Sri Lankan Institute of Information Technology

Case Studies in Software Engineering- SE3070

Group ID	Y3S2-WE-32
Case Study Name	Case Study 02 - Smart Waste Management System for Urban Area
Campus	Malabe

Member Details

	Student Registration Number	Student Name
01	IT22292872	Wahundeniya W.M.V.S.B
02	IT22203380	J. Aaron Charles
03	IT22210692	Dissanayake D.M.S. N
04	IT22050908	Premaratne R.A.N.C

Contents

Introduction

At the moment, Sri Lanka waste management shows abundant issues due to the rapid shift towards urbanization. Traditional methods are inefficient and quite costly. This can lead to irregular garbage collection, inflexible schedules, limited resources and poor recycling patterns. The conventional methods lead to overloaded bins, wasted fuel, high operating costs, as well as negative environmental and health effects.

For this assignment, we focus on designing a **Smart Waste Management System** for Urban Cities with introduction to digital innovations such as IoT-based smart bins, GPS-tracking-enabled vehicles, and mobile applications. Smart bins provide real-time waste levels, allowing coordinators to plan route-optimized collection teams. Citizens can choose pick-up times through the mobile application, pay online, and report illegal dumping, while an equitable Pay-As-You-Throw (Envac, 2024) billing plan promotes residents to dispose of waste in a proper way.

Administrators and technicians make smooth operation possible through a centralized dashboard and maintenance notifications. As administrators manage users, compliance, and performance reports, technicians are notified of device repair and sensor alarm alerts. Together, these capabilities aim to create a more effective, cost-effective, and sustainable waste management system that assists in building greener and smarter cities in Sri Lanka.

