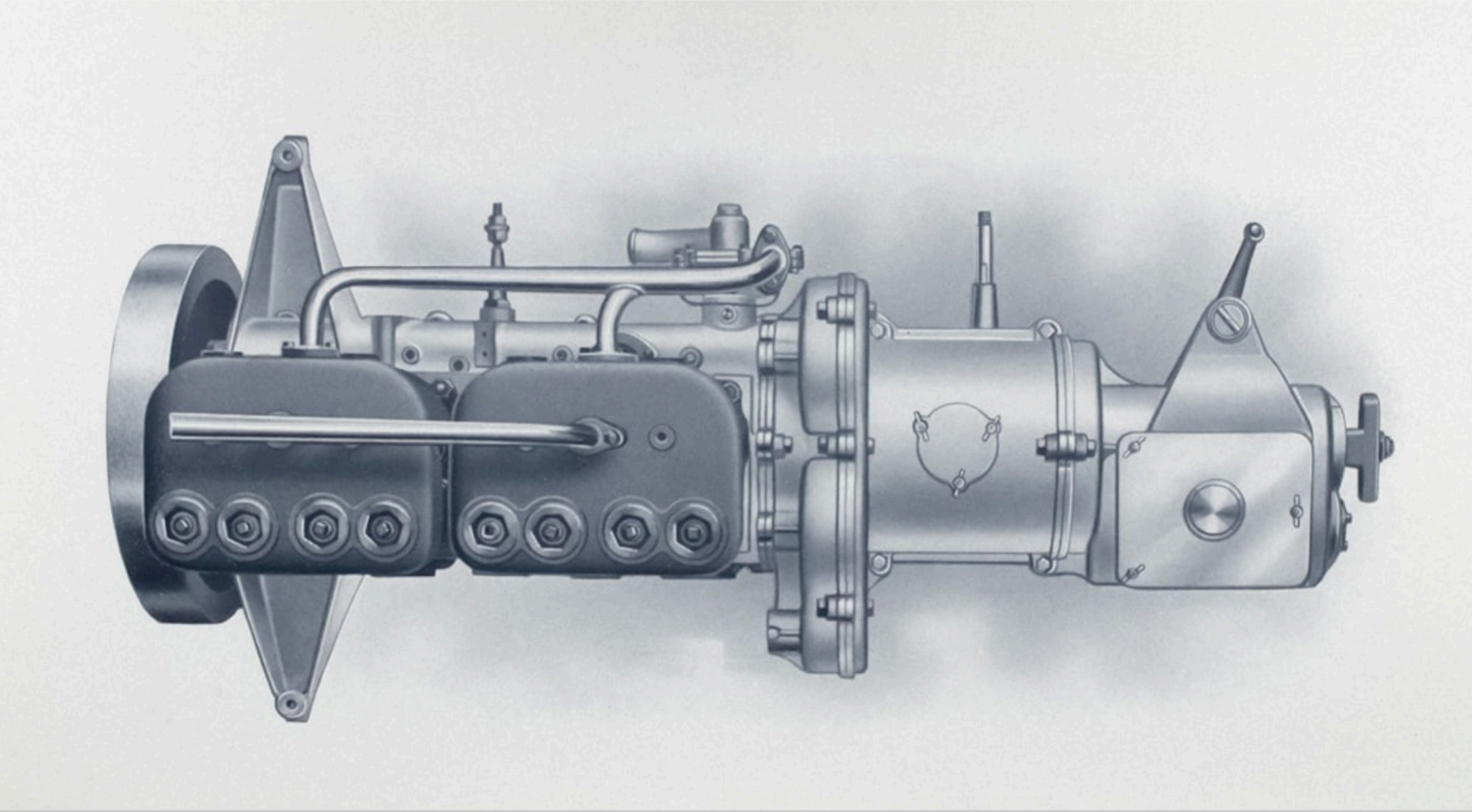

SMART MAINTENANCE

Salleha

Systems Analysis and Design
First Semester
2025/2026

University of Jordan

Systems Analysis and Design
Supervised by: Dr.Hamad Alsawalqah
First Semester 2025-10-15

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Version Control

Version	Description
Version 1.0	Initial version of the software documentation. Added Chapter 1 (Project Initiation) and Chapter 2 (Project Management Plan).
Version 2.0	Updated version of the software documentation. Added Chapter 3 (Software Requirements Specifications).
Version 3.0	Updated version of the software documentation. Added Chapter 4 (System Analysis and Design), Chapter 5 (User Manual), and Chapter 6 (References), excluding implementation details.

Excutive Summary

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1. Project initiation

1.1. Project Overview

SALLEHA is a platform designed for managing maintenance requests in facilities like offices or residential buildings, making maintenance and reporting more efficient and easier. Users can report issues, track progress, and get updates. Admins and technicians can assign, prioritize, and resolve tasks effectively.

1.2. Problem Definition

In many residential buildings, offices, and shared facilities people often face significant challenges in reaching authority of those In charge of maintenance managers and staff. In traditional methods such as : emails, paper forms, or phone calls, are typically inefficient, lack transparency and lead to delays. This often creates a communication gap between users and the authorities responsible, which results in frustration, unaddressed issues, and potential safety hazards.

1.2.1. Issues

Issue	weight
Users often struggle to reach the right maintenance personnel, resulting in delays or ignored requests. Without a centralized and accessible system, reporting issues becomes time-consuming and unreliable.	10
Maintenance teams often work without proper tools to prioritize, assign, and track tasks. This leads to missed or delayed repairs, no clear ownership of responsibilities, and no data to measure performance or improve operations.	9
Users rarely receive updates on the status of their maintenance requests. This lack of visibility creates frustration and reduces trust in the system, while maintenance teams struggle to keep everyone informed.	7
Users lack Privacy through and through with traditional reporting methods, this can lead to an upset and distrust to some people. Users care for their own privacy hence why some reports have never been sent before because of their own worry about the system.	6

1.2.2. Objectives

1. Simplify and centralize issue reporting through a user-friendly web/mobile interface that allows users to easily report maintenance problems and is available 24/7.
2. Enhance communication and transparency by providing real-time updates and notifications on request statuses
3. Create an analytics dashboard to provide administrators with insights and help them to identify trends and areas needing improvement.
4. Create a confidential system that ensures users anonymity and keeping their data secure and private from intruders.

1.2.3. Requirements

1. The system must ensure data security and protect the privacy of all users.
2. The system must be intuitive and user-friendly, allowing non-technical users to navigate and interact with it easily.

3. The analytics dashboard must be restricted to administrators only.
4. Maintenance reports must be submitted anonymously to ensure user comfort and honesty.

1.2.4. Constraints

1. Development costs must not exceed 45,000 JD
2. The project should be done by Sunday 4, Jan 2026

1.2.5. Vision Document

1.2.5.1. Problem Description

Ever since the digitalization of almost everything, people's expectations rose. People are in constant demand of systems that fulfills there needs. Current methods are almost obsolete they are ineffecient and insuffecient because the older methods have lack of transparency, increased delays, and unavaliable hence the overall user frustration, not to mention the diffuculty of managing the reports.

Without a system to hold everything together it require a lot of effort to pull through the maintenance tasks. To satisfy users, they need a system to adapt to their needs. Providing a smooth, painless experience through an easy to use interface. A system is needed such that it enables feedback submission, tracks administrative responses, and provides data-driven insights for continuous service improvement. Delaying this solution risks further dissatisfaction and missed opportunities for institutional growth.

1.2.5.2. System Capabilities

1. Ticket Submission Capabilities.
   - Users are able to submit maintenance tickets through a user-friendly interface.
   - Tickets include:
     - Text description of the issue.
     - Image attachments to provide visual context.
     - Location tagging to help technicians identify where the issue is.

2. Role-Based Dashboards.
   - The system provides separate dashboards based on user roles.
   - Roles include:
     - Users: Can submit and track tickets, view status updates, and provide feedback.
     - Technicians: Can view assigned tickets, update task statuses, and log maintenance work.
     - Administrators: Can assign tasks, monitor performance, and access analytics dashboards (restricted access).

3. Task Assignment and Scheduling.
   - Administrators can assign tasks to technicians based on priority and availability.
   - System supports:
     - Priority-based task distribution depending on if its urgent or normal.
     - Scheduling of tasks to optimize technician workload and response time.

4. Push and Email Notifications.
   - The system provides real time updates on ticket statuses.
   - Notification types include:
     - Push notifications via web or mobile.
     - Email alerts for important status changes.

5. Maintenance History and Analytics.
   - System keeps a log of all past maintenance activities.
   - Analytics dashboard features:
     - Insights into frequent issues by area or equipment.
     - Performance tracking for continuous improvement.
     - Access restricted to administrators only.

1.2.5.3. Business Benefits

- Providing a better quality of life.
- Overall increase of the user satisfaction.
- Increasing speed of maintenance tasks.
- Eliminating delays and lessening risks.
- Providing better communication channels.

1.3. Feasbility Studies

1.3.1. Techinical Feasibility

The technical feasibility assesses the technological components necessary to develop and operate the SALLEHA platform. This includes evaluating the required hardware, software tools, and the technical skills essential for building and maintaining the system.

Technology: The SALLEHA website is built using basic and easy-to-use Web tools like HTML, CSS, JavaScript, Bootstrap, and jQuery. These Tools help create a clean and responsive design that works well on Different devices. We also use Canva to design simple and clear images and graphics, making the website easy for Seniors users to understand and use .

Cloud Hosting: We are using GitHub to store and manage the project online. It helps us work together, keep track of changes, and easily share the project with others.

All the required resources including hardware, software tools, and hosting services are already available and accessible, ensuring smooth development and operation of the SALLEHA platform.

Since all these technologies are part of what we have learned at university and practiced in various projects, we are fully capable of developing and maintaining the SALLEHA platform using them. Our academic background and hands-on experience give us the technical foundation and confidence to build this system successfully.

1.3.2. Operational Feasibility

The proposed web and mobile application is operationally feasible. It is designed to receive maintenance requests in facilities such as universities, offices, or residential buildings, enabling users to report issues, track progress, and receive updates. Since it is both a web and mobile application, users can access it from anywhere. We expect that our system will gain wide acceptance from users, admins, and technicians because it addresses an essential need and saves time and effort. It will have clear privacy guidelines and mechanisms to ensure that our users' data will be secured, and it complies with the policies set by the country's laws and institutions. Additionally, the system is well-suited to the local culture and environment. The end users are capable of using it smoothly and effectively without requiring extensive training, due to its simple and user-friendly design.

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1.3.3. Economic Feasibility

Development Costs:

Table 1: Devlopment Costs

Expense Category	Amount
Salaries	20,000 JD
Equipment and installations	8,000 JD
Training	1,500 JD
Facilities	2,000 JD
Utilities	1,000 JD
Travel\Miscellaneous	2,000 JD
Total	**39,500 JD**

Operational Costs:

Table 2: Operational Costs

Service	Annual Cost(Per year)
Operational maintenance	7,000 JD
Total Cost	**7,000 JD**

Table 3: Intangible Benefits

Intangible Benefits
Enhanced Institutional Trust and reputation
Increasing users satisfaction
Saving time and effort for both users and Institutions

Benefit and Payback Analysis:

Table 4: Benefit and Payback Analysis

Category	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Value of benefits	0	16,000 JD	17,000 JD	18,000 JD	19,000 JD	20,000 JD
Development costs	−39,500 JD	0	0	0	0	0
Annual expenses	0	−7,000 JD	−7,000 JD	−7,000 JD	−7,000 JD	−7,000 JD
Net Benefit / Costs	−39,500 JD	9,000 JD	10,000 JD	11,000 JD	12,000 JD	13,000 JD
Discount Rate (7%)	1	0.934	0.873	0.813	0.763	0.713
Net Present Value (NPV)	−39,500 JD	8,406 JD	8,730 JD	8,943 JD	9,156 JD	9,269 JD
Cumulative NPV	−39,500 JD	−31,094 JD	−22,364 JD	−13,421 JD	−4,265 JD	5,004 JD
Payback Period	**4 years+**					**4.6 years**

Lifetime ROI = $\frac{90{,}000-74{,}500}{74{,}500} = 0.208 \vee 20.8\%$

Annual ROI = $\frac{20.8\%}{5} = 4.16\%$

1.3.4. Schedule Feasibility

Table 5: Project Development Schedule

Phase	Task	Estimated Time
Planning	Define Project Scope & Objectives	1 week
Analysis	Requirements Gathering, Process Analysis, and Document Delivery	2 weeks
Design	System Architecture and Interface Design	2 weeks
Implementation	Development of Core Features	4 weeks
Testing	System Testing and Quality Assurance	2 weeks
Deployment	System Deployment	1 week

1.3.5. Legal Feasibility

The proposed platform fully aligns with Jordanian laws, university policies, and institutional standards. All required approvals will be obtained from the University of Jordan's relevant departments before deployment. The system does not infringe upon any legal frameworks or intellectual property rights.

Licensing Compliance: All development tools, frameworks, and libraries used in the platform will be properly licensed. Open-source components will be used in accordance with their respective licenses, while any proprietary technologies will be incorporated only after acquiring valid usage rights.

Copyright and Intellectual Property Protection: The platform will comply with the Jordanian Copyright Law No. 22 of 1992 and its amendments. Any third-party content whether text, images, or software will be original, licensed, or used under fair use conditions with full attribution.

Data Privacy and Confidentiality: To comply with the Jordanian Personal Data Protection Law No. 24 of 2023, the system will:

1. Obtain explicit user consent prior to collecting or processing personal information.
2. Employ encryption and secure storage for sensitive data.
3. Ensure that personal data is used strictly for its intended purpose and accessed only by authorized personnel.

Electronic Communication and Records Compliance: Under the Electronic Transactions Law No. 15 of 2015, all digital communications and transactions carried out through the platform will be handled as legally recognized records, protected through appropriate technical and procedural safeguards.

Terms of Service and Legal Disclosures: Users will be provided with clear Terms of Service and Privacy Policy agreements outlining:
- Data collection and usage practices
- User rights and responsibilities
- Risk disclosures and security provisions

These documents will comply with both university IT regulations and national legal requirements.

1.4. Recommended Solution and Expected Project Deliverables

To manage the maintenance requests of issues as they arise, we can use a great solution: a Maintenance Request software system that allows requesters to report maintenance issues directly to the maintenance team using a web-based form or mobile app. It helps streamline communication, submission, and tracking without wasting time gathering complete and accurate information or delaying repairs. The people who the maintenance teams usually rely on, such as employees and visitors, will be able to submit detailed maintenance forms that include descriptions, images, and location information. Other processes such as workflows for reviewing and approving requests will be managed through a dashboard that allows the team to assign, prioritize, and monitor tasks. Technicians can update the status of each request in real time, and notifications will be sent to users to inform them about progress and completion.

Expected Deliverables: A Maintenance Request Software that will include:

- **Request Submission:**

Maintenance teams will accept requests through the system to ensure they collect all necessary information to proceed with other maintenance processes.
Users will submit it like a post; It'll have a title, location, photo and description.

- **Review and Approve Requests:**

A dashboard and analysis tool will help the organization review all forms and decide which requests will be approved. Each request will be evaluated to ensure that it is valid, not redundant, and not already being addressed.

- **Status Updates to Deliver Better Customer Service:**

To build trust between managers and customers, there will be a communication tool that responds back to requesters to inform them that their requests are accepted and to update them about the status of their issues until completion. These updates will be automated through real-time notifications.

- **Database Design and Documentation:**

For storing and tracking requests, there will be request records that provide a clear view of all issues, and a database that documents what issues were reported, how they were resolved, and when. This will help with future planning and decision-making, as well as provide tools for summarizing the analysis, design, and implementation process.

- **Performance Tracking:**

Updates on team work status for measuring team performance will help ensure that the original problem has been addressed and will identify bottlenecks in the request process. This will lead to providing excellent customer service and demonstrate that the maintenance team is responsive, works well, and continues improving the organization's overall reputation. This will be done by tracking average response time and turnaround time.

1.5. Local and Global Impact of the Proposed Solution

Locally: The maintenance request system will ensure accuracy and enable the maintenance team to begin planning and scheduling maintenance work more quickly through automatically generated work orders from approved requests. Following best practices will also provide better customer service in this area. Automation means better experiences! It will reduce delays in handling requests, minimize manual paperwork, and ensure maintenance work is managed from start to finish through automated tools. This can lead to better resource management, higher efficiency, and greater satisfaction not just among staff but also among customers by keeping them updated about the status of their requests without delaying feedback.

Globally: It contributes to digital transformation and sustainability efforts. It is essential for businesses of all sizes to rely on such systems in their operations to efficiently allocate resources and maximize the performance of their assets. A well-designed maintenance request system demonstrates how technology enables organizations to make data-driven decisions to achieve better operational efficiency by centralizing all maintenance requests in one platform.

2. Project Management plan

2.1. Project Organization

The project organization shows how the team is structured and who is responsible for each part of the project. It helps make sure everyone knows their role and who to report to, keeping the work organized and efficient. The structure for our team also supports good communication between team members during development, as shown in Figure 1.

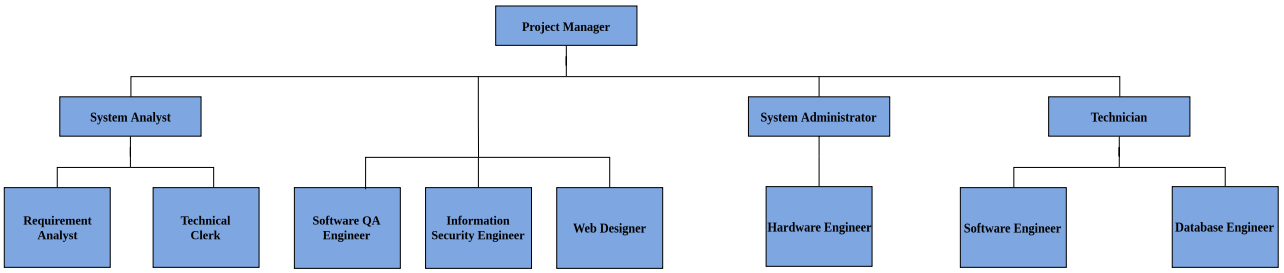


Figure 1: Project Organizational Structure

Table 6: Team Roles Assignments and Responsibilities

Assigned Membe	Roles
Anas	Project Manager, System Analyst, Requirement Analyst
Orjoan	Technical Clerk, Technician
Mosa	System Administrator, Hardware Engineer,Database Engineer
Haneen	Software Engineer, Web Designer,
Shaima	Software Engineer, Web Designer, Technical Clerk
External	Information Security Engineer, Software QA Engineer

2.2. Roles and Responsibilities

In this section, we will explain each role with its responsibilities in perspective. see Table 7.

Table 7: Roles and Responsibilities

Role	Responsibility
Project Manager	Responsible for planning, organizing, and overseeing projects to ensure they are completed on time, within budget, and meet quality standards. They coordinate team efforts, manage resources, and communicate with stakeholders throughout the project lifecycle.

System Analyst	Systematically assesses how businesses function by examining the inputting and processing of data and the outputting of information with the intent of improving organizational processes.
Requirement Analyst	Gathers and documents user requirements, ensuring alignment between business needs and system design.
Technical Clerk	Assists in maintaining documentation, schedules, and techinical records. Supports techinical team with admin tasks.
Software QA Engineer	Ensuring that software products meet the highest standards of quality and functionality.
Information Security Engineer	Rresponsible for designing, implementing, and maintaining security systems to protect an organization's data and networks from cyber threats. They also monitor security measures, respond to incidents, and ensure compliance with security policies and regulations.
Web Designer	Responsible for creating the visual layout and user experience of websites, ensuring they are both attractive and functional. Their tasks include designing page layouts, coding navigation, and collaborating with clients to meet their needs.
System Administrator	Responsible for managing and maintaining an organization's computer systems and networks, ensuring they operate efficiently and securely. This role often involves troubleshooting issues, installing software, and managing user accounts.
Hardware Engineer	Responsible for analyzing blueprints and technical drawings, reviewing system tests and performing updates as needed, implementing the latest systems and processes and ensuring everyone follows them, monitoring the manufacturing and assembly of hardware equipment, acting as the technical leader in product development
Technician	Responsible for installing, maintaining, and repairing equipment and systems across various industries. Their key duties include troubleshooting issues, performing routine maintenance, and ensuring compliance with safety standards
Software Engineer	Responsible for designing, developing, testing, and maintaining software applications and systems to meet user needs. Their responsibilities include analyzing user requirements, writing and testing code, and collaborating with other team members to ensure software functionality and performance.
Database Engineer	Rponsible for designing, implementing, and maintaining database systems to ensure efficient data storage and re-

	trieval. Their key responsibilities include database design, data security, performance optimization, backup and recovery, and data migration.

2.3. Software Process Model

We are going to use the Waterfall Software Process Model. This model is suitable because our project goals and requirements are clearly defined from the beginning, and we have a strict timeline to follow. Since this model is based on a highly structured approach, it will help us maintain organization and ensure that all deliverables are completed on time. See Figure 2.

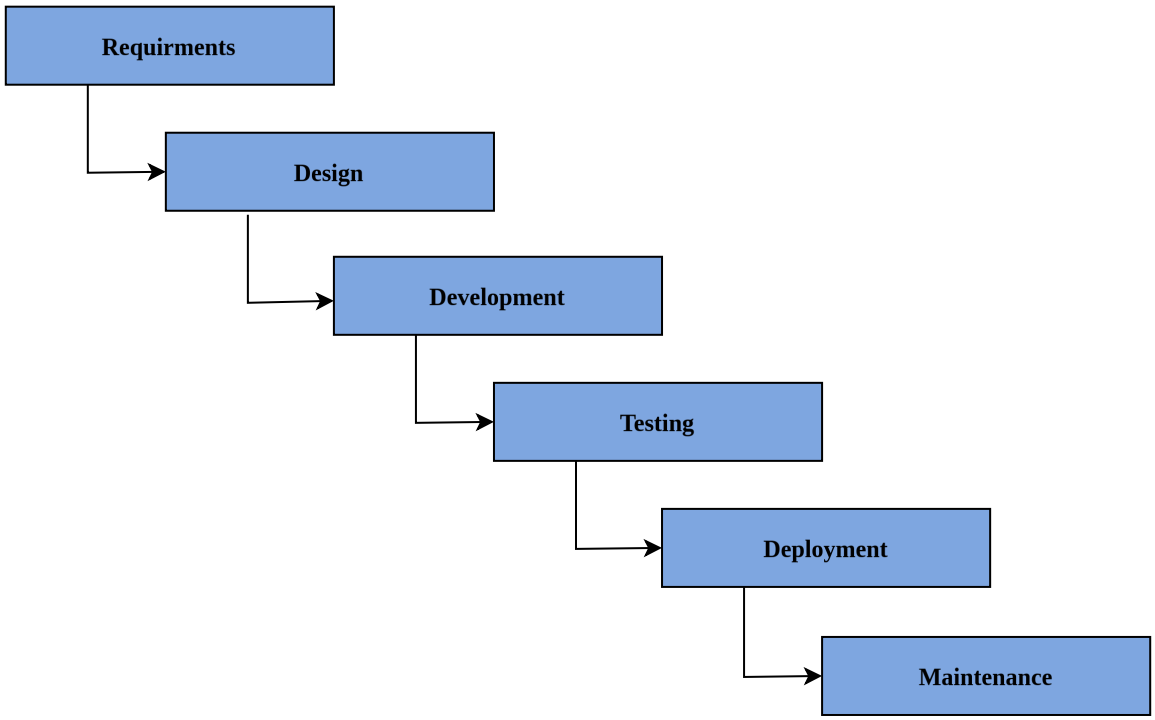


Figure 2: Waterfall Software Process Model

2.3.1. Main Phases :

1. **Requirements Analysis and Specification:**
   - Requirements Analysis: Gathering and understanding all the requirements of the client, then documenting and analyzing them.
   - Requirement Specification: Documenting the analyzed requirements in a software requirement specification document that serves as a reference for the next phases.
2. **System Design:**
   - Translating the requirements from the requirement specification document into a detailed system design as well as creating the overall architecture.
3. **Development:**
   - Developing the web and mobile applications according to the designs created earlier, using a suitable programming languages and frameworks.
4. **Testing and Deployment:**
   - Testing the whole software and verifying that all components work correctly and satisfy user expectations. After testing, the software is ready and available for use.

5. **Maintenance:**
   - The final, ongoing phase. It ensures that the software remains functional, secure, and up-to-date throughout its operational life.

2.4. Project Environment

2.4.1. Procedures

- **Initiation:**
  - Establish the project team, define the requirements goals, and potential risks.
- **Planning:**
  - Create a detailed project plan using the Waterfall methodology, this includes outlining all necessary steps, allocating resources, and developing cost, schedule, and communication plans to achieve our outcomes.
- **Execution and Testing:**
  - Implement the planned activities and test them carefully to ensure quality and functionality.
- **Monitoring:**
  - Track progress and compare it with planned goals to ensure timely delivery and quality control.
- **Documentation:**
  - All design diagrams, reports, and testing results are documented using Typst and stored in a shared repository to ensure collaboration among team members.

2.4.2. Tools

Table 8: Tools

Tool	Purpose
Development Tools	Visual Studio Code for developing the web application, and Flutter for building a responsive mobile application using one shared codebase.
Documentation	Typst for creating our PDF documentation.
Version Control	GitHub for sharing and tracking project progress and managing team collaboration.
Design & Prototyping	Figma for creqting UI/UX design, and Draw.io for diagrams.
Database Management	MySQL, chosen for its reliability, speed, and support for relational data.
Testing	JUnit, an open-source testing framework, to verify our code's correctness and performance.
Communication Tools	Google Meet, WhatsApp, and GitHub for coordination.

2.4.3. Hardware (HW) Resources:

Table 9: Hardware (HW) Resources

Category	Description
Developer Devices	Personal laptops and PCs for developing both the web and mobile applications.
Database Server	A server for hosting MySQL database, optimized for security and data backup.
Testing Devices	PCs for testing the website, and Android smartphones for mobile testing

2.4.4. Software (SW) Resources:

Table 10: Software (SW) Resources

Category	Description
Frontend Technologies	HTML, Tailwind CSS, and JavaScript for dynamic and responsive designs.
Mobile Development	Flutter for building the mobile app.
Frameworks and Libraries	React for web development, and Flutter for mobile.
Backend Technologies	Java and Node.js for handling server-side operations and building a secure and scalable backend.
Database	MySQL for storing and managing maintenance request data efficiently.
Operating System	Windows

2.5. Project tasks

Table 11: Project Tasks

Phase	Task	Detailed task	EstimatedTime
• Resource & Schedule Planning (T1) • Requirements Gathering (T2)	• Develop Work Breakdown Structure for web and mobile app development • Create risk register and define quality standards for the application	• Define project phases and deliverables • Assign WBS elements to team members • Identify risks and quality objectives • Define acceptance criteria and mitigation strategies	1 weeks
	Resources Needed	**Dependencies and Constraints**	**Deliverables & Milestones**

	• N/A	• **Dependencies**
		  ▸ Approved project charter
		  ▸ Availability of key stakeholders for interviews such as the requesters and the facility managers
		• **Constraints**
		  ▸ Budget constraints
			• **Deliverables**
			  ▸ Work breakdown structure diagram
			  ▸ Table with risk, impact, probability, priority, and mitigation
			  ▸ Quality standards document (acceptance criteria checklist)
			• **Milestones**
			  ▸ M1.1: Charter Approved and communicated to the team.
			  ▸ M1.2: Work Breakdown Structure completed and reviewed by all members.

			▸ M1.3: Resource plan and schedule baseline approved. ▸ M1.4: Risk register and quality standards finalized.
Phase	**Task**	**Detailed task**	**EstimatedTime**
Analysis	• Requirements Elicitation (T3) • Requirements Modeling & Documentation (T4) • Requirements Validation (T5)	• Conduct stakeholder interviews • Distribute surveys to end-users • Observe existing maintenance request processes • Write Software Requirements Specification (SRS) • Create use-case diagrams for maintenance workflows • Develop entity-relationship diagrams (ERDs) for database • Document non-functional requirements (performance, security, compatibility) • Facilitate requirements review sessions • Build wireframes for React web and Flutter mobile interfaces • Resolve conflicts and ambiguities	2 weeks

		• Obtain formal sign-off on SRS	
	Resources Needed	**Dependencies and Constraints**	**Deliverables & Milestones**

	• N/A	• **Dependencies**
		  ▸ Access to collaboration tools so the informations can be shared and reviewed.
		• **Constraints**
		  ▸ Stakeholder time; limited availability may restrict depth of interviews
		  ▸ Data privacy when handaling the facility data
			• **Deliverables**
			  ▸ Software Requirements Specification
			  ▸ Use-case diagrams for the main maintenance workflows
			  ▸ Entity-Relationship Diagram
			  ▸ Wireframes
			  ▸ Survey results and interview notes
			  ▸ Non-functional requirements list
			  ▸ Requirements validation report
			  ▸ Requirements Traceability Matrix
			• **Milestones**
			  ▸ M2.1: Software Requirements Specification (SRS) reviewed and approved by stakeholders.
			  ▸ M2.2: Requirements validation and traceability matrix completed.

Phase	**Task**	**Detailed task**	**EstimatedTime**

Design	• Architectural Design (T6) • High-Level (Logical) Design (T7) • Detailed (Physical) Design (T8) • Design Review & Approval (T9)	• Choose overall system architecture for web and mobile • Define network topology and cloud infrastructure • Break system into modules (frontend, backend, database) • Define REST API contracts and module interfaces • Draft high-level sequence diagrams for maintenance request workflows • Create class diagrams for React and Flutter components • Design database schema with tables, indices, and constraints • Specify UI layouts and navigation flows for web and mobile • Define error-handling and logging approaches • Organize design walkthroughs with team and stakeholders	2 weeks
	Resources Needed	**Dependencies and Constraints**	**Deliverables & Milestones**
	• Information Security Engineer	• **Dependencies** ‣ Completion and approval of Software Requirements Specification	• **Deliverables** ‣ Web and Mobile System Architecture Document

		▸ UI design depends on confirmed user workflows and functional requirements because they show what the user needs to do and how the system should respond • **Constraints** ▸ Technology constraints ▸ Design must comply with quality standards and security requirements	▸ High-Level Design including system modules and interaction diagrams ▸ Detailed Design including Class diagrams, Sequence diagrams, Database schema and API documentation ▸ UI/UX prototypes for web and mobile • **Milestones** ▸ M3.1: System architecture approved. ▸ M3.2: High-level and detailed design documents completed. ▸ M3.3: UI/UX prototypes finalized and validated with stakeholders. ▸ M3.4: Design reviewed and approved by all stakeholders.
Phase	**Task**	**Detailed task**	**EstimatedTime**
Development	• Development Setup (T10) • Front-end Code (T11) • Back-end Code (T12) • Database Physical Design (T13)	• Configure Git repository and version control • Set up web development environment • Set up Flutter development	4 weeks

		environment with Android/iOS SDKs • Initialize backend framework and dependencies • Configure linters, formatters, and testing frameworks • Implement web frontend components for maintenance request management • Build Flutter screens for mobile app navigation • Develop responsive UI for web and mobile platforms • Create RESTful API endpoints for maintenance operations • Implement authentication and authorization logic • Build business logic for request processing and notifications • Create database tables, indices, and relationships • Implement data access layer with ORM • Set up database migrations and seeders	
	Resources Needed	**Dependencies and Constraints**	**Deliverables & Milestones**
	• N/A	• **Dependencies**	• **Deliverables** ‣ Git repository

		▸ Depends on approved design phase deliverables auch as architecture, and database schema • **Constraints** ▸ Follow the coding standards, security rules, and framework versions that were set in the earlier phases ▸ Internet or cloud service interruptions may slow down integration and testing activities	▸ Working web and mobile front-end modules (React and Flutter) ▸ Implemented database schema ▸ Unit testing and integration tests • **Milestones** ▸ M4.1: Development environment configured and repository initialized. ▸ M4.2: Initial Functional prototype completed. ▸ M4.3: Unit and integration testing completed with 80% code coverage. ▸ M4.4: Quality assurance (QA) verification passed and build approved for testing. ▸ M4.5: Production environment prepared and ready for deployment.
Phase	**Task**	**Detailed task**	**EstimatedTime**
Testing	• Test Planning (T14) • Integration Testing (T15)	• Develop comprehensive test plan for web and mobile platforms • Define test environments	2 weeks

	• System & Acceptance Testing (T16) • Regression & Release Testing (T17)	(development, staging, production) • Prepare test data sets for maintenance request scenarios • Test integration between web frontend and backend API • Test integration between Flutter mobile app and backend API • Verify database operations and data integrity • Conduct end-to-end system testing across all platforms • Perform user acceptance testing with stakeholders • Test cross-platform compatibility (iOS, Android, Web browsers) • Execute regression tests after bug fixes • Perform security and performance testing • Conduct final release testing and quality checks	
	Resources Needed	**Dependencies and Constraints**	**Deliverables & Milestones**
	• External QA engineers	• **Dependencies** ▸ Test data and environment setup depends on finalized database	• **Deliverables** ▸ Completed integration and system test reports

		▸ Test plan and test cases finalized • **Constraints** ▸ Availability of performance-test and security-test tools ▸ Limited time for testing may constrain full regression coverage ▸ Must follow project's quality assurance and version control procedures	▸ Signed-off User Acceptance Test report from stakeholders to be ready for deployment • **Milestones** ▸ M5.1: Test plan and test cases developed and approved. ▸ M5.2: System and integration tests executed successfully. ▸ M5.3: User Acceptance Testing (UAT) completed and approved. ▸ M5.4: Exit criteria met and testing phase formally closed.
Phase	**Task**	**Detailed task**	**EstimatedTime**
Deployment	• Release Planning (T18) • Environment Provisioning (T19) • Go-Live Execution (T20) • Transition & Support (T21) • Post-Deployment Review (T22)	• Create release plan with rollback strategy • Prepare deployment documentation and checklists • Schedule go-live date with stakeholders • Provision cloud servers and configure network • Set up production database with security settings • Configure CI/CD pipelines for	1 weeks

		automated deployment • Deploy web application to hosting platform • Publish Flutter mobile app to App Store and Google Play • Configure production environment variables and API keys • Conduct user training sessions for web and mobile platforms • Provide technical documentation and user guides • Establish helpdesk and support channels • Monitor system performance and user feedback • Review deployment metrics and KPIs • Document lessons learned and improvement areas	
	Resources Needed	**Dependencies and Constraints**	**Deliverables & Milestones**

	• N/A	• **Dependencies**
		  ▸ Dependent on successful completion of testing
		• **Constraints**
		  ▸ It must be scheduled
			• **Deliverables**
			  ▸ Successfully deployed web and mobile applications
			  ▸ User training and support materials completed

		▸ Risk of configuration errors ▸ Security and data compliance must be checked and confirmed before the system goes live	▸ Documented post-deployment review and lessons learned • **Milestones** ▸ M6.1: Final stakeholder approval for production release obtained. ▸ M6.2: Web and mobile applications deployed to production environment. ▸ M6.3: User training sessions completed. ▸ M6.4: Post-deployment review completed. ▸ M6.5: Project officially closed.

2.6. Project Schedule

2.6.1. Activity Network

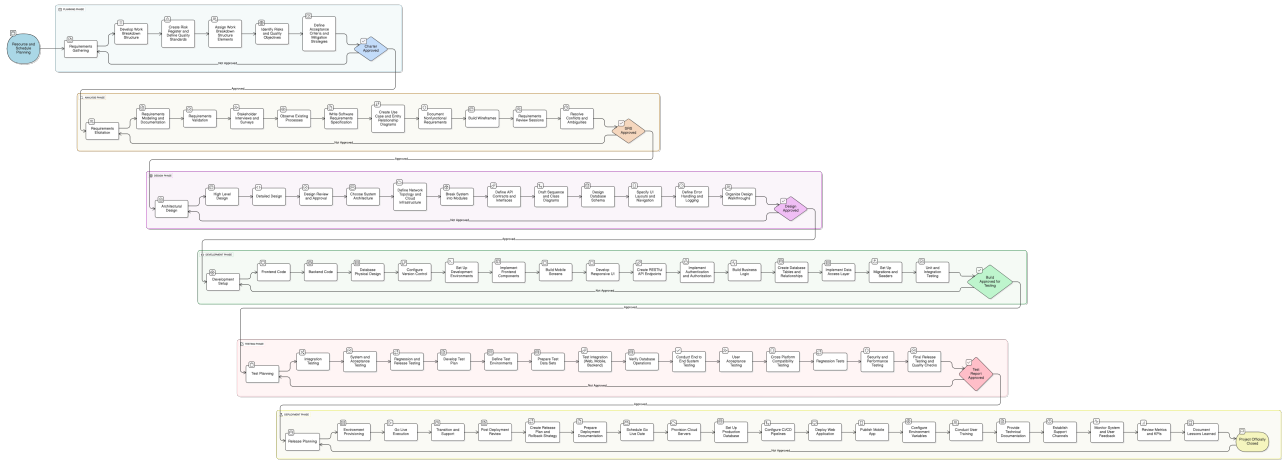


Figure 3: Activity Network Diagram

2.6.2. Gantt Chart

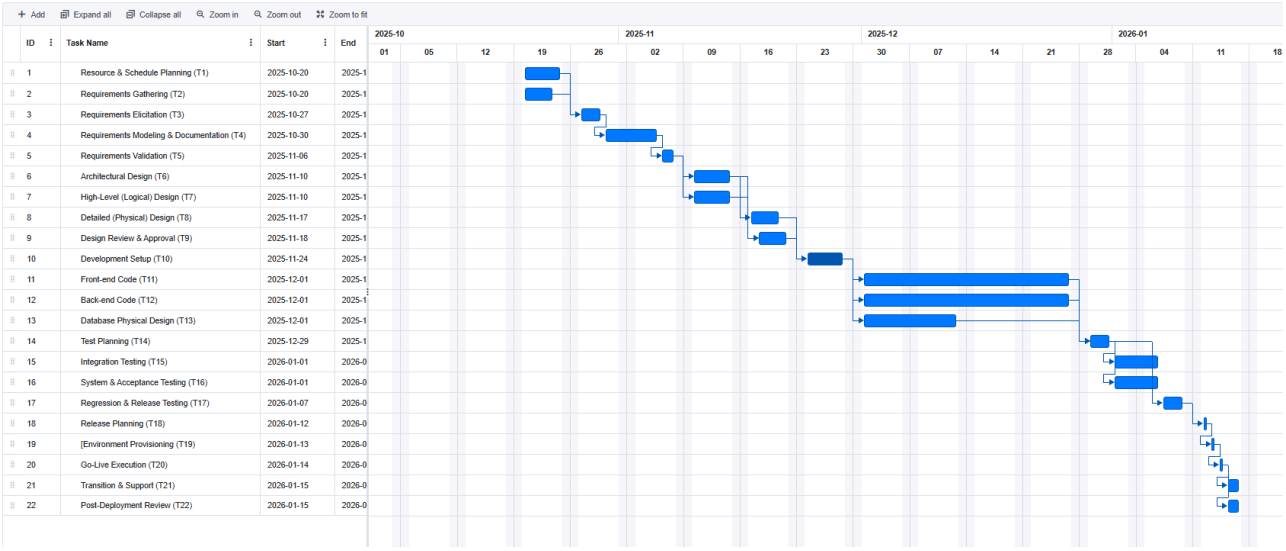


Figure 4: Gantt Chart

2.7. Assigning Team Members to Tasks

Table 12: Task-to-Team Member Assignment

Task ID	Assigned to
T1	Project Manager (Anas), Technical Clerk (Orjoan)
T2	Project Manager (Anas)
T3	System Analyst (Anas), Requirement Analyst (Anas), Technical Clerk (Orjoan)
T4	System Analyst (Anas), Requirement Analyst (Anas)
T5	System Analyst (Anas), Technical Clerk (Orjoan)
T6	Software Engineer (Haneen & Shaima), Hardware Engineer (Mosa), Web Designer (Haneen & Shaima)
T7	Software Engineer (Haneen & Shaima), Database Engineer (Mosa)
T8	Software Engineer (Haneen & Shaima), Database Engineer (Mosa), Web Designer (Haneen & Shaima)
T9	System Analyst (Anas), Software Engineer (Haneen & Shaima), InfoSec Engineer (Ext.)
T10	Software Engineer (Haneen & Shaima)
T11	Software Engineer (Haneen & Shaima)
T12	Software Engineer (Haneen & Shaima)
T13	Database Engineer (Mosa)
T14	Software Engineer (Haneen & Shaima), Software QA Engineer (External)
T15	Software Engineer (Haneen & Shaima)
T16	Software QA Engineer (External), System Analyst (Anas)
T17	Software QA Engineer (External), Software Engineer (Haneen & Shaima)
T18	Software QA Engineer (External), System Analyst (Anas)
T19	Software QA Engineer (External)
T20	System Administrator (Mosa), Project Manager (Anas), Software Engineer (Haneen & Shaima)
T21	System Administrator (Mosa), Database Engineer (Mosa)
T22	System Administrator (Mosa), Software Engineer (Haneen & Shaima), InfoSec Engineer (Ext.)

2.8. Monitoring and Controlling Mechanisms

Earned value management

Table 13: Earned Value Management Progress Tracking

Phase	Estimated cost	Cumulative estimate	Estimated duration	Stage completed	Actual cost of Phase to date	Actual cost of project to date
Planning	4,000 JD	4,000 JD	2 weeks	80%	1,000 JD	1,000 JD
Analysis	6,500 JD	10,500 JD	2 weeks	0%	Not yet begun	Not yet begun
Design	8,000 JD	18,500 JD	2 weeks	0%	Not yet begun	Not yet begun
Implem entation	16,000 JD	34,500 JD	4 weeks	0%	Not yet begun	Not yet begun
Testing	8,000 JD	42,500 JD	2 weeks	0%	Not yet begun	Not yet begun
Deployment	5,000 JD	47,500 JD	1 week	0%	Not yet begun	Not yet begun

- $P = 80\%$
- **Planned Value (PV) = 4,000 JD**
- **Actual Cost (AC) = 1,000 JD**
- **Earned Value (EV) = 3,200 JD**
- **Cost Variance (CV) = 2,200 JD**
  - We have saved 2,200 JD on the planning phase
- **Schedule Variance (SV) = (-800) JD**
  - This indicates delayed progress in the planning phase.
- **Cost Performance Index (CPI)= (3.2)**
  - We are under budget. The team is spending less than planned to accomplish the work.
- **Schedule Performance Index (SPI) = (0.8)**
  - We are behind schedule. The progress is slower than expected.
- **Estimate to Complete (ETC) = (13,593.75) JD**
- **Estimate at Completion (EAC) = 14843.75 JD**

- Based on information we gained from EVM analysis, we have to expedite our schedule.

Table 14: Time and Cost Options

Activity	Estimated duration (days)	Crash time (days)	Cost/day (JD)
T1	5	3	200
T2	4	4	200
T3	3	3	300
T4	5	4	450
T5	2	2	300
T6	5	5	300
T7	5	5	300
T8	4	4	300
T9	4	4	300
T10	5	4	250
T11	20	17	350
T12	20	19	400
T13	10	18	450
T14	3	3	250
T15	4	4	250
T16	4	4	300
T17	3	2	300
T18	1	1	300
T19	1	1	250
T20	1	1	250
T21	2	1	150
T22	2	2	300

Table 15: Schedule Expediting Table

Eligible activities	Activity chosen	Time for each path (Days)			Cost (JD/day)	Cumulative cost (JD)
		83	**83**	**73**		
T1,T4, T10,T11,T12, T17,T21	T21	82	82	72	150	150
T1,T4, T10,T11,T12, T17	T1	81	81	71	200	350
T1,T4, T10,T11,T12, T17	T1	80	80	70	200	550
T4, T10,T11,T12, T17	T10	79	79	69	250	800
T4, ,T11,T12, T17	T17	78	78	68	300	1100
T4, ,T11,T12, T17	T17	77	77	67	300	1400
T4, ,T11,T12,	T11	76	77	67	350	1750
T4, ,T11,T12,	T11	75	77	67	350	2100
T4, ,T11,T12,	T11	74	77	67	350	2450
T4, ,T12,	T12	74	76	67	400	2850
T4	T4	73	75	66	450	3300

2.9. Risk Analysis

2.9.1. Effects and Causes

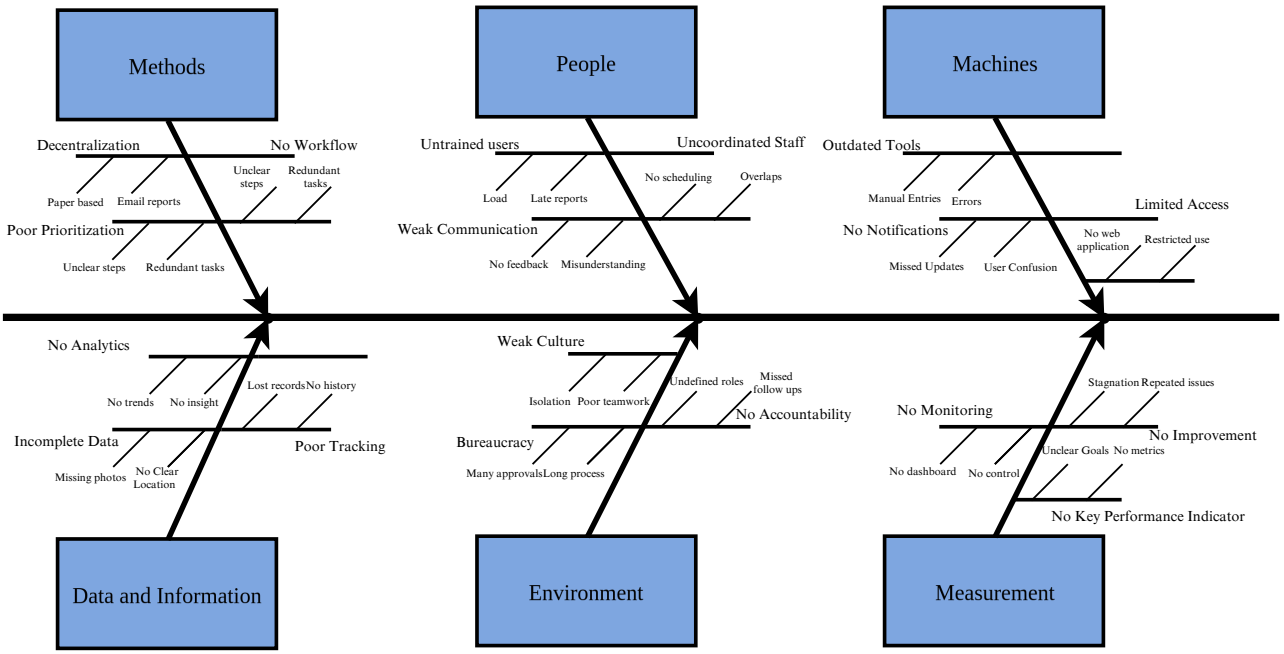


Figure 5: Fishbone Diagaram

2.10. Communication Plan

Our team will maintain communication through online meetings using Google Meet, and instant messaging using a WhatsApp group to assign tasks and ensure that everyone is updated on progress and deadlines. **Communication Methods:**

- In-Class Meetings:
  - Held every Sunday to discuss progress, issues, and next steps.
- Out-of-Class Meetings:
  - Through Google Meet whenever there is a need for rapid discussion.
- Messaging:
  - A WhatsApp group for updates and daily coordination.
- Version Control:
  - GitHub is used for tracking code updates and version history.
  - We also use GitHub to store and organize our documentation created using Typst, ensuring all of us can access the latest versions easily.

3. Software Requirements Specifications

3.1. System Stakeholders and Requirement Sources

3.1.1. System Stakeholders

1. **Operational Stakeholders**

   - End Users
     - Residents, Students, Employees.
     - Invdiviuals who report maintenance issues through the application.

- Their main concerns are ease of use, privacy and clear updates with minimum delay.

- Techinicians
  - Invdiviuals who resolve maintenance requests assigned by the admin.
  - Their main concerns are clear task assignments, prioritization, smooth workflow and centralization.

2. **Internal Stakeholders**

- Maintenance Administrators
  - Invdiviuals who oversee the whole maintenance workflow.
  - Their main concerns are efficiency, resource optimization and centralization.

- Project Manager
  - Resposible for overall planning and coordination and project execution.
  - Main concerns are great communication, maintaining quality standards and ensuring project completion.

- System Administrators
  - Invdiviuals who are responsible for the systems infrastructure, backups, user access controls and system performance.
  - Their main concerns are to ensure data integrity and smooth operation through out all the application processes.

3. **Excutive Stakeholders**
   - Executive Management / Facility Management Leadership
     - Use system reports and analytics for decision-making.
     - Their main concerns are efficiency, cost control, and performance monitoring.

4. **External Stakeholders**
   - Regulatory Authorities
     - Ensuring that the system complies with national laws.
   - Institution Responsible for Maintenance Services
     - Funds and authorizes the development of the system.
     - Main concerns are return on investment, system reliability, and long-term sustainability.

3.1.2. Information Gathering

To make sure the project's vision is well understoond and defined, while also having the culture in mind, we will preform a set of techniques in our search for information.

3.1.2.1. Interviews

Table 16: Operational Stakeholders Interviews

End Users (Residents, Students, Employees)	
Question	**Question Type**
How do you currently report maintenance issues?	open-ended
Do you find the current maintenance reporting process easy to use?	close-ended: yes or no
What difficulties do you face when submitting a maintenance request?	open-ended
How important is privacy when reporting maintenance issues?	scale
Do you receive timely updates about the status of your requests?	close-ended: yes or no
What type of notifications or updates would you prefer to receive?	open-ended
How satisfied are you with the response time for maintenance issues?	scale
Would you use a centralized application for all maintenance-related issues?	close-ended: yes or no
Technicians	
Question	**Question Type**
How are maintenance tasks currently assigned to you?	open-ended
Are task priorities clearly defined when you receive assignments?	close-ended: yes or no
What information do you need most to complete a maintenance task efficiently?	open-ended
How easy is it to track your assigned tasks and their status?	scale
Do you face delays due to unclear or incomplete requests?	close-ended: yes or no
What features would improve your daily maintenance workflow?	open-ended
Would a centralized system improve communication between you and administrators?	close-ended: yes or no

Table 17: Internal Stakeholders Interviews

Maintenance Administrators	
How do you currently manage and track maintenance requests?	open-ended
Do you find it difficult to prioritize maintenance tasks?	close-ended: yes or no
How effective is the current system in allocating technicians and resources?	scale
What challenges do you face in overseeing the entire maintenance workflow?	open-ended
Do you require reporting or analytics to support decision-making?	close-ended: yes or no
What type of reports would be most useful for you?	open-ended
Would automation help reduce your workload?	close-ended: yes or no
Project Manager	
Question	**Question Type**
What are the key objectives you expect this system to achieve?	open-ended

Do you believe the current maintenance process meets project goals?	close-ended: yes or no
How important is cross-team communication in this project?	scale
What risks do you foresee in implementing this system?	open-ended
Do you require milestone tracking and progress reports?	close-ended: yes or no
What indicators would you use to measure project success?	open-ended

Table 18: Executive Stakeholder Interviews

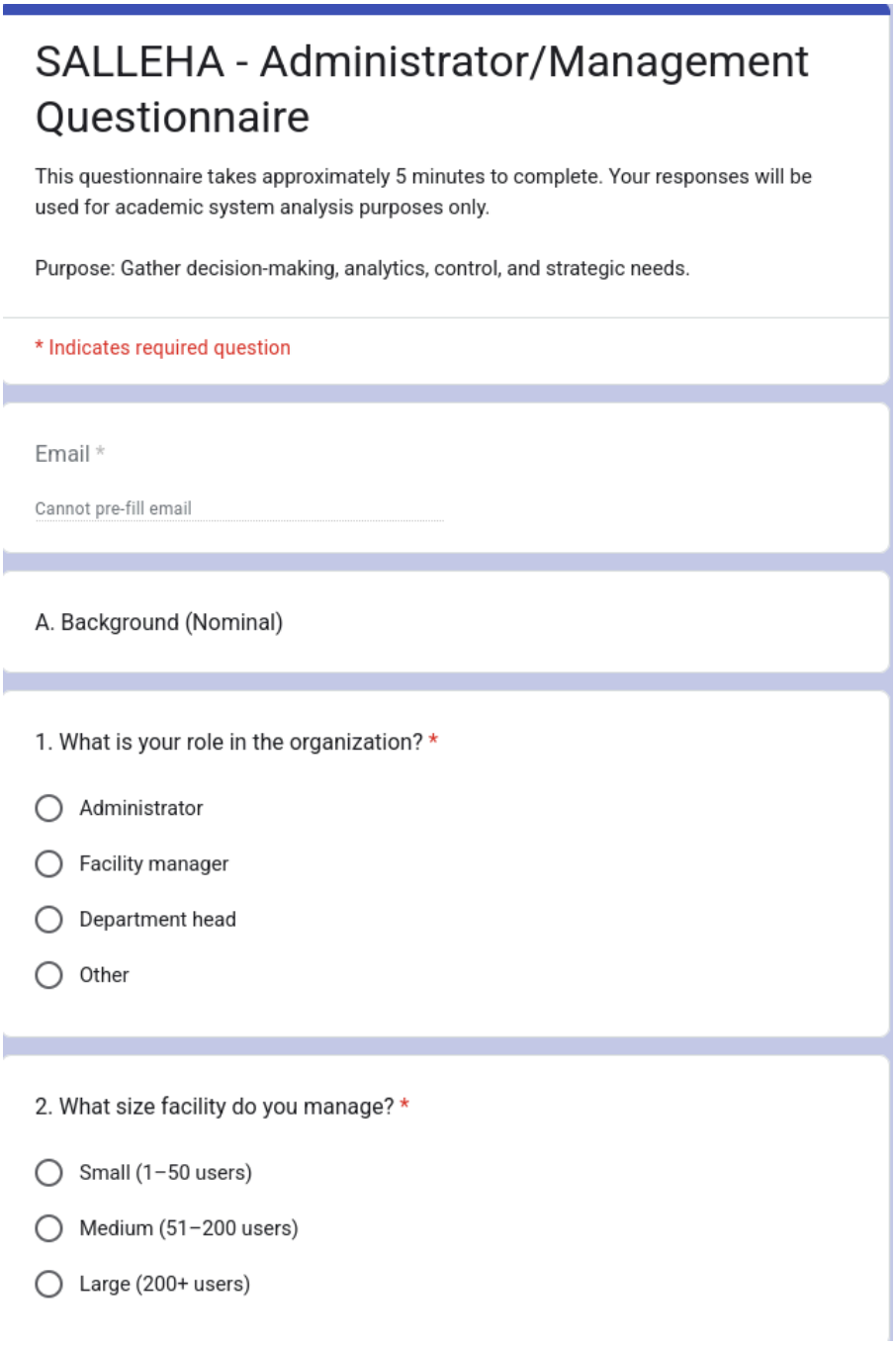
Executive Management / Facility Management Leadership	
Question	**Question Type**
How do you currently evaluate maintenance performance?	open-ended
Do you rely on reports and analytics for decision-making?	close-ended: yes or no
How important is cost efficiency in maintenance operations?	scale
What key performance indicators would you like to monitor?	open-ended
Would real-time dashboards improve strategic oversight?	close-ended: yes or no
System Administrators	
Question	**Question Type**
What systems or tools are currently used to manage maintenance data?	open-ended
Is data security a major concern for this system?	close-ended: yes or no
How critical is system availability and uptime?	scale
What access control mechanisms are required for different users?	open-ended
Do you require regular backups and recovery mechanisms?	close-ended: yes or no
What performance issues do you anticipate as the system scales?	open-ended

Table 19: External Stakeholder Interview

Regulatory Authorities	
Question	**Question Type**
What regulations must this system comply with?	open-ended
Is data protection compliance mandatory for this system?	close-ended: yes or no
How strict are reporting and audit requirements?	scale
What documentation or logs are required for compliance checks?	open-ended

3.1.2.2. Questionnaires

- **Administrator Questionnaire**



SALLEHA - Administrator/Management Questionnaire

This questionnaire takes approximately 5 minutes to complete. Your responses will be used for academic system analysis purposes only.

Purpose: Gather decision-making, analytics, control, and strategic needs.

* Indicates required question

Email *

Cannot pre-fill email

A. Background (Nominal)

1. What is your role in the organization? *

- Administrator
- Facility manager
- Department head
- Other

2. What size facility do you manage? *

- Small (1–50 users)
- Medium (51–200 users)
- Large (200+ users)

Figure 6: Admin Questionnaire (Nominal)

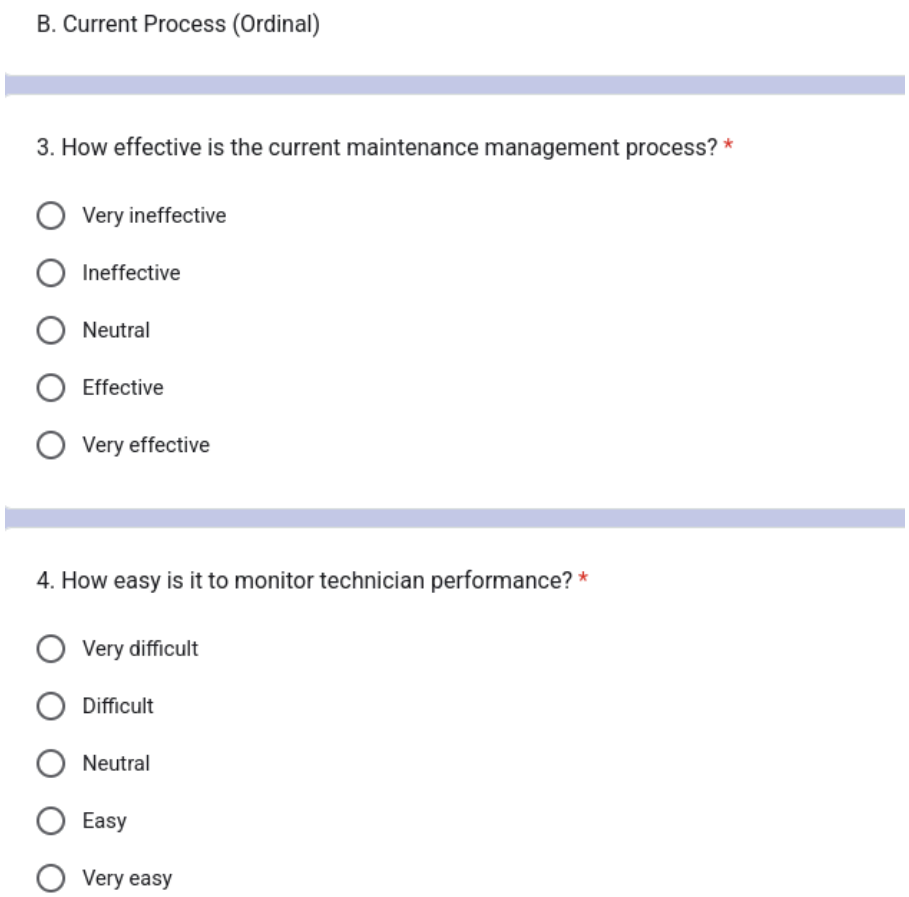


Figure 7: Admin Questionnaire (Ordinal)

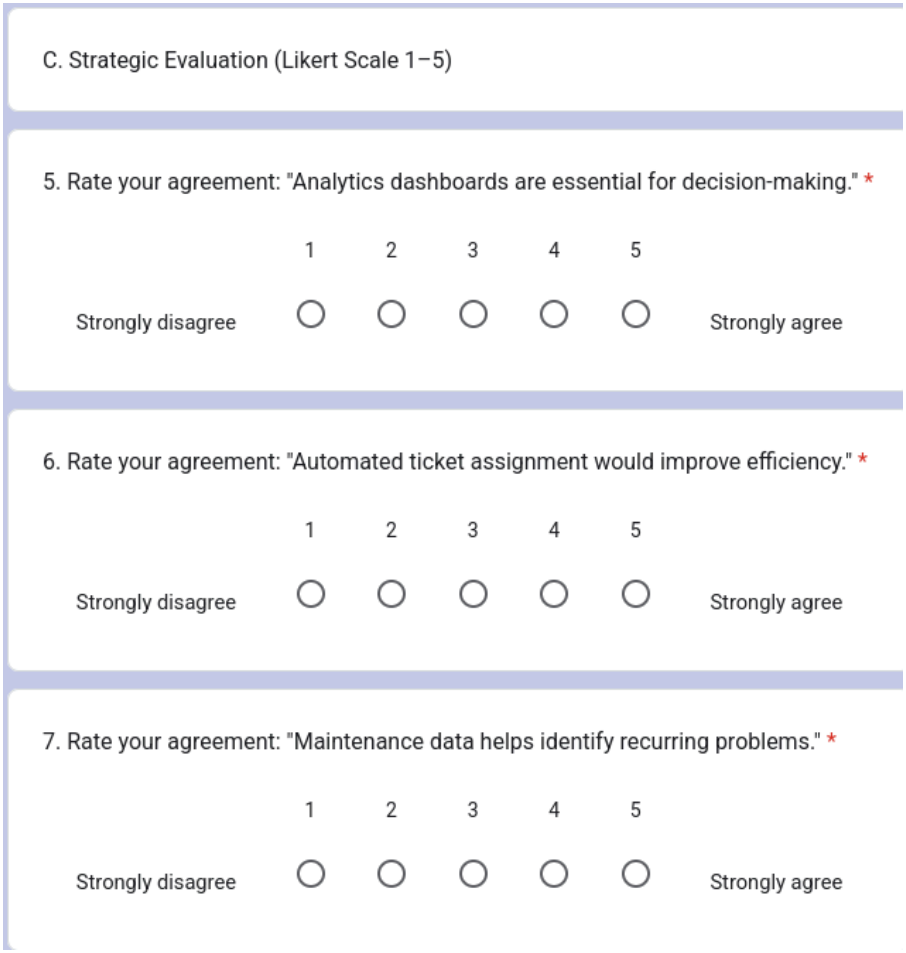


Figure 8: Admin Questionnaire (Interval)

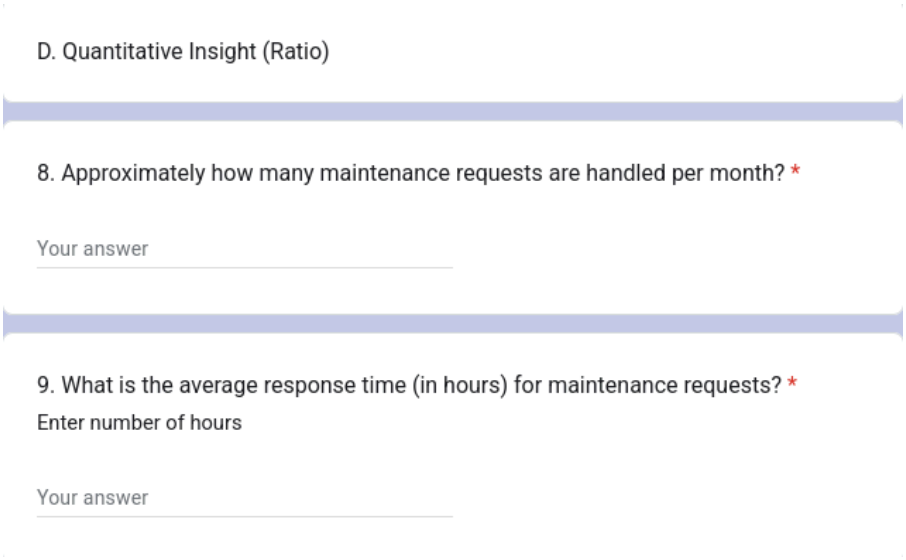


Figure 9: Admin Questionnaire (Ratio)

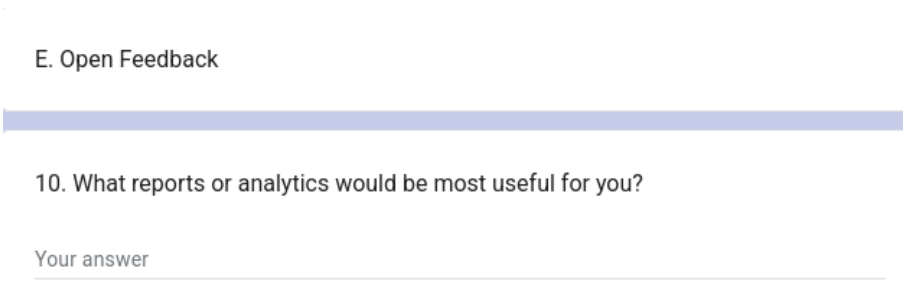
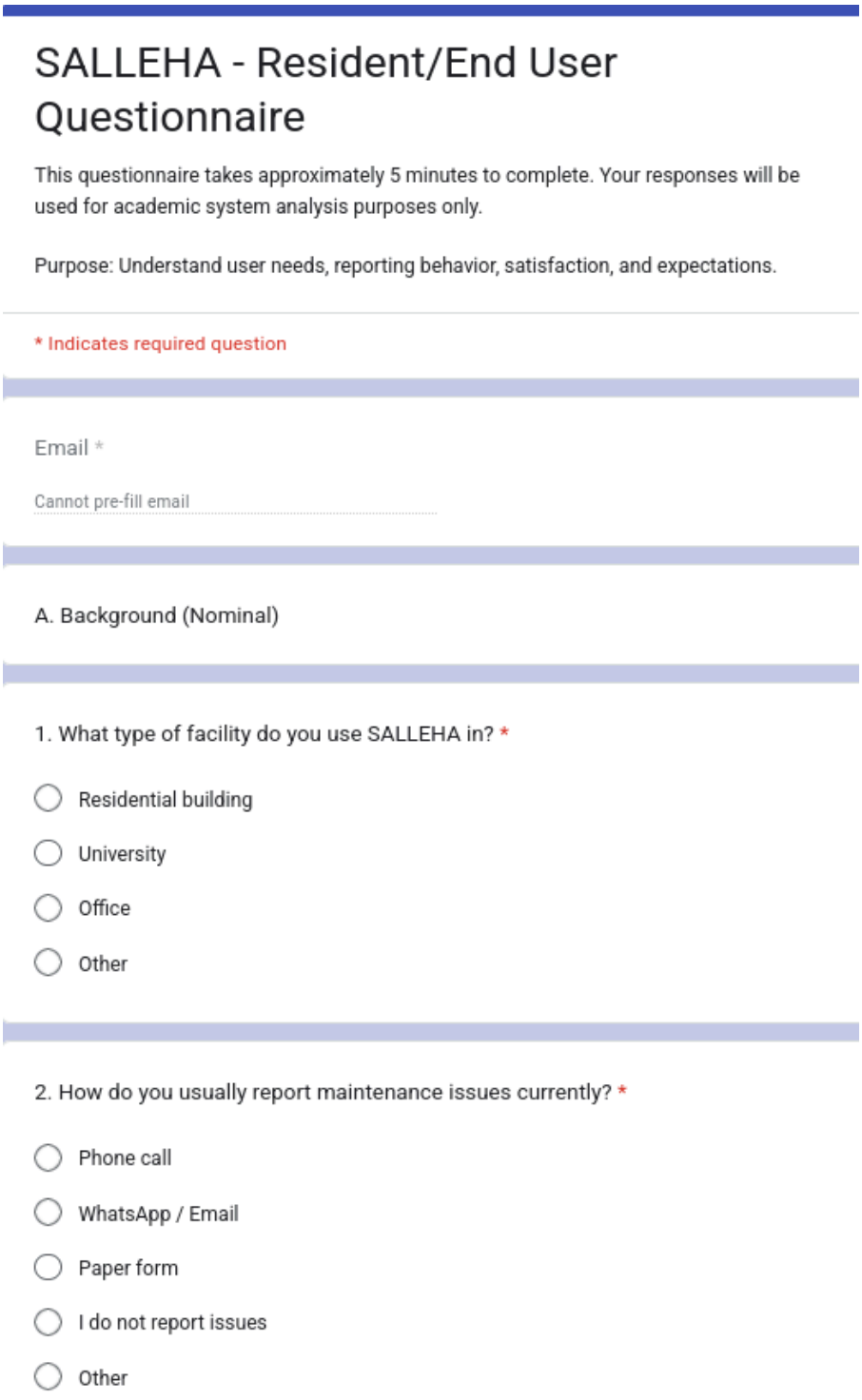


Figure 10: Admin Questionnaire (Open-ended)

- **Resident Questionnaire**



SALLEHA - Resident/End User Questionnaire

This questionnaire takes approximately 5 minutes to complete. Your responses will be used for academic system analysis purposes only.

Purpose: Understand user needs, reporting behavior, satisfaction, and expectations.

