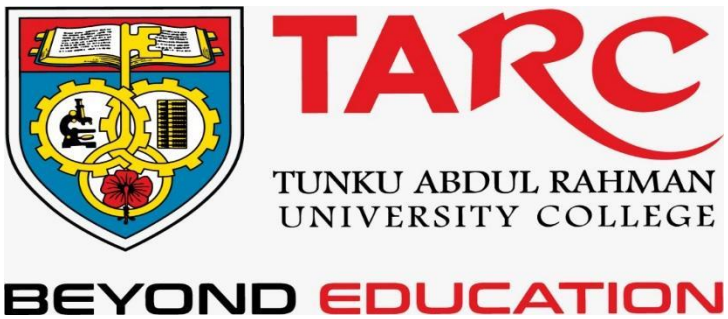
Analytical Human Resource Management System

By

Teo Jian Xiang



FACULTY OF COMPUTING AND
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By

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Supervisor: Ts. Ong Jia Hui

A project report submitted to the
Faculty of Computing and Information Technology
in partial fulfillment of the requirement for the
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Department of Software Engineering and Technology
Faculty of Computing and Information Technology
Tunku Abdul Rahman University College
Kuala Lumpur

Declaration

The project submitted herewith is a result of my own efforts in totality and in every aspect of the project works. All information that has been obtained from other sources had been fully acknowledged. I understand that any plagiarism, cheating or collusion or any sorts constitutes a breach of TAR University College rules and regulations and would be subjected to disciplinary actions.

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Abstract

Human Resource Management (HRM) has been known for being slow and arduous due to the lack of agility, contributed by the large amount of data exchange needed to perform HR related tasks. A HRM software helps in making it more fluid and efficient, however, most HRM software is rigid and tailored for a specific target group of users. It is also no longer enough for HRM software to be a passive tool waiting to be used. HRM software must actively monitor workforce status and report any anomaly or possible complications. To confront these challenges, a cloud-based Human Resource Management Service System will be developed. It is determined that this system will help companies that employ shift-based work to be productive with its workforce and solve problems which may lead to low productivity such as attendance. Its key features would include workforce management, shift management, leave self-service, dashboard analytics, training module, payroll module, admin management, company management, benefits & compensation, reporting module and role management. The methodology used in this project will be the Agile Model. The system will be coded entirely in Microsoft Visual Studio Community 2022 with supporting tools such as Microsoft Azure and Github. The system adopts a monolithic architecture and uses the ASP.NET Core MVC framework version 7.0. A SQL database is to be hosted on Microsoft Azure, and APIs will be provided to allow CRUD functionality for mobile applications that complement the system. To ensure the system meets all functional requirements listed and to assure the system's quality, black-box testing would be performed on the system to thoroughly test the functionality offered by the system.

Acknowledgement

During the course of this project, I have received help in various forms from many individuals and parties. I would like to use this opportunity to express my deepest gratitude to all those who have helped me in completing this project.

Yaw Foong Zeng, one of my team members in this project, will be the first person I like to express my gratitude to. He has been a great team player, and has always been cooperative since the start of this project. I would also like to thank him for providing good suggestions and solutions every time I face the issues. His help and contribution is a major reason that this project is a success. The next person I would like to thank is another team member, Looi Jia Toong. She is responsible for designing and implementing the user interface and she has done a great job on it. Her efforts are what made the system user friendly.

I would also like to express my gratitude towards the mobile team members, Lim Zhi Shuang and Liew Yan Lin. As both teams frequently meet with our supervisor together, whenever we forget some information discussed during the meeting, Lim Zhi Shuang will always provide me with the information I am missing. Aside from that, both of them have been patient and cooperative when problems arise that affect both platforms, such as requirements conflict. Meetings conducted between them and us have always been productive, which provided us much inspiration to solve certain implementation problems. Their cooperation represents another major factor that the project is a success.

The next person I would like to thank is my supervisor, Ts. Ong Jia Hui. Firstly, he provided us a chance to undertake an industrial project with him, which has greatly increased my knowledge and experience. Whenever we are unclear about the system requirements, he would also explain to us patiently and provide guidance on certain subjects we are inexperienced in. His support is why the project was even conceived in the first place, and it is easy to say he was a major contributor in the success of our project.

Additionally, I would also like to thank our moderator, Dr. Goh Chin Pang. During our presentations, despite experiencing multiple technical difficulties such as UI failure and laptop battery depletion, he still patiently listened to our presentation without reprimanding us. He also provided valuable suggestions to improve our system with. I would like to thank him for spending his time on our system demonstration.

Finally, my friends and family, although not involved in the project, have helped greatly in indirect ways. When I was stressed and anxious about the project, their support is always the motivation that pushes me forward. It is with great honor to say thank you to everyone who has helped me on my journey.

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Chapter 1

Introduction

1 Introduction

This chapter discusses the problem currently faced by human resource management which the project aims to solve, a brief introduction to the proposed solution which is an Analytical Human Resource Management System, and the proposed components of aforementioned system as well as how the components helps in the problem stated. By the end of this chapter, the reader will gain an understanding of the problem the project is solving, and the scope of the project.

1.1 Problem

HRM is a strategic and comprehensive approach to managing employees and the workplace culture and environment. If the HRM does well, it enables employees to contribute effectively and productively to the overall company direction and the accomplishment of the organization's goals and objectives. (Heathfield, S.M. , 2021). In tradisional HRM, the HR department is manually to process a large amount of data that is related to the HR. The HR department is responsible for creating and managing the shift work for all the workers manually. It is to help the HR department to track the employee attendance. But, there is a challenge in this situation which is they may create two shift workflows to overlap. Besides that, the HR department task has included creating and assigning the training course for the employee. The purpose of the training course is to improve the skills of the employee. The HR department also has to track the license and certification of the employee. The HR department should remind employees and employers when they should be renewed. The challenge is that it is difficult for the HR department to track all the employees' and employers' licenses and certifications. Furthermore, the HR department also will calculate the payroll for the employee according to the employee's shift work. The challenge is the HR department will be time-consuming to process the data. If the time taken in hrm is long, the productivity of the employee to the overall company direction will decrease.

1.2 Proposed Solution : Cloud-Based Analytical HRM System

The solution of the problem is to develop a smart human resource management system for the HR department. The HRM system is responsible for providing a platform to store all the data and information that is related to the HR. The functions of the HRM software include shift management, manage and track training of the employee, admin management for controlling the system and payroll according to shifts worked by employees. The HRM system has an

access control module to control the privacy information. For the normal employee, The system will allow the normal employee to view their own basic HR information such as payroll and time table. For the manager, The task of the manager in the system is to schedule the shift work for the employee and also manage the training and track the progress of the training. For the HR employee, the system will help them to calculate the payroll for the employees.

To fulfill its goal of improving the HRM system, the following modules will be targeted:

1.2.1 Shift Management

Responsible for managing staff profile, performance rating and related documents. Home to the access level control, which will dictate what every employee gets access to. Also allows staff to self-edit their profile, and submit changes to their documents.

1.2.2 Training

Tracks license and certification, reminding employer and employee when they should be renewed. Management and monitoring of training courses is also provided

1.2.3 Payroll

Calculates payroll according to company defined pay rate and allows employees to see how their payroll is calculated.

1.2.4 Admin Management

This module is to allow the super admin to create and remove admin for manage the company

1.3 Objectives

Based on the problem stated prior, the described system set out to fulfill several objectives in order to solve the underlying problem plaguing traditional HRM.

1.3.1 Lower Hardware Cost

Since the system is cloud-based, the company does not need much high performance hardware to support the system. Therefore, the company can reduce the cost of hardware spend in HRM

1.3.2 Accurate Productivity Tracking

The real-time attendance system can be used to accurately track employee attendance and detect unproductive employees. This makes sure no employees can cheat the system. In addition, the tracking provides information that can be used to monitor overall organization productivity.

1.4 Advantages

1.4.1 Competition Analysis

Table 1.1: Competitor HRM's Attributes

Software	Sapling HR People Ops Platform	WorkPuls Time Tracking
Website	https://www.saplinghr.com/plans	https://www.workpuls.com/
Price	$6.99 per user monthly with optional add ons	$10.00 per monthly
Real Time Attendance Tracking	None	Yes
Work Scheduling	No	Yes
Leave Self-Service	Yes, with $175 per month add on.	No
Dashboard Analytics	Common dashboard and employee experience tracking.	Simple information dashboard
Other Features	Onboarding - Give new hires access to update their personal profile and complete all required paperwork. Surveys - Analyze employee experience feedback and track progress overtime.	Reports - Receive the report via email on daily, weekly and monthly.

Both competitors only offer simple dashboards, which only offer a summary of information contained within the system. No analysis is performed to detect trends or anomalies. In contrast, the system within this project performs predictive analysis to detect anomalies such as high absence rate.

As such, the proposed system's contributions are as follows:

1.4.2 Cloud Based

The system will be hosted in the service provider's central server. This means that the company who wishes to use the system does not need to install any hardware or IT infrastructure to be able to use this system. They would only require Internet connection. The company that uses

the system would not need to bother with maintenance of the system and the databases involved since it is the service provider's responsibility.

1.4.3 AI Assisted Workflow

AI technology is used to assist in workflows such as scheduling and paid time off accrual, greatly enhancing the efficiency of said processes. This ensures a large portion of the workflow can be automated, greatly reducing the need for human effort, meaning the company can reduce costs in managing human resources.

1.4.4 License and Certificate Tracking

The system has allowed the employee to upload their license and certificate. After the employee uploaded the certificate and license information, the system will automatically help the employee to track the employee's license expired date. If the date is nearly to the expired date, the system will notify the employee early for renewing his or her licenses.

1.4.5 Real-Time Attendance Tracking

The proposed system will contain attendance tracking using advanced techniques such as face recognition and geofencing to increase accuracy. The features will be built with customizability in mind, allowing attendance tracking based on shifts scheduling and work assigned. In addition, the tracking system will interface with the payroll module in the system to simplify calculation of payroll.

1.4.6 Payroll Calculation

The proposed system will automatically calculate the payroll for each employee according to their own shift work. The payroll will also include other necessary items such as KWSP, SOCSO, Zakat and the overtime pay rate.

1.5 Contributions

Although most organizations that have a HRM department, due to the fact that the system is built with shift-based work in mind, several industries could benefit greatly from our proposed system.

The industries that the system could contributes to are:

1.5.1 Manufacturing Company

The system is designed with factory workers in mind, and thus manufacturing companies that own factories is our main target. The attendance system will be useful in tracking whether a worker completes a shift, and leave request management would decrease unexpected absence.

1.5.2 Construction Company

Since construction companies pay workers by shift work, the system will also be suitable for them.

1.5.3 Retail Company

Most retailers such as convenience stores and supermarkets have cashiers and staff work around day shift and night shifts. This system can be used by retailers to keep track of shifts and payroll.

1.5.4 Emergency Services

Emergency Services also employs shift work, with the one working their shifts on standby for emergency response. They might not necessarily pay their staff according to shifts worked, but the system would still be useful to track overtime worked.

1.6 Project Plan

The proposed system will be developed by practicing the waterfall model. The project will be separated into several phases which are project conception, literature review, methodology and requirement analysis, design and implementation, testing and submission.

Each phase contains several milestones that must be completed. Once all milestones in a phase are successfully completed, the project will move to the next phase. An estimated deadline is provided to ensure the project is completed within the time limit.

Table 1.2: Estimated Date for Project Milestone Completion

Milestone	**Estimated Finish Date**
Project Conception	
Proposal Preparation	**21/2/2022**
Project Goals and Objectives	**26/2/2022**
Project Plan	**8/3/2022**

Project Scope	**18/3/2022**
Literature Review	
Company Background	**23/3/2022**
Project Background	**26/3/2022**
Literature Review	**2/4/2022**
Feasibility of Study	**9/4/2022**
Methodology and Requirement Analysis	
Research Approaches	**23/4/2022**
SDLC Methodology	**7/5/2022**
Requirement Analysis	**14/5/2022**
Design & Implementation	
Diagrams Creation	**21/5/2022**
UI Design & Development	**11/6/2022**
System Module Design & Development	**2/7/2022**
Database Design & Development	**23/7/2022**
Testing	
Initial Unit Testing	**30/7/2022**
System Testing	**6/8/2022**
Problem Identification	**13/8/2022**

Problem Correction and Debugging	**27/8/2022**
Final Testing	**3/9/2022**
Submission	
User Guides Preparation	**10/9/2022**
Fine Tuning Documentation	**24/9/2022**
Project Handover	**25/9/2022**

1.7 Project Team & Organization

As the proposed system's are complex and contain a lot of components, to ensure it is feasible, three teams of two are assigned for this project.

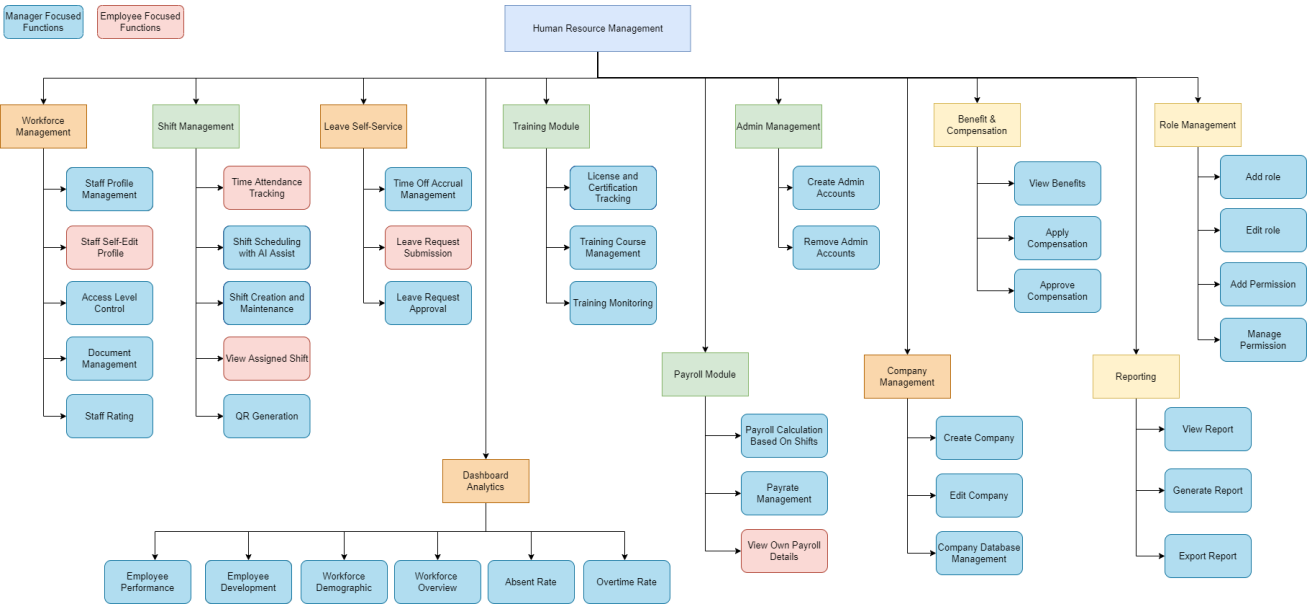


Figure 1.3: An Overall Structure Chart of the Proposed System

1.7.1 Website and Backend Team: Yaw Foong Zeng and Teo Jian Xiang

This team will be responsible for creating the backend to support the both website and mobile version of the system, which includes business logic, databases and API required by the mobile version of the system. In addition, the team will be responsible for creating the website where companies use to access the HRM.

1.7.2 Mobile Team: Lim Zhi Shuang and Liew Yan Lin

This team will be responsible for developing the mobile version of the system. Some functions differs from the website version, as such, the mobile version can be seen as a lite version of the system. This team's main focus will be developing the real-time attendance tracking system using face recognition and geo-fencing.

1.7.3 User Interface Team: Looi Jia Toong and Angelina

This team will be responsible for creating the UI design for both versions of the system. In addition, the team will assist in the previous two teams by developing UI heavy modules.

1.8 Chapter Summary and Evaluation

This chapter provided a description of the problems faced by modern HRM used by companies as well as proposing a cloud-based analytical HRM as the solution.

This chapter detailed the components that make up the proposed system, as well as the feature it offered which gave it an advantage over its competitor’s HRM.

This chapter also provided a detailed timeline and team organization for the development of the project.

REMINDER TO STUDENTS ABOUT FIGURES AND TABLES

Important figures and tables are to be integrated into and/or explicitly referred to in the various appropriate sections in the Final Project Report. The figures and tables should also be labeled with a figure/table number using the legal numbering style and appropriately titled. For example, Figure 1.3 will be used to refer to the third figure appearing in Chapter 1. Similarly, appendices must also be explicitly referenced in the appropriate part of the Final Report. For example:

- "Refer to Table 1.1 for the survey questionnaire results."
- "The experiment result is given in Figure 1.1."

All tables must be labeled with proper captions, placed on top of the table and centralized as shown in Table 1.1 below.

Table 1.1: Example of Table

	Series 1	Series 2	Series 3
Category 1	4.3	2.4	2
Category 2	2.5	4.4	2
Category 3	3.5	1.8	3
Category 4	4.5	2.8	5

Similar to table, all figures must be labeled with proper captions, placed below of the figure and centralized, as shown in Figure 1.1.

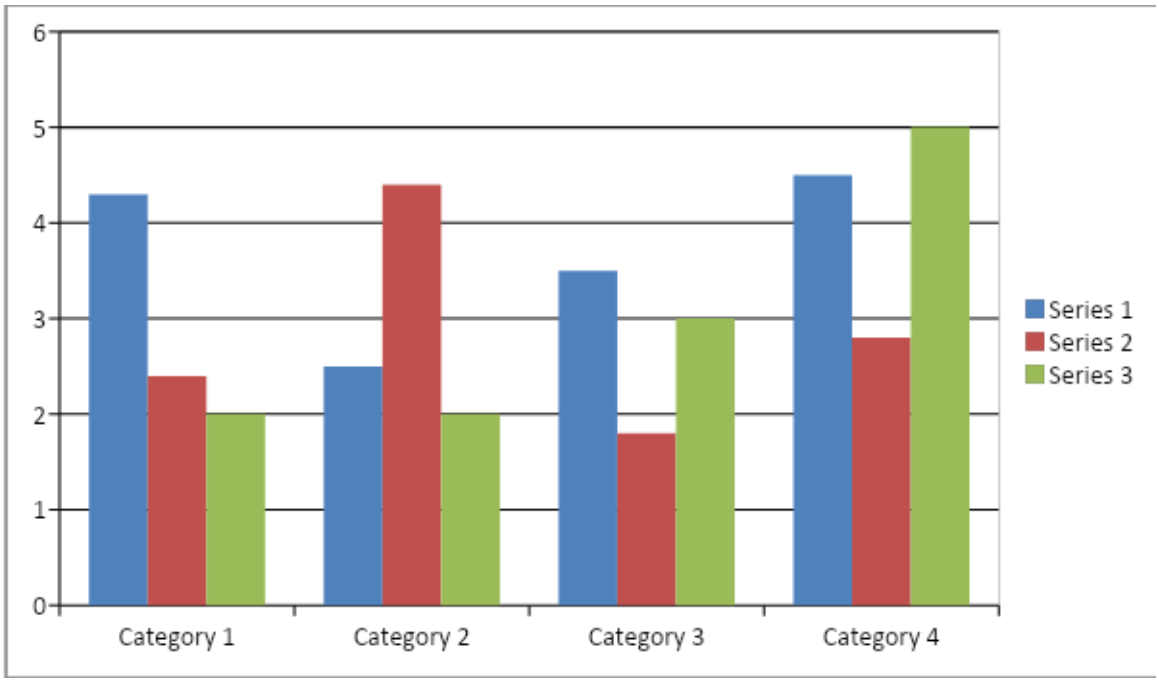


Figure 1.1: Example of Figure

For Chapter 2, the numbering for the figures that appear should be as follows: Figure 2.1, Figure 2.2, Figure 2.3, etc.

IMPORTANT: Remember to apply this throughout your FYP documentation.

Chapter 2

Literature Review

Literature Review

In this chapter, previous research and literature written on the subject of elements related to Analytical HRM will be revealed and reviewed. First, this chapter will explain what is a HRMS via review of several literature and discuss their importance. Continuing, factors impeding HRMS adoption is discussed among several literature reviews. Next, HR analytics will be discussed and defined via studying related articles and the result of applying HR analytics will be discussed. After that, the chapter reviews the reason for unsuccessful HR analytic adoption. Finally, a feasibility study is conducted to determine the technical feasibility and operational feasibility of the system.

2.1 Human Resource Management System

2.1.1 Definition of HRMS

HRMs can be referred to by a number of interchangeable words, including e-HRM, HR intranet, web-based HR, and HRIS. A specialized information system within the traditional functional domains of the company, designed to assist the planning, administration, decision-making, and control functions of HRM, was the first definition of HRMS given by DeSanctis in 1986. The preceding definition, however, was contested by a number of specialists because it limited the subject matter to HR positions while ignoring the adoption and deployment of information technology within business organizations. According to Kavanagh et al. (2012), although HRMS primarily consists of software and technology, it also includes people, forms, policies & processes, and data. Recently, HRMS has switched its emphasis to be more strategic.

2.1.2 Importance of HRMS

The majority of HR tasks may be carried out by HRMS on a daily basis, which has many advantages for the company. For instance, HRMS suggests automation of procedures and tasks, which aids in reducing the usage of resources, including human, material, and financial ones. Reduced resource consumption includes cutting back on paper use, lowering HR costs, and assisting managers with the HR process, to name just a few (Chakraborty, 2013). According to Hendrickson (2003), HRMS offer self-services capabilities like computer-based training and online recruitment in addition to increasing the efficiency and efficacy of HR activities in a firm. Additionally, the HRMS generates data as a byproduct that may be distributed to staff members and line managers via front-end web apps (Ruel et al., 2011). Employees can now enter and update data on their own, which results in more accurate data and time savings. By monitoring and managing transactions pertaining to human resources, HRMS decreases information accuracy (Lengnick-Hall & Moritz, 2003).

2.1.3 Factors preventing HRMS adoption

Despite the obvious advantages that HRMS offers, numerous research on the obstacles impeding adoption have been conducted. Since HRMS is viewed as an invention in HRM, this research largely adhered to Rogers' Diffusion of Innovation hypothesis. According to Rogers' theory, the initial adoption decision is influenced by five distinct characteristics: relative advantage, complexity, compatibility, trialability, and voluntariness (Rogers, 2003).In another research five contextual factors were identified which influence innovation adoption: innovation characteristics, organizational characteristics, environmental characteristics, task characteristics and individual characteristics (Kwon & Zmud, 1987). According to earlier study and the research models of Teo et al. (2007) and Troshani et al. (2011), organizational, technological, and environmental factors are the three main influences on HRMS adoption.

Organizational factors are features of an organization that hinder the adoption of HRMS. According to Yang et al. (2007), the degree of centralization in an organization can have an impact on HRMS acceptance since resistance from lower level managers or staff might make HRMS implementation challenging. Additionally, the needs of HR functions could be determined by business sizes (Hendrickson. 2003). For example, a small company with less than 10 employees may not be able to justify implementing a costly HRMS. The organization's level of HRMS knowledge is another important consideration. The speed of HRMS adoption has been hindered by a lack of IT expertise and competency (Teo et al, 2007).

The adoption of HRMS can be influenced by technological factors, which are an organization's technical characteristics. This largely refers to an organization's technological preparedness, which depends on the organization's technological infrastructure and the amount of IT human resources (Oliveira & Martins, 2010). The type and size of HRMS that a business can adopt are strongly influenced by the infrastructure that is available, and the IT human resources' knowledge is a major factor in whether or not the HRMS can be maintained affordably so that it runs without interruption. Without both, implementing HRMS is expensive and impractical (Oliveira & Martins, 2010).

Environmental factors describe physical characteristics the organization operates under, such as the area they operate in, industry-specific characteristics, government regulations and supporting infrastructure (Oliveira & Martins, 2010; Troshani et al., 2011). Adoption of HRMS can be greatly influenced by competition. Firms have come to the realization that they cannot be competitive without effectively managing their human resources (Teo et al, 2007), which has led to the adoption of HRMS, as competitive pressure to cut costs, serve a more strategic role, and better manage the employees in the organization grows (Teo et al., 2007). The

organization is less likely to embrace HRMS, on the other hand, if none of their rivals do so. In addition to competition, governments can play a crucial role in promoting technology adoption by increasing awareness, providing financing, training, and support (Troshani et al., 2011).

2.2 HR Analytics

2.2.1 Definition of HR Analytics

Human Resource Analytics (HRA) first appeared in the HR published literature in 2003-2004. Lawler et al (2004) distinguish HRA as separate from HR metrics. HR metrics are a measure of key HRM outcomes, commonly classified as efficiency, effectiveness or impact. Lawler et al. (2004) state that HRA are measures but rather represent statistical techniques and experimental approaches that could be utilized to show the impact of HR activities. Despite this distinction, there is still a definitional ambiguity in the literature.

Bassi (2011) debates that HRA should be considered both as "systematically reporting on an array of HR metrics" or more sophisticated solutions, based on "predictive models". Furthermore, Bassi's definition includes the notion of using an "evidence-based approach" to making decisions on the "people's side of business". The conclusion she gives for HRA is that it is "an approach for making better decisions on the people's side of the business; it consists of an array of tools and technologies, ranging from simple reporting of HR metrics all the way up to predictive modeling" (Bassi, 2011).

HRA also has its fair share of controversy. Rasmussen and Ulrich (2015), argued that HRA is merely a fad. Fad means 'largely insignificant, non-rational swings that come and go with little or no lasting impact on the language of management techniques or organization themselves' (Abrahamson & Eisenman, 2008). They arise from a chance conjunction of forces that trigger diffusion largely based on bandwagon effects and eventually disappear when the inflated expectations for the innovation are not realized (Abrahamson & Eisenman, 2008).

From the definitions and labels given by previous researchers, several characteristics about the HRA can be determined:

- HRA is not the same as HR metrics. It involves a more sophisticated analysis of HR-related data.
- HRA does not only focus on HR functional data, it involves integrating data from different sources, internal and external to the firm.
- HRA uses information technology to collect, manipulate and report data.
- HRA supports people-related decisions.

- HRA is the practice of linking HR decisions to business outcomes and organizational performance.

Based on all the various definitions, Marler et al. (2017) define HRA as a HR practice enabled by information technology that uses descriptive, visual, and statistical analyses of data related to HR processes, human capital, organizational performance, and external economic benchmarks to establish business impact and enable data-driven decision-making.

2.2.2 How does HR Analytics work?

Most articles prescribe some version of the LAMP model, first introduced in the book Beyond HR: The New Science of Human Capital (Boudreau & Ramdstad, 2007) which stood for Logic, Analytics, Measures and Processes. According to Boudreau & Ramstad (2007), a measurement system needs these four essential elements in order to identify associations supported by evidence and inspire better decision-making based on those studies. The two also asserted that LAMP is essential for comprehending how HRM procedures relate to strategic HRM business outcomes and their cause-and-effect chain.

