Trailer Management System

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INFO-C451 System Implementation

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Customer Problem Statement

Problem Statement

Every trailer that comes onto the property must be put into an open parking spot or dock door. A driver arrives at the gate with a loaded inbound trailer. The gatekeeper uses a 2-way radio to communicate with the spotters in order to identify an open parking spot or dock door. Then, the gatekeeper directs the driver where to park the trailer. In the time it takes to complete the check-in process and then drive to the designated location, another trailer may have been put in that location. Ideally, the driver would return to the gate to get new instructions on where to put the trailer. However, in most cases, the driver finds an open parking spot and parks the trailer there. The driver then leaves without saying that they put the trailer in a different parking spot, so the gatekeeper's records are incorrect.

Every trailer that leaves the property must be loaded before a driver can pick it up. When a driver arrives to pick up a load, the driver gives the load number to the gatekeeper. The gatekeeper looks up the load in the system to find which trailer is assigned to the load. (The system does not provide any indication of the status or location of the trailer.) Then, the gatekeeper radios the spotters to find the location of the trailer. The responding spotter then drives around the property to visually locate the trailer. This may take up to 15 minutes. If the trailer is in an outbound dock, the spotter relays the location to the gatekeeper. If the trailer is in a parking spot, the spotter inspects the trailer to make sure it is loaded and sealed with an outbound seal and then relays the location to the gatekeeper.

However, the designated trailer may be in one of various unready states: parked in a parking spot still loaded with its inbound load; parked in an inbound dock door still to be unloaded; parked in an inbound dock door or in a parking spot and empty. In these cases, the spotter relays the status to the gatekeeper and starts the processes to get the trailer loaded. These emergency unloads/loads create havoc for the warehouse team, who have to pause whatever they are doing. The gatekeeper informs the driver that they will have to wait for the trailer to be ready. Trucking companies charge detention fees when their drivers are held at a location for more than two hours.

The current system for staging and tracking trailers at the distribution center is manual and inefficient, resulting in a lot of wasted time searching for trailers and figuring out their status. Without visibility of the status of parking spots and dock doors, the gatekeeper is blindly directing the drivers, and spotters cannot tell whether a parking spot is already designated for another trailer. Without visibility to the status of trailers, spotters are guessing when to move trailers into and out of dock doors, and warehouse personnel are often idle while waiting for trailers to unload or load.

A new system that shows real-time status of trailers, parking spots, and dock doors to all users would allow the gatekeepers, spotters, and warehouse personnel to act independently without getting in each other's way. If a gatekeeper marked a location as occupied by an inbound trailer, a spotter would not be able to put a different trailer into the same location. Visibility of trailer status would direct spotters to trailers that need to be moved and would indicate the next action for that trailer and where it needs to go next. Warehouse operations would benefit from steady rotation of trailers, allowing continuous loading and unloading, reducing wasted time, and increasing throughput. Finally, when a driver arrives to pick up a trailer, a gatekeeper would be able to see the location and status of the trailer and immediately direct the driver there. Trailers would be loaded in a timelier manner, reducing detention fees.

Glossary of Terms

Trailer – Standard semi-trailer that is on the warehouse property. A trailer is identified by a unique number, labeled on all four sides and on the inside wall at the back of the trailer.

Load – Product to be unloaded from a trailer or loaded onto a trailer. A load is designated by a unique load number and indicator of inbound or outbound.

Dock door – Warehouse overhead door which allows access to a trailer. A dock door is identified by a unique number painted on the outside and inside of the door.

Parking spot – Designated spot in the warehouse parking lot, where a trailer can be parked. A parking spot is identified by a unique number painted on the pavement.

Spotter – Employee who moves trailers around on the warehouse property. A spotter is identified by a unique employee ID.

Gatekeeper – Employee at the property gate, who checks trailers in and out. A gatekeeper is identified by a unique employee ID.

Driver – Non-employee who delivers or picks up a trailer. Drivers are not tracked in the system.

System Requirements

Functional Requirements

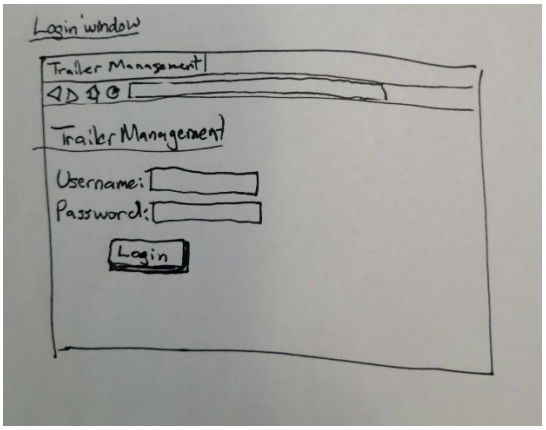
No.	Priority Weight	Description
FREQ-1	High	Users must log in to the program
FREQ-2	High	Only admin can add or delete user, parking spot, dock door
FREQ-3	High	A trailer may not have multiple locations or statuses
FREQ-4	High	A dock door or parking spot may not have multiple trailers assigned
FREQ-5	High	All users can view all trailer records
FREQ-6	High	Only gatekeepers can add or delete trailer records
FREQ-7	Med	Only spotters can update trailer location
FREQ-8	Med	Only warehouse personnel can update trailer status
FREQ-9	Med	Only warehouse personnel can update trailer load
FREQ-10	Med	Users can search for a record using any field
FREQ-11	Low	Records dynamically color-coded per trailer location and status

Nonfunctional Requirements

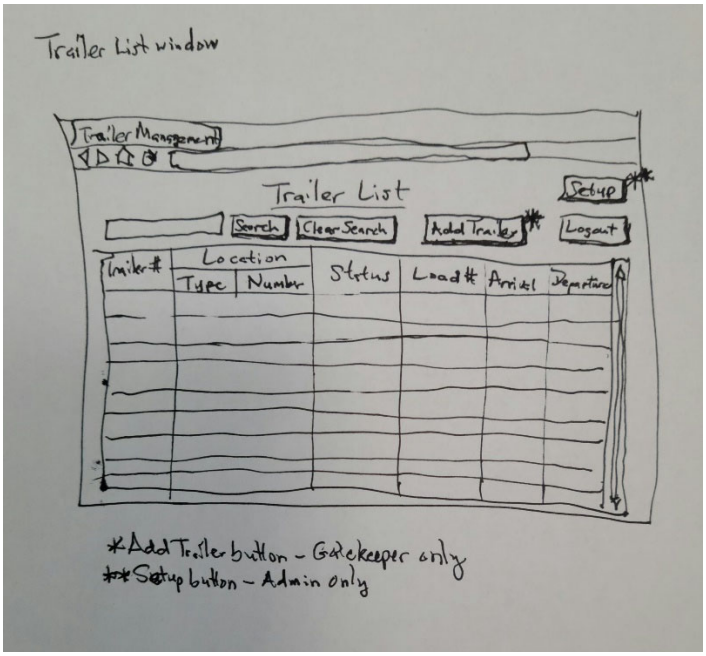
No.	Priority Weight	Description
NREQ-1	High	Minimum of 15 simultaneous users
NREQ-2	High	Search speed high, even when maximum records are populated
NREQ-3	High	Program documentation and user guides
NREQ-4	Med	Field selection and data entry compatible with touchscreen

User Interface Requirements

1. Login window:
    a. Fields for username and password
    b. Login button
        i. Clicking Login button after entering valid credentials opens the Trailer List window

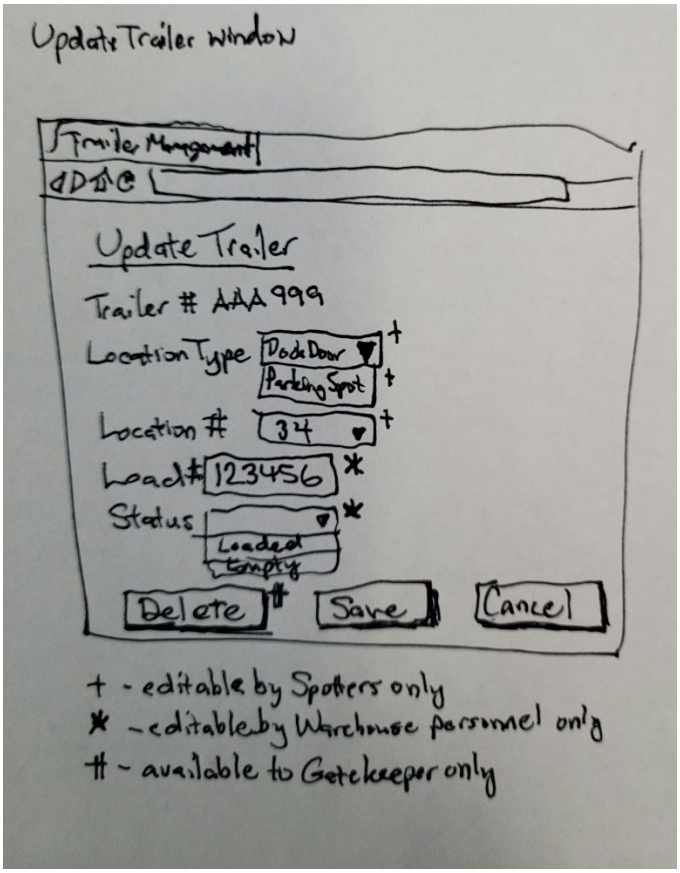


2. Trailer List window:
    a. Lists all trailer records in table view
        i. Clicking on a trailer record opens the Update Trailer window
    b. Search field and button
        i. Enter search string into Search field
        ii. Clicking Search button searches all table fields for search string and filters table to show only matching records
    c. Clear Search button
        i. Clicking Clear Search button reloads the Trailer List window to show all records
    d. Add Trailer button (Gatekeeper only)
        i. Clicking Add Trailer button opens Add Trailer window
    e. Setup button (admin user only)
        i. Clicking Setup button opens Setup Options window
    f. Logout button
        i. Clicking Logout button closes Records List window and opens Login window

