GROUP SUBMISSION – ASSESSMENT TASK 3: SOFTWARE DESIGN AND DEVELOPMENT

KIT519 – Software Engineering and HCI

Group Number : 36

Name	**Student ID**
Parth Patel	**684138**
Ravi Savani	**685167**

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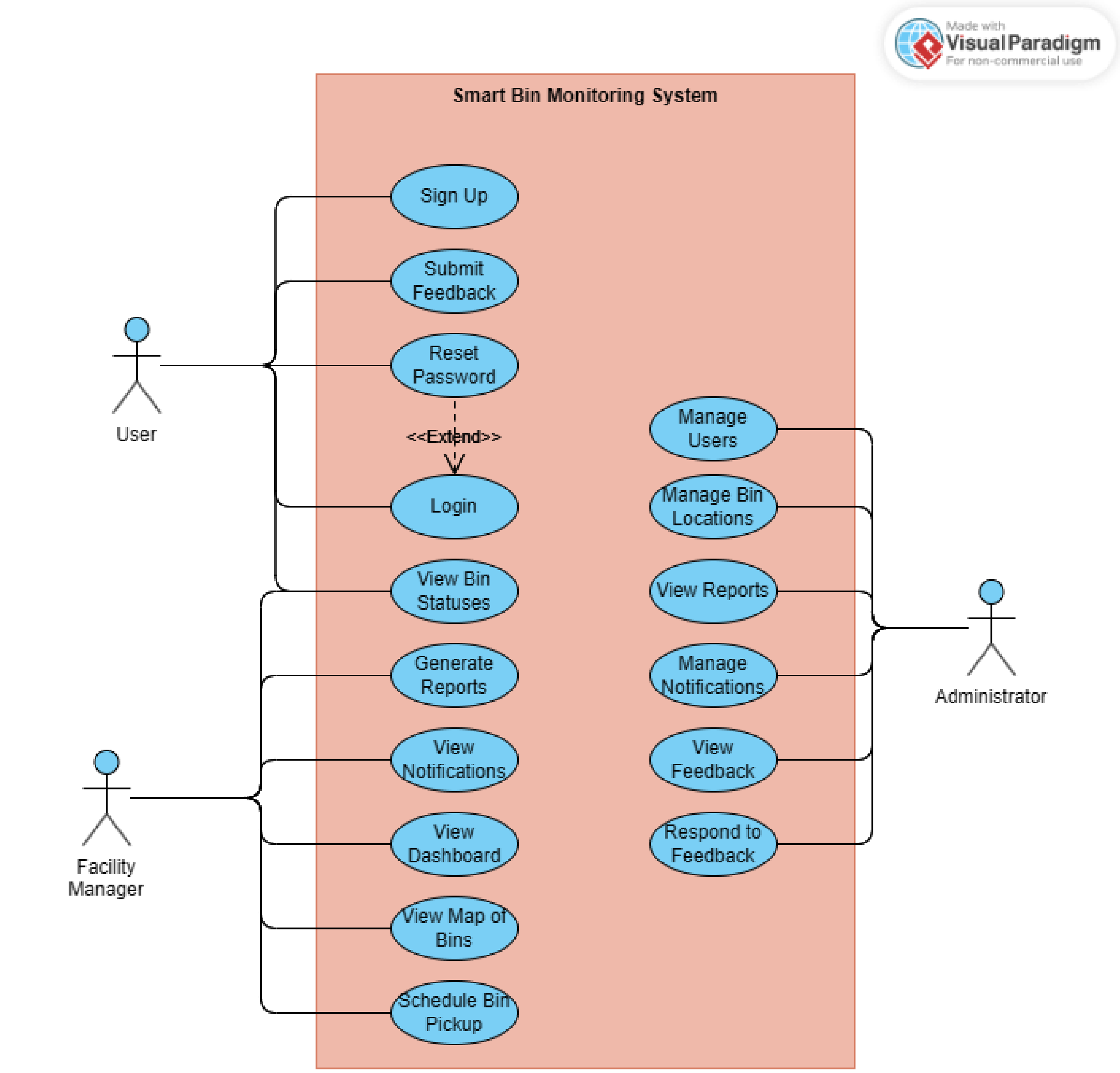
INTRODUCTION

Smart Bin Monitoring System is an Intelligent Waste Management System that has been developed to meet the rising demands of waste collection on the University of Tasmania. In addition, real-time data from IoT and data analytics help the campus staff to get information on bin fill levels, contamination, and pickup schedules. This report outlines the software requirements and design of the Smart Bin Monitoring System, in order to design a user friendly, effective and sustainable system for the university.

This design report serves the following objectives: The functional requirements, the overall interaction diagrams, the sequence diagrams and the functional testing for the system. The report is structured as follows: an example of a use case diagram, extended use cases with interaction scenarios, system sequence and class diagrams, a functional testing report, and a place for the object-oriented code in C#. This makes it easier since all the components of the system are examined and tested in a structured manner.

DESIGN REPORT

USE CASE DIAGRAM OF THE WHOLE SYSTEM

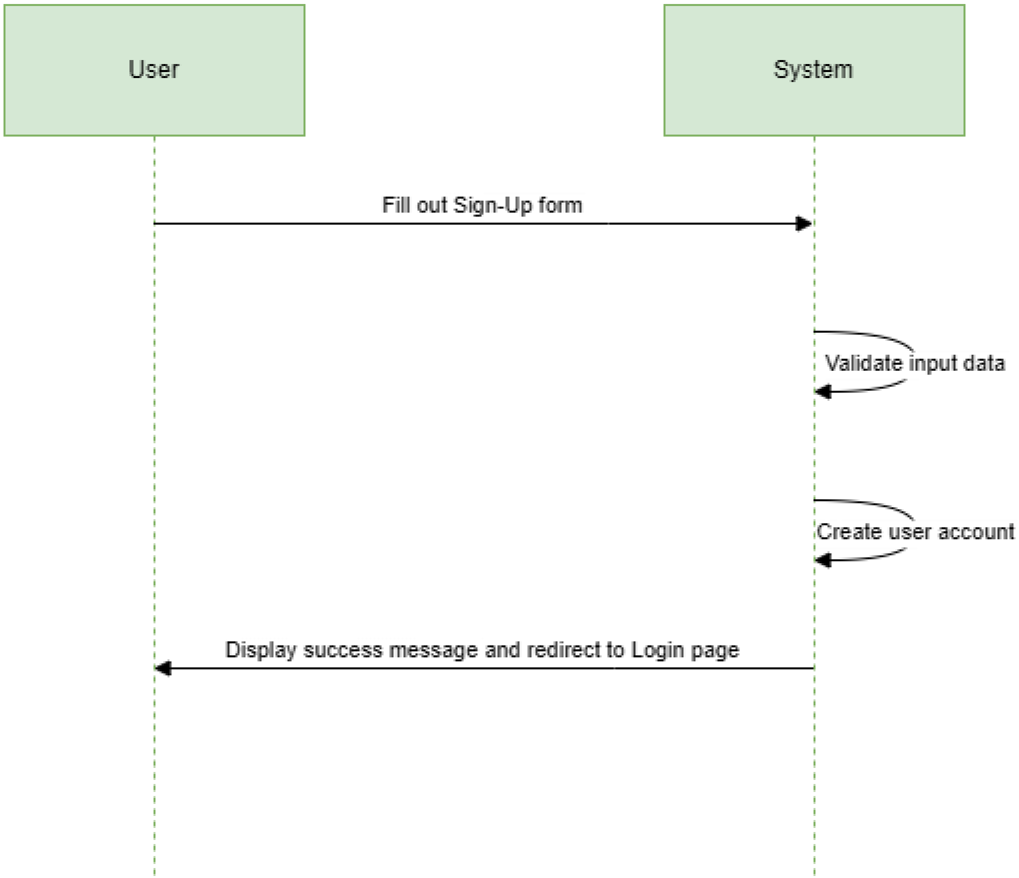


EXTENDED USE CASES WITH HIGH-LEVEL INTERACTION DIAGRAMS

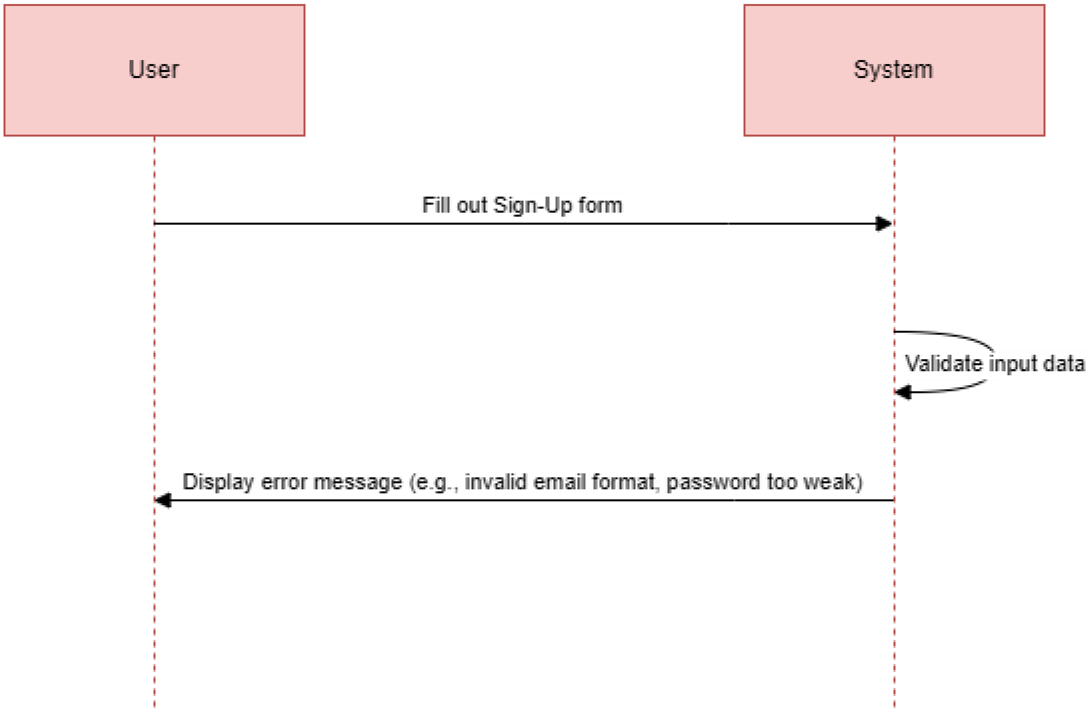
COMPONENT 1: USER REGISTRATION AND LOGIN

USE CASE 1.1: SIGN UP

SUNNY DAY

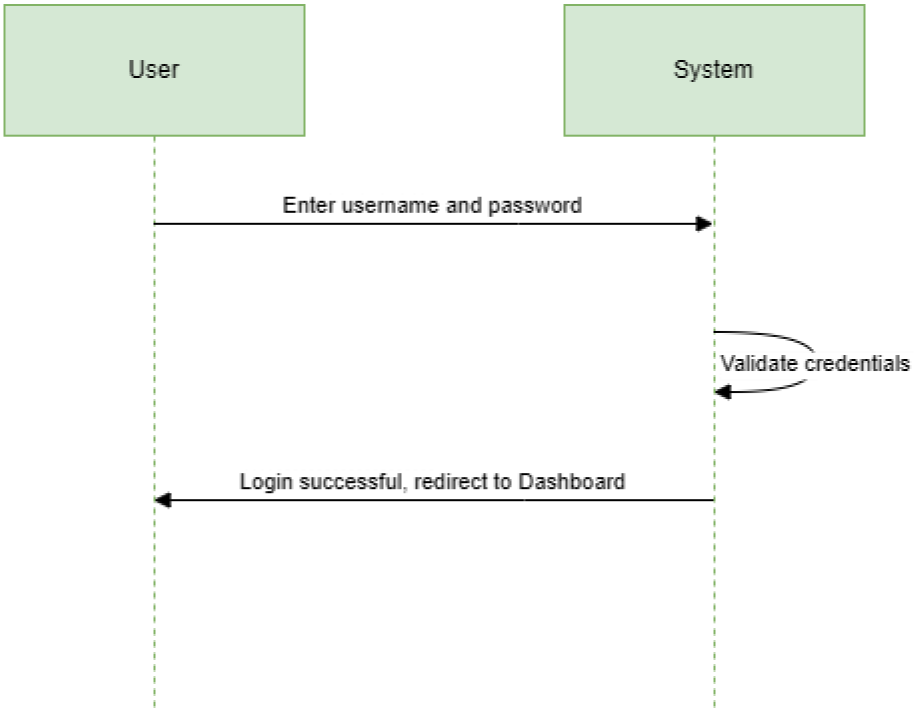

User
System
Fill out Sign-Up form
Validate input data
Create user account
Display success message and redirect to Login page