It appears that there is a lot of room for incorporating theories of innovation, social impact, and cognition to direct and clarify the cause-and-effect links between the moderators, outcomes, and antecedents of HR Analytics. Historically, industrial psychology has addressed this issue in relation to the use of "utility analysis" in the 1970s and 1980s (Cascio & Boudreau, 2010). By Retooling' HR analysis and reporting utilizing comparisons to frameworks from other management disciplines like operations, finance, and marketing, Boudreau (2012) also argues that decisions made by leaders outside the HR discipline may be affected (Boudreau, 2010; Rousseau & Boudreau, 2011).

2.2.3 What are the outcomes of HR Analytics?

Previous studies have suggested strong evidence for a positive cause-effect relationship between HRA and financial performance (Aral et al., 2012). In a thorough case study of how the home improvement retail chain Lowes implemented HRA, Coco et al. (2011) were able to demonstrate that highly engaged staff members result in 4% higher average consumer ticket sales per store. To demonstrate the effect of HRA on business, Harris et al. gave a number of high-level study scenarios. They explain how Google uses HRA, for instance, to forecast employee performance using their applicant information. Sysco makes use of HRA to identify causal links between employee satisfaction surveys, customer loyalty, and increased revenue.

2.2.4 What moderating factors affect HRA outcomes?

The most common reason that HRA is not widely adopted is the lack of skilled analytical HR professionals. Bassi (2011) predicts that without the necessary knowledge to use analytical

software and how to use measures of business results, the HR department will inevitably cede responsibility of analytics to the IT and finance departments. Angrave et al. (2016) echo this concern and suggest that not only does the lack of analytical skill impede the uptake of HRA, there is a concern that should HRA be adopted it will not be used by HR professionals but by others that is likely to misinterpret the analyses.

In order for HRA to be successful, the organization must be politically accepting of HRA. In order for HR professionals to gain access to the cross department data needed to perform analyses, managers from other departments must be willing to provide access as well as be involved in the process. In addition, Rasmussen and Ulrich (2015) observe that there is a tendency to reject data that threatens existing beliefs. People have a tendency to reject new data that contradicts their previous belief. Thus, it is important for HR professionals to establish their credibility among managers that may not believe data-driven results and involve key stakeholders in the process of analysis.

Finally, HRA cannot disregard the significance of HRM information technology, such as HCM software. Companies having HRA but without HCM software did not observe a rise in performance, as demonstrated empirically by Aral et al. (2012). According to other studies, information technology can both greatly facilitate and seriously impede HRA. Information technology collects and archives data from all corporate divisions and generates reports that are useful for HRA. However, the current reality is that HRM IT does not have capabilities that match that promise. Data collected may not be collected or inaccurate (Bassi, 2011), data across departments are not accessible (Douthitt & Mondore, 2014).

2.2.5 Implementation of HRA

There are several common implementation techniques for HRA. The goal of HR analytics is to seek answers to critical questions such as improvement of productivity, suitability of an employee for a job, staffing requirements of organizations, performance of individuals, teams and departments, and identification of skill gaps. The insights requires to answer these questions can be obtained through several analytical techniques (Shrivastava, S et al., 2018):

- Data Mining and Machine Learning:

  Data mining is the process of identifying patterns in vast amounts of unstructured data that are then transformed into pertinent knowledge. This frequently goes hand in hand with machine learning, which is the process of using computers to analyze data and spot patterns. The majority of people would classify this as an artificial intelligence.

- Contextual Analysis:

An analysis of text in an attempt to understand its meaning, characteristics, the context of historical and structural setting. This would enable one to comprehend the author's objectives and the objective that he or she is trying to convey through the use of language. An excellent illustration of this is when employers examine applicants' resumes to gauge a candidate's suitability for the position, career stability, attitude, and behavior.

- Predictive Analytics:

  As the name suggests, data analysis techniques such as predictive algorithms and data mining are used to forecast what would likely happen in the future, what-if scenarios and estimation of risk. As an instance, using predictive analytics to forecast change staffing changes during organizational restructuring.

- Prescriptive Analytics:

  Provide solutions to organizational problems while keeping in consideration various possibilities based on a specific scenario.

2.3 Feasibility Study

2.3.1 Technical Feasibility

The project can be separated into two parts, which are mobile application and the web backend.

The ASP.NET Core framework will be utilized for the web backend. Access to ASP.NET Core is simple, and free IDEs like Microsoft Visual Studio are freely accessible. It is assumed that the system will use the ASP.NET Core framework, which is reasonable given the technical expertise of the web backend team and involves HTML, CSS, and Javascript. The databases will be run on SQL Server. Since everyone on the team has a basic understanding of SQL, there are no technical concerns. Since they are the most widely used technologies for developing web apps, a wealth of internet information and assistance are easily accessible, making the majority of difficulties and hurdles encountered during development trivial.

The mobile team will use Flutter to create the application for mobile devices and an API to connect to the backend. Since the mobile application development team has experience, there would be little technical risk on the mobile side as well.

Both teams have a number of powerful laptops that they can use to code the system. Additionally, both teams have a variety of mobile devices running various operating systems, making testing across several platforms possible.

In conclusion, the project is doable since the technologies it uses are widely available, the team members' technical proficiency is reasonable, and hardware constraints are not an issue.

2.3.2 Operation Feasibility

With the HRMS in operation, collecting and maintaining huge amounts of data required by HR functions becomes feasible. Transfer of data is also streamlined, promoting efficiency of HR processes. Each function is segregated into its own module. Since only one module can fail without affecting the others, corrective maintenance is inexpensive.

The system caters to people with limited technological knowledge and is extremely adaptable. This guarantees that HRMS is no longer a rigid system that is limited in its application. Users are not likely to need customer service frequently, making maintenance of the system's operation manageable.

The self-service feature also lessens the strain for HR staff, which lowers the expense of overtime. Certain HR procedures, such as requesting leave, can be completed by employees directly, speeding up the process.

Additionally, managers would no longer need to continuously monitor a vast quantity of data because they could simply glance at the dashboard analytics and immediately spot any irregularities occurring. The severity of that abnormality can then be mitigated right away.

In conclusion, the operation of this system will significantly increase the company's productivity and efficiency, and since there are no significant dangers associated with its continuing operation, the system is operationally practicable.

Chapter 3

Methodology and Requirements Analysis

2 Methodology and Requirements Analysis

This chapter will give a brief introduction into the development methodology the project will follow, which is the agile method. In addition, this chapter will describe the requirements gathering techniques used to gather the expected requirements for the system. Requirement analysis will then be performed to identify key stakeholders and their concern in order to extract useful requirements. Finally, all identified functional and non-functional requirements from said gathering technique will be listed.

2.1 Methodology: The Agile SDLC Model

2.1.1 Introduction to Agile SDLC Model

The software development life cycle of this project will utilize the agile model.

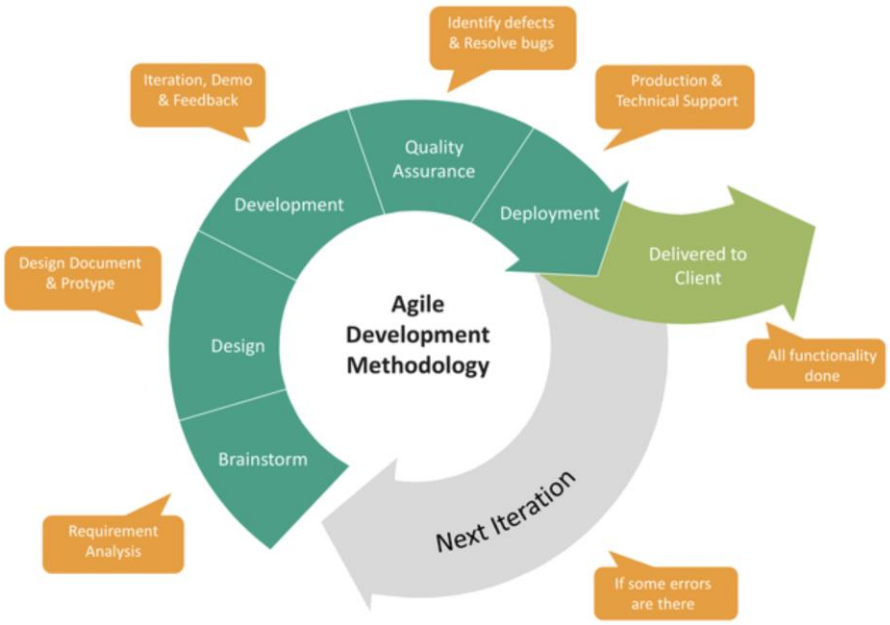


Figure 3.1: Agile Model

Agile process model is a software development approach based on iterative development. Agile methods break tasks into smaller iterations, or parts do not directly involve long term planning. The project scope and requirements are laid down at the beginning of the development process. Plans regarding the number of iterations, the duration and the scope of each iteration are clearly defined in advance.

On every iteration, the project goes through various phases before the iteration is considered complete. The phases are as follows, in the order they are supposed to be completed (www.javatpoint.com. ,n.d)

1. **Requirement Gathering**:

   Requirements of the system will be gathered from the key stakeholders of the company via requirement gathering technique. Concerns about the initial system or the previous iteration are gathered and recorded to develop the requirements that should be implemented in the current iteration.

2. **Designing**:

   After the requirements are correctly identified, the team will start to design the system and also figure out how the system should implement the requirements gathered. In this phase, A high-level UML diagram of the system also will be produced to assist in construction of the system.

3. **Development**:

   Also commonly known as the iteration phase, this is where the actual coding begins. Developers work on the project implementation according to what was discussed during the designing phases. Keeping in mind the product will be improved on future iteration, the product will include minimal changes or functionality to ensure the iteration meets the deadline.

4. **Testing**:

   After a product is produced, it will have a testing to scrutinize any possible bugs to ensure the product quality via software quality assurance.

5. **Deployment**:

   Deploy the finished product to the client's work environment. Technical support will be provided, and feedback is gathered for improvements needed in the next iteration.

The iteration continues until the product is deemed finished or completed, in which they go into permanent maintenance phase.

2.2 Requirements Gathering Technique

For our requirement gathering technique, an interview with key stakeholders is the selected requirement gathering technique. The interview will determine the expected requirements and functionality that the stakeholders wish to see in the project.

An interview with stakeholders are chosen because of their experience and knowledge in the HR field. The Clear requirements can be got from the key stakeholders. The reason we did not

perform a survey is because it is impossible to perform a survey on a large number of the shift workers even shift workers are the main focus of this system

As for why one-on-one interview is not considered, the team wishes to save time and also the stakeholders have a busy schedule, and having a group interview would encourage discussion and allow conflicting requirements to be resolved prematurely.

2.2.1 Conducting the Interview

The interview was conducted on 9th of March 2022, Wednesday. The duration of the interview was one hour, starting from 9 p.m. to 10 p.m. The interviewee of this session are Mr. Anderson Chua, the founder of the company Beyond Alpha and its co-founder, Mr. Chua Kok Jiun and Ts. Ong Jia Hui. The interviewer are members from every team working on this project, namely Yaw Foong Zeng and Teo Jian Xiang from the Web Backend Team, Lim Zhi Shuang and Liew Yan Lin from the Mobile App Team, as well as Angelina Ooi Ruo Qi and Loo Jia Toong from the UI Design Team. In addition, Mr. Ooi, a TARUC lecturer is present to guide the interview and provide his professional opinions on the project scope.

The goal of this interview is to draft rough parameters for the system and identify the functional requirements that the system should fulfill as well as enquiring about the work processes of the industry.

2.2.2 Interview Questions and Answers

The interview questions are unstructured and are posed on the fly.

1. **Is the developed system solely used by BeyondAlpha?**

   No, the developed system will be provided as a complimentary system to the companies that are already using BeyondAlpha's services. Thus, there will be different companies using the system.

2. **Since the system will be used by different companies, how should we standardize the requirements? For example, some companies would like to set the break time at 1pm, some prefer to be 2pm.**

   In that case, the HRMS that is going to be developed should have a flexible setting to let the companies customize their own preference.

3. **What is the programming language that should be used in developing the HRMS?**

For the Mobile Apps, Flutter Dart programming language will be used. As for web applications, .NET Core will be used.

4. **How should overtime be counted? How can we verify if a worker deserves overtime pay?**

   The supervisor for the worker should register for an overtime period beforehand. If the worker requires overtime pay for period that are not discussed prior, it should be sent as a request and approved by the supervisor.

5. **When a leave is requested, it should be approved or denied by their immediate supervisor, correct? If the supervisor does not process the leave request for a set period of time, what should happen?**

   Yes, the leave request should be approved by the supervisor. If the supervisor does not respond, it is escalated to the next superior officer. If it is still unapproved, a fallback option should be implemented, in which the request is sent to their HR department.

6. **Since multiple companies will be using this system, will the system be cloud-based?**

   Yes, the system will be cloud-based and allow multiple companies to access it via unique company ID.

7. **How should the workers of a company register their information in the system?**

   The worker will register an account using the company's unique ID, then the staff of the company will approve the registration.

8. **How should the attendance of the workers be taken?**

   The workers will need to choose the shift they are checking in or out first before scanning the QR code or going through facial recognition.

9. **Do we need to track the attendance of the workers when they are attending the training programme?**

   No, tracking the attendance of the employees when they are attending the training is not compulsory. But the training module should include the function of letting the employees upload their certificate of attendance and the certificate they received after they attended it.

10. **Is the Benefit and Compensation Module the same for the mobile application side and web application side?**

    No, the mobile application side would be more for the employees and workers side. As for the web application side, it is more for the administrator. For example, if the employees would like to apply for compensation, they can apply through the phone. But upon approval, the administrator has to approve via the web.

11. **For the Leave Application Module, how should the Emergency Leave be treated? Can the leave application be approved immediately or should the leave still need to be on pending and wait for the employers to approve?**

    Emergency leave would usually be approved immediately as it is an emergency. But it also depends on the company as some companies have their own policies as they should apply the leave within 5 working days. Thus, it would be better if there is a flexible setting on the web version provided to the administrator.

12. **How should we manage if employees forgot to check out after their shift?**

    When the shift is over for 15 minutes and the employee has not checked out, the system shall prompt a message to notify them to check out.

13. **Is there any leave cancellation?**

    The leave application should be flexible there will be a cancel option to let the employee to cancel their leave.

14. **A minimum leave application is on daily basis?**

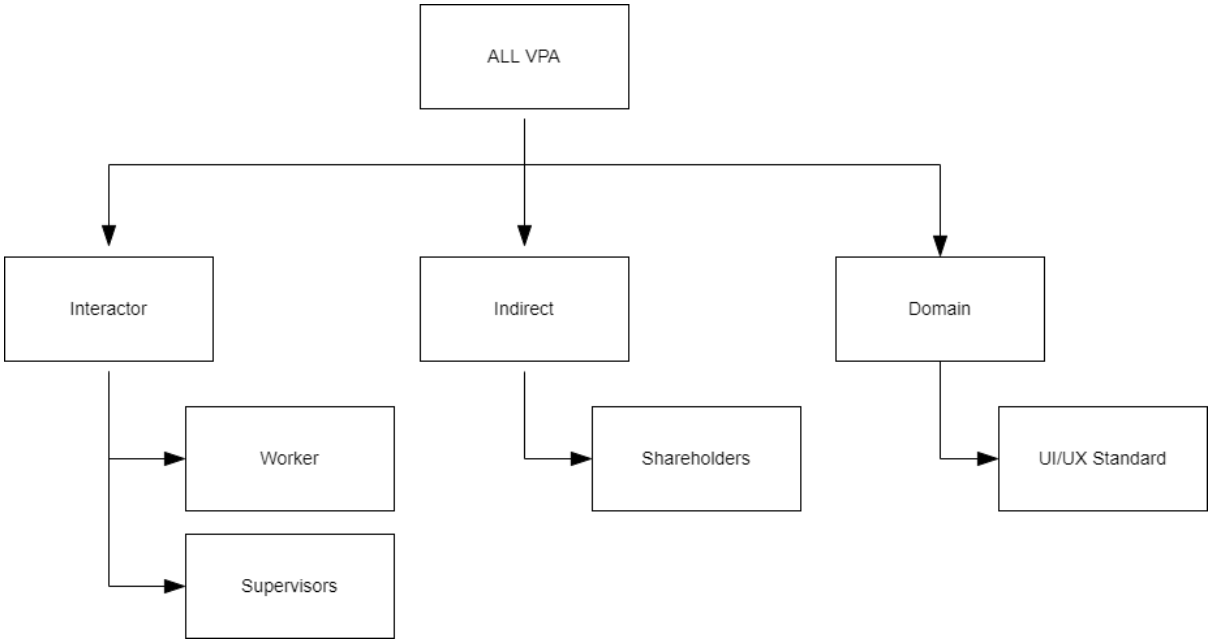
    It should be flexible because every company has its own policy. So the system will calculate using hours.

2.3 Requirements Analysis

The following section will detail the requirements analysis process performed for this project.

2.3.1 Identification of Key Stakeholders and End-Users

To initiate the requirements analysis process, key stakeholders are identified.



Using viewpoint analysis, the identified stakeholders are workers, their supervisors, shareholders and User Interface(UI)/User experience (UX) standards.

Workers and their supervisors represent the interactors of the system. They are the users of the system as they will need the system to process the daily Human Resources(HR) processes. Their needs and technical literacy should be taken into account when designing the system to let the system can fulfills its goal as a functional Human Resources Management System(HRMS)

For indirect stakeholders, shareholders control and make long-term business decisions for the company. They have the company's best interests in mind and design a business plan to guide the company into success. Therefore, it is important the system fits the vision of the shareholders. The system should be able to provide various reports for the shareholders for their decision making. The shareholders viewpoint will be explored through a scheduled interview with one of the company major shareholders.

As for the domain section, UI/UX Standards affect the user experience. A standardized UI/UX design provides an easy to use and learn interface for the users, enhancing user experience.

2.3.2 Requirement Capturing

The identified stakeholders' requirements will be gathered via the selected requirements gathering techniques.

As mentioned above, a group interview will be conducted with the company's founder and shareholders to gather requirements that the system is expected to be fulfilled by the system

2.3.3 Categorize Requirements

The requirements are then categorized into functional requirements and non-functional requirements. For the functional requirements, it has been categorized into 4 requirements which are business requirements, user requirements, administrative requirements and system requirements. For the non-functional requirements, it has been categorized into usability requirements , security requirements , reliability requirements and availability requirements

2.3.4 Interpret and Record Requirements

After the requirements are categorized, feasibility of every requirement is examined and documented. The requirements are defined precisely and prioritization of the requirements are worked out via an impact analysis.

Conflicts found within requirements, such as overlapping requirements are to be resolved before final documentation. Requirement conflicts are resolved through further discussion with stakeholders after their identification.

2.4 Functional Requirements

2.4.1 Business Requirement

Leave Self-Service

- The system should allow users to submit leave requests.
- The system should allow supervisors to approve or deny leave requests.
- The system should allow supervisors to manage how time off accrual works.

Payroll Calculation

- The system should calculate payroll for each employee based on their attendance.
- The system should allow staff to view the summary of their own monthly payroll.

Shift Management

- The system should allow users to schedule shifts with the help of AI.
- The system should allow staff to create and edit work shifts.
- The system should allow supervisors to adjust the pay rate for different shifts.
- The system should allow tracking of staff's attendance.

Workforce Management

- The system should allow staff to register an account.
- The system should allow staff to edit their profile.

- The system should allow staff to edit profiles of staff under their lead.The system should enforce access level control to restrict which staff can access which functionality of the system.
- The system should allow staff to update their relevant work documents such as resumes and work permits.

Training Module

- The system should allow staff to track their license and certification.
- The system should allow staff to create and edit training courses.

2.4.2 Administrative Requirement

Role Management

- The system should allow company admins to add a new role.
- The system should allow company admins to edit an existing role.
- The system should allow company admins to add permissions to a role
- The system should allow company admins to edit permissions of a role.

Company Management

- The system should allow system admins to create a company.
- The system should allow system admins to edit a company.
- The system should allow system admins to manage the company's database.

Admin Management

- The system should allow super admin to create admin accounts.
- The system should allow super admin to remove admin accounts.

2.4.3 User Requirement

Workforce Management

- The system should allow staff to rate their co-worker.
- The system should allow staff to view shifts assigned to them.

Shift Management

- The system should allow staff to generate QR code for attendance tracking purposes.

Dashboard Analytics

- The system should allow staff to view employees' performance.
- The system should allow staff to view employees’ development.
- The system should allow staff to view the workforce demographic.
- The system should allow staff to view the workforce overview
- The system should allow staff to view the absent rate.

- The system should allow staff to view the overtime rate.

Training Module

- The system should allow staff to monitor their training.

Benefit and Compensation

- The system should allow staff to view offered benefits.
- The system should allow staff to apply for compensation.
- The system should allow staff to approve compensation.

2.4.4 System Requirement

General

- The system should be coded in ASP.NET Core.
- The system should use SQL Server for its database.
- The system should run on Google Chrome, Mozilla Firefox and Microsoft Edge.

2.5 Non-Functional Requirements

2.5.1 Usability

- The system should be able to provide response to user interaction with a maximum waiting time of 1 second.

2.5.2 Reliability

- The system shall perform needed calculations correctly and accurately display the results of dashboard analytics.
- The system shall calculate the payroll of staff correctly.

2.5.3 Availability

- The system should not have downtime more than 10 days per year.

2.5.4 Security

- The system should not allow unauthorized users to access the company database.
- The system should not allow information of a company to be leaked to users of other companies.
- The system should utilize OAuth 2.0 to avoid cross site scripting attacks.
- The system should encrypt the information stored within the database

2.6 Chapter Summary and Evaluation

In this chapter, an introduction to the Agile SDLC Model, and its various phases are given. Besides that, the requirements gathering technique used by this project is detailed, which is an interview. The interview conducted with the founder and co-founders of BeyondAlpha is provided, as well as the questions asked and answer given. Continuing, a detailed description of the requirements analysis performed in this project is discussed. A viewpoint analysis is performed to identify key stakeholders, which are the worker and shareholders. The requirements are captured through interviews, followed by interpretation and documentation of the requirements. Finally, a list of functional and non-functional requirements are listed.

Chapter 4

System Design

3 System Design

This chapter will solidify the various designs of the proposed system. It will begin with an overall design explanation of the proposed system, followed by the user interface design and data design. Next, several reports planned to be included in the system will be presented. This is followed by several security designs planned for implementation in order to ensure the system' secureness. Continuing, how activities will be performed within the system are presented in the process design. A detailed walkthrough of the software architecture will also be provided. Finally, algorithms that are planned to be implemented will be described and explained.

3.1 System Design

The proposed system has included a total 11 modules with different functionalities.

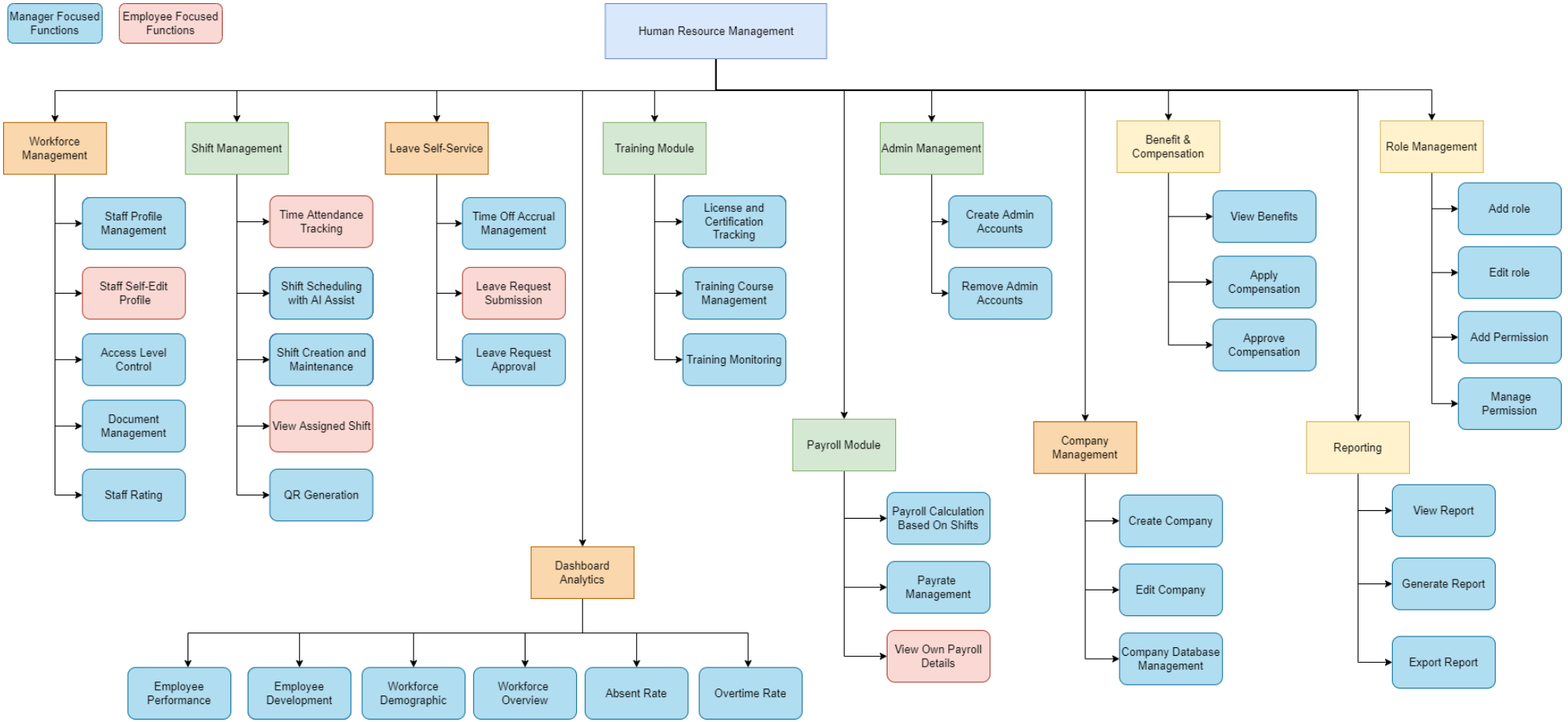


Figure 1.3: An Overall Structure Chart of the Proposed System

3.1.1 Workforce Management

This module keeps track of all employees across every organization. The existence module allows users to login and logout of their account since it holds all employee profiles. It also provides employees the ability to edit their personal profile as well as team member's profile that are led by them. Since it is responsible for managing user accounts, it will also be responsible for access level control. This will restrict certain critical functions to only those with proper authorization. Aside from that, this module also provides some non-essential functions to ease employee management. The document management function will allow employees to peruse their personal documents such as license and medical reports. Authorized managers may even request to look at other employee documents without the need of physically contacting said employee. In addition, a simple rating system allows employees to rate people they had worked with no matter their position. Ratings will be displayed on the employee's profile to assist in HR assessment.

3.1.2 Shift Management

This module focuses on utilizing the workforce effectively. This module allows managers to create shifts, which are the working time of the employees. After creating, he or she can assign the employees into the shifts and employees can view their working time in their timetable.This module is also equipped with an AI algorithm that chooses appropriate employees to work on created shifts, hastening the process. Besides that, it also performs attendance tracking. After employees have been assigned a shift, the employee will have taken their attendance by using a generated QR code. The attendance will be mark and the employe will be considered present

3.1.3 Leave Self-Services

This module maintains the duration of paid time off and sick times of every employee. Depending on the company policy, managers can adjust how the time off is accrued and carried over to the next year. A normal employee can also request a leave of absence via this module by submitting a simple form. The request will be processed by their immediate supervisor, which may accept or reject the request via this module as well.

