Software Requirements Specification

Tezla - eVehicle

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Visas R Us

Development Team Members:

Student Number	Student Name
43408920	Dayan Syed
44751575	Saisrikar Paruchuri
43190234	Sharde Nel
43603665	Winifred Liang
44450663	Virpal kaur

Tezla

Client Team Members:

Student Number	Student Name
44000992	Tom Quirk
44019248	Yue Ming Lee
43442504	Haythm Alshehab
42927059	Alex Sharpe
43561768	Zach Yusi

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Version History

Issue	Date	Change
1.0	31/03/2017	Added introduction
2.0	31/03/2017	Added use case package diagrams
3.0	1/04/2017	Added package descriptions
4.0	1/04/2017	Added use case diagrams
4.1	2/04/2017	Edited use case diagrams
4.2	2/04/2017	Edited use case package diagrams
5.0	2/04/2017	Added more use case diagrams
5.1	3/04/2017	Edited use case diagrams
6.0	3/04/2017	Added actor descriptions
7.0	3/04/2017	Added use case summaries
7.1	3/04/2017	Edited use case summaries
8.0	4/04/2017	Added more use case summaries
8.1	4/04/2017	Edited use case summaries
9.0	4/04/2017	Added use case descriptions
9.1	4/04/2017	Edited use case descriptions
10.0	4/04/2017	Added activity diagrams
11.0	12/04/2017	Changed use case diagrams
11.1	13/04/2017	Edited use case summaries
11.2	15/04/2017	Added use case descriptions
11.3	17/04/2017	Added activity diagrams
11.4	21/04/2017	Added more use case descriptions
11.5	23/04/2017	Added more activity diagrams
11.6	26/04/2017	Edited activity diagrams
11.7	27/04/2017	Edited use case descriptions
11.8	01/05/2017	Edited activity diagrams
11.9	02/05/2017	Edited use case descriptions
12.0	04/05/2017	Added class package diagram
12.1	04/05/2017	Added class diagrams
12.2	04/05/2017	Edited class diagrams
12.3	05/05/2017	Added more class diagrams
12.4	05/05/2017	Edited class diagrams
12.5	05/05/2017	Added class summaries
12.6	08/05/2017	Added more class diagrams
12.7	08/05/2017	Edited class diagrams
12.8	09/05/2017	Edited class summaries
13.0	11/05/2017	Added non-functional requirements
14.0	14/05/2017	Added risks
15.0	14/05/2017	Added release one
15.1	14/05/2017	Added release two
15.2	15/05/2017	Added release three
15.3	15/05/2017	Edited release one, two, three
16.0	18/05/2017	Added references
16.1	18/05/2017	Added appendix
16.2	18/05/2017	Added glossary
16.3	20/05/2017	Edited risks
17.0	22/05/2017	Added state diagrams

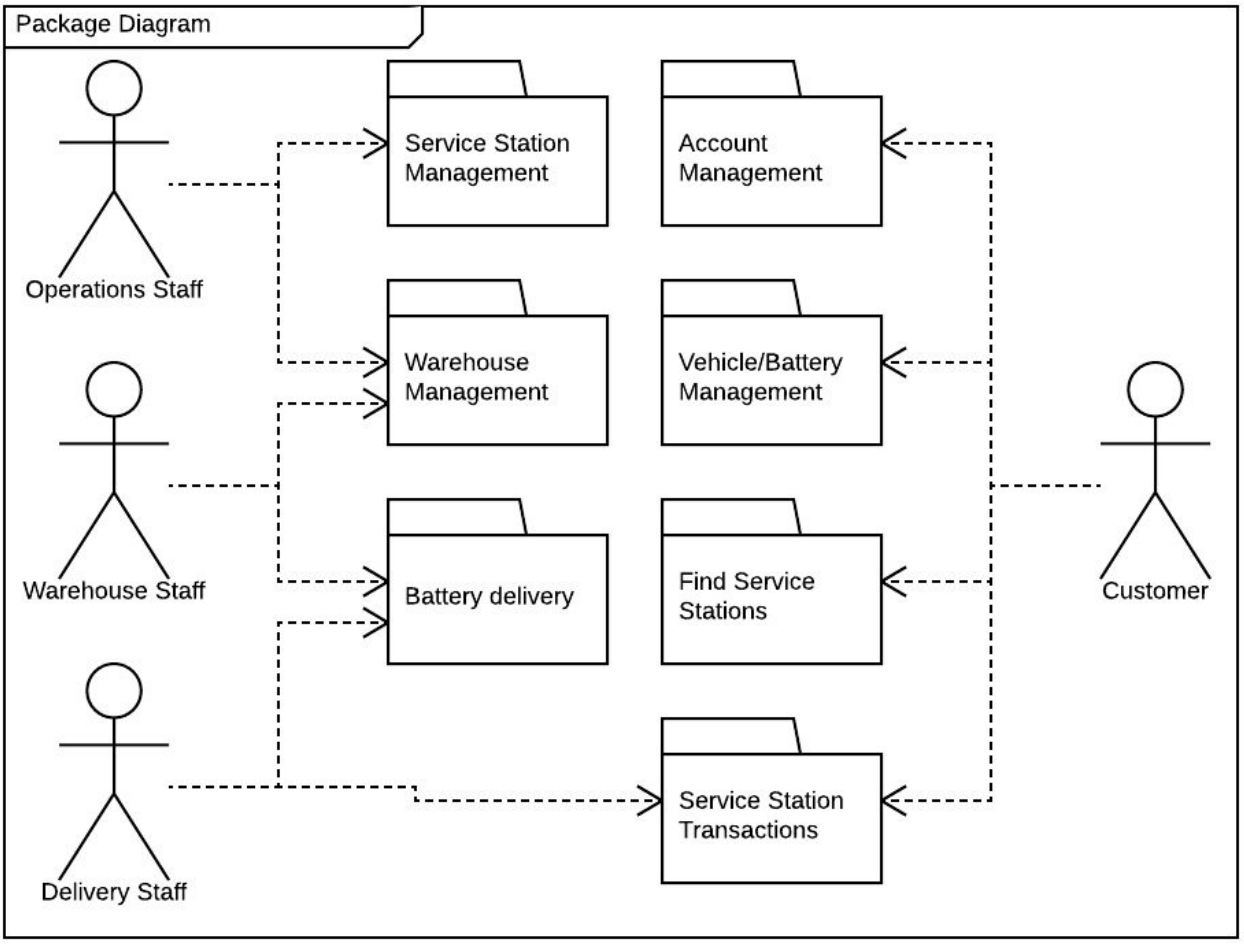
17.1	23/05/2017	Edited state diagrams
17.2	23/05/2017	Added more state diagrams
17.3	25/05/2017	Edited appendix
17.4	25/05/2017	Added more to appendix
18.0	27/05/2017	Added summary

1.0 Introduction

This document provides the requirement specification for eVehicle; a universal battery swap software system for electric cars. This system is designed to track batteries and their location with respect to the nearest station, fulfil customers' needs and store information regarding interactions the company has with energy suppliers, battery manufacturers and service stations. The system will also see to customer needs through the use of an online portal where customers can view their account details, the status of their battery and make payment.

2.0 Use Case Packages

2.1 Package Diagram

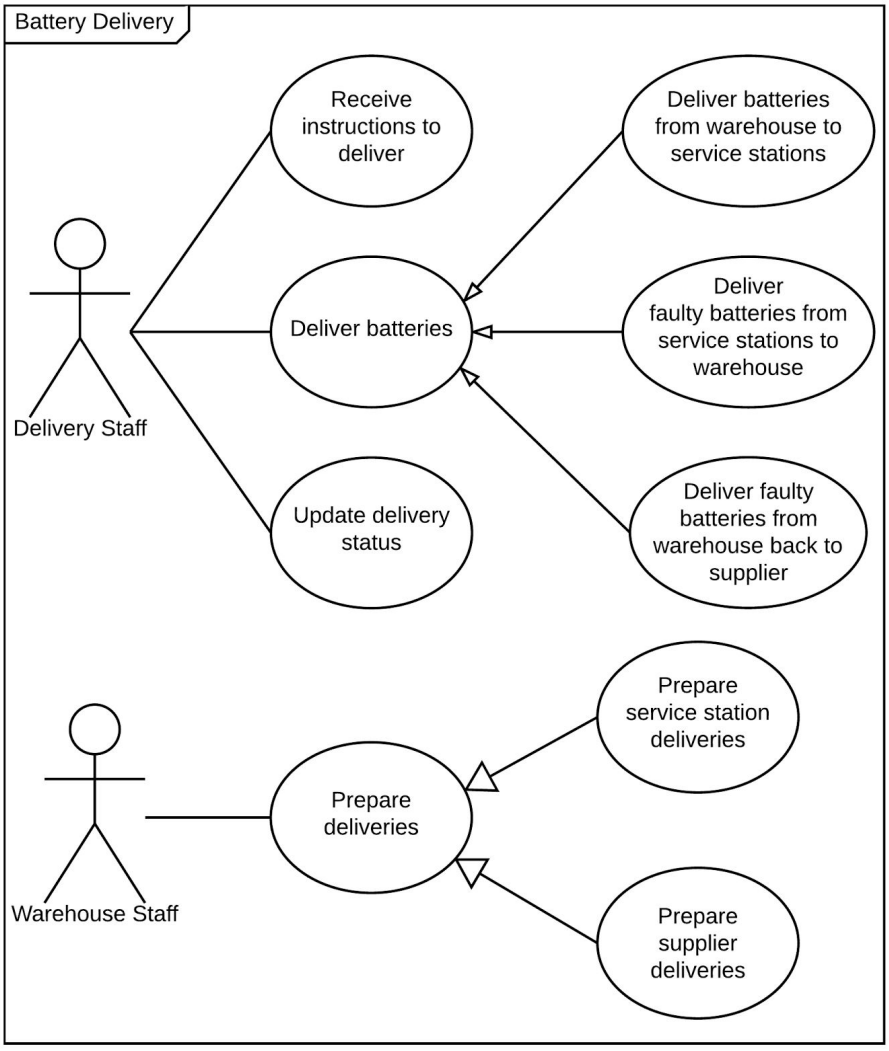


2.2 Package Descriptions

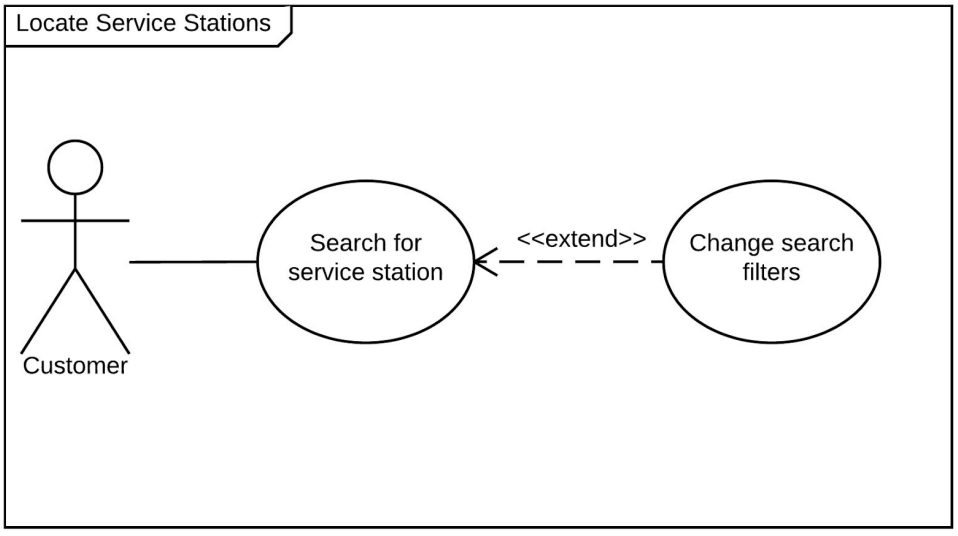
Package Name	Description
Service Station Management	Management of service stations that provide battery charging or swapping.
Warehouse Management	Management of warehouses and their inventories.
Battery Delivery	Delivery of batteries.
Account Management	Customer's management of their account.
Vehicle/Battery Management	Customer's management of their vehicles and batteries.
Find Service Stations	Search for service stations.
Service Station Transactions	Transactions that occur at a service station.