RAINY DAY

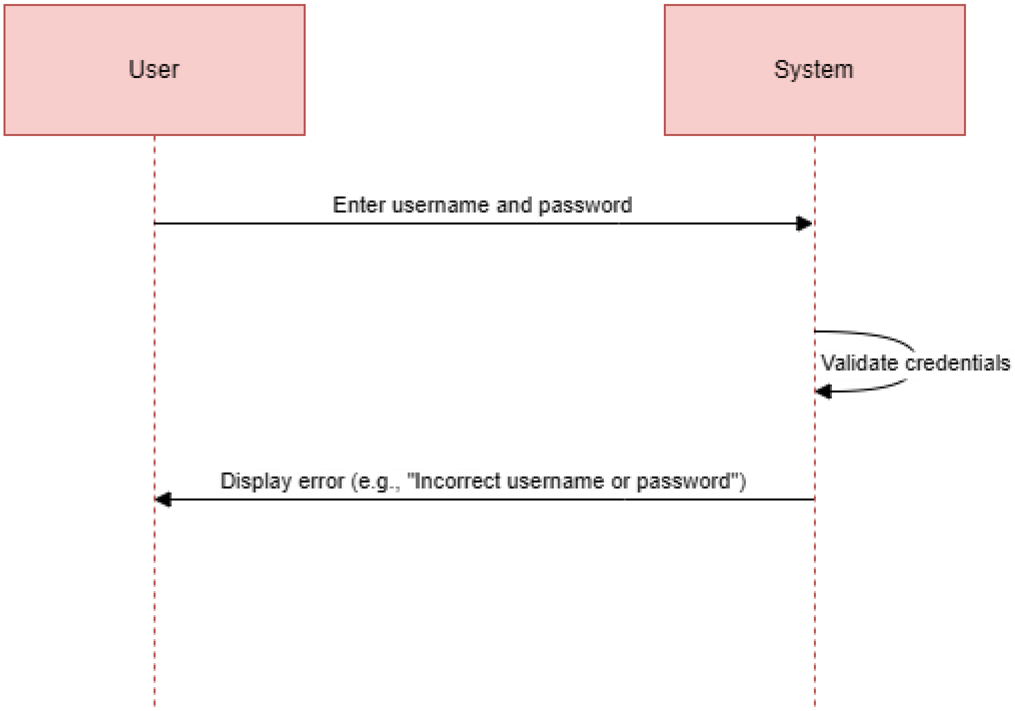

User
System
Fill out Sign-Up form
Validate input data
Display error message (e.g., invalid email format, password too weak)

USE CASE 1.2: LOGIN

SUNNY DAY


User
System
Enter username and password
Validate credentials
Login successful, redirect to Dashboard

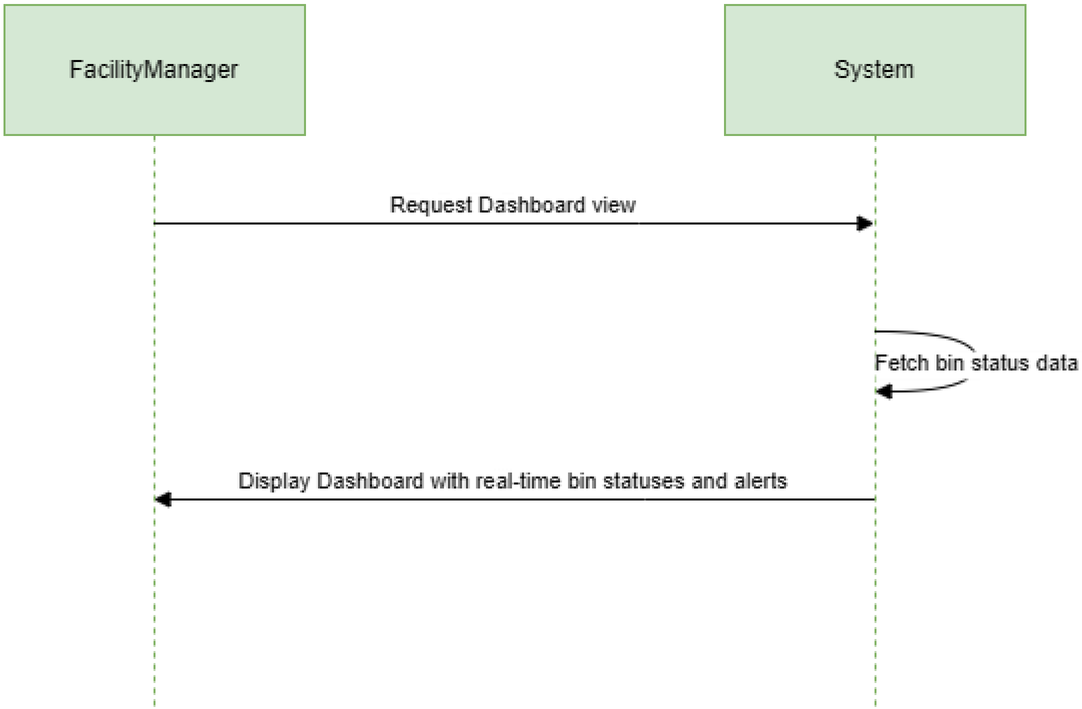
RAINY DAY


User
System
Enter username and password
Validate credentials
Display error (e.g., "Incorrect username or password")

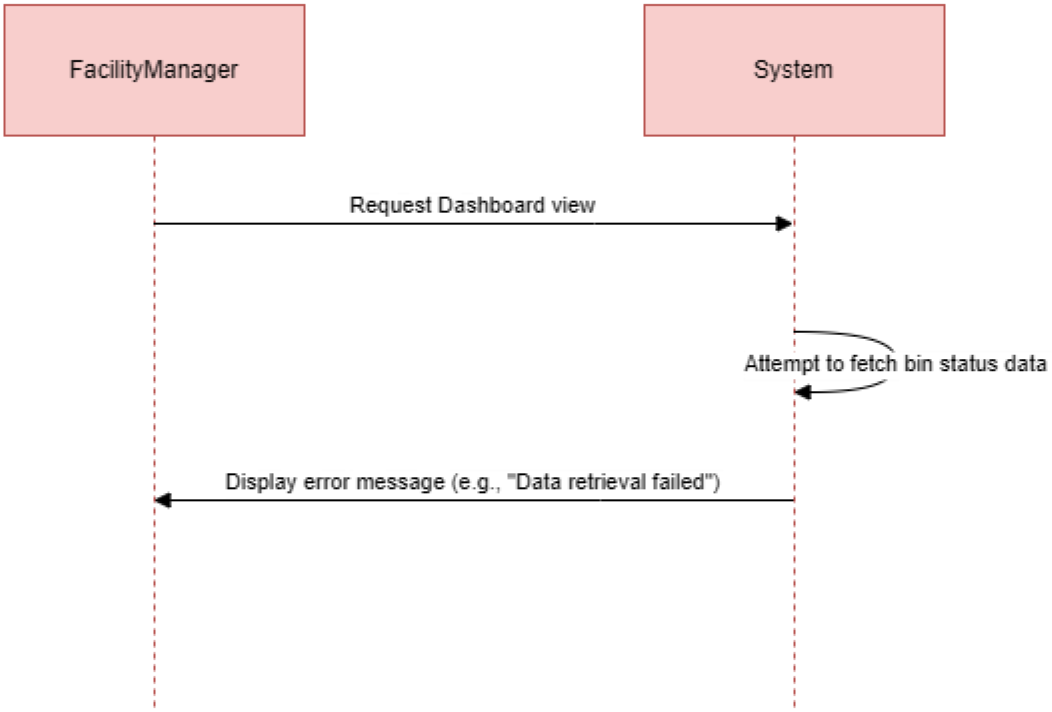
COMPONENT 2: BIN MONITORING AND DASHBOARD

USE CASE 2.1: VIEW DASHBOARD

SUNNY DAY

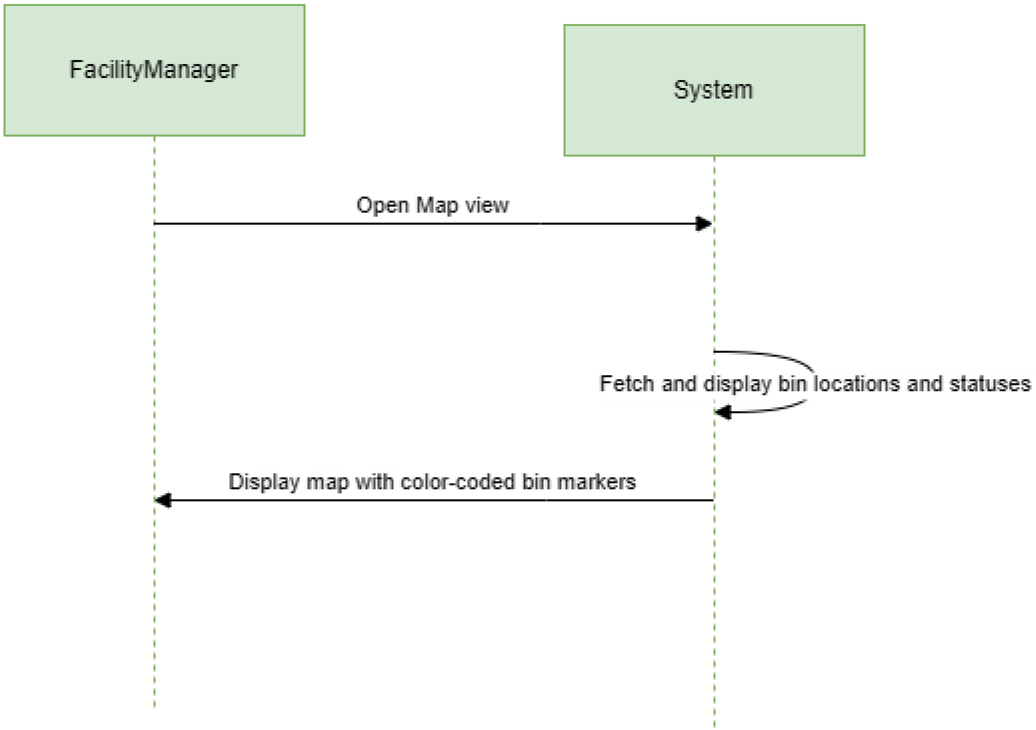


RAINY DAY

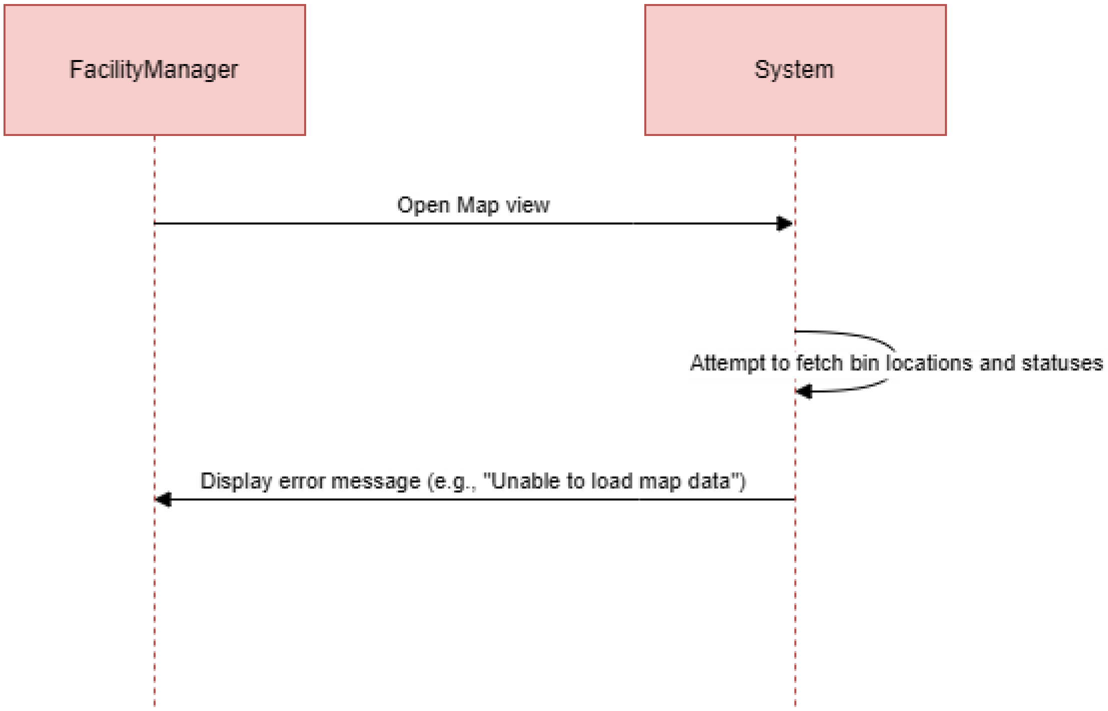

FacilityManager
System
Request Dashboard view
Attempt to fetch bin status data
Display error message (e.g., "Data retrieval failed")

USE CASE 2.2: VIEW BIN STATUSES ON MAP

SUNNY DAY


FacilityManager
System
Open Map view
Fetch and display bin locations and statuses
Display map with color-coded bin markers

