



# ETHRONICS

## Institute of **Robotics** **& Autonomous Systems**

### Project Documentation: Biometric Attendance & HR System

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# **Chapter 1**

## **1.1 Introduction**

In today's fast paced and technologically advanced world, managing employee attendance and human resources (HR) efficiently is crucial for the smooth operation of any organization. Traditional methods of attendance tracking and HR management often involve manual processes that can be time consuming, prone to errors, and lack the necessary security measures to protect sensitive information.

The **Biometric Attendance and HR System** is designed to address these challenges by leveraging biometric technology to automate and streamline attendance tracking and HR management. By using biometric data (fingerprints) this system ensures accurate and reliable attendance records while enhancing security and efficiency.

The primary objective of this project is to develop and implement a comprehensive Biometric Attendance and HR System that can be seamlessly integrated into the existing infrastructure of an organization. This system will not only automate the attendance tracking process but also provide a robust platform for managing employee information, generating reports, and ensuring data security.

This documentation outlines the detailed plan for developing the Biometric Attendance and HR System, including the project timeline, system design, requirements, implementation steps, testing procedures, and deployment strategy. It serves as a comprehensive guide for all stakeholders involved in the project, ensuring a clear understanding of the project goals, processes, and deliverables.

## **1.2 Background**

The traditional methods of employee attendance tracking and human resource (HR) management have long relied on manual processes such as paper based timesheets, punch cards, and manual data entry. While these methods have served organizations for decades, they come with significant drawbacks including human error, time inefficiency, and vulnerability to fraud.

With the advent of digital technologies, organizations have sought more reliable and efficient ways to manage attendance and HR functions. Biometric technology, which uses unique physical characteristic fingerprints for identification, has emerged as a powerful solution to these challenges. Unlike traditional methods, biometric systems offer high accuracy, are difficult to forge, and provide a seamless user experience.

The **Biometric Attendance and HR System** leverages these advantages by integrating biometric technology into a comprehensive platform for managing employee attendance and HR data. This system captures biometric data to authenticate employees, records their attendance automatically, and stores this information securely. Additionally, it offers features for HR management such as employee records maintenance, leave management, and performance tracking.

The impetus for this project arises from the need to modernize attendance and HR management processes to improve accuracy, efficiency, and security. Many organizations are transitioning to digital solutions to keep pace with technological advancements and to enhance their operational capabilities. By implementing a Biometric Attendance and HR System, organizations can not only streamline their processes but also ensure a higher level of data integrity and security.

### **1.3 Statement of the problem**

In Ethiopia, many organizations still rely on traditional, manual methods for tracking employee attendance and managing human resource (HR) functions. These methods typically include paper based attendance logs, punch cards, and manual data entry, which are not only time consuming but also prone to errors and fraud. Additionally, these outdated systems often lack the necessary security measures to protect sensitive employee information, leading to potential data breaches and misuse.

Several specific problems have been identified with the current methods of attendance and HR management in Ethiopian organizations:

1. **Inaccurate Attendance Records:** Manual processes are susceptible to human error, leading to inaccurate attendance records. This can result in payroll discrepancies, disputes, and dissatisfaction among employees.
2. **Time Inefficiency:** The process of manually recording, verifying, and managing attendance data is labor intensive and time-consuming. HR personnel spend a significant amount of time on these tasks, diverting their attention from more strategic HR activities.
3. **Vulnerability to Fraud:** Traditional methods are easily manipulated. Practices such as buddy punching, where one employee clocks in for another, are common and lead to false attendance records, impacting productivity and fairness.
4. **Lack of Security:** Paper-based and manual systems do not offer adequate security for sensitive employee information. Unauthorized access to employee records can lead to data breaches and misuse of personal information.
5. **Inefficient HR Management:** The absence of an integrated system for managing employee data, attendance, and HR functions results in fragmented and inefficient HR processes. This fragmentation makes it difficult to generate accurate reports, track employee performance, and manage HR tasks effectively.

Given these challenges, there is a clear need for a more accurate, efficient, and secure system for managing employee attendance and HR functions in Ethiopian organizations. The **Biometric Attendance and HR System** aims to address these issues by leveraging biometric technology to automate attendance tracking, reduce the potential for fraud, and enhance the overall efficiency of HR management. By implementing this system, organizations in Ethiopia can improve data accuracy, protect sensitive information, and streamline HR operations, ultimately contributing to a more productive and secure working environment.

## 1.4 Purpose of the project

The purpose of the **Biometric Attendance and HR System** project is to develop and implement a robust solution that automates employee attendance tracking and enhances HR management processes. By utilizing biometric technology, the system aims to improve data accuracy, reduce time inefficiencies, prevent fraudulent practices, and ensure the security of sensitive employee information. This project seeks to modernize HR operations in Ethiopian organizations, leading to a more efficient, reliable, and secure working environment.

## 1.5 Objectives of the Project

### 1.5.1 General Objectives

The general objective of the **Biometric Attendance and HR System** project is to design, develop, and implement an integrated biometric-based system that automates the attendance tracking and human resource management processes in Ethiopian organizations. This system aims to enhance accuracy, efficiency, and security in managing employee data and HR functions, ultimately improving organizational productivity and operational effectiveness.

### 1.5.2 Specific Objectives

- Implement a biometric-based attendance tracking system to accurately record employee clock-in and clock-out times.
- Integrate the attendance data with the HR module to enable efficient payroll management, leave tracking, and employee information management.
- Provide a centralized web-based platform for employees and HR staff to access and manage attendance and HR-related information.
- Generate comprehensive reports and analytics to support data-driven decision-making in HR and operations.
- Ensure data security and integrity through role-based access controls and backup mechanisms.

## 1.6 Scope and Limitation

The Biometric Attendance & HR System is designed to address the following key areas:

### 1.6.1 Scope

#### Geographical Scope:

- Coverage: The system will be implemented across all branches of the Ethonics Institute of Robotics and Autonomous System.

#### Stakeholder Scope

- Target Users: The system will cater to employees, HR managers, and administrators within the organization.
- Stakeholders: Includes IT staff, management, and external auditors who will interact with the system for various purposes.

#### Quality Scope

- Standards: The system will adhere to industry standards for data security, user privacy, and system reliability.
- Compliance: Ensuring compliance with local regulations and international standards for biometric data handling and HR management.

#### Detailed Functional Scope

- Attendance Management
- Biometric Verification: Integration of fingerprint technologies for accurate and secure attendance tracking.
- Real-time Logging: Immediate logging of attendance data upon biometric verification.
- Historical Records: Maintenance and retrieval of historical attendance records.
- HR Management
- Employee Information System: Comprehensive management of employee details including personal information, job history, and performance data.
- Leave Management: Automated processing of leave applications, approvals, and tracking.
- Payroll Integration: Integration of attendance data with payroll systems to streamline salary computations.
- User Roles and Permissions
- Role-based Access Control: Different access levels for employees, HR managers, and administrators to ensure data security.

- User Authentication: Secure login mechanisms using biometric and password-based authentication.
- Reporting and Analytics
- Custom Reports: Generation of attendance, leave, and performance reports.
- Data Analytics: Analysis tools to provide insights into attendance patterns and HR metrics.

### 1.6.2 Limitation

Despite its comprehensive design, the Biometric Attendance & HR System has certain limitations:

#### Integration Challenges:

- **Device Compatibility:** Ensuring compatibility with a wide range of biometric devices may require custom configurations.
- **Initial Setup:** The initial integration with existing systems can be complex and time-consuming.

#### Internet Dependency:

- **Connectivity Issues:** The system relies on continuous internet access for real-time operations, which can be a limitation in areas with poor connectivity.
- **Offline Functionality:** Limited offline capabilities may hinder operations in certain scenarios.

#### Hardware Dependence:

- **Biometric Device Reliability:** The system's accuracy and reliability are contingent on the quality and maintenance of biometric hardware.
- **Hardware Malfunctions:** Device failures can disrupt the attendance tracking process.

#### Data Privacy and Security:

- **Sensitive Information:** Managing and securing biometric data is critical and challenging, posing risks of data breaches.
- **Regulatory Compliance:** Ensuring the system adheres to local and international data protection laws is essential.

#### User Adaptation:

- **Training Requirements:** Employees and HR personnel may need training to effectively use the system.
- **Resistance to Change:** Transitioning from traditional methods to a biometric system may face resistance.

#### Cost Implications:

- **Initial Investment:** The cost of biometric devices and system setup can be significant.
- **Maintenance Costs:** Ongoing maintenance and support add to the overall expenditure.

### **Customization and Upgrades:**

- **Specific Needs:** Customizing the system to meet specific organizational requirements may require additional development.
- **Upgrading Efforts:** Incorporating new features or technologies can be resource-intensive.

### **Operational Constraints:**

- **User Load:** The system's performance may vary with the number of concurrent users.
- **Operational Downtime:** Maintenance and updates may require temporary downtime, affecting availability.

## **1.7 Feasibility Study**

### **1.7.1 Technical Feasibility**

The Biometric Attendance & HR System is technically feasible as it utilizes well-established biometric technologies, web-based application development, and integration with HR/payroll systems. The required hardware and software components are readily available in the market.

### **1.7.2 Operational Feasibility**

The system is intended to simplify the path to follow for those who are in charge of attendance tracking and HR management, thus reducing mistakes that can be made and creating more effective data. The centralized web-based application will be usable by both employees and HR personnel, leading to the easy handling of the process and the maximum adoption.

### **1.7.3 Economical Feasibility**

It is expected that the pros of the Biometric Attendance & HR System, like the less prediction errors, the superior payroll management, and the better HR decision-making, will be more than the initial investment and ongoing maintenance costs. A good result of the system is that it will enable the company to earn a profit.

### **1.7.4 Budget Feasibility**

The project budget has been estimated based on the cost of biometric hardware, software development, integration with existing systems, and ongoing maintenance. The budget is deemed feasible and within the organization's financial capabilities.

### **1.7.5 Schedule Feasibility**

The project timeline has been carefully planned, taking into account the system development, implementation, and training phases. The schedule is considered feasible and achievable within the given timeframe.

### **1.7.6 Market Feasibility**

The Biometric Attendance & HR System addresses a common challenge faced by many organizations, making it a viable and marketable solution. The demand for such integrated systems is expected to continue growing as organizations strive to improve their HR and attendance management processes.

## **1.8 Significance of the Project**

The Biometric Attendance & HR System will deliver the following benefits to the organization:

- Eliminates manual methods like paper-based registers or swipe cards.
- Biometric authentication ensures real-time accuracy, minimizing errors and preventing time theft.
- Automates tasks such as leave management, employee information handling, and reporting, saving time and effort with centralized data management.
- Frees HR personnel from administrative tasks, allowing focus on strategic initiatives and employee development, enhancing overall efficiency.
- Biometric authentication provides a high level of security for attendance tracking. The unique physiological or behavioral characteristics used for authentication are difficult to replicate or forge, ensuring that only authorized individuals can mark their attendance.
- Reduces expenses associated with traditional methods like paper-based systems or ID cards, minimizing paperwork and storage needs.
- Facilitates easy access to accurate attendance records, ensuring transparency and compliance with labor regulations during audits.
- Offers a user-friendly experience for attendance marking, leave requests, and accessing HR services, enhancing overall employee satisfaction and engagement.

## **1.9 Beneficiaries of the Project**

The primary beneficiaries of the Biometric Attendance & HR System are:

**Employees:** Efficient and accurate attendance tracking, easy access to HR information, and improved work-life balance.

**HR department:** Automated HR processes, centralized employee data, and enhanced decision-making capabilities.

**Management:** Comprehensive reporting, data-driven insights, and improved operational efficiency.

## 1.10 Methodology

### 1.10.1 Data Source

The Biometric Attendance & HR System will utilize the following data sources:

- Employee master data (personal details, employment information, etc.)
- Attendance records from the biometric devices
- Leave requests and approvals
- Payroll and compensation data

### 1.10.2 Fact Finding Methodologies

The project team will employ the following fact-finding methodologies:

- Interviews with HR managers, department heads, and end-users
- Observation of current attendance tracking and HR processes
- Review of existing HR policies, procedures, and legal/regulatory requirements
- Analysis of historical attendance and HR data

### 1.10.3 System Development Methodology

For the development of our system, we adopted the Agile software development methodology.

#### Reasons for Choosing Agile:

- **Iterative Development:** Agile breaks down the development process into iterations or sprints, where small increments of functionality are delivered and reviewed. This approach enables us to continuously refine and improve the system based on ongoing feedback.
- **Flexibility:** Agile methodologies, such as Scrum or Kanban, provide flexibility in accommodating changing requirements and priorities. By focusing on delivering incremental value, we prioritize the highest impact features and functionalities first.
- **Quick Response to Feedback:** Agile promotes regular collaboration with stakeholders and end-users, facilitating quick feedback loops. This ensures that the developed system aligns closely with user expectations and business needs.

## 1.11 Development Tools

### 1.11.1 Software tools

No	Activity	Tools/Programs	purpose/description
1	Front-end development	JavaScript	Used for front-end development and client-side interaction
2	Back-end development	Python	Used for back-end development and server-side logic
3	Front-end framework	React	A JavaScript library for building user interfaces, providing a responsive and interactive experience for users
4	back-end framework	Django	A high-level Python web framework that encourages rapid development and clean, pragmatic design
5	Database	MySQL	A reliable and scalable relational database management system for storing biometric data and HR-related information
6	Code editing tools	Visual Studio Code	An integrated development environment (IDE) for writing, debugging, and testing code
7	Version control	Git	A version control system for tracking changes in source code during development
8	Code hosting	GitHub	A platform for hosting and collaborating on code repositories
9	API testing	Postman	For testing APIs and ensuring correct data transfer between the frontend and backend
10	Project management	ClickUp.com	For project management and tracking development progress
11	communication	Slack	For communication purposes
12	Documentation	Google Docs	Web-based Google Docs Editors suite offered by Google

### 1.11.2 Hardware tools

No	Name	Purpose/Description
1	Biometric Device	Fingerprint scanners used for capturing biometric data.

## **1.12 Test Plan**

### **1.12.1 Unit Testing**

Individual components of the Biometric Attendance & HR System, such as the biometric authentication, attendance tracking, leave management, and reporting modules, will be thoroughly tested to ensure their functionality and reliability.

### **1.12.2 Integration Testing**

The system's various modules and components will be tested for seamless integration, data flow, and overall system performance.

### **1.12.3 System Testing**

End-to-end testing of the complete Biometric Attendance & HR System will be conducted to validate the system's functionality, usability, and compliance with the specified requirements.

### **1.12.4 Acceptance Testing**

The system will be tested by the client/end-users to ensure that it meets their expectations and requirements. User acceptance testing will be conducted to obtain final approval before deployment.

## **1.13 Project Execution Phase**

The project execution will consist of the following phases:

- Requirement Gathering and Analysis

- System Design and Architecture
- Development and Integration
- Testing and Quality Assurance
- Implementation and Deployment

## **1.14 Required Resources with Tools**

The project will require the following resources and tools:

- Project management and coordination tools (e.g., ClickUp)
- Database software for storing biometric and attendance data
- HR management software
- Web-based interface for HR management and an employee self-service portal
- Programming tools for developing user interfaces and system Integration.
- Biometric hardware and SDK/API

## **1.15 Task and Schedule**

The project schedule will be divided into the following key tasks and milestones:

- Requirement Gathering and Analysis (week 1)
- System Design and Architecture (week 2)
- Development and Integration (week 3 -4)
- Testing and Quality Assurance (week 5)
- Implementation and Deployment (week 6-7)

## **1.16 Team composition**

Name	Workload
<b>Abel Bekele</b>	Backend Dev,Ui Designer ,Tester,PM
<b>Abrham Demesew</b>	Ui Designer and Frontend Dev
<b>Ajmel Abes</b>	Backend Dev & Tester
<b>Miraf Tsegaye</b>	Ui Designer & Front End dev

# **Chapter 2**

## **2.1 Major Functions of Manual Method**

In many Ethiopian organizations, traditional attendance and human resource management systems rely heavily on manual processes. These systems often include the following key functions:

- **Manual Attendance Recording:** Employees mark their attendance through paper registers or manual logs, which can lead to inaccuracies and data loss.
- **Leave Management:** Leave requests are submitted through informal channels, such as verbal communication or handwritten notes, making tracking and approval cumbersome and prone to errors.
- **Performance Tracking:** Employee performance metrics are often collected sporadically, relying on subjective assessments rather than structured evaluation criteria, which can result in bias and inconsistency.
- **Employee Record Maintenance:** Personnel records are frequently stored in physical files, making it challenging to access, update, or analyze employee information efficiently.
- **Reporting:** Generating reports on attendance, leave, and performance is often a time-consuming process, requiring manual compilation of data, which can lead to delays and inaccuracies.

These existing functions, while serving fundamental purposes, present significant challenges in terms of efficiency, accuracy, and security. By addressing these shortcomings, the Biometric Attendance and HR System aims to enhance organizational productivity and streamline HR operations through automated, reliable, and secure processes.

## **2.2 Users of the current system**

The current attendance and HR management system in Ethiopian organizations primarily involves the following users:

- **Employees:**
  - Interact with the manual attendance system, often signing in or using punch cards. They are responsible for ensuring their attendance is accurately recorded.
- **Human Resource Personnel:**
  - Manage attendance records, process payroll based on attendance data, and handle employee information. They often spend considerable time verifying and correcting attendance records.
- **Management:**

- Utilize attendance and HR data for decision-making, performance evaluation, and workforce planning. They require accurate and timely reports on employee attendance and HR metrics.
- **IT Support Staff:**
  - Provide technical support for any issues related to the current system, such as data entry errors or hardware malfunctions associated with manual attendance tracking methods.

## 2.3 Guiding Principles of the System

The **Biometric Attendance and HR System** operates under the following guiding principles:

- **Accuracy:** Ensure precise recording and verification of employee attendance through reliable biometric authentication methods, reducing errors in attendance tracking.
- **Efficiency:** Streamline HR processes by automating attendance management, thereby saving time and resources traditionally spent on manual data entry and verification.
- **Security:** Implement robust security measures to protect biometric data and employee information from unauthorized access, ensuring confidentiality and integrity.
- **User-Friendliness:** Design an intuitive user interface that facilitates ease of use for both employees and HR administrators, promoting adoption and minimizing training requirements.
- **Integration:** Ensure seamless integration with existing organizational systems and workflows to maximize operational efficiency and minimize disruption during deployment.
- **Compliance:** Adhere to relevant legal and regulatory requirements regarding data protection and privacy, ensuring the system's compliance with Ethiopian laws and international standards.

## 2.4 Drawbacks of the Manual System

The current system used for employee attendance tracking and human resource management in many Ethiopian organizations suffers from several significant drawbacks:

- **Manual Data Entry:** Reliance on manual methods such as paper-based attendance logs and punch cards leads to errors in data entry, resulting in inaccurate attendance records and payroll discrepancies.
- **Time-Consuming Processes:** The process of manually recording and verifying attendance data is labor-intensive and time-consuming, diverting HR personnel from more strategic tasks.
- **Vulnerability to Fraud:** Traditional methods are susceptible to fraudulent practices such as buddy punching, where employees clock in for absent colleagues, leading to false attendance records and decreased accountability.

- **Security Risks:** Paper-based systems lack adequate security measures to protect sensitive employee information, making them vulnerable to unauthorized access and potential data breaches.
- **Inefficient HR Management:** The lack of an integrated system for managing employee data and HR functions results in fragmented HR processes, hindering the ability to generate accurate reports, track employee performance, and make informed decisions.

These drawbacks highlight the need for a more modern, automated, and secure system like the Biometric Attendance and HR System to address these challenges effectively.

## Chapter 3

### 3.1 Overview of Proposed System

The proposed **Biometric Attendance and HR System** represents a modern solution designed to revolutionize employee attendance tracking and human resource management. This chapter provides an overview of the system's architecture, components, and functionalities, outlining how it addresses the current challenges in traditional attendance and HR management methods.

### 3.2 Functional requirement

The fingerprint biometric and attendance hr system has the following functionality

- **Biometric Data Capture:**
  - The system must accurately capture and store biometric data (fingerprint or facial recognition) for each employee during registration.
- **Attendance Recording:**
  - The system must verify employee identity using biometric data and record the time of arrival and departure.
- **Real-Time Data Transfer:**
  - The system must transfer attendance data to the HR management software in real-time.
- **Integration with HR Software:**
  - The system must integrate with existing HR management software to automate payroll, leave management, and other HR functions.
- **User Interfaces:**

- The system must provide a user-friendly interface for employees to check in/out and for HR administrators to manage records.
- **Reporting and Analytics:**
  - The system generates attendance reports and allows HR administrators to perform analytics on attendance and HR data.
- **Alerts and Notifications:**
  - The system sends alerts and notifications to HR administrators for any discrepancies or issues in attendance data.
- **Employee database management:** The system allows for the creation, modification, and management of employee profiles, including personal information, contact details, job details, and promotion.
- **Leave Management:** The system facilitates leave application, approval workflows, and tracking of leave balances. Employees must be able to view their leave status and history through a self-service portal.
- **Payroll integration and management:** The system automatically calculates payroll based on attendance data.

### **3.3 Non-functional requirement**

- **Performance:**
  - The system must process biometric data and record attendance within a few seconds to ensure a smooth user experience.
  - Real-time data transfer to the HR management software should occur without noticeable delays.
- **Security:**
  - The system must encrypt all biometric data during capture, storage, and transfer to protect against unauthorized access and data breaches.
  - Access to the system and data should be controlled through secure authentication mechanisms.
- **Scalability:**
  - The system must be able to handle an increasing number of employees and biometric records without degradation in performance.
- **Reliability:**
  - The system must have high availability and minimal downtime to ensure continuous operation.

