

A WEB BASED TEACHERS' PAYROLL MANAGEMENT SYSTEM FOR SECONDARY SCHOOLS IN UGANDA

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DECLARATION

We, as Group 2 hereby declare that this project report titled **A Web-Based Teachers' Payroll Management System for Secondary Schools in Uganda** is our original work and has not been submitted to any other institution for any academic award. All materials consulted during the development of this study has been duly acknowledged and referenced in accordance with academic standards.

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DEDICATION

This project is dedicated to my family for their continuous support, encouragement, and motivation throughout my academic journey. It is also dedicated to educational institutions striving to adopt technological solutions to enhance administrative efficiency and financial accountability.

ACKNOWLEDGEMENT

We express our sincere gratitude to God for granting us the strength, wisdom, and perseverance to successfully complete this project.

We also extend our sincere gratitude to our supervisor for the professional guidance, technical insight, and constructive feedback provided throughout the development of this project. The continuous mentorship and academic support greatly contributed to the successful completion of this study.

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Finally, we acknowledge our colleagues and friends for their encouragement, and our families for their unwavering moral and financial support throughout the course of this project.

List of Acronyms

API	Application Programming Interface.
CSS	Cascading Style Sheets.
DBMS	Database Management System.
ERD	Entity Relationship Diagram.
HR	Human Resource.
HTML	HyperzText Markup Language.
ICT	Information and Communication Technology.
JWT	JSON Web Token.
MFA	Multi-Factor Authentication.
NSSF	National Social Security Fund.
OTP	One-Time Password.
PAYE	Pay As You Earn.
PDF	Portable Document Format.
RBAC	Role-Based Access Control.
REST	Representational State Transfer.
SQL	Structured Query Language.
UAT	User Acceptance Testing.
UI	User Interface.
URL	Uniform Resource Locator.

Table of content

DECLARATION	2
ACKNOWLEDGEMENT	4
Table of content	6
ABSTRACT	8
1.1 Background of the Study	10
1.2 Problem Statement.....	12
1.3 Main Objective	12
1.4 Specific Objectives	12
1.5 Scope of the Study	12
1.6 Significance of the Study	13
CHAPTER TWO	13
2.1 Introduction.....	13
2.2 Concept of Payroll Management Systems.....	14
2.3 Traditional Payroll Systems.....	15
2.3.1 High Risk of Errors.....	15
2.3.2 Time Consuming Processes	15
2.3.3 Lack of Data Security	15
2.3.4 Limited Reporting Capabilities.....	16
2.3.5 Fragmented Data Storage.	16
2.4 Automated Payroll Systems.....	16
2.4.1 Improved Accuracy	16
2.4.2 Faster Payroll Processing.....	16
2.4.3 Improved Compliance with Regulations	17
2.4.4 Enhanced Record Keeping	17
2.4.5 Improved Reporting.....	17
2.5 Web-Based Payroll Systems.....	17
2.6 Role-Based Access Control in Payroll Systems	18
2.7 Database Management Systems in Payroll Applications	19
2.8 Security Considerations in Payroll Systems	20
2.9 Empirical Review of Related Studies	21
2.10 Research Gap.	21

CHAPTER THREE	21
METHODOLOGY	21
3.1 Introduction	21
3.2 Research Design	22
3.3 System Development Methodology	22
3.4 Advantages of Agile Methodology	23
3.5 Data Collection Methods	23
3.5.1 Interviews	23
3.5.2 Observation.	23
3.5.3 Document Review.	24
3.6 System development phase	24
3.6.1 Functional Requirements	24
3.6.2 Non-Functional Requirements	25
3.7 System Design	25
3.7.1 System Architecture.....	26
3.7.2 Database Design	26
3.7.3 Use Case Design	27
3.8 System Development Tools and Technologies.....	29
3.9 System Implementation	29
3.10 System Testing.....	29
3.11 Ethical Considerations	29
4.1 Introduction.....	31
4.2 System Implementation Overview	31
4.3 System User Roles.....	32
4.4 System Authentication.....	32
4.4.1 Multi-Factor Authentication (MFA).....	33
4.5 System Administrator Dashboard.....	33
4.6 Teacher Management Module	33
4.7 Salary Structure Configuration.....	34
4.8 Payroll Processing Module.....	35
4.9 Payslip Generation.....	36
4.10 Payroll Reporting.....	37

4.11 Notification System	37
5.1 Introduction.....	40
5.2 Summary of the Study	40
5.3 Achievement of Project Objectives	41
5.5 Limitations of the Study	42
Limited Access to Real Payroll Data.....	42
Time Constraints.....	42
Limited System Integration	42
5.6 Recommendations.....	42
6.0 REFERENCES	43

ABSTRACT

Payroll management is a critical administrative function in educational institutions, directly affecting financial accountability and staff satisfaction. In many private secondary schools in Uganda, payroll operations are still managed manually or through spreadsheet-based systems, which are prone to computational errors, delayed salary processing, weak audit controls, and inadequate compliance tracking.