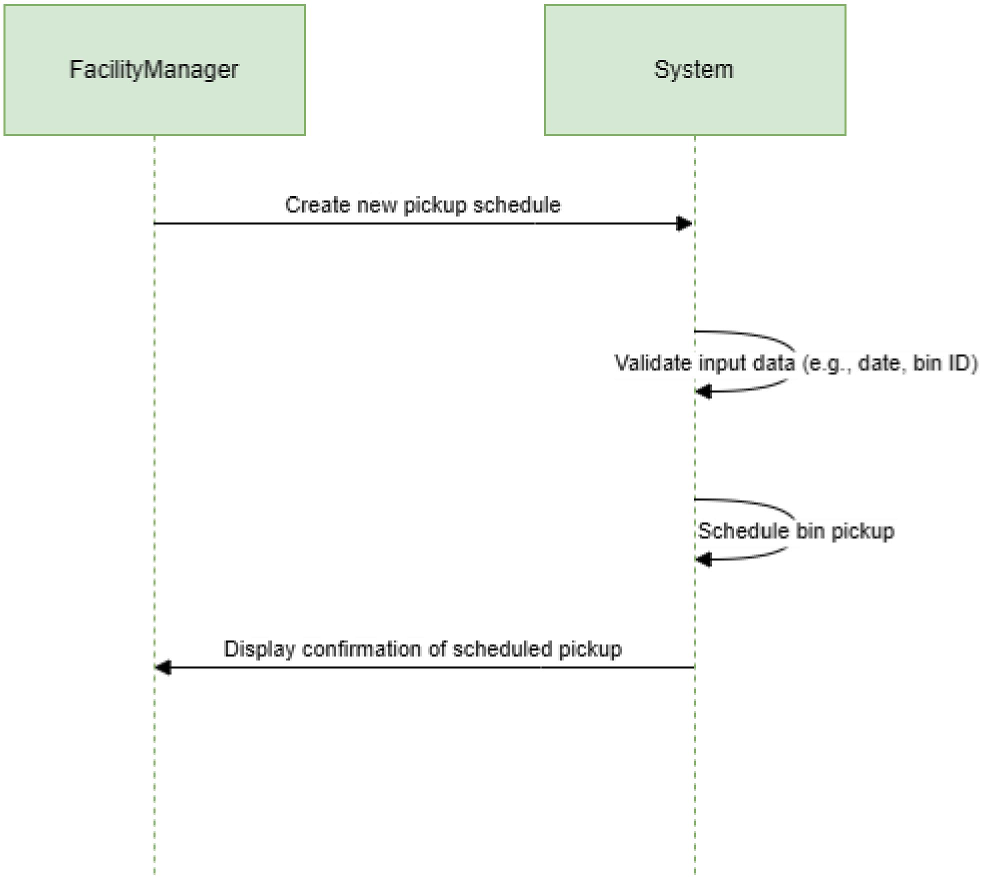
RAINY DAY


FacilityManager
System
Open Map view
Attempt to fetch bin locations and statuses
Display error message (e.g., "Unable to load map data")

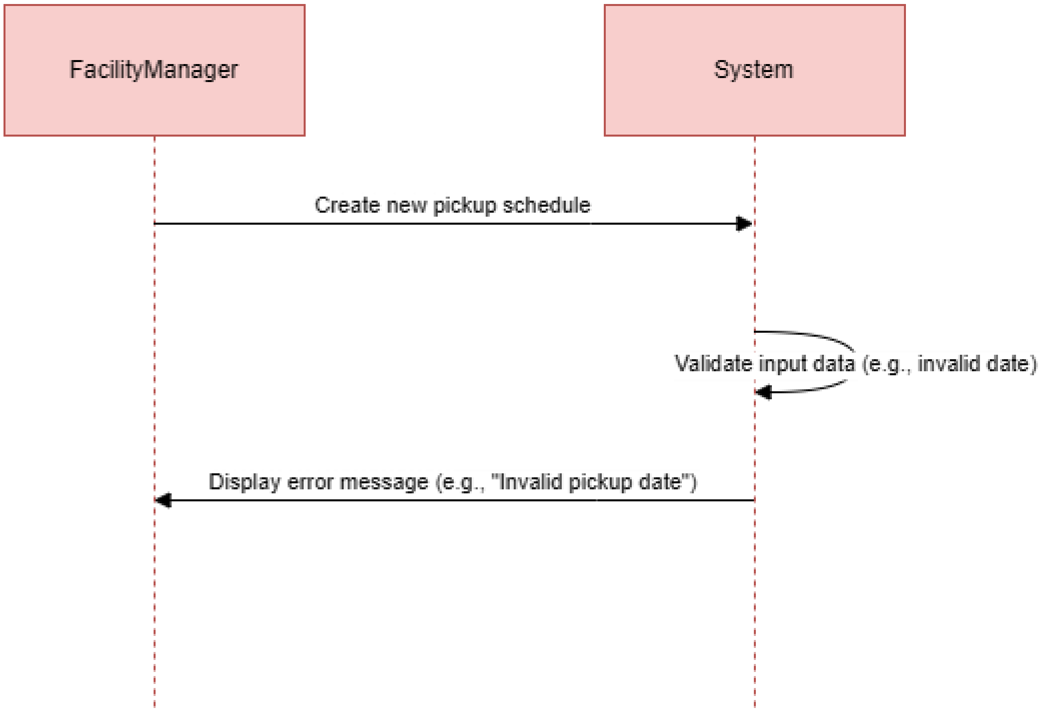
COMPONENT 3: SCHEDULING AND NOTIFICATIONS

USE CASE 3.1: SCHEDULE BIN PICKUP

SUNNY DAY

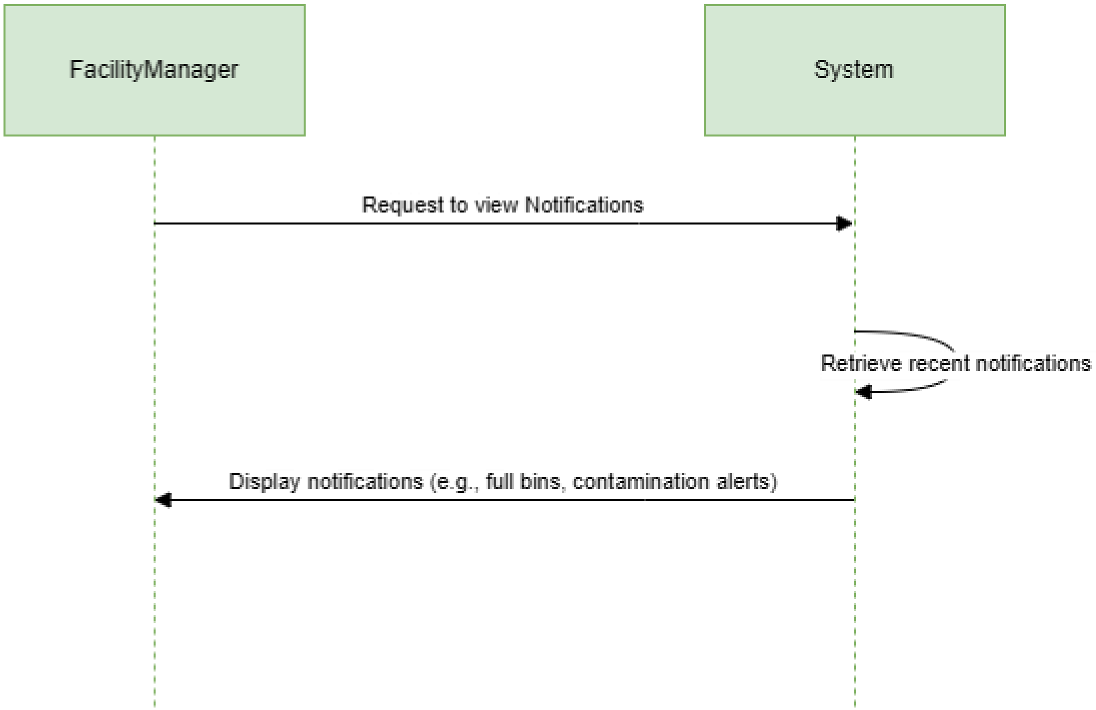

FacilityManager
System
Create new pickup schedule
Validate input data (e.g., date, bin ID)
Schedule bin pickup
Display confirmation of scheduled pickup

RAINY DAY

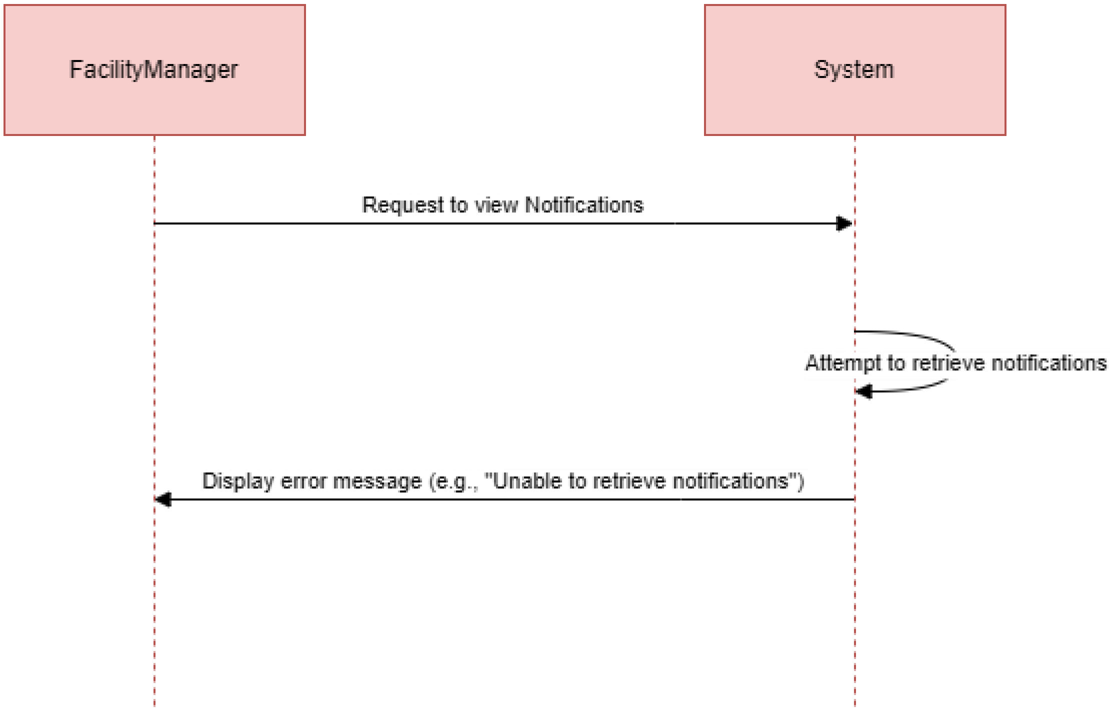

FacilityManager
System
Create new pickup schedule
Validate input data (e.g., invalid date)
Display error message (e.g., "Invalid pickup date")

USE CASE 3.2: VIEW NOTIFICATIONS

SUNNY DAY


FacilityManager
System
Request to view Notifications
Retrieve recent notifications
Display notifications (e.g., full bins, contamination alerts)

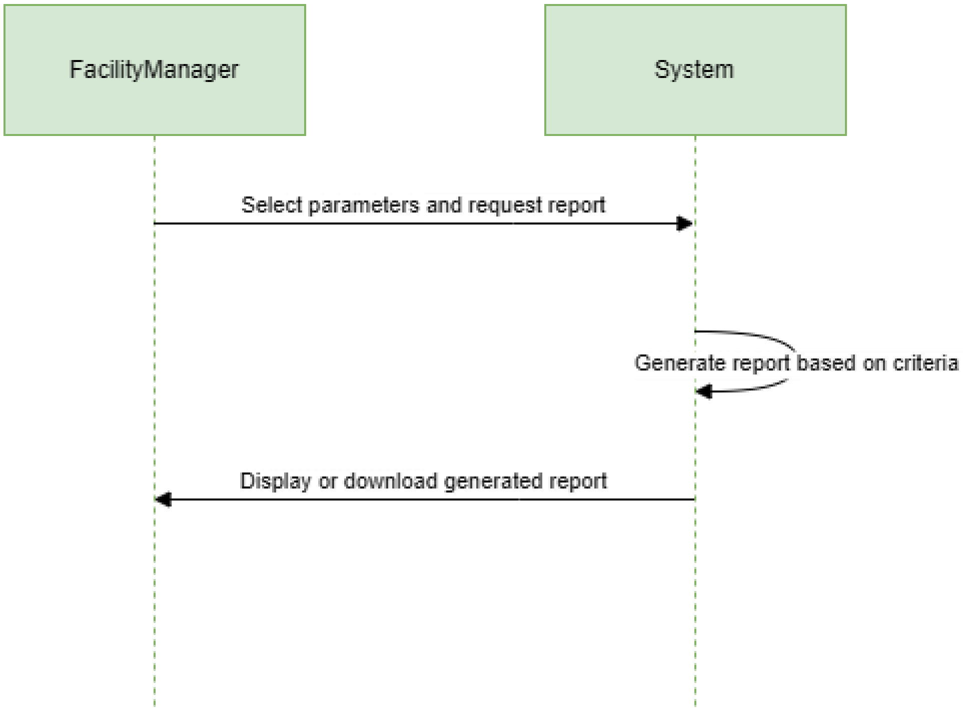
RAINY DAY


FacilityManager
System
Request to view Notifications
Attempt to retrieve notifications
Display error message (e.g., "Unable to retrieve notifications")

