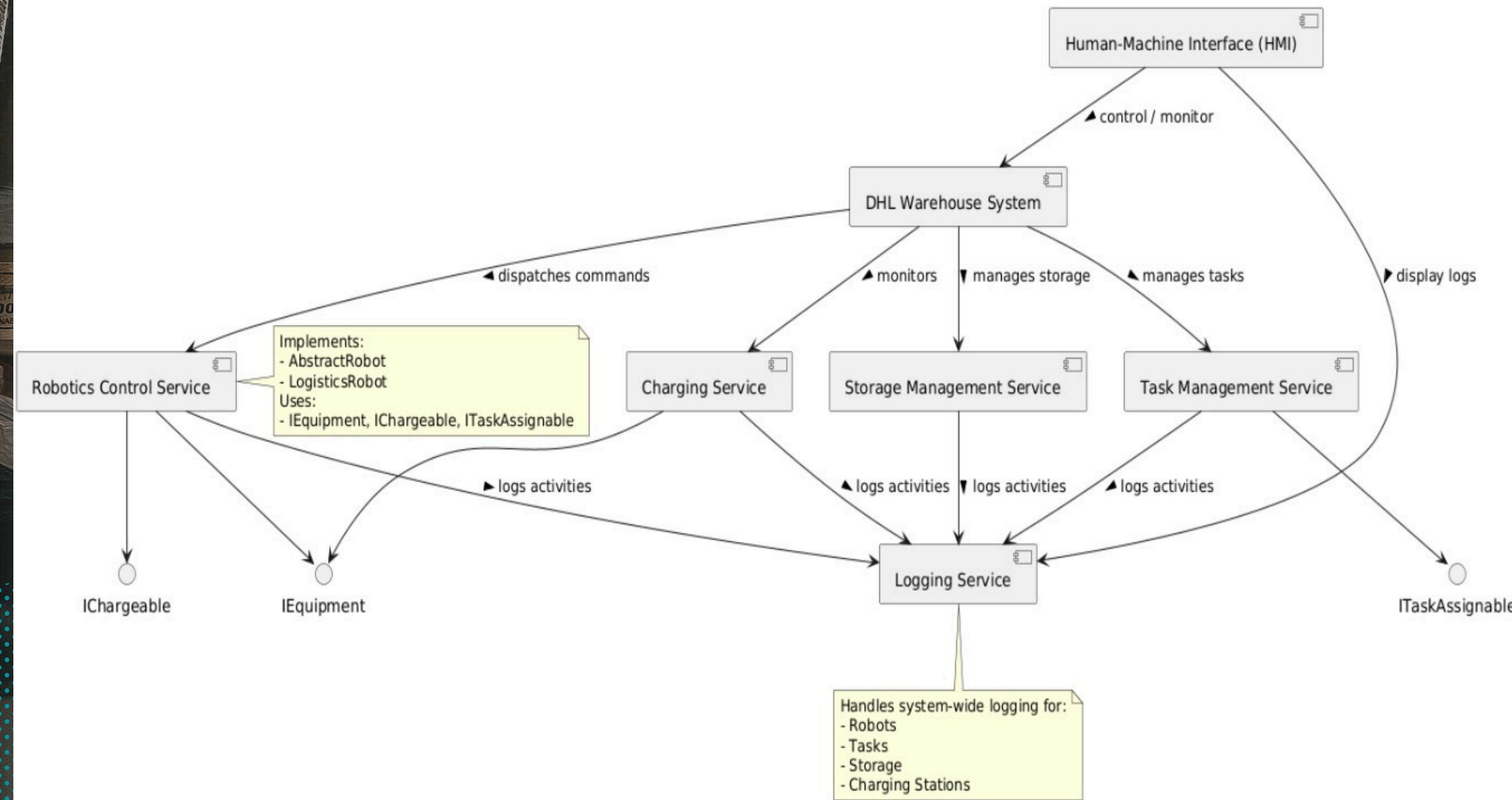
Asaad Alawy

Robot Management