3.0 Use Case Diagrams

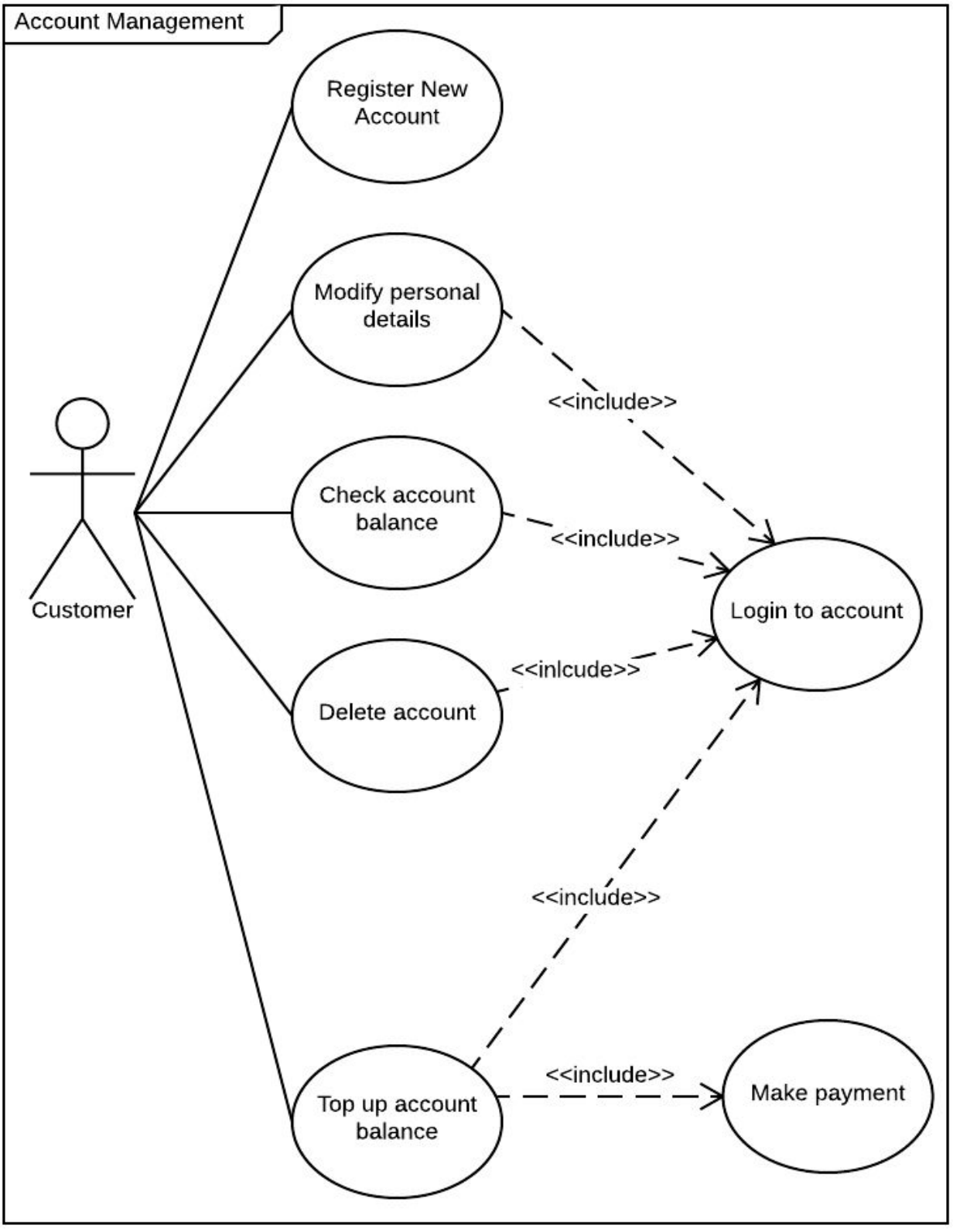
3.1 Battery Delivery



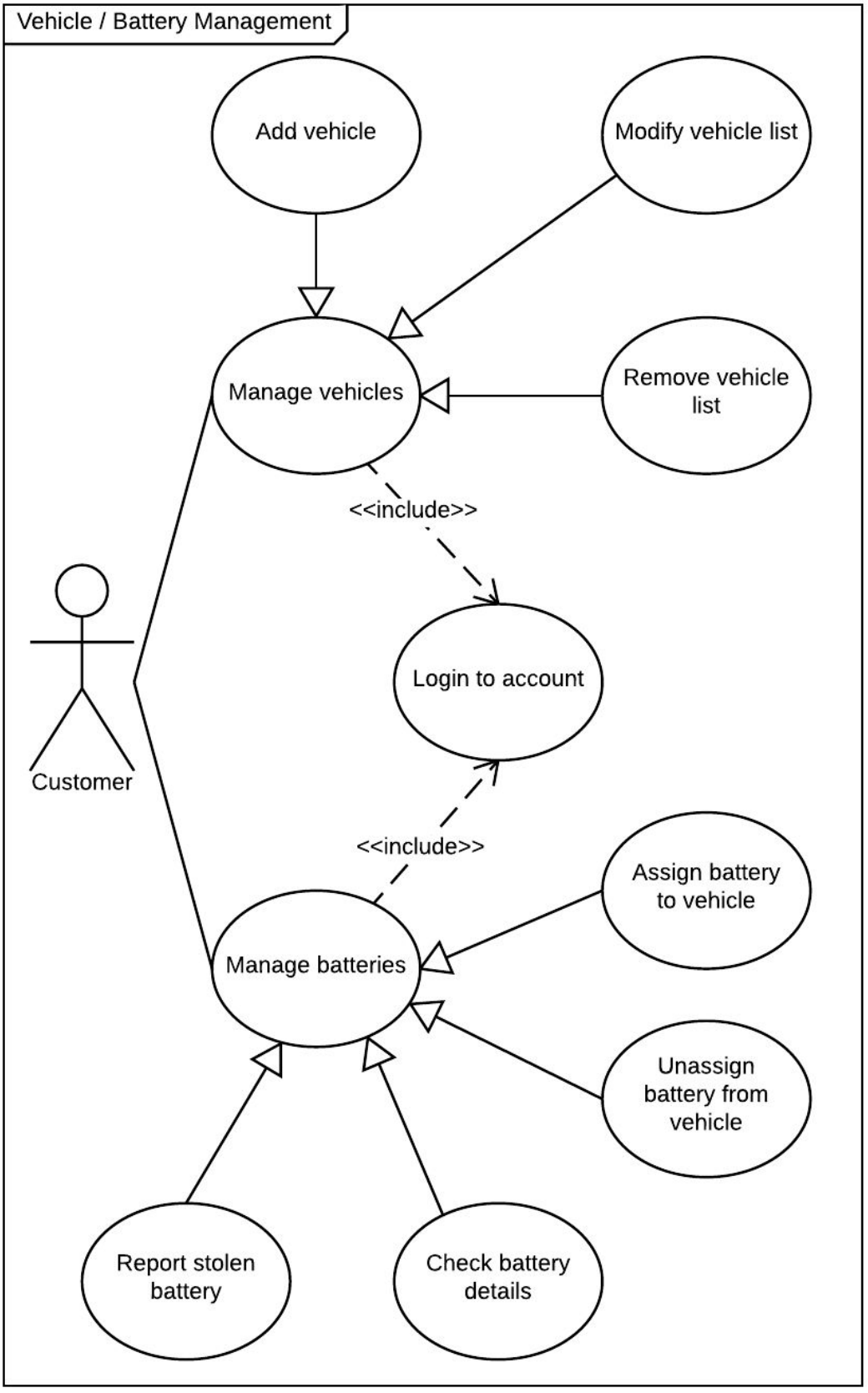
3.2 Locate Service Stations



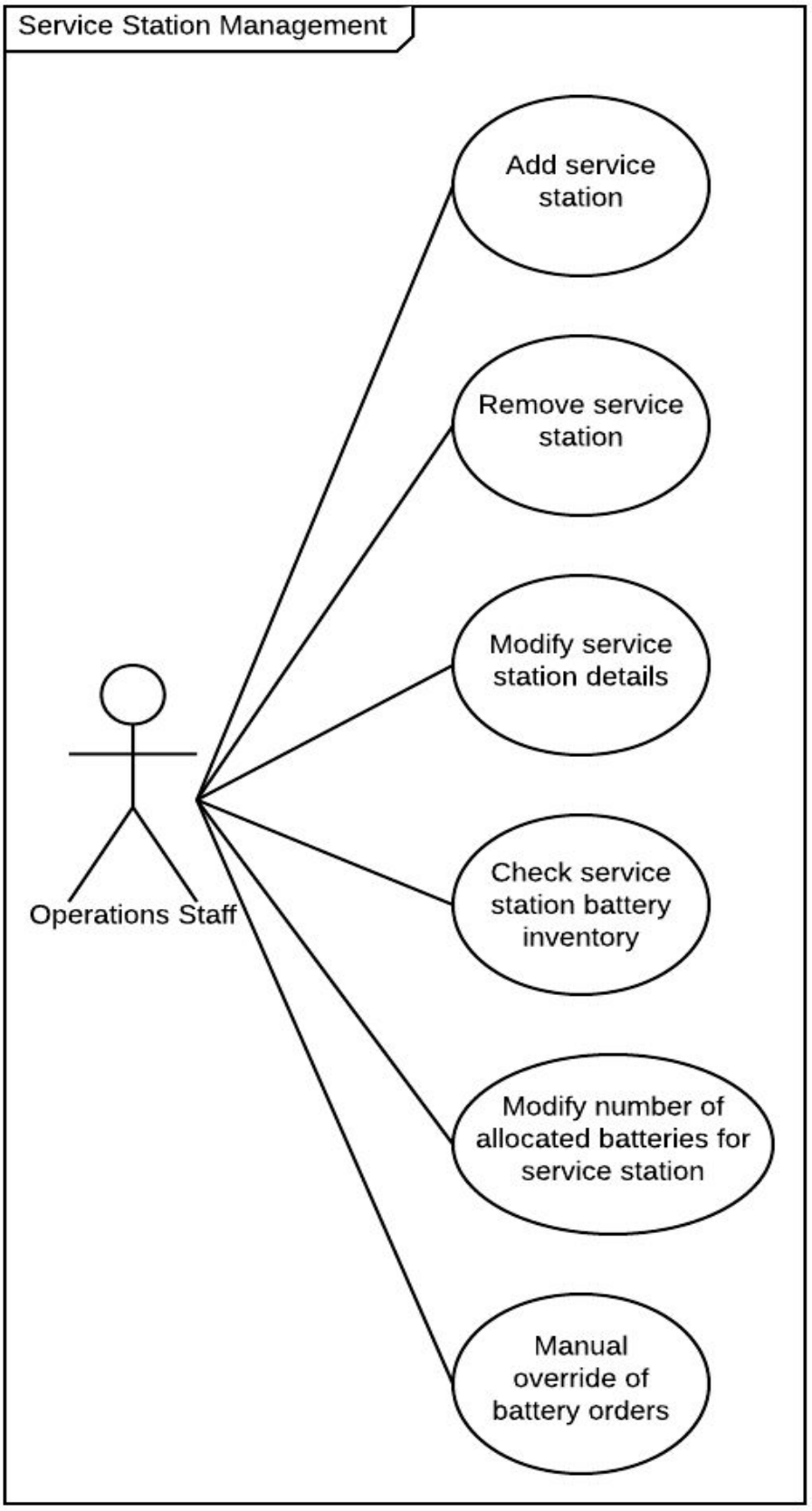
3.3 Account Management



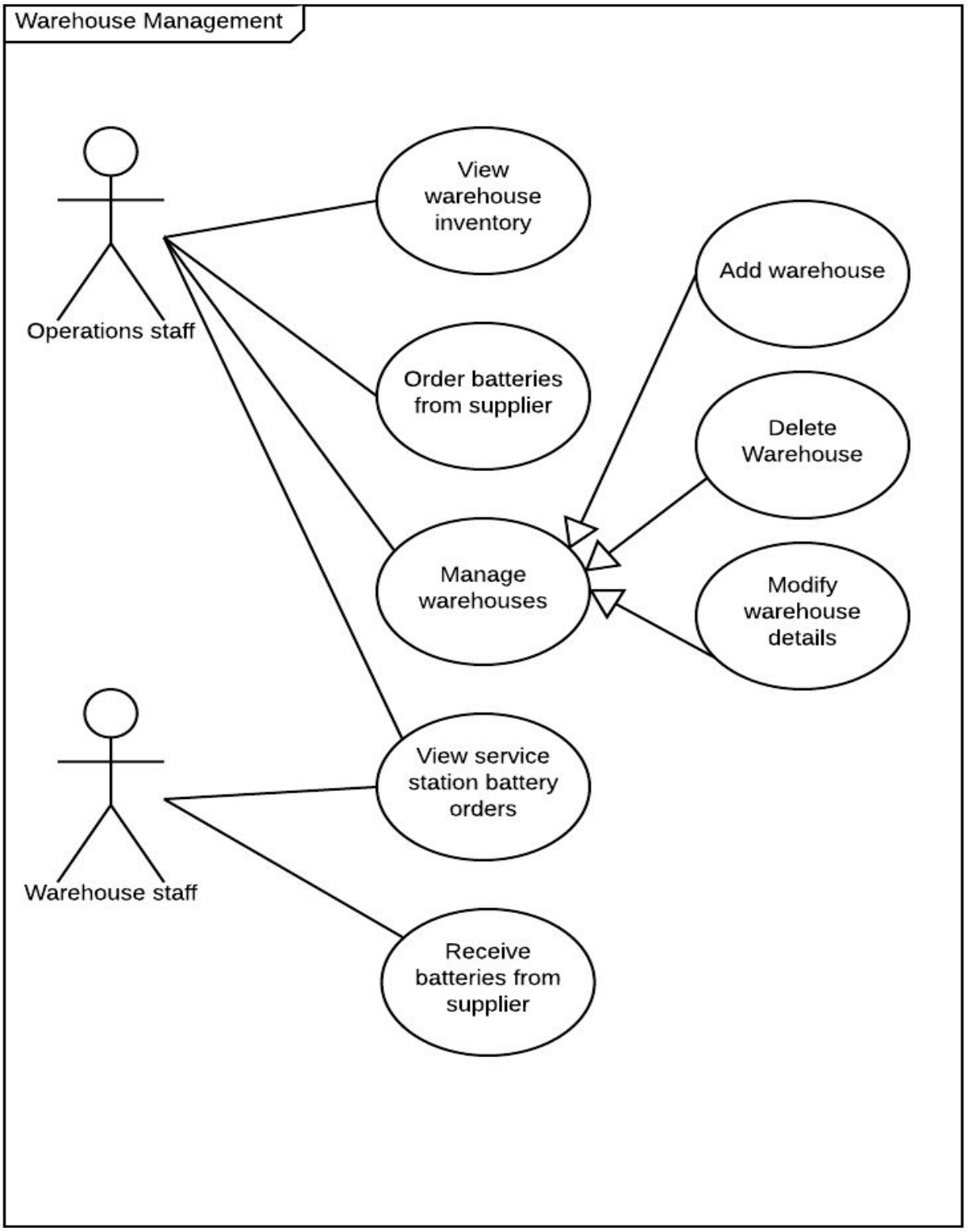
3.4 Vehicle / Battery Management



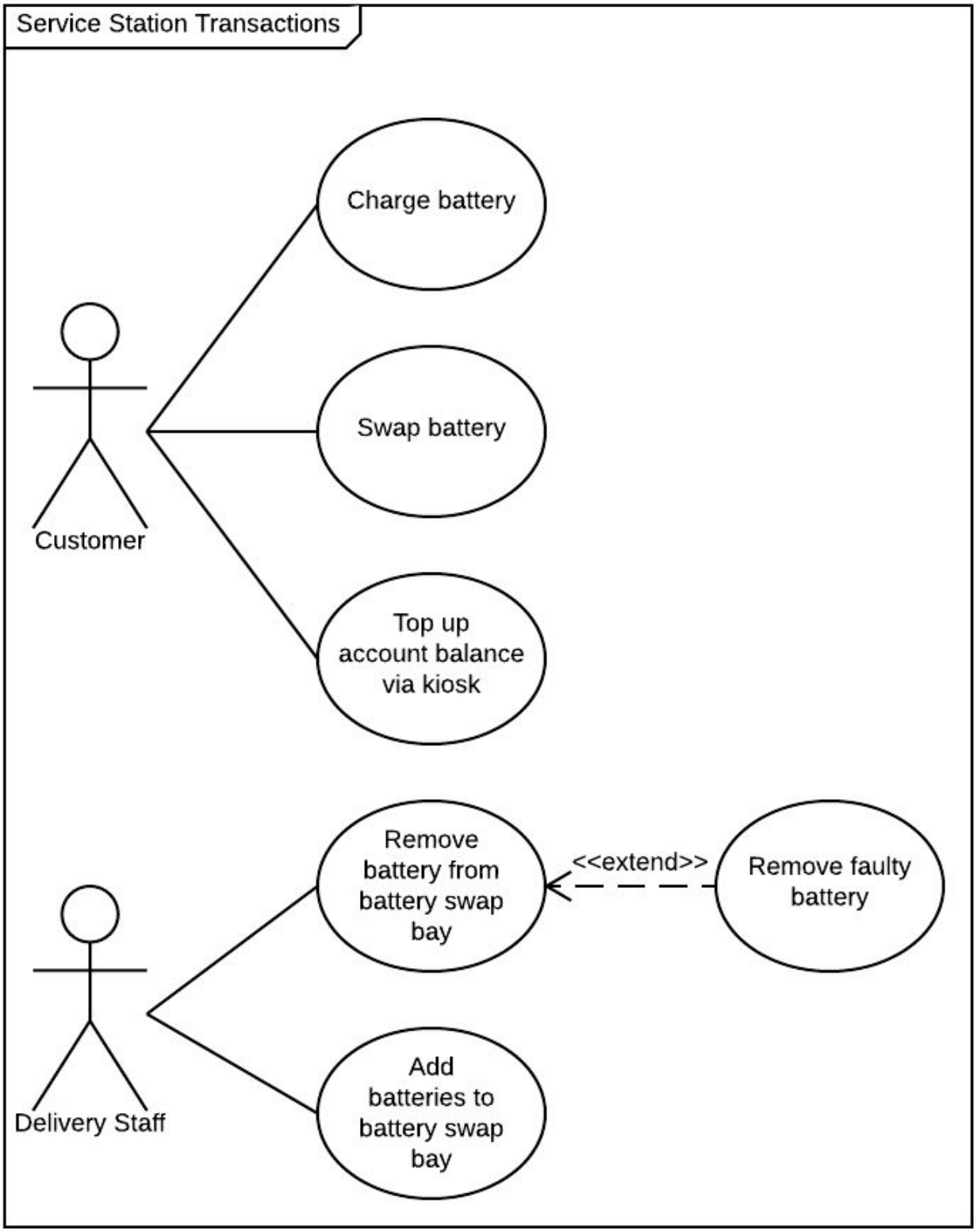
3.5 Service Station Management



3.6 Warehouse Management



3.7 Service Station Transactions



4.0 Actor Descriptions

Actor Name	Description
Delivery Staff	Responsible for delivering batteries to and from service stations and warehouses.
Operations Staff	Responsible for managing operations (e.g. battery distributions) on a high level.
Customer	Customers of this system; owners of electric cars. Responsible for creating and managing their account on the web portal.
Warehouse Staff	Responsible for managing battery orders in the warehouse.

5.0 Use Case Summaries

5.1 Battery Delivery

Use Case	Summary
Receive instructions to deliver	Receive instructions from either the warehouse or service station to deliver batteries .
Deliver batteries	Deliver batteries to and from the warehouse and service stations.
Deliver batteries from warehouse to service stations	Deliver batteries (in working condition) from the warehouse to service stations to replace faulty ones or to meet customers' demands.
Deliver faulty batteries from service stations to warehouse	Deliver faulty batteries from the service station to the warehouse to get them replaced.
Deliver faulty batteries from warehouse back to supplier	Deliver faulty batteries that are located at a warehouse back to the battery supplier.
Update delivery status	Update delivery status on battery deliveries.
Prepare deliveries	Prepare deliveries for pickup.
Prepare service station deliveries	Prepare deliveries that are sent to the service stations.
Prepare supplier deliveries	Prepare deliveries that are sent to the suppliers.

5.2 Locate Service Stations

Use Case	Summary
Search for service station	Search for a service station by location.
Change search filters	Change the search filters to get more specific results.

5.3 Account Management

Use Case	Summary
Register New Account	Login to account using a unique username and password.
Modify Personal Details	Modify personal, vehicle and payment details in the account.
Check Account Balance	Check the amount of credits in the account.
Delete Account	Delete the account and erase all personal information from database.
Top-up Account Balance	Top-up credits for the account by making payment.
Login to Account	Login to account using a unique username and password.
Make Payment	Make payment through a secure transaction for the batteries and the energy used.

5.4 Vehicle/Battery Management

Use Case	Summary
Manage Vehicles	Add, modify or remove vehicles from the account.
Add Vehicle	Add a new vehicle to the account.
Modify Vehicle List	Modify the existing vehicle details in the account.
Remove Vehicle List	Remove a vehicle from the account.
Login to Account	Login to an account using a unique ID and password.
Manage Batteries	Assign and unassign a battery to a vehicle in the account.
Assign Battery to Vehicle	Assign a battery to a vehicle in the account.
Unassign Battery from Vehicle	Unassign a battery from a vehicle in the account.
Check Battery Details	Check battery details of an assigned battery in the account.
Report Stolen Battery	Report a stolen battery.

5.5 Service Station Management

Use Case	Summary
Add Service Station	Add a service station to the system.
Remove Service Station	Remove a service station from the system.
Modify Service Station Details	Modify existing service station details in the system.
Check Service Station Battery Inventory	Check the battery inventory of service stations in the system.
Modify number of allocated batteries for service station	Modify the number of allocated batteries (depending on demands) for service stations registered in the system.
Manual Override of Battery Orders	Make decisions to change/add/remove battery orders, overriding current orders.

5.6 Warehouse Management

Use Case	Summary
View Warehouse Inventory	View the number of batteries available in the warehouse.
Order Batteries from Supplier	Order more batteries from the supplier.
Manage Warehouse Battery Quantities	Add/delete a warehouse in the system, modify warehouse details and manage warehouse battery quantities
Add warehouse	Add a warehouse to the system.
Delete warehouse	Delete a warehouse from the system.
Modify warehouse details	Modify details of a warehouse registered in the system.
View Service Station Battery Orders	View battery orders from different service stations.
Receive Batteries from Supplier	Receive new batteries from supplier.

5.7 Service Station Transactions

Use Case	Summary
Charge Battery	Vehicle owners can charge their batteries at charging bays.
Swap Battery	Vehicle owners can swap their out of charge battery for a fully charged battery at the battery swapping bay.
Top-up Account Balance via Kiosk	Top up the credits in an account at a kiosk in service stations.
Remove Battery from Battery Swap Bay	Delivery staff can remove out of charge/faulty batteries from the swapping bay.
Remove Faulty Battery	Delivery staff can remove faulty batteries from the swapping bay.
Add Batteries to Battery Swap Bay	Delivery staff can add fully charged batteries to the swapping bay.

6.0 Use Case Descriptions

6.1 Battery Delivery - Deliver batteries from warehouse to service stations

Version	1.1	**Date**	22/5/2017
Package	Battery Delivery		
Summary	Deliver batteries to and from the warehouse and service stations.		
Primary Actor	Delivery staff		
Secondary Actors	-		
Inherits	Deliver batteries		
Includes	-		
Extension Points	-		
Business Rules	1. Delivery staff to deliver the batteries to predetermined location. 2. Delivery staff to update the delivery status after picking up the batteries and after dropping off batteries at destination.		
Estimate	1 week		
Pre-Condition(s)	1. Delivery staff must be authorised to deliver the batteries. 2. Delivery order has already been prepared for delivery.		