- Backup and recovery mechanisms should be in place to prevent data loss.
- **Usability:**
  - The user interface must be intuitive and easy to use for both employees and HR administrators.
  - The system should provide clear instructions and feedback to users during biometric scans and data entry.
- **Maintainability:**
  - The system must be designed in a modular way to facilitate easy maintenance, updates, and troubleshooting.
  - Documentation should be provided for system components and their interactions.
- **Compatibility:**
  - The system should be compatible with various biometric sensors and HR management software to ensure seamless integration.
  - The system must support different operating environments, such as Windows, macOS, or Linux, if applicable.
- **Efficiency:**
  - The system must optimize resource usage to ensure efficient operation without unnecessary consumption of power or processing capabilities.
  - The system should minimize network bandwidth usage for data transfers.
- **Accessibility:**

The system should be accessible to users with disabilities, providing necessary accommodations as required by accessibility standards.

## 3.4 System Model

### 3.4.1 Scenarios

#### Scenario 1: Employee Management

##### 1. User Registration

- Actor: HR Manager
- Description: The HR manager adds new workers to the system. They input personal info and assign each worker a unique ID number.
- Outcome: The system registers the worker, enabling them to enroll their fingerprints.

##### 2. Fingerprint Enrollment

- Actor: Employee

- Description: Workers scan their fingerprint with a biometric device. The system securely stores this fingerprint information.
- Outcome: The worker's fingerprint is saved and linked to their profile.

### **3. Employee Profile Management**

- Actor: HR Manager
- Description: The HR manager updates the employee's profile with changes such as contact information, job roles, and department.
- Outcome: The system saves the updated profile information.

### **Scenario 2: Attendance Tracking**

### **4. Clock In/Out**

- Actor: Employee
- Description: The employee uses their fingerprint to clock in and out at the beginning and end of their shift.
- Outcome: The system records the employee's work hours.

### **5. Time Tracking**

- Actor: System
- Description: The system calculates the total hours worked by each employee based on their clock in and clock out times.
- Outcome: The system saves the calculated work hours.

### **6. Absence Tracking**

- Actor: HR Manager
- Description: The HR manager reviews attendance records to monitor employee absences, marking any unexcused absences.
- Outcome: Absence records are updated and available for reporting.

### **7. Overtime Tracking**

- Actor: System
- Description: The system calculates overtime hours based on predefined rules and the total hours worked by employees.
- Outcome: Overtime hours are recorded and used for payroll.

### **Scenario 3: Reporting and Data Management**

## **8. Generate Attendance Reports**

- Actor: HR Manager
- Description: The HR manager generates attendance reports for a specified period, showing total hours worked, absences, and overtime.
- Outcome: The attendance report is generated and can be printed or distributed.

## **9. Export Data**

- Actor: HR Manager
- Description: The HR manager exports attendance and employee data for integration with other HR or payroll systems.
- Outcome: Data is exported in a compatible format for other systems.

## **10. Data Integration**

- Actor: System
- Description: The system integrates with external HR and payroll systems to synchronize employee and attendance information.
- Outcome: Data is synchronized, ensuring consistency and accuracy.

### **Scenario 4: Employee CheckIn**

## **11. Employee Arrival**

- Description: An employee arrives and uses the fingerprint scanner to check in.
- Actions: The employee places their finger on the scanner, which captures the fingerprint and sends it to the system.
- Outcome: The system verifies the fingerprint and records the employee's arrival time.

## **12. Fingerprint Verification**

- Description: The system verifies the employee's identity using their fingerprint.
- Actions: The system compares the scanned fingerprint with stored data. If it matches, the employee is marked as present.
- Outcome: Attendance records are updated.

### **Scenario 5: Employee CheckOut**

## **13. Employee Departure**

- Description: An employee uses the fingerprint scanner to check out.

- Actions: The employee places their finger on the scanner, which captures the fingerprint and sends it to the system.
- Outcome: The system verifies the fingerprint and records the employee's departure time.

#### **14. Fingerprint Verification**

- Description: The system verifies the employee's identity using their fingerprint.
- Actions: The system compares the scanned fingerprint with stored data. If it matches, the employee is marked as having left.
- Outcome: Attendance records are updated.

#### **Scenario 6: Attendance Report Generation**

#### **15. Request Report**

- Actor: HR Manager
- Description: The HR manager requests an attendance report.
- Actions: The HR manager logs into the system, selects the report criteria (e.g., dates, departments), and generates the report.
- Outcome: The system generates the report, which the HR manager can view, print, or save.

#### **16. Report Generation**

- Description: The system compiles the necessary data to create the attendance report.
- Actions: The system retrieves data from the database and formats it into a report.
- Outcome: The attendance report is ready for review.

#### **17. Report Delivery**

- Description: The HR manager receives the generated attendance report.
- Actions: The HR manager views the report on their screen, receives it via email, or prints it.
- Outcome: The report is available for review and distribution.

#### **Scenario 7: Employee Leave Request**

#### **18. Submit Leave Request**

- Actor: Employee
- Description: An employee submits a leave request through the system.

- Actions: The employee logs into the HR system, fills out the leave request form, and submits it.
- Outcome: The leave request is sent to the HR manager for approval.

## **19. Review Leave Request**

- Actor: HR Manager
- Description: The HR manager reviews the leave request.
- Actions: The HR manager receives a notification, reviews the request, and approves or rejects it.
- Outcome: The employee is notified of the decision, and the leave balance is updated if approved.

## **20. Update Records**

- Description: The system updates the leave request and attendance records.
- Actions: The system adjusts the employee's leave balance and updates attendance logs.
- Outcome: Records are updated, and the employee is notified.

## **Scenario 8: Employee Information Management**

## **21. Onboard New Employees**

- Actor: HR Manager
- Description: The HR manager registers new employees in the system.
- Actions: The HR manager enters the new employee's information and enrolls their fingerprint.
- Outcome: The new employee is added to the system.

## **22. Update Employee Information**

- Actor: HR Manager
- Description: The HR manager updates existing employee information.
- Actions: The HR manager modifies the employee's profile (e.g., department changes, job title updates).
- Outcome: The updated information is saved in the system.

## **Scenario 9: Employee Self Service**

### **23. View Attendance Records**

- Actor: Employee

- Description: Employees access their attendance records.
- Actions: Employees log into the system and navigate to their attendance records.
- Outcome: Employees can view their clockin/out times, total hours worked, and any absences.

## **24. Update Personal Information**

- Actor: Employee
- Description: Employees update their personal information (e.g., contact details).
- Actions: Employees log into the system and update their personal information.
- Outcome: The updated information is saved in the system.

## **Scenario 10: Compliance and Auditing**

## **25. Conduct Audits**

- Actor: Compliance Officer
- Description: Compliance officers review attendance and employee records for accuracy and compliance.
- Actions: Compliance officers log into the system and access audit trails and records.
- Outcome: Compliance officers ensure that records are accurate and compliant with regulations.

## **26. Generate Compliance Reports**

- Actor: Compliance Officer
- Description: Compliance officers generate reports to ensure regulatory compliance.
- Actions: Compliance officers select report criteria and generate compliance reports.
- Outcome: Compliance reports are generated and reviewed.

## **Scenario 11: Payroll Integration**

## **27. Calculate Payroll**

- Actor: HR Manager
- Description: The HR manager uses attendance data to calculate payroll.
- Actions: The HR manager exports attendance data and integrates it with the payroll system.
- Outcome: Payroll calculations are accurate and based on actual work hours and overtime.

## **28. Distribute Payroll Data**

- Actor: HR Manager
- Description: The HR manager distributes payroll data to the finance department.
- Actions: The HR manager exports and shares payroll data.
- Outcome: Payroll data is ready for processing by the finance department.

## **Scenario 12: System Maintenance**

### **29. Perform System Updates**

- Actor: IT Support Staff
  - Description: IT support staff perform system updates and maintenance.
  - Actions: IT staff apply updates and patches to the system.
- Outcome: The system is up-to-date and functioning properly.

### **30. Backup Data**

- Actor: IT Support Staff
- Description: IT support staff perform regular data backups.
- Actions: IT staff back up attendance and employee data.
- Outcome: Data is securely backed up to prevent loss.

## **Scenario 13: Security Management**

### **31. Monitor System Security**

- Actor: IT Support Staff
- Description: IT support staff monitor the system for security threats.
- Actions: IT staff review security logs and alerts.
- Outcome: The system remains secure against potential threats.

### **32. Respond to Security Incidents**

- Actor: IT Support Staff
- Description: IT support staff respond to security incidents.
- Actions: IT staff investigate and resolve security breaches.
- Outcome: Security incidents are addressed and mitigated.

## **Scenario 14: Employee Feedback**

### **33. Submit Feedback**

- Actor: Employee

- Description: Employees submit feedback about the HR system.
- Actions: Employees log into the system and fill out feedback forms.
- Outcome: Feedback is collected and reviewed by HR.

#### **34. Review Feedback**

- Actor: HR Manager
- Description: The HR manager reviews employee feedback.
- Actions: The HR manager analyzes feedback and makes necessary improvements.
- Outcome: The system is improved based on employee feedback.

#### **Scenario 15: Training and Support**

#### **35. Provide Training**

- Actor: HR Manager
- Description: The HR manager provides training for new employees on using the biometric system.
- Actions: The HR manager conducts training sessions and provides materials.
- Outcome: Employees are trained and can effectively use the system.

#### **36. Offer Support**

- Actor: IT Support Staff
- Description: IT support staff provide assistance to employees and HR managers.
- Actions: IT staff offer support through help desks and troubleshooting.
- Outcome: Users receive help with any issues they encounter with the system.

### **3.5 Use case model**

In Biometrics attendance and HR system, we have the following actors

#### **1. Employee:**

- Employees are the primary users of the Biometric Attendance and HR System.
- They are responsible for authenticating themselves using biometric data (fingerprints) to access the system.

#### **2. HR Manager:**

- HR managers are responsible for managing employee information, leave, payroll, and generating reports.

- They can create, update, and maintain employee profiles, including personal details, job history, and performance data.

### **3. ITSupportStaff:**

- The IT Support Staff actor is responsible for resolving technical issues and performing data backups.

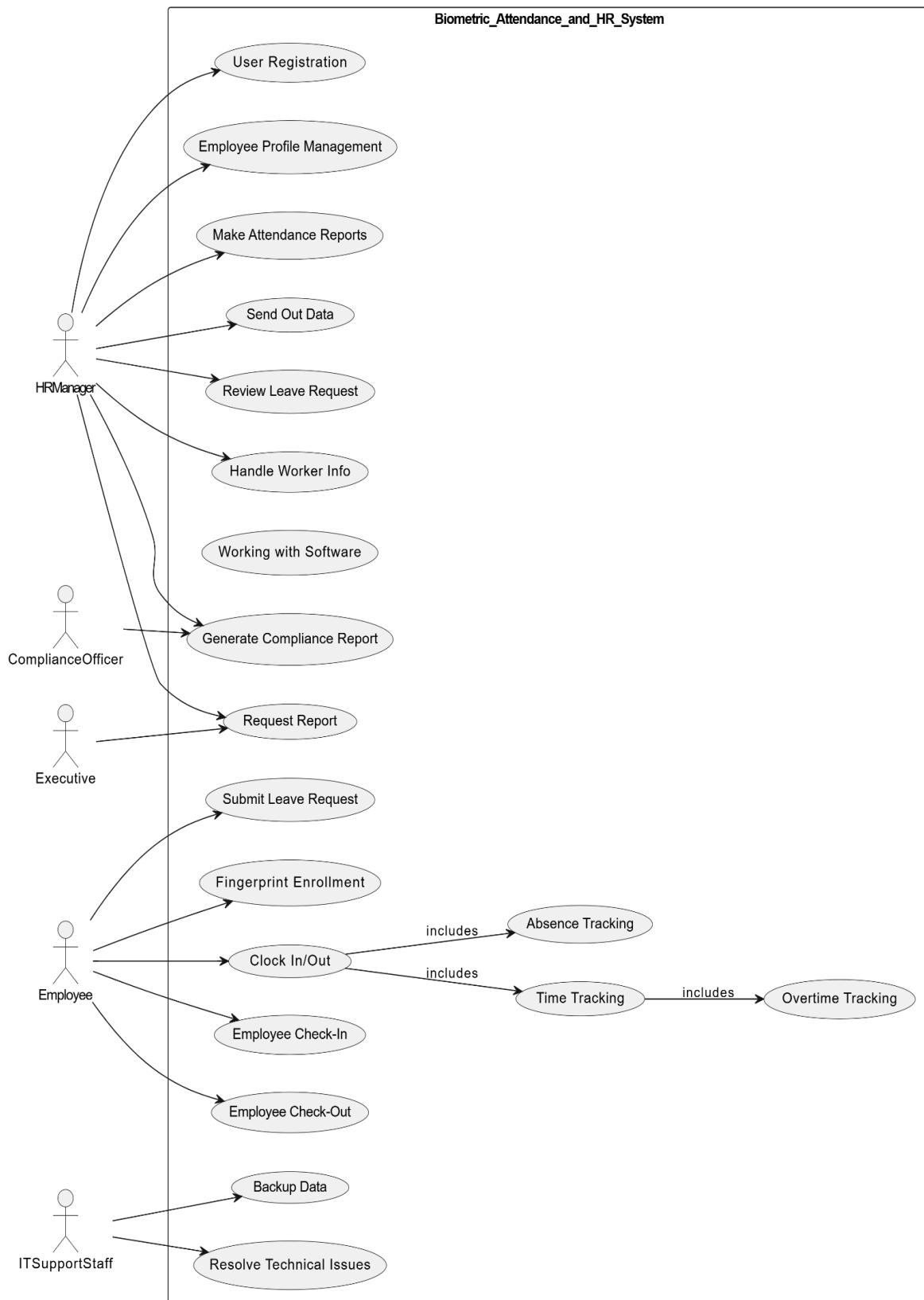
### **4. ComplianceOfficer:**

- The Compliance Officer actor is responsible for generating compliance reports.

### **5. Executive:**

- The Executive actor is responsible for requesting reports.

### 3.5.2 Use Case Diagram & Description



Description 1	
Use case name	Register
Use case number	UC01
Participating actors	HR Manager, Employee
Precondition	Employees must have a valid email address and phone number.
Flow Control	<ol style="list-style-type: none"> <li>1. HR manager opens the employee registration</li> <li>2. The HR manager enters the employee's personal details such as name, contact information, job role, and department.</li> <li>3. Employees scan their fingerprint using the biometric device.</li> <li>4. The system verifies the fingerprint and creates a new employee profile.</li> </ol>
Post condition	The system saves the new employee's information and fingerprint data.
Alternate condition	If the employee information is incomplete, the system prompts the HR manager to fill in the missing details.
Description	Employee registration to the attendance tracking platform

Table 3.5.2.1 Use case description of User Registration

Description 2	
Use case name	Clock In/Out
Use case number	UC02

Participating actors	Employee
Precondition	Employees must be registered in the system and have their fingerprint enrolled.
Flow Control	<ol style="list-style-type: none"> <li>1. Employee places their finger on the biometric device to clock in.</li> <li>2. The system verifies the employee's fingerprint and records the clock-in time.</li> <li>3. At the end of the shift, the employee clocks out using the same fingerprint scanning process.</li> </ol>
Post condition	The system updates the employee's attendance records with the clock-in and clock-out times.
Alternate condition	If the employee's fingerprint is not recognized, the system prompts them to try again or contact the HR manager.
Description	Employees clock in and out using fingerprint scanning

Table 3.5.2.2 Use case description of Employee Attendance Tracking

Description 3	
Use case name	Generate Attendance Report
Use case number	UC03
Participating actors	HR manager generates attendance reports for employees
Precondition	HR Manager
Flow Control	<ol style="list-style-type: none"> <li>1. HR manager selects the "Generate Attendance Report" option.</li> <li>2. The HR manager specifies the report criteria, such as the date range, employee, or department.</li> <li>3. The system compiles the attendance data and generates the report.</li> <li>4. HR manager reviews, prints, or exports the attendance report.</li> </ol>

Post condition	The attendance report is made available to the HR manager.
Alternate condition	If there is no attendance data available for the specified criteria, the system displays a message indicating the lack of data.
Description	HR manager generates attendance reports for employees

Table 3.5.2.3 Use case description of Attendance Reporting

Description 4	
Use case name	Employee Arrival
Use case number	UC04
Participating actors	Employee
Precondition	Employees must be registered in the system and have their fingerprint enrolled.
Flow Control	<ol style="list-style-type: none"> <li>1. Employee places their finger on the biometric device to check in.</li> <li>2. The system verifies the employee's fingerprint and records the check-in time.</li> </ol>
Post condition	The employee's attendance record is updated with the check-in time.
Alternate condition	If the employee's fingerprint is not recognized, the system prompts them to try again or contact the HR manager.
Description	Employees use fingerprint to check in at the start of their shift

Table 3.5.2.4 Use case description of Employee Check-In

Description 5	
Use case name	Employee Departure
Use case number	UC05
Participating actors	Employee
Precondition	Employees must be registered in the system and have their fingerprint enrolled.
Flow Control	<ol style="list-style-type: none"> <li>1. Employee places their finger on the biometric device to check out.</li> <li>2. The system verifies the employee's fingerprint and records the check-out time.</li> </ol>
Post condition	The employee's attendance record is updated with the check-out time.
Alternate condition	If the employee's fingerprint is not recognized, the system prompts them to try again or contact the HR manager.
Description	Employees use fingerprint to check out at the end of their shift

Table 3.5.2.5 Use case description of Employee Check-Out

Description 6	
Use case name	Generate Attendance Report
Use case number	UC06
Participating actors	HR Manager
Precondition	Employees' attendance data must be recorded in the system.
Flow Control	<ol style="list-style-type: none"> <li>1. HR manager selects the "Generate Attendance Report" option.</li> <li>2. HR manager specifies the report criteria, such as the date range, employee, or department</li> <li>3. The system compiles the attendance data and generates the report.</li> </ol>

	4. HR manager reviews, prints, or exports the attendance report.
Post condition	The attendance report is made available to the HR manager.
Alternate condition	If there is no attendance data available for the specified criteria, the system displays a message indicating the lack of data.
Description	HR manager generates attendance reports for employees

Table 3.5.2.6 Use case description of Attendance Report Generation

Description 7	
Use case name	Submit Leave Request
Use case number	UC07
Participating actors	Employee, HR Manager
Precondition	Employees must be registered in the system.
Flow Control	<ol style="list-style-type: none"> <li>1. Employee submits a leave request, providing details such as the leave type, start and end dates, and reason.</li> <li>2. The HR manager reviews the leave request.</li> <li>3. The HR manager approves or rejects the leave request.</li> <li>4. The system updates the employee's leave records accordingly.</li> </ol>
Post condition	The employee's leave request is processed, and their attendance records are updated.
Alternate condition	If the leave request is incomplete or exceeds the employee's available leave days, the system prompts the employee to revise the request.
Description	Employees submit leave requests, which are reviewed and approved by the HR manager

Table 3.5.2.7 Use case description of Employee Leave Request

Description 8	
Use case name	Onboard New Employees
Use case number	UC08
Participating actors	HR Manager, Employee
Precondition	None
Flow Control	<ol style="list-style-type: none"> <li>1. The HR manager opens the employee registration page.</li> <li>2. The HR manager enters the new employee's personal details, such as name, contact information, job role, and department.</li> <li>3. Employees scan their fingerprint using the biometric device.</li> <li>4. The system creates a new employee profile and stores the fingerprint data.</li> </ol>
Post condition	The new employee's information is saved in the system.
Alternate condition	If the employee information is incomplete, the system prompts the HR manager to fill in the missing details.
Description	HR manager registers new employees in the system

Table 3.5.2.8 Use case description of Employee Information Management

Description 9	
Use case name	View Attendance Records
Use case number	UC09
Participating actors	Employee
Precondition	Employees must be registered in the system.
Flow Control	<ol style="list-style-type: none"> <li>1. Employees log into the attendance tracking platform.</li> <li>2. Employee navigates to the "Attendance Records" section.</li> <li>3. The system displays the employee's</li> </ol>

	clock-in/out times, total hours worked, and any recorded absences.
Post condition	The employee can view and monitor their own attendance information.
Alternate condition	If the employee's attendance data is not available, the system displays a message indicating the lack of data.
Description	Employees can view their own attendance records

Table 3.5.2.9 Use case description of Employee Self-Service

Description 10	
Use case name	Integrate with HR and Payroll Systems
Use case number	UC10
Participating actors	HR Manager
Precondition	The attendance tracking platform and external systems have compatible data formats
Flow Control	<ol style="list-style-type: none"> <li>1. HR manager or payroll administrator initiates the data integration process.</li> <li>2. The attendance tracking platform exports the necessary employee and attendance data.</li> <li>3. The external HR or payroll system imports the data and updates their records accordingly.</li> </ol>
Post condition	The employee and attendance data is synchronized between the attendance tracking platform and the external systems.
Alternate condition	If the data formats are incompatible, the system displays an error message, and the integration process is halted.
Description	The attendance tracking platform integrates with external HR and payroll systems