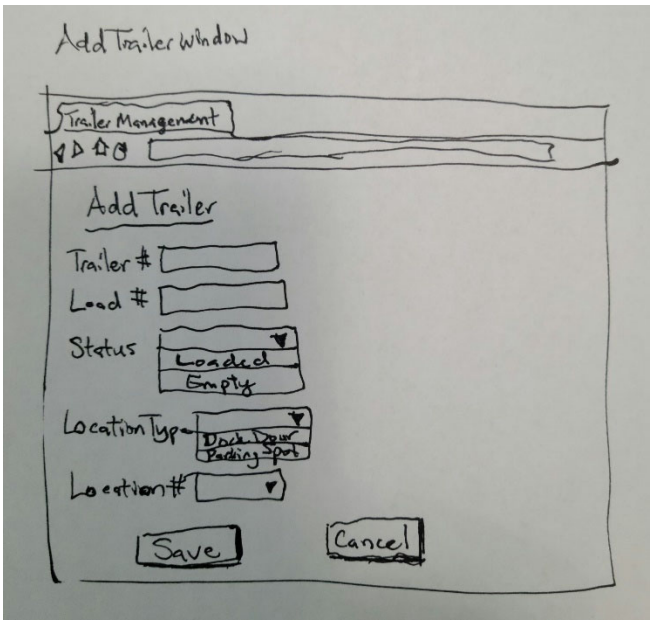


3. Update Trailer window:
    a. User can edit fields according to their role permissions
        i. Gatekeeper – Add or delete entire record
        ii. Warehouse personnel – Update Status, Load
        iii. Spotter – Update Location
    b. Delete button (gatekeeper only)
        i. Clicking Delete button opens verification window
        ii. Clicking Yes in verification window deletes record, closes Update Trailer window, and reloads Trailer List window
        iii. Clicking No in verification window closes verification window

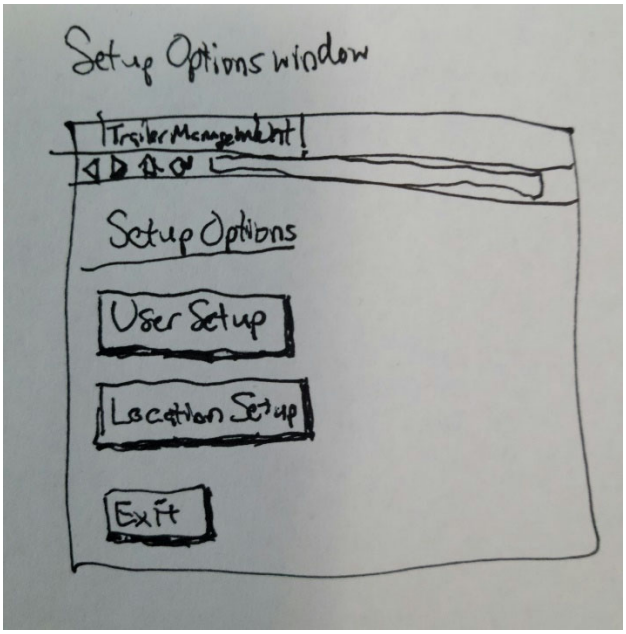
c. Save button
    i. Clicking Save button commits changes, closes Update Trailer window, and reloads Trailer List window
d. Cancel button
    i. Clicking Cancel button discards changes, closes Update Trailer window, and returns to Trailer List window



4. Add Trailer window:
    a. Empty form for entering new trailer record
    b. Save button
        i. Clicking Save button checks required fields for data
            1. If required data is complete, adds record to database, closes Add Trailer window, and reloads Trailer List window
            2. If required data is incomplete, opens alert window and highlights required fields
    c. Cancel button
        i. Clicking Cancel button discards changes and returns to Trailer List window

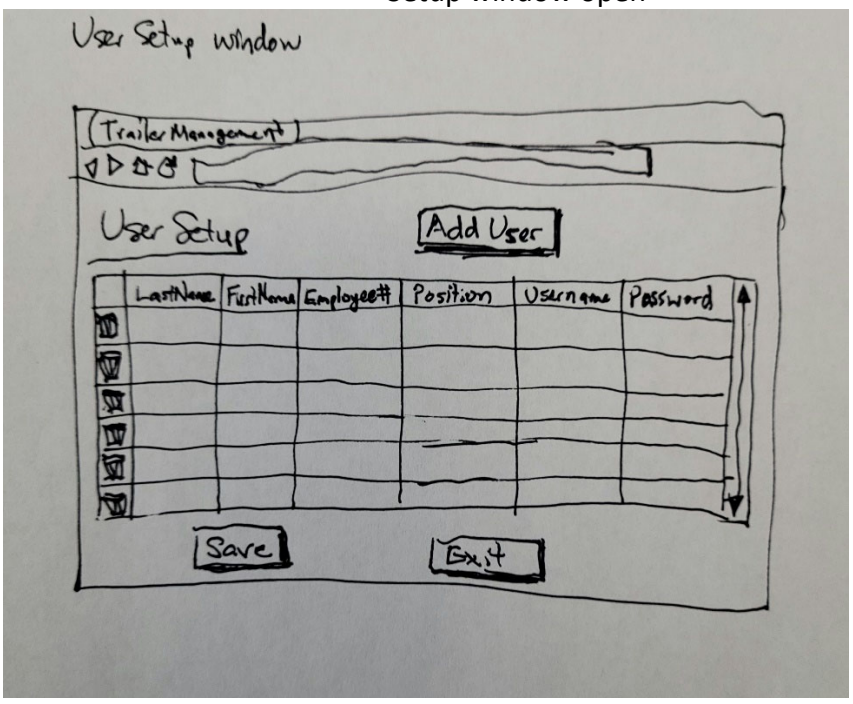


5. Setup Options window
    a. User button
        i. Clicking User button opens User Setup window
    b. Location button
        i. Clicking Location button opens Location Setup window
    c. Exit button
        i. Clicking Exit button closes Setup window and returns to Trailer List window



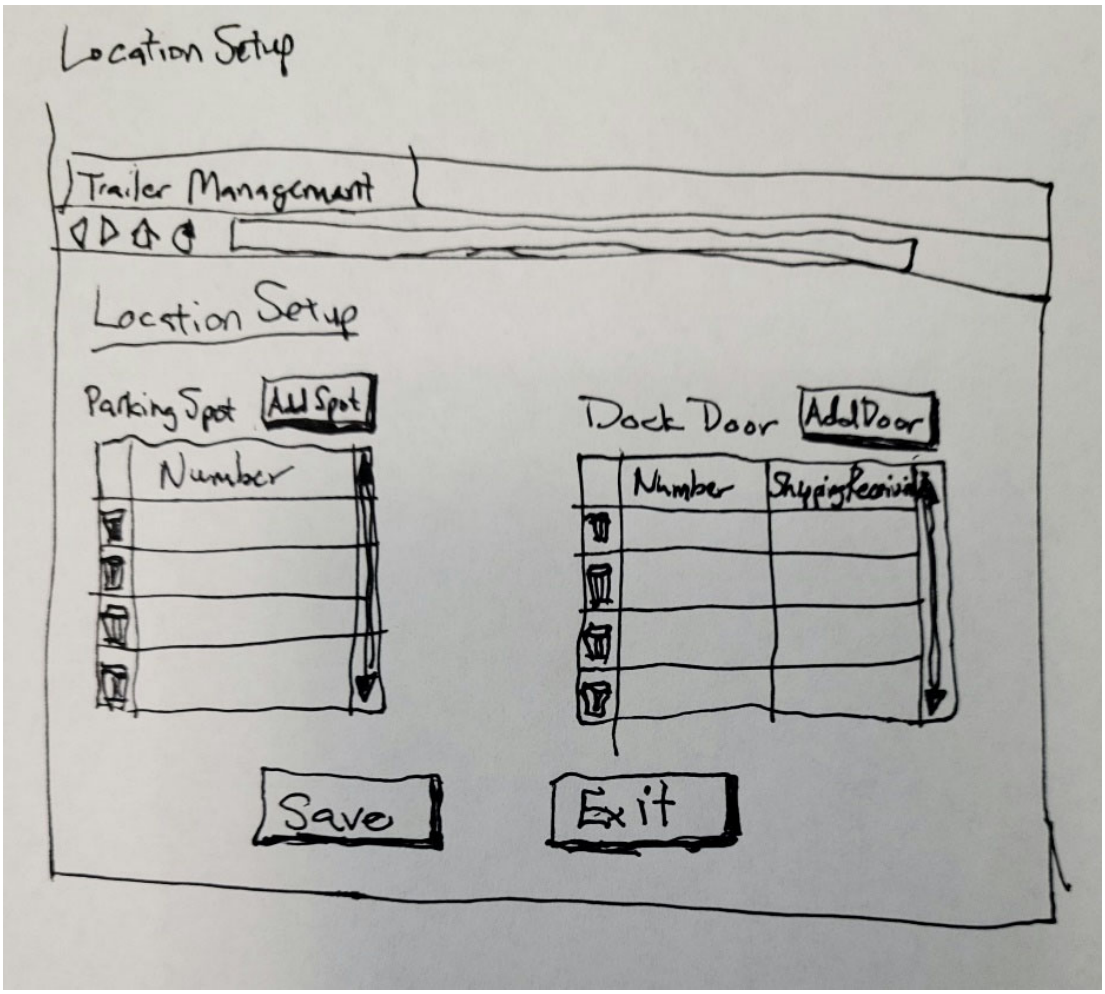
6. User Setup window

a. Lists all user records in table view
b. Trashcan button beside each record
    i. Clicking Trashcan button opens verification window
    ii. Clicking Yes in verification window logs out selected user, deletes user record, and reloads User Setup window
    iii. Clicking No in verification window closes verification window
c. All fields are editable in this window
d. Add User button
    i. Clicking Add User button creates new row in table view
e. Save button
    i. Clicking Save button checks required fields for data
        1. If required data is complete, commits changes and reloads User Setup window
        2. If required data is incomplete, opens alert window and highlights required fields
f. Exit button
    i. Clicking Exit button checks for unsaved changes
        1. If no changes found, closes User Setup window
        2. If changes found, verification window tells user unsaved changes will be discarded
            a. Clicking Yes discards unsaved changes and closes User Setup window
            b. Clicking No closes verification window and leaves User Setup window open