3.1.4 Dashboard Analytics

This module will be the first page every user sees when logging in. To put it simply, this module extracts data from the current company's database, processes it using predictive analytics and finally displays it in a visual dashboard. Several dashboards had been planned for the proposed system, such as employee demographics and employee performance, however, more dashboards can be added in easily whenever needed.

3.1.5 Training Module

This module will manage and keep tracks of all training currently undergoing or completed by every employee. Training courses or learning paths can be created and assigned to employees that need it. It will then monitor the duration of training undergone by the employee until it is completed. Other than that, this module also keeps track of any license and certifications owned by an employee. If the license and certification needs to be renewed periodically, the module will remind the employee and their immediate superior.

3.1.6 Payroll Module

This module retrieves information about all the shifts an employee has worked and calculates the proper payment that should be given to that employee. The pay rate that is assigned to every shift whether it be normal pay rate or overtime rate can also be modified here. Once payroll has been calculated, employees may look at a report that details how their payroll is calculated.

3.1.7 Admin Management

This module is responsible for maintaining admin accounts which possess special privileges within the system. Admin's responsibility includes creating and maintaining company profile that will be using the proposed system. Different admins may have different privileges. For example, a company admin can only manage their own company, but a super admin will be able to make modifications to all companies.

3.1.8 Company Management

This module stores and maintains all company profile and personalization settings for every company registered within the system. It is also within thie module that the registration of company and modification of company profile happens. Employees are registered under their own company and cannot access the database of the other companies.

3.1.9 Benefits & Compensation

This module allows employees to view benefits that the company provides for them. It is also here that employees can apply compensation for expenditures spent during company businesses. Similarly to leave requests, the compensation has to be approved by an authorized personnel before it is counted into their payroll.

3.1.10 Reporting

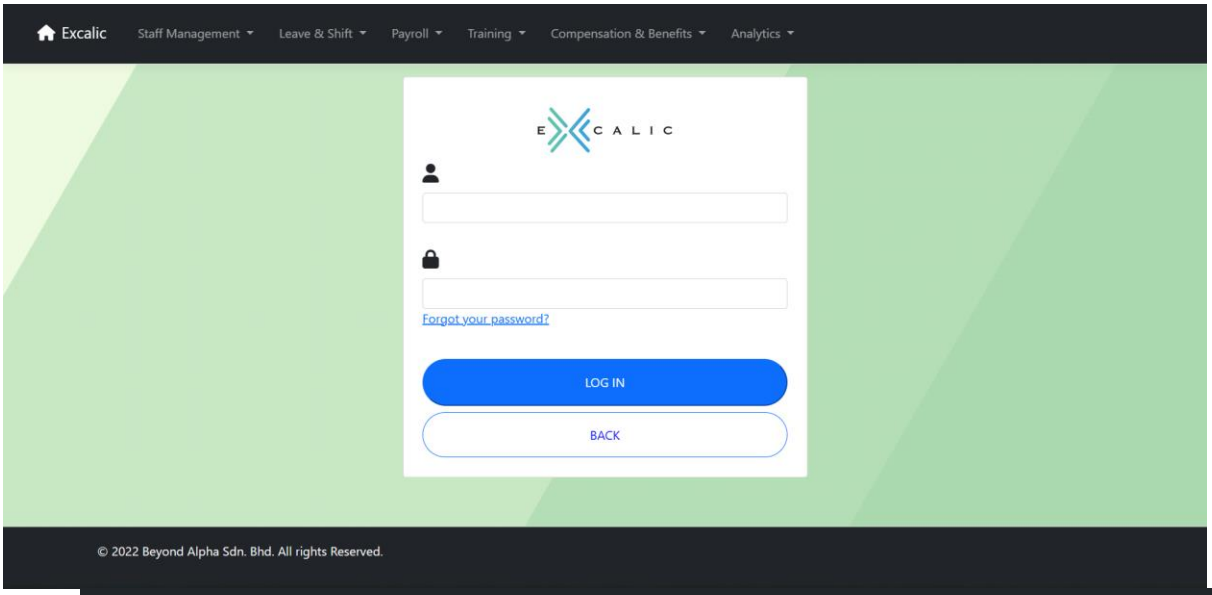
This module provides a detailed summary of information deemed crucial for managing the HR of an organization. Employees with proper authorization may generate customized reports to monitor the status of the workforce here. In addition, they may also view previously generated reports for comparison and export generated reports into other formats

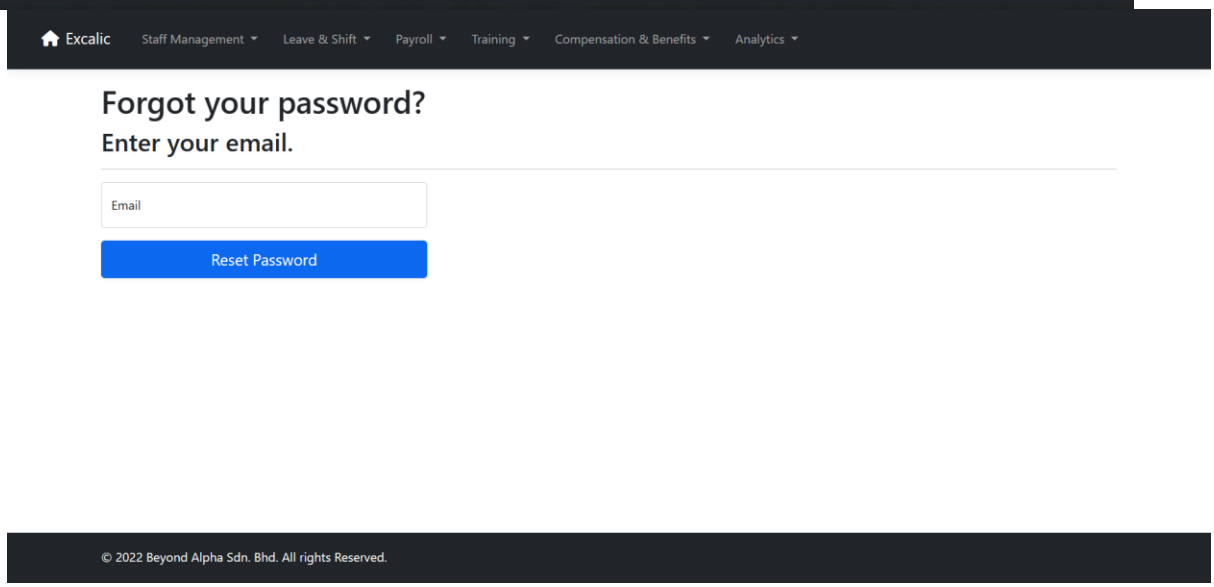
3.1.11 Role Management

This module represents the user authorization control of the system. This module, together with the workforce management module limits the action an unauthorized user can perform on the system for security reasons. This is done via the creation and maintenance of roles, which is basically a checklist of operations that an employee or an admin is allowed to perform. This role can then be assigned to users or admins to allow or disallow them from performing certain tasks. Roles can be edited and their permissions changed in this module as well.

3.2 UI Design

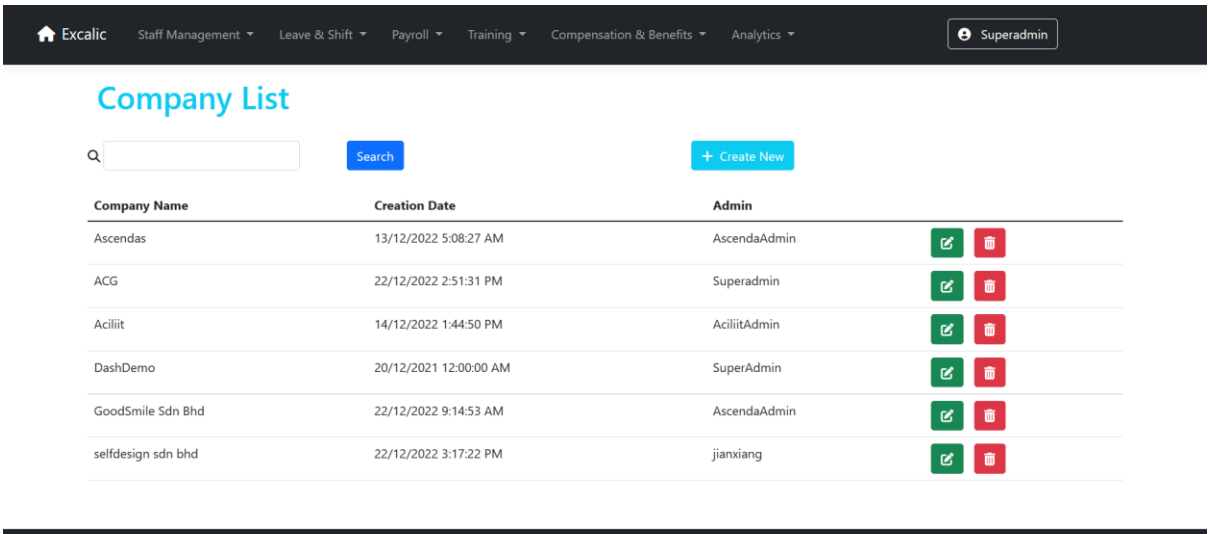
3.2.1 Login Screen

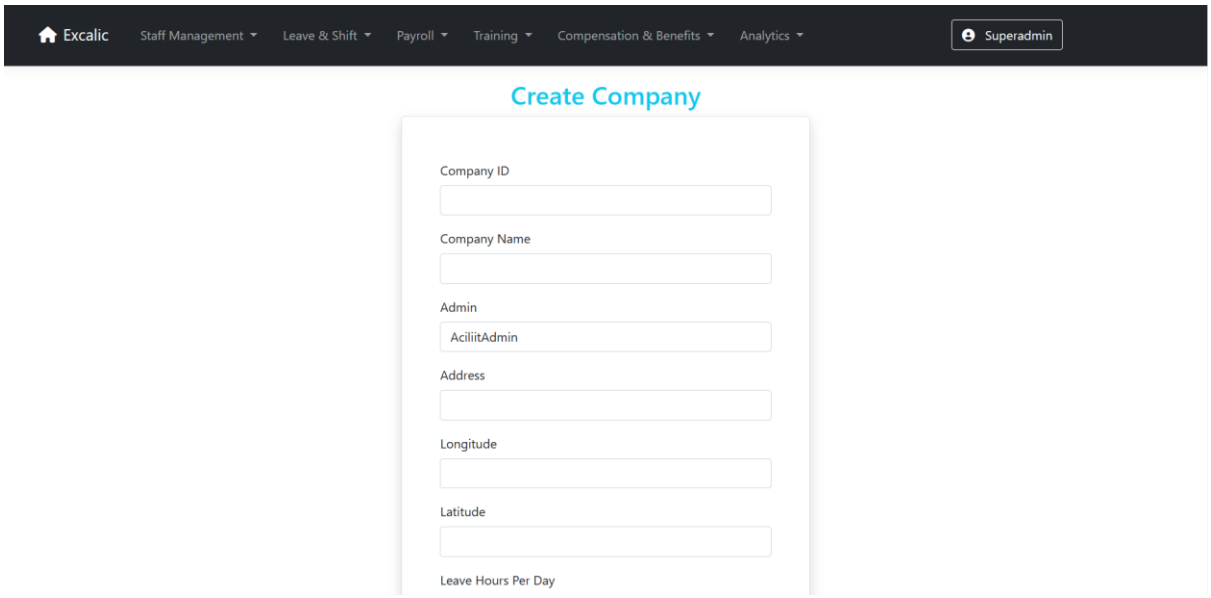




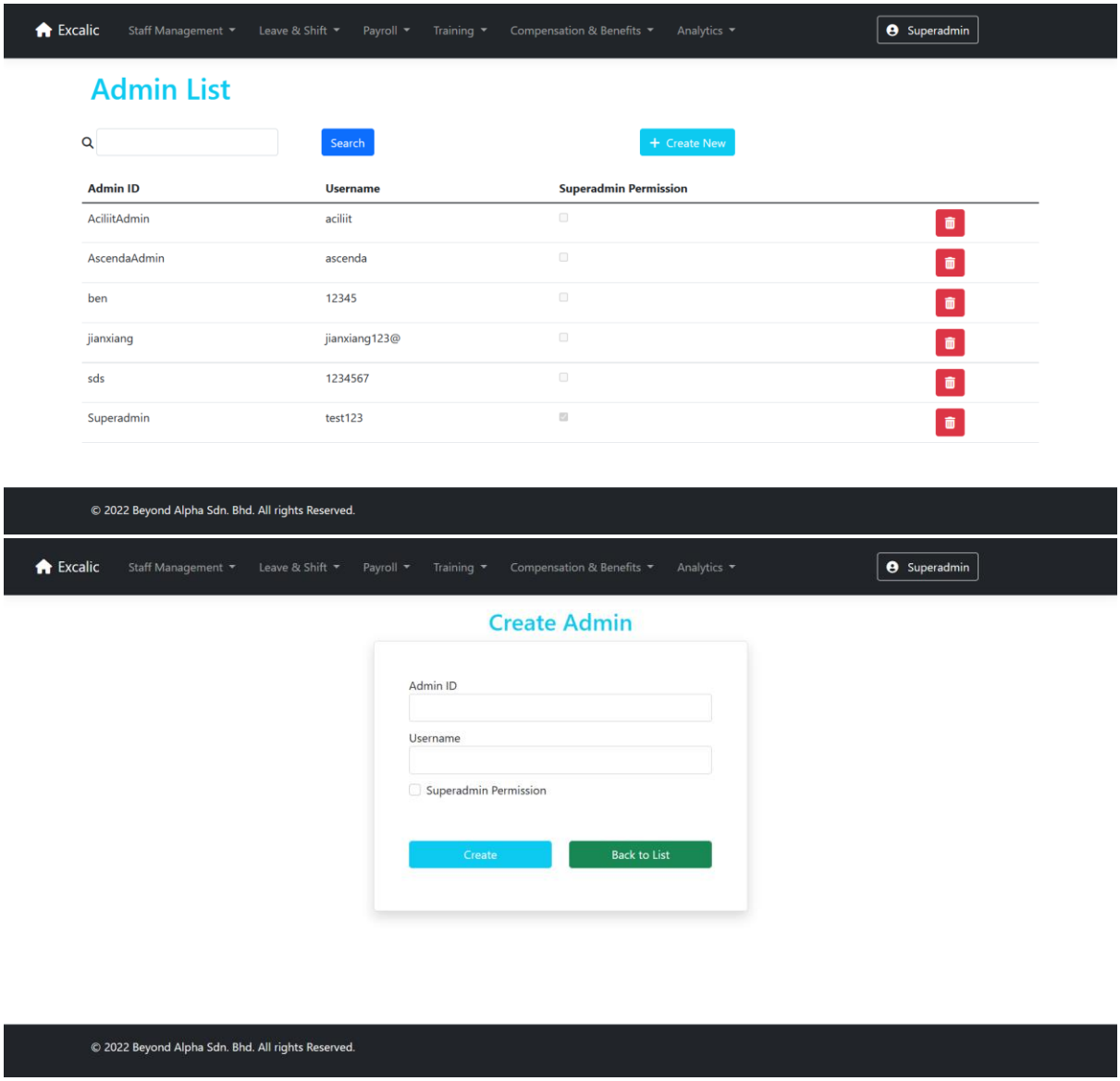
3.2.2 Homepage

3.2.3 Company Management





3.2.4 Admin Management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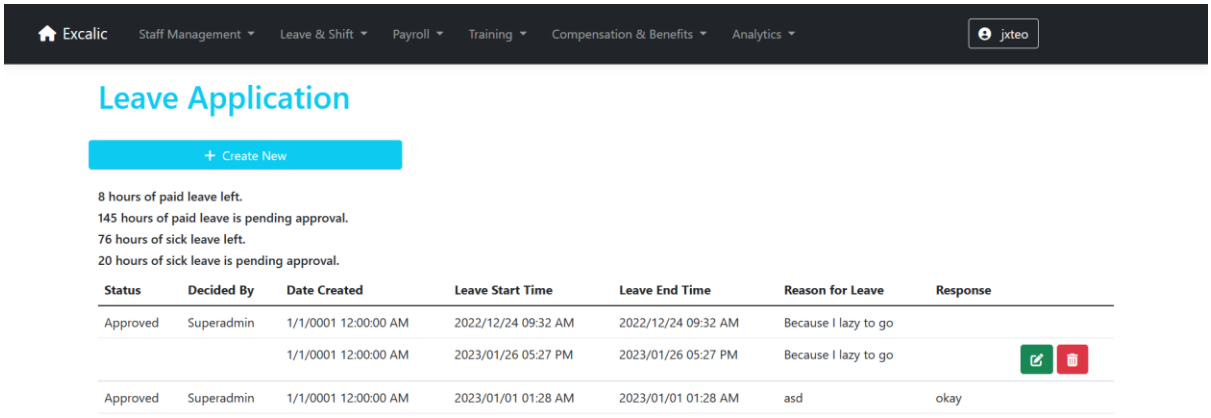
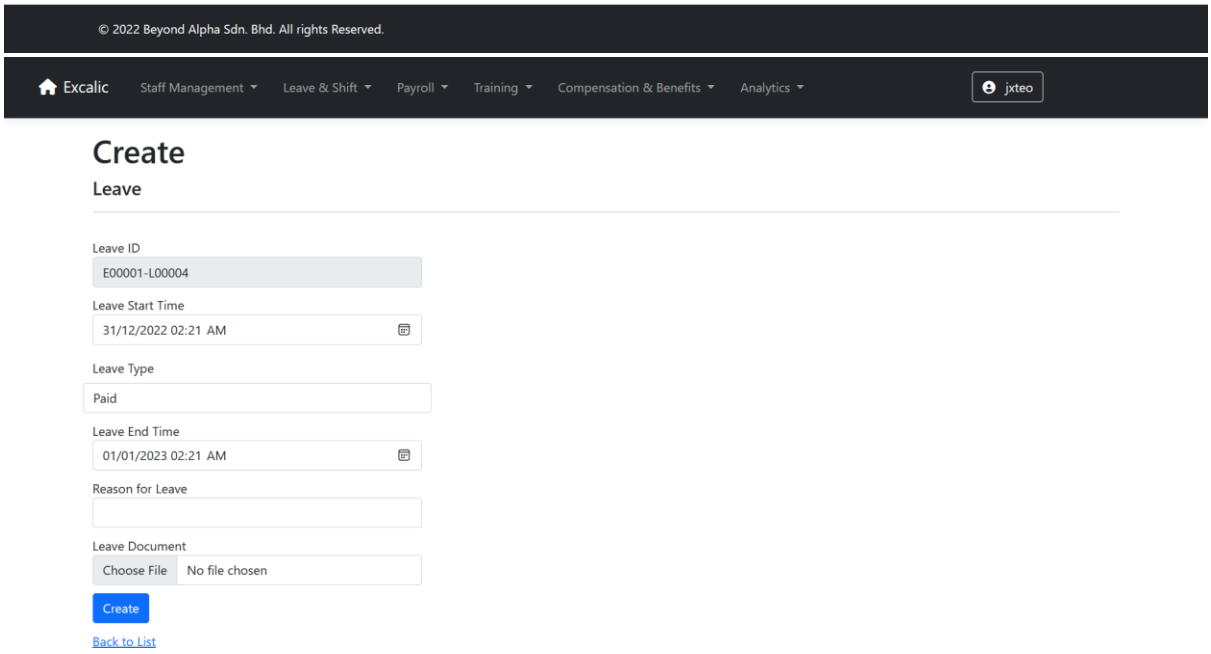
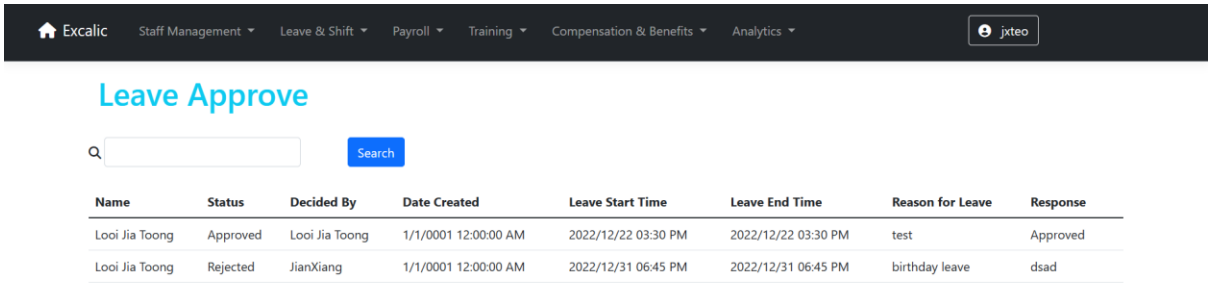
3.2.5 Leave Management



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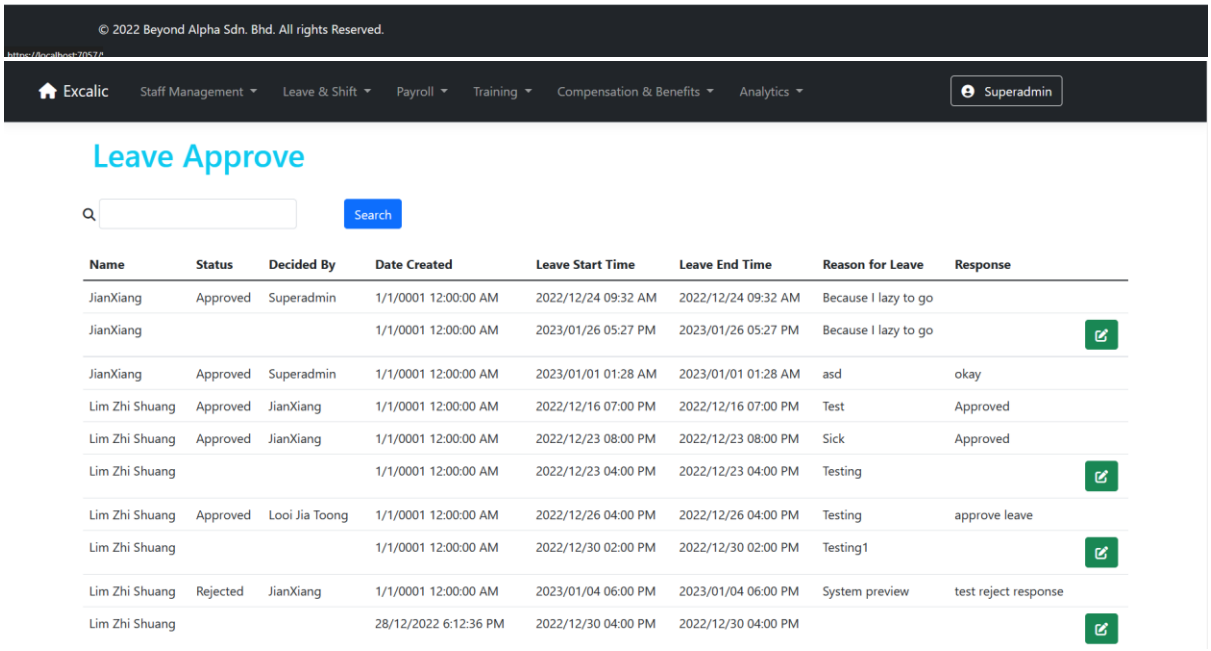
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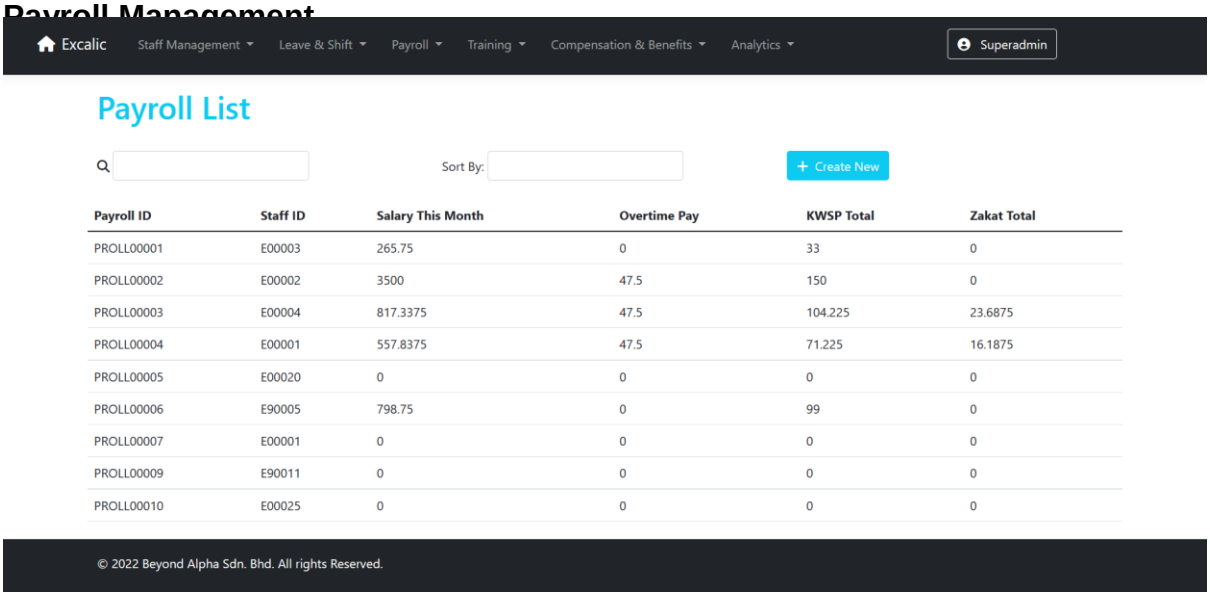
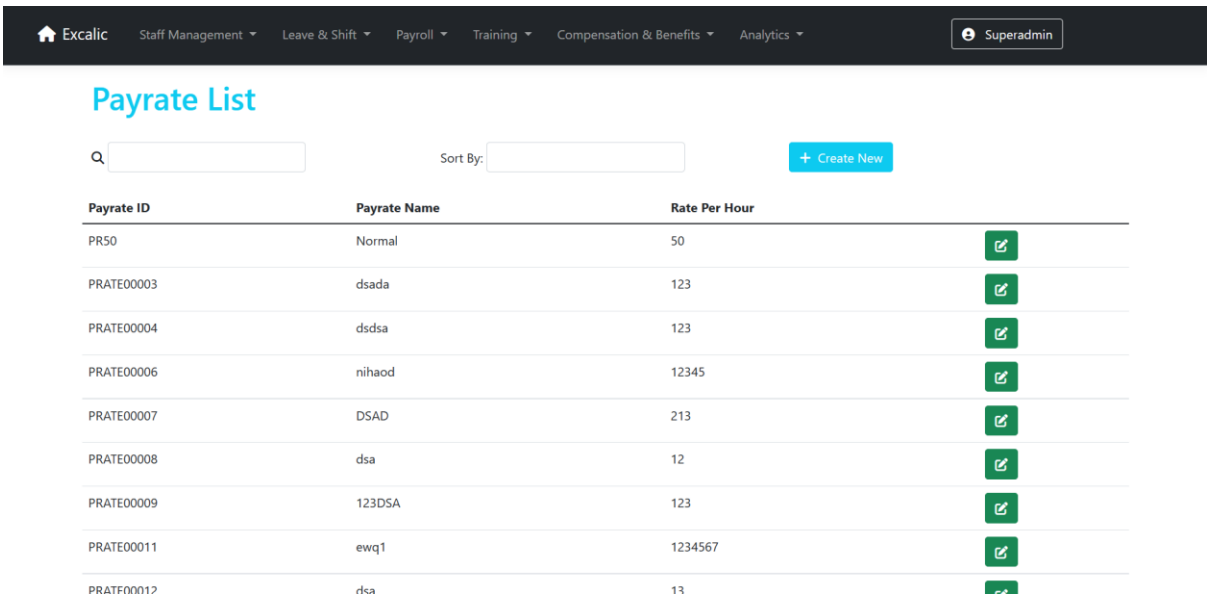
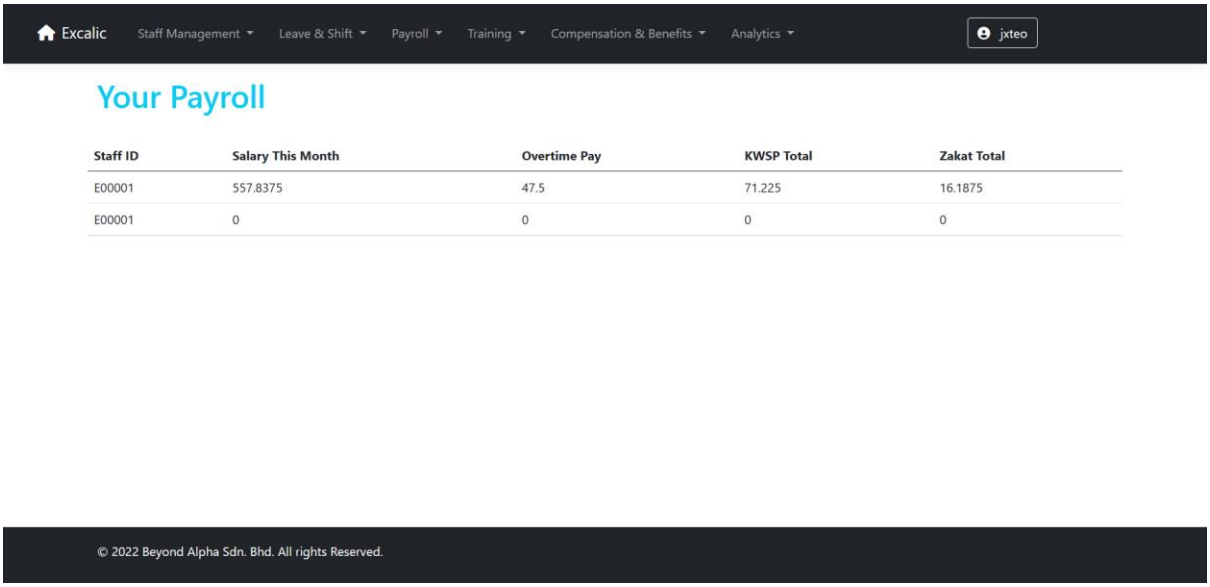
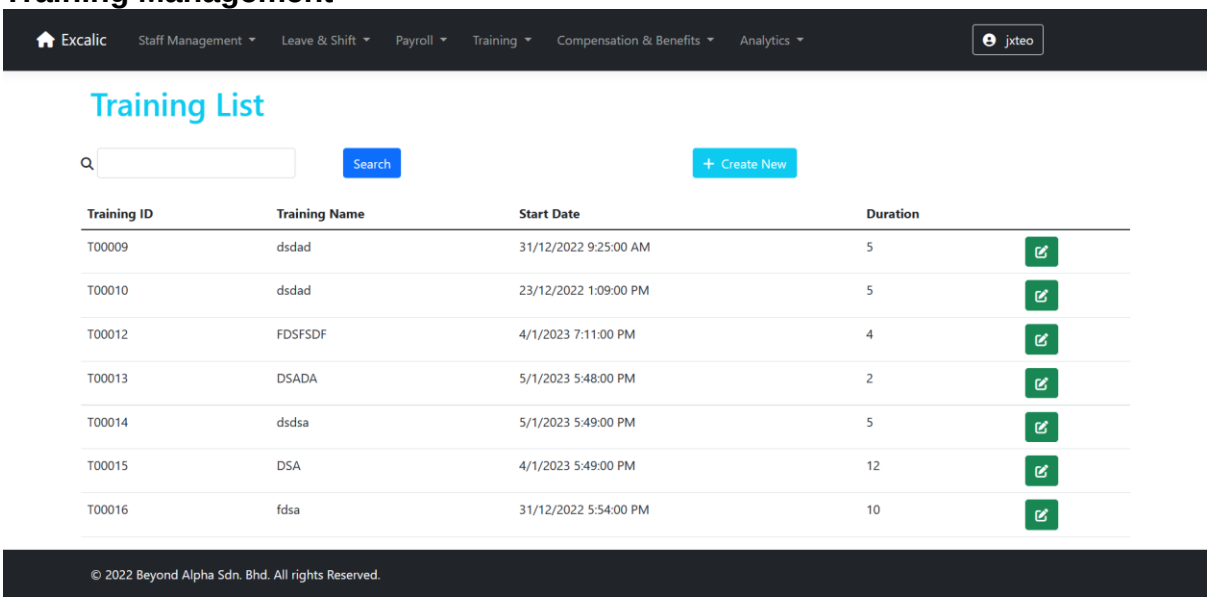
3.2.6 Payroll Management

