ST. MARY'S UNIVERSITY

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Title: Human Resource and Payroll Management System For small to medium enterprises

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Certificate of Authenticated work

This is to certify that this project "HR and Payroll Management System" was carried out by group of students of computer science at St. Mary's University as a requirement for senior project 1 by:

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The matter embodied in this project is authentic and is genuine work done by the student and has not been submitted whether to this university or any other university / institute for the fulfillment of the requirement of any course of study.

This Project proposal was reviewed and approved (for examination) by:

Advisor Name	Signature	Date
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Acronym

SME's	*small to medium sized enterprises*
HR	*human resource*
MVC	*model view controller*
OOAD	*object oriented analysis and design*
HTML	*hyper-text mark-up language*
CSS	*cascading Style sheet*
API	*application programming interface*
UI	*user interface*
UX	*user experience*
RBAC	*role-based access control*
2FA	*Two-factor authentication*
DGM	*deputy general manager*

CHAPTER ONE

Introduction

1.1 Background of the Project

In Ethiopia, SMEs play a significant role in driving economic growth, creating employment opportunities, and contributing to national development [1]. These companies often operate with limited resources and face numerous challenges in managing their internal administrative functions, particularly in the areas of HR and Payroll management.

Efficient HR and payroll systems are essential for ensuring employee satisfaction, compliance with labour laws, and accurate financial reporting. However, many SMEs in Ethiopia still rely on traditional manual methods, such as spreadsheets or paper-based records, to handle employee data, track attendance, calculate salaries, and manage benefits. This often leads to data inconsistencies, calculation errors, delays in salary processing, and lack of transparency in HR practices.

Moreover, as businesses grow and their workforce expands, the complexity of managing HR tasks and payroll processes also increases. Without a proper digital system in place, companies may struggle to keep up with employee information, leave tracking, tax deductions, and other critical aspects of employee management.

To address these challenges, we propose the development of a comprehensive “HR and Payroll Management System “tailored specifically for small to medium-sized companies in Ethiopia. This system will automate key HR functions and payroll processes, allowing organizations to manage employee records, calculate salaries, generate payslips, and handle other administrative tasks through a centralized digital platform. The solution aims to enhance efficiency, accuracy, and compliance, ultimately supporting SMEs in building stronger and more organized operations.

1.2 Statement of the Problem and Justification

In Ethiopia, many SMEs across various sectors struggle to efficiently manage their human resource and payroll operations. These organizations often lack the technological infrastructure and expertise required to streamline administrative tasks related to employee management, payroll processing, and benefits tracking [1]. As a result, they face operational challenges that hinder productivity and employee satisfaction.

Currently, most SMEs rely heavily on manual processes or basic digital tools like spreadsheets to handle HR and payroll tasks [1]. This approach involves manually tracking employee attendance, calculating salaries, handling deductions, preparing payslips, and managing employee leave requests. These tasks are time-consuming, prone to human error, and difficult to scale as the company grows. In some cases, the absence of proper documentation or the misplacement of files can lead to disputes, compliance issues, and loss of trust among employees.

Moreover, the lack of a centralized system often leads to inconsistencies in employee data, inefficient leave and attendance tracking, and delays in salary disbursements. Payroll staff face an increased administrative burden, and management has limited visibility into workforce data for decision-making. These inefficiencies can negatively impact the overall performance and growth potential of the organization.

To address these challenges, we propose the development of a centralized HR and Payroll Management System tailored specifically for small to medium-sized companies in Ethiopia.

In general, the proposed system aims to address the following gaps:

- Lack of a centralized, automated system for HR and payroll management.
- Reliance on manual processes leading to frequent errors and inefficiencies.
- Time-consuming tasks such as attendance tracking, leave management, and payroll calculation.
- Difficulty in maintaining accurate and up-to-date employee records.
- Administrative overload on HR and finance departments due to the absence of digital tools.

1.3 Objective of the Project

1.3.1 General Objective

The general objective of this project is to design and develop a user-friendly web-based HR and Payroll Management System that streamlines employee administration and payroll processing for small to medium-sized enterprises, improving operational efficiency and data accuracy.

1.3.2 Specific Objectives

The specific objectives of this project are:

- To develop an efficient web-based system that simplifies HR and payroll operations for small to medium-sized enterprises.
- To implement a digital solution that reduces dependency on manual processes, thereby minimizing errors and improving the organization of employee records.
- To automate key HR tasks such as attendance tracking, leave management, and payroll calculation, reducing administrative workload and enhancing accuracy.
- To ensure that users, including HR staff and company management, can access the system from various locations through a responsive and user-friendly interface.
- To increase overall operational efficiency by centralizing employee data and streamlining payroll processing, tax calculations, and payslip generation.

1.4. Methodologies

The methodology is designed to pinpoint areas for improvement by thoroughly evaluating the current processes and challenges. By assessing the existing system and its data, it allows us to identify gaps and deficiencies. This analysis provides the foundation for developing a system that effectively addresses these identified issues.

1.4.1 Data Collection

There are various methods available for collecting relevant information during the development of a software project. For this project, we plan to adopt the following data gathering techniques to understand the existing HR and payroll processes in small to medium-sized enterprises:

- Interview and Survey
- Observation
- Document Analysis

1.4.1.1 Interview and Survey

We will conduct structured interviews and distribute surveys to HR personnel, accountants, and administrative staff within the selected reference company. This will help us gather first-hand insights into their daily operations, challenges, and expectations from a digital system.

1.4.1.2 Observation

Direct observation will be used to understand how current HR and payroll tasks are performed manually. By watching the workflow in real-time, we aim to identify inefficiencies and pain points that the proposed system should address.

1.4.1.3 Document Analysis

We will review available forms, payroll sheets, employee records, and any other relevant documents used by the company. Analysing these documents will provide a clearer picture of the data requirements, processes, and structure needed for the digital solution.

1.4.2. System design and analysis

1.4.2.1. Software Development Process Model

For this project, we are applying the **Iterative Software Development Model**. This approach allows us to develop the system in repeated cycles, improving and expanding features based on ongoing evaluation and user feedback [2]. Rather than attempting to deliver the final system all at once, we divide the development process into manageable iterations, each including activities such as requirement gathering, design, implementation, and testing [2]. So by choosing the Iterative Model, we ensure that the HR and Payroll Management System we

develop is both flexible and reliable, tailored to meet the real-world expectations of our target users.

This model suits our project for the following reasons:

- It enables us to **adjust to changes in requirements**, which is crucial when developing for SMEs whose needs might evolve over time.
- Development is carried out in **small, incremental releases**, allowing us to identify risks or technical issues early and resolve them before they impact the entire system.
- Feedback collected from each iteration including from **stakeholders such as SME administrators or staff** guides enhancements and ensures the final system is user-friendly and practical.
- The model fosters **collaboration and consistent team engagement**, helping us stay aligned, share progress, and refine decisions as the project moves forward.

1.4.2.2. Software Analysis and Design Model

In this project, system analysis and design play a vital role in shaping the foundation of our HR and Payroll Management System. This phase involves examining current challenges in employee and payroll management, outlining system requirements, and crafting an efficient and scalable system architecture that aligns with the needs of small to medium-sized enterprises. [4]

To guide this process, we adopt the **OOAD** model. This approach allows us to break down the system into manageable and reusable components (objects) based on real-world entities such as employees, departments, payroll entries, and attendance records. [4]
OOAD provides the following advantages in our project:

- It offers a structured way to analyse the problem and design solutions that reflect real-life business processes.
- Using object-oriented principles like **encapsulation, inheritance,** and **modularity**, we ensure the system is both easy to maintain and flexible for future upgrades.[4]
- It helps us define clear responsibilities for each component, making development more organized and communication between team members smoother.

- The use of class diagrams, use case models, and sequence diagrams during design makes it easier to document and visualize system behaviour from both technical and non-technical perspectives.

Object-Oriented Analysis (OOA)

During the analysis phase, we focus on identifying the key system requirements by observing workflows, interviewing company personnel, and reviewing existing manual processes. We pinpoint critical objects (e.g., Employee, Salary, Leave Request, Department) and define their roles in the system.

Object-Oriented Design (OOD)

In the design phase, we transform the findings from OOA into a detailed software blueprint. This involves creating class hierarchies, defining relationships, and modelling behaviors through interactions. The goal is to produce a design that accurately reflects the HR and payroll functions within an SME, ensuring the system remains intuitive and robust.

By using OOAD, we ensure that our system design is both realistic and aligned with actual business practices, ultimately leading to a better, more maintainable final product.

1.4.2.3 Design Architecture Pattern

For this project, we are adopting the MVC architectural pattern to guide the development and design of our HR & Payroll Management System. This pattern is widely recognized for separating the application logic, user interface, and control flow, which enhances maintainability and clarity [3]. Using This structure aligns well with the modular needs of SMEs, enabling future enhancements like report generation, payroll automation, or third-party integrations without needing to overhaul the entire system.

MVC allows us to:

- Organize the system into logical components, making it easier to develop and debug.
- Support parallel development, where backend and frontend components can be worked on independently.
- Promote reusability and scalability, as system requirements evolve over time.

1.5. System Development Tools

1.5.1. Software Requirement

Table 1.1 Software Requirement

Category	Tools	Description
Programming Languages	Python	Backend logic for payroll calculations, tax compliance, and API integration.
	JavaScript (React)	Frontend development for dynamic user interfaces (e.g., dashboards).
	SQL	Database querying and management.
Frameworks	Django	Backend framework for secure, scalable HR and payroll workflows.
	React.js	Library for building reusable UI components (e.g., employee self-service).
	Bootstrap	Responsive design framework for mobile-friendly layouts.
Database & Server	PostgreSQL	Relational database for storing employee records, payroll, and attendance.
	Nginx	Web server for handling HTTP requests and load balancing.
Development Tools	Visual Studio Code	Code editor for Python, JavaScript, and HTML/CSS development.
	PyCharm	IDE for advanced Django backend debugging.
	Git & GitHub	Version control for collaborative development and code tracking.
Design & Prototyping	Figma	UI/UX design tool for creating wireframes and prototypes.
	Draw.io	For system architecture diagrams and flowcharts.

Testing & Deployment	pytest	Python testing framework for backend logic validation.
	Jest	Testing React components for UI consistency.
	Docker	Containerization for consistent deployment across environments.
Documentation	Microsoft Word	Drafting project reports, user manuals, and technical guides.
	Markdown	Developer documentation (e.g., API endpoints, setup instructions).

1.6. Scope and Limitation

1.6.1. Scope of the project

- Design a simple and intuitive employee registration interface for organizations to on-board staff.
- Enable HR personnel to manage employee profiles, including job titles, departments, and salary details.
- Allow the company to generate and manage monthly payroll based on attendance, overtime, and deductions.
- Provide functionality for uploading and storing employee-related documents (contracts, certificates, etc.).
- Integrate basic payment handling features to calculate and track salary disbursements.
- Develop an admin panel for authorized users to view, approve, and manage HR and payroll operations.
- Offer employees real-time access to their salary history, payslips, and leave balances through a self-service portal.

1.6.2. Limitation of the project

- Functional Scope: The system does not support advanced HR functions like performance reviews, recruitment workflows, or training management.

- Platform Compatibility: Initial development focuses on web browsers, limiting mobile accessibility until future phases.
- Integration Constraints: The system does not integrate with external accounting software (e.g., QuickBooks) or legacy payroll systems.
- Fraud Detection Limitations: While data validation rules minimize errors, the system cannot detect sophisticated payroll fraud (e.g., collusion between employees and managers).
- Biometric Attendance: The absence of fingerprint or facial recognition requires manual verification for attendance disputes.
- Scalability: Designed for SMEs with up to 500 employees, the system may require optimization

1.7. Significance of the Project

This project aims to provide a practical solution to the challenges faced by SMEs in managing human resources and payroll operations. By implementing a centralized HR and Payroll Management System, this project will:

- Improve operational efficiency by automating core HR tasks such as employee record management, salary calculation, and leave tracking.
- Enhance transparency and accountability in payroll processing, reducing the chances of payment errors and disputes.
- Save time and administrative effort for both HR staff and company management through easy access to organized data and reports.
- Support better decision-making by providing timely and structured information on employee performance, attendance, and compensation.
- Strengthen compliance with employment policies and labour laws through proper documentation and system-generated records.
- **Enables Employees to Track and View Their Data**: Employees can **log in to the system** to view and monitor their payroll details, leave status, and other personal records in real-time, improving their engagement and reducing the need for HR to handle repetitive queries.

1.8. Feasibility Study

A feasibility study is essential to assess whether the proposed **HR & Payroll Management System** is practical, financially viable, and capable of achieving its objectives within the constraints of the project. The study evaluates the technical, operational, and financial aspects of the project to determine if it is worth pursuing. In the context of this project, we focus on three main feasibility areas:

1.8.1. Technical Feasibility

This aspect evaluates whether the necessary technology and resources are available to develop and deploy the system successfully.

- The project will be built using widely adopted technologies that ensures compatibility with various devices and platforms.
- The system can operate on standard computer and mobile devices that meet the basic requirements for web and mobile app usage. It does not require complex or high-end hardware, making it accessible for small and medium enterprises with limited IT resources.
- **Integration with Existing Systems**: The system will not require integration with legacy payroll or accounting systems, reducing potential complications related to legacy data migration or system compatibility.
- The system will incorporate strong security protocols, such as **SSL encryption** for data transmission and secure authentication methods to protect sensitive employee and payroll data.

1.8.2. Operational Feasibility

This aspect assesses whether the organization has the capability to operate the system after implementation and whether it meets the intended business needs.

- The system is designed to be intuitive and easy to use for both HR staff and employees. The registration and payroll management processes are simplified to minimize training time for staff and reduce the likelihood of errors.

- The system allows employees to easily track their payroll information, leave balances, and other personal records. This transparency promotes better engagement and reduces the need for HR staff to address routine inquiries.
- The system will require minimal maintenance after deployment. Regular updates and troubleshooting will be handled by an internal or outsourced team to ensure smooth operation.
- Given the user-friendly nature of the system, employees will be able to adapt quickly to the system. Furthermore, the ability to access payroll details and leave balances enhances employee satisfaction, encouraging wider adoption.

1.8.3. Financial Feasibility

This aspect examines whether the project is financially viable and can be completed within the allocated budget.

- For documentation or any physical copies required during the development process or final submission.
- If we decide to host the project on a server for testing or showcasing, there may be minimal hosting costs depending on the chosen platform.
- While many development tools and libraries are free, if we decide to use any paid tools or services, there may be associated costs.
- As we are focused on completing the project for graduation, these costs will be kept to a minimum. If the project is later scaled for real-world deployment, further financial considerations would be made at that stage.

1.8.4. Legal and Regulatory Feasibility

The system will comply with applicable labor laws and payroll regulations, such as:

- **Labor Law Compliance:** The system will incorporate features that ensure payroll calculations and tax deductions align with national labor laws.
- The system will adhere to privacy regulations regarding employee data, including secure data storage and user consent for data usage.

1.9. Risk, assumption and constraints

1.9.1. Risk

During the development and management of this project, we may face the following challenges:

- Limited Internet Access: Users, particularly in remote or rural areas, may experience slow or unreliable internet connections, which could hinder their ability to fully access and use the system.
- Data Privacy Concerns: Users might be hesitant to upload sensitive personal documents or share their data through the system due to concerns over data security and privacy. This could lead to reduced user engagement.
- Technology Adoption Barriers: There might be a general reluctance from certain users to adapt to the new system, especially if it requires learning how to use mobile apps or online forms. This could affect the overall user base.
- Unwillingness of Company Employees to Cooperate: Employees within the organization may be resistant to adopting the new system due to unfamiliarity with technology or reluctance to change from manual processes. This could affect the system's implementation and usage.
- Unforeseen Bugs or System Downtime: During development, unforeseen bugs or technical issues could arise, delaying the system's deployment. Additionally, after deployment, there could be periods of downtime that impact the system's availability.
- Legal or Regulatory Changes: Changes in data protection laws, HR management regulations, or government policies could require rapid updates to the system, potentially causing delays or additional work.

1.9.2. Assumptions

During the development and management of this project, we are assuming the following:

- It is assumed that users will have access to internet-enabled devices (smartphones or computers) to access the system.
- The development team is assumed to have the necessary skills to design, implement, and deploy the system successfully.

- It is assumed that stakeholders will participate and provide valuable input and feedback during the project's development.
- It is assumed that users will have a reliable internet connection to access the system, which could impact the user experience in areas with unstable internet service.
- Tax regulations will remain stable during the 5-month development period.
- Employees have basic digital literacy to use self-service portals.
- The university's lab resources (e.g., servers) will be available for testing.

1.9.3. Constraints

- Budget Limitations: Since this is a school project, financial resources are limited, and the project will rely heavily on free tools and resources, with minimal budget for external services or technologies.
- Time Constraints: The project must be completed within the academic timeline, which could limit the depth of features or thorough testing available before final deployment.
- Technology Constraints: The project will focus on basic features for payroll management and document handling, leaving out more advanced functionalities like facial recognition, fingerprint scanning, or integration with external systems like accounting software.

1.10 Work Breakdown

Table 1.2: Work Breakdown Structure

Task Name	Description	Duration (Weeks)
Requirement Analysis		
Requirements Gathering & Analysis	Collect business needs from stakeholders (e.g., HR staff), study manual processes, and document detailed system requirements.	2
Requirement Management & Change Tracking	Handle scope changes and update requirements due to evolving payroll policies or SME-specific workflows.	Ongoing throughout the project
System Design		

System Modeling & Workflow Design	Create diagrams (use case, class, activity) to illustrate how the system will handle user roles, document flows, and payroll processing.	3
UI/UX Prototyping	Design and prototype web interfaces for both admin and employee portals with a focus on ease of use and clarity.	2
System Architecture & Design	Use MVC architecture to plan a modular, scalable backend and integrate it with frontend components.	4
Architecture Refinement	Continuously revise and improve architecture and design decisions throughout development and testing phases.	Distributed throughout project
Coding		
Feature Development – Core Modules	Build the main functionalities: employee records, payroll processing, attendance tracking, role-based access, and dashboard.	5
Document Upload & Validation	Implement secure upload and basic validation for personal documents (IDs, payment records, etc.)	1
Payroll Calculation & Report Generation	Automate salary calculations and generate downloadable salary slips or reports.	2
Testing		
Testing & Quality Assurance	Conduct functional and integration testing, fix bugs, and ensure it meets SME needs.	2
Feedback & Maintenance		
Feedback Loop & UI Revisions	Collect feedback from mock users (e.g., students or instructors) and revise UI/UX based on feedback.	1
Deployment		
Deployment Setup	Prepare deployment on free or low-cost web hosting, configure environment, and test production environment.	1
Documentation & Final Delivery		
Documentation & Reporting	Write technical documentation, user manuals, and compile the final graduation project report.	1

Final Submission & Presentation	Organize deliverables and prepare slides and visuals for final presentation/ defence.	1

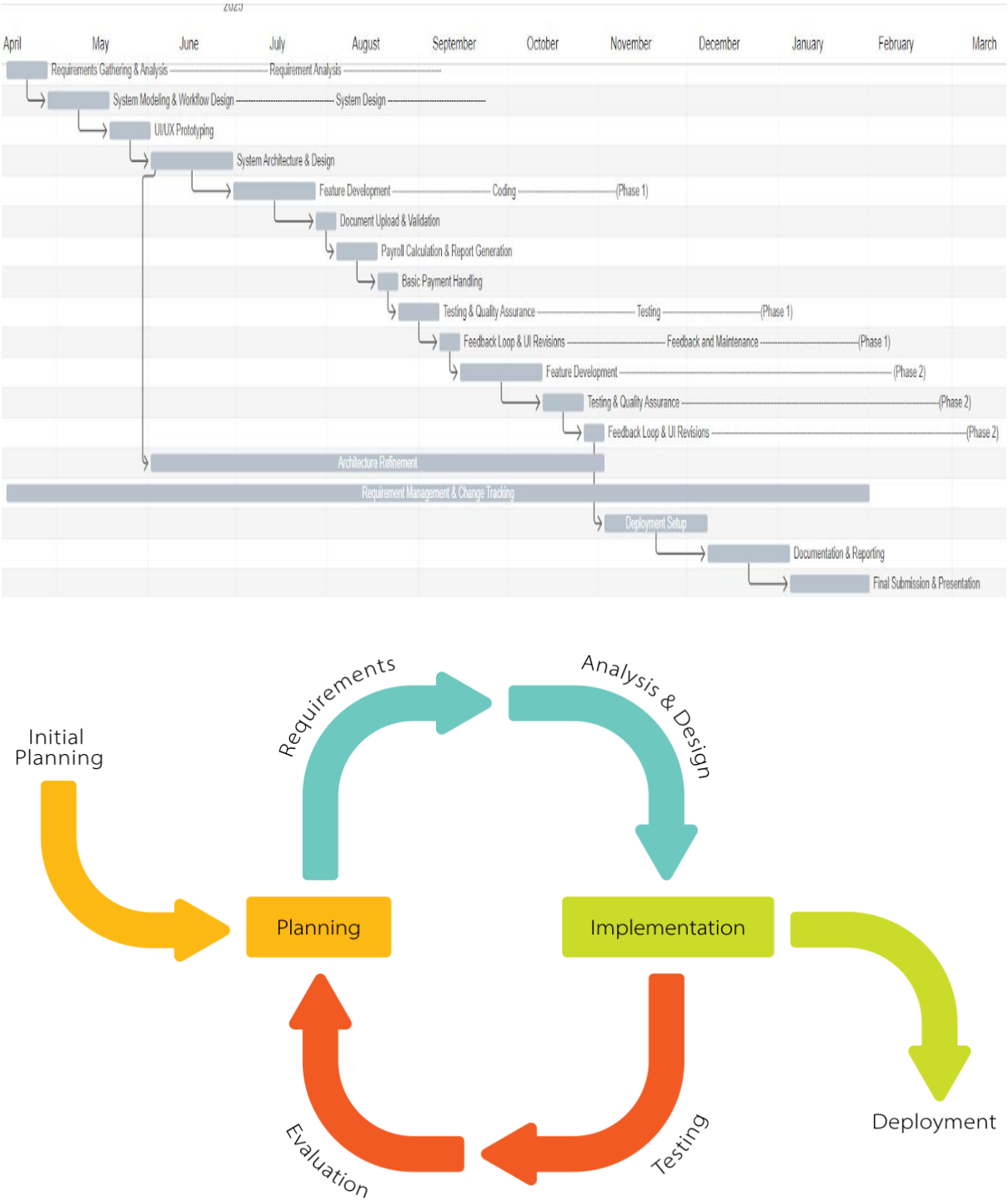

Figure 1.1Project Gantt Chart and Iterative model of the project

Chapter Two

Requirement Analysis and Specification

2.1 Introduction

In this chapter, we will conduct an in-depth analysis of the business environment related to the development of the HR and Payroll Management System for SMEs. The primary objective of this analysis is to understand the organizational structure, workflows, and administrative processes involved in managing human resources and payroll activities.