Typical Sequence of Events

Actor Stimulus	System Response
1. Delivery staff wishes to carry out a delivery.	2. Assign delivery order to delivery staff (associated with their unique staff ID)
3.1 Pick up the batteries from warehouse. 3.2 Change delivery status to “On route”.	4. Update delivery status to “On route”.
5.1 Install batteries at destination. 5.2 Change delivery status to “Delivered”.	6. Update delivery status to “Delivered”.

Post-Condition(s)	1. The batteries have been delivered to their destination. 2. The delivery status in the system is up to date (“Delivered”).

Alternative Sequences of Events

Alternative 1: Order is canceled after step 4

Actor Stimulus	System Response
	4.1 Update order status to “Canceled” 4.2 Send instructions to return to origin.
5. Return batteries to origin (Warehouse)	

Alternative 2: Order is unable to be delivered after step 4

Actor Stimulus	System Response
5.1 Unable to deliver batteries. 5.2 Change status to “Unable to be delivered”	6.1 Update delivery status to “Unable to be delivered”. 6.2 Send instructions to return to origin.
7. Return batteries to origin.	

Priority	Must have
Outstanding Issues	-
Author	Dayan
Business Owner	-
Notes	-
Version History	Initial version

6.2 Locate Service Stations - Search for service stations

Version	1.0	**Date**	22/5/2017
Package	Locate service stations		
Summary	Find service stations		
Primary Actor	Customer		
Secondary Actors	-		
Inherits	-		
Includes	-		
Extension Points	Change search filters		
Business Rules	-		
Estimate	8 weeks		
Pre-Condition(s)	-		

Typical Sequence of Events

Actor Stimulus	System Response
1.1 Customer wishes to find a service station. 1.2 Customer enters postcode/location name.	2. Display service stations in that area/postcode.
3. <<extend>> Change search filters.	4.1 Apply changed search filters to search result. 4.2 Display new search result.

Post-Condition(s)	Customer finds the service station they were looking for.

Alternative Sequences of Events

Alternative 1: There are no service stations in selected area or postcode.

Actor Stimulus	System Response
	2.1. Display a message stating that there are no service stations in the selected area/postcode. 2.2. Request for user to enter another area/postcode

Priority	Must have
Outstanding Issues	-
Author	Dayan
Business Owner	-
Notes	-
Version History	Initial version

6.3 Locate Service Stations - Change Search Filters

Version	1.0	**Date**	27/5/2017
Package	Locate service stations		
Summary	Change search filters to look for a particular service station		
Primary Actor	Customer		
Secondary Actors	-		
Inherits	-		
Includes	-		
Extension Points	-		
Business Rules	1. Service stations must be registered in the eBattery system 2. Multiple search filters may be applied		
Estimate	1 week		
Pre-Condition(s)	1. The customer has already entered the postcode/location name to search 2. There are results for the initial search		

Typical Sequence of Events

Actor Stimulus	System Response
1.1. Customer wishes to change search filters 1.2. Customer selects filters that apply to his/her desired results	2.1. Apply filters to search results 2.2. Display the new search results that match the filters

Post-Condition(s)	Customer changes the search filters and finds the service station they were looking for.

Alternative Sequences of Events

Alternative 1: There are no service stations that match the applied filters at step 2.2.

Actor Stimulus	System Response
	2.3. Display message that states no results were found 2.4. Request customer to try different filters

Priority	Must have
Outstanding Issues	-
Author	Winifred
Business Owner	-
Notes	-
Version History	Initial version

6.4 Account Management - Login to Account

Version	1.0	**Date**	22/5/2017
Package	Account Management		
Summary	Customers logging into their accounts		
Primary Actor	Customer		
Secondary Actors	-		
Inherits	-		
Includes	-		
Extension Points	-		
Business Rules	1. An account should be under a single user's name		
Estimate	2 weeks		
Pre-Condition(s)	1. Customer has an existing account		

Typical Sequence of Events

Actor Stimulus	System Response
1. Customer enters their email and password	2.1. Validates their email and password 2.2. Opens up their account homepage

Post-Condition(s)	Customer successfully logins to their account.

Alternative Sequences of Events

Alternative 1: Invalid email at step 1.

Actor Stimulus	System Response
	2.1. Display an error message stating that the email/ is invalid. 2.2. Request for user to enter their email and password again.

Alternative 2: Invalid password at step 1.

Actor Stimulus	System Response
	2.1. Display an error message stating that the email/password is invalid. 2.2. Request for user to enter their email and password again.

Priority	Must have
Outstanding Issues	-

Author	Winifred
Business Owner	-
Notes	-
Version History	Initial version

6.5 Account Management - Delete account

Version	1.0	**Date**	22/05/2017
Package	Account Management		
Summary	Delete customer account		
Primary Actor	Customer		
Secondary Actors	-		
Inherits	-		
Includes	Login to account		
Extension Points	-		
Business Rules	1. Deleting an account will delete all personal information stored in the system's database		
Estimate	1 week		
Pre-Condition(s)	1. Customer has an existing account. 2. Customer is already logged in.		

Typical Sequence of Events

Actor Stimulus	System Response
1. Customer selects delete account in account management page.	2. Ask customer if they are sure about deleting their account and display a message stating that all information will be lost.
3. Confirm account deletion	4. Delete customer's account and remove all personal information from database.

Post-Condition(s)	1. Customer's account is no longer in the system.

Alternative Sequences of Events

Alternative 1: The customer does not confirm deletion at step 3

Actor Stimulus	System Response
	4. Return to account management screen.

Priority	Must have
Outstanding Issues	-
Author	Dayan
Business Owner	-
Notes	-
Version History	Initial version

6.6 Account Management - Register new account

Version	1.0	**Date**	22/05/2017
Package	Account Management		
Summary	Create a new customer account for web portal		
Primary Actor	Customer		
Secondary Actors	-		
Inherits	-		
Includes	-		
Extension Points	-		
Business Rules	1. One user can only have one account under their name and license number 2. Registering for an account will result in personal details of the user being stored in the system's database (until they terminate their account) 3. Registering for an account gives the system permission to track the user's location via their batteries		
Estimate	8 weeks		
Pre-Condition(s)	1. The customer has a car that can use the services provided. 2. The customer doesn't already have an existing account.		

Typical Sequence of Events

Actor Stimulus	System Response
1. Customer wishes to register a new account	2. Request for customer's email address.
3. Enter email address.	4.1. Validate email address 4.2. Check if email address already exists in the database. 4.3. Request personal details.
5. Enter personal details	6.1. Ensure all fields are answered 6.2. Validate all personal details 6.3. Prompt customer for account creation confirmation.
7. Confirm account creation	8.1. Create account in database 8.2. Open up account homepage

Post-Condition(s)	1. The user's account is created.

Alternative Sequences of Events

Alternative 1: Email is invalid at step 4.1

Actor Stimulus	System Response
	4.2. Prompt user that the email entered is invalid. 4.3. Request the user to try again with a different

	email address. (Return to step 3)

Alternative 2: Email already exists in the database at step 4.2

Actor Stimulus	System Response
	4.3. Prompt user that the email already exists in the database. 4.4. Request the user try again with a different email address. (Return to step 3)

Alternative 3: Invalid personal details at step 6.1

Actor Stimulus	System Response
	6.2. Prompt user that the personal details entered is invalid. Highlight to the user which details are invalid. 6.3. Request user to enter their personal details again. (Return to step 5)

Priority	Must have
Outstanding Issues	-
Author	Dayan
Business Owner	-
Notes	-
Version History	Initial version

6.7 Account Management - Report Stolen Batteries

Version	1.0	**Date**	23/05/2017
Package	Vehicle/Battery Management		
Summary	Report when a vehicle (with a registered battery) has been stolen		
Primary Actor	Vehicle Owner		
Secondary Actors	-		
Inherits	-		
Includes	-		
Extension Points	-		
Business Rules	1. The system does not alert any government agencies about the stolen vehicle; customers are expected to report that themselves 2. The system flags the battery assigned as "Stolen" and if it checks in at any service station, the battery ID will trigger the system		
Estimate	4 weeks		
Pre-Condition(s)	1. The customer has an existing account 2. The vehicle has to be registered in the account 3. The battery assigned to the stolen vehicle has been registered		

Typical Sequence of Events

Actor Stimulus	System Response
1. Vehicle owner enters email and password to login.	2. Opens up their account.
3. Navigates to the list of registered vehicles in the account.	4. Displays list of registered vehicles.
5. Clicks on the stolen vehicle.	6. Opens up an information page for that particular vehicle.
7. Marks vehicle as "Stolen".	8.1. Vehicle's status is updated to "Stolen". 8.2. Battery's status is updated to "Stolen". 8.3. Tracks location of battery and displays pin on map if successfully located

Post-Condition(s)	2. The vehicle is marked as "Stolen" and the battery's location is tracked

Alternative Sequences of Events

Alternative 1: The email or password is wrong at step 1

Actor Stimulus	System Response
	2.1. Shows an error message 2.2. Requests user to try again (Return to step 1)

Alternative 2: The battery's location cannot be tracked at step 8.3.

Actor Stimulus	System Response
	8.3. Shows a message stating the battery cannot be located

Priority	Must have
Outstanding Issues	-
Author	Winifred
Business Owner	-
Notes	-
Version History	Initial version

6.8 Service Station Management - Add Service Station

Version	1.0	**Date**	23/05/2017
Package	Service Station Management		
Summary	Add a new service station to the system		
Primary Actor	Operations Staff		
Secondary Actors	-		
Inherits	-		
Includes	-		
Extension Points	-		
Business Rules	1. Service stations are identified by their unique ID		
Estimate	2 weeks		
Pre-Condition(s)	1. The service station hasn't already been registered		

Typical Sequence of Events

Actor Stimulus	System Response
1. Operations staff logins using their employee ID and password	2.1. Check ID and password. 2.2. Opens up the main page.
3. Navigates to the list of registered service stations	4. Displays list of service stations
5. Clicks on "Add service station"	6. Opens up a page with empty information fields for the employee to fill up with information about the service station
7. Fills up all information fields	8.1. Validates service station information 8.2. Adds service station

Post-Condition(s)	1. The service station is added to the system

Alternative Sequences of Events

Alternative 1: The ID or password is invalid at step 1

Actor Stimulus	System Response
	2.1. Shows an error message 2.2. Requests staff to try again

Alternative 2: The service station information is wrong at step 8

Actor Stimulus	System Response
	8.1. Display error message 8.2. Requests staff to double check information and try again

Alternative 3: The service station already exists in the system at step 8

Actor Stimulus	System Response
	8.1. Display error message stating the service station is already registered

Priority	Must have
Outstanding Issues	-
Author	Winifred
Business Owner	-
Notes	-
Version History	Initial version

6.9 Account Management - Top-up account balance

Version	1.1	**Date**	26/5/2017
Package	Account Management		
Summary	Customers can top-up their account with money		
Primary Actor	Delivery staff		
Secondary Actors	-		
Inherits	-		
Includes	- Login to Account - Make Payment		
Extension Points	-		
Business Rules	1. Balance in account cannot be negative 2. Customers may top-up their account at a physical kiosk at service stations or on their own through the web a. In this case since it is via the web, customers can only pay using a credit card		
Estimate	4 weeks		
Pre-Condition(s)	1. Customer has an existing account 2. Customer is already logged in 3. Customer already has a payment method set up for their account		

Typical Sequence of Events

Actor Stimulus	System Response
1. Customer selects Account Balance	2.1. Displays the account balance 2.2. Displays options to top-up
3. Selects to top-up the account	4. Requests for amount to be added
5. Enters amount they wish to add into their account	6. Requests for payment details
7. Enters payment details	8.1. Validates payment details 8.2. Confirms transaction 8.3. Updates amount in account 8.4. Redirects to account homepage

Alternative Sequences of Events

Alternative 1: The payment details are incorrect/cannot be validated at step 8.1.

Actor Stimulus	System Response
	8.2. Shows an error message 8.3. Requests customer to try again

Priority	Must have
Outstanding Issues	-
Author	Winfred
Business Owner	-
Notes	-
Version History	Initial version

6.10 Vehicle/Battery Management - Add vehicle to account

Version	1.0	**Date**	26/05/2017
Package	Vehicle/Battery Management		
Summary	Customers can add a vehicle to their account		
Primary Actor	Vehicle Owner		
Secondary Actors	-		
Inherits	-		
Includes	-		
Extension Points	-		
Business Rules	1. Multiple vehicles may be added to the account 2. There is no limit to the number of vehicles that may be registered under an account		
Estimate	4 weeks		
Pre-Condition(s)	1. Customer have an existing account 2. Customer is logged in		

Typical Sequence of Events

Actor Stimulus	System Response
1. Navigate to the vehicle management page	2. Display option to add/modify/remove a vehicle
3. Select add a vehicle	4.1. Redirect to the add vehicle page 4.2. Request customer to fill out information about the vehicle
5. Fill out information for the vehicle	6.1. Check that the vehicle isn't already registered 6.2. Validate vehicle information 6.3. Add the vehicle into the account

Post-Condition(s)	The vehicle is now registered in the user's account

Alternative Sequences of Events

Alternative 1: The vehicle has already been registered at step 6.1.

Actor Stimulus	System Response
	6.2. Display error message stating the vehicle has already been registered

Alternative 2: The vehicle information cannot be validated at step 6.2.

Actor Stimulus	System Response
	6.3. Display error message stating information is incorrect 6.4. Request user to check information and fix errors

Priority	Must have
Outstanding Issues	-
Author	Winifred
Business Owner	-
Notes	-
Version History	Initial version

6.11 Account Management - Modify personal details

Version	1.0	**Date**	22/5/2017
Package	Account Management		
Summary	Modifying account details of the customer account		
Primary Actor	Customer		
Secondary Actors	-		
Inherits	-		
Includes	Login to account		
Extension Points	-		
Business Rules	1. Modification to details may take up to an hour to process 2. There is a daily limit of making 2 modifications per day		
Estimate	2 weeks		
Pre-Condition(s)	1. Customer is already logged in 2. Changes must be validated with a password		

Typical Sequence of Events

Actor Stimulus	System Response
1.1. Customer wants to modify personal details (e.g. Name, email, date of birth, address, phone number, credit card information etc.) 1.2. Customer navigates to settings and modifies details	2.1. Checks new details and validates it 2.2. Requests for customer's password to validate modifications
3. Enters password	4.1. Confirms password is correct 4.2. Updates details to new modified details

Post-Condition(s)	The customer's personal details in the system is modified**.**

Alternative Sequences of Events

Alternative 1: The new modified personal details is not accepted at step 2.1.

Actor Stimulus	System Response
	2.2. Requests customer to check details and fix any errors

Alternative 2: If the password is incorrect at step 2.2

Actor Stimulus	System Response
	2.3. Displays error message stating the password is incorrect 2.4. Requests customer to enter their password

	again

Priority	Must have
Outstanding Issues	-
Author	Winifred, Sai
Business Owner	-
Notes	-
Version History	Initial version

6.12 Account Management - Check Account Balance

Version	1.0	**Date**	24/5/2017
Package	Check Account balance		
Summary	Checking the account balance details of the customer account		
Primary Actor	Customer		
Secondary Actors	-		
Inherits	-		
Includes	-		
Extension Points	-		
Business Rules	1. The balance in the account cannot be negative 2. The customer may top-up the balance in their account through the portal or using a kiosk located at any service station		
Estimate	1 week		
Pre-Condition(s)	1. Customer has an existing account 2. Customer is already logged in		

Typical Sequence of Events

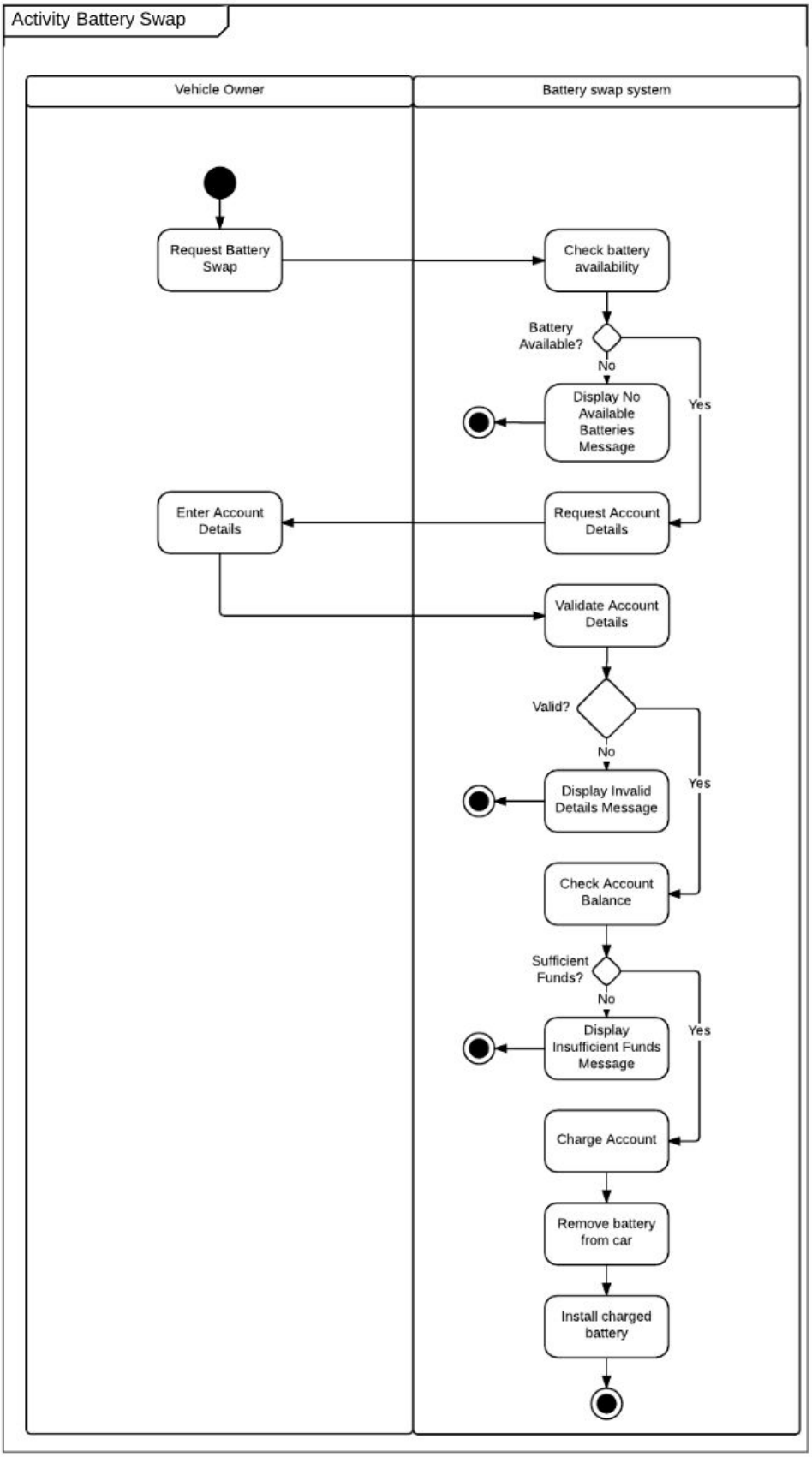
Actor Stimulus	System Response
1.1. Customer navigates to account management 1.2. Customer selects to view account balance	2. Displays account balance

Post-Condition(s)	1. Customer knows how much is left in their account.