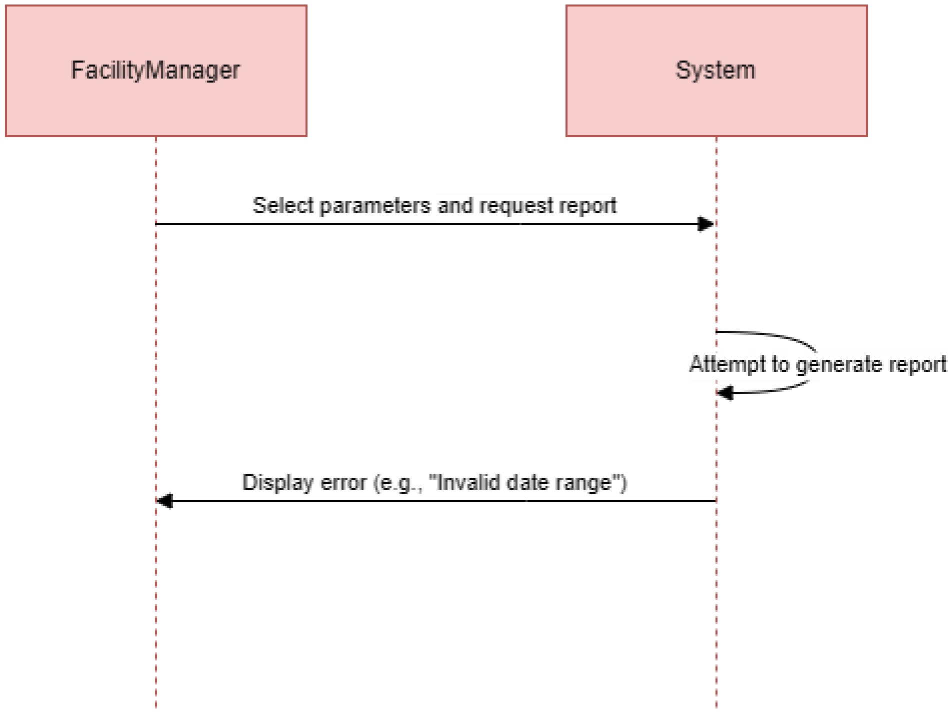
COMPONENT 4: REPORT GENERATION AND FEEDBACK

USE CASE 4.1: GENERATE REPORT

SUNNY DAY

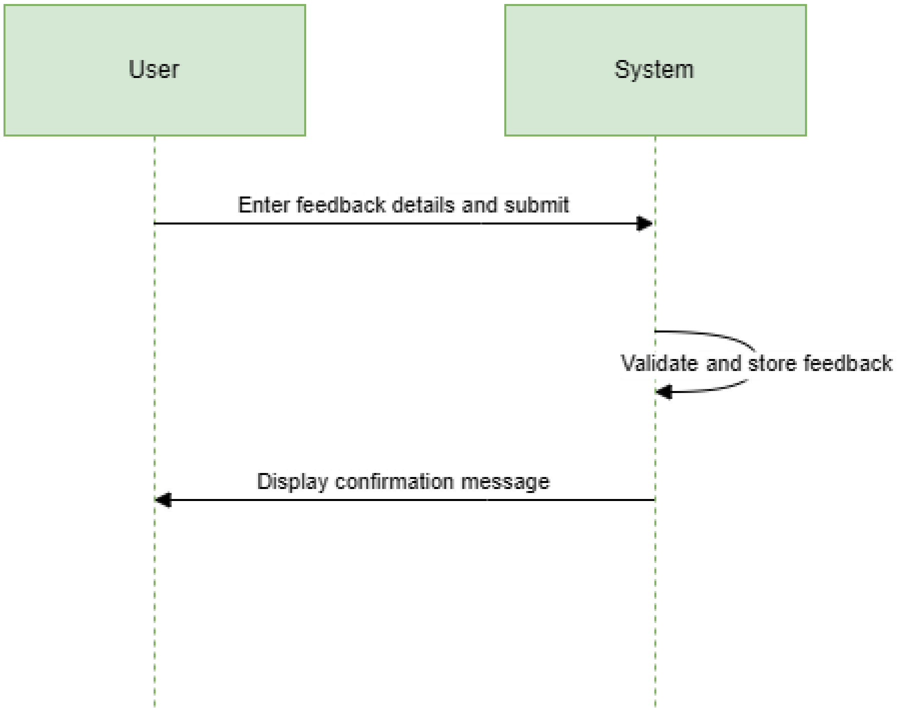

FacilityManager
System
Select parameters and request report
Generate report based on criteria
Display or download generated report

RAINY DAY

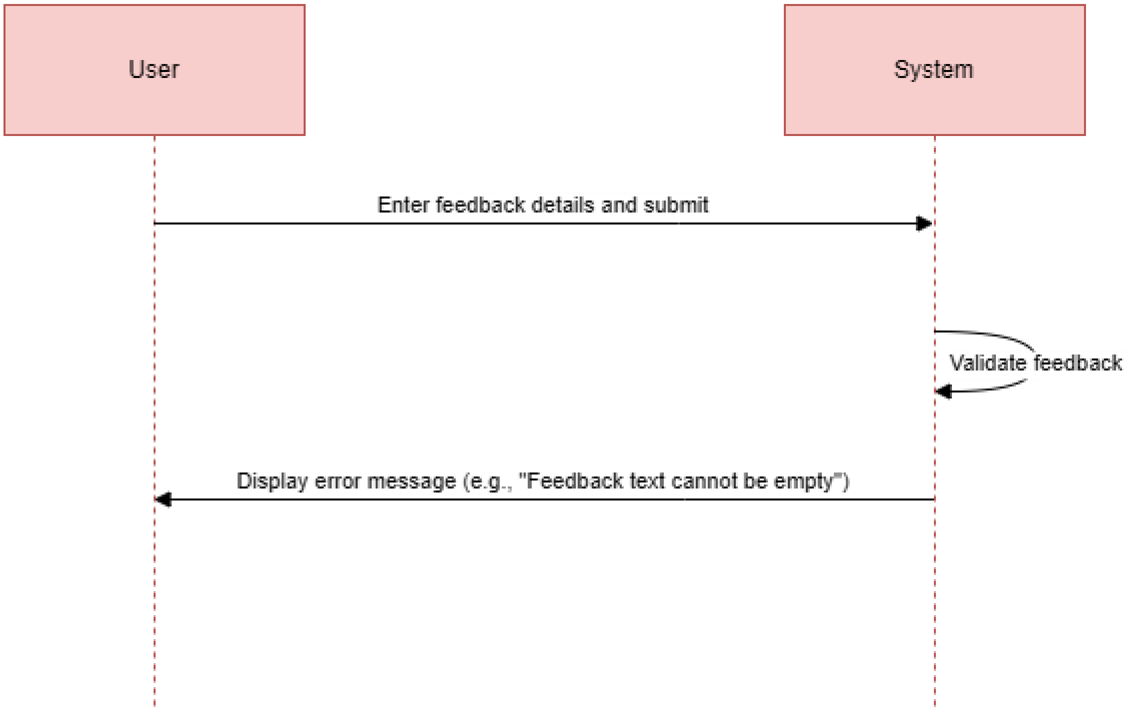

FacilityManager
System
Select parameters and request report
Attempt to generate report
Display error (e.g., "Invalid date range")

USE CASE 4.2: SUBMIT FEEDBACK

SUNNY DAY


User
System
Enter feedback details and submit
Validate and store feedback
Display confirmation message

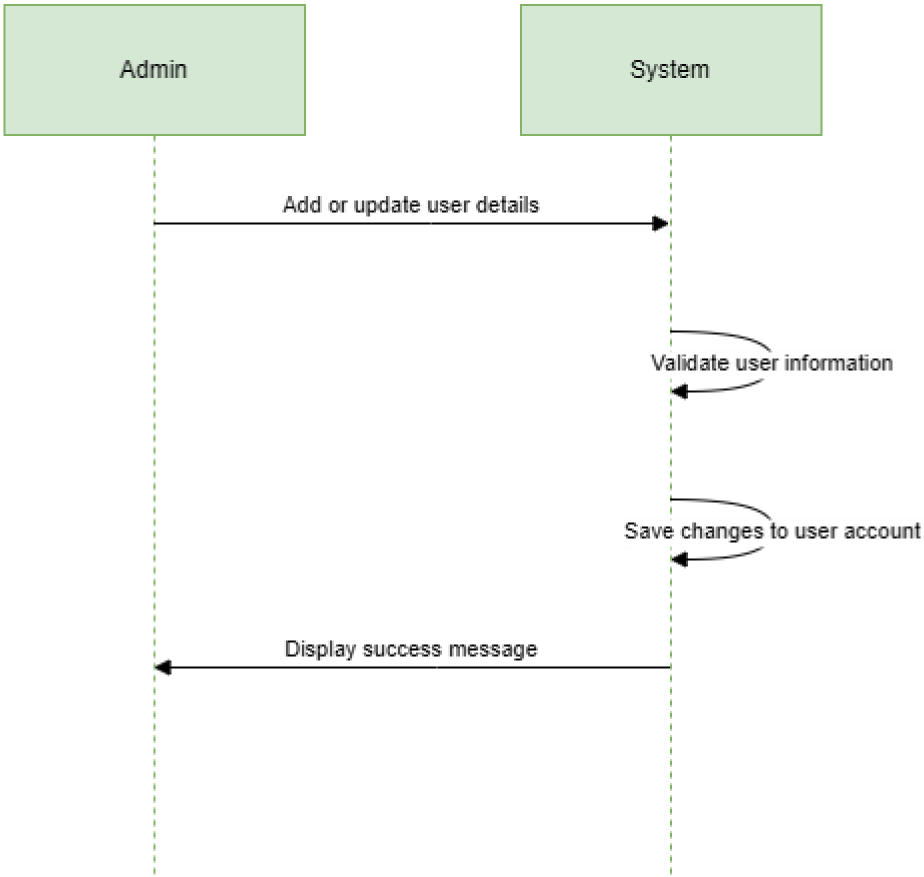
RAINY DAY


User
System
Enter feedback details and submit
Validate feedback
Display error message (e.g., "Feedback text cannot be empty")

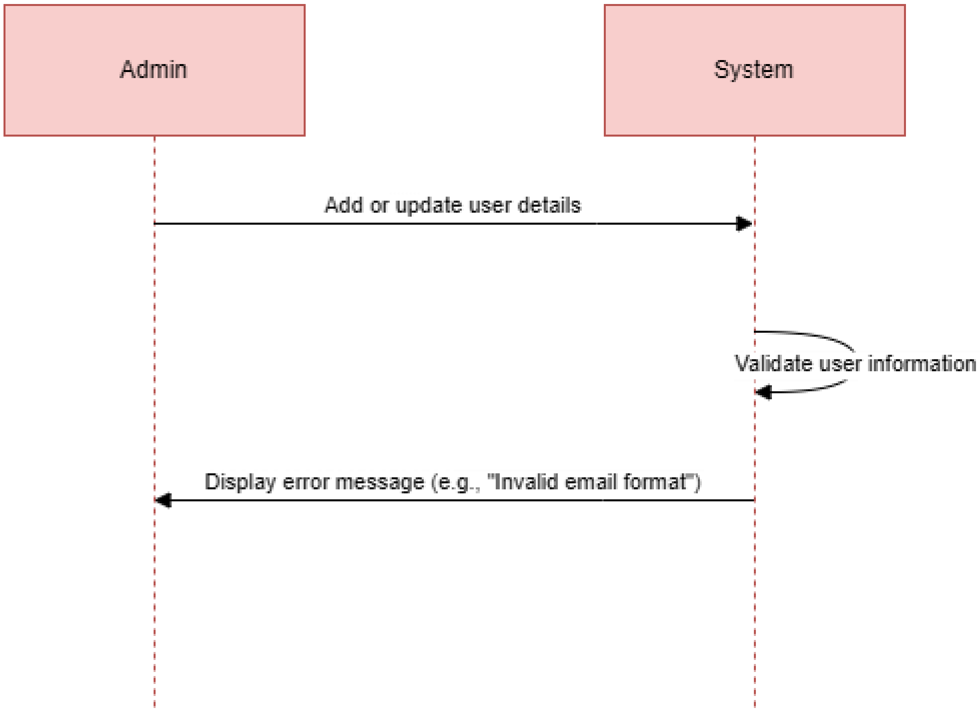
COMPONENT 5: ADMINISTRATOR FUNCTIONS

USE CASE 5.1: MANAGE USERS

SUNNY DAY

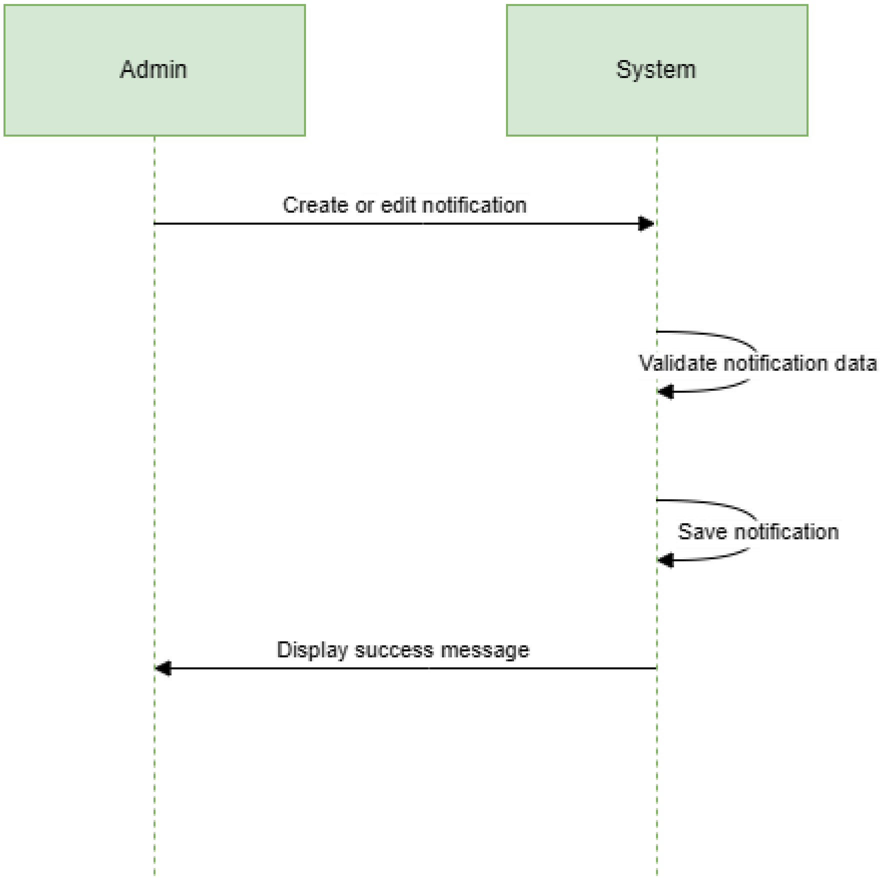

Admin
System
Add or update user details
Validate user information
Save changes to user account
Display success message