Based on this analysis, we will define the functional requirements of the proposed system which may include managing employee records, processing payroll, generating payslips, and handling leave requests. In addition, we will outline the non-functional requirements, which address system qualities such as usability, reliability, security, and performance. To better illustrate how the system will operate and interact with its users, we will also include system modelling tools such as use case diagrams, activity diagrams, and sequence diagrams. These models will serve to clarify system functionality and ensure the solution aligns with both business needs and technical feasibility.

2.2. Detailed Analysis

To conduct a comprehensive analysis of the proposed HR and Payroll Management System, we employed a range of data collection methods, including formal interviews, surveys, direct observations, and document analysis. These approaches were focused on SMEs, particularly commerce institutions, to gain contextual understanding of their internal HR and payroll operations, the challenges they face, and the features they expect from a modernized system.

We interviewed key personnel in selected companies, including DGM, Finance and Administration such as Finance manager, HR Services manager, General Services Head. These stakeholders offered valuable insights into their current practices and the difficulties they experience with manual or semi-automated systems. The interviews were guided by specific themes to ensure comprehensive coverage of relevant business processes:

- HR Processes: We inquired about how employee records are managed, including on boarding, promotions, leave tracking, and contract termination. It was noted that many

organizations still rely on paper-based files or disconnected spreadsheets, which increases the likelihood of data loss and errors.

- Payroll Processing: We explored how salaries are calculated, approved, and disbursed. Respondents indicated that salary calculations are often done using semi-automated way, making them prone to miscalculations, especially when organizing data and considering overtime, deductions, bonuses, or tax computations.
- Roles and Responsibilities: We asked managers and HR staff to describe the roles within their HR and finance departments. This helped us understand the hierarchy and workflow.
- Challenges: We observed that the organization relies on manual or semi-automated (Excel-based) systems for key HR functions such as employee attendance tracking, announcements, and on boarding. These manual processes often lead to common challenges, including delays, data inconsistencies, difficulty in maintaining accurate records, and limited accessibility to centralized employee information.

Furthermore, most the of respondents showed strong interest in a self-service digital platform that would enable them to access and manage their own HR-related information. Desired features that have been mentioned include automated payslip generation, leave request and tracking tools, attendance monitoring, performance evaluation access, and departmental reporting. Respondents also emphasized the need for secure role-based access, allowing different user types (e.g., employees, HR managers, finance officers) to access only the information relevant to their roles. These survey results, supported by direct observations of current practices, underline a clear need for an integrated and user-friendly HR and payroll management system tailored to the operational needs of growing organizations.

2.3. Current System

The HR and payroll management processes in most small to medium-sized enterprises, particularly within commercial institutions, are heavily reliant on manual methods and disconnected systems. Employee records are often kept in paper files or Excel spreadsheets, and attendance tracking is done manually through paper sign-in sheets or physical forms. Payroll calculations are performed in semi-automated way using tools like Peachtree and other methods by finance staff, who gather data from department heads and HR officers. This process is prone to errors, delays, and inconsistencies, particularly when accounting for overtime, deductions, bonuses, or leave entitlements.

Employees face significant challenges in accessing their own HR and payroll information. To view payslips, check leave balances, or review performance evaluations, they must rely on HR or finance staff, leading to delays and frustration. The lack of a self-service system means employees are left without real-time access to their data, contributing to a lack of transparency. Moreover, the communication between HR, payroll, and department managers is primarily conducted through manual channels, which leads to inefficiencies in the payroll approval process and further delays in processing. These issues highlight the urgent need for a more automated, transparent, and user-friendly system to streamline HR and payroll operations.

2.3.1. Problems Observed

- **Manual Data Entry**: The current HR and payroll processes require manual data entry for employee records, attendance, and payroll details. This is time-consuming and prone to errors, especially when calculating salary components, leave balances, and bonuses.
- **Limited Employee Access to Information**: Employees face difficulties in accessing their payslips, leave balances, or performance evaluations. They must rely on HR or finance staff to provide this information, which leads to delays and frustration. The absence of a self-service portal limits transparency and self-management.
- **Payroll Calculation Errors**: The manual payroll calculation process often leads to miscalculations, especially with overtime, bonuses, deductions, and tax computations. This creates discrepancies and delays in salary disbursement.
- **Manual Attendance Tracking**: Attendance is often tracked using paper-based forms or manually updated spreadsheets. This not only creates room for inaccuracies but also makes it difficult to track leave balances or verify attendance records in real time.
- **Staff Workload**: The reliance on manual processes places an overwhelming workload on HR and payroll staff, resulting in inefficiencies and delays in processing requests such as leave approvals, salary disbursements, and employee inquiries.
- **Lack of Payroll Transparency**: Employees often have little visibility into how their pay is calculated, including deductions, bonuses, and other allowances. This lack of transparency can lead to dissatisfaction and a lack of trust in the payroll system.
- **Data Security Concerns**: Sensitive employee information is stored in both physical and digital formats, increasing the risk of data breaches and unauthorized access.

- **Inefficient Communication between Departments**: The communication between HR, payroll, and department managers is largely manual and disjointed, causing delays in approvals and the payroll processing cycle.
- **Limited Scalability**: The current system, relying on manual processes spreadsheets and excels, is not scalable as the organization grows, leading to further inefficiencies and potential errors.

2.3.2. Players of the Existing HR and Payroll System

The key players involved in the HR and payroll system include:

- **Employees**: Individuals who receive salary and benefits from the organization. They interact with the system to submit personal data, request leave, check attendance, and view/download payslips. Their limited access is based on their profile, allowing them to manage only their personal data and requests.
- **HR Manager**: The HR Manager is responsible for managing all employee-related data and overseeing HR functions such as recruitment, attendance management, leave requests, and performance tracking. The HR Manager interacts with the system to add/edit employee records, approve/reject leave requests, and generate HR reports.
- **Payroll Officer**: Responsible for calculating salaries, processing payroll, and handling bonuses, deductions, and statutory compliance (e.g., taxes and pension contributions). The Payroll Officer uses the system to generate payslips, process payments, and create financial reports.
- **General Administrator / System Admin**: Oversees system-level operations, ensures security, and manages user roles and permissions. The System Admin handles user account management, access control, system configuration, data security, and system backups.
- **Department Managers**: Department Managers, such as Marketing or Training Managers, act as intermediaries between employees and upper management. They are involved in approving/rejecting leave requests, providing performance feedback, and ensuring attendance data is accurate. They interact with the system to approve leave, submit performance evaluations, and manage work schedules.

2.4. Business Rules

- **BR-01:** Employees must provide all required documents and files that meet the necessary qualifications and standards to be considered for employment and during the on-boarding process.
- **BR-02:** Employees must submit leave requests through the system, and they are not permitted to take leave without proper approval.
- **BR-03:** Employees can only access their own records such as payslips, attendance, and profile access to other employee data is restricted.
- **BR-04:** Only the HR Manager can create, update, or delete employee records, including job roles and contract status.
- **BR-05:** All leave requests must be reviewed and finalized by the HR Manager after department-level approval.
- **BR-06:** Department Managers are responsible for reviewing and passing the attendance and leave records of their team members.to the HR manager
- **BR-07:** Salary calculations must be based on approved attendance, leaves, bonuses, deductions and overtime.
- **BR-08:** The finance department must generate payslips monthly and ensure their availability to employees in the system.
- **BR-09:** All payroll reports and payment processes must follow legal standards regarding taxes, deductions, and contributions.
- **BR-10:** The System Admin must manage access rights, ensuring that users only access functions and data relevant to their roles.
- **BR-11:** System backups must be performed regularly to prevent data loss and ensure system reliability.
- **BR-12:** Any change to critical data (e.g., attendance, salary structure, system settings) must be logged and traceable for auditing.

2.5 Proposed system

2.5.1. Overview

The proposed solution, titled “HR and Payroll Management System,” is a web-based platform designed to automate and modernize the human resource and payroll operations of SMEs. It is intended to replace the existing manual methods of managing employee records, attendance tracking, leave processing, and salary computations, all of which have contributed to inefficiencies, inaccuracies, and administrative burdens in the current system.

The proposed system directly responds to the shortcomings observed in the manual process. Manual data entry, which has proven to be time-consuming and error-prone, will be replaced with digital forms and automated processing for all core HR and payroll functions. This minimizes calculation mistakes and ensures data consistency throughout the system. Employees, who previously had limited access to their own information, will benefit from a self-service portal that allows them to securely view and manage their personal profiles, check attendance logs, track leave balances, and download payslips without needing to contact HR staff. This self-reliance not only increases employee satisfaction but also reduces the workload on HR personnel.

The system eliminates payroll calculation errors by automating all salary-related computations, including allowances, deductions, bonuses, overtime, and statutory tax contributions. These calculations are dynamically linked to attendance records and approved leave data, ensuring accuracy and transparency in salary disbursements. Attendance tracking, which was previously handled through paper-based or spreadsheet methods, will now be digitized. Employees or HR managers can input attendance data directly into the system, allowing real-time monitoring and eliminating the inaccuracies often associated with manual input.

Communication between departments is significantly improved through system notifications, real-time status updates, and shared dashboards. This integration allows HR, payroll, and department managers to collaborate more effectively, streamlining workflows and ensuring everyone remains informed about key tasks and approvals. Finally, the platform is designed with scalability in mind. Unlike spreadsheets and paper-based processes that quickly become unwieldy as an organization grows, this system can easily accommodate a growing workforce without compromising performance or usability.

2.5.2. Functional Requirements

This section outlines the functional requirements of the HR and Payroll Management System. Functional requirements define the specific operations, processes, and features that the system must support in order to fulfil the needs of its users. Each user role in the system is granted distinct permissions and access rights that align with their responsibilities.

Employee

- Log in securely using email and password credentials.
- View and update personal profile information (e.g., contact info, bank details).
- Submit leave requests and track their approval status.
- View monthly attendance reports.
- Access and download payslips and salary details if the company permits.
- Submit complaints, requests, or HR inquiries.
- Receive notifications for salary disbursements, announcements, or approved requests.

Department Manager

- Log in using a secure username and password.
- View the list of employees under their supervision.
- Review and approve or reject leave requests submitted by employees in their department.
- Submit performance feedback or appraisal data for employees.
- Monitor attendance trends and raise concerns to HR if needed.
- View department-specific reports such as absence rates or performance records.

HR Manager

- Log in securely with admin credentials.
- Manage employee records including hiring, updating, or terminating employee profiles.
- Track and process leave requests received from department managers.
- Record and monitor employee attendance manually or via automated integrations.
- Assign roles and departments to new employees.
- Initiate and manage performance review cycles.

- Handle HR-related announcements and documentation distribution (e.g., policy updates).
- Generate reports on HR metrics such as turnover, absenteeism, and workforce composition.

Payroll Officer

- Log in with secure credentials.
- Calculate monthly payroll based on attendance, overtime, deductions, and bonuses.
- Generate and distribute digital payslips to employees (optional).
- Manage payroll rules, such as tax brackets, allowances, and statutory deductions.
- Handle salary adjustments, arrears, or advances.
- Generate payroll reports for management and financial audits.
- Export payroll data to external systems or accounting software if needed.

System Administrator

- Access the system using secure admin credentials.
- Create, manage, and deactivate user accounts for all roles (HR, Payroll, Managers, etc.).
- Define and enforce access permissions and role-based functionalities.
- Configure system-wide settings such as departments, job titles, working hours, and holidays.
- Monitor system activity logs and security events.
- Backup system data and restore previous versions if required.
- Ensure system updates, uptime monitoring, and general maintenance.

2.5.3 Non-functional Requirements

In this section, we define the non-functional requirements of the HR and Payroll Management System. These requirements specify how the system should behave, perform, and exhibit certain qualities, ensuring it meets the expectations of users and stakeholders in terms of usability, security, performance, and other aspects.

Usability: The HR and Payroll Management System shall provide an intuitive, easy-to-use interface for all users, including HR managers, employees, payroll officers, and system administrators. The system should be designed with simplicity in mind, ensuring that users can quickly navigate and perform tasks such as managing employee records, submitting leave requests, or processing payroll with minimal training. The interface should be responsive, adjusting seamlessly across various screen sizes to accommodate both desktop and mobile users.

Security: The system shall enforce strict security protocols to ensure that only authorized users can access sensitive data and perform restricted actions. This includes RBAC to grant varying levels of permissions based on user roles, such as HR managers, payroll officers, and employees. All sensitive information, such as payroll data, employee personal details, and salary information, shall be encrypted both in transit and at rest. 2FA shall be implemented for added security during login for all administrative roles.

Maintainability: The system shall be built with a modular architecture that allows for easy updates and maintenance. The code should be well-documented, with clear comments and instructions for future developers and maintainers. Additionally, the system should follow best practices in software design, ensuring that new features, bug fixes, or updates can be implemented without significant disruption to the service. This will make it easier to handle future upgrades.

Reliability: The HR and Payroll Management System should exhibit high reliability, ensuring that critical functions such as payroll processing, employee record management, and attendance tracking are available and function properly without failure. In case of an error, the system should provide clear error messages and allow users to recover from failures or perform

corrective actions quickly. Automatic backups of employee and payroll data should be scheduled regularly to prevent data loss.

Compliance: The system must comply with local labour laws, tax regulations, and any other relevant government regulations regarding payroll processing, benefits, and recordkeeping. The system should be capable of generating reports that meet legal and regulatory standards for tax filings and audits.

2.5.4.1 Use Case Model

2.5.4.1.1 Actor Identification

Table 2.1 Actor Identification

Identification	Description	Role
AC-00: Employee	An individual employee whose personal information and work-related data are stored in the system.	Can view and manage personal information, submit leave requests, view attendance, access personal data's, and update contact details.
AC-01: HR Manager	A senior HR professional who is responsible for overseeing and managing employee records, recruitment, training, and employee relations.	Can manage employee records, approve/reject leave requests, monitor attendance, generate general reports, and ensure compliance with HR policies.
AC-02: Payroll Officer	A professional responsible for processing and managing employee payroll, including the calculation of salaries, benefits, and tax deductions.	Can calculate and process employee salaries, generate payslips, handle payroll-related inquiries, and ensure tax compliance.

AC-03:Department manager	A manager who oversees a department and has the responsibility for managing team-specific functions such as approving leave and monitoring employee performance within their department.	Can approve/reject leave requests, monitor attendance, provide performance feedback, and submit department-level reports.
AC-04: System Administrator	A user who manages the configuration, security, and maintenance of the HR and Payroll Management System.	Can manage user roles and permissions, perform system backups, configure system settings, and ensure data security and system integrity.
AC-05: Senior Manager	Higher-level executives (e.g., CEO, CFO) who require access to high-level reports related to payroll, employee performance, and attendance.	Can access payroll summaries, review financial and performance reports, and approve financial decisions or budget allocations.

2.5.4.1.2 Use Case Identification

Table 2.2 Use Case Identification

Use Case Name	**Use Case ID**
Sign up	UC-1
Login	UC-2
Manage Profile	UC-3
Add Employee Information	UC-4
Upload Documents (Employee)	UC-5
Generate Payroll	UC-6

Request Leave	UC-7
Approve/Reject Leave	UC-8
View Attendance	UC-9
Track Employee Attendance	UC-10
Manage Employee Account	UC-11
Update Employee Information	UC-12
View Employee Reports	UC-13
Manage Department Information	UC-14
View Payroll Report	UC-15
Manage Payroll System	UC-16
Assign Roles & Permissions	UC-17
Manage Tax Information	UC-18
Generate Tax Reports	UC-19
View Employee Salary History	UC-20
Schedule Payroll Runs	UC-21
View Notifications	UC-22
Send Notifications	UC-23
Manage Holidays	UC-24
Manage Time Off Requests	UC-25
Log Out	UC-26