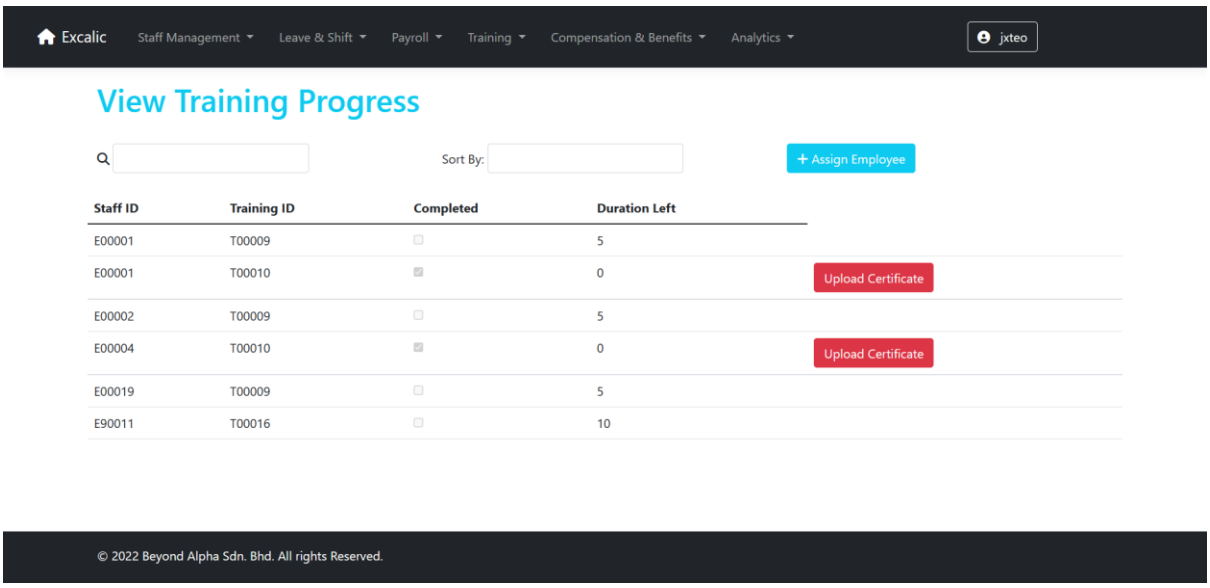




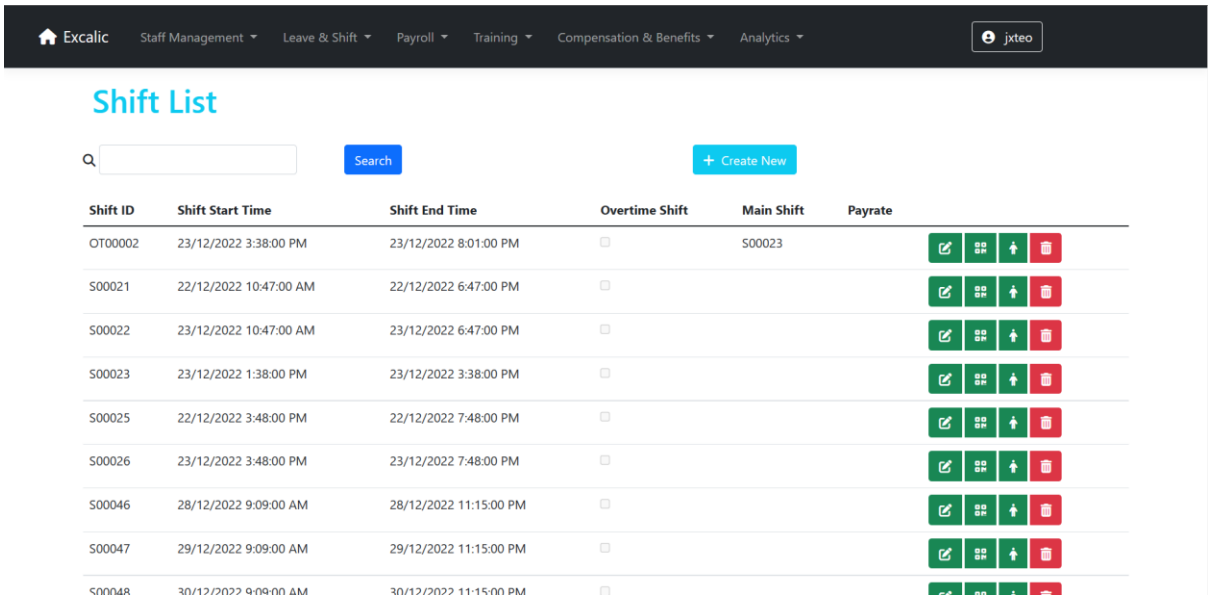


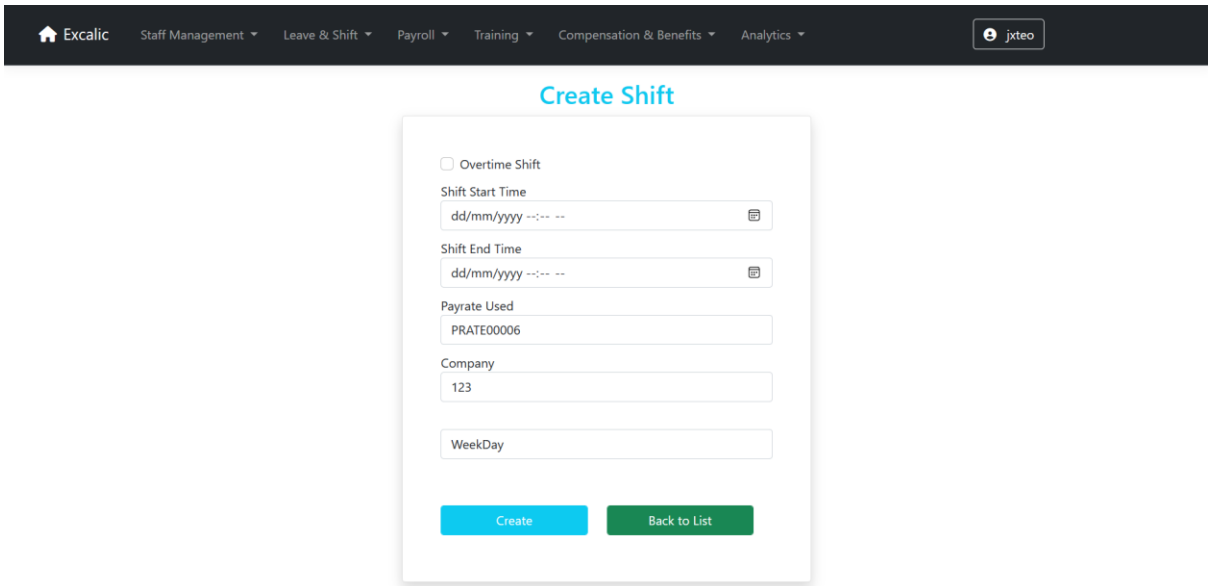
3.2.7 Training Management

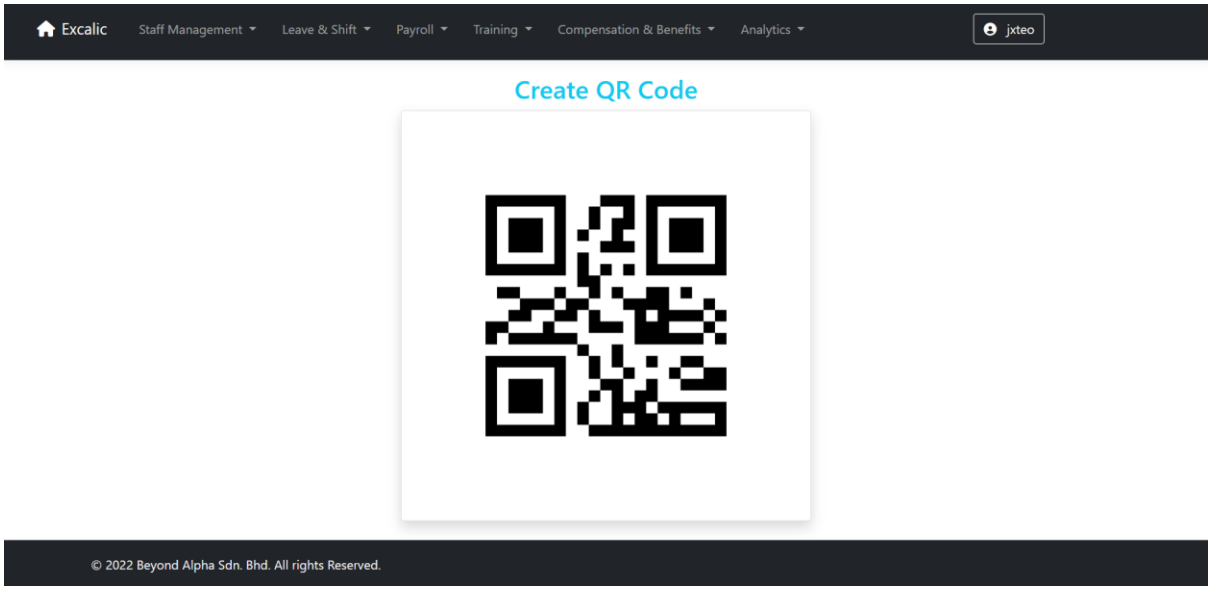




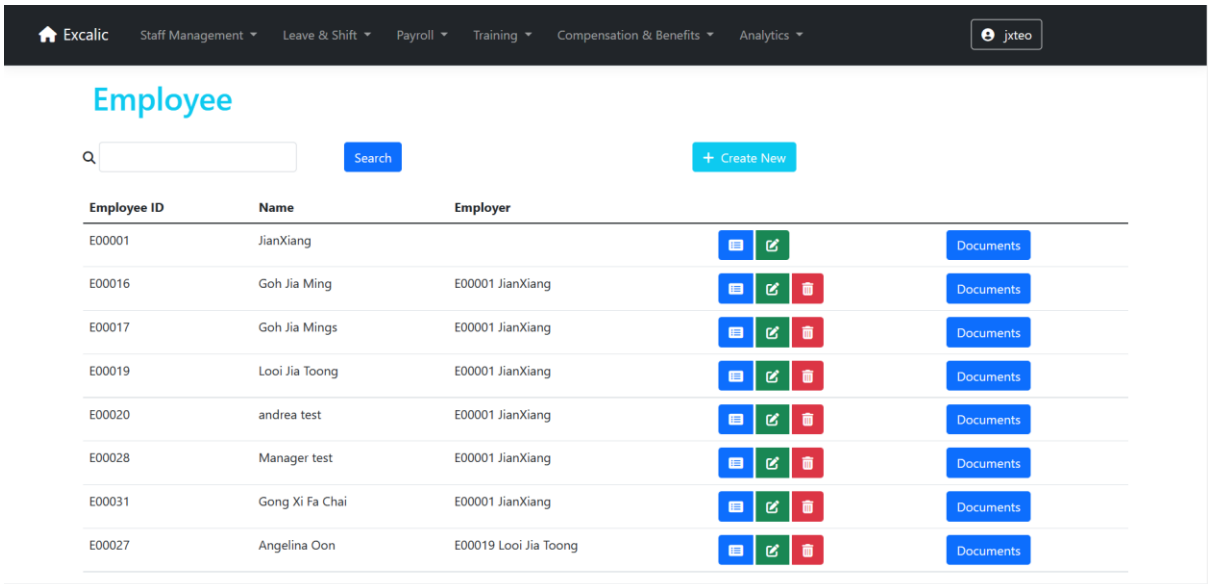
3.2.8 Shift Management

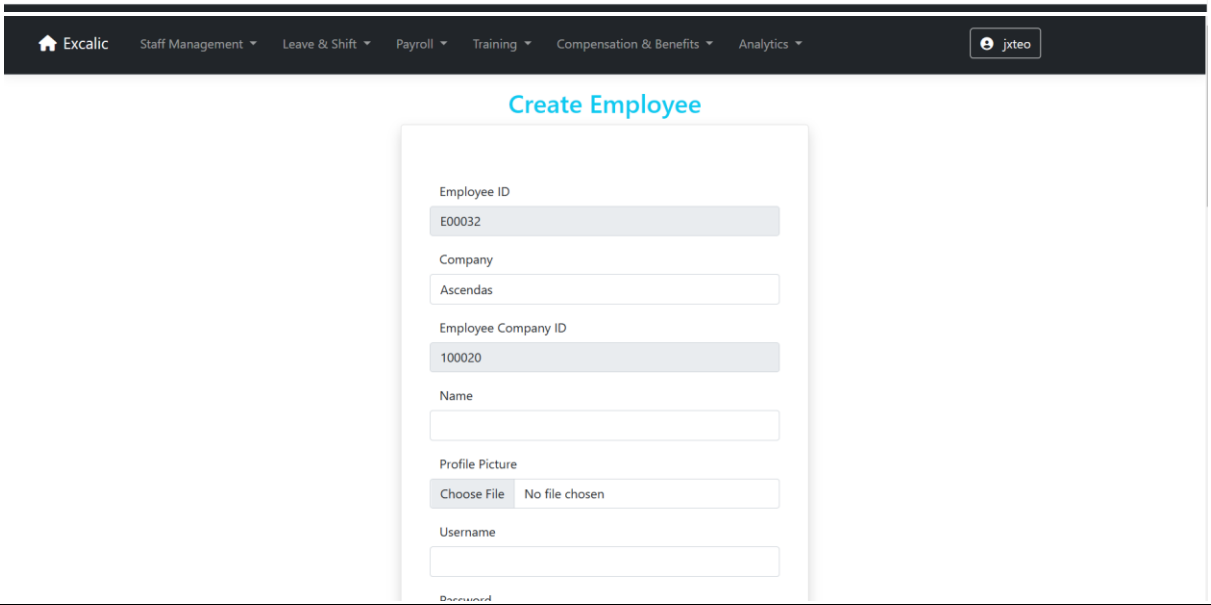


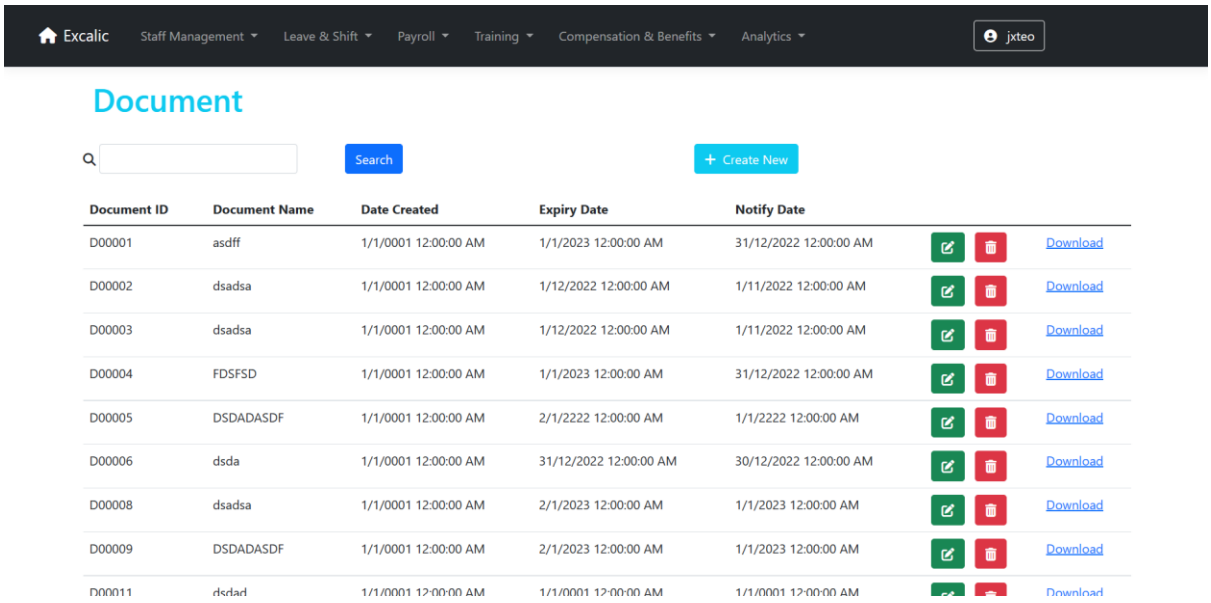




3.2.9 Workforce Management



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Payroll
Training
Compensation & Benefits
Analytics
jxteo
Document
Search
+ Create New
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Document Name
Date Created
Expiry Date
Notify Date
D00001 asdff 1/1/0001 12:00:00 AM 1/1/2023 12:00:00 AM 31/12/2022 12:00:00 AM Download
D00002 dsadsa 1/1/0001 12:00:00 AM 1/12/2022 12:00:00 AM 1/11/2022 12:00:00 AM Download
D00003 dsadsa 1/1/0001 12:00:00 AM 1/12/2022 12:00:00 AM 1/11/2022 12:00:00 AM Download
D00004 FDSFSD 1/1/0001 12:00:00 AM 1/1/2023 12:00:00 AM 31/12/2022 12:00:00 AM Download
D00005 DSDADASDF 1/1/0001 12:00:00 AM 2/1/2222 12:00:00 AM 1/1/2222 12:00:00 AM Download
D00006 dsda 1/1/0001 12:00:00 AM 31/12/2022 12:00:00 AM 30/12/2022 12:00:00 AM Download
D00008 dsadsa 1/1/0001 12:00:00 AM 2/1/2023 12:00:00 AM 1/1/2023 12:00:00 AM Download
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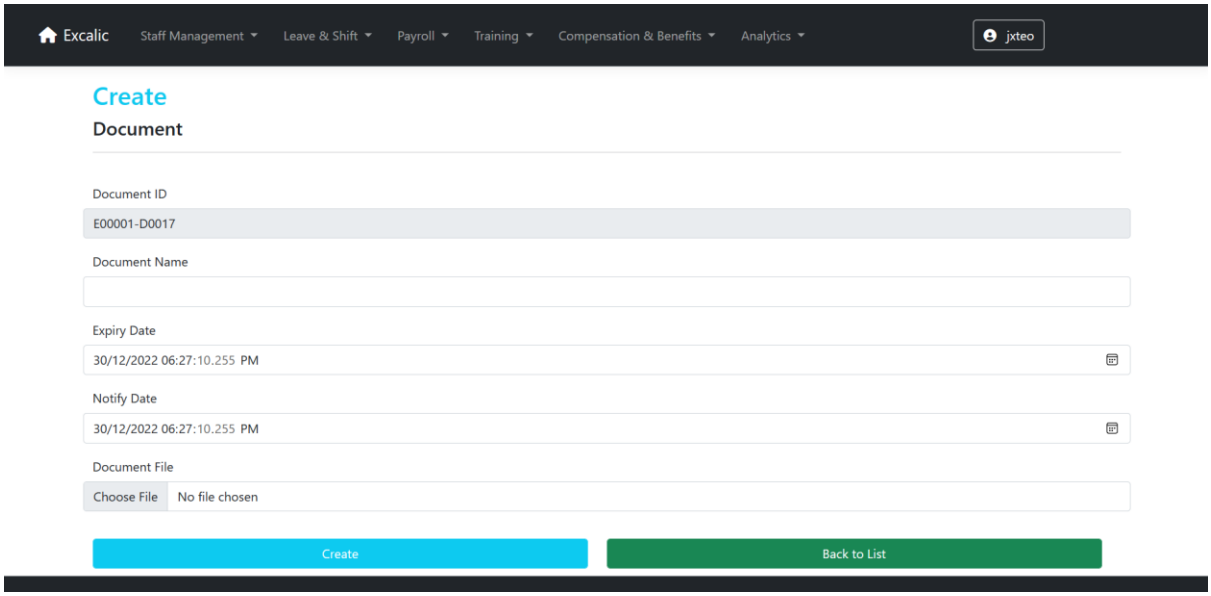
Excalic
Staff Management
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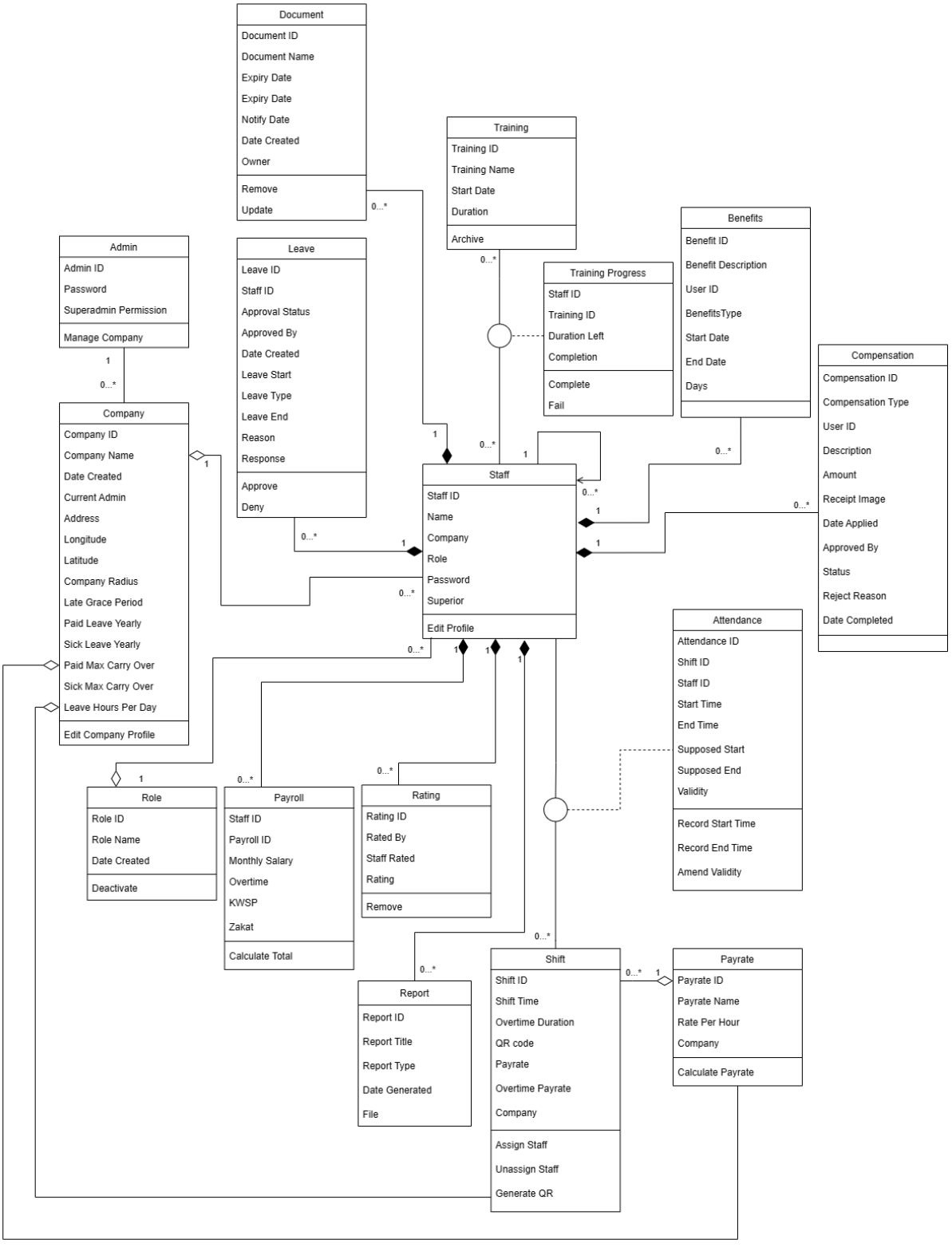
Payroll
Training
Compensation & Benefits
Analytics
jxteo
Create
Document
Document ID
E00001-D0017
Document Name
Expiry Date
30/12/2022 06:27:10.255 PM
Notify Date
30/12/2022 06:27:10.255 PM
Document File
Choose File
No file chosen
Create
Back to List