7. Location Setup window

a. Lists all Dock Door and Parking Spot records in two tables
b. Trashcan button beside each record
    i. Clicking Trashcan button opens verification window
    ii. Clicking Yes in verification window checks for Trailer record with same location
        1. If no Trailer record found with selected location, deletes location record, and reloads Location Setup window
        2. If Trailer record found with selected location, opens alert window informing user that location is in use and cannot be deleted, and reloads Location Setup window
    iii. Clicking No in verification window closes verification window
c. All fields are editable in this window
d. Add Dock Door button
    i. Clicking Add Dock Door button creates new row in Dock Door table view
e. Add Parking Spot button
    i. Clicking Add Parking Spot button creates new row in Parking Spot table view
f. Save button
    i. Clicking Save button checks required fields in both tables for data
        1. If required data is complete, commits changes and reloads Location Setup window
        2. If required data is incomplete, opens alert window and highlights required fields
g. Exit button
    i. Clicking Exit button checks for unsaved changes
        1. If no changes found, closes Location Setup window
        2. If changes found, verification window tells user unsaved changes will be discarded
            a. Clicking Yes discards unsaved changes and closes Location Setup window
            b. Clicking No closes verification window and leaves Location Setup window open


Location Setup
Trailer Management
Location Setup
Parking Spot
Add Spot
Number
Dock Door
Add Door
Number
Save
Exit

Functional Requirements Specification

Stakeholders

- VP of Logistics - Sponsor
- Warehouse Manager – Project Lead
- Warehouse Supervisor – Admin
- Warehouse Personnel (Loader/Unloader) – User
- Spotter – User
- Gatekeeper – User

Actors and Goals

Primary actors

- **Gatekeeper** will create, edit, and delete trailer records, assign drop-off parking spots, and look up pick-up parking spots.
- **Spotter** will move trailers between parking spots and dock doors and record those movements.
- **Warehouse operator** will update the status of trailers in dock doors as they are loaded and unloaded.

Secondary actors

- **Admin** will create, edit, and delete parking locations and create, edit, delete user accounts.
- **System** will indicate status of parking spots and dock doors and display data and status of the trailers on the premises.

Use Cases (Implementation time in engineering workdays)

Admin (total: 13 days)

- Login/Logout: To login/logout to/from admin account (1)
- Add parking spot: To add a parking spot (2)
- Add dock door: To add a dock door (1)
- Edit dock door: To change the status of a dock door (active or inactive) (1)
- Edit parking spot: To change the status of a parking spot (active or inactive) (1)
- View parking locations: To see details of parking spots and dock doors including status and occupancy (2)
- Add user: To add a gatekeeper, spotter, or warehouse operator (2)
- Edit user: To change user details and passwords (1)
- Delete user: To remove a user from the system (1)
- View users: To see details of all users, like name, job title, username, password (1)

Gatekeeper (total: 8 days)

- Login/Logout: To login/logout to/from gatekeeper account (1)
- Add trailer: To add a trailer record (2)
- Delete trailer: To remove a trailer record (1)

- View trailers: To see details of trailers including status and location (2)
- View parking locations: To see details of parking spots and dock doors including status and occupancy (2)

Spotter (total: 6 days)

- Login/Logout: To login/logout to/from spotter account (1)
- Edit trailer: To change trailer location (1)
- View trailers: To see details of trailers including status and location (2)
- View parking locations: To see details of parking spots and dock doors including status and occupancy (2)

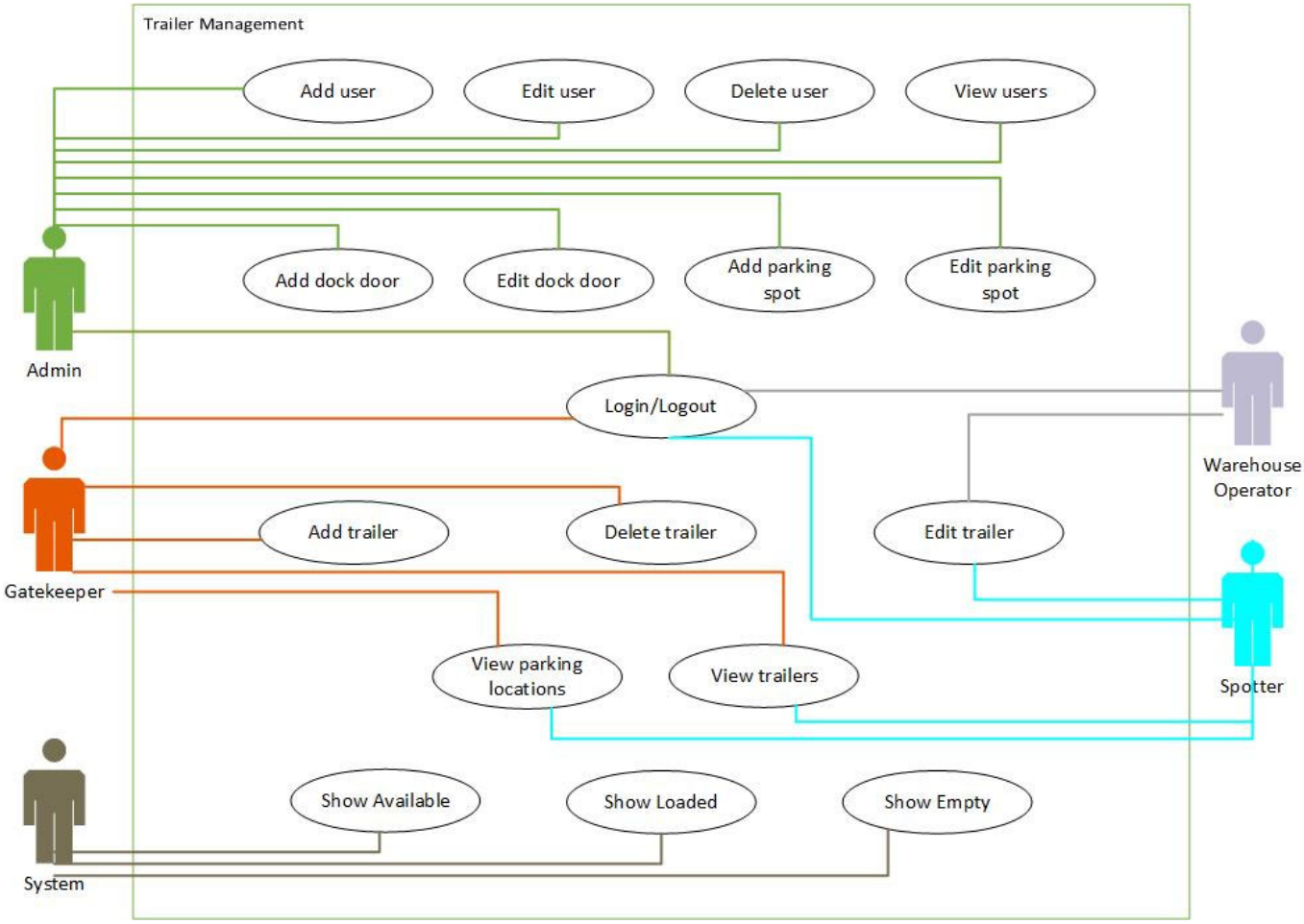
Warehouse operator (total: 2 days)

- Login/Logout: To login/logout to/from operator account (1)
- Edit trailer: To maintain trailer status (loaded or empty) (1)

System (total: 7 days)

- Show available: To show details of available parking spots and dock doors (3)
- Show loaded: To show trailers that are loaded (2)
- Show empty: To show trailers that are empty (2)