2.5.4.1.3 Use Case Diagram

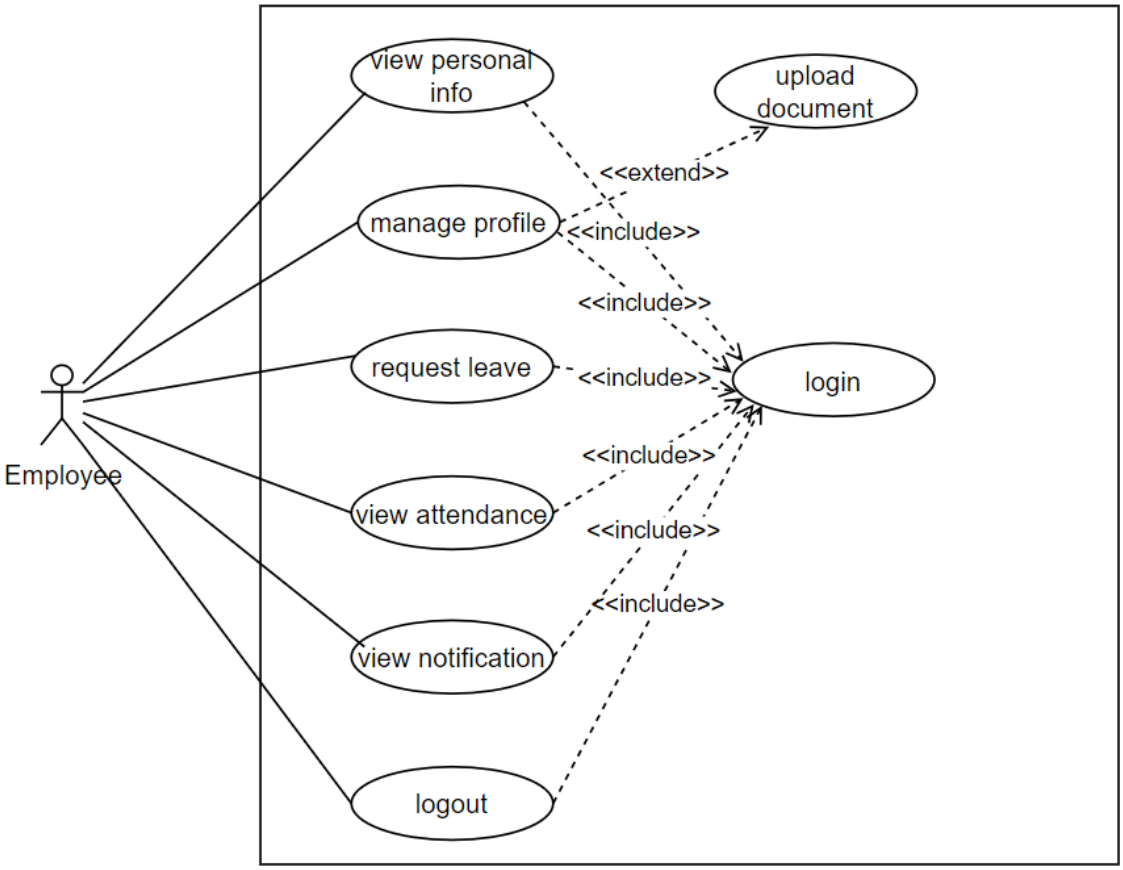

Figure 2.1 Use Case Diagram for Employee

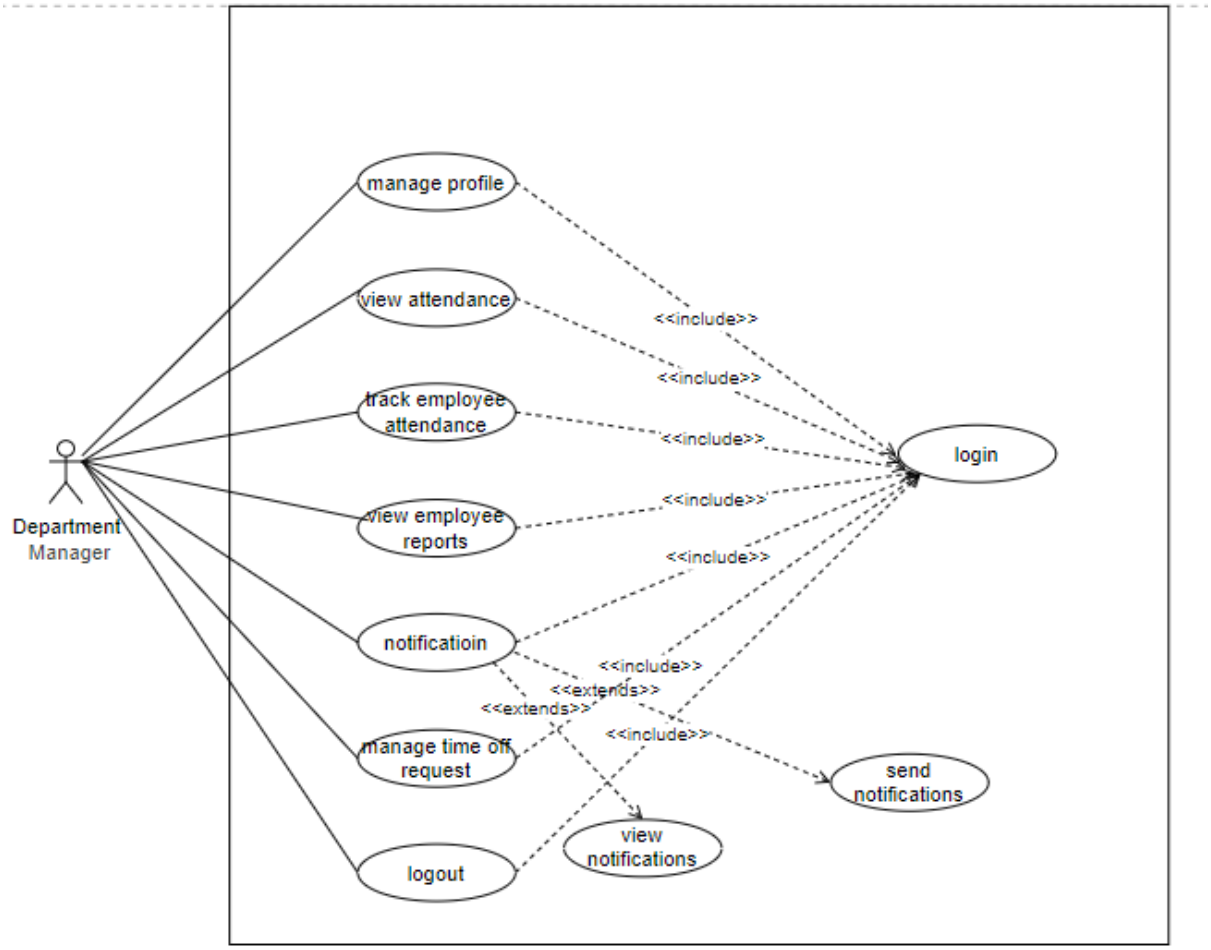

Figure 2.2 Use Case Diagram for Department Manager

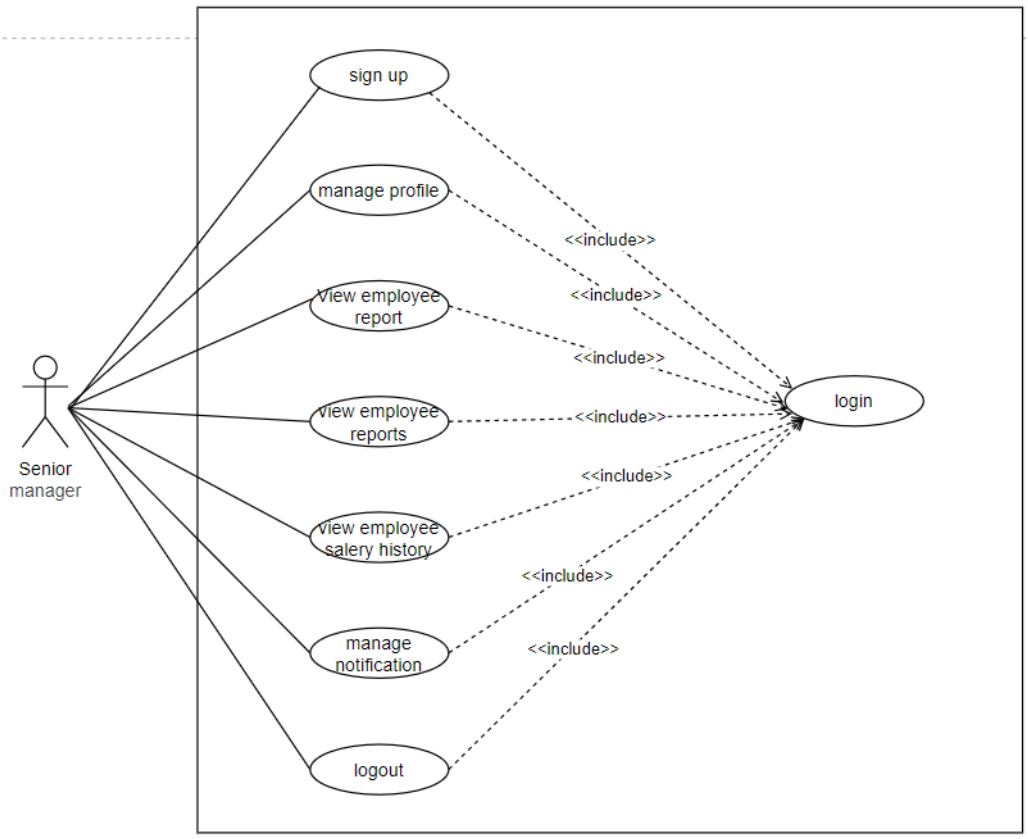

Figure 2.3 Use Case Diagram for Senior Manager

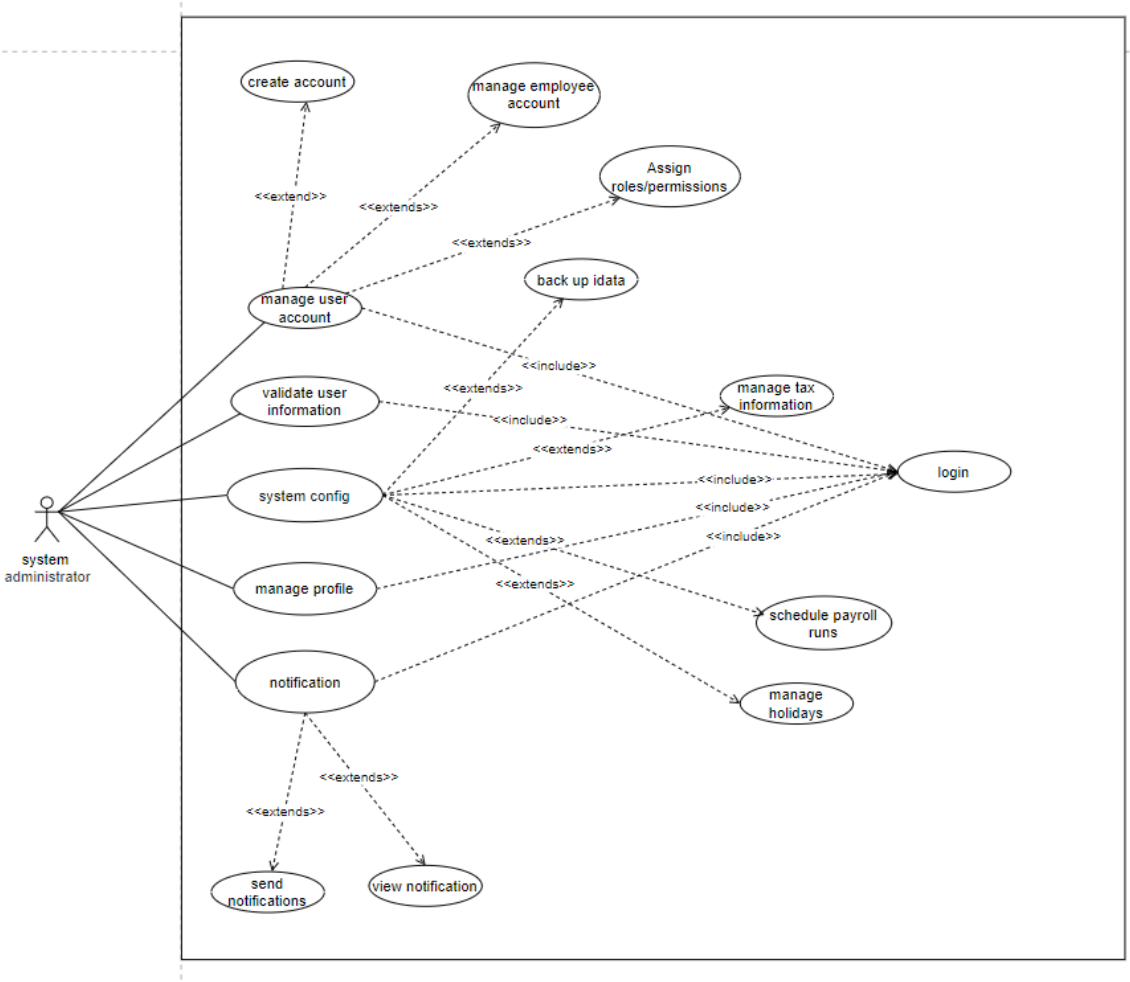

Figure 2.4 Use Case Diagram for System Administrator

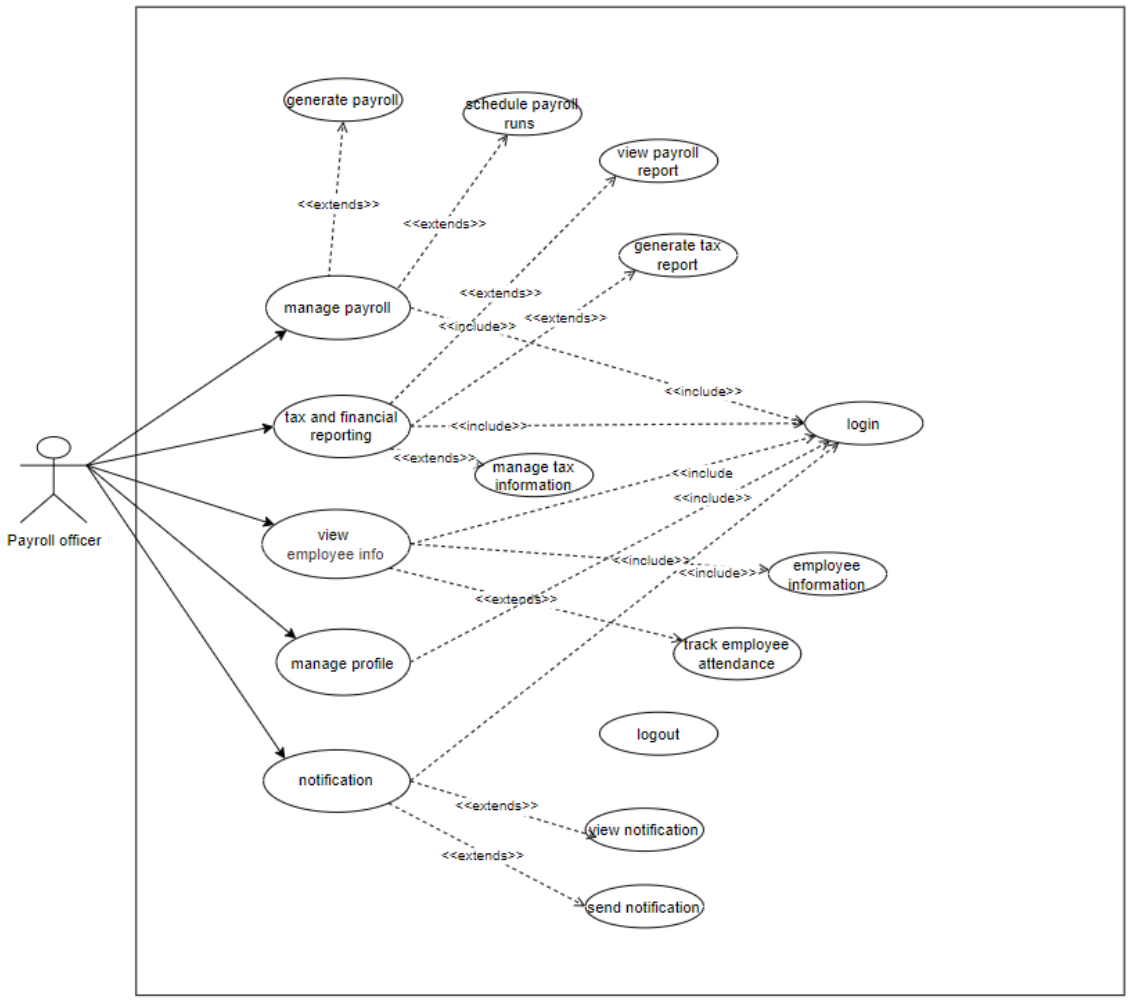

Figure 2.5 Use Case Diagram for Payroll officer

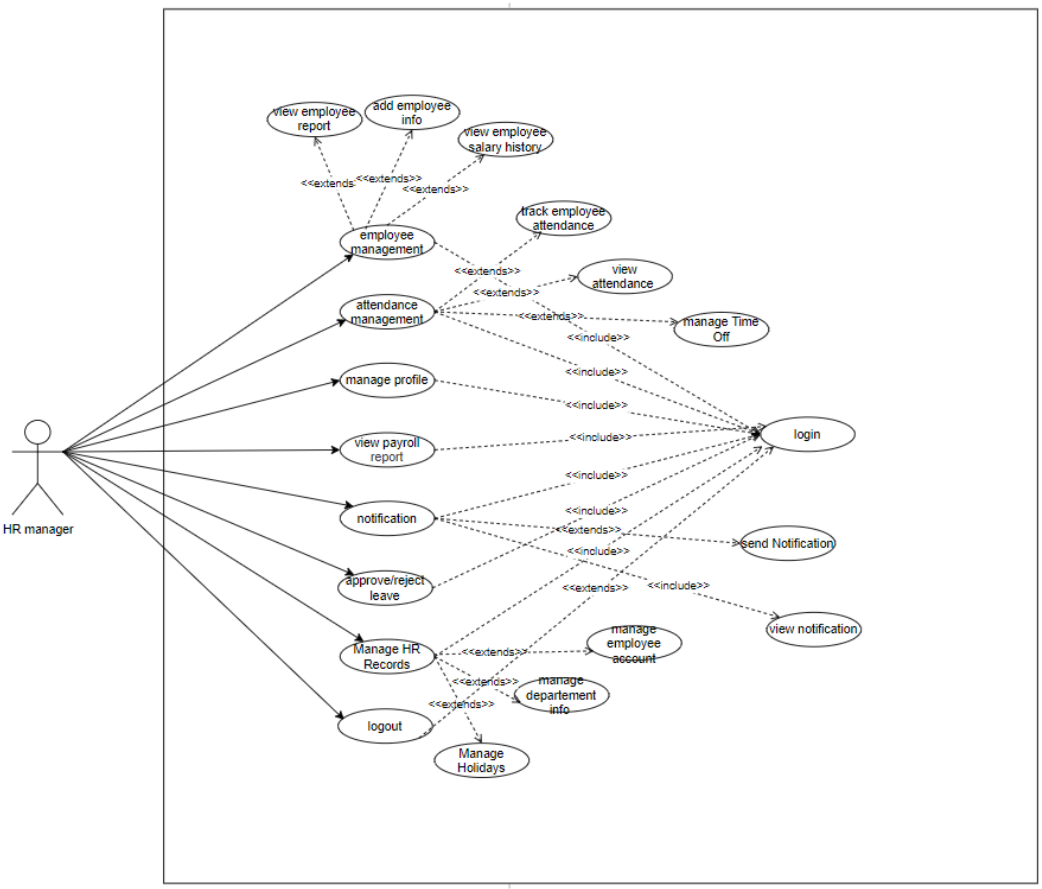

Figure 2.6 Use Case Diagram for Hr Manager

2.5.4.1.4 Use Case Description

Table 2.3: Use Case Description for Sign Up

UC Identification	UC-1
Use Case Name	Create account
Description	This use case allows a new user account to be registered in the HR and Payroll Management System by authenticated actors to access its features.
Actor	System Administrator, Senior Manager

Pre-condition	The user must have access permission and detail info about the user to be registered
Post-condition	The actor has successfully created an account for the new user, and their credentials are stored in the system, pending verification or approval if required.
Basic Flow	1. The actor navigates to the add-user section of the system. 2. The system displays a registration form requesting details (e.g., name, email, employee ID, password, and other required information). 3. The user enters the required information and submits the form. 4. The system validates the input (e.g., checks for unique email or employee ID). 5. The system creates the user account and sends a confirmation (e.g., email verification link or notification to the CEO or HR manager for approval).

Table 2.4: Use Case Description for Login

UC Identification	UC-2
Use Case Name	Login
Description	This use case allows a registered user to log in to the HR and Payroll Management System to access their authorized features.
Actor	Employee, HR Manager, Payroll Officer, Department Manager, System Administrator, Senior Manager
Pre-condition	The user must have a registered account in the system and valid login credentials (e.g., email/username and password).

Post-condition	The user is successfully authenticated and granted access to the system with permissions corresponding to their role.
Basic Flow	1. The user navigates to the login section of the system. 2. The system displays a login form requesting credentials (e.g., email/username and password). 3. The user enters their credentials and submits the form. 4. The system validates the credentials against the stored user data. 5. The system grants access and redirects the user to their role-specific dashboard.

Table 2.5: Use Case Description for Manage Profile

UC Identification	UC-3
Use Case Name	Manage Profile
Description	This use case allows a user to view and update their personal profile information in the HR and Payroll Management System.
Actor	Employee, HR Manager, Payroll Officer, Department Manager, System Administrator, Senior Manager
Pre-condition	The user must be logged into the system with valid credentials and have access to the profile management section.
Post-condition	The user's profile information is successfully updated in the system, and changes are saved (e.g., updated contact details).
Basic Flow	1. The user navigates to the profile management section of the system. 2. The system displays the user's current profile information (e.g., name, email, phone number …). 3. The user selects the option to edit their profile.

	4. The user updates the desired and permitted fields (e.g., contact details, address) and submits the changes. 5. The system validates the input (e.g., checks for valid email format) and saves the updated profile information. 6. The system confirms the successful update to the user.

Table 2.6: Use Case Description for Add Employee Information

UC Identification	UC-4
Use Case Name	Add Employee Information
Description	This use case allows an authorized user to add a new employee's information to the HR and Payroll Management System.
Actor	HR Manager, System Administrator
Pre-condition	The user must be logged into the system with valid credentials, have the necessary permissions to manage employee records, and have the required employee details (e.g., name, employee ID, contact information).
Post-condition	The new employee's information is successfully added to the system, and their record is created for further management (e.g., payroll, attendance).
Basic Flow	1. The user navigates to the employee management section of the system. 2. The system displays an option to add a new employee. 3. The user selects the option to add a new employee and is presented with a form. 4. The user enters the required employee details (e.g., name, employee ID, contact information, department, and salary). 5. The user submits the form.

	6. The system validates the input (e.g., checks for duplicate employee ID) and saves the new employee record. 7. The system confirms the successful addition of the employee information.

Table 2.7: Use Case Description for Upload Documents (Employee)

UC Identification	UC-5
Use Case Name	Upload Documents (Employee)
Description	This use case allows an employee to upload required documents to the HR and Payroll Management System for verification or record-keeping.
Actor	Employee
Pre-condition	The employee must be logged into the system with valid credentials and have access to the document upload section, with the documents in a supported format (e.g., PDF, JPEG).
Post-condition	The employee's documents are successfully uploaded to the system and stored for review or processing by authorized personnel (e.g., HR Manager).
Basic Flow	1. The employee navigates to the document upload section of the system. 2. The system displays a form or interface for uploading documents. 3. The employee selects the document type (e.g., ID proof, tax forms, certificates) and uploads the file(s). 4. The employee submits the uploaded documents. 5. The system validates the upload (e.g., checks file format and size) and stores the documents in the employee's record.

	6. The system confirms the successful upload to the employee and may notify relevant personnel (e.g., HR Manager) for review.

Table 2.8: Use Case Description for Generate Payroll

UC Identification	UC-6
Use Case Name	Generate Payroll
Description	This use case allows an authorized user to calculate and process payroll for employees, including salaries, deductions, and taxes.
Actor	Payroll Officer
Pre-condition	The user must be logged into the system with valid credentials, have permissions to manage payroll, and have access to employee data (e.g., attendance, salary details, tax information).
Post-condition	The payroll is successfully generated, employee salaries are calculated, and the data is ready for disbursement and payslip generation.
Basic Flow	1. The user navigates to the payroll management section of the system. 2. The system displays options to generate payroll for a specific period (e.g., monthly). 3. The user selects the payroll period and initiates the payroll generation process. 4. The system retrieves relevant employee data (e.g., hours worked, bonuses, deductions, taxes). 5. The system calculates each employee's salary based on the data. 6. The user reviews the calculated payroll and confirms the process. 7. The system finalizes the payroll, stores the data, and prepares it for disbursement and payslip generation.

	8. The system confirms the successful generation of payroll.

Table 2.9: Use Case Description for Request Leave

UC Identification	UC-7
Use Case Name	Request Leave
Description	This use case allows an employee to submit a leave request for approval in the HR and Payroll Management System.
Actor	Employee
Pre-condition	The employee must be logged into the system with valid credentials, have access to the leave request section, and have sufficient leave balance (if applicable).
Post-condition	The leave request is successfully submitted and stored in the system, awaiting approval from the appropriate authority (e.g., Department Manager or HR Manager).
Basic Flow	1. The employee navigates to the leave request section of the system. 2. The system displays a form for submitting a leave request, including fields for leave type (e.g., vacation, sick), dates, and reason (optional). 3. The employee fills out the form and submits the leave request. 4. The system validates the request (e.g., checks leave balance, date conflicts). 5. The system saves the request and notifies the appropriate approver (e.g., Department Manager or HR Manager). 6. The system confirms to the employee that the leave request has been submitted.

Table 2.10: Use Case Description for Approve/Reject Leave

UC Identification	UC-8
Use Case Name	Approve/Reject Leave
Description	This use case allows an authorized user to review and approve or reject leave requests submitted by employees in the HR and Payroll Management System.
Actor	HR Manager, Department Manager
Pre-condition	The user must be logged into the system with valid credentials, have permissions to approve/reject leave requests, and a leave request must have been submitted by an employee.
Post-condition	The leave request is either approved or rejected, the employee's leave record is updated, and the employee is notified of the decision.
Basic Flow	1. The user navigates to the leave management section of the system. 2. The system displays a list of pending leave requests from employees. 3. The user selects a specific leave request to review. 4. The system displays the details of the leave request (e.g., leave type, dates, reason). 5. The user chooses to approve or reject the leave request, optionally providing a reason for rejection. 6. The system updates the leave request status and the employee's leave balance (if approved). 7. The system notifies the employee of the decision. 8. The system confirms the action to the user.

Table 2.11: Use Case Description for View Attendance

UC Identification	UC-9
Use Case Name	View Attendance
Description	This use case allows a user to view their own or their team's attendance records in the HR and Payroll Management System.
Actor	Employee, HR Manager, Department Manager
Pre-condition	The user must be logged into the system with valid credentials, have access to the attendance section, and attendance data must be recorded in the system.
Post-condition	The user successfully views the attendance records, displaying details such as clock-in/out times, total hours worked, or absenteeism.
Basic Flow	1. The user navigates to the attendance section of the system. 2. The system displays options to view attendance (e.g., personal attendance for Employee, team attendance for Department Manager, or all employees for HR Manager). 3. The user selects the desired attendance record or period (e.g., daily, weekly, monthly). 4. The system retrieves and displays the attendance details (e.g., clock-in/out times, total hours, absences). 5. The user views the attendance information and may export or print the data if needed.

Table 2.12: Use Case Description for Track Employee Attendance

UC Identification	UC-10

Use Case Name	Track Employee Attendance
Description	This use case allows an authorized user to monitor and analyse employee attendance data for payroll, compliance, or performance purposes in the HR and Payroll Management System.
Actor	HR Manager, Payroll Officer, Department Manager
Pre-condition	The user must be logged into the system with valid credentials, have permissions to access employee attendance data, and attendance records must be available in the system.
Post-condition	The user successfully tracks employee attendance, viewing detailed reports or trends (e.g., absenteeism, tardiness) for their team or organization.
Basic Flow	1. The user navigates to the attendance tracking section of the system. 2. The system displays options to track attendance (e.g., by employee, department, or period). 3. The user selects the desired criteria (e.g., specific employee, department, or date range). 4. The system retrieves and displays detailed attendance data (e.g., clock-in/out times, total hours, absences, late arrivals). 5. The user analyses the data and may generate a report or export the information for further use. 6. The system confirms the successful retrieval of attendance data.