Group Deliverables

Use Case Diagram

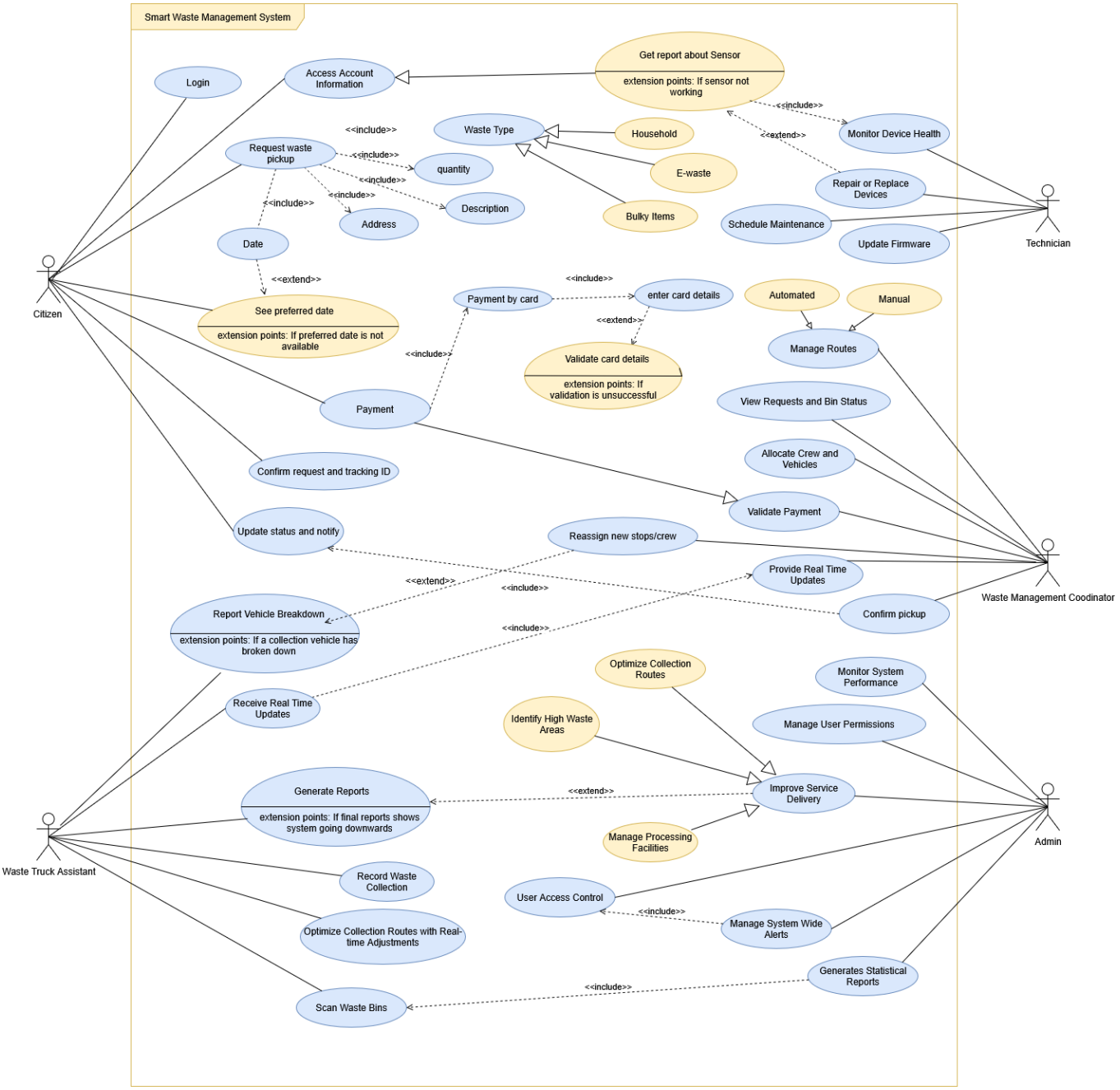


Figure 1: Use Case Diagram for the Smart Waste Management System

Class Diagram

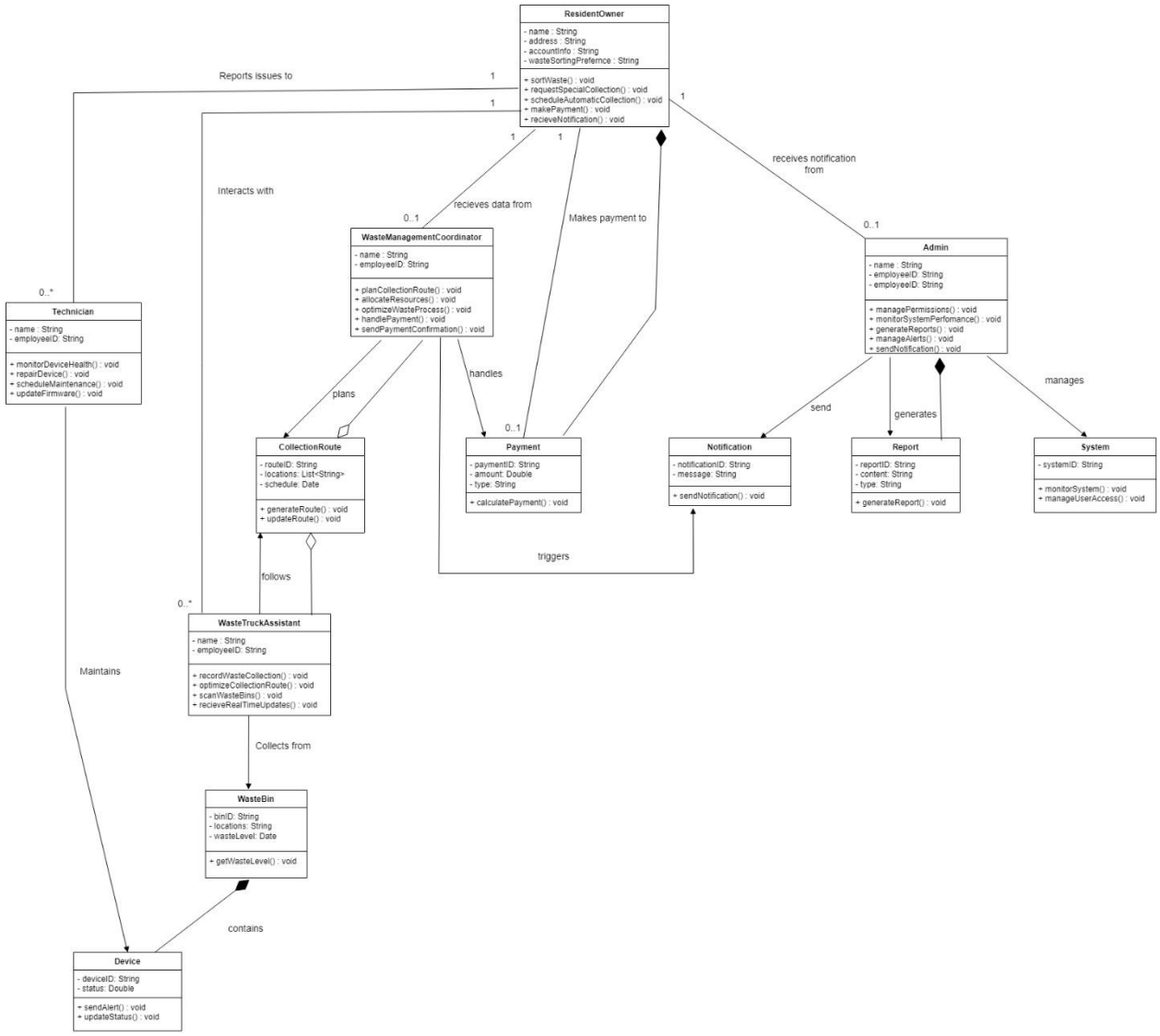


Figure 2: Class Diagram for the Smart Waste Management System

Individual Deliverables

Member 01 – IT22292872- Wahundeniya W.M.V.S.B

Use Case Scenario

Use Case Scenario	Manage Waste Collection	
Primary Actor	Coordinator	
Secondary Actor(s)	Collection Crew, System (Automation)	
Brief Description	This use case allows a Waste Management Coordinator to plan, dispatch, monitor, and confirm waste collection routes. Routes are created based on both smart bin sensor data (fill-level) and citizen-initiated special pickup requests.	
Preconditions	**1**	The coordinator is logged to the system.
	2	Data sources (Smart bin sensors, citizen request queues) are available.
Postconditions	**1**	A collection route is created, updated, and/or assigned to a crew.
	2	The assigned crew receives the updated route details
	3	The system records the completion status of the collection.
	4	Citizen request statuses are updated (e.g., from "Pending" to "Scheduled" to "Completed").
Main Flow	**1**	The coordinator opens the Route Management Dashboard.
	2	System displays: ▪ A map with bins color coded according to their fill level. ▪ A list of “Special Pickup requests” from citizens
	3	The coordinator selects the option to “Generate Optimized Route”
	4	The system considers the parameters “Include bins filled over 90% and include all pending special requests”
	5	The coordinator confirms the parameters.
	6	The system generates an optimized route that efficiently meets scheduled stops
	7	The coordinator reviews the suggested route.
	8	The coordinator assigns the generated route to an available Collection Crew
	9	The system: ▪ Sends the route to the crew's in-truck device. ▪ Updates the status of all included citizen requests to "Scheduled." ▪ Notifies the citizens that their pickup is scheduled.
	10	The crew follows the route and scan for the bins.
	11	The system provides audio/visual confirmation for each scan and updates the bin/request status in real-time.
	12	After the crew confirms route completion, the system updates all statuses to "Completed" and notifies the relevant citizens.
Alternative Flows	**AF1 – Citizen Requests Review**	
	3a	The coordinator rejects the request, providing a reason.
	3b	The coordinator sees a request for a prohibited waste type (e.g., hazardous material).
	3c	The system notifies the citizen of the rejection. The request is not included in routing.
	AF2 – Manual Route Adjustment (Create route manually instead of automating).	
Exception Flows	**EF2 – Vehicle Breakdown**	
	10a	A collection vehicle breaks down during the route.
	10b	The crew selects "Report Breakdown" on their in-truck device.
	10c	The system alerts the coordinator, providing the vehicle's GPS location and crew details.
	10d	The system displays all uncollected stops from the broken-down route.
	10e	The coordinator selects one or more nearby crews to reassign the stops to.
	10f	The system calculates the optimal way to add the new stops to the selected crews' existing routes and dispatches the updates.