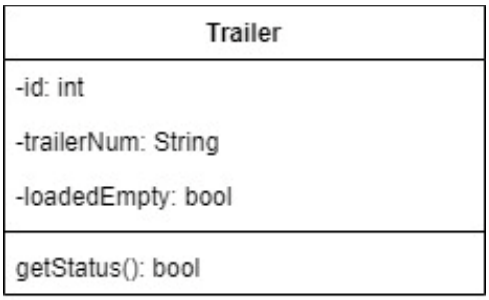
Use Case Diagram



Class Diagram

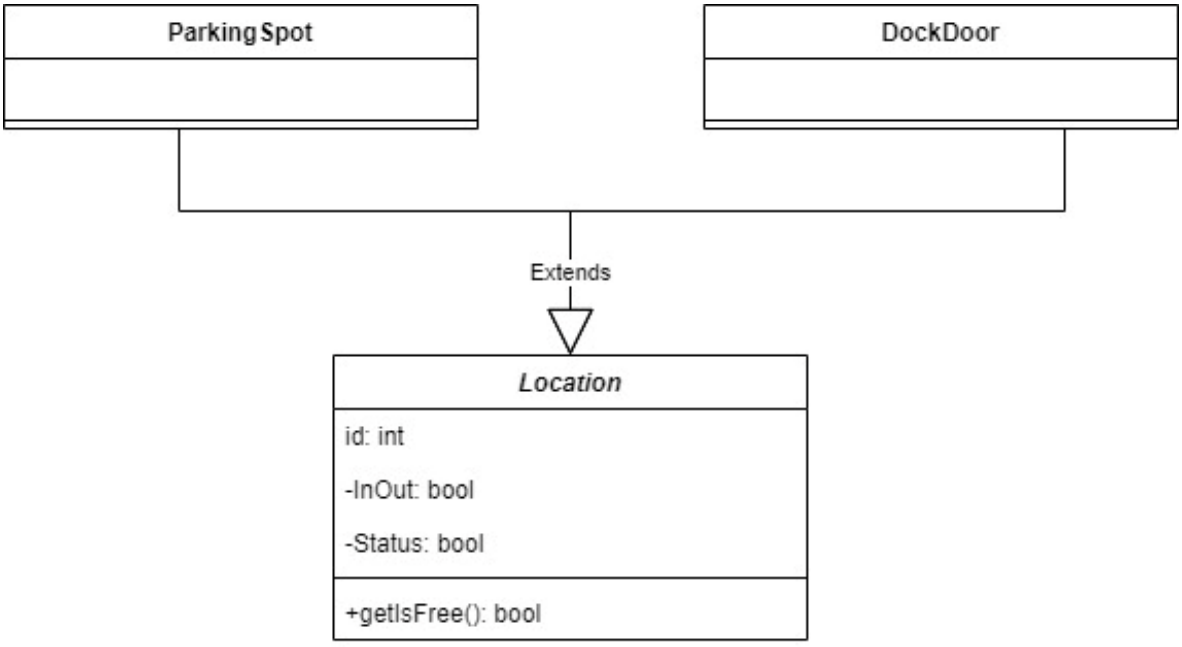
Trailer

This class can be used to get the load status of a trailer, which will be either loaded or empty.



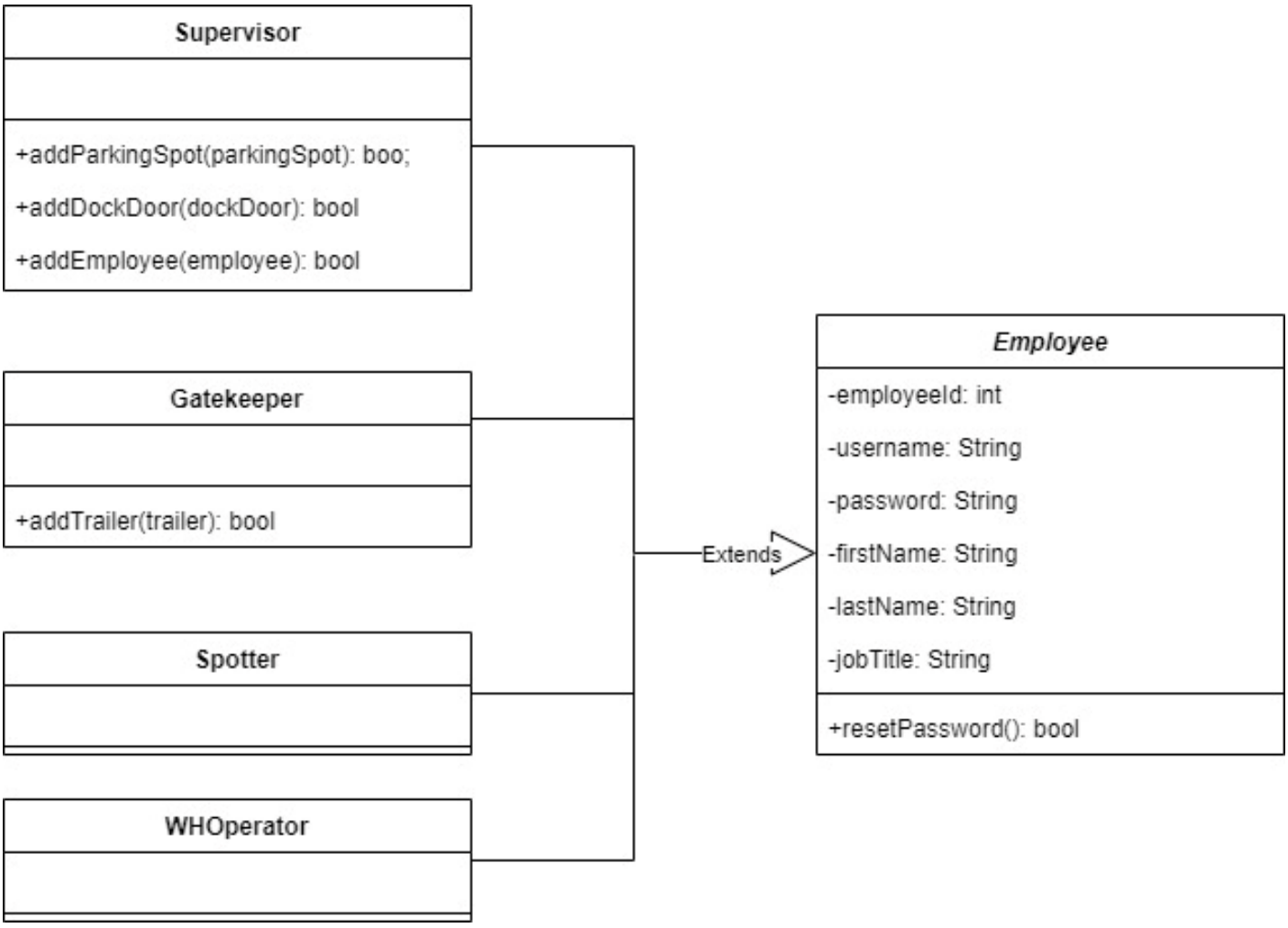
Location

This class is an abstract containing the two types of locations, which are Parking Spot and Dock Door. Dock doors need to be separate from parking spots because the warehouse operators will interact only with trailers that are in dock doors.



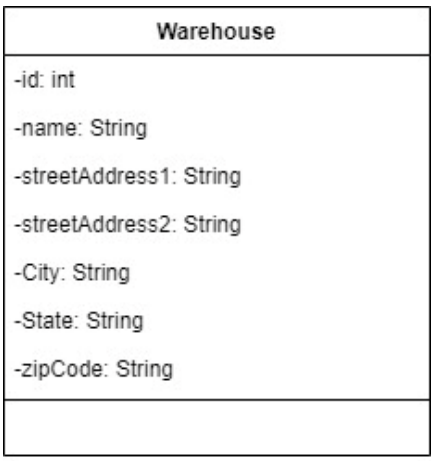
Employee

This class is another abstract, which splits out into the four types of employees in the system



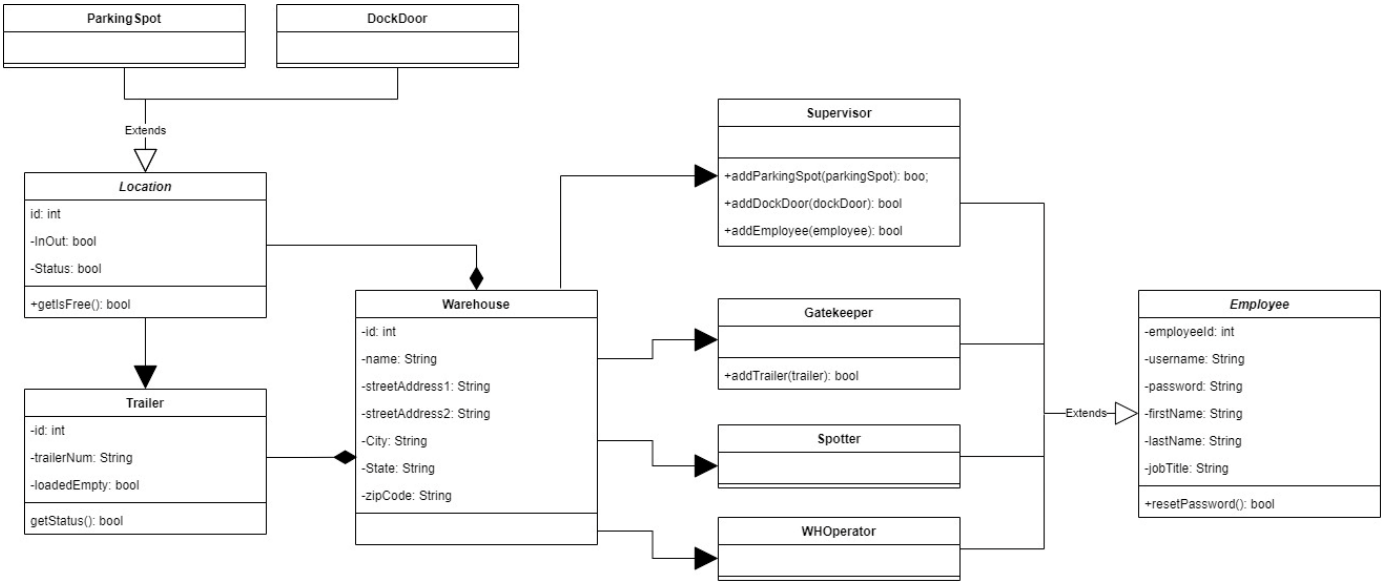
Warehouse

This class is the main class that everything else feeds into. If we wanted to scale up the scope of the project, multiple warehouses could come into play.