Table 3.5.2.10 Use case description of Data Integration

### 3.6 Object model

**Table 1** Object model

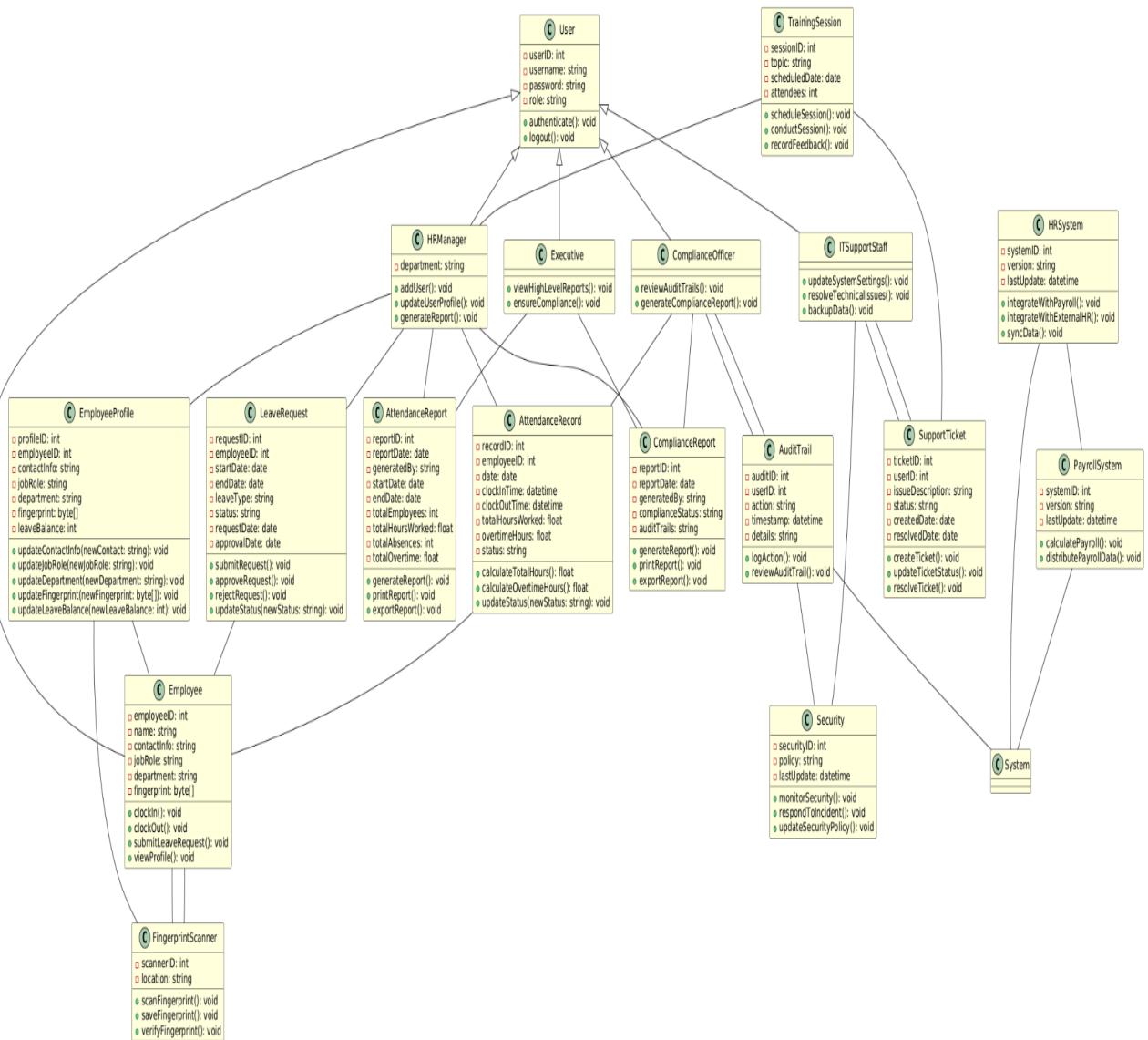
Class	Attribute	Operations	Description
User	userID, username, password, role	authenticate(), logout()	Represents a user in the system with authentication capabilities.
HRManager	department	addUser(), updateUserProfile(), generateReport()	Manages HR functions such as adding users and generating reports.
Employee	employeeID, name, contactInfo, jobRole, department, fingerprint	clockIn(), clockOut(), submitLeaveRequest(), viewProfile()	Represents an employee with attendance and profile management capabilities.
ITSupportStaff		updateSystemSettings(), resolveTechnicalIssues(), backupData()	Manages system settings and resolves technical issues.
ComplianceOfficer		reviewAuditTrails(), generateComplianceReport()	Reviews audit trails and generates compliance reports.
Executive		viewHighLevelReports(), ensureCompliance()	Views high-level reports and ensures compliance.
FingerprintScanner	scannerID, location	scanFingerprint(), saveFingerprint(), verifyFingerprint()	Scans, saves, and verifies fingerprints.
EmployeeProfile	profileID, employeeID, contactInfo, jobRole, department, fingerprint, leaveBalance	updateContactInfo(), updateJobRole(), updateDepartment(), updateFingerprint(), updateLeaveBalance()	Manages employee profile information.
AttendanceRecord	recordID, employeeID, date, clockInTime, clockOutTime, totalHoursWorked, overtimeHours,	calculateTotalHours(), calculateOvertimeHours(), updateStatus()	Tracks attendance and calculates working hours.

	status		
LeaveRequest	requestID, employeeID, startDate, endDate, leaveType, status, requestDate, approvalDate	submitRequest(), approveRequest(), rejectRequest(), updateStatus()	Manages leave requests and their statuses.
AttendanceReport	reportID, reportDate, generatedBy, startDate, endDate, totalEmployees, totalHoursWorked, totalAbsences, totalOvertime	generateReport(), printReport(), exportReport()	Generates and manages attendance reports.
ComplianceReport	reportID, reportDate, generatedBy, complianceStatus, auditTrails	generateReport(), printReport(), exportReport()	Generates and manages compliance reports.
HRSystem	systemID, version, lastUpdate	integrateWithPayroll(), integrateWithExternalHR(), syncData()	Integrates with payroll and external HR systems.
PayrollSystem	systemID, version, lastUpdate	calculatePayroll(), distributePayrollData()	Calculates and distributes payroll data.
AuditTrail	auditID, userID, action, timestamp, details	logAction(), reviewAuditTrail()	Logs and reviews audit trails.
Security	securityID, policy, lastUpdate	monitorSecurity(), respondToIncident(), updateSecurityPolicy()	Monitors security and responds to incidents.
TrainingSession	sessionID, topic, scheduledDate, attendees	scheduleSession(), conductSession(), recordFeedback()	Manages training sessions and records feedback.

SupportTicket	ticketID, userID, issueDescription, status, createdDate, resolvedDate	createTicket(), updateTicketStatus(), resolveTicket()	Manages support tickets and their statuses.
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### 3.7 Class diagram

Below diagram shows class diagram of Biometric Attendance & HR System:

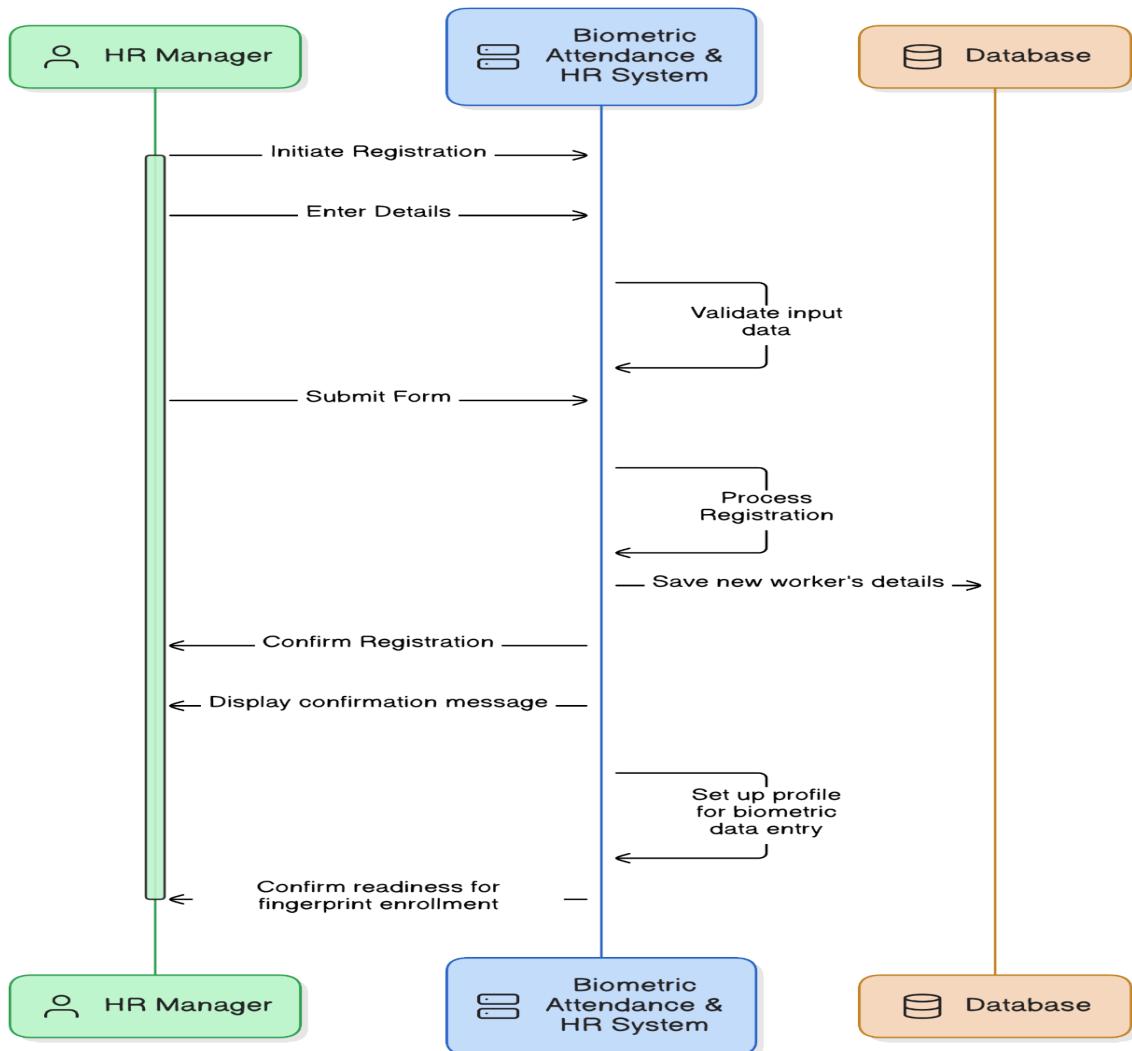


**Figure** Biometric Attendance & HR System Class Diagram

## 3.8 Dynamic model

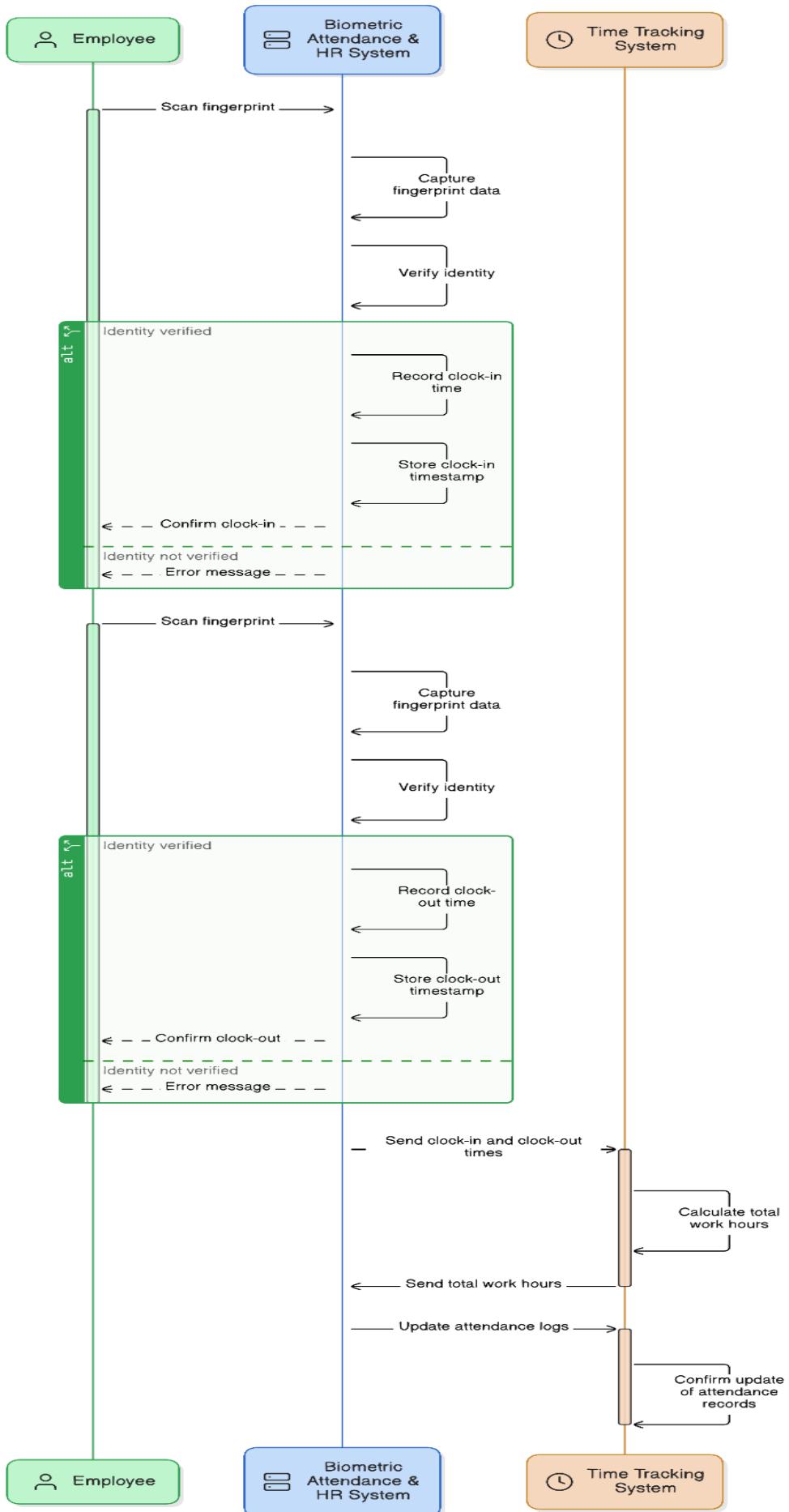
### 3.8.1 Sequence diagram

User Registration in Biometric Attendance & HR System

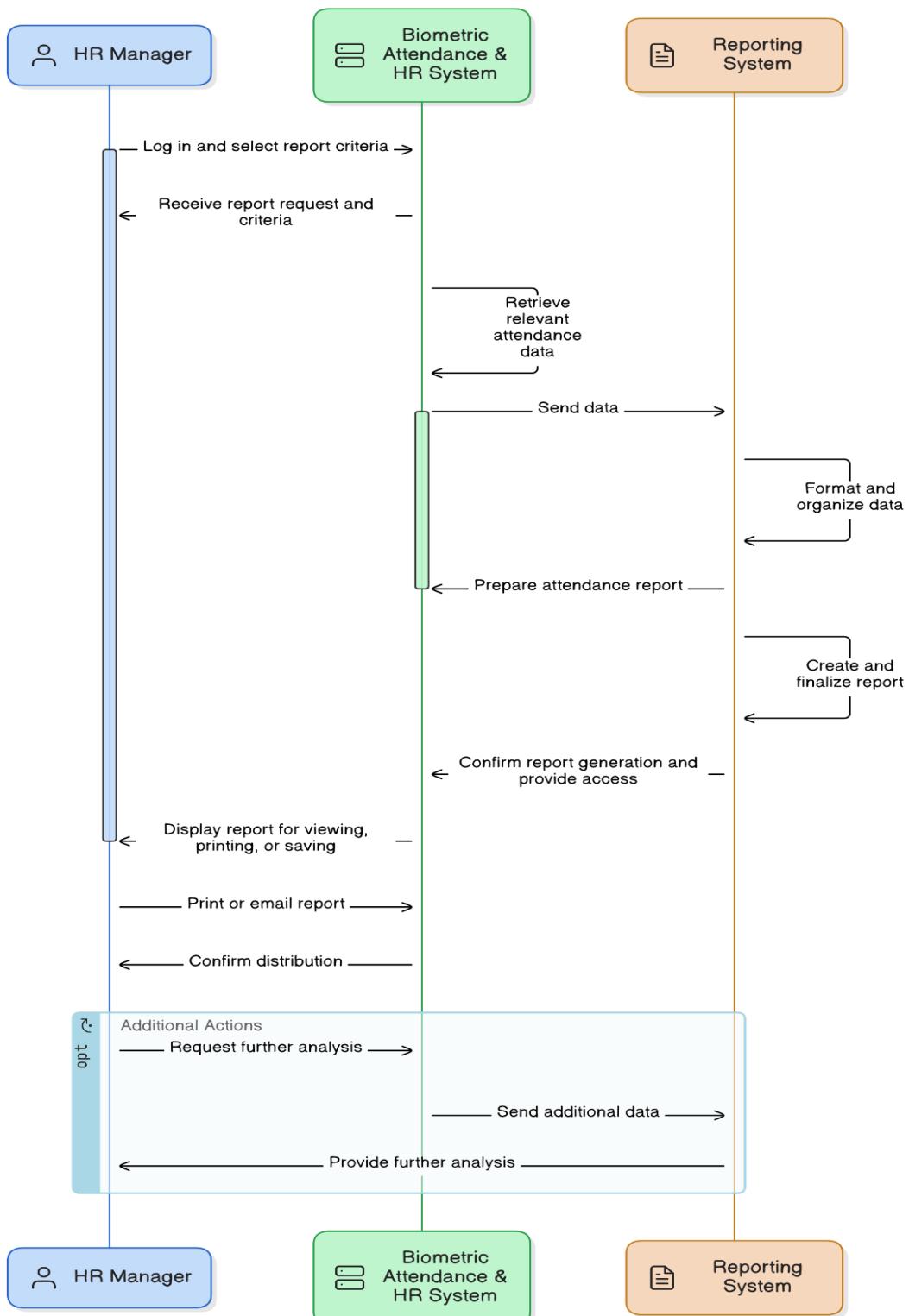




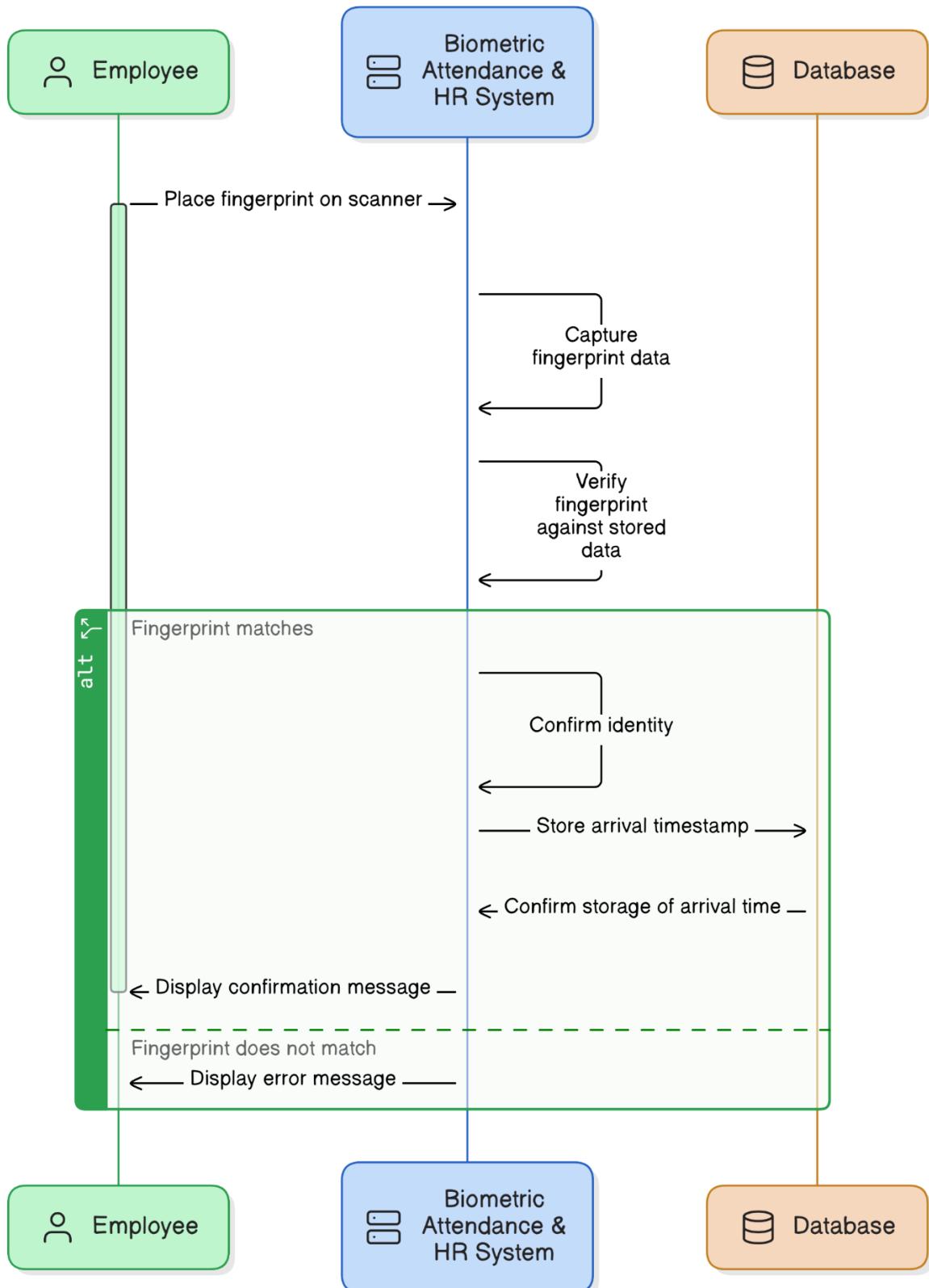
### Clock In/Out in Biometric Attendance & HR System