Table 2.13: Use Case Description for Manage Employee Account

UC Identification	UC-11
Use Case Name	Manage Employee Account

Description	This use case allows an authorized user to create, update, or deactivate employee accounts in the HR and Payroll Management System to manage system access.
Actor	HR Manager, System Administrator
Pre-condition	The user must be logged into the system with valid credentials, have permissions to manage employee accounts, and have relevant employee details (e.g., employee ID, role).
Post-condition	The employee account is successfully created, updated, or deactivated, and system access is adjusted accordingly.
Basic Flow	1. The user navigates to the employee account management section of the system. 2. The system displays options to create, update, or deactivate an employee account. 3. The user selects the desired action (e.g., create a new account, update an existing account, or deactivate an account). 4. For creating/updating, the user enters or modifies account details (e.g., username, role, permissions). For deactivating, the user confirms the account to deactivate. 5. The user submits the changes. 6. The system validates the input (e.g., checks for unique username) and updates the account status. 7. The system confirms the successful management of the employee account.

Table 2.14: Use Case Description for Update Employee Information

UC Identification	UC-12
Use Case Name	Update Employee Information
Description	This use case allows an authorized user to update an existing employee's information in the HR and Payroll Management System.
Actor	HR Manager, Payroll Officer, System Administrator

Pre-condition	The user must be logged into the system with valid credentials, have permissions to manage employee records, and the employee's record must exist in the system.
Post-condition	The employee's information is successfully updated in the system, and the changes are reflected in relevant modules (e.g., payroll, attendance).
Basic Flow	1. The user navigates to the employee management section of the system. 2. The system displays a list of employee records or a search option. 3. The user selects the employee whose information needs to be updated. 4. The system displays the employee's current information in an editable form (e.g., contact details, department, salary, job title). 5. The user updates the necessary fields and submits the changes. 6. The system validates the input (e.g., checks for valid data formats) and saves the updated information. 7. The system confirms the successful update of the employee's information.

Table 2.15: Use Case Description for View Employee Reports

UC Identification	UC-13
Use Case Name	View Employee Reports
Description	This use case allows an authorized user to view reports related to employee data, such as performance, attendance, or leave summaries, in the HR and Payroll Management System.
Actor	HR Manager, Department Manager, Senior Manager
Pre-condition	The user must be logged into the system with valid credentials, have permissions to access employee reports, and relevant employee data must be available in the system.
Post-condition	The user successfully views the employee reports, displaying summarized or detailed data based on the selected criteria.
Basic Flow	1. The user navigates to the reports section of the system.

	2. The system displays options for generating employee reports (e.g., by department, performance, attendance, leave). 3. The user selects the report type and criteria (e.g., specific employee, department, or time period). 4. The system retrieves the relevant data and generates the report. 5. The system displays the report, showing details such as performance metrics, attendance summaries, or leave balances. 6. The user views the report and may export or print it if needed.

Table 2.16: Use Case Description for Manage Department Information

UC Identification	UC-14
Use Case Name	Manage Department Information
Description	This use case allows an authorized user to create, update, or delete department information in the HR and Payroll Management System to organize employee records and reporting.
Actor	HR Manager, System Administrator
Pre-condition	The user must be logged into the system with valid credentials, have permissions to manage department records, and have relevant department details (e.g., department name, manager).
Post-condition	The department information is successfully created, updated, or deleted, and the changes are reflected in employee records and system reports.
Basic Flow	1. The user navigates to the department management section of the system. 2. The system displays options to create, update, or delete department information. 3. The user selects the desired action (e.g., create a new department, update an existing department, or delete a department). 4. For creating/updating, the user enters or modifies department details (e.g., department name, manager, budget). For deleting, the user confirms the department to remove. 5. The user submits the changes.

	6. The system validates the input (e.g., checks for duplicate department names or ensures no employees are assigned to a deleted department). 7. The system saves the changes and updates related records (e.g., employee department assignments). 8. The system confirms the successful management of department information.

Table 2.17: Use Case Description for View Payroll Report

UC Identification	UC-15
Use Case Name	View Payroll Report
Description	This use case allows an authorized user to view payroll reports summarizing payroll data, such as total salaries, deductions, or department-wise payroll costs, in the HR and Payroll Management System.
Actor	HR Manager, Payroll Officer, Senior Manager
Pre-condition	The user must be logged into the system with valid credentials, have permissions to access payroll reports, and payroll data must be available in the system.
Post-condition	The user successfully views the payroll report, displaying summarized or detailed payroll information based on the selected criteria.
Basic Flow	1. The user navigates to the payroll reports section of the system. 2. The system displays options for generating payroll reports (e.g., by department, pay period, or employee). 3. The user selects the report type and criteria (e.g., specific department, pay period, or summary level). 4. The system retrieves the relevant payroll data and generates the report. 5. The system displays the report, showing details such as total salaries, taxes, deductions, or department-wise costs. 6. The user views the report and may export or print it if needed.

Table 2.18: Use Case Description for Manage Payroll System

UC Identification	UC-16
Use Case Name	Manage Payroll System
Description	This use case allows an authorized user to configure and maintain the payroll system settings, such as payroll schedules, deduction rules, or tax rates, in the HR and Payroll Management System.
Actor	Payroll Officer, System Administrator
Pre-condition	The user must be logged into the system with valid credentials, have permissions to manage payroll system settings, and have relevant payroll configuration details (e.g., tax rates, deduction policies).
Post-condition	The payroll system settings are successfully configured or updated, and the changes are applied to payroll processing.
Basic Flow	1. The user navigates to the payroll system management section of the system. 2. The system displays options to configure payroll settings (e.g., payroll schedules, deduction rules, tax rates). 3. The user selects the setting to configure or update (e.g., update tax rates or set payroll run dates). 4. The user enters or modifies the required details. 5. The user submits the changes. 6. The system validates the input (e.g., ensures tax rates are within legal limits) and saves the updated settings. 7. The system confirms the successful management of payroll system settings.

Table 2.19: Use Case Description for Assign Roles & Permissions

UC Identification	UC-17
Use Case Name	Assign Roles & Permissions

Description	This use case allows an authorized user to assign or modify roles and permissions for users in the HR and Payroll Management System to control access to system features.
Actor	System Administrator
Pre-condition	The user must be logged into the system with valid credentials, have administrative permissions to manage user roles, and the user accounts to be modified must exist in the system.
Post-condition	The roles and permissions for the selected users are successfully assigned or updated, and their system access reflects the changes.
Basic Flow	1. The user navigates to the user management section of the system. 2. The system displays a list of user accounts or a search option. 3. The user selects the user account to assign or modify roles and permissions for. 4. The system displays the available roles (e.g., Employee, HR Manager, Payroll Officer) and associated permissions (e.g., access to payroll, reports). 5. The user assigns or updates the role and permissions for the selected user. 6. The user submits the changes. 7. The system validates the input (e.g., ensures no conflicting permissions) and saves the updated roles and permissions. 8. The system confirms the successful assignment or modification of roles and permissions.

Table 2.20: Use Case Description for Manage Tax Information

UC Identification	UC-18
Use Case Name	Manage Tax Information
Description	This use case allows an authorized user to create, update, or delete tax-related information (e.g., tax rates, employee tax details) in the HR and Payroll Management System to ensure accurate payroll processing.
Actor	Payroll Officer, System Administrator

Pre-condition	The user must be logged into the system with valid credentials, have permissions to manage tax information, and have relevant tax details (e.g., tax rates, employee tax forms).
Post-condition	The tax information is successfully created, updated, or deleted, and the changes are applied to payroll calculations and reporting.
Basic Flow	1. The user navigates to the tax management section of the system. 2. The system displays options to create, update, or delete tax information (e.g., tax rates, employee tax exemptions). 3. The user selects the desired action (e.g., update tax rates or add employee tax details). 4. The user enters or modifies the tax information (e.g., new tax rate, employee tax ID, or exemptions). 5. The user submits the changes. 6. The system validates the input (e.g., ensures tax rates comply with regulations or tax IDs are valid). 7. The system saves the updated tax information and applies it to payroll processes. 8. The system confirms the successful management of tax information.
Exceptions	- If the entered tax information is invalid (e.g., tax rate outside legal limits), the system displays an error message and prompts the user to correct the input. – If an employee's tax details cannot be updated (e.g., missing tax ID), the system notifies the user and logs the issue for review.

Table 2.21: Use Case Description for Generate Tax Reports

UC Identification	UC-19
Use Case Name	Generate Tax Reports
Description	This use case allows an authorized user to generate tax reports summarizing tax-related data (e.g., employee tax deductions, company tax liabilities) for compliance or auditing in the HR and Payroll Management System.
Actor	Payroll Officer, HR Manager, Senior Manager

Pre-condition	The user must be logged into the system with valid credentials, have permissions to access tax reports, and tax data (e.g., deductions, tax rates) must be available in the system.
Post-condition	The tax report is successfully generated and displayed, providing accurate tax-related information for the selected criteria.
Basic Flow	1. The user navigates to the tax reports section of the system. 2. The system displays options for generating tax reports (e.g., by employee, department, or tax period). 3. The user selects the report type and criteria (e.g., specific tax period, employee, or summary level). 4. The system retrieves the relevant tax data (e.g., employee tax deductions, total tax liabilities). 5. The system generates and displays the tax report, showing details such as tax amounts, exemptions, or compliance status. 6. The user views the report and may export or print it for submission or auditing purposes. 7. The system confirms the successful generation of the tax report.
Exceptions	- If the required tax data is incomplete (e.g., missing employee tax details), the system displays an error message and suggests corrective actions (e.g., updating tax information via UC-22). – If the report criteria are invalid (e.g., future tax period), the system notifies the user to adjust the criteria.

Table 2.22: Use Case Description for View Employee Salary History

UC Identification	UC-20
Use Case Name	View Employee Salary History
Description	This use case allows an authorized user to view an employee's historical salary data, including past salaries, raises, or bonuses, in the HR and Payroll Management System.
Actor	HR Manager, Payroll Officer, Senior Manager

Pre-condition	The user must be logged into the system with valid credentials, have permissions to access employee salary data, and the employee's salary history must be recorded in the system.
Post-condition	The user successfully views the employee's salary history, displaying details such as past salaries, raises, bonuses, or deductions for the selected period.
Basic Flow	1. The user navigates to the employee salary history section of the system. 2. The system displays a list of employees or a search option to select an employee. 3. The user selects the employee whose salary history they wish to view. 4. The system retrieves and displays the employee's salary history (e.g., salary changes, bonuses, deductions) for a specified period. 5. The user views the salary history and may export or print the data if needed. 6. The system confirms the successful retrieval of the salary history.
Exceptions	- If the employee's salary history is incomplete (e.g., missing records for a period), the system displays a warning and shows available data only. – If the user lacks permission to view the selected employee's salary history, the system displays an access denied message.

Table 2.23: Use Case Description for Schedule Payroll Runs

UC Identification	UC-21
Use Case Name	Schedule Payroll Runs
Description	This use case allows an authorized user to schedule payroll processing runs (e.g., monthly or bi-weekly) in the HR and Payroll Management System to automate payroll generation.
Actor	Payroll Officer, System Administrator
Pre-condition	The user must be logged into the system with valid credentials, have permissions to manage payroll schedules, and have payroll configuration details (e.g., pay periods, processing dates).

Post-condition	The payroll run schedule is successfully created or updated, and the system is set to process payroll automatically on the specified dates.
Basic Flow	1. The user navigates to the payroll scheduling section of the system. 2. The system displays options to create or update payroll run schedules. 3. The user selects the option to schedule a new payroll run or modify an existing schedule. 4. The user enters or updates the schedule details (e.g., frequency: monthly, bi-weekly; specific dates; processing time). 5. The user submits the schedule. 6. The system validates the input (e.g., ensures no conflicting schedules or invalid dates). 7. The system saves the payroll run schedule and configures the system to trigger payroll processing accordingly. 8. The system confirms the successful scheduling of payroll runs.
Exceptions	- If the schedule conflicts with existing payroll runs (e.g., overlapping dates), the system displays an error message and prompts the user to adjust the schedule. – If the input dates are invalid (e.g., past dates), the system notifies the user to correct the dates.

Table 2.24: Use Case Description for View Notifications

UC Identification	UC-22
Use Case Name	View Notifications
Description	This use case allows a user to view system-generated notifications related to HR and payroll activities (e.g., leave request status, payroll updates) in the HR and Payroll Management System.
Actor	Employee, HR Manager, Payroll Officer, Department Manager, System Administrator, Senior Manager

Pre-condition	The user must be logged into the system with valid credentials, have access to the notifications section, and notifications must have been generated by the system.
Post-condition	The user successfully views the relevant notifications, which provide updates or alerts about system activities or tasks.
Basic Flow	1. The user navigates to the notifications section of the system. 2. The system displays a list of unread and/or read notifications specific to the user's role (e.g., leave approval for Department Manager, payslip availability for Employee). 3. The user selects a notification to view its details (e.g., message content, timestamp, action required). 4. The system displays the notification details. 5. The user may mark the notification as read or take further action if prompted (e.g., approve a leave request). 6. The system updates the notification status (e.g., marks as read) and confirms the action.
Exceptions	- If no notifications are available (e.g., no recent system activity), the system displays a message indicating no notifications. - If the user lacks permission to view certain notifications (e.g., system-level alerts for non-admins), the system filters out those notifications.

Table 2.25: Use Case Description for Send Notifications

UC Identification	UC-23
Use Case Name	Send Notifications
Description	This use case allows an authorized user or the system to send notifications to users about HR and payroll activities (e.g., leave request outcomes, payroll updates) in the HR and Payroll Management System.
Actor	HR Manager, Payroll Officer, Department Manager, System Administrator

Pre-condition	The user must be logged into the system with valid credentials, have permissions to send notifications, or the system must be triggered by an event (e.g., leave approval). Relevant recipient data (e.g., user IDs) must be available.
Post-condition	The notification is successfully sent to the intended recipient(s) and is available for viewing in the system (e.g., via UC-30).
Basic Flow	1. The user navigates to the notification section of the system, or the system initiates a notification based on an event (e.g., leave approval). 2. The system displays options to compose a manual notification or confirms an automated notification. 3. For manual notifications, the user selects the recipient(s) (e.g., specific employee, department) and enters the message content (e.g., payroll update, leave status). 4. The user submits the notification, or the system automatically generates it for event-based notifications. 5. The system validates the notification (e.g., ensures valid recipients, appropriate content). 6. The system sends the notification to the recipient(s) via the system interface (and possibly email or other channels). 7. The system confirms the successful sending of the notification to the user (for manual cases) or logs the action (for automated cases).
Exceptions	- If the recipient's contact information is invalid (e.g., missing email), the system logs the failure and notifies the user or administrator to update the recipient's details. - If the notification content violates system rules (e.g., exceeds character limit), the system prompts the user to revise the message.

Table 2.26: Use Case Description for Manage Holidays

UC Identification	UC-24
Use Case Name	Manage Holidays

Description	This use case allows an authorized user to create, update, or delete holiday records in the HR and Payroll Management System to ensure accurate scheduling and payroll calculations.
Actor	HR Manager, System Administrator
Pre-condition	The user must be logged into the system with valid credentials, have permissions to manage holiday records, and have relevant holiday details (e.g., date, name, type).
Post-condition	The holiday records are successfully created, updated, or deleted, and the changes are reflected in system schedules and payroll processes.
Basic Flow	1. The user navigates to the holiday management section of the system. 2. The system displays options to create, update, or delete holiday records. 3. The user selects the desired action (e.g., create a new holiday, update an existing holiday, or delete a holiday). 4. For creating/updating, the user enters or modifies holiday details (e.g., holiday name, date, paid/unpaid status). For deleting, the user confirms the holiday to remove. 5. The user submits the changes. 6. The system validates the input (e.g., checks for valid dates or conflicts with existing holidays). 7. The system saves the holiday record and updates related modules (e.g., attendance, payroll calculations). 8. The system confirms the successful management of holiday records.
Exceptions	- If the holiday date is invalid (e.g., past date or conflicts with another holiday), the system displays an error message and prompts the user to correct the input. - If deleting a holiday affects payroll or attendance (e.g., already processed), the system warns the user and may require additional confirmation.

Table 2.27: Use Case Description for Manage Time Off Requests

UC Identification	UC-25
Use Case Name	Manage Time Off Requests

Description	This use case allows an authorized user to review, approve, reject, or modify time-off requests (e.g., vacation, sick leave) submitted by employees in the HR and Payroll Management System.
Actor	HR Manager, Department Manager
Pre-condition	The user must be logged into the system with valid credentials, have permissions to manage time-off requests, and time-off requests must have been submitted by employees (e.g., via UC-10).
Post-condition	The time-off request is successfully approved, rejected, or modified, the employee's time-off record is updated, and the employee is notified of the decision.
Basic Flow	1. The user navigates to the time-off management section of the system. 2. The system displays a list of pending time-off requests from employees. 3. The user selects a specific time-off request to review. 4. The system displays the request details (e.g., type, dates, reason, employee's leave balance). 5. The user chooses to approve, reject, or modify the request (e.g., adjust dates), optionally providing a reason for rejection or modification. 6. The user submits the decision. 7. The system updates the request status, adjusts the employee's time-off balance (if approved), and notifies the employee of the decision. 8. The system confirms the successful management of the time-off request to the user.
Exceptions	- If the time-off request conflicts with scheduling or policies (e.g., insufficient leave balance), the system warns the user and may suggest rejection or modification. - If the employee's record is incomplete (e.g., missing department assignment), the system notifies the user to update the record before processing.

Table 2.28: Use Case Description for Log Out

UC Identification	UC-26

Use Case Name	Log Out
Description	This use case allows a user to log out of the HR and Payroll Management System, terminating their active session for security purposes.
Actor	Employee, HR Manager, Payroll Officer, Department Manager, System Administrator, Senior Manager
Pre-condition	The user must be logged into the system with valid credentials and have an active session.
Post-condition	The user's session is successfully terminated, and they are logged out of the system, preventing further access until they log in again.
Basic Flow	1. The user navigates to the logout option in the system (e.g., via a menu or button). 2. The system prompts the user to confirm the logout action (optional, depending on system settings). 3. The user confirms the logout. 4. The system terminates the user's active session. 5. The system redirects the user to the login page or a confirmation message indicating successful logout.
Exceptions	- If the system encounters an error during session termination (e.g., server issue), the system displays an error message and may automatically terminate the session after a timeout. - If the user's session has already expired, the system informs the user and redirects them to the login page.