Trailer Management System

This is the whole class diagram for the system.

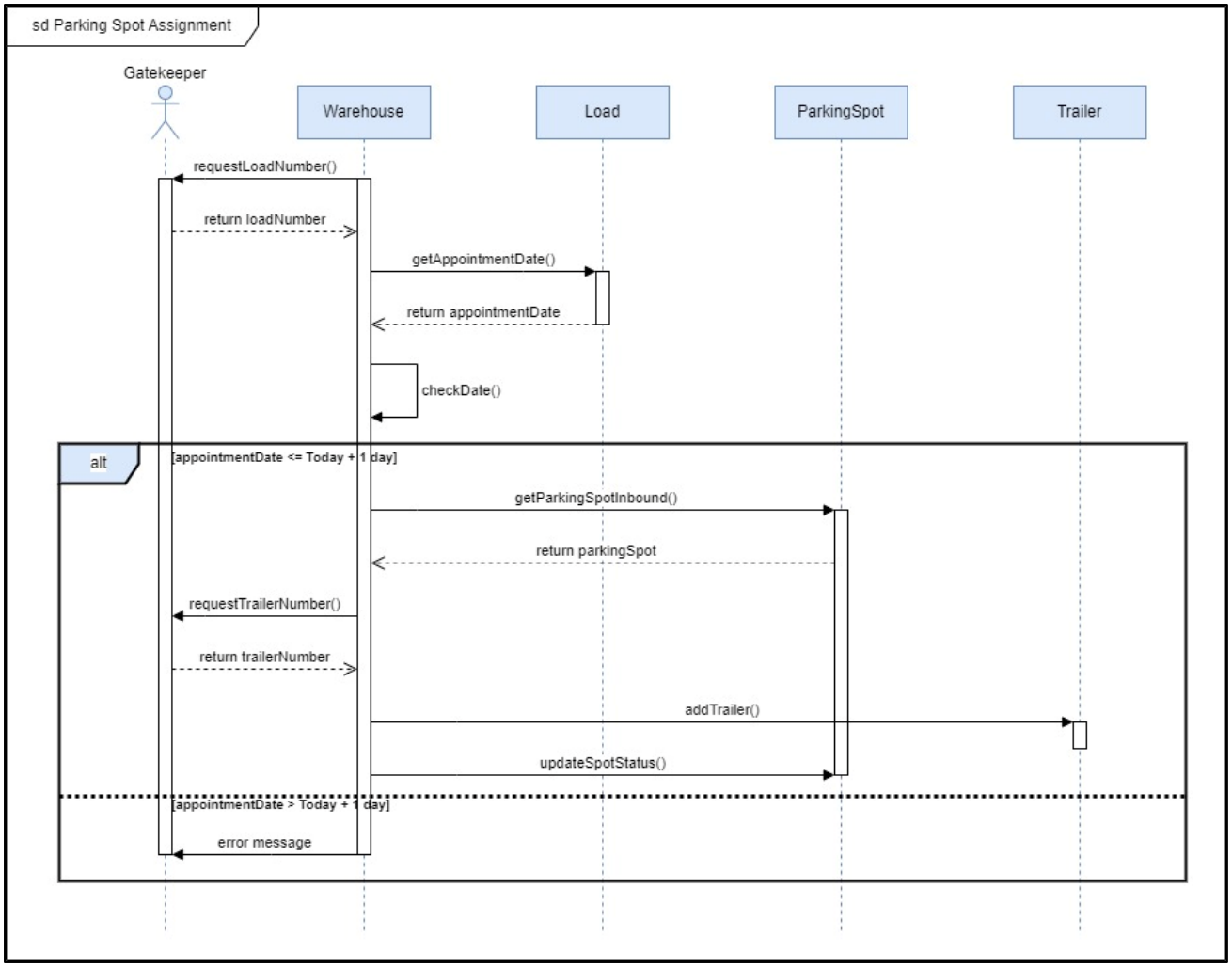


Sequence Diagram and Activity Diagram

System Sequence Diagram – Parking Spot Assignment

Actor: Gatekeeper
Object: Warehouse, Load, Trailer, ParkingSpot

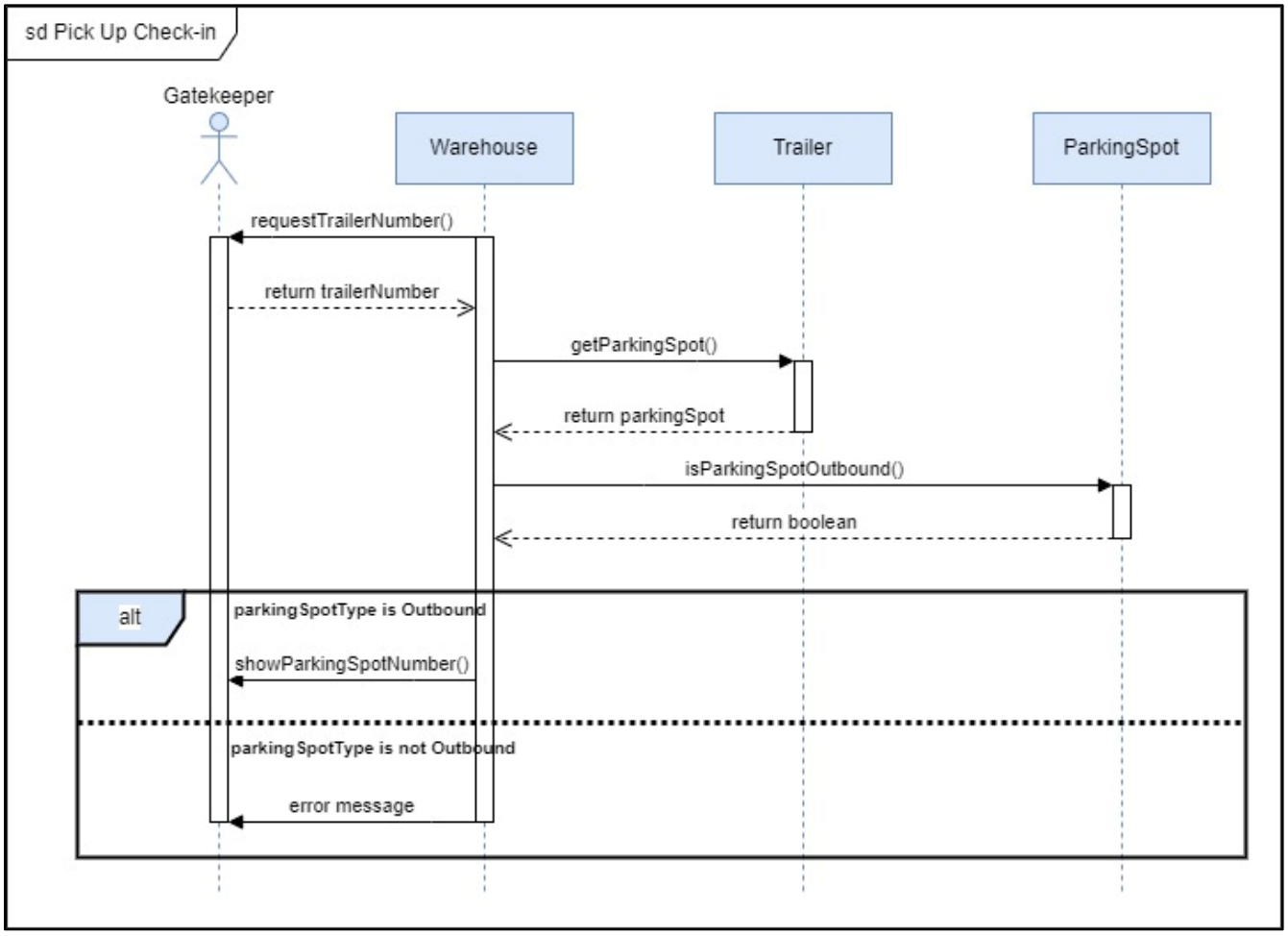
1. Gatekeeper enters load number into Warehouse
2. Warehouse gets Load appointment date
3. If appointment date is greater than 1 day from today: 1. Warehouse displays a message that the arrival date is too early
4. If appointment date is less than or equal to 1 day from today:
   1. Warehouse gets lowest number available inbound parking spot
   2. Warehouse prompts Gatekeeper to enter trailer number
   3. Gatekeeper enters trailer number
   4. Warehouse creates Trailer object
   5. Warehouse updates assigned Parking Spot status to unavailable



System Sequence Diagram – Pick Up Check-in

Actor: Gatekeeper
Object: Warehouse, Trailer, ParkingSpot

1. Gatekeeper enters trailer number into Warehouse
2. Warehouse gets Trailer parking spot
3. If parking spot is not outbound: 1. Warehouse displays error message that trailer is not ready
4. If parking spot is outbound: 1. Warehouse displays the parking spot number