* Indicates required question

Email *

Cannot pre-fill email

A. Background (Nominal)

1. What type of facility do you use SALLEHA in? *

- Residential building
- University
- Office
- Other

2. How do you usually report maintenance issues currently? *

- Phone call
- WhatsApp / Email
- Paper form
- I do not report issues
- Other

Figure 11: Resident Questionnaire (Nominal)

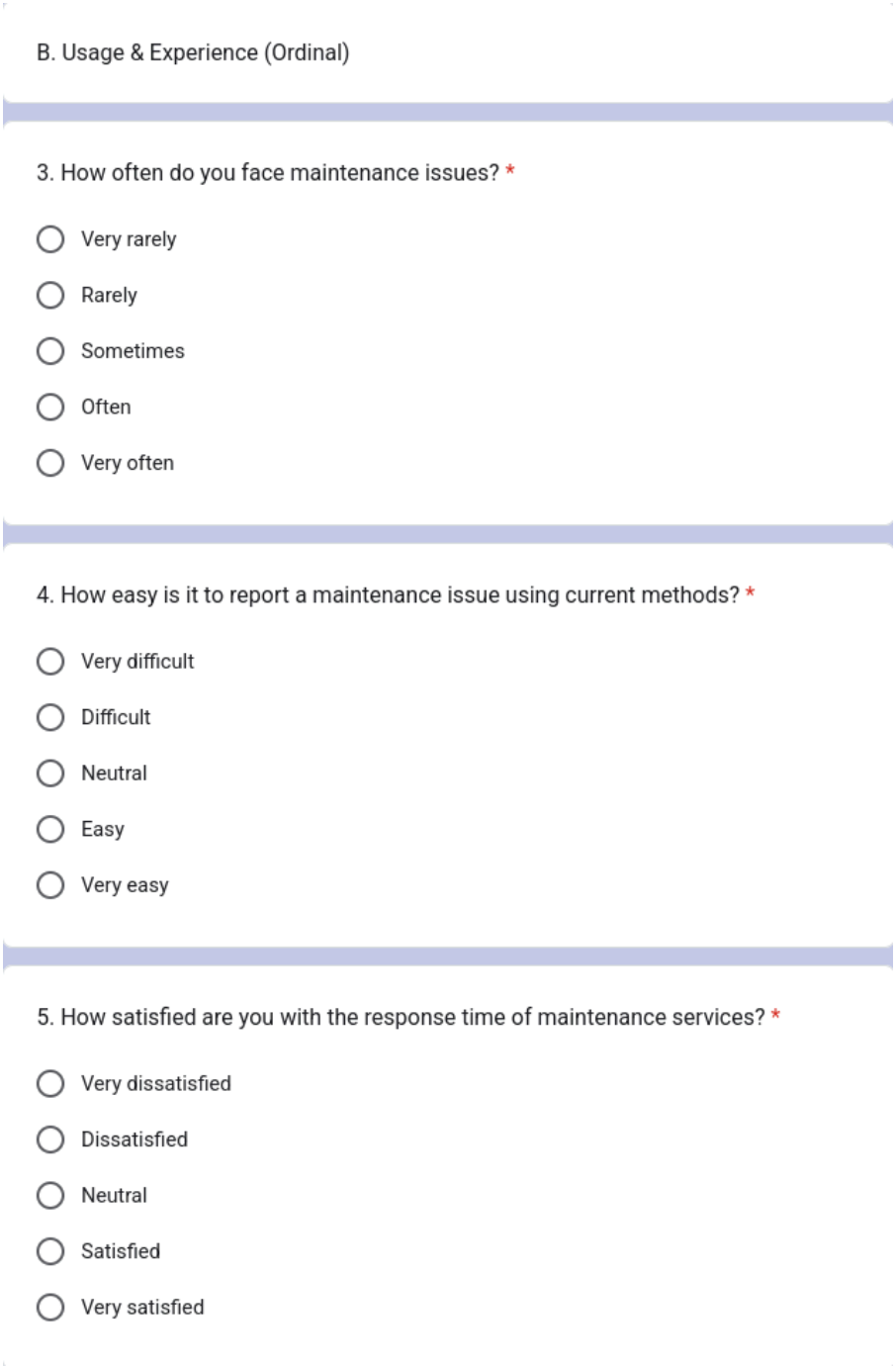


Figure 12: Resident Questionnaire (Ordinal)

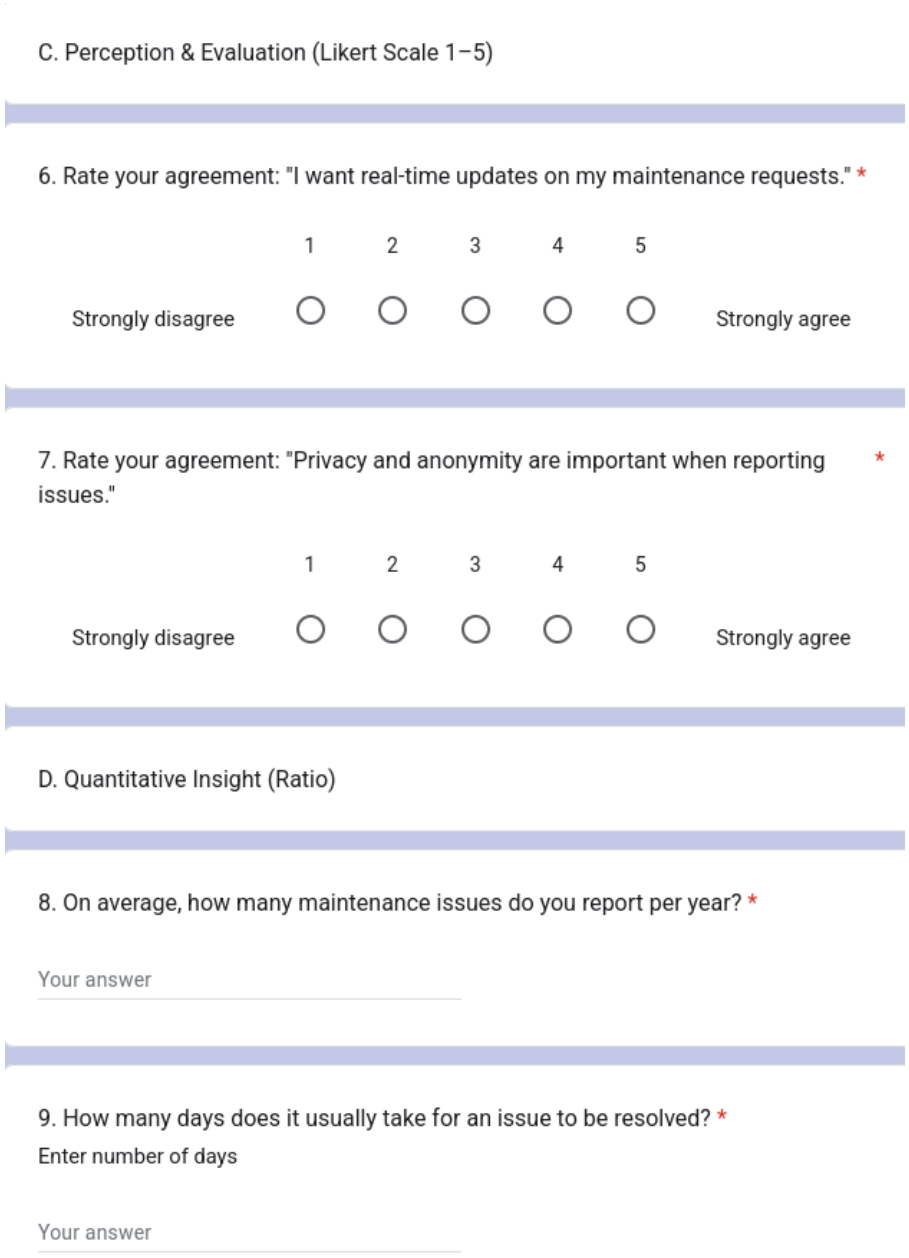


Figure 13: Resident Questionnaire (Interval and Ratio)

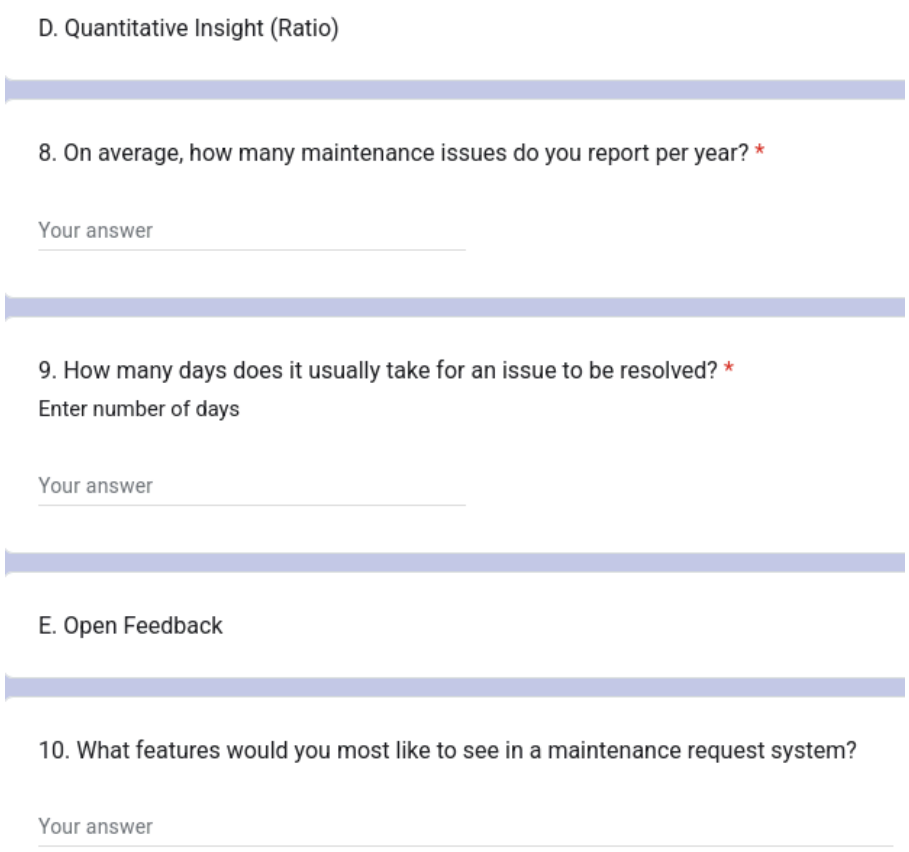
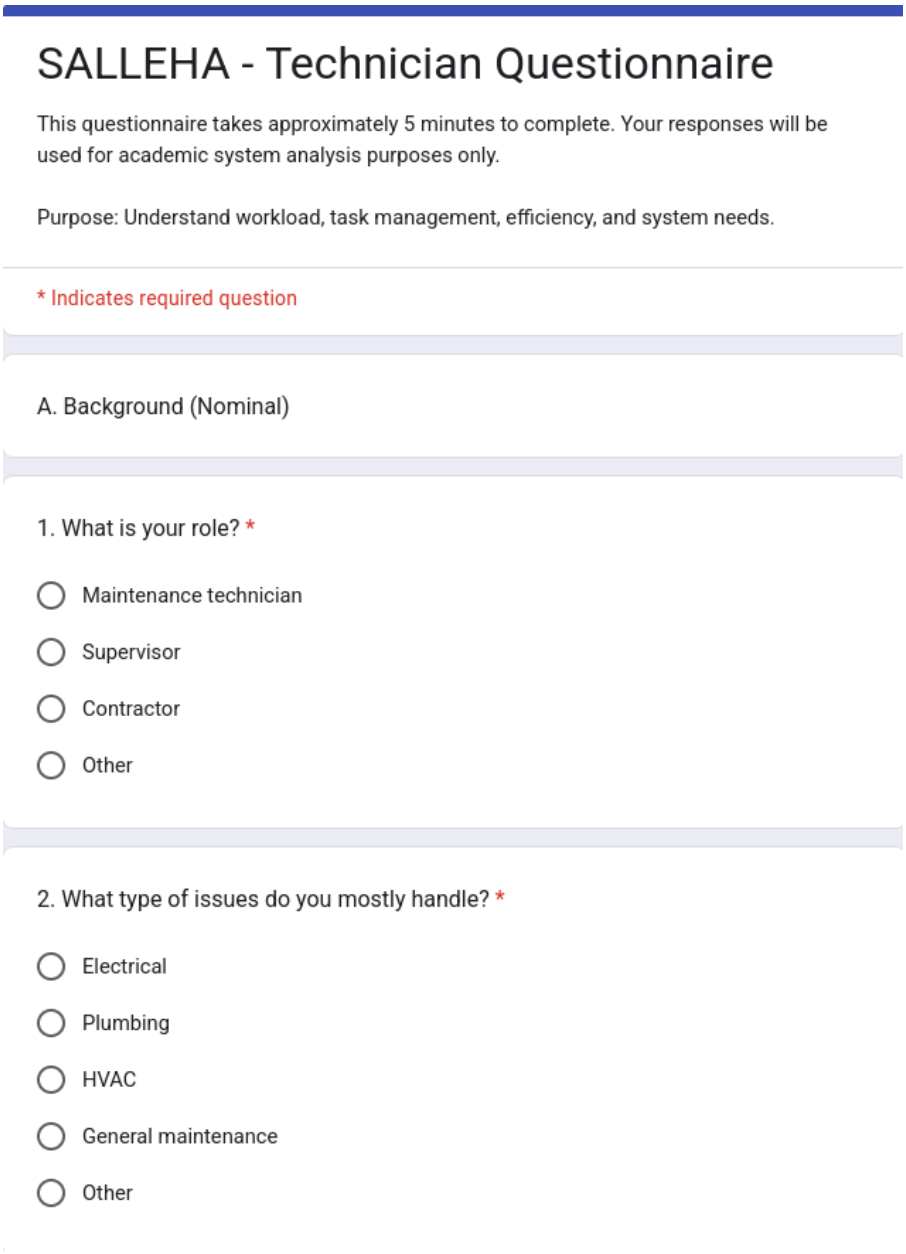


Figure 14: Resident Questionnaire (Open-ended)

- **Technician Questionnaire**



SALLEHA - Technician Questionnaire

This questionnaire takes approximately 5 minutes to complete. Your responses will be used for academic system analysis purposes only.

Purpose: Understand workload, task management, efficiency, and system needs.

* Indicates required question

A. Background (Nominal)

1. What is your role? *

- Maintenance technician
- Supervisor
- Contractor
- Other

2. What type of issues do you mostly handle? *

- Electrical
- Plumbing
- HVAC
- General maintenance
- Other

Figure 15: Technician Questionnaire (Nominal)

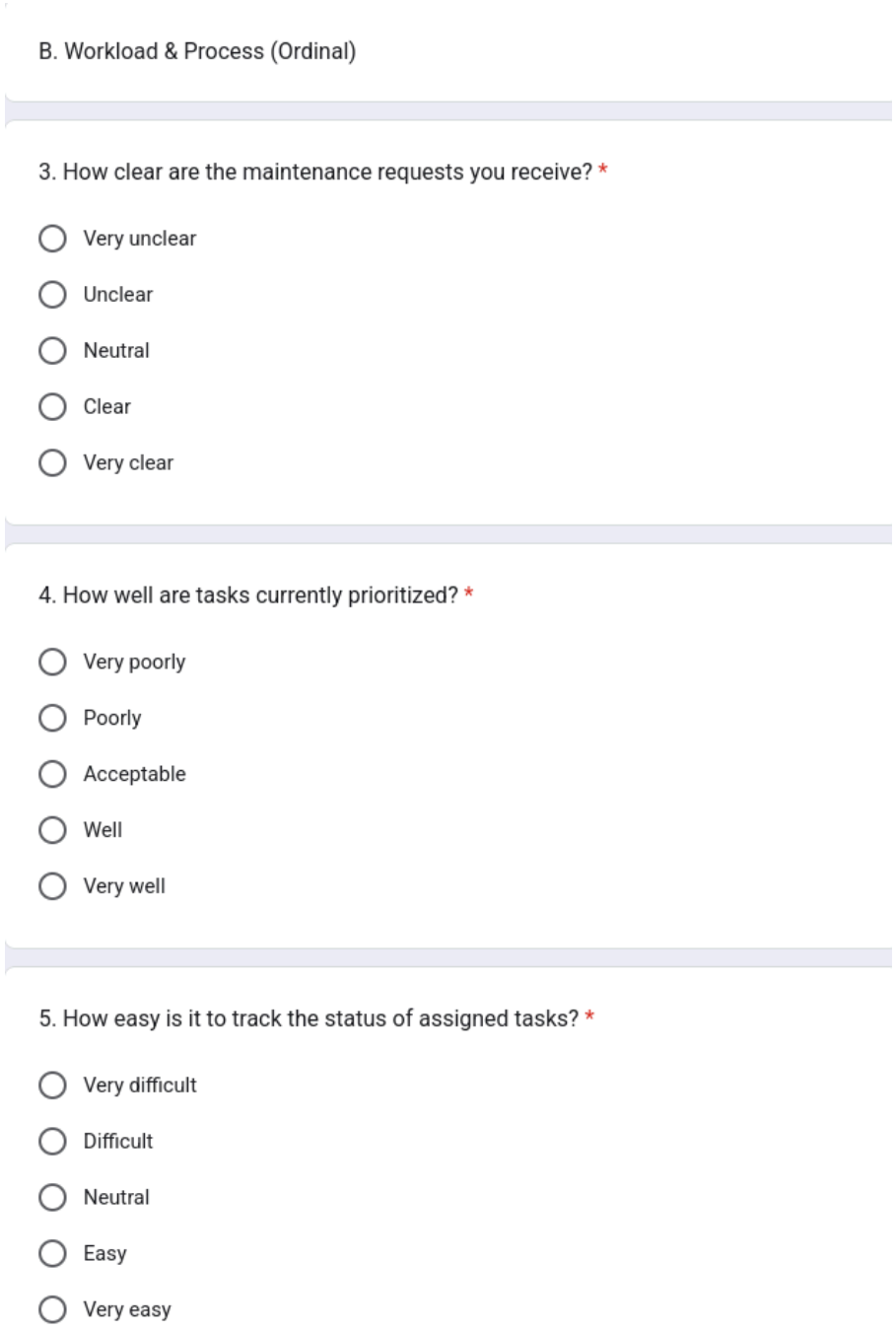


Figure 16: Technician Questionnaire (Ordinal)

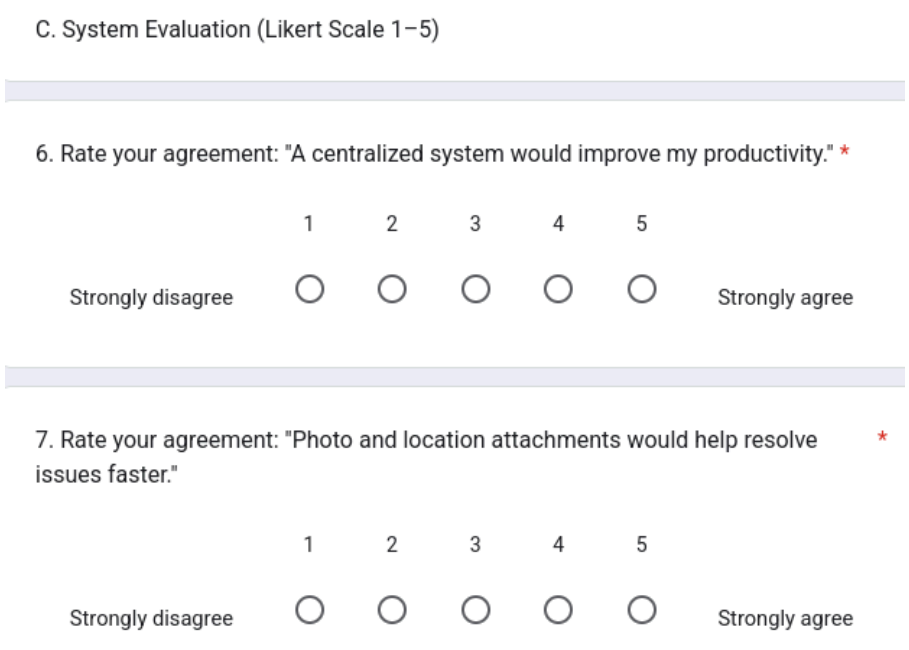


Figure 17: Technician Questionnaire (Interval)

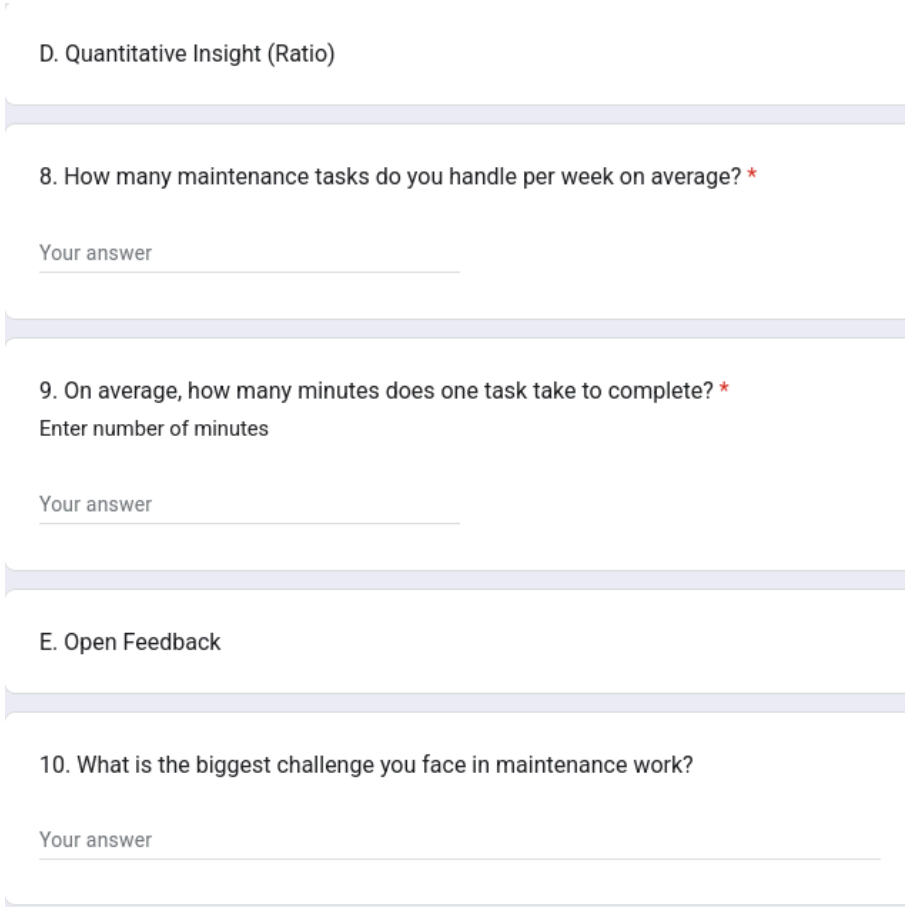


Figure 18: Technician Questionnaire (Ratio and Open-ended)

3.1.2.3. Document Analysis

In this project, we systematically reviewed a range of institutional maintenance-related documents to gain a deeper understanding of stakeholder needs. These included historical mainte-

nance service records, internal workflow reports, facility management evaluations, and previous user feedback from residents, students, and staff. This analysis helped identify inefficiencies, recurring issues, and key areas for improvement within the existing maintenance process. Additionally, it enabled us to uncover implicit requirements not directly expressed by stakeholders, ensuring that the proposed application addresses operational, usability, and performance needs effectively.

3.1.2.4. Observation

Based on the analysis of the questionnaire responses, it was observed that a significant number of participants expressed dissatisfaction with the current organization of maintenance services. Respondents frequently reported unclear reporting procedures, lack of prioritization, and delays caused by poor coordination between involved parties. Many users indicated that they often feel stressed or uncertain due to the absence of timely updates regarding the status of their requests. The findings suggest that implementing a centralized maintenance management system would improve organization, enhance transparency, and ensure continuous status updates. Such a system would reduce user stress, improve communication, and increase overall satisfaction by providing a more structured and reliable maintenance process.

3.1.2.5. Prototype

- **Authentication Screens**

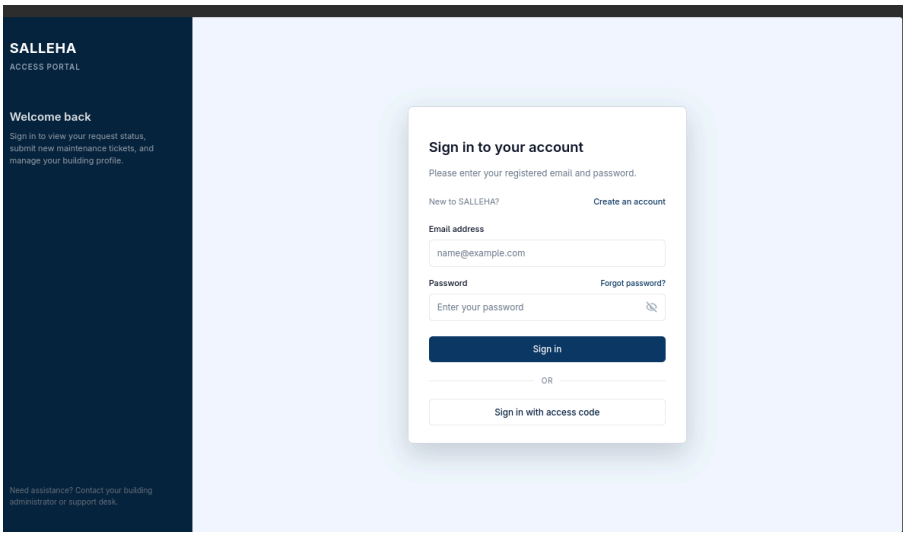


Figure 19: Login Screen

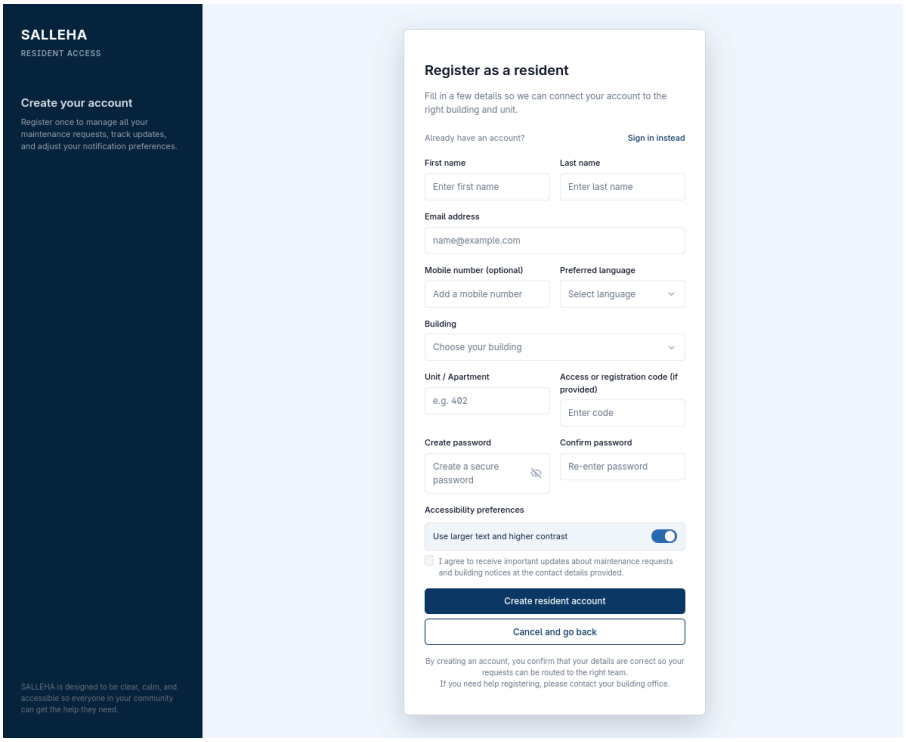


Figure 20: Registration Screen

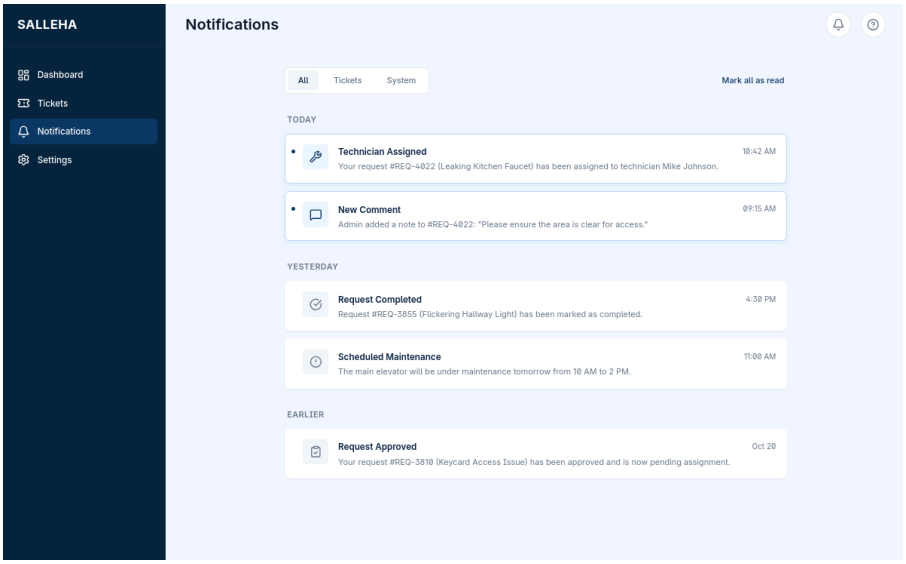


Figure 21: Notifications Screen

- **Resident Prototype Screens**

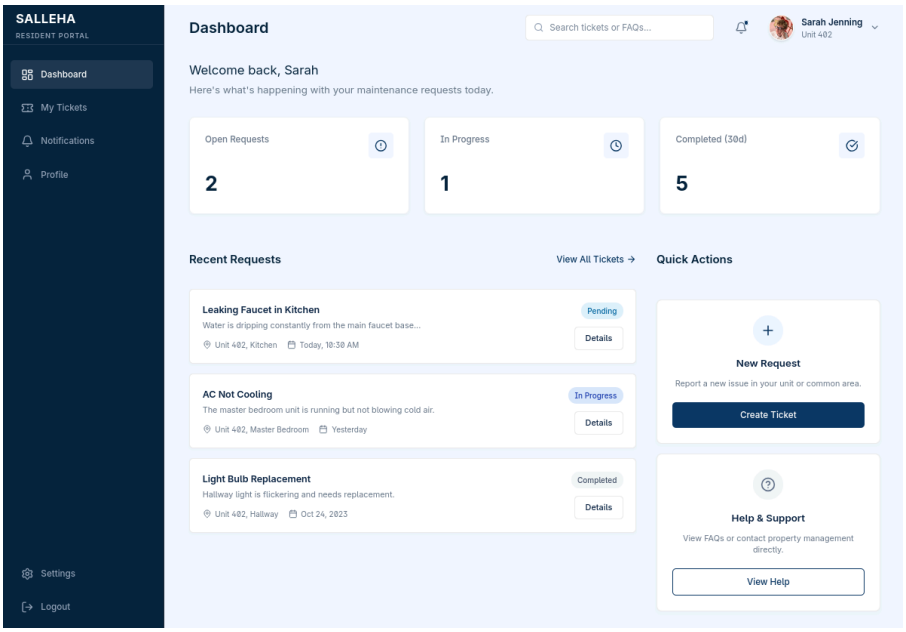


Figure 22: Resident – Dashboard

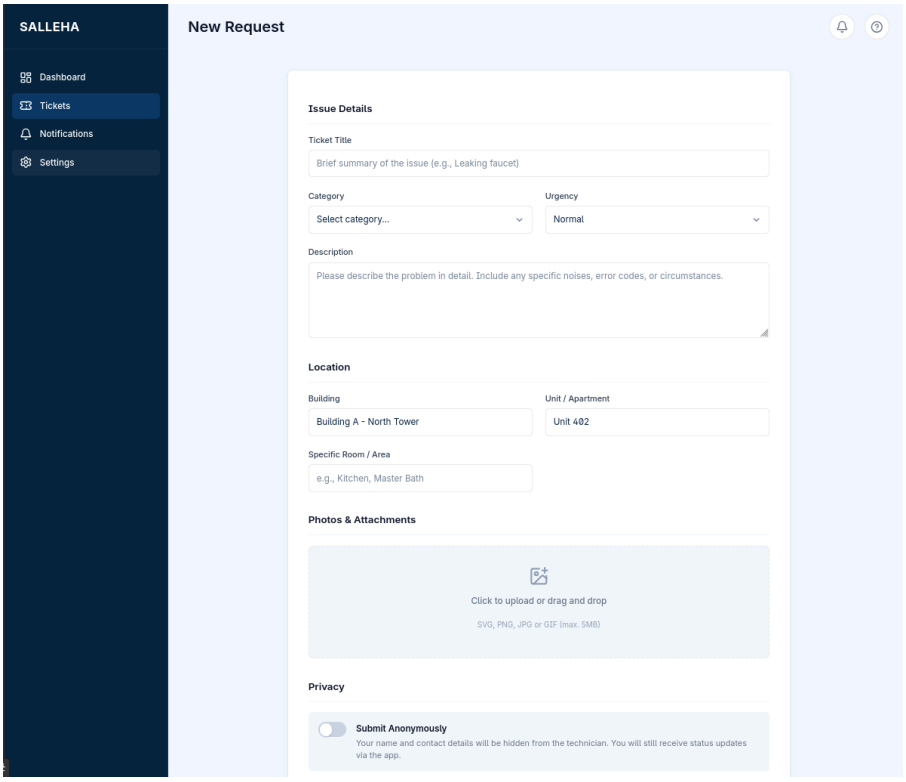


Figure 23: Resident – Ticket Request

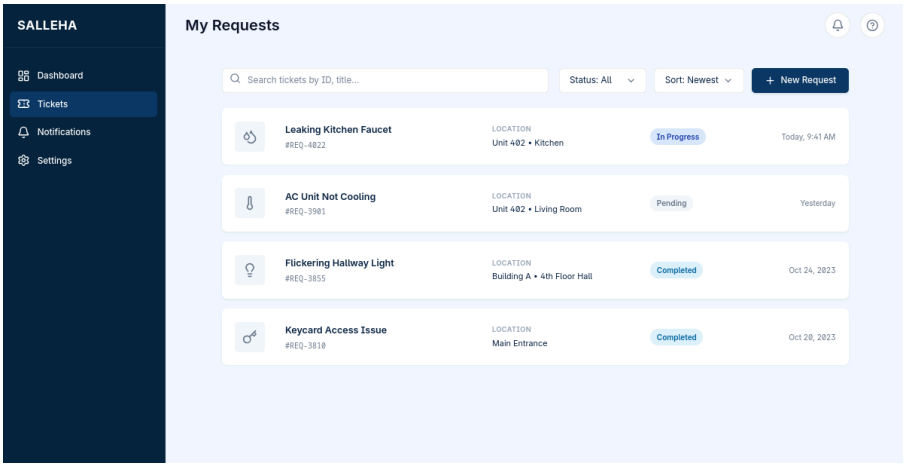


Figure 24: Resident – Tickets Screen

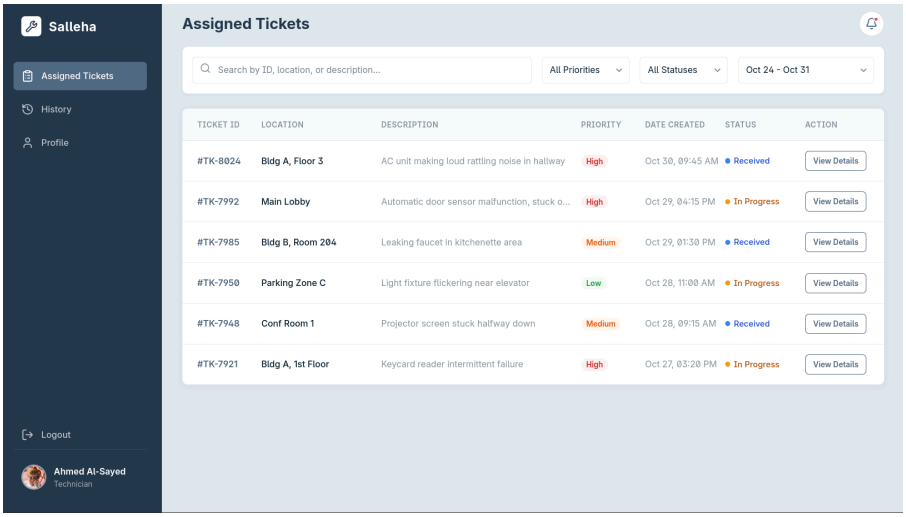


Figure 25: Technician – Dashboard

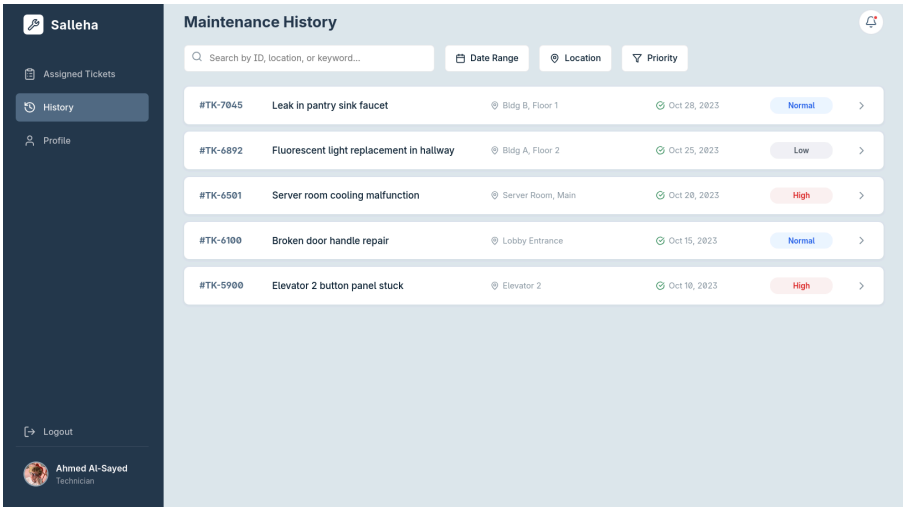


Figure 26: Technician – Maintenance History

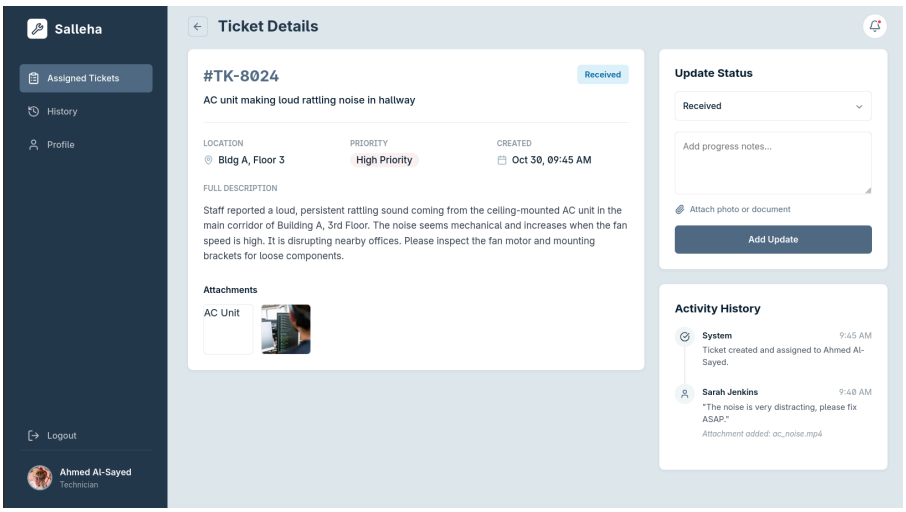


Figure 27: Technician – Ticket Details

- **Administrator Prototype Screens**

Figure 28: Administrator – Dashboard

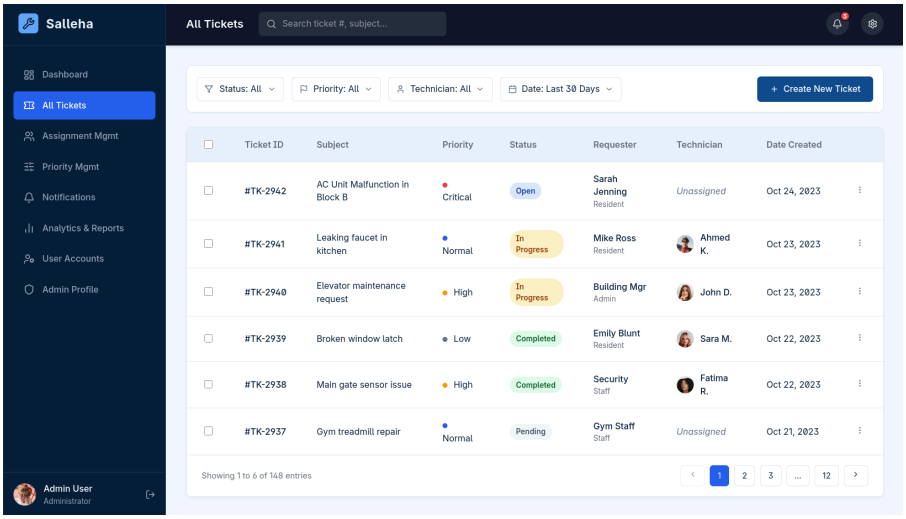


Figure 29: Administrator – All Tickets

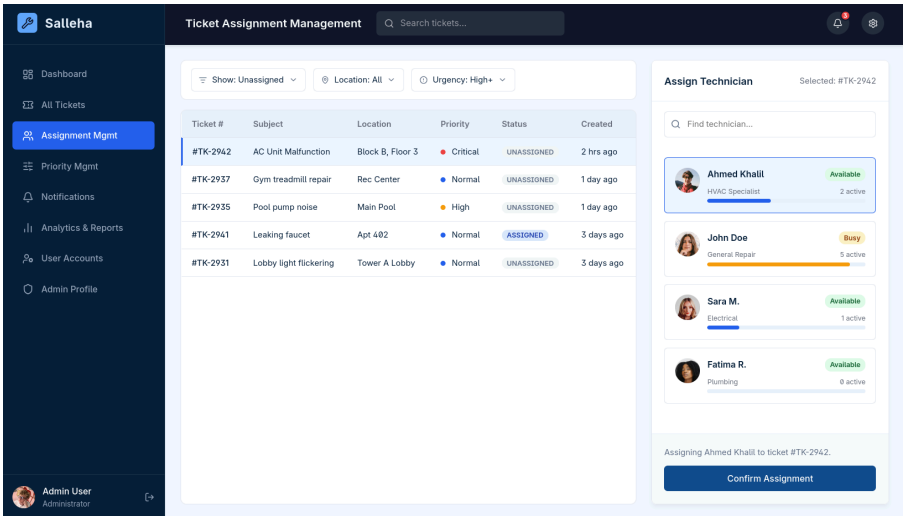


Figure 30: Administrator – Assignment Management

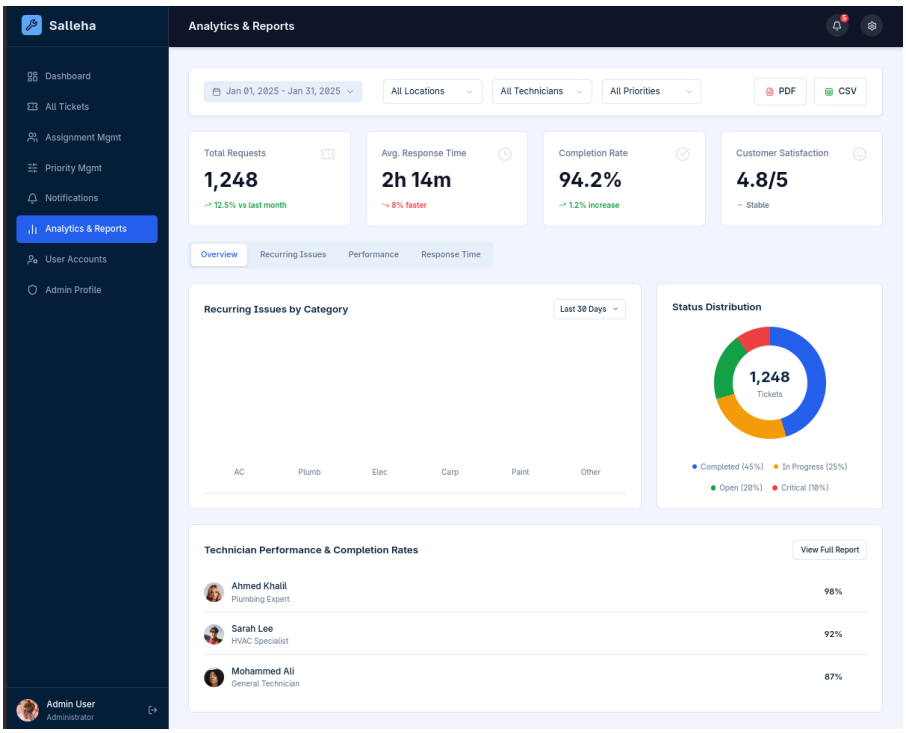


Figure 31: Administrator – Analytics & Reports

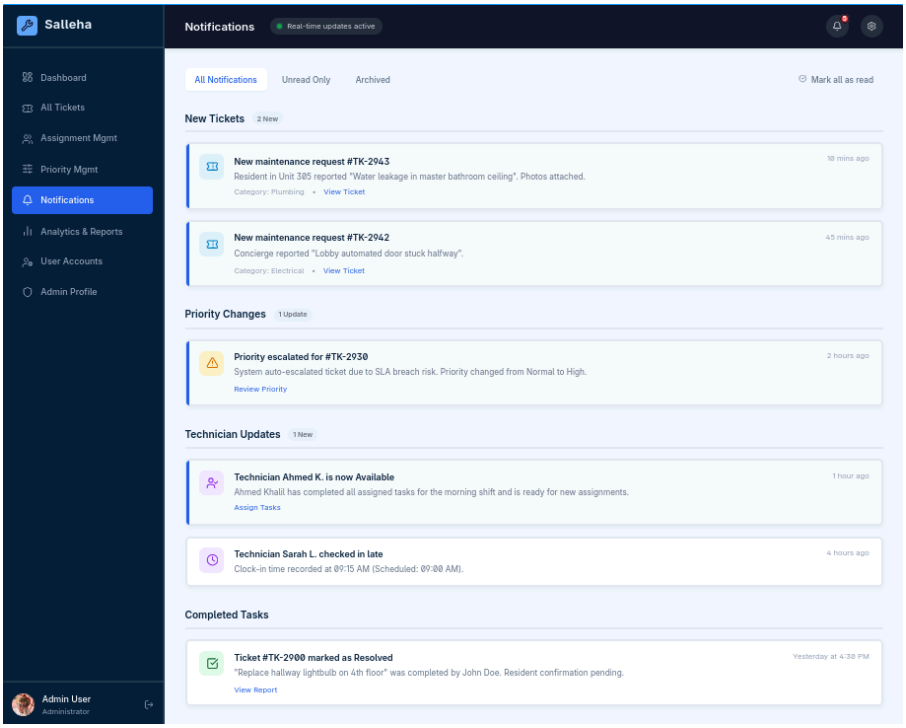


Figure 32: Administrator – Notifications

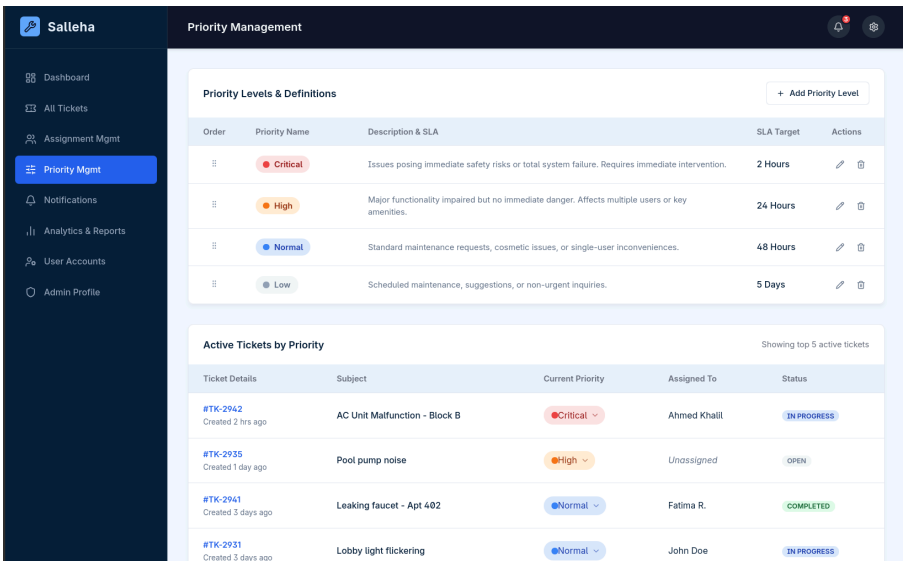


Figure 33: Administrator – Priority Management

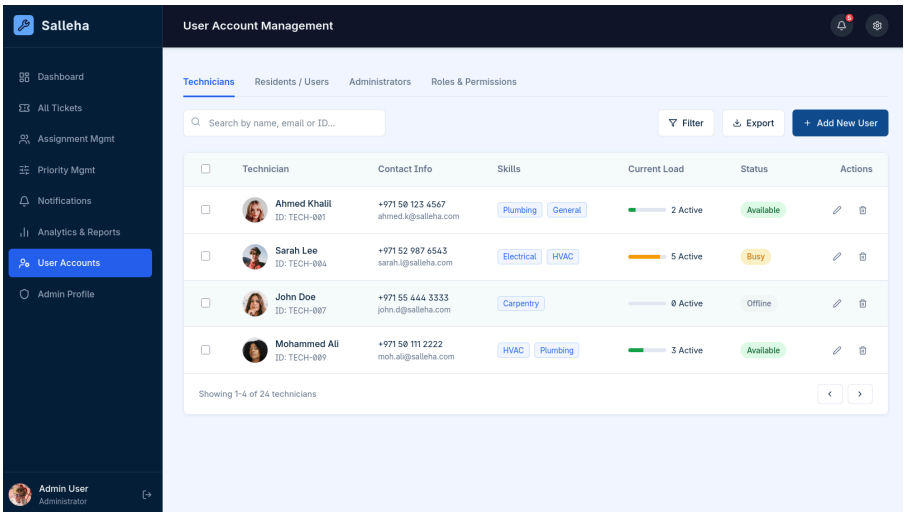


Figure 34: Administrator – User Accounts Management

3.2. User Requirements

Table 20: High level Functional Requirements

FR ID	Function Name	Description	User/Role
FR-1	User Registration	The system shall provide a registration interface where users can create an account by entering full name, email, national ID, username, password, and selecting their role. All fields shall be validated.	All Users
FR-2	User Login	The system shall allow users to log in using only their username and password. The system shall automatically retrieve the user's role	All Users

		from the database and redirect to the appropriate dashboard.	
FR-3	Logout	The system shall provide a logout option accessible from the navigation menu that securely ends the session and redirects to the login page.	All Users
FR-4	Password Recovery	The system shall provide a password recovery mechanism using registered email and national ID with a one-time verification code.	All Users
FR-5	Resident Dashboard	Upon login, residents shall see a dashboard displaying an overview of reported tickets and their current statuses.	Resident
FR-6	Resident Navigation Menu	Residents shall have a navigation menu containing Home, Report Status, Open Ticket, Notifications, Profile.	Resident
FR-7	View Reports Feed	Residents shall view a feed of reported maintenance issues with ticket title, category, location, and status (Open, In Progress, Fixed).	Resident
FR-8	Open Maintenance Ticket	Residents shall open a maintenance ticket with issue category, description, location, priority, and optional images.	Resident
FR-9	Track Ticket Status	Residents shall track the real-time status of their submitted tickets.	Resident
FR-10	Notifications for Residents	Residents shall receive notifications when ticket status changes.	Resident
FR-11	Avoid Duplicate Reports	Residents shall see existing reports to avoid duplicate ticket submissions.	Resident
FR-12	Profile Management	Residents shall view and edit their profile, excluding their role.	Resident
FR-13	Technician Dashboard	Technicians shall see a dashboard showing assigned tasks, pending requests, and statuses.	Technician
FR-14	Technician Navigation Menu	Technicians shall have a navigation menu with Home, Assigned	Technician

		Tasks, Maintenance History, Notifications, Profile.	
FR-15	Accept Maintenance Requests	Technicians shall view and accept maintenance requests assigned by the system or administrators.	Technician
FR-16	Update Task Status	Technicians shall update task status (Open, In Progress, Fixed) as work progresses.	Technician
FR-17	Upload Maintenance Evidence	Technicians shall upload images or notes as evidence of maintenance completion.	Technician
FR-18	Technician Notifications	Technicians shall receive notifications when a new task is assigned or updated.	Technician
FR-19	View Maintenance History	Technicians shall view maintenance history, including equipment and location details.	Technician
FR-20	Technician Analytics	Technicians shall see basic analytics for completed tasks, equipment, and areas.	Technician
FR-21	Admin Dashboard	Administrators shall see a dashboard displaying total tickets, open issues, resolved issues, and technician workload.	Administrator
FR-22	Admin Navigation Menu	Administrators shall have a navigation menu with Home, Ticket Management, Technician Management, Analytics and Reports, Profile.	Administrator
FR-23	Assign Tickets	Administrators shall assign maintenance tickets to technicians based on priority, availability, and expertise.	Administrator
FR-24	Set Ticket Priority	Administrators shall set and modify ticket priority levels.	Administrator
FR-25	Admin Notifications	Administrators shall receive notifications of new tickets, overdue tasks, and completed maintenance work.	Administrator
FR-26	View Analytics	Administrators shall view analytics dashboards for maintenance trends, frequently reported areas,	Administrator

		equipment performance, and task completion times.	
FR-27	Export Reports	Administrators shall export maintenance reports and analytics in PDF or Excel.	Administrator
FR-28	Manage Users	Administrators shall manage registered users, including activating, deactivating, or updating accounts.	Administrator

3.3. Context Diagram

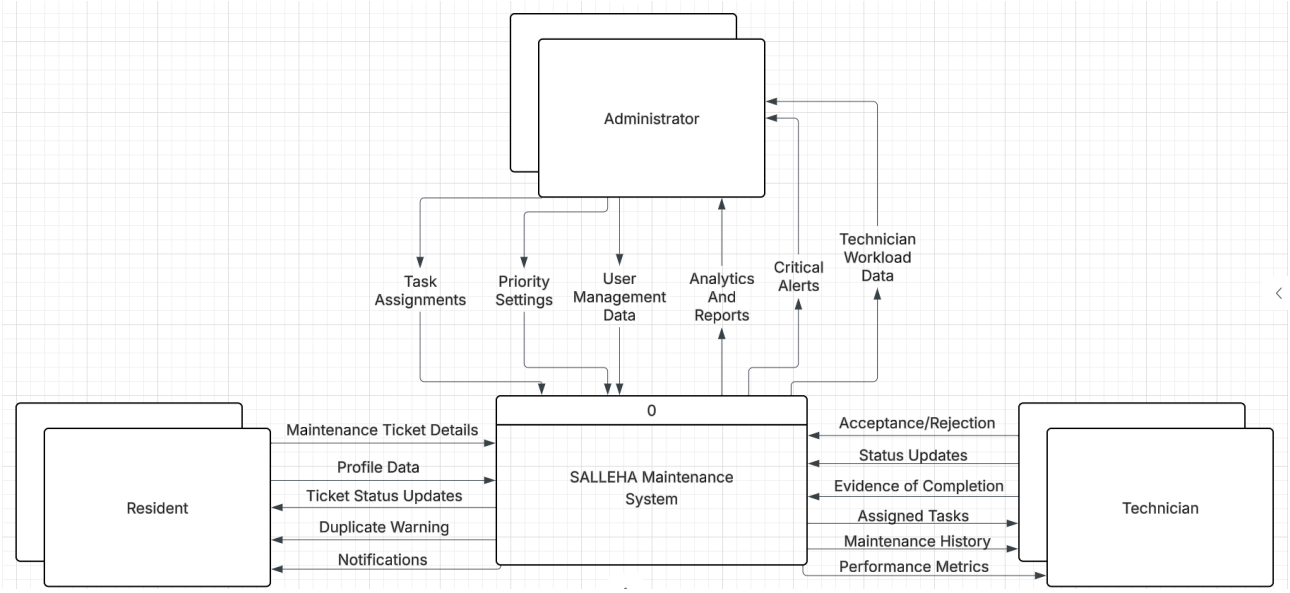


Figure 35: Context Diagram

3.4. Use Case Model

3.4.1. Use Case diagram

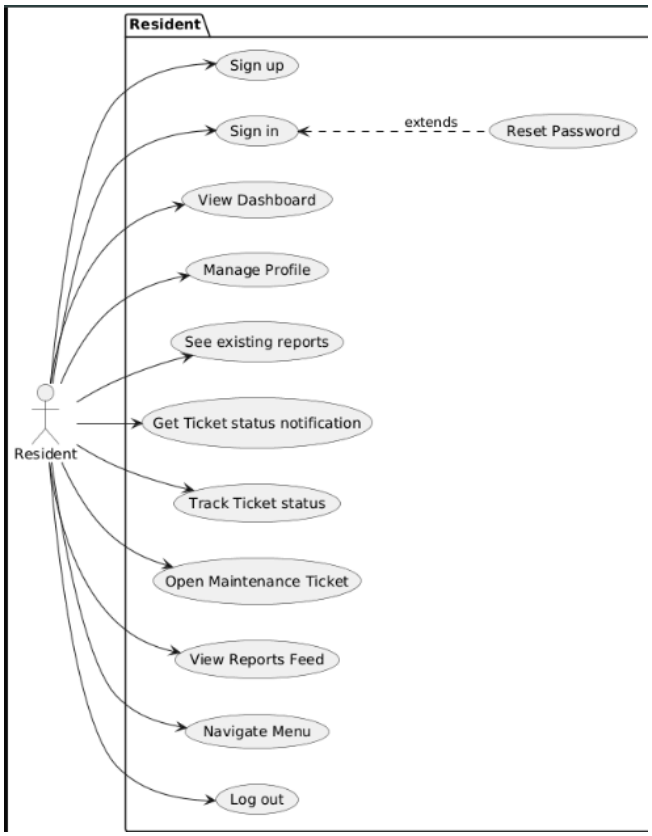


Figure 36: Use Case Diagram - Resident

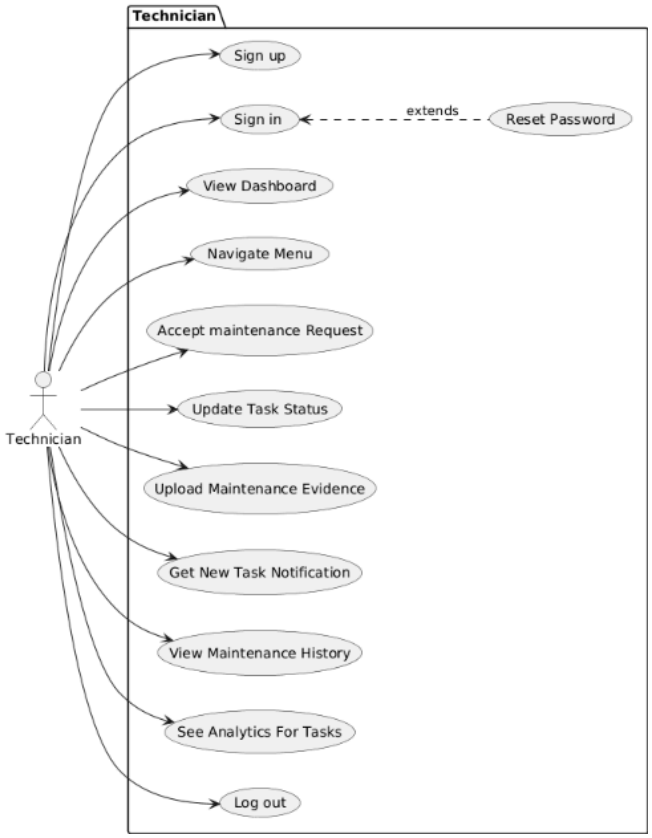


Figure 37: Use Case Diagram - Technician

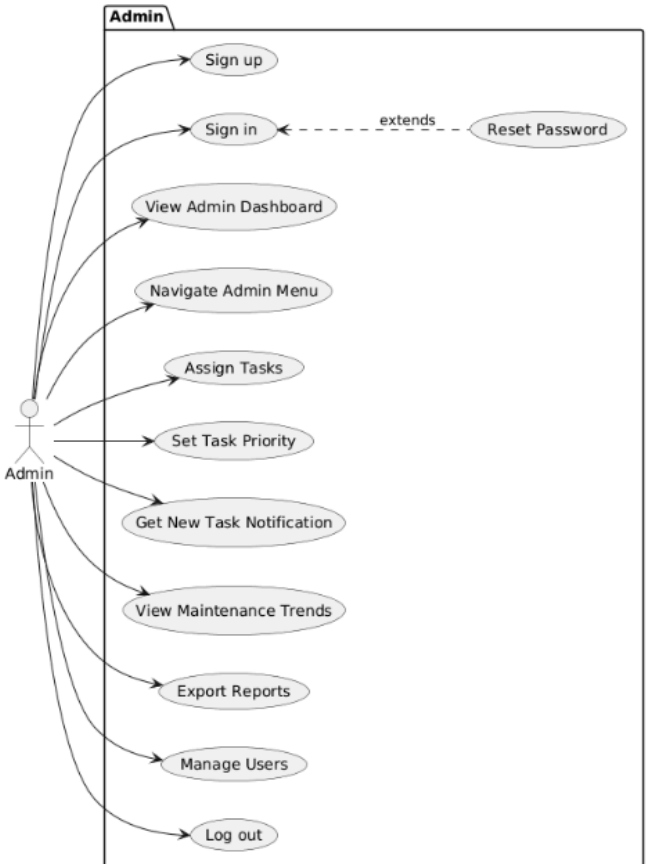


Figure 38: Use Case Diagram - Administrator

3.4.2. Use Case descriptions

Table 21: Use Cases Descriptions

Use Case	Brief Use Case description
Sign Up	Allows users to create an account by entering and validating personal information and role selection.
Sign In	Allows users to log in using username and password and redirects them to the appropriate dashboard.
Reset Password	Allows users to reset their password using email, national ID, and a one-time verification code.
Logout	Allows users to securely end their session and return to the login page.
Manage Profile	Allows users to view and edit their personal profile information.
See existing reports	Displays existing reports to prevent submitting duplicate maintenance tickets.
Get Ticket Status notification	Notifies users when the status of their maintenance tickets changes.
Track Ticket Status	Allows users to monitor the real-time status of submitted maintenance tickets.
Open Maintenance Ticket	Allows users to submit a new maintenance ticket with issue details and optional images.
View Reports Feed	Allows users to view a list of reported maintenance issues with details and status.
Navigate resident Menu	Provides access to system features through a resident navigation menu.
View resident Dashboard	Displays an overview of reported tickets and their current statuses after login.
View Technician Dashboard	Displays assigned tasks, pending requests, and task statuses.
Navigate Technician Menu	Provides technicians with access to task-related features through a navigation menu
Accept Maintenance Requests	Allows technicians to view and accept assigned maintenance tasks.
Update Task Status	Allows technicians to update the status of maintenance tasks as work progresses.
Upload Maintenance Evidence	Allows technicians to upload images or notes as proof of task completion.

Get new task notification	Notifies technicians when tasks are assigned or updated.
View Maintenance History	Allows technicians to view completed maintenance tasks with location and equipment details.
see analytics for tasks	Displays basic analytics related to completed maintenance tasks and areas.
View Admin Dashboard	Displays an overview of tickets, issue statuses, and technician workload
Navigate Admin Menu	Provides administrators with access to management and analytics features.
Assign Tickets	Allows administrators to assign maintenance tickets to technicians based on criteria.
Set Ticket Priority	Allows administrators to set or modify maintenance ticket priority levels.
Get New Tickets notification	Notifies administrators of new, overdue, or completed maintenance tasks.
View Maintenance Trends	Allows administrators to analyze maintenance trends and performance metrics.
Export Reports	Allows administrators to export maintenance reports and analytics in PDF or Excel format.
Manage Users	Allows administrators to activate, deactivate, or update user accounts.

3.5. Functional Requirements Specification

Table 22: FR-1 User Registration

Number	Description
FR-1.1	The system shall allow users to create an account by providing necessary information such as full name, email address, national ID number, username, and password.
FR-1.2	The system shall require users to select their role during registration: Resident, Technician, or Administrator.
FR-1.3	The system shall validate all input fields in real-time, including email format, password strength (minimum 8 characters with uppercase, lowercase, number, and special character), and national ID uniqueness.
FR-1.4	The system shall display clear error messages when validation fails and prevent form submission until all fields are valid.
FR-1.5	The system shall securely hash and store passwords in the database using industry-standard encryption algorithms.
FR-1.6	The system shall send a confirmation email to the user's registered email address with an activation link to verify the account.

FR-1.7	The system shall require email verification before allowing the user to log in to the system.
FR-1.8	The system shall prevent duplicate registrations using the same email address or national ID number.

Table 23: FR-2 User Login

Number	Description
FR-2.1	The system shall provide a login interface where users can enter their username and password.
FR-2.2	The system shall authenticate users against stored credentials in the database.
FR-2.3	The system shall automatically retrieve the user's role from the database upon successful authentication.
FR-2.4	The system shall redirect users to their role-specific dashboard after successful login: Resident Dashboard, Technician Dashboard, or Administrator Dashboard.
FR-2.5	The system shall display a CAPTCHA challenge after 3 consecutive failed login attempts to prevent brute-force attacks.
FR-2.6	The system shall lock the account temporarily after 5 consecutive failed login attempts, requiring administrative intervention or email verification to unlock.
FR-2.7	The system shall maintain user sessions with appropriate timeout periods: 30 minutes of inactivity for Residents, 15 minutes for Technicians, and 60 minutes for Administrators.
FR-2.8	The system shall provide a "Remember Me" option that extends the session duration to 30 days for convenience.

Table 24: FR-3 Logout

Number	Description
FR-3.1	The system shall provide a logout option accessible from the main navigation menu on all pages.
FR-3.2	The system shall immediately terminate the user's session upon logout.
FR-3.3	The system shall clear all session data and authentication tokens.
FR-3.4	The system shall redirect the user to the login page after successful logout.
FR-3.5	The system shall display a confirmation message indicating successful logout.

Table 25: FR-4 Password Recovery

Number	Description
FR-4.1	The system shall provide a "Forgot Password" link on the login page.
FR-4.2	The system shall require users to enter their registered email address and national ID number to initiate password recovery.
FR-4.3	The system shall verify that the email and national ID match a valid user account in the database.

FR-4.4	The system shall generate a unique, time-limited (15 minutes) one-time verification code and send it to the user's registered email.
FR-4.5	The system shall require users to enter the verification code received via email.
FR-4.6	The system shall allow users to create a new password only after successful verification code validation.
FR-4.7	The system shall require password confirmation (re-typing the new password) to prevent typographical errors.
FR-4.8	The system shall enforce the same password strength requirements as during registration.
FR-4.9	The system shall prevent reusing the last 3 previously used passwords.
FR-4.10	The system shall send a confirmation email to the user's registered email address once the password has been successfully changed.

Table 26: FR-5 Resident Dashboard

Number	Description
FR-5.1	The system shall display a personalized dashboard for residents upon successful login.
FR-5.2	The dashboard shall show an overview of all tickets submitted by the resident, categorized by status: Open, In Progress, Fixed.
FR-5.3	The system shall display a summary widget showing: total tickets submitted, currently open tickets, and tickets fixed in the last 30 days.
FR-5.4	The system shall provide a quick action button to "Report New Issue" prominently displayed on the dashboard.
FR-5.5	The system shall show recent activity, including status changes to tickets, with timestamps.
FR-5.6	The system shall provide a search functionality to filter tickets by ticket ID, category, or date range.
FR-5.7	The system shall display notifications count in a badge on the dashboard header.
FR-5.8	The dashboard shall be responsive and adapt to different screen sizes (desktop, tablet, mobile).

Table 27: FR-6 Resident Navigation Menu

Number	Description
FR-6.1	The system shall provide a consistent navigation menu accessible from all resident pages.
FR-6.2	The navigation menu shall include the following items: Home (Dashboard), Report Status, Open Ticket, Notifications, Profile.
FR-6.3	The system shall highlight the currently active menu item for user orientation.
FR-6.4	The navigation menu shall collapse to a hamburger menu on mobile devices.
FR-6.5	The system shall display the user's name and role in the navigation header.

FR-6.6	The system shall include a logout button in the navigation menu.

Table 28: FR-7 Maintenance Issue Feed

Number	Description
FR-7.1	The system shall display a feed of reported maintenance issues accessible to residents.
FR-7.2	Each entry in the feed shall display: Ticket Title, Category, Location (Building/Room), Status (Open/In Progress/Fixed), and Date Reported.
FR-7.3	The system shall allow residents to filter the feed by: Category (Plumbing, Electrical, HVAC, Structural, Other), Status, and Date Range.
FR-7.4	The system shall provide a search functionality within the feed to find specific issues by keywords.
FR-7.5	The system shall indicate tickets submitted by the logged-in resident with a "Your Ticket" badge.
FR-7.6	The system shall prevent display of sensitive information or personal details of other residents.
FR-7.7	The system shall update the feed in real-time when new tickets are submitted or statuses change.
FR-7.8	The system shall paginate results if more than 20 items are displayed.

Table 29: FR-8 Open Maintenance Ticket

Number	Description
FR-8.1	The system shall provide a form for residents to submit new maintenance tickets.
FR-8.2	The form shall require the following mandatory fields: Issue Category (dropdown), Description (text area), Location (dropdown or text), Priority (Low/Medium/High/Urgent).
FR-8.3	The system shall allow residents to upload up to 5 images (JPEG, PNG, max 5MB each) to illustrate the issue.
FR-8.4	The system shall provide a preview of uploaded images before submission.
FR-8.5	The system shall validate that the description contains at least 20 characters to ensure adequate detail.
FR-8.6	The system shall check for duplicate tickets by comparing category, location, and description with recent (last 7 days) submissions.
FR-8.7	The system shall show a warning if a similar ticket exists, with an option to proceed or cancel.
FR-8.8	The system shall generate a unique ticket ID (format: TKT-YYYYMMDD-XXXXX) upon successful submission.
FR-8.9	The system shall display a confirmation page with the ticket ID and estimated response time based on priority.