RAINY DAY

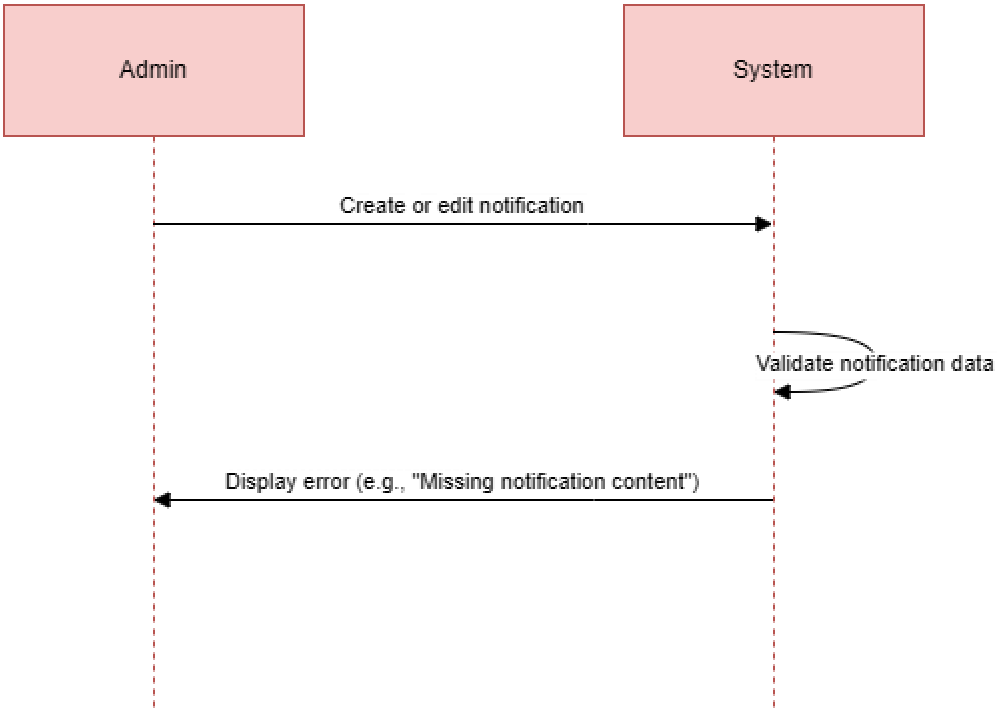

Admin
System
Add or update user details
Validate user information
Display error message (e.g., "Invalid email format")

USE CASE 5.2: MANAGE NOTIFICATIONS

SUNNY DAY

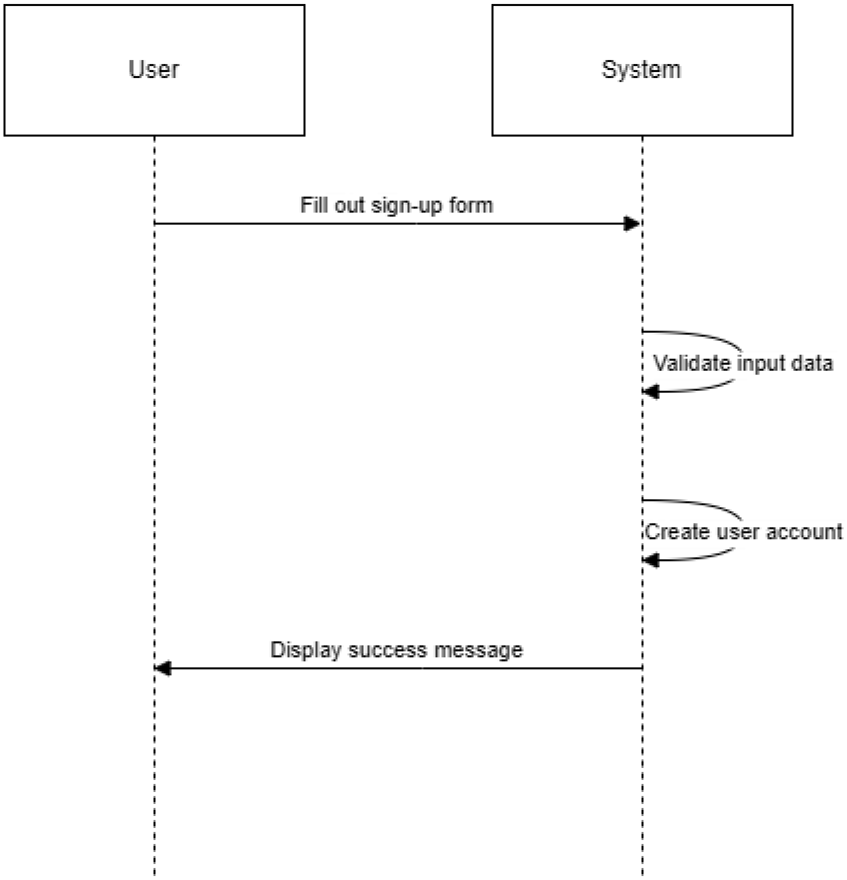

Admin
System
Create or edit notification
Validate notification data
Save notification
Display success message

RAINY DAY

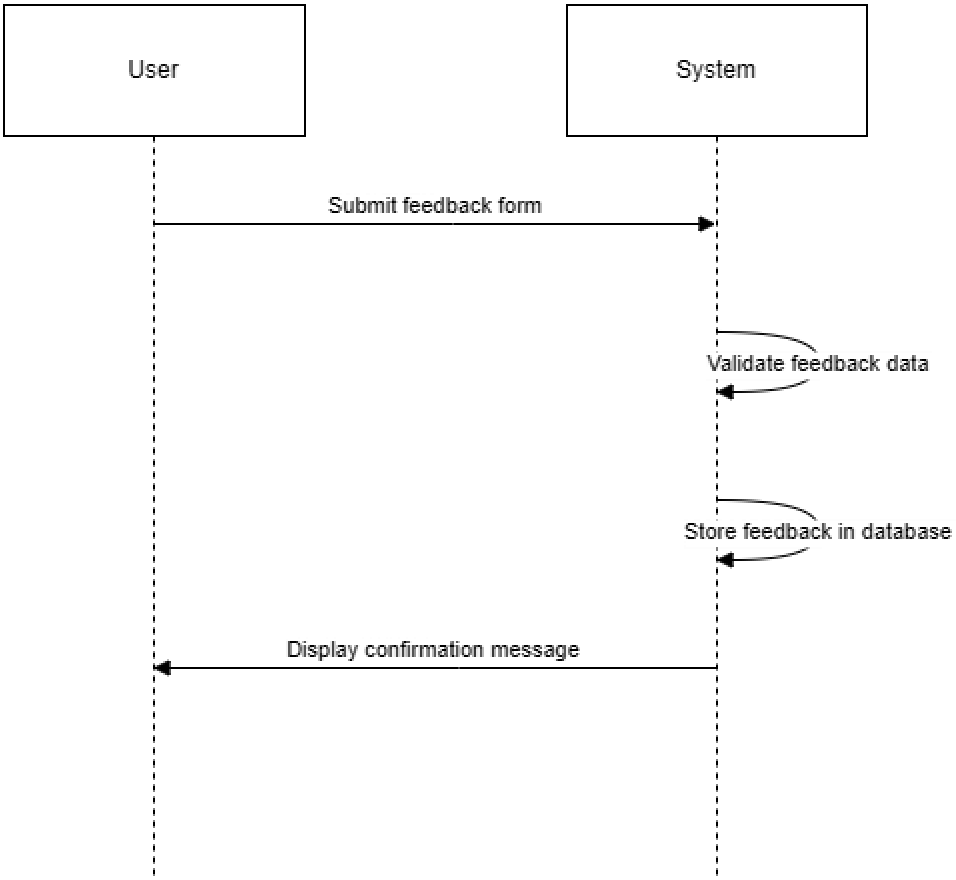

Admin
System
Create or edit notification
Validate notification data
Display error (e.g., "Missing notification content")