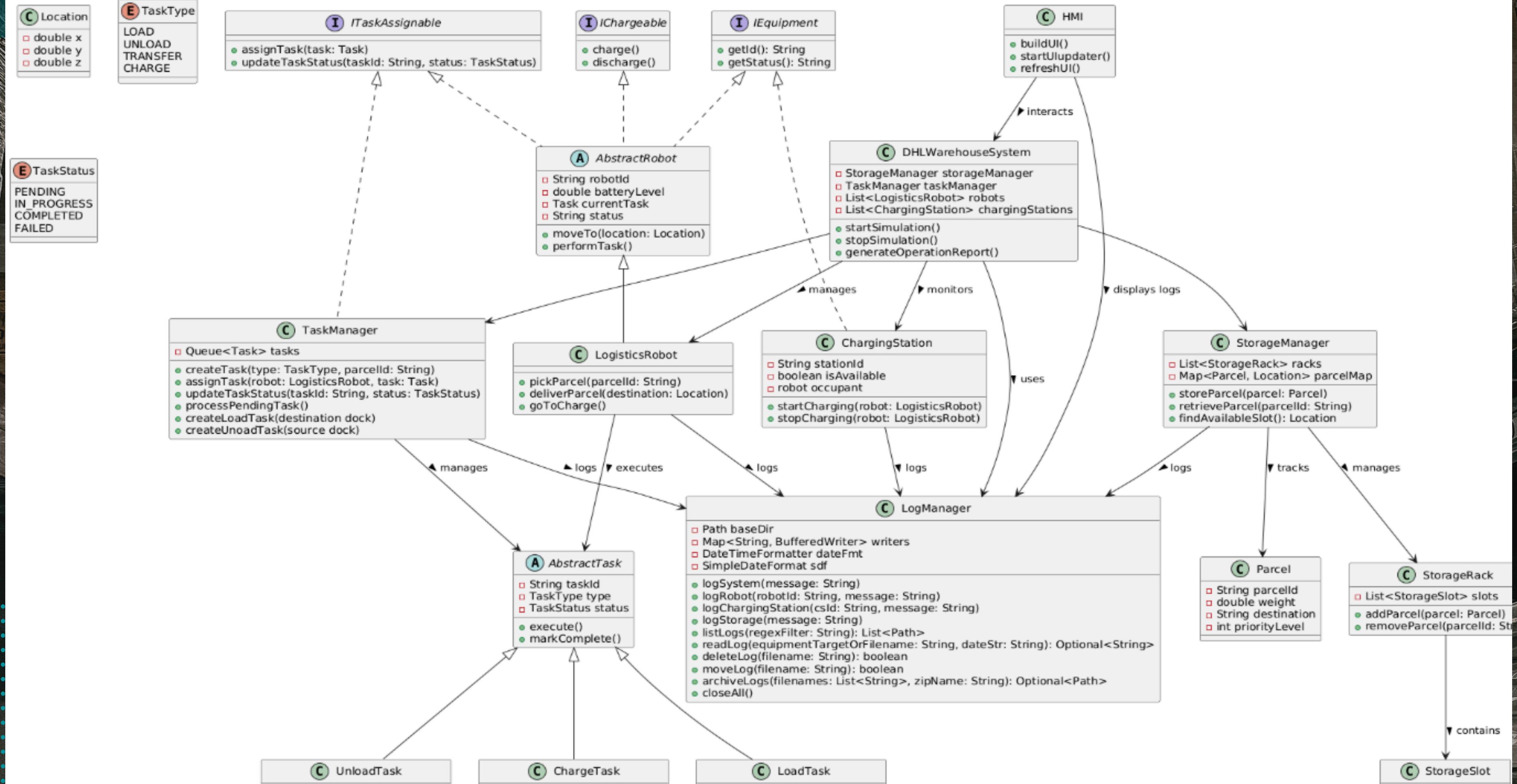
Implementation related to AGVs and its management