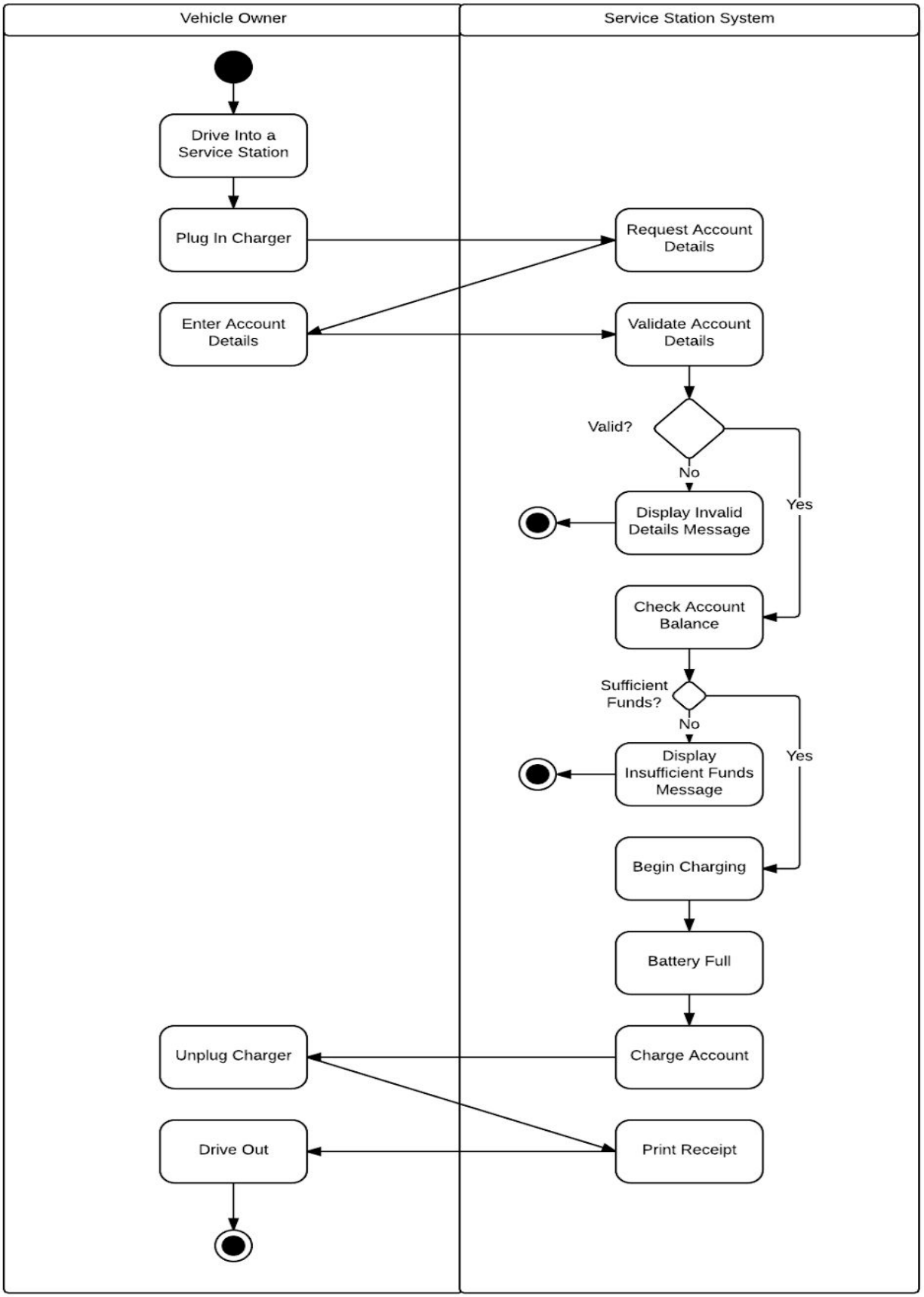
Priority	Must have
Outstanding Issues	-
Author	Winifred, Virpal
Business Owner	-
Notes	-
Version History	Initial version