SYSTEM SEQUENCE DIAGRAMS FOR EACH USE CASE

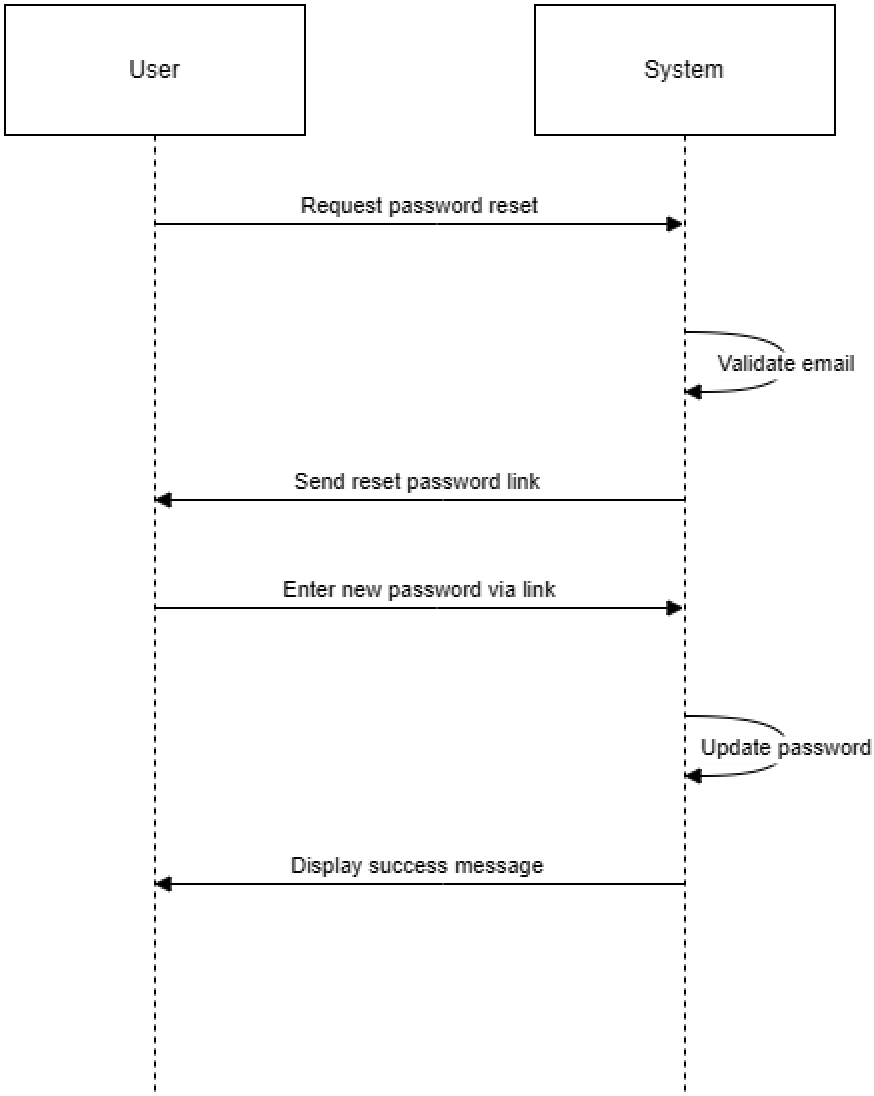
SIGN UP



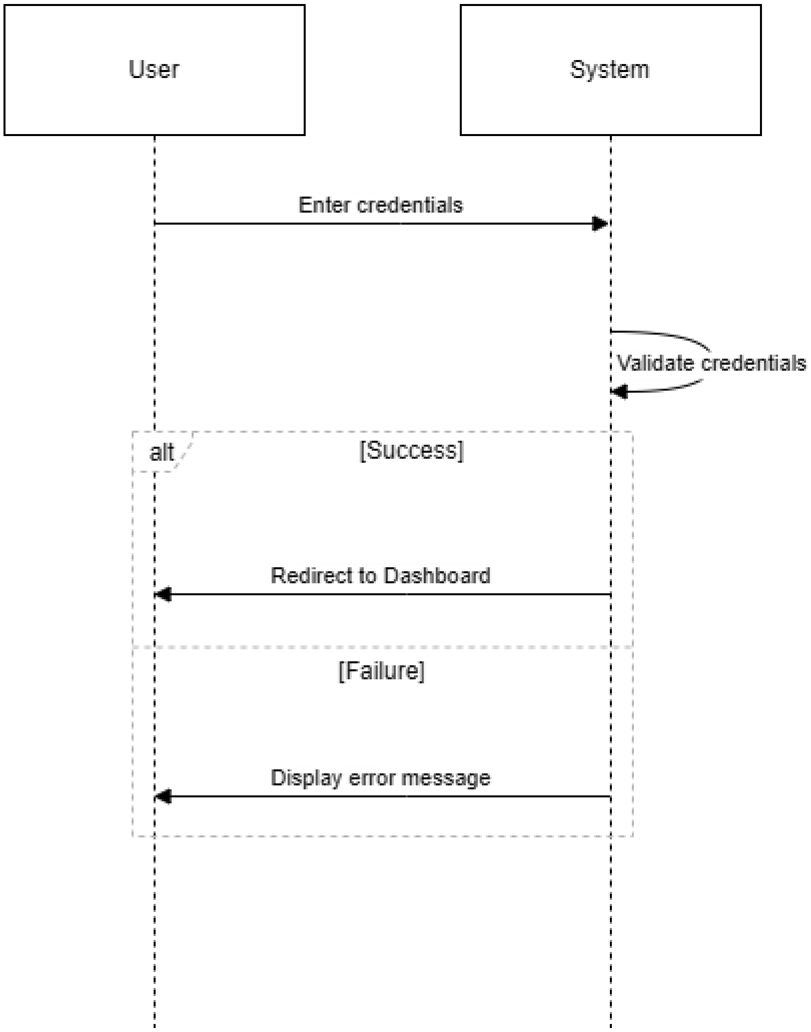
SUBMIT FEEDBACK



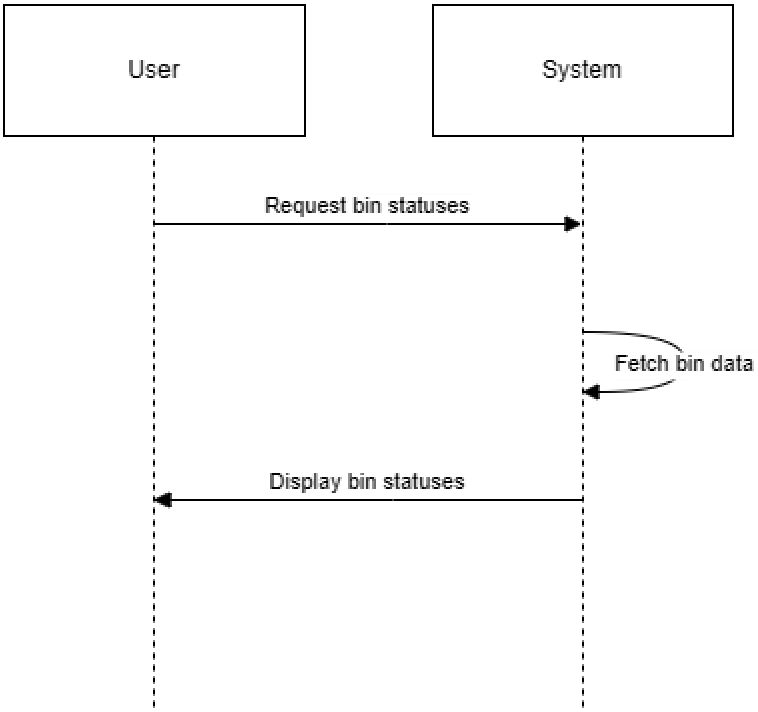
RESET PASSWORD


User
System
Request password reset
Validate email
Send reset password link
Enter new password via link
Update password
Display success message