Component diagram

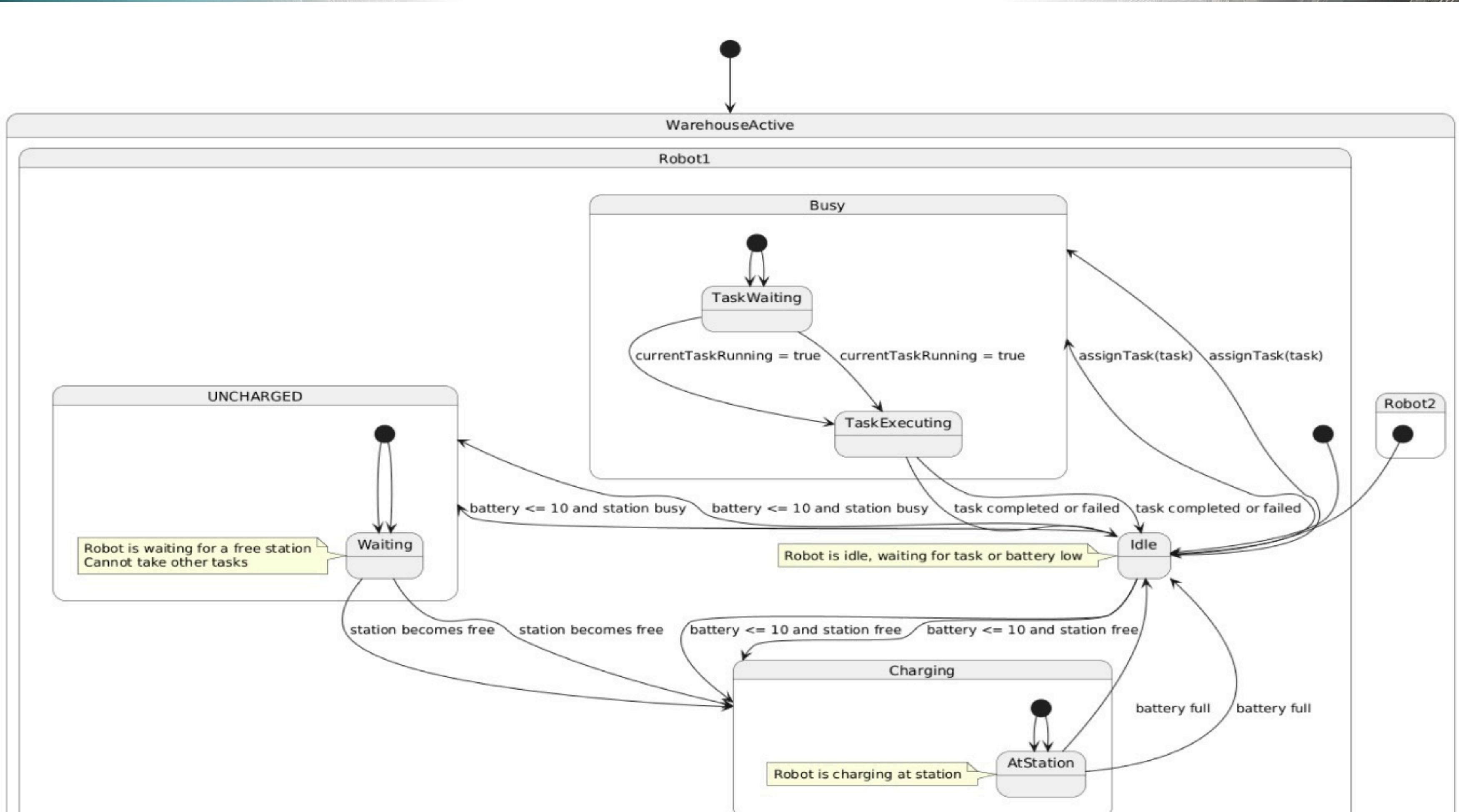
DHL Smart Automated Warehouse System - Component Diagram