Activity Diagram – Parking Spot Assignment

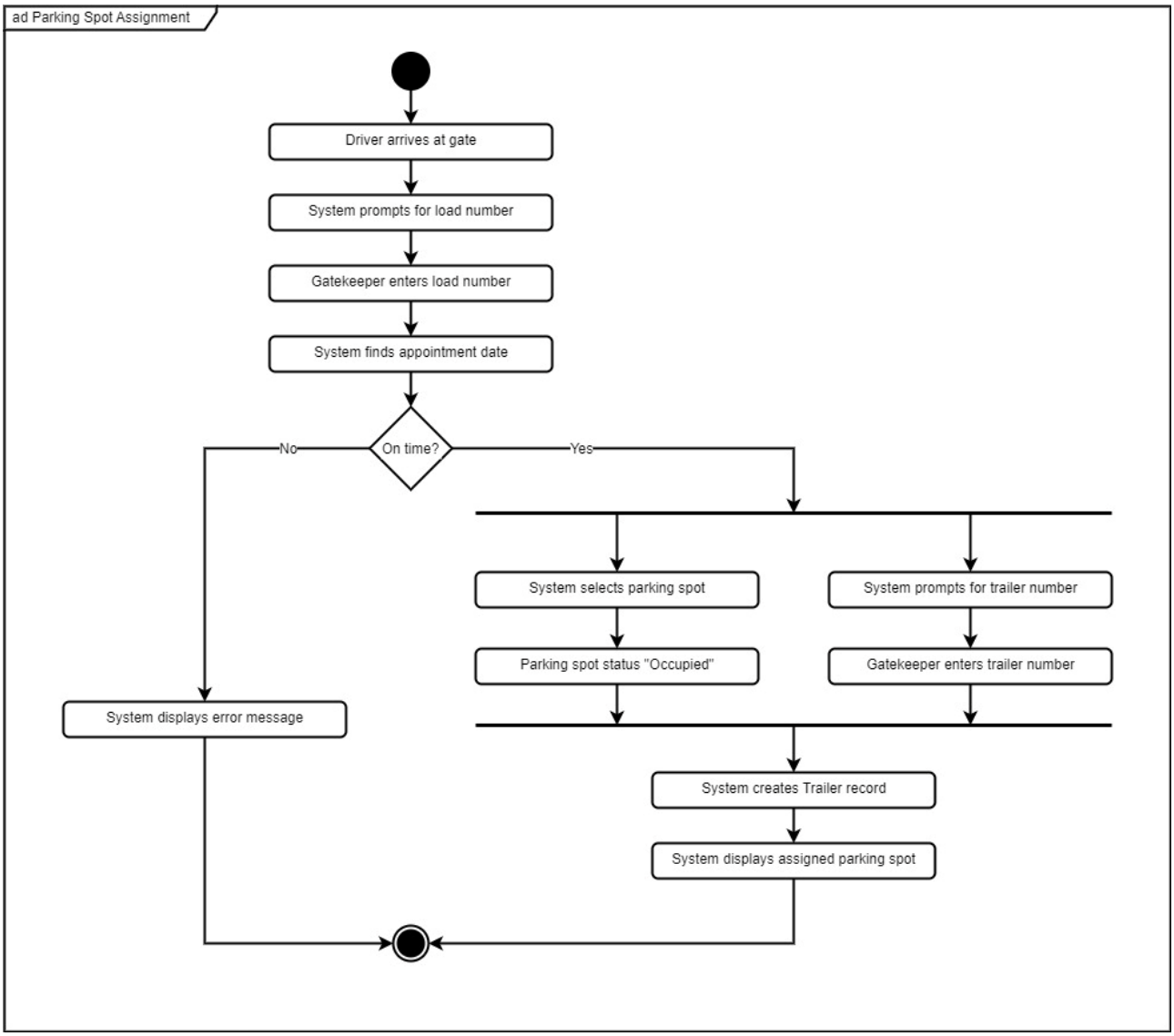
States

Initial State: Trailer arrives at the gate

Final State: 1. The trailer is assigned a parking spot and allowed into the parking lot
2. The trailer is too early and is denied entry to the parking lot

Actions

A driver arrives at the gate with a loaded trailer and gives the gatekeeper the load number. The gatekeeper enters the load number into the system. The system checks the appointment date. If the trailer arrived too early, the system tells the gatekeeper not to allow the trailer into the lot. Otherwise, the system assigns an inbound parking spot and prompts the gatekeeper to enter the trailer number. Then, the system displays the assigned parking spot, and the gatekeeper allows the trailer into the lot.



Activity Diagram – Parking Spot Assignment

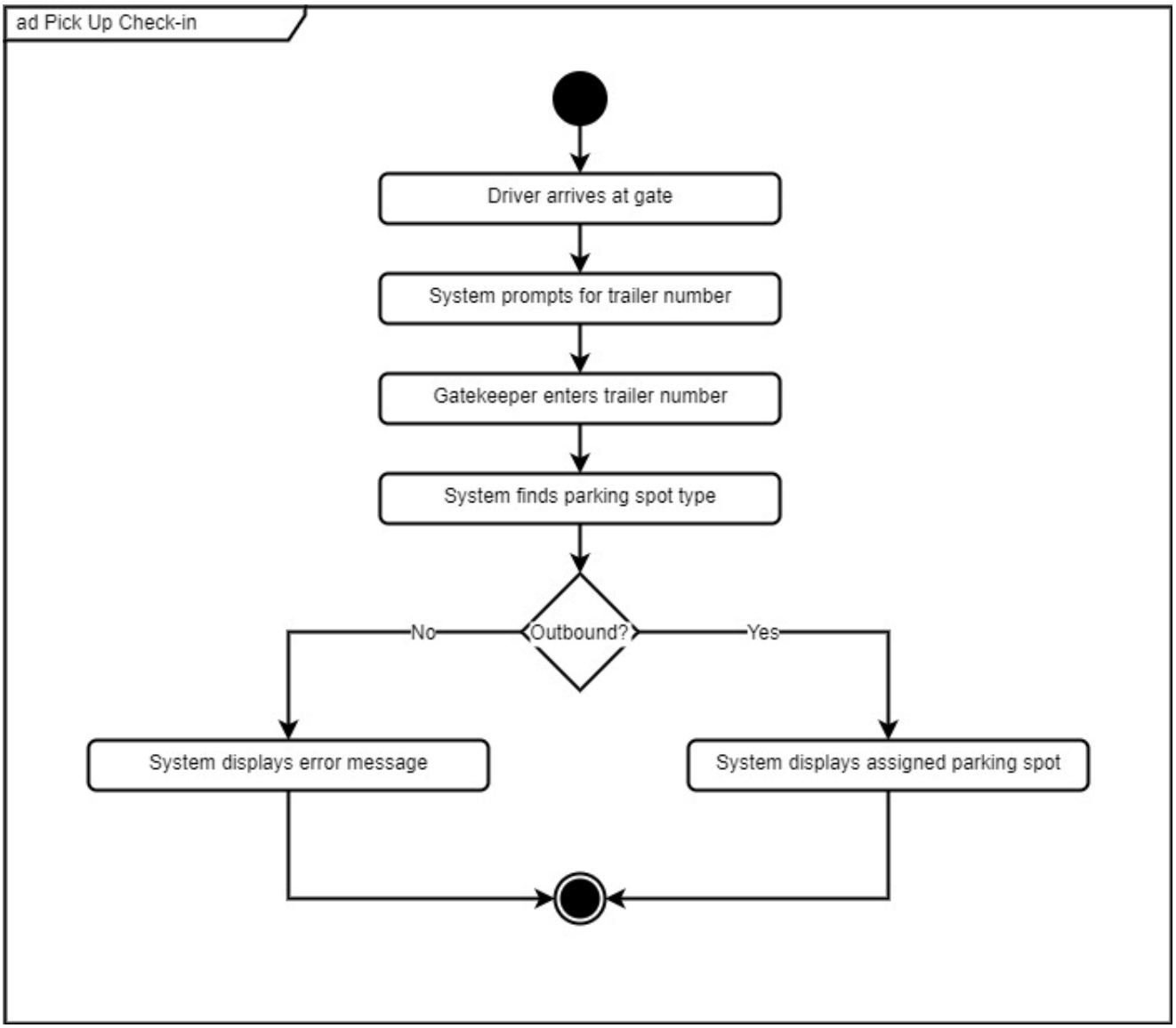
States

Initial State: Driver arrives at gate to pick up a trailer

Final State: 1. The driver is told the trailer parking spot and allowed into the parking lot
2. The trailer is not ready, so the driver is not allowed into the parking lot

Actions

A driver arrives at the gate and gives the gatekeeper the trailer number to pick up. The gatekeeper enters the trailer number into the system, and the system checks the location. If the trailer is not in an outbound parking spot, the system tells the gatekeeper not to allow the driver into the lot. Otherwise, the system displays the trailer parking spot, and the gatekeeper allows the driver into the lot.