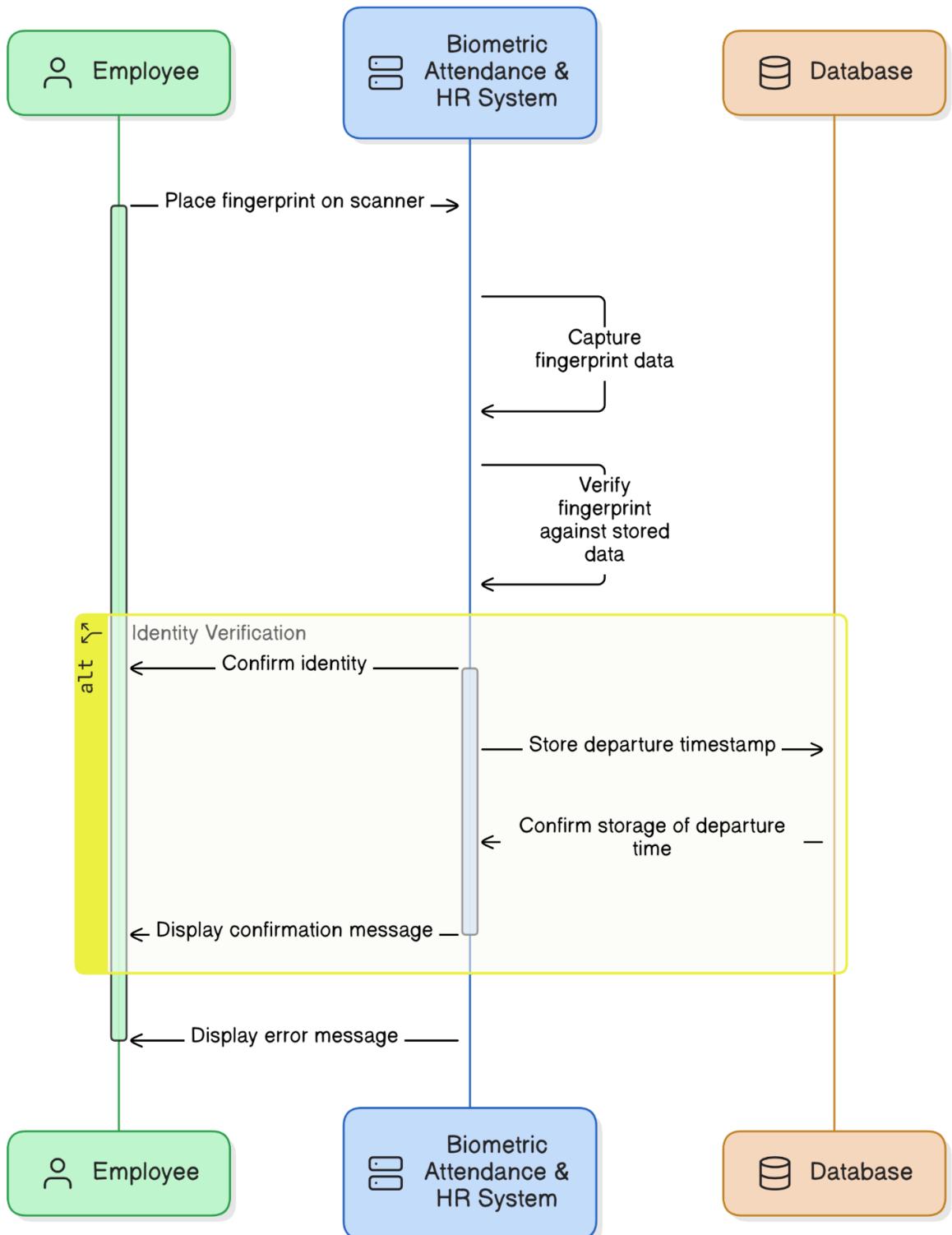
## Generate Attendance Reports in Biometric Attendance & HR System



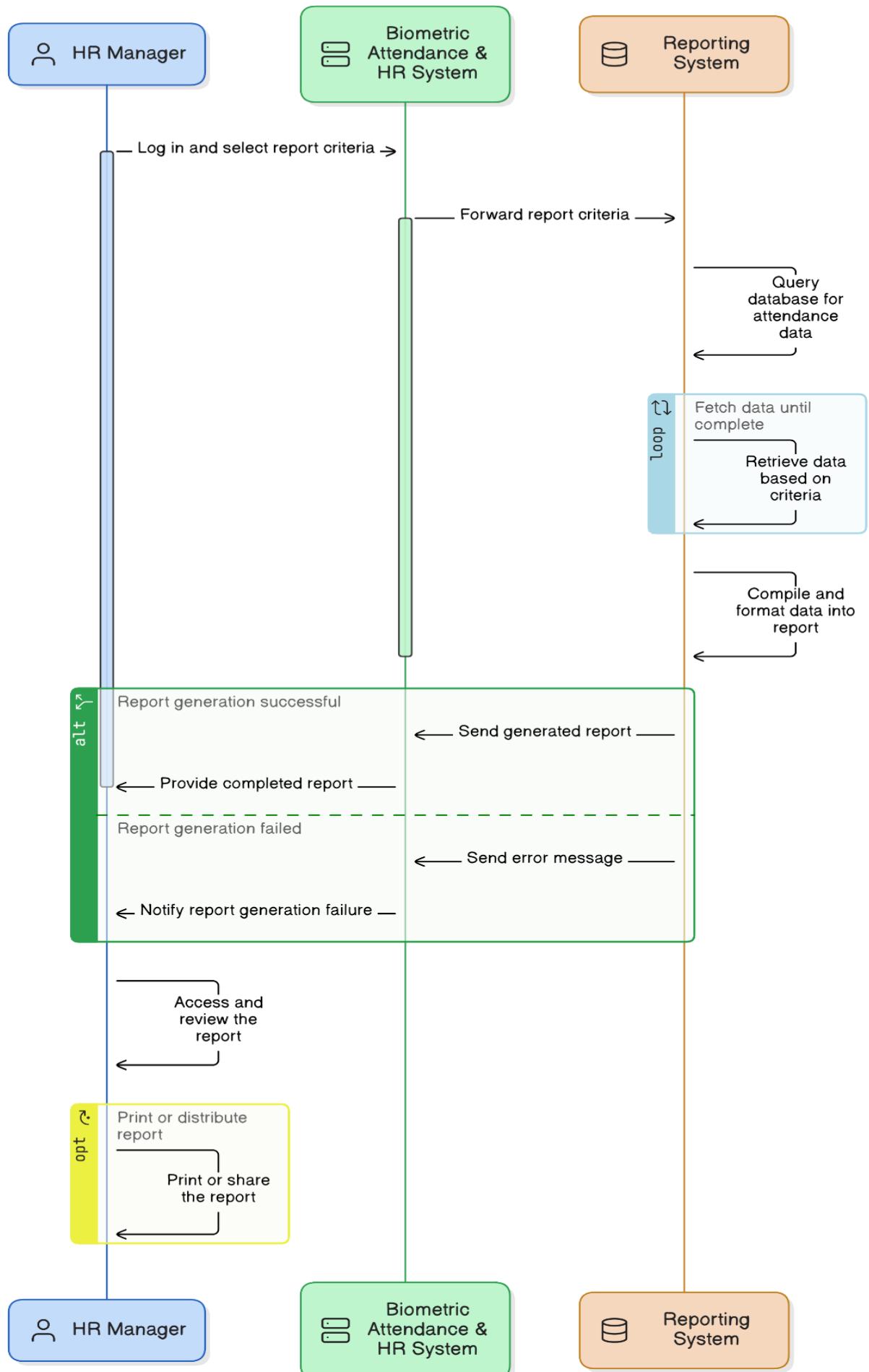
## Employee Check-In at Arrival in Biometric Attendance & HR System



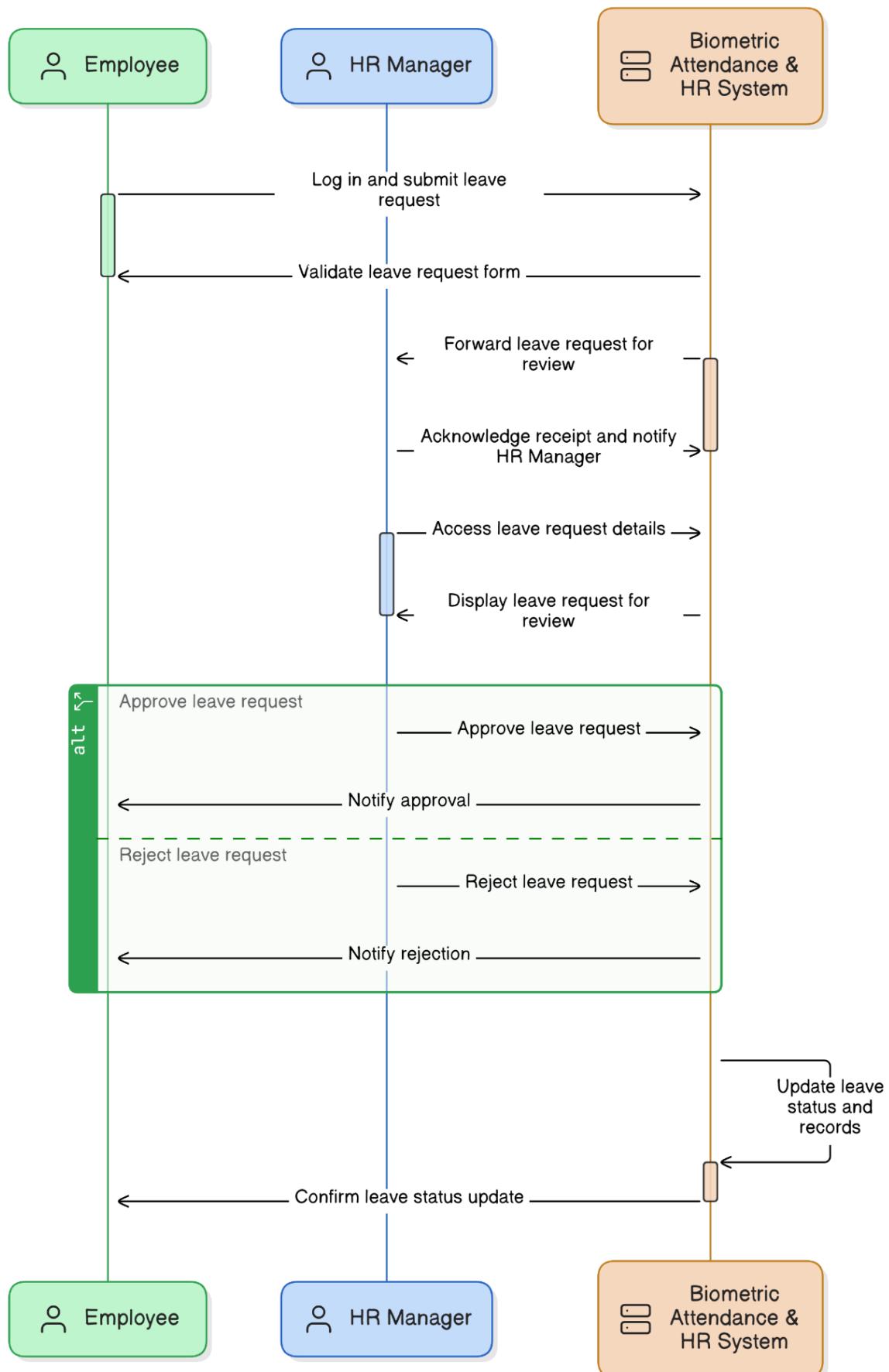
## Employee Check-Out at Departure in Biometric Attendance & HR System



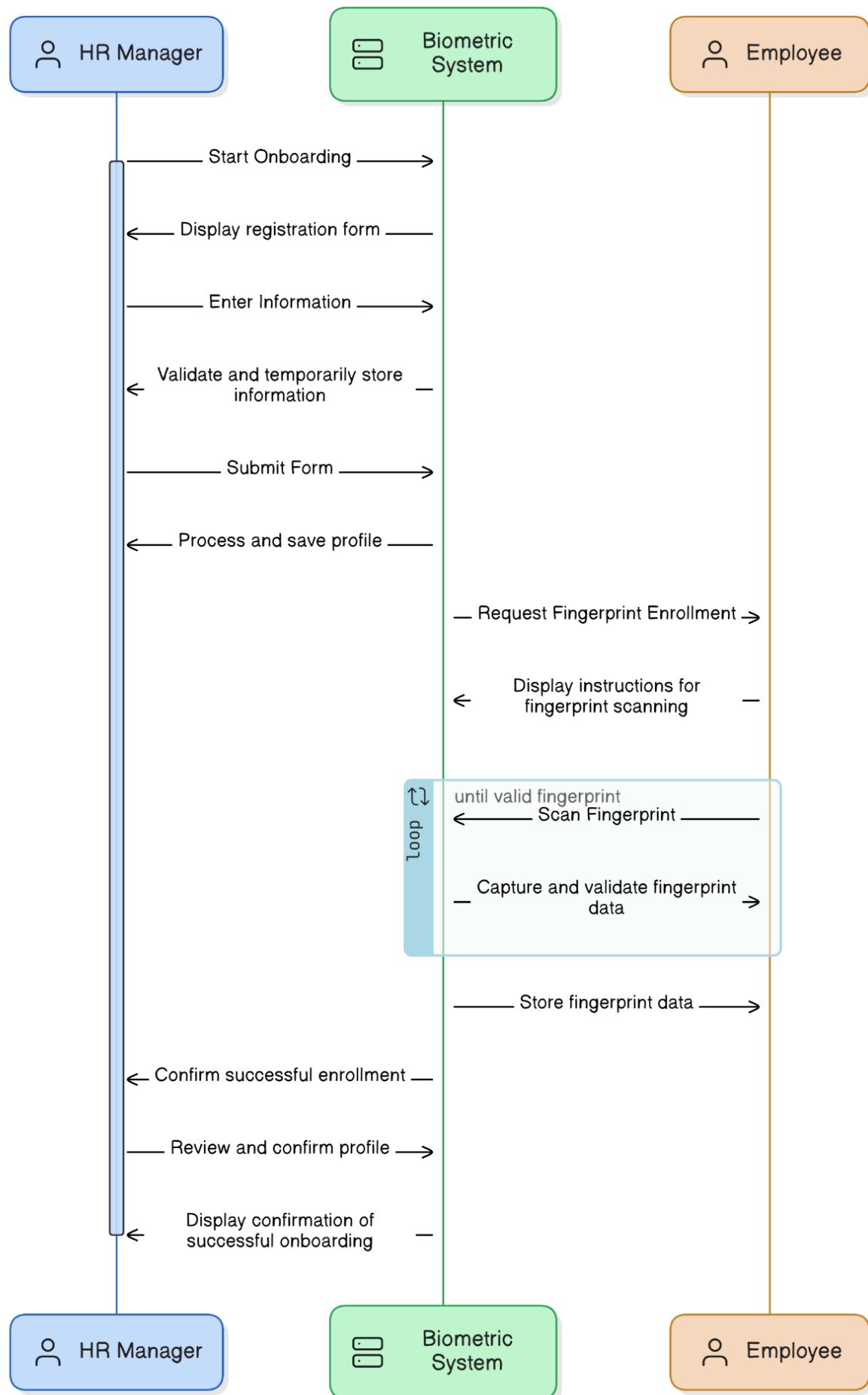
## Request Attendance Report in Biometric Attendance & HR System



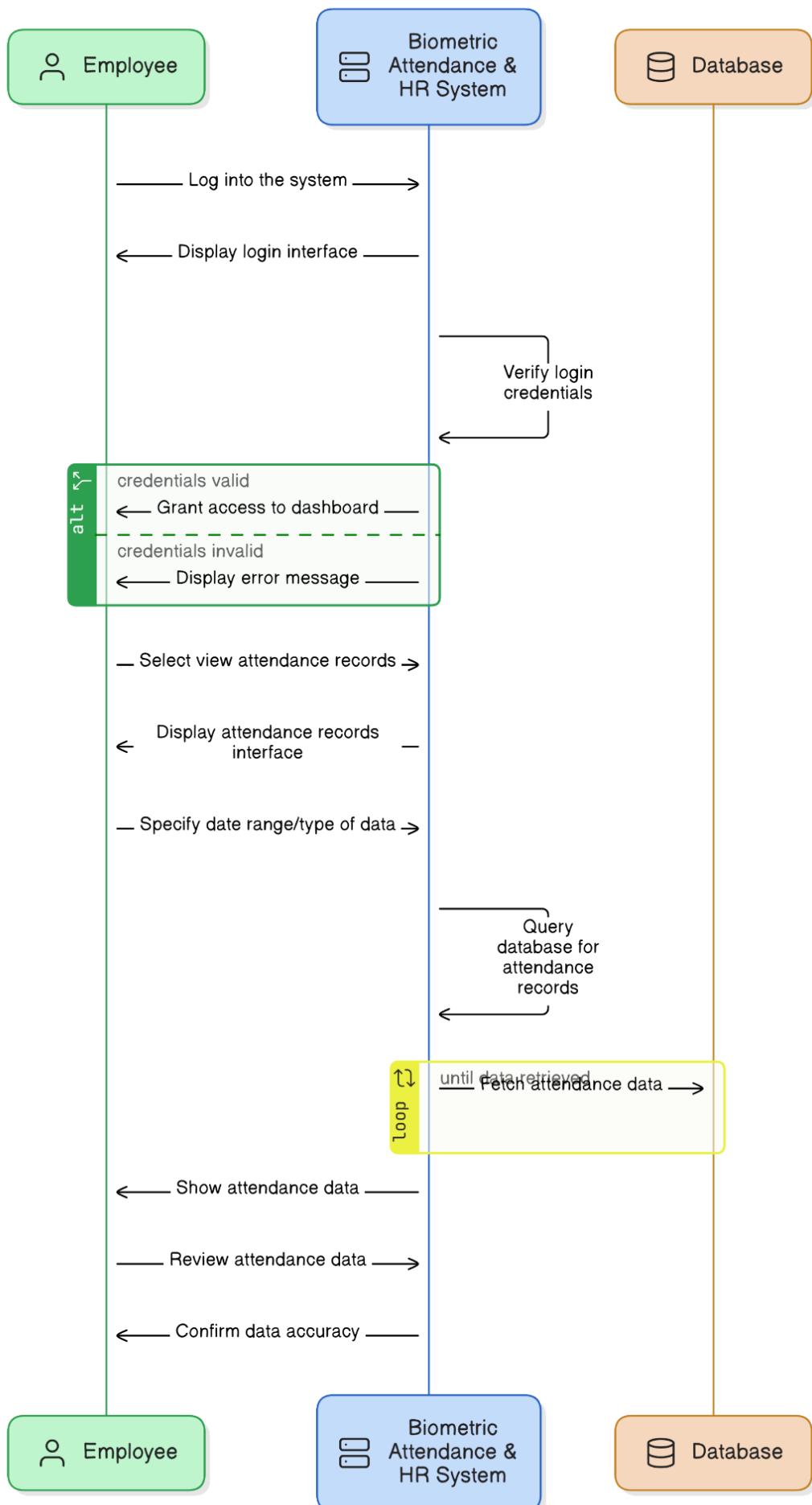
## Submit Leave Request in Biometric Attendance & HR System



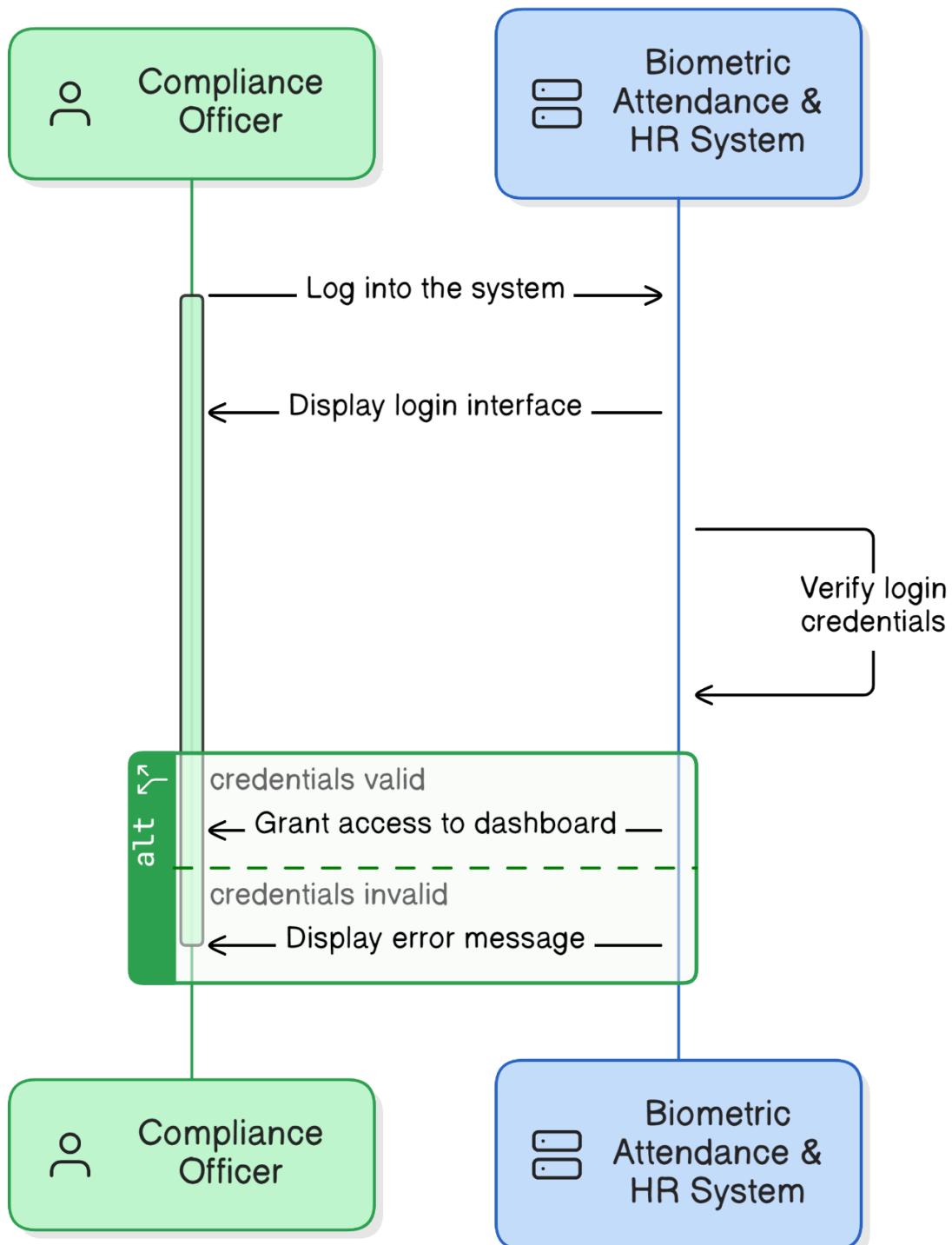
## Onboard New Employees in Biometric Attendance & HR System