Sequential Diagram

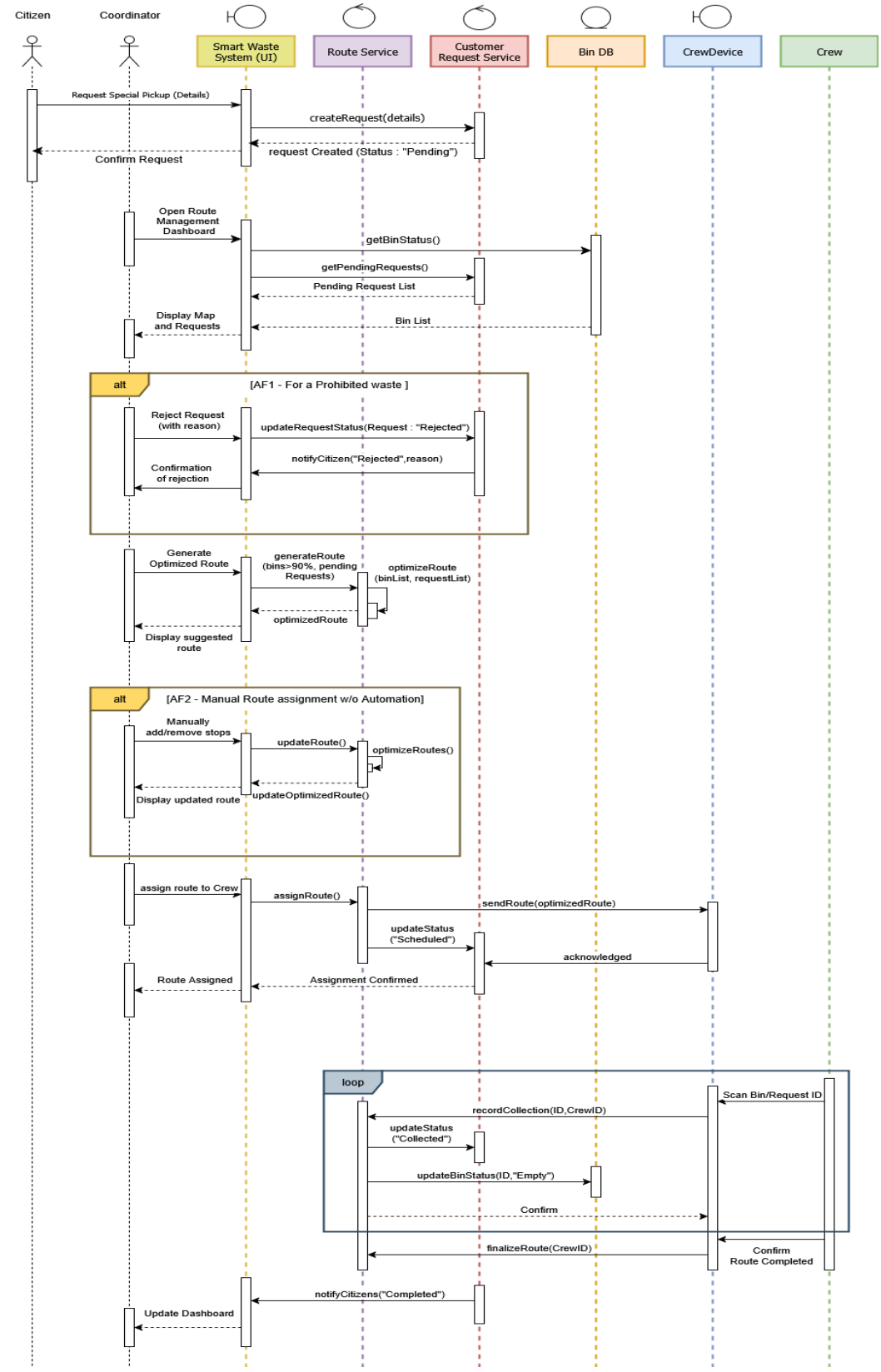


Figure 3: Sequence Diagram for Waste Collection Management

Storyboard

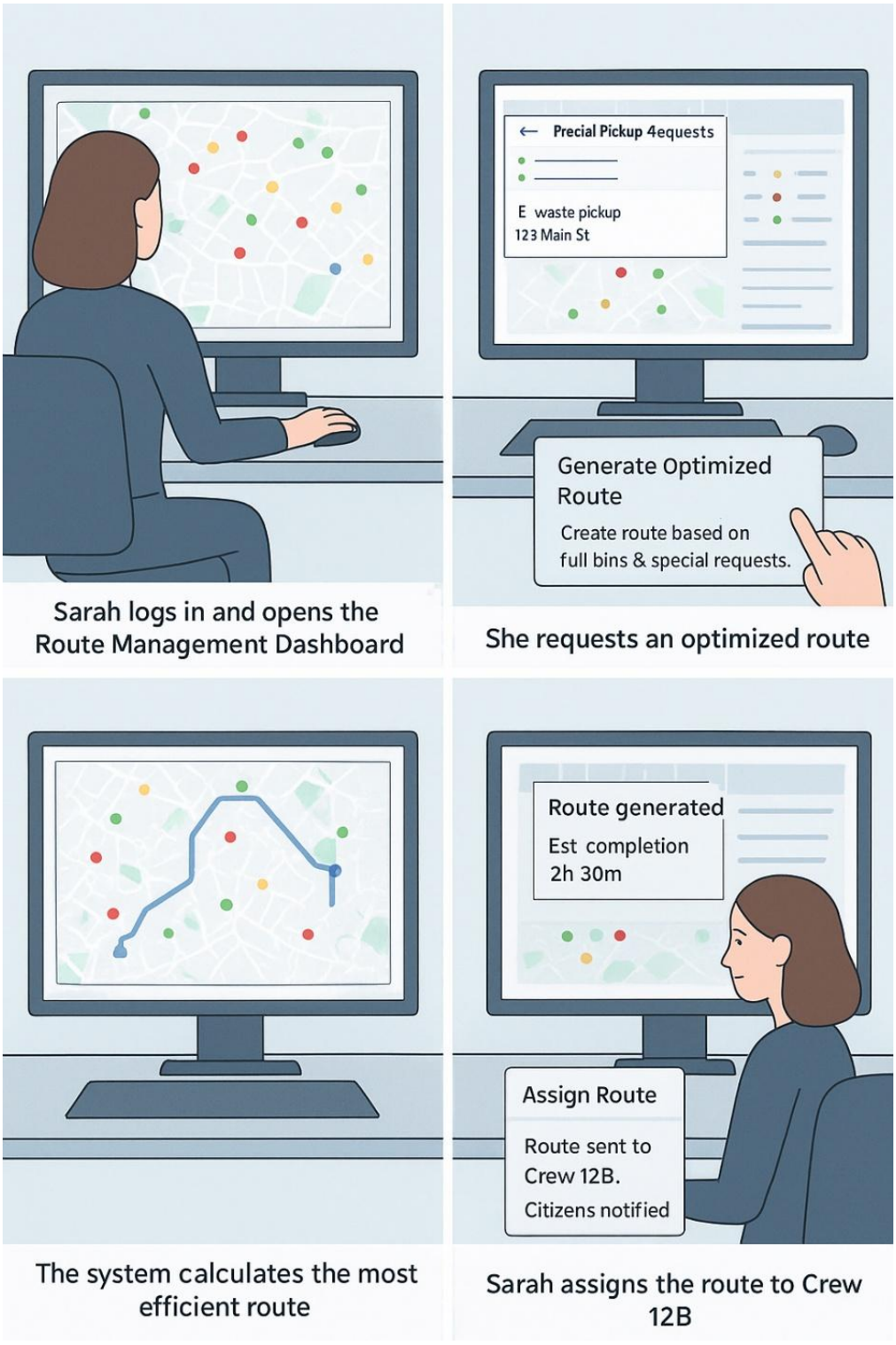


Figure 4: Storyboard for Waste Collection Management

Low Fidelity Design

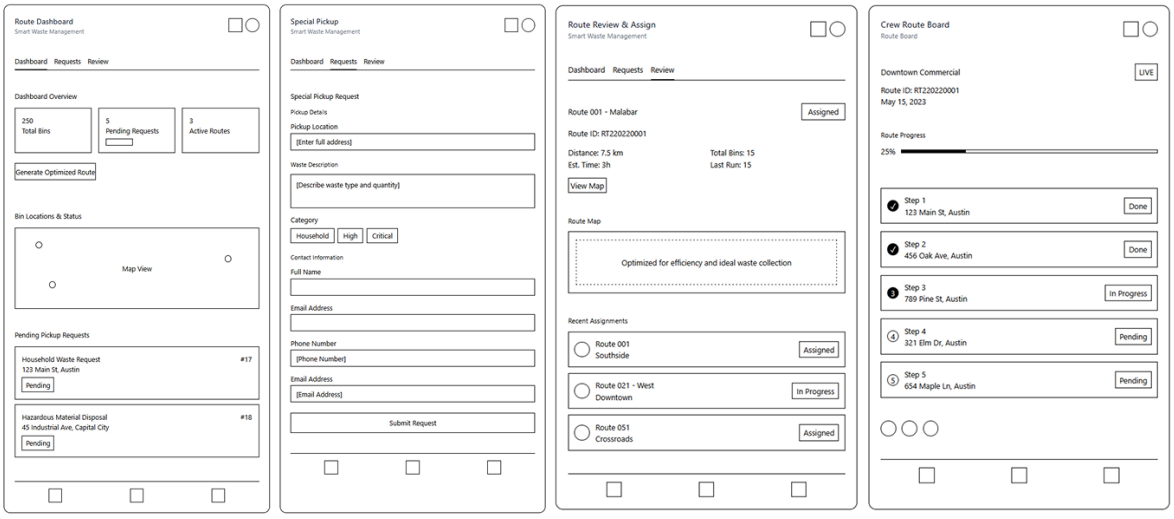


Figure 5: Low Fidelity Wireframes for Waste Collection Management

High Fidelity Wireframe

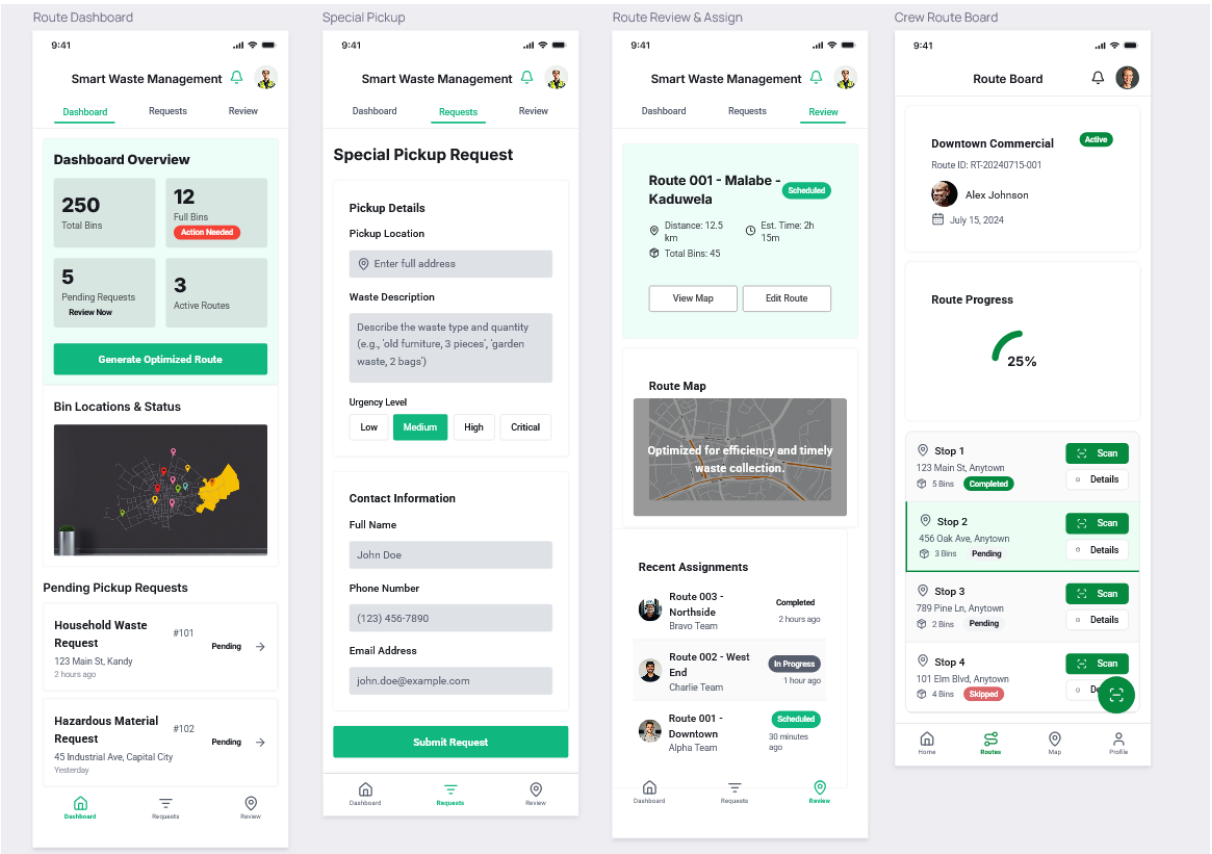


Figure 6: High Fidelity Wireframes for Waste Collection Management

Member 2 – IT22203380- J. Aaron Charles

Use case Scenario

Number	02	
Name	System Administration	
Primary Actor(s)	Admin	
Secondary Actor(s)	Security Service, User Management, Billing Service, Database	
Priority	4	
Preconditions	• Admin is logged in with highest privileges. • System services (Authentication, User Management, Billing, Privacy) are active.	
Postconditions	• User access roles are updated correctly. • System reports and billing data are collected and stored. • Privacy settings are enforced and saved successfully.	
Trigger	Admin performs routine system administration tasks (login, role management, reporting, privacy updates).	
Main Scenario	**Step**	**Action**
	1.	Admin submits login credentials to the Admin UI.
	2.	Admin UI forwards credentials to Security Service → credentials are verified against the Database.
	3.	If valid, Admin UI confirms successful login.
	4.	Admin selects “Manage Users”; for each user, Admin updates roles/permissions.

	5.	Admin requests reports.
	6	Admin updates privacy configurations (encryption, anonymization rules).
Extensions	**Step**	**Action**
	2a.	**Invalid Credentials:** Authentication fails → Admin is denied access.
	2b	**Unauthorized Attempts (neg):** If multiple failed logins occur, system locks account.
	4a.	**User Role Update Fails:** System sends error → Admin retries or escalates.
	5a.	**Missing Data Source:** If reports cannot fetch logs, Admin UI shows a partial report.
	6a	**Privacy Update Error:** If saving privacy config fails, system reverts to last stable configuration.
Open Issues	1.	Handling **synchronization delays** when reports fetch data in parallel.
	2.	Ensuring **privacy settings compliance** with local data laws.