7.0 Activity Diagrams

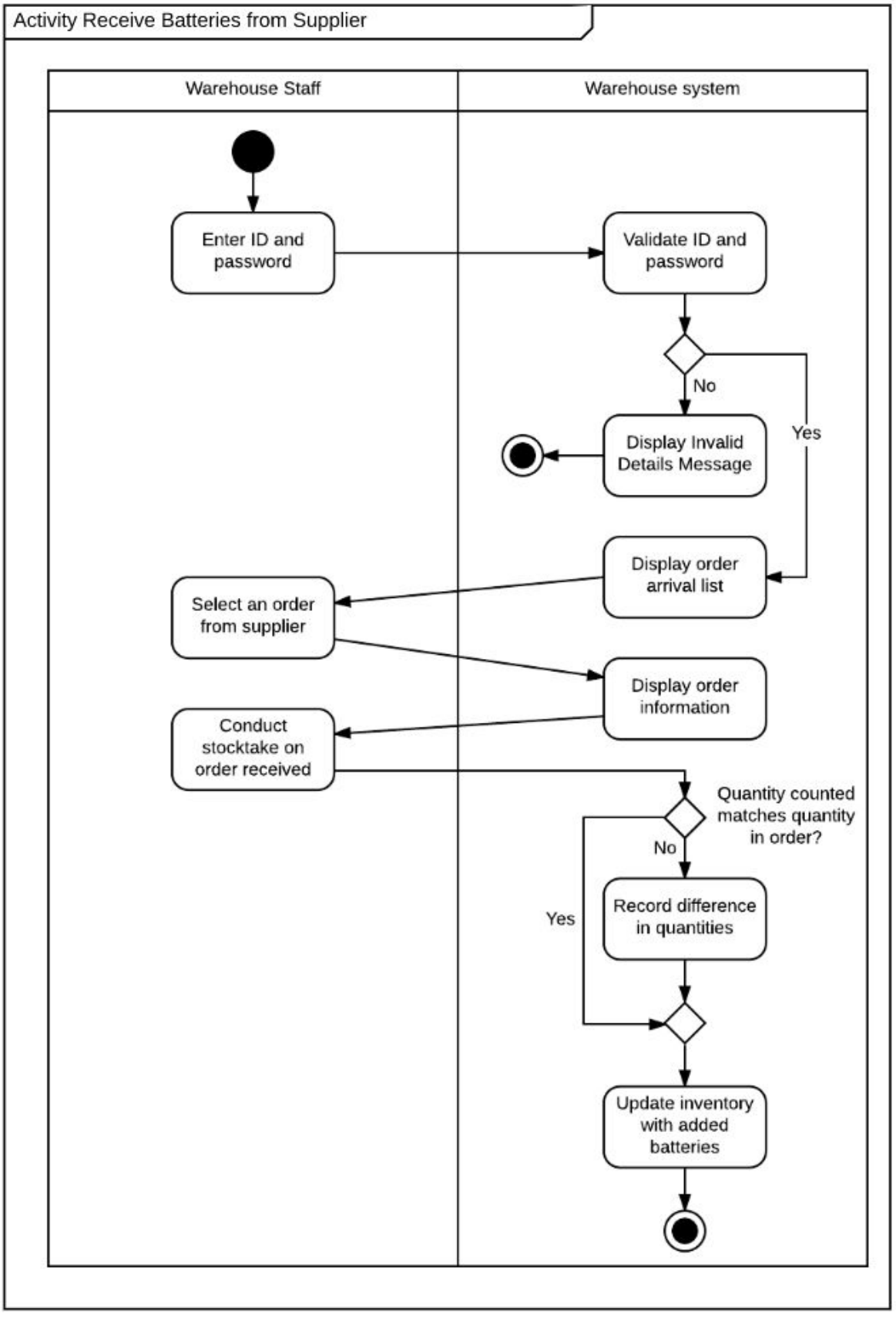
7.1 Battery Swap



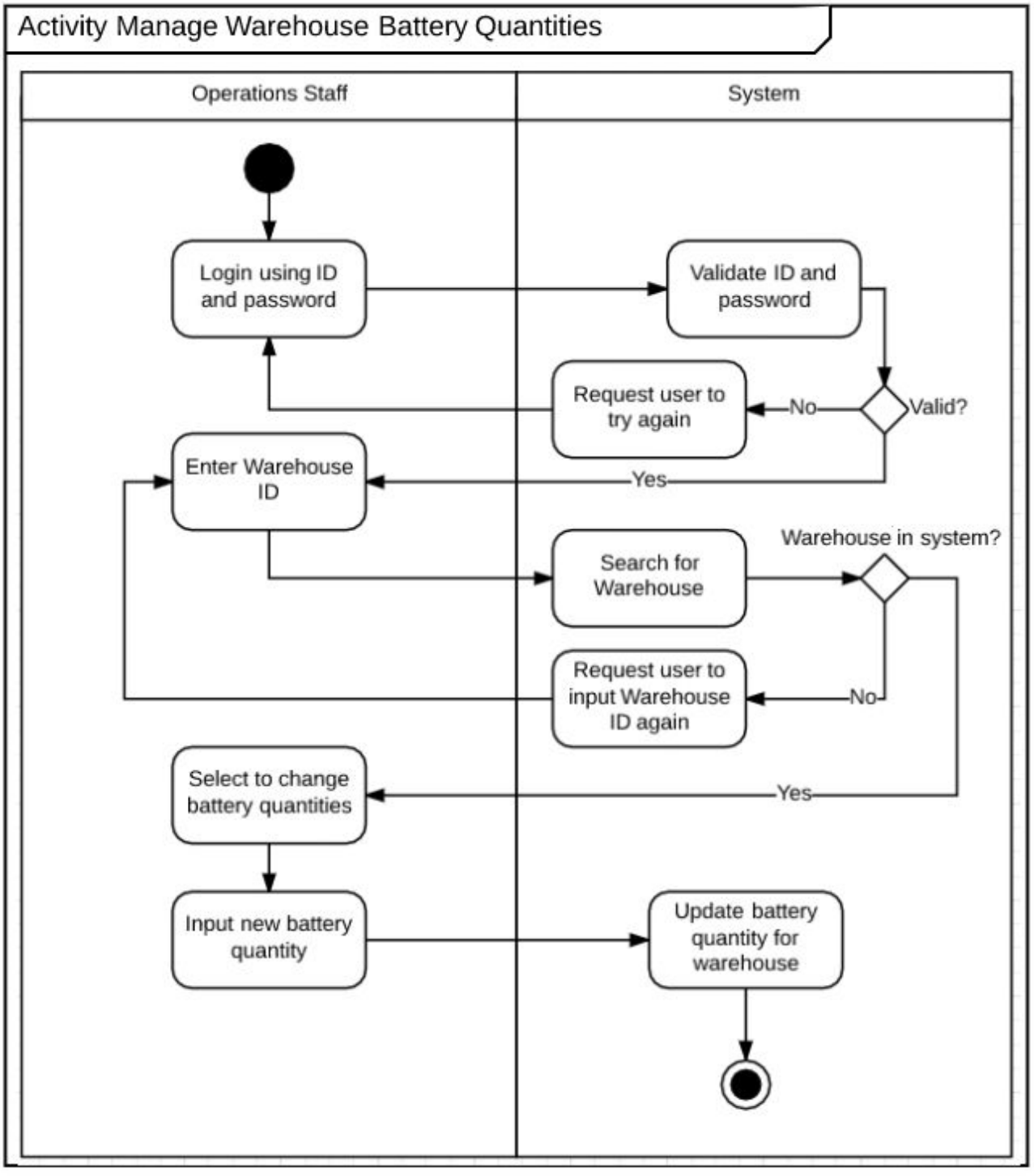
7.2 Charge Battery



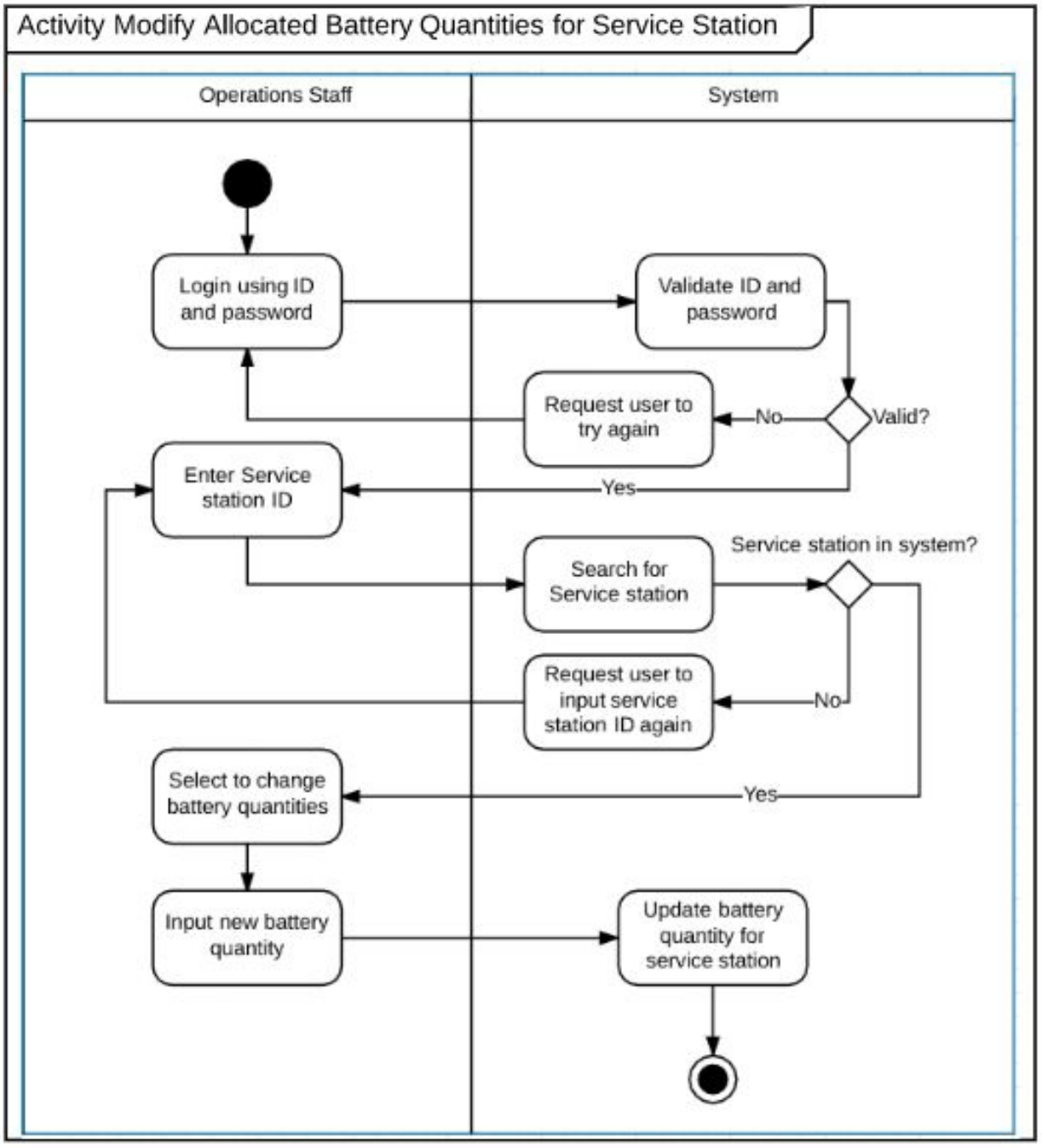
7.3 Receive batteries from supplier



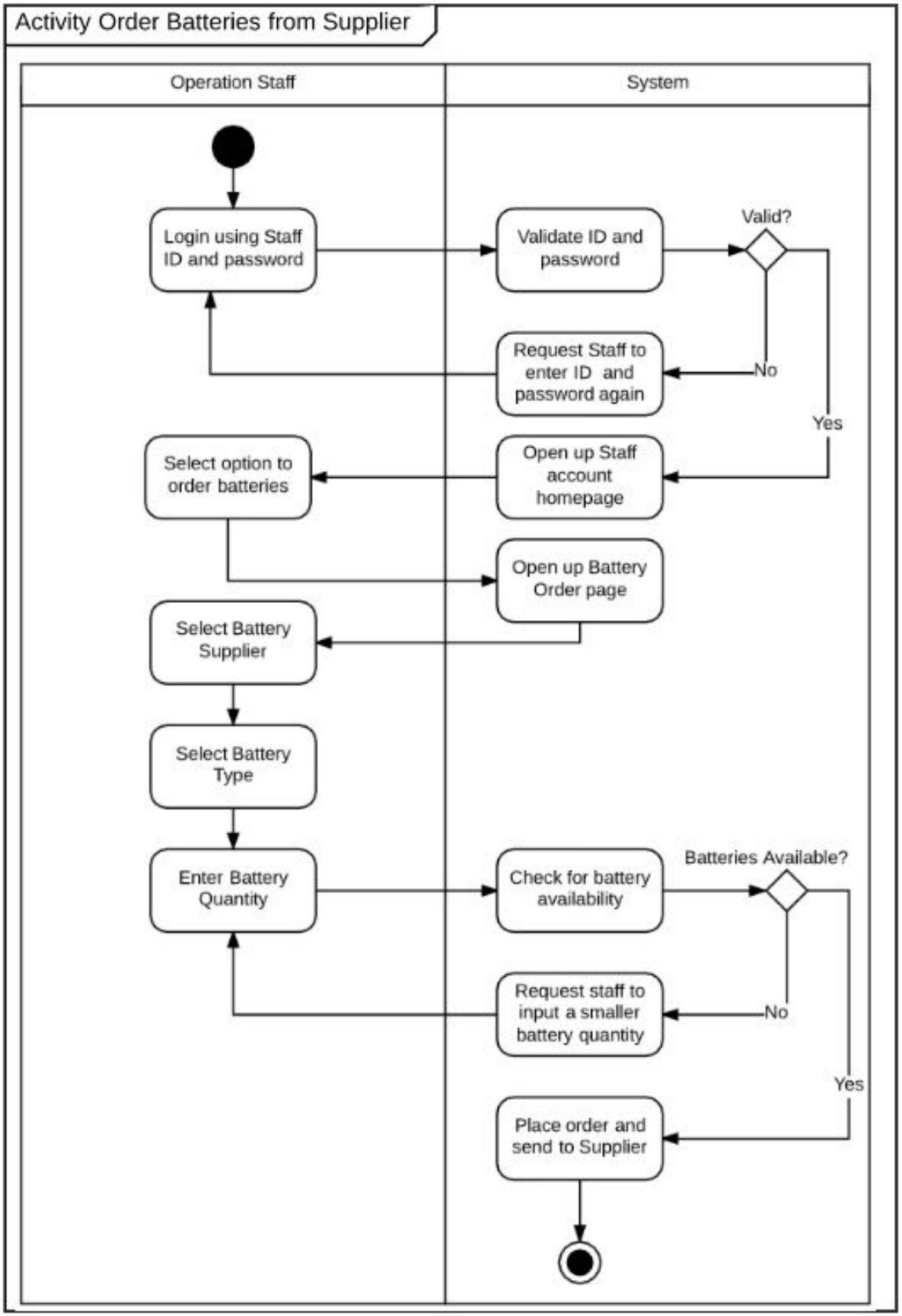
7.4 Manage Warehouse Battery Quantities



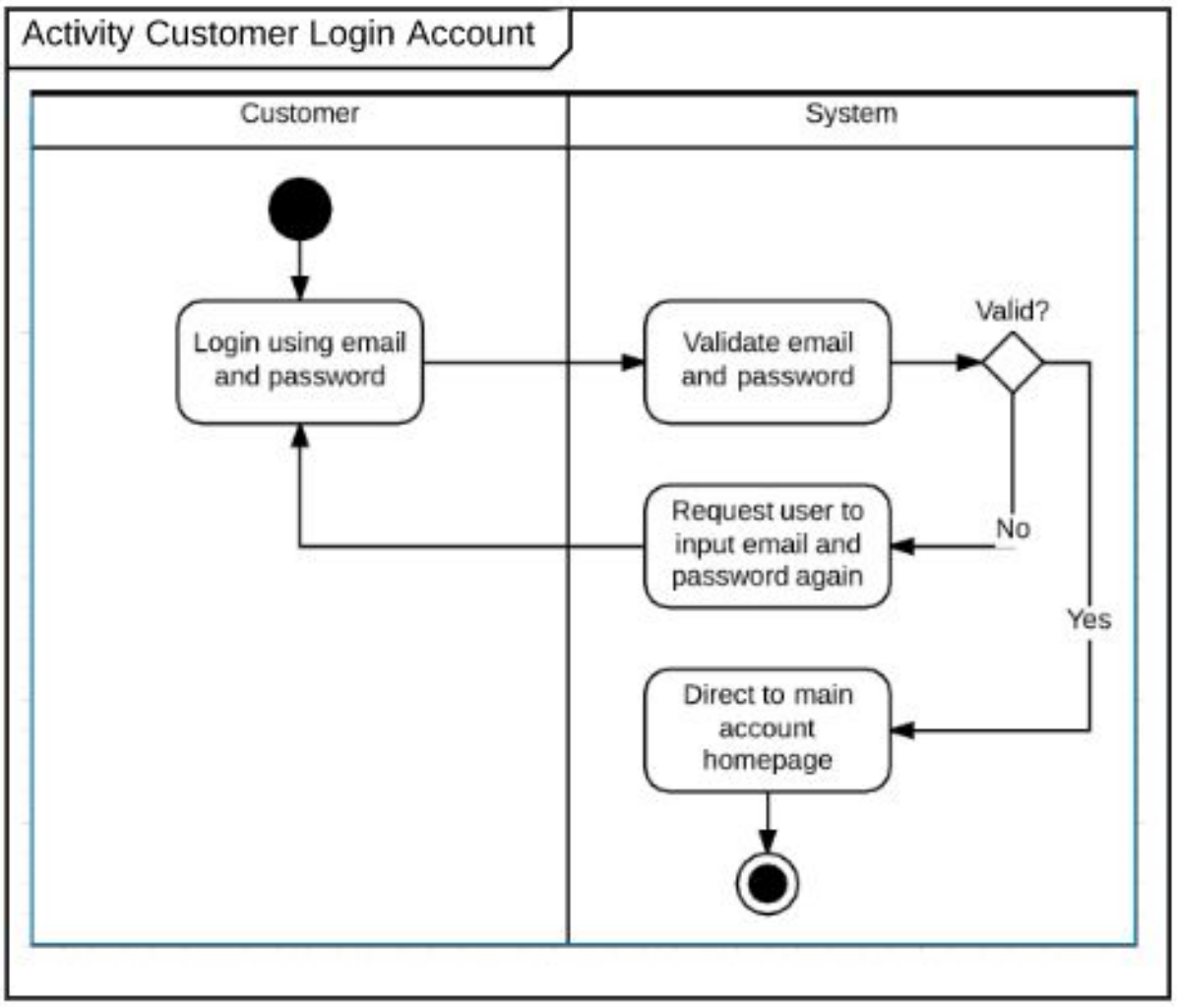
7.6 Modify Allocated Battery Quantities for Service Station