User Interface Specification

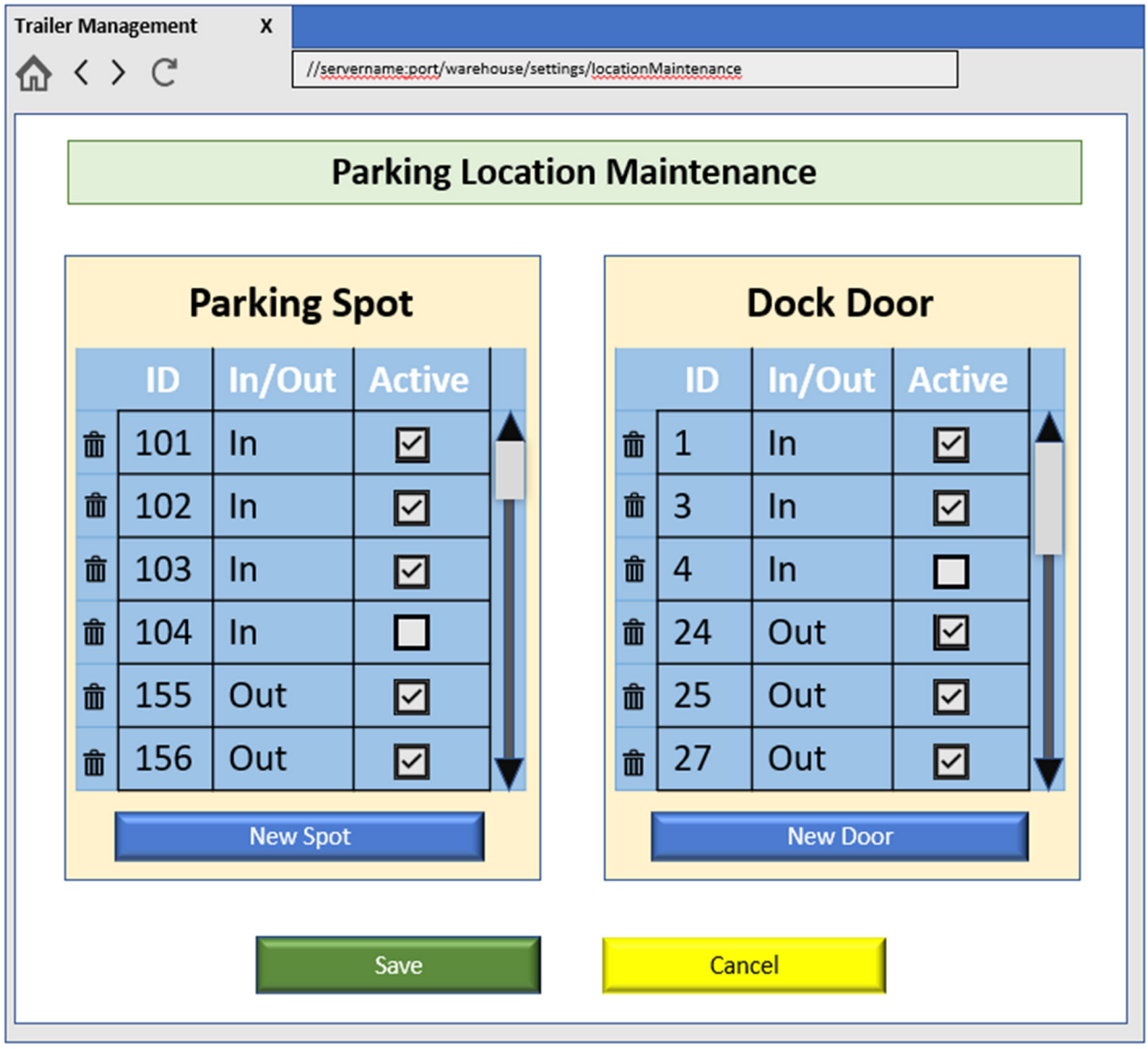
Parking Location Maintenance

Description: This page includes functionality for all use cases related to maintenance of both types of parking locations

Prerequisite: Admin user logged in and selected Parking Location Maintenance from the Settings menu

Navigation: Settings → Parking Location Maintenance

Actor: Admin



Use Cases and Effort:

	Steps	User Effort Estimation
Add Parking Spot	1. Click “New Spot” button 2. Enter ID 3. (Optional) Select “Out” instead of “In” 4. (Optional) Uncheck Active checkbox 5. Click “Save” button	2-5 mouse clicks 1 data field (keystroke count depends on ID length)
Add Dock Door	1. Click “New Door” button 2. Enter ID 3. (Optional) Select “Out” instead of “In” 4. (Optional) Uncheck Active checkbox 5. Click “Save” button	2-5 mouse clicks 1 data field (keystroke count depends on ID length)
Edit Parking Spot Status	1. Scroll or drag scroll bar to desired record 2. Click Active checkbox 3. Click “Save” button	Scrolling 2 mouse clicks
Edit Dock Door Status	1. Scroll or drag scroll bar to desired record 2. Click Active checkbox 3. Click “Save” button	Scrolling 2 mouse clicks
Delete Parking Spot	1. Scroll or drag scroll bar to desired record 2. Click trash can icon 3. Click “Save” button	Scrolling 2 mouse clicks
Delete Dock Door	1. Scroll or drag scroll bar to desired record 2. Click trash can icon 3. Click “Save” button	Scrolling 2 mouse clicks

Trailers

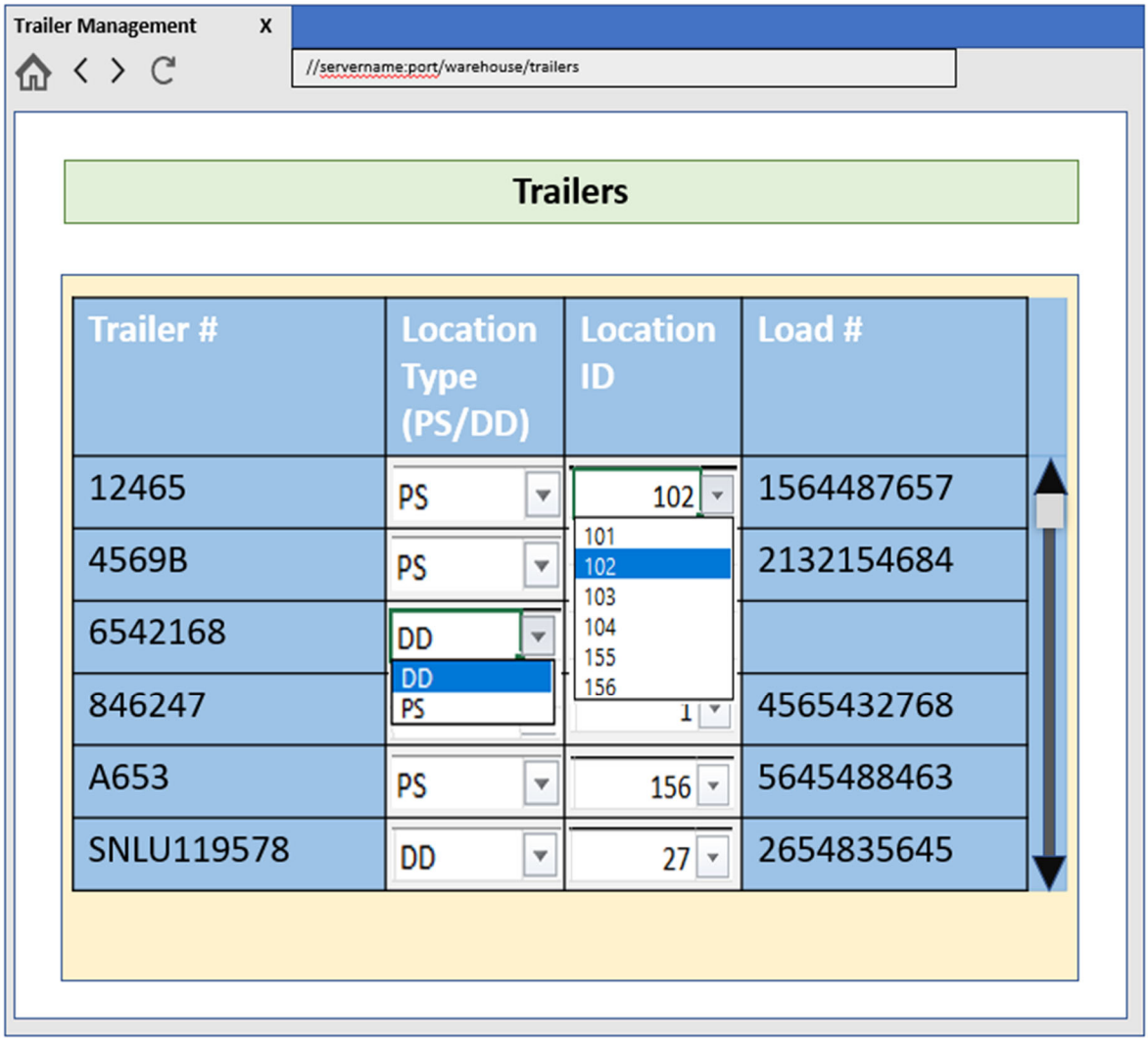
Description: This page is the home page for all users; read access is available to all users; editing functions will be different depending on the type of user. Options for each user type are detailed below.