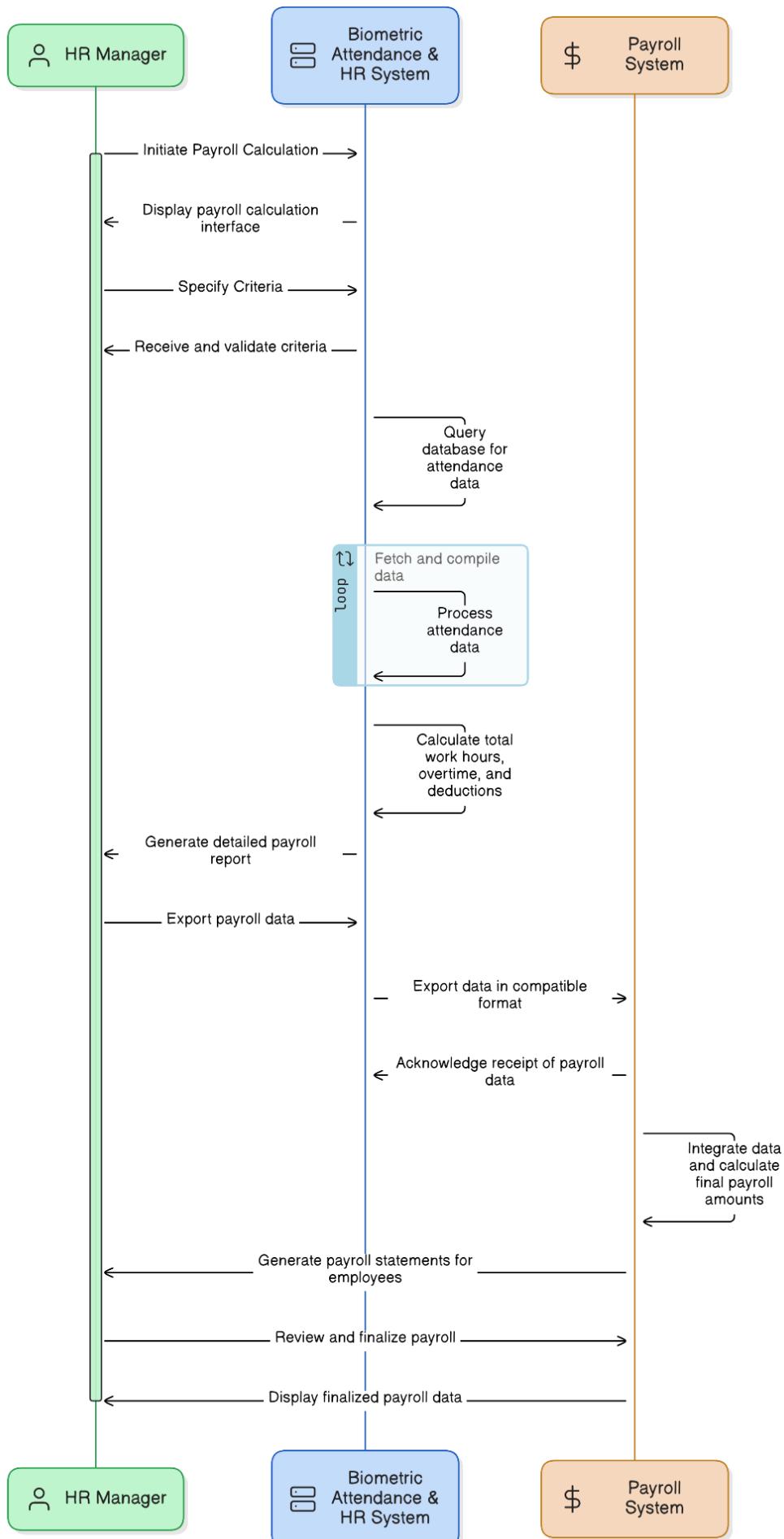
## View Attendance Records in Biometric Attendance & HR System



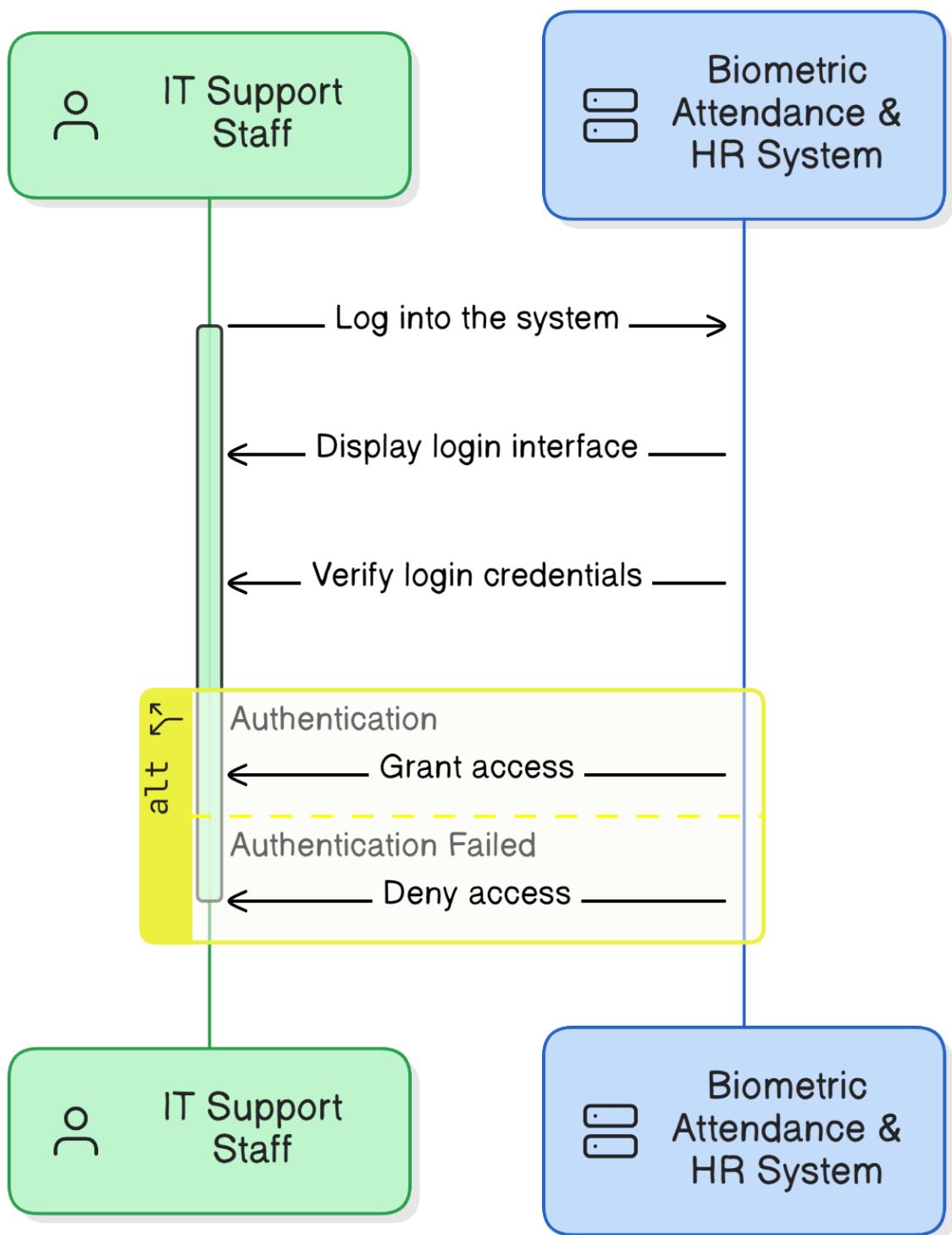
# Conduct Audits in Biometric Attendance & HR System



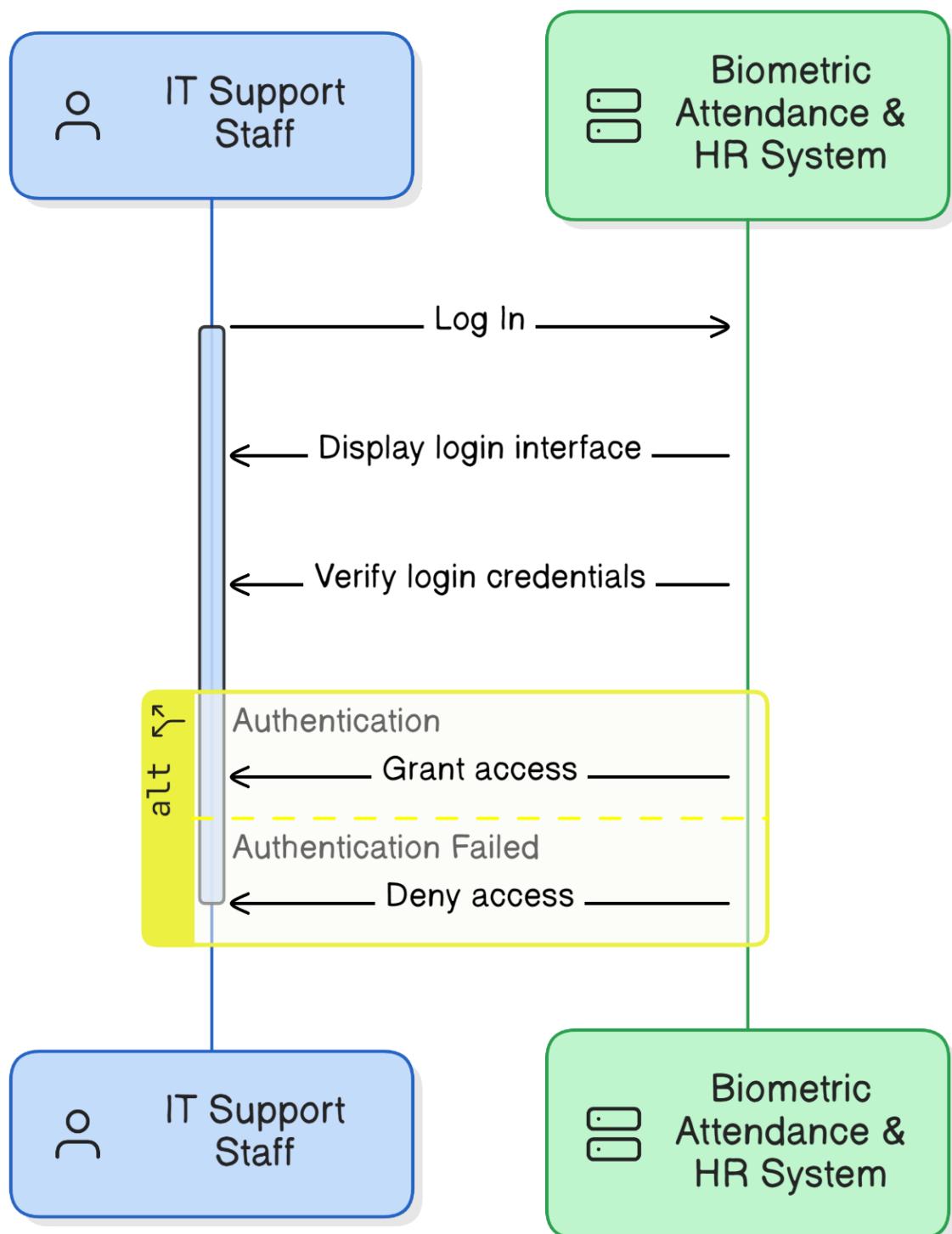
## Calculate Payroll in Biometric Attendance & HR System



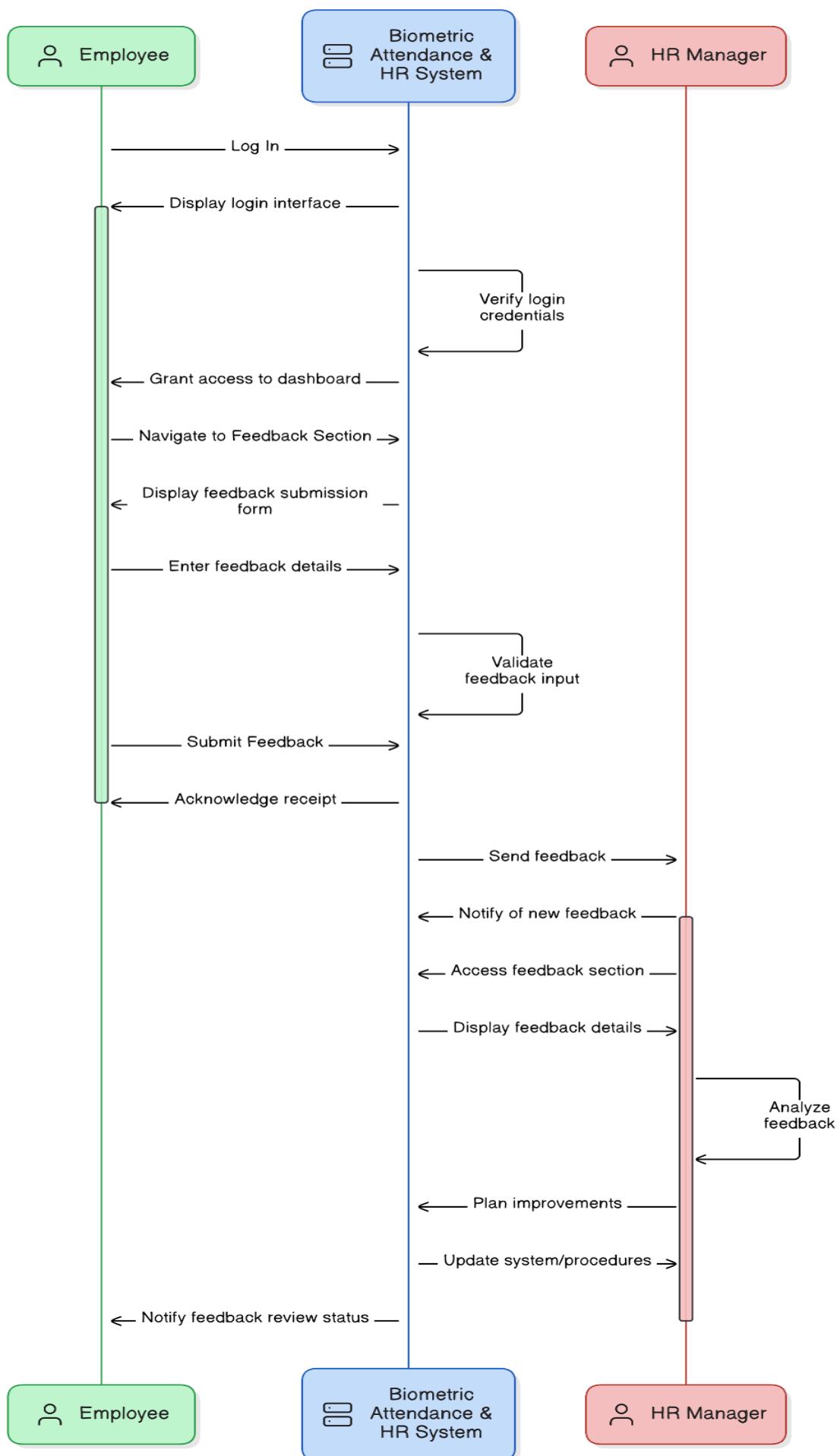
# Perform System Updates in Biometric Attend



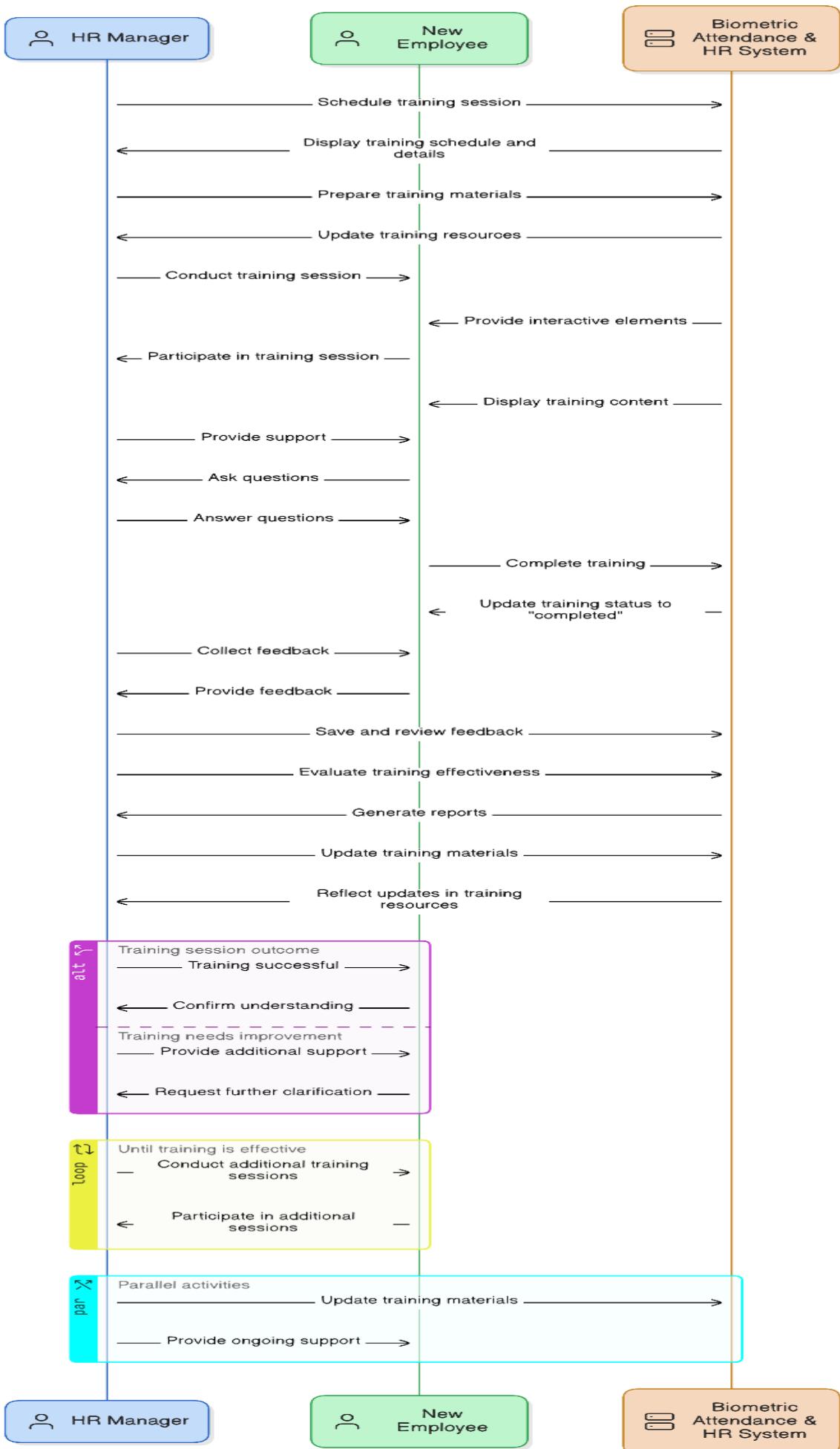
# Monitor System Security in Biometric Attendance