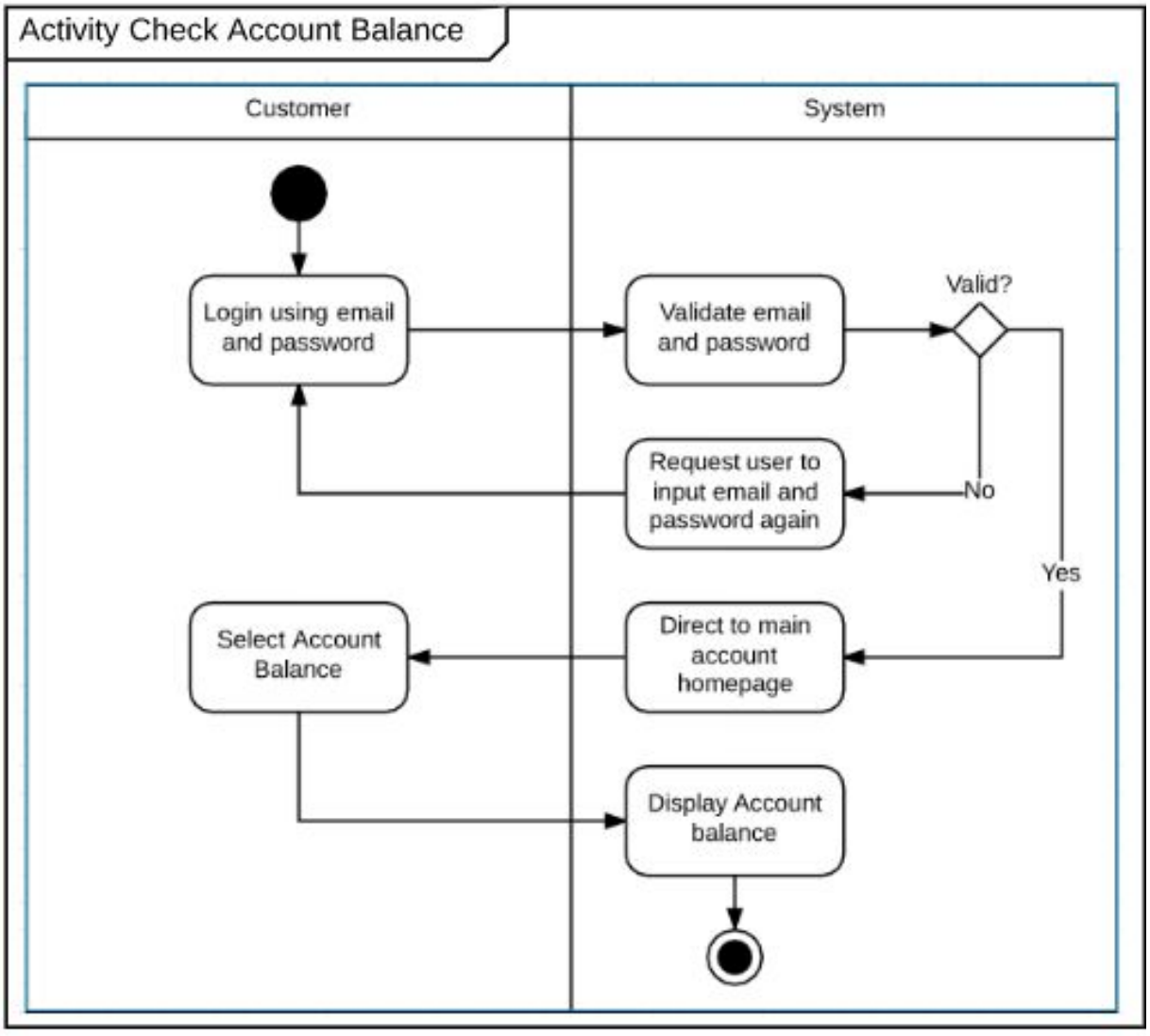
7.7 Order Batteries from supplier



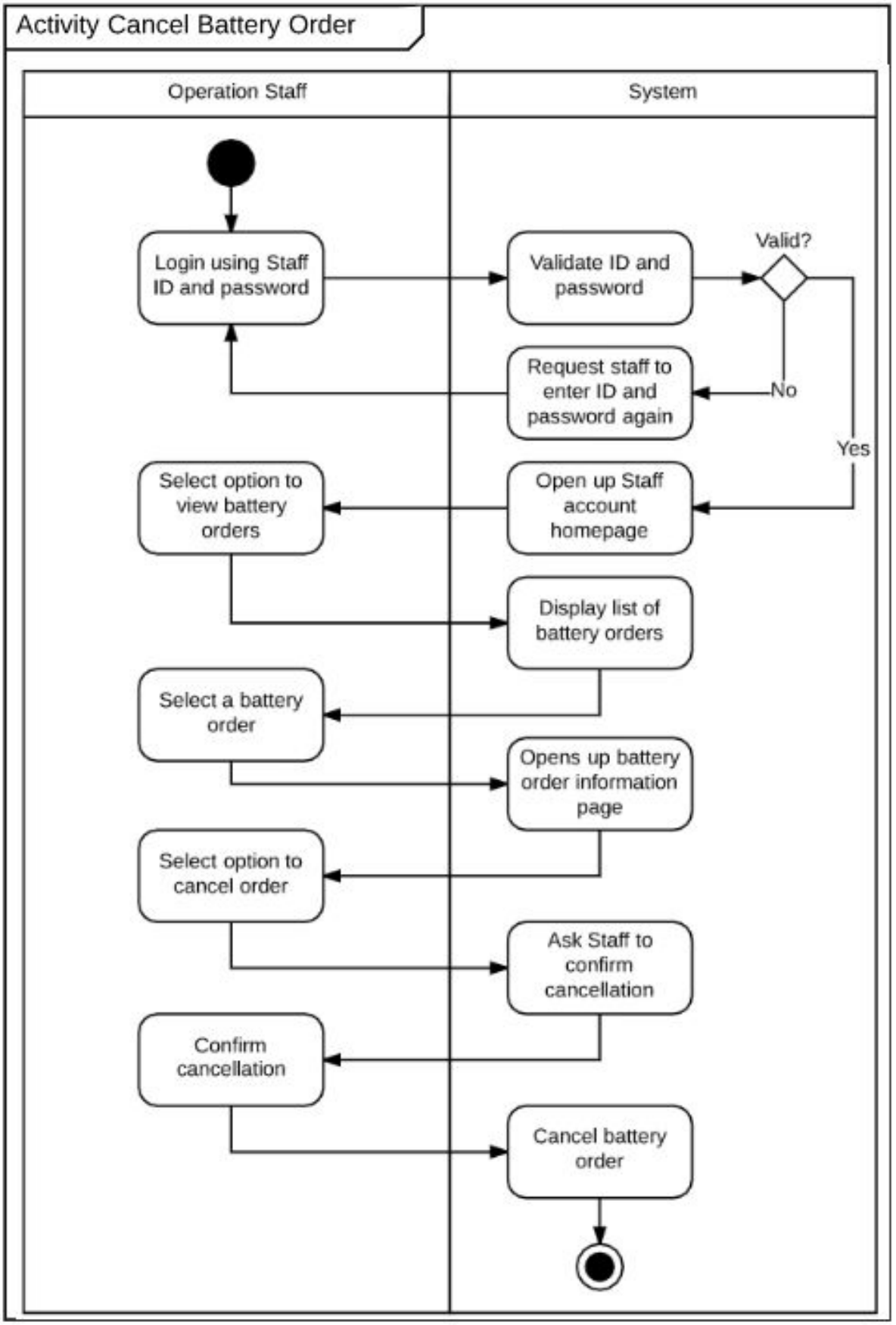
7.8 Customer Login Account



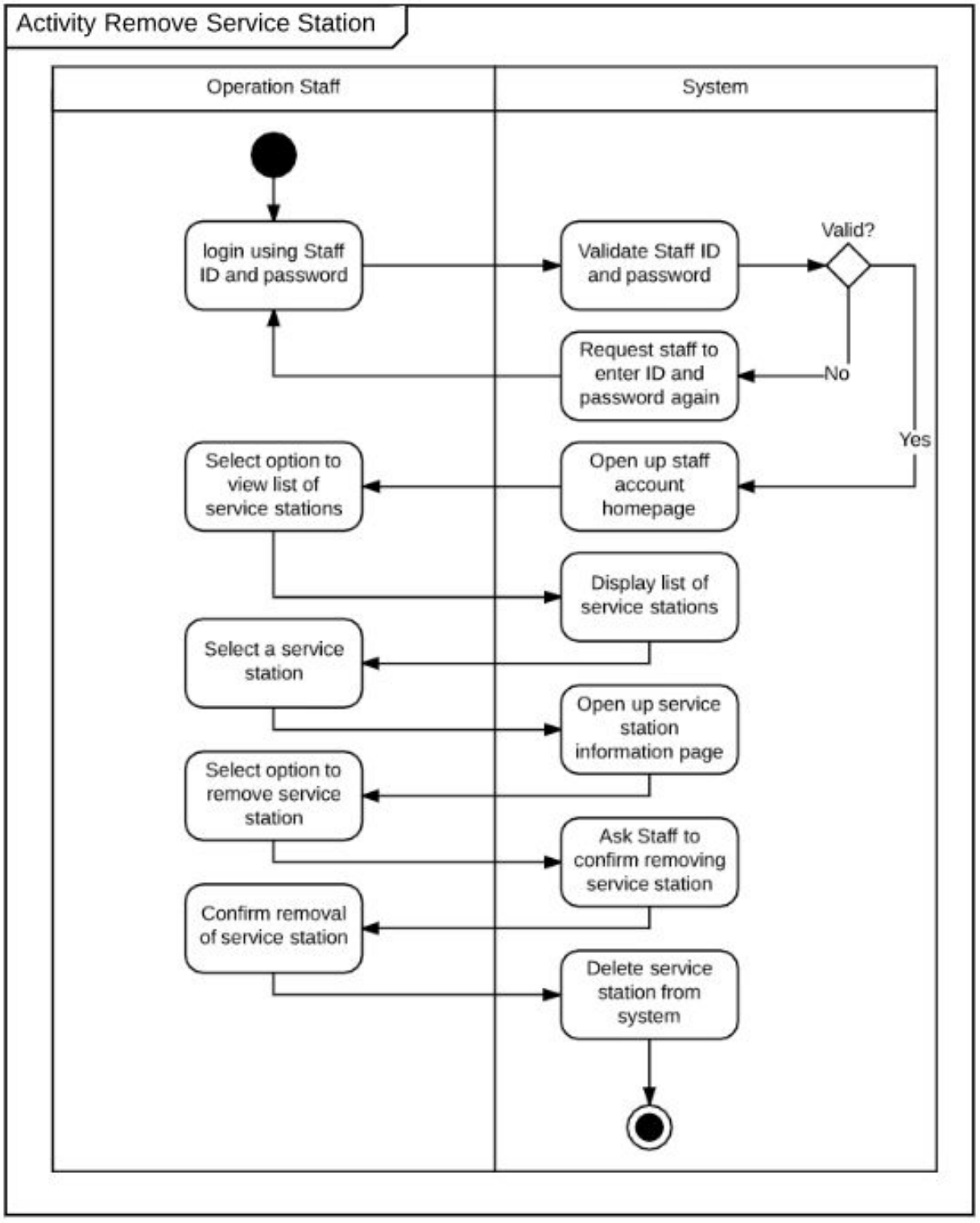
7.9 Check Account Balance



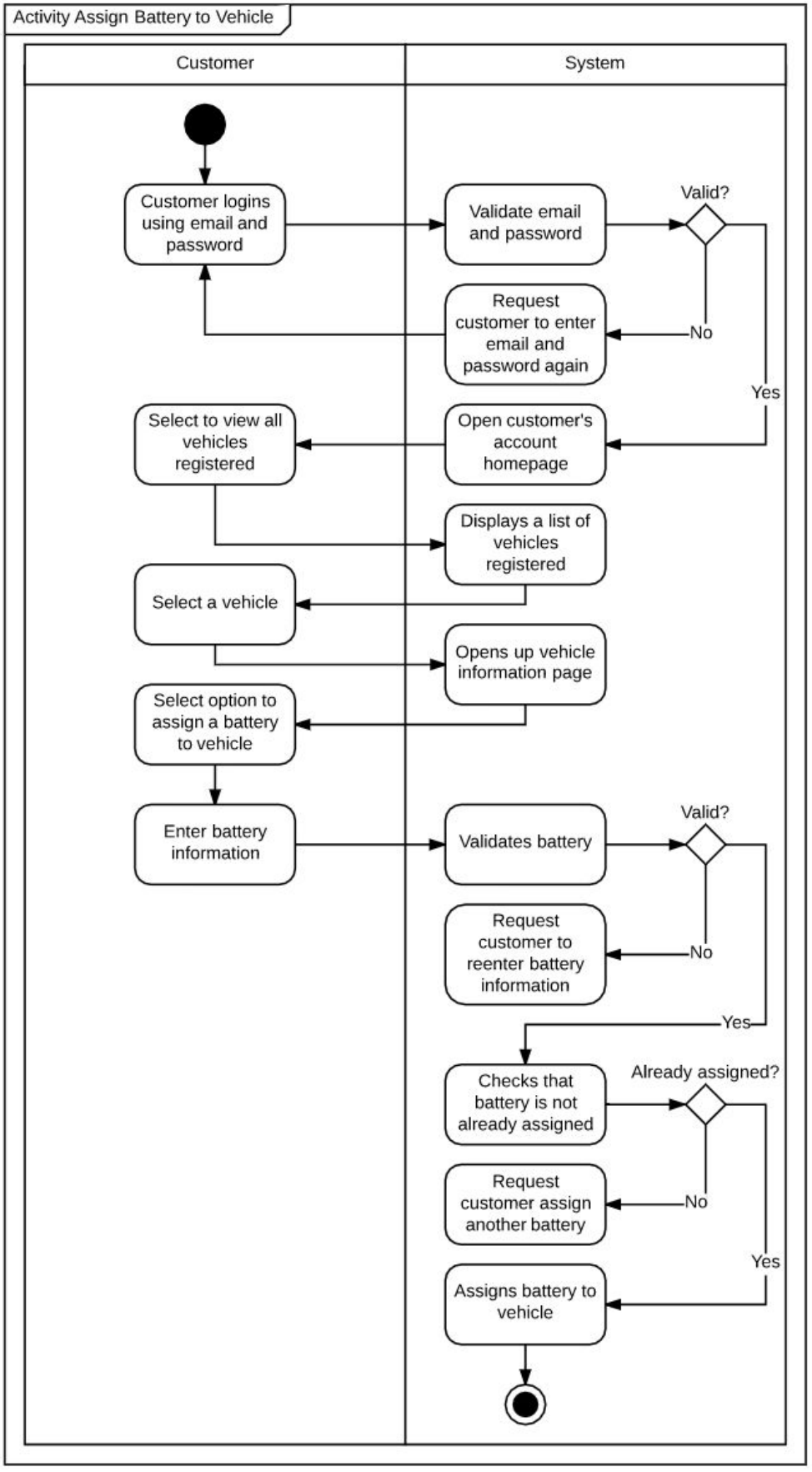
7.10 Cancel Battery Order



7.11 Remove Service Station

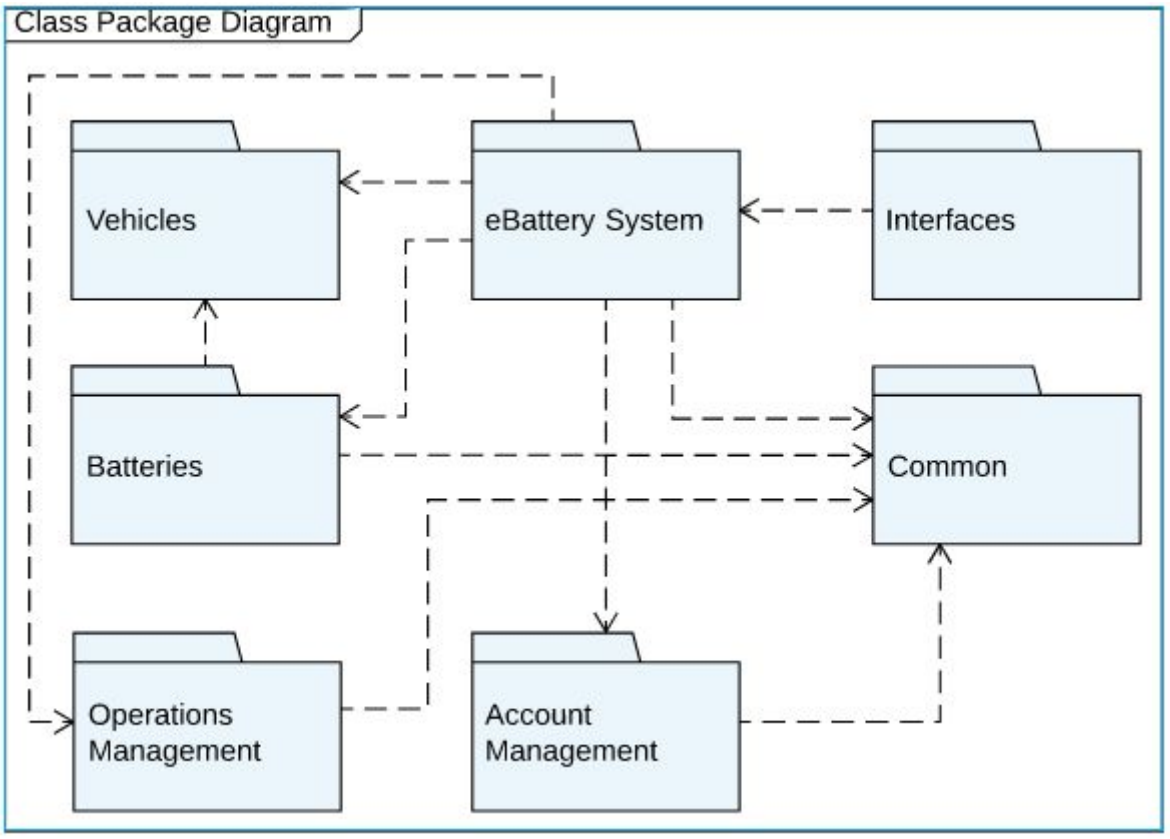


7.12 Assign Battery to Vehicle



8.0 Class Diagram Packages

8.1 Package Diagram

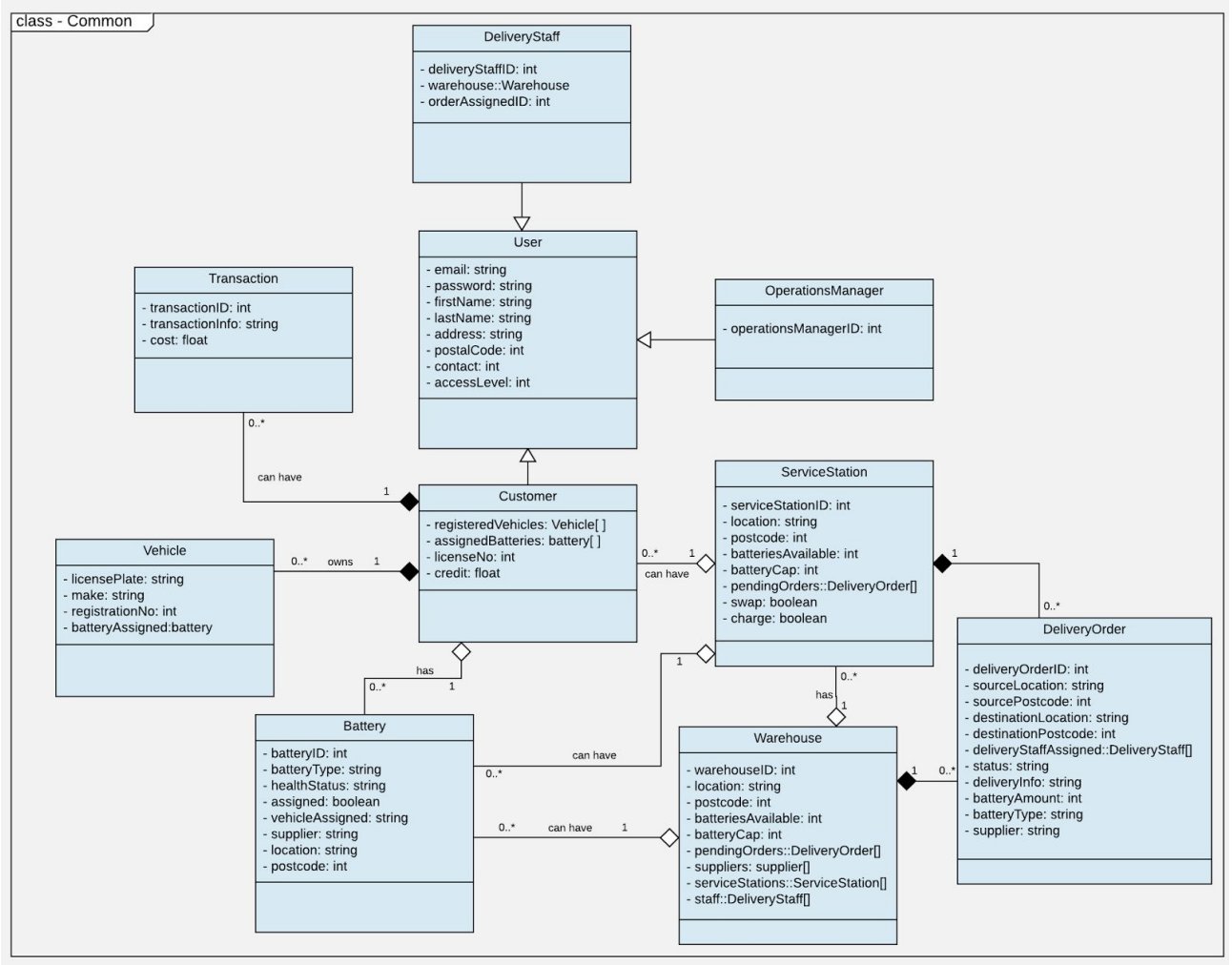


8.2 Package Descriptions

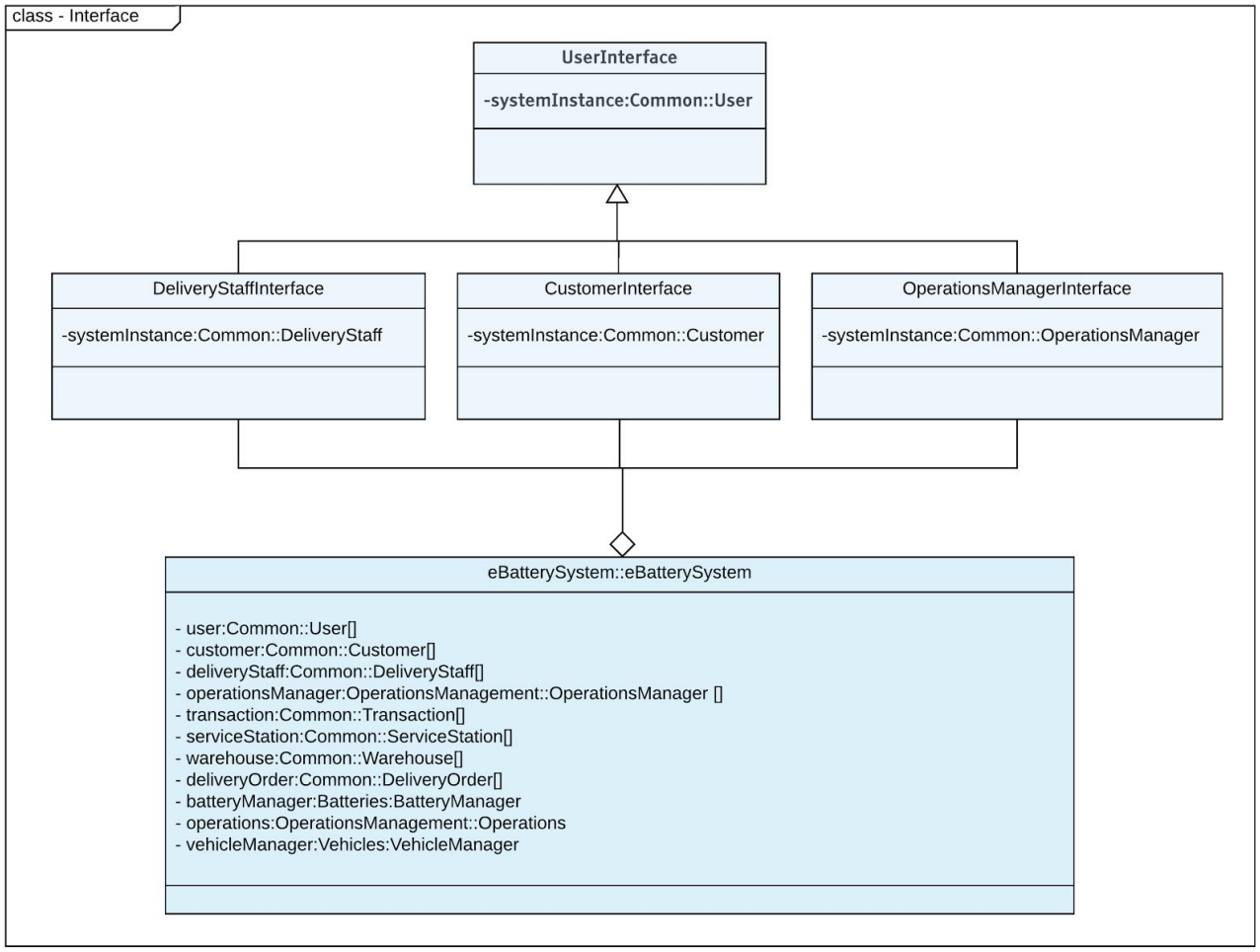
Package Name	Description
Common	A common set of models shared across multiple packages
Interfaces	A collection of methods interfaced
Batteries	This package is responsible for assigning batteries to vehicles
Vehicles	This package is responsible for the registration of vehicles
Operations Management	This package is responsible for determining whether the supply of batteries meets the demand of service stations and contains methods to manage the inventory (includes deliveries and order requests)
Account Management	This package is responsible for the creation, viewing, updating and deletion of user accounts
eBattery System	This package is the architecture of the eBattery system software