2.5.4.2 Sequence diagram

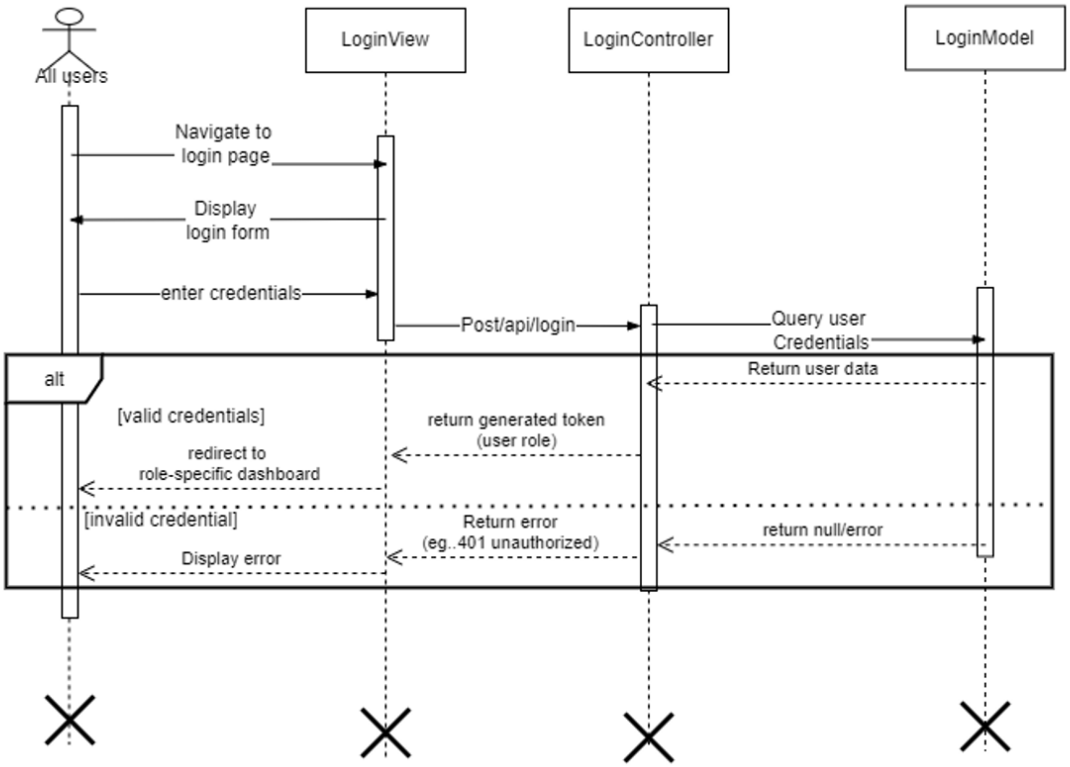

Figure 2.7 Sequence Diagram for Login

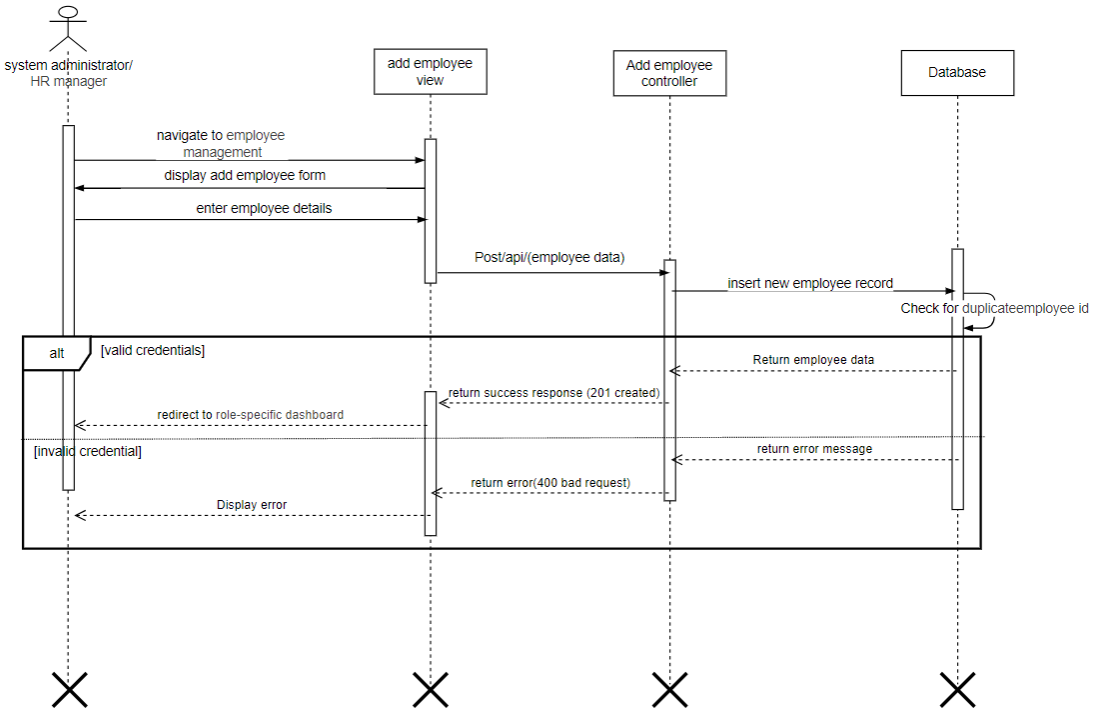

Figure 2.8 Sequence Diagram for Add Employee Information

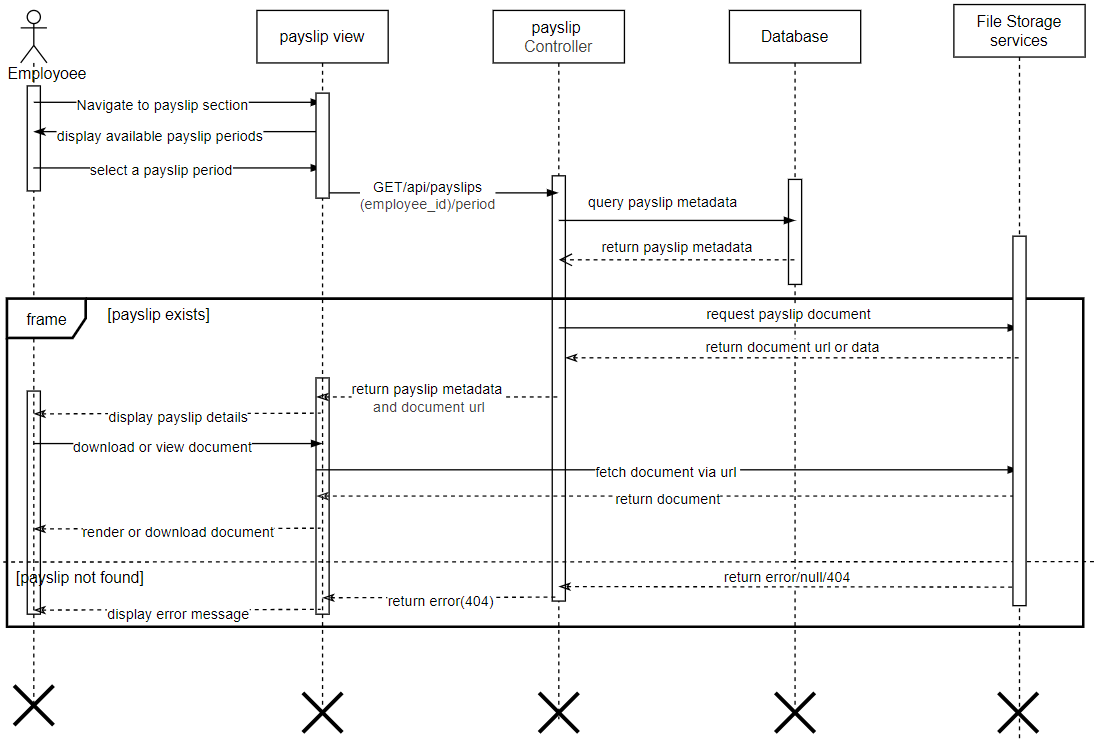

Figure 2.9 Sequence Diagram for View Payslips

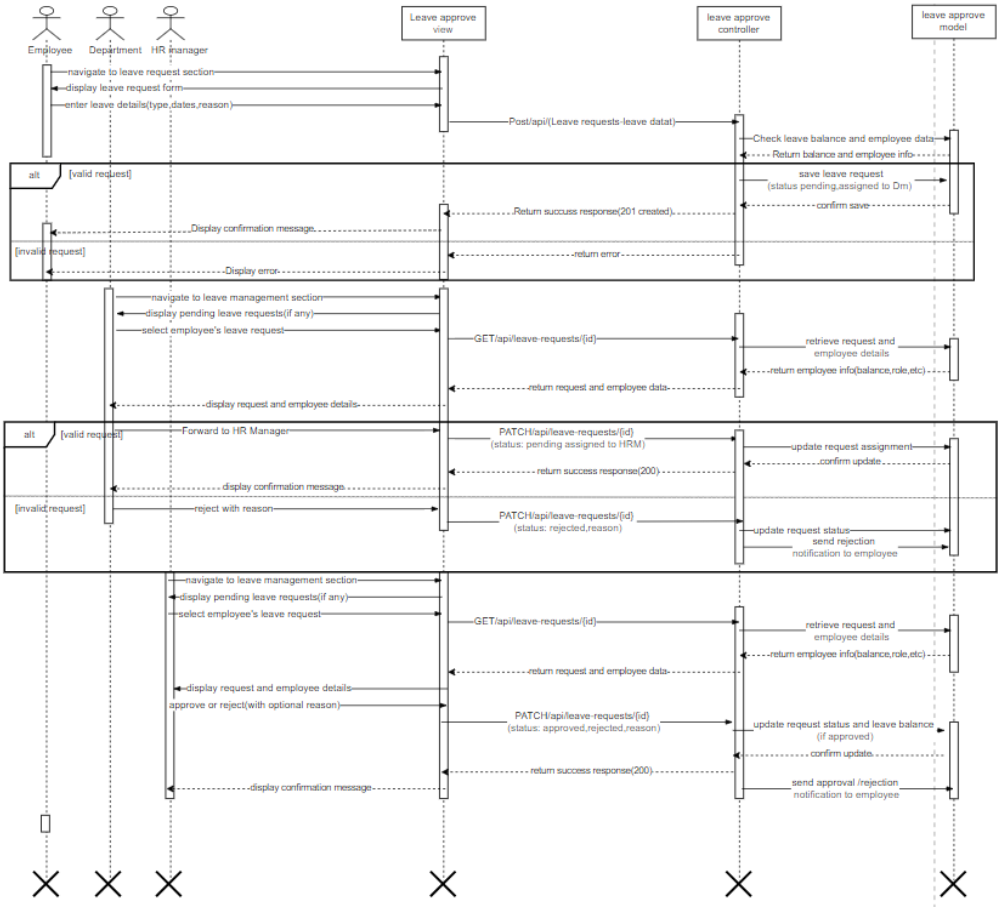

Figure 2.10 Sequence Diagram for Leave Request and Approve / Reject

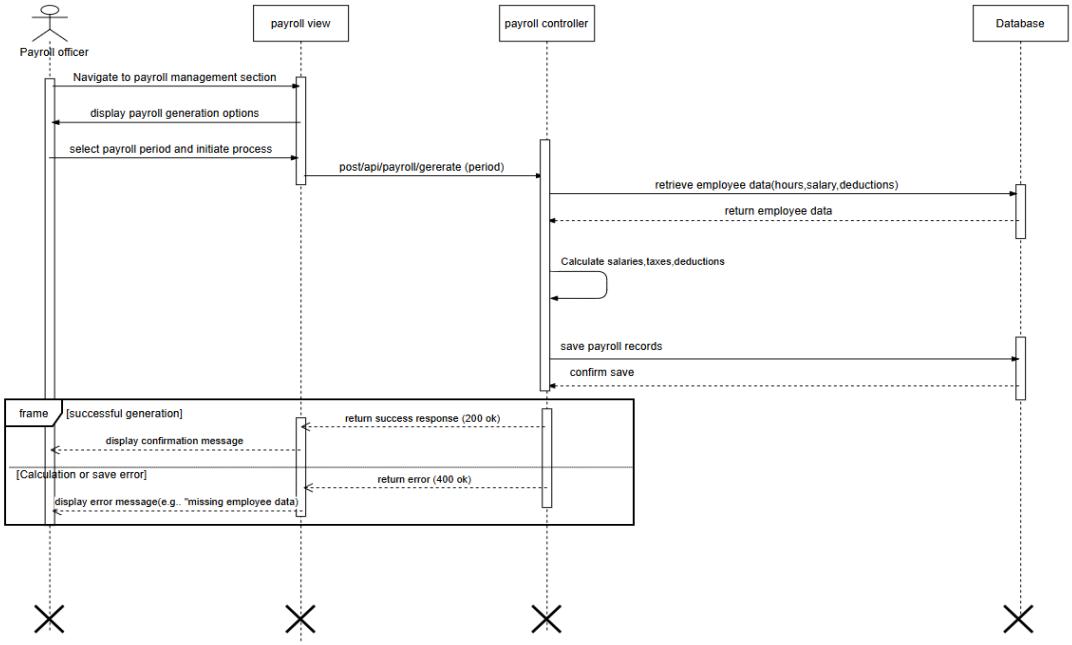

Figure 2.11 Sequence Diagram for Generate Payroll

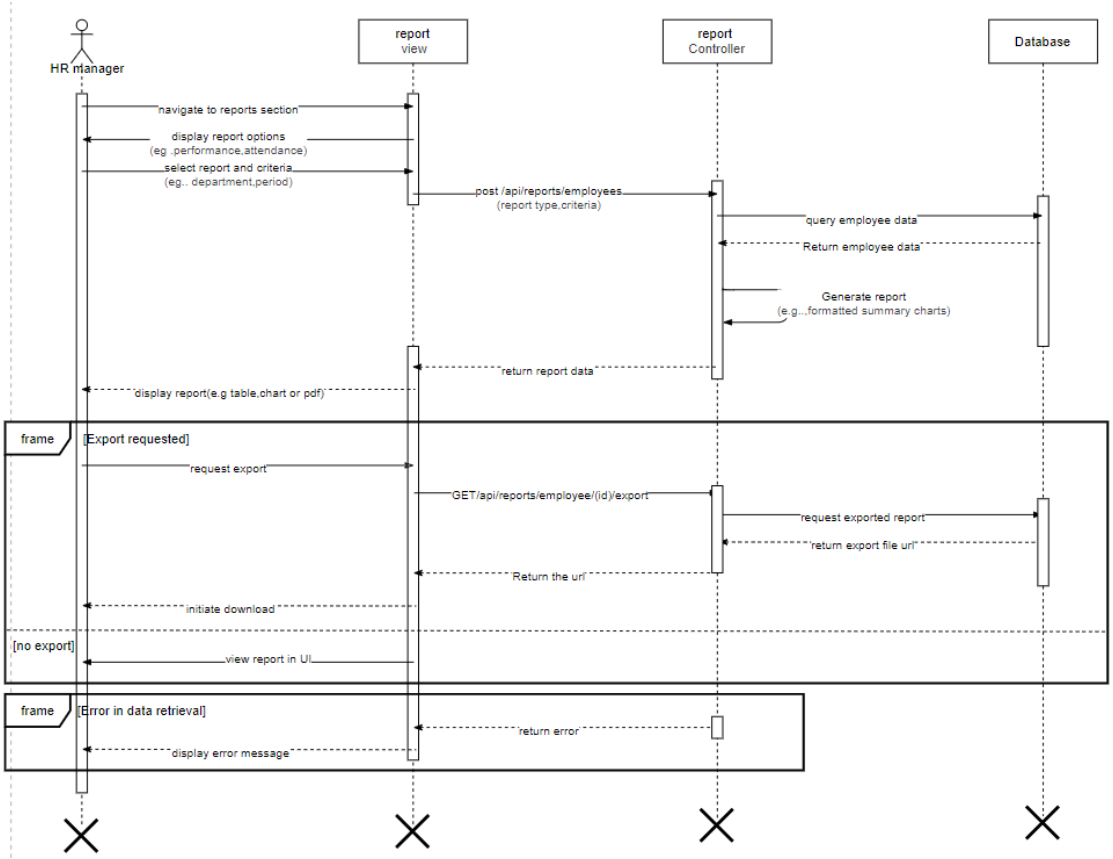

Figure 2.12 Sequence Diagram for View employee Report

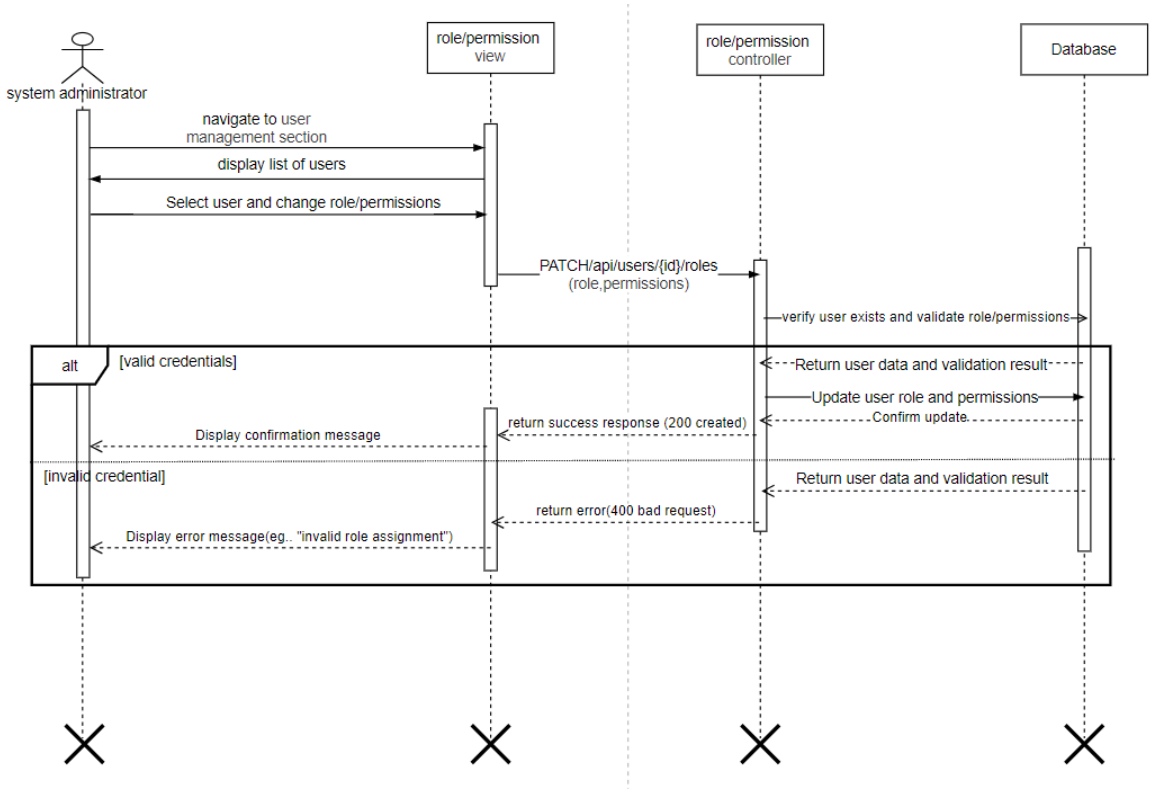

Figure 2.13 Sequence Diagram for changing and setting user role/permission

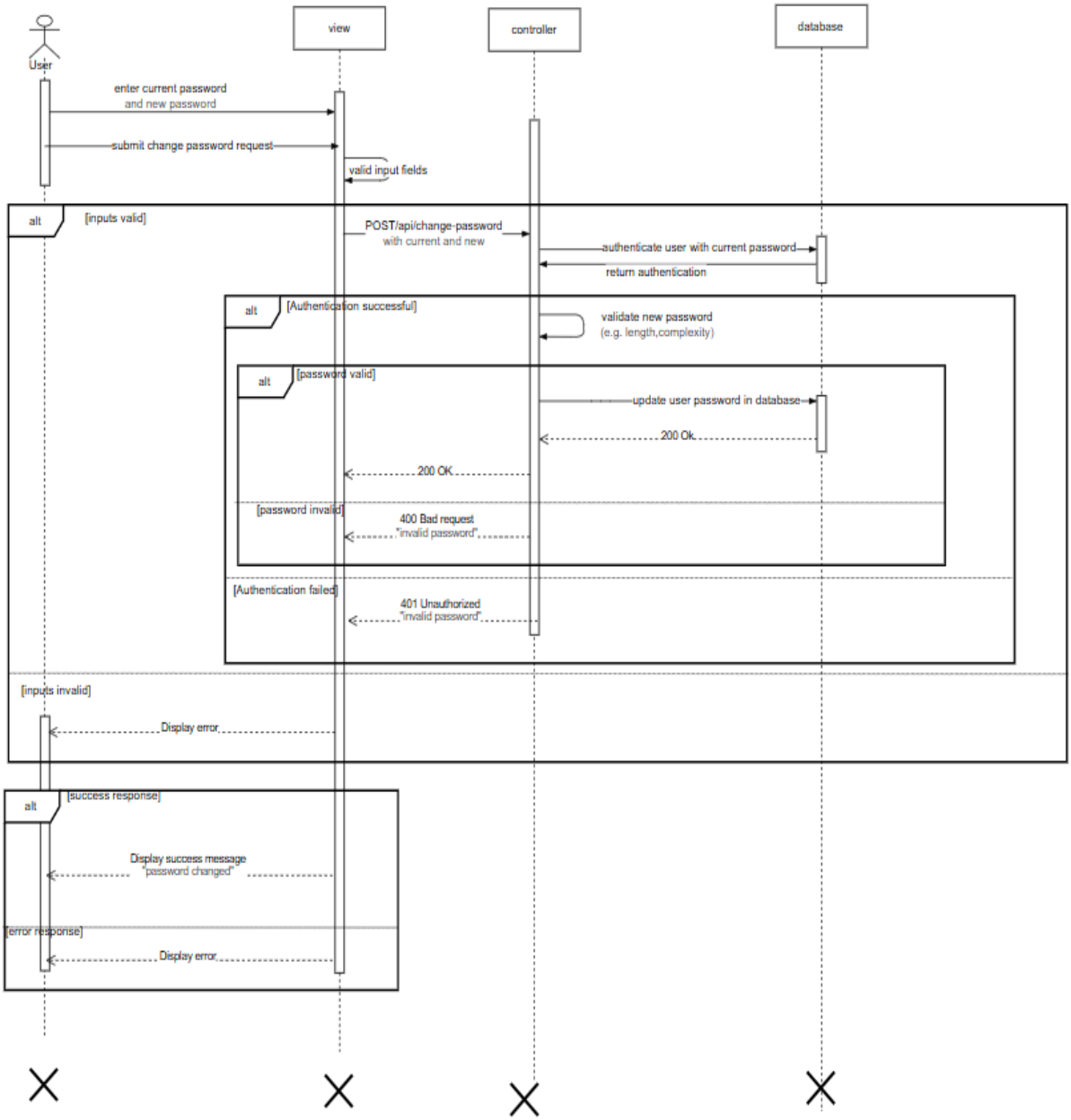

Figure 2.14 Sequence Diagram for changing password

2.5.4.3 State chart diagram

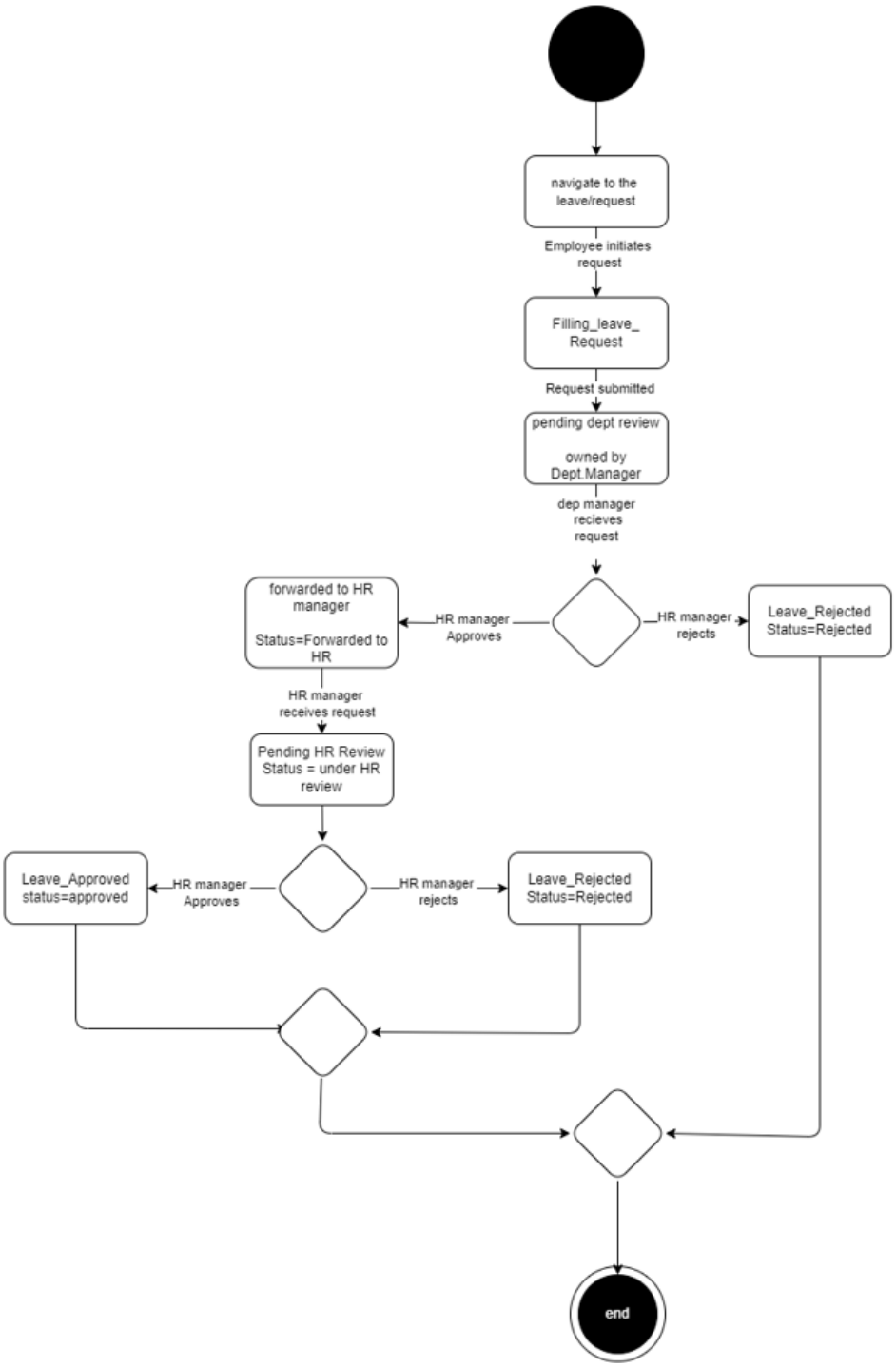

Figure 2.15 State Diagram for Leave Request /Acceptance

2.5.4.4 Activity diagram

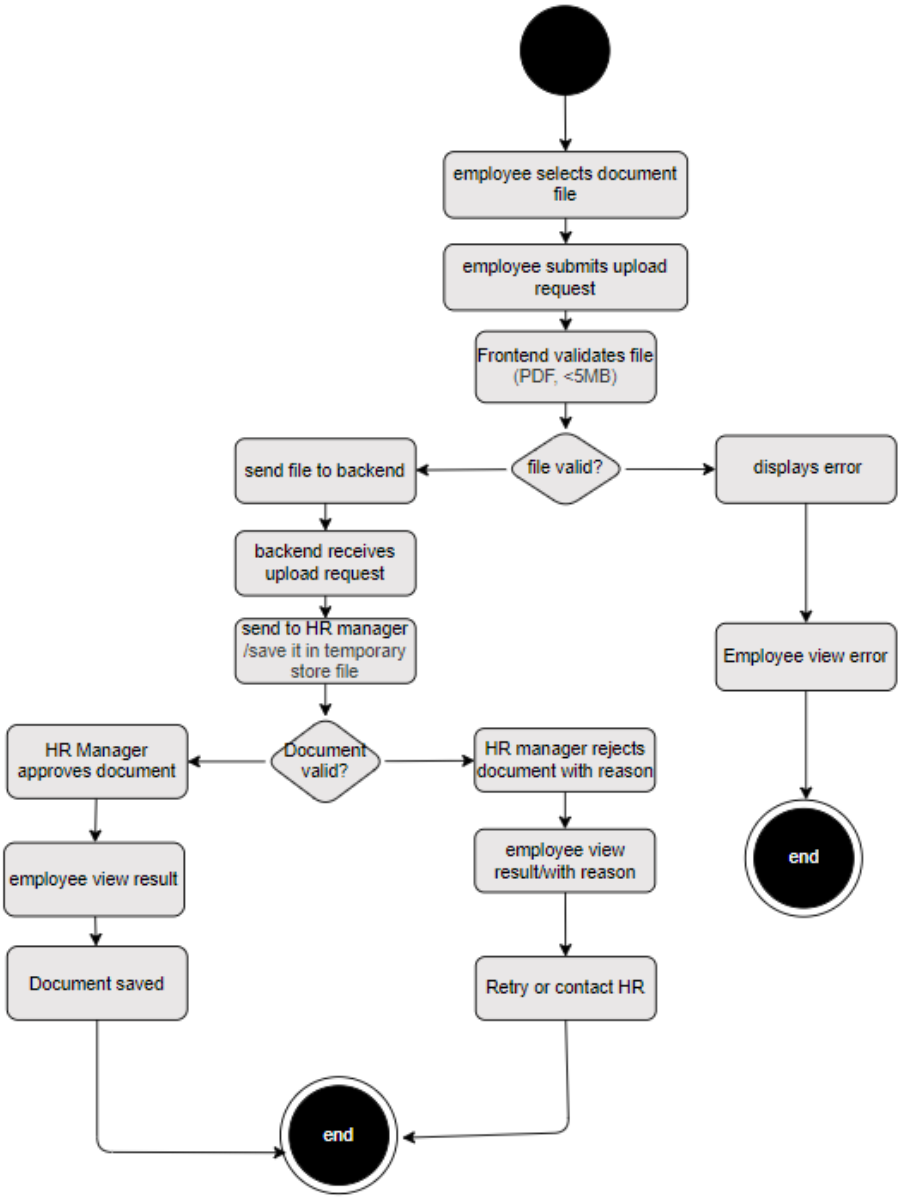

Figure 2.16 Activity Diagram for Upload Documents

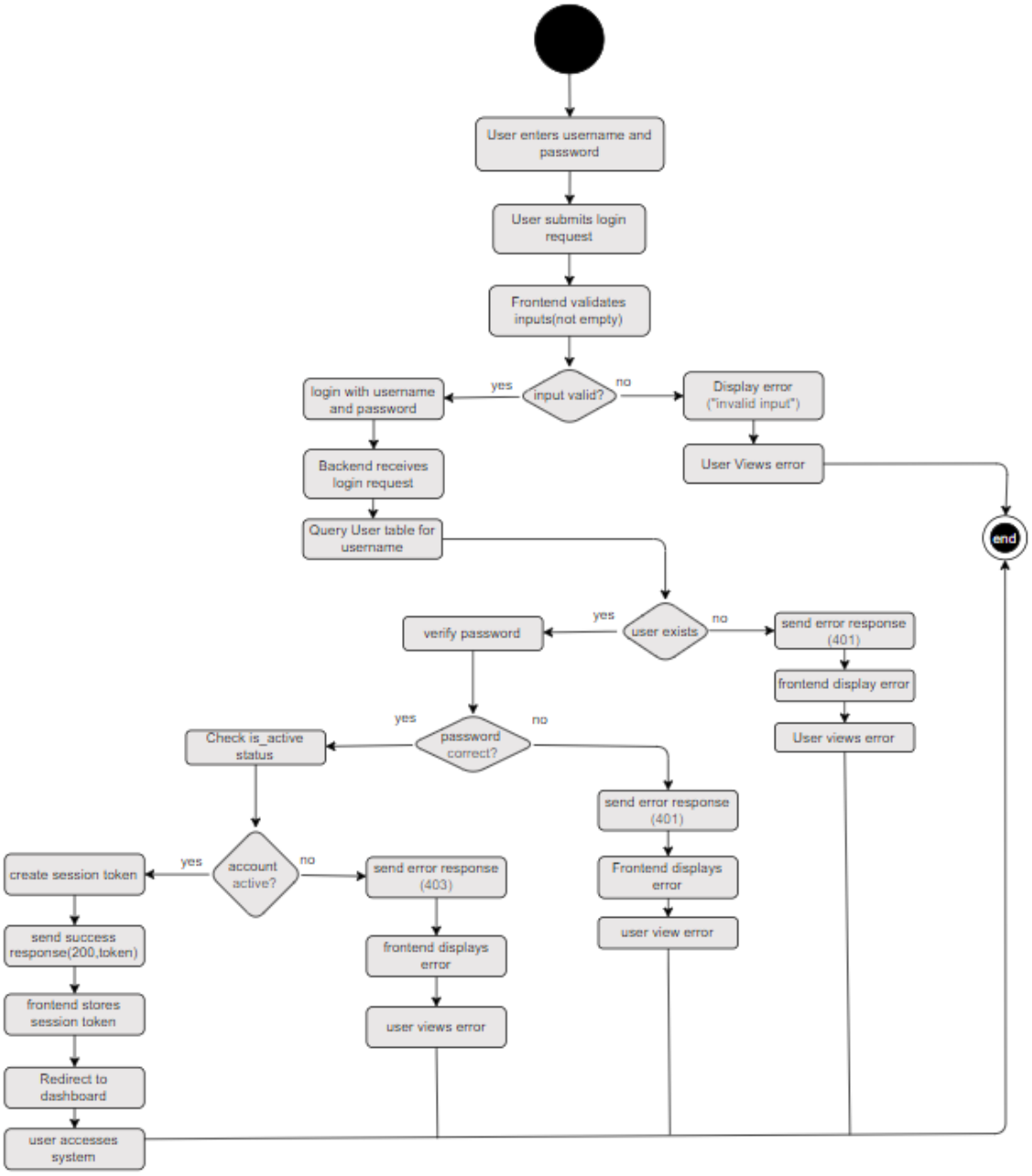

Figure 2.17 Activity Diagram for Log in

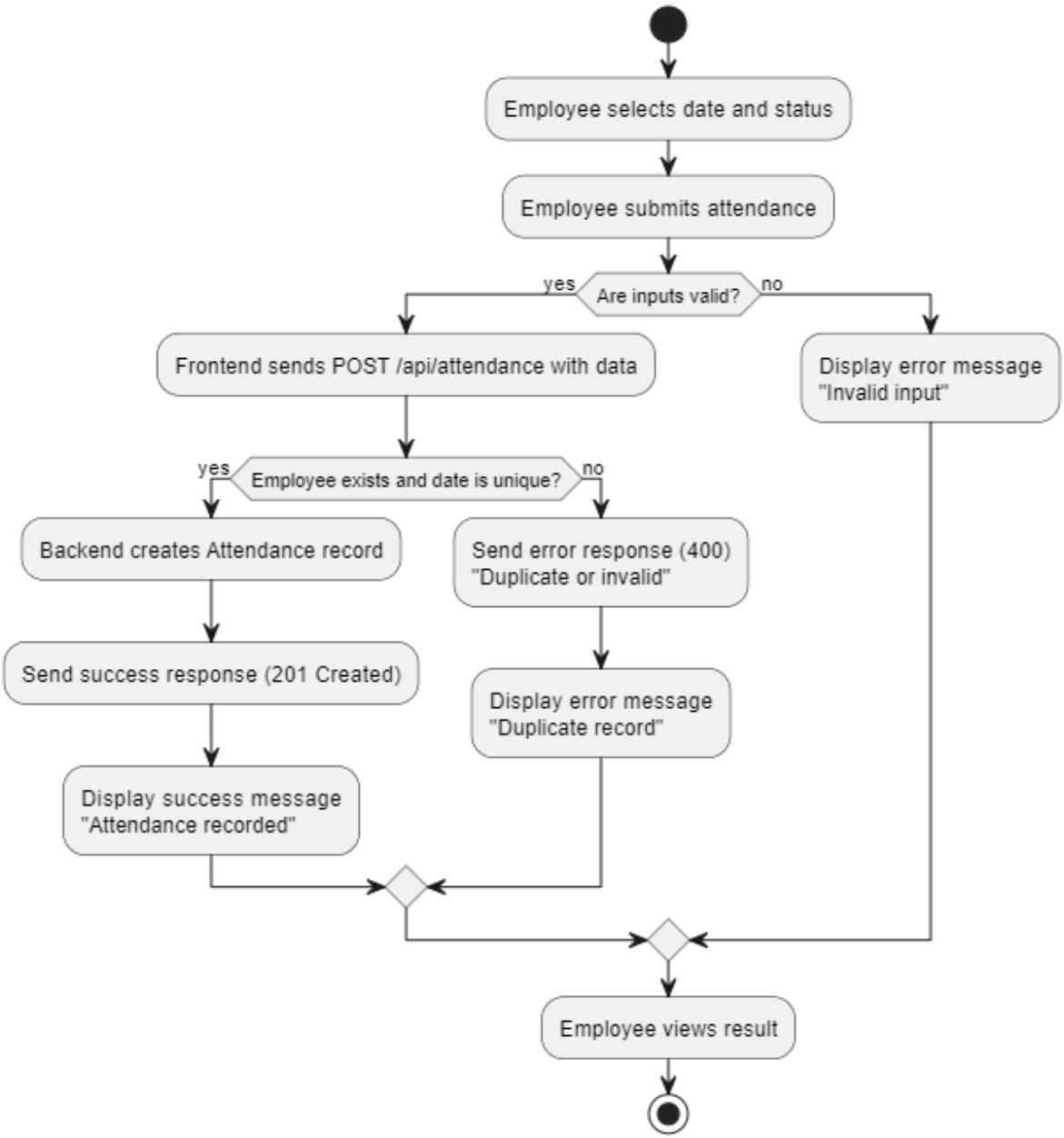

Figure 2.18 Activity Diagram for submitting attendance

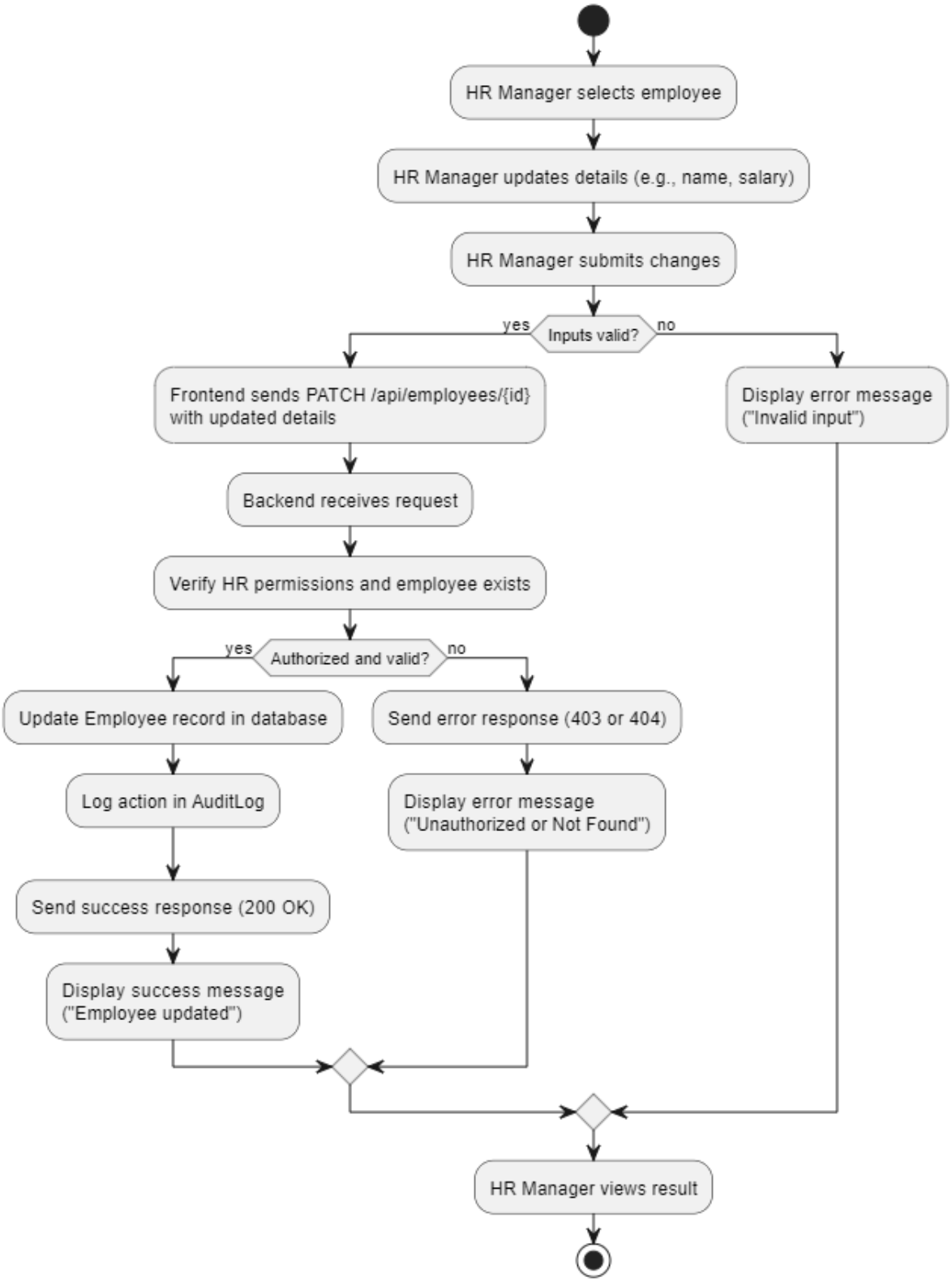

Figure 2.19 Activity Diagram for HR Manager updating employee details

2.5.4.5 Class diagram

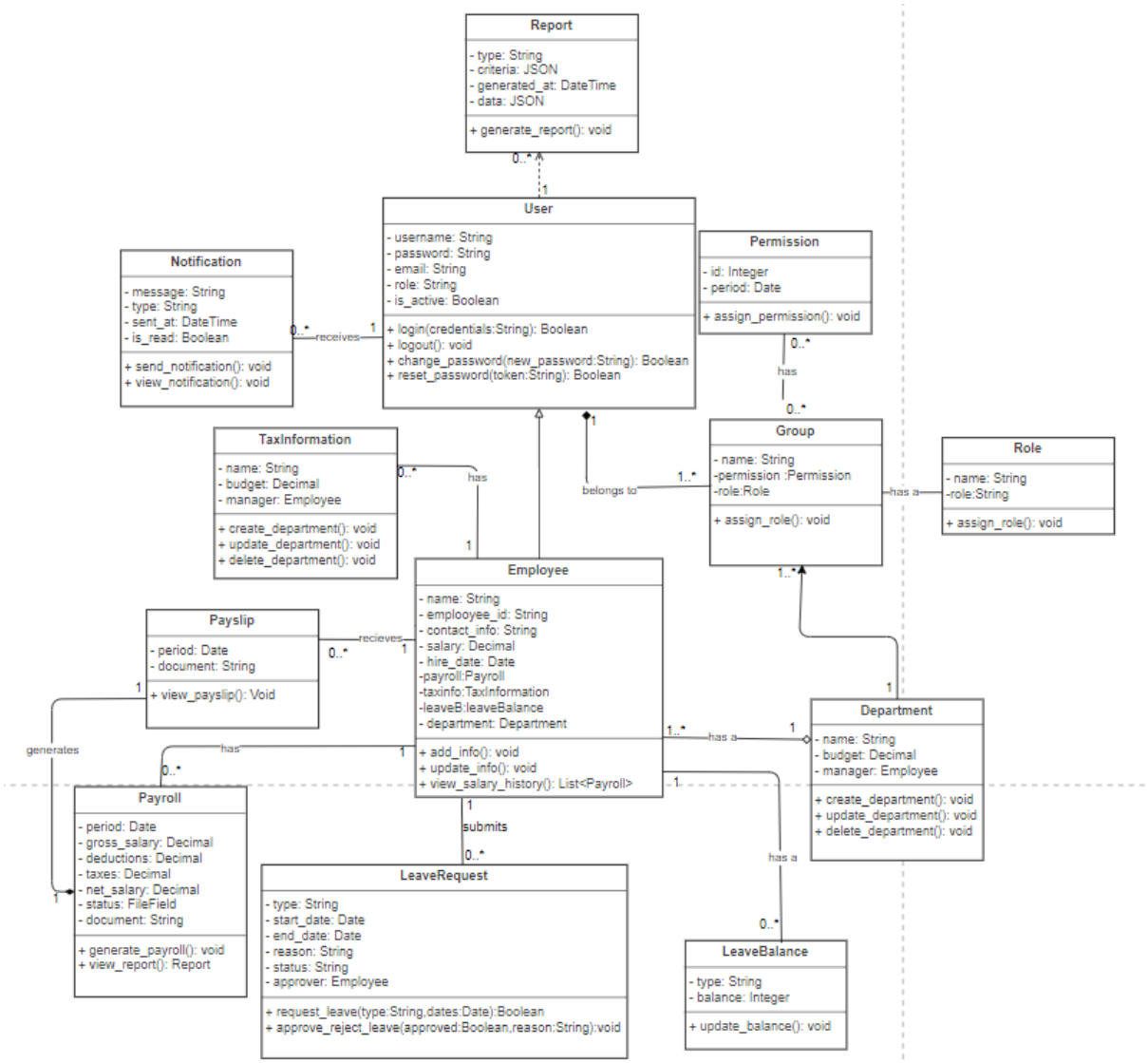

Figure 2.20 Class Diagram

2.5.4.6 ER diagram

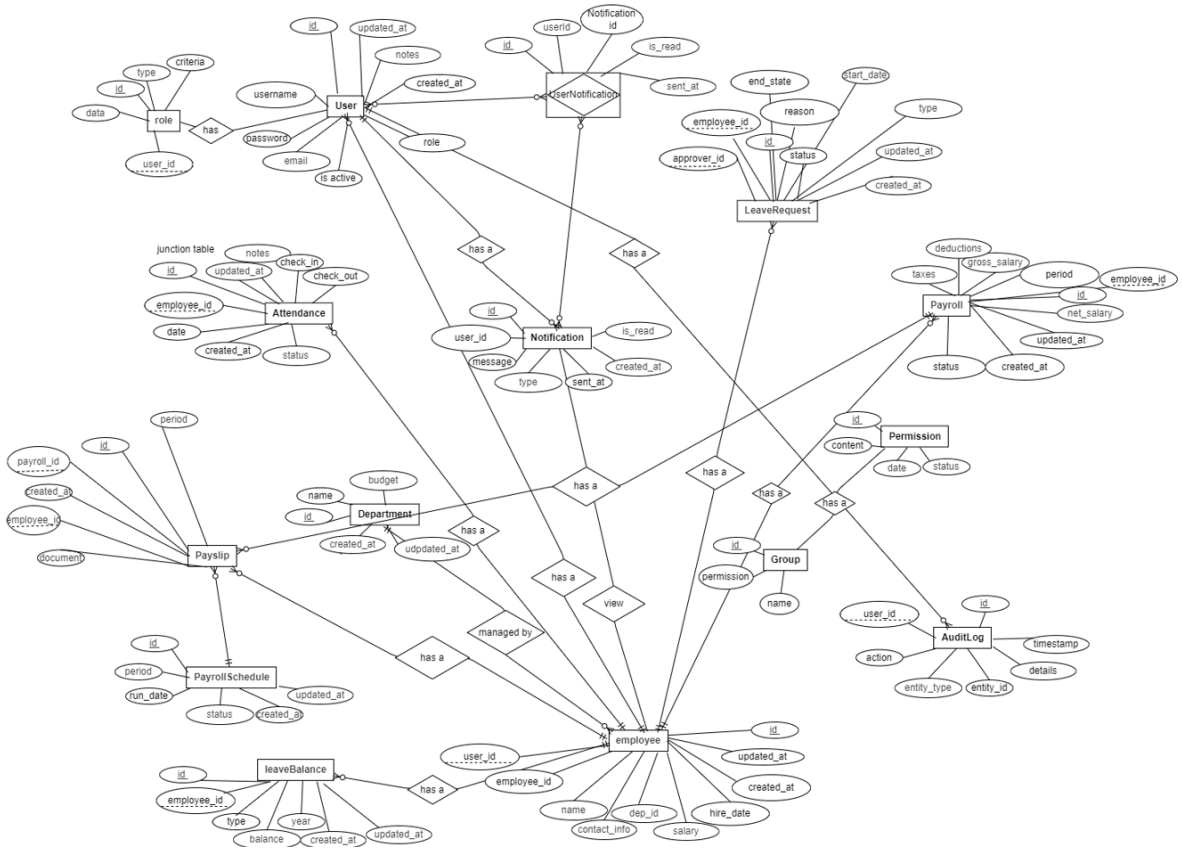

Figure 2.21 ER Diagram

2.5.4.7 User interface prototyping

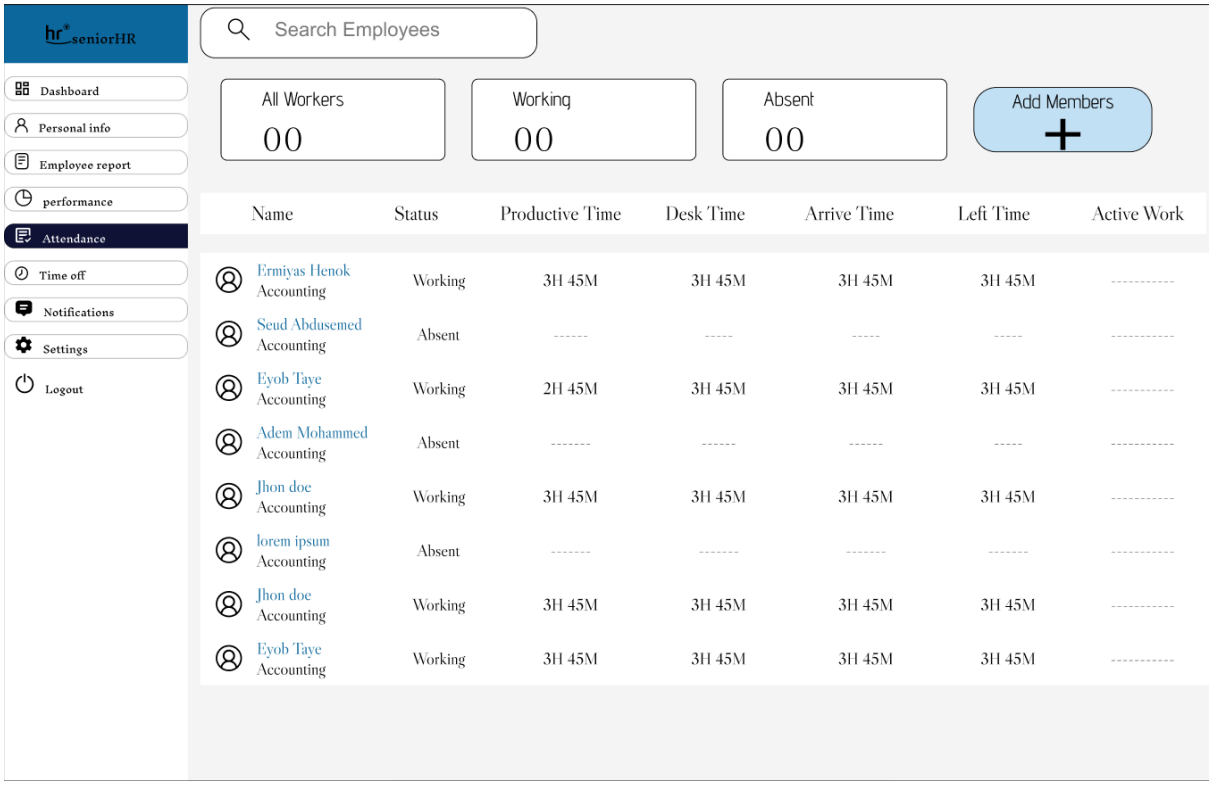

Figure 2.22 Attendance tracking for HR manager

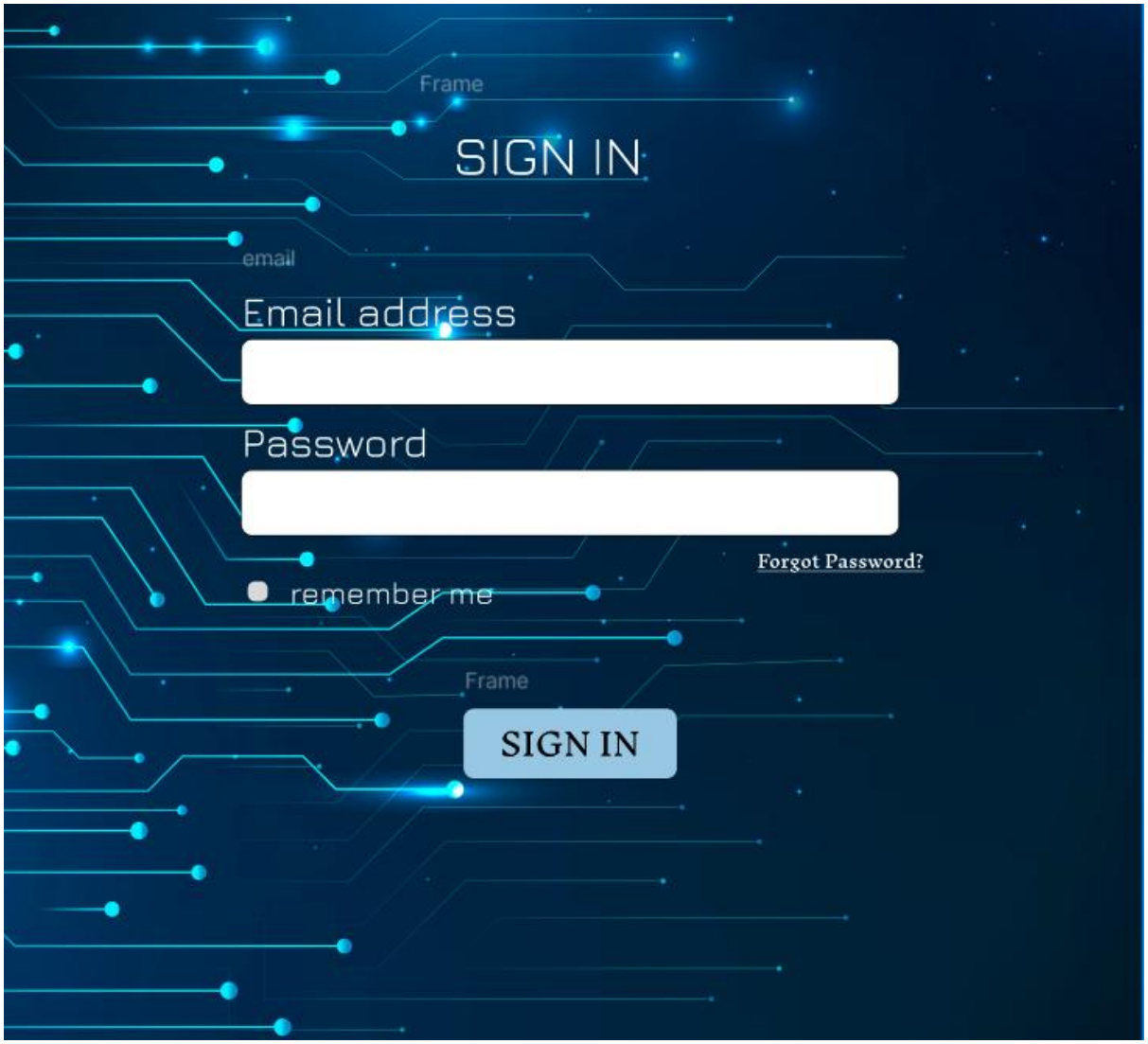

Figure 2.23 Login page

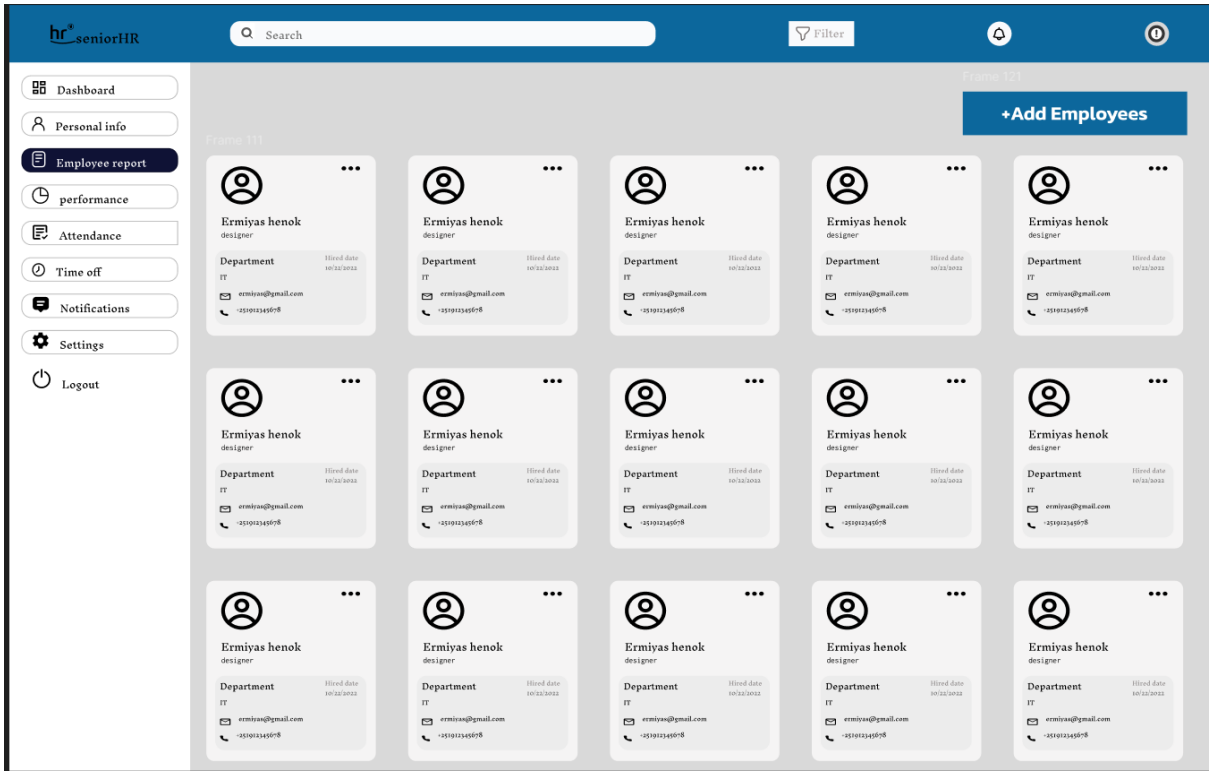

Figure 2.24 Employee management page

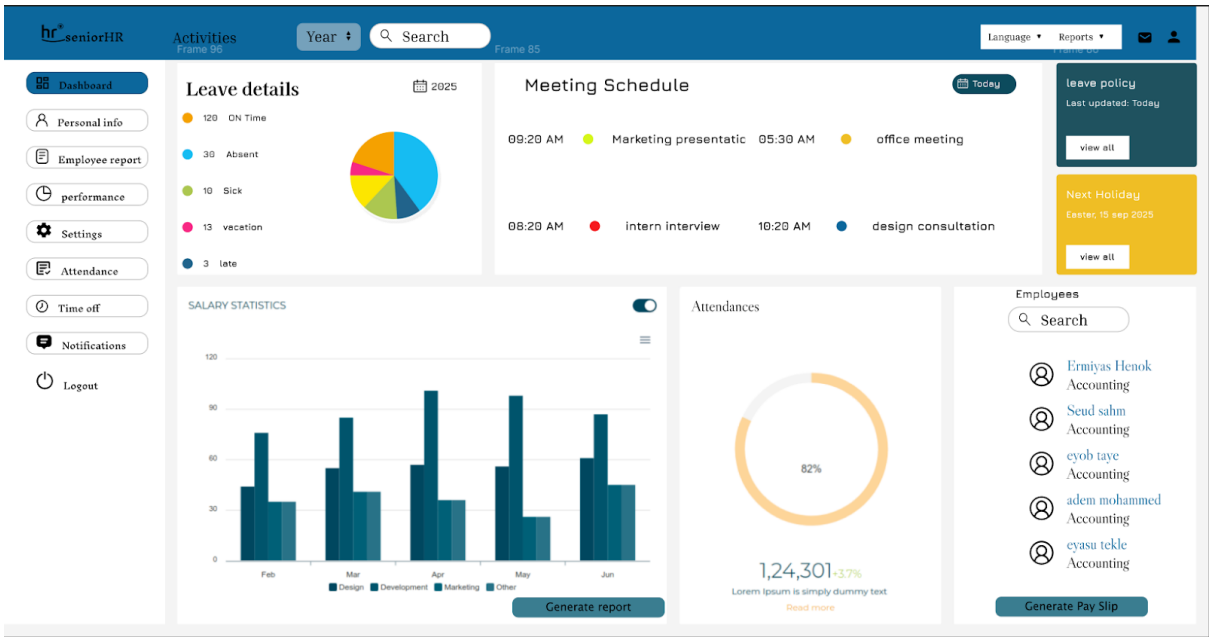

Figure 2.25Dash board page for department manager

CHAPTER THREE

System Design

3.1 Introduction

The system design phase, a crucial step in developing our software solution, is examined in this chapter. In order to satisfy all specified requirements, the system's architecture, modules, components, and data must be established. Future modifications, such as the incorporation of biometrics or updates to tax laws, will be supported by the system's modular and flexible architecture. Because of its design, individual parts can be changed or replaced without affecting the system as a whole. We will take a step-by-step approach, outlining the architecture, data flow, security measures, and the system's goal.

3.2 Purpose of the System

The proposed system is designed to change human resource operations and salary management for Ethiopian SMEs through digital automation. The main goals of the system are:

• **Modernize HR operations:** Replace paper records and spreadsheet tracking with a digital platform for managing employee data, from onboarding to separation.

• **Automate payroll processing**: Remove manual calculation mistakes by systematically handling salaries, deductions, bonuses, and tax compliance.

• **Empower workforce visibility**: Provide role-based portals that allow employees to access their personal records and give managers an overview of team metrics.

• Ensure regulatory compliance: Keep payroll calculations updated automatically according to changes in labor laws and tax regulations.

• **Optimize HR productivity**: Cut down on administrative tasks through automated workflows for leave approvals, attendance tracking, and document management.

3.3 Design Goals

The HR and Payroll Management System focuses on key non-functional requirements like reliability, efficiency, and flexibility to ensure smooth operation for Ethiopian SMEs. These design goals are set to match technical implementation with organizational needs.

We classify design priorities based on the main stakeholder groups: end-users and development teams.