Table 30: FR-9 Ticket Status Tracking

Number	Description
FR-9.1	The system shall allow residents to track the real-time status of their submitted tickets.
FR-9.2	The system shall display a visual status indicator showing the current stage: Submitted → Assigned → In Progress → Fixed → Closed.
FR-9.3	The system shall show the timestamp for each status change.
FR-9.4	For tickets "In Progress," the system shall display the assigned technician's name (if available).
FR-9.5	The system shall provide estimated time to completion based on priority and historical data.
FR-9.6	The system shall allow residents to add follow-up comments to their tickets, which will be visible to technicians and administrators.
FR-9.7	The system shall prevent residents from modifying the original ticket details after submission, except for adding comments.
FR-9.8	The system shall provide a "Mark as Urgent" option for tickets that have exceeded their estimated completion time.

Table 31: FR-10 Status Change Notifications

Number	Description
FR-10.1	The system shall automatically notify residents when their ticket status changes.
FR-10.2	Notifications shall be delivered through: In-app notification bell, Email (optional), SMS (optional, configurable).
FR-10.3	The notification shall include: Ticket ID, New Status, Timestamp, and a direct link to view the ticket details.
FR-10.4	The system shall allow residents to configure notification preferences for each type of status change.
FR-10.5	The system shall group related notifications (multiple status changes within a short period) to avoid notification overload.
FR-10.6	The system shall maintain a notification history accessible to residents for 90 days.

Table 32: FR-11 Duplicate Ticket Prevention

Number	Description
FR-11.1	The system shall show residents existing reports in the same location/category before they submit a new ticket.
FR-11.2	The system shall automatically detect potential duplicates by comparing: issue category, location, description keywords, and submission date (within last 7 days).
FR-11.3	When a potential duplicate is detected, the system shall display a warning message with links to the existing similar tickets.

FR-11.4	The system shall provide residents with the option to: proceed with new submission, add a comment to existing ticket, or cancel submission.
FR-11.5	The system shall allow residents to "follow" existing tickets to receive updates on their progress.
FR-11.6	The system shall track duplicate detection accuracy and allow administrators to adjust sensitivity thresholds.

Table 33: FR-12 Resident Profile Management

Number	Description
FR-12.1	The system shall allow residents to view their profile information including: full name, email, national ID, username, registration date.
FR-12.2	The system shall allow residents to edit the following fields: full name, email address, password, profile picture.
FR-12.3	The system shall prevent residents from editing their role, national ID, and registration date.
FR-12.4	The system shall require password verification before allowing sensitive changes (email, password).
FR-12.5	The system shall validate new email addresses by sending a verification link before applying the change.
FR-12.6	The system shall maintain an audit log of all profile changes with timestamp and IP address.
FR-12.7	The system shall allow residents to export their profile data in PDF format.

Table 34: FR-13 Technician Dashboard

Number	Description
FR-13.1	The system shall display a personalized dashboard for technicians upon successful login.
FR-13.2	The dashboard shall show assigned tasks categorized by: Pending (not started), In Progress, Completed Today, Overdue.
FR-13.3	The system shall display key performance metrics: total assigned tasks, completion rate (%), average resolution time, customer satisfaction rating.
FR-13.4	The system shall provide a calendar view showing scheduled maintenance tasks.
FR-13.5	The dashboard shall display urgent/high-priority tasks in a prominent "Priority Queue" section.
FR-13.6	The system shall show notifications for: new task assignments, task status updates from residents, scheduled maintenance reminders.
FR-13.7	The system shall provide quick action buttons: "Start Next Task", "View All Tasks", "Update Status".
FR-13.8	The dashboard shall display workload distribution across technicians (visible to technicians with team lead permissions).

Table 35: FR-14 Technician Navigation Menu

Number	Description
FR-14.1	The system shall provide a consistent navigation menu accessible from all technician pages.
FR-14.2	The navigation menu shall include: Home (Dashboard), Assigned Tasks, Maintenance History, Notifications, Profile, Logout.
FR-14.3	For technicians with team lead permissions, the menu shall include additional items: Team Schedule, Performance Reports.
FR-14.4	The system shall display the technician's current status (Available/Busy/On Break) in the navigation header.
FR-14.5	The system shall provide a quick status toggle button in the navigation menu to update availability.
FR-14.6	The navigation menu shall show badge counts for: pending tasks, unread notifications.
FR-14.7	The system shall collapse the navigation menu to an icon-only view on tablet devices.

Table 36: FR-15 Maintenance Request Management

Number	Description
FR-15.1	The system shall allow technicians to view maintenance requests assigned by the system or administrators.
FR-15.2	The system shall display request details including: ticket ID, issue category, location, priority, description, submitted images, resident contact information.
FR-15.3	Technicians shall be able to accept or decline assigned tasks, with a required reason for declining.
FR-15.4	The system shall automatically reassign declined tasks to the next available technician based on expertise and workload.
FR-15.5	Technicians shall be able to filter tasks by: priority, location, category, due date, or status.
FR-15.6	The system shall provide a "Claim Task" feature for technicians to voluntarily take unassigned tasks matching their expertise.
FR-15.7	The system shall display estimated time to complete based on similar historical tasks.
FR-15.8	Technicians shall be able to request additional information from the resident before accepting a task.

Table 37: FR-16 Task Status Updates

Number	Description
FR-16.1	The system shall allow technicians to update task status through the following workflow: Open → In Progress → Fixed → Closed.

FR-16.2	When changing status to “In Progress,” the system shall record start time and expected completion time.
FR-16.3	When changing status to “Fixed,” the system shall require: completion notes, actual resolution time, and optional images.
FR-16.4	Technicians shall be able to set a task to “On Hold” with reason codes: Waiting for Parts, Requires Specialist, Resident Not Available.
FR-16.5	The system shall automatically escalate tasks that remain “In Progress” beyond the estimated completion time.
FR-16.6	Technicians shall be able to reassign tasks to other technicians with proper justification and administrator approval.
FR-16.7	All status changes shall be timestamped and recorded in the task history.
FR-16.8	The system shall notify the resident and administrator of significant status changes.

Table 38: FR-17 Maintenance Evidence Submission

Number	Description
FR-17.1	The system shall allow technicians to upload images as evidence of maintenance completion.
FR-17.2	The system shall support multiple image formats: JPEG, PNG, with maximum file size of 10MB per image.
FR-17.3	Technicians shall be able to add descriptive captions to each uploaded image.
FR-17.4	The system shall allow technicians to add completion notes describing: work performed, parts used, time spent, any follow-up required.
FR-17.5	The system shall provide a checklist of standard completion criteria based on issue category.
FR-17.6	Technicians shall be able to attach PDF documents such as: warranty information, part specifications, safety checklists.
FR-17.7	The system shall require at least one piece of evidence (image or detailed notes) before marking a task as “Fixed.”
FR-17.8	All submitted evidence shall be stored securely with timestamps and technician identification.

Table 39: FR-18 Technician Notifications

Number	Description
FR-18.1	The system shall notify technicians when a new task is assigned to them.
FR-18.2	The system shall notify technicians of updates to assigned tasks, including: resident comments, priority changes, due date adjustments.
FR-18.3	Notifications shall be delivered through: in-app notifications, push notifications (mobile app), SMS for urgent tasks.
FR-18.4	The system shall provide priority-based notification levels: High (immediate), Medium (within 15 minutes), Low (within 1 hour).

FR-18.5	Technicians shall be able to set “Do Not Disturb” periods during which only emergency notifications are delivered.
FR-18.6	The system shall group related notifications to reduce notification fatigue.
FR-18.7	Technicians shall be able to customize notification preferences by: notification type, delivery method, time of day.

Table 40: FR-19 Maintenance History Access

Number	Description
FR-19.1	The system shall provide technicians access to complete maintenance history for equipment and locations.
FR-19.2	The history shall include: ticket ID, issue description, location details, equipment ID, technician assigned, resolution details, date/time stamps.
FR-19.3	Technicians shall be able to filter history by: equipment ID, location, date range, technician, issue category.
FR-19.4	The system shall display recurring issues patterns and suggest preventive maintenance schedules.
FR-19.5	Technicians shall be able to view equipment-specific history including: all previous maintenance, warranty information, manufacturer details.
FR-19.6	The system shall provide a “Similar Issues” feature showing historical resolutions for current problems.
FR-19.7	Technicians shall be able to export maintenance history for specific equipment or locations in CSV format.

Table 41: FR-20 Basic Analytics for Technicians

Number	Description
FR-20.1	The system shall provide technicians with basic analytics on completed tasks.
FR-20.2	Analytics shall include: tasks completed per period (day/week/month), average resolution time, completion rate by category.
FR-20.3	The system shall display equipment performance trends showing frequency of issues by equipment type.
FR-20.4	Technicians shall be able to view area-specific statistics showing most frequently serviced locations.
FR-20.5	The system shall provide personal performance metrics compared to team averages.
FR-20.6	Analytics shall be visualized through: bar charts, line graphs, pie charts, and trend lines.
FR-20.7	Technicians shall be able to set personal performance goals and track progress.
FR-20.8	The system shall provide recommendations for skill development based on frequently assigned task categories.

Table 42: FR-21 Administrator Dashboard

Number	Description
FR-21.1	The system shall display a comprehensive dashboard for administrators upon successful login.
FR-21.2	The dashboard shall show key performance indicators (KPIs) including: total tickets (current month), open issues, resolved issues (last 7 days), average resolution time.
FR-21.3	The system shall display technician workload distribution showing: assigned tasks per technician, completion rates, current availability status.
FR-21.4	The dashboard shall include a real-time ticker showing: new tickets submitted, tickets resolved, overdue tasks.
FR-21.5	The system shall provide geographical heat map showing issue density by building/ location.
FR-21.6	Administrators shall be able to customize dashboard widgets and rearrange layout according to preference.
FR-21.7	The dashboard shall display system health metrics: active users, system uptime, database performance.
FR-21.8	The system shall provide quick action buttons: “Assign Pending Tickets”, “Generate Reports”, “Manage Users”.

Table 43: FR-22 Administrator Navigation Menu

Number	Description
FR-22.1	The system shall provide a comprehensive navigation menu accessible from all administrator pages.
FR-22.2	The navigation menu shall include: Home (Dashboard), Ticket Management, Technician Management, Analytics and Reports, System Configuration, User Management, Profile, Logout.
FR-22.3	The system shall display administrator privileges and access level in the navigation header.
FR-22.4	The navigation menu shall include sub-menus for each main category with expanded options.
FR-22.5	The system shall highlight critical alerts in the navigation menu (e.g., “5 Urgent Tickets Pending”).
FR-22.6	Administrators shall be able to pin frequently used menu items to a quick access bar.
FR-22.7	The system shall provide keyboard shortcuts for common navigation actions.

Table 44: FR-23 Ticket Assignment Management

Number	Description
FR-23.1	The system shall allow administrators to assign maintenance tickets to technicians manually or automatically.

FR-23.2	For manual assignment, the system shall show: technician availability, current workload, expertise match, location proximity.
FR-23.3	The system shall support automatic assignment based on: priority level, technician specialization, workload balancing, geographical zones.
FR-23.4	Administrators shall be able to override automatic assignments with manual reassignments.
FR-23.5	The system shall provide bulk assignment functionality for multiple tickets at once.
FR-23.6	When assigning tickets, administrators shall be able to set: expected completion time, special instructions, required tools/parts.
FR-23.7	The system shall maintain assignment history showing all assignment changes with timestamps and reasoning.
FR-23.8	Administrators shall be able to set up assignment rules and automation policies for recurring ticket types.

Table 45: FR-24 Ticket Priority Management

Number	Description
FR-24.1	The system shall allow administrators to set and modify ticket priority levels: Low, Medium, High, Urgent, Emergency.
FR-24.2	Priority levels shall determine: response time expectations, assignment order, escalation rules.
FR-24.3	Administrators shall be able to bulk update priorities for multiple tickets based on criteria.
FR-24.4	The system shall automatically adjust priorities based on: time since submission, number of similar issues, affected users count.
FR-24.5	Administrators shall be able to define custom priority rules based on: location criticality, time of day, equipment importance.
FR-24.6	Priority changes shall trigger notifications to assigned technicians and residents.
FR-24.7	The system shall maintain audit trail of all priority changes with justification notes.

Table 46: FR-25 Administrator Notifications

Number	Description
FR-25.1	The system shall notify administrators of new high-priority ticket submissions.
FR-25.2	Administrators shall receive notifications for: overdue tasks (exceeding expected completion time), unassigned tickets exceeding threshold time.
FR-25.3	The system shall notify administrators when maintenance work is completed, requiring quality assurance review.
FR-25.4	Notifications shall be categorized by: urgency (Immediate/High/Medium/Low), department, location.
FR-25.5	Administrators shall be able to configure notification thresholds and escalation paths.

FR-25.6	The system shall provide notification summary reports showing: notification volume, response times, unresolved alerts.
FR-25.7	Administrators shall be able to snooze notifications or set “Out of Office” auto-replies.

Table 47: FR-26 Analytics and Reporting

Number	Description
FR-26.1	The system shall provide comprehensive analytics dashboards showing maintenance trends over time.
FR-26.2	Analytics shall include: frequently reported areas/equipment, recurring issue patterns, seasonal trends.
FR-26.3	The system shall display equipment performance analytics: MTBF (Mean Time Between Failures), maintenance costs, downtime analysis.
FR-26.4	Administrators shall be able to analyze task completion times by: technician, category, location, priority.
FR-26.5	The system shall provide predictive analytics suggesting preventive maintenance schedules.
FR-26.6	Analytics shall include cost analysis: labor costs, parts costs, total maintenance expenditure by period.
FR-26.7	Administrators shall be able to create custom reports using drag-and-drop report builder.
FR-26.8	The system shall support comparative analysis: month-over-month, year-over-year, location comparisons.

Table 48: FR-27 Report Export Functionality

Number	Description
FR-27.1	The system shall allow administrators to export maintenance reports in multiple formats: PDF, Excel (XLSX), CSV.
FR-27.2	PDF exports shall include: company logo, report title, date range, pagination, professional formatting.
FR-27.3	Excel exports shall preserve: formulas, charts, filters, and data validation where applicable.
FR-27.4	Administrators shall be able to schedule automated report generation and email distribution.
FR-27.5	The system shall provide pre-built report templates: monthly maintenance summary, technician performance, equipment history.
FR-27.6	Exported reports shall include all relevant metadata: generation timestamp, exported by, report parameters.
FR-27.7	Administrators shall be able to export raw data for external analysis in statistical software.

FR-27.8	The system shall maintain export history with download logs for audit purposes.

Table 49: FR-28 User Account Management

Number	Description
FR-28.1	The system shall allow administrators to manage all registered user accounts.
FR-28.2	Administrators shall be able to: activate, deactivate, suspend, or delete user accounts.
FR-28.3	For technician accounts, administrators shall be able to: assign specializations, set work zones, define skill levels.
FR-28.4	Administrators shall be able to update user information: contact details, role changes (with approval workflow), access permissions.
FR-28.5	The system shall provide bulk user management operations: import users from CSV, bulk role assignment, mass communication.
FR-28.6	Administrators shall be able to reset user passwords and force password change on next login.
FR-28.7	The system shall maintain comprehensive audit logs of all user management activities.
FR-28.8	Administrators shall be able to set account expiration dates and receive renewal reminders.

3.6. Data Requirements

Data requirements is the specification for the information the system will depend on, store in the database, and process to achieve the business goals. These requirements are important for effective system design and implementation. For our smart maintenance request system, the core data entities, including their attributes, constraints, and the key relationships between them, are:

Table 50: Data Requirements

Entity	Description	Attributes	Constraints	Key relationships
Users	The Users entity represents any system user, including technicians, staff, admins, and requestors.	UserID (PK), full name, password hash, NationalID to initiate password recovery, IsEmailVerified, role (which can be User, Technician, Admin, or other staff), registration	UserID is the Primary Key, Email and NationalID have a uniqueness constraint, role can be User, Technician, Admin, or other staff.	• One user can submit many requests (one to many). • One user receives multiple notifications (one to many). • A user can be linked to zero or one technician record

		date, account status (Active, Suspended, Locked), LastLoginAt for security, account expiration date, failed login attempts, and profile picture. Email address will also be stored for communication, and a Phone number (is an optional field).		depending on their role (one to one or one to zero).
Technician	The Technician entity represents technicians or teams responsible for carrying out maintenance tasks.	This entity tracks their skills, an availability status to indicate whether they are available, busy, or on break. Other fields are for skill level, certifications, specialization, work zone, work schedules, TeamLeadFlag to identify technicians with team lead permissions, average resolution time (analytics), customer satisfaction rating. It also tracks their	TechnicianID is the Primary Key, UserID is a Foreign Key referring to the User table, specialization is required.	• One technician may handle many requests. • One technician can have many scheduled tasks.

		performance, such as the number of tasks they have completed. Each technician has a unique TechnicianID (PK) and a UserID, which is a FK referring to the User table.		
Maintenance Request	The Maintenance Request entity documents the actual problem submitted by users or a need for service.	A request captures details such as the issue description, TicketID, title, category, the requester's ID (a FK referring to the User table), TechnicianID (FK), LocationID (FK), ReportedAt, AssignedAt, and ResolvedAt. It also includes priority (Low, Medium, High, Critical), current status (new, in progress, completed, rejected), estimated completion time, IsUrgentFlag, SimilarityFlag to prevent duplicate tickets, escalation level	TicketId is PK, requester's ID, TechnicianID, and LocationID are required Foreign keys, description minimum length is 20 chars, ReportedAt is required, AssignedAt is optional, ResolvedAt is optional, ImageURL is optional	• Each maintenance request is assigned to one location. • One location can have many requests.

		for escalate tasks that remain “In Progress” beyond the estimated completion time, OnHoldReason to allow technicians to set a task to “On Hold” for specific reasons, ResidentEditableFlag (to enforce FR-9.7), and an ImageURL that is optional.		
Location	The Location entity represents the building or place where maintenance is required, facilitating easy navigation and assignment of work to the correct place.	Each location has a LocationID (PK). It also includes fields for zone, building name, location criticality, GeoCoordinates for heat map, and a column for other details if there is a specific description of the components needed for repairs. Additional useful fields include room number and floor number and they are optional.	LocationID is the Primary Key, BuildingName is required	Each request is associated with exactly one location (one to many).

Maintenance Schedule	The Maintenance Schedule entity includes a list of planned maintenance tasks.	Each schedule has a ScheduleID (PK), TechnicianID (FK referring to Technician), LinkedRequestID to indicate which maintenance request the schedule is created for, expected duration, scheduled start time, recurrence pattern (None (default), Daily, Weekly, Monthly, Yearly), schedule status (Scheduled, Completed, Cancelled) and notes (String, optional).	ScheduleID is the Primary Key, TechnicianID is a Foreign Key, scheduled start time is required.	One technician can have many scheduled tasks.
Notifications	The Notifications entity tracks alerts sent to users.	NotificationID (PK), UserID (FK), RelatedTiketID (FK to Maintenance Request table), expiration date (90 days as it is set in the rules), notification type (StatusChange, Assignment, Alert…), message	NotificationID is the Primary Key, UserID is a Foreign Key, Message is required, CreatedAt is required.	One user receives many notifications.

		(String), IsRead (Boolean), CreatedAt (DateTime).		

And to allow the system to automate workflows, these entities we listed are interconnected in a centralized database, interacting with each other to streamline the maintenance lifecycle from issue reporting to resolution and performance optimization.

3.7. Non-Functional Requirements

The non-functional requirements for the Maintenance Management System are outlined in the table below. Each requirement is assigned a unique number for reference.

Table 51: Non-Functional Requirements

Number	Non-Functional Requirements	Description
1	Performance	Users must be able to submit and track maintenance requests without delays or timeouts, even during peak usage times.
2	Dependability	The System must operate 24/7 with minimal downtime.
3	Security	The system must prevent unauthorized access and encrypt data such as login credentials and ticket details.
4	Usability	The system must have a simple , user-friendly interface that is easy to understand for all users.
5	Operational and Environmental Constraints	The system must run in web browsers and mobile devices and require a stable internet connection ; data will be stored using a database management system.
6	Maintainability and Supportability	The system must be easy to maintain , and it should deal with errors and solve them when they appear in the system.

3.8. Requirements Validation and Review Summary

3.8.1. How We Verified the Requirements

We verified the requirements by reviewing them with both our team and the stakeholders.

3.8.1.1. Team Review

All team members **(Anas, Shaima, Orjoan, Musa, and Hanen)** reviewed the requirements together. We went through each requirement to ensure everyone fully understood it. Each member provided feedback and suggestions, which were used to refine the requirements.

3.8.1.2. Stakeholder Review

We presented the requirements to **Dr. Hamad** for validation. We also gathered feedback from three classmates acting as potential users. We updated and improved the requirements based on their comments and suggestions.

3.8.2. How We Confirmed the Requirements Are Correct, Clear, and Complete

We used two main methods to validate the clarity and correctness of the requirements: **Mockups** and **Walkthroughs**.

3.8.2.1. Method 1: Mockups

What we did: We created UI mockups using Figma.

What we showed:

- User dashboard showing submitted maintenance requests
- Technician dashboard with assigned tasks organized by priority
- Admin panel for monitoring and managing maintenance requests
- Notification screen showing status updates

How this helped:

- Clarified how users will report maintenance issues
- Confirmed that role-based dashboards function correctly
- Verified that priority assignment and task flow work as intended

3.8.2.2. Method 2: Walkthroughs

What we did: We conducted a full system walkthrough during a meeting.

How we did it: We explained each feature step-by-step and demonstrated how it works for the different user roles. We walked through realistic scenarios such as:

- “A student reports a broken AC.”
- “A technician receives the notification and accepts the task.”
- “An admin monitors all requests and reassigns urgent tasks.”

How this helped:

- Ensured everyone clearly understood the maintenance workflow
- Confirmed that email and system notifications meet requirements
- Verified that priority-based task assignment is correct
- Ensured that requirements for maintenance history and analytics are complete

4. System Analysis and Design

4.1. Structured Analysis and Design

4.1.1. Level 0 DFD

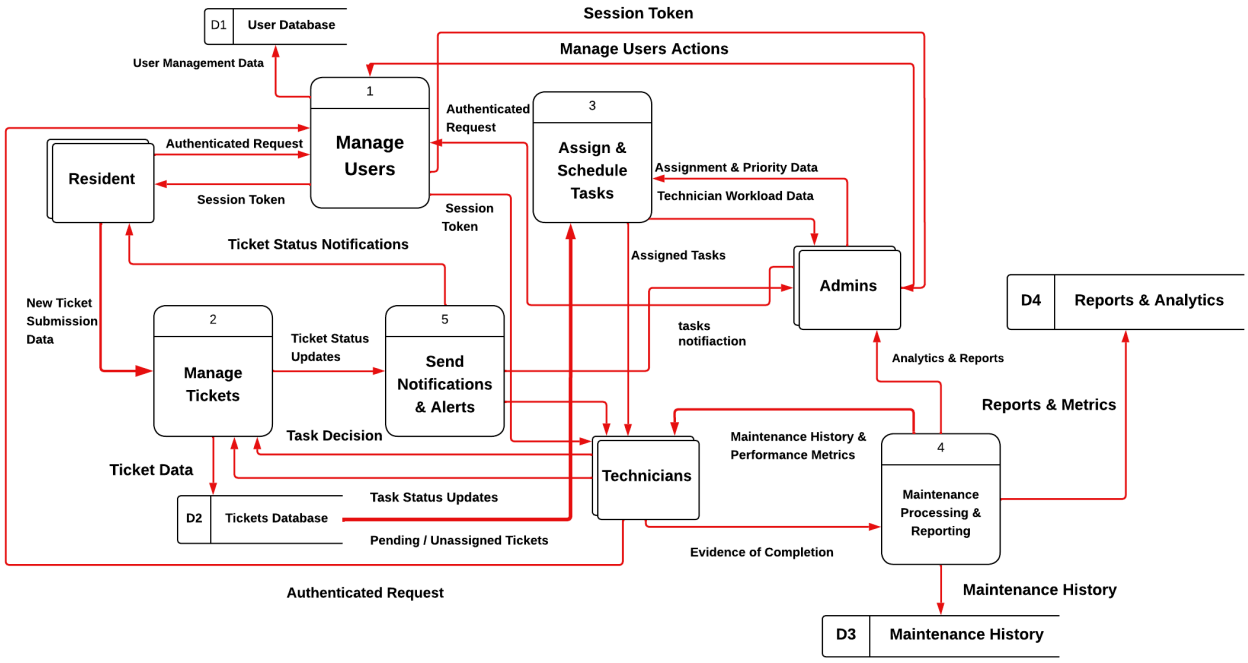


Figure 39: DFD Level 0

4.1.2. Level 1 DFDs

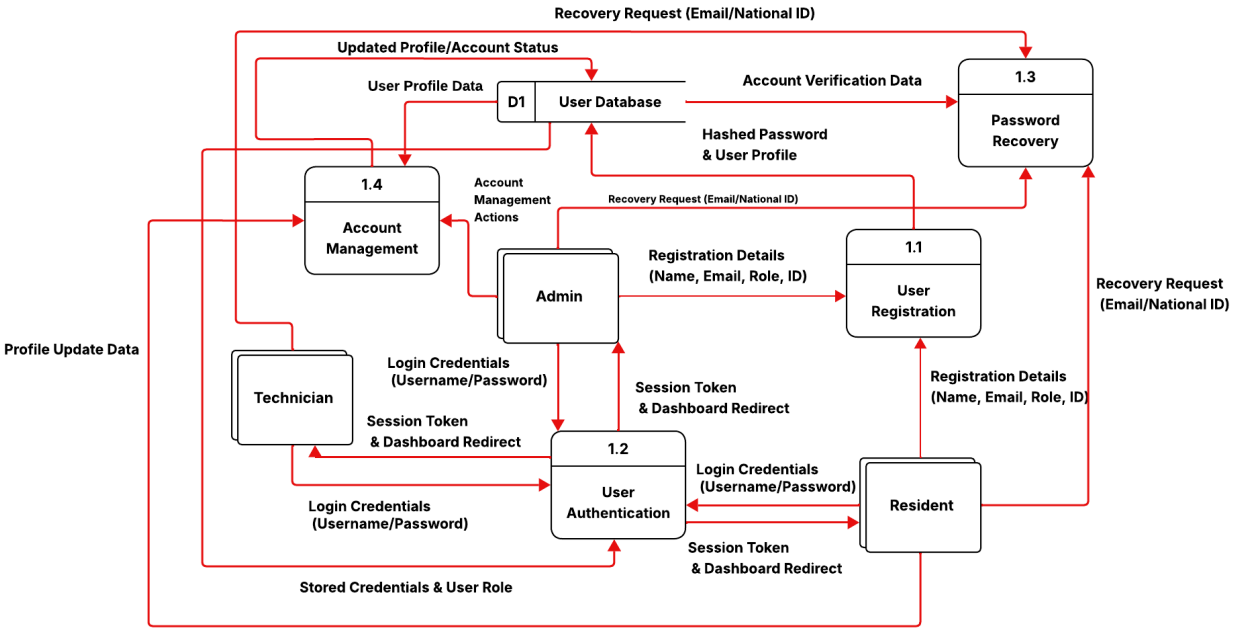


Figure 40: DFD Level 1-Fragment 1

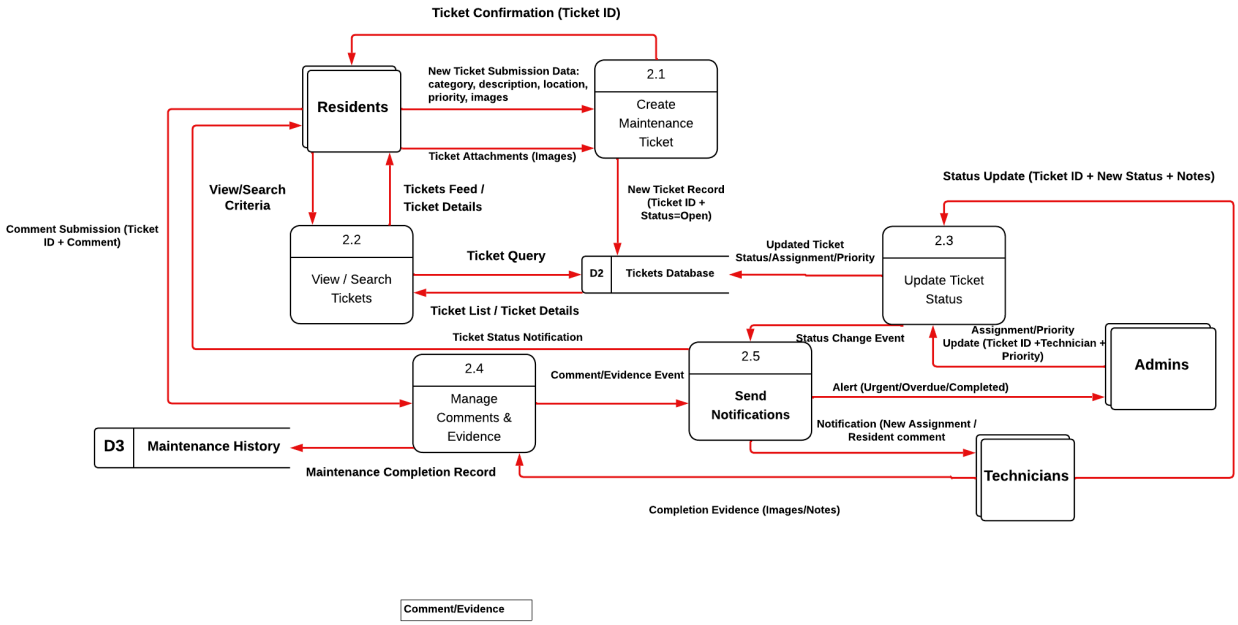


Figure 41: DFD Level 1-Fragment 2

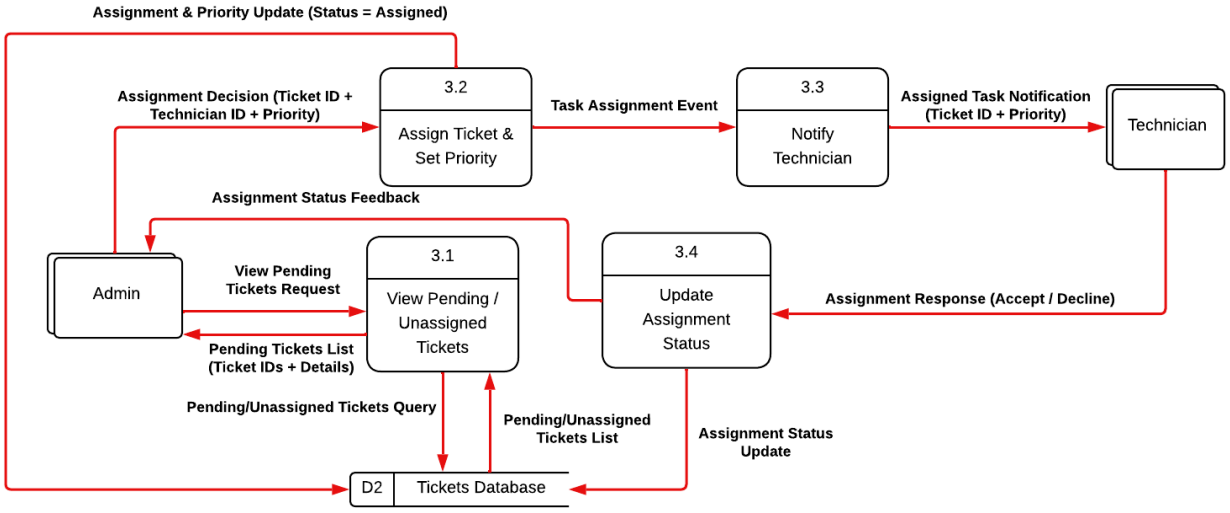


Figure 42: DFD Level 1-Fragment 3

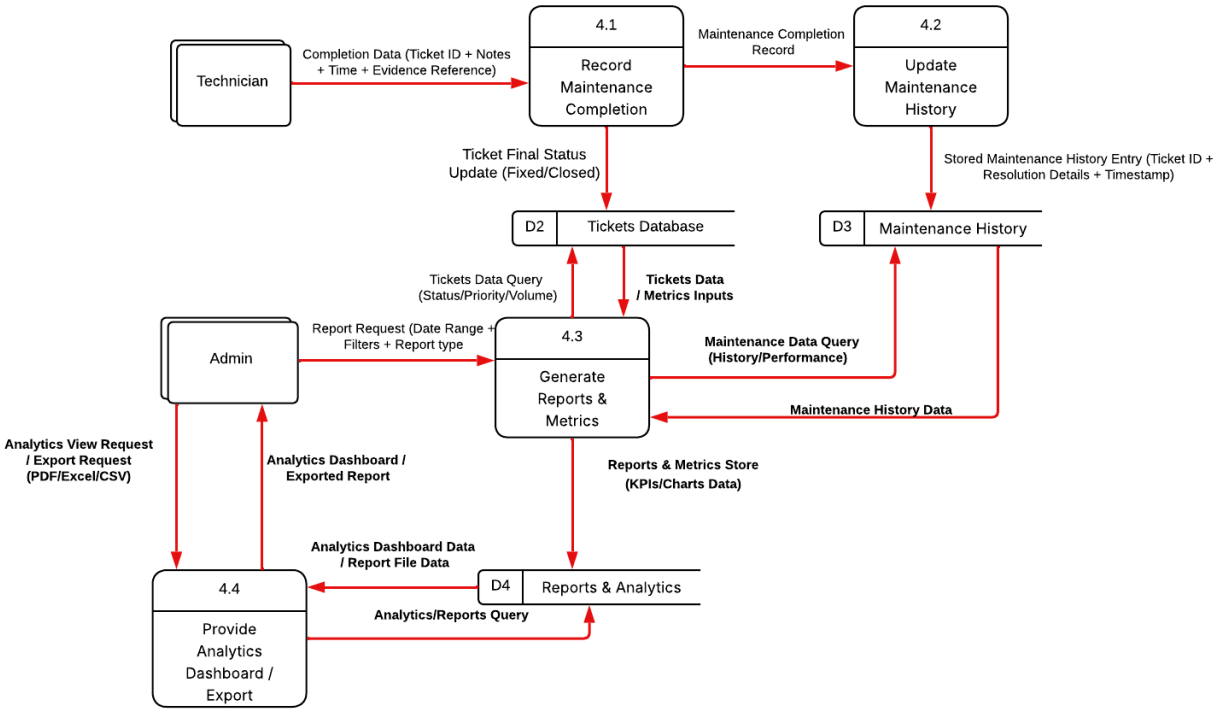


Figure 43: DFD Level 1-Fragment 4

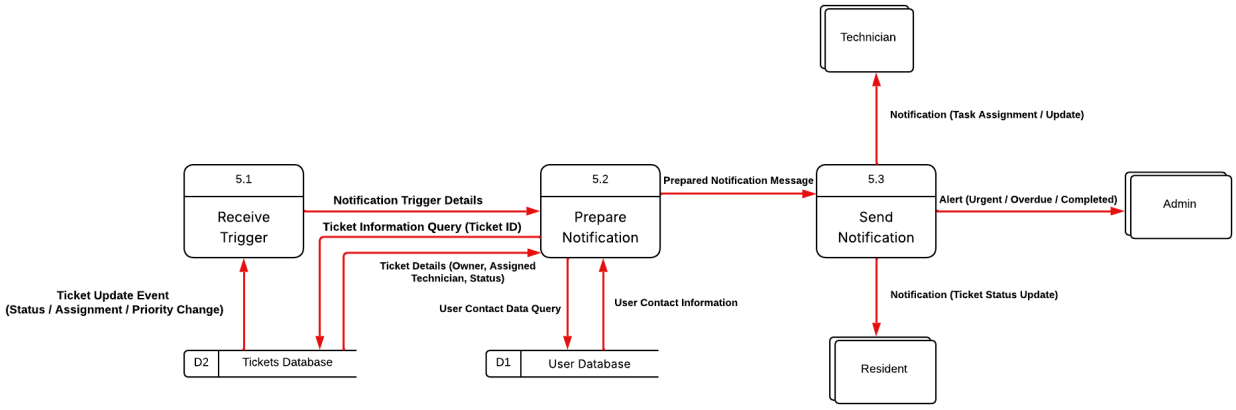


Figure 44: DFD Level 1-Fragment 5

4.1.3. Data Dictionary

4.1.3.1. Data flow

Table 52: Data Flow 1 Details

Field	Details
Name	Registration Details
Description	User information submitted during account registration.
Source	External Entities: Resident / Admin
Destination	Process 1.1: User Registration
Type	Screen
Data Structure	Name, Email, Role, National ID

Volume/Time	Per registration
Comments	Used to create a new user account.

Table 53: Data Flow 2 Details

Field	Details
Name	User Profile Data
Description	User profile information stored or retrieved from database.
Source	User Database (D1)
Destination	Processes 1.4
Type	Database Read
Data Structure	User ID, Name, Email, Role, Account Status
Volume/Time	On demand
Comments	Represents stored user account information.

Table 54: Data Flow 3 Details

Field	Details
Name	Login Credentials
Description	Credentials submitted by user for authentication.
Source	External Entities: Resident / Technician / Admin
Destination	Process 1.2: User Authentication
Type	Screen
Data Structure	Username, Password
Volume/Time	Per login attempt
Comments	Validated against stored credentials.

Table 55: Data Flow 4 Details

Field	Details
Name	Stored Credentials & User Role
Description	Stored authentication data retrieved for validation.
Source	User Database (D1)
Destination	Process 1.2: User Authentication
Type	Database Read
Data Structure	Username, Hashed Password, Role, Account Status
Volume/Time	Per login attempt
Comments	Used to verify user identity and access level.

Table 56: Data Flow 5 Details

Field	Details
Name	Session Token & Dashboard Redirect
Description	Authentication response indicating successful login.
Source	Process 1.2: User Authentication
Destination	External Entities: Resident / Technician / Admin
Type	System Response
Data Structure	Session Token, User Role, Redirect Path
Volume/Time	Per successful login
Comments	Grants access to authorized system functions.

Table 57: Data Flow 6 Details

Field	Details
Name	Recovery Request
Description	User request to recover account access.
Source	External Entity: Resident,Admin,Technician
Destination	Process 1.3: Password Recovery
Type	Screen
Data Structure	Email or National ID
Volume/Time	On demand
Comments	Used to initiate password recovery.

Table 58: Data Flow 7 Details

Field	Details
Name	Account Verification Data
Description	User data used to verify identity during recovery.
Source	User Database (D1)
Destination	Process 1.3: Password Recovery
Type	Database Read
Data Structure	User ID, Email, National ID, Account Status
Volume/Time	Per recovery request
Comments	Ensures recovery request is valid.

Table 59: Data Flow 8 Details

Field	Details
Name	Updated Profile / Account Status
Description	Updated user profile or account status information.
Source	Process 1.4: Account Management
Destination	User Database (D1)
Type	Database Write
Data Structure	User ID, Updated Fields, Account Status
Volume/Time	Per update
Comments	Reflects administrative or user profile changes.

Table 60: Data Flow 9 Details

Field	Details
Name	Profile Update Data
Description	Profile changes submitted by resident for account update.
Source	External Entity: Resident
Destination	Process 1.4: Account Management
Type	Screen
Data Structure	User ID, Updated Profile Fields
Volume/Time	On demand
Comments	Used to update resident profile information.

Table 61: Data Flow 10 Details

Field	Details
Name	New Ticket Submission Data
Description	Resident submits information to create a new maintenance ticket.
Source	External Entity: Residents
Destination	Process 2.1: Create Maintenance Ticket
Type	Screen / Form
Data Structure	Category, Description, Location, Priority
Volume/Time	On demand (per new ticket)
Comments	Core input required to open a new ticket.

Table 62: Data Flow 11 Details

Field	Details
Name	Ticket Attachments (Images)
Description	Images uploaded by resident as supporting evidence for the ticket.
Source	External Entity: Residents
Destination	Process 2.1: Create Maintenance Ticket
Type	File Upload
Data Structure	Image File(s), File Type, File Size, (Optional) Attachment Reference
Volume/Time	0..N images per ticket
Comments	Stored as files or references/URLs depending on implementation.

Table 63: Data Flow 12 Details

Field	Details
Name	Ticket Confirmation (Ticket ID)
Description	Confirmation sent to resident after successful ticket creation.
Source	Process 2.1: Create Maintenance Ticket
Destination	External Entity: Residents
Type	Screen / Message
Data Structure	Ticket ID, Status (=Open), Created Date/Time
Volume/Time	Per ticket submission
Comments	Used by resident to track the ticket.

Table 64: Data Flow 13 Details

Field	Details
Name	New Ticket Record
Description	New ticket record written into the tickets database.
Source	Process 2.1: Create Maintenance Ticket
Destination	Tickets Database (D2)
Type	Database Write
Data Structure	Ticket ID, Resident ID, Category, Description, Location, Priority, Status=Open, Created Date, Attachment References
Volume/Time	Per new ticket
Comments	Initializes the ticket life-cycle in D2.

Table 65: Data Flow 14 Details

Field	Details
Name	View/Search Criteria
Description	Criteria entered by resident to search or filter tickets (query merged here).
Source	External Entity: Residents
Destination	Process 2.2: View / Search Tickets
Type	Screen
Data Structure	Ticket ID (optional), Status, Category, Date Range, Keyword
Volume/Time	On demand
Comments	Used to define ticket search conditions.

Table 66: Data Flow 15 Details

Field	Details
Name	Ticket List / Ticket Details
Description	Matching tickets returned from D2 for list view or detailed view.
Source	Tickets Database (D2)
Destination	Process 2.2: View / Search Tickets
Type	Database Read Result
Data Structure	Ticket ID, Category/Title, Description, Location, Priority, Status, Created Date, Assigned Technician (optional), Last Updated, Notes (optional)
Volume/Time	Depends on number of matches
Comments	Retrieved ticket data for display purposes

Table 67: Data Flow 16 Details

Field	Details
Name	Comment Submission (Ticket ID + Comment)
Description	Resident submits a comment related to an existing ticket.
Source	External Entity: Residents
Destination	Process 2.4: Manage Comments & Evidence
Type	Screen
Data Structure	Ticket ID, Resident ID, Comment Text, Comment Date/Time
Volume/Time	0..N per ticket
Comments	Stored and used for communication/updates.

Table 68: Data Flow 17 Details

Field	Details
Name	Completion Evidence (Images/Notes)
Description	Technician uploads evidence/notes for progress or completion.
Source	External Entity: Technicians
Destination	Process 2.4: Manage Comments & Evidence
Type	Screen / File Upload
Data Structure	Ticket ID, Technician ID, Notes, Evidence Image(s)/References, Evidence Date/Time
Volume/Time	Per update/completion
Comments	Supports verification and maintenance history logging.

Table 69: Data Flow 18 Details

Field	Details
Name	Maintenance Completion Record
Description	Completion details stored in maintenance history.
Source	Process 2.4: Manage Comments & Evidence
Destination	Maintenance History (D3)
Type	Database Write
Data Structure	Ticket ID, Technician ID, Work Summary/Notes, Completion Date/Time, Evidence References, Final Status
Volume/Time	Typically once per completed ticket
Comments	Archived record used for reporting and future reference.

Table 70: Data Flow 19 Details

Field	Details
Name	Assignment/Priority Update
Description	Admin assigns a technician and sets/updates ticket priority.
Source	External Entity: Admins
Destination	Process 2.3: Update Ticket Status
Type	Screen
Data Structure	Ticket ID, Technician ID, Priority, (Optional) Notes
Volume/Time	Per assignment/change
Comments	Changes are written to D2 and may trigger notifications.

Table 71: Data Flow 20 Details

Field	Details
Name	Status Update (Ticket ID + New Status + Notes)
Description	Technician updates ticket status with optional notes.
Source	External Entity: Technicians
Destination	Process 2.3: Update Ticket Status
Type	Screen
Data Structure	Ticket ID, New Status, Notes (optional), Updated Date/Time
Volume/Time	Per status change
Comments	Example statuses: In Progress, Completed, On Hold.

Table 72: Data Flow 21 Details

Field	Details
Name	Updated Ticket Status/Assignment/Priority
Description	Updated ticket information written back to the tickets database.
Source	Process 2.3: Update Ticket Status
Destination	Tickets Database (D2)
Type	Database Write
Data Structure	Ticket ID, Status, Technician ID (optional), Priority (optional), Notes (optional), Last Updated
Volume/Time	Per update
Comments	Ensures D2 reflects the latest ticket state.

Table 73: Data Flow 22 Details

Field	Details
Name	Notification
Description	System-generated notification sent to users based on ticket updates or comments.
Source	Process 2.5: Send Notifications
Destination	External Entities: Residents / Technicians / Admins
Type	Notification
Data Structure	Ticket ID, Notification Type, Status/Priority (as applicable), Message Summary, Timestamp
Volume/Time	As triggered
Comments	Unified structure for all system notifications.

Table 74: Data Flow 23 Details

Field	Details
Name	View Pending / Tickets Request
Description	Request sent by Admin to view all pending or unassigned tickets.
Source	External Entity: Admin
Destination	Process 3.1: View Pending / Unassigned Tickets
Type	Screen
Data Structure	Request Parameters
Volume/Time	On demand
Comments	Used to retrieve tickets that are not yet assigned.

Table 75: Data Flow 24 Details

Field	Details
Name	Pending Tickets List
Description	List of pending or unassigned tickets returned from database.
Source	Tickets Database (D2)
Destination	Process 3.1: View Pending / Unassigned Tickets
Type	Database
Data Structure	Ticket ID, Title, Description, Status, Created Date
Volume/Time	Depends on number of tickets
Comments	Displayed to admin for assignment decision.

Table 76: Data Flow 25 Details

Field	Details
Name	Assignment Decision
Description	Admin selects technician and sets ticket priority.
Source	External Entity: Admin
Destination	Process 3.2: Assign Ticket & Set Priority
Type	Screen
Data Structure	Ticket ID, Technician ID, Priority
Volume/Time	Per assignment
Comments	Ticket status becomes Assigned.

Table 77: Data Flow 26 Details

Field	Details
Name	Assignment & Priority Update
Description	Updates ticket assignment and priority in database.
Source	Process 3.2: Assign Ticket & Set Priority
Destination	Tickets Database (D2)
Type	Database
Data Structure	Ticket ID, Technician ID, Priority, Status
Volume/Time	Per assignment
Comments	Status is set to Assigned.

Table 78: Data Flow 27 Details

Field	Details
Name	Assigned Task Notification
Description	Notification sent to technician for assigned ticket.
Source	Process 3.3: Notify Technician
Destination	External Entity: Technician
Type	Notification
Data Structure	Ticket ID, Priority
Volume/Time	Per assignment
Comments	Notification via system, email, or sms.

Table 79: Data Flow 28 Details

Field	Details
Name	Assignment Response
Description	Technician accepts or declines assigned task.
Source	External Entity: Technician
Destination	Process 3.4: Update Assignment Status
Type	Screen
Data Structure	Ticket ID, Response Status
Volume/Time	Per notification
Comments	Determines next assignment status.

Table 80: Data Flow 29 Details

Field	Details
Name	Assignment Status Update
Description	Updates ticket status based on technician response.
Source	Process 3.4: Update Assignment Status
Destination	Tickets Database (D2)
Type	Database
Data Structure	Ticket ID, Status
Volume/Time	Per response
Comments	Status may be Accepted or Declined.

Table 81: Data Flow 30 Details

Field	Details
Name	Completion Data
Description	Maintenance completion information submitted by technician.
Source	External Entity: Technician
Destination	Process 4.1: Record Maintenance Completion
Type	Screen
Data Structure	Ticket ID, Completion Notes, Completion Time, Evidence Reference
Volume/Time	Per completed ticket
Comments	Used to record task completion.

Table 82: Data Flow 31 Details

Field	Details
Name	Maintenance Completion Record
Description	Completed maintenance record sent for history update.
Source	Process 4.1: Record Maintenance Completion
Destination	Process 4.2: Update Maintenance History
Type	Internal Data
Data Structure	Ticket ID, Resolution Details, Completion Time, Evidence Reference
Volume/Time	Per completion
Comments	Passed for archival storage.

Table 83: Data Flow 32 Details

Field	Details
Name	Ticket Final Status Update
Description	Final ticket status written after maintenance completion.
Source	Process 4.1: Record Maintenance Completion
Destination	Tickets Database (D2)
Type	Database Write
Data Structure	Ticket ID, Final Status (Fixed/Closed), Last Updated
Volume/Time	Per completed ticket
Comments	Closes the ticket life-cycle.

Table 84: Data Flow 33 Details

Field	Details
Name	Stored Maintenance History Entry
Description	Archived maintenance history entry.
Source	Process 4.2: Update Maintenance History
Destination	Maintenance History (D3)
Type	Database Write
Data Structure	Ticket ID, Resolution Details, Completion Timestamp
Volume/Time	Per completion
Comments	Used for reporting and audits.

Table 85: Data Flow 34 Details

Field	Details
Name	Report Request
Description	Request parameters for generating reports or analytics.
Source	External Entity: Admin
Destination	Process 4.3: Generate Reports & Metrics
Type	Screen
Data Structure	Date Range, Filters, Report Type
Volume/Time	On demand
Comments	Defines report scope.

Table 86: Data Flow 35 Details

Field	Details
Name	Tickets Data / Metrics Inputs
Description	Ticket data used for analytics and KPI calculations.
Source	Tickets Database (D2)
Destination	Process 4.3: Generate Reports & Metrics
Type	Database Read
Data Structure	Ticket ID, Status, Priority, Timestamps
Volume/Time	As requested
Comments	Provides operational metrics.

Table 87: Data Flow 36 Details

Field	Details
Name	Maintenance History Data
Description	Historical maintenance data retrieved for analysis.
Source	Maintenance History (D3)
Destination	Process 4.3: Generate Reports & Metrics
Type	Database Read
Data Structure	Ticket ID, Resolution Details, Completion Time
Volume/Time	As requested
Comments	Supports performance analysis.

Table 88: Data Flow 37 Details

Field	Details
Name	Reports & Metrics Store
Description	Generated reports and analytics data stored for access.
Source	Process 4.3: Generate Reports & Metrics
Destination	Reports & Analytics (D4)
Type	Database Write
Data Structure	Report ID, KPI Data, Charts Data, Generated Date
Volume/Time	Per report
Comments	Enables reuse and export.

Table 89: Data Flow 38 Details

Field	Details
Name	Analytics View / Export Request
Description	Admin request to view or export analytics reports.
Source	External Entity: Admin
Destination	Process 4.4: Provide Analytics Dashboard / Export
Type	Screen
Data Structure	Report ID, Export Format (PDF/Excel/CSV)
Volume/Time	On demand
Comments	Triggers dashboard or export.

Table 90: Data Flow 39 Details

Field	Details
Name	Analytics Dashboard Data / Report File Data
Description	Analytics data or exported report returned to admin.
Source	Reports & Analytics (D4)
Destination	Process 4.4: Provide Analytics Dashboard / Export
Type	Database Read
Data Structure	KPI Values, Charts Data, Report File
Volume/Time	Per request
Comments	Prepared for presentation or download.

Table 91: Data Flow 40 Details

Field	Details
Name	Analytics Dashboard / Exported Report
Description	Final analytics dashboard or exported report.
Source	Process 4.4: Provide Analytics Dashboard / Export
Destination	External Entity: Admin
Type	Screen / File
Data Structure	Dashboard View or Report File
Volume/Time	On demand
Comments	Supports monitoring and decision-making.

Table 92: Data Flow 41 Details

Field	Details
Name	Notification Trigger Details
Description	Trigger details passed for notification preparation.
Source	Process 5.1: Receive Trigger
Destination	Process 5.2: Prepare Notification
Type	Internal Data
Data Structure	Ticket ID, Trigger Type (Status/Assignment/Priority)
Volume/Time	Per trigger
Comments	Defines what notification is needed.

Table 93: Data Flow 42 Details

Field	Details
Name	Ticket Information Query
Description	Request to retrieve ticket details using the ticket ID.
Source	Process 5.2: Prepare Notification
Destination	Tickets Database (D2)
Type	Database Read
Data Structure	Ticket ID
Volume/Time	Per trigger
Comments	Fetches ticket context for the message.

Table 94: Data Flow 43 Details

Field	Details
Name	Ticket Details
Description	Ticket information returned for notification preparation.
Source	Tickets Database (D2)
Destination	Process 5.2: Prepare Notification
Type	Database Read Result
Data Structure	Ticket ID, Owner, Assigned Technician, Status, Priority
Volume/Time	Per query
Comments	Used to personalize notification content.

Table 95: Data Flow 44 Details

Field	Details
Name	User Contact Data Query
Description	Request to retrieve contact info for notification delivery.
Source	Process 5.2: Prepare Notification
Destination	User Database (D1)
Type	Database Read
Data Structure	User ID(s) (Owner/Technician/Admin)
Volume/Time	Per trigger
Comments	Retrieves recipient contact details.

Table 96: Data Flow 45 Details

Field	Details
Name	User Contact Information
Description	Recipient contact details returned from user database.
Source	User Database (D1)
Destination	Process 5.2: Prepare Notification
Type	Database Read Result
Data Structure	User ID, Name, Email, Phone (optional), Role
Volume/Time	Per query
Comments	Used to route notifications correctly.

Table 97: Data Flow 46 Details

Field	Details
Name	Prepared Notification Message
Description	Final notification message prepared for sending.
Source	Process 5.2: Prepare Notification
Destination	Process 5.3: Send Notification
Type	Internal Data
Data Structure	Ticket ID, Recipient Role, Notification Type, Message Summary, Time-stamp
Volume/Time	Per notification
Comments	Ready for delivery to recipients.

Table 98: Data Flow 47 Details

Field	Details
Name	Notification
Description	Notification delivered to system users.
Source	Process 5.3: Send Notification
Destination	External Entities: Technician / Admin / Resident
Type	Notification
Data Structure	Ticket ID, Notification Type, Message Summary, Timestamp
Volume/Time	As triggered
Comments	Unified structure for all recipients.

4.1.3.2. Data Structures

1. Maintenance Request Submission

Maintenance Request Submission = Title + Description + Service Category + Priority Level + (Location) + (Attachment) + Timestamp + Requester Username

2. Technician Response

Technician Response = Ticket ID + Technician Reply + (Actions Taken) + (Current Status) + Timestamp + Responder Technician Name

3. Ticket Review Summary (Resident)

Ticket Review Summary = Title + Description + Priority Level + Status + (Technician Reply) + Timestamp

4. Full Ticket Review for Admin

Full Ticket Review for Admin = Maintenance Request Submission + Technician Response Record + (Escalation Level) + (Admin Notes)

5. Notification Message

Notification Message = Ticket ID + Username + Notification Type + Status + Timestamp

6. Analytics Filter Parameters

Analytics Filter Parameters = (Date Range) + (Service Category) + (Priority Level) + (Status) + (Technician) + (Export Format)

7. Aggregated Maintenance Summary

Aggregated Maintenance Summary = { Service Category + Total Tickets + Average Resolution Time } + { Priority Level + Ticket Count } + (Most Frequent Issue Category) + (Least Frequent Issue Category) + Time Period

8. Ticket Status

Ticket Status = [New | In Progress | Completed | Rejected | On Hold | Closed | Reopened]

9. Service Category

Service Category = [Plumbing | Electrical | HVAC | Structural | IT Infrastructure | Cleaning Services | Safety Systems | Other]

Data Elements
1. CAPTCHA Code

Alias: Verification Code Description: Randomized alphanumeric string used to verify human interaction during login. Type: Alphanumeric Length: 5 Input Format: X(5) Output Format: X(5) Base or Derived: Derived Default Value: None Continuous/Discrete: Discrete Comments: Generated per session and expires after use.

2. SMS Verification Code

Alias: Admin SMS Token Description: One-time numeric code sent to administrators for login verification. Type: Numeric Length: 6 Input Format: 9(6) Output Format: 9(6) Base or Derived: Derived Default Value: None Continuous/Discrete: Discrete Comments: Valid for 5 minutes; admin-only authentication.

3. Title

Alias: Maintenance Request Title Description: Short summary of the maintenance issue. Type: Alphanumeric Length: 80 characters Input Format: X(80) Continuous/Discrete: Continuous Base or Derived: Base Default Value: None Comments: Displayed in ticket lists and reports.

4. Description

Alias: Issue Description Description: Detailed explanation of the reported maintenance problem. Type: Text Length: 1000 characters Input Format: X(1000) Continuous/Discrete: Continuous Base or Derived: Base Default Value: None Comments: Must be at least 20 characters.

5. Service Category

Alias: Maintenance Category Description: Type of maintenance service requested. Type: Enum Length: Max 40 characters Input Format: Dropdown list Continuous/Discrete: Discrete Base or Derived: Base Default Value: "Other" Comments: Used for analytics and technician assignment.

6. Priority Level

Alias: Urgency Level Description: Indicates urgency of the maintenance request. Type: Enum Length: 1 value Input Format: Selection Continuous/Discrete: Discrete Base or Derived: Base Default Value: Medium Comments: Affects escalation and response time.

7. Attachment

Alias: Uploaded Evidence Description: Optional image or document supporting the maintenance request. Type: Binary Length: Up to 5MB Input Format: JPG, PNG, PDF Continuous/Discrete: Discrete Base or Derived: Base Default Value: None Comments: Stored securely and linked to the ticket.

8. Timestamp

Alias: Submission Date Description: Date and time when a ticket or response is created. Type: DateTime Length: 14 characters Input Format: yyyy-mm-dd hh:mm:ss Continuous/Discrete: Continuous Base or Derived: Derived Default Value: System time Comments: Used for sorting, filtering, and SLA tracking.

9. Username

Alias: System User Identifier Description: Unique identifier of the user submitting the request. Type: Alphanumeric Length: 10 characters Input Format: X(10) Continuous/Discrete: Discrete Base or Derived: Base Default Value: Retrieved from authenticated session Comments: Not publicly visible.

10. Ticket ID

Alias: Maintenance Ticket Identifier Description: Unique system-generated identifier for each maintenance request. Type: Alphanumeric Length: 20 characters Input Format: TKT-YYYYMMDD-XXXXX Continuous/Discrete: Discrete Base or Derived: Derived Default Value: Auto-generated Comments: Primary reference across all system modules.

4.1.3.3. Data Stores

Table 99: Data Store D1: User Database

Field	Details
ID	D1
Name	User Database
Alias	User Data File
Description	Stores user credentials, profiles, roles, and account status.
File Type	Computerized
File Format	Relational Database (SQL)
Record Size	Approx. 1 KB
Maximum Records	100,000
Average Records	50,000
Percent Growth/Year	10%
Data Set / Table Name	Users
Data Structure	User Profile Data
Primary Key	User ID
Secondary Keys	Username, Email, National ID, Role, Account Status

Table 100: Data Store D2: Tickets Database

Field	Details
ID	D2
Name	Tickets Database
Alias	Ticket Data File
Description	Stores all maintenance ticket records and their lifecycle states.
File Type	Computerized
File Format	Relational Database (SQL)
Record Size	Approx. 1 KB
Maximum Records	500,000
Average Records	200,000
Percent Growth/Year	12%
Data Set / Table Name	Tickets
Data Structure	Maintenance Request Submission + Ticket Status
Primary Key	Ticket ID
Secondary Keys	Resident ID, Technician ID, Status, Priority, Service Category, Created Date

Table 101: Data Store D3: Maintenance History

Field	Details
ID	D3
Name	Maintenance History
Alias	Maintenance Record File
Description	Stores completed maintenance records for audit and reporting.
File Type	Computerized
File Format	Relational Database (SQL)
Record Size	Approx. 800 bytes
Maximum Records	100,000
Average Records	50,000
Percent Growth/Year	10%
Data Set / Table Name	MaintenanceHistory
Data Structure	Maintenance Completion Record
Primary Key	History ID
Secondary Keys	Ticket ID, Technician ID, Completion Date, Final Status

Table 102: Data Store D4: Reports & Analytics

Field	Details
ID	D4
Name	Reports & Analytics
Alias	Reporting File
Description	Stores generated analytics reports and KPI metrics.
File Type	Computerized
File Format	Relational Database (SQL)
Record Size	Approx. 1 KB
Maximum Records	100,000
Average Records	25,000
Percent Growth/Year	15%
Data Set / Table Name	AnalyticsReports
Data Structure	Aggregated Maintenance Summary
Primary Key	Report ID
Secondary Keys	Date Range, Service Category, Priority Level, Generated Date

4.1.3.4. Data Elements

1. **CAPTCHA Code**

- Alias: Verification Code
- Description: A randomized alphanumeric string used to confirm that the login attempt is made by a human user.

- Type: Alphanumeric
- Length: 5
- Input Format: X(5)
- Output Format: X(5)
- Base or Derived: Derived
- Default Value: None
- Continuous/Discrete: Discrete
- Comments: Generated per session and expires after use.

2. **Username**

- Alias: System User Identifier
- Description: Unique identifier used by a user to access the system.
- Type: Alphanumeric
- Length: 10
- Input Format: X(10)
- Output Format: X(10)
- Base or Derived: Base
- Default Value: None
- Continuous/Discrete: Discrete
- Comments: Must be unique across the system.

3. **Email Address**

- Alias: User Email
- Description: Email address associated with the user account.
- Type: Alphanumeric
- Length: 100
- Input Format: email@domain
- Output Format: email@domain
- Base or Derived: Base
- Default Value: None
- Continuous/Discrete: Discrete
- Comments: Used for communication and password recovery.

4. **Password Hash**

- Alias: Encrypted Password
- Description: Securely hashed version of the user's password.
- Type: Alphanumeric
- Length: 255
- Input Format: System-generated
- Output Format: Hashed value
- Base or Derived: Derived

- Default Value: None
- Continuous/Discrete: Discrete
- Comments: Plain-text passwords are never stored.

5. **User Role**

- Alias: Account Role
- Description: Defines the access level of the user.
- Type: Enum
- Length: 1 value
- Input Format: Selection
- Output Format: Text
- Base or Derived: Base
- Default Value: User
- Continuous/Discrete: Discrete
- Comments: Possible values: Resident, Technician, Admin.

6. **Ticket ID**

- Alias: Maintenance Ticket Identifier
- Description: Unique identifier assigned to each maintenance request.
- Type: Alphanumeric
- Length: 20
- Input Format: TKT-YYYYMMDD-XXXXX
- Output Format: Same as input
- Base or Derived: Derived
- Default Value: Auto-generated
- Continuous/Discrete: Discrete
- Comments: Used to track tickets across the system.

7. **Ticket Title**

- Alias: Maintenance Request Title
- Description: Short summary describing the maintenance issue.
- Type: Alphanumeric
- Length: 80
- Input Format: X(80)
- Output Format: X(80)
- Base or Derived: Base
- Default Value: None
- Continuous/Discrete: Continuous
- Comments: Displayed in ticket lists and reports.

8. **Ticket Description**

- Alias: Issue Description
- Description: Detailed explanation of the maintenance problem.
- Type: Text
- Length: 1000
- Input Format: X(1000)
- Output Format: X(1000)
- Base or Derived: Base
- Default Value: None
- Continuous/Discrete: Continuous
- Comments: Must be at least 20 characters.

9. **Service Category**

- Alias: Maintenance Category
- Description: Classification of the maintenance issue.
- Type: Enum
- Length: Max 40
- Input Format: Dropdown
- Output Format: Text
- Base or Derived: Base
- Default Value: Other
- Continuous/Discrete: Discrete
- Comments: Used for analytics and technician assignment.

10. **Priority Level**

- Alias: Urgency Level
- Description: Indicates urgency of the maintenance request.
- Type: Enum
- Length: 1 value
- Input Format: Selection
- Output Format: Text
- Base or Derived: Base
- Default Value: Medium
- Continuous/Discrete: Discrete
- Comments: Affects escalation and response time.

11. **Ticket Status**

- Alias: Maintenance Status
- Description: Current processing state of the maintenance request.
- Type: Enum
- Length: 1 value
- Input Format: System-controlled

- Output Format: Text
- Base or Derived: Derived
- Default Value: New
- Continuous/Discrete: Discrete
- Comments: Examples: New, In Progress, Completed, Closed.

12. **Timestamp**

- Alias: System Date and Time
- Description: Date and time when an action occurs in the system.
- Type: DateTime
- Length: 14 characters
- Input Format: YYYY-MM-DD HH:MM:SS
- Output Format: Same as input
- Base or Derived: Derived
- Default Value: System time
- Continuous/Discrete: Continuous
- Comments: Used for auditing and reporting.

4.2. Process Specifications

4.2.1. Fragment 1: User Management Processes

Number: 1.1 **Name:** User Registration **Description:** Creates a new user account by validating input data, hashing password, storing user information, and sending email verification.

Input Data Flow:
- Registration Details (from Resident/Admin/Technician)
  - Full Name
  - Email
  - National ID
  - Username
  - Password
  - Role

Output Data Flow:
- User Profile Data (to User Database D1)
- Email Verification Request (to Email Service)
- Registration Confirmation (to User)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `registerUser()`

Process Logic (Structured English):

```
BEGIN Process 1.1: User Registration

READ Registration Details from User

VALIDATE Email Format
IF Email Format Invalid THEN
    DISPLAY "Invalid email format"
    EXIT Process
ENDIF

VALIDATE Password Strength
IF Password Length < 8 OR
   Missing Uppercase OR
   Missing Lowercase OR
   Missing Number OR
   Missing Special Character THEN
    DISPLAY "Password does not meet strength requirements"
    EXIT Process
ENDIF

CHECK Email Uniqueness in User Database
IF Email Already Exists THEN
    DISPLAY "Email already registered"
    EXIT Process
ENDIF

CHECK National ID Uniqueness in User Database
IF National ID Already Exists THEN
    DISPLAY "National ID already registered"
    EXIT Process
ENDIF

HASH Password using bcrypt
GENERATE UserID
SET IsEmailVerified = FALSE
SET AccountStatus = "Pending Verification"
SET RegistrationDate = CURRENT_DATETIME
SET FailedLoginAttempts = 0

WRITE User Record to User Database (D1)

GENERATE Email Verification Token
SEND Verification Email with Activation Link

DISPLAY "Registration successful. Please check your email to verify your account."

END Process
```

Refer to:

- FR-1.1 through FR-1.8
- Table 52: Data Flow 1 Details

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
Email Format Valid	Y	Y	Y	Y	N
Password Strength Valid	Y	Y	Y	N	-
Email Unique	Y	Y	N	-	-
National ID Unique	Y	N	-	-	-
Create User Account	X	-	-	-	-
Send Verification Email	X	-	-	-	-
Display “National ID exists”	-	X	-	-	-
Display “Email exists”	-	-	X	-	-
Display “Weak password”	-	-	-	X	-
Display “Invalid email”	-	-	-	-	X

Unresolved Issues: None

Number: 1.2 **Name:** User Authentication **Description:** Authenticates user credentials, manages failed login attempts, enforces CAPTCHA and account locking, creates session tokens, and redirects to role-specific dashboards.