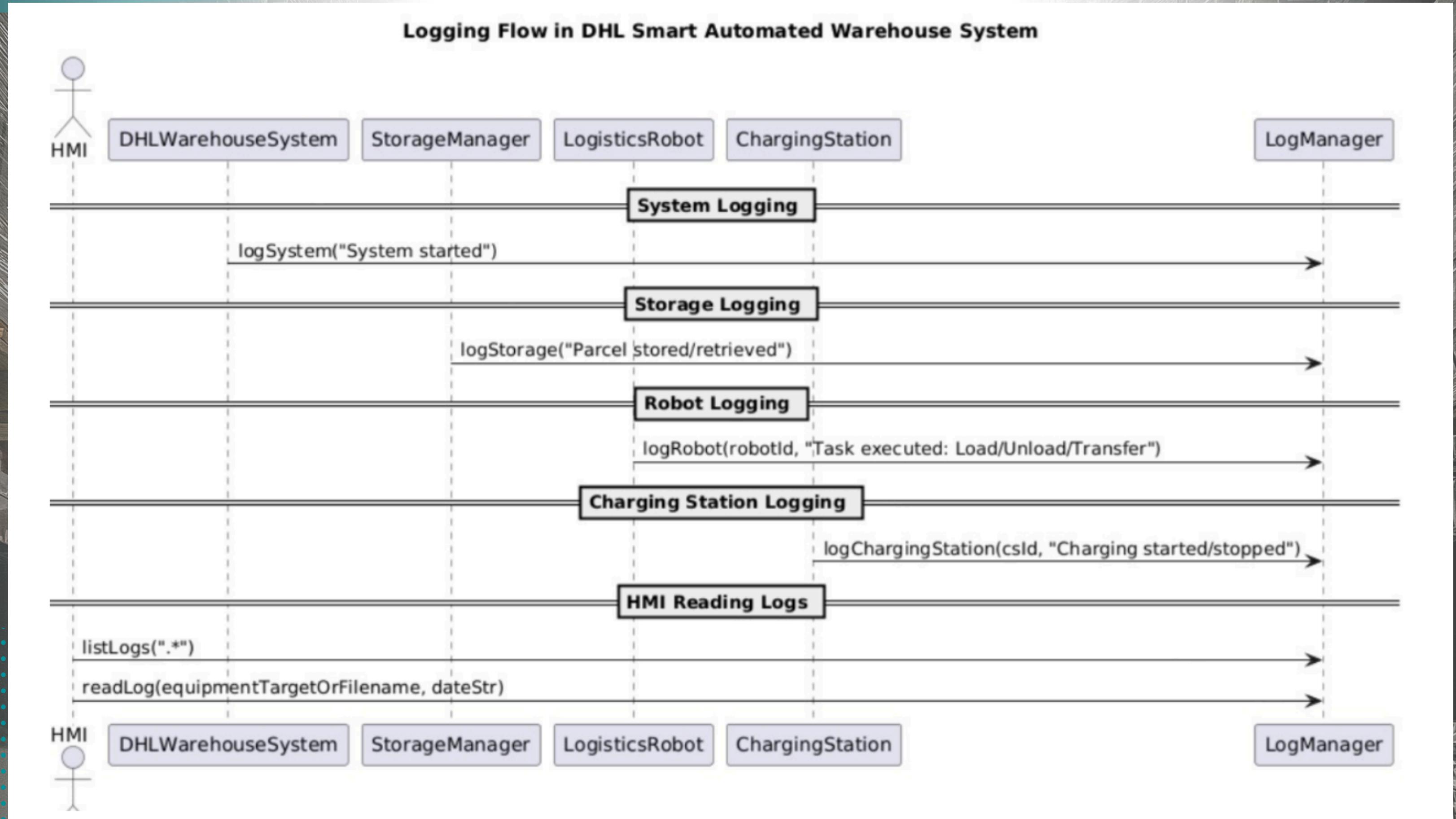
UML class diagram



Concurrency (State Diagram of AGVs)



Management I/O



Simulation

Implemented with JAVAFX for GUI and Timeline simulation.

- Real-time, continuous simulation loop
- Decoupled UI and logic for smooth updates

Simulation runs continuously with cycles(ticks), updating warehouse objects.

GUI updated at regular intervals to reflect current system state.

Logs capture actions allowing post simulation analyses

USER INTERFACE

DHL Smart Automated Warehouse - Simulation (Logging Enhanced)

Start Simulation Stop Simulation Create Load Task BEL Create Unload Task (random)

Robot	Status	Battery	
R-1	CHARGING@CS-1	20.9	
R-2	BUSY(UNLOAD)	3.5	
R-3	BUSY(UNLOAD)	3.5	
R-4	BUSY(UNLOAD)	14.1	
R-5	BUSY(UNLOAD)	24.6	

Task	Type	Parcel	Status	
T-57	UNLOAD	P-DE-1033	PENDING	
T-58	UNLOAD	P-AU-1034	PENDING	
T-59	UNLOAD	P-FR-1035	PENDING	
T-60	UNLOAD	P-GE-1036	PENDING	
T-61	UNLOAD	P-FR-1037	PENDING	
T-62	UNLOAD	P-FR-1038	PENDING	
T-63	UNLOAD	P-DE-1039	PENDING	

Warehouse Layout

RACK-1	RACK-2	RACK-3	RACK-4	RACK-5
P-FR-1024	P-GE-1025	P-AU-1023		P-BE-1026

Log Management

Log target/filename: Equipment name or filename (e.g. ROBOT-R-1 or SYSTEM or ROBOT-R-1_2025-10-26.log) Date yyyy-MM-dd (opti) Open Log Archive Selected Move Log Delete Log

Operation Log (selected file)



A large warehouse aisle filled with tall stacks of cardboard boxes. The boxes are stacked on metal shelving units that reach almost to the ceiling. The lighting is bright, coming from overhead fixtures. In the background, there are more shelves and some industrial equipment. The overall atmosphere is one of a busy distribution center.

THANK YOU!