This project presents the design and development of EduPay, a web-based Teachers' Payroll Management System developed to automate salary processing and improve payroll accuracy, security, and transparency. The system is implemented as a monolithic web application using Node.js and Express.js for backend processing, PostgreSQL for relational database management, and HTML, CSS, and JavaScript for the frontend interface. It is deployed on the DigitalOcean App Platform with secure environment configuration.

EduPay implements role-based access control (RBAC) supporting system administrators, human resource personnel, accountants, and teachers. The system incorporates secure authentication using JSON Web Tokens (JWT) and supports multi-factor authentication (MFA) to enhance access security. Core features include automated salary computation, configurable salary structures, statutory deduction calculations (PAYE and NSSF), structured payroll approval workflow, salary advance and leave management, Excel and PDF report generation, individual payslip generation, notification handling, and comprehensive audit logging.

Payroll processing is executed within PostgreSQL transactions to ensure atomicity, consistency, and data integrity. The system enforces payroll lifecycle states (processed, approved, paid) and maintains immutable payroll records for traceability. Additional security mechanisms include bcrypt password hashing, parameterized SQL queries to prevent injection attacks, HTTPS enforcement, and role-based middleware protection.

System evaluation using simulated payroll data demonstrated high computational accuracy, reliable workflow management, improved data security and enhanced reporting capabilities. Although features such as attendance integration and advanced tax band computation remain areas for future enhancement, the developed system successfully achieves its objective of automating

payroll management while improving efficiency, accountability, and institutional transparency in Bishop Senior secondary Mukono.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Payroll management is a fundamental administrative process within any organization, including educational institutions. It involves calculating employee earnings, applying statutory deductions, maintaining financial records, and ensuring timely salary disbursement. In secondary schools, teacher salaries constitute a significant proportion of operational expenditure. Therefore, accuracy, efficiency, and accountability in payroll management are essential for institutional sustainability and staff morale. Traditionally, many private secondary schools in Uganda rely on manual payroll systems or spreadsheet-based solutions. These systems require repetitive data entry, manual formula maintenance and continuous reconciliation between employee records, salary structures and deductions. Such processes are time consuming and highly susceptible to arithmetic errors, data inconsistencies, duplication and unauthorized alterations. In addition, these approaches often lack proper audit mechanisms and structured workflows, making it difficult to enforce accountability and transparency in payroll processing.

The rapid advancement of information and communication technologies has led to the adoption of web-based payroll management systems that automate salary computation, centralize data storage, and enhance operational efficiency. These systems support multi-user access with defined roles and permissions, enabling controlled interaction with payroll data. Furthermore, modern systems incorporate security features such as authentication mechanisms, role-based access control and audit logging to safeguard sensitive financial information.

Recent developments in web technologies have also enabled the integration of advanced features such as application programming interfaces (APIs), transactional data processing, and multi-factor authentication (MFA), which significantly improve system reliability, scalability, and security. These features allow payroll systems to enforce structured workflows, maintain data integrity, and provide real-time reporting capabilities. The increasing adoption of internet technologies and cloud-based platforms in Uganda presents an opportunity for private secondary schools to modernize their administrative processes. By transitioning from manual systems to secure web-

based solutions, schools can improve payroll accuracy, reduce administrative workload, and enhance financial transparency.

This study therefore focuses on the design and development of EduPay, a secure, scalable, and efficient web-based Teachers' Payroll Management System tailored to the operational needs of Bishop Senior secondary Mukono. The system leverages modern web technologies, database management systems, and security mechanisms to provide an automated and reliable payroll solution.

1.2 Problem Statement

Despite technological advancements, many private secondary schools continue to experience challenges in managing payroll operations. Many private schools continue using manual or spreadsheet-based payroll systems. This causes limited digital adoption and manual data entry processes, poor integration between attendance and payroll records, lack of centralized payroll databases.