Input Data Flow:
- Login Credentials (from Resident/Technician/Admin)
  - Username
  - Password
  - CAPTCHA (if required)

Output Data Flow:
- Session Token & Dashboard Redirect (to User)
- Updated Failed Login Attempts (to User Database D1)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `authenticateUser()`

Process Logic (Structured English):

```
BEGIN Process 1.2: User Authentication

READ Username and Password from User

RETRIEVE User Record from User Database (D1) by Username
IF User Record Not Found THEN
    DISPLAY "Invalid credentials"
    EXIT Process
ENDIF
```

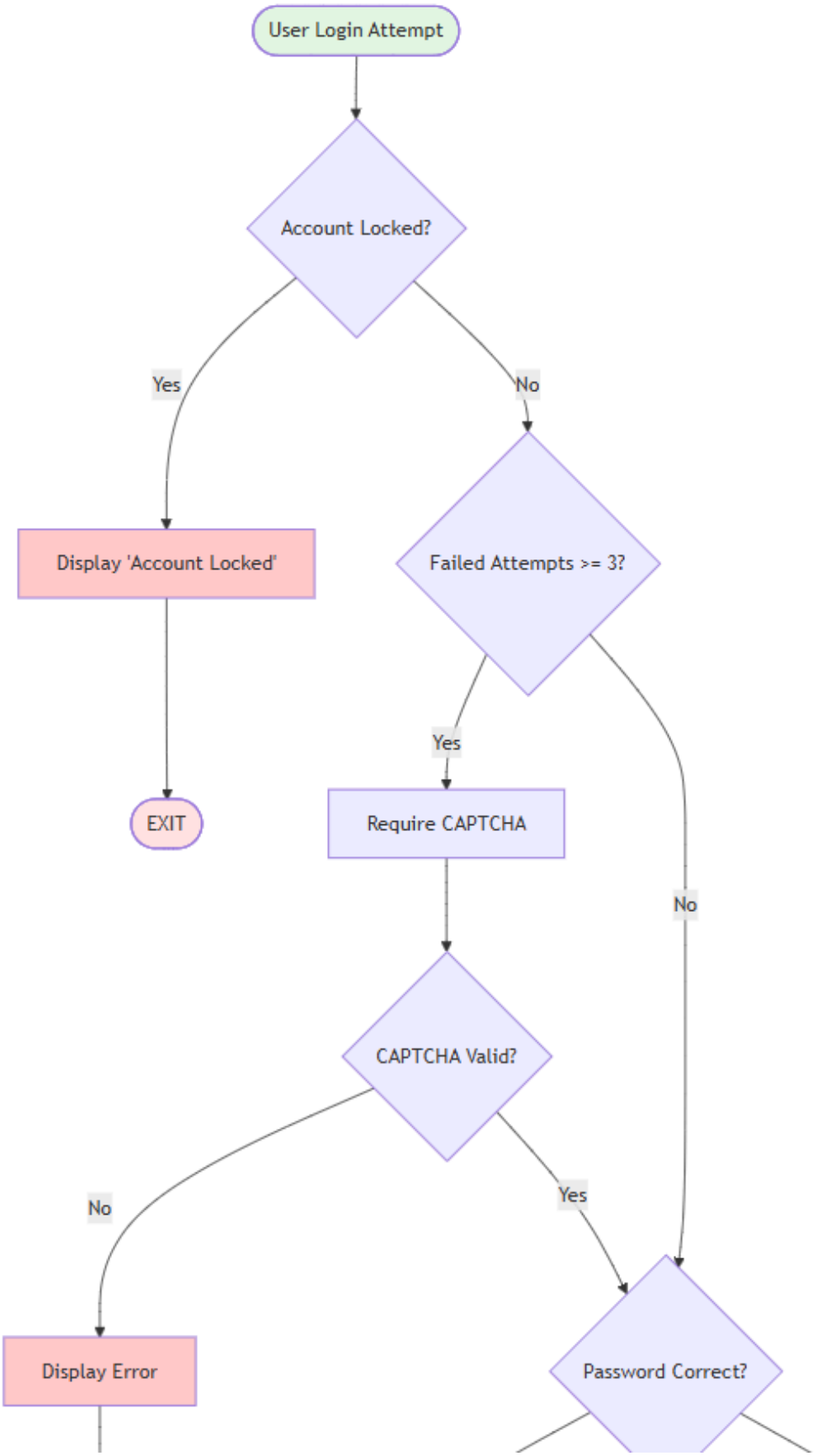
```
CHECK AccountStatus
IF AccountStatus = "Locked" THEN
    DISPLAY "Account is locked. Contact administrator or verify email to unlock."
    EXIT Process
ENDIF

CHECK FailedLoginAttempts
IF FailedLoginAttempts >= 3 AND FailedLoginAttempts < 5 THEN
    REQUIRE CAPTCHA Validation
    IF CAPTCHA Invalid THEN
        DISPLAY "Invalid CAPTCHA"
        EXIT Process
    ENDIF
ENDIF

VERIFY Password against PasswordHash using bcrypt
IF Password Incorrect THEN
    INCREMENT FailedLoginAttempts

    IF FailedLoginAttempts >= 5 THEN
        SET AccountStatus = "Locked"
        SEND Notification "Account Locked" to User Email
        DISPLAY "Account locked due to multiple failed attempts"
    ELSE
        DISPLAY "Invalid credentials"
    ENDIF

    UPDATE User Record in User Database (D1)
    EXIT Process
ENDIF

CHECK IsEmailVerified
IF IsEmailVerified = FALSE THEN
    DISPLAY "Please verify your email before logging in"
    EXIT Process
ENDIF

// Successful Authentication
SET FailedLoginAttempts = 0
SET LastLoginAt = CURRENT_DATETIME
GENERATE Session Token (JWT)

DETERMINE Session Timeout based on Role
IF Role = "Resident" THEN
    SET SessionTimeout = 30 minutes
ELSIF Role = "Technician" THEN
    SET SessionTimeout = 15 minutes
ELSIF Role = "Administrator" THEN
    SET SessionTimeout = 60 minutes
ENDIF

STORE Session in Redis Cache
UPDATE User Record in User Database (D1)
```

```
REDIRECT to Role-Specific Dashboard
    IF Role = "Resident" THEN REDIRECT to Resident Dashboard
    ELSIF Role = "Technician" THEN REDIRECT to Technician Dashboard
    ELSIF Role = "Administrator" THEN REDIRECT to Administrator Dashboard
    ENDIF

END Process
```

Refer to:

- FR-2.1 through FR-2.8
- Table 55: Data Flow 4 Details
- Table 56: Data Flow 5 Details

Decision Tree:



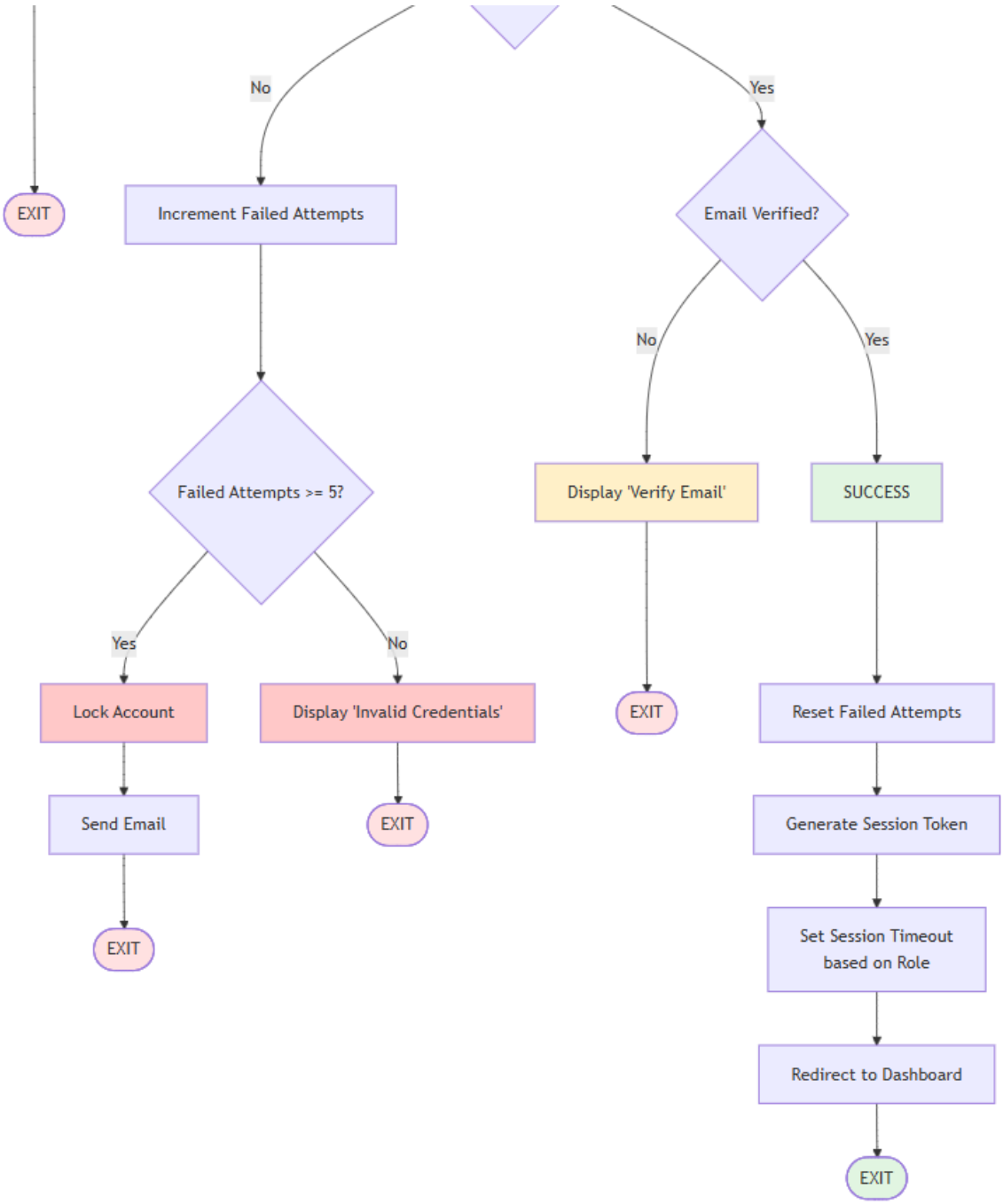


Figure 46: Decision Tree 1.2

Number: 1.3 **Name:** Password Recovery **Description:** Allows users to reset forgotten passwords by verifying email and national ID, sending one-time verification code, and updating password after validation.

Input Data Flow:

- Recovery Request (from Resident/Technician/Admin)
  - Email OR National ID
  - Verification Code (after email sent)
  - New Password
  - Password Confirmation

Output Data Flow:
- Account Verification Data (from User Database D1)
- Updated Password (to User Database D1)
- Verification Email (to Email Service)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `recoverPassword()`

Process Logic (Structured English):

```
BEGIN Process 1.3: Password Recovery

// Step 1: Initiate Recovery
READ Email and National ID from User

RETRIEVE User Record from User Database (D1)
IF User Record Not Found OR
   Email Not Matching OR
   National ID Not Matching THEN
    DISPLAY "Invalid information provided"
    EXIT Process
ENDIF

GENERATE One-Time Verification Code (6-digit random number)
SET Code Expiration = CURRENT_DATETIME + 15 minutes
STORE Verification Code with UserID and Expiration in Redis Cache

SEND Verification Code to User Email
DISPLAY "Verification code sent to your email"

// Step 2: Verify Code
READ Verification Code from User

RETRIEVE Stored Code from Redis Cache by UserID
IF Code Not Found THEN
    DISPLAY "Verification code expired or invalid"
    EXIT Process
ENDIF

IF Current Time > Code Expiration THEN
    DELETE Code from Redis Cache
    DISPLAY "Verification code expired. Please request a new one."
    EXIT Process
ENDIF

IF Entered Code ≠ Stored Code THEN
    DISPLAY "Invalid verification code"
    EXIT Process
ENDIF
```

```
// Step 3: Reset Password
READ New Password and Password Confirmation from User

IF New Password ≠ Password Confirmation THEN
    DISPLAY "Passwords do not match"
    EXIT Process
ENDIF

VALIDATE Password Strength
IF Password Length < 8 OR
   Missing Uppercase OR
   Missing Lowercase OR
   Missing Number OR
   Missing Special Character THEN
    DISPLAY "Password does not meet strength requirements"
    EXIT Process
ENDIF

RETRIEVE Last 3 Passwords from User Database (D1)
FOR EACH Previous Password DO
    IF bcrypt Compare(New Password, Previous Password Hash) = TRUE THEN
        DISPLAY "Cannot reuse recent passwords"
        EXIT Process
    ENDIF
ENDFOR

HASH New Password using bcrypt
UPDATE PasswordHash in User Database (D1)
ARCHIVE Old Password Hash to Password History
DELETE Verification Code from Redis Cache

SEND Confirmation Email "Password Changed Successfully"
DISPLAY "Password reset successful. Please login with your new password."

END Process
```

Refer to:

- FR-4.1 through FR-4.10
- Table 57: Data Flow 6 Details
- Table 58: Data Flow 7 Details

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
User Found with Email+ID	Y	Y	Y	Y	Y	N
Code Valid & Not Expired	Y	Y	Y	Y	N	-
Passwords Match	Y	Y	Y	N	-	-
Password Strength Valid	Y	Y	N	-	-	-
Not in Last 3 Passwords	Y	N	-	-	-	-
Update Password	X	-	-	-	-	-
Send Confirmation Email	X	-	-	-	-	-
Display “Cannot reuse password”	-	X	-	-	-	-
Display “Weak password”	-	-	X	-	-	-
Display “Passwords don’t match”	-	-	-	X	-	-
Display “Code expired/invalid”	-	-	-	-	X	-
Display “Invalid information”	-	-	-	-	-	X

Unresolved Issues: None

Number: 1.4 **Name:** Account Management **Description:** Allows users to view and update profile information, and allows administrators to manage user accounts (activate, deactivate, update roles).

Input Data Flow:
- Profile Update Data (from Resident)
- User Management Commands (from Administrator)
- User Profile Data (from User Database D1)

Output Data Flow:
- Updated Profile/Account Status (to User Database D1)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `manageUserAccount()`

Process Logic (Structured English):

```
BEGIN Process 1.4: Account Management

READ Action Type (View, Update Profile, Admin Action)

// Resident Profile Update
IF Action = "Update Profile" THEN
    READ UserID and Updated Fields from Resident
    RETRIEVE Current Profile from User Database (D1)

    IF Updating Sensitive Field (Email, Password) THEN
```

```
        REQUIRE Password Verification
        IF Password Verification Fails THEN
            DISPLAY "Password verification required"
            EXIT Process
        ENDIF
    ENDIF

    IF Updating Email THEN
        CHECK Email Uniqueness
        IF Email Already Exists THEN
            DISPLAY "Email already in use"
            EXIT Process
        ENDIF

        GENERATE Email Verification Token
        SEND Verification Email to New Email Address
        SET PendingEmail = New Email
        DISPLAY "Verification email sent. Email will be updated after
verification."
    ENDIF

    IF Updating Password THEN
        VALIDATE Password Strength
        IF Password Strength Invalid THEN
            DISPLAY "Password does not meet requirements"
            EXIT Process
        ENDIF

        CHECK Last 3 Passwords
        IF Password Used Recently THEN
            DISPLAY "Cannot reuse recent passwords"
            EXIT Process
        ENDIF

        HASH New Password
        UPDATE PasswordHash
    ENDIF

    IF Updating Profile Picture THEN
        VALIDATE File Type (JPEG, PNG)
        VALIDATE File Size (< 5MB)
        IF Validation Fails THEN
            DISPLAY "Invalid file format or size"
            EXIT Process
        ENDIF
        UPLOAD to AWS S3
        UPDATE ProfilePictureURL
    ENDIF

    IF Updating Full Name THEN
        UPDATE FullName
    ENDIF

    LOG Profile Change with Timestamp and IP Address
```

```
    UPDATE User Record in User Database (D1)
    DISPLAY "Profile updated successfully"
ENDIF

// Administrator User Management
IF Action = "Admin Manage User" THEN
    VERIFY Admin Privileges
    IF Not Administrator THEN
        DISPLAY "Unauthorized action"
        EXIT Process
    ENDIF

    READ TargetUserID and Admin Action

    IF Admin Action = "Activate Account" THEN
        SET AccountStatus = "Active"
        SET IsEmailVerified = TRUE
        SEND Notification to User
    ELSIF Admin Action = "Deactivate Account" THEN
        SET AccountStatus = "Suspended"
        INVALIDATE All Active Sessions
        SEND Notification to User
    ELSIF Admin Action = "Delete Account" THEN
        SOFT DELETE User Record (mark as deleted)
        INVALIDATE All Active Sessions
        ARCHIVE User Data
    ELSIF Admin Action = "Unlock Account" THEN
        SET AccountStatus = "Active"
        SET FailedLoginAttempts = 0
        SEND Notification to User
    ELSIF Admin Action = "Reset Password" THEN
        GENERATE Temporary Password
        HASH Temporary Password
        UPDATE PasswordHash
        SET ForcePasswordChange = TRUE
        SEND Temporary Password to User Email
    ELSIF Admin Action = "Update Role" THEN
        REQUIRE Approval Workflow
        IF Approval Granted THEN
            UPDATE Role
            UPDATE Permissions
            SEND Notification to User
        ENDIF
    ELSIF Admin Action = "Assign Technician Specialization" THEN
        IF User Role = "Technician" THEN
            UPDATE Specialization
            UPDATE SkillLevel
            UPDATE WorkZone
        ELSE
            DISPLAY "User is not a technician"
        ENDIF
    ENDIF

    LOG Admin Action with Timestamp and Admin ID
```

```
    UPDATE User Record in User Database (D1)
    DISPLAY "User account updated successfully"
ENDIF

END Process
```

Refer to:
- FR-12 (Resident Profile Management)
- FR-28 (User Account Management)
- Table 59: Data Flow 8 Details
- Table 60: Data Flow 9 Details

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
Actor = Resident	Y	Y	Y	N	N
Actor = Administrator	N	N	N	Y	Y
Updating Sensitive Field	Y	Y	N	-	-
Password Verified	Y	N	-	-	-
Admin Privileges Valid	-	-	-	Y	N
Allow Profile Update	X	-	X	-	-
Require Password Verification	X	X	-	-	-
Deny Update	-	X	-	-	X
Allow Admin Action	-	-	-	X	-
Log Change	X	-	X	X	-

Unresolved Issues: None

4.2.2. Fragment 2: Maintenance Request Management Processes

Number: 2.1 **Name:** Create Maintenance Ticket **Description:** Validates and creates a new maintenance ticket, checks for duplicates, uploads images, generates unique ticket ID, and stores ticket information.

Input Data Flow:
- New Ticket Submission Data (from Resident)
  - Category
  - Description
  - Location
  - Priority
- Ticket Attachments/Images (from Resident)

Output Data Flow:
- New Ticket Record (to Tickets Database D2)
- Ticket Confirmation (to Resident)

- Notification Trigger (to Process 2.5)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `createMaintenanceTicket()`

Process Logic (Structured English):

```
BEGIN Process 2.1: Create Maintenance Ticket

READ Ticket Details from Resident
    Category, Description, Location, Priority, Images

VALIDATE Mandatory Fields
IF Category = NULL OR
   Description = NULL OR
   Location = NULL OR
   Priority = NULL THEN
    DISPLAY "All mandatory fields must be filled"
    EXIT Process
ENDIF

VALIDATE Description Length
IF Description Length < 20 characters THEN
    DISPLAY "Description must be at least 20 characters"
    EXIT Process
ENDIF

VALIDATE Images (if provided)
IF Images Attached THEN
    IF Number of Images > 5 THEN
        DISPLAY "Maximum 5 images allowed"
        EXIT Process
    ENDIF

    FOR EACH Image DO
        VALIDATE File Type (JPEG, PNG only)
        VALIDATE File Size (< 5MB per image)
        IF Validation Fails THEN
            DISPLAY "Invalid image format or size"
            EXIT Process
        ENDIF
    ENDFOR
ENDIF

// Duplicate Detection
CHECK for Similar Tickets in Last 7 Days
QUERY Tickets Database (D2) WHERE:
    Category = Input Category AND
    Location = Input Location AND
    ReportedAt >= (CURRENT_DATE - 7 days)
```

```
CALCULATE Similarity Score for Description
FOR EACH Retrieved Ticket DO
    COMPUTE Text Similarity (Cosine Similarity, Levenshtein Distance)
    IF Similarity Score > 80% THEN
        SET SimilarityFlag = TRUE
        ADD Ticket to Similar Tickets List
    ENDIF
ENDFOR

IF SimilarityFlag = TRUE THEN
    DISPLAY Warning "Similar tickets found:"
    DISPLAY Similar Tickets List with Links
    PROMPT User "Proceed with submission?" OR "Add comment to existing ticket" OR
"Cancel"

    IF User Selects "Cancel" THEN
        EXIT Process
    ELSIF User Selects "Add comment to existing ticket" THEN
        REDIRECT to Process 2.4 (Add Comment)
        EXIT Process
    ENDIF
    // If Proceed, continue below
ENDIF

// Upload Images to AWS S3
IF Images Attached THEN
    FOR EACH Image DO
        COMPRESS Image (if size > 1MB)
        GENERATE Unique Image Name
        UPLOAD to AWS S3 Bucket
        STORE Image URL
    ENDFOR
ENDIF

// Create Ticket
GENERATE Unique TicketID (Format: TKT-YYYYMMDD-XXXXX)
SET Status = "Open"
SET ReportedAt = CURRENT_DATETIME
SET RequesterID = Current User ID
SET TechnicianID = NULL (not yet assigned)
SET AssignedAt = NULL
SET ResolvedAt = NULL
SET IsUrgentFlag = FALSE
SET EstimatedCompletionTime = CALCULATE based on Priority

WRITE Ticket Record to Tickets Database (D2)

// Calculate Estimated Response Time
IF Priority = "Emergency" THEN
    EstimatedResponse = "Within 1 hour"
ELSIF Priority = "Urgent" THEN
    EstimatedResponse = "Within 4 hours"
ELSIF Priority = "High" THEN
    EstimatedResponse = "Within 24 hours"
```

```
ELSIF Priority = "Medium" THEN
    EstimatedResponse = "Within 3 days"
ELSE // Low
    EstimatedResponse = "Within 7 days"
ENDIF

SEND Notification to Administrators (Process 2.5)
DISPLAY Confirmation Page
    "Ticket Created Successfully"
    "Ticket ID: " + TicketID
    "Estimated Response Time: " + EstimatedResponse

REDIRECT to Ticket Details View

END Process
```

Refer to:

- FR-8 (Open Maintenance Ticket)
- FR-11 (Duplicate Ticket Prevention)
- Table 61: Data Flow 10 Details
- Table 62: Data Flow 11 Details
- Table 63: Data Flow 12 Details
- Table 64: Data Flow 13 Details

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
All Mandatory Fields Filled	Y	Y	Y	Y	Y	N
Description >= 20 chars	Y	Y	Y	Y	N	-
Images Valid (if provided)	Y	Y	Y	N	-	-
Duplicate Detected	Y	Y	N	-	-	-
User Proceeds Anyway	Y	N	-	-	-	-
Create Ticket	X	-	X	-	-	-
Generate Ticket ID	X	-	X	-	-	-
Send Admin Notification	X	-	X	-	-	-
Show Confirmation	X	-	X	-	-	-
Show Duplicates Warning	X	X	-	-	-	-
User Chooses Action	X	X	-	-	-	-
Display “Invalid images”	-	-	-	X	-	-
Display “Description too short”	-	-	-	-	X	-
Display “Missing fields”	-	-	-	-	-	X

Unresolved Issues: Should the expected arrival date of goods on order be considered when calculating estimated completion time for tickets requiring parts?

Number: 2.2 **Name:** View/Search Tickets **Description:** Retrieves and displays tickets based on search criteria, applies filters, paginates results, and shows ticket details.

Input Data Flow:
- View/Search Criteria (from Resident/Technician/Admin)
  - Ticket ID (optional)
  - Status
  - Category
  - Date Range
  - Keyword

Output Data Flow:
- Ticket List/Ticket Details (from Tickets Database D2 to User)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `viewSearchTickets()`

Process Logic (Structured English):

```
BEGIN Process 2.2: View/Search Tickets

READ Search Criteria from User
    Optional: TicketID, Status, Category, DateRange, Keyword

GET Current User Role and UserID

// Build Query
INITIALIZE Query = "SELECT * FROM Tickets WHERE 1=1"

// Role-based filtering
IF User Role = "Resident" THEN
    ADD to Query "AND RequesterID = Current UserID"
ELSIF User Role = "Technician" THEN
    ADD to Query "AND (TechnicianID = Current UserID OR Status = 'Open')"
ELSIF User Role = "Administrator" THEN
    // No restriction - can view all tickets
ENDIF

// Apply Search Filters
IF TicketID Provided THEN
    ADD to Query "AND TicketID = Input TicketID"
ENDIF

IF Status Provided THEN
    IF Status is Multi-Select THEN
        ADD to Query "AND Status IN (Selected Statuses)"
    ELSE
        ADD to Query "AND Status = Input Status"
```

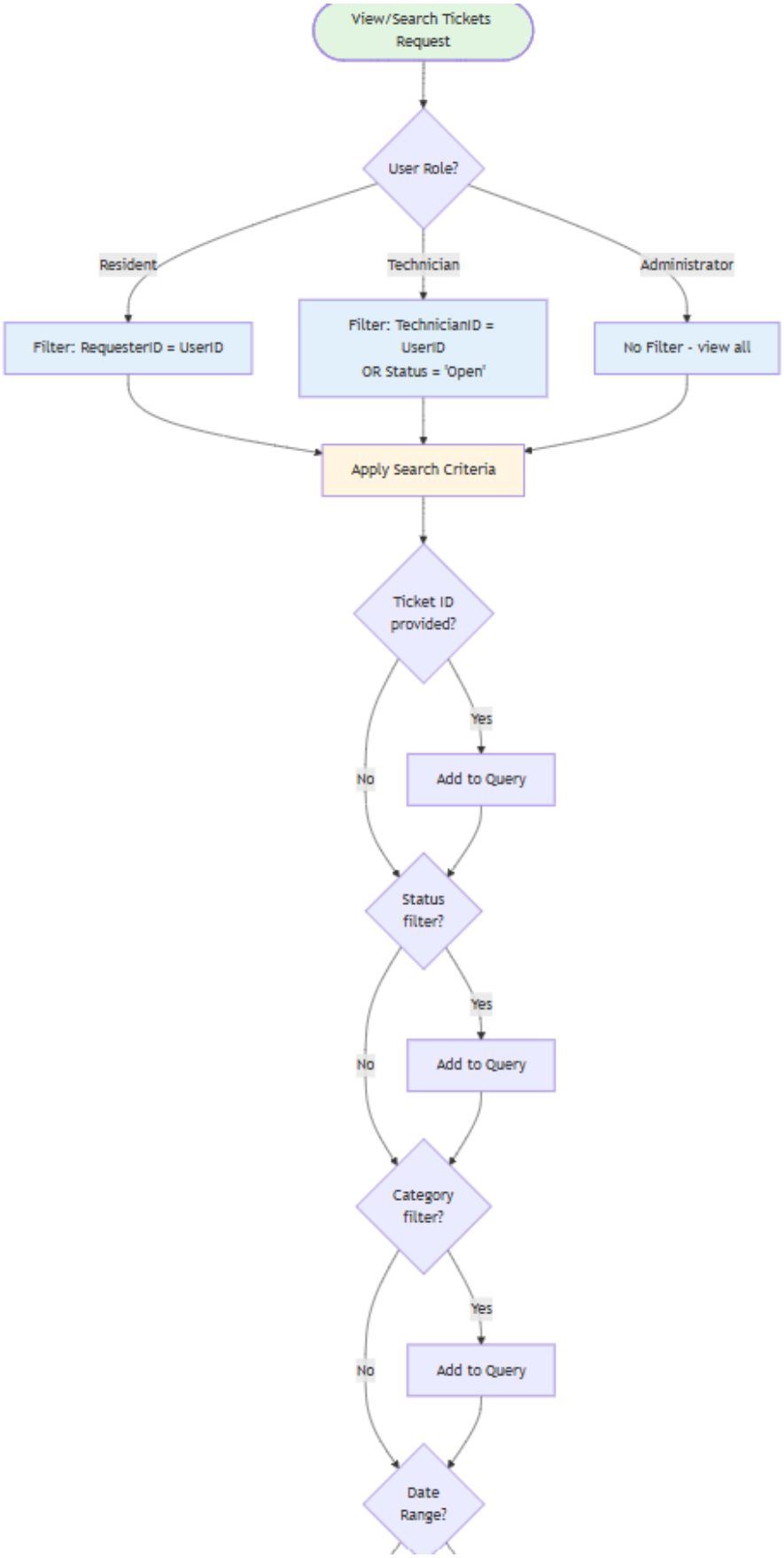
```
    ENDIF
ENDIF

IF Category Provided THEN
    ADD to Query "AND Category = Input Category"
ENDIF

IF Date Range Provided THEN
    ADD to Query "AND ReportedAt BETWEEN StartDate AND EndDate"
ENDIF

IF Keyword Provided THEN
    ADD to Query "AND (Title LIKE '%Keyword%' OR Description LIKE '%Keyword%')"
ENDIF

// Execute Query
EXECUTE Query against Tickets Database (D2)
SET Tickets = Query Results

// Check if results found
IF Tickets is Empty THEN
    DISPLAY "No tickets found matching your criteria"
    EXIT Process
ENDIF

// Sort Results
IF User Specifies Sort Order THEN
    SORT Tickets by Specified Field (Priority DESC, ReportedAt DESC, etc.)
ELSE
    // Default sorting
    IF User Role = "Administrator" THEN
        SORT by Priority DESC, then ReportedAt DESC
    ELSIF User Role = "Technician" THEN
        SORT by AssignedAt DESC, then Priority DESC
    ELSE // Resident
        SORT by ReportedAt DESC
    ENDIF
ENDIF

// Pagination
SET ItemsPerPage = 20
CALCULATE TotalPages = CEILING(Tickets Count / ItemsPerPage)
GET Current Page from User (default = 1)
SET StartIndex = (Current Page - 1) * ItemsPerPage
SET EndIndex = StartIndex + ItemsPerPage
EXTRACT Page Items = Tickets[StartIndex to EndIndex]

// Prepare Display Data
FOR EACH Ticket in Page Items DO
    // Mark user's own tickets for residents
    IF User Role = "Resident" AND Ticket.RequesterID = Current UserID THEN
        SET Ticket.IsOwned = TRUE
    ENDIF
```

```
    // Hide sensitive information
    IF User Role ≠ "Administrator" THEN
        REMOVE Ticket.RequesterPersonalInfo
        REMOVE Ticket.InternalNotes
    ENDIF

    // Format display fields
    FORMAT Ticket.ReportedAt as "MMM DD, YYYY HH:MM"
    FORMAT Ticket.Status with Status Badge/Color
    FORMAT Ticket.Priority with Priority Icon
ENDFOR

// Display Results
DISPLAY Ticket List with:
    - Ticket ID
    - Title
    - Category
    - Location
    - Status
    - Priority
    - Reported Date
    - Assigned Technician (if applicable)
    - "Your Ticket" badge (if applicable)

DISPLAY Pagination Controls
DISPLAY Search/Filter Panel
DISPLAY "Total Results: " + Tickets Count

// Real-time Updates
IF Real-time Mode Enabled THEN
    ESTABLISH WebSocket Connection
    LISTEN for Ticket Updates
    ON Ticket Update Received DO
        IF Updated Ticket matches Current Filters THEN
            UPDATE Ticket in Display List
            SHOW Notification "Ticket Updated"
        ENDIF
    ENDDO
ENDIF

END Process
```

Refer to:

- FR-7 (View Reports Feed)
- FR-9 (Track Ticket Status)
- Table 65: Data Flow 14 Details
- Table 66: Data Flow 15 Details

Decision Tree:



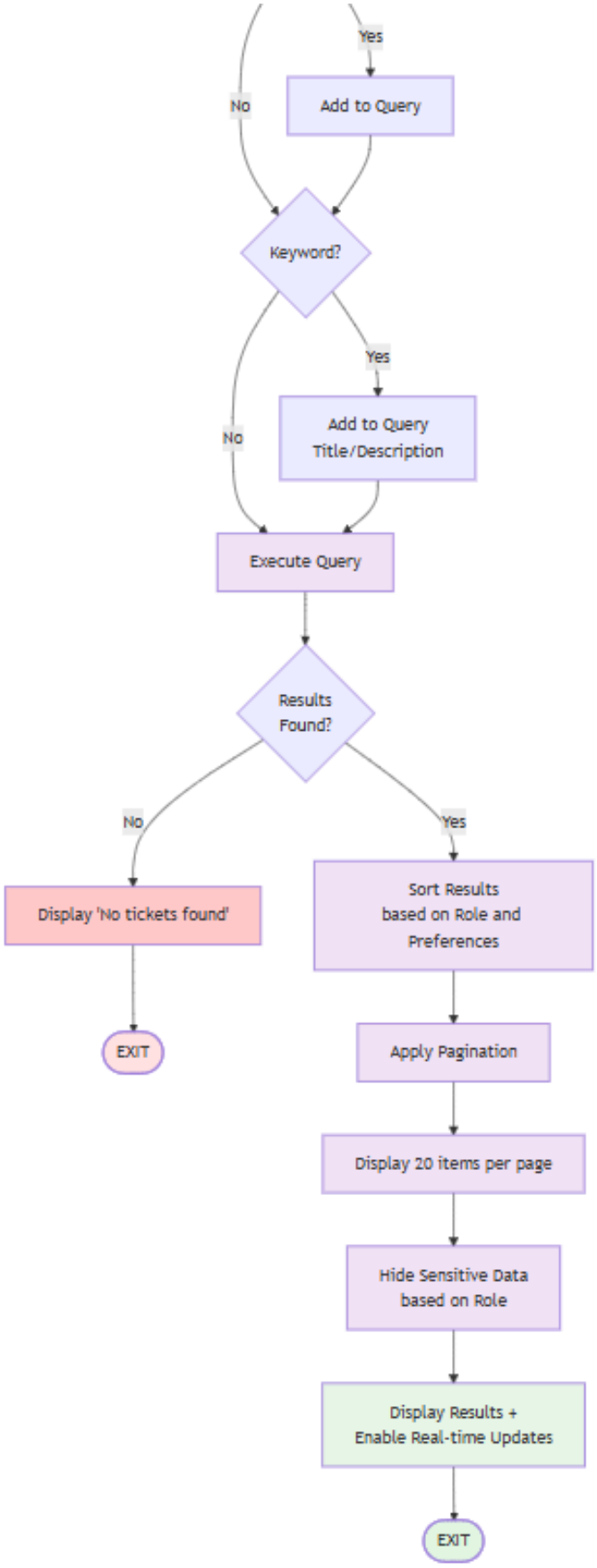


Figure 48: Decision Tree 2.3

Unresolved Issues: None

Number: 2.3 **Name:** Update Ticket Status **Description:** Updates the status of maintenance tickets based on technician progress or administrator actions, validates status transitions, and triggers notifications.

Input Data Flow:
- Assignment/Priority Update (from Administrator)
- Status Update (from Technician)

Output Data Flow:
- Updated Ticket Status/Assignment/Priority (to Tickets Database D2)
- Status Change Notification (to Process 2.5)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `updateTicketStatus()`

Process Logic (Structured English):

```
BEGIN Process 2.3: Update Ticket Status

READ Update Request from User (Technician or Administrator)
    TicketID, New Status/Assignment/Priority, Optional Notes

RETRIEVE Current Ticket from Tickets Database (D2)
IF Ticket Not Found THEN
    DISPLAY "Ticket not found"
    EXIT Process
ENDIF

GET Current User Role and UserID
SET Current Status = Ticket.Status

// Authorization Check
IF User Role = "Technician" THEN
    IF Ticket.TechnicianID ≠ Current UserID THEN
        DISPLAY "You are not authorized to update this ticket"
        EXIT Process
    ENDIF
ELSIF User Role = "Administrator" THEN
    // Administrators can update any ticket
ELSE
    DISPLAY "Unauthorized action"
    EXIT Process
ENDIF

// Process Administrator Updates
IF User Role = "Administrator" THEN
    IF Updating Assignment THEN
        READ New TechnicianID
```

```
        VALIDATE Technician Exists and Is Active
        IF Technician Invalid THEN
            DISPLAY "Invalid technician selected"
            EXIT Process
        ENDIF

        // Check technician availability and workload
        GET Technician Current Workload
        GET Technician Availability Status
        GET Technician Specialization

        IF Availability Status = "On Break" OR Availability Status = "Busy" THEN
            WARN "Technician is currently " + Availability Status
            PROMPT "Proceed anyway?"
            IF User Declines THEN
                EXIT Process
            ENDIF
        ENDIF

        // Check expertise match
        IF Ticket.Category NOT IN Technician.Specialization THEN
            WARN "Technician specialization doesn't match ticket category"
            PROMPT "Proceed anyway?"
            IF User Declines THEN
                EXIT Process
            ENDIF
        ENDIF

        SET Ticket.TechnicianID = New TechnicianID
        SET Ticket.AssignedAt = CURRENT_DATETIME
        SET Ticket.Status = "Assigned"

        SEND Notification to New Technician (Process 2.5)
        LOG "Ticket assigned to " + Technician.Name + " by " + Admin.Name
    ENDIF

    IF Updating Priority THEN
        READ New Priority Level

        VALIDATE Priority Level IN (Low, Medium, High, Urgent, Emergency)
        IF Priority Invalid THEN
            DISPLAY "Invalid priority level"
            EXIT Process
        ENDIF

        SET Old Priority = Ticket.Priority
        SET Ticket.Priority = New Priority

        // Recalculate estimated completion time
        CALCULATE Estimated Completion Time based on New Priority
        SET Ticket.EstimatedCompletionTime = Calculated Time

        IF New Priority > Old Priority THEN
            SET Ticket.IsUrgentFlag = TRUE
```

```
            SEND Notification to Assigned Technician (Process 2.5)
        ENDIF

        LOG "Priority changed from " + Old Priority + " to " + New Priority
    ENDIF

    IF Manually Closing Ticket THEN
        SET Ticket.Status = "Closed"
        SET Ticket.ResolvedAt = CURRENT_DATETIME
        LOG "Ticket manually closed by administrator"
        SEND Notification to Requester (Process 2.5)
    ENDIF
ENDIF

// Process Technician Status Updates
IF User Role = "Technician" THEN
    READ New Status, Optional Notes

    // Validate Status Transition
    CALL ValidateStatusTransition(Current Status, New Status)
    IF Transition Invalid THEN
        DISPLAY "Invalid status transition from " + Current Status + " to " + New
Status
        EXIT Process
    ENDIF

    IF New Status = "In Progress" THEN
        IF Current Status ≠ "Assigned" AND Current Status ≠ "On Hold" THEN
            DISPLAY "Cannot set to In Progress from current status"
            EXIT Process
        ENDIF

        SET Ticket.Status = "In Progress"
        SET Ticket.ActualStartTime = CURRENT_DATETIME

        CALCULATE Expected Completion = ActualStartTime + EstimatedDuration
        SET Ticket.ExpectedCompletionTime = Expected Completion

        LOG "Work started by " + Technician.Name
        SEND Notification to Requester (Process 2.5)
    ENDIF

    IF New Status = "On Hold" THEN
        IF Current Status ≠ "In Progress" THEN
            DISPLAY "Can only put In Progress tickets on hold"
            EXIT Process
        ENDIF

        REQUIRE On Hold Reason
        READ Hold Reason (Waiting for Parts, Requires Specialist, Resident Not
Available)
        IF Hold Reason Not Provided THEN
            DISPLAY "Please provide a reason for putting ticket on hold"
            EXIT Process
```

```
        ENDIF

        SET Ticket.Status = "On Hold"
        SET Ticket.OnHoldReason = Hold Reason
        SET Ticket.OnHoldDate = CURRENT_DATETIME

        LOG "Ticket placed on hold: " + Hold Reason
        SEND Notification to Administrator and Requester (Process 2.5)
    ENDIF

    IF New Status = "Fixed" THEN
        IF Current Status ≠ "In Progress" THEN
            DISPLAY "Ticket must be In Progress before marking as Fixed"
            EXIT Process
        ENDIF

        REQUIRE Completion Evidence (handled by Process 2.4)
        // Technician must submit evidence before fixing
        CHECK if Evidence Submitted for This Ticket
        IF No Evidence THEN
            DISPLAY "Please upload completion evidence before marking as Fixed"
            REDIRECT to Evidence Upload (Process 2.4)
            EXIT Process
        ENDIF

        SET Ticket.Status = "Fixed"
        SET Ticket.ResolvedAt = CURRENT_DATETIME

        CALCULATE Actual Resolution Time = ResolvedAt - ActualStartTime
        SET Ticket.ActualResolutionTime = Actual Resolution Time

        // Update technician performance metrics
        UPDATE Technician.AverageResolutionTime
        UPDATE Technician.CompletionRate

        LOG "Ticket marked as Fixed by " + Technician.Name
        SEND Notification to Administrator and Requester for Review (Process 2.5)
    ENDIF

    IF New Status = "Closed" THEN
        IF Current Status ≠ "Fixed" THEN
            DISPLAY "Only Fixed tickets can be closed"
            EXIT Process
        ENDIF

        // Usually closed by Administrator after review
        DISPLAY "Ticket will be closed after administrator review"
        EXIT Process
    ENDIF

    IF Notes Provided THEN
        SET Ticket.UpdateNotes = Notes
    ENDIF
ENDIF
```

```
// Check for Overdue Escalation
IF Current Status = "In Progress" THEN
    IF CURRENT_DATETIME > Ticket.EstimatedCompletionTime THEN
        SET Ticket.IsUrgentFlag = TRUE
        INCREMENT Ticket.EscalationLevel
        SEND Escalation Notification to Administrator (Process 2.5)
        LOG "Ticket escalated due to overdue status"
    ENDIF
ENDIF

// Update Database
UPDATE Ticket Record in Tickets Database (D2)
SET Ticket.LastUpdated = CURRENT_DATETIME

// Trigger Notifications
SEND Status Change Notification (Process 2.5)

DISPLAY "Ticket updated successfully"

END Process
```

Subfunction: ValidateStatusTransition

```
FUNCTION ValidateStatusTransition(Current Status, New Status) RETURNS Boolean

// Valid Transitions Matrix
SET Valid Transitions = {
    "Open": ["Assigned"],
    "Assigned": ["In Progress", "Open"],
    "In Progress": ["On Hold", "Fixed"],
    "On Hold": ["In Progress"],
    "Fixed": ["Closed"],
    "Closed": []
}

IF New Status IN Valid Transitions[Current Status] THEN
    RETURN TRUE
ELSE
    RETURN FALSE
ENDIF

END FUNCTION
```

Refer to:

- FR-16 (Task Status Updates)
- FR-23 (Ticket Assignment Management)
- FR-24 (Ticket Priority Management)
- Table 70: Data Flow 19 Details
- Table 71: Data Flow 20 Details
- Table 72: Data Flow 21 Details

Decision Table (Technician Status Updates):

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
Current Status = Assigned	Y	N	N	N	N	N
Current Status = In Progress	N	Y	Y	Y	N	N
Current Status = On Hold	N	N	N	N	Y	N
Current Status = Fixed	N	N	N	N	N	Y
New Status = In Progress	Y	N	N	N	Y	N
New Status = On Hold	N	Y	N	N	N	N
New Status = Fixed	N	N	Y	N	N	N
Evidence Submitted	-	-	Y	N	-	-
Set Status = In Progress	X	-	-	-	X	-
Record Start Time	X	-	-	-	-	-
Set Status = On Hold	-	X	-	-	-	-
Require Hold Reason	-	X	-	-	-	-
Set Status = Fixed	-	-	X	-	-	-
Update Metrics	-	-	X	-	-	-
Display “Need Evidence”	-	-	-	X	-	-
Display “Invalid Transition”	-	-	-	-	-	X
Send Notifications	X	X	X	-	X	-

Unresolved Issues: None

Number: 2.4 **Name:** Manage Comments & Evidence **Description:** Allows residents to add comments to tickets and technicians to upload maintenance completion evidence (images, notes, documents).

Input Data Flow:
- Comment Submission (from Resident)
- Completion Evidence (from Technician)

Output Data Flow:
- Maintenance Completion Record (to Maintenance History D3)
- Updated Ticket with Evidence (to Tickets Database D2)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `manageCommentsEvidence()`

Process Logic (Structured English):

```
BEGIN Process 2.4: Manage Comments & Evidence

READ Action Type (Add Comment OR Upload Evidence)

// ============================================
// RESIDENT: Add Comment to Ticket
// ============================================
IF Action = "Add Comment" THEN
    READ TicketID and Comment Text from Resident

    RETRIEVE Ticket from Tickets Database (D2)
    IF Ticket Not Found THEN
        DISPLAY "Ticket not found"
        EXIT Process
    ENDIF

    VERIFY Resident is Ticket Owner
    IF Ticket.RequesterID ≠ Current UserID THEN
        DISPLAY "You can only comment on your own tickets"
        EXIT Process
    ENDIF

    CHECK Ticket Status
    IF Ticket.Status = "Closed" THEN
        IF Ticket.ResidentEditableFlag = FALSE THEN
            DISPLAY "Cannot add comments to closed tickets"
            EXIT Process
        ENDIF
    ENDIF

    VALIDATE Comment Text
    IF Comment Text is Empty OR Length < 5 characters THEN
        DISPLAY "Comment must be at least 5 characters"
        EXIT Process
    ENDIF

    GENERATE CommentID
    CREATE Comment Record
        CommentID = Generated ID
        TicketID = Input TicketID
        UserID = Current UserID
        Content = Comment Text
        CreatedAt = CURRENT_DATETIME
        IsInternal = FALSE

    WRITE Comment to Database

    // Send notification to assigned technician (if any)
    IF Ticket.TechnicianID ≠ NULL THEN
        SEND Notification to Technician (Process 2.5)
            "New comment added to ticket " + TicketID
    ENDIF

    // Send notification to administrators
```

```
    SEND Notification to Administrators (Process 2.5)

    DISPLAY "Comment added successfully"
ENDIF

// ============================================
// TECHNICIAN: Upload Maintenance Evidence
// ============================================
IF Action = "Upload Evidence" THEN
    READ TicketID, Images, Notes, Documents from Technician

    RETRIEVE Ticket from Tickets Database (D2)
    IF Ticket Not Found THEN
        DISPLAY "Ticket not found"
        EXIT Process
    ENDIF

    VERIFY Technician is Assigned to Ticket
    IF Ticket.TechnicianID ≠ Current UserID THEN
        DISPLAY "You can only upload evidence for your assigned tickets"
        EXIT Process
    ENDIF

    CHECK Ticket Status
    IF Ticket.Status ≠ "In Progress" AND Ticket.Status ≠ "Fixed" THEN
        DISPLAY "Evidence can only be uploaded for In Progress or Fixed tickets"
        EXIT Process
    ENDIF

    // Validate Images
    IF Images Provided THEN
        IF Number of Images > 10 THEN
            DISPLAY "Maximum 10 evidence images allowed"
            EXIT Process
        ENDIF

        FOR EACH Image DO
            VALIDATE File Type (JPEG, PNG)
            VALIDATE File Size (< 10MB per image)
            IF Validation Fails THEN
                DISPLAY "Invalid image format or size. Allowed: JPEG, PNG up to
10MB"
                EXIT Process
            ENDIF
        ENDFOR
    ENDIF

    // Validate Documents
    IF Documents Provided THEN
        FOR EACH Document DO
            VALIDATE File Type (PDF only)
            VALIDATE File Size (< 20MB)
            IF Validation Fails THEN
                DISPLAY "Invalid document. Only PDF files up to 20MB allowed"
```

```
            EXIT Process
        ENDIF
    ENDFOR
ENDIF

// Validate that at least one piece of evidence is provided
IF Images is Empty AND Notes is Empty AND Documents is Empty THEN
    DISPLAY "Please provide at least one piece of evidence (image or notes)"
    EXIT Process
ENDIF

// Upload Images to AWS S3
IF Images Provided THEN
    FOR EACH Image DO
        COMPRESS Image (if size > 2MB, compress to maintain quality)
        GENERATE Unique Filename
            Format: evidence_<TicketID>_<Timestamp>_<Index>.<ext>

        UPLOAD to AWS S3
            Bucket: maintenance-evidence
            Path: /<Year>/<Month>/<TicketID>/

        STORE Image URL

        // Add caption if provided
        IF Caption Provided for Image THEN
            STORE Caption with Image URL
        ENDIF
    ENDFOR
ENDIF

// Upload Documents to AWS S3
IF Documents Provided THEN
    FOR EACH Document DO
        GENERATE Unique Filename
        UPLOAD to AWS S3
            Bucket: maintenance-documents
            Path: /<Year>/<Month>/<TicketID>/
        STORE Document URL
    ENDFOR
ENDIF

// Get Standard Completion Checklist for Category
RETRIEVE Completion Checklist Template
    based on Ticket.Category

IF Checklist Items Provided THEN
    FOR EACH Checklist Item DO
        VALIDATE Item is Checked or Has Note
        STORE Checklist Response
    ENDFOR
ENDIF

// Create Evidence Record
```

```
    GENERATE EvidenceID
    CREATE Evidence Record
        EvidenceID = Generated ID
        TicketID = Input TicketID
        TechnicianID = Current UserID
        CompletionNotes = Input Notes
        ImagesURL = Uploaded Image URLs Array
        DocumentsURL = Uploaded Document URLs Array
        ChecklistData = Completed Checklist
        WorkPerformed = Notes.WorkPerformed
        PartsUsed = Notes.PartsUsed
        TimeSpent = Notes.TimeSpent
        FollowUpRequired = Notes.FollowUpRequired
        UploadedAt = CURRENT_DATETIME

    WRITE Evidence Record to Database

    // Update Ticket with Evidence Reference
    UPDATE Ticket in Tickets Database (D2)
        SET EvidenceID = Generated EvidenceID
        SET HasEvidence = TRUE

    // Store in Maintenance History
    IF Ticket.Status = "Fixed" THEN
        CREATE Maintenance History Record
            TicketID = Input TicketID
            TechnicianID = Current UserID
            LocationID = Ticket.LocationID
            Category = Ticket.Category
            ResolutionSummary = Notes
            CompletionDate = CURRENT_DATETIME
            EvidenceID = Generated EvidenceID
            ActualResolutionTime = Ticket.ActualResolutionTime

        WRITE to Maintenance History (D3)
    ENDIF

    // Send Notification
    SEND Notification to Requester (Process 2.5)
        "Maintenance work completed with evidence"
    SEND Notification to Administrators (Process 2.5)
        "Evidence uploaded for ticket " + TicketID

    DISPLAY "Evidence uploaded successfully"
    DISPLAY "Ticket ID: " + TicketID
    DISPLAY "Evidence ID: " + EvidenceID
ENDIF

END Process
```

Refer to:

- FR-17 (Maintenance Evidence Submission)
- FR-9.6 (Resident Comments)

- Table 67: Data Flow 16 Details
- Table 68: Data Flow 17 Details
- Table 69: Data Flow 18 Details

Decision Table (Evidence Upload):

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
Assigned to Technician	Y	Y	Y	Y	Y	N
Status = In Progress/Fixed	Y	Y	Y	Y	N	-
Images Provided	Y	Y	Y	N	-	-
Images Valid	Y	Y	N	-	-	-
Notes Provided	Y	N	-	Y	-	-
Upload Images	X	X	-	-	-	-
Store Evidence Record	X	X	-	X	-	-
Update Ticket	X	X	-	X	-	-
Update History (if Fixed)	X	X	-	X	-	-
Send Notifications	X	X	-	X	-	-
Display “Invalid images”	-	-	X	-	-	-
Display “Wrong status”	-	-	-	-	X	-
Display “Not authorized”	-	-	-	-	-	X

Unresolved Issues: None

Number: 2.5 **Name:** Send Notifications **Description:** Central notification dispatcher that sends real-time notifications via in-app, email, and SMS channels based on ticket events and status changes.

Input Data Flow:
- Notification Trigger (from Processes 2.1, 2.3, 2.4, 3.2, 4.1)

Output Data Flow:
- Notification (to Resident/Technician/Administrator)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `sendNotification()`

Process Logic (Structured English):

```
BEGIN Process 2.5: Send Notifications

READ Notification Trigger Data
    TicketID, Event Type, RecipientRole, RecipientUserID
```

```
RETRIEVE Ticket Details from Tickets Database (D2)
RETRIEVE Recipient User Data from User Database (D1)

// Determine Notification Type
SET Notification Type based on Event
IF Event = "Ticket Created" THEN
    SET Type = "Alert"
ELSIF Event = "Status Changed" THEN
    SET Type = "StatusChange"
ELSIF Event = "Ticket Assigned" THEN
    SET Type = "Assignment"
ELSIF Event = "Priority Changed" THEN
    SET Type = "PriorityChange"
ELSIF Event = "Comment Added" THEN
    SET Type = "StatusChange"
ELSIF Event = "Evidence Uploaded" THEN
    SET Type = "StatusChange"
ELSIF Event = "Ticket Overdue" THEN
    SET Type = "Alert"
ELSE
    SET Type = "System"
ENDIF

// Determine Priority Level
IF Event = "Ticket Overdue" OR
   Event = "Emergency Ticket" OR
   Event = "Account Locked" THEN
    SET Priority Level = "High" // Immediate delivery
ELSIF Event = "Status Changed" OR
      Event = "Priority Changed" OR
      Event = "Ticket Assigned" THEN
    SET Priority Level = "Medium" // Within 15 minutes
ELSE
    SET Priority Level = "Low" // Within 1 hour
ENDIF

// Check User Notification Preferences
RETRIEVE User Notification Preferences from User Database (D1)
IF Recipient.DoNotDisturb = TRUE THEN
    IF Priority Level ≠ "High" THEN
        QUEUE Notification for Later Delivery
        EXIT Process
    ENDIF
ENDIF

// Check if Notification Should Be Grouped
CHECK for Recent Similar Notifications (within last 10 minutes)
IF Similar Notifications Exist THEN
    GROUP Notifications Together
    UPDATE Existing Notification with Latest Status
ELSE
    CREATE New Notification
ENDIF
```

```
// Build Notification Message
SET Message = ""
IF Event = "Ticket Created" THEN
    SET Message = "New maintenance ticket created: " + Ticket.Title
ELSIF Event = "Status Changed" THEN
    SET Message = "Ticket " + TicketID + " status changed to " + Ticket.Status
ELSIF Event = "Ticket Assigned" THEN
    SET Message = "New ticket assigned to you: " + Ticket.Title + " (Priority: " +
Ticket.Priority + ")"
ELSIF Event = "Priority Changed" THEN
    SET Message = "Ticket " + TicketID + " priority changed to " + Ticket.Priority
ELSIF Event = "Comment Added" THEN
    SET Message = "New comment added to your ticket " + TicketID
ELSIF Event = "Evidence Uploaded" THEN
    SET Message = "Maintenance evidence uploaded for ticket " + TicketID
ELSIF Event = "Ticket Overdue" THEN
    SET Message = "ALERT: Ticket " + TicketID + " is overdue"
ENDIF

GENERATE NotificationID
CREATE Notification Record
    NotificationID = Generated ID
    UserID = RecipientUserID
    RelatedTicketID = TicketID
    NotificationType = Type
    Message = Message
    Priority = Priority Level
    IsRead = FALSE
    CreatedAt = CURRENT_DATETIME
    ExpirationDate = CURRENT_DATETIME + 90 days

WRITE Notification to Database

// Send via Multiple Channels
// 1. In-App Notification
IF Recipient.Preferences.InAppEnabled = TRUE THEN
    SEND via WebSocket to Active User Sessions
    UPDATE Notification Badge Count
ENDIF

// 2. Email Notification
IF Recipient.Preferences.EmailEnabled = TRUE THEN
    IF Priority Level = "High" OR
       Recipient.Preferences.EmailForAllUpdates = TRUE THEN

        COMPOSE Email
            Subject = "SALLEHA: " + Message
            Body = Build HTML Email Template with:
                - Ticket Details
                - Status/Update Information
                - Direct Link to View Ticket
                - User Preferences Link
```

```
        SEND Email via Nodemailer SMTP
        LOG Email Sent
    ENDIF
ENDIF

// 3. SMS Notification (Optional - Only for Urgent)
IF Recipient.Preferences.SMSEnabled = TRUE THEN
    IF Priority Level = "High" OR Ticket.Priority = "Emergency" THEN
        IF Recipient.PhoneNumber ≠ NULL THEN
            COMPOSE SMS Message (max 160 chars)
                "SALLEHA ALERT: " + Message + " View: " + Short URL

            SEND SMS via Twilio API
            LOG SMS Sent
        ENDIF
    ENDIF
ENDIF

// 4. Push Notification (Mobile App)
IF Recipient Has Active Mobile Session THEN
    COMPOSE Push Notification
        Title = "SALLEHA Maintenance"
        Body = Message
        Data = {TicketID, Type, DeepLink}

    SEND via Firebase Cloud Messaging (FCM)
    LOG Push Notification Sent
ENDIF

DISPLAY "Notification sent successfully"

END Process
```

Refer to:

- FR-10 (Status Change Notifications)
- FR-18 (Technician Notifications)
- FR-25 (Administrator Notifications)
- Table 73: Data Flow 22 Details

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
Priority Level = High	Y	Y	N	N	N
Do Not Disturb Active	Y	N	Y	N	N
In-App Enabled	-	Y	-	Y	Y
Email Enabled	-	Y	-	Y	N
SMS Enabled	-	Y	-	N	-
Send Immediately	X	X	-	-	-
Queue for Later	-	-	X	-	-
Send In-App	X	X	-	X	X
Send Email	X	X	-	X	-
Send SMS	X	X	-	-	-
Send Push Notification	X	X	-	X	X
Group Notifications	-	X	-	X	X

Unresolved Issues: None

4.2.3. Fragment 3: Assignment & Task Management Processes

Number: 3.1 **Name:** View Pending/Unassigned Tickets **Description:** Displays all tickets that haven't been assigned to technicians, sorted by priority and submission time for administrator review.

Input Data Flow:
- View Pending Tickets Request (from Administrator)

Output Data Flow:
- Pending Tickets List (from Tickets Database D2 to Administrator)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `viewPendingTickets()`

Process Logic (Structured English):

```
BEGIN Process 3.1: View Pending/Unassigned Tickets

VERIFY User is Administrator
IF User Role ≠ "Administrator" THEN
    DISPLAY "Unauthorized access"
    EXIT Process
ENDIF

READ Filter Options from Administrator (Optional)
    Priority Filter, Category Filter, Date Range, Location Filter

// Query Pending Tickets
```

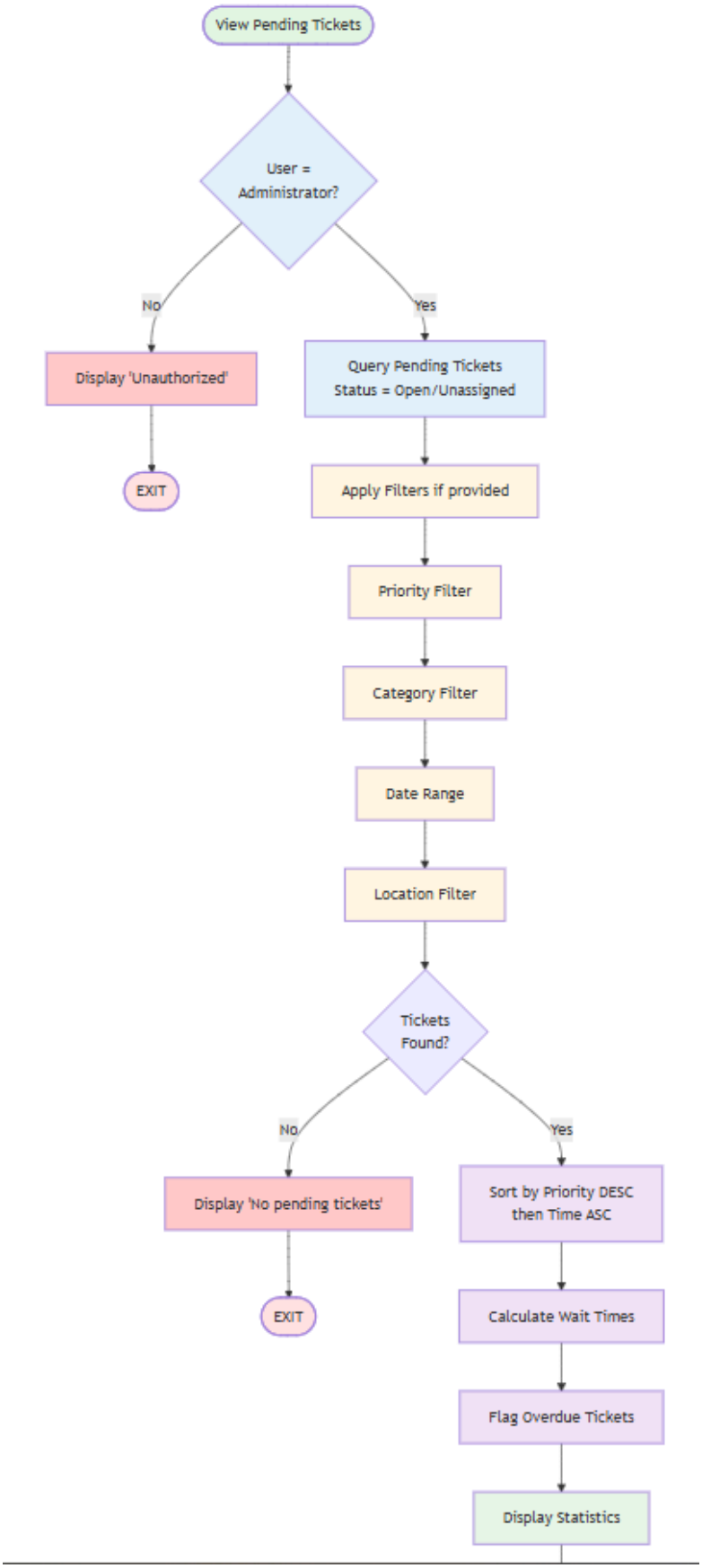
```
QUERY Tickets Database (D2) WHERE:
    Status IN ("Open", "Assigned") AND
    (TechnicianID IS NULL OR Status = "Open")

// Apply Optional Filters
IF Priority Filter Provided THEN
    FILTER Results by Priority IN Selected Priorities
ENDIF

IF Category Filter Provided THEN
    FILTER Results by Category = Selected Category
ENDIF

IF Date Range Provided THEN
    FILTER Results by ReportedAt BETWEEN StartDate AND EndDate
ENDIF

IF Location Filter Provided THEN
    FILTER Results by LocationID = Selected Location
ENDIF

SET Pending Tickets = Query Results

IF Pending Tickets is Empty THEN
    DISPLAY "No pending tickets found"
    EXIT Process
ENDIF

// Sort by Priority and Time
SORT Pending Tickets by:
    1. Priority DESC (Emergency > Urgent > High > Medium > Low)
    2. IsUrgentFlag DESC
    3. ReportedAt ASC (oldest first)

// Calculate Wait Times
FOR EACH Ticket in Pending Tickets DO
    CALCULATE Wait Time = CURRENT_DATETIME - Ticket.ReportedAt
    SET Ticket.WaitTime = Wait Time

    // Highlight overdue tickets
    IF Wait Time > Expected Response Time for Priority THEN
        SET Ticket.IsOverdue = TRUE
    ENDIF

    // Get available technicians for this ticket
    QUERY Available Technicians WHERE:
        AvailabilityStatus = "Available" AND
        Specialization MATCHES Ticket.Category

    SET Ticket.AvailableTechnicians = Query Results Count
ENDFOR

// Display Statistics
CALCULATE Total Pending = Pending Tickets Count
```

```
CALCULATE Total Overdue = Count of Tickets WHERE IsOverdue = TRUE
CALCULATE Avg Wait Time = AVERAGE(All Tickets WaitTime)

DISPLAY Dashboard Header
    "Total Pending: " + Total Pending
    "Overdue: " + Total Overdue
    "Average Wait Time: " + Avg Wait Time

// Display Ticket List
FOR EACH Ticket in Pending Tickets DO
    DISPLAY Ticket Row
        TicketID (Clickable)
        Title
        Category
        Location
        Priority (Color-coded badge)
        Reported Time (Relative: "2 hours ago")
        Wait Time
        Available Technicians Count
        "Assign" Button
        "View Details" Link

    IF Ticket.IsOverdue THEN
        HIGHLIGHT Row in Red
        SHOW "OVERDUE" Badge
    ENDIF
ENDFOR

// Provide Quick Actions
DISPLAY Quick Action Buttons
    "Auto-Assign All"
    "Bulk Assign by Category"
    "Refresh List"
    "Export to Excel"

END Process
```

Refer to:

- FR-23 (Ticket Assignment Management)
- Table 74: Data Flow 23 Details
- Table 75: Data Flow 24 Details

Decision Tree:



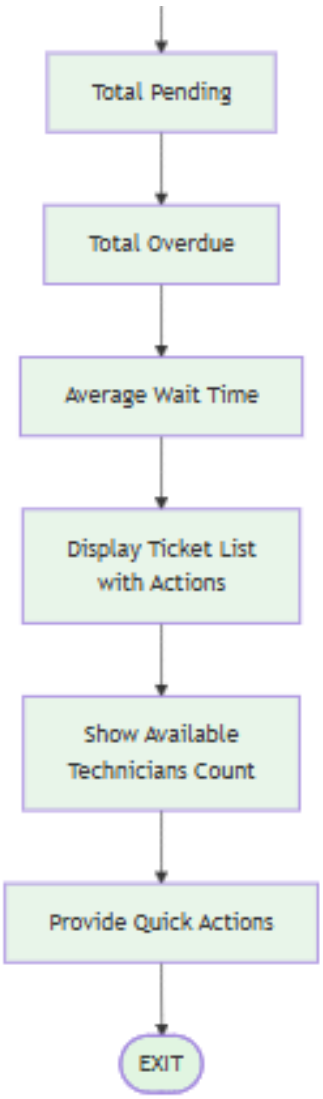


Figure 50: Decision Tree 3.2

Unresolved Issues: None

Number: 3.2 **Name:** Assign Ticket & Set Priority **Description:** Assigns maintenance tickets to technicians based on availability, expertise, and workload. Sets or updates ticket priority levels.

Input Data Flow:
- Assignment Decision (from Administrator)
  - TicketID
  - TechnicianID
  - Priority Level

Output Data Flow:
- Assignment & Priority Update (to Tickets Database D2)
- Assigned Task Notification (to Process 3.3 → Technician)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `assignTicketAndSetPriority()`

Process Logic (Structured English):

```
BEGIN Process 3.2: Assign Ticket & Set Priority

VERIFY User is Administrator
IF User Role ≠ "Administrator" THEN
    DISPLAY "Unauthorized access"
    EXIT Process
ENDIF

READ Assignment Data from Administrator
    TicketID, TechnicianID, Priority Level (Optional)

RETRIEVE Ticket from Tickets Database (D2)
IF Ticket Not Found THEN
    DISPLAY "Ticket not found"
    EXIT Process
ENDIF

RETRIEVE Technician from User Database (D1)
IF Technician Not Found OR Technician.Role ≠ "Technician" THEN
    DISPLAY "Invalid technician selected"
    EXIT Process
ENDIF

// Check Ticket is Assignable
IF Ticket.Status = "Closed" THEN
    DISPLAY "Cannot assign closed tickets"
    EXIT Process
ENDIF

// Validate Technician Status
IF Technician.AccountStatus ≠ "Active" THEN
    DISPLAY "Selected technician account is not active"
    EXIT Process
ENDIF

// Check Availability
GET Technician Current Availability
IF Technician.AvailabilityStatus = "On Break" THEN
    WARN "Technician is currently on break"
    PROMPT "Assign anyway?"
    IF Administrator Declines THEN
        EXIT Process
    ENDIF
ENDIF

// Check Workload
```

```
GET Technician Current Assigned Tasks Count
CALCULATE Current Workload = Count of Tickets WHERE:
    TechnicianID = Selected Technician AND
    Status IN ("Assigned", "In Progress")

IF Current Workload >= 10 THEN
    WARN "Technician already has " + Current Workload + " active tasks"
    DISPLAY "Average workload: 5 tasks"
    PROMPT "Assign anyway?"
    IF Administrator Declines THEN
        SUGGEST Alternative Technicians with Lower Workload
        EXIT Process
    ENDIF
ENDIF

// Check Expertise Match
GET Technician Specialization
IF Ticket.Category NOT IN Technician.Specialization THEN
    WARN "Technician specialization: " + Technician.Specialization
    WARN "Ticket category: " + Ticket.Category
    WARN "Specializations don't match"
    PROMPT "Assign anyway?"
    IF Administrator Declines THEN
        // Suggest better matched technicians
        QUERY Technicians WHERE:
            Specialization CONTAINS Ticket.Category AND
            AvailabilityStatus = "Available"
        DISPLAY "Suggested Technicians: " + Query Results
        EXIT Process
    ENDIF
ENDIF

// Check Location Proximity (if WorkZone defined)
IF Technician.WorkZone ≠ NULL THEN
    GET Ticket Location Zone
    IF Technician.WorkZone ≠ Ticket.Location.Zone THEN
        INFO "Technician's work zone: " + Technician.WorkZone
        INFO "Ticket location zone: " + Ticket.Location.Zone
        PROMPT "Proceed with cross-zone assignment?"
        IF Administrator Declines THEN
            EXIT Process
        ENDIF
    ENDIF
ENDIF

// Update Priority (if provided)
IF Priority Level Provided THEN
    VALIDATE Priority IN (Low, Medium, High, Urgent, Emergency)
    IF Priority Invalid THEN
        DISPLAY "Invalid priority level"
        EXIT Process
    ENDIF

    SET Old Priority = Ticket.Priority
```

```
    SET Ticket.Priority = New Priority Level

    // Recalculate estimated times
    CALCULATE Estimated Response Time based on New Priority
    CALCULATE Estimated Completion Time based on New Priority

    IF New Priority > Old Priority THEN
        SET Ticket.IsUrgentFlag = TRUE
    ENDIF

    LOG "Priority changed from " + Old Priority + " to " + New Priority + " by " +
Admin.Name
ENDIF

// Set Expected Completion Instructions (Optional)
IF Administrator Provides Special Instructions THEN
    SET Ticket.AdminNotes = Special Instructions
    SET Ticket.RequiredTools = Specified Tools
    SET Ticket.RequiredParts = Specified Parts
ENDIF

// Perform Assignment
IF Ticket Already Assigned to Different Technician THEN
    SET Old TechnicianID = Ticket.TechnicianID
    LOG "Ticket reassigned from Technician " + Old TechnicianID + " to " +
TechnicianID

    // Notify old technician of reassignment
    SEND Notification to Old Technician (Process 2.5)
        "Ticket " + TicketID + " has been reassigned"
ENDIF

SET Ticket.TechnicianID = Selected TechnicianID
SET Ticket.AssignedAt = CURRENT_DATETIME
SET Ticket.Status = "Assigned"

// Calculate Expected Completion Based on Priority and Historical Data
QUERY Historical Average Resolution Time WHERE:
    Category = Ticket.Category AND
    Priority = Ticket.Priority

IF Historical Data Available THEN
    SET Estimated Duration = Historical Average
ELSE
    // Use default estimates
    IF Priority = "Emergency" THEN
        SET Estimated Duration = 1 hour
    ELSIF Priority = "Urgent" THEN
        SET Estimated Duration = 4 hours
    ELSIF Priority = "High" THEN
        SET Estimated Duration = 1 day
    ELSIF Priority = "Medium" THEN
        SET Estimated Duration = 3 days
    ELSE // Low
```

```
        SET Estimated Duration = 7 days
    ENDIF
ENDIF

SET Ticket.ExpectedCompletionTime = CURRENT_DATETIME + Estimated Duration

// Update Database
UPDATE Ticket in Tickets Database (D2)
SET Ticket.LastUpdated = CURRENT_DATETIME

// Maintain Assignment History
CREATE Assignment History Record
    TicketID = TicketID
    TechnicianID = TechnicianID
    AssignedBy = Administrator.UserID
    AssignedAt = CURRENT_DATETIME
    Priority = Ticket.Priority
    Reasoning = Assignment Notes

WRITE to Assignment History Table

// Send Notification to Technician
TRIGGER Process 3.3 (Notify Technician)
    TicketID, TechnicianID, Priority

// Send Notification to Requester
SEND Notification to Ticket Requester (Process 2.5)
    "Your ticket has been assigned to a technician"

DISPLAY "Ticket " + TicketID + " successfully assigned to " + Technician.FullName

END Process
```

Refer to:

- FR-23 (Ticket Assignment Management)
- FR-24 (Ticket Priority Management)
- Table 76: Data Flow 25 Details
- Table 77: Data Flow 26 Details

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
Technician Active	Y	Y	Y	Y	Y	N
Ticket Assignable	Y	Y	Y	Y	N	-
Workload < 10 Tasks	Y	Y	Y	N	-	-
Expertise Matches	Y	Y	N	-	-	-
Admin Confirms Mismatch	-	-	Y	-	-	-
Zone Matches (if defined)	Y	N	-	-	-	-
Actions	Assign Ticket	X	X	X	X	-
-	Update Priority	X	X	X	X	-
-	Send Notification	X	X	X	X	-
-	Log Assignment	X	X	X	X	-
-	Warn Zone Mismatch	-	X	-	-	-
-	Warn Expertise Mismatch	-	-	X	-	-
-	Warn High Workload	-	-	-	X	-
-	Display “Not Assignable”	-	-	-	-	X
-	Display “Invalid Technician”	-	-	-	-	-
X						

Unresolved Issues: None

Number: 3.3 **Name:** Notify Technician **Description:** Sends notification to technician when a new task is assigned, including ticket details and priority information.