Sequence Diagram

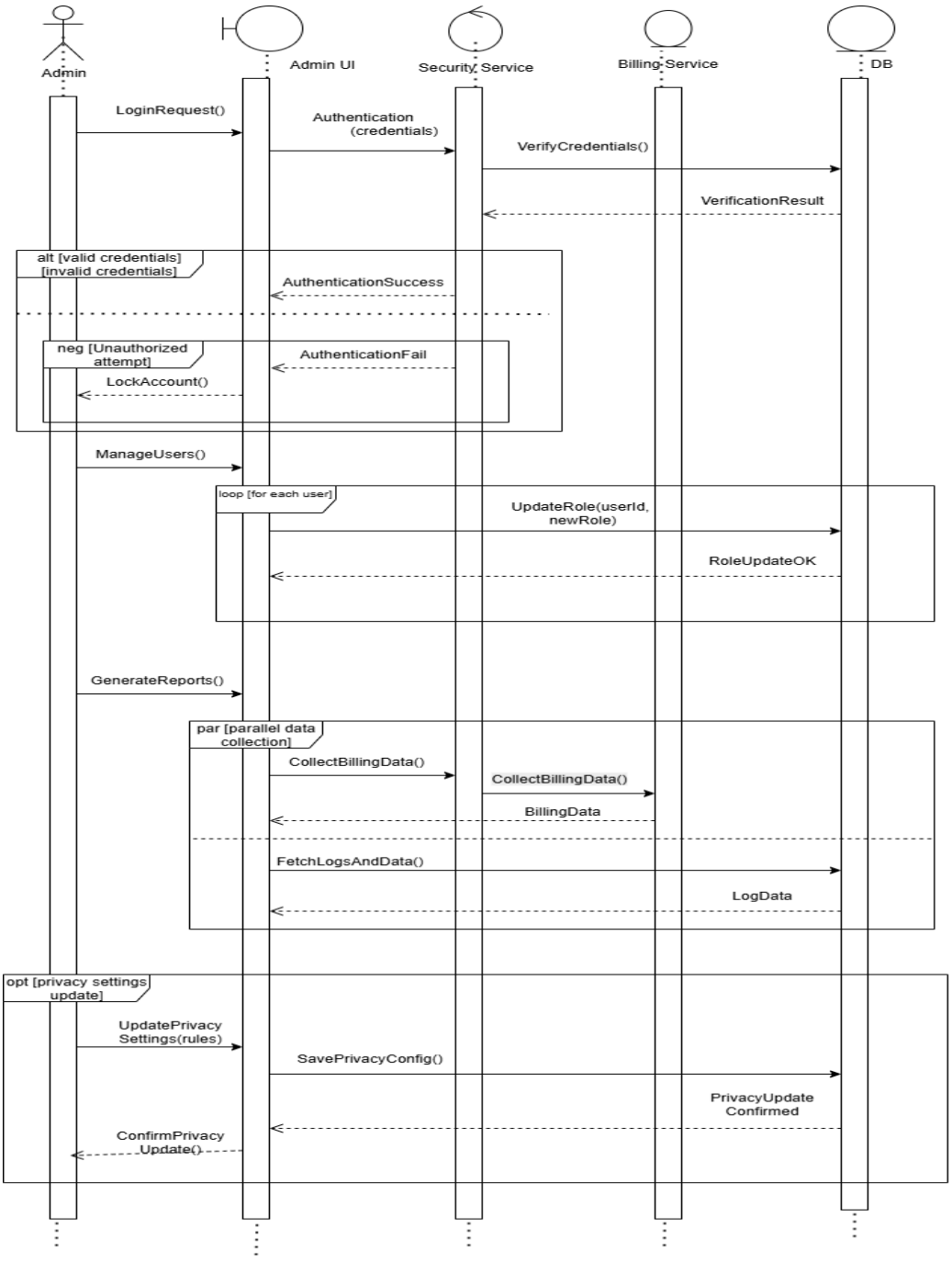


Figure 7: Sequence Diagram for System Administration

Storyboard

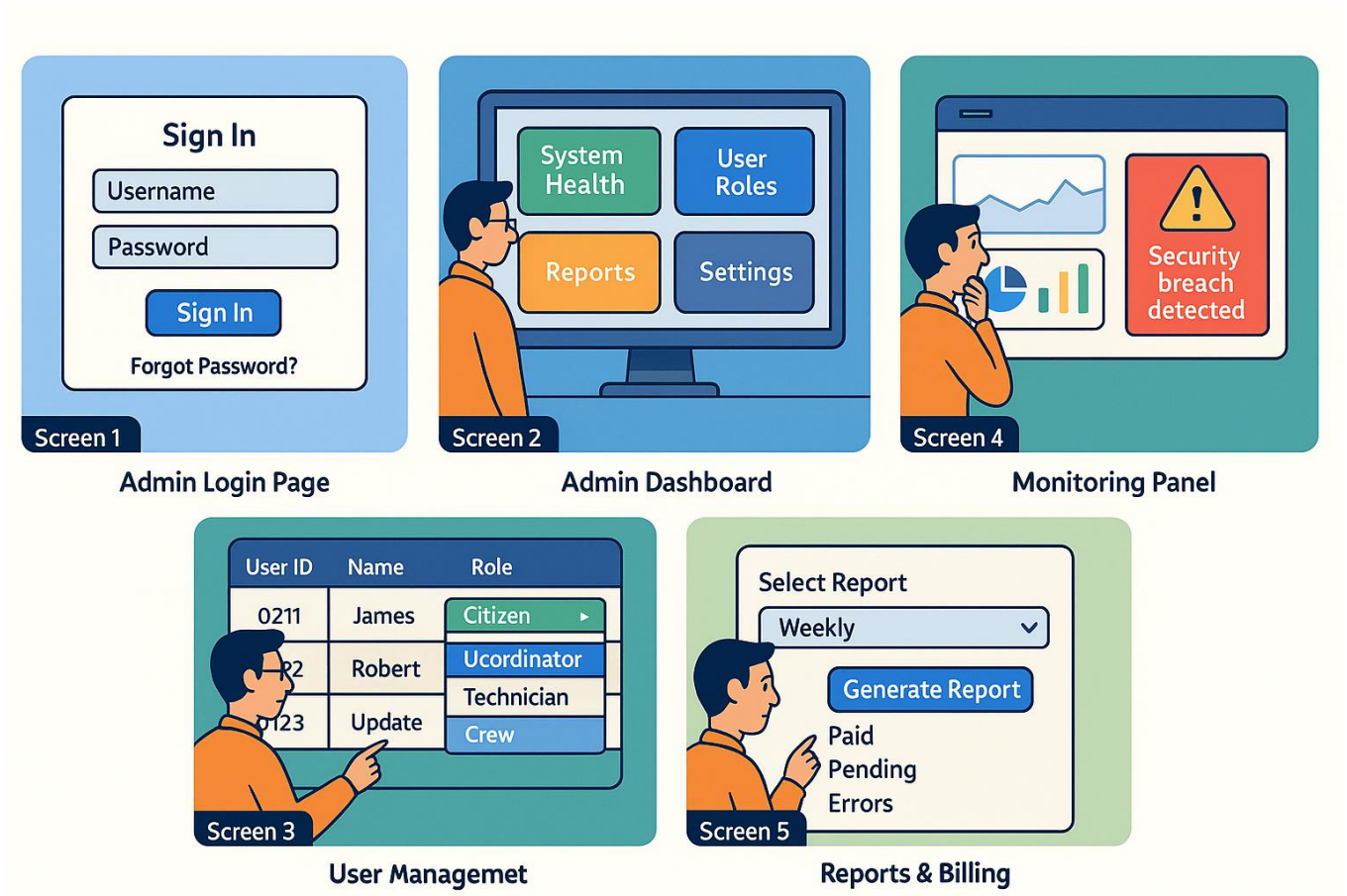


Figure 8: Storyboard for System Administration

Low fidelity Design

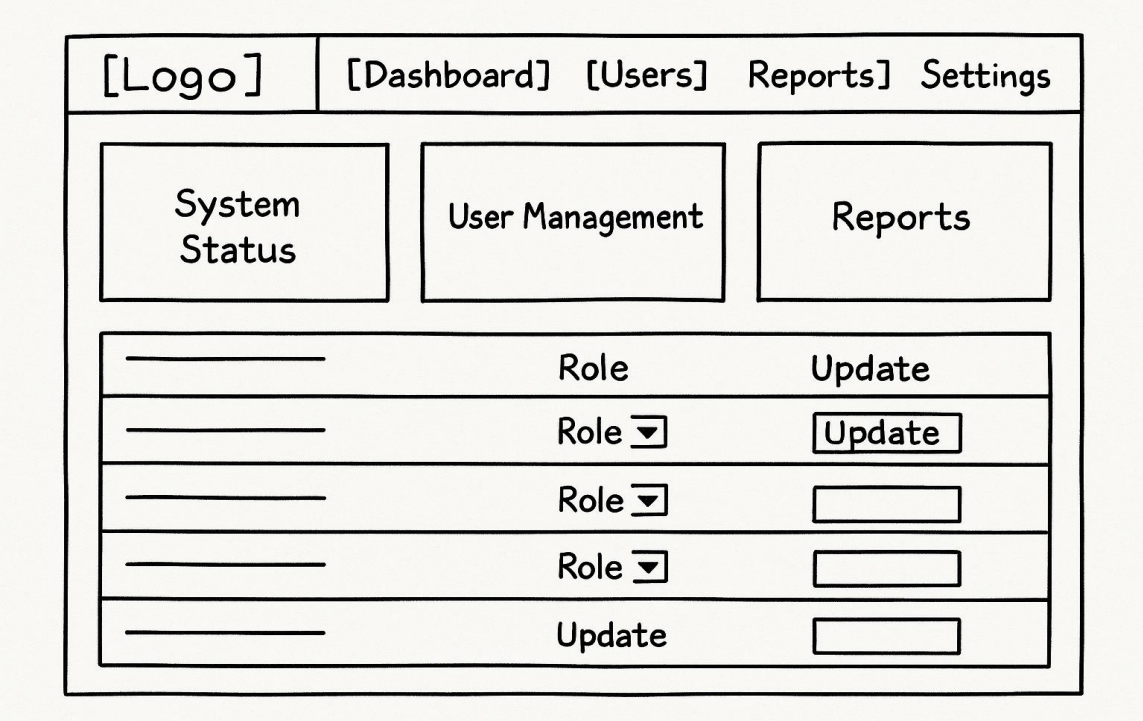


Figure 9: Low Fidelity Wireframe for System Administration

High fidelity Design

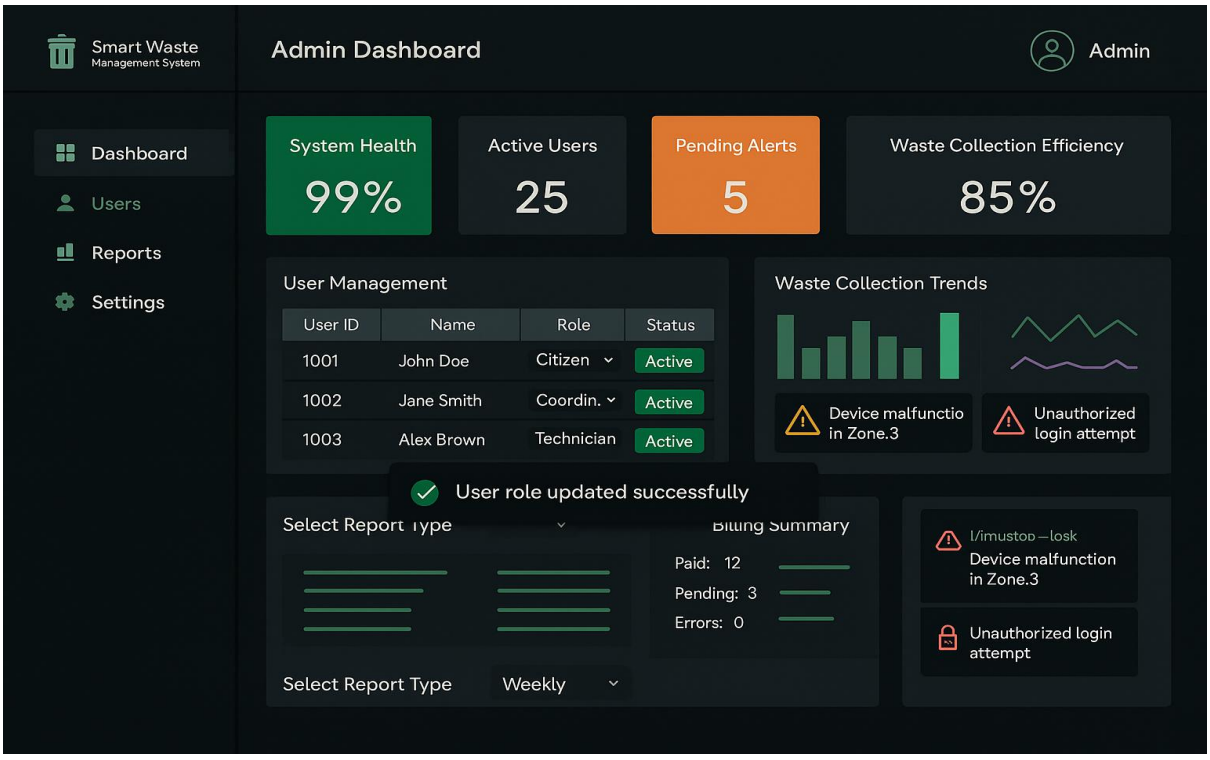


Figure 10: High Fidelity Wireframe for System Administration

Member 3 – IT22210692 – Dissanayake D.M.S.N

Use case Scenario

Number	03	
Name	Citizen Waste Management	
Summary	To request and track waste collection services easily	
Priority	4	
Preconditions	The citizen will get registered and logged into the system	
Postconditions	1. Waste is collected successfully, and the citizen is informed. 2. The citizen can view the request using the tracking ID. 3. Payment record is updated.	
Primary Actor	Citizen (Resident)	
Secondary Actor(s)	Admin, Waste Management Coordinator	
Trigger	The citizen logs into the system to manage their waste.	
Main Scenario	**Step**	**Action**
	1.	The citizen opens the Smart waste management system.
	2.	He/She selects “Request Waste Pickup.”
	3.	System displays a form to enter waste for entering details like (waste type (Household, E-waste, and Bulky Item), quantity, address, preferred date, and description).
	4.	Citizen fills in the details and submits the request.

	5.	The system confirms the request and provides a tracking ID.
	6.	The system checks if payment is required (Bulky items, e-waste, or additional pickups) • If payment is required, system shows the calculated amount. • Citizen confirms the payment. • System confirms the paid amount. • If no payment is required, the request continues directly.
	7.	System confirms the pickup request.
	8.	On the scheduled date, the collection crew scans the bin/device and completes the pickup.
	9.	The system updates the status as “Completed” and notifies the citizen
Extensions	**Step**	**Action**
	3a.	If details are incomplete, the system asks the citizen to re-enter them again.
	3b.	If waste cannot be collected on the chosen date, the system suggests another date.
	6a.	If the payment details are not valid, system asks to re-enter the card details again.