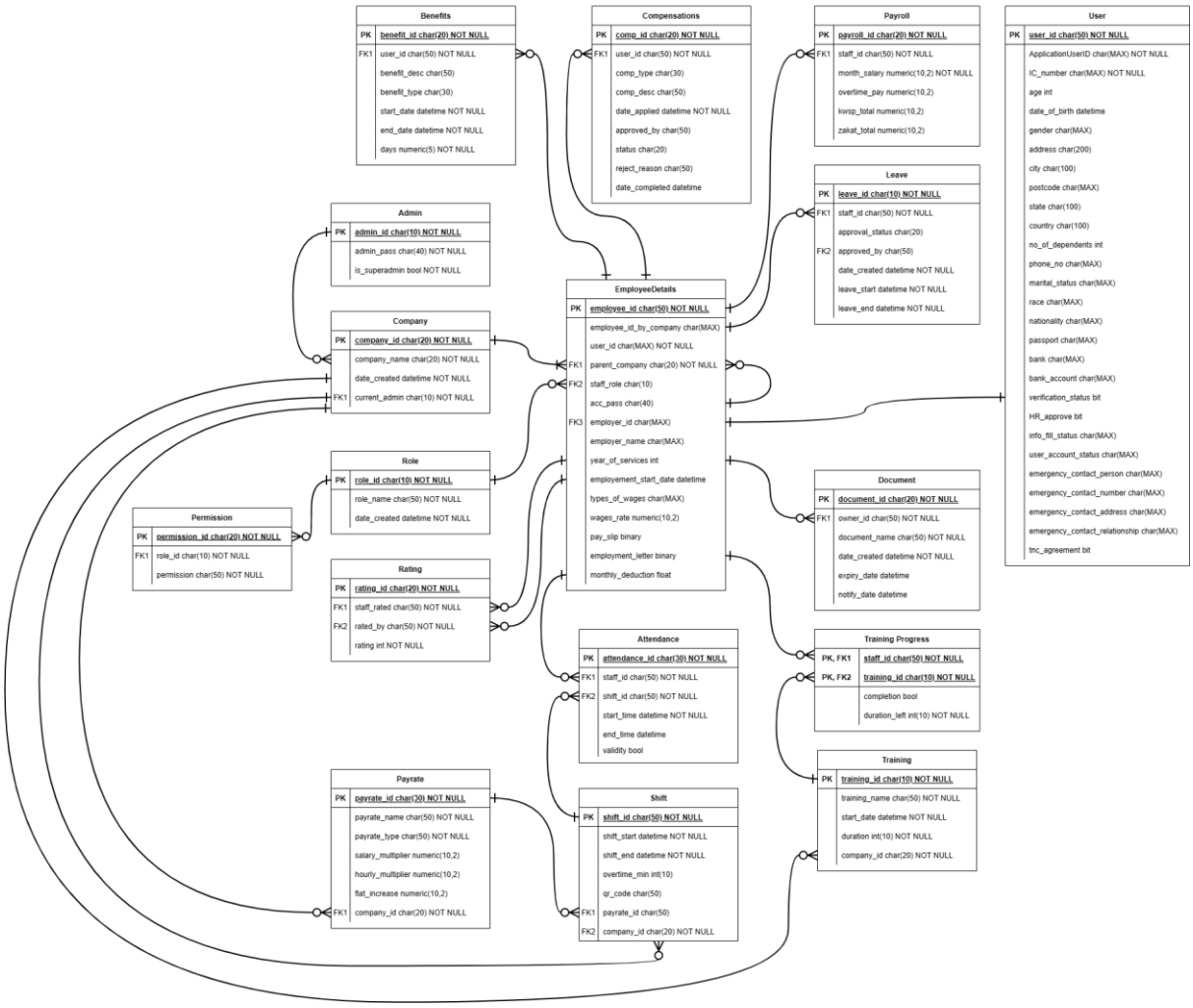
3.3 Data Design

The data design of the proposed system is details in the following diagrams

3.3.1 Class Diagram



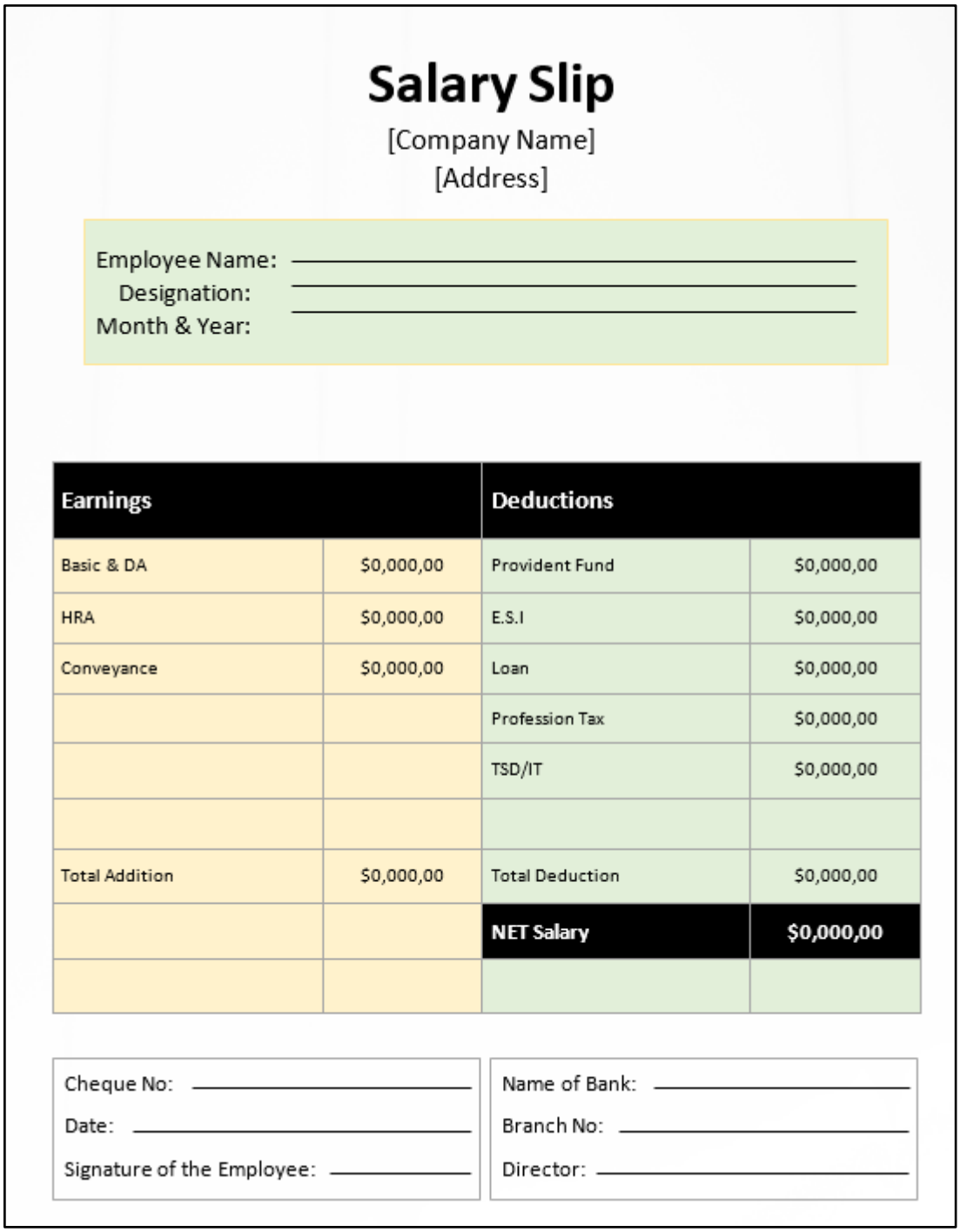
3.3.2 Entity Relationship Diagram



3.4 Report Design

The report design included in the proposed system has details in the following diagrams

3.4.1 Salary Slip



Salary Slip

[Company Name]
[Address]

Employee Name: _____
Designation: _____
Month & Year: _____

Earnings		Deductions	
Basic & DA	$0,000,00	Provident Fund	$0,000,00
HRA	$0,000,00	E.S.I	$0,000,00
Conveyance	$0,000,00	Loan	$0,000,00
		Profession Tax	$0,000,00
		TSD/IT	$0,000,00
Total Addition	$0,000,00	Total Deduction	$0,000,00
		NET Salary	**$0,000,00**

Cheque No: _____
Date: _____
Signature of the Employee: _____

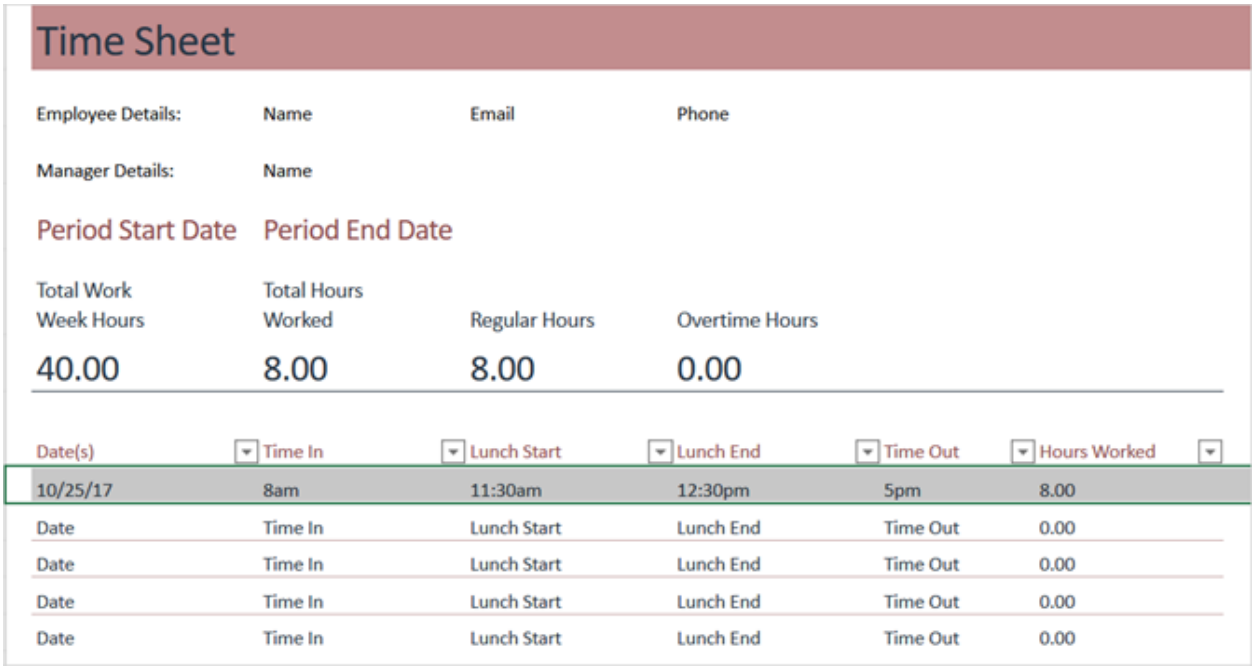
Name of Bank: _____
Branch No: _____
Director: _____

3.4.2 Payroll Report

Month: 02, 2016 MICRO MART Page 1

No.	Emp No.	Employee Name	Basic Pay	Overtime	Bonus/ Allowance	Deduction	Gross Pay	Employee EPF	Employee Socso	PCB	Net Pay	Employer EPF	Employer Socso	Leave Ann.	Leave Med.	Leave Oth.	Month End Pay
1	001	DAVID LIM	7,500.00	0.00	10,000.00	0.00	0.00	1,100.00	0.00	2,447.80	0.00	1,200.00	0.00	0	0	0	0.00
2	002	RAJ KUMAR A/L SUBRAMANIAI	7,500.00	0.00	8,100.00	0.00	15,600.00	1,716.00	14.75	2,255.20	11,614.05	1,872.00	51.65	3	1	1	11,614.05
3	003	ALI MUHAMMAD	3,380.00	0.00	0.00	0.00	3,380.00	372.00	14.75	0.00	2,993.25	440.00	51.65	0	0	0	2,993.25
4	004	SIVARAMAN	2,000.00	0.00	0.00	0.00	2,000.00	220.00	9.75	0.00	1,770.25	260.00	34.15	0	0	0	1,770.25
5	004X	SIVA KUMAR	6,000.00	0.00	0.00	0.00	6,000.00	660.00	14.75	245.90	5,079.35	720.00	51.65	0	0	0	5,079.35
6	005	VIMALA	7,000.00	0.00	0.00	0.00	7,000.00	770.00	14.75	582.45	5,632.80	840.00	51.65	0	0	0	5,632.80
7	006	JASON LEE	4,453.00	0.00	0.00	0.00	4,453.00	491.00	14.75	144.10	3,803.15	580.00	51.65	0	0	0	3,803.15
8	007	AHMAD FAIZ	5,000.00	0.00	5,000.00	0.00	10,000.00	1,100.00	14.75	658.35	8,226.90	1,300.00	51.65	0	0	0	4,276.95
		Grand Total	42,833.00	0.00	23,100.00	0.00	48,433.00	6,429.00	98.25	6,333.80	39,119.75	7,212.00	344.05	3	1	1	35,169.80

3.4.3 Individual Attendance Report



Time Sheet

Employee Details: Name Email Phone

Manager Details: Name

Period Start Date Period End Date

Total Work Week Hours	Total Hours Worked	Regular Hours	Overtime Hours
40.00	8.00	8.00	0.00

Date(s)	Time In	Lunch Start	Lunch End	Time Out	Hours Worked
10/25/17	8am	11:30am	12:30pm	5pm	8.00
Date	Time In	Lunch Start	Lunch End	Time Out	0.00
Date	Time In	Lunch Start	Lunch End	Time Out	0.00
Date	Time In	Lunch Start	Lunch End	Time Out	0.00
Date	Time In	Lunch Start	Lunch End	Time Out	0.00

3.4.4 Weekly Attendance Report

Company Name

Manager Name:

Department:

Week Starting: 1/4/2021

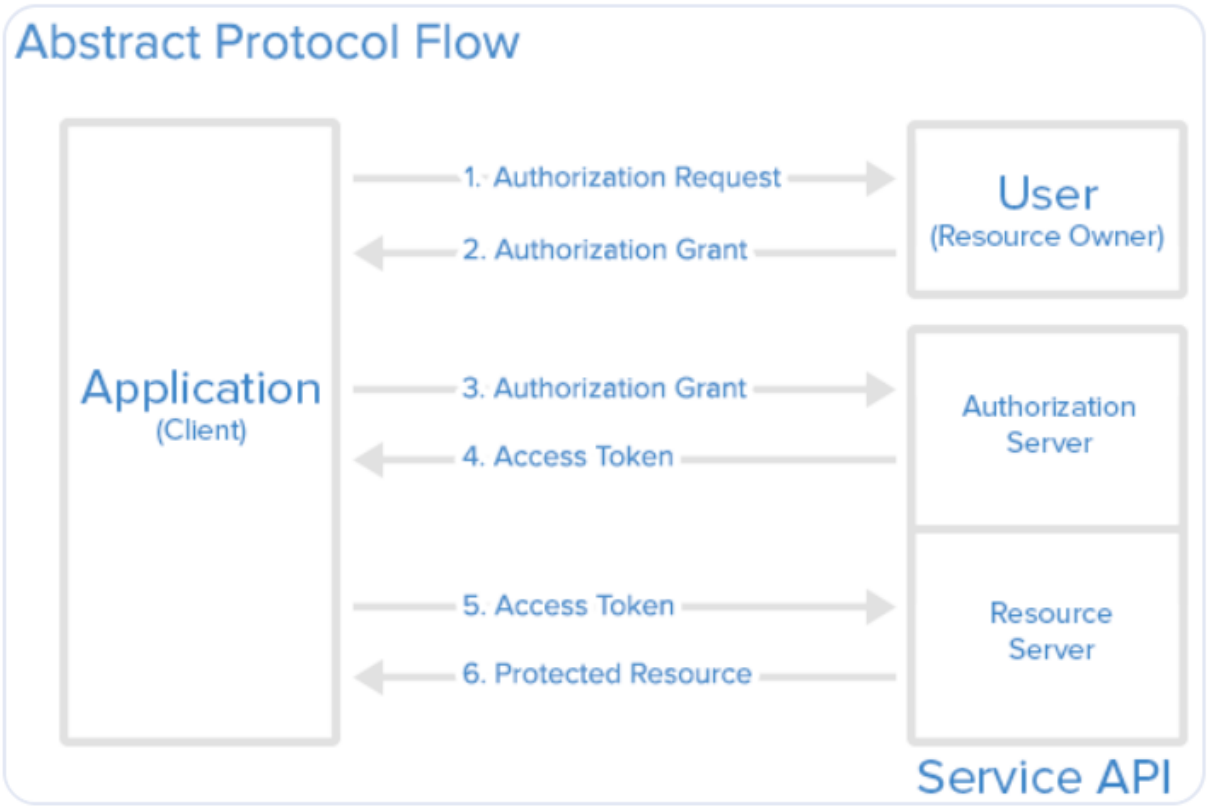
	Employee Name	Monday	Tuesday	Wednesday	Thursday	Friday	Total Hours	Signature
1							0:00	
2							0:00	
3							0:00	
4							0:00	
5							0:00	
6							0:00	
7							0:00	
8							0:00	
9							0:00	
10							0:00	

Manager Signature: _____

Attendance Total 0

3.5 Security Design

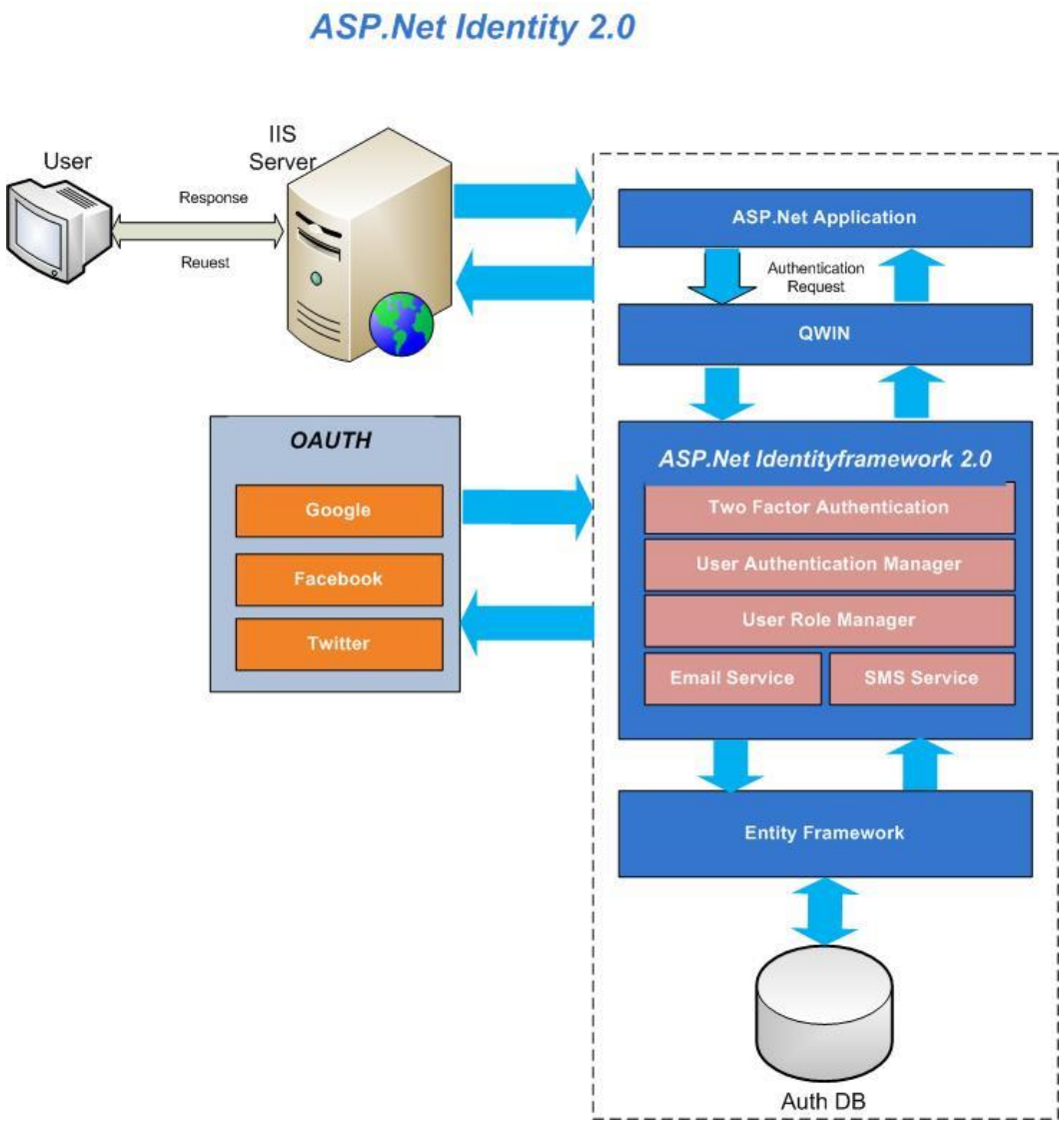
3.5.1 OAUTH 2.0



Open Authentication (OAUTH) is a standard authentication that is designed to allow the application to represent the user for accessing the resources hosted by other applications. OAuth 2.0 provides consented access and restricts actions of what the client app can perform on

resources on behalf of the user, without ever sharing the user's credentials (auth0. , n.d.). The diagram above is showing the step of the OAUTH process in the application. First, the application will request authorization to access the service resources from the user. If the user authorized the request of the application, the application will receive an authorization grant. After the application has received the authorization grant, the application will request an access token form the authorization server and present the access token for authentication. If the application identity is authenticated and the authorization grant is valid, the authorization server will issue an access token to the application and the authorization will be complete. (Anicas, M. , 2014)

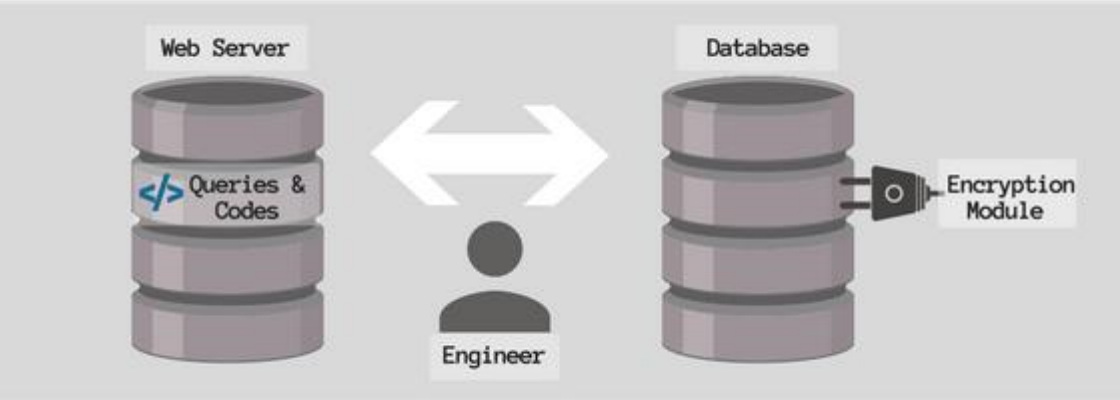
3.5.2 ASP.NET Identity



ASP.NET Identity (ANI) is a membership system that focuses on the authentication and authorization of the users in ASP.NET applications. API also allows the developer to easily

customize the login and logout functionality (www.c-sharpcorner.com, n.d.). . There are several reasons why we choose the ANI for the proposed system. First of all, it has support for all types of ASP.NET applications such as Web Form, MVC, Web API and others. Secondly, the developer can easily customize things such as add a new field to the user profile in no time by using ANI. Besides that, developers can easily modify the database such as change table name, primary keys, data type or others by using ANI. This is because the database schema is in the developer's hand when using ANI. Lastly, the ANI has support for claims and roles. By using Role, the functionality of the application that users can access will be different. For example, Role “Staff” will only be able to access the basic functionalities of the application such as view personal information, sign attendance and others. For Role “Manager” they can use other functionalities such as create shifts for the employee, assign the employee to the existing shift and others (jongalloway, n.d.)..