Input Data Flow:
- Assignment Notification Trigger (from Process 3.2)

Output Data Flow:
- Assigned Task Notification (to Technician)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `notifyTechnicianAssignment()`

Process Logic (Structured English):

```
BEGIN Process 3.3: Notify Technician
```

```
READ Notification Trigger Data
    TicketID, TechnicianID, Priority

RETRIEVE Ticket Details from Tickets Database (D2)
RETRIEVE Technician Data from User Database (D1)

// Build Notification Message
SET Message = "New ticket assigned: " + Ticket.Title
SET Details = {
    "Ticket ID": TicketID,
    "Category": Ticket.Category,
    "Location": Ticket.Location.BuildingName + " - " + Ticket.Location.RoomNumber,
    "Priority": Ticket.Priority,
    "Reported": Ticket.ReportedAt (Relative Time),
    "Expected Completion": Ticket.ExpectedCompletionTime
}

IF Ticket.AdminNotes ≠ NULL THEN
    ADD "Special Instructions: " + Ticket.AdminNotes to Details
ENDIF

IF Ticket.RequiredTools ≠ NULL THEN
    ADD "Required Tools: " + Ticket.RequiredTools to Details
ENDIF

// Determine Notification Priority
IF Ticket.Priority IN ("Emergency", "Urgent") THEN
    SET Notification Priority = "High" // Immediate
ELSIF Ticket.Priority = "High" THEN
    SET Notification Priority = "Medium" // Within 15 min
ELSE
    SET Notification Priority = "Low" // Within 1 hour
ENDIF

// Create Notification Record
GENERATE NotificationID
CREATE Notification
    NotificationID = Generated ID
    UserID = TechnicianID
    RelatedTicketID = TicketID
    NotificationType = "Assignment"
    Message = Message
    Details = Details JSON
    Priority = Notification Priority
    IsRead = FALSE
    CreatedAt = CURRENT_DATETIME
    ExpirationDate = CURRENT_DATETIME + 90 days

WRITE to Notifications Database

// Send Multi-Channel Notifications
// 1. In-App Push Notification
SEND Real-time Notification via WebSocket
    IF Technician Has Active Session THEN
```

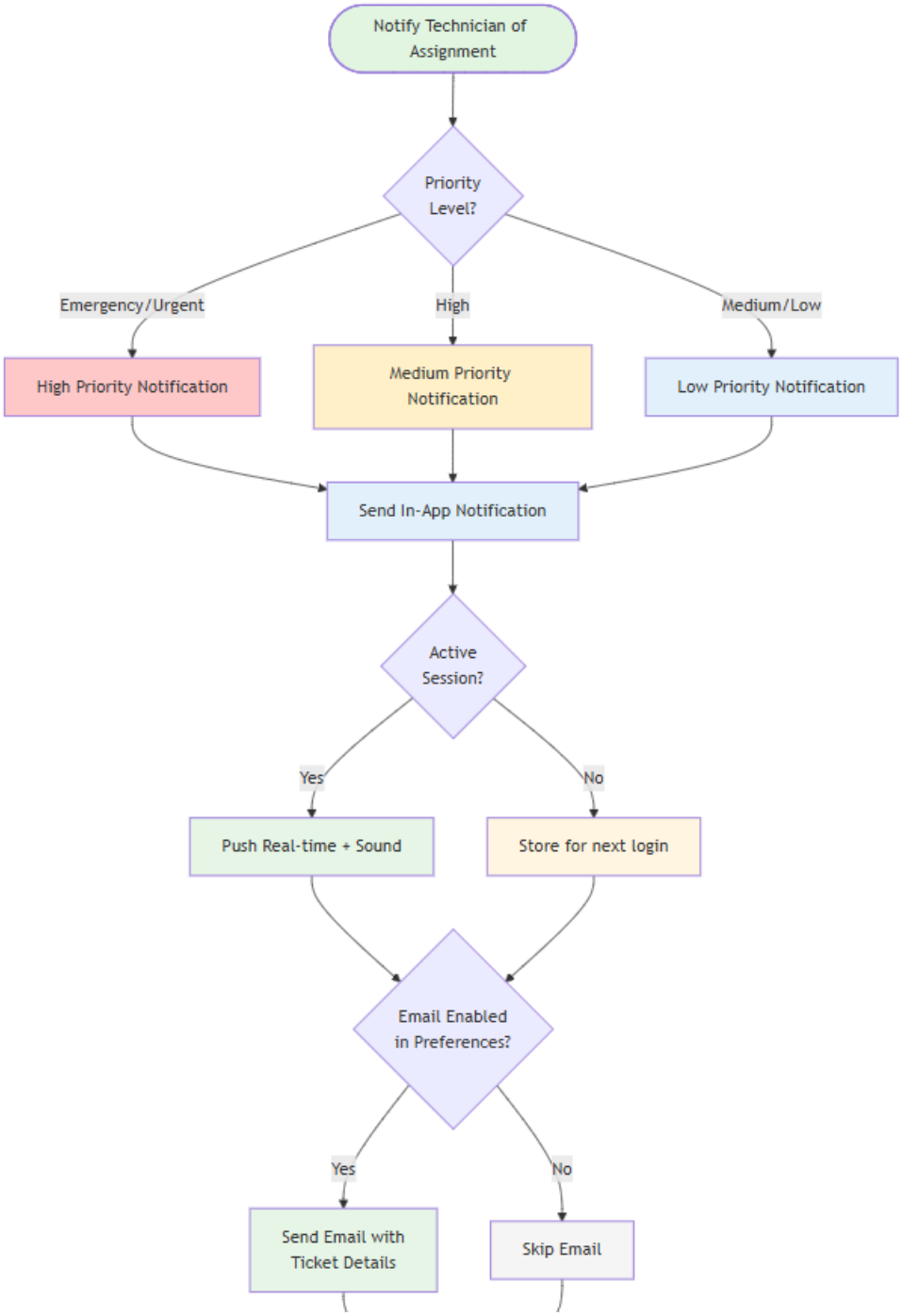
```
        PUSH Notification to Dashboard
        UPDATE Notification Badge
        PLAY Notification Sound (if Priority = High)
    ENDIF

// 2. Email Notification
IF Technician.Preferences.EmailNotifications = TRUE THEN
    COMPOSE Email
        To: Technician.Email
        Subject: "[SALLEHA] New Task Assigned - Priority: " + Priority
        Body: HTML Template with:
            - Ticket Summary
            - Location and Category
            - Priority Badge
            - Expected Completion Time
            - "View Ticket" Button (Deep Link)
            - "Accept Task" Quick Action Link

    SEND via Email Service
ENDIF

// 3. SMS (Only for Urgent/Emergency)
IF Ticket.Priority IN ("Emergency", "Urgent") THEN
    IF Technician.Preferences.SMSNotifications = TRUE THEN
        IF Technician.PhoneNumber ≠ NULL THEN
            COMPOSE SMS (max 160 chars)
                "URGENT: New task " + TicketID + " at " + Location + ". Priority: "
+ Priority + ". View: " + Short URL

            SEND via SMS Service (Twilio)
        ENDIF
    ENDIF
ENDIF

// 4. Mobile Push Notification
IF Technician Has Mobile App Installed THEN
    COMPOSE Push Notification
        Title: "New Task Assigned"
        Body: Ticket.Title + " (" + Priority + ")"
        Badge: Increment Unread Count
        Sound: (Priority = High ? "urgent.mp3" : "default.mp3")
        Data: {
            type: "assignment",
            ticketID: TicketID,
            priority: Priority,
            deepLink: "salleha://tickets/" + TicketID
        }

    SEND via Firebase Cloud Messaging (FCM)
ENDIF

LOG "Assignment notification sent to Technician " + TechnicianID + " for Ticket " +
TicketID
```

```
END Process
```

Refer to:

- FR-18 (Technician Notifications)
- Table 78: Data Flow 27 Details

Decision Tree:



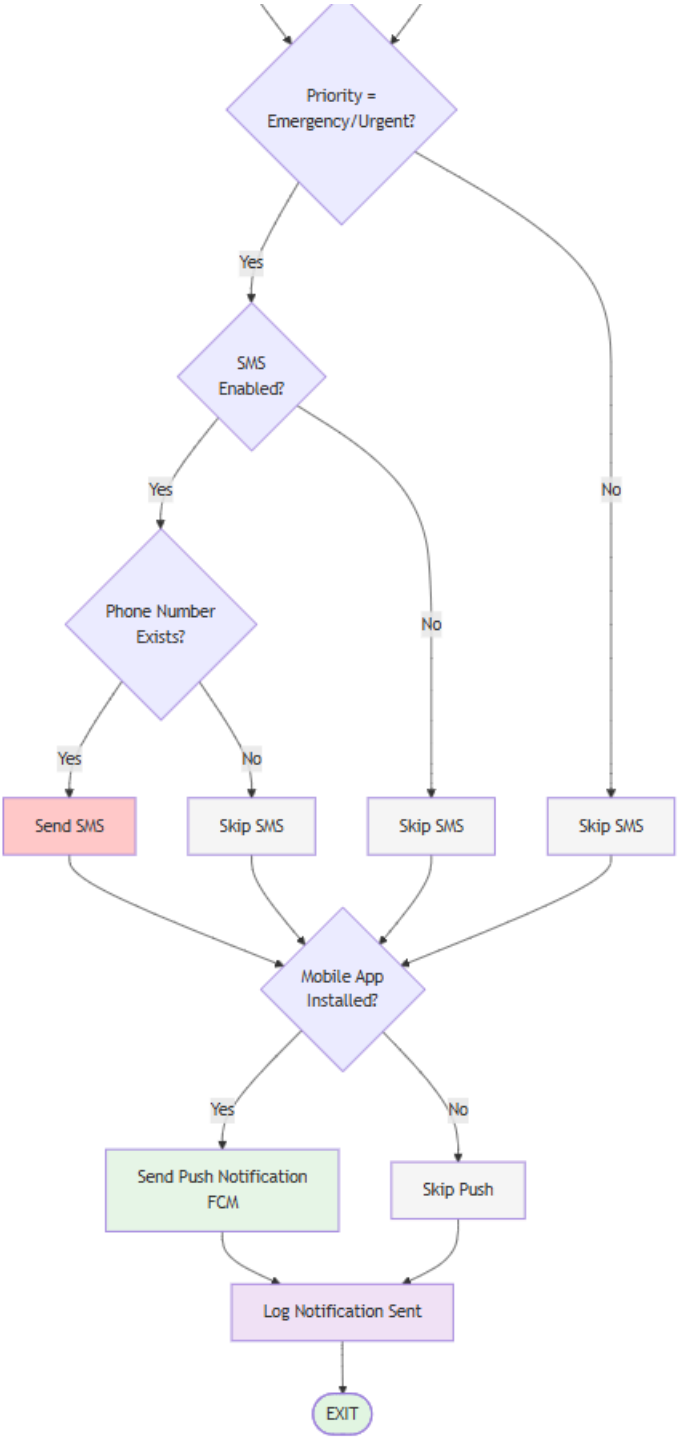


Figure 52: Decision Tree 3.3

Unresolved Issues: None

Number: 3.4 **Name:** Update Assignment Status **Description:** Updates ticket assignment status based on technician response (accept or decline), handles reassignment if declined.

Input Data Flow:

- Assignment Response (from Technician)
  - TicketID
  - Response (Accept/Decline)

- Decline Reason (if declining)

Output Data Flow:
- Assignment Status Update (to Tickets Database D2)
- Reassignment Trigger (if declined)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `updateAssignmentStatus()`

Process Logic (Structured English):

```
BEGIN Process 3.4: Update Assignment Status

READ Assignment Response from Technician
    TicketID, Response Status, Optional Decline Reason

RETRIEVE Ticket from Tickets Database (D2)
IF Ticket Not Found THEN
    DISPLAY "Ticket not found"
    EXIT Process
ENDIF

VERIFY Technician is Assigned to Ticket
IF Ticket.TechnicianID ≠ Current UserID THEN
    DISPLAY "You are not assigned to this ticket"
    EXIT Process
ENDIF

CHECK Ticket Current Status
IF Ticket.Status ≠ "Assigned" THEN
    DISPLAY "Ticket cannot be accepted/declined in current status"
    EXIT Process
ENDIF

// ============================================
// TECHNICIAN ACCEPTS TASK
// ============================================
IF Response Status = "Accept" THEN
    SET Ticket.Status = "Accepted"
    SET Ticket.AcceptedAt = CURRENT_DATETIME

    UPDATE Ticket in Tickets Database (D2)

    LOG "Ticket " + TicketID + " accepted by Technician " + Technician.Name

    // Send Notification to Requester
    SEND Notification to Ticket Requester (Process 2.5)
        "Your ticket has been accepted by a technician"

    // Send Notification to Administrator
```

```
    SEND Notification to Administrators (Process 2.5)
        "Ticket " + TicketID + " accepted by " + Technician.Name

    DISPLAY "Task accepted successfully"
    REDIRECT to Ticket Details Page
ENDIF

// ============================================
// TECHNICIAN DECLINES TASK
// ============================================
IF Response Status = "Decline" THEN
    // Require Decline Reason
    IF Decline Reason is Empty THEN
        DISPLAY "Please provide a reason for declining"
        PROMPT Reason Selection:
            - "Outside my specialization"
            - "Current workload too high"
            - "Lack required equipment/parts"
            - "Urgent personal matter"
            - "Other (specify)"
        READ Decline Reason

        IF Decline Reason is Still Empty THEN
            DISPLAY "Reason is required to decline task"
            EXIT Process
        ENDIF
    ENDIF

    // Log Decline
    CREATE Decline Record
        TicketID = TicketID
        TechnicianID = Current UserID
        DeclinedAt = CURRENT_DATETIME
        DeclineReason = Decline Reason

    WRITE to Decline History

    // Clear Assignment
    SET Old TechnicianID = Ticket.TechnicianID
    SET Ticket.TechnicianID = NULL
    SET Ticket.AssignedAt = NULL
    SET Ticket.Status = "Open"
    SET Ticket.DeclineCount = Ticket.DeclineCount + 1

    UPDATE Ticket in Tickets Database (D2)

    LOG "Ticket " + TicketID + " declined by Technician " + Old TechnicianID + ".
Reason: " + Decline Reason

    // If ticket declined multiple times, escalate
    IF Ticket.DeclineCount >= 3 THEN
        SET Ticket.IsUrgentFlag = TRUE
        INCREMENT Ticket.EscalationLevel
        SEND Urgent Notification to Administrator (Process 2.5)
```

```
            "ALERT: Ticket " + TicketID + " declined " + Ticket.DeclineCount + "
times"
    ENDIF

    // Auto-Reassign to Next Available Technician
    QUERY Available Technicians WHERE:
        AvailabilityStatus = "Available" AND
        Specialization MATCHES Ticket.Category AND
        UserID ≠ Old TechnicianID // Exclude technician who declined

    ORDER BY:
        1. SkillLevel DESC
        2. Current Workload ASC
        3. CustomerSatisfactionRating DESC

    LIMIT 1

    IF Next Technician Found THEN
        // Auto-assign
        SET Ticket.TechnicianID = Next Technician.UserID
        SET Ticket.AssignedAt = CURRENT_DATETIME
        SET Ticket.Status = "Assigned"
        SET Ticket.AutoAssigned = TRUE

        UPDATE Ticket in Tickets Database (D2)

        // Notify new technician
        TRIGGER Process 3.3 (Notify Technician)
            TicketID, Next Technician.UserID, Ticket.Priority

        // Notify administrator
        SEND Notification to Administrator (Process 2.5)
            "Ticket " + TicketID + " auto-reassigned to " + Next Technician.Name +
" after decline"

        DISPLAY "Task declined. Ticket has been reassigned to another technician."
    ELSE
        // No available technician found
        SEND Urgent Notification to Administrator (Process 2.5)
            "ALERT: Ticket " + TicketID + " declined but no available technician
found for manual reassignment"

        DISPLAY "Task declined. Administrator will manually reassign this ticket."
    ENDIF
ENDIF

END Process
```

Refer to:

- FR-15 (Accept Maintenance Requests)
- Table 79: Data Flow 28 Details
- Table 80: Data Flow 29 Details

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
Response = Accept	Y	N	N	N	N
Response = Decline	N	Y	Y	Y	N
Decline Reason Provided	-	Y	Y	Y	-
Next Technician Available	-	Y	Y	N	-
Decline Count >= 3	-	N	Y	-	-
Set Status = Accepted	X	-	-	-	-
Notify Requester + Admin	X	-	-	-	-
Record Decline	-	X	X	X	-
Clear Assignment	-	X	X	X	-
Auto-Reassign	-	X	X	-	-
Escalate (Urgent Flag)	-	-	X	-	-
Alert Admin (No Technician)	-	-	-	X	-
Display “Reason Required”	-	-	-	-	X

Unresolved Issues: None

4.2.4. Fragment 4: Analytics & Reporting Processes

Number: 4.1 **Name:** Record Maintenance Completion **Description:** Records the completion of maintenance work, validates evidence submission, updates ticket status, and calculates resolution metrics.

Input Data Flow:
- Completion Data (from Technician)
  - TicketID
  - Completion Notes
  - Completion Time
  - Evidence Reference

Output Data Flow:
- Maintenance Completion Record (to Process 4.2 → Maintenance History D3)
- Ticket Final Status Update (to Tickets Database D2)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `recordMaintenanceCompletion()`

Process Logic (Structured English):

```
BEGIN Process 4.1: Record Maintenance Completion
```

```
READ Completion Data from Technician
    TicketID, Completion Notes, Work Summary, Parts Used, Time Spent

RETRIEVE Ticket from Tickets Database (D2)
IF Ticket Not Found THEN
    DISPLAY "Ticket not found"
    EXIT Process
ENDIF

VERIFY Technician Ownership
IF Ticket.TechnicianID ≠ Current UserID THEN
    DISPLAY "You are not authorized to complete this ticket"
    EXIT Process
ENDIF

CHECK Ticket Status
IF Ticket.Status ≠ "In Progress" THEN
    DISPLAY "Ticket must be In Progress to mark as completed"
    EXIT Process
ENDIF

// Verify Evidence Was Submitted
CHECK if Evidence Exists for Ticket
IF Ticket.EvidenceID IS NULL OR Ticket.HasEvidence = FALSE THEN
    DISPLAY "Please upload completion evidence before marking as complete"
    REDIRECT to Evidence Upload (Process 2.4)
    EXIT Process
ENDIF

// Validate Completion Notes
IF Completion Notes is Empty OR Length < 20 characters THEN
    DISPLAY "Please provide detailed completion notes (minimum 20 characters)"
    EXIT Process
ENDIF

// Retrieve Evidence Record
RETRIEVE Evidence from Evidence Table WHERE EvidenceID = Ticket.EvidenceID

// Update Ticket Status
SET Ticket.Status = "Fixed"
SET Ticket.ResolvedAt = CURRENT_DATETIME

// Calculate Resolution Metrics
IF Ticket.ActualStartTime ≠ NULL THEN
    CALCULATE Actual Resolution Time = ResolvedAt - ActualStartTime
    SET Ticket.ActualResolutionTime = Actual Resolution Time
ELSE
    // If start time wasn't recorded, use assigned time
    CALCULATE Actual Resolution Time = ResolvedAt - AssignedAt
    SET Ticket.ActualResolutionTime = Actual Resolution Time
ENDIF

// Compare with Estimated Time
IF Ticket.EstimatedCompletionTime ≠ NULL THEN
```

```
    IF ResolvedAt > EstimatedCompletionTime THEN
        SET Ticket.CompletedLate = TRUE
        CALCULATE Delay = ResolvedAt - EstimatedCompletionTime
        SET Ticket.DelayDuration = Delay
    ELSE
        SET Ticket.CompletedOnTime = TRUE
    ENDIF
ENDIF

// Update Ticket Final Details
SET Ticket.CompletionNotes = Completion Notes
SET Ticket.ResolutionSummary = Work Summary
SET Ticket.PartsUsed = Parts Used
SET Ticket.LaborHours = Time Spent

UPDATE Ticket in Tickets Database (D2)

// Update Technician Performance Metrics
GET Technician Current Metrics
CALCULATE New Average Resolution Time
    = (Current Avg * Completed Count + Actual Resolution Time) / (Completed Count +
1)

INCREMENT Technician.CompletedTasksCount
UPDATE Technician.AverageResolutionTime = New Average Resolution Time
CALCULATE Technician.CompletionRate
    = (CompletedTasksCount / TotalAssignedTasks) * 100

UPDATE Technician Record in User Database (D1)

// Prepare Completion Record for History
CREATE Completion Data Object
    TicketID = TicketID
    TechnicianID = Ticket.TechnicianID
    LocationID = Ticket.LocationID
    Category = Ticket.Category
    Priority = Ticket.Priority
    ResolutionSummary = Work Summary
    CompletionNotes = Completion Notes
    PartsUsed = Parts Used
    LaborHours = Time Spent
    CompletionDate = ResolvedAt
    ActualResolutionTime = Actual Resolution Time
    EvidenceID = Ticket.EvidenceID
    CompletedOnTime = Ticket.CompletedOnTime

// Send to Maintenance History Process
TRIGGER Process 4.2 (Update Maintenance History)
    Pass Completion Data Object

// Send Notifications
// 1. Notify Administrator for Review
SEND Notification to Administrators (Process 2.5)
    "Ticket " + TicketID + " marked as Fixed by " + Technician.Name + ". Awaiting
```

```
review."

// 2. Notify Requester
SEND Notification to Ticket Requester (Process 2.5)
    "Your ticket " + TicketID + " has been completed. Please verify the work."

LOG "Ticket " + TicketID + " completed by Technician " + Technician.Name
DISPLAY "Maintenance work completed successfully"
DISPLAY "Ticket ID: " + TicketID
DISPLAY "Resolution Time: " + Actual Resolution Time

END Process
```

Refer to:
- FR-16.3 (Task Status Updates - Fixed)
- Table 81: Data Flow 30 Details
- Table 82: Data Flow 31 Details
- Table 83: Data Flow 32 Details

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
Status = In Progress	Y	Y	Y	Y	N
Evidence Submitted	Y	Y	Y	N	-
Completion Notes Valid	Y	Y	N	-	-
Completed On Time	Y	N	-	-	-
Set Status = Fixed	X	X	-	-	-
Calculate Metrics	X	X	-	-	-
Update Technician Performance	X	X	-	-	-
Send to History	X	X	-	-	-
Send Notifications	X	X	-	-	-
Flag as Late	-	X	-	-	-
Display “Notes too short”	-	-	X	-	-
Display “Need evidence”	-	-	-	X	-
Display “Wrong status”	-	-	-	-	X

Unresolved Issues: None

Number: 4.2 **Name:** Update Maintenance History **Description:** Archives completed maintenance records for historical tracking, trend analysis, and performance reporting.

Input Data Flow:
- Maintenance Completion Record (from Process 4.1)

Output Data Flow:
• Stored Maintenance History Entry (to Maintenance History D3)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `updateMaintenanceHistory()`

Process Logic (Structured English):

```
BEGIN Process 4.2: Update Maintenance History

READ Completion Data from Process 4.1
    TicketID, TechnicianID, LocationID, Category, Priority,
    ResolutionSummary, CompletionNotes, PartsUsed, LaborHours,
    CompletionDate, ActualResolutionTime, EvidenceID, CompletedOnTime

GENERATE History Record ID
CREATE Maintenance History Record
    HistoryID = Generated ID
    TicketID = Input TicketID
    TechnicianID = Input TechnicianID
    TechnicianName = Get from User Database
    LocationID = Input LocationID
    LocationDetails = Get from Location Database
    Category = Input Category
    Priority = Input Priority
    IssueDescription = Get from Original Ticket
    ResolutionSummary = Input ResolutionSummary
    CompletionNotes = Input CompletionNotes
    WorkPerformed = Extract from Notes
    PartsUsed = Input PartsUsed
    PartsOrderPrice = Calculate Total (if Parts Cost Available)
    LaborHours = Input LaborHours
    LaborCost = Calculate (LaborHours * Hourly Rate)
    TotalCost = PartsOrderPrice + LaborCost
    CompletionDate = Input CompletionDate
    ActualResolutionTime = Input ActualResolutionTime
    EvidenceID = Input EvidenceID
    CompletedOnTime = Input CompletedOnTime
    RecordedAt = CURRENT_DATETIME

// Link to Equipment (if equipment ID was specified)
IF Ticket Contains Equipment Information THEN
    SET EquipmentID = Ticket.EquipmentID
    SET ManufacturerDetails = Get from Equipment Database
    SET WarrantyInfo = Get from Equipment Database

    // Update Equipment Maintenance Log
    ADD History Record ID to Equipment.MaintenanceHistory
ENDIF

// Calculate MTBF (Mean Time Between Failures) for Equipment
```

```
IF EquipmentID ≠ NULL THEN
    QUERY Previous Maintenance for Same Equipment
    IF Previous Records Exist THEN
        GET Last Maintenance Date
        CALCULATE Time Between Failures = CompletionDate - Last Maintenance Date
        UPDATE Equipment.MTBF Calculation
    ENDIF
ENDIF

WRITE Maintenance History Record to Maintenance History (D3)

// Update Location Statistics
UPDATE Location Statistics
    INCREMENT Location.TotalMaintenanceCount
    ADD Category to Location.MaintenanceCategories
    CALCULATE Location.AverageResolutionTime

// Update Category Statistics
UPDATE Category Statistics
    INCREMENT Global Category Count
    CALCULATE Average Resolution Time for Category
    UPDATE Most Common Issues List

LOG "Maintenance history archived for Ticket " + TicketID

END Process
```

Refer to:

- FR-19 (Maintenance History Access)
- FR-26 (Analytics and Reporting)
- Table 84: Data Flow 33 Details

Structured English (Simplified):

```
BEGIN

READ completion data
GENERATE history record ID

CREATE comprehensive history record with:
    - Ticket details
    - Technician details
    - Location details
    - Work performed
    - Parts and costs
    - Time metrics
    - Evidence reference

IF equipment involved THEN
    UPDATE equipment maintenance log
    CALCULATE MTBF for equipment
ENDIF
```

```
WRITE to maintenance history database

UPDATE location statistics
UPDATE category statistics

LOG archive completion

END
```

Unresolved Issues: None

Number: 4.3 **Name:** Generate Reports & Metrics **Description:** Compiles maintenance data, calculates KPIs, generates analytics dashboards, and produces reports for administrators.

Input Data Flow:
- Report Request (from Administrator)
  - Date Range
  - Filters
  - Report Type

Output Data Flow:
- Reports & Metrics Store (to Reports & Analytics D4)
- Analytics Dashboard Data (from D2, D3 to Administrator)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `generateReportsAndMetrics()`

Process Logic (Structured English):

```
BEGIN Process 4.3: Generate Reports & Metrics

VERIFY User is Administrator
IF User Role ≠ "Administrator" THEN
    DISPLAY "Unauthorized access"
    EXIT Process
ENDIF

READ Report Parameters from Administrator
    Report Type, Date Range, Filters (Category, Location, Technician, Priority)

// Default to Current Month if no date range specified
IF Date Range Not Provided THEN
    SET Start Date = First Day of Current Month
    SET End Date = CURRENT_DATE
ENDIF

VALIDATE Date Range
```

```
IF Start Date > End Date THEN
    DISPLAY "Invalid date range"
    EXIT Process
ENDIF

// ============================================
// COLLECT DATA BASED ON REPORT TYPE
// ============================================

IF Report Type = "Overall Dashboard" OR Report Type = "Summary" THEN
    // === KEY PERFORMANCE INDICATORS ===

    // 1. Total Tickets
    QUERY COUNT(*) FROM Tickets WHERE
        ReportedAt BETWEEN Start Date AND End Date
    SET KPI.TotalTickets = Query Result

    // 2. Open Issues
    QUERY COUNT(*) FROM Tickets WHERE
        Status IN ("Open", "Assigned", "In Progress") AND
        ReportedAt BETWEEN Start Date AND End Date
    SET KPI.OpenIssues = Query Result

    // 3. Resolved Issues
    QUERY COUNT(*) FROM Tickets WHERE
        Status IN ("Fixed", "Closed") AND
        ResolvedAt BETWEEN Start Date AND End Date
    SET KPI.ResolvedIssues = Query Result

    // 4. Average Resolution Time
    QUERY AVG(ActualResolutionTime) FROM Tickets WHERE
        Status = "Fixed" OR Status = "Closed" AND
        ResolvedAt BETWEEN Start Date AND End Date
    SET KPI.AvgResolutionTime = Query Result
    CONVERT to Hours or Days

    // 5. Completion Rate
    CALCULATE Completion Rate = (ResolvedIssues / TotalTickets) * 100
    SET KPI.CompletionRate = Completion Rate + "%"

    // 6. On-Time Completion Rate
    QUERY COUNT(*) FROM Tickets WHERE
        CompletedOnTime = TRUE AND
        ResolvedAt BETWEEN Start Date AND End Date
    SET On Time Count = Query Result
    CALCULATE On Time Rate = (On Time Count / ResolvedIssues) * 100
    SET KPI.OnTimeCompletionRate = On Time Rate + "%"
ENDIF

IF Report Type = "Maintenance Trends" OR Report Type = "Summary" THEN
    // === TREND ANALYSIS ===

    // Tickets by Category
    QUERY Category, COUNT(*) as Count FROM Tickets
```

```
    WHERE ReportedAt BETWEEN Start Date AND End Date
    GROUP BY Category
    ORDER BY Count DESC
    SET Trends.ByCategory = Query Results

    // Tickets by Priority
    QUERY Priority, COUNT(*) as Count FROM Tickets
    WHERE ReportedAt BETWEEN Start Date AND End Date
    GROUP BY Priority
    SET Trends.ByPriority = Query Results

    // Tickets Over Time (Daily/Weekly/Monthly)
    DETERMINE Time Granularity based on Date Range
    IF Date Range <= 7 days THEN
        SET Granularity = "Daily"
    ELSIF Date Range <= 90 days THEN
        SET Granularity = "Weekly"
    ELSE
        SET Granularity = "Monthly"
    ENDIF

    QUERY Date, COUNT(*) as Count FROM Tickets
    WHERE ReportedAt BETWEEN Start Date AND End Date
    GROUP BY Date (Grouped by Granularity)
    ORDER BY Date ASC
    SET Trends.TicketsOverTime = Query Results

    // Recurring Issue Patterns
    QUERY Category, LocationID, COUNT(*) as Frequency FROM Tickets
    WHERE ReportedAt BETWEEN Start Date AND End Date
    GROUP BY Category, LocationID
    HAVING Frequency >= 3
    ORDER BY Frequency DESC
    SET Trends.RecurringIssues = Query Results
ENDIF

IF Report Type = "Frequently Reported Areas" OR Report Type = "Summary" THEN
    // === LOCATION ANALYSIS ===

    QUERY
        L.LocationID,
        L.BuildingName,
        L.Zone,
        COUNT(T.TicketID) as IssueCount,
        AVG(T.ActualResolutionTime) as AvgResolutionTime
    FROM Tickets T
    JOIN Locations L ON T.LocationID = L.LocationID
    WHERE T.ReportedAt BETWEEN Start Date AND End Date
    GROUP BY L.LocationID
    ORDER BY IssueCount DESC
    LIMIT 10

    SET LocationData.TopLocations = Query Results
```

```
    // Generate Heat Map Data
    QUERY LocationID, GeoCoordinates, COUNT(*) as Density
    FROM Tickets T
    JOIN Locations L ON T.LocationID = L.LocationID
    WHERE ReportedAt BETWEEN Start Date AND End Date
    GROUP BY LocationID

    SET LocationData.HeatMapData = Query Results (for FR-21.5)
ENDIF

IF Report Type = "Equipment Performance" OR Report Type = "Summary" THEN
    // === EQUIPMENT ANALYSIS ===

    QUERY
        EquipmentID,
        EquipmentType,
        COUNT(*) as MaintenanceFrequency,
        AVG(ActualResolutionTime) as AvgRepairTime,
        SUM(TotalCost) as TotalMaintenanceCost
    FROM Maintenance_History
    WHERE CompletionDate BETWEEN Start Date AND End Date
    AND EquipmentID IS NOT NULL
    GROUP BY EquipmentID
    ORDER BY MaintenanceFrequency DESC

    SET EquipmentData = Query Results

    // Calculate MTBF for Equipment
    FOR EACH Equipment DO
        QUERY Previous Maintenance Dates for Equipment
        CALCULATE Average Time Between Failures
        SET Equipment.MTBF = Calculated MTBF
    ENDFOR
ENDIF

IF Report Type = "Technician Performance" OR Report Type = "Summary" THEN
    // === TECHNICIAN ANALYSIS ===

    QUERY
        T.TechnicianID,
        U.FullName,
        COUNT(CASE WHEN T.Status IN ('Fixed','Closed') THEN 1 END) as
CompletedTasks,
        COUNT(CASE WHEN T.Status IN ('Assigned','In Progress') THEN 1 END) as
ActiveTasks,
        AVG(T.ActualResolutionTime) as AvgResolutionTime,
        AVG(CASE WHEN T.CompletedOnTime = TRUE THEN 1.0 ELSE 0.0 END) * 100 as
OnTimeRate,
        Technician.CustomerSatisfactionRating
    FROM Tickets T
    JOIN Users U ON T.TechnicianID = U.UserID
    JOIN Technician ON U.UserID = Technician.UserID
    WHERE T.AssignedAt BETWEEN Start Date AND End Date
    GROUP BY T.TechnicianID
```

```
    ORDER BY CompletedTasks DESC

    SET TechnicianData.Performance = Query Results

    // Workload Distribution
    QUERY TechnicianID, COUNT(*) as CurrentWorkload
    FROM Tickets
    WHERE Status IN ('Assigned', 'In Progress')
    GROUP BY TechnicianID

    SET TechnicianData.WorkloadDistribution = Query Results
ENDIF

IF Report Type = "Cost Analysis" OR Report Type = "Summary" THEN
    // === COST ANALYSIS ===

    QUERY
        SUM(PartsOrderPrice) as TotalPartsCost,
        SUM(LaborCost) as TotalLaborCost,
        SUM(TotalCost) as TotalMaintenanceCost
    FROM Maintenance_History
    WHERE CompletionDate BETWEEN Start Date AND End Date

    SET CostData.Summary = Query Results

    // Cost by Category
    QUERY Category, SUM(TotalCost) as TotalCost
    FROM Maintenance_History
    WHERE CompletionDate BETWEEN Start Date AND End Date
    GROUP BY Category
    ORDER BY TotalCost DESC

    SET CostData.ByCategory = Query Results

    // Cost Trend Over Time
    QUERY
        DATE(CompletionDate) as Date,
        SUM(TotalCost) as DailyCost
    FROM Maintenance_History
    WHERE CompletionDate BETWEEN Start Date AND End Date
    GROUP BY DATE(CompletionDate)
    ORDER BY Date ASC

    SET CostData.Trend = Query Results
ENDIF

// ============================================
// GENERATE VISUALIZATIONS
// ============================================

CREATE Chart Data Objects

// 1. Tickets by Status Pie Chart
PREPARE Pie Chart Data
```

```
    Labels: ["Open", "In Progress", "Fixed", "Closed"]
    Values: [Count for Each Status]
    Colors: [Status-specific colors]

// 2. Tickets Over Time Line Chart
PREPARE Line Chart Data
    X-Axis: Dates
    Y-Axis: Ticket Count
    Data: Trends.TicketsOverTime

// 3. Category Distribution Bar Chart
PREPARE Bar Chart Data
    X-Axis: Categories
    Y-Axis: Count
    Data: Trends.ByCategory

// 4. Technician Performance Comparison
PREPARE Multi-Bar Chart Data
    X-Axis: Technician Names
    Y-Axis: Metrics
    Series 1: Completed Tasks
    Series 2: Active Tasks
    Data: TechnicianData.Performance

// 5. Location Heat Map
PREPARE Heat Map Data
    Coordinates: Location.GeoCoordinates
    Intensity: Issue Density
    Data: LocationData.HeatMapData

// ============================================
// STORE REPORT
// ============================================

GENERATE Report ID
CREATE Report Record
    ReportID = Generated ID
    ReportType = Report Type
    GeneratedBy = Administrator.UserID
    GeneratedAt = CURRENT_DATETIME
    DateRange = {Start Date, End Date}
    Filters = Applied Filters
    KPIs = KPI Data Object
    Trends = Trends Data Object
    LocationData = Location Data Object
    EquipmentData = Equipment Data Object
    TechnicianData = Technician Data Object
    CostData = Cost Data Object
    Charts = Chart Data Objects

WRITE Report to Reports & Analytics (D4)

LOG "Report " + Report ID + " generated by " + Administrator.Name
```

```
// Return Report for Display
RETURN Report Data Object

END Process
```

Refer to:

- FR-26 (Analytics and Reporting)
- Table 85-87: Data Flow 35-37 Details

Decision Tree:

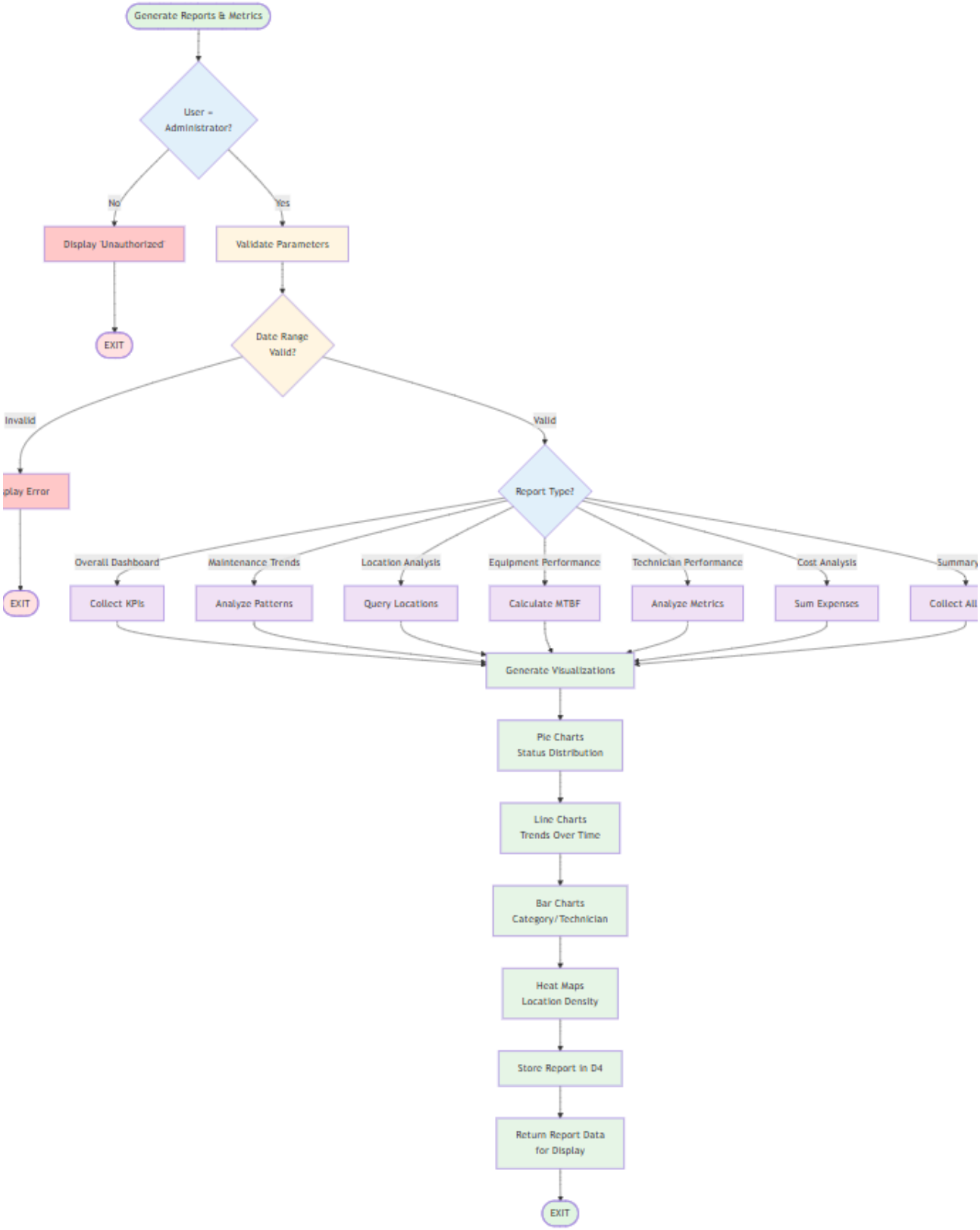


Figure 53: Decision Tree 4.3

Unresolved Issues: None

Number: 4.4 **Name:** Provide Analytics Dashboard / Export **Description:** Displays analytics dashboards to administrators and allows exporting reports in PDF, Excel, or CSV formats.

Input Data Flow:
- Analytics View/Export Request (from Administrator)
  - Report ID (optional, for existing reports)
  - Export Format (PDF/Excel/CSV)

Output Data Flow:
- Analytics Dashboard / Exported Report (to Administrator)

Type of Process: ☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `provideAnalyticsDashboard()`

Process Logic (Structured English):

```
BEGIN Process 4.4: Provide Analytics Dashboard / Export

VERIFY User is Administrator
IF User Role ≠ "Administrator" THEN
    DISPLAY "Unauthorized access"
    EXIT Process
ENDIF

READ Request Type (View Dashboard OR Export Report)

// ==========================================
// VIEW ANALYTICS DASHBOARD
// ==========================================
IF Request Type = "View Dashboard" THEN
    // Check for existing recent report
    QUERY Most Recent Report from Reports & Analytics (D4)
    WHERE GeneratedBy = Administrator.UserID
    AND GeneratedAt >= (CURRENT_DATE - 1 day)

    IF Recent Report Exists THEN
        RETRIEVE Report Data from D4
    ELSE
        // Generate new report
        TRIGGER Process 4.3 (Generate Reports & Metrics)
        WITH Report Type = "Summary"
        WAIT for Report Generation
        RETRIEVE Generated Report Data
    ENDIF

    // Render Dashboard
    DISPLAY Dashboard Header
        Title: "Maintenance Analytics Dashboard"
        Date Range: Report.DateRange
```

```
        Last Updated: Report.GeneratedAt

    // Display KPIs in Cards
    DISPLAY KPI Cards Grid
        Card 1: Total Tickets (KPI.TotalTickets)
        Card 2: Open Issues (KPI.OpenIssues) - Red Badge
        Card 3: Resolved Issues (KPI.ResolvedIssues) - Green Badge
        Card 4: Avg Resolution Time (KPI.AvgResolutionTime)
        Card 5: Completion Rate (KPI.CompletionRate)
        Card 6: On-Time Rate (KPI.OnTimeCompletionRate)

    // Display Charts
    RENDER Chart Section "Tickets Overview"
        Pie Chart: Tickets by Status
        Line Chart: Tickets Over Time
        Bar Chart: Tickets by Category

    RENDER Chart Section "Location Analysis"
        Heat Map: Issue Density by Location
        Top 10 Locations Table: Most Reported Areas

    RENDER Chart Section "Technician Performance"
        Multi-Bar Chart: Completed vs Active Tasks
        Table: Detailed Technician Metrics
        Workload Distribution Pie Chart

    RENDER Chart Section "Cost Analysis"
        Line Chart: Cost Trend Over Time
        Pie Chart: Cost by Category
        Summary Cards: Total Costs

    RENDER Chart Section "Equipment Performance"
        Table: Equipment Maintenance Frequency
        Bar Chart: MTBF by Equipment Type

    // Provide Dashboard Actions
    DISPLAY Action Buttons
        "Refresh Data"
        "Export Report"
        "Customize Filters"
        "Schedule Automated Report"

    // Enable Drill-Down
    FOR EACH Interactive Chart Element DO
        ON CLICK Event DO
            SHOW Detailed View
            ALLOW Filtering by Clicked Element
        ENDDO
    ENDFOR
ENDIF

// ============================================
// EXPORT REPORT
// ============================================
```

```
IF Request Type = "Export Report" THEN
    READ Export Format and Report ID from Administrator

    RETRIEVE Report Data from Reports & Analytics (D4)
    IF Report Not Found THEN
        DISPLAY "Report not found. Please generate a report first."
        EXIT Process
    ENDIF

    VALIDATE Export Format
    IF Export Format NOT IN ("PDF", "Excel", "CSV") THEN
        DISPLAY "Invalid export format. Supported: PDF, Excel, CSV"
        EXIT Process
    ENDIF

    // === EXPORT TO PDF ===
    IF Export Format = "PDF" THEN
        CREATE PDF Document using iText Library

        // Add Header
        ADD Company Logo (if available)
        ADD Title "SALLEHA Maintenance Report"
        ADD Date Range
        ADD Generated By: Administrator.Name
        ADD Generated At: Report.GeneratedAt
        ADD Page Numbers

        // Add Executive Summary Section
        ADD Section "Executive Summary"
        ADD KPIs Table
            Row: Total Tickets | KPI.TotalTickets
            Row: Open Issues | KPI.OpenIssues
            Row: Resolved Issues | KPI.ResolvedIssues
            Row: Avg Resolution Time | KPI.AvgResolutionTime
            Row: Completion Rate | KPI.CompletionRate

        // Add Charts as Images
        ADD Section "Maintenance Trends"
        CONVERT Chart to Image (PNG)
        EMBED Chart Images in PDF

        ADD Section "Location Analysis"
        ADD Top Locations Table
        EMBED Heat Map Image

        ADD Section "Technician Performance"
        ADD Technician Performance Table
        EMBED Performance Charts

        ADD Section "Equipment Analysis"
        ADD Equipment Table with MTBF

        ADD Section "Cost Analysis"
        ADD Cost Summary Table
```

```
        ADD Cost Breakdown by Category

        // Add Footer
        ADD Disclaimer: "Generated by SALLEHA Maintenance System"
        ADD Contact Information

        SET Filename = "SALLEHA_Report_" + Report.DateRange + "_" + TIMESTAMP +
".pdf"
        SAVE PDF File
    ENDIF

    // === EXPORT TO EXCEL ===
    IF Export Format = "Excel" THEN
        CREATE Excel Workbook using Apache POI

        // Sheet 1: Summary
        CREATE Sheet "Summary"
        ADD Title Row
        ADD KPIs Table with Formatting
            - Bold Headers
            - Color-coded Cells based on Values
            - Conditional Formatting
        ADD Charts (Excel Native Charts)

        // Sheet 2: Tickets Data
        CREATE Sheet "Tickets Detail"
        ADD Headers: TicketID, Title, Category, Location, Status, Priority,
ReportedAt, ResolvedAt, ResolutionTime
        QUERY All Tickets in Date Range
        FOR EACH Ticket DO
            ADD Row with Ticket Data
        ENDFOR
        APPLY AutoFilter
        FREEZE Top Row

        // Sheet 3: Location Analysis
        CREATE Sheet "Locations"
        ADD Location Statistics Table
        ADD Formulas for Calculations

        // Sheet 4: Technician Performance
        CREATE Sheet "Technicians"
        ADD Technician Performance Table
        ADD Formulas for Metrics
        ADD Charts

        // Sheet 5: Cost Analysis
        CREATE Sheet "Costs"
        ADD Cost Breakdown Table
        ADD SUM Formulas
        ADD Cost Charts

        // Sheet 6: Raw Data (for pivot tables)
        CREATE Sheet "Raw Data"
```

```
        ADD Complete Dataset
        ENABLE Pivot Table Creation

        SET Filename = "SALLEHA_Report_" + Report.DateRange + "_" + TIMESTAMP +
".xlsx"
        SAVE Excel File
    ENDIF

    // === EXPORT TO CSV ===
    IF Export Format = "CSV" THEN
        CREATE CSV File

        // Determine CSV Content based on Report Type
        IF Administrator Selects "All Data" THEN
            // Export comprehensive dataset
            ADD CSV Headers
                TicketID, Title, Description, Category, Location, Priority, Status,
                RequesterID, TechnicianID, TechnicianName, ReportedAt, AssignedAt,
                ResolvedAt, ActualResolutionTime, PartsUsed, LaborHours, TotalCost,
                CompletedOnTime, EvidenceID

            QUERY All Tickets in Date Range
            JOIN with Related Tables
            FOR EACH Ticket DO
                ADD Row with All Fields
                ESCAPE Commas and Quotes in Text Fields
            ENDFOR
        ELSIF Administrator Selects "Summary Only" THEN
            // Export aggregated data
            ADD CSV Headers
                Metric, Value

            ADD Rows
                "Total Tickets", KPI.TotalTickets
                "Open Issues", KPI.OpenIssues
                "Resolved Issues", KPI.ResolvedIssues
                ...
        ENDIF

        SET Filename = "SALLEHA_Report_" + Report.DateRange + "_" + TIMESTAMP +
".csv"
        SAVE CSV File
    ENDIF

    // Store Export History
    CREATE Export Record
        ReportID = Report.ReportID
        ExportedBy = Administrator.UserID
        ExportedAt = CURRENT_DATETIME
        ExportFormat = Export Format
        Filename = Filename

    WRITE to Export History Table
```

```
    // Provide Download
    GENERATE Download Link
    SET Download Expiration = CURRENT_DATETIME + 24 hours

    DISPLAY "Report exported successfully"
    DISPLAY "Format: " + Export Format
    DISPLAY "Filename: " + Filename
    PROVIDE Download Button

    LOG "Report " + Report.ReportID + " exported by " + Administrator.Name + " as "
+ Export Format
ENDIF

END Process
```

Refer to:
- FR-27 (Report Export Functionality)
- Table 88-90: Data Flow 38-40 Details

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
Request = View Dashboard	Y	N	N	N	N
Request = Export	N	Y	Y	Y	N
Recent Report Exists	Y	-	-	-	-
Export Format = PDF	-	Y	N	N	-
Export Format = Excel	-	N	Y	N	-
Export Format = CSV	-	N	N	Y	-
Retrieve Existing Report	X	-	-	-	-
Generate New Report	-	X	X	X	-
Render Dashboard	X	-	-	-	-
Export as PDF	-	X	-	-	-
Export as Excel	-	-	X	-	-
Export as CSV	-	-	-	X	-
Provide Download Link	-	X	X	X	-
Display Error	-	-	-	-	X

Unresolved Issues: None

4.2.5. Fragment 5: Notification Management Processes

Number: 5.1
Name: Receive Trigger
Description: Receives and validates notification triggers from various system processes (ticket creation, status changes, assignments, etc.) and prepares them for notification generation.

Input Data Flow:
- Notification triggers from various processes (2.1, 2.3, 2.4, 3.2, 4.1)
  - Event Type
  - TicketID
  - Affected UserIDs
  - Priority Level
  - Timestamp

Output Data Flow:
- Notification Trigger Details (to Process 5.2)

Type of Process:
☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `receiveTrigger()`

Process Logic (Structured English):

```
BEGIN Process 5.1: Receive Trigger

READ Trigger Event from Source Process
    Event Type, TicketID, Affected UserIDs, Additional Data

VALIDATE Trigger Data
IF Event Type is NULL OR TicketID is NULL THEN
    LOG "Invalid trigger received"
    EXIT Process
ENDIF

// Determine affected users based on event type
INITIALIZE Recipients List

IF Event Type = "Ticket Created" THEN
    ADD All Active Administrators to Recipients
ELSIF Event Type = "Status Changed" THEN
    RETRIEVE Ticket from Tickets Database (D2)
    ADD Ticket.RequesterID to Recipients
    IF Ticket.TechnicianID ≠ NULL THEN
        ADD Ticket.TechnicianID to Recipients
    ENDIF
ELSIF Event Type = "Ticket Assigned" THEN
    RETRIEVE Ticket from Tickets Database (D2)
    ADD Ticket.TechnicianID to Recipients
```

```
    ADD Ticket.RequesterID to Recipients
ELSIF Event Type = "Priority Changed" THEN
    RETRIEVE Ticket from Tickets Database (D2)
    IF Ticket.TechnicianID ≠ NULL THEN
        ADD Ticket.TechnicianID to Recipients
    ENDIF
    ADD All Active Administrators to Recipients
ELSIF Event Type = "Comment Added" THEN
    RETRIEVE Ticket from Tickets Database (D2)
    ADD Ticket.RequesterID to Recipients
    IF Ticket.TechnicianID ≠ NULL THEN
        ADD Ticket.TechnicianID to Recipients
    ENDIF
ELSIF Event Type = "Evidence Uploaded" THEN
    RETRIEVE Ticket from Tickets Database (D2)
    ADD Ticket.RequesterID to Recipients
    ADD All Active Administrators to Recipients
ELSIF Event Type = "Ticket Overdue" THEN
    ADD All Active Administrators to Recipients
    RETRIEVE Ticket from Tickets Database (D2)
    IF Ticket.TechnicianID ≠ NULL THEN
        ADD Ticket.TechnicianID to Recipients
    ENDIF
ENDIF

// Remove duplicate user IDs
REMOVE Duplicates from Recipients List

// Determine notification priority
IF Event Type IN ("Ticket Overdue", "Emergency Ticket", "Account Locked") THEN
    SET Priority Level = "High"
ELSIF Event Type IN ("Status Changed", "Priority Changed", "Ticket Assigned") THEN
    SET Priority Level = "Medium"
ELSE
    SET Priority Level = "Low"
ENDIF

// Create trigger details object
CREATE Trigger Details Object
    TriggerID = GENERATE UUID
    EventType = Event Type
    TicketID = TicketID
    Recipients = Recipients List
    PriorityLevel = Priority Level
    Timestamp = CURRENT_DATETIME
    AdditionalData = Additional Data

LOG "Notification trigger received: " + Event Type + " for Ticket " + TicketID

// Pass to notification preparation
TRIGGER Process 5.2 (Prepare Notification)
    Pass Trigger Details Object

END Process
```

Refer to:
- Table 91: Data Flow 41 Details
- Figure 44: DFD Level 1-Fragment 5

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
Event Type Valid	Y	Y	Y	Y	N
TicketID Provided	Y	Y	Y	N	-
Event = Ticket Created	Y	N	N	-	-
Event = Status Changed	N	Y	N	-	-
Event = Ticket Assigned	N	N	Y	-	-
Identify Recipients	X	X	X	-	-
Set Priority Level	X	X	X	-	-
Create Trigger Object	X	X	X	-	-
Pass to Process 5.2	X	X	X	-	-
Display “Invalid TicketID”	-	-	-	X	-
Display “Invalid Event Type”	-	-	-	-	X

Unresolved Issues: None

Number: 5.2
Name: Prepare Notification
Description: Retrieves ticket details and user contact information, constructs personalized notification messages, and determines delivery methods based on user preferences.

Input Data Flow:
- Notification Trigger Details (from Process 5.1)
- Ticket Details (from Tickets Database D2)
- User Contact Information (from User Database D1)

Output Data Flow:
- Prepared Notification Message (to Process 5.3)

Type of Process:
☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `prepareNotification()`

Process Logic (Structured English):

```
BEGIN Process 5.2: Prepare Notification
```

```
READ Trigger Details from Process 5.1
    TriggerID, EventType, TicketID, Recipients, PriorityLevel, Timestamp

// Retrieve ticket information
QUERY Tickets Database (D2) WHERE TicketID = Input TicketID
IF Ticket Not Found THEN
    LOG "Ticket not found for notification: " + TicketID
    EXIT Process
ENDIF

RETRIEVE Ticket Details
    Title, Category, Status, Priority, Location, RequesterID, TechnicianID

// Retrieve location details for context
IF Ticket.LocationID ≠ NULL THEN
    QUERY Locations Database WHERE LocationID = Ticket.LocationID
    SET Location Details = BuildingName + " - " + RoomNumber
ELSE
    SET Location Details = "Unspecified"
ENDIF

// Process notifications for each recipient
FOR EACH RecipientID in Recipients List DO

    // Retrieve recipient information
    QUERY User Database (D1) WHERE UserID = RecipientID
    IF User Not Found THEN
        LOG "User not found: " + RecipientID
        CONTINUE to Next Recipient
    ENDIF

    RETRIEVE User Details
        FullName, Email, PhoneNumber, Role

    // Retrieve notification preferences
    QUERY Notification Preferences WHERE UserID = RecipientID
    IF Preferences Not Found THEN
        // Use default preferences
        SET InAppEnabled = TRUE
        SET EmailEnabled = TRUE
        SET SMSEnabled = FALSE
        SET PushEnabled = TRUE
    ELSE
        RETRIEVE Preferences
            InAppEnabled, EmailEnabled, SMSEnabled, PushEnabled,
            DoNotDisturbStart, DoNotDisturbEnd
    ENDIF

    // Check Do Not Disturb settings
    SET Current Time = CURRENT_TIME
    IF DoNotDisturbStart ≠ NULL AND DoNotDisturbEnd ≠ NULL THEN
        IF Current Time BETWEEN DoNotDisturbStart AND DoNotDisturbEnd THEN
            IF PriorityLevel ≠ "High" THEN
                LOG "User " + RecipientID + " in Do Not Disturb mode"
```

```
                QUEUE Notification for Later Delivery
                CONTINUE to Next Recipient
            ENDIF
        ENDIF
    ENDIF

    // Build notification message based on event type and user role
    INITIALIZE Message = ""
    INITIALIZE Subject = ""

    IF EventType = "Ticket Created" THEN
        SET Subject = "New Maintenance Ticket Created"
        SET Message = "A new maintenance ticket has been submitted."
        SET Details = "Ticket ID: " + TicketID + "\n" +
                      "Title: " + Ticket.Title + "\n" +
                      "Category: " + Ticket.Category + "\n" +
                      "Location: " + Location Details + "\n" +
                      "Priority: " + Ticket.Priority

    ELSIF EventType = "Status Changed" THEN
        SET Subject = "Ticket Status Updated"
        IF User.Role = "Resident" THEN
            SET Message = "Your maintenance ticket status has been updated to: " +
                          Ticket.Status
        ELSE
            SET Message = "Ticket " + TicketID + " status changed to: " +
Ticket.Status
        ENDIF
        SET Details = "Ticket ID: " + TicketID + "\n" +
                      "New Status: " + Ticket.Status + "\n" +
                      "Location: " + Location Details

    ELSIF EventType = "Ticket Assigned" THEN
        SET Subject = "New Task Assigned"
        IF User.Role = "Technician" THEN
            SET Message = "A new maintenance task has been assigned to you."
            SET Details = "Ticket ID: " + TicketID + "\n" +
                          "Title: " + Ticket.Title + "\n" +
                          "Category: " + Ticket.Category + "\n" +
                          "Priority: " + Ticket.Priority + "\n" +
                          "Location: " + Location Details
        ELSE
            SET Message = "Your ticket has been assigned to a technician."
            SET Details = "Ticket ID: " + TicketID
        ENDIF

    ELSIF EventType = "Priority Changed" THEN
        SET Subject = "Ticket Priority Updated"
        SET Message = "The priority of ticket " + TicketID +
                      " has been changed to: " + Ticket.Priority
        SET Details = "Ticket ID: " + TicketID + "\n" +
                      "New Priority: " + Ticket.Priority + "\n" +
                      "Location: " + Location Details
```

```
    ELSIF EventType = "Comment Added" THEN
        SET Subject = "New Comment on Your Ticket"
        SET Message = "A new comment has been added to your maintenance ticket."
        SET Details = "Ticket ID: " + TicketID + "\n" +
                      "Status: " + Ticket.Status

    ELSIF EventType = "Evidence Uploaded" THEN
        SET Subject = "Maintenance Evidence Submitted"
        IF User.Role = "Resident" THEN
            SET Message = "The technician has uploaded completion evidence for your
ticket."
        ELSE
            SET Message = "Completion evidence has been uploaded for ticket " +
TicketID
        ENDIF
        SET Details = "Ticket ID: " + TicketID + "\n" +
                      "Please review the evidence."

    ELSIF EventType = "Ticket Overdue" THEN
        SET Subject = "URGENT: Ticket Overdue"
        SET Message = "Ticket " + TicketID + " is overdue and requires immediate
attention."
        SET Details = "Ticket ID: " + TicketID + "\n" +
                      "Category: " + Ticket.Category + "\n" +
                      "Priority: " + Ticket.Priority + "\n" +
                      "Location: " + Location Details
    ENDIF

    // Determine notification type for database
    IF EventType = "Ticket Created" OR EventType = "Ticket Overdue" THEN
        SET NotificationType = "Alert"
    ELSIF EventType = "Ticket Assigned" THEN
        SET NotificationType = "Assignment"
    ELSIF EventType = "Priority Changed" THEN
        SET NotificationType = "PriorityChange"
    ELSE
        SET NotificationType = "StatusChange"
    ENDIF

    // Check for notification grouping (last 10 minutes)
    QUERY Notifications Database WHERE
        UserID = RecipientID AND
        RelatedTicketID = TicketID AND
        NotificationType = NotificationType AND
        CreatedAt >= (CURRENT_DATETIME - 10 minutes) AND
        IsRead = FALSE

    IF Similar Unread Notification Exists THEN
        // Update existing notification instead of creating new
        SET GroupedNotification = TRUE
        UPDATE Existing Notification
            Message = "Multiple updates for ticket " + TicketID
            UpdatedAt = CURRENT_DATETIME
    ELSE
```

```
        SET GroupedNotification = FALSE
    ENDIF

    // Generate notification ID
    GENERATE NotificationID

    // Create prepared notification object
    CREATE Prepared Notification
        NotificationID = NotificationID
        UserID = RecipientID
        UserName = User.FullName
        UserEmail = User.Email
        UserPhone = User.PhoneNumber
        UserRole = User.Role
        RelatedTicketID = TicketID
        NotificationType = NotificationType
        Subject = Subject
        Message = Message
        Details = Details
        PriorityLevel = PriorityLevel
        DeliveryMethods = {
            InApp: InAppEnabled,
            Email: EmailEnabled,
            SMS: SMSEnabled,
            Push: PushEnabled
        }
        IsGrouped = GroupedNotification
        CreatedAt = CURRENT_DATETIME
        ExpirationDate = CURRENT_DATETIME + 90 days

    LOG "Notification prepared for User " + RecipientID + " - " + EventType

    // Send to delivery process
    TRIGGER Process 5.3 (Send Notification)
        Pass Prepared Notification Object

ENDFOR

END Process
```

Refer to:

- Table 92-96: Data Flow 42-46 Details
- FR-10 (Status Change Notifications)
- FR-18 (Technician Notifications)
- FR-25 (Administrator Notifications)

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
Ticket Found	Y	Y	Y	Y	Y	N
User Found	Y	Y	Y	Y	N	-
In DND Mode	Y	Y	N	N	-	-
Priority = High	Y	N	-	-	-	-
Recent Similar Notification	-	-	Y	N	-	-
Retrieve Preferences	X	X	X	X	-	-
Build Message	X	X	X	X	-	-
Override DND	X	-	-	-	-	-
Queue for Later	-	X	-	-	-	-
Group Notification	-	-	X	-	-	-
Create New Notification	X	-	-	X	-	-
Send to Process 5.3	X	-	X	X	-	-
Log “User Not Found”	-	-	-	-	X	-
Log “Ticket Not Found”	-	-	-	-	-	X

Unresolved Issues: None

Number: 5.3
Name: Send Notification
Description: Delivers notifications to users through multiple channels (in-app, email, SMS, push notifications) based on user preferences and priority levels.