## Submit Feedback in Biometric Attendance & HR System



## Provide Training in Biometric Attendance & HR System



### 3.9 Activity diagram

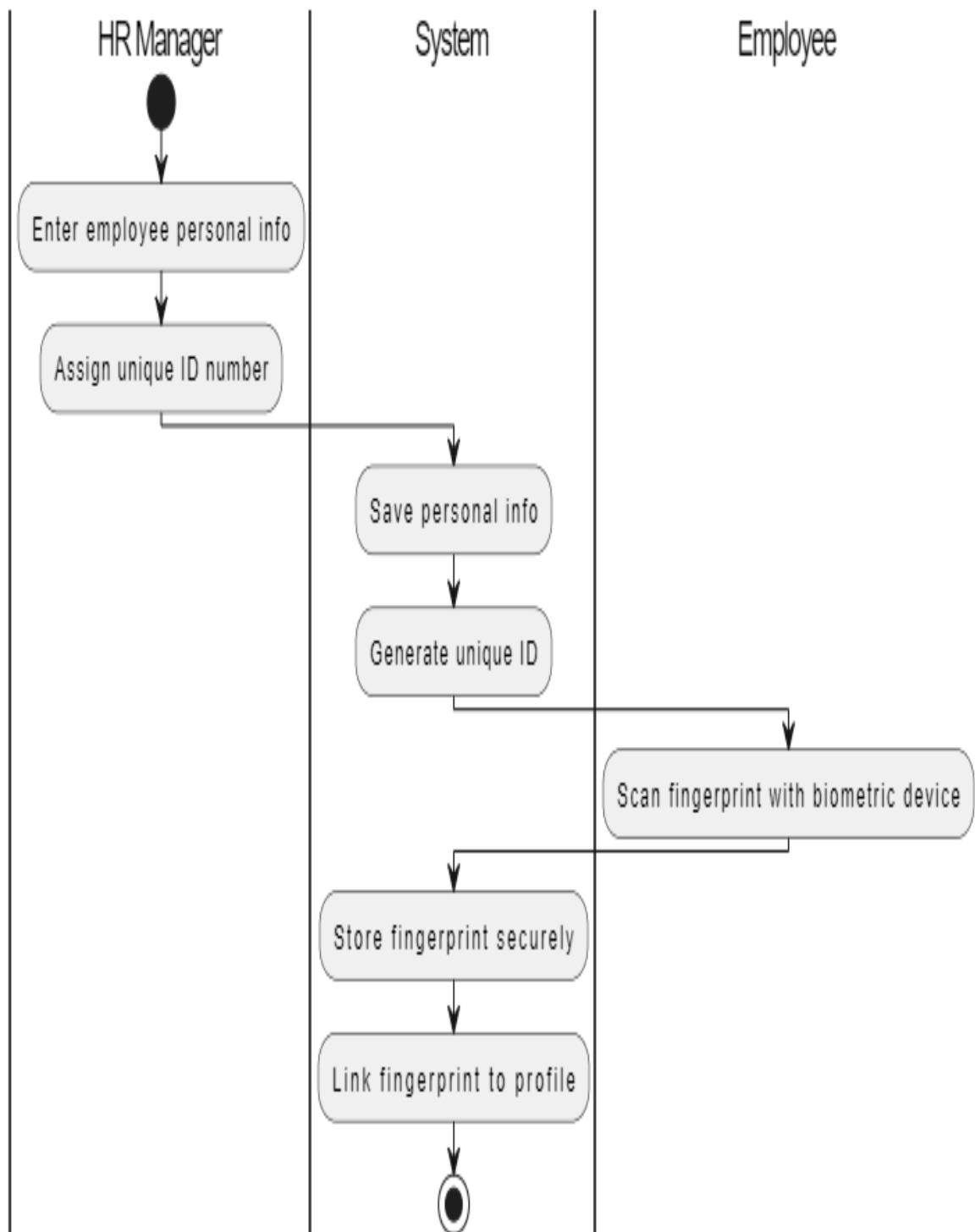
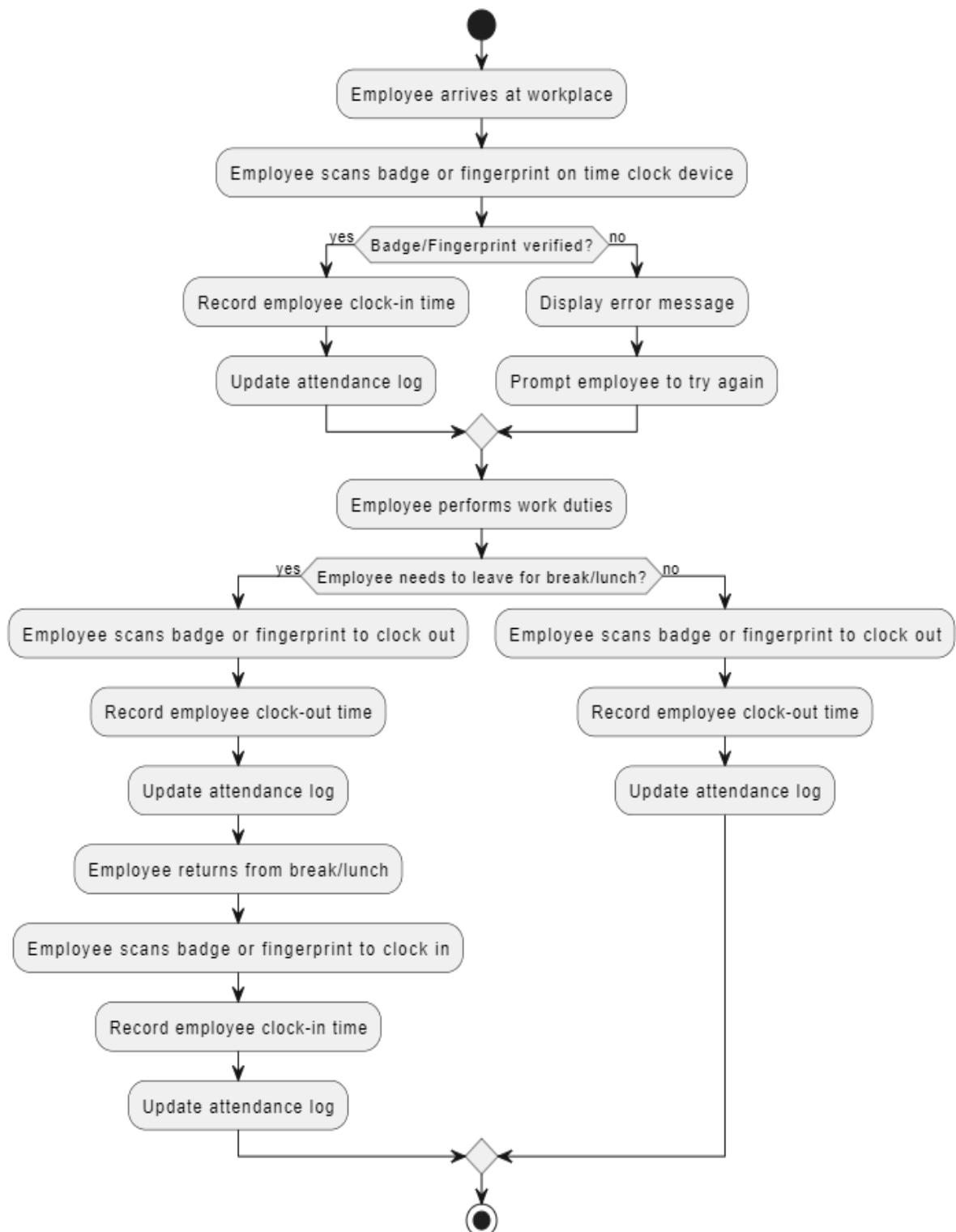
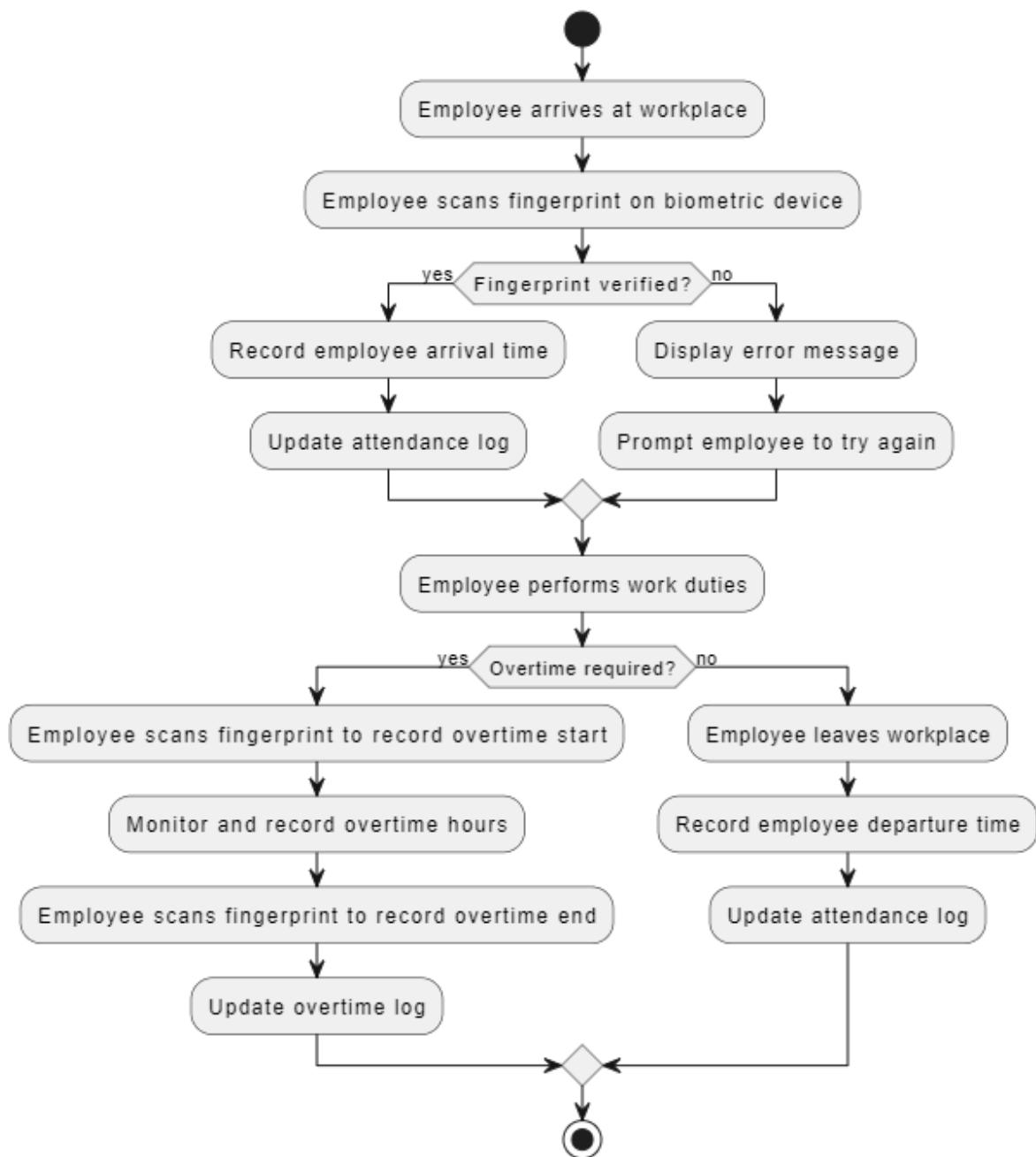


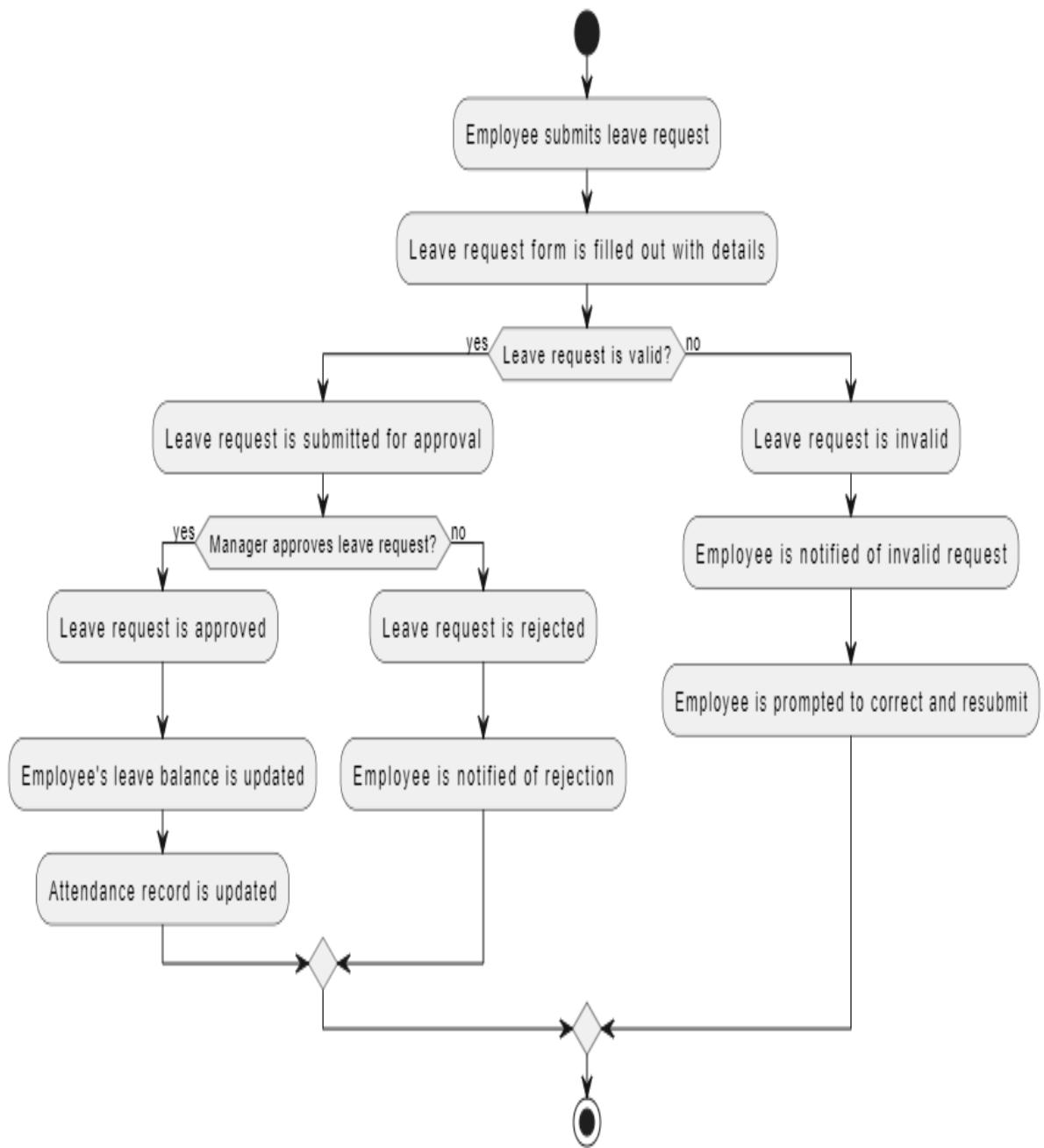
Figure : user registration and Fingerprint enrollment



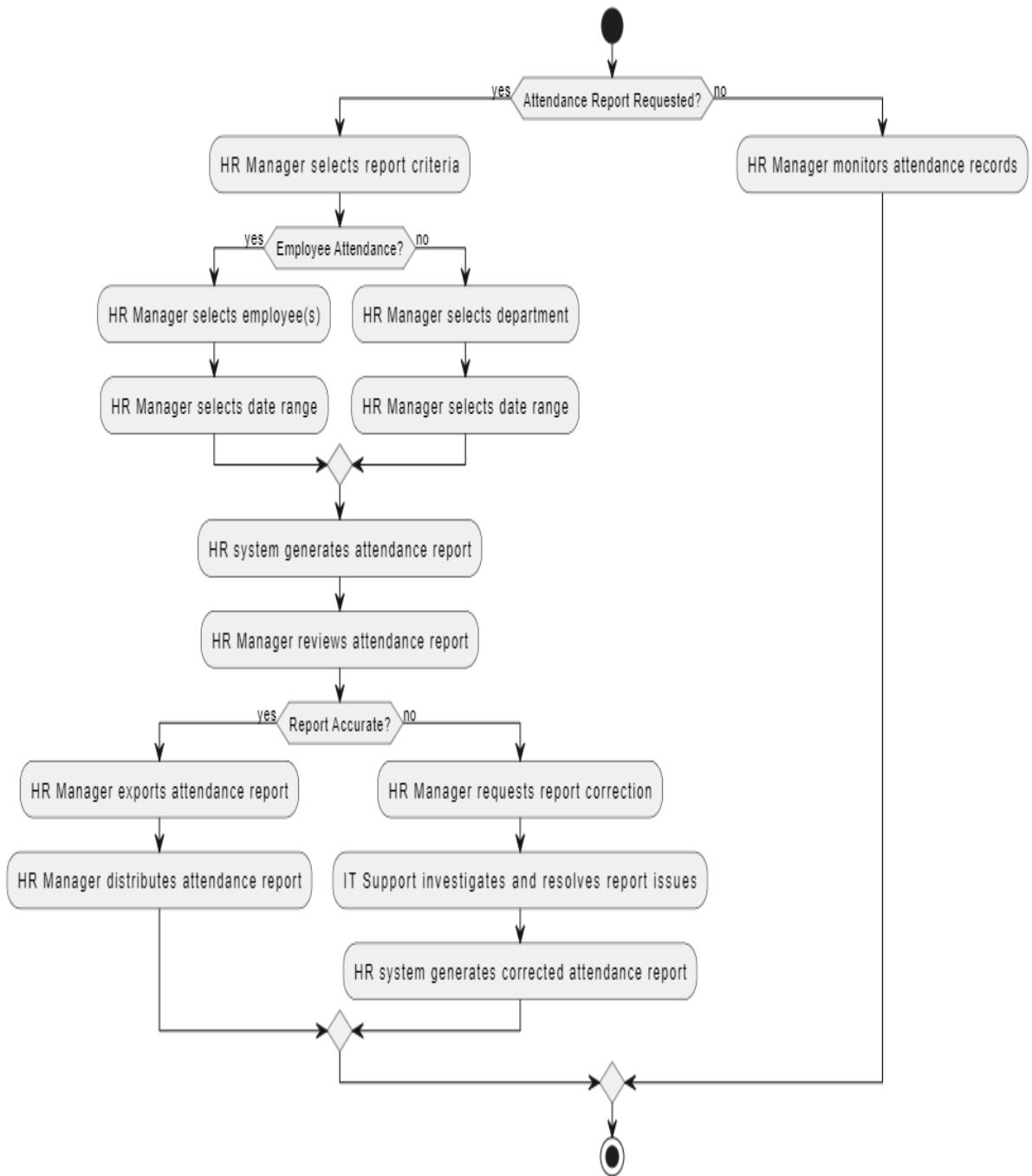
**Figure: Clock In/Out process**



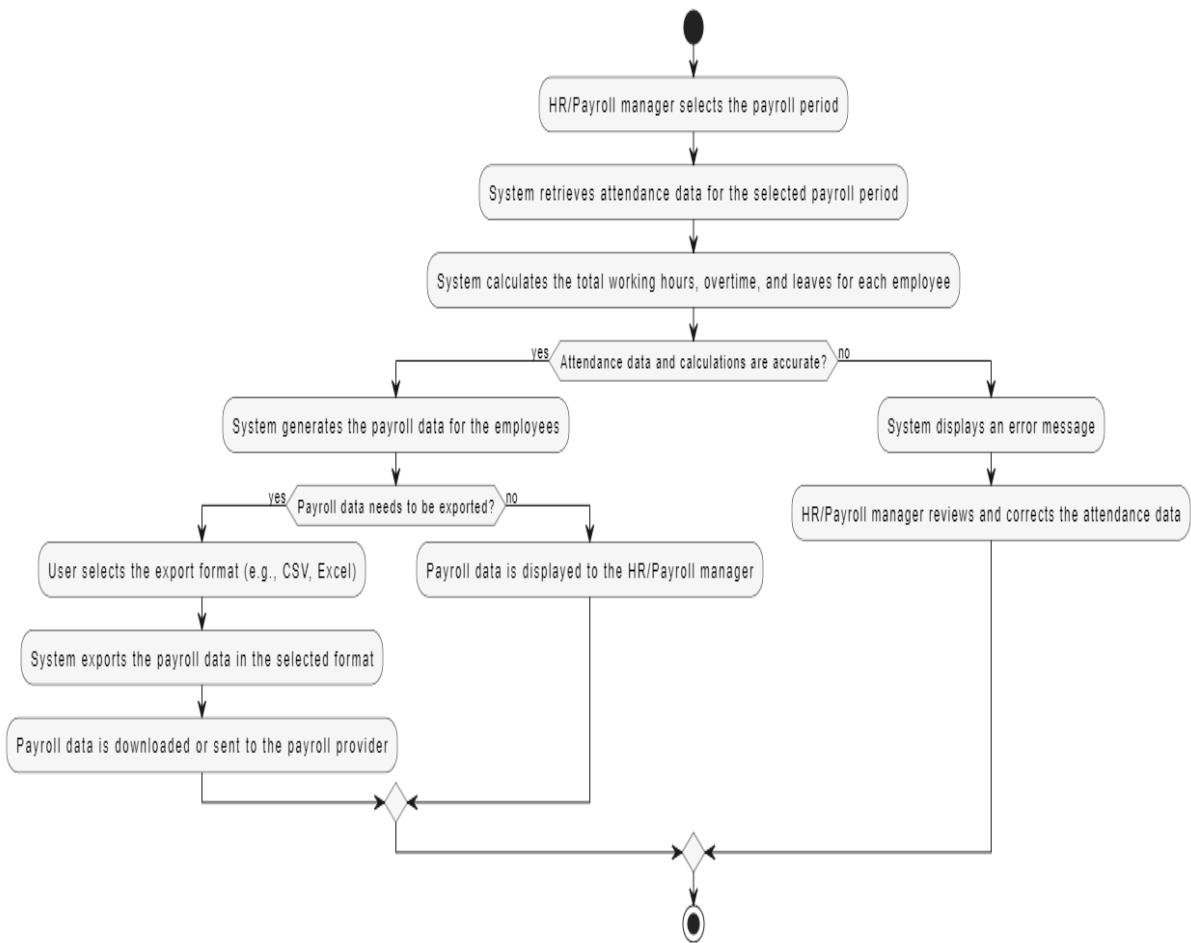
**Figure: Attendance and Overtime tracking**