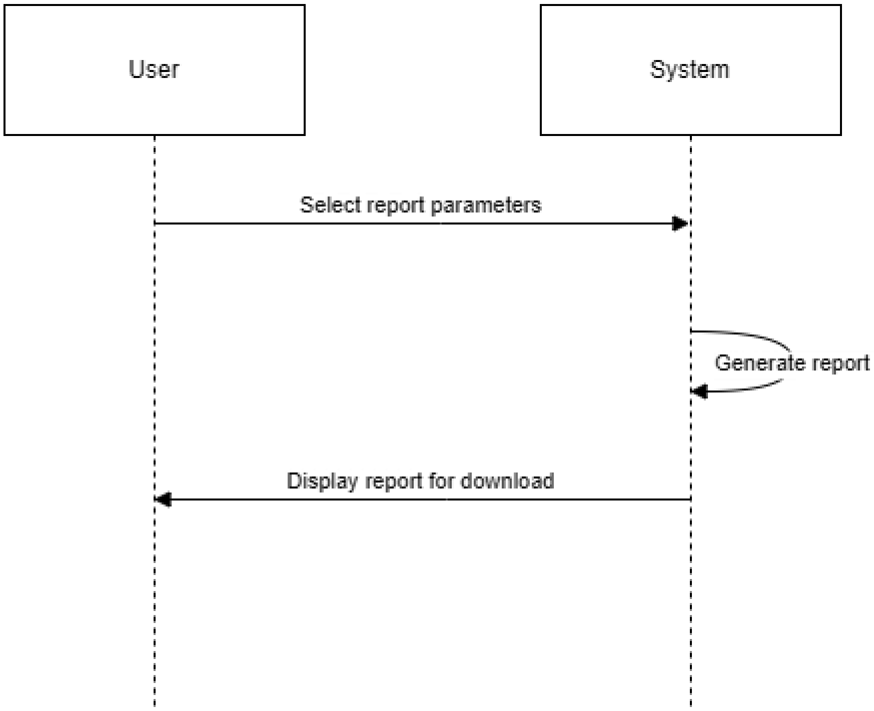
LOGIN



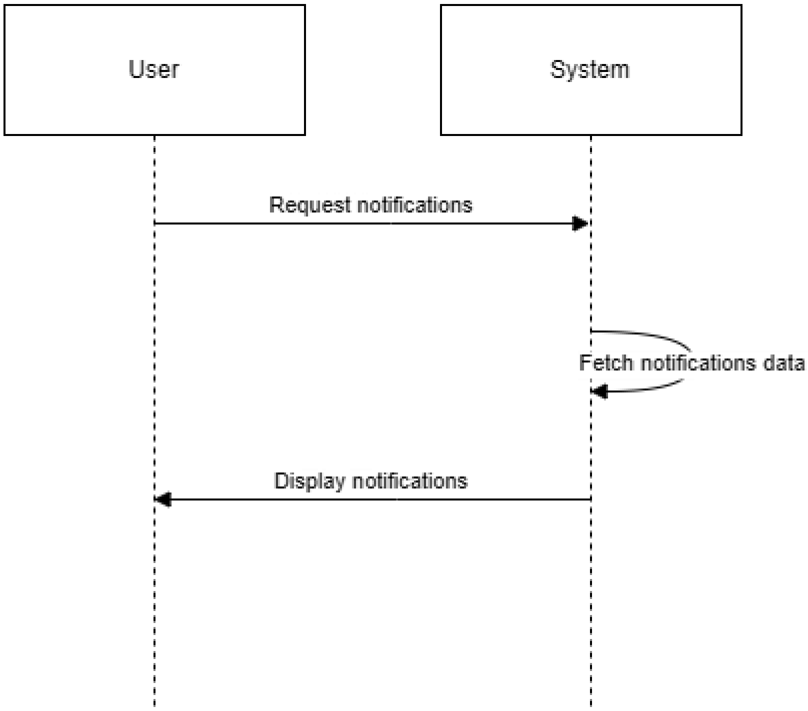
VIEW BIN STATUSES



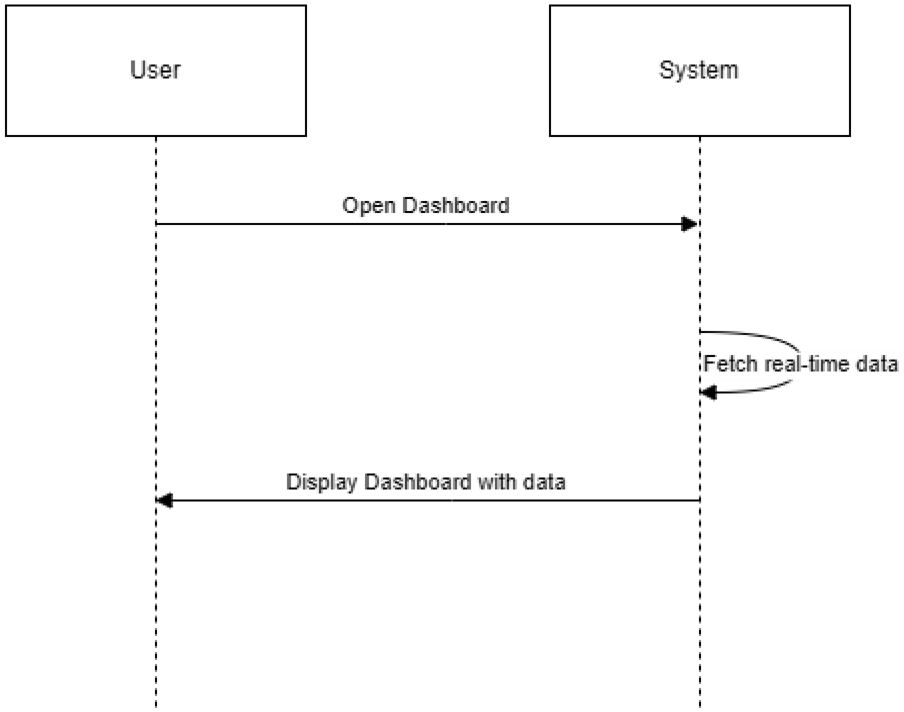
GENERATE REPORTS



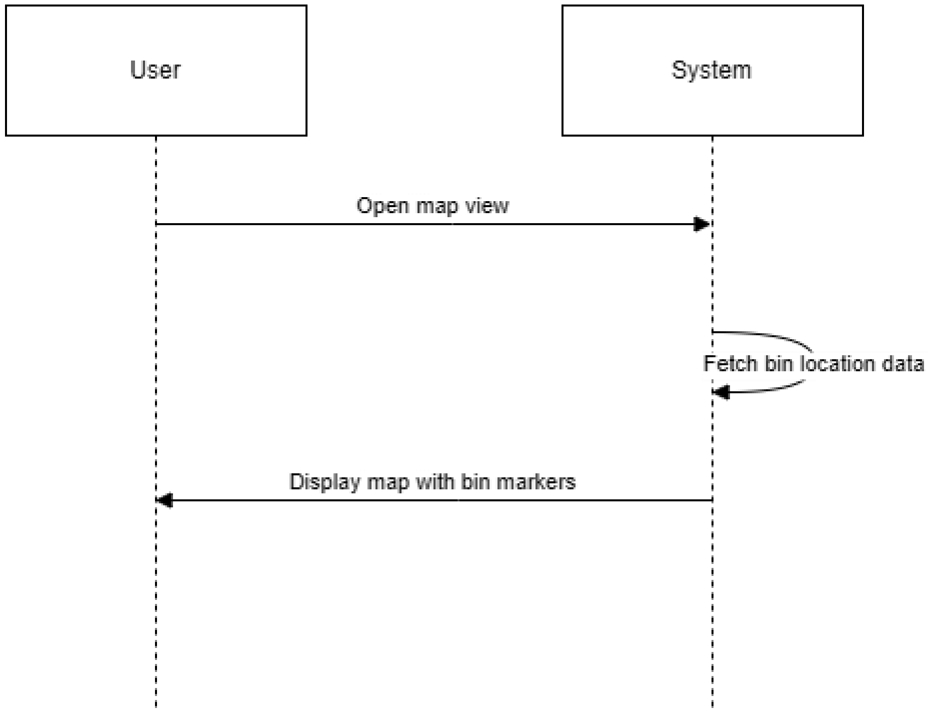
VIEW NOTIFICATIONS



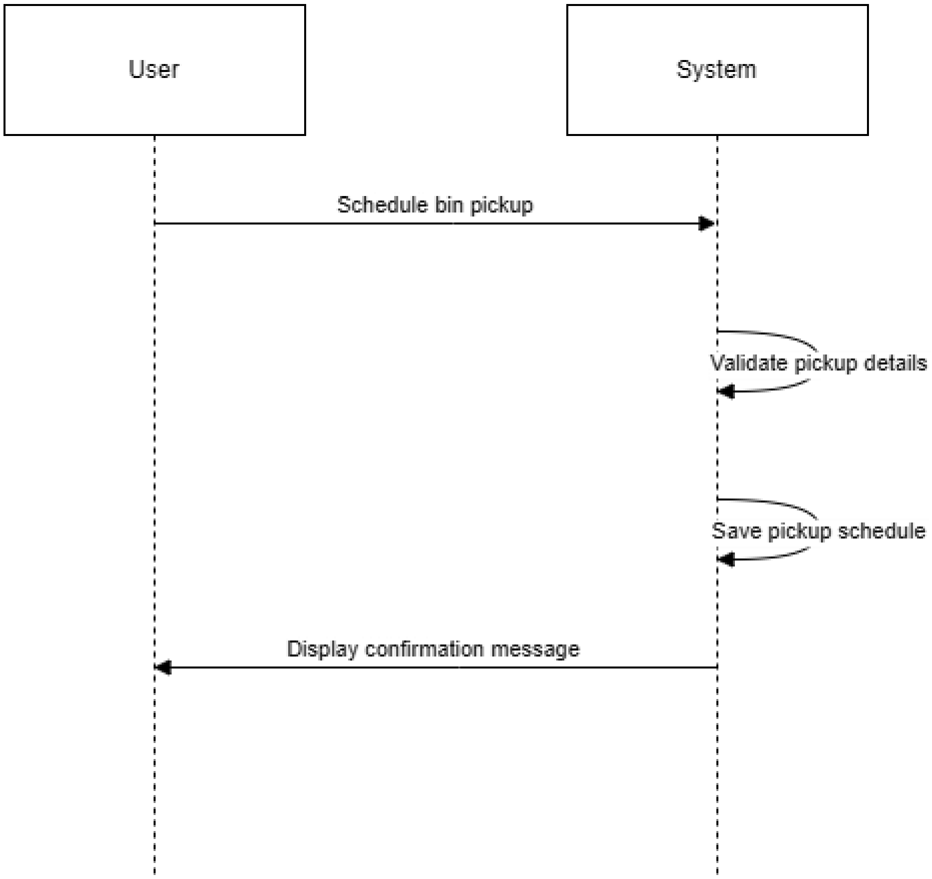
VIEW DASHBOARD



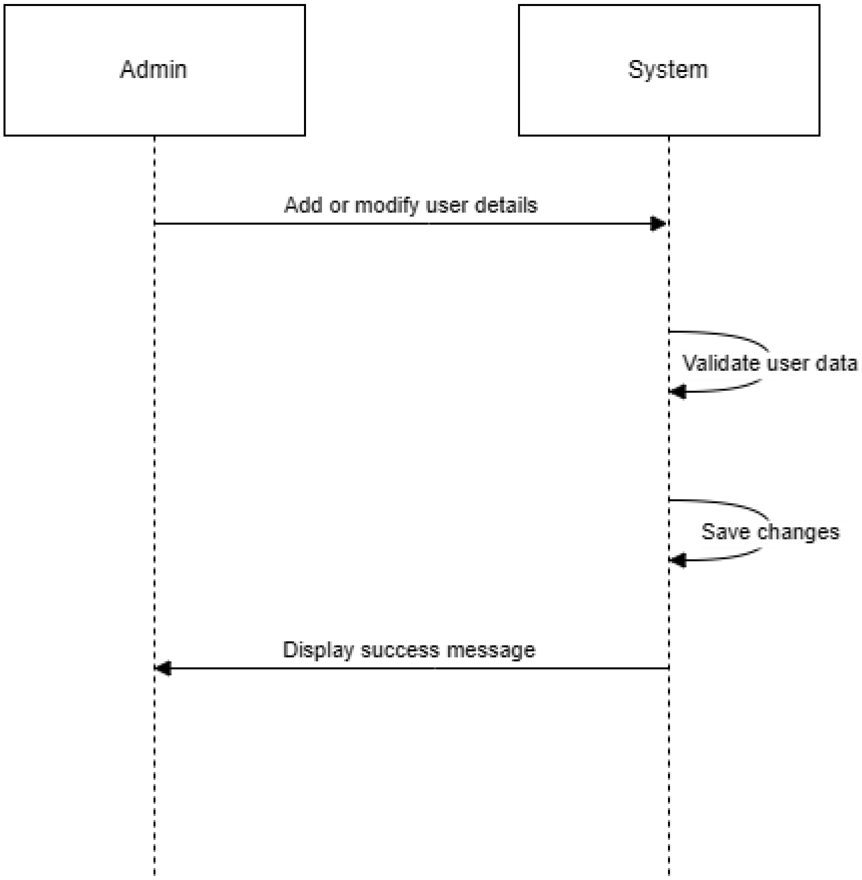
VIEW MAP OF BINS



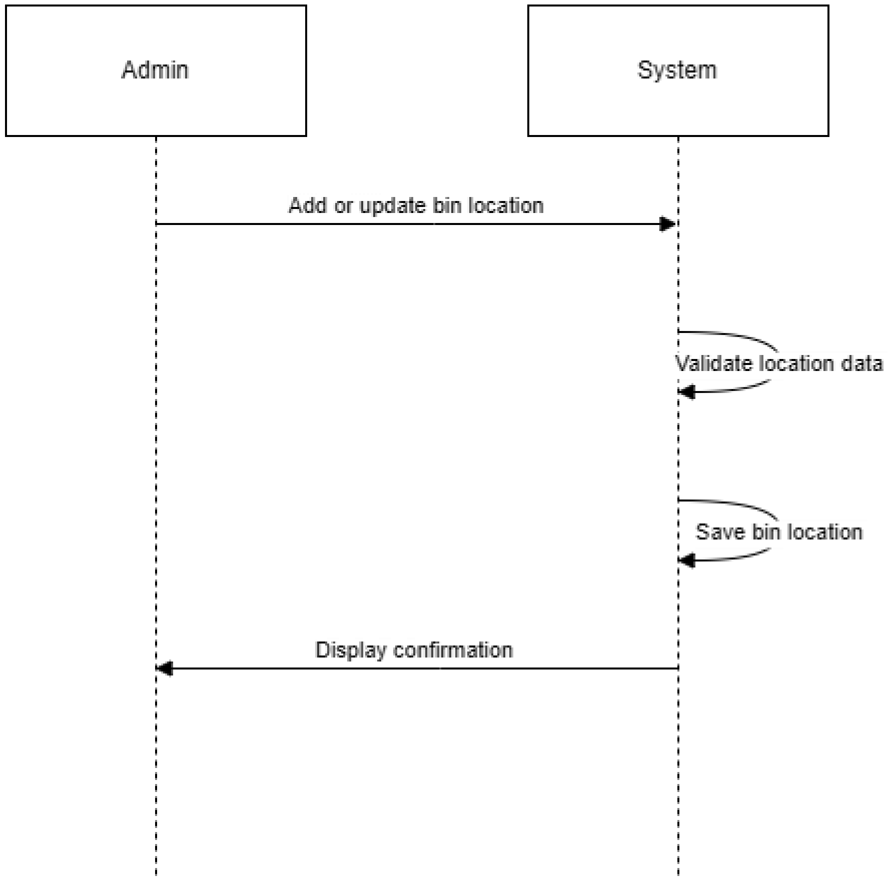
SCHEDULE BIN PICKUP



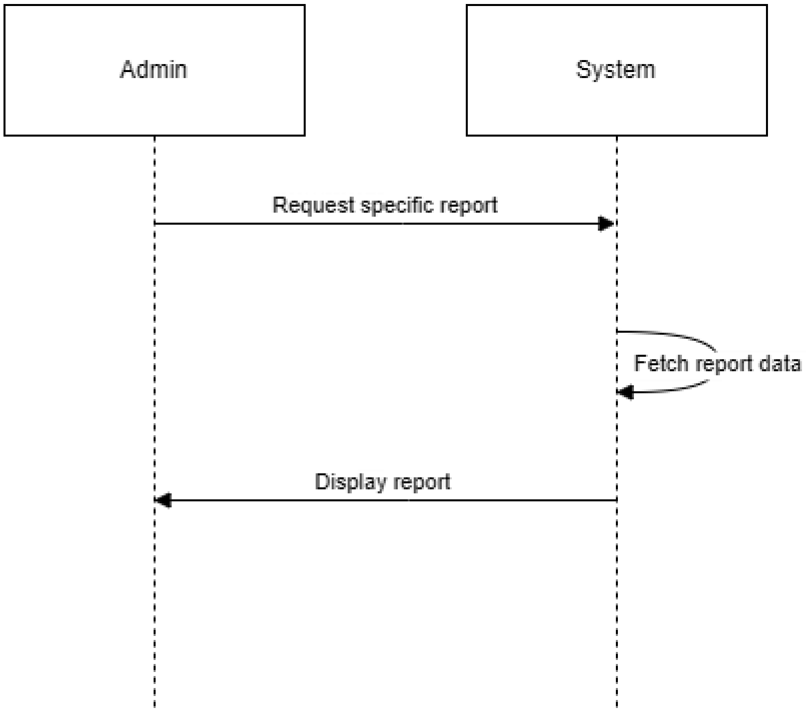
MANAGE USERS



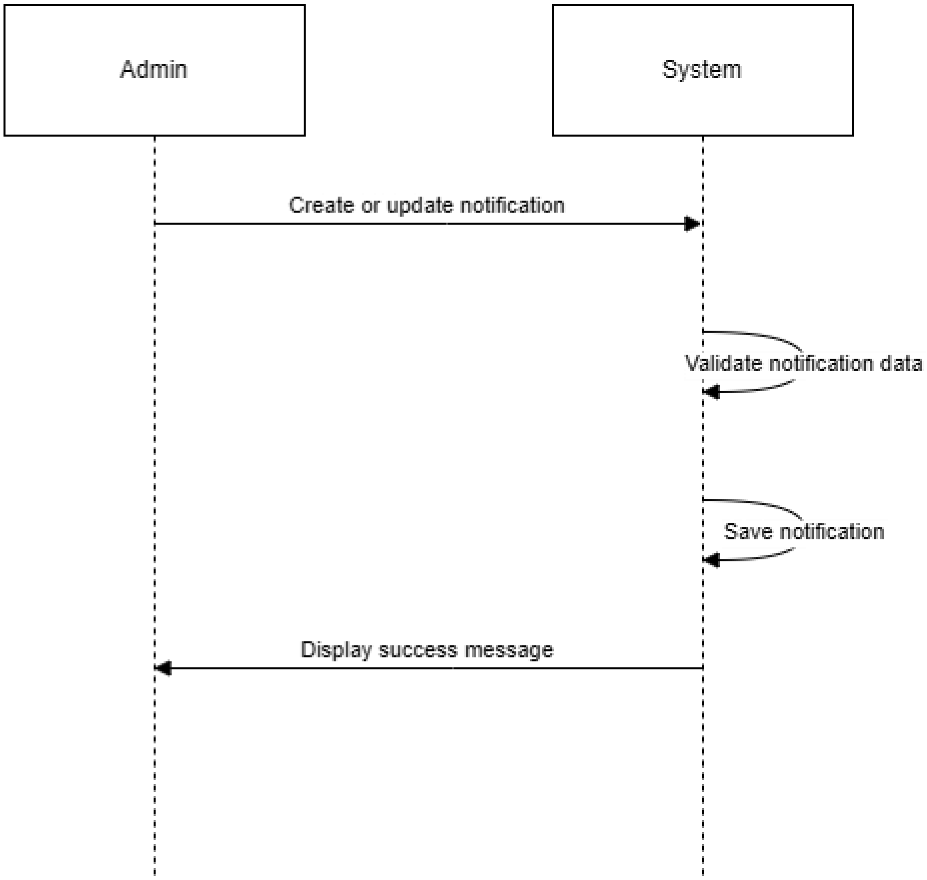
MANAGE BIN LOCATIONS



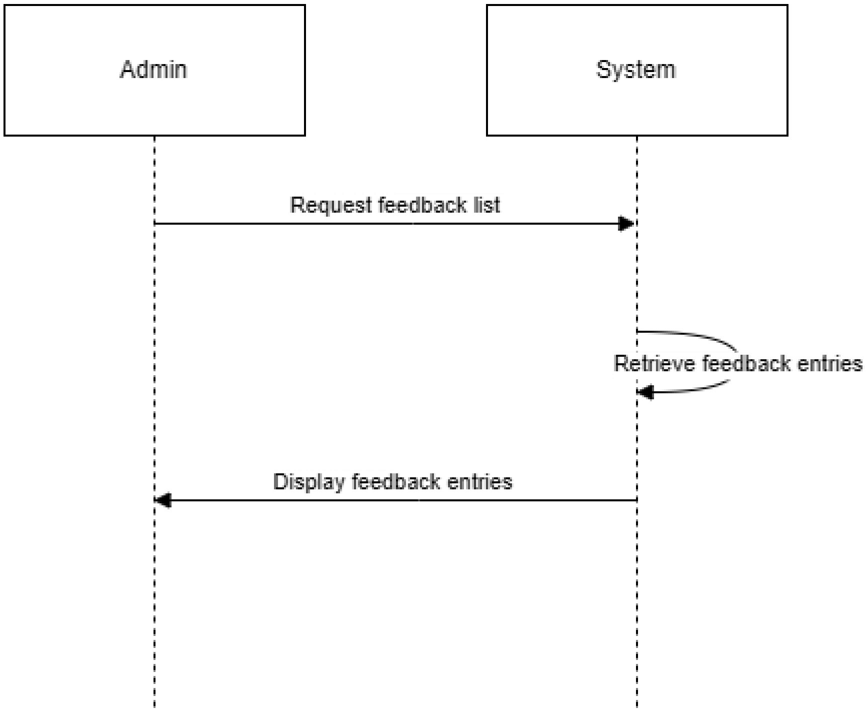
VIEW REPORTS



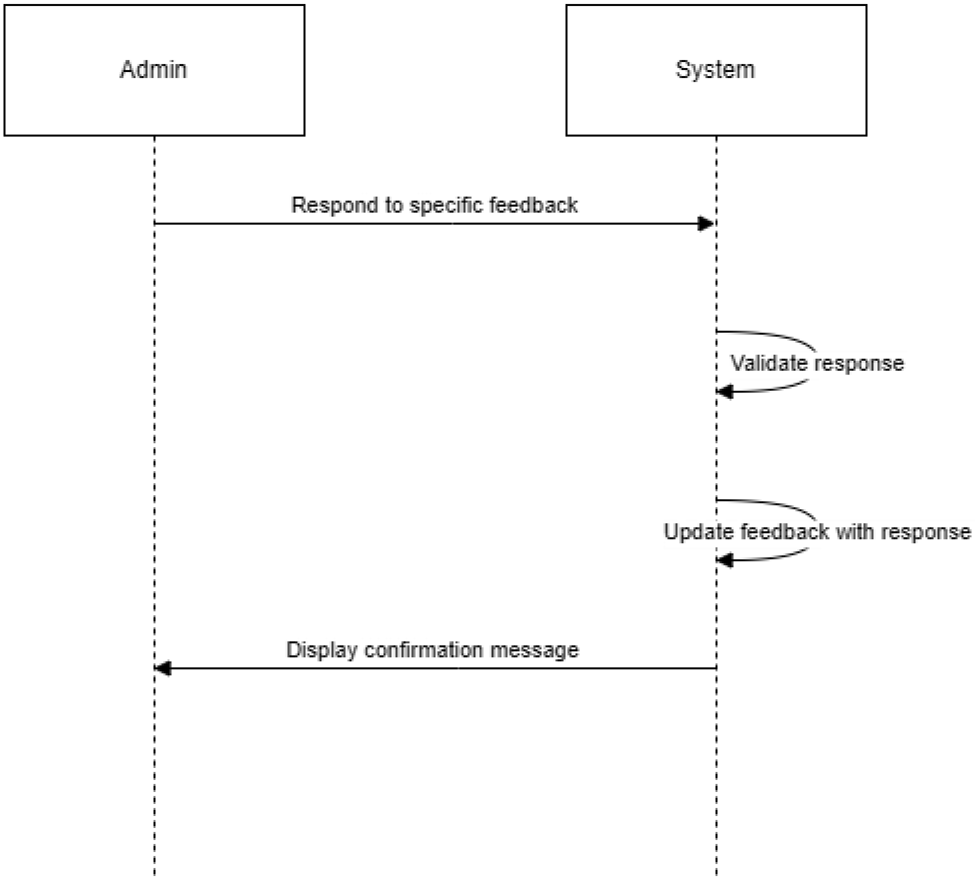
MANAGE NOTIFICATIONS



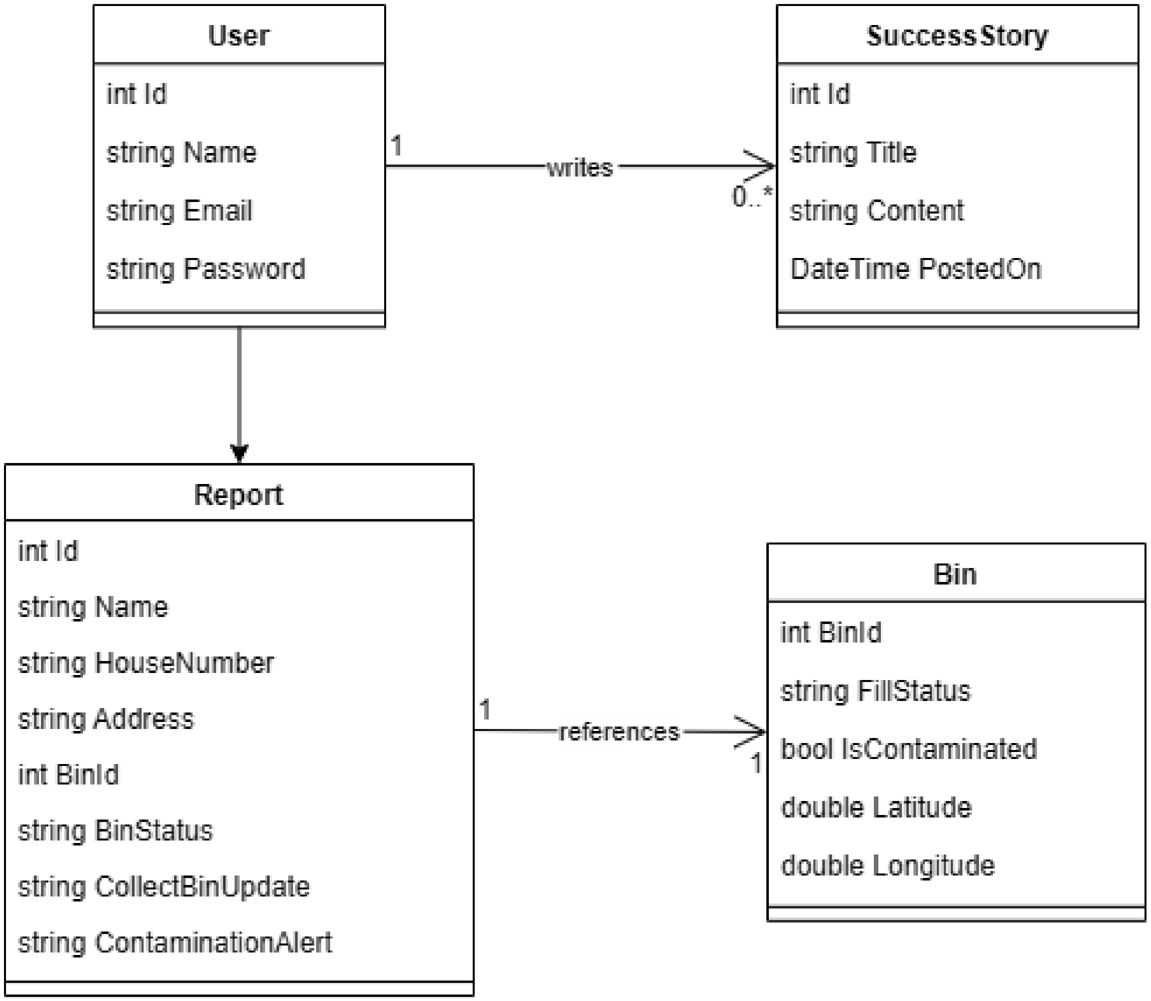
VIEW FEEDBACK



RESPOND TO FEEDBACK


Admin
System
Respond to specific feedback
Validate response
Update feedback with response
Display confirmation message

SYSTEM CLASS DIAGRAM



FUNCTIONAL TESTING REPORT

The brief Functional Testing Report of Smart Bin Monitoring System based on the Black-box test design approach of each use case is as follows. The report includes test cases to verify the functionality of each use case based on expected inputs and outputs.

Use Case	Test Case	Input	Expected Output	Result
Sign Up	Verify user sign-up with valid data	Valid name, email, password, role	Success message and redirection to login page	Pass/Fail
	Verify sign-up with invalid email format	Invalid email	Display error message ("Invalid email format")	Pass/Fail
	Verify sign-up with weak password	Password below strength requirements	Display error message ("Password too weak")	Pass/Fail

Submit Feedback	Submit feedback with valid data	Feedback text	Confirmation message displayed	Pass/Fail
	Submit feedback with empty text	No feedback text	Display error message ("Feedback text cannot be empty")	Pass/Fail
Reset Password	Reset password with valid email	Valid email	Password reset link sent to email	Pass/Fail
	Reset password with invalid email	Invalid email	Display error message ("Email not registered")	Pass/Fail
Login	Login with valid credentials	Valid username and password	Successful login and redirection to Dashboard	Pass/Fail
	Login with incorrect password	Valid username, incorrect password	Display error message ("Incorrect password")	Pass/Fail
	Login with unregistered email	Unregistered email, any password	Display error message ("User not found")	Pass/Fail
View Bin Statuses	View bin statuses	Request to view bin statuses	Bin statuses displayed with color-coded indicators	Pass/Fail
Generate Reports	Generate report with valid parameters	Location, date range, bin status filter	Report generated and displayed/downloaded	Pass/Fail
	Generate report with invalid date range	Invalid date range	Display error message ("Invalid date range")	Pass/Fail
View Notifications	View recent notifications	Request to view notifications	Notifications list displayed with recent alerts	Pass/Fail
View Dashboard	Access Dashboard	Request to access Dashboard	Dashboard loaded with real-time bin data and alerts	Pass/Fail
View Map of Bins	Access map view	Request to view map	Map displayed with color-coded bin markers	Pass/Fail
Schedule Bin Pickup	Schedule bin pickup with valid details	Bin ID, pickup date, address	Confirmation message and pickup scheduled	Pass/Fail
	Schedule pickup with invalid bin ID	Non-existing bin ID	Display error message ("Bin ID not found")	Pass/Fail
Manage Users	Add new user with valid details	Name, email, role, password	User added successfully and confirmation displayed	Pass/Fail
	Add user with invalid email	Invalid email format	Display error message ("Invalid email format")	Pass/Fail
Manage Bin Locations	Add bin location with valid details	Bin ID, location details	Confirmation message displayed	Pass/Fail
	Add bin location with missing data	Missing bin ID or location	Display error message ("All fields required")	Pass/Fail