3.5.3 Database Encryption



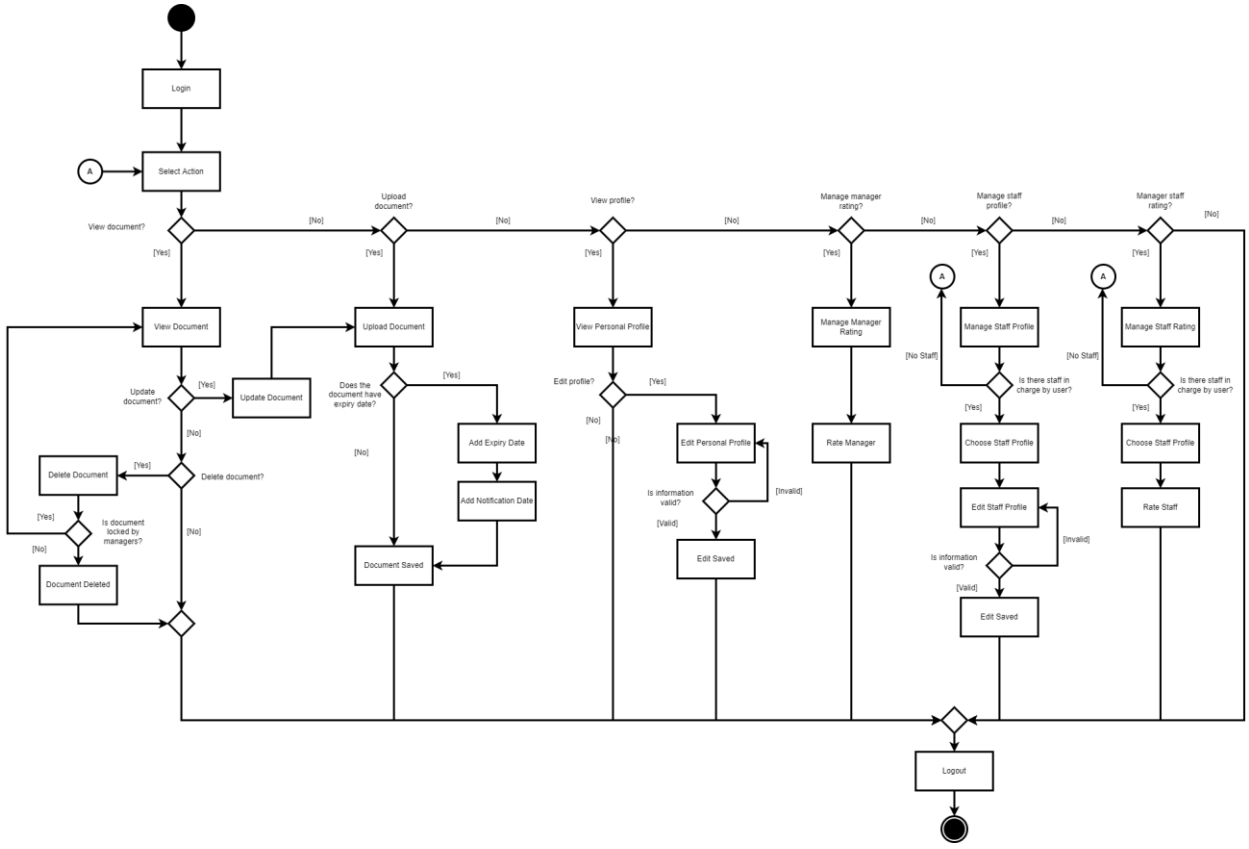
Database encryption works by transforming data stored in a database from a readable state into a cipher text of unreadable characters via the utilization of an encryption algorithm. Unlike other security methods such as antivirus software, this form of defense is positioned at the data level itself (MyDiamo, 2016) . Without the proper decryption key, even if the data is stolen, it is meaningless to the attacker. The project will utilize the plug-in database encryption method. The concept of this method is that an encryption package will be attached onto the database itself. Unlike other methods, this encryption works independently of the application and requires less modification to query and code. This is very useful for column-level encryption, access control and auditing. (N-able, 2019).

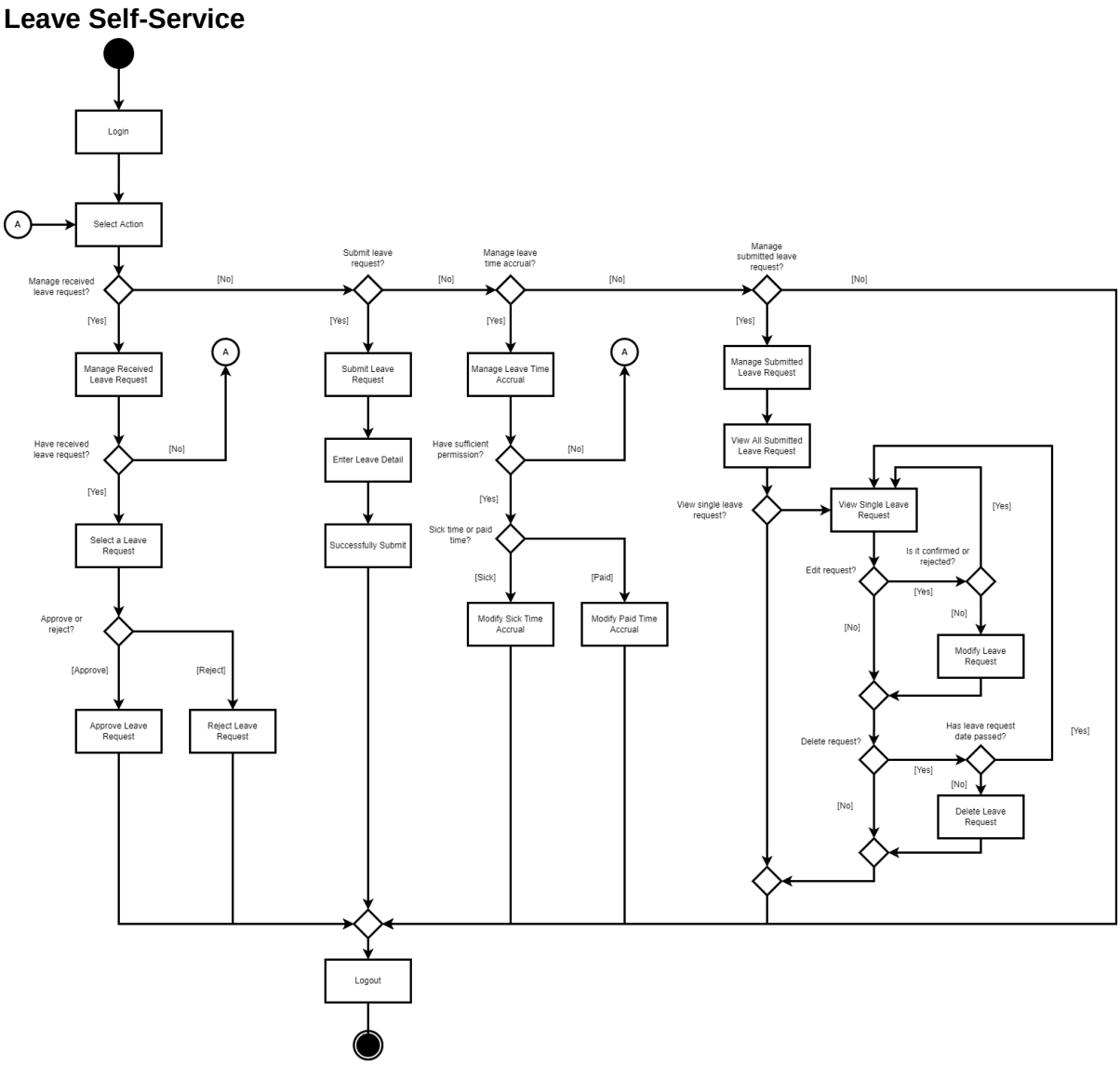
3.6 Process Design

The workflow for each module of the proposed system will be show in the following diagram

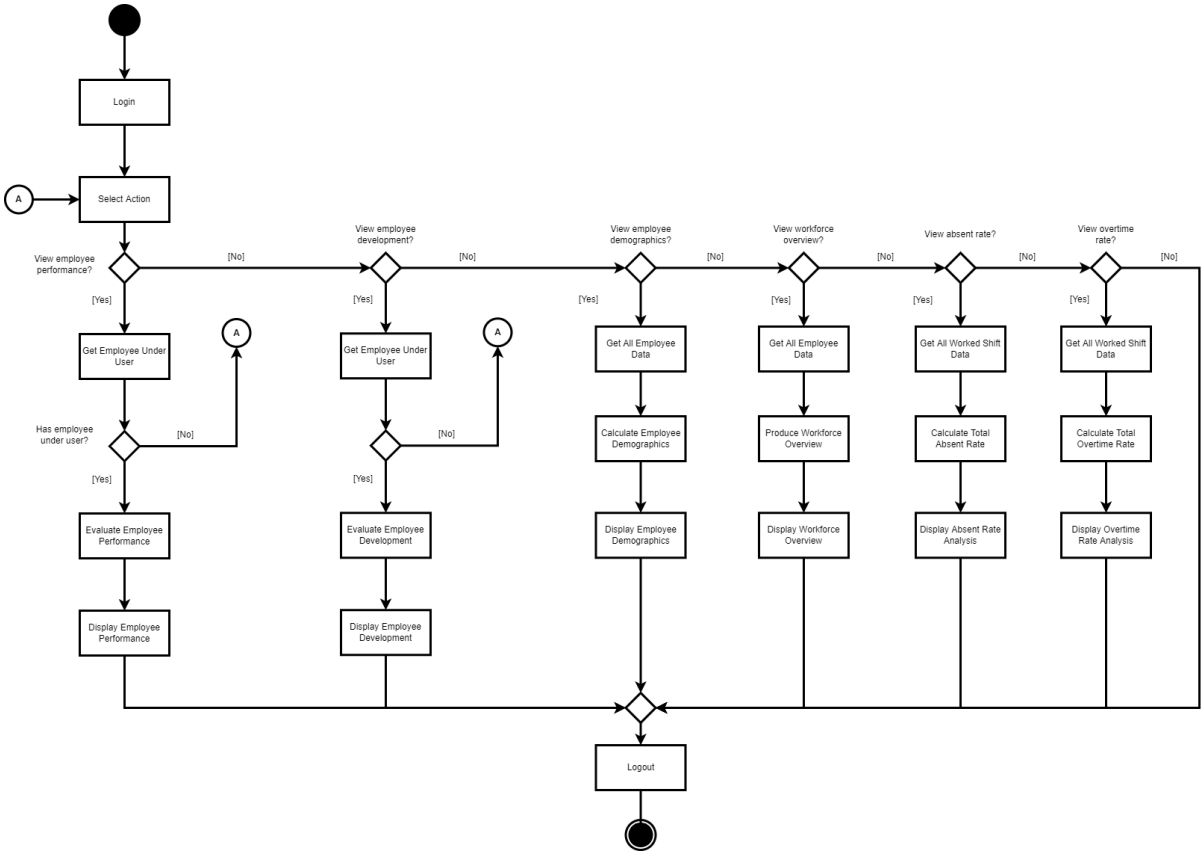
3.6.1 Activity Diagram

Workforce Management

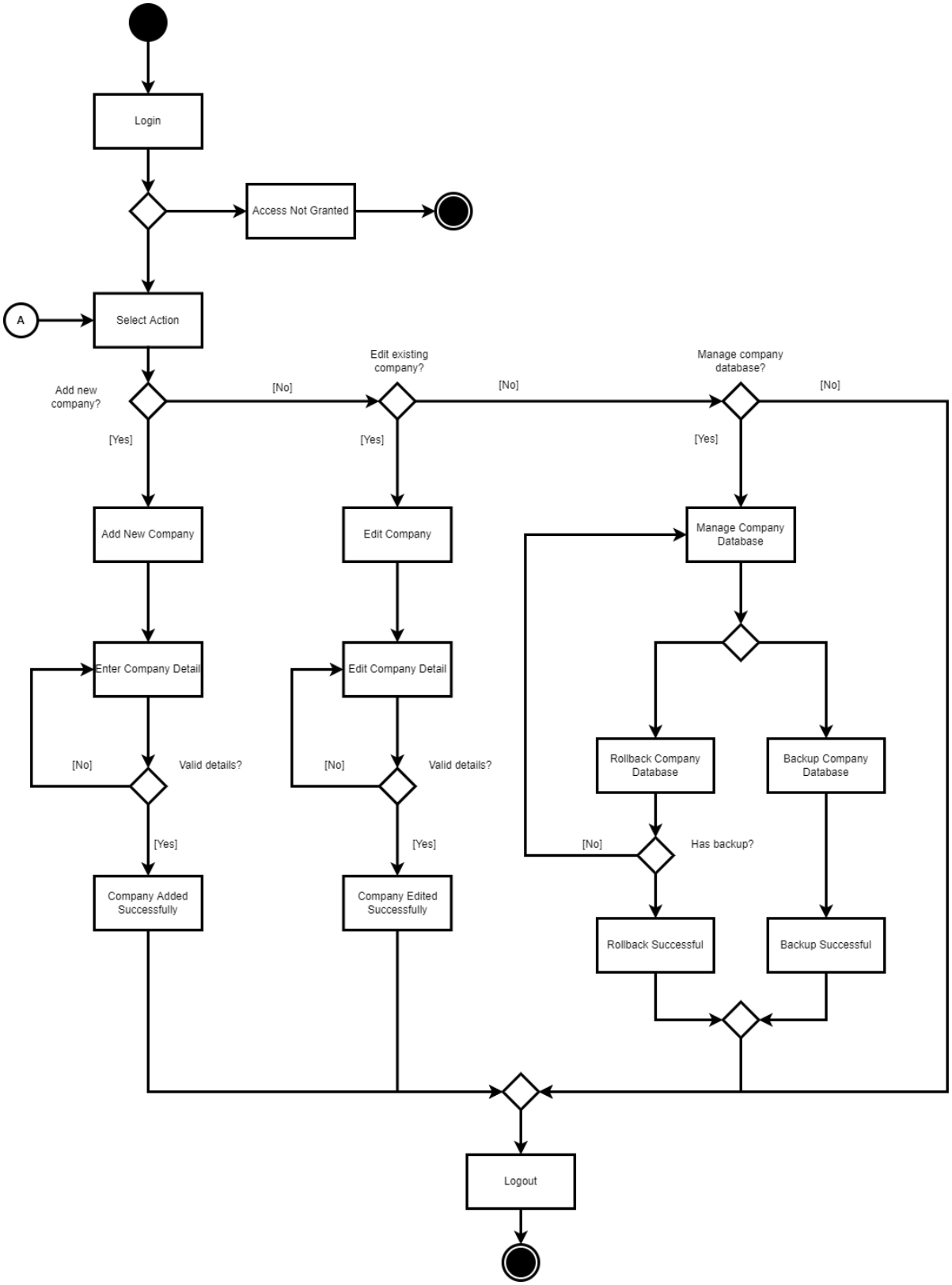



Leave Self-Service
Login
A
Select Action
Manage received leave request?
[No]
[Yes]
Manage Received Leave Request
Have received leave request?
[No]
A
[Yes]
Select a Leave Request
Approve or reject?
[Approve]
[Reject]
Approve Leave Request
Reject Leave Request
Submit leave request?
[No]
[Yes]
Submit Leave Request
Enter Leave Detail
Successfully Submit
Manage leave time accrual?
[No]
[Yes]
Manage Leave Time Accrual
Have sufficient permission?
[No]
A
[Yes]
Sick time or paid time?
[Sick]
[Paid]
Modify Sick Time Accrual
Modify Paid Time Accrual
Manage submitted leave request?
[No]
[Yes]
Manage Submitted Leave Request
View All Submitted Leave Request
View single leave request?
View Single Leave Request
[Yes]
Edit request?
Is it confirmed or rejected?
[Yes]
[No]
Modify Leave Request
[No]
Delete request?
Has leave request date passed?
[Yes]
[Yes]
[No]
Delete Leave Request
[No]
Logout