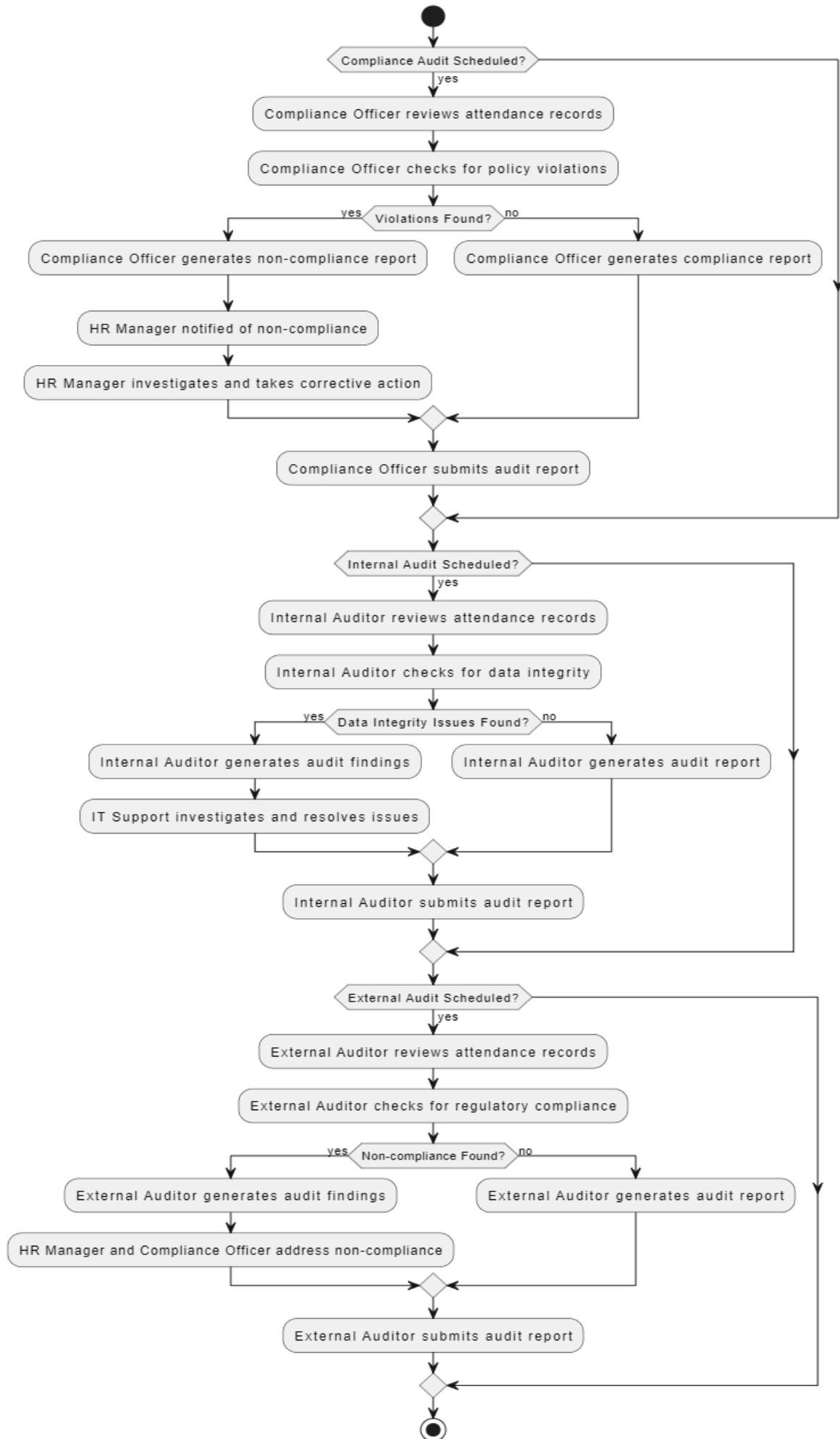
**Figure : leave request and approval**



**Figure : Generate and export attendance report**



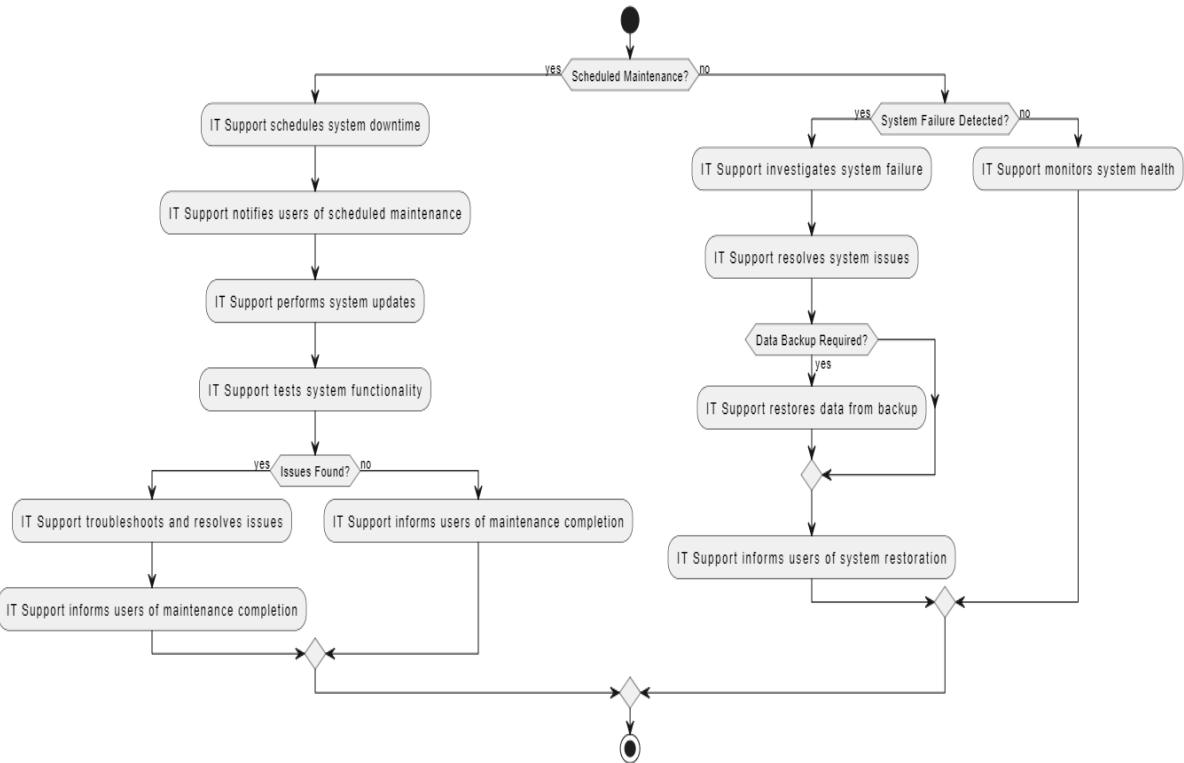
**Figure: Payroll integration**



**Figure : compliance and auditing**

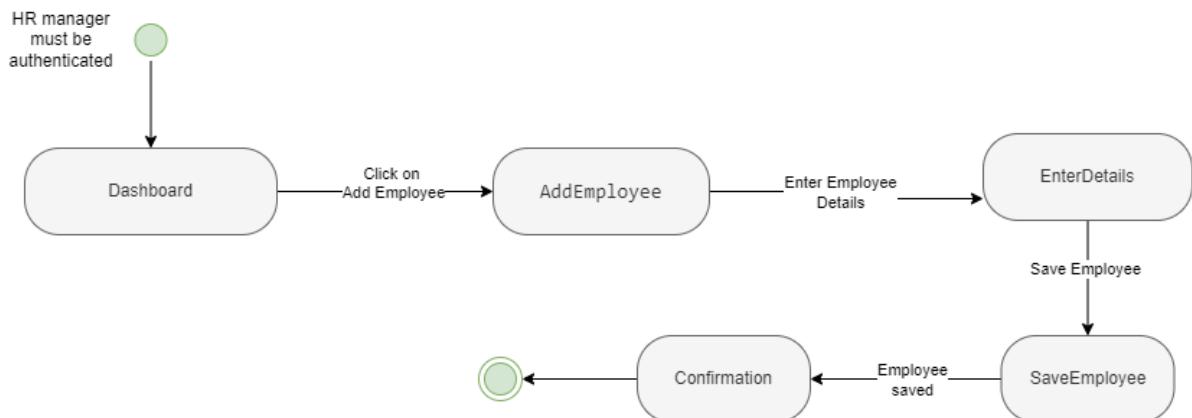


**Figure: Employee information management**

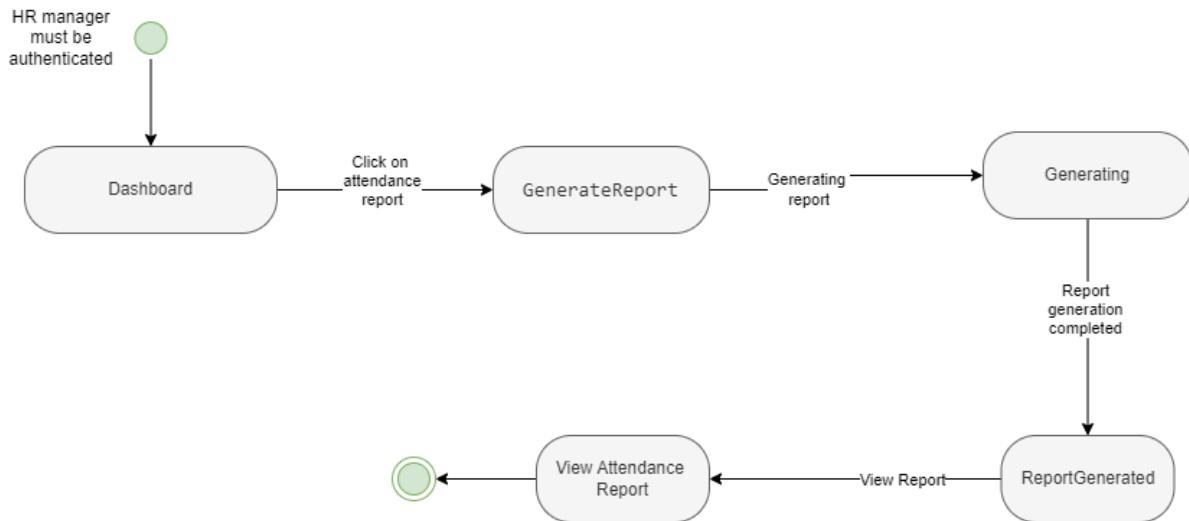


**Figure : System Maintenance**

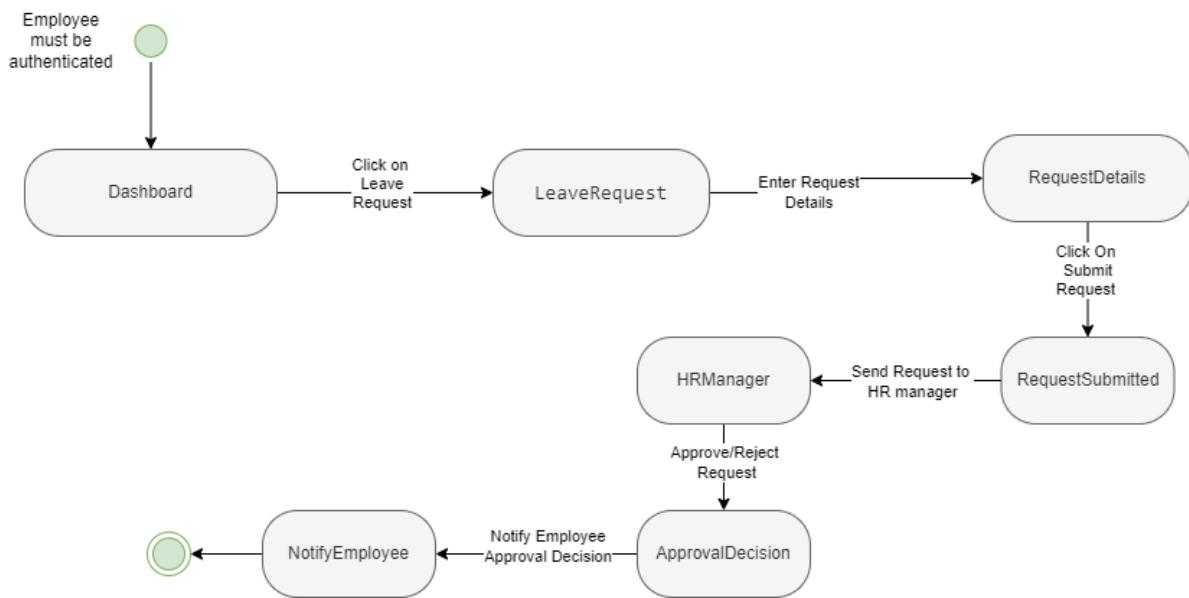
### 3.10 State diagram



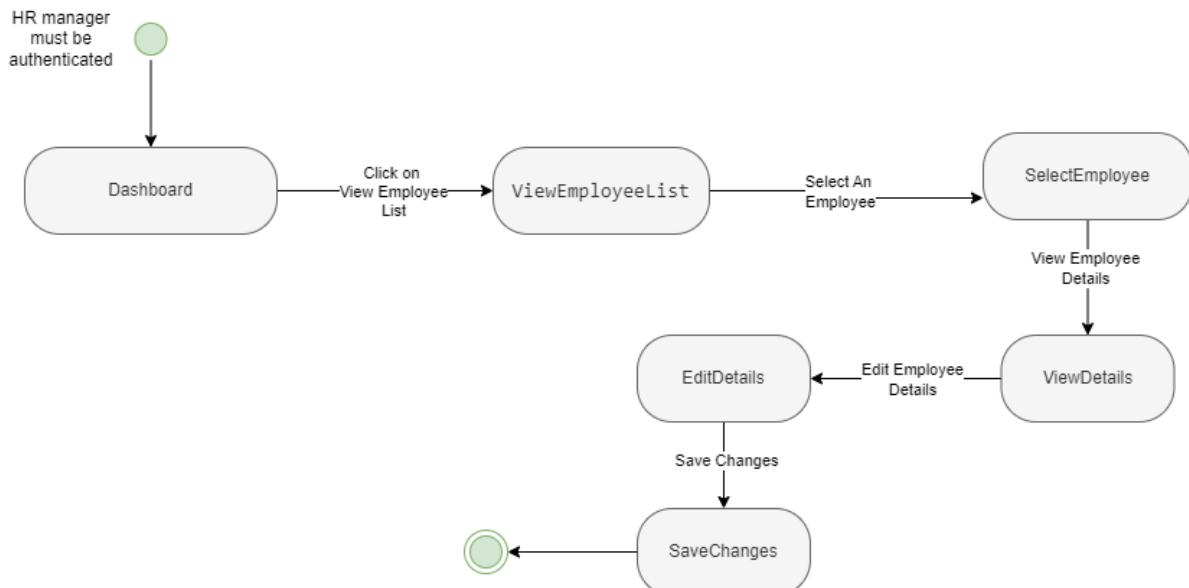
Onboard New Employees



### Attendance report generation



### Leave Request



## Chapter 4: System Design

### 4.1 Overview

In this chapter, we delve into the design of our Biometric Attendance & HR System, outlining the architecture and components that ensure efficient functionality and user experience. Our focus is on creating a robust, scalable, and secure system that meets the needs of both HR managers and employees. We will explore the various modules and their interactions, detailing the design decisions that guide our implementation. This chapter serves as a blueprint for understanding how the system's components integrate to deliver a seamless and reliable HR management solution.

#### 4.1.1 Purpose of the System Design

The purpose of our system design is to define the architecture, components, interfaces, and data for the Biometric Attendance & HR System. This design ensures that all requirements are met and the system operates seamlessly, providing accurate and reliable functionality for

user management, biometric data handling, attendance tracking, leave management, reporting, and compliance.

### **4.1.2 Design Goals**

Our design goals for the Biometric Attendance & HR System include:

- Scalability: Ensuring the system can handle an increasing number of users and data without performance degradation.
- Usability: Creating an intuitive and user-friendly interface for all types of users.
- Security: Implementing robust security measures to protect sensitive biometric and personal data.
- Reliability: Designing the system to be highly reliable, with minimal downtime and accurate data processing.
- Integration: Facilitating seamless integration with external HR and payroll systems for efficient data exchange.
- Compliance: Ensuring the system meets all relevant legal and regulatory requirements for data protection and employee rights.
- Maintainability: Building the system in a way that makes it easy to maintain, update, and expand.

## **4.2 Proposed System**

### **4.2.1 Overview**

In this section, we present the proposed Biometric Attendance & HR System designed to streamline and enhance the management of employee attendance and HR functionalities. The system leverages biometric technology, such as fingerprint scanning, to ensure accurate and reliable attendance tracking. Additionally, it integrates various HR processes, including user management, leave management, and comprehensive reporting.

The proposed system aims to address the limitations of traditional attendance and HR systems by providing a more secure, efficient, and user-friendly solution. It encompasses various modules and components tailored to meet the specific needs of HR managers, employees, IT support staff, compliance officers, and executives. By utilizing advanced technologies and adhering to best practices in system design, our proposed solution ensures scalability, reliability, and compliance with legal and regulatory standards.

### **4.2.2 System Process**

The system process for the Biometric Attendance & HR System involves several key steps that ensure seamless operation and interaction between various system components and users. Below is a detailed description of the system process:

- **User Authentication:**
  - Users (HR Managers, Employees, IT Support Staff, Compliance Officers, Executives) authenticate themselves using their credentials.
  - Biometric authentication is performed using fingerprint scanning to enhance security and accuracy.
- **Employee Profile Management:**
  - HR Managers add new employee profiles to the system.
  - Employee profiles include details such as employeeID, name, contact information, job role, department, and biometric data (fingerprints).
  - Employees can update their personal information and view their profiles.
- **Attendance Tracking:**
  - Employees clock in and clock out using fingerprint scanners.
  - The system records attendance details, including clock-in and clock-out times, total hours worked, and overtime hours.
  - Attendance records are automatically updated and stored in the database.
- **Leave Management:**
  - Employees submit leave requests through the system, specifying leave type, start date, and end date.
  - HR Managers review and approve or reject leave requests.
  - Approved leave requests are updated in the employee's profile and attendance records.
- **Reporting and Compliance:**
  - HR Managers generate attendance reports, leave reports, and compliance reports.
  - Compliance Officers review audit trails and ensure that the system adheres to legal and regulatory standards.
  - Executives access high-level reports to monitor overall HR metrics and compliance status.
- **System Maintenance and Support:**
  - IT Support Staff manage system settings, resolve technical issues, and perform regular data backups.
  - Security measures are implemented to monitor and respond to any security incidents.
  - Training sessions are conducted to ensure users are proficient with the system.
- **Data Integration and Synchronization:**
  - The system integrates with external HR and payroll systems for seamless data synchronization.
  - Payroll data is calculated and distributed based on attendance records and leave balances.

### 4.2.3. Subsystem decomposition

The Biometric Attendance and HR System is a complex platform that can be effectively decomposed into smaller, more manageable subsystems. This approach allows for a structured and organized design, where each subsystem focuses on a specific set of functionalities, ultimately contributing to the overall system's coherence and maintainability.

The Subsystem Decomposition diagram presented here illustrates the key subsystems within the Biometric Attendance and HR System. This visual representation serves as a blueprint, outlining the different modules and their respective responsibilities, enabling a clear understanding of the system's architecture and facilitating future development and enhancements.