From the user perspective, important design goals are:

- Provide easy-to-use interface navigation
- Ensure accurate payroll calculations
- Maintain responsive system performance

For the development team, key design goals include:

- Use a modular component structure
- Ensure a scalable database design
- Set up strong error handling procedures

3.4 Current Software Architecture

The HR and Payroll Management System used by Ethiopian SMEs is mostly manual, with some automation. It lacks a single software platform to streamline operations. Human resource tasks, such as managing employee records, tracking leave, and monitoring attendance, mostly rely on paper documents and Excel spreadsheets. Payroll processing is partly automated with Peachtree accounting software, which handles salary calculations and basic tax deductions. However, it still requires manual data entry and reconciliation. The absence of an integrated system causes inefficiencies, data inconsistencies, and raises the chances of errors. This situation is common in small companies with limited resources, underscoring the need for a digital solution to improve efficiency and accuracy in HR and payroll management..

3.5 Proposed Software Architecture

The proposed software structure for the HR and Payroll Management System aims to combine and simplify human resource and payroll processes for small and medium-sized enterprises in Ethiopia. It ensures efficient, secure, and scalable management of all related activities. By shifting from manual, paper-based, and Excel-dependent methods to a digital solution, the system addresses inefficiencies, data inconsistencies, and error-prone processes. The structure uses the Model-View-Controller (MVC) pattern for the backend web platform and the Model-View-ViewModel (MVVM) pattern for the mobile application. This approach offers a connected, API-driven experience, with the mobile app serving as the main user interface.

3.5.1 Architectural Pattern

Model-View-Controller (MVC) for Backend Web Platform

The MVC pattern organizes the backend application into three connected components, promoting modularity and clear roles:

- **Model**: Encapsulates all business rules and data operations, managing employee records, payroll calculations, attendance tracking, and compliance with tax laws. It connects directly to the PostgreSQL database, ensuring data integrity and independence from the API.
- **View**: Serves as an API interface, not a user-facing interface. It uses Django's browsable API to expose endpoints for the mobile application. This allows interaction with the backend and provides structured data for employee records, payroll details, and other functions while keeping business logic separate.
- **Controller**: Manages HTTP requests and controls the data flow between the Model and the API. Built with Django, the Controller handles user authentication, checks payroll inputs, enforces security rules, and manages all interactions, ensuring smooth and secure API operations.

Model-View-ViewModel (MVVM) Implementation

For the frontend components across all platforms, the MVVM pattern provides a consistent and maintainable architecture:

- **Model**: Manages application state and business rules. In the React.js web frontend, it handles API data fetching and state management via Redux. For both Android applications, it maintains platform-specific operations - profile/notification data in the employee app and biometric processing in the fingerprint collector - while connecting to the shared Django backend through REST APIs.
- **View**: Contains UI components for each platform. The React.js frontend uses components for HR/admin interfaces. The employee Android app employs Activities for profile/notification screens, while the fingerprint collector uses minimal layouts for biometric capture. All Views bind exclusively to ViewModel properties.