Input Data Flow:
- Prepared Notification Message (from Process 5.2)

Output Data Flow:
- Notification (to Resident/Technician/Administrator)
- Stored Notification Record (to Notifications Database)

Type of Process:
☑ Online ☐ Batch ☐ Manual

Subprogram/Function Name: `sendNotification()`

Process Logic (Structured English):

```
BEGIN Process 5.3: Send Notification

READ Prepared Notification from Process 5.2
    NotificationID, UserID, UserName, UserEmail, UserPhone, UserRole,
    RelatedTicketID, NotificationType, Subject, Message, Details,
    PriorityLevel, DeliveryMethods, IsGrouped, CreatedAt, ExpirationDate
```

```
// Store notification in database first
CREATE Notification Record
    NotificationID = NotificationID
    UserID = UserID
    RelatedTicketID = RelatedTicketID
    NotificationType = NotificationType
    Message = Message
    IsRead = FALSE
    DeliveryMethod = "multi-channel"
    PriorityLevel = PriorityLevel
    ExpirationDate = ExpirationDate
    CreatedAt = CreatedAt

WRITE Notification Record to Notifications Database

LOG "Notification " + NotificationID + " stored for User " + UserID

// Track delivery status for each channel
INITIALIZE Delivery Status = {
    InApp: FALSE,
    Email: FALSE,
    SMS: FALSE,
    Push: FALSE
}

// ============================================
// CHANNEL 1: IN-APP NOTIFICATION
// ============================================

IF DeliveryMethods.InApp = TRUE THEN
    TRY
        // Check if user has active session
        QUERY Active Sessions WHERE UserID = UserID

        IF Active Session Exists THEN
            // Send via WebSocket
            CREATE WebSocket Payload
                type: "notification"
                notificationID: NotificationID
                ticketID: RelatedTicketID
                subject: Subject
                message: Message
                priority: PriorityLevel
                timestamp: CreatedAt

            SEND WebSocket Message to User Session

            // Update notification badge count
            INCREMENT User.NotificationBadgeCount
            SEND Badge Update via WebSocket

            // Play sound for high priority
            IF PriorityLevel = "High" THEN
```

```
                SEND Sound Trigger "urgent.mp3"
            ELSE
                SEND Sound Trigger "notification.mp3"
            ENDIF

            SET Delivery Status.InApp = TRUE
            LOG "In-app notification sent to User " + UserID
        ELSE
            LOG "No active session for User " + UserID + " - notification queued"
        ENDIF

    CATCH Error
        LOG "In-app notification failed: " + Error.Message
        SET Delivery Status.InApp = FALSE
    ENDTRY
ENDIF

// ============================================
// CHANNEL 2: EMAIL NOTIFICATION
// ============================================

IF DeliveryMethods.Email = TRUE THEN
    IF UserEmail ≠ NULL AND UserEmail ≠ "" THEN
        TRY
            // Build HTML email template
            CREATE Email Content
                To: UserEmail
                Subject: "[SALLEHA] " + Subject

                Body (HTML):
                    <html>
                    <body style="font-family: Arial, sans-serif;">
                        <div style="background: #f5f5f5; padding: 20px;">
                            <div style="background: white; padding: 20px; border-
radius: 8px;">
                                <h2 style="color: #333;">Hello, {UserName}</h2>
                                <p>{Message}</p>
                                <div style="background: #f9f9f9; padding: 15px;
margin: 15px 0;">
                                    <pre style="margin: 0;">{Details}</pre>
                                </div>
                                <a href="https://salleha.system.com/tickets/
{RelatedTicketID}"
                                   style="display: inline-block; background:
#007bff;
                                          color: white; padding: 10px 20px;
                                          text-decoration: none; border-radius:
5px;">
                                    View Ticket
                                </a>
                                <hr style="margin: 20px 0;">
                                <p style="font-size: 12px; color: #666;">
                                    You are receiving this notification because you
have
```

```
                                    email notifications enabled.
                                    <a href="https://salleha.system.com/
preferences">
                                        Manage your notification preferences
                                    </a>
                                </p>
                            </div>
                        </div>
                    </body>
                    </html>

            // Send email via Nodemailer
            SEND Email via SMTP
                Service: Gmail SMTP / SendGrid / AWS SES
                From: "SALLEHA System <no-reply@salleha.system.com>"

            SET Delivery Status.Email = TRUE
            LOG "Email sent to " + UserEmail

        CATCH Error
            LOG "Email delivery failed: " + Error.Message
            SET Delivery Status.Email = FALSE
        ENDTRY
    ELSE
        LOG "No email address for User " + UserID
    ENDIF
ENDIF

// ============================================
// CHANNEL 3: SMS NOTIFICATION
// ============================================

IF DeliveryMethods.SMS = TRUE THEN
    IF PriorityLevel = "High" OR PriorityLevel = "Immediate" THEN
        IF UserPhone ≠ NULL AND UserPhone ≠ "" THEN
            TRY
                // Build SMS message (max 160 characters)
                SET SMS Text = "SALLEHA ALERT: " + Message
                IF LENGTH(SMS Text) > 140 THEN
                    SET SMS Text = SUBSTRING(SMS Text, 0, 137) + "..."
                ENDIF

                // Add short URL
                GENERATE Short URL for Ticket
                    FullURL: "https://salleha.system.com/tickets/" +
RelatedTicketID
                    ShortURL: "https://slh.tk/t/" + RelatedTicketID

                SET SMS Text = SMS Text + " View: " + ShortURL

                // Send via Twilio API
                SEND SMS via Twilio
                    To: UserPhone
                    From: Configured Twilio Number
```

```
                    Body: SMS Text

                SET Delivery Status.SMS = TRUE
                LOG "SMS sent to " + UserPhone

            CATCH Error
                LOG "SMS delivery failed: " + Error.Message
                SET Delivery Status.SMS = FALSE
            ENDTRY
        ELSE
            LOG "No phone number for User " + UserID
        ENDIF
    ELSE
        LOG "SMS only sent for high priority notifications"
    ENDIF
ENDIF

// ============================================
// CHANNEL 4: PUSH NOTIFICATION (Mobile App)
// ============================================

IF DeliveryMethods.Push = TRUE THEN
    TRY
        // Check if user has FCM token (mobile app installed)
        QUERY Firebase Tokens WHERE UserID = UserID

        IF FCM Token Exists THEN
            // Build push notification payload
            CREATE Push Notification
                to: User.FCMToken
                notification:
                    title: Subject
                    body: Message
                    sound: (PriorityLevel = "High" ? "urgent.mp3" : "default.mp3")
                    badge: User.NotificationBadgeCount + 1
                    icon: "ic_notification"
                    color: "#007bff"
                data:
                    type: NotificationType
                    ticketID: RelatedTicketID
                    notificationID: NotificationID
                    priority: PriorityLevel
                    deepLink: "salleha://tickets/" + RelatedTicketID

            // Send via Firebase Cloud Messaging
            SEND Push Notification via FCM API

            SET Delivery Status.Push = TRUE
            LOG "Push notification sent to User " + UserID
        ELSE
            LOG "No FCM token for User " + UserID + " - mobile app not installed"
        ENDIF

    CATCH Error
```

```
        LOG "Push notification failed: " + Error.Message
        SET Delivery Status.Push = FALSE
    ENDTRY
ENDIF

// ============================================
// UPDATE DELIVERY STATUS
// ============================================

// Store delivery attempts
CREATE Delivery Log Record
    NotificationID = NotificationID
    InAppDelivered = Delivery Status.InApp
    EmailDelivered = Delivery Status.Email
    SMSDelivered = Delivery Status.SMS
    PushDelivered = Delivery Status.Push
    AttemptedAt = CURRENT_DATETIME

WRITE to Delivery Log Table

// Check if at least one channel succeeded
SET Success Count = 0
IF Delivery Status.InApp = TRUE THEN INCREMENT Success Count
IF Delivery Status.Email = TRUE THEN INCREMENT Success Count
IF Delivery Status.SMS = TRUE THEN INCREMENT Success Count
IF Delivery Status.Push = TRUE THEN INCREMENT Success Count

IF Success Count = 0 THEN
    // All channels failed - queue for retry
    LOG "WARNING: All notification channels failed for " + NotificationID
    CREATE Retry Job
        NotificationID = NotificationID
        RetryAt = CURRENT_DATETIME + 5 minutes
        RetryCount = 1
    WRITE to Notification Retry Queue
ELSE
    LOG "Notification " + NotificationID + " delivered via " + Success Count + "
channel(s)"
ENDIF

// Send success response
DISPLAY "Notification sent successfully"

END Process
```

Refer to:

- Table 97-98: Data Flow 47 Details
- FR-10 (Status Change Notifications)
- FR-18 (Technician Notifications)
- FR-25 (Administrator Notifications)

Decision Table:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5	Rule 6
In-App Enabled	Y	Y	Y	N	N	N
Email Enabled	Y	Y	N	Y	Y	N
SMS Enabled	Y	N	N	Y	N	N
Priority = High	Y	Y	Y	Y	N	-
Send In-App	X	X	X	-	-	-
Send Email	X	X	-	X	X	-
Send SMS	X	-	-	X	-	-
Send Push	X	X	X	X	X	-
Store in Database	X	X	X	X	X	X
Log Delivery	X	X	X	X	X	X
Queue for Retry (if all fail)	-	-	-	-	-	X

Unresolved Issues: None

4.2.6. Summary of All Process Specifications

This document contains **20 comprehensive process specifications** covering all major system processes:

Fragment 1: User Management (4 Processes)

1. **1.1 User Registration** - Account creation with validation and email verification
2. **1.2 User Authentication** - Login with JWT, CAPTCHA, and session management
3. **1.3 Password Recovery** - Reset forgotten passwords with verification codes
4. **1.4 Account Management** - Profile updates and admin user management

Fragment 2: Maintenance Requests (5 Processes)

5. **2.1 Create Maintenance Ticket** - Submit tickets with duplicate detection
6. **2.2 View/Search Tickets** - Query and filter tickets by various criteria
7. **2.3 Update Ticket Status** - Manage ticket lifecycle and assignments
8. **2.4 Manage Comments & Evidence** - Add comments and upload completion evidence
9. **2.5 Send Notifications** - Multi-channel notification dispatcher

Fragment 3: Assignment & Tasks (4 Processes)

10. **3.1 View Pending/Unassigned Tickets** - Display unassigned tickets for admins
11. **3.2 Assign Ticket & Set Priority** - Assign technicians and set priorities
12. **3.3 Notify Technician** - Send assignment notifications to technicians
13. **3.4 Update Assignment Status** - Handle accept/decline and reassignment

Fragment 4: Analytics & Reporting (4 Processes)

14. **4.1 Record Maintenance Completion** - Archive completed work with metrics
15. **4.2 Update Maintenance History** - Store historical records for analysis
16. **4.3 Generate Reports & Metrics** - Compile data and calculate KPIs
17. **4.4 Provide Analytics Dashboard / Export** - Display dashboards and export reports

Fragment 5: Notification Management (3 Processes)

18. **5.1 Receive Trigger** - Capture notification events and identify affected users
19. **5.2 Prepare Notification** - Construct personalized messages with ticket context
20. **5.3 Send Notification** - Deliver via multiple channels (in-app, email, SMS, push)

4.3. Object-Oriented Analysis

4.3.1. Activity Diagrams

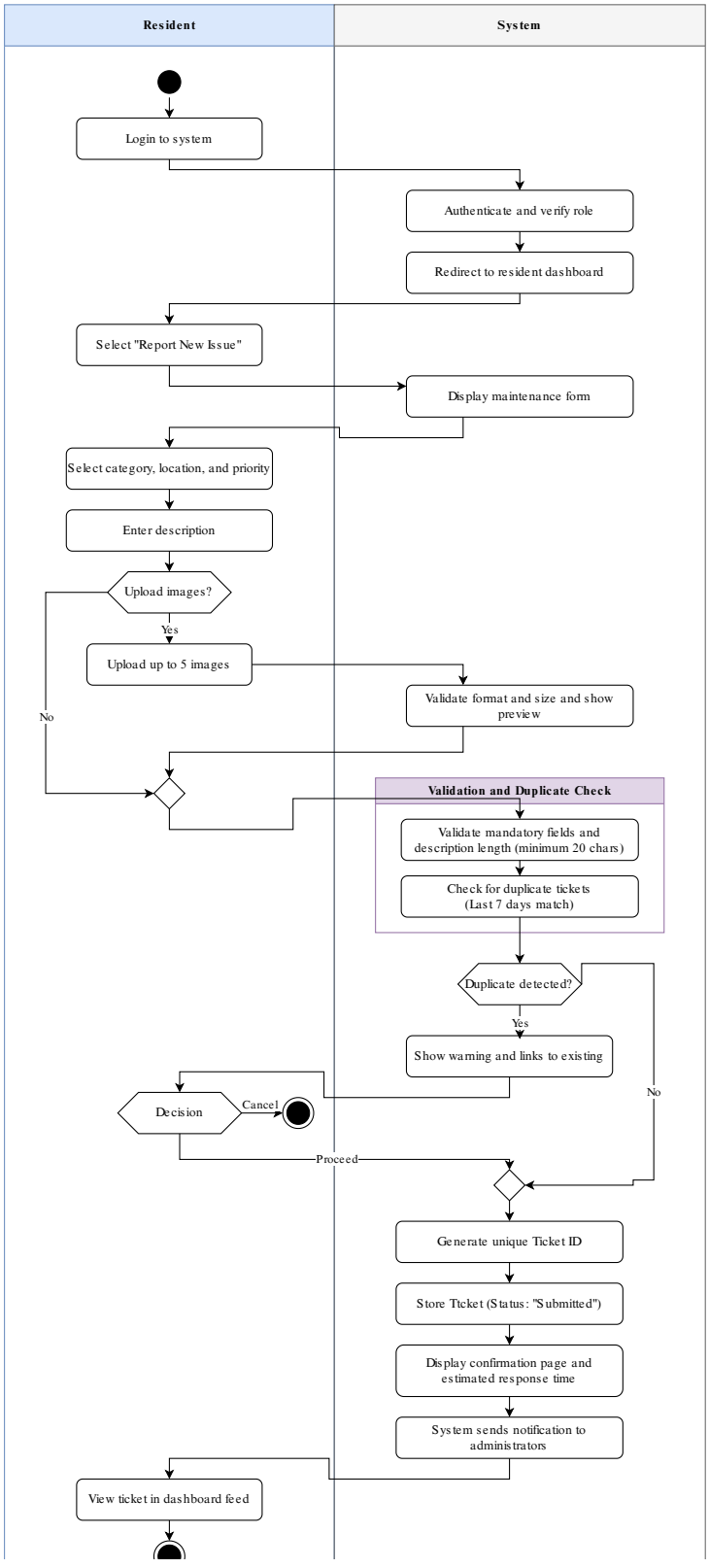


Figure 54: Resident Activity Diagram

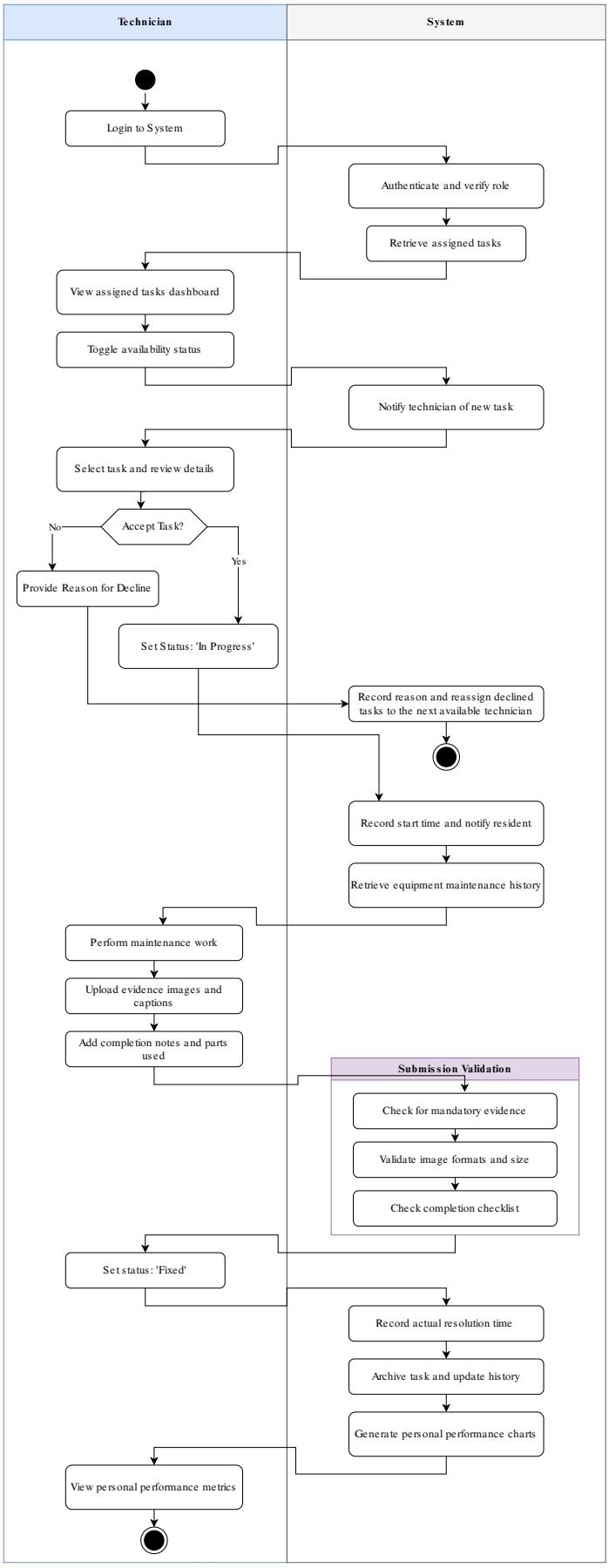


Figure 55: Technician Activity Diagram

4.4. System Architecture Design

4.4.1. Architectural Style

4.4.1.1. Primary Architecture Pattern: Three-Tier Client-Server Architecture

The SALLEHA system follows a **three-tier client-server architecture** with clear separation of concerns:

- **Presentation Tier**: Web (React) and Mobile (Flutter) applications
- **Application Tier**: RESTful API backend services (Node.js + Java)
- **Data Tier**: MySQL relational database with ORM layer

4.4.1.2. Architectural Characteristics

Layered Architecture: Each tier operates independently with well-defined interfaces:
- Enhances maintainability (NFR-6)
- Supports scalability for 24/7 operation (NFR-2)
- Enables parallel development across teams

Service-Oriented Design: Backend exposes RESTful APIs consumed by multiple clients (web + mobile), promoting reusability and platform independence.

Event-Driven Components: Real-time notification system using push notifications and email alerts for status changes.

4.4.2. Technology Stack

4.4.2.1. Frontend Technologies

4.4.2.1.1. Web Application

- **Framework**: React 18.x
- **UI Library**: Bootstrap 5.x + Tailwind CSS (for responsive design)
- **State Management**: React Context API / Redux (for complex state)
- **HTTP Client**: Axios
- **Form Validation**: Formik + Yup
- **Routing**: React Router v6
- **Real-time Updates**: WebSocket (Socket.io-client)
- **Charts/Analytics**: Recharts or Chart.js

4.4.2.1.2. Mobile Application

- **Framework**: Flutter 3.x
- **Language**: Dart
- **State Management**: Provider / Riverpod
- **HTTP Client**: Dio
- **Local Storage**: Shared Preferences
- **Push Notifications**: Firebase Cloud Messaging (FCM)
- **Image Handling**: image_picker, cached_network_image

4.4.2.2. Backend Technologies

4.4.2.2.1. API Server

- **Primary Runtime**: Node.js (v18 LTS) with Express.js framework
- **Secondary Services**: Java (Spring Boot) for computationally intensive analytics
- **API Architecture**: RESTful services with JSON data exchange
- **Authentication**: JWT (JSON Web Tokens) + bcrypt for password hashing
- **Session Management**: Redis (for session storage and caching)
- **File Upload**: Multer middleware (max 5MB per image)
- **Email Service**: Nodemailer with SMTP
- **SMS Service**: Twilio API (optional notifications)
- **Real-time Communication**: Socket.io for WebSocket connections

4.4.2.2.2. Database Layer

- **RDBMS**: MySQL 8.x
- **ORM**: Sequelize (Node.js) / Hibernate (Java)
- **Migration Management**: Sequelize CLI
- **Connection Pooling**: Built-in Sequelize pooling
- **Backup Strategy**: Automated daily backups with 90-day retention

4.4.2.3. Infrastructure & DevOps

- **Version Control**: GitHub (with Git Flow branching strategy)
- **CI/CD Pipeline**: GitHub Actions (automated testing + deployment)
- **Hosting**:
  - **Web**: Vercel or Netlify (static frontend hosting)
  - **API**: AWS EC2 or DigitalOcean Droplets
  - **Database**: AWS RDS MySQL or managed MySQL hosting
- **Cloud Storage**: AWS S3 (for ticket images and documents)
- **Monitoring**: PM2 (process management), CloudWatch (AWS monitoring)
- **Load Balancing**: Nginx (reverse proxy + load balancer)
- **SSL/TLS**: Let's Encrypt certificates

4.4.2.4. Development & Testing Tools

- **Code Editor**: Visual Studio Code
- **API Testing**: Postman, Thunder Client
- **Unit Testing**: Jest (Node.js), JUnit (Java), Flutter Test
- **Code Quality**: ESLint, Prettier, SonarQube
- **Documentation**: Typst (project docs), Swagger/OpenAPI (API docs)
- **Design & Prototyping**: Figma (UI/UX), Draw.io (diagrams)

4.4.3. Component/Module-Level View

4.4.3.1. System Components Diagram

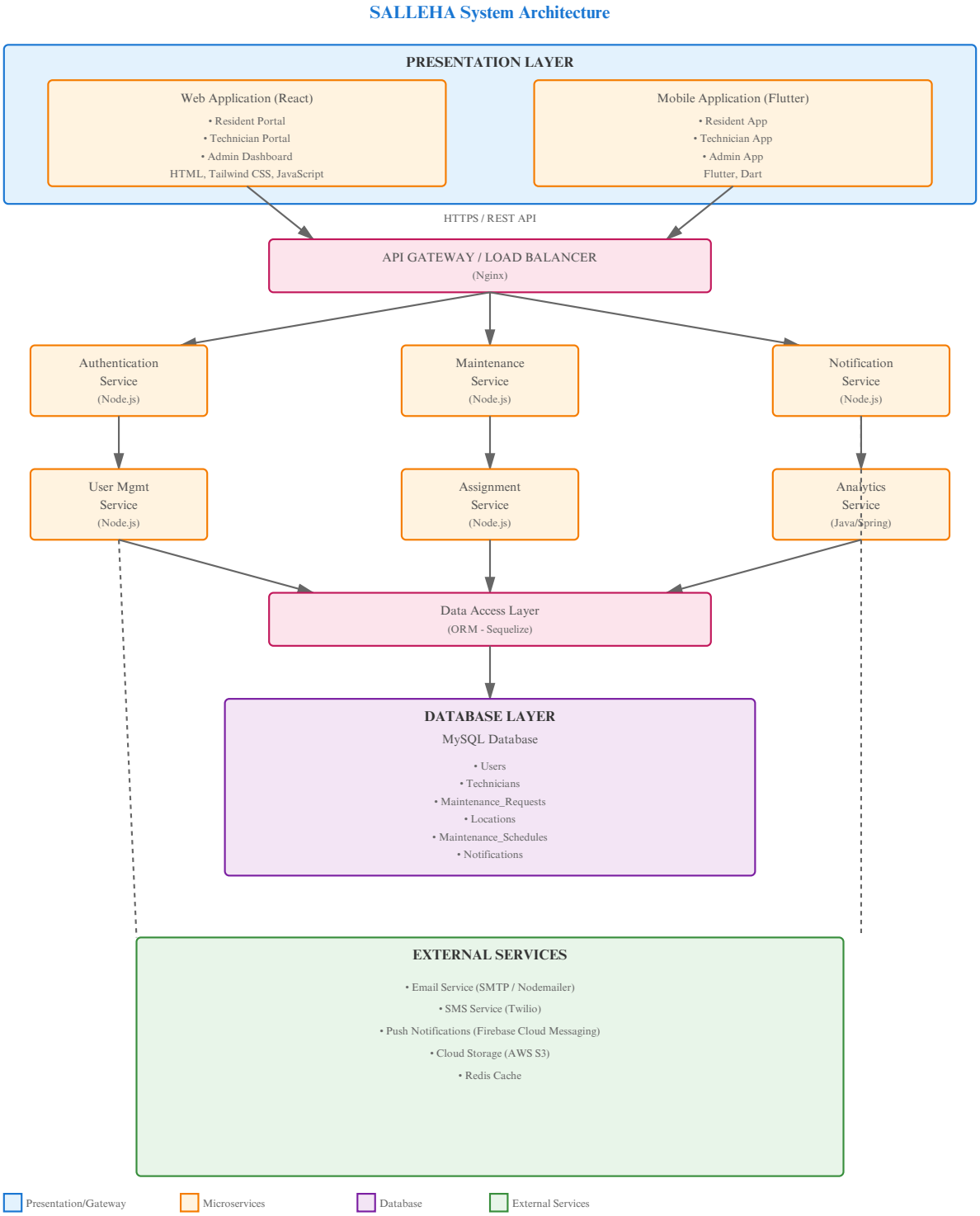


Figure 56: System Components Diagram

4.4.3.2. Core Modules and Components

4.4.3.2.1. MODULE 1: Authentication & Authorization Module

Responsibilities:

- User registration with email verification (FR-1)
- Login authentication with JWT token generation (FR-2)

- Password recovery with one-time verification codes (FR-4)
- Session management with role-based access control (RBAC)
- Account lockout after failed login attempts (FR-2.6)
- CAPTCHA integration for security (FR-2.5)

Components:
- `AuthController`: Handles authentication endpoints
- `TokenService`: JWT token generation and validation
- `PasswordHashService`: bcrypt password hashing
- `EmailVerificationService`: Sends and validates verification codes
- `SessionManager`: Redis-based session storage

Technologies: Node.js, JWT, bcrypt, Redis

4.4.3.2.2. MODULE 2: User Management Module

Responsibilities:
- User profile management (FR-12, FR-28)
- Role assignment and permissions management
- User account activation/deactivation (FR-28.2)
- Profile picture upload and storage
- Audit logging of user activities
- Bulk user operations (FR-28.5)

Components:
- `UserController`: User CRUD operations
- `ProfileService`: Profile update logic
- `RoleManager`: Role-based permission validation
- `AuditLogger`: Tracks all user management activities
- `FileUploadHandler`: Manages profile picture uploads

Technologies: Node.js, Multer, AWS S3

4.4.3.2.3. MODULE 3: Maintenance Request Management Module

Responsibilities:
- Ticket submission with validation (FR-8)
- Duplicate detection algorithm (FR-11)
- Ticket status lifecycle management (FR-9)
- Image upload handling (max 5 images, 5MB each)
- Real-time status tracking (FR-9)
- Maintenance request feed (FR-7)

Components:
- `TicketController`: Ticket CRUD operations
- `DuplicateDetectionService`: Similarity algorithm (category, location, keywords)

- `StatusManager`: Status transition workflow (Submitted → Assigned → In Progress → Fixed → Closed)
- `ImageUploadService`: Image validation, compression, S3 storage
- `TicketValidationService`: 20-character minimum description validation

Technologies: Node.js, Multer, AWS S3, Text similarity algorithms

4.4.3.2.4. MODULE 4: Task Assignment & Scheduling Module

Responsibilities:

- Automatic ticket assignment to technicians (FR-23)
- Manual assignment override by admins
- Priority-based task distribution (FR-24)
- Workload balancing across technicians
- Maintenance scheduling (FR for Maintenance Schedule entity)
- Escalation for overdue tasks

Components:

- `AssignmentEngine`: Auto-assignment algorithm (expertise, workload, location)
- `PriorityManager`: Priority level management (Low/Medium/High/Urgent/Emergency)
- `ScheduleService`: Technician schedule management
- `EscalationService`: Monitors and escalates overdue tasks
- `WorkloadBalancer`: Distributes tasks evenly

Technologies: Node.js, Scheduling algorithms

4.4.3.2.5. MODULE 5: Technician Workflow Module

Responsibilities:

- Task acceptance/decline by technicians (FR-15)
- Task status updates with timestamps (FR-16)
- Maintenance evidence submission (FR-17)
- Access to maintenance history (FR-19)
- Technician performance tracking (FR-20)

Components:

- `TechnicianTaskController`: Task management endpoints
- `EvidenceService`: Image/note uploads as completion proof
- `MaintenanceHistoryService`: Historical data retrieval
- `PerformanceTracker`: Completion rates, resolution time analytics
- `StatusUpdateService`: Handles status transitions with notifications

Technologies: Node.js, AWS S3

4.4.3.2.6. MODULE 6: Notification & Communication Module

Responsibilities:

- Real-time push notifications (FR-10, FR-18, FR-25)
- Email notifications for status changes

- SMS alerts for urgent tickets (optional)
- Notification preference management
- Notification history (90-day retention)

Components:
- `NotificationController`: Notification CRUD operations
- `PushNotificationService`: WebSocket (Socket.io) + FCM integration
- `EmailService`: Nodemailer SMTP integration
- `SMSService`: Twilio API integration
- `NotificationScheduler`: Batches and schedules notifications

Technologies: Node.js, Socket.io, Firebase Cloud Messaging, Nodemailer, Twilio

4.4.3.2.7. MODULE 7: Analytics & Reporting Module

Responsibilities:
- Admin analytics dashboard (FR-26)
- Maintenance trend analysis
- Equipment performance metrics (MTBF)
- Cost analysis (labor, parts, total expenditure)
- Predictive analytics for preventive maintenance
- Custom report generation (FR-27)

Components:
- `AnalyticsEngine`: Data aggregation and statistical analysis (Java/Spring Boot)
- `ReportGenerator`: PDF/Excel export functionality
- `TrendAnalyzer`: Pattern recognition for recurring issues
- `DashboardService`: KPI calculation (total tickets, resolution time, completion rates)
- `PredictiveModel`: ML-based preventive maintenance suggestions

Technologies: Java (Spring Boot), Apache POI (Excel), iText (PDF), Chart.js/Recharts

4.4.3.2.8. MODULE 8: Location & Equipment Management Module

Responsibilities:
- Location data management
- Geographic heat map generation (FR-21.5)
- Equipment tracking and history
- Zone-based assignment

Components:
- `LocationController`: Location CRUD operations
- `HeatMapService`: Generates issue density visualizations
- `EquipmentService`: Equipment history and warranty tracking
- `ZoneManager`: Manages work zones for technician assignment

Technologies: Node.js, Geolocation APIs

4.4.3.2.9. MODULE 9: Data Access Layer (DAL)

Responsibilities:

- Database connection management
- ORM-based CRUD operations
- Query optimization
- Data migration and seeding
- Connection pooling

Components:

- `UserRepository`: User entity operations
- `TicketRepository`: Maintenance request operations
- `TechnicianRepository`: Technician entity operations
- `LocationRepository`: Location entity operations
- `NotificationRepository`: Notification entity operations
- `DatabaseMigrator`: Schema migrations

Technologies: Sequelize ORM (Node.js), MySQL

4.4.4. Module Responsibilities Summary Table

Module	Primary Responsibility	Key Technologies	User Roles Affected
Authentication & Authorization	User login, registration, password recovery, session management	Node.js, JWT, bcrypt, Redis	All Users
User Management	Profile management, role assignment, account lifecycle	Node.js, AWS S3	All Users, Admin
Maintenance Request Management	Ticket submission, duplicate detection, status tracking	Node.js, AWS S3, Similarity algorithms	Resident, Admin
Task Assignment & Scheduling	Automatic/manual assignment, priority management, escalation	Node.js, Scheduling algorithms	Admin, Technician
Technician Workflow	Task acceptance, status updates, evidence upload, history	Node.js, AWS S3	Technician
Notification & Communication	Push notifications, email/SMS alerts, notification history	Socket.io, FCM, Nodemailer, Twilio	All Users
Analytics & Reporting	Dashboard analytics, trend analysis, report export	Java (Spring Boot), Apache POI, iText	Admin, Technician
Location & Equipment Management	Location tracking, heat maps, equipment history	Node.js, Geolocation APIs	Admin, Technician
Data Access Layer	Database operations, ORM, migrations	Sequelize, MySQL	Backend Services

4.4.5. Architectural Design Decisions

4.4.5.1. Why Three-Tier Architecture?

1. **Separation of Concerns**: Presentation, business logic, and data layers are independent
2. **Scalability**: Each tier can be scaled independently (e.g., add more API servers)
3. **Maintainability**: Easier to update one layer without affecting others (NFR-6)
4. **Security**: Database is isolated from direct client access (NFR-3)
5. **Multi-Platform Support**: Same API serves both web (React) and mobile (Flutter)

4.4.5.2. Why RESTful API?

1. **Platform Independence**: Web and mobile apps consume the same endpoints
2. **Statelessness**: Each request contains all necessary information (JWT tokens)
3. **Caching**: HTTP caching mechanisms improve performance (NFR-1)

4. **Industry Standard**: Well-documented and widely supported

4.4.5.3. Why Node.js + Java Hybrid Backend?

1. **Node.js**: Excellent for I/O-bound operations (ticket management, notifications)
2. **Java (Spring Boot)**: Better for CPU-intensive analytics and complex computations (FR-26)
3. **Team Expertise**: Leverages team skills (Table 6, 7)

4.4.5.4. Why MySQL?

1. **Relational Data**: Strong relationships between entities (Users, Tickets, Technicians)
2. **ACID Compliance**: Ensures data integrity for critical operations (NFR-2)
3. **Mature Ecosystem**: Excellent tooling, backup, and recovery options
4. **Cost-Effective**: Open-source with strong community support

4.4.5.5. Why Redis for Sessions?

1. **Performance**: In-memory storage for fast session retrieval (NFR-1)
2. **Expiration**: Built-in TTL for session timeout (FR-2.7)
3. **Scalability**: Supports distributed caching for multiple API servers

4.4.6. Security Architecture

4.4.6.1. Security Measures

1. **Authentication**: JWT tokens with 15-60 minute expiration
2. **Authorization**: Role-based access control (RBAC) middleware
3. **Data Encryption**:
   - Passwords: bcrypt hashing (cost factor 12)
   - Data in transit: HTTPS/TLS 1.3
   - Sensitive data at rest: AES-256 encryption
4. **Input Validation**: Server-side validation for all inputs (SQL injection prevention)
5. **File Upload Security**:
   - MIME type validation
   - File size limits (5MB for images)
   - Malware scanning (ClamAV integration)
6. **Rate Limiting**: API rate limiting to prevent DDoS attacks
7. **CAPTCHA**: After 3 failed login attempts (FR-2.5)
8. **Account Lockout**: After 5 failed attempts (FR-2.6)
9. **Audit Logging**: All sensitive operations logged with timestamps and IP addresses

4.4.6.2. Data Privacy

1. **Email Verification**: Required before account activation (FR-1.7)
2. **Anonymous Reporting**: Residents can submit tickets anonymously (Constraint 1.2.3.4)
3. **90-Day Notification History**: Automatic deletion after retention period
4. **Data Export**: Users can export their profile data (FR-12.7)

4.4.7. Performance Optimization Strategies

1. **Database Indexing**: Indexes on TicketID, UserID, LocationID, Status
2. **Query Optimization**: ORM query optimization, eager loading
3. **Caching**: Redis caching for frequently accessed data (user sessions, notifications)

4. **Image Compression**: Automatic compression before S3 upload
5. **Pagination**: Results limited to 20 items per page (FR-7.8)
6. **Lazy Loading**: Frontend lazy loading of images and components
7. **Connection Pooling**: Database connection pooling (Sequelize built-in)
8. **CDN**: Static assets (CSS, JS) served via CDN
9. **Load Balancing**: Nginx distributes traffic across multiple API servers
10. **Asynchronous Processing**: Background jobs for email/SMS notifications

4.4.8. Deployment Architecture

4.4.8.1. Production Environment

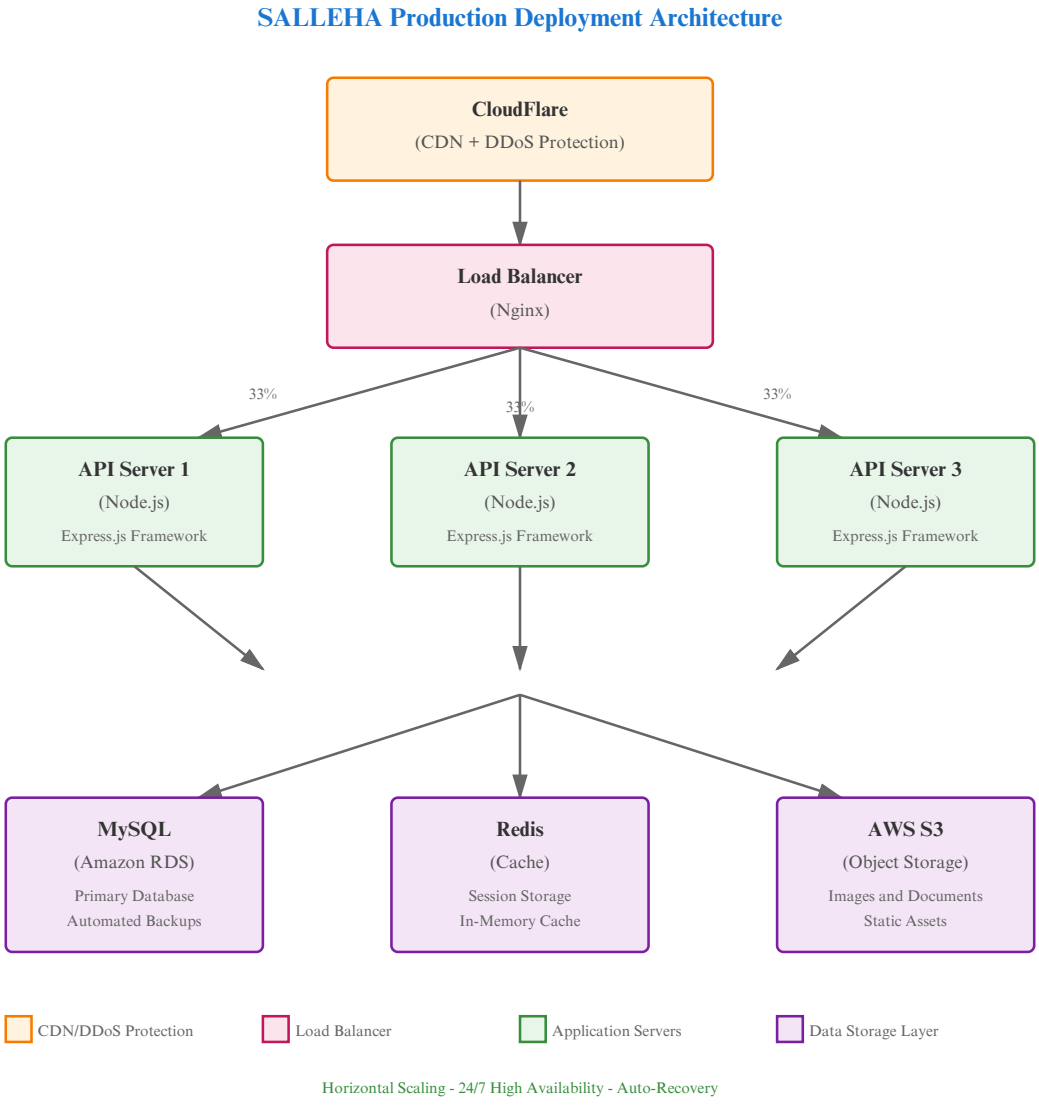


Figure 57: Deployment Diagram

4.4.8.2. Continuous Integration/Deployment

1. **Development**: Feature branches → Pull Request → Code Review
2. **Testing**: Automated tests via GitHub Actions (Jest, JUnit)
3. **Staging**: Deploy to staging environment for QA testing
4. **Production**: Blue-green deployment to minimize downtime

4.4.9. Monitoring & Observability

1. **Application Monitoring**: PM2 for Node.js process management
2. **Performance Monitoring**: AWS CloudWatch metrics (CPU, memory, response time)
3. **Error Tracking**: Sentry for error logging and alerting
4. **Log Aggregation**: ELK Stack (Elasticsearch, Logstash, Kibana)
5. **Uptime Monitoring**: Pingdom or UptimeRobot (24/7 availability check)
6. **Database Monitoring**: Query performance, slow query logs

4.4.10. Scalability Considerations

1. **Horizontal Scaling**: Add more API servers behind load balancer
2. **Database Read Replicas**: MySQL read replicas for analytics queries
3. **Microservices Migration**: Future migration to microservices if needed
4. **Message Queue**: RabbitMQ/Redis for asynchronous task processing
5. **Auto-Scaling**: AWS Auto Scaling Groups based on traffic patterns

4.4.11. Alignment with Non-Functional Requirements

NFR	Architectural Support
Performance (NFR-1)	Redis caching, database indexing, pagination, CDN, load balancing
Dependability (NFR-2)	24/7 hosting, automated backups, health monitoring, redundant servers
Security (NFR-3)	JWT auth, bcrypt, HTTPS, input validation, rate limiting, RBAC
Usability (NFR-4)	React/Flutter for intuitive UIs, responsive design, error messages
Operational Constraints (NFR-5)	Web browsers (React), mobile devices (Flutter), stable internet
Maintainability (NFR-6)	Modular architecture, ORM, comprehensive logging, CI/CD pipeline

4.4.12. Future Enhancements

1. **GraphQL API**: For more flexible data querying
2. **Microservices**: Split monolithic API into independent services
3. **Machine Learning**: Predictive maintenance models
4. **Offline Mode**: Mobile app offline functionality with sync
5. **WebAssembly**: Performance-critical frontend components
6. **Kubernetes**: Container orchestration for better scalability