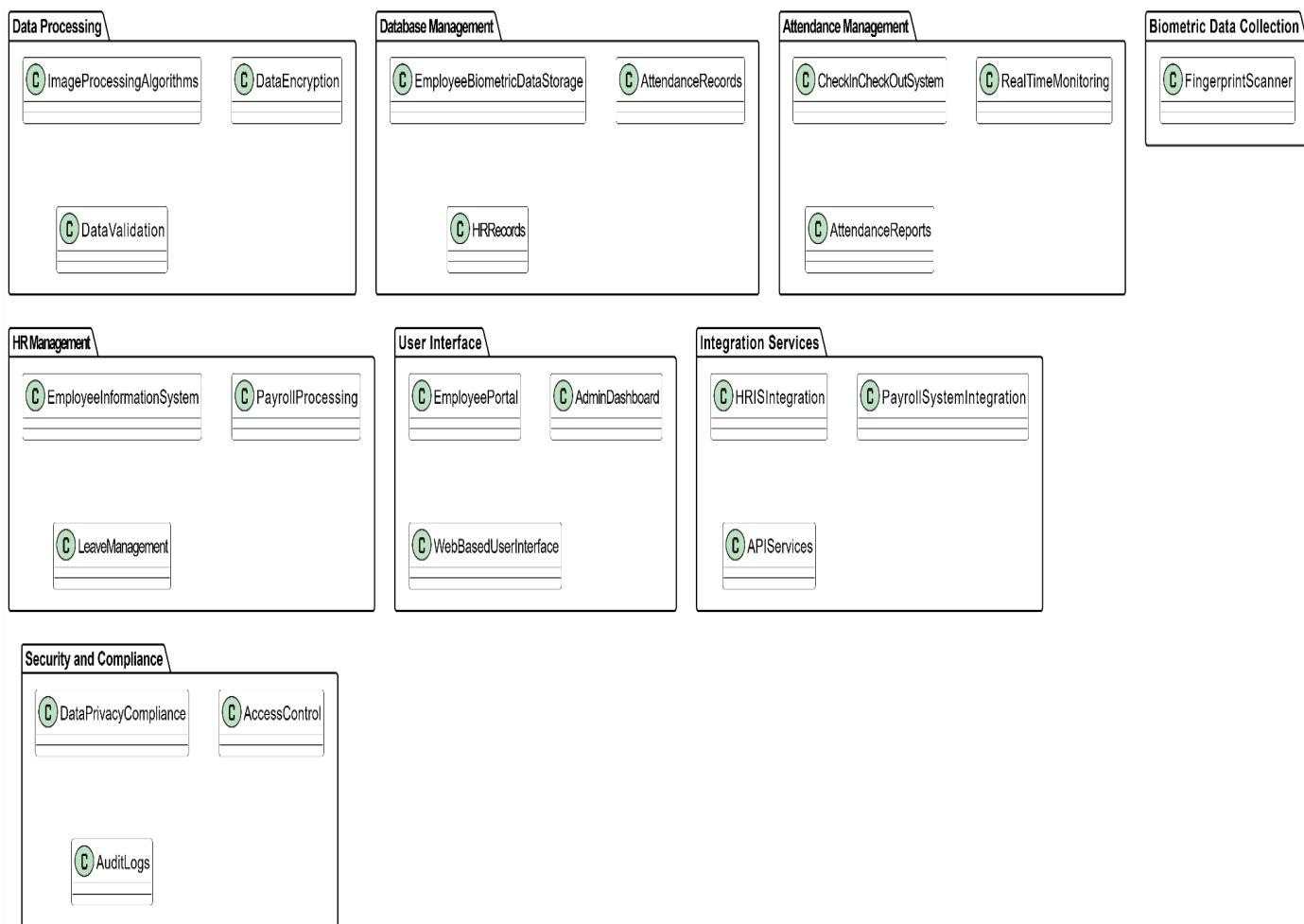


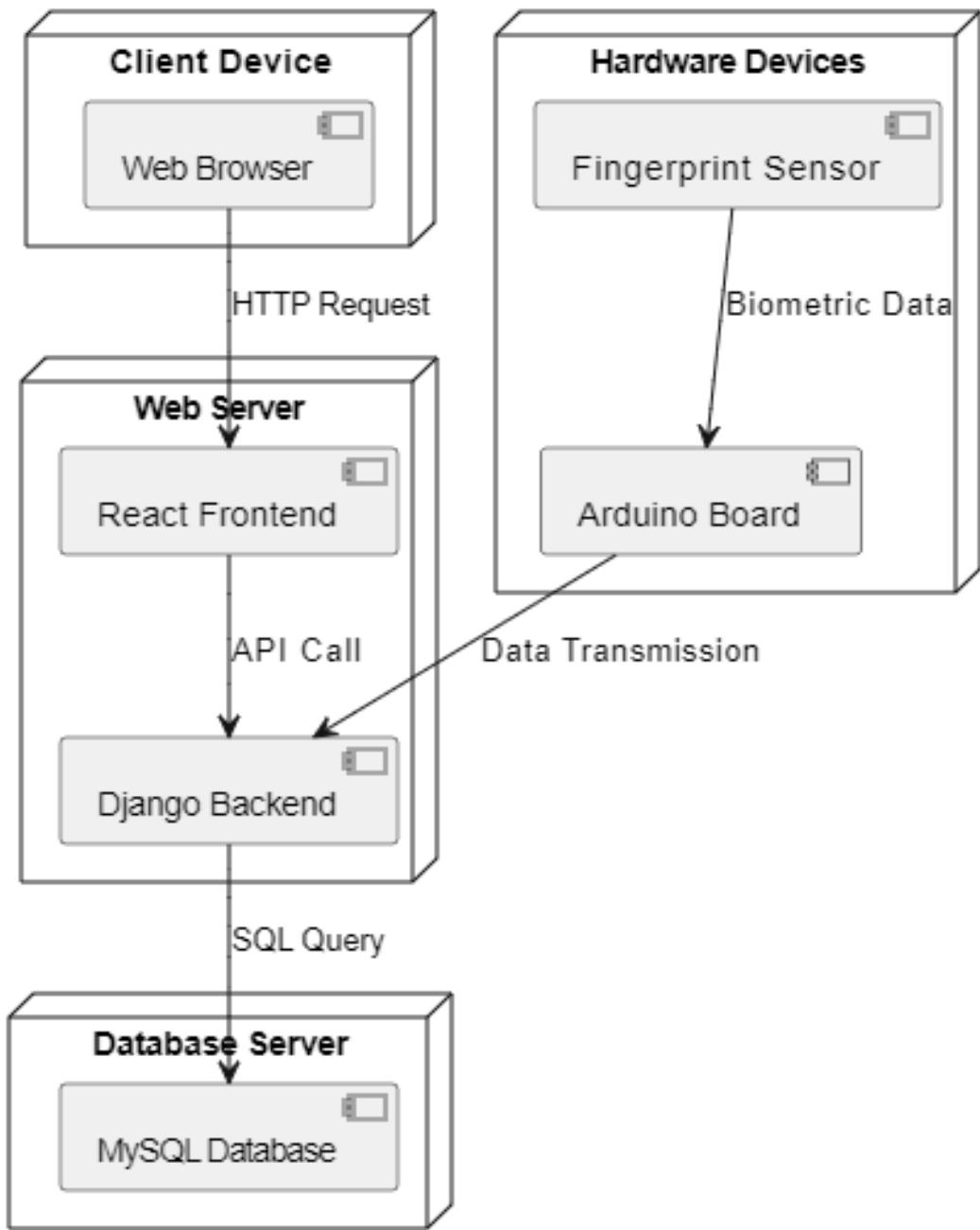
Figure 4.2.3.1: Subsystem decomposition diagram

Table 4.2.3.1: Subsystem decomposition

Subsystem	Purpose	Class
Biometric Data Collection	Collect biometric data from employees	FingerprintScanner
Data Processing	Process and validate biometric data	ImageProcessingAlgorithms, DataEncryption, DataValidation
Database Management	Store and manage biometric and HR data	EmployeeBiometricDataStorage, AttendanceRecords, HRRecords
Attendance Management	Manage employee attendance	CheckInCheckOutSystem, RealTimeMonitoring, AttendanceReports
HR Management	Handle HR-related tasks	EmployeeInformationSystem, PayrollProcessing, LeaveManagement
User Interface	Provide user interfaces for employees and admins	EmployeePortal, AdminDashboard, WebBasedUserInterface
Integration Services	Integrate with other systems	HRISIntegration, PayrollSystemIntegration, APIServices
Security and Compliance	Ensure data security and compliance	DataPrivacyCompliance, AccessControl, AuditLogs

#### 4.2.4 Hardware / Software mapping

The Fingerprint Biometrics Attendance and HR Management System combines hardware and software parts to work . The system has two main processes: the webserver process and the database process. These can run on one machine or on different machines. The web server uses React for the front end and Django for the back end. It handles requests from clients and hosts web pages. The database process uses MySQL to manage data operations. For hardware, Arduino boards and fingerprint sensors capture biometric data. The system then processes and stores this data. This setup helps handle data well and lets users interact . Clients can access the system through a web browser. The hardware/software map shows how these parts fit together. It also deals with issues about multiple nodes and reusing software.



**Figure :** HW/SW mapping

#### 4.2.5 Persistent data management

This section typically includes a description of data schemes, the selection of a database, the description of encapsulation of database.

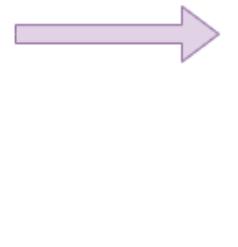


Employee			
	employee_id		
	first_name		
	last_name		
	date_of_birth		
	sex		
	phone_number		
	email		
	address		
	job_position		
	date_joined		

Employee			
	Column name	Data type	Allow null
1	employee_id	INT	<input type="radio"/>
2	first_name	VARCHAR(255)	<input type="radio"/>
3	last_name	VARCHAR(255)	<input type="radio"/>
4	date_of_birth	DATE	<input type="radio"/>
5	sex	VARCHAR(6)	<input type="radio"/>
6	phone_number	VARCHAR(255)	<input type="radio"/>
7	email	VARCHAR(255)	<input type="radio"/>
8	address	VARCHAR(255)	<input type="radio"/>
9	job_position	VARCHAR(255)	<input type="radio"/>
10	date_joined	DATE	<input type="radio"/>

### Object-employee



Employee document			
	document_id		
	employee_id		
	document_type		
	document_file		

Employee document			
	Column name	Data type	Allow null
1	document_id	INT	<input type="radio"/>
2	employee_id	INT	<input type="radio"/>
3	document_type	VARCHAR(255)	<input type="radio"/>
4	document_file	BLOB	<input type="radio"/>



Employee photo			
	photo_id		
	employee_id		
	photo_file		

Employee photo			
	Column name	Data type	Allow null
1	photo_id	INT	<input type="radio"/>
2	employee_id	INT	<input type="radio"/>
3	photo_file	BLOB	<input type="radio"/>

### Object-employee document and employee photo



HR manager			
	Column name	Data type	Allow null
	id	INT	<input type="radio"/>
	user_name	VARCHAR(255)	<input type="radio"/>
	password	VARCHAR(255)	<input type="radio"/>



Fingerprint			
	Column name	Data type	Allow null
	id	INT	<input type="radio"/>
	employee_id	INT	<input type="radio"/>
	fingerprint_data	BLOB	<input type="radio"/>

### Object - HR manager and fingerprint



Attendance			
	Column name	Data type	Allow null
	attendance_id	INT	<input type="radio"/>
	employee_id	INT	<input type="radio"/>
	clock_in	TIMESTAMP	<input type="radio"/>
	clock_out	TIMESTAMP	<input type="radio"/>
	date	DATE	<input type="radio"/>

### Object - attendance

Leave
leave_id
employee_id
leave_type
start_date
end_date
status



Leave			
	Column name	Data type	Allow null
1	leave_id	INT	<input type="radio"/>
1	employee_id	INT	<input type="radio"/>
	leave_type	VARCHAR(255)	<input type="radio"/>
	start_date	DATE	<input type="radio"/>
	end_date	DATE	<input type="radio"/>
	status	VARCHAR(255)	<input type="radio"/>

### Object - leave

Payroll
payroll_id
employee_id
salary
bonus
deduction
net_pay
pay_date



Payroll			
	Column name	Data type	Allow null
1	payroll_id	INT	<input type="radio"/>
1	employee_id	INT	<input type="radio"/>
	salary	DECIMAL	<input type="radio"/>
	bonus	DECIMAL	<input checked="" type="radio"/>
	deduction	DECIMAL	<input checked="" type="radio"/>
	net_pay	DECIMAL	<input type="radio"/>
	pay_date	DATE	<input type="radio"/>

### Object - payroll

Report
report_id
employee_id
report_date
report_type
detail



Report			
	Column name	Data type	Allow null
report_id	INT	<input type="radio"/>	
employee_id	INT	<input type="radio"/>	
report_date	DATE	<input type="radio"/>	
report_type	VARCHAR(255)	<input type="radio"/>	
detail	VARCHAR(255)	<input type="radio"/>	

Training
trainig_id
employee_id
training_name
start_date
end_date
status
completion



Training			
	Column name	Data type	Allow null
trainig_id	INT	<input type="radio"/>	
employee_id	INT	<input type="radio"/>	
training_name	VARCHAR(255)	<input type="radio"/>	
start_date	DATE	<input type="radio"/>	
end_date	DATE	<input type="radio"/>	
status	VARCHAR(50)	<input type="radio"/>	
completion			<input type="radio"/>

### Object - report and training

The diagram illustrates the transformation of an object-oriented class into a database table. On the left, a table represents the **Performance** class with attributes: report\_id, employee\_id, review\_date, reviewer\_id, performance\_score, and feedback. On the right, a more detailed table represents the same structure as a database schema, including column names, data types, and nullability.

Performance			
	Column name	Data type	Allow null
	report_id	INT	<input type="radio"/>
	employee_id	INT	<input type="radio"/>
	review_date	DATE	<input type="radio"/>
	reviewer_id	INT	<input type="radio"/>
	performance_score	INT	<input type="radio"/>
	feedback	TEXT	<input checked="" type="radio"/>

The diagram illustrates the transformation of an object-oriented class into a database table. On the left, a table represents the **ApplianceTracking** class with attributes: appliance\_id, appliance\_name, assigned\_to, status, purchase\_date, and last\_service\_date. On the right, a more detailed table represents the same structure as a database schema, including column names, data types, and nullability.

ApplianceTracking			
	Column name	Data type	Allow null
	appliance_id	INT	<input type="radio"/>
	appliance_name	VARCHAR(255)	<input type="radio"/>
	assigned_to	INT	<input checked="" type="radio"/>
	status	VARCHAR(255)	<input type="radio"/>
	purchase_date	DATE	<input type="radio"/>
	last_service_date	DATE	<input checked="" type="radio"/>

## Object - performance and appliance tracking

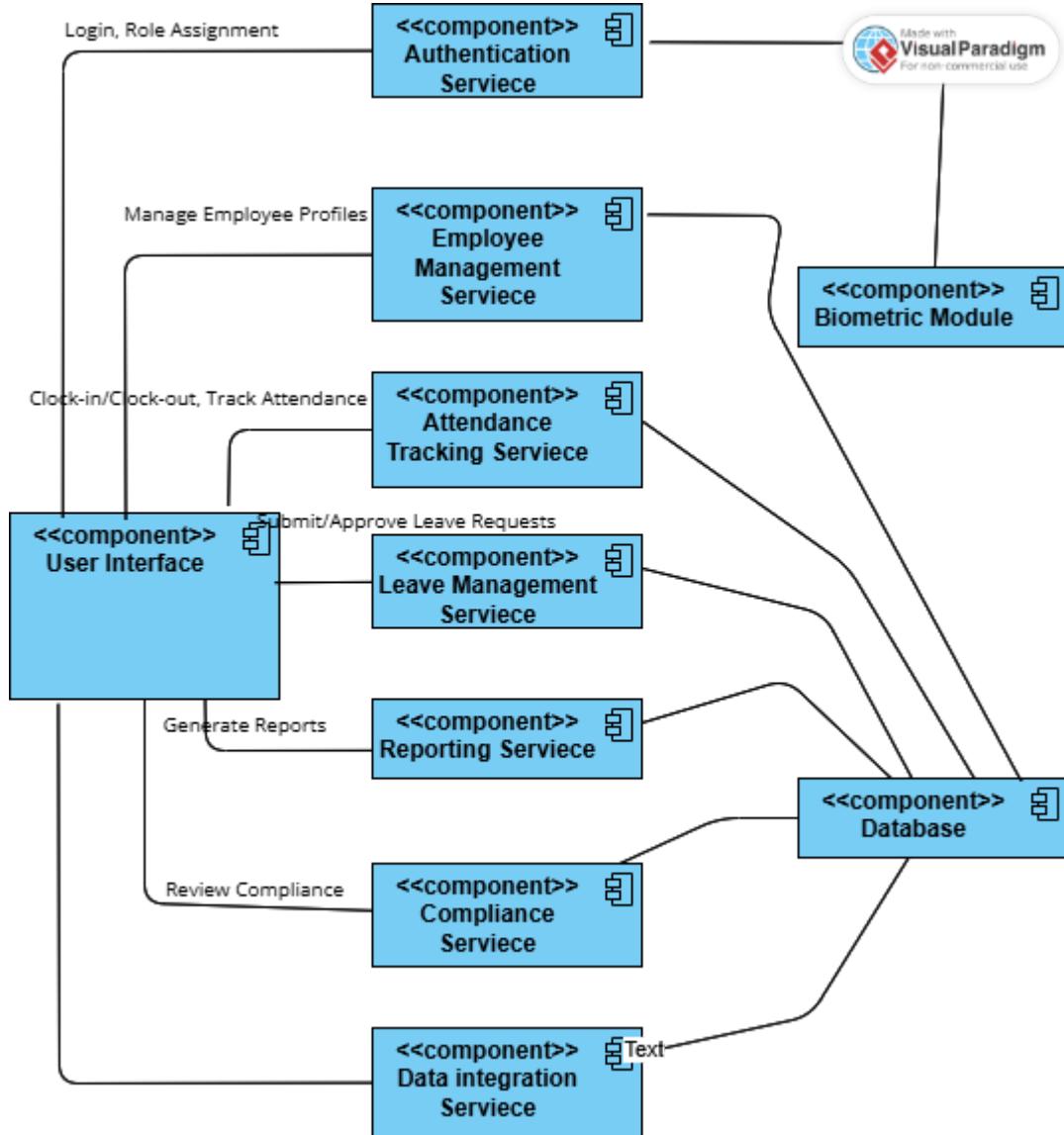
### 4.2.6 Component Diagram

A component diagram illustrates the structural relationship of software components and how they interact within the system. For the Biometric Attendance & HR System, we will outline the main components and their relationships.

#### Components:

- **User Interface (UI)**
  - Manages user interactions

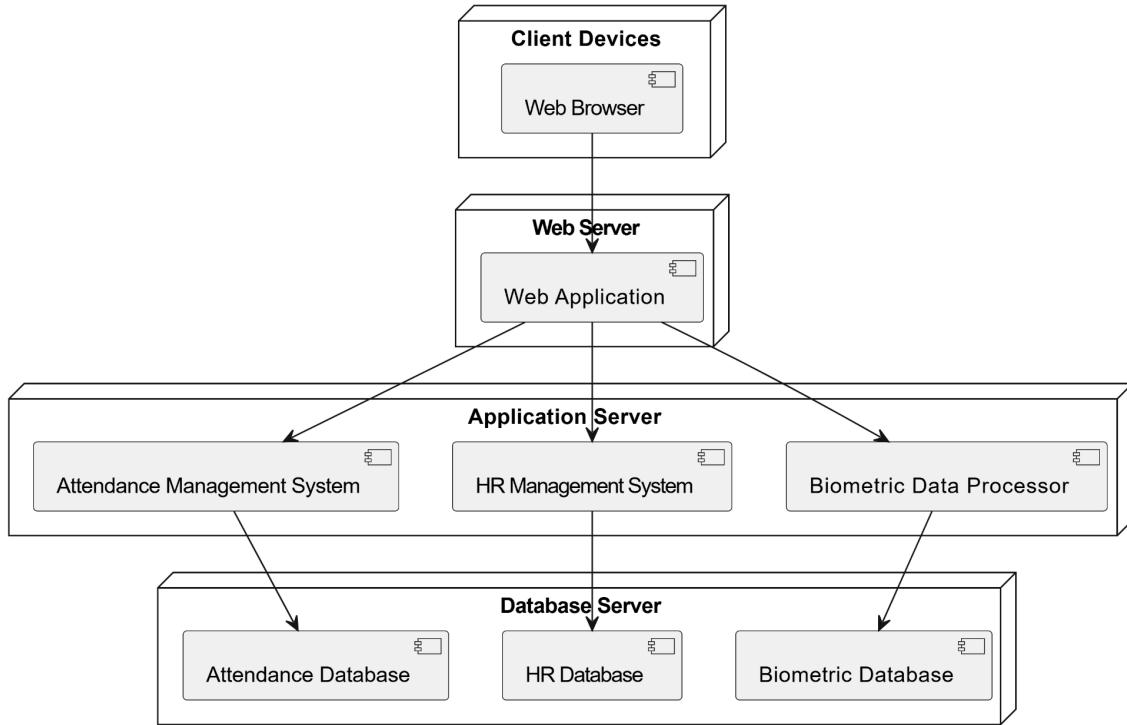
- Includes login screens, dashboards, attendance tracking, leave management, and reporting interfaces
- **Authentication Service**
  - Handles user authentication and authorization
  - Verifies user credentials and assigns roles
- **Biometric Module**
  - Manages fingerprint scanning and verification
  - Stores and retrieves biometric data
- **Employee Management Service**
  - Manages employee profiles
  - Handles CRUD operations (Create, Read, Update, Delete) for employee data
- **Attendance Tracking Service**
  - Tracks employee clock-in and clock-out times
  - Calculates total hours worked and overtime
- **Leave Management Service**
  - Handles leave requests and approvals
  - Manages leave balances
- **Reporting Service**
  - Generates attendance and compliance reports
  - Provides data export functionality
- **Compliance Service**
  - Monitors system compliance with regulations
  - Logs audit trails and generates compliance reports
- **Data Integration Service**
  - Integrates with external systems like payroll and HR systems
  - Synchronizes data between systems
- **Database**
  - Stores all system data, including employee profiles, attendance records, leave requests, biometric data, and audit trails



#### 4.2.7 Deployment Diagram

The deployment diagram specifies a set of constructs that define the execution architecture of the Biometric Attendance and HR system. It represents the assignment of software artifacts to nodes and maps the system's software components to the hardware that will execute them. Furthermore, it shows a static view of software components and hardware in their runtime configuration. Nodes are connected through communication paths to create network systems of arbitrary complexity. Nodes are typically defined in a nested manner and represent either hardware devices or software execution environments. Artifacts represent concrete elements in the physical world that are the result of a development process. The following deployment diagram shows the physical allocation of the Biometric Attendance and HR system components to computational units.

The deployment diagram is shown below:



#### 4.2.8 boundary condition

In this section, we will discuss how the Fingerprint Biometrics Attendance and HR Management System operates at its steady-state, initialization, and finalization (terminating) state. While most of the system design focuses on steady-state behavior, it is also essential to address the initiation and finalization of the system.

##### Initialization

To start the Fingerprint Biometrics Attendance and HR Management System, you need to have these things ready:

- **Internet Connection:** A stable and reliable internet connection is necessary to access the web-based platform.
- **Compatible Device:** A computer, laptop, or smartphone with a web browser.
- **Web Browser:** An updated web browser to access the system's web pages.
- **Biometric Hardware:** Fingerprint scanners must be properly connected and installed with the necessary drivers.
- **Database:** A MySQL database set up to store user and attendance data.
- **Backend Server:** A server running Django to handle application logic and database interactions.

- **Frontend Framework:** React integrated with the Django backend to provide a user-friendly interface.
- **User Credentials:** HR managers and employees must have their login credentials to access the system.

## User Interface at Startup

The user interfaces of the system are accessible only when the user launches the application from their device by logging in/signing up to their account after navigating to the platform web page. The user interface remains inactive and invisible to the user when the platform is off. For the user interfaces to function, the platform must be already started up and running.

### Termination:

If the application or the system is not running, the user interface will not be visible, and the application will be inactive. After the user completes their interaction with the platform, they can terminate or exit the platform by logging out of their account and then closing the web page.

### Failures:

One big problem is when people don't get the fingerprint scanner's working conditions right. Things like how hot or cold it is, how much moisture is in the air, and how clean the surface is matter. If no one thinks about these things, the fingerprint matching tech might mess up. It could say "no" when it should say "yes," or the other way around. This messes with keeping track of who's there and collecting HR info making the whole system less trustworthy.

Also, people's fingerprints can change over time. Maybe their skin gets super dry, or they cut their finger, or hurt it somehow. This breaks the rules the system thought it knew about fingerprint patterns. So, the tech might not recognize fingerprints it knew before. This causes headaches when trying to figure out who someone is or letting them in somewhere.

Math problems in the fingerprint matching software can cause issues at the edges with poor or partial fingerprint pictures. This can make the system act weird and unpredictable, messing up how well the attendance and HR management system works overall.

To fix these edge problems, you might need to keep adjusting the fingerprint scanners, use smart learning software to deal with fingerprint changes, and add ways to handle errors. This helps keep the system working well and makes sure people trust the HR management tool.

#### **4.2.9 Database Design**

### biometric attendance and hr system