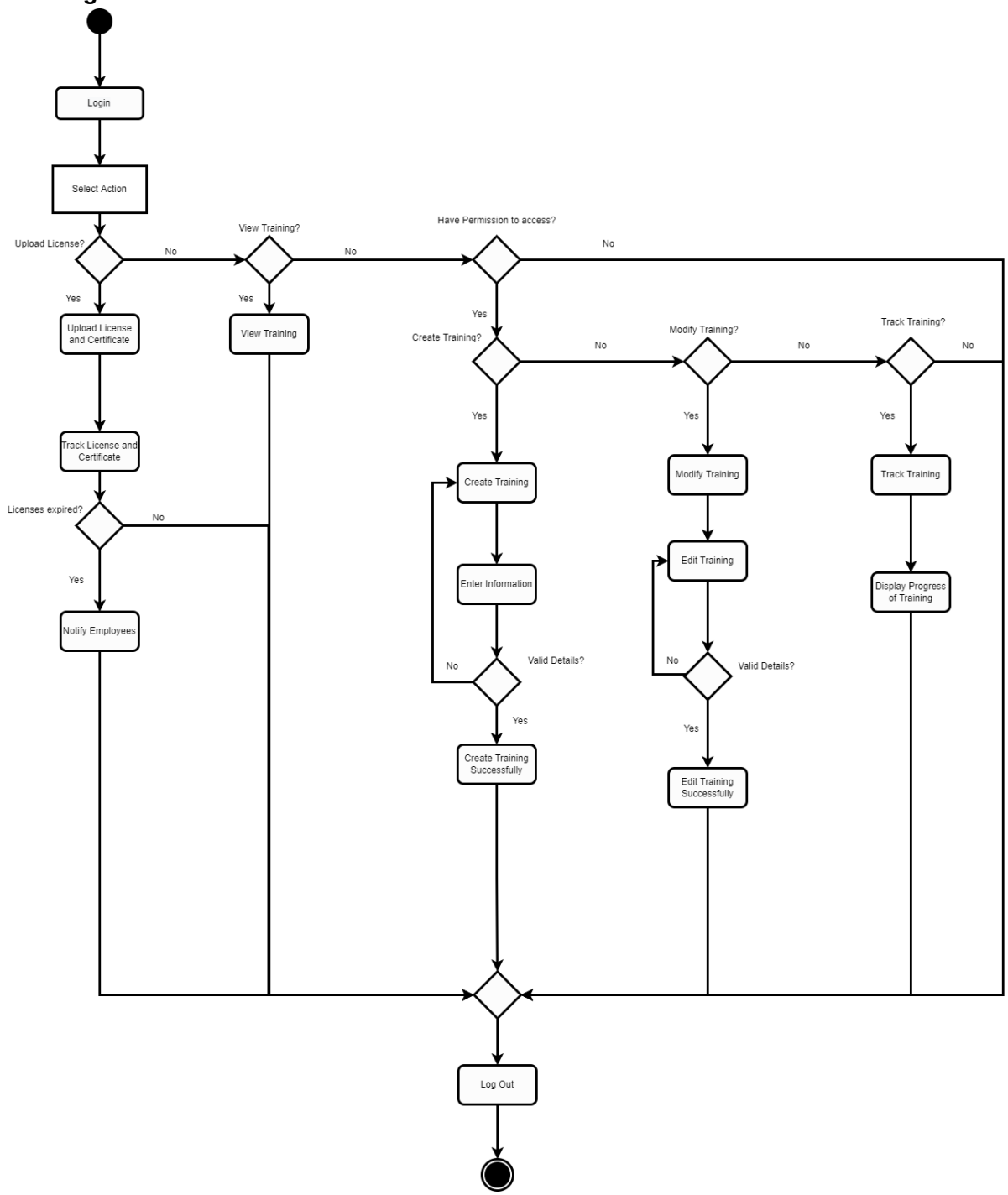
Dashboard Analytics



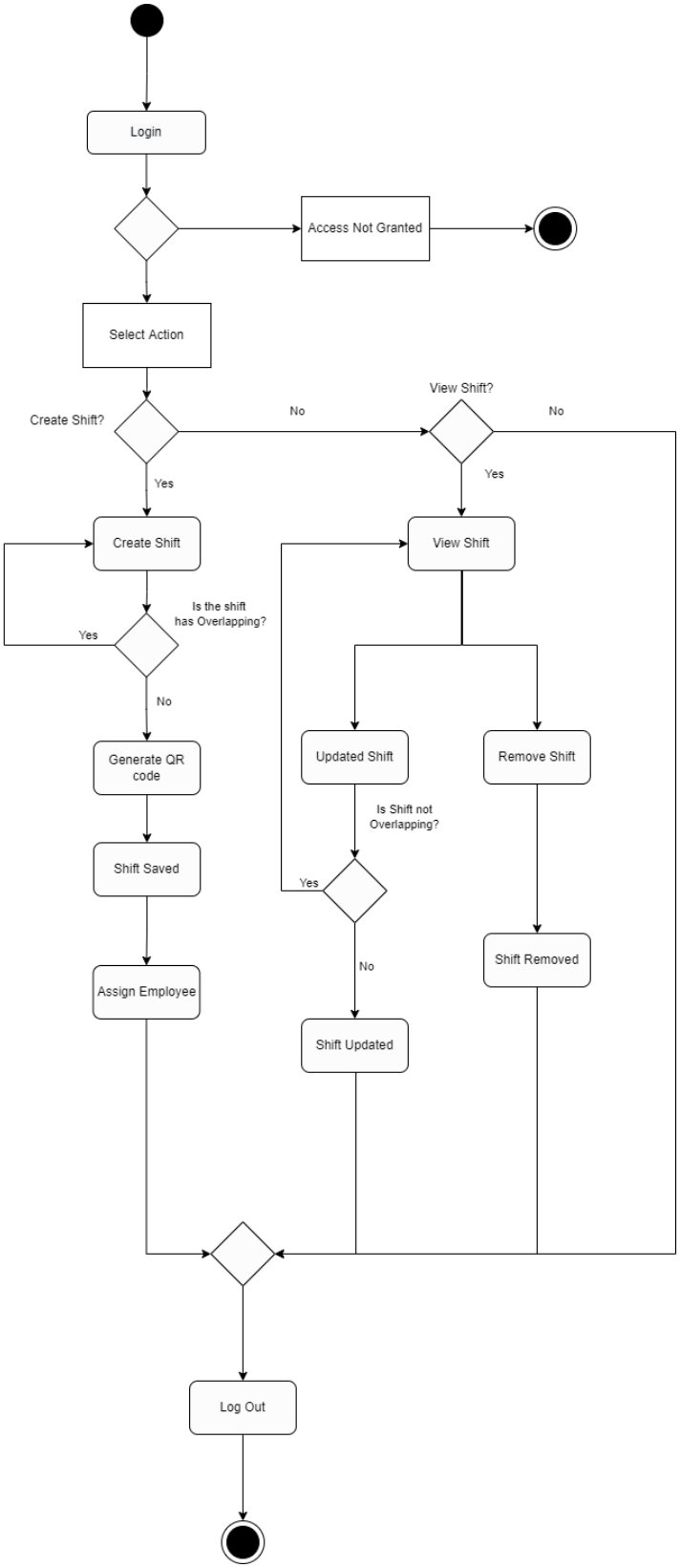
Company Management



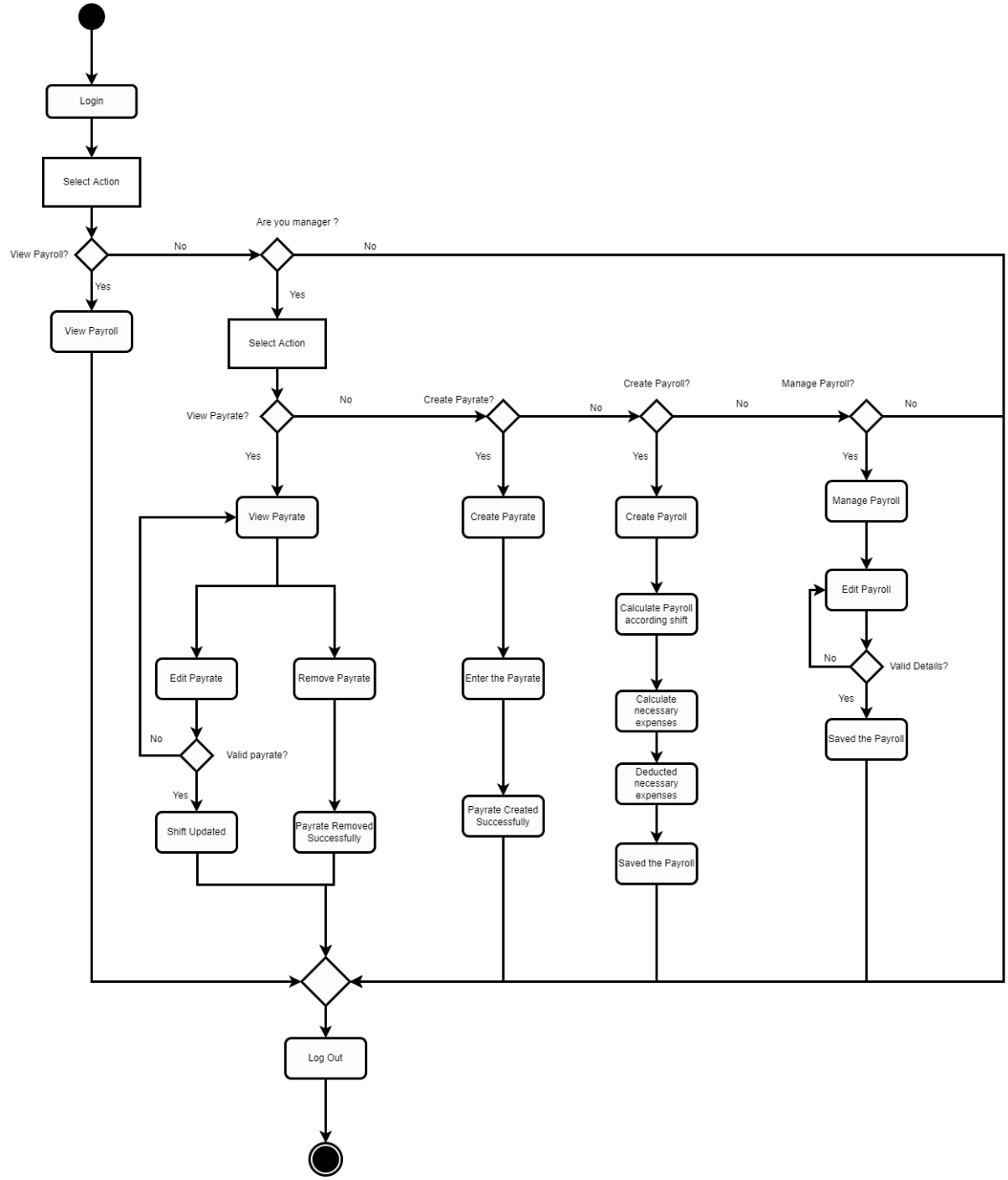
Training Module



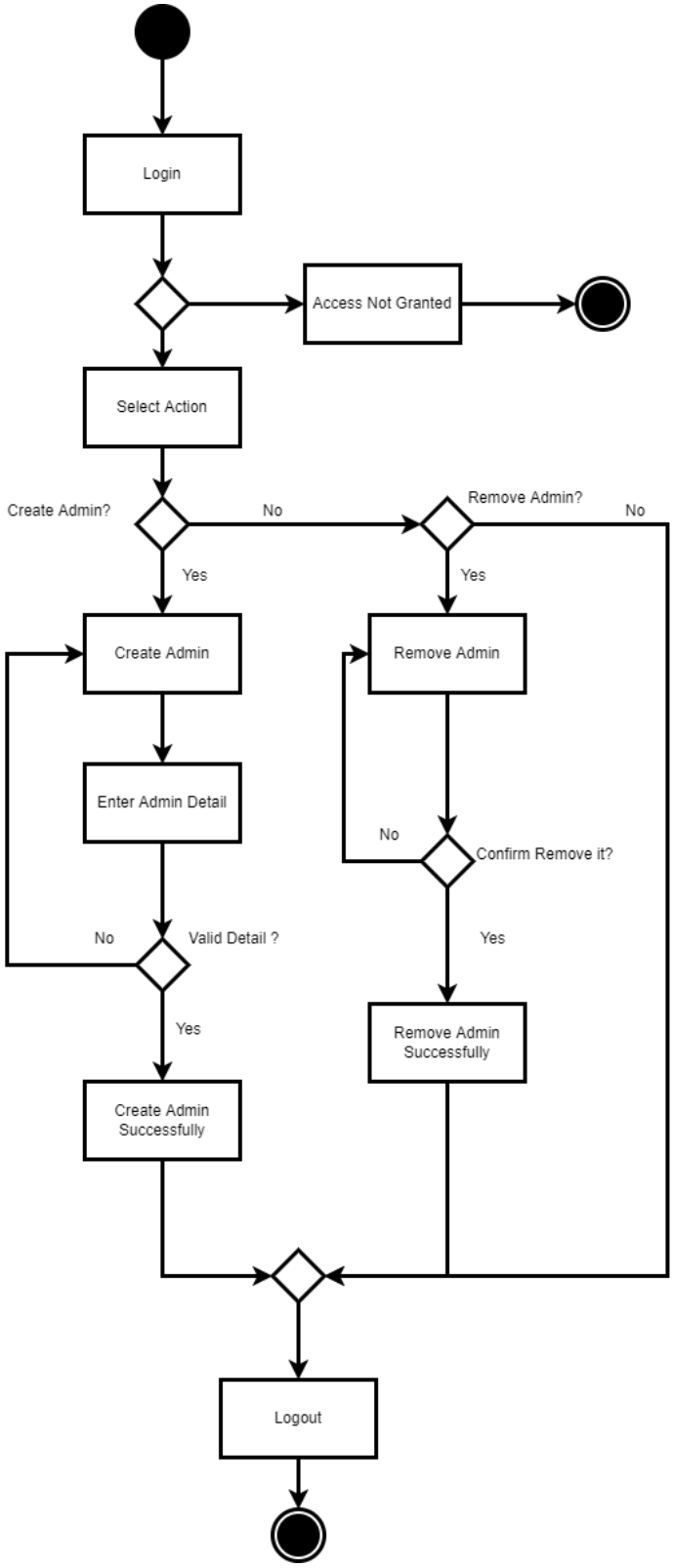
Shift Management



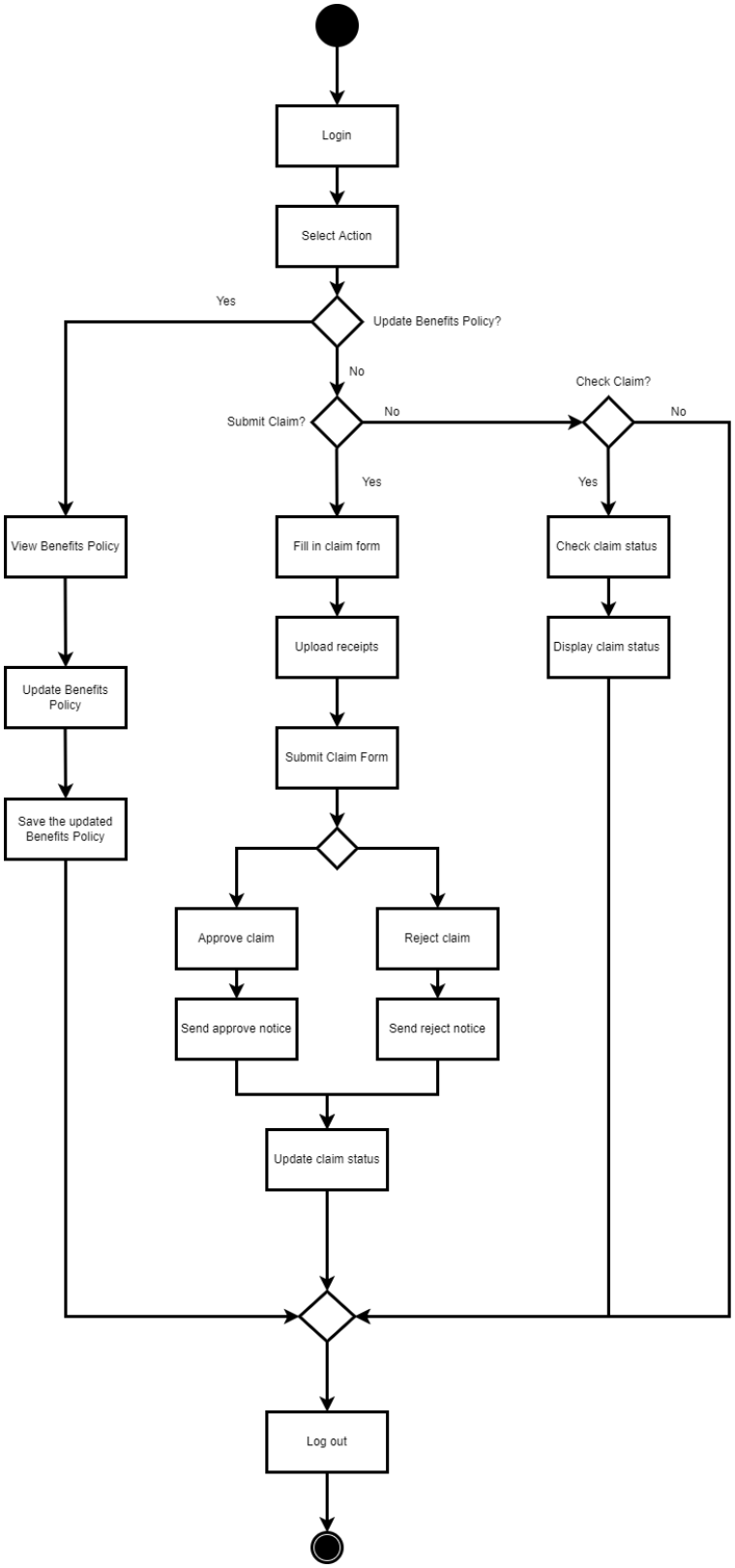
Payroll Module



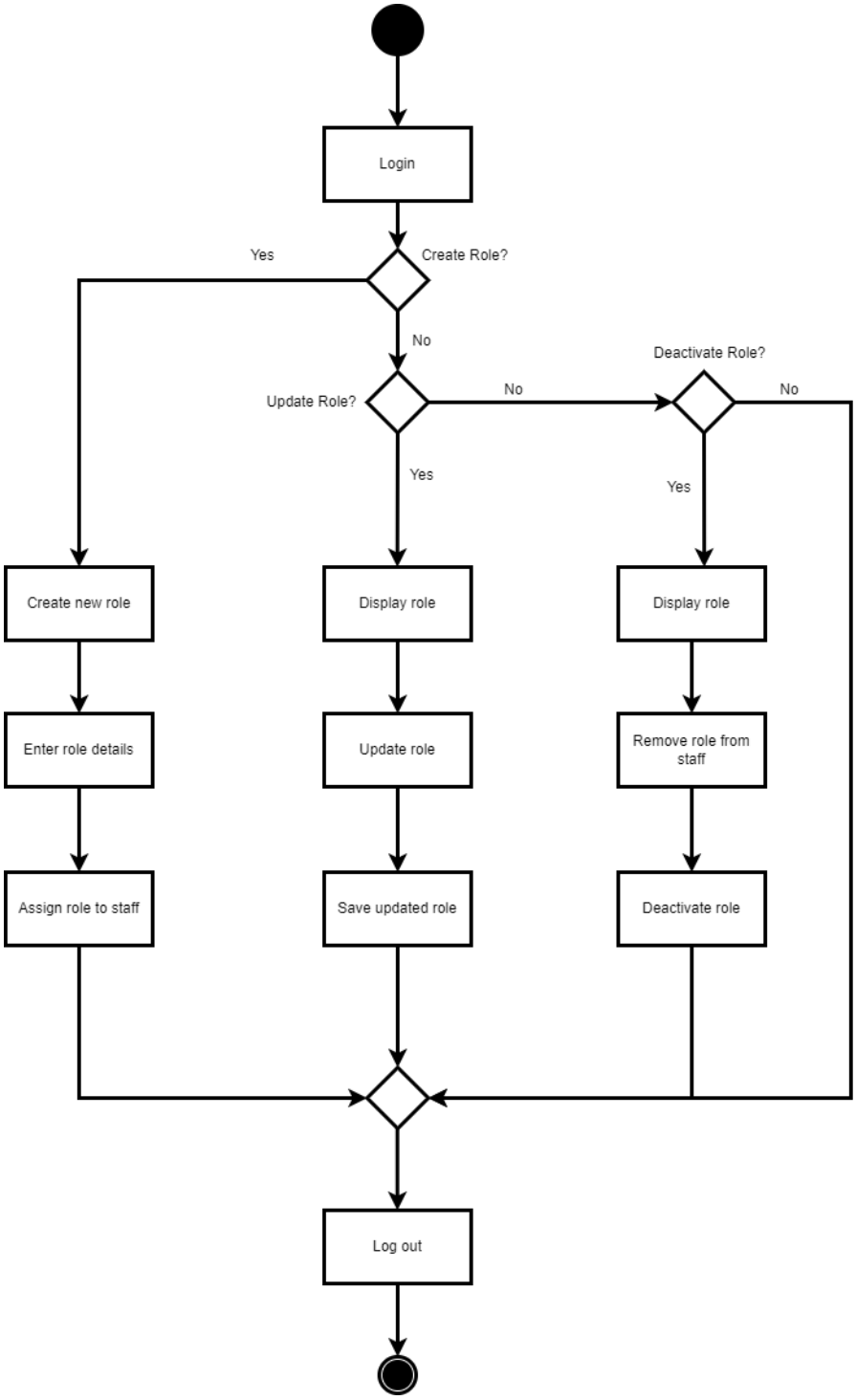
Admin Management



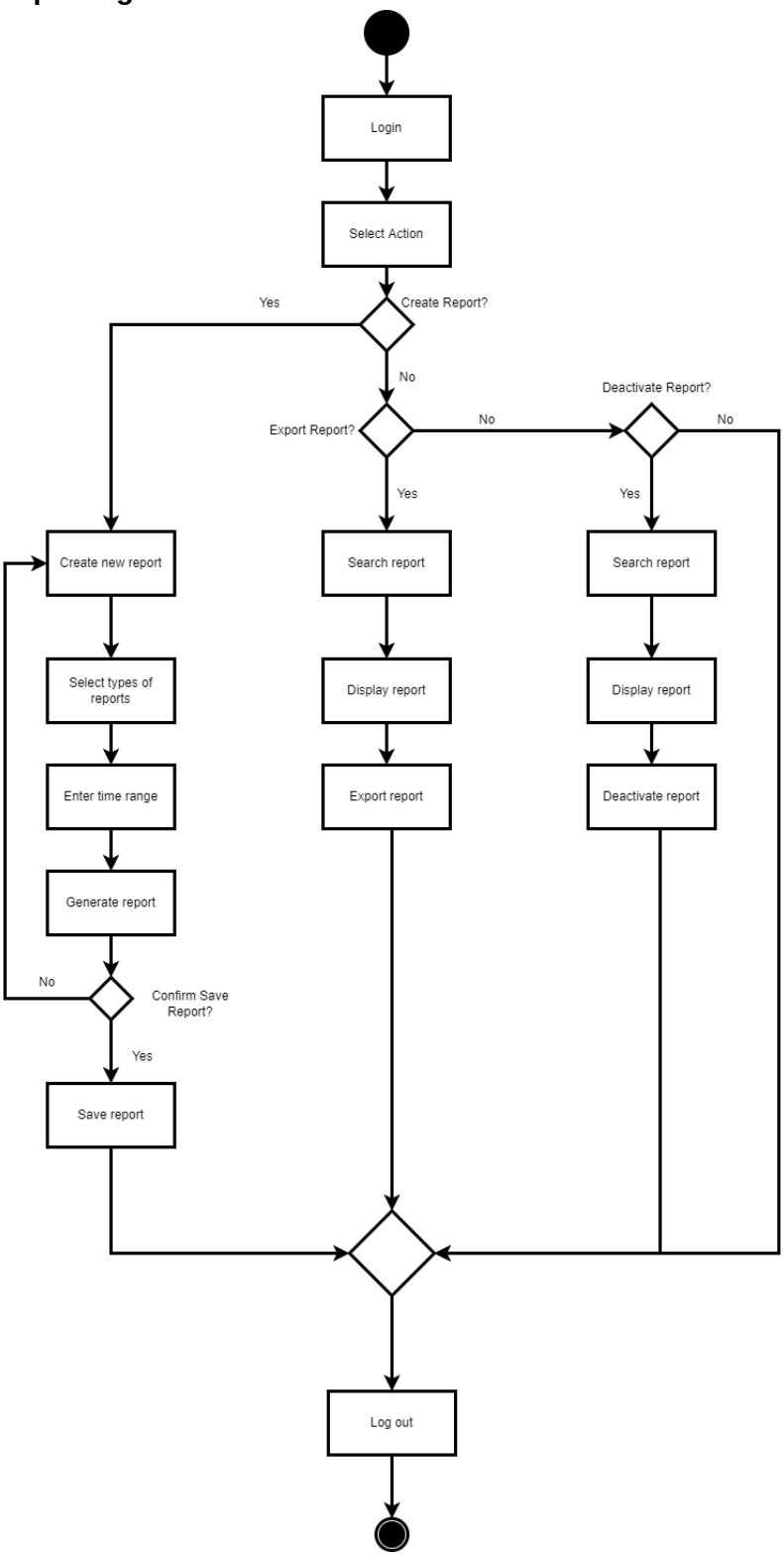
Benefits and Compensation


Login
Select Action
Yes
Update Benefits Policy?
No
Submit Claim?
No
Check Claim?
No
Yes
Yes
View Benefits Policy
Fill in claim form
Check claim status
Upload receipts
Display claim status
Update Benefits Policy
Submit Claim Form
Save the updated Benefits Policy
Approve claim
Reject claim
Send approve notice
Send reject notice
Update claim status
Log out

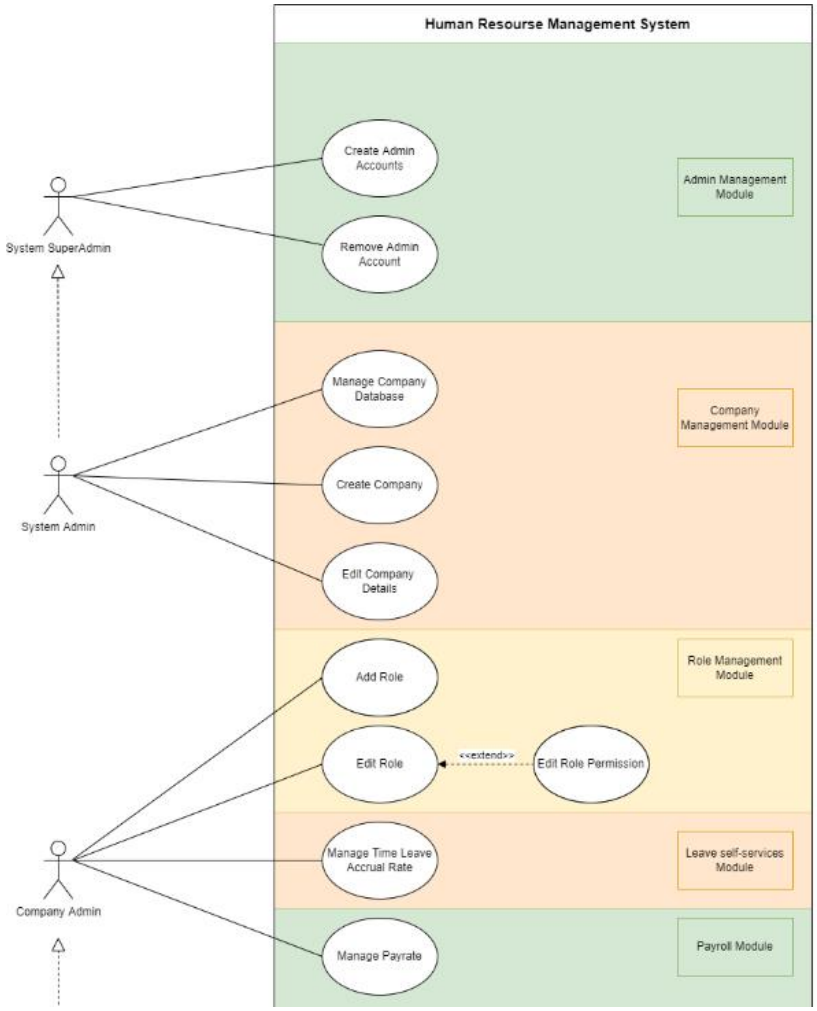
Role Management

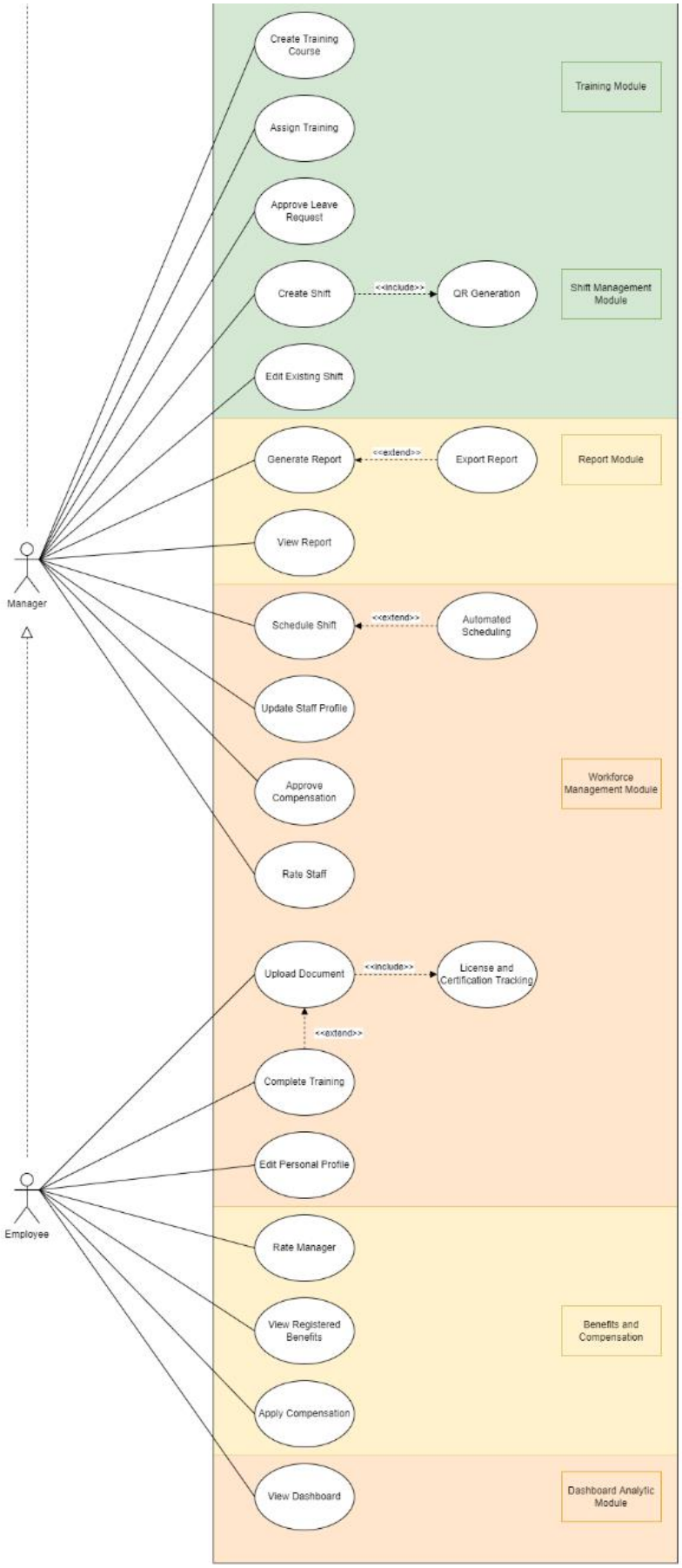


Reporting


Login
Select Action
Create Report?
Yes
No
Export Report?
No
Deactivate Report?
No
Yes
Yes
Create new report
Search report
Search report
Select types of reports
Display report
Display report
Enter time range
Export report
Deactivate report
Generate report
No
Confirm Save Report?
Yes
Save report
Log out

3.6.2 Use Case Diagram




Create Training Course
Assign Training
Approve Leave Request
Create Shift
<<include>>
QR Generation
Edit Existing Shift
Training Module
Shift Management Module
Generate Report
<<extend>>
Export Report
View Report
Report Module
Manager
Schedule Shift
<<extend>>
Automated Scheduling
Update Staff Profile
Approve Compensation
Rate Staff
Workforce Management Module
Upload Document
<<include>>
License and Certification Tracking
<<extend>>
Complete Training
Edit Personal Profile
Employee
Rate Manager
View Registered Benefits
Apply Compensation
Benefits and Compensation
View Dashboard
Dashboard Analytic Module

3.7 Software Architecture Design

3.7.1 ASP.NET Core MVC

The project will adapt the Model-View-Controller(MVC) architectural pattern by utilizing the ASP.NET Core MVC framework. MVC architectural pattern separates an application into three main groups of components, which are Models, Views and Controllers.

First group is The Model and it represents the state of the application and any business logic or operation should be performed by the application. The business logic will store in the model and used to implement any business logic for maintaining the state of application

Second group is The View and it represents the user interface that presents the content to the user. In ASP.NET Core MVC, they use the Razor view engine to embed .NET code in HTML markup. A view will only contain the business logic that related to the context presentation to the users

Last group is the Controller and is responsible for handling the user interactions, working with the Model and ultimately selects a view to render. In an MVC application. It handles and responds to the user input and interacts and the view is only responsible for displaying the information to the users. Therefore, it is an initial entry point and is responsible for selecting what model works with it and what view needs to be rendered. (tutorialspoint , 2019)

The ASP.NET Core MVC framework provides a patterns-based way to build dynamic websites that enables a clean separation of concerns and gives developers full control over markup and uses the latest web standards. This delineates responsibilities and helps in scaling the application in terms of complexity. The application becomes easier to code, debug and test since everything has a single job. For example, the Model depends on neither the View nor the Controller even though the two depend on the Model. This allows the Model to be built and tested independent of the visual representation.

3.7.2 Monolith

The proposed system will use monolith architecture, which is a traditional unified model for designing a software application. A monolithic software is designed to be self contained, with tightly coupled components and operations. Each monolithic application must include every component and the related components to execution and compilation. The monolithic application is built and deployed as a unique application, no matter how the user uses it. The component and the model of the monolithic application will always be tightly coupled, no matter whether the user accesses it with desktop or mobile devices. This type of application is using single data sources, mainly used for data management systems. Monolith applications have better throughput and less variables and elements. Therefore, it is easy for testing and

debugging. A single codebase also simplifies several development concerns such as logging, configuration and performance (WhatIs.com, n.d.).

3.8 Software Architecture Design

3.8.1 Case-Based Reasoning

Case-Based Reasoning (CBR) is an experience-based approach by adapting previous successful solutions that solve similar problems to the new problems. (SearchEnterpriseAI., n.d.) CBR uses previous successful solutions to solve the problem, which means it follows the human way of thinking . THis is because the successful solution is the human expert using their own knowledge to solve the problem and CBR is learning the knowledge from the successful solution. For addressing memory, learning, planning and problem solving, CBR has provided a basis for new technology of the intelligent computer system to let the technology solve the problem and also adapt to the new situation. (www.sciencedirect.com, n.d.).

3.9 Chapter Summary and Evaluation

In this chapter, an overview of the proposed system's system design is given. This chapter also explained the system's eleven modules, workforce management, shift management, leave self-service, dashboard analytics, training module, payroll module, admin management, company management, benefits and compensation, reporting and role management.

Next, this chapter included initial concept design of the user interfaces planned for the system. The designs are revealed in the form of wireframes.

Then, the data structure that will be used in the system is presented. A detailed class diagram and an entity relationship diagram is provided for better understanding.

Following that, several reports that will be included in the system are given initial concept design. Some report templates that have been designed are salary slip, payroll report, individual attendance report and weekly attendance report.

Continuing, security practices implemented in the system are explained. OAuth 2.0 is used to grant external websites information without giving passwords. ASP.NET identity will provide membership control to the system. Lastly, database encryption will be implemented to further improve privacy.

Aside from that, a detailed process design for the system is given. Activity diagrams are used to show the different flow of activities a user may undertake in the system while use case diagrams are provided to show all the possible functionalities users can make use of.

In the next section, this chapter provides a clear picture of the software architecture design that will be adapted by the system, which is the ASP.NET Core MVC framework, providing separation of concern. The system will also use a monolithic architecture, which is self-contained, with tightly coupled components and operations.

Finally, several algorithms that are used to provide predictive analytics to the system are introduced and explained. CBR is useful to predict singular cases since it draws conclusions from similar cases in the past. ANN, a model mimicking human brain physiology, are used to find patterns emerging from past data and attempts to predict the likely occurrence of different possibilities.

Chapter 5

Implementation and Testing

4 Implementation and Testing

In this chapter, a detailed description of how the system is actually implemented will be given. The framework and the data structure that supports the coding of the system will be explained and described. Following that, certain functions that are deemed notable will be presented and explained on how they are implemented. External dependencies used during the development of this system will be listed as well. The other half of this section will describe the test plan executed for the system for quality assurance purposes. The main strategy for testing will be given as well as test data needed to perform these tests. Finally, a collection of test cases executed will be provided.

4.1 implementation

The system is coded into existence using Microsoft Visual Studio Community 2022. A framework and a data structure as well as several external dependencies are used in the development of this project. The following section will describe some of the prominent implementation method of the system.

4.1.1 Framework

The system is based on the ASP.NET Core, a cross-platform, high-performance, open-source framework for building modern, cloud-enabled, Internet-connected applications. The version being used is ASP.NET Core 7.0. The system structure follows the typical design of an ASP.NET Core MVC web application, where the system is split into models, controllers and views

4.1.2 Data Structure

The data structure used for the system is coded as an object model within the system. Data objects strictly follow the design decided in the class diagram revealed prior. Once the attributes and relationships between the classes are defined clearly, Entity Framework Core (EFC) will be used to transform the objects into SQL database tables. Entity Frame Core is a modern object-database mapper for .NET Core software. Using the application database context, it is possible to define which object classes should be included within the database. Everytime a modification is made towards the classes, EFC can automatically detect the changes since it keeps track of the current database by maintaining a snapshot of the entire database structure and generating migration files which alter the database to match the current classes' attributes. Migrations can then be applied via the Package Manager Console.