Sequential Diagram

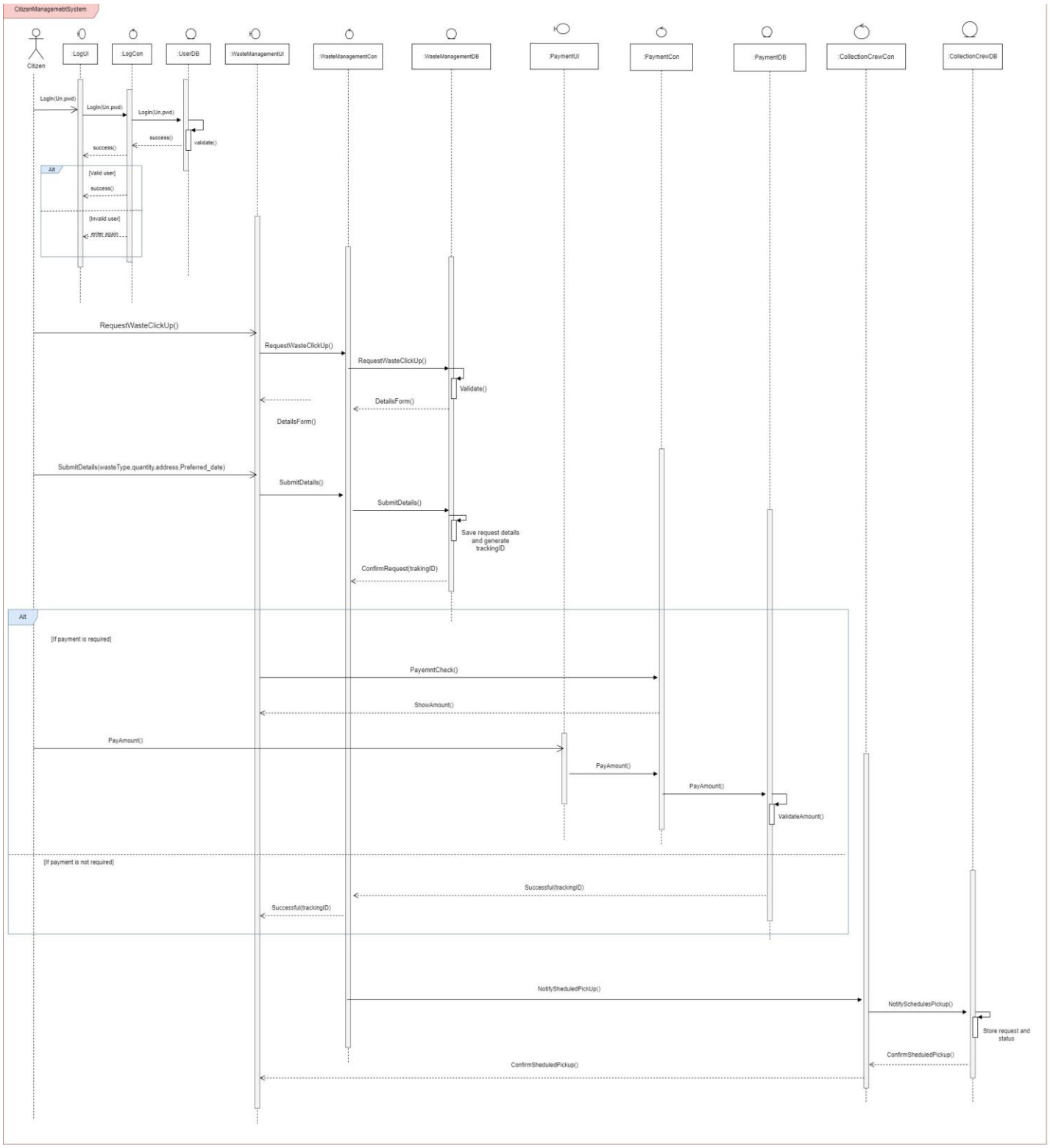


Figure 11: Sequence Diagram for Citizen Waste Management

Storyboard

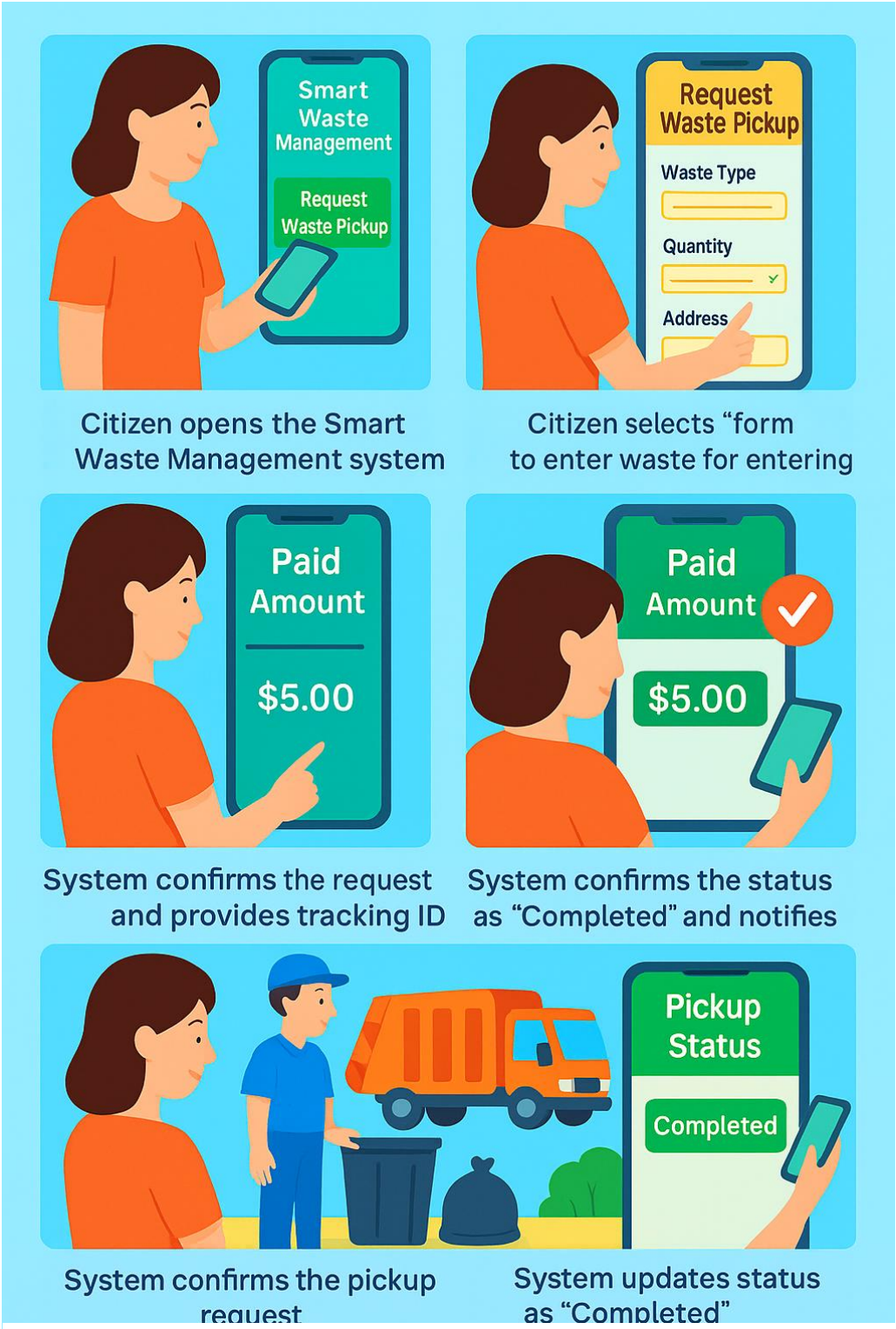


Figure 12: Storyboard for Citizen Waste Management

Low fidelity Design

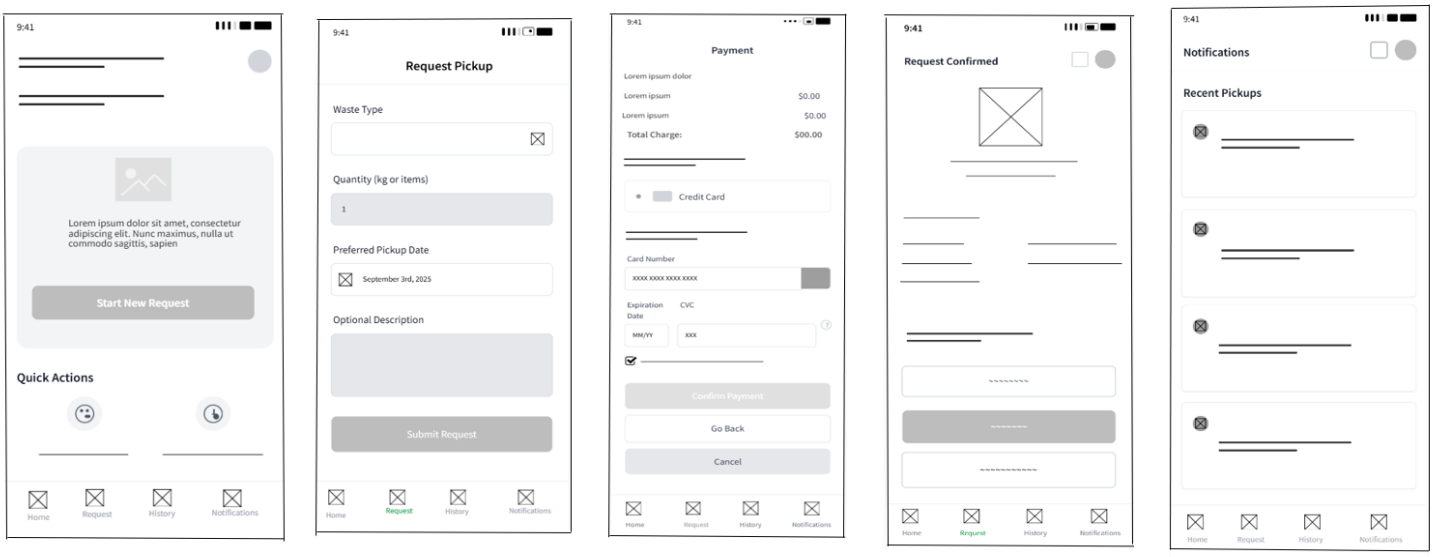


Figure 13: Low Fidelity Wireframe for Citizen Waste Management

High Fidelity Design

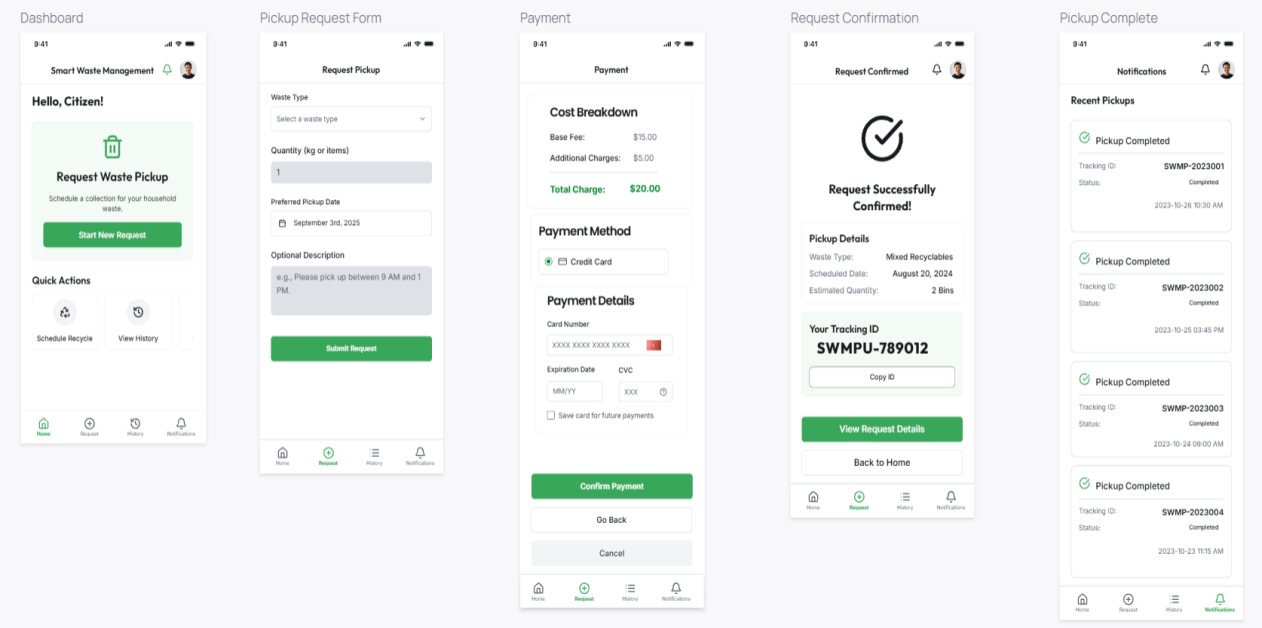


Figure 14: High Fidelity Diagram for Citizen Waste Management

Member 04 – IT22050908- Premaratne R.A.N.C.