9.0 Class Diagrams

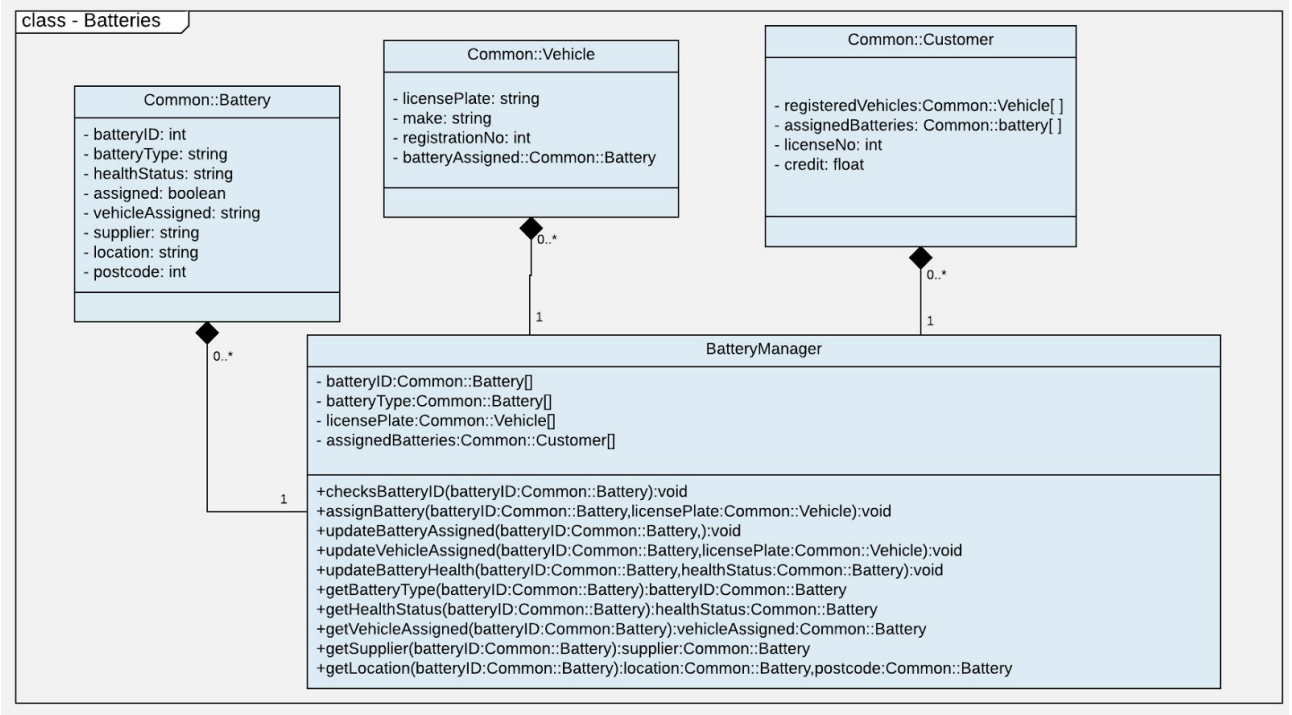
9.1 Common



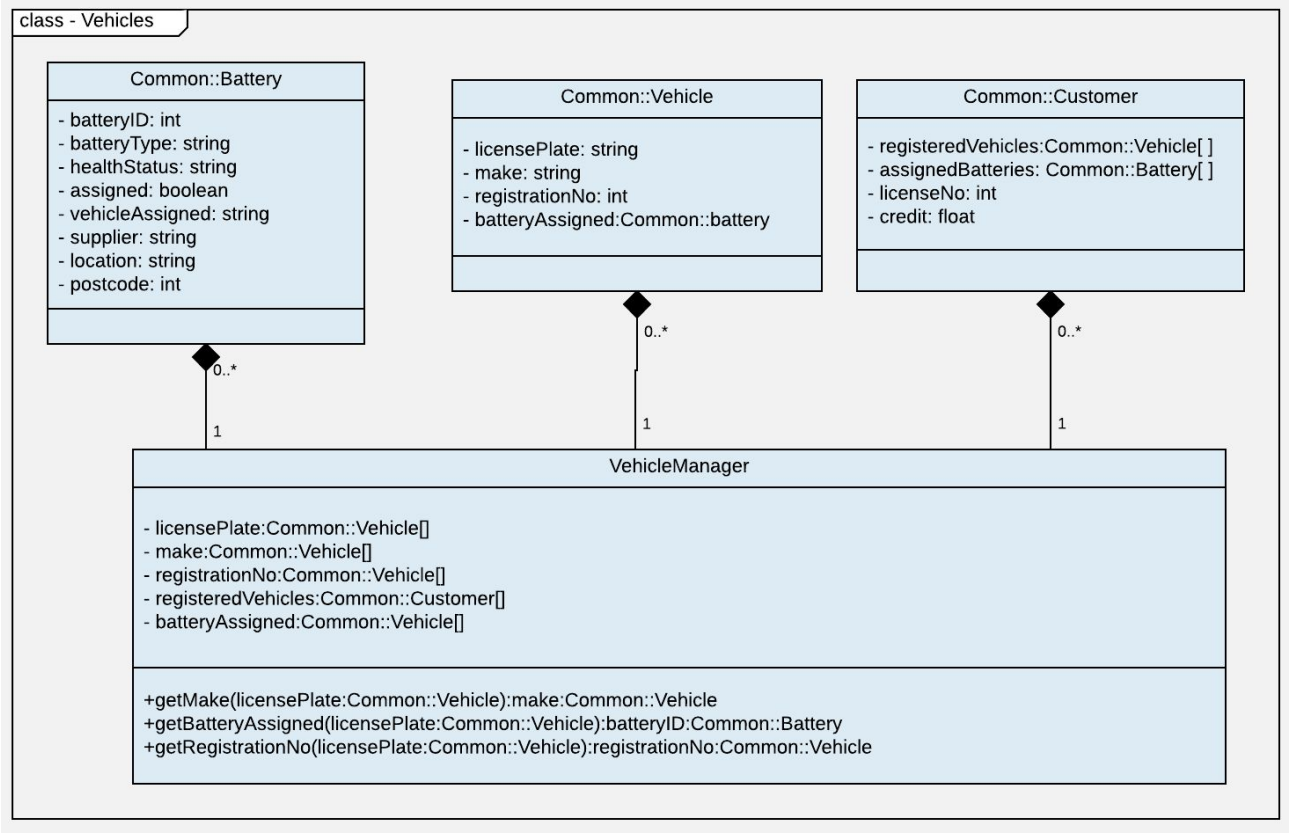
9.2 Interfaces



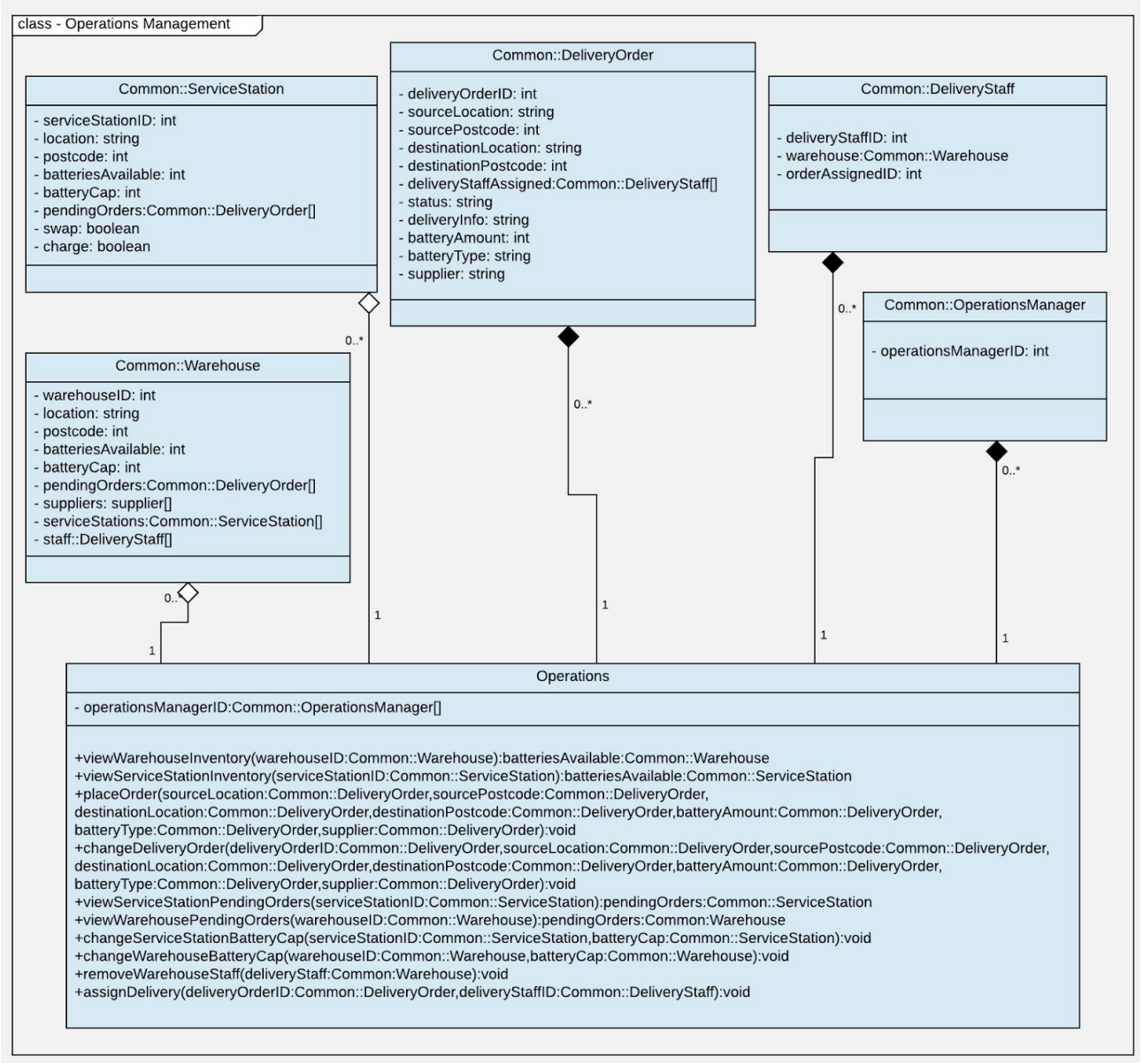
9.3 Batteries



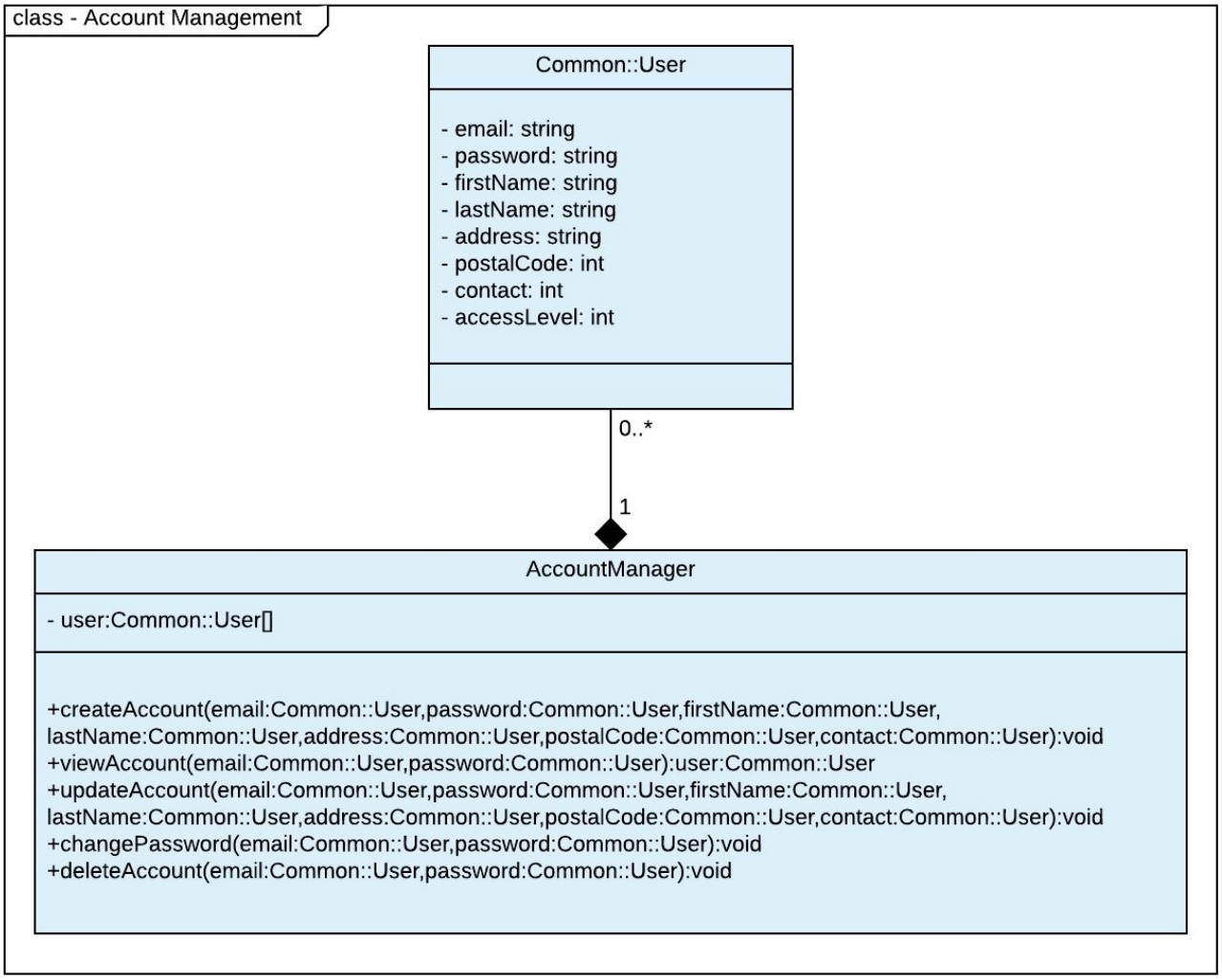
9.4 Vehicles


class - Vehicles
Common::Battery
- batteryID: int
- batteryType: string
- healthStatus: string
- assigned: boolean
- vehicleAssigned: string
- supplier: string
- location: string
- postcode: int
Common::Vehicle
- licensePlate: string
- make: string
- registrationNo: int
- batteryAssigned:Common::battery
Common::Customer
- registeredVehicles:Common::Vehicle[ ]
- assignedBatteries: Common::Battery[ ]
- licenseNo: int
- credit: float
0..*
1
0..*
1
0..*
1
VehicleManager
- licensePlate:Common::Vehicle[]
- make:Common::Vehicle[]
- registrationNo:Common::Vehicle[]
- registeredVehicles:Common::Customer[]
- batteryAssigned:Common::Vehicle[]
+getMake(licensePlate:Common::Vehicle):make:Common::Vehicle
+getBatteryAssigned(licensePlate:Common::Vehicle):batteryID:Common::Battery
+getRegistrationNo(licensePlate:Common::Vehicle):registrationNo:Common::Vehicle

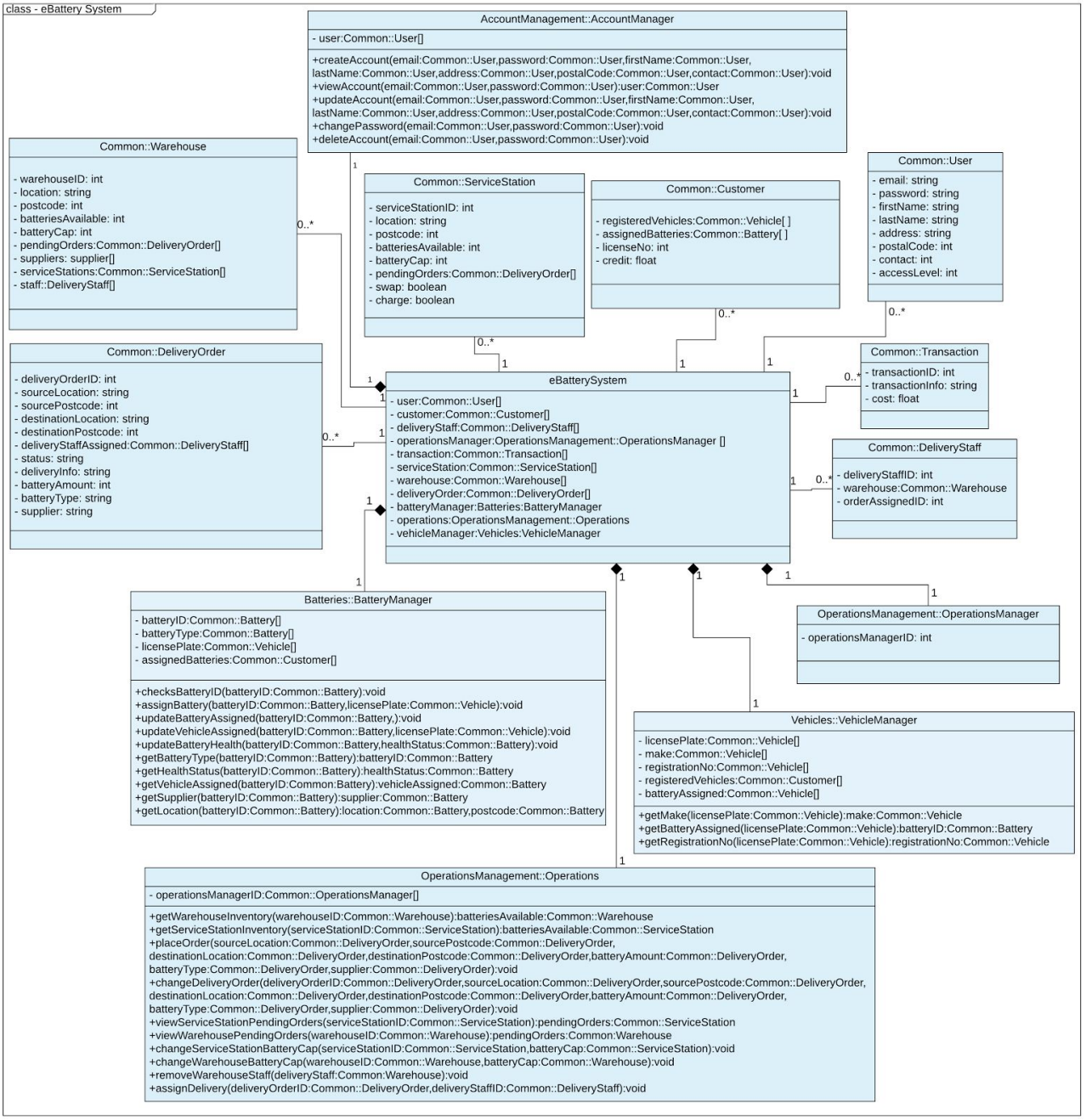
9.5 Operations Management



9.6 Account Management



9.7 eBattery System



10.0 Class Summaries

10.1 Common

Ref. #	Class Name	Description
10.1.1	User	A base class for users of the system containing email, password, first and last names, address, contact information, and access levels.
10.1.2	Delivery Staff	A subclass for delivery staff that inherits from the user class and contains the staff's ID, their warehouse, and the orders assigned to them.
10.1.3	Operations Manager	A subclass for operation managers that inherits from the user class and contains the staff ID.
10.1.4	Customer	A subclass for customers that inherits from the user class and contains their list of registered vehicles, their list of assigned batteries, their license number, and the amount of credit in their account.
10.1.5	Transaction	A class containing all details related to transactions.
10.1.6	Vehicle	A class containing all details related to vehicles; including registration number, license plate, battery assigned, and make.
10.1.7	Battery	A class containing all details related to batteries; including battery ID, battery type, vehicle assigned, health status, supplier, and its location.
10.1.8	Service Station	A class containing all details related to a service station; including service station ID, location, number of batteries available, pending orders, number of allocated batteries, and swap and charge availability.
10.1.9	Warehouse	A class containing all details related to a warehouse; including warehouse ID, location, supplier, number of batteries available, pending orders, list of staff, number of batteries allocated, and list of service stations.
10.1.10	Delivery Order	A class containing all details related to a delivery order; including order ID, source and destination information, delivery information, and delivery status.

10.2 Interfaces

Ref. #	Class Name	Description
10.2.1	UserInterface	A base class with an instance of the eBattery System for overriding other interfaces.
10.2.2	DeliveryStaffInterface	The interface delivery staff use when interacting with the system.
10.2.3	CustomerInterface	The interface customers use when interacting with the system.
10.2.4	OperationsManagerInterface	The interface Operation Managers use when interacting with the system.

10.3 Batteries

Ref. #	Class Name	Description
10.3.1	Battery Manager	A class that handles the assignment of batteries to vehicles.