Prerequisite: User logged in

Navigation: Home page

Trailers – Spotter

Actor: Spotter

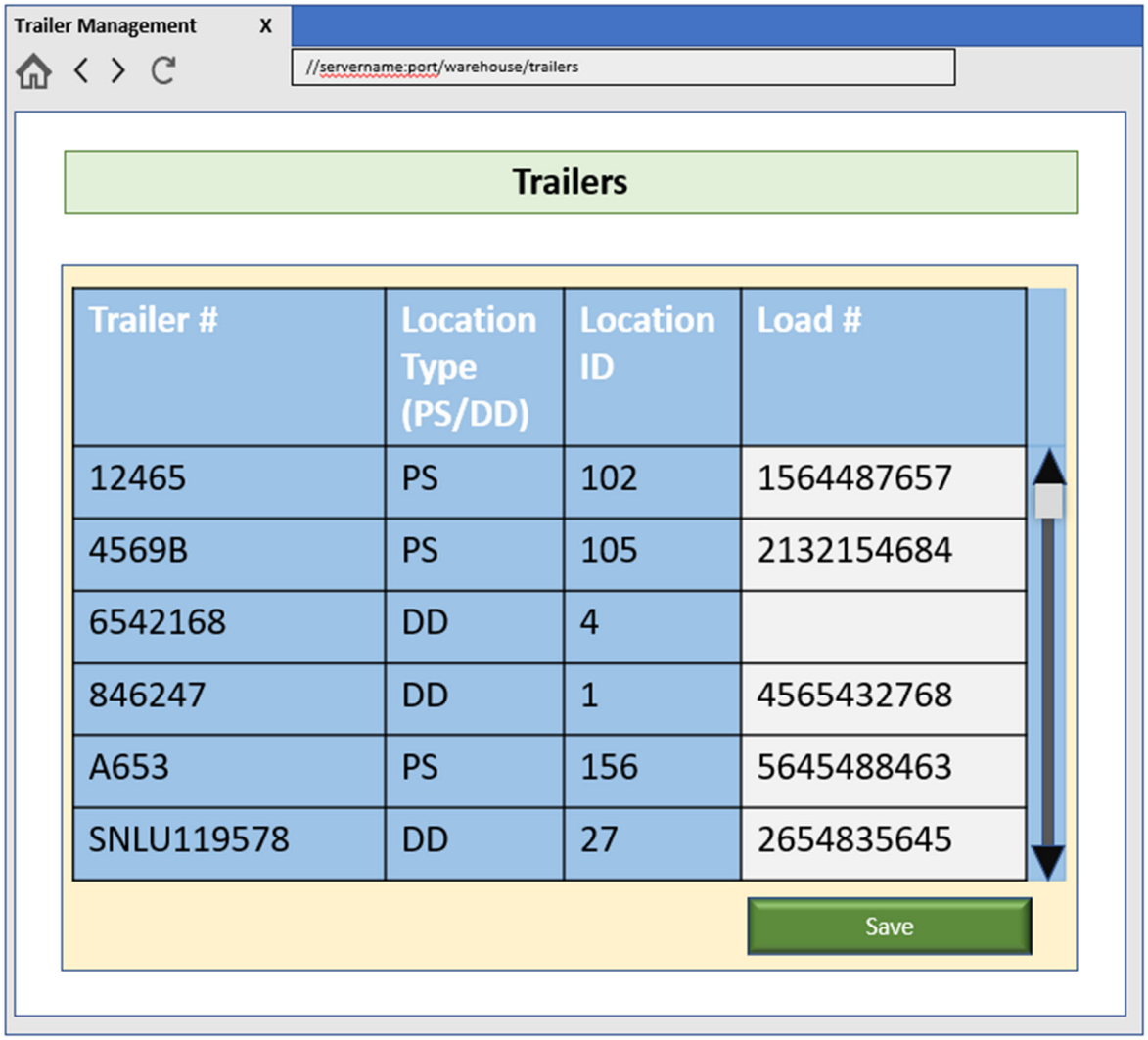


Use Cases and Effort:

	Steps	User Effort Estimation
View Trailers	1. Scroll to find trailer	Scrolling
Edit Trailer Location	1. Click dropdown arrow on Location Type 2. Click “DD” or “PS” for Dock Door or Parking Spot 3. Click dropdown arrow on Location ID 4. Scroll (if needed) 5. Click desired Location ID NOTE: values are saved on selection since Location ID list will change depending on selection of “DD” or “PS”	4 mouse clicks Scrolling, if Location ID list is long

Trailers – Warehouse Operator

Actor: Warehouse Operator

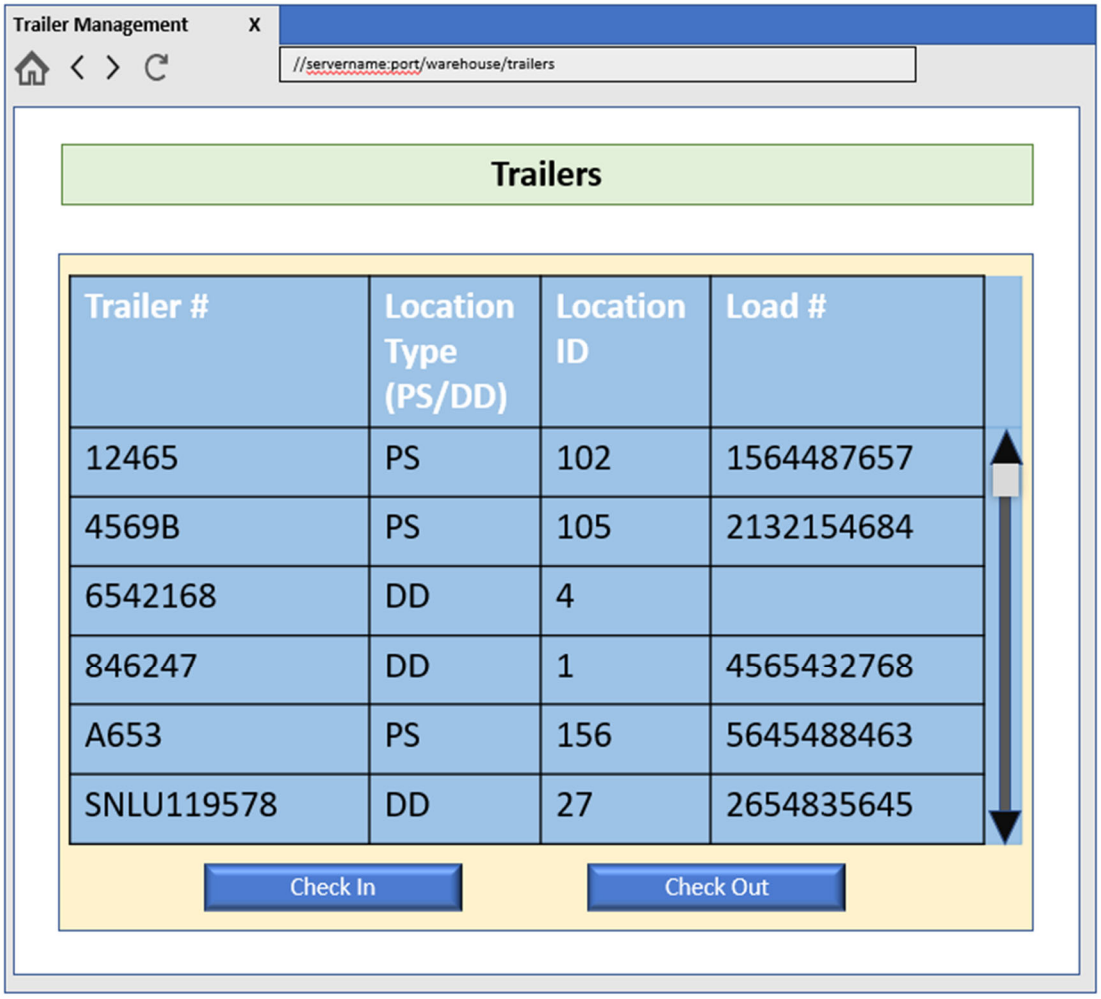


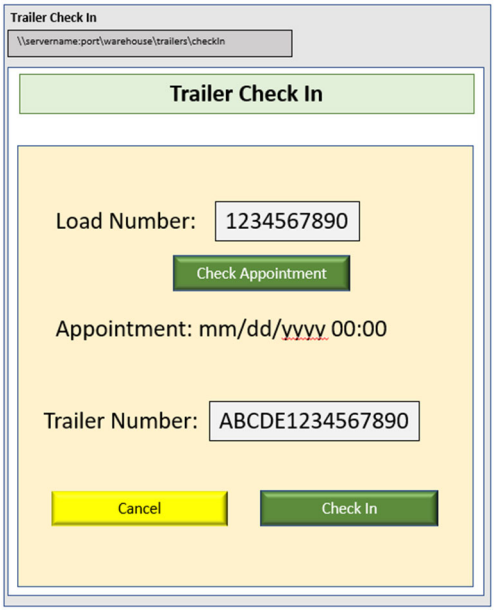
Use Cases and Effort:

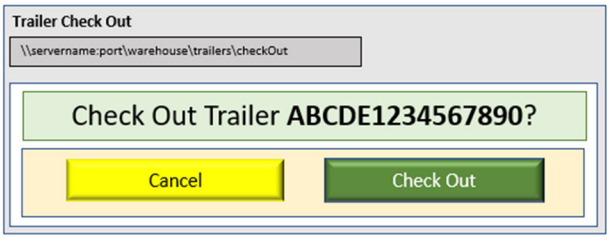
	Steps	User Effort Estimation
View Trailers	1. Scroll to find trailer	Scrolling
Edit Trailer Load	1. Click Load # field to place cursor 2. Delete Load # if trailer is empty Enter Load # if trailer is loaded 3. Click Save button	2 mouse clicks 10 keystrokes max

Trailers – Gatekeeper

Actor: Gatekeeper







Use Cases and Effort:

	Steps	User Effort Estimation
View Trailers	1. Scroll to find trailer	Scrolling
Add Trailer (Check In)	1. Click “Check In” button on Trailers page 2. Enter Load Number on pop-up 3. Click “Check Appointment” button on pop-up 4. Enter Trailer Number on pop-up 5. Click “Check In” button on pop-up	3 mouse clicks 10 keystrokes for Load Number 15 max keystrokes for Trailer Number
Delete Trailer (Check Out)	1. Scroll to find trailer 2. Click on trailer record to select it 3. Click “Check Out” button 4. Click “Check Out” button on confirmation pop-up	Scrolling 3 mouse clicks

Plan of Work

W1-2: Completed; Determine framework and structure, and get the underlying setup completed, including web hosting on the server, mySQL database table structure, sketches of UI

W3-4: In Progress; Implement UI and related database tables and calls for Warehouse Supervisor: view/add/edit/delete users; assign security role

W5: Implement UI and related database calls for Gatekeeper: view/add/edit/delete locations

W6-7: Implement UI and related database calls for remaining users: view/add/edit/delete trailers; check-in/out trailers (Gatekeeper only)

W8: Address any issues with the previous work; record midterm demo

W9-12: Implement management functionality with the indicators and color coding of trailer records as detailed in the table above; if time allows, develop overhead map view of parking locations and status with color coding

W13-14: Write test cases for all features, and prepare for final demo

W15: Record final presentation