Use case Scenario

Use Case Scenario	Repair or Replace Device	
Primary Actor	Technician	
Secondary Actor(s)	System (Automation)	
Description	This use case describes the process a technician follows to record the resolution of a faulty waste bin tracking device (e.g., RFID tag, sensor) in the system.	
Preconditions	• The Technician is successfully authenticated and logged into the system. • The faulty device already exists in the system and has a status of OFFLINE • The Technician has the physical device and any replacement parts.	
Postconditions	• The device's status in the system is updated to ACTIVE. • If the device has been replaced, the new device is registered and connected to the correct bin, and the old device is decommissioned. • A permanent record of the repair action, including time stamp and technician notes, is added to the device's history log.	
Main Flow	**Step**	**Action**
	1	Technician navigates their "Work Orders" dashboard.
	2	System displays a list of active work orders, sorted by priority and date.
	3	Technician selects the work order for the device they have physically repaired or replaced.

	4	System displays a detailed work order view, showing device information (ID, location, error logs) and available actions.
	5	Technician selects the "Resolve Work Order" button.
	6	System presents a resolution form, requiring: • Action Taken: A choice between 'Repaired' or 'Replaced'. • New Status: To be set to ACTIVE. • Notes: A mandatory field for describing the work performed. • New Device ID: (If 'Replaced' is selected) A field to scan or enter the ID of the new device.
	7	Technician selects 'Repaired', enters notes (e.g., "Resoldered power connection"), and submits the form.
	8	System validates the inputs, saves the changes, updates the device status to ACTIVE, logs the resolution notes, and closes the work order.
	9	System displays a confirmation message: "Work Order #12345 resolved successfully."
Alternative Flows	**Step**	**Alternative Action**
	6a	Device was Replaced: • Technician selects 'Replaced' from the "Action Taken" dropdown. • System reveals the "New Device ID" field and activates the device scanner. • Technician scans the barcode/RFID of the new physical device.

		• System auto-populates the "New Device ID" field and links the new device to the original bin. • System automatically changes the status of the old device to DECOMMISSIONED.
Exception Flows	**Step**	**Branching Action**
	6a	New Device ID Already in Use: • If the new device ID scanned is already registered to another bin, the system displays an error: "Error: Device ID [ID] is already assigned to [Address]. Please scan another device." • The technician returns to the use case resolution form so that he can scan another device.
	6b	Technician Cannot Complete Repair: • If a problem cannot be resolved on-site, the technician chooses "Escalate" instead of "Resolve", causing the work order status to change to PENDING REVIEW, without altering the device status.
	7a	Network Failure: • The mobile app saves data offline if the system fails to submit a form due to connectivity loss, displaying a message indicating synchronization once connectivity is restored. A message is displayed: "Resolution saved offline and will be submitted when connected."

Sequence Diagram

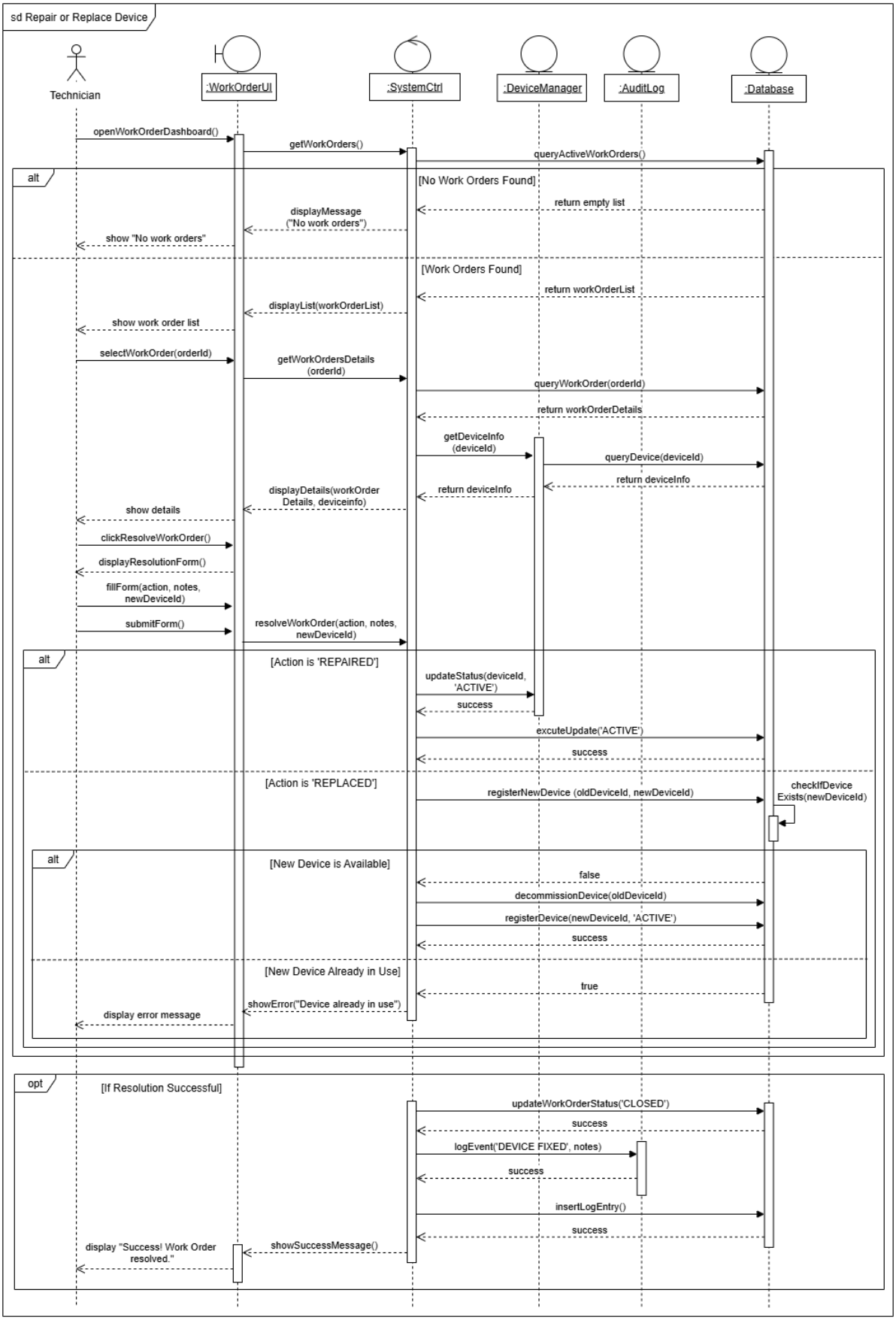
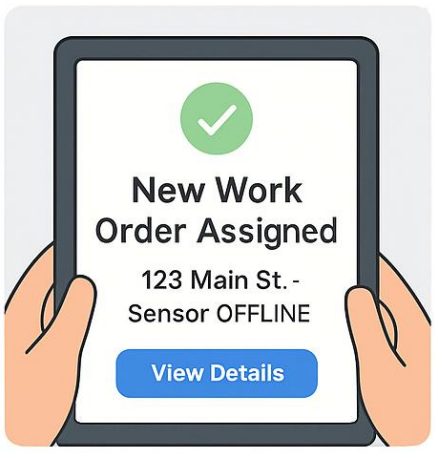
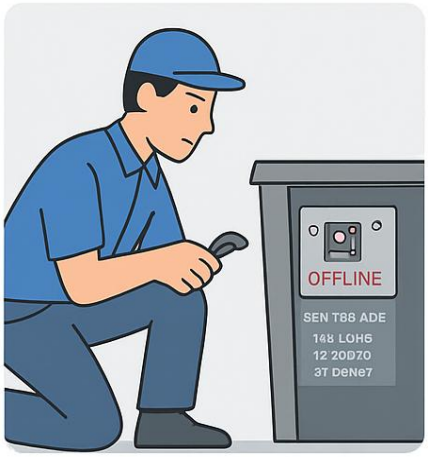


Figure 15: Sequence Diagram for Repair or Replace Device

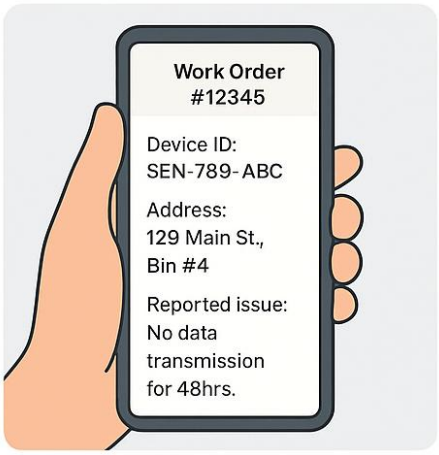
Storyboard



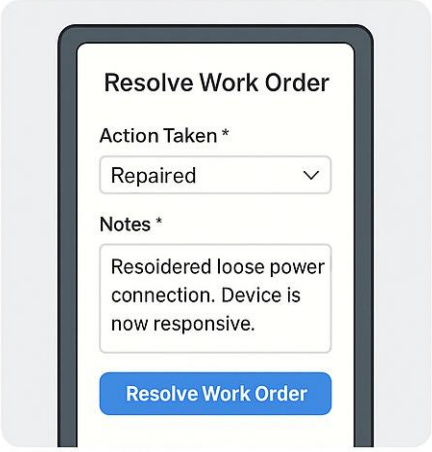
Alex, the technician, receives a push notification about a faulty sensor at 123 Main St. He taps **View Details** to open the job.