4.5. Object-Oriented Design

4.5.1. Class Diagram

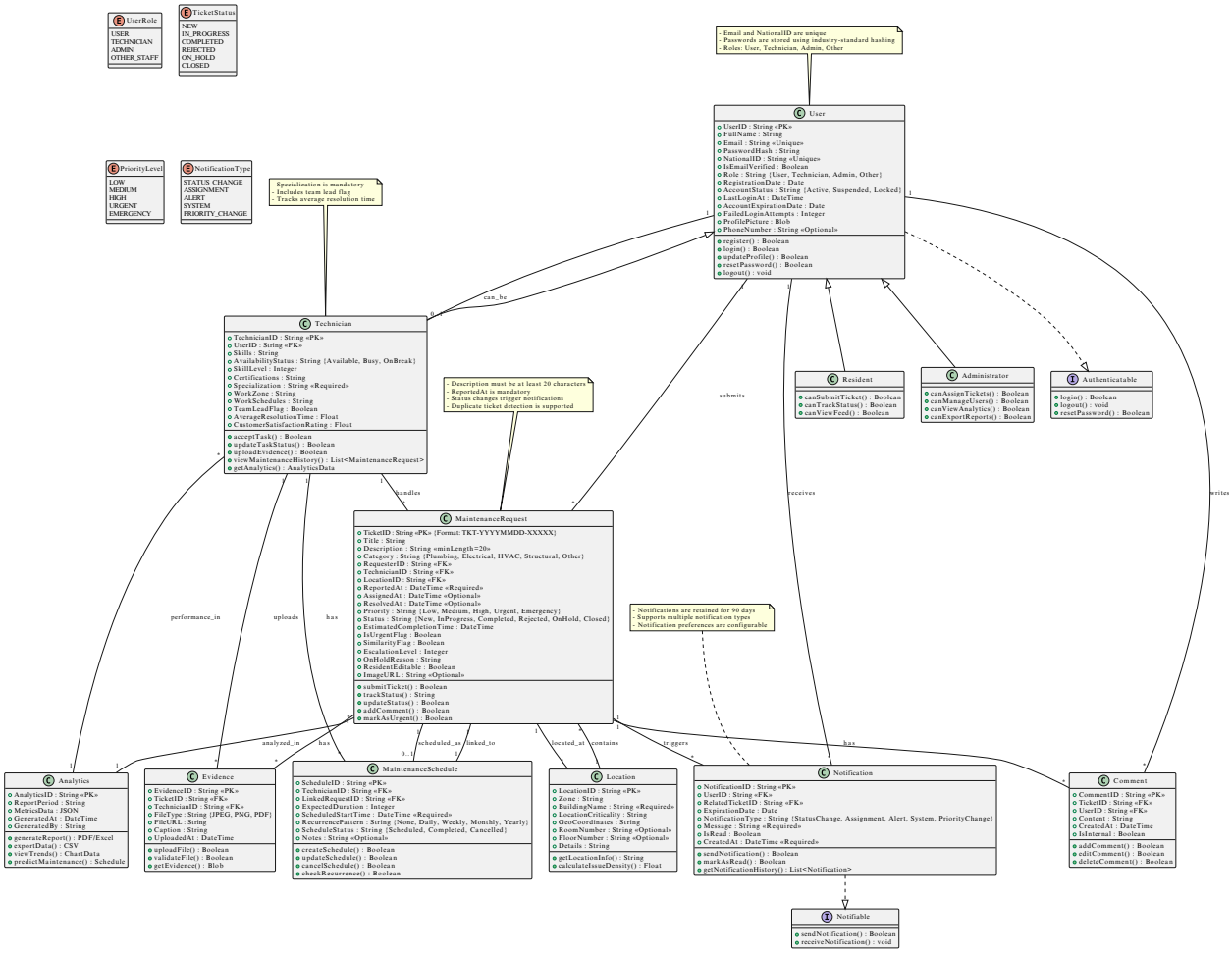


Figure 58: Class Diagram

4.5.2. Sequence Diagrams

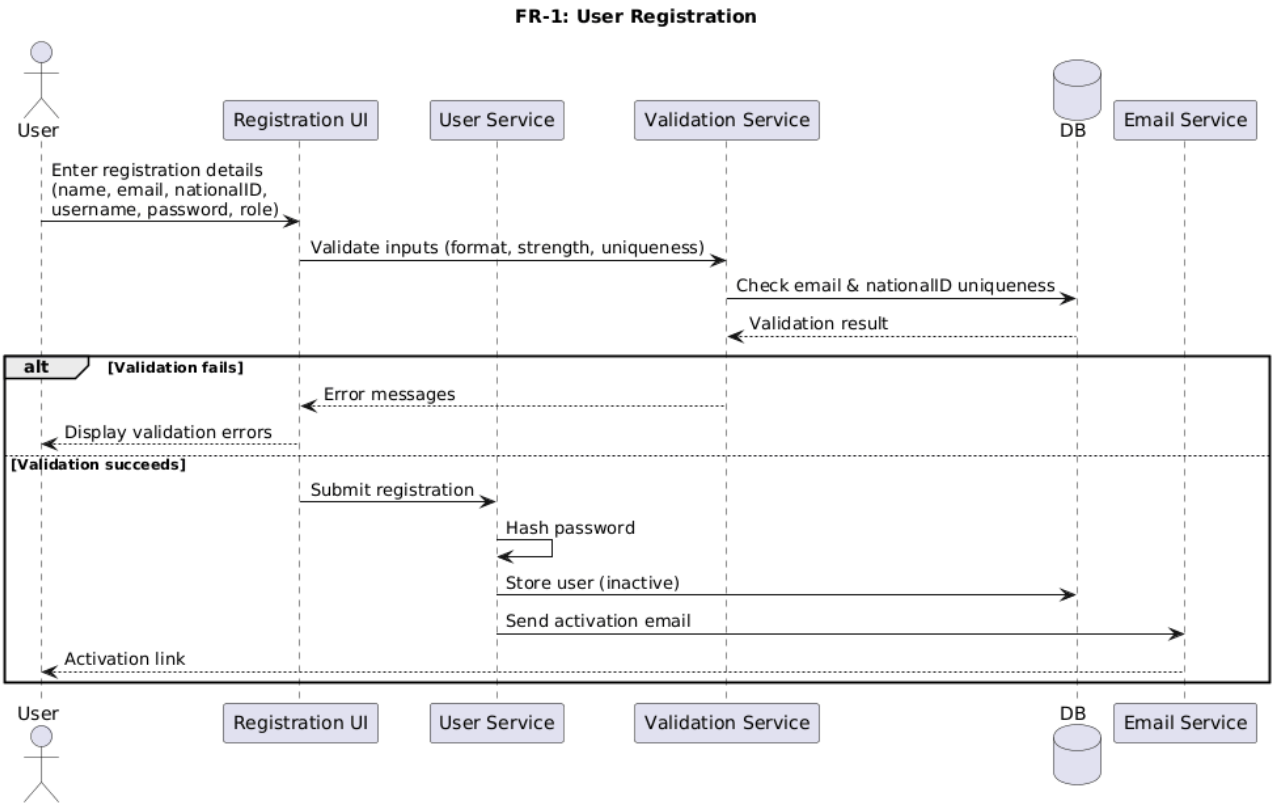


Figure 59: FR-1 Sequence Diagram

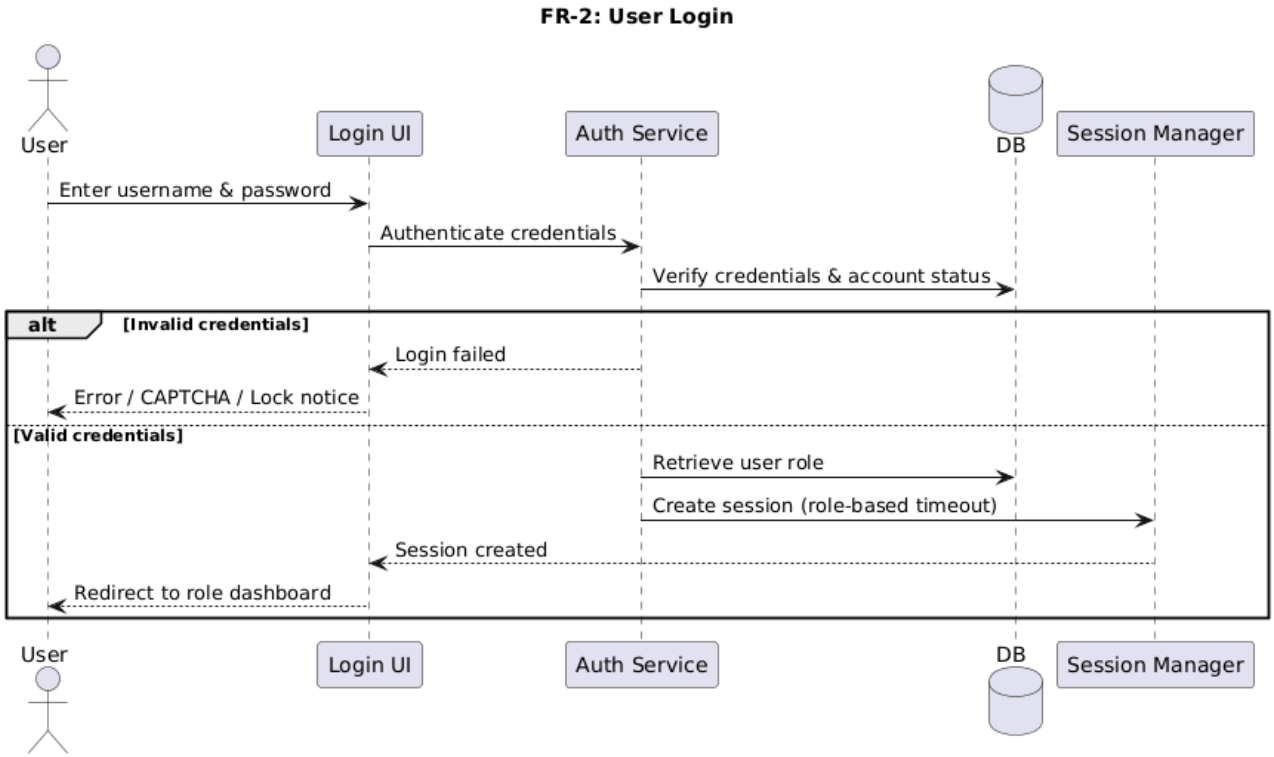


Figure 60: FR-2 Sequence Diagram

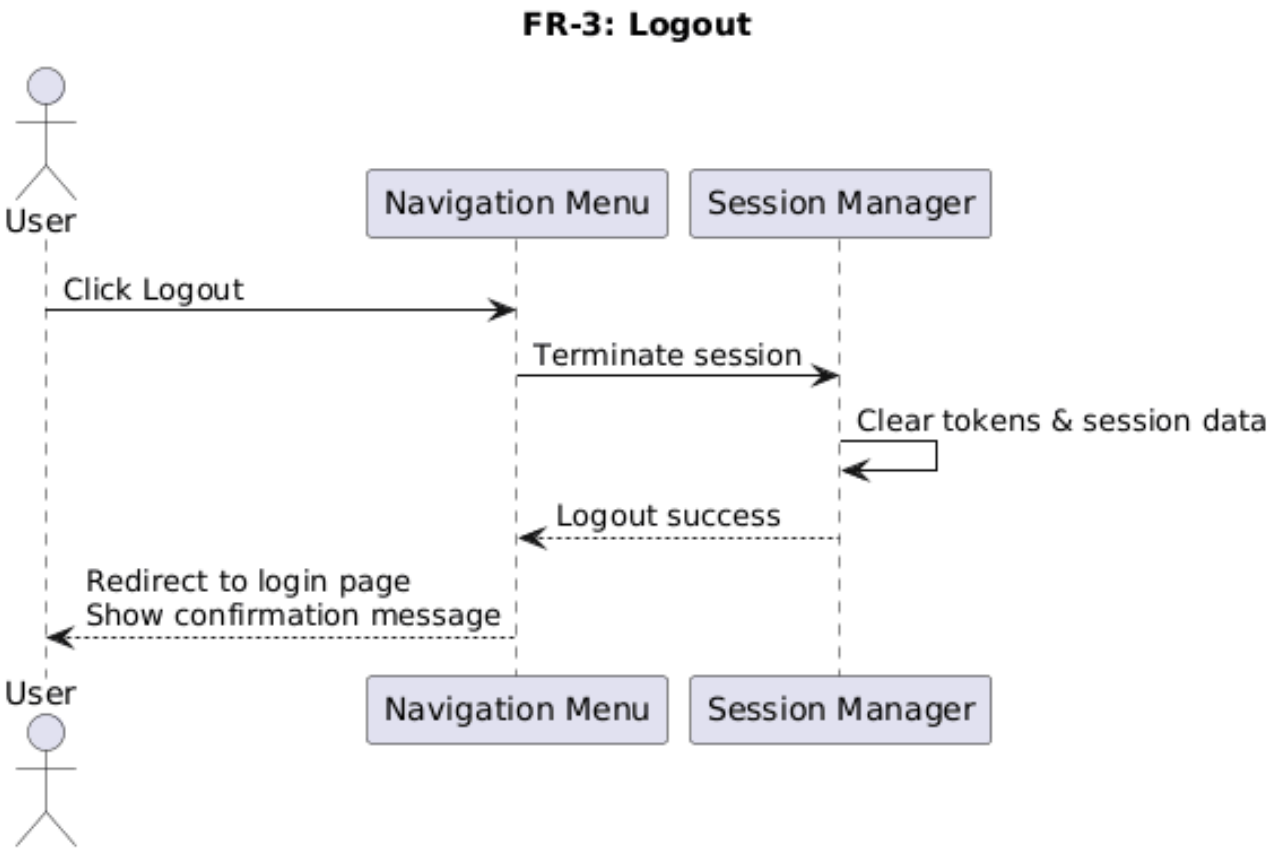


Figure 61: FR-3 Sequence Diagram

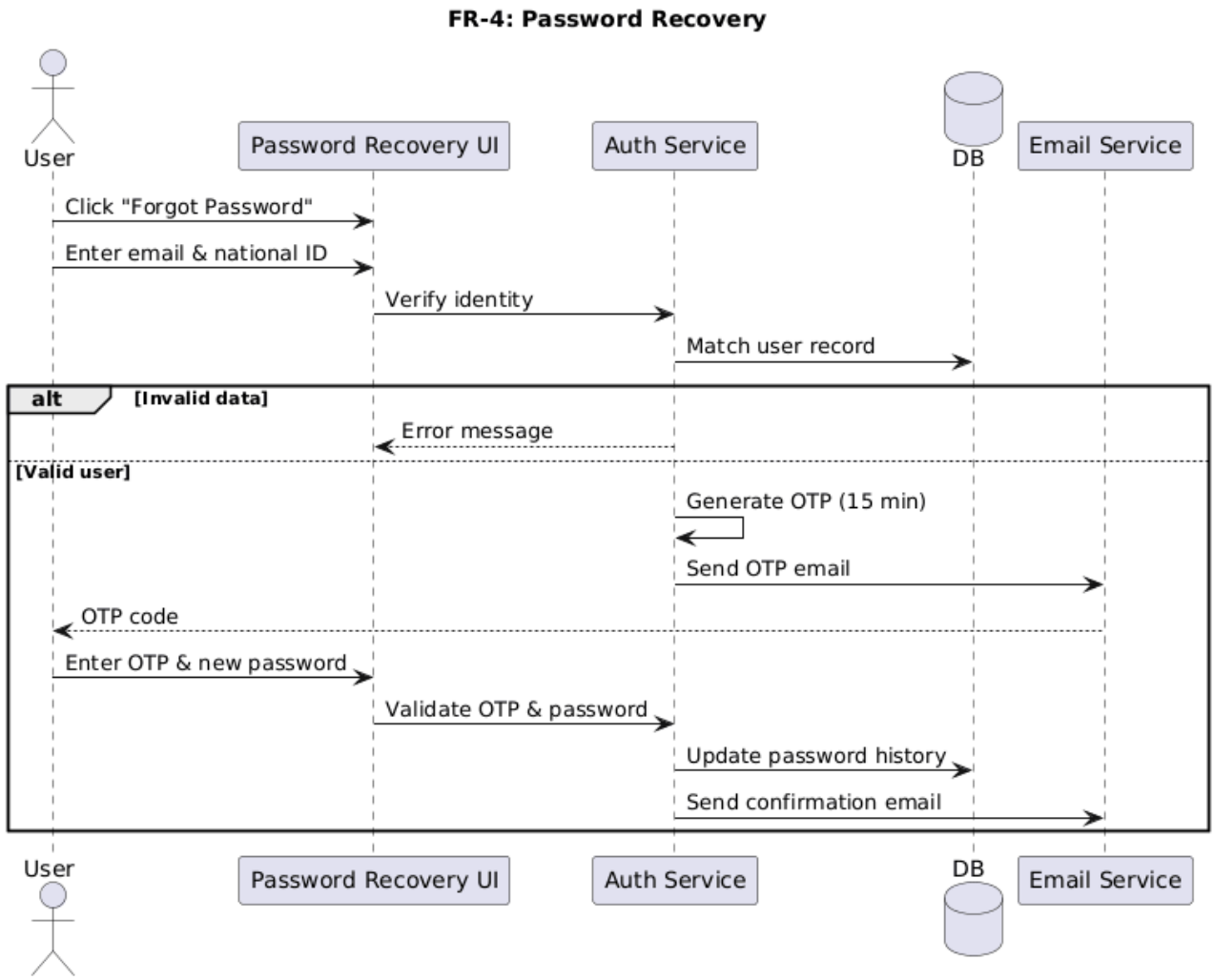


Figure 62: FR-4 Sequence Diagram

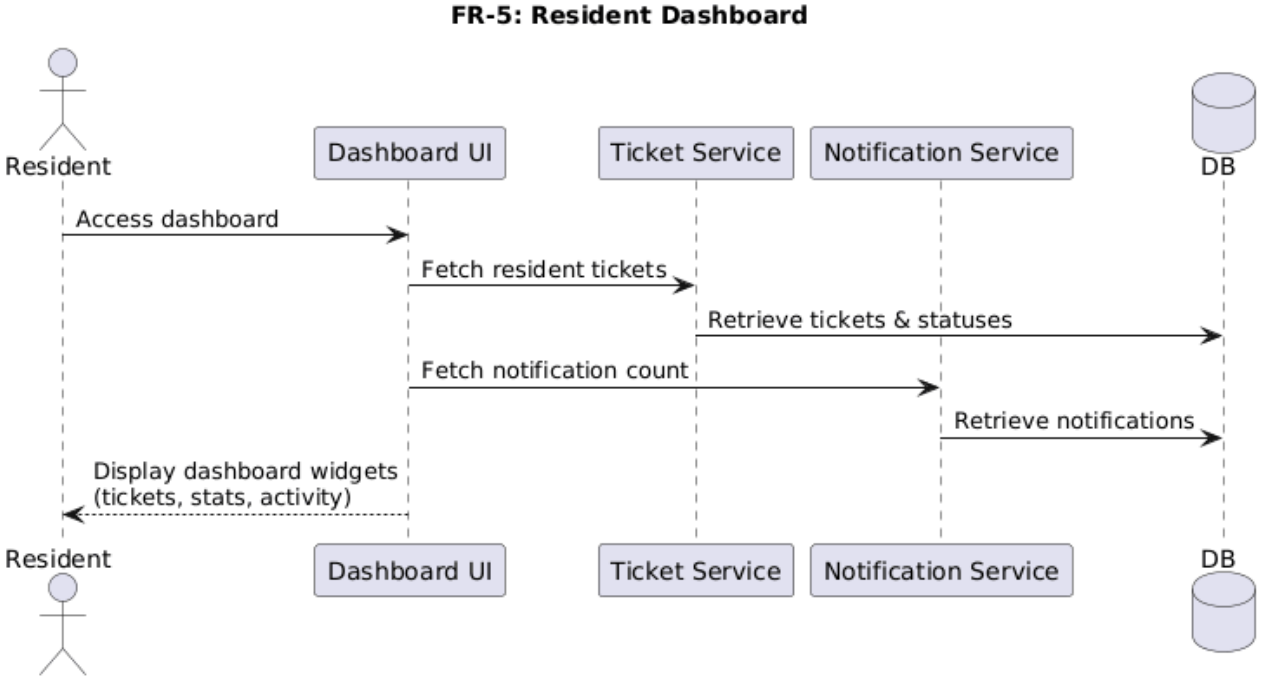


Figure 63: FR-5 Sequence Diagram

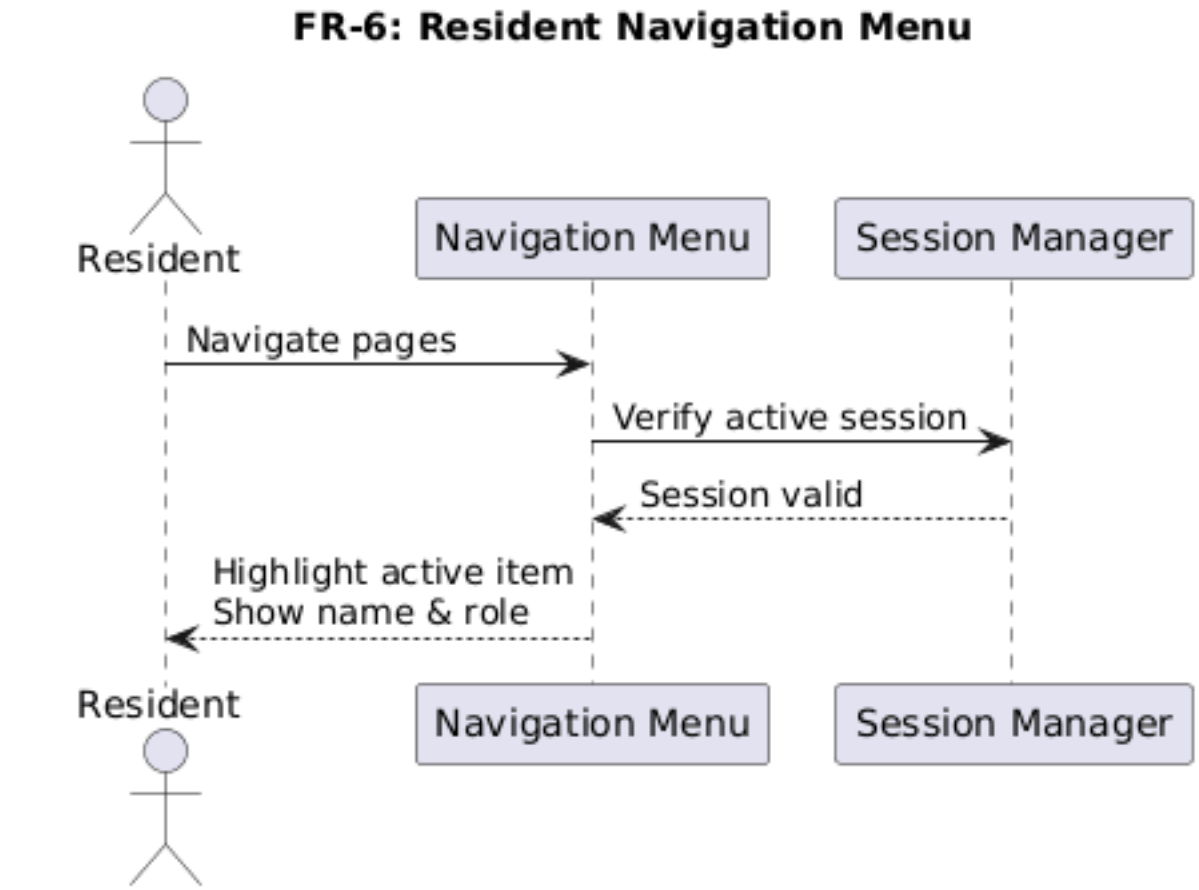


Figure 64: FR-6 Sequence Diagram

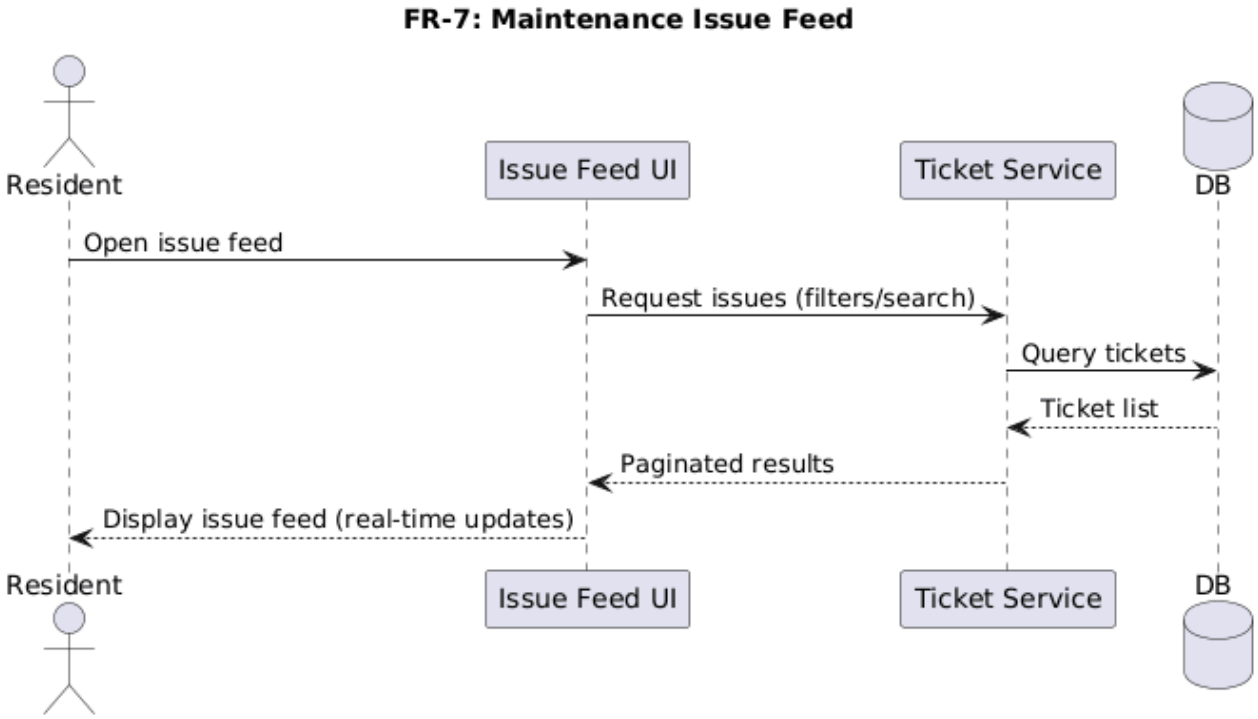


Figure 65: FR-7 Sequence Diagram

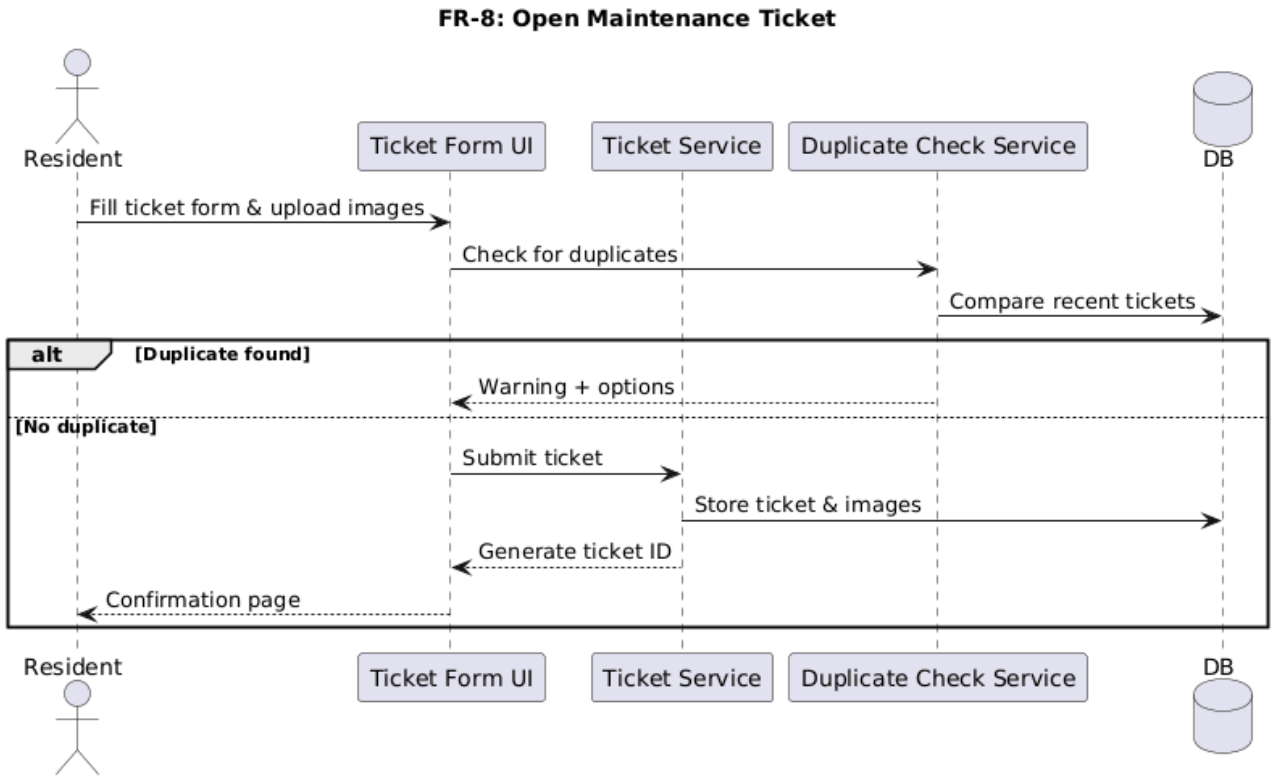


Figure 66: FR-8 Sequence Diagram

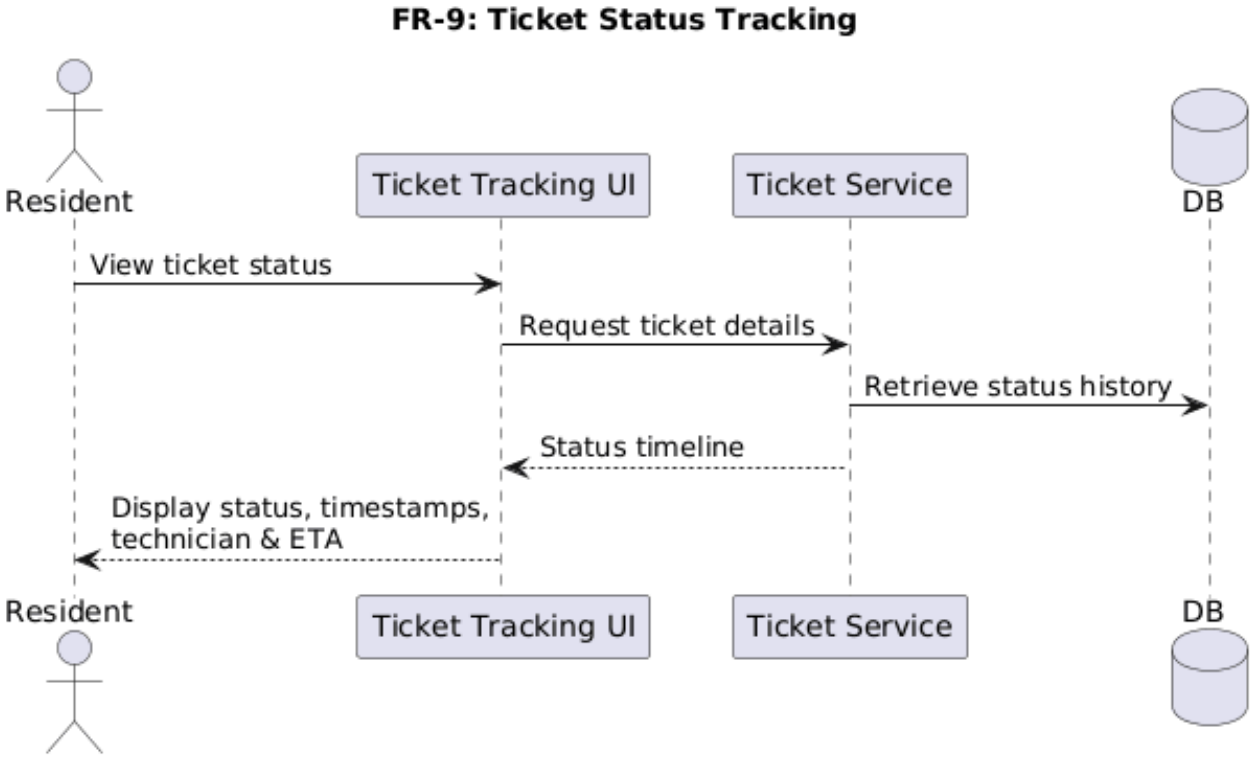


Figure 67: FR-9 Sequence Diagram

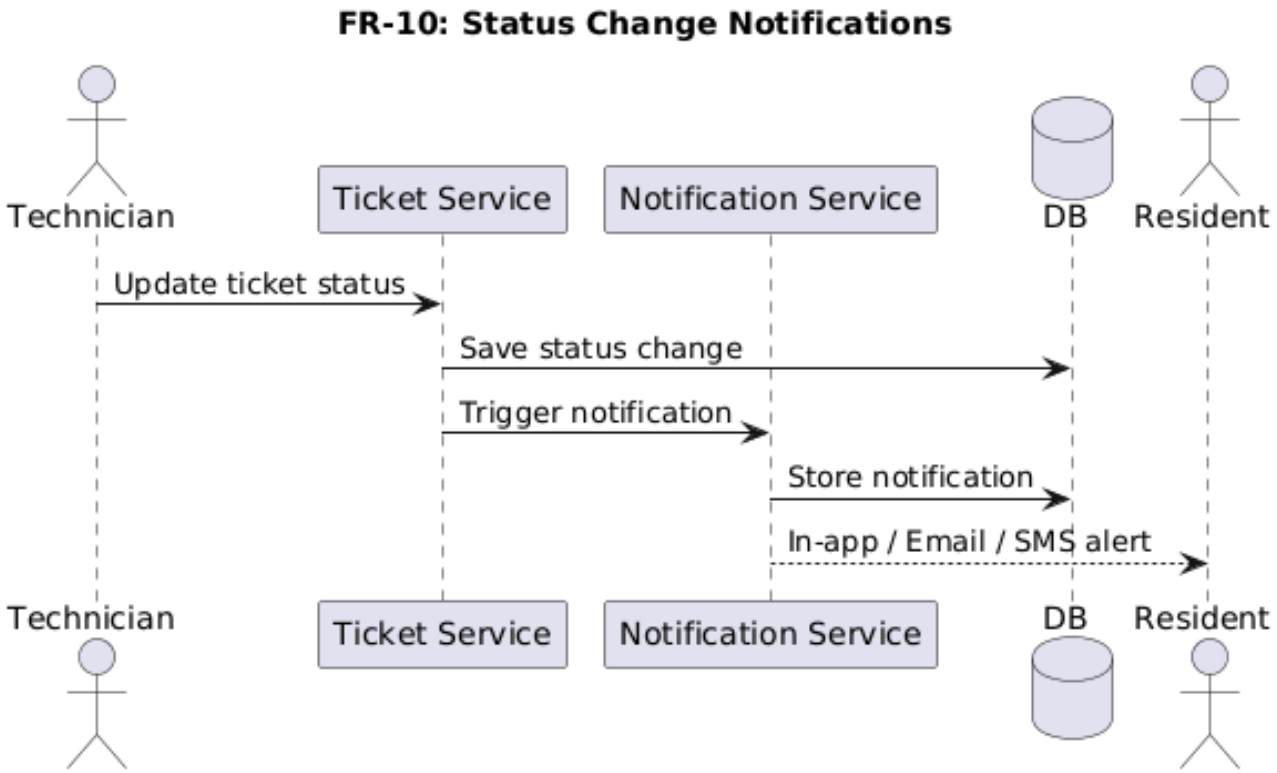


Figure 68: FR-10 Sequence Diagram

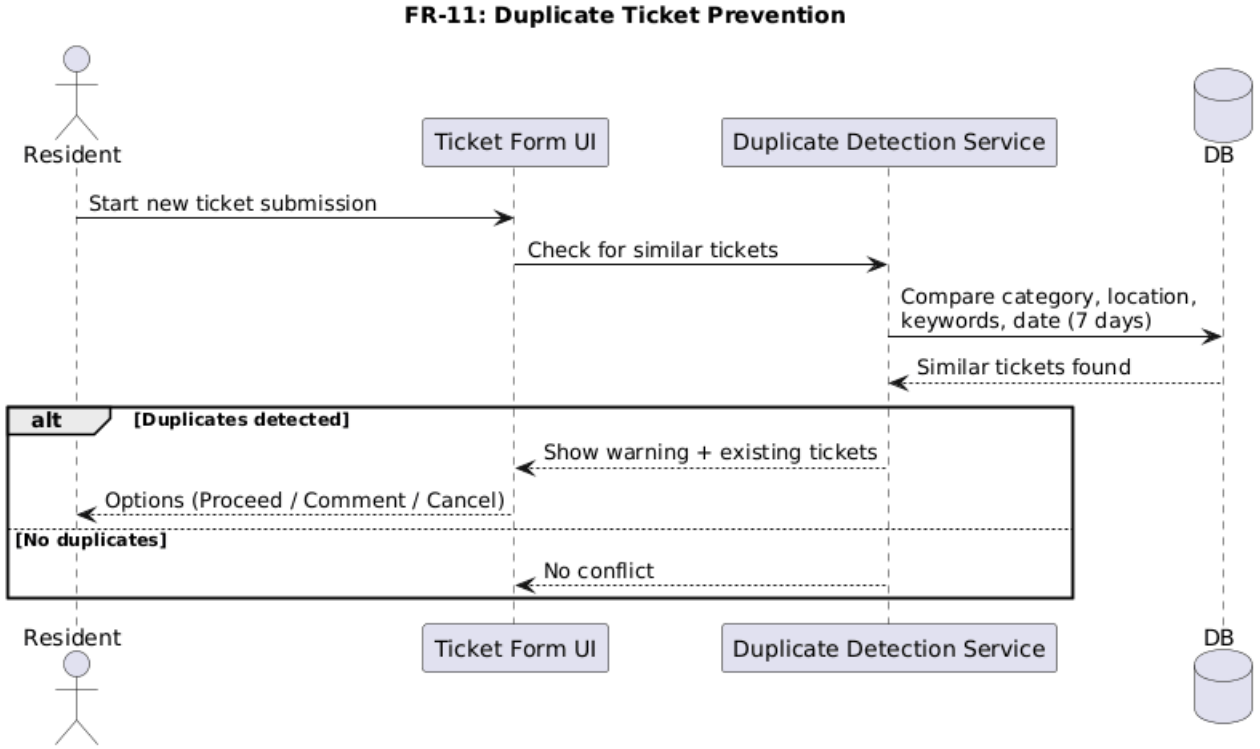


Figure 69: FR-11 Sequence Diagram

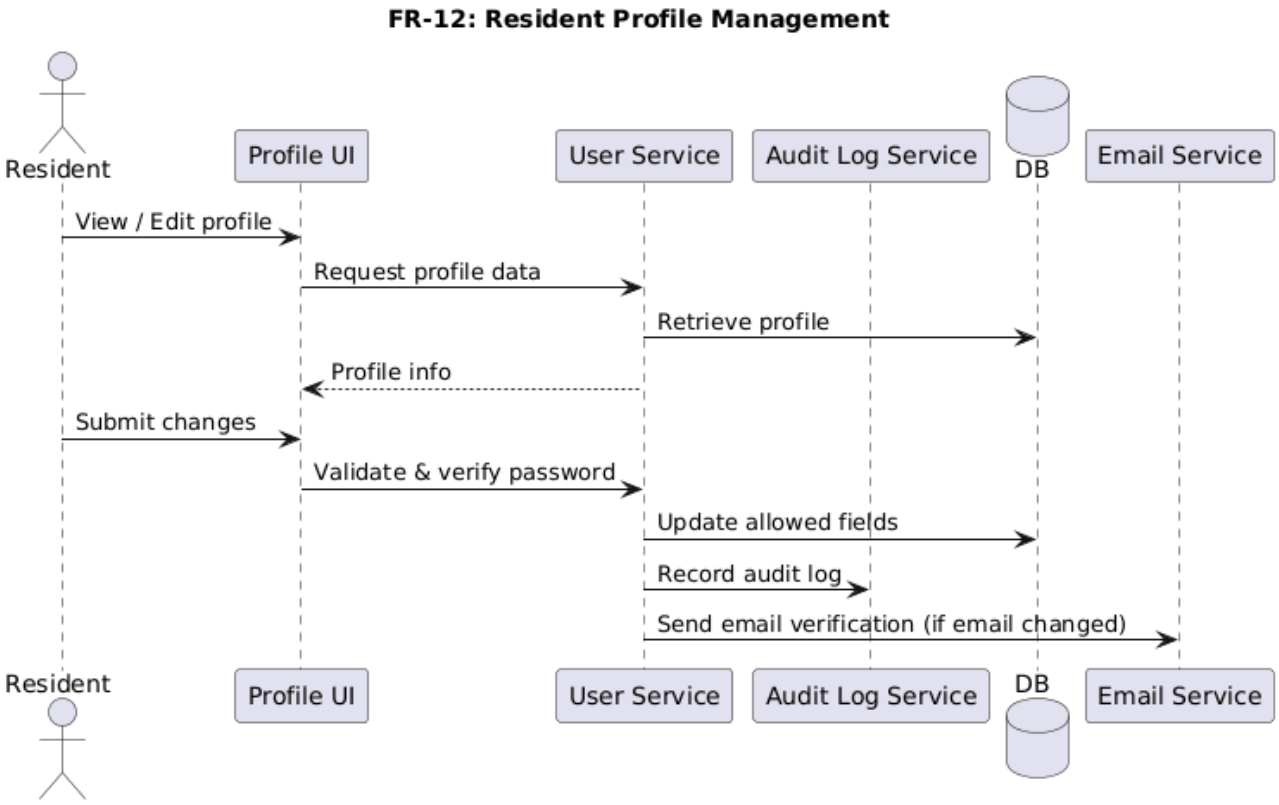


Figure 70: FR-12 Sequence Diagram

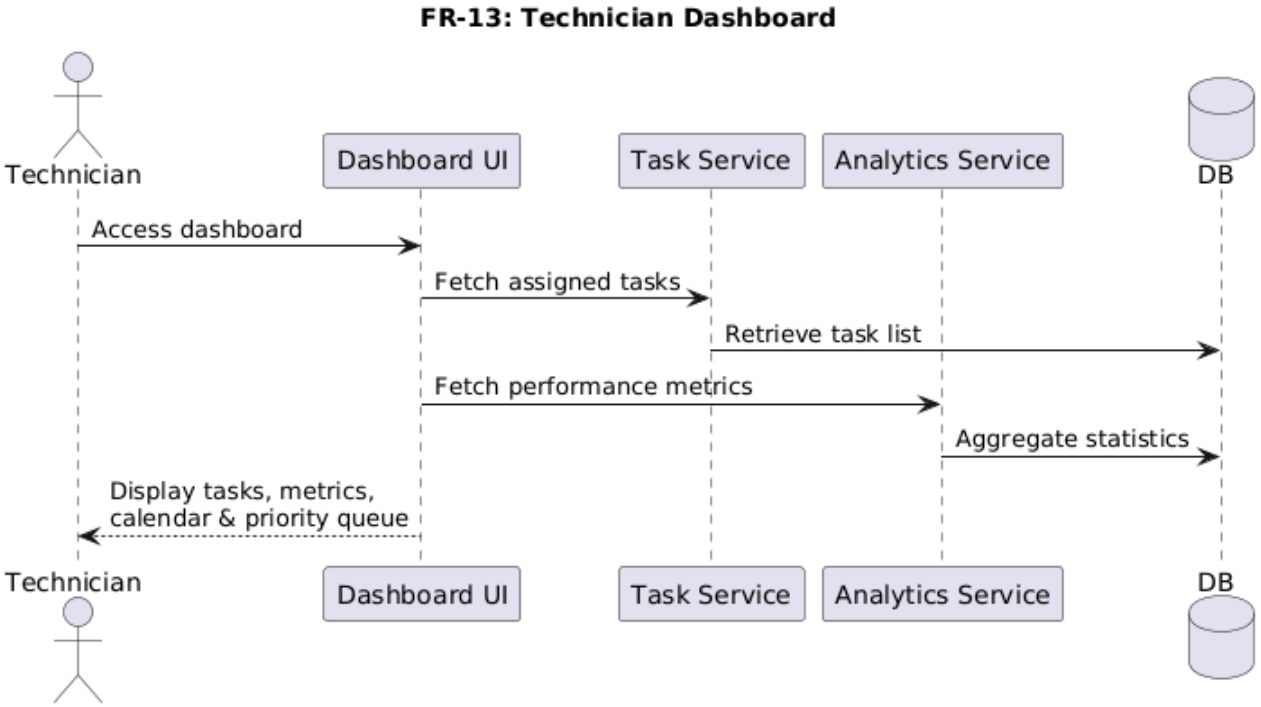


Figure 71: FR-13 Sequence Diagram

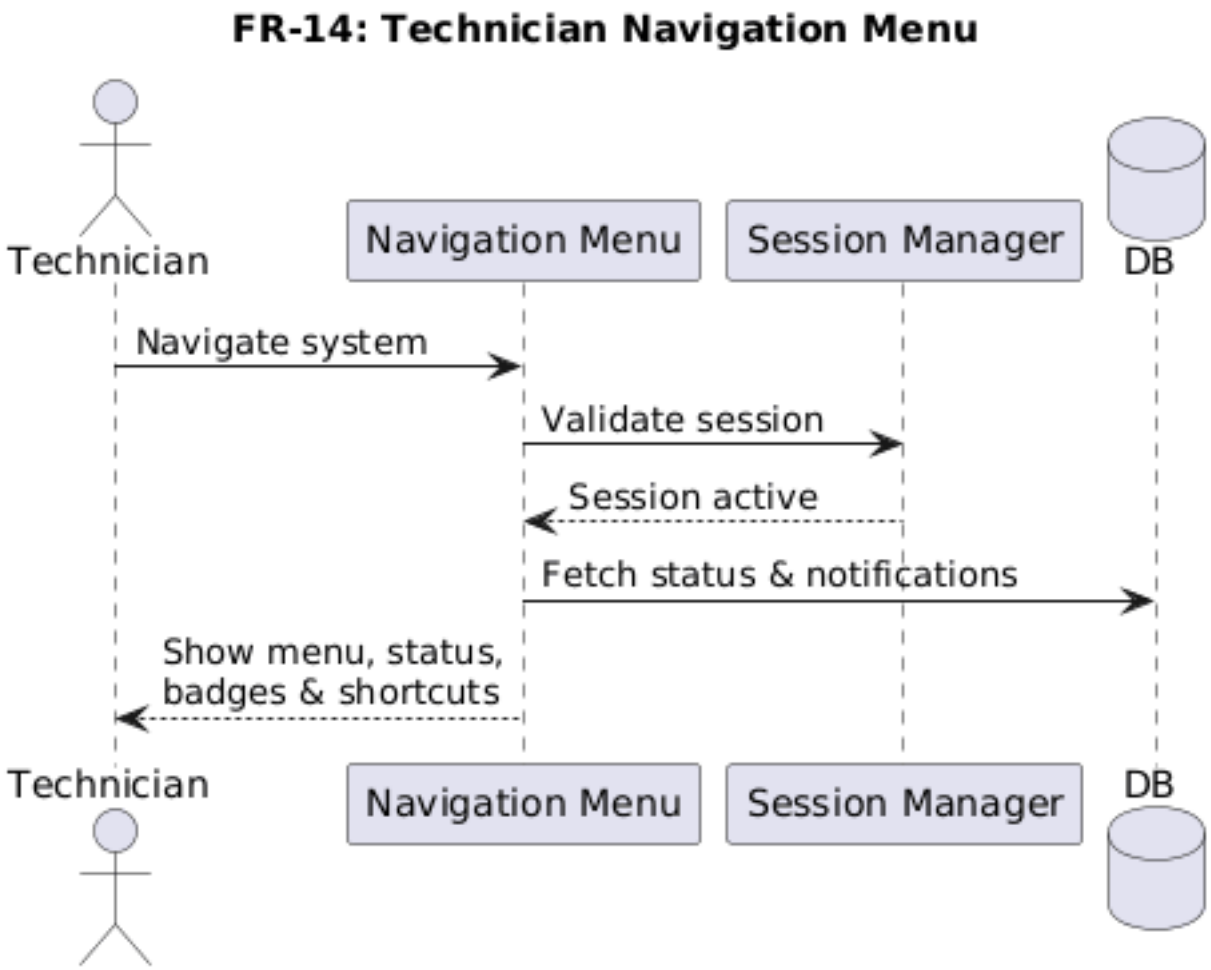


Figure 72: FR-14 Sequence Diagram

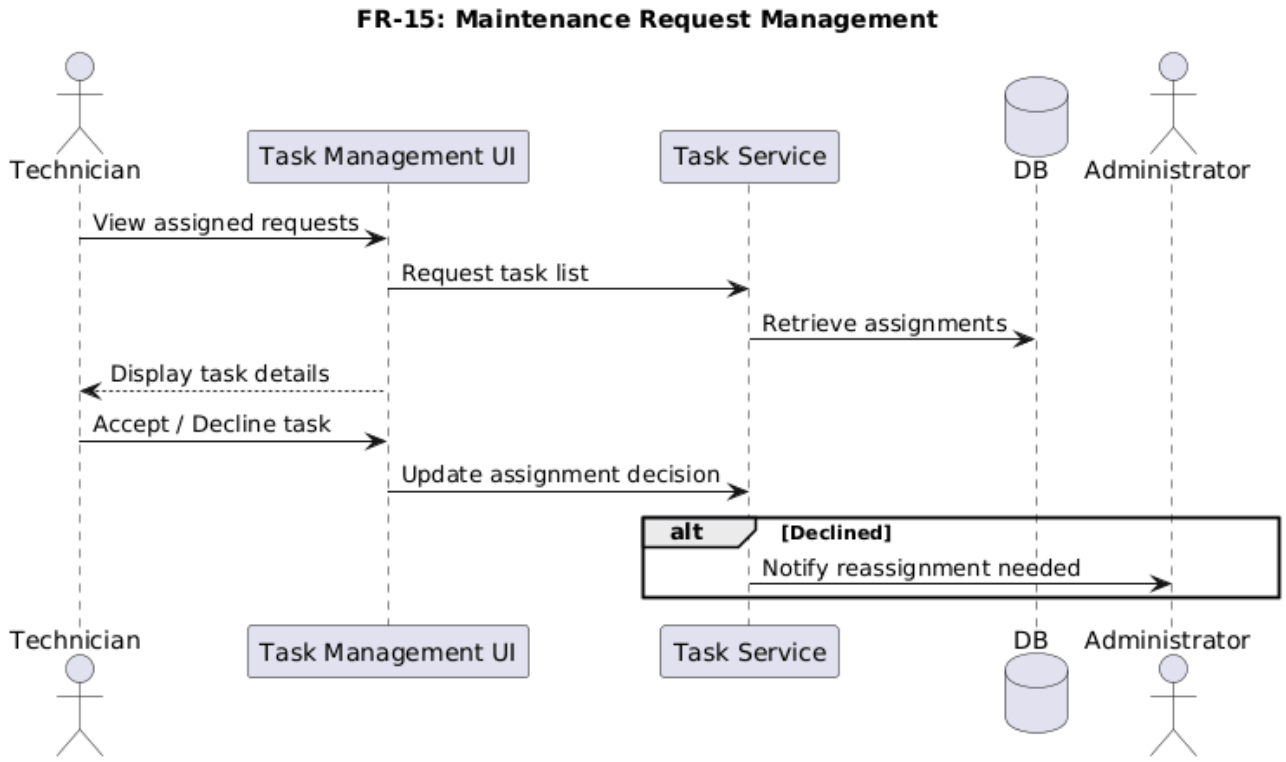


Figure 73: FR-15 Sequence Diagram

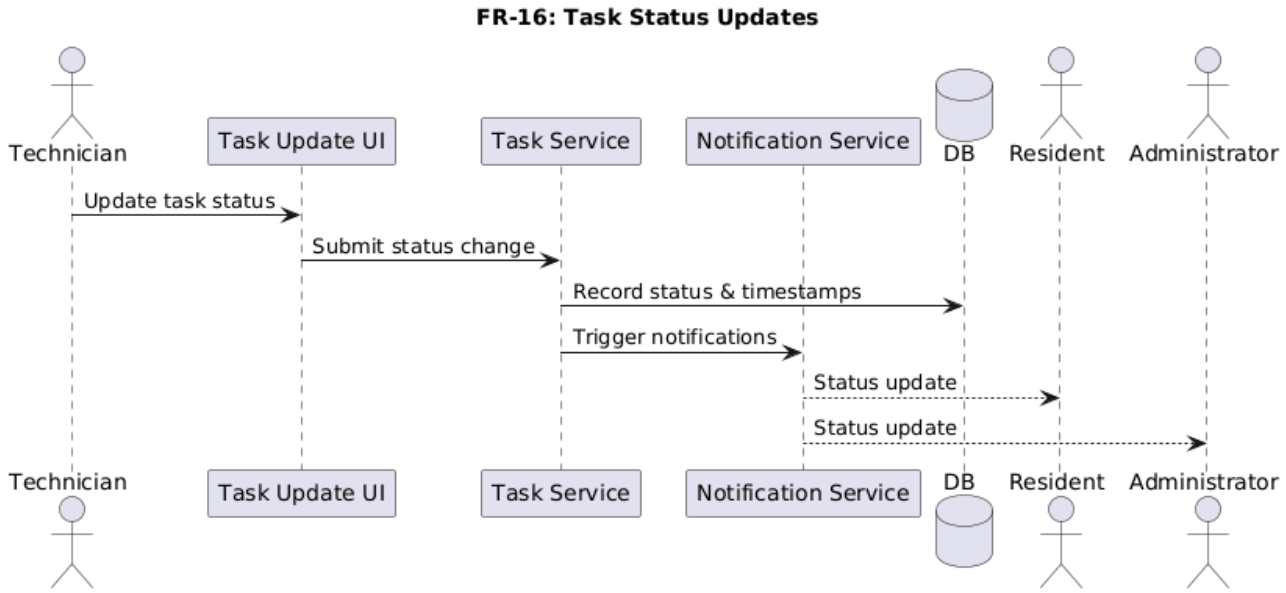


Figure 74: FR-16 Sequence Diagram

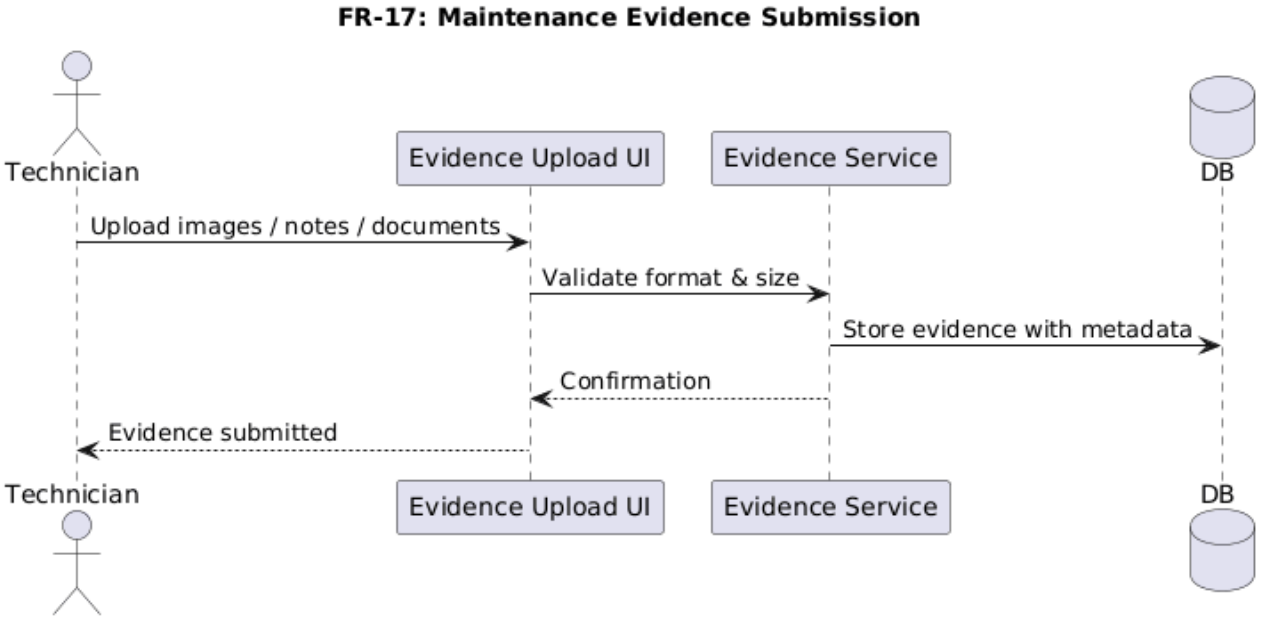


Figure 75: FR-17 Sequence Diagram

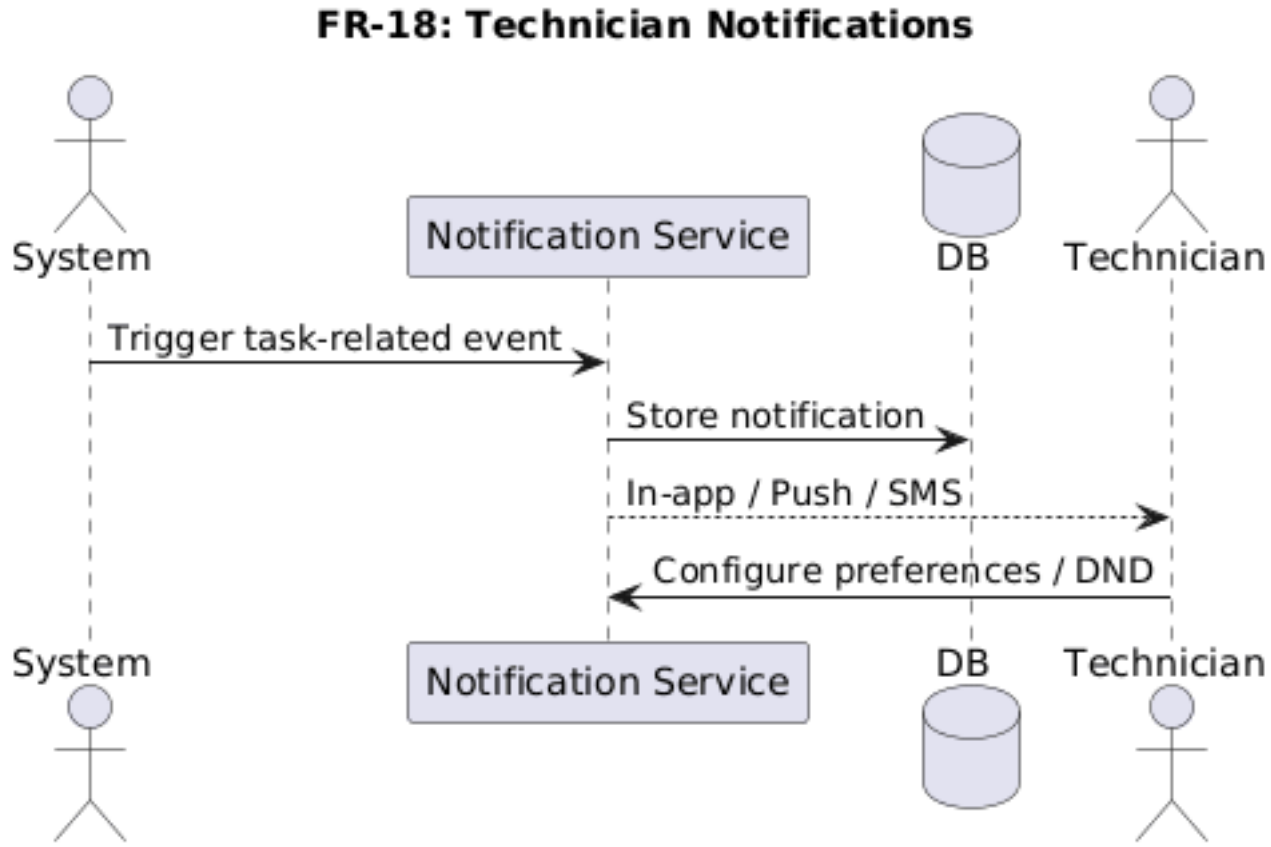


Figure 76: FR-18 Sequence Diagram

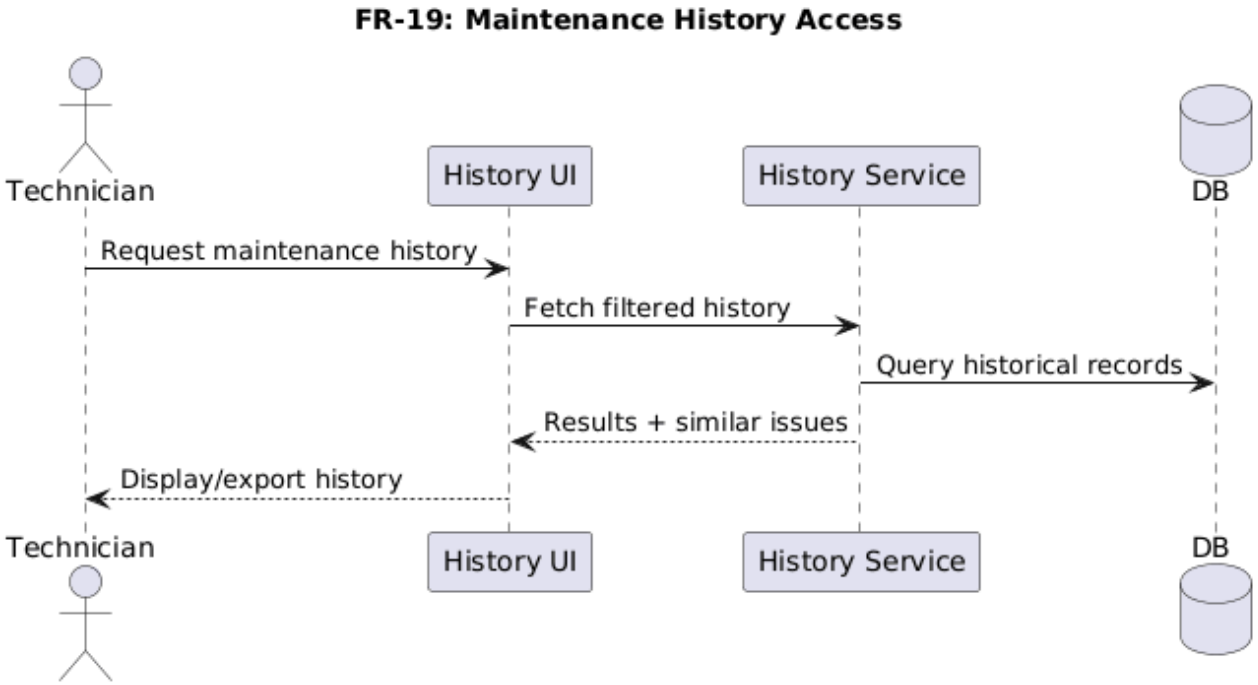


Figure 77: FR-19 Sequence Diagram

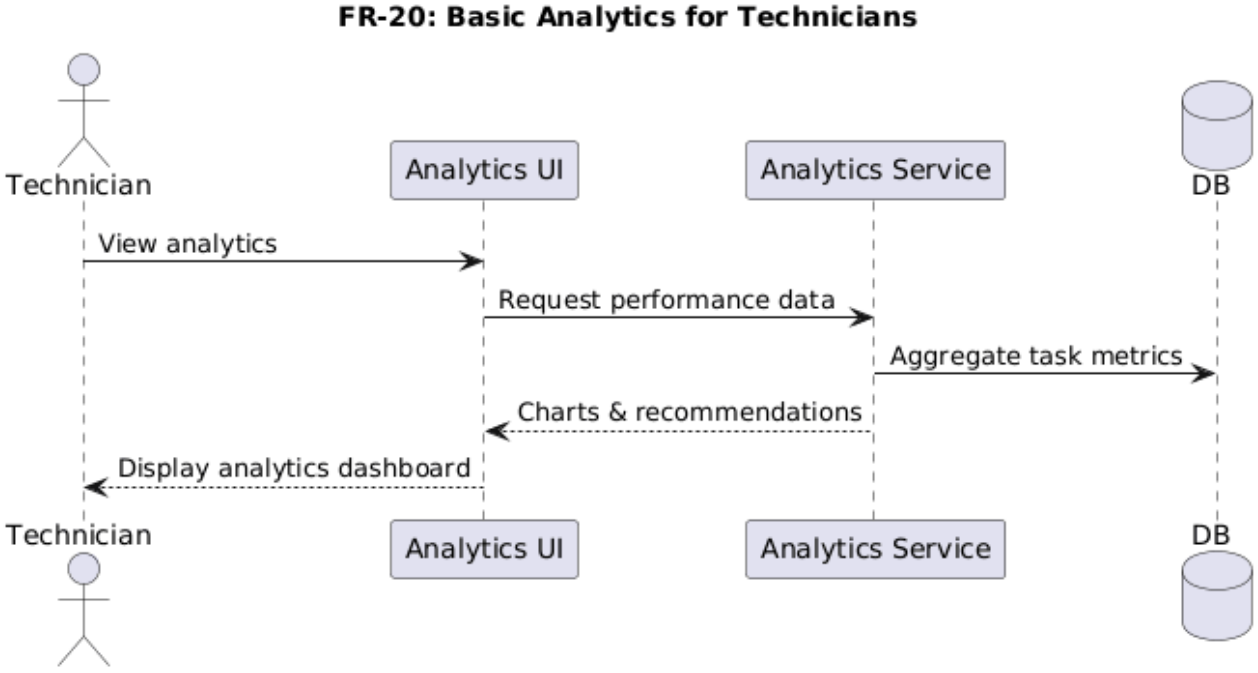


Figure 78: FR-20 Sequence Diagram

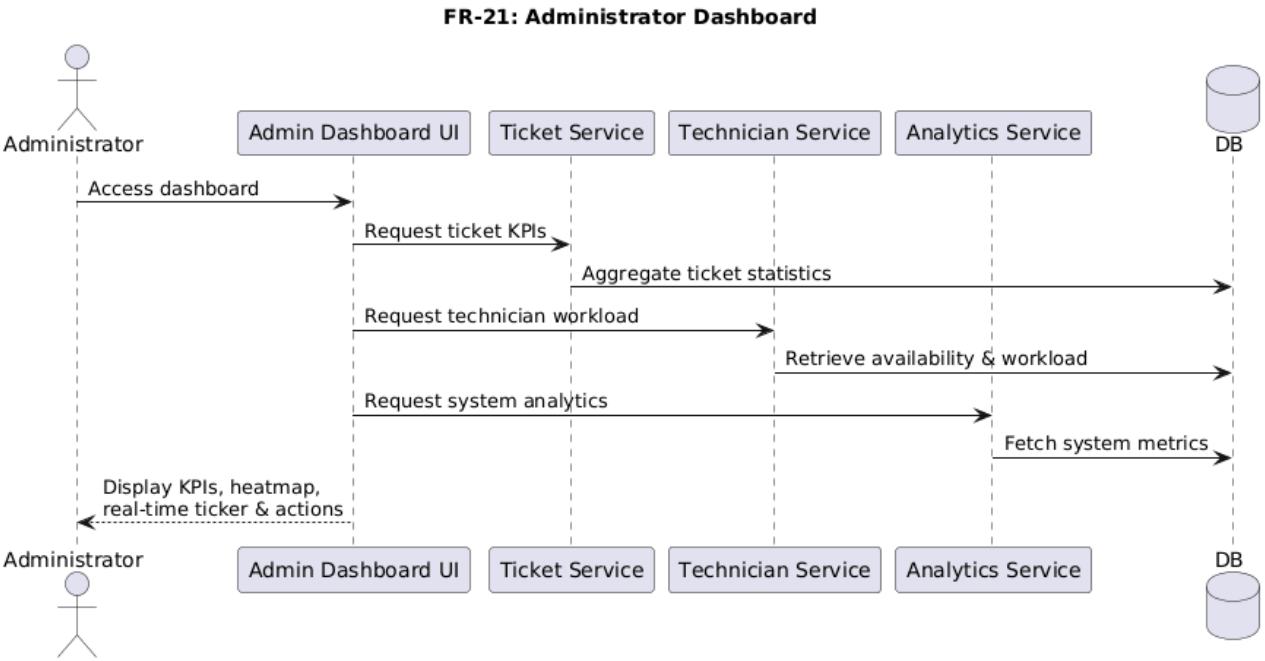


Figure 79: FR-21 Sequence Diagram

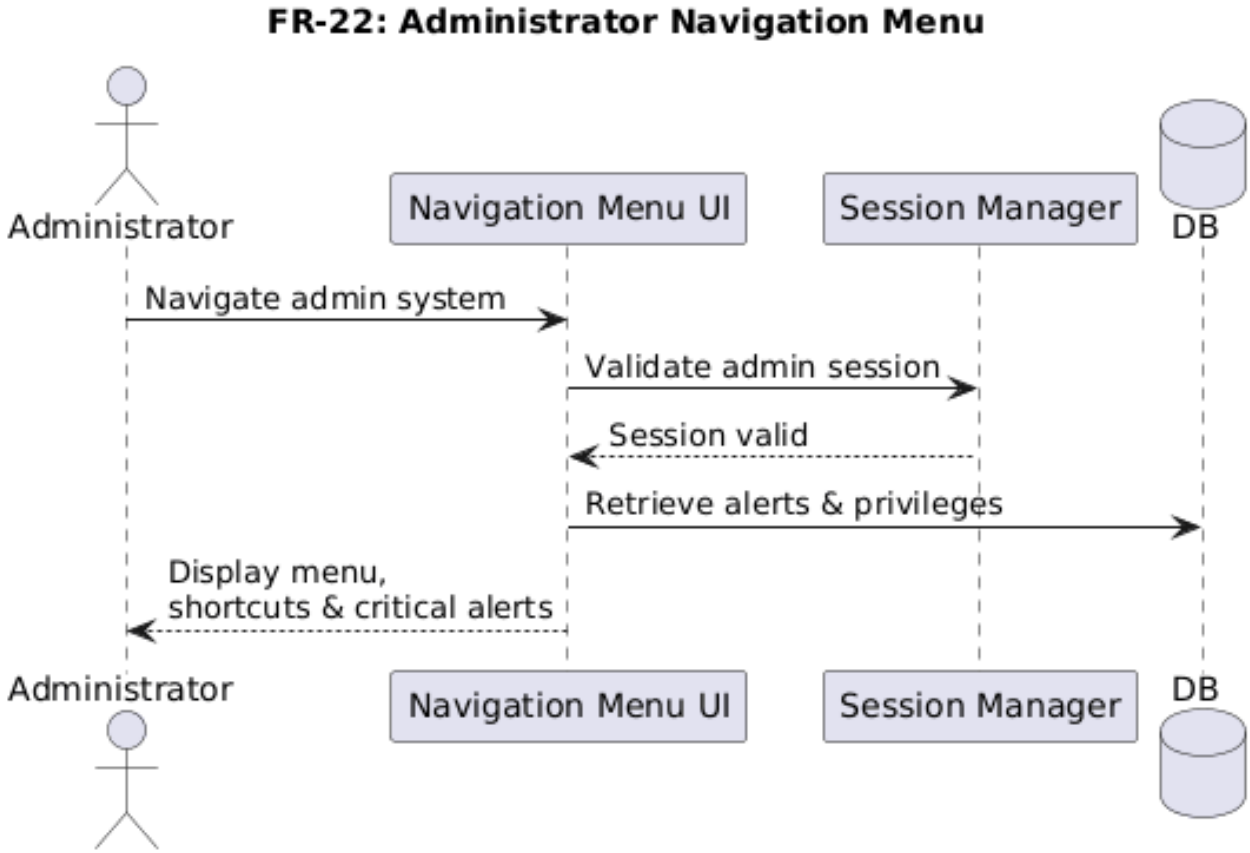


Figure 80: FR-22 Sequence Diagram

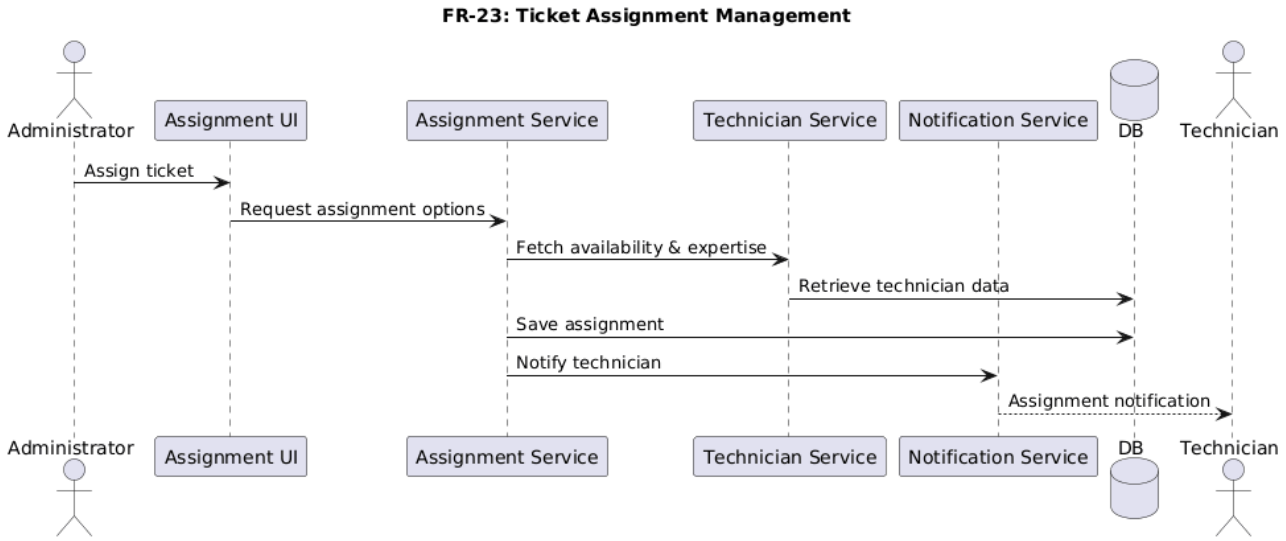


Figure 81: FR-23 Sequence Diagram

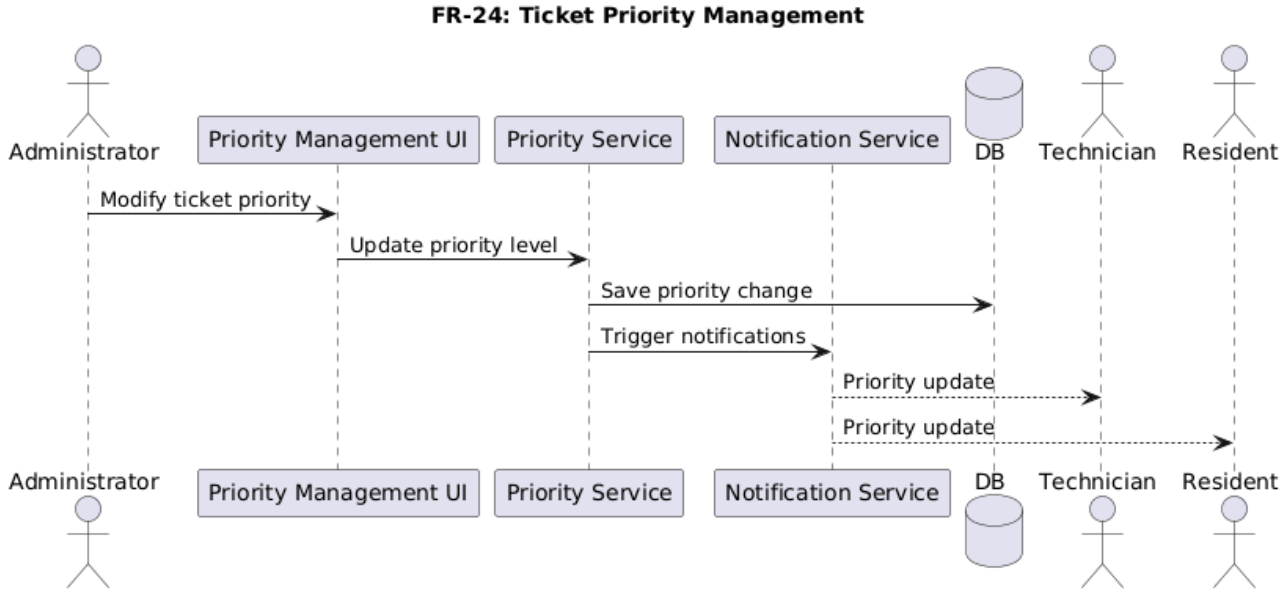


Figure 82: FR-24 Sequence Diagram

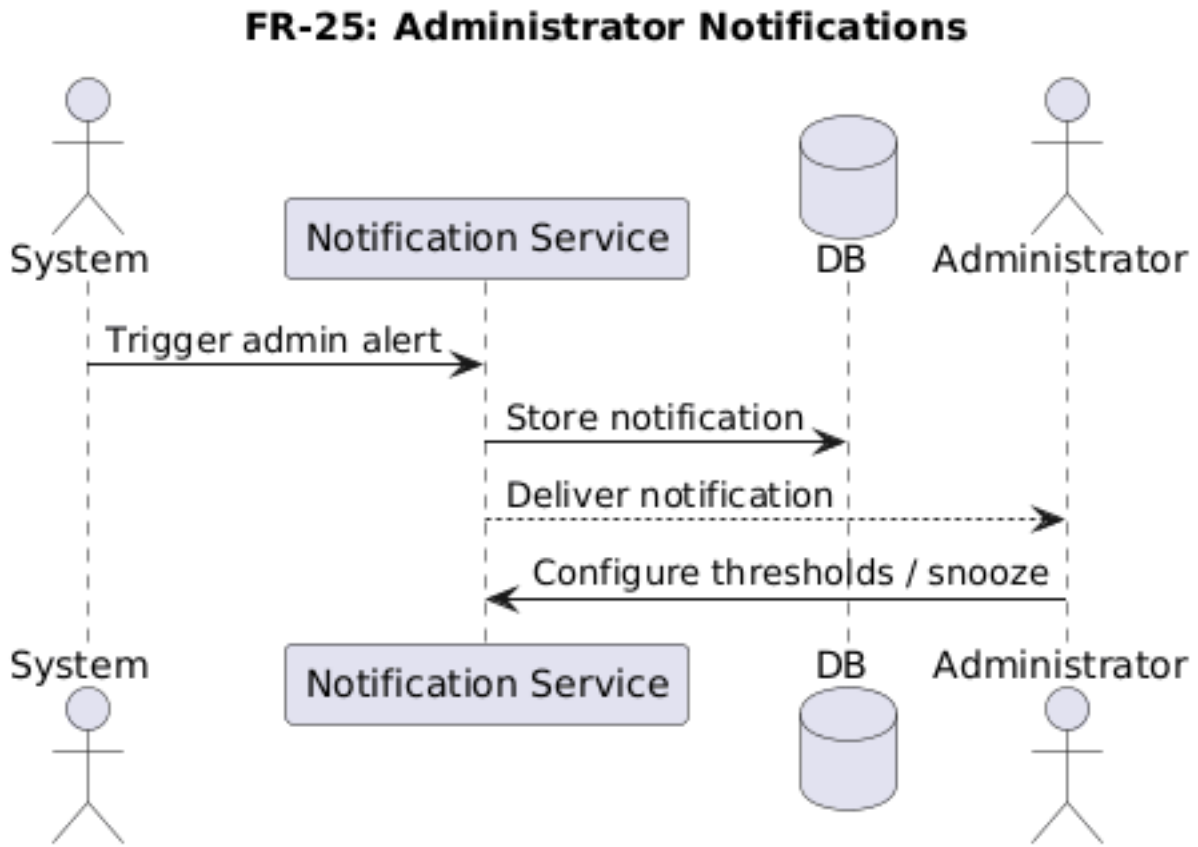


Figure 83: FR-25 Sequence Diagram

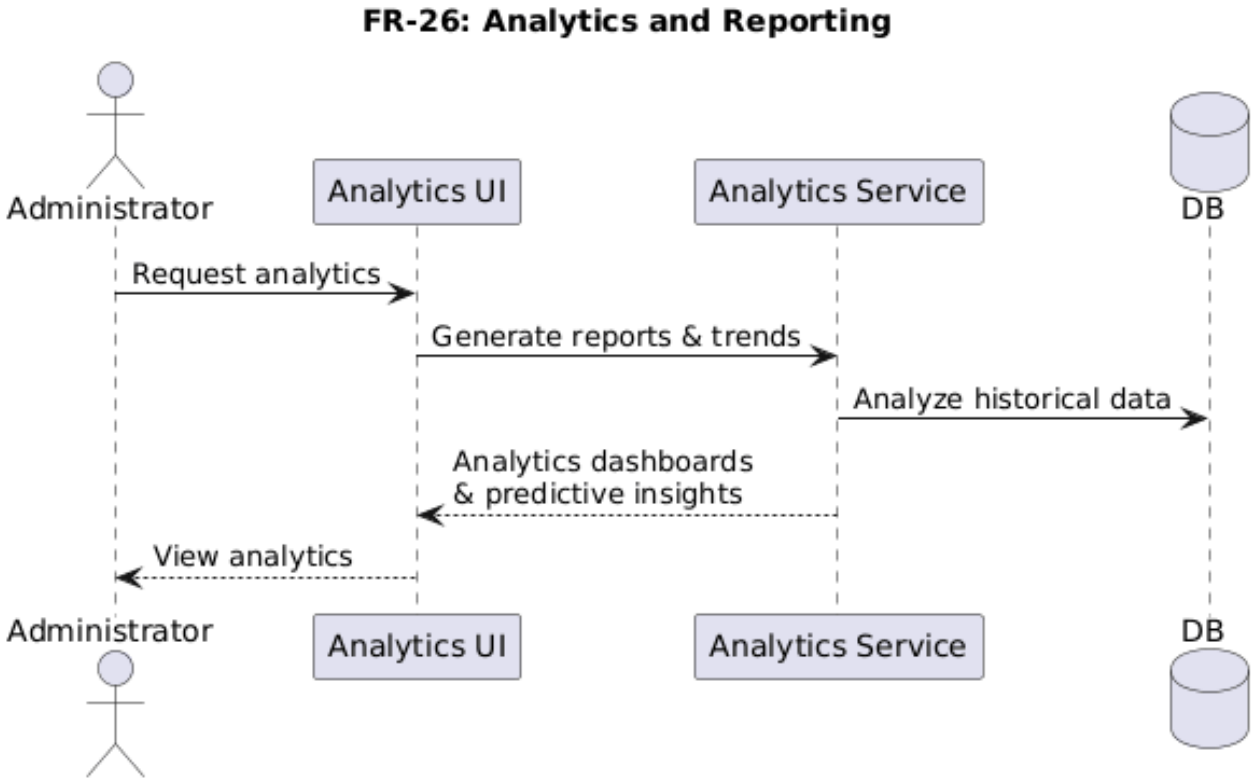


Figure 84: FR-26 Sequence Diagram

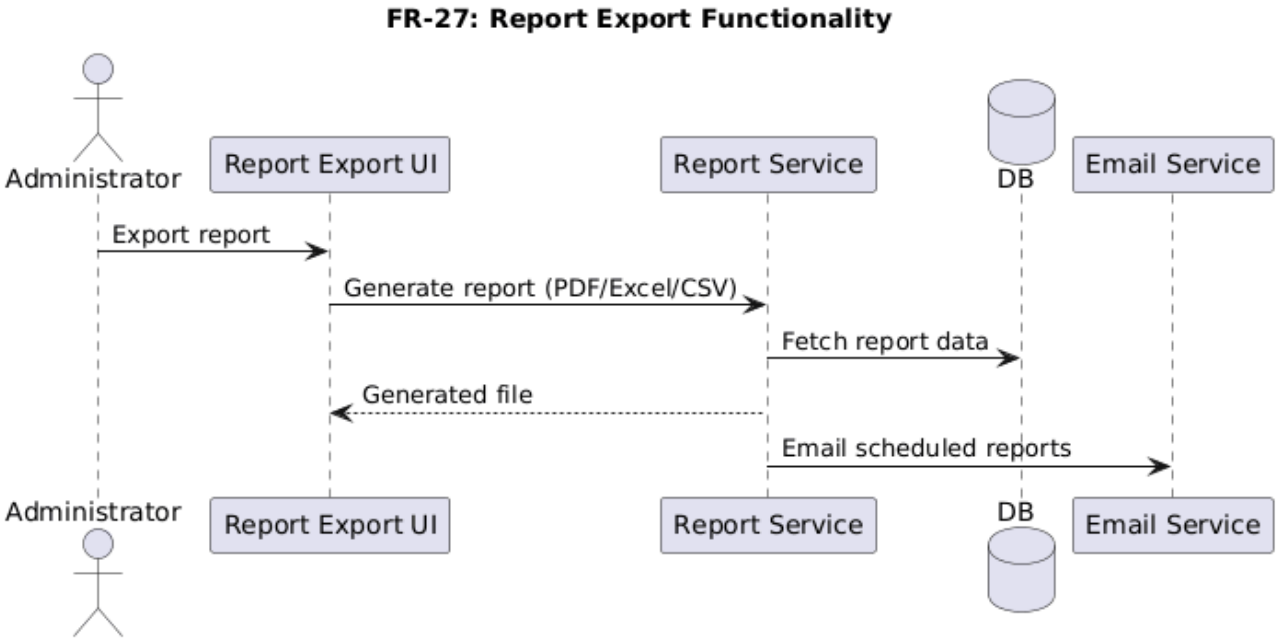


Figure 85: FR-27 Sequence Diagram

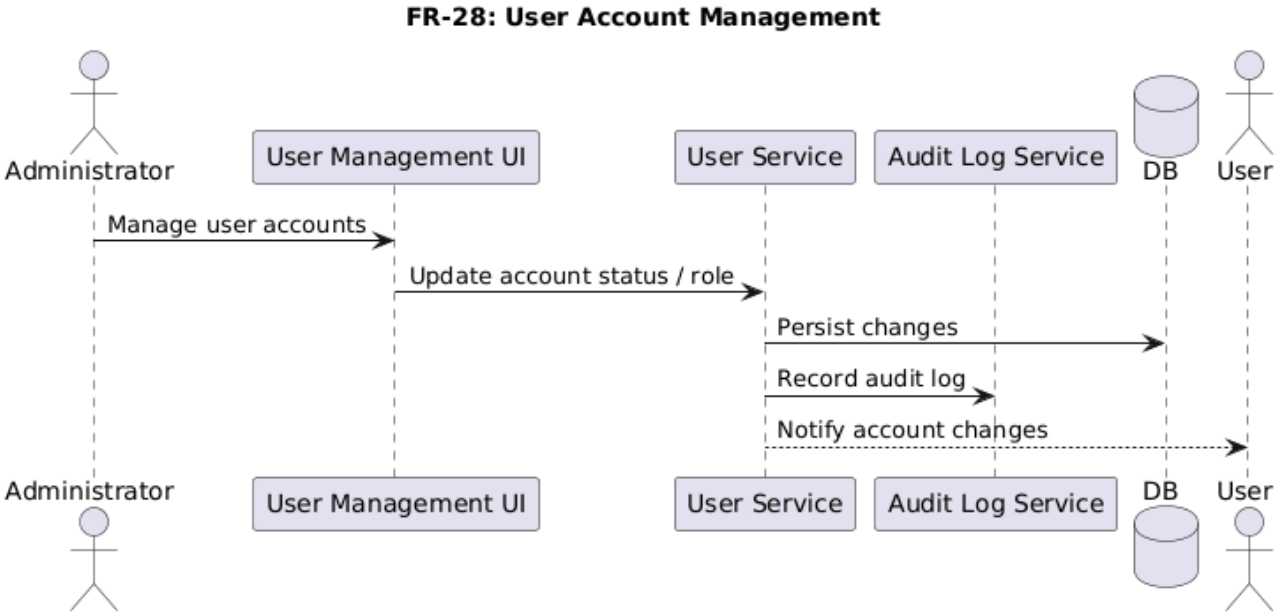


Figure 86: FR-28 Sequence Diagram

4.5.3. Classes and Components Design

Class Specifications

1. User Classes (Abstract Base Class)

Class: User Attributes:

- userID: String (private)
- fullName: String (private)
- email: String (private)
- nationalID: String (private)

- username: String (private)
- passwordHash: String (private)
- phoneNumber: String (private, optional)
- role: String (private)
- isEmailVerified: Boolean (private)
- accountStatus: String (private)
- failedLoginAttempts: Integer (private)
- lastLoginAt: DateTime (private)
- sessionToken: String (private)
- registrationDate: DateTime (private)

Methods:
+ register(fullName: String, email: String, nationalID: String, username: String, password: String, role: String): Boolean
+ login(username: String, password: String, captcha: String): Boolean
+ logout(): Boolean
+ resetPassword(email: String, nationalID: String): Boolean
+ verifyEmail(token: String): Boolean
+ updateProfile(fullName: String, email: String, password: String): Boolean
- isAccountLocked(): Boolean
- validateCredentials(): Boolean
- hashPassword(password: String): String
- validatePasswordStrength(password: String): Boolean
- incrementFailedLoginAttempts(): void
- resetFailedLoginAttempts(): void

Responsibilities:
- Handle user registration, authentication, and session management
- Enforce password security and account locking rules
- Provide base functionality for all system user roles

2. Resident Class (Inherits User)

Class: Resident Attributes:
- profilePictureURL: String (private)

Methods:
+ submitMaintenanceRequest(category: String, description: String, locationID: String, priority: String, images: List): String
+ viewDashboard(): void
+ viewTicketStatus(ticketID: String): String
+ addTicketComment(ticketID: String, comment: String): Boolean
+ markTicketAsUrgent(ticketID: String): Boolean
+ configureNotificationPreferences(): void

Responsibilities:
- Submit and track maintenance requests
- Monitor ticket status and history
- Receive and manage notifications related to submitted tickets

3. Technician Class (Inherits User)

Class: Technician Attributes:
- technicianID: String (private)
- specialization: String (private)
- skillLevel: String (private)
- availabilityStatus: String (private)
- workZone: String (private)
- teamLeadFlag: Boolean (private)
- averageResolutionTime: Double (private)
- customerSatisfactionRating: Double (private)

Methods:
+ viewAssignedTasks(): List
+ acceptTask(ticketID: String): Boolean
+ declineTask(ticketID: String, reason: String): Boolean
+ updateTaskStatus(ticketID: String, status: String): Boolean
+ uploadMaintenanceEvidence(ticketID: String, images: List, notes: String): Boolean
+ requestAdditionalInfo(ticketID: String): Boolean
+ setAvailabilityStatus(status: String): void

Responsibilities:
- Perform maintenance tasks and update their status
- Upload completion evidence and notes
- Communicate with residents and administrators

4. Administrator Class (Inherits User)

Class: Administrator Attributes:
- adminLevel: String (private)

Methods:
+ viewSystemDashboard(): void
+ assignTicket(ticketID: String, technicianID: String): Boolean
+ reassignTicket(ticketID: String, technicianID: String): Boolean
+ manageUserAccount(userID: String, action: String): Boolean
+ updateTicketPriority(ticketID: String, priority: String): Boolean
+ generateReports(type: String, dateRange: String): File
+ configureSystemRules(): void

Responsibilities:
- Oversee system operations and performance
- Manage users, tickets, and technician assignments
- Analyze system data and generate reports

5. Maintenance Request Class

Class: MaintenanceRequest Attributes:
- ticketID: String (private)
- title: String (private)
- description: String (private)
- category: String (private)
- priority: String (private)
- status: String (private)
- reportedAt: DateTime (private)
- assignedAt: DateTime (private)
- resolvedAt: DateTime (private)
- requesterID: String (private)
- technicianID: String (private)
- locationID: String (private)
- estimatedCompletionTime: DateTime (private)
- isUrgentFlag: Boolean (private)
- similarityFlag: Boolean (private)

Methods:
+ create(): Boolean
+ updateStatus(status: String): Boolean
+ addComment(comment: String): Boolean
+ attachImages(images: List): Boolean
- checkForDuplicates(): Boolean
- calculateEstimatedCompletion(): DateTime

Responsibilities:
- Store and manage maintenance request lifecycle
- Prevent duplicate ticket submissions
- Track status, priority, and escalation

6. Notification Class

Class: Notification Attributes:
- notificationID: String (private)
- userID: String (private)
- relatedTicketID: String (private)
- message: String (private)

- notificationType: String (private)
- isRead: Boolean (private)
- createdAt: DateTime (private)
- expirationDate: DateTime (private)

Methods:
+ markAsRead(): void
- deleteExpired(): void
- send(): Boolean

Responsibilities:
- Notify users of important system events
- Track notification history and read status

7. Location Class

Class: Location Attributes:
- locationID: String (private)
- buildingName: String (private)
- zone: String (private)
- floorNumber: String (private)
- roomNumber: String (private)
- geoCoordinates: String (private)

Methods:
+ getLocationDetails(): String

Responsibilities:
- Represent physical locations for maintenance requests
- Support analytics and technician assignment

Note There are private methods represented with (-) because they encapsulate internal implementation details, reduce system complexity, and are only accessed within the class itself, not directly by external classes.

State Diagrams

1. User authentication and account lifecycle States: Logged Out (Initial), Registering, Email verification Pending, Account active, Entering credentials, CAPTCHA validation, Authenticated, Session active, Session expired, Account locked, Password recovery, Password reset successful.

Transitions:
- Logged Out → Registering [user clicks Sign Up]

- Registering → Email Verification Pending [all inputs valid and registration submitted]
- Email Verification Pending → Account Active [email activation link verified]
- Logged Out → Entering Credentials [user clicks Sign In]
- Entering Credentials → CAPTCHA Validation [3 consecutive failed login attempts]
- CAPTCHA Validation → Authenticated [CAPTCHA valid and credentials correct]
- Entering Credentials → Authenticated [credentials correct and attempts < 3]
- Any State → Account Locked [5 consecutive failed login attempts]
- Account Locked → Entering Credentials [account unlocked by admin or email verification]
- Authenticated → Session Active [successful login and role identified]
- Session Active → Session Expired [inactivity timeout reached]
- Session Active → Logged Out [user logs out]
- Logged Out → Password Recovery [forgot password clicked]
- Password Recovery → Password Reset Successful [verification code valid]
- Password Reset Successful → Logged Out [confirmation sent]

Entry Actions:
- Registering: validate input fields in real-time.
- Email Verification Pending: invoke Notification.send() with activation email.
- Authenticated: load role-specific dashboard.
- Session Active: start session timer.
- Account Locked: disable login and invoke Notification.send() with lock message and unlock instructions.
- Password Recovery: invoke Notification.send() with verification code.

Exit Actions:
- Session Active: clear session tokens.
- Password Recovery: invalidate verification code.

2. Maintenance ticket lifecycle States: Draft (Initial), Submitted, Duplicate check, Open, Escalated, Assigned, In Progress, On Hold, Fixed, Closed.

Transitions:
- Draft → Submitted [resident submits ticket]
- Submitted → Duplicate Check [system checks tickets within last 7 days]
- Duplicate Check → Open [no duplicate detected]
- Open → Escalated [resident marks ticket as Urgent]
- Open → Assigned [admin and system assigns technician]
- Escalated → Assigned [technician with high skill level assigned]
- Assigned → In Progress [technician accepts task]
- Assigned → Open [technician declines task]
- In Progress → On Hold [waiting for parts and availability]
- On Hold → In Progress [blocking issue resolved]
- In Progress → Fixed [technician uploads evidence]
- Fixed → Closed [admin review and resident verification completed]

- Any State → Closed [admin manually closes]

Entry Actions:
- Submitted: generate ticket ID and store timestamp.
- Duplicate Check: compare category, location, and description.
- Escalated: recalculate estimated completion time and invoke Notification.send() to Admin.
- Assigned: invoke Notification.send() to technicianID.
- In Progress: record start time.
- Fixed: validate evidence and invoke Notification.send() to requesterID for verification.
- Closed: archive ticket, update analytics, and invoke Notification.send() to resident.

3. Resident interaction States: Dashboard (Initial), Viewing ticket feed, Creating ticket, Viewing ticket details, Adding comment, Viewing notifications, Managing profile.

Transitions:
- Dashboard → Viewing Ticket Feed [view reports feed]

-Dashboard → Creating Ticket [open maintenance ticket]
- Creating Ticket → Viewing Ticket Details [ticket submitted successfully]
- Viewing Ticket Details → Adding Comment [resident adds comment]
- Adding Comment → Viewing Ticket Details [comment saved]
- Any State → Viewing Notifications [notification icon clicked]
- Any State → Managing Profile [profile selected]

Entry Actions:
- Dashboard: load ticket summary widgets.
- Creating Ticket: validate inputs and preview images.
- Viewing Ticket Details: load status timeline.
- Viewing Notifications: invoke Notification.markAsRead().

4. Technician task handling States: Available (Initial), Task assigned, Task accepted, Task In Progress, Task On Hold, Task Fixed, Task reassigned.

Transitions:
- Available → Task Assigned [new ticket assigned]
- Task Assigned → Task Accepted [technician accepts]
- Task Assigned → Task Reassigned [technician declines]
- Task Accepted → Task In Progress [work started]
- Task In Progress → Task On Hold [issue encountered]
- Task In Progress → Task Fixed [work completed and evidence submitted]
- Task Fixed → Available [task closed]

Entry Actions: -Task Assigned: invoke Notification.send() with ticket details.
- Task In Progress: record start time.

- Task Fixed: invoke Notification.send() to admin and resident for evidence review.

5. Administrator ticket management States: Dashboard (Initial), Reviewing tickets, Assigning ticket, Monitoring progress, Reviewing completion, Generating reports.

Transitions:
- Dashboard → Reviewing Tickets [view pending]
- Reviewing Tickets → Assigning Ticket [assign technician]
- Assigning Ticket → Monitoring Progress [assignment completed]
- Monitoring Progress → Reviewing Completion [ticket marked as fixed]
- Reviewing Completion → Dashboard [ticket approved/closed]
- Dashboard → Generating Reports [export analytics]

Entry Actions:
- Reviewing Tickets: sort tickets by priority/urgency.

-Assigning Ticket: check technician workload and expertise.
- Generating Reports: compile analytics data.

Component Dependencies

1. Authentication and user management component

- Dependencies: Data access layer, Email service, CAPTCHA Service, Password hashing library.
- Provides: User registration, login, logout, role-based authentication, account locking, session management.
- Interfaces: IAuthenticationService, IUserAccountManager, ISessionService.

2. Resident management component

- Dependencies: Data access layer, Authentication component, Notification management Ccmponent.
- Provides: Resident dashboard data, profile management, ticket viewing, ticket tracking.
- Interfaces: IResidentService, IProfileManager, IDashboardProvider.

3. Maintenance ticket management component

- Dependencies: Data access layer, Authentication component, File and evidence storage component, Duplicate detection engine, Notification management component.
- Provides: Maintenance ticket creation, ticket validation, duplicate detection, ticket lifecycle management.
- Interfaces: IMaintenanceTicketService, ITicketRepository, IDuplicateChecker.

4. Technician task management component

- Dependencies: Data access layer, Authentication component, Notification management component, File and evidence storage component.
- Provides: Task assignment handling, task acceptance or rejection, task status updates, maintenance evidence submission.
- Interfaces: ITaskManager, ITaskAssignmentService, IEvidenceService.

5. Administrator management component

- Dependencies: Data access layer, Authentication component, Technician task management component, Maintenance ticket management component, Notification management component.
- Provides: Ticket assignment, priority management, user account management, system monitoring.
- Interfaces: IAdminService, ITicketAssignmentManager, IUserManagementService.

6. Notification management component

- Dependencies: Email service, SMS gateway, In-App notification engine, Queue service (for asynchronous delivery).
- Provides: Notification delivery, notification preferences handling, notification history tracking.
- Interfaces: INotificationService, IMessageDispatcher, INotificationRepository.

7. Analytics and reporting component

- Dependencies: Data access layer, Chart libraries, Export services (PDF, Excel), Maintenance ticket management component, Technician task management component.
- Provides: Maintenance analytics, technician performance analysis, trend visualization, report generation.
- Interfaces: IAnalyticsEngine, IReportGenerator, IDataAggregator.

8. File and evidence storage component

- Dependencies: Cloud Storage API (e.g. AWS S3, Azure Blob), Security Access Control.
- Provides: Image upload, document storage, secure file access, file metadata management.
- Interfaces: IFileStorageService, IEvidenceRepository.

9. System configuration and rules engine component

- Dependencies: Data access layer.
- Provides: Priority rules, assignment automation policies (Auto-assign), notification thresholds, system configuration settings.
- Interfaces: IConfigurationService, IRuleEngine.