10.4 Vehicles

Ref. #	Class Name	Description
10.4.1	Vehicle Manager	A class that handles the registration of vehicles.

10.5 Operations Management

Ref. #	Class Name	Description
10.5.1	Operations	A class that handles the inventories of service stations and warehouses, delivery orders, and manages the supply and demand of service stations and their warehouses.

10.6 Account Management

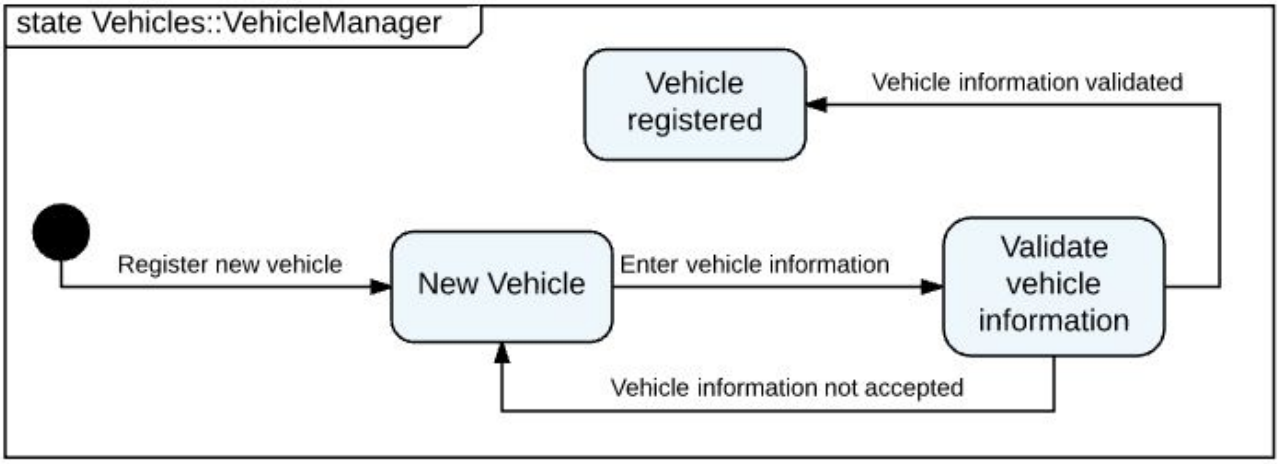
Ref. #	Class Name	Description
10.6.1	Account Manager	A class that handles the creation, modification to and deletion of user accounts.

10.7 eBattery System

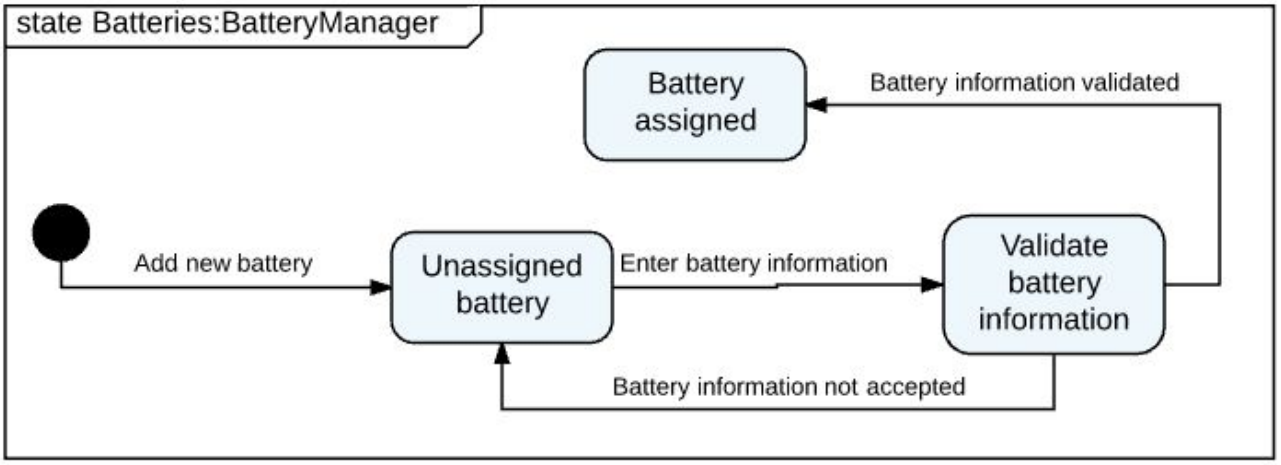
Ref. #	Class Name	Description
10.7.1	eBattery System	The class which holds references to all parts of the architecture of the eBattery System.

11.0 State Machine Diagrams

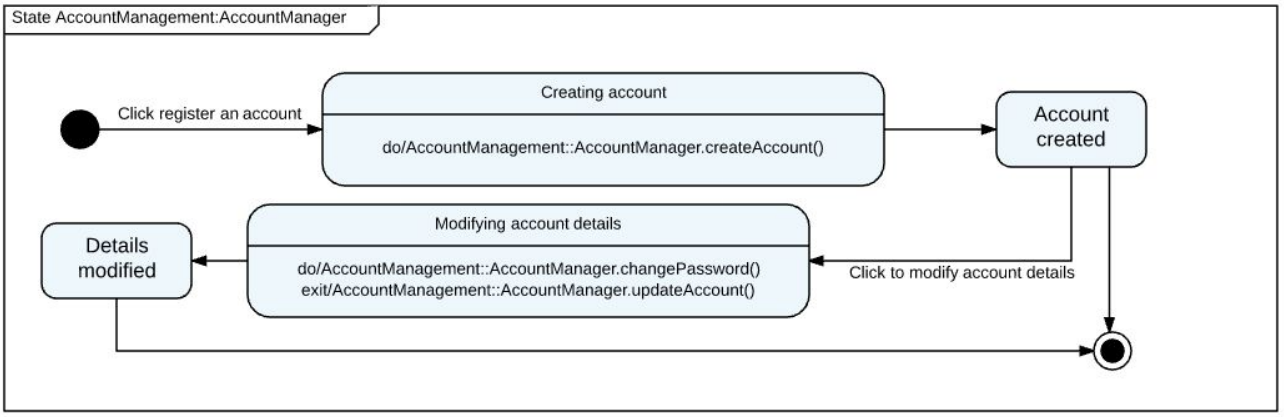
11.1 Vehicles/VehicleManager



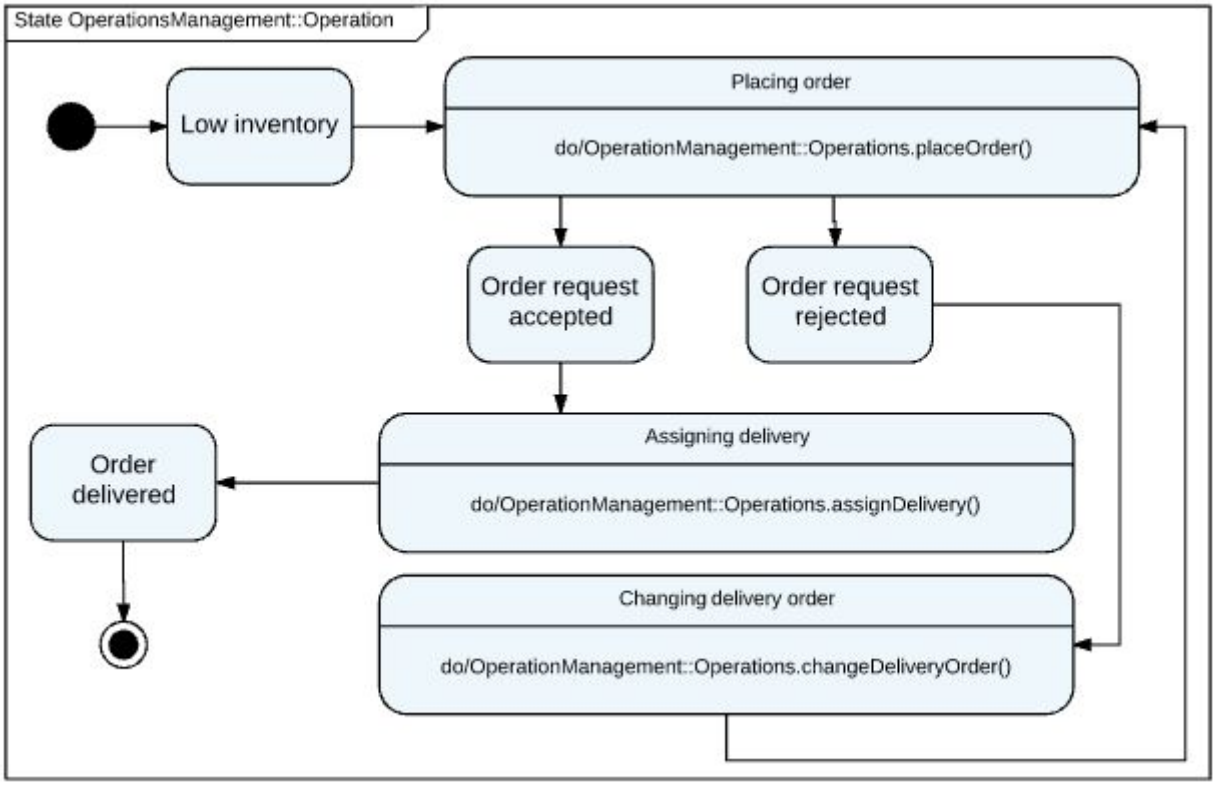
11.2 Batteries/BatteryManager



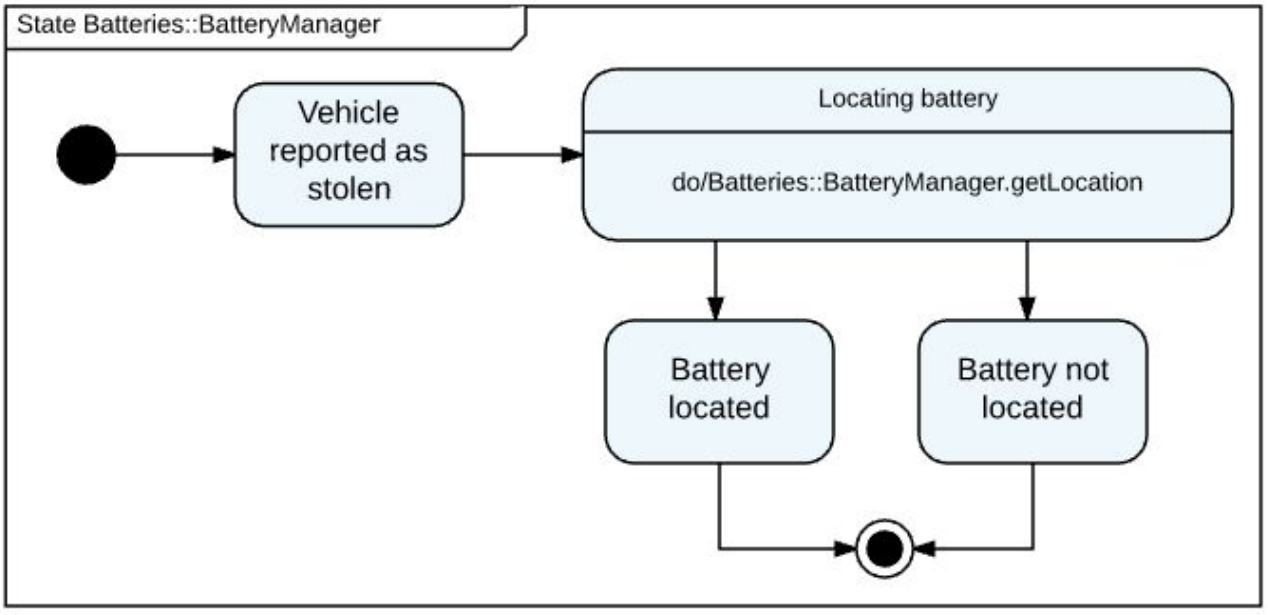
11.3 AccountManagement/AccountManager



11.4 OperationsManagement/Operations



11.5 Batteries/BatteryManager



12.0 Non-Functional Requirements

Ref. #	Description
NFR 1	The website must be responsive, with an average response time of less than 40 seconds.
NFR 2	The user, service station, warehouse, and staff data must be stored securely, users must only be able to access information that they are authorised to.
NFR 3	The system must recover from a major failure within 60 minutes.
NFR 4	All passwords must not be stored as plaintext
NFR 5	Customers must be able to navigate through the website and complete the task they have set out to do within 10 minutes including load times.

13.0 Risk Management

13.1 Risk Table

Ref. #	Risk	Probability	Impact
Risk01	Change in specification during development	Remote	Critical
Risk02	Incomplete specifications	Remote	Critical
Risk03	Inability to cater to a large number of users	Occasional	Catastrophic
Risk04	The project goes over budget	Probable	Serious
Risk05	The project takes longer than expected	Probable	Minor
Risk06	Personal data of customers is not secure	Remote	Catastrophic
Risk07	Inability to achieve requirements stated in SRS	Remote	Critical

13.2 Mitigation Plan

Both budget and the timeline of the project must be monitored to foresee and prevent any of the risks identified.

An impactful risk is the inability to cater to a large number of users (risk03) and to mitigate this risk, numerous technologies will be utilized to distribute traffic across servers to manage larger amounts of users.

One strategy that could be used to mitigate risk04 would be constantly test for errors and resolve any issues at the early stages of development. Catching errors earlier in the development process will incur fewer costs compared to later in development.

In order to safeguard from any potential security risks surrounding all users' data (risk06),a qualified information security expert will be consulted beforehand to ensure the database is secure and thoroughly protected.

14.0 Release Plan

14.1 Release One

Release One will deliver core functionalities of the system including basic account management, basic vehicle and battery registration and assignment, and basic operations surrounding the demand and supply of batteries for service stations and warehouses.

Use Cases to be delivered in Release One:

- Account Management:
  - Register New Account
  - Modify Personal Details
  - Check Account Balance
  - Top-up Account Balance
  - Login to Account
  - Make Payment
- Vehicle/Battery Management:
  - Add Vehicles
  - Modify Vehicle List
  - Remove Vehicle from List
  - Assign Battery to Vehicle
  - Unassign Battery from Vehicle
  - Check Battery Details
- Service Station Management:
  - Add Service Station
  - Remove Service Station
  - Modify Service Station Details
  - Check Service Station Battery Inventory
- Warehouse Management:
  - View Warehouse Inventory
  - Order Batteries from Supplier
  - Add Warehouse
  - Delete Warehouse
  - Modify Warehouse Details
  - View Service Station Battery Orders
- Service Station Transactions:
  - Charge Battery
  - Swap Battery

14.2 Release Two

Release Two will deliver additional functionality of the system including a search function that enable customers to locate service stations, and better account and vehicle management such as the deleting of an account and reporting a vehicle to be stolen.

Use Cases to be delivered in Release Two:

- Account Management:
  - Delete Account
  - Report Stolen
- Vehicle/Battery Management:
  - Report Stolen Battery
- Locate Service Stations:
  - Search for Service Station
  - Change Search Filters

14.3 Release Three

Release Three will deliver an improved user experience by having top-up kiosks at service stations, and will also introduce a better management for delivery staff.

Use Case to be delivered in Release Three:

- Service Station Transactions:
  - Top-up Account Balance via Kiosk
- Battery Deliver:
  - Update delivery status

15.0 Glossary

Term	Definition
Battery Cap	The number of batteries allocated to either a service station or warehouse and can be adjusted according to demand.

16.0 Summary

In summary, the eBattery system will shape a global and mass-market industry through implementation of an efficient and reliable universal battery swap system for electric cars. The system will provide electric car owners a safe and affordable alternative to battery ownership through the automation of the management of batteries and numerous benefits of using this system. In conclusion, the eBattery system is complex, though still able to be modelled and planned effectively. Guided by the Requirement Specifications, the eBattery system can be implemented within the budget and timeframe.

17.0 References

Alshehab, H., Lee, Y.M., Quirk, T., Sharpe, A., Yusi, Z. (2017), *Project Charter Tezla*

Thomas, R. (2016), *Music Player Requirements Specification*

Thomas, R. (2016), *GEMS Requirements Specification*

18.0 Appendix

18.1 Changes to Project Charter

- Added a top-up kiosk at service stations
- Eliminated the need for staff at service stations; instead delivery staff from warehouses will travel to and fro service stations to collect payment from kiosks.
- Added the ability to report vehicles/batteries assigned as stolen

18.2 Story Points

Use Case	Story Points
Receive instructions to deliver	1
Deliver batteries	1
Deliver batteries from warehouse to service stations	1
Deliver faulty batteries from service stations to warehouse	1
Deliver faulty batteries from warehouse back to supplier	1
Update delivery status	1
Prepare deliveries	2
Prepare service station deliveries	2
Prepare supplier deliveries	2
Search for service station	8
Change search filters	1
Register New Account	8
Modify Personal Details	2
Check Account Balance	1
Delete Account	1
Report Stolen Batteries	4
Top-up Account Balance	4
Login to Account	2
Make Payment	4
Manage Vehicles	4
Add Vehicle	4
Modify Vehicle List	4
Remove Vehicle List	2
Login to Account	2

Manage Batteries	2
Assign Battery to Vehicle	2
Unassign Battery from Vehicle	2
Check Battery Details	2
Report Stolen Battery	4
Add Service Station	2
Remove Service Station	1
Modify Service Station Details	2
Check Service Station Battery Inventory	2
Modify number of allocated batteries for service station	2
Manual Override of Battery Orders	4
View Warehouse Inventory	1
Order Batteries from Supplier	4
Manage Warehouse Battery Quantities	16
Add warehouse	8
Delete warehouse	2
Modify warehouse details	4
Manage warehouse battery quantities	4
View Service Station Battery Orders	2
Receive Batteries from Supplier	1
Charge Battery	32
Swap Battery	32
Top-up Account Balance via Kiosk	32
Remove Battery from Battery Swap Bay	16
Remove Faulty Battery	16
Add Batteries to Battery Swap Bay	16