- **ViewModel**: Mediates between Views and backend services. For React.js, it uses hooks and context for state transformation. In Android apps, it processes user interactions - profile updates in the employee app and scan validation in the fingerprint device - converting Model data into observable fields for responsive UIs.

This integrated approach creates a unified platform for HR and payroll management. All components communicate with the Django backend through shared APIs, enabling real-time data synchronization across platforms. By connecting these frontends to the centralized PostgreSQL database, the system streamlines operations, reduces manual processing, and supports scalable growth for Ethiopian SMEs.

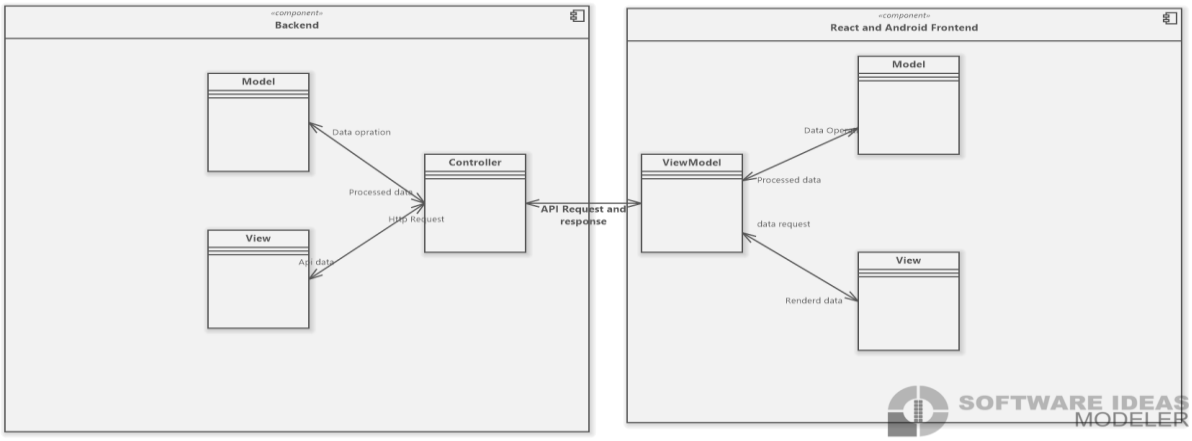

Figure 3.1 Architectural pattern of the project

3.5.2 Subsystem Decomposition

Subsystem decomposition involves breaking the HR and Payroll Management System into smaller, more manageable parts. This approach aims to create modularity, reduce complexity, and improve flexibility, scalability, and reusability. Based on the system's functional requirements, we have identified seven subsystems to simplify human resource and payroll processes for Ethiopian SMEs.

1. **User Management Subsystem**

   Handles secure access and role-based authentication for system users.

   - **Role-Based Authentication (RBAC):** Applies authentication for employees, HR staff, and administrators with specific access levels.
   - **Password** Policies: Enforces secure password requirements and manages user credentials.
   - **Profile Management:** Deals with user registration, updates, and deactivation.
   - **Notification Component**: Delivers real-time updates to employees (added feature).

2. **Employee Management Subsystem**: Oversees the entire employee lifecycle.

- **Onboarding and Offboarding:** Manages employee entry/exit processes and documentation.
- **Contract Management:** Tracks employment contracts and terms.
- **Department Assignments:** Assigns employees to departments and manages hierarchies.

3. **Payroll Processing Subsystem**: Automates payroll calculations and financial transactions.

    - **Salary Calculations:** Computes gross-to-net salaries including bonuses/overtime.
    - **Tax Deductions:** Applies Ethiopian statutory tax and pension deductions.

4. **Report Generation Subsystem**: Produces compliance and management reports.

    - **Statutory Reports:** Generates tax filings and regulatory documents.
    - **Management Dashboards**: Provides workforce metrics and payroll summaries.
    - **Employee Payslips:** Creates payslips in PDF/Excel formats.

5. **Leave & Attendance Subsystem**: Tracks attendance and leave requests.

    - **Attendance Tracking:** Records work hours and check-in/check-out data.
    - **Leave Management:** Processes leave approvals and balance updates.
    - **Payroll Integration:** Links attendance/leave data to payroll deductions.

6. **Notification Subsystem**: Manages real-time communication to employees.

    - **General Broadcasts**: Sends company-wide announcements to all employees (e.g., policy updates, event notifications).
    - **Individual Notifications**: Delivers targeted alerts to specific employees (e.g., leave approvals, payroll alerts, task assignments).

7. **Database Subsystem**: Manages persistent storage and data operations.

    - **PostgreSQL Storage**: Stores HR records, payroll transactions, and audit logs.
    - **Data Access Layer:** Provides standardized CRUD operations for all subsystems.
    - **Backup Functionality:** Performs daily backups for data integrity.

By decomposing the HR and Payroll Management System into these subsystems, the architecture ensures an organized, secure, and efficient approach to managing human resource and payroll processes, enabling seamless integration and scalability for small-sized Ethiopian SMEs.