View Reports	View specific report	Report type, date range	Selected report displayed with accurate data	Pass/Fail
Manage Notifications	Add notification with valid data	Notification message and priority	Notification saved and displayed	Pass/Fail

	Add notification with missing data	Empty notification message	Display error message ("Message cannot be empty")	Pass/Fail
View Feedback	View list of feedback	Request feedback list	Feedback entries displayed in list format	Pass/Fail
Respond to Feedback	Respond to specific feedback	Feedback ID, response text	Response saved and displayed in feedback section	Pass/Fail
	Respond with empty response text	Feedback ID, empty response	Display error message ("Response cannot be empty")	Pass/Fail

OBJECT-ORIENTED CODE REPRESENTING DESIGN ARTEFACTS IN C#

```
namespace SmartBin.Models
{
  public class User
  {
    public int Id { get; set; }
    public string Name { get; set; }
    public string Email { get; set; }
    public string Password { get; set; }
  }
}

using System.ComponentModel.DataAnnotations;

namespace SmartBin.Models
{
  public class SuccessStory
  {
    [Key]
    public int Id { get; set; }

    [Required]
    public string Title { get; set; }

    [Required]
    public string Content { get; set; }

    [Required]
    public DateTime PostedOn { get; set; }
  }
}

using System.ComponentModel.DataAnnotations;

namespace SmartBin.Models
{
  public class Report
  {
    [Key]
    public int Id { get; set; }
```

```
        [Required]
        public string Name { get; set; }

        [Required]
        public string HouseNumber { get; set; }

        [Required]
        public string Address { get; set; }

        [Required]
        public int BinId { get; set; }

        [Required]
        public string BinStatus { get; set; } // Options: "Filled", "Empty", "Partial"

        [Required]
        public string CollectBinUpdate { get; set; } // Options: "Collected" or "Not Collected"

        [Required]
        public string ContaminationAlert { get; set; } // Options: "Good", "Bad", "Normal"
    }
}

using System.ComponentModel.DataAnnotations;

namespace SmartBin.Models
{
    public class Bin
    {
        [Key]
        public int BinId { get; set; }

        [Required]
        public string FillStatus { get; set; } // Options: "Filled", "Empty", "Partial"

        [Required]
        public bool IsContaminated { get; set; } // True if contaminated, otherwise false

        [Required]
        public double Latitude { get; set; }

        [Required]
        public double Longitude { get; set; }
    }
}
```

CONCLUSION

This report seeks to outlines the overall design and testing of the Smart Bin Monitoring System; a sustainable waste management system. The design strategy included developing an extensive set of use case, sequence and class diagrams that jointly describe the system's features, the interactions between them and the objects. To check the functional requirements as well as the reliability of the system, black-box testing was performed on each of the use cases.

The ideas identified from the design and testing stage are the accuracy of information in real-time, the simplicity of the interface, and notification of the waste management system. The use of the structured interaction diagrams and test cases enabled finding problems that users may input or the system may output, as well as problems in how the system will validate and retrieve data, hence enhancing the systems' stability and usability.

It is possible to expand the application in the future by including more sophisticated data analysis for the prediction of waste disposition, the incorporation of the use of mobile application, and the use of multiple languages so that the targeted audience could easily comprehend the message. These enhancements would further enhance the system's functionality, expandability and responsiveness to environmental initiatives.