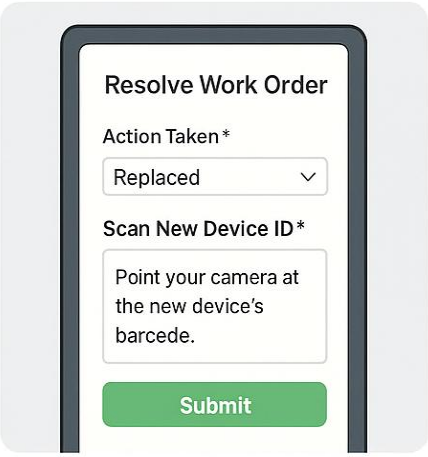
Alex arrives on-site, locates the sensor, and confirms it is unresponsive with no lights — matching the "OFFLINE" status in the work order.



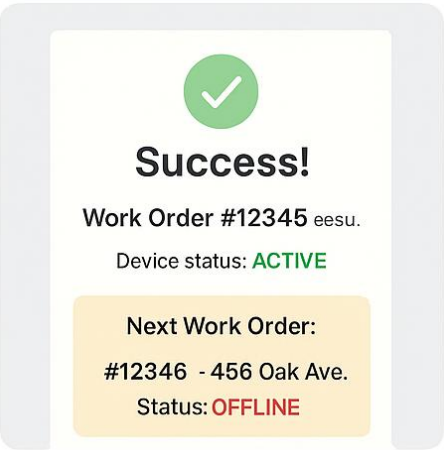
Alex verifies the device ID, address, and error logs in the app. Once confirmed, he taps **Resolve Work Order** to start documenting the solution.



Alex finds a loose wire, fixes it, and the sensor powers on. In the app, he selects **Repaired** and documents the fix before submitting.



If the sensor were beyond repair, Alex would select **Replaced**. The app prompts him to scan the barcode of the new sensor, so the system updates record automatically.



The system confirms the work order is resolved, updates the device status to **ACTIVE**, and assigns Alex his next task automatically.

Figure 16: Storyboard for Repair or Replace Device

Low-Fidelity Wireframe

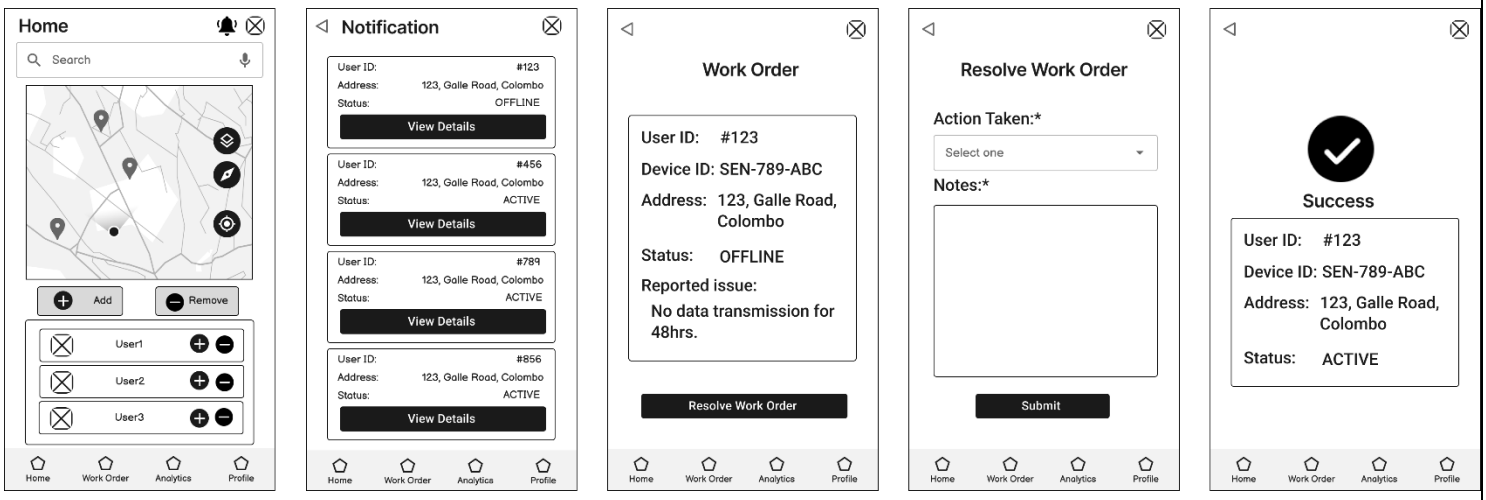


Figure 17: Low Fidelity Wireframe for Repair or Replace Device

High-Fidelity Wireframe

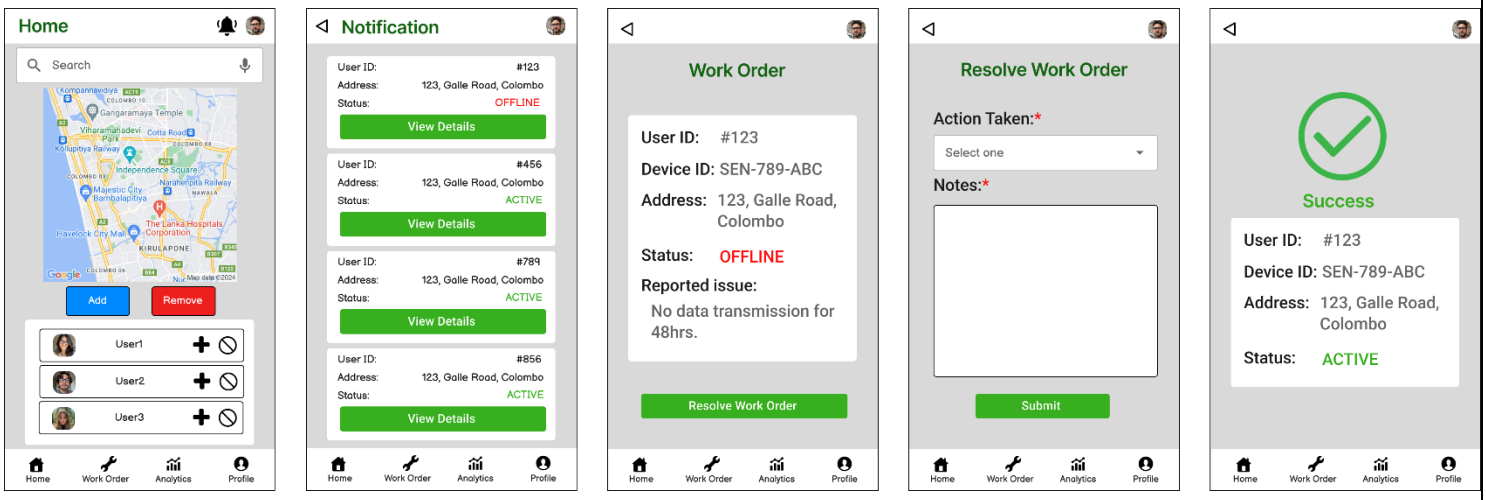


Figure 18: High Fidelity Wireframe for Repair or Replace Device

Works Cited

Envac. (2024, 03). *Envac*. Retrieved from envacgroup.com: https://www.envacgroup.com/insights/payt-pay-as-you-throw-an-innovative-approach-to-promoting-sustainability-and-reducing-waste/

IZeeM. (2025). *izeem.com*. Retrieved from IZeeM: https://www.izeem.com/articles/2019/10/smart-waste-management-part-1

Method Recycling. (2024, April). *What Is Smart Waste Management?* Retrieved from Method Recycling: https://methodrecycling.com/world/journal/what-is-smart-waste-management

Romuno, J. (2024, January). *6 Smart Waste Management Technologies Emerging in 2025*. Retrieved from Recycle Track Systems: https://www.rts.com/blog/smart-waste-management-technologies/