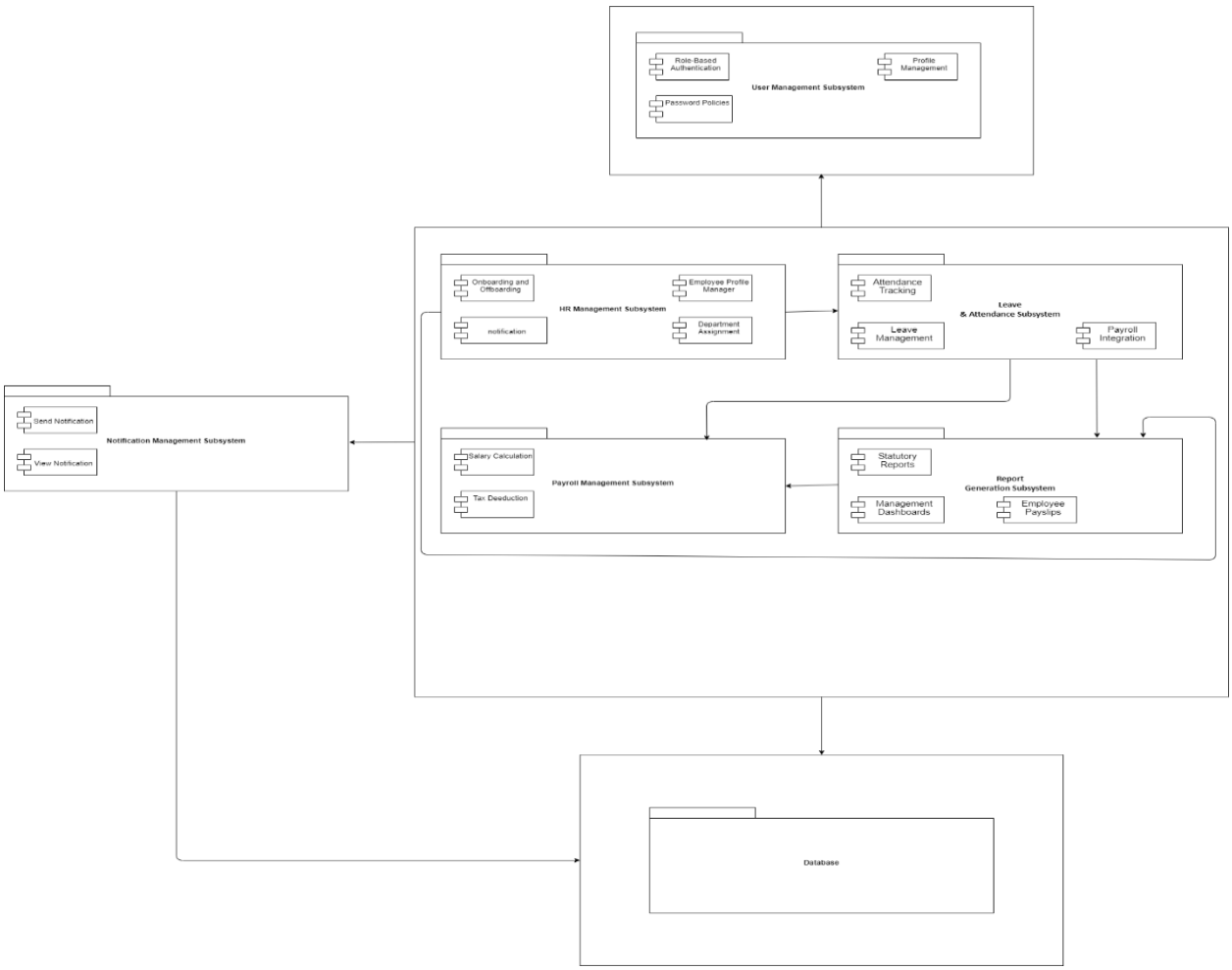

Figure 3.2 Subsystem Decomposition

3.5.3 Component Diagram

The component diagram for the HR and Payroll Management System illustrates the high-level architecture of the system, highlighting the key components and their interactions. The diagram focuses on the core components: User Management, Payroll Processing, Leave & Attendance, Database Connector, and Reporting Module. Each component is equipped with specific interfaces, which define the operations they provide and require. These interfaces facilitate communication and data exchange between components, ensuring seamless integration and functionality across the system. The relationships and dependencies between the components, such as user authentication, payroll calculations, leave approvals, data storage, and report generation, are clearly depicted to provide a detailed understanding of the system's structure and operation.

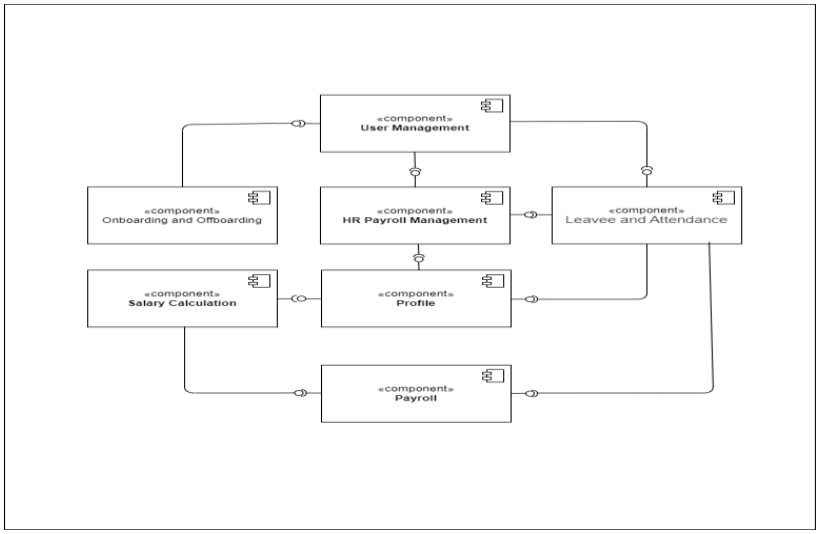

Figure 3.3 Component Diagram

3.5.4 Deployment Diagram

The deployment architecture of the HR and Payroll Management System is designed to ensure scalability, maintainability, and secure access across different system components. The system comprises client-facing interfaces, backend services, and infrastructure hosted within containerized environments.

Core Deployment Components

1. **Client Device**
    - Hosts all end-user interfaces and device-specific components:
        - **Web Browser**: Access point for administrative interfaces
        - **Android Phone**:

          Deployed artifacts:
            - Notification.java (push notification handler)
            - Profile.java (user profile management)
        - **Android Device for Biometrics**:

          Deployed artifact:
            - BiometricsAttendance.java (fingerprint attendance processor)
2. **Server Infrastructure**
    - Hosted within a Docker container environment:
        - **Nginx**: Reverse proxy handling HTTP routing
        - **Gunicorn**: WSGI server for Django application
        - **Django App**: Core business logic and REST API
        - **PostgreSQL**: Primary relational database
        - **Redis**: Caching and message brokering service
3. **Communication Protocols**
    - **HTTP Request/Response**:
        - Between Web Browser and Nginx for administrative access
    - **REST API Request/Response**:
        - Between Android devices and Django backend for data exchange

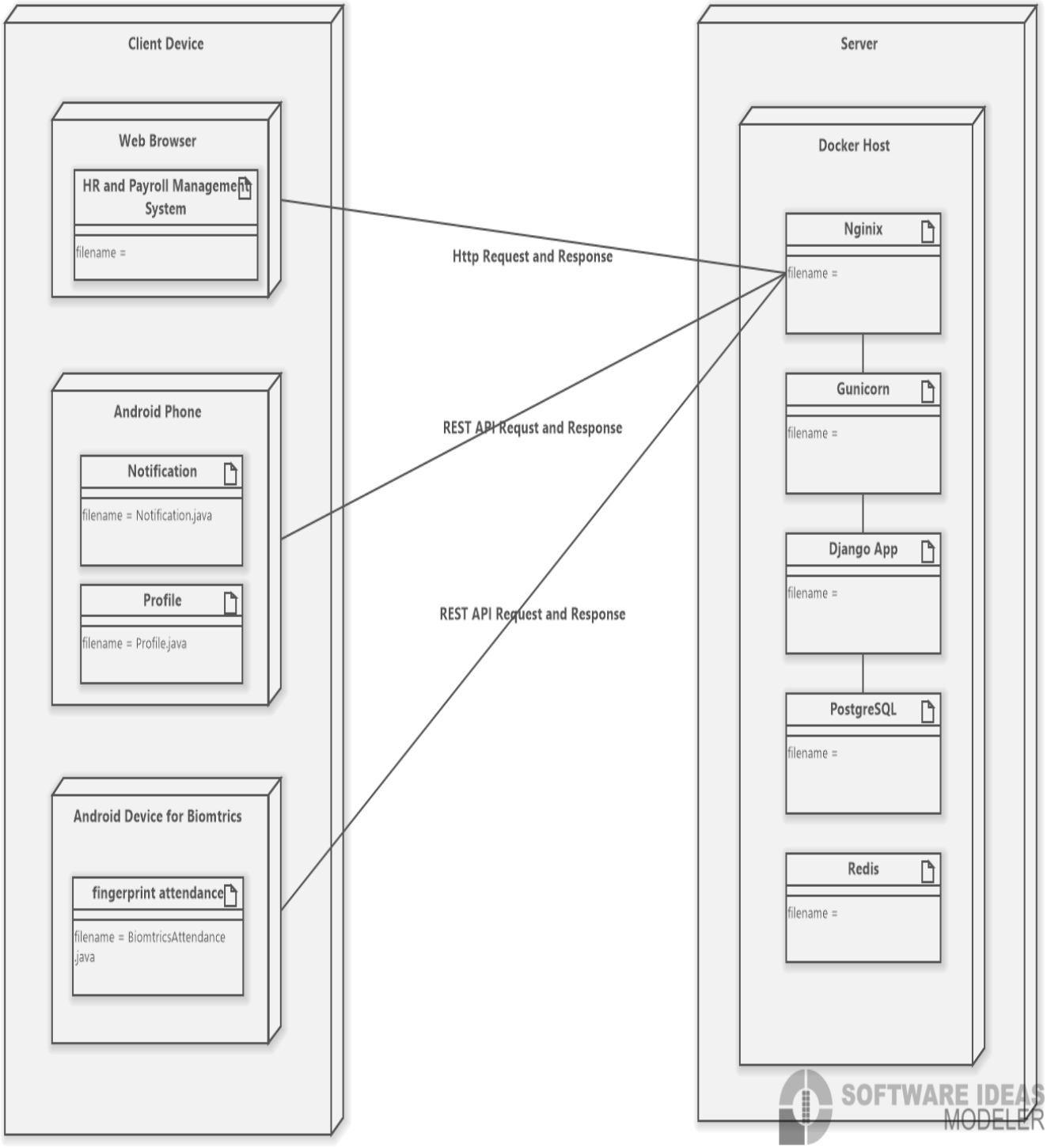

Figure 3.4 Deployment Diagram

3.5.5 Persistent Data Management

Reliable long-term data storage serves as the backbone of our HR and Payroll Management System, guaranteeing continuous availability of essential workforce information throughout all business operations.

For structured data retention, we implement PostgreSQL as our relational database solution, leveraging its strict data organization capabilities to maintain orderly records. The system stores critical HR data categories including employee profiles, salary payment histories, timekeeping records, and benefit enrollment details.

All database operations occur through a dedicated Data Access Layer that shields application logic from direct SQL interactions. This intermediary component standardizes data handling procedures through four fundamental operations: record creation, information retrieval, updates, and deletions while maintaining database independence.

Maintaining flawless data quality remains paramount for system reliability. We enforce strict quality controls through two primary methods: database-level integrity rules and application-side input validation protocols.

3.5.5.1 EER Diagram

The **Enhanced Entity-Relationship (EER) Diagram** for the **HR and Payroll Management System** extends the traditional ER model to provide a more comprehensive and semantically rich representation of data. While the ER model focuses on entities, relationships, and attributes, the EER diagram introduces advanced concepts such as **specialization**, **generalization**, **aggregation**, and **categorization**, making it ideal for modeling complex enterprise systems

Purpose and Role in the System

The EER diagram in this system illustrates how key business entities such as Employee**,** Payroll**,** Attendance**,** Leave**, and** User Roles **are interconnected, capturing both structural and hierarchical relationships.**

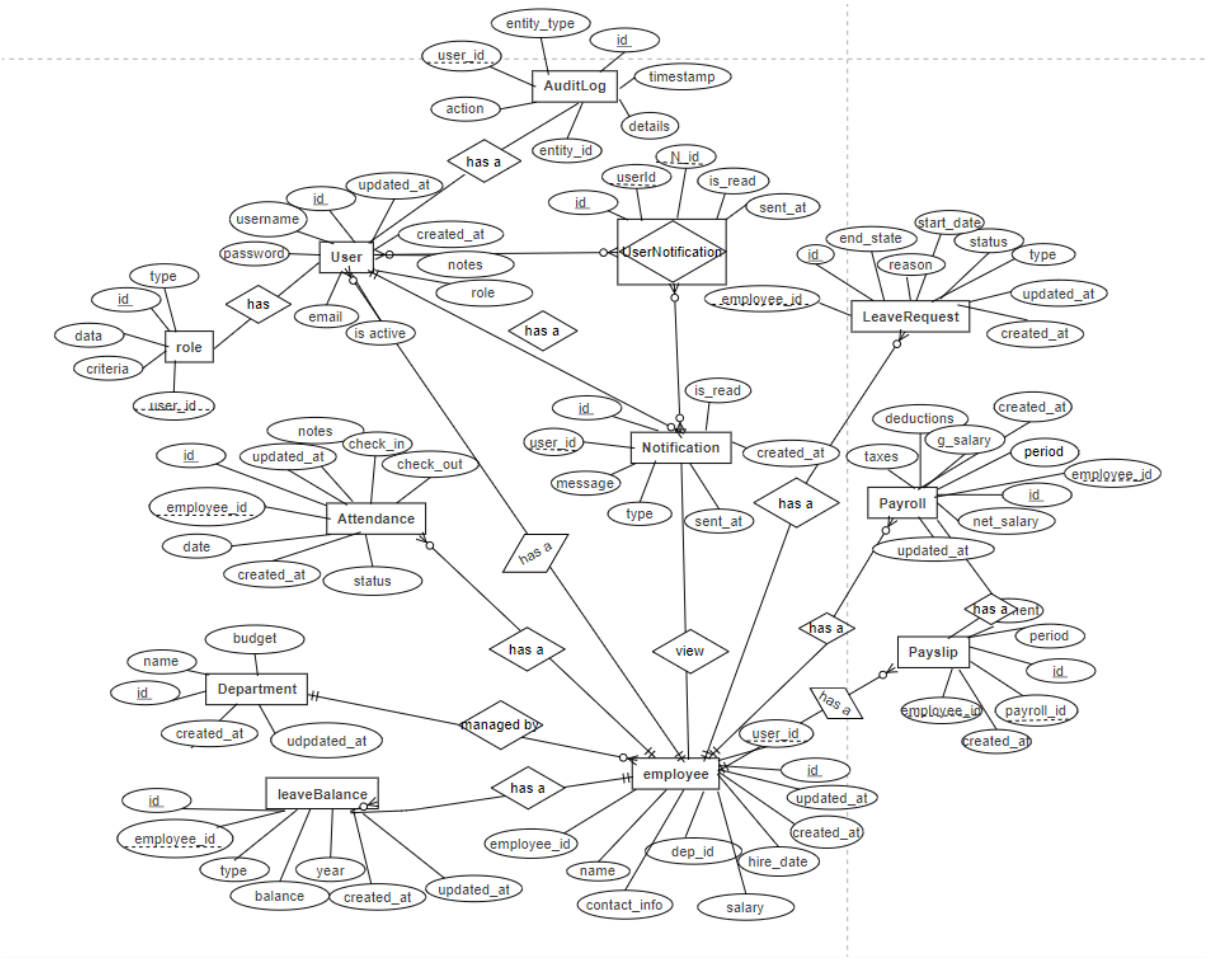

Figure 3.5 EER Diagram

3.5.5.2 Data Model

1. **Employee**: Stores comprehensive employee records including attributes: employee_id, national_id, full_name, hire_date, job_title, department_id, salary_grade, with indexes on employee_id and national_id.
2. **Department**: Maintains organizational unit information with attributes: department_id, name, manager_id, location, budget_code, with indexes on department_id and name.
3. **Payroll**: Records salary transactions containing attributes: payroll_id, employee_id, pay_period, basic_salary, overtime_pay, tax_deductions, net_salary, payment_status, with indexes on payroll_id and employee_id.
4. **Attendance**: Tracks daily work records with attributes: attendance_id, employee_id, date, check_in, check_out, status, overtime_hours, with indexes on attendance_id and employee_id.
5. **Leave**: Manages time-off requests with attributes: leave_id, employee_id, leave_type, start_date, end_date, approval_status, approver_id, with indexes on leave_id and employee_id.
6. **Tax**: Stores tax computation rules with attributes: tax_bracket_id, min_income, max_income, tax_rate, pension_rate, with indexes on tax_bracket_id.
7. **User**: Contains system access credentials with attributes: user_id, employee_id, email, password_hash, role_id, last_login, with indexes on user_id and employee_id.
8. **Role**: Defines access permissions with attributes: role_id, name, permissions, description, with indexes on role_id.
9. **Document**: Manages employee documents with attributes: document_id, employee_id, type, file_path, upload_date, expiry_date, with indexes on document_id and employee_id.
10. **Organization**: Stores company structure with attributes: branch_id, name, address, tax_identification_number, with indexes on branch_id.

3.5.5.3 Relational tables

Table 3.0 Relational Table

Field Name	Type	Key	Description
EMPLOYEE			
employee_id	INT	PK	Unique employee ID
national_id	VARCHAR(50)	-	National identification number
full_name	VARCHAR(100)	-	Full name of the employee
hire_date	DATE	-	Date of employment
job_title	VARCHAR(100)	-	Job position
department_id	INT	FK → Department	Department to which the employee belongs
salary_grade	VARCHAR(20)	-	Salary scale or grade
DEPARTMENT			
department_id	INT	PK	Unique department ID
name	VARCHAR(100)	-	Department name
manager_id	INT	FK → Employee	Department manager
location	VARCHAR(100)	-	Department location
budget_code	VARCHAR(50)	-	Code related to department's budget
PAYROLL			
payroll_id	INT	PK	Unique payroll transaction ID
employee_id	INT	FK → Employee	Employee receiving payment
pay_period	VARCHAR(20)	-	Month or period of payment
basic_salary	DECIMAL(10,2)	-	Base salary before additions or deductions
overtime_pay	DECIMAL(10,2)	-	Payment for overtime hours
tax_deductions	DECIMAL(10,2)	-	Deducted tax amount
net_salary	DECIMAL(10,2)	-	Final take-home salary after deductions

payment_status	ENUM	-	Payment status (e.g., paid, pending, failed)
ATTENDANCE			
attendance_id	INT	PK	Unique attendance ID
employee_id	INT	FK → Employee	Employee who is being tracked
date	DATE	-	Date of the attendance record
check_in	TIME	-	Time the employee checked in
check_out	TIME	-	Time the employee checked out
status	ENUM	-	Attendance status (e.g., present, absent)
overtime_hours	DECIMAL(5,2)	-	Number of overtime hours worked
LEAVE			
leave_id	INT	PK	Unique leave ID
employee_id	INT	FK → Employee	Employee requesting leave
leave_type	VARCHAR(50)	-	Type of leave (e.g., sick, vacation)
start_date	DATE	-	Start date of the leave
end_date	DATE	-	End date of the leave
approval_status	ENUM	-	Status of leave approval (e.g., approved, denied)
approver_id	INT	FK → Employee	Who approved the leave
TAX			
tax_bracket_id	INT	PK	Unique tax bracket ID
min_income	DECIMAL(10,2)	-	Minimum income for bracket
max_income	DECIMAL(10,2)	-	Maximum income for bracket
tax_rate	DECIMAL(5,2)	-	Tax rate percentage
pension_rate	DECIMAL(5,2)	-	Pension contribution rate
USER			

user_id	INT	PK	Unique system user ID
employee_id	INT	FK → Employee	Linked employee record
email	VARCHAR(100)	UNIQUE	User email address
password_hash	VARCHAR(255)	-	Encrypted password
role_id	INT	FK → Role	Assigned role of the user
last_login	TIMESTAMP	-	Last login timestamp
ROLE			
role_id	INT	PK	Unique role ID
name	VARCHAR(50)	-	Role name (e.g., admin, HR manager, employee)
permissions	TEXT	-	List or JSON of permissions
description	TEXT	-	Description of the role
DOCUMENT			
document_id	INT	PK	Unique document ID
employee_id	INT	FK → Employee	Owner of the document
type	VARCHAR(50)	-	Type of document (e.g., ID, contract)
file_path	VARCHAR(255)	-	File location in the system
upload_date	DATE	-	Date the file was uploaded
expiry_date	DATE	-	Optional expiration date for the document
ORGANIZATION			
branch_id	INT	PK	Unique branch ID
name	VARCHAR(100)	-	Branch name
address	VARCHAR(255)	-	Physical address
tax_identification_number	VARCHAR(100)	-	Organization's tax ID number

3.5.5.4 Normalization

Normalization is the process of organizing data in a relational database to reduce redundancy and improve data integrity. It involves dividing large tables into smaller, related ones and defining relationships between them.

There are several **normal forms**, each with specific rules:

- **1NF (First Normal Form):** Eliminates repeating groups by ensuring each field contains only atomic values.
- **2NF (Second Normal Form):** Builds on 1NF by removing partial dependencies all non-key attributes must depend on the whole primary key.
- **3NF (Third Normal Form):** Removes transitive dependencies non-key attributes should not depend on other non-key attributes.
- Higher forms like **BCNF**, **4NF**, and **5NF** further reduce anomalies but are less commonly used in everyday systems.

3.5.6 Access Control and Security

The HR and Payroll Management System processes highly sensitive employee compensation data and personal identification records, demanding enterprise-grade security measures to prevent unauthorized access and maintain data confidentiality. The system incorporates multiple protection layers to secure critical human resources information.

User authentication forms the primary security barrier, requiring all employees, managers, and administrators to verify their identity through unique credentials. The validation process compares provided login details with encrypted records in the secure database, ensuring only authorized personnel gain system entry.

Upon successful verification, the system generates an encrypted JSON Web Token containing the user's employee identification, department affiliation, and access privileges. This token transmits securely via HTTPS protocol to the user's device, where it persists for session maintenance.

For every subsequent request to protected resources like payroll records or employee profiles, the client application automatically attaches the security token. The server validates this token before permitting access to sensitive HR data, creating a continuous authentication chain throughout the user session.

Role-Based Access Control enforces strict permission hierarchies across four user categories. System administrators possess full configuration rights, including security policy management and user privilege assignment. HR department staff access comprehensive employee records

and payroll functions, while department managers view only their team's attendance and leave data. Regular employees interact solely with personal information through self-service portals.

Comprehensive input validation protocols scrutinize all data entries, including form submissions and file uploads. The system verifies proper formatting for national IDs, salary figures, and contact information, rejecting malformed inputs that could indicate malicious activity.

Document uploads undergo additional security checks, validating file types, size limits, and content structure. These multilayered validation measures work in concert to prevent data corruption, injection attacks, and unauthorized information disclosure, ensuring complete data integrity throughout all system operations.

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