Component Design Diagram

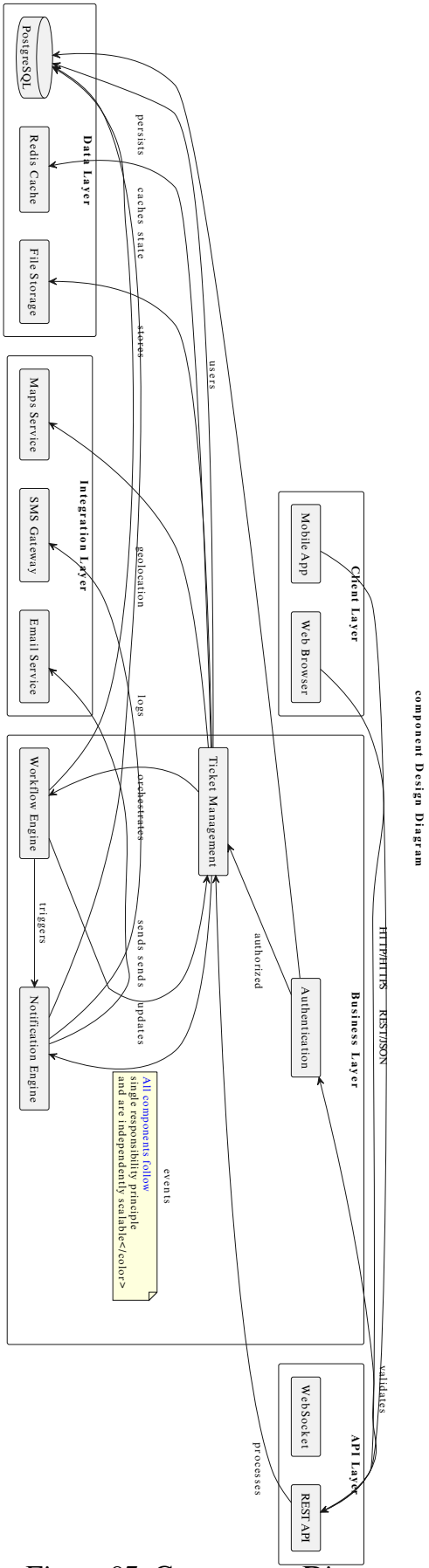


Figure 87: Component Diagram

4.6. ERD analysis and Database Design

4.6.1. Database Design (ERD)

Figure 88: Entity Relation Diagram

4.6.2. Object to ER Mapping

Table 119: Object to ER Mapping – User

User			
Class (Object) Name	**Table Name**	**Attributes (Fields → Columns)**	**Relationships**
User	users	user_id → user_id (PK) fullName → full_name email → email (UNIQUE) passwordHash → password_hash nationalID → national_id (UNIQUE) isEmailVerified → is_email_verified role → role registrationDate → registration_date accountStatus → account_status lastLoginAt → last_login_at accountExpirationDate → account_expiration_date failedLoginAttempts → failed_login_attempts profilePicture → profile_picture_url phoneNumber → phone_number createdAt → created_at updatedAt → updated_at	One-to-Many with MaintenanceRequest One-to-Many with Notification One-to-Many with Comment One-to-One with Technician

Table 120: Object to ER Mapping – Technician

Technician			
Class (Object) Name	**Table Name**	**Attributes (Fields → Columns)**	**Relationships**
Technician	technicians	technician_id → technician_id (PK) userID → user_id (FK) skills → skills availabilityStatus → availability_status skillLevel → skill_level certifications → certifications specialization → specialization workZone → work_zone workSchedules → work_schedules teamLeadFlag → team_lead_flag averageResolutionTime → average_resolution_time_minutes customerSatisfactionRating → customer_satisfaction_rating createdAt → created_at updatedAt → updated_at	One-to-One with User One-to-Many with MaintenanceRequest One-to-Many with MaintenanceSchedule One-to-Many with MaintenanceEvidence

Table 121: Object to ER Mapping – Maintenance Request

Maintenance Request			
Class (Object) Name	**Table Name**	**Attributes (Fields → Columns)**	**Relationships**
MaintenanceRequest	maintenance_requests	ticketID → ticket_id (PK) title → title description → description category → category requesterID → requester_id (FK) technicianID → technician_id (FK) locationID → location_id (FK) reportedAt → reported_at assignedAt → assigned_at resolvedAt → resolved_at priority → priority status → status estimatedCompletionTime → estimated_completion_time isUrgentFlag → is_urgent_flag similarityFlag → similarity_flag escalationLevel → escalation_level onHoldReason → on_hold_reason residentEditable → resident_editable createdAt → created_at updatedAt → updated_at	Many-to-One with User Many-to-One with Technician Many-to-One with Location One-to-Many with TicketImages One-to-Many with TicketComments One-to-Many with MaintenanceEvidence One-to-Many with Notifications One-to-Many with MaintenanceSchedule

Table 122: Object to ER Mapping – Location

Location			
Class (Object) Name	**Table Name**	**Attributes (Fields → Columns)**	**Relationships**
Location	locations	locationID → location_id (PK) zone → zone buildingName → building_name locationCriticality → location_criticality geoCoordinates → geo_coordinates roomNumber → room_number floorNumber → floor_number details → details createdAt → created_at updatedAt → updated_at	One-to-Many with MaintenanceRequest

Table 123: Object to ER Mapping – Maintenance Schedule

Maintenance Schedule			
Class (Object) Name	**Table Name**	**Attributes (Fields → Columns)**	**Relationships**
MaintenanceSchedule	maintenance_schedules	scheduleID → schedule_id (PK) technicianID → technician_id (FK) linkedRequestID → linked_request_id (FK) expectedDuration → expected_duration_minutes scheduledStartTime → scheduled_start_time recurrencePattern → recurrence_pattern scheduleStatus → schedule_status notes → notes createdAt → created_at updatedAt → updated_at	Many-to-One with Technician Many-to-One with MaintenanceRequest

Table 124: Object to ER Mapping – Notification

Notification			
Class (Object) Name	**Table Name**	**Attributes (Fields → Columns)**	**Relationships**
Notification	notifications	notificationID → notification_id (PK) userID → user_id (FK) relatedTicketID → related_ticket_id (FK) notificationType → notification_type message → message isRead → is_read deliveryMethod → delivery_method priorityLevel → priority_level expirationDate → expiration_date createdAt → created_at	Many-to-One with User Many-to-One with MaintenanceRequest

5. User Manual

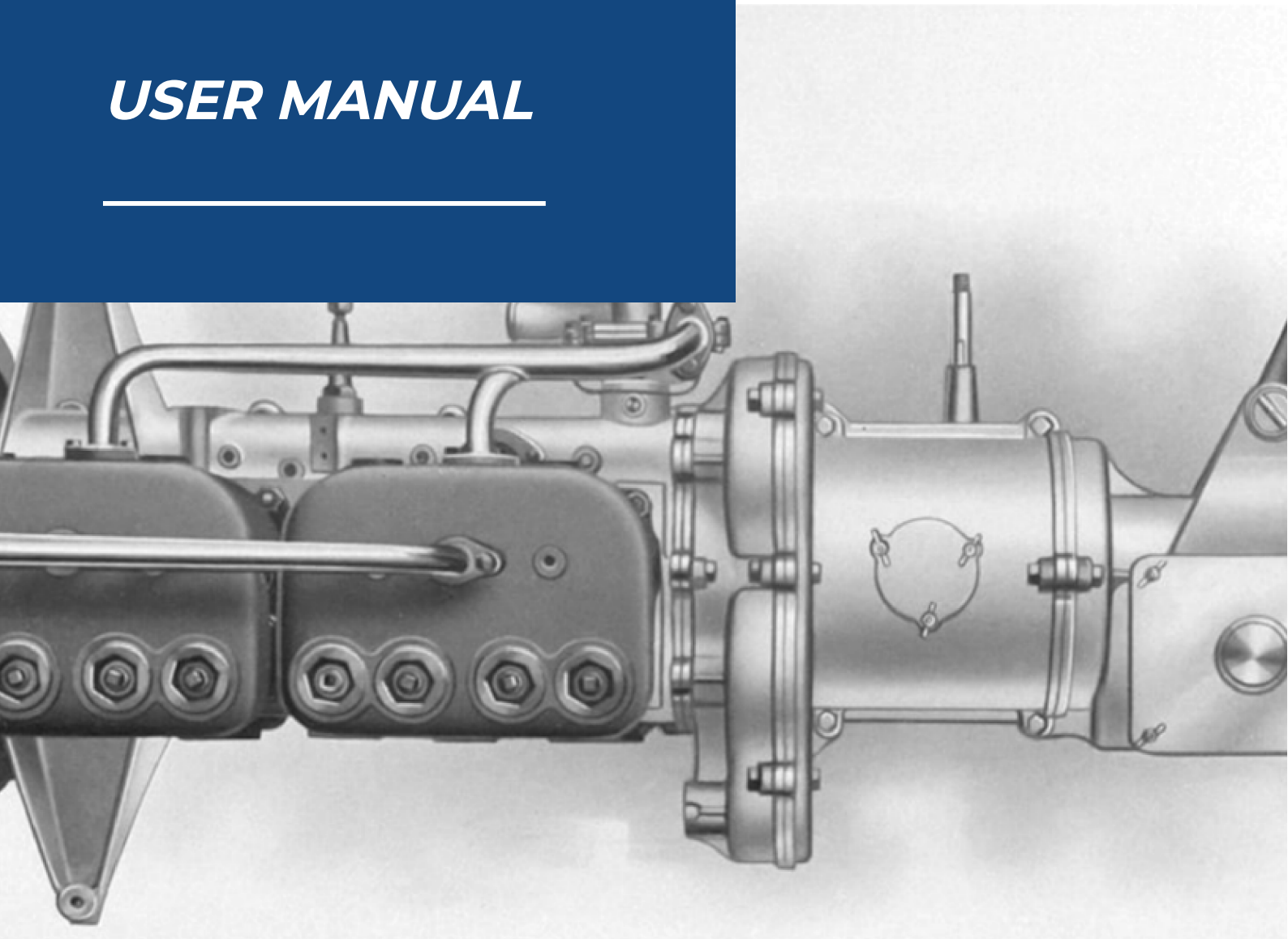
SALLEHA

2025-
2026

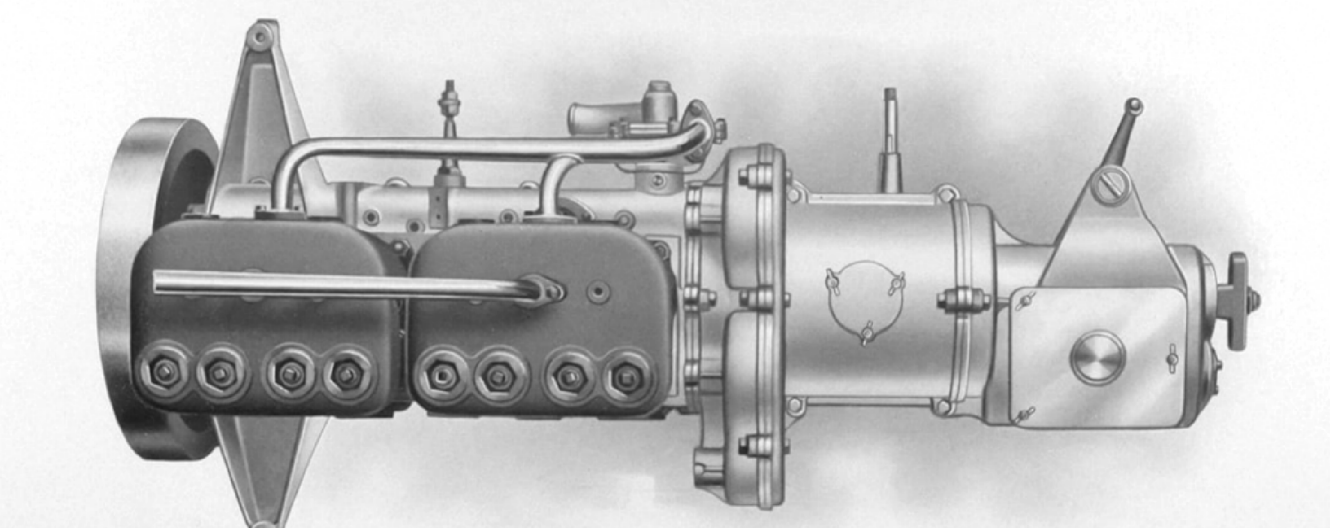
Supervisor: Prof
Hamad Alsawalqah

SALLEHA

USER MANUAL



INDICE



1. Introduction

Overview

Salleh System is a maintenance management system designed to help residents submit maintenance requests easily, while enabling administrators and technicians to manage, track, and resolve maintenance issues efficiently. Purpose of the System The purpose of the system is to streamline the maintenance request process, reduce response time, avoid duplicate requests, and improve communication between residents, technicians, and administrators.

Key features and benefits

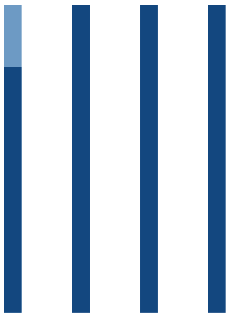
- Easy submission of maintenance requests - Real-time tracking of request status - Technician task assignment and updates - Notification system for status changes - Centralized dashboard for all users

2. Getting Started

System Requirements - Internet connection - Web browser (Chrome, Edge, or Firefox) - Mobile or desktop device Installation Instructions No installation is required. The system is accessed through a web browser using the provided system URL.

First-time Setup

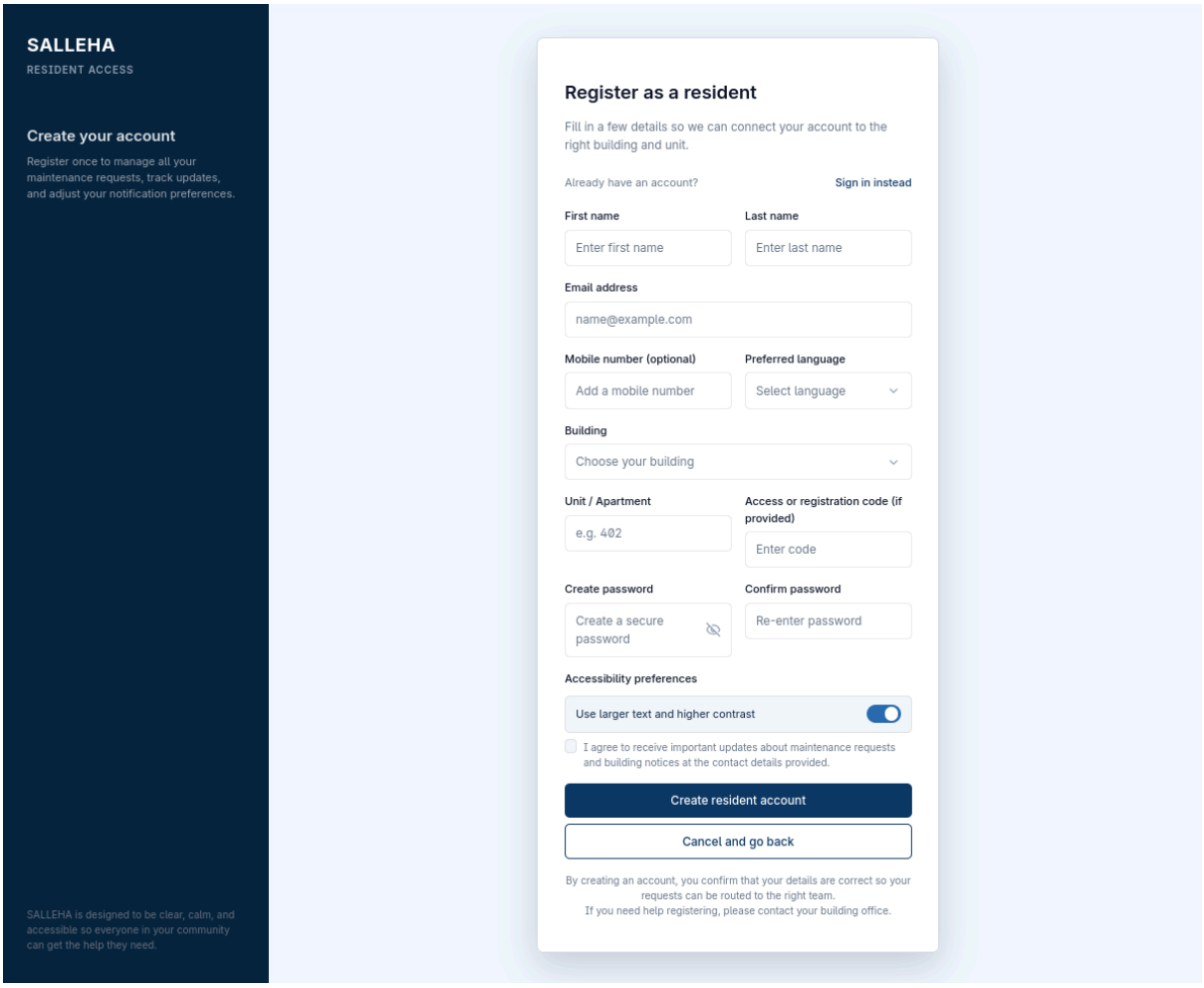
- Open the system URL - Create a new account - Verify your email (if required) - Log in using your credentials

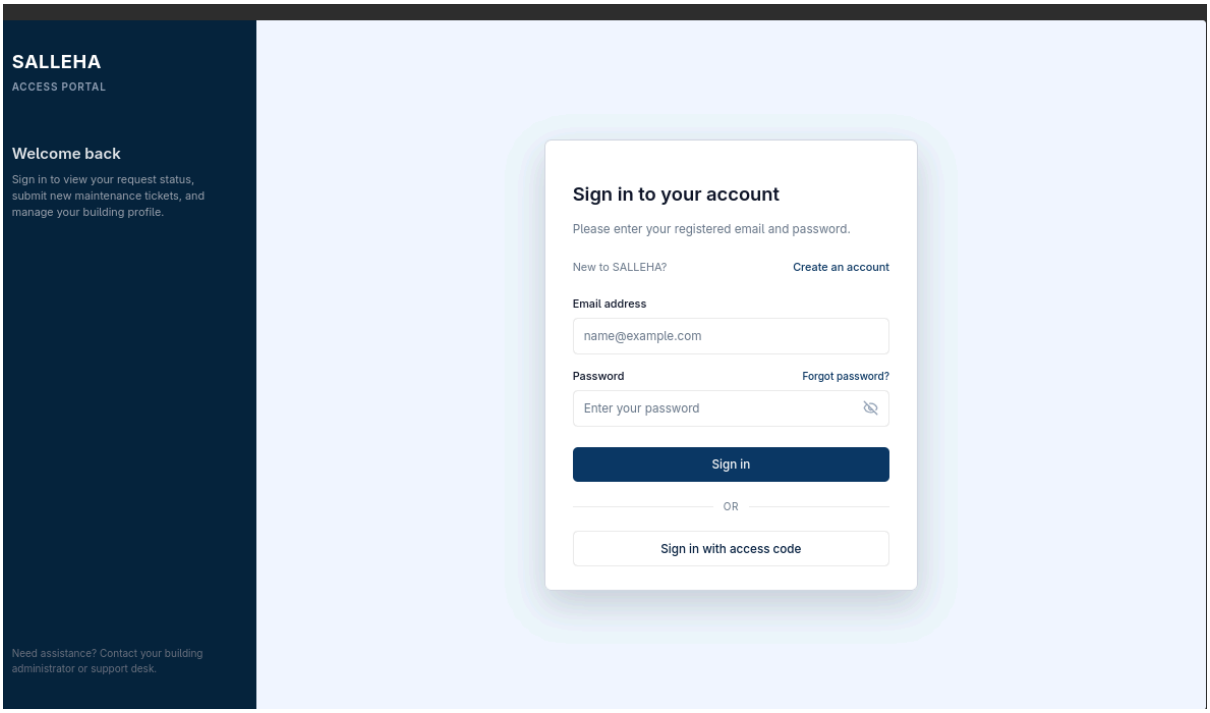


Account Creation and Login Process

- Click Register and enter required personal information - Create a username and password - Log in using your username, password, and CAPTCHA verification

Account Creation and Login Process





3. System Interface

Navigation Overview

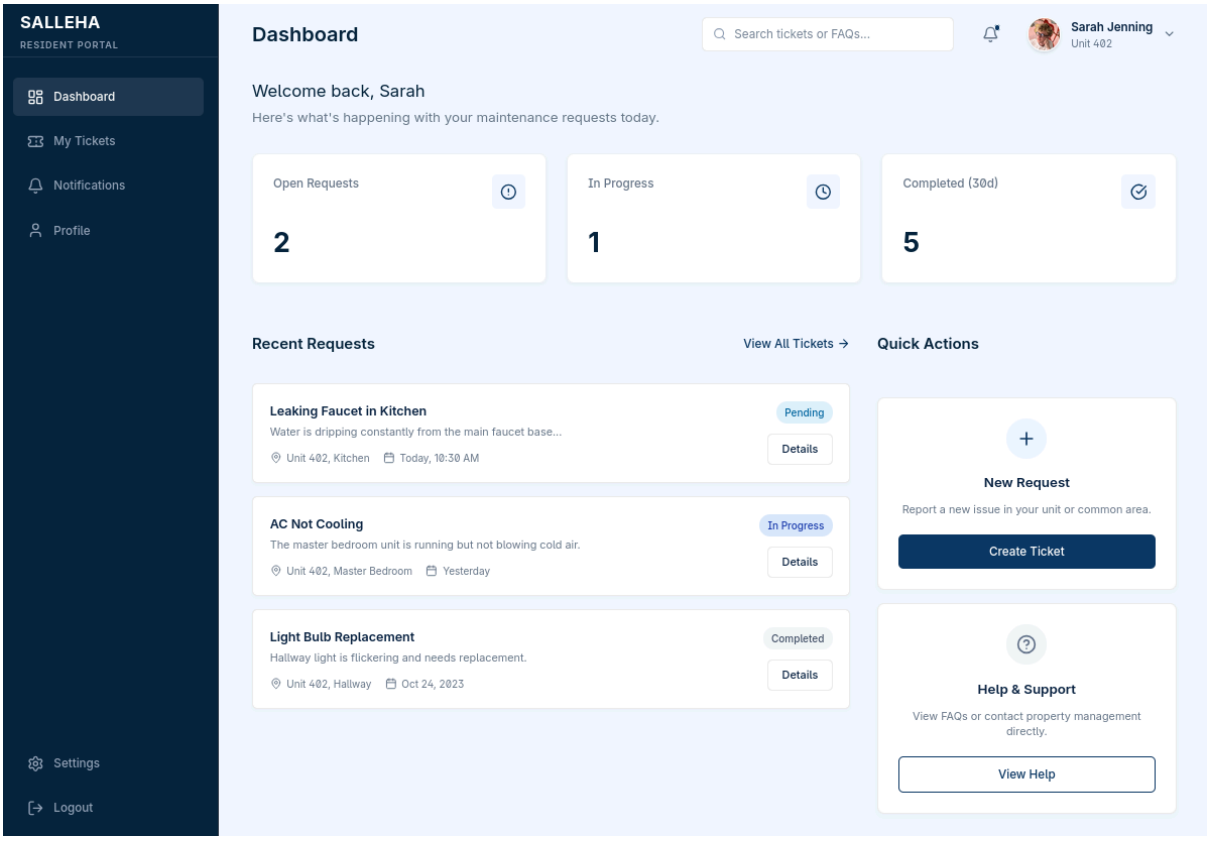
The system uses a simple menu-based navigation with access to Dashboard, Maintenance Requests, Notifications, and Profile settings.

Dashboard Description

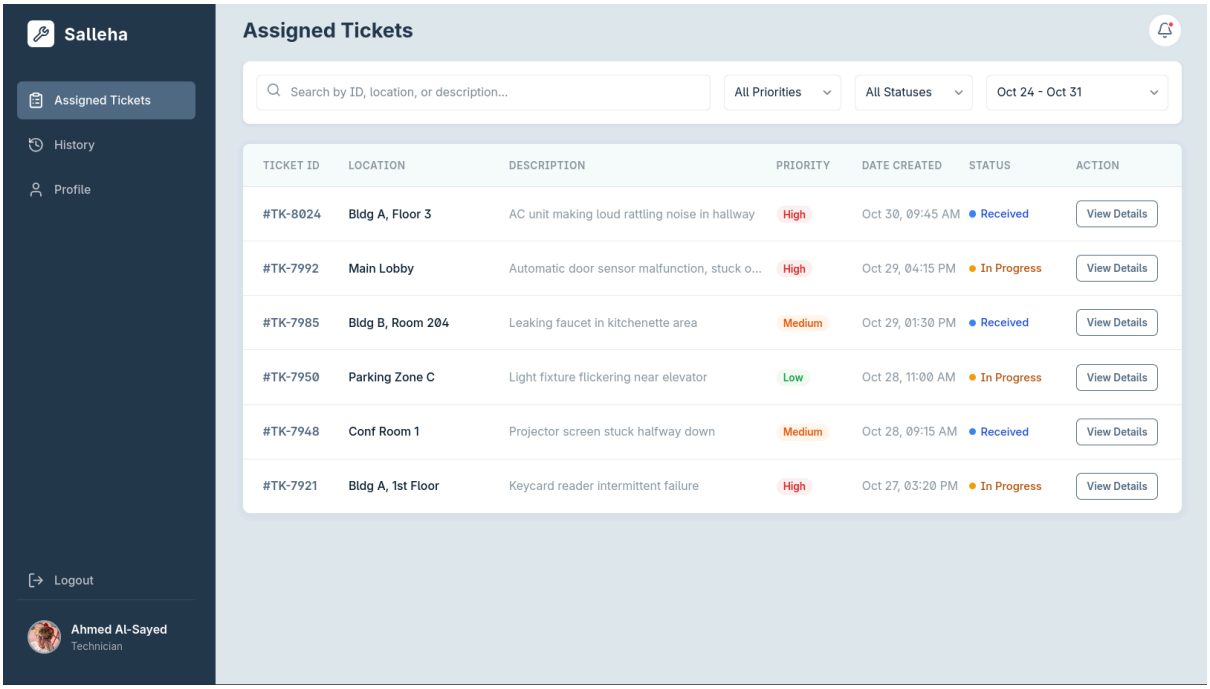
The dashboard displays:

- Current maintenance requests
- Request statuses
- Notifications and updates
- Quick access to main features

Resident dashboard:



Technician dashboard:



Admin dashboard:

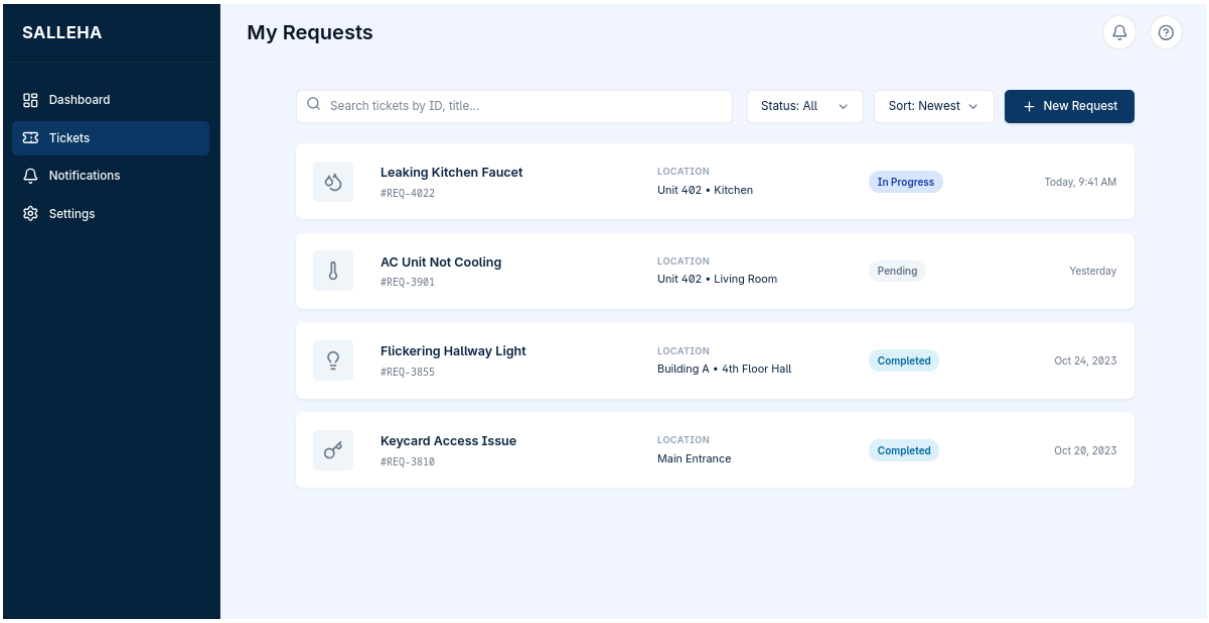
Key Sections of the Interface

- Dashboard

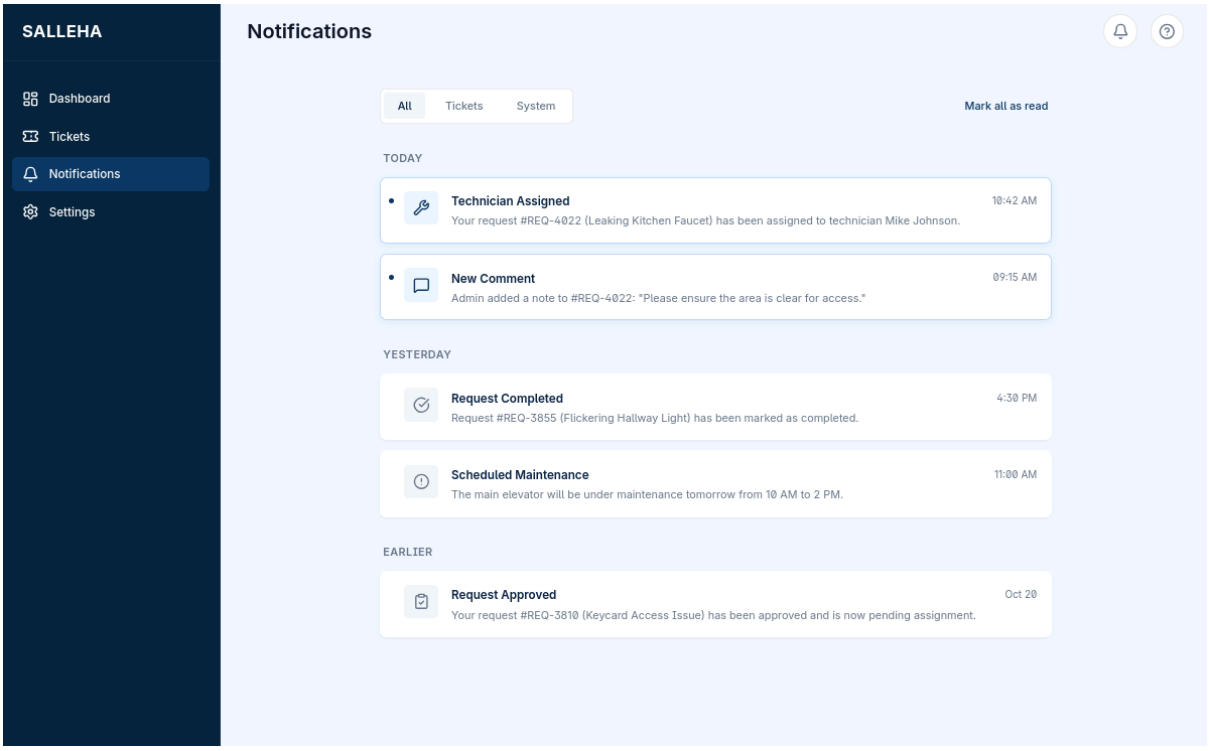
- Maintenance Requests

- Notifications
- User Profile

Ticket screen:



Notification screen:



Icons and Buttons

- Add: Create a new request
- Notification icon: View alerts
- Edit: Modify information
- Status icons: Show request progress

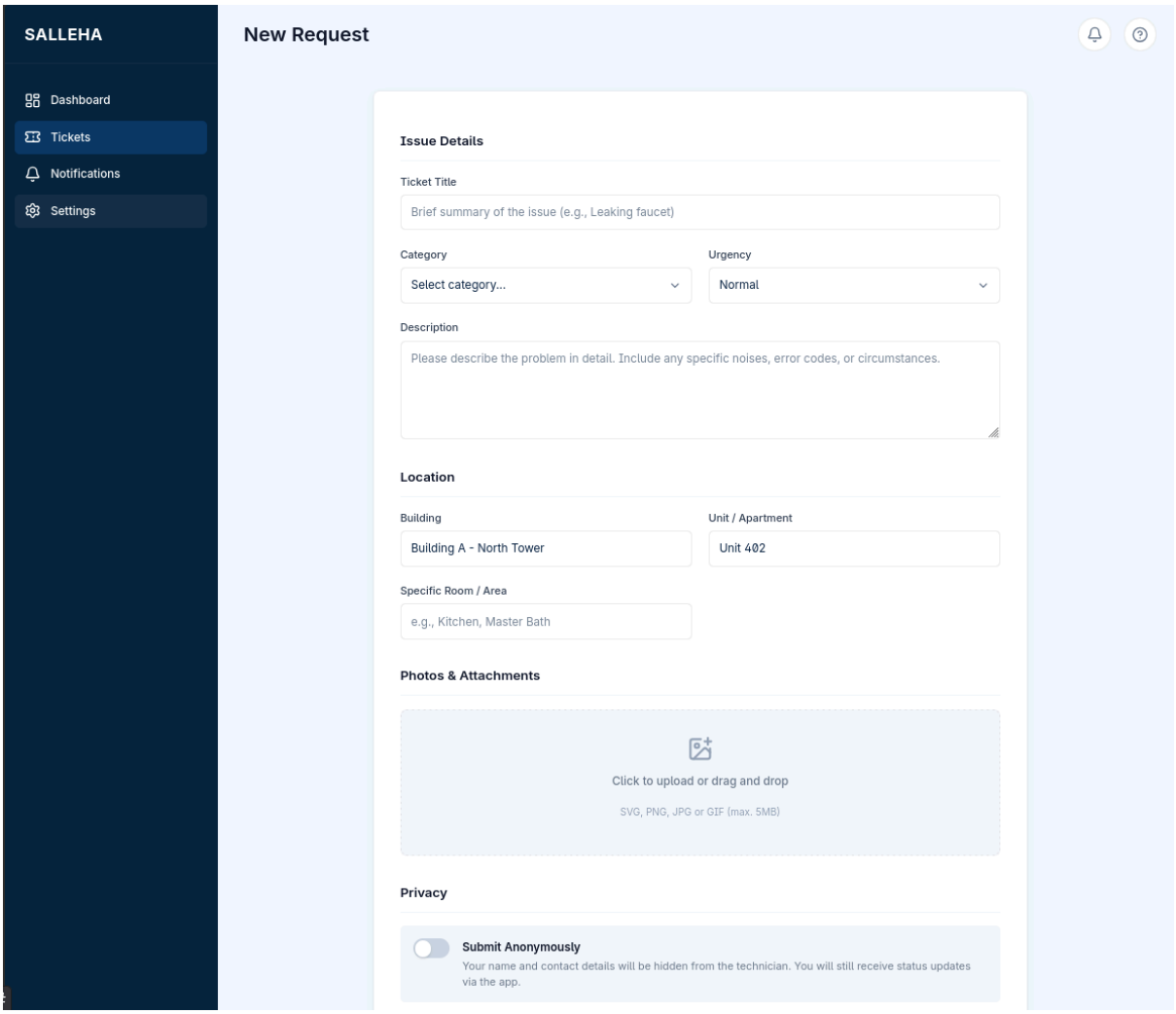
4. Using the System

Step-by-step Instructions for Common Tasks

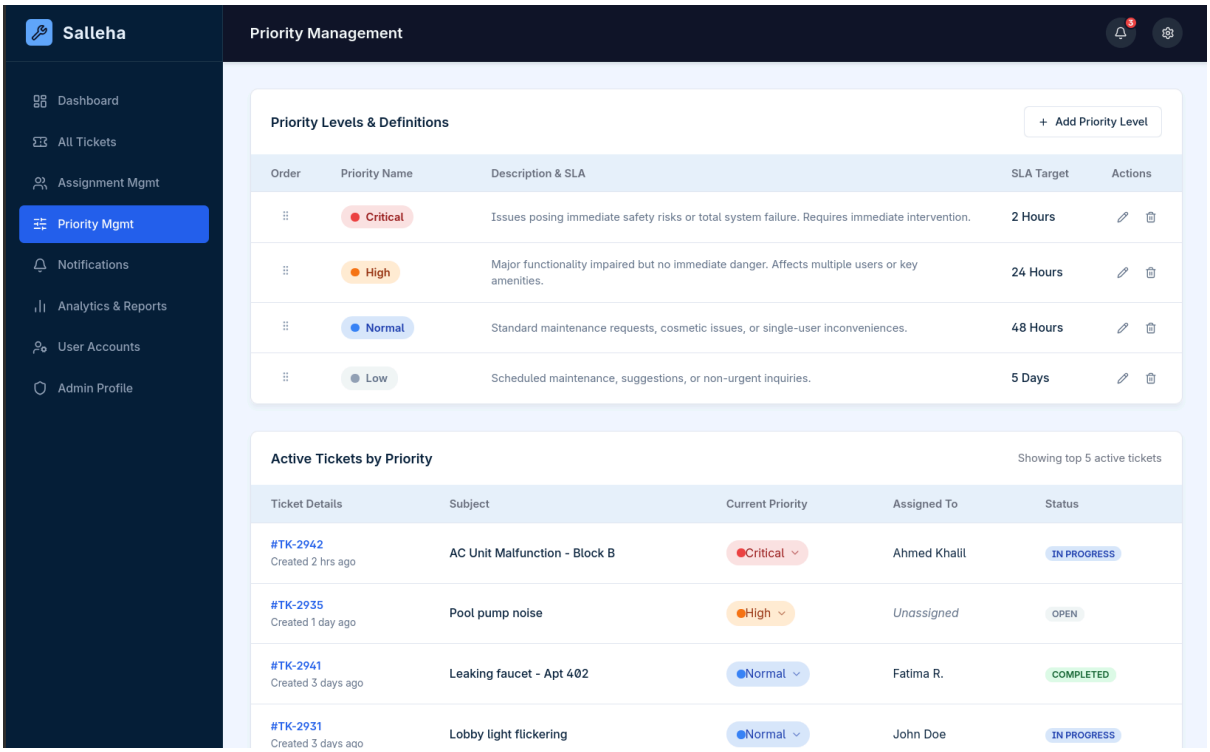
Task 1: Submitting a Maintenance Request

- Log in to the system
- Click Report New Issue
- Select category, priority, and location
- Enter a description
- Upload images (optional)
- Submit the request

Tickets request screen:



Priority management:



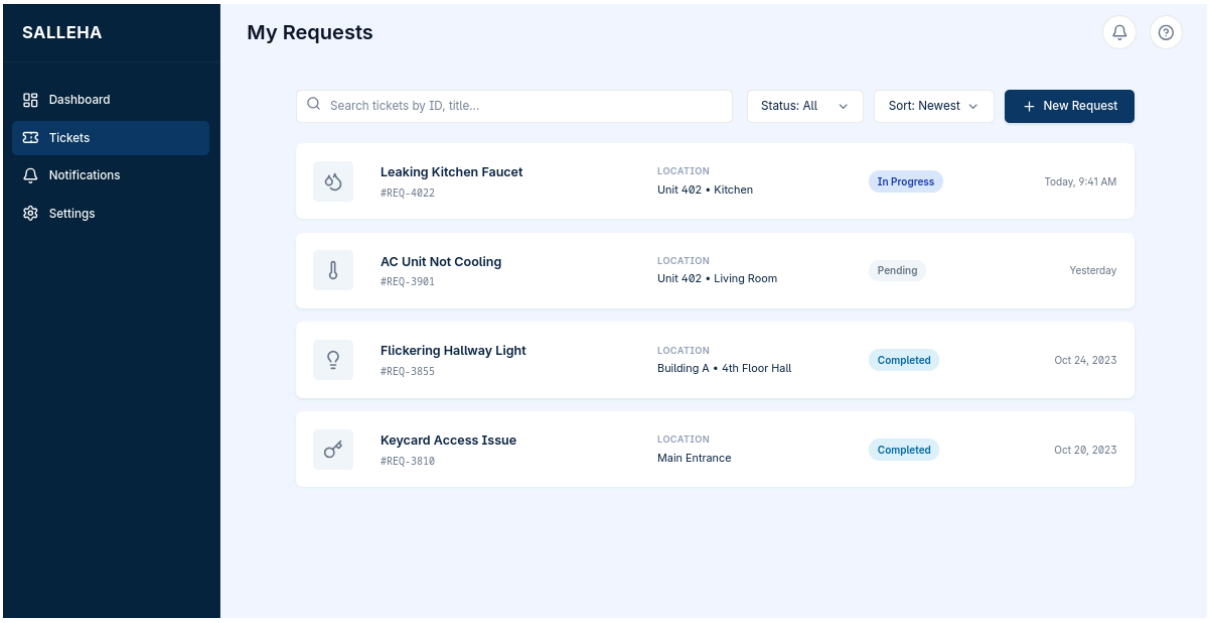
Task 2: Tracking Request Status

- Open Dashboard

- View submitted requests

- Check current status and updates

Tickets screen:

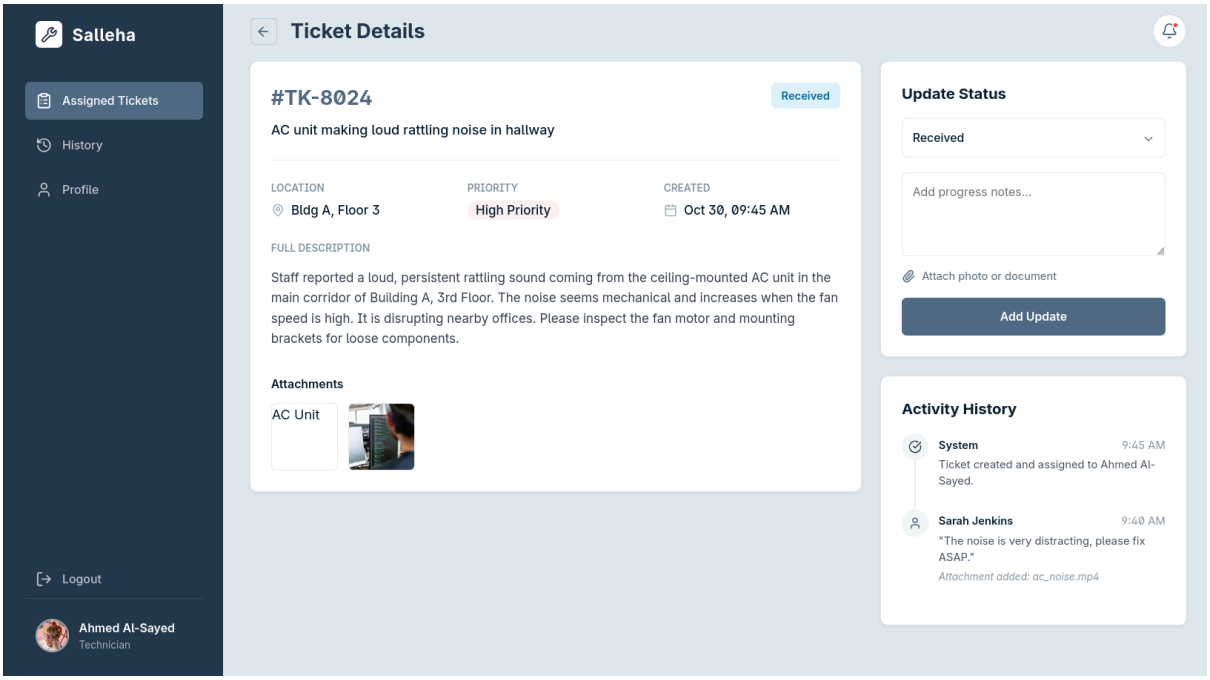


Task 3: Managing Requests (Admin/Technician)

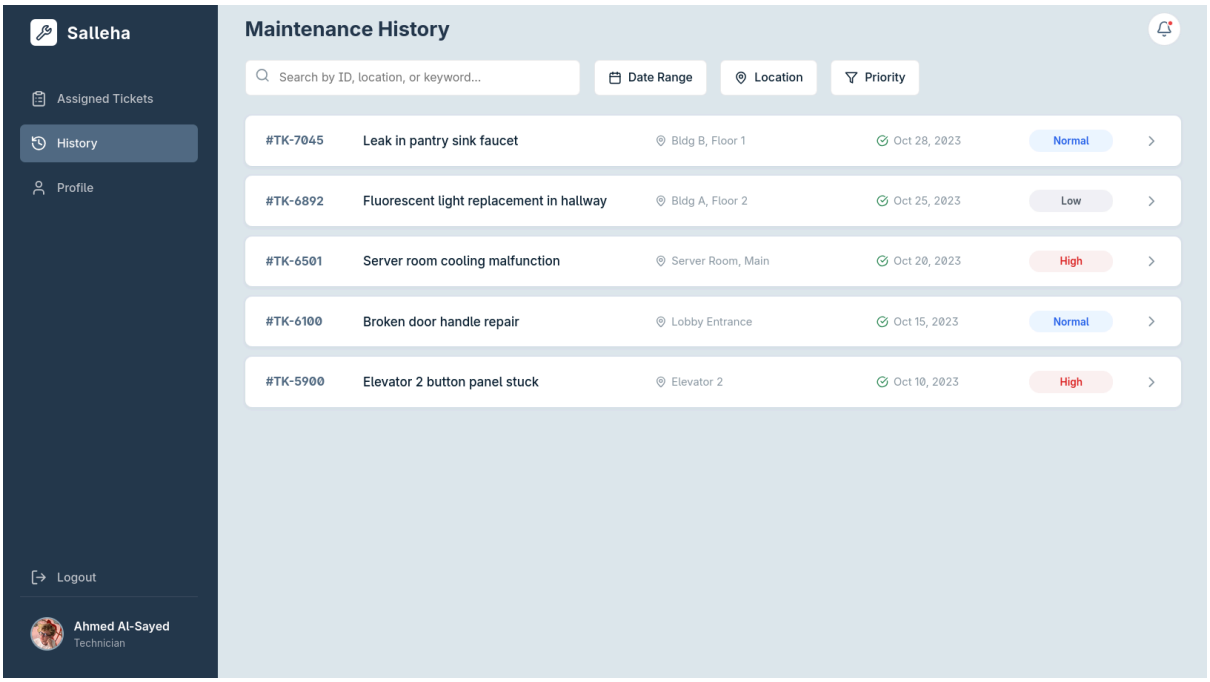
- View assigned or incoming requests
- Update request status
- Add comments or evidence
- Close request after resolution

Technician side:

Ticket details

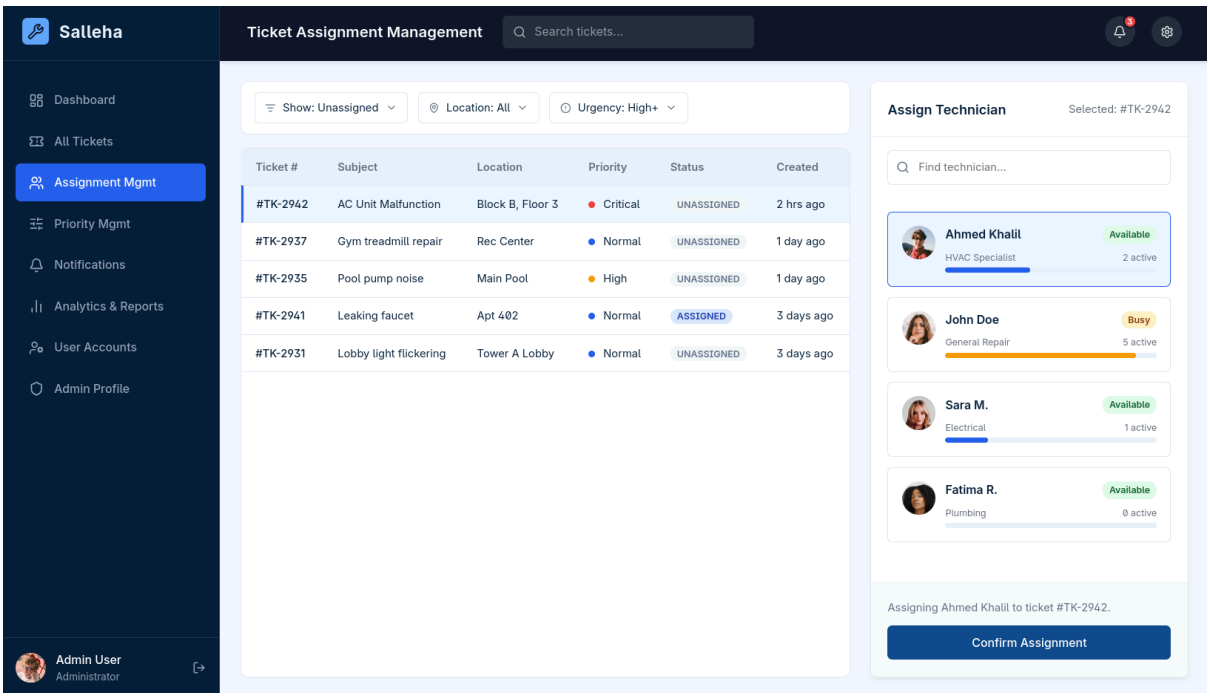


Maintenance History

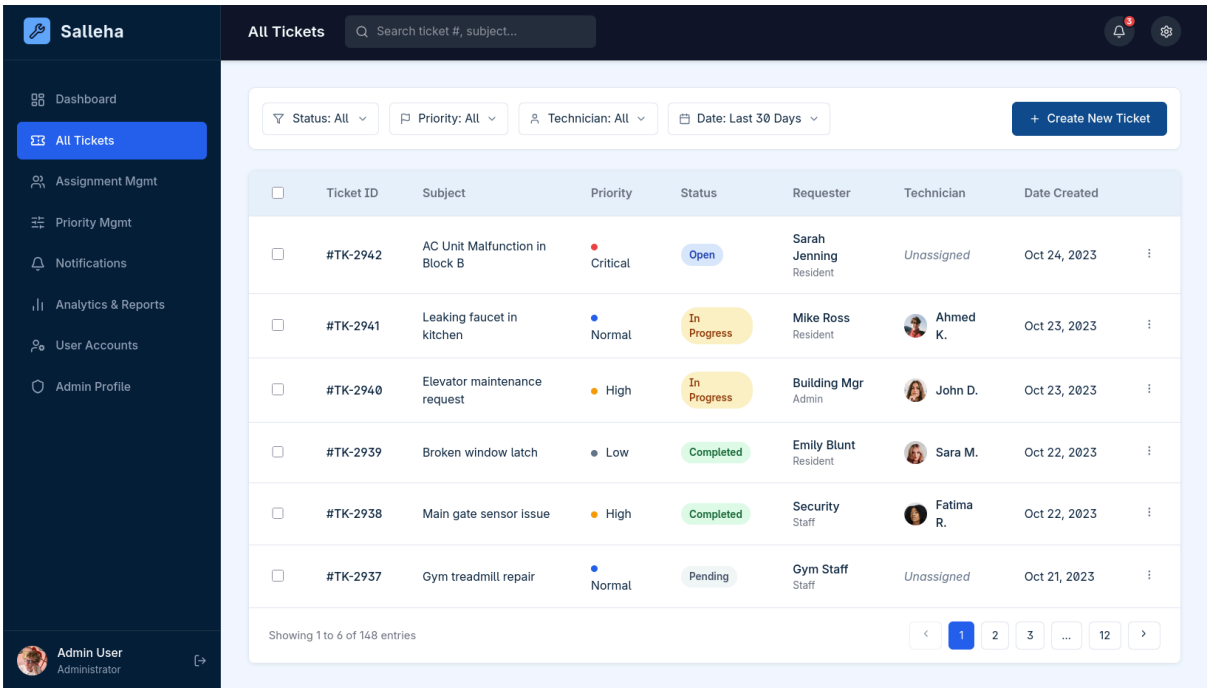


Admin side:

Admin assignment management



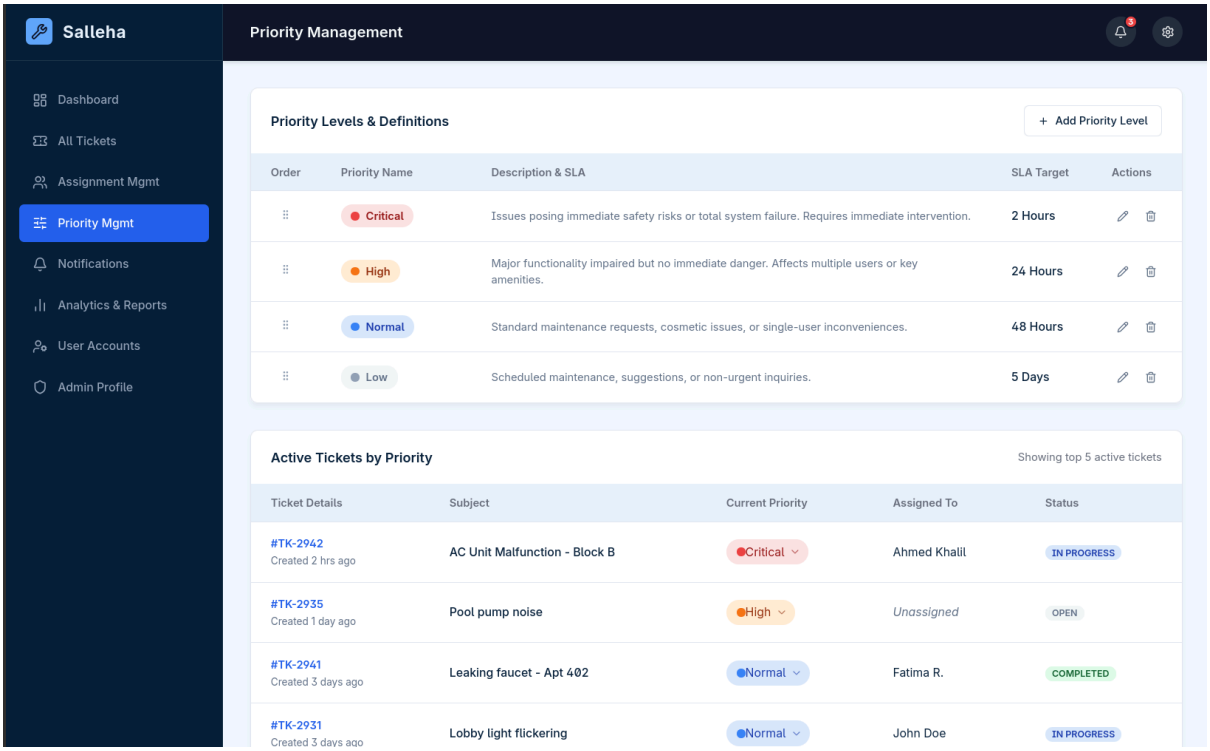
Admin all tickets



Advanced Features

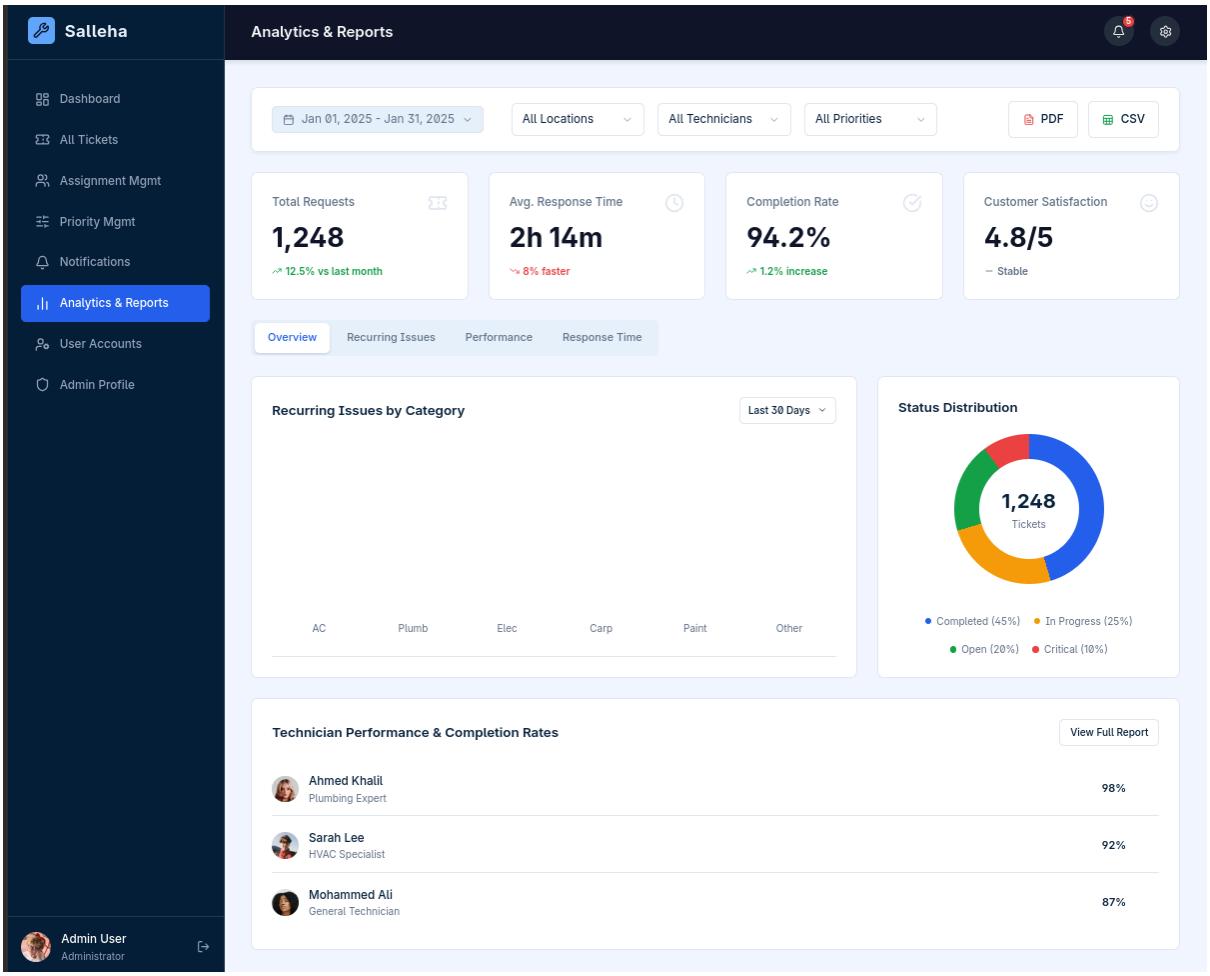
- Duplicate request detection

- Priority escalation



- Notification preferences

- Report generation (Admin only)



5. Frequently Asked Questions (FAQs)

1. How do I submit a maintenance request?

Log in to the system, go to the Dashboard, click on Report New Issue, fill in the required details, and submit the request.

2. What information is required to submit a maintenance request?

You need to select the issue category, location, priority level, and provide a clear description. Uploading images is optional but recommended.

3. Can I upload images with my maintenance request?

Yes. You can upload up to 5 images to help technicians better understand the issue.

4. How can I track the status of my request?

You can track your request from the Dashboard under My Maintenance Requests, where the current status is displayed.

5. What do the different request statuses mean?

Submitted: Request has been sent successfully

Assigned: Technician has been assigned

In Progress: Work is currently being done

Awaiting Response: More information is required

Resolved: Issue has been fixed

Closed: Request is completed and archived

6. Can I edit or cancel a request after submitting it?

You can edit or cancel the request only before it is assigned to a technician.

7. What happens if I submit a duplicate request?

The system checks for similar requests submitted within the last 7 days and will notify you if a possible duplicate is detected.

8. How will I be notified about updates?

You will receive notifications through the system dashboard and, if enabled, via email or SMS.

9. What should I do if my request is urgent?

You can mark the request as urgent during submission or update its priority later if allowed.

10. Why was my request marked as “Awaiting User Response”?

This means the technician or administrator needs additional information to continue working on the issue.

11. Can technicians communicate with residents through the system?

Yes. Technicians can add comments and request additional information through the request details page.

12. What should I do if I forget my password?

Click on Forgot Password, enter your registered email or national ID, and follow the password reset instructions.

13. Why is my account locked?

Your account may be locked due to multiple failed login attempts. Please wait or contact support.

14. Can administrators reassign a maintenance request?

Yes. Administrators can reassign requests to another technician if needed.

15. How long does it take to resolve a maintenance request?

Resolution time depends on the issue type, priority level, and technician availability.

16. Can I view my past maintenance requests?

Yes. All previous requests are available in your request history.

17. Is my personal information secure?

Yes. The system uses secure authentication and access control to protect user data.

18. What file formats are supported for image uploads?

Common image formats such as JPG and PNG are supported.

19. What should I do if the system is not loading properly?

Try refreshing the page, checking your internet connection, or logging out and back in.

20. Who can I contact for technical support?

You can contact system support via the support email or phone number listed in the Support section.

6. Troubleshooting Tips

Issues and solutions

- Login failed: Ensure correct username/password

- Images not uploading: Check file size and format

Error Codes and Their Meanings

• ERR-401: Unauthorized access

• ERR-403: Account locked or inactive

• ERR-500: System error

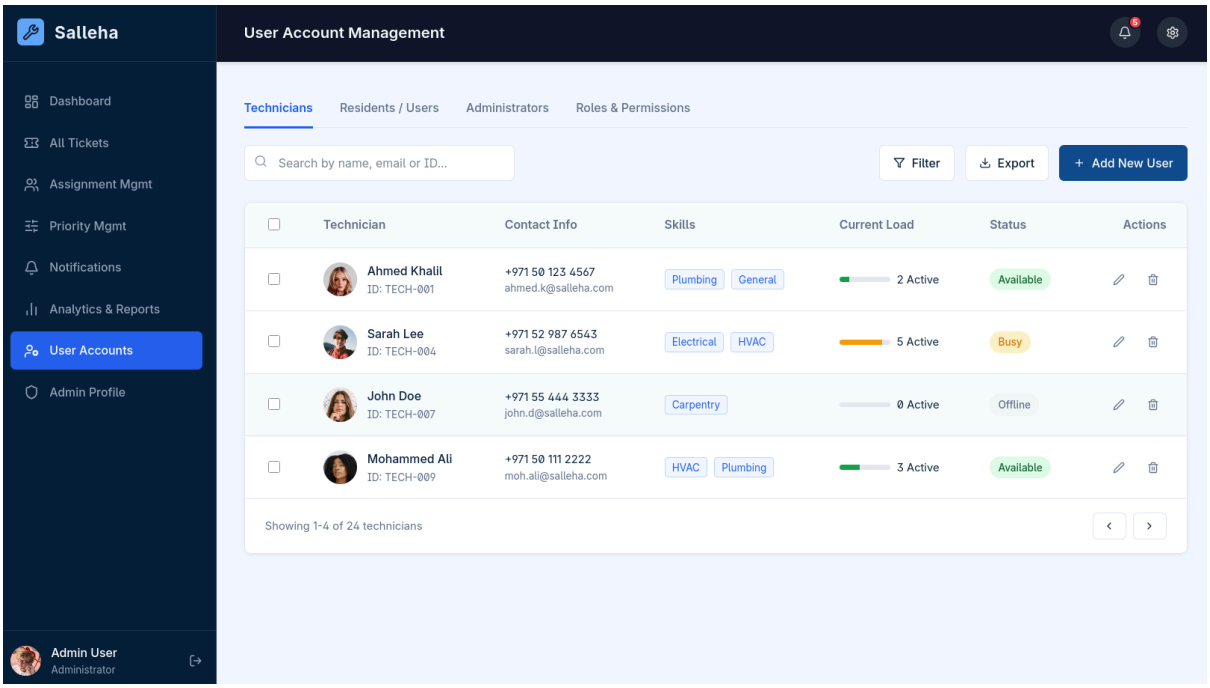
Contacting Support

Contact system support through the provided support email or phone number.

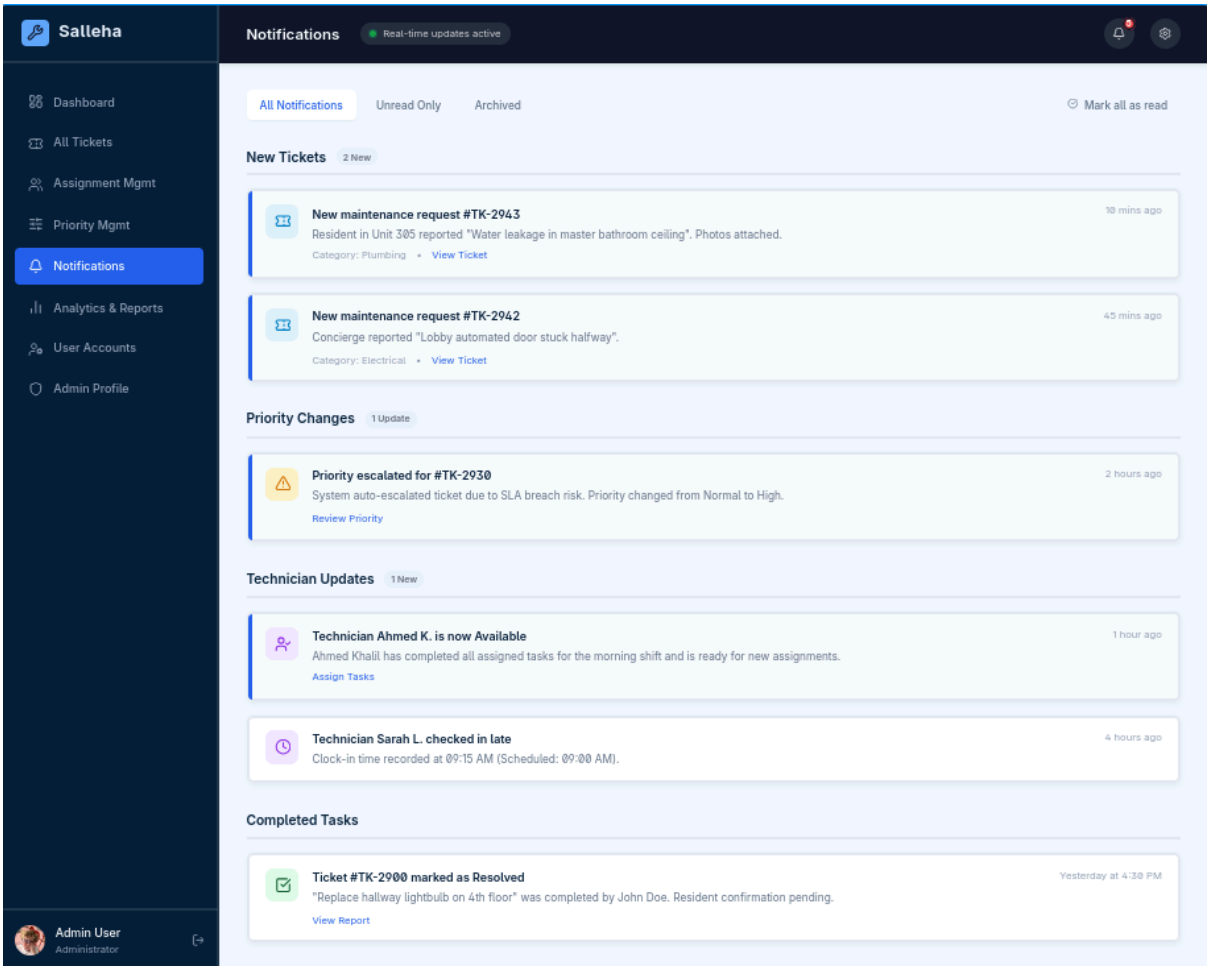
7. Administrative Management Screens

This section presents administrative interfaces used to manage user accounts, system notifications, and internal system operations.

Admin user accounts:



Admin notifications:



8. Legal and Safety Information

Terms of Service

Users must comply with system usage policies and provide accurate information.

Privacy Policy

User data is securely stored and used only for system operations.

Safety Guidelines

Do not submit false or misleading maintenance requests.

9. Support and Contact Information

How to Contact Support

- Email: support@sallehsystem.com
- Phone: 0797777777

Hours of Availability

Sunday to Thursday, 9:00 AM - 5:00 PM

10. Conclusion

Summary of Features

Salleh System provides an efficient and user-friendly way to manage maintenance requests from submission to resolution.

Final Thoughts on System Usage

Using the system correctly ensures faster response times, better communication, and improved maintenance management.

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6. References

[1] K. E. Kendall and J. E. Kendall, **Systems Analysis and Design**, 11th ed. Hoboken, NJ, USA: Pearson, 2023.

[2] J. W. Satzinger, R. B. Jackson, and S. D. Burd, **Systems Analysis and Design in a Changing World**, 7th ed. Boston, MA, USA: Cengage Learning, 2016.

[3] TutorialsPoint, "System Analysis and Design Tutorial." [Online]. Available: https://www.tutorialspoint.com/system_analysis_and_design/

[4] dbdiagram.io, "Database Diagram Design Tool." [Online]. Available: https://dbdiagram.io/

[5] draw.io, "Online Diagramming Tool." [Online]. Available: https://www.diagrams.net/

[6] Figma, "Collaborative Interface Design Tool." [Online]. Available: https://www.figma.com/

[7] PlantUML, "Text-Based UML Diagram Generator." [Online]. Available: https://plantuml.com/