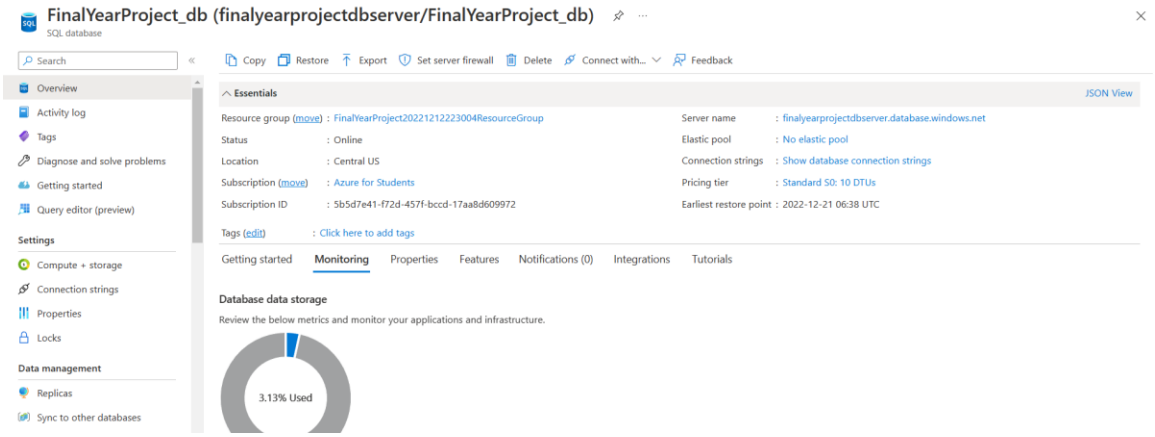
```
16 references
public class Payrate
{
    [Key]
    6 references
    public string? payrate_id { get; set; }

    [Required]
    8 references
    public string? payrate_name { get; set; }

    9 references
    public float? payrate_ratePerHour { get; set; }

    [Display(Name = "Company")]
    6 references
    public string? company_id { get; set; }

    [ForeignKey("company_id")]
    3 references
    public virtual Company? Company { get; set; }
}
```

```
58 references
public class ApplicationDbContext : IdentityDbContext
{
    0 references
    public ApplicationDbContext(DbContextOptions<ApplicationDbContext> options)
        : base(options)
    {
    }

    0 references
    protected override void OnModelCreating(ModelBuilder builder)
    {
        base.OnModelCreating(builder);

        builder.Entity<TrainingProgress>().HasKey(table => new {
            table.staff_id,
            table.training_id
        });

    }

    11 references
    public DbSet<Admin> Admin { get; set; }
    35 references
    public DbSet<Company> Company { get; set; }
    14 references
    public DbSet<Role> Role { get; set; }
    97 references
    public DbSet<EmployeeDetails> EmployeeDetails { get; set; }
```

```
namespace FinalYearProject.Data.Migrations
{
    /// <inheritdoc />
    1 reference
    public partial class documentCompensation : Migration
    {
        /// <inheritdoc />
        0 references
        protected override void Up(MigrationBuilder migrationBuilder)
        {
            migrationBuilder.AddColumn<string>(
                name: "supporting_document",
                table: "Compensation",
                type: "nvarchar(max)",
                nullable: true);
        }

        /// <inheritdoc />
        0 references
        protected override void Down(MigrationBuilder migrationBuilder)
        {
            migrationBuilder.DropColumn(
                name: "supporting_document",
                table: "Compensation");
        }
    }
}
```

The database will be an SQL database hosted on a server provided by Microsoft Azure. The details of the server are as follows:

Server Name	finalyearprojectdbserver.database.windows.net
Connection String	Server=tcp:finalyearprojectdbserver.database.windows.net,1433; Initial Catalog=FinalYearProject_db; Persist Security Info=False; UserID=Nicholas; Password={your_password}; MultipleActiveResultSets=False; Encrypt=True; TrustServerCertificate=False; Connection Timeout=30;



4.1.3 ASP.NET Core Identity

ASP.NET Core Identity (ACI) is a pre-included API that supports login and user authentication functionality. It manages users, passwords, email confirmation and more. ACI is extensively used throughout the system to implement user authentication and authorization as well as maintaining user access control. When creating administrator and staff, a corresponding ACI user will be created. The administrator and staff may use this ACI user account to access the system and perform their tasks.

Aside from that, ACI also supports logging in using an external login provider. Although ACI supports multiple platforms for logging in, this system has only implemented login via Google Account.

4.1.4 Shift Management and Payroll

The Shift Management allows Create, Read, Update and Delete functionalities of shift within the system. When Creating a new shift, the start and end time of the shift and the pay rate per hour for the shift is required. For the pay rate per hour, it has been included in the payroll module. Besides that, Shift management also has allowed the employer to assign the employee into the shift and provided QR Code for the user to take attendance. For the payroll, It allows the employer to generate each of the employee;s payroll based on their valid attendance. Pay rate per hour also can be created and edited by this module.

4.1.5 Training and Admin Management

In the training module, it has provided create and edit functionalities for the employer. Employers can use it to create any training for the employees. Assign employees to the training function also were provided by it since it provides a create function. When the training progress

has been completed, It also allows the employee and employer to upload the certificate of the training for their own or employer. For the admin management, it only provided create and delete admin in the system. This module will only be in charge of the super admin. The admin is used for another module called company module, which is in charge by my teammate, Yaw Foong Zeng.

4.2 Testing

The following section will describe in detail the test plan drafted for the HRMS web system The test plan will include the general strategy chosen for the project, the test data required and the test cases executed. By including the test plan and ensuring that there are no visible defects or vulnerabilities, it is hoped that the HRMS web system's quality will be assured. It is also the objective of the test plan to demonstrate that the system has fulfilled all functional requirements as well as non-functional requirements laid out for it.

4.2.1 Test Scope

The test plan will only examine the functionalities of the modules listed below:

1. Admin Management Module
2. Shift Management Module
3. Training Module
4. Payroll Module

4.2.2 Test Strategy

The testing strategy that will be used for the HRMS is black box testing. Black Box Testing is also known as Behavioural Testing. It is a testing method for evaluating software applications' functionality without knowing the internal code structure, implementation details and internal paths. This testing strategy is primarily focused on input and output of applications.

Figure 5.2 Black Box Testing

The above figure is an example of how black box testing works. The black box can be any system or applications that we want to test. We can test the system or applications by just focusing on the inputs and outputs without knowing their internal code implementation

4.3 Test Data

To effectively demonstrate that the system works and the test cases can be run smoothly, test data must be generated before the testing begins.

4.3.1 Admin Management Module

Create Admin		
Username	admin	admin
Password	password	null
Comment	Valid	Invalid: password cannot be null

4.3.2 Shift Management Module

Create Work Shift		
Is OverTimeShift	False	False
Shift ID	S00001	S00001
Parent Shift	Null	Null
Shift Start TIme	12/23/2022 2:01:00 PM	12/23/2022 2:01:00 PM
Shift End Time	12/23/2022 8:01:00 PM	12/23/2022 1:01:00 PM
Company ID	GoodSmile	GoodSmile
Pay Rate ID	PRATE12	PRATE12
Repeatable	WeekDay	WeekDay
Comment	Valid	Invalid: Shift End TIme cannot early than Shift Start Time

Create Over Time Shift		
Is OverTimeShift	True	True
Parent Shift	S00001	Null

Shift Start TIme	12/23/2022 2:01:00 PM	12/23/2022 2:01:00 PM
Shift End Time	12/23/2022 8:01:00 PM	12/23/2022 1:01:00 PM
Company ID	GoodSmile	GoodSmile
Pay Rate ID	PRATE12	PRATE12
Repeatable	WeekDay	WeekDay
Comment	Valid	Invalid: Over Time Shift must have parent Shift

4.3.3 Training Module

Create Training		
Training ID	T000001	T000001
Training Name	New Technology Training	New Technology Training
Training Start Time	12/23/2022 12:00:00 PM	12/23/2022 12:00:00 PM
Duration	10	0
Comment	Valid	Invalid - Duration cannot be 0

4.3.4 Payroll Module

Create Payroll	
Payroll ID	PROLL00001
Staff ID	E00001
Monthly Salary	865
KWSP	110
ZAKAT	25
Date Created	12/23/2022 12:00:00 PM

4.4 Test case

4.4.1 Admin Management Module

Test Case ID: TC_01	**Test Designed by: Teo Jian Xiang**

Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Create Admin	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Create Admin with valid username and password	**Test Execution date: 29/12/2022**
Description: Test Create Admin with valid username and password	

Pre-conditions: Login To Super Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Admin page	Username: admin Password: password	Admin has been created	Admin has been created and User will navigated to Admin page	Pass	
2	Press Create Admin Button					
3	Provide valid username					
4	Provide valid password					
5	Click on Create button					

Post-conditions: Admin has been created and store in database

Test Case ID: TC_02	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Create Admin	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Create Admin with valid username only	**Test Execution date: 29/12/2022**
Description: Test Create Admin with valid username only	

Pre-conditions: Login To Super Admin Account

Step	Test Steps	Test Data	Expected	Actual Result	Status	Notes

			Result		(Pass/Fail)	
1	Navigate to Admin page	Username: admin Password:	An Error message with “password cannot be empty‘ will be displayed	An Error message with “password cannot be empty‘ will be displayed	Pass	
2	Press Create Admin Button					
3	Provide valid username					
5	Click on Create button					

Post-conditions: An Error message with “password cannot be empty‘ will be displayed

Test Case ID: TC_03	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: View all Admin	**Test Executed by: Teo Jian Xiang**
Test Title: Verify View Admin	**Test Execution date: 29/12/2022**
Description: Test View Admin	

Pre-conditions: Login To Super Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Admin page		All admin in database will be displayed	All admin in database will be displayed	Pass	

Post-conditions: All admin in database will be displayed

4.4.2 Shift Management Module

Test Case ID: TC_04	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Create Shift	**Test Executed by: Teo Jian Xiang**

Test Title: Verify Create Shift with valid data	Test Execution date: 29/12/2022
Description: Test Create Shift with valid data	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Shift page	is overtime shift: False Shift ID: S00001 Shift start time 12/23/2022 2:01:00 PM Shift end time 12/23/2022 8:01:00 PM Company: GoodSmile Pay Rate: PRATE12 Repeatable: WeekDay	Shift has been created	Shift has been created and User will navigated to Shift page	Pass	
2	Press Create Shift Button					
3	Select is over time shift or not					
4	Select shift start time					
5	Select shift end time					
6	Select Company					
7	Select Pay Rate					
8	Select Repetabe					
9	Click Create Button					

Post-conditions: Shift has been created and store in database

Test Case ID: TC_05	Test Designed by: Teo Jian Xiang
Test Priority (Low/Medium/High): Medium	Test Designed date: 29/12/2022
Module Name: Create Shift	Test Executed by: Teo Jian Xiang
Test Title: Verify Create Shift with invalid data	Test Execution date: 29/12/2022
Description: Test Create Shift with invalid data	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Shift page	is overtime shift: False Shift ID: S00001 Shift start time Null Shift end time 12/23/2022 8:01:00 PM Company: GoodSmile Pay Rate: PRATE12 Repeatable: WeekDay	Shift cannot be created	An Error message “Shift Start Time cannot be empty” will be displayed	Pass	
2	Press Create Shift Button					
3	Select is over time shift or not					
4	Select shift start time					
5	Select shift end time					
6	Select Company					
7	Select Pay Rate					
8	Select Repetabe					
9	Click Create Button					

Post-conditions: An Error message “Shift Start Time cannot be empty” will be displayed

Test Case ID: TC_06	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: View all Shift	**Test Executed by: Teo Jian Xiang**
Test Title: Verify View Shift	**Test Execution date: 29/12/2022**
Description: Test View Shift	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Shift page		All the shift of the company under the account in database will be displayed	All the shift of the company under the account in database will be displayed	Pass	

Post-conditions: **All the shift of the company under the account in database will be displayed**

Test Case ID: TC_07	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Edit Shift	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Edit Shift with new shift start Time	**Test Execution date: 29/12/2022**
Description: Test Edit Shift with new shift start Time	

Pre-conditions: **Login To Admin Account**

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Shift page	Shift start time 12/23/2022 2:01:00 PM	Shift has been Updated	Shift has been Updated and User will navigated to Shift page	Pass	
2	Press Edit Button					
3	Select new shift start time					
4	Click Edit Button					

Post-conditions: **Shift has been Updated into the database**

Test Case ID: TC_08	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Delete Shift	**Test Executed by: Teo Jian Xiang**

Test Title: Verify Delete Shift	Test Execution date: 29/12/2022
Description: Test Delete Shift	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Shift page		Shift has been Deleted	Shift has been Deleted and User will navigated to Shift page	Pass	
2	Press Delete Button					
3	Press confirm Button					

Post-conditions: Shift has been Deleted from the database

Test Case ID: TC_09	Test Designed by: Teo Jian Xiang
Test Priority (Low/Medium/High): Medium	Test Designed date: 29/12/2022
Module Name: Assign Shift	Test Executed by: Teo Jian Xiang
Test Title: Verify Assign Shift with valid data	Test Execution date: 29/12/2022
Description: Test Assign Shift with valid data	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Assign Shift page	Staff ID E00001 Shift ID S00001	The Attendance has been created	Attendance has been created and User will navigated to Assign Shift page	Pass	
2	Press Assign Button					
3	Select Staff ID					
4	Select Shift ID					

5	Click Assign Button					

Post-conditions: Attendance has been created in the database

4.4.3 Training Module

Test Case ID: TC_010	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Create Shift	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Create Training with valid data	**Test Execution date: 29/12/2022**
Description: Test Create Training with valid data	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Training page	Training ID: T00001 Training start time 12/23/2022 12:00:00 PM Duration 5	Training has been created	Training has been created and User will navigated to Training page	Pass	
2	Press Create Training Button					
3	Provide Training Name					
4	Provide Training Start Time					
5	Provide Duration					
6	Click Create Button					

Post-conditions: Training has been created and store in database

Test Case ID: TC_011	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Create Shift	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Create Training with invalid	**Test Execution date: 29/12/2022**

data	
Description: Test Create Training with invalid data	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Training page	Training ID: T00001 Training start time 12/23/2022 12:00:00 PM Duration 0	Training cannot be created	An Error message "Duration cannot be 0" will be displayed	Pass	
2	Press Create Training Button					
3	Provide Training Name					
4	Provide Training Start Time					
5	Provide Duration					
6	Click Create Button					

Post-conditions: An Error message "Duration cannot be 0" will be displayed

Test Case ID: TC_012	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Assign Training	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Assign Training with invalid data	**Test Execution date: 29/12/2022**
Description: Test Assign Training with invalid data	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Assign Training page	Staff ID: T00001	Training Attendance cannot be	Training Attendance has been created	Pass	

2	Press Assign Training Button	Training ID: T00001	created	and User will navigated to Assign Shift page		
3	Provide Staff ID					
4	Provide Training ID					
5	Click Assign Button					

Post-conditions: Training Attendance has been created and stored in database

Test Case ID: TC_013	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Upload Certificate	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Upload Certificate with valid data	**Test Execution date: 29/12/2022**
Description: Test Upload Certificate with valid data	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Assign Training page	Document ID: E0001-D0001 Document Name Certificate Expired Date 12/1/2022 12:00:00 PM Notify Date 1/1/2022 12:00:00 PM	Document has been uploaded	Document has been uploaded and User will navigated to Assign Training page	Pass	
2	Press Upload Button					
3	Provide Document Name					
4	Provide expired date					
5	Provide notify date					
6	Upload document in pdf format					
7	Click Upload Button					

Post-conditions: **Document has been uploaded and stored in database.**

4.4.4 Payroll Module

Test Case ID: TC_14	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Create Payroll	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Create Payroll	**Test Execution date: 29/12/2022**
Description: Test Create Payroll	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Payroll page	Shift ID: S00001	Payroll has been created	Payroll has been created and User will navigated to Payroll page	Pass	
2	Press Create Payroll Button					
3	Click Create Button					

Post-conditions: **Payroll has been created and store in database**

Test Case ID: TC_015	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: View all Payroll	**Test Executed by: Teo Jian Xiang**
Test Title: Verify View Payroll	**Test Execution date: 29/12/2022**
Description: Test View Payroll	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Payroll page		All the Payroll of the company under the account in database will be displayed	All the Payroll of the company under the account in database will be displayed	Pass	

Post-conditions: **All the Payroll of the company under the account in database will be displayed**

Test Case ID: TC_016	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Create Pay Rate	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Create Pay Rate with valid data	**Test Execution date: 29/12/2022**
Description: Test Create Pay Rate with valid data	

Pre-conditions: **Login To Admin Account**

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Pay Rate page	Pay rate ID: PRATE00001 Pay Rate Name Overtime Pay Rate Pay rate per hour 10 Company ID GoodSmile	Pay rate has been created	Pay rate has been created and User will navigated to Pay rate page	Pass	
2	Press Create Pay Rate Button					
3	Provide Pay rate Name					
4	Provide Pay rate per hour					
5	Select Company					
6	Click Create Button					

Post-conditions: **Pay Rate has been created and store in database**

Test Case ID: TC_017	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: Create Pay Rate	**Test Executed by: Teo Jian Xiang**
Test Title: Verify Create Pay Rate with invalid data	**Test Execution date: 29/12/2022**
Description: Test Create Pay Rate with invalid data	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Pay Rate page	Pay rate ID: PRATE00001 Pay Rate Name Overtime Pay Rate Pay rate per hour 0 Company ID GoodSmile	Pay rate cannot be created	An error message “pay rate per hour cannot be 0” will be displayed	Pass	
2	Press Create Pay Rate Button					
3	Provide Pay rate Name					
4	Provide Pay rate per hour					
5	Select Company					
6	Click Create Button					

Post-conditions: An error message “pay rate per hour cannot be 0” will be displayed

Test Case ID: TC_018	**Test Designed by: Teo Jian Xiang**
Test Priority (Low/Medium/High): Medium	**Test Designed date: 29/12/2022**
Module Name: View all Pay rate	**Test Executed by: Teo Jian Xiang**
Test Title: Verify View Pay rate	**Test Execution date: 29/12/2022**
Description: Test View Pay rate	

Pre-conditions: Login To Admin Account

Step	Test Steps	Test Data	Expected Result	Actual Result	Status (Pass/Fail)	Notes
1	Navigate to Pay rate page		All the Pay rate of the company under the account in database will be displayed	All the Pay rate of the company under the account in database will be displayed	Pass	

Post-conditions: All the Pay rate of the company under the account in database will be displayed

4.5 Chapter Summary and Evaluation

To summarise, this chapter explained the underlying framework and data structure used by the HRMS, which are ASP.NET Core version 7.0, Entity Framework Core and SQL database. How certain functions are implemented are also demonstrated, with support from external dependencies such as Cronos and Sendgrid. Code snippets are also provided for further clarification.

The chapter also informed readers about the test plan planned for the system, which is black-box testing because it is less time consuming and focuses on user interaction. The test data required for the testing of the various functions are also described in this chapter. Finally, a collection of test case, with detailed description of actions to be taken, expected results and whether it passes is provided.

Chapter 6 *(if applicable)*

System Deployment

5 System Deployment

This chapter describes the steps taken to ensure the system can be deployed, implemented and utilised with minimal friction at site of choice. It will first describe how system backup and risk of system failure are managed. Then, it will describe the steps needed to set up the system on-site as well as system training planned to be carried out for the users. Finally, follow-up procedures will be proposed and discussed for possible changeover.

5.1 System Backup and Risk Management

The entire project is uploaded to a Git repository to ensure that the system can recover from catastrophic failure in the event of issues caused by modifications in newer versions. A full system restore is possible since the repository retains account of all previous versions and changes made to the project. A new branch extracted from the master branch can be used as the foundation for any planned switch. A merge request can be filed to update the master branch once the new branch has been tried out and proven to work. The master branch can be degraded into a lower commit version if the branch contains a lot of mistakes.

5.2 On-site Setup

The system will only require a minimal amount of setup work before it can be used in the company. To make the most recent version of the website accessible to all the company and employee members, it only has to be uploaded to a Microsoft Azure server or other cloud platform. A new Microsoft Azure database must be created, and the system must be modified to use the new connection string, if a firm requires a standalone system that is distinct from the one used by several companies.

5.3 Training Procedure

For those granted manager privileges, we can create a guidebook detailing how to actually manage the system. This guide can also include quick start guides on how to set up preset templates, including created companies and roles that users can modify as needed.

For employees without administrative privileges, a simple demonstration video is sufficient to detail the common processes that employees will use, such as confirming emails, filling out personal information, requesting leave, and checking attendance.

5.4 Follow-up

Follow-up meetings can be held every month to gauge user satisfaction with the current system and determine whether more transitions are necessary. If users are not pleased, more requirements might be obtained and prepared for inclusion in subsequent iterations. The follow-up meetings can be spaced out if no transitions are required, starting with one every two months, moving up to one every six months, and finally only holding meetings when users desire them.

5.5 Chapter Summary and Evaluation

This chapter explained that the system source code, including previous versions of the system are stored and maintained on a Git repository. The Azure database also utilises geo-redundant backup storage, which means data copies are preserved across regions. These greatly reduce the risk of system failure and data loss.

Following that, the chapter also explained that little setup effort is needed to set up a system for usage since it is already uploaded to a Microsoft Azure server. As for training the employees, a guidebook explaining concepts new to HRMS will be provided for employees. To increase efficiency of learning, a video presentation demonstrating common processes such as attendance tracking will be given as well. Follow-up meetings will conducted once per month to gather feedback and plan for further improvements.

Chapter 7

Discussions and Conclusion

6 Discussions and Conclusion

6.1 Summary

In conclusion, the project's goal was to address the issues with HRM, including its rigidity, steep learning curve, and passive nature. Therefore, a cloud-based analytical HRM system was proposed as a project. The system's goals are to reduce hardware costs, make it simple to use, give precise productivity tracking, and be adaptable. The project has been divided into three segments, each segment handled by a team of two members. The report primarily focuses on the website and backend team, which handles backend coding and API providing to the mobile team.

A brief literature review was given on the concepts of HRMS and its importance and details about HR Analytics in previous research works. Notable real life implementations of HR Analytics are also given.

The methodology used to develop this project is the Agile Model, which gives the user a great amount of involvement in this user-centric system. By conducting interviews with the executive of our industrial project's requester, the team is able to elicit the functional requirements and non-functional requirements expected from the system.

The system will include 11 modules in order to satisfy the functional required set for the system. Those modules are workforce management, shift management, leave self-service, dashboard analytics, training module, payroll module, admin management, company management, benefits and compensation, reporting and role management. The system will be built in monolith form and using the ASP. NET Core MVC framework.

For the implementation, the system is coded in ASP. NET Core 7.0, where the system is split into models, controllers and views. We are using SQL database tables for the database used and hosted on Microsoft Azure's server and maintained using Entity Framework Core. Authentication and authorization of users are implemented using ASP. NET Core Identity, which maintains user, passwords and role-based access level control. API for the mobile team are also implemented. Several external libraries are used, including Cronos, a library that enables periodically executing a specific function and SendGrid, which makes sending confirmation email possible. The testing of the system primarily uses black-box testing strategy, and multiple use cases have been executed to ensure the quality of the system.

To ensure that the system can recover from disastrous failure, all versions of the software system are saved in a Git repository. The database on Microsoft Azure also uses geo-redundant backup storage, which could prevent data loss even under region wide datacenter failure. To

implement the system, it merely needs to be uploaded to a Microsoft Azure server or any other cloud platform. Training can be given in the form of a guidebook for upper management to understand the concepts that are relatively new. For normal employees, a simple presentation video will be sufficient to guide them on common processes in the web system.

6.2 Achievements

The original objectives laid out for this project are lower hardware costs and ease of access, The completion of this project has achieved these objectives in various ways.

6.2.1 Lower Hardware Cost

Since the web system is hosted on Microsoft Azure server or other cloud platform that supports ASP.NET Core web applications, there is no need for any investment in physical hardware. In addition, the database is also hosted on a Microsoft Azure server, which means there is no need for supporting maintenance-expensive data servers. Furthermore, the HRMS also supports multiple companies. As long as technical limitations do not affect performance, organizations hosting HRMS can allow any number of businesses to use HRMS, avoiding the cost of deploying HRMS across multiple businesses. Thus, it is evident that this project has successfully lowered the hardware costs for implementing HRMS.

6.2.2 Ease of Access

Since the web system is hosted on a Microsoft Azure server, employees can access the HRMS anywhere they want on any devices. The mobile application further provides ease of access by eliminating the need of accessing the web system to use the HRMS. Mobile applications on mobile devices may be easier to use than accessing the website through a browser, lowering the difficulty of using the HRMS. Since the mobile application also operates on the same database as the web system via the API, the data is synchronized across both platforms. Employees may perform a task on the mobile application and resume it on the web application if needed. Thus, it is evident that the HRMS has successfully provided ease of access to its users.

6.3 Contributions

Shift management, attendance tracking and leave self-service remains the primary innovation done in this HRMS project compared to other software on the market. The creativity of tracking attendance individually based on duration that takes into account shift assigned and leave applied grants the HRMS a competitive advantage over other software currently available on the market. It allows much needed flexibility for shift-based industries such as manufacturing companies and construction companies that prefer to track pay by shifts that only last a few hours. Thus, it is

presumed that the HRMS will contribute the most towards shift-based industries and will be well received by the market there.

Current workforce management module of the system allows for employees to be placed under another employee without restriction of roles, which allows for multiple types of organization chart possible. The role management system also introduced role based authorization, which restricts what a user can do based on the role given to him and permissions given to that role. Thus, flexibility on how the organization is structured is guaranteed while not compromising the system's security measures.

Aside from that, the HRMS is also a cloud-based application that syncs with a mobile application. With the ability to support multiple companies, organizations which own multiple companies will benefit from the HRMS, as a single software allows for unity and standardization. As most of the features are also accessible through the mobile application, employees that do not own a laptop can also use the HRMS effectively. All in all, the HRMS introduced multiple new concepts to how a workforce can be managed, such as shift and leave by hours.

6.4 Limitations and Future Improvements

Although the project can be stated as complete and quite successful, several limitations remain in the system.

6.4.1 Potential Of Improvement: Auto Assign Employee To Shift

In HRMS, we have used the algorithm to allow the system to have the functionality of assigning employees to shift automatically. This algorithm will select all the available employees for the shift and assign them to the shift based on their attendance in the month. Based on the algorithm we implemented for this function, the system may require more time for this function. For example, if you want the system to assign two employees into the system, the system may require 1-2 minutes to finish the task. To improve upon the issue, we can implement an efficient algorithm in the future.

6.5 Issues and Solution

Several issues were faced during the implementation of this system. However, these issues are handled correctly and eventually solved without critically affecting the progress of the project.

6.5.1 Miscommunication of Functional Requirements

The first issue is miscommunication of functional requirements of both the web system and mobile application between the web system team and mobile application team. The requirements stated by both parties demanded features from the opposite party that are not

originally in the party's project scope. For example, the mobile application team assumed that signing up as an employee is possible, however the web system team assumed that employees can only be created via the web system only by another employee with permission. The required API was not provided, and it causes conflicts between both parties' requirements. Another example would be different assumptions on how cross-platform processes such as attendance tracking and shift assignment would work by both parties. If unreconciled, it could lead to two different systems instead of the same system supported by both applications.

To solve the issue of miscommunication, both parties decided to enhance our communication rate by conducting regular meetings where both parties would discuss conflicts within the requirements or general questions about how things actually work. Diagrams such as process flow would be drawn to further clarify how both parties would handle a cross-platform process request. By brainstorming ideas and compromise from both parties, the requirements of both systems are able to be standardized, with an agreed version of project scope. Further conflicts would go through the same process, meeting, brainstorming and providing solutions. With this, the issue is effectively solved without further action needed.

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Appendices