Only 50% of private schools adopted digital systems (InsightPostUG, 2023). This leads to salary delays, deduction errors and administrative workload. Limited transparency and poor financial reporting resulting in teacher dissatisfaction and financial mismanagement risk.

1.3 Main Objective

To develop a robust web-based payroll management system that automates teacher salary processing, improves computational accuracy, ensures statutory compliance and enhances operational efficiency in private secondary schools.

1.4 Specific Objectives

- To analyze the existing payroll processes in secondary schools.
- To design a secure system architecture for payroll automation.
- To implement automated salary computation and deduction logic.
- To develop structured payroll reporting and payslip generation features.
- To evaluate system performance based on accuracy, usability, compliance, reporting and security.

1.5 Scope of the Study

The study focuses on the design and development of a web-based payroll management system for teachers in secondary schools. The system includes, User account management, Teacher and accountant management, Salary structure configuration, Payroll processing and approval workflow, statutory deduction computation, Report generation (Excel and PDF), Payslip generation, Notification management and Audit logging

The study does not cover; Student management systems, Library or academic modules and Attendance integration (planned for future development)

1.6 Significance of the Study

The significance of this study lies in its contribution to improving administrative efficiency within educational institutions. Specifically the system; Reduces payroll computation errors, Enhances financial accountability, Improves compliance with statutory regulations, Minimizes administrative workload, Provides secure centralized payroll data management and Enhances transparency through audit logging.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews existing literature related to payroll management systems, focusing on their importance, evolution, and technological implementation in organizations and educational institutions. The chapter examines key concepts such as payroll management, automated payroll systems, web-based information systems, and database management systems. It also reviews related empirical studies on payroll automation and employee management systems.

The purpose of this literature review is to establish the theoretical and technological foundation for the development of the proposed Web-Based Teachers' Payroll Management System for Bishop's Senior Secondary Mukono. By examining existing studies and technologies, the chapter highlights the limitations of traditional payroll systems and identifies the need for improved automated solutions tailored to educational institutions.

2.2 Concept of Payroll Management Systems

Payroll management is a crucial administrative process in organizations that involves calculating employee salaries, managing deductions, maintaining financial records, and ensuring timely salary payments. According to Armstrong (2016), payroll management plays a central role in human resource management because it directly affects employee satisfaction and organizational financial accountability.

In educational institutions such as secondary schools, payroll management is particularly important because teachers' salaries constitute a large proportion of institutional operational expenses. Efficient payroll management ensures that teachers are compensated accurately while maintaining transparency in financial records.

Payroll systems generally perform several core functions including; Calculation of employee earnings, Management of allowances and benefits, Application of statutory deductions such as taxes and pension contributions, Generation of payroll reports and Issuance of employee payslips

According to Dessler (2017), payroll management systems are designed to streamline salary processing by automating calculations and maintaining structured employee records. The use of computerized payroll systems reduces administrative workload and minimizes errors associated with manual salary calculations.

However, in many developing countries, like Uganda, many educational institutions still rely on manual payroll systems or spreadsheet-based payroll management methods, which often lead to inefficiencies and inaccuracies.

2.3 Traditional Payroll Systems

Traditional payroll systems involve manual methods of calculating employee salaries and maintaining payroll records. These systems typically rely on handwritten salary sheets, attendance registers, or spreadsheet software such as Microsoft Excel.

According to Tushabe (2021), many private secondary schools in Uganda still use manual payroll processing methods due to limited technological infrastructure and lack of specialized payroll software. While spreadsheets provide basic computational capabilities, they still require manual data entry and formula management.

Manual payroll systems present several challenges.

2.3.1 High Risk of Errors

Manual payroll calculations increase the likelihood of arithmetic mistakes and incorrect salary computations. Even small errors in formulas can result in inaccurate salary payments.

According to Laudon and Laudon (2018), manual data processing systems are highly susceptible to human error, particularly when dealing with complex financial calculations such as tax deductions and allowances.

2.3.2 Time Consuming Processes

Payroll processing requires significant time when calculations are performed manually. Payroll administrators must verify employee details, calculate deductions, and prepare payslips individually. This process becomes even more complicated when dealing with large numbers of employees.

2.3.3 Lack of Data Security

Manual payroll systems provide limited data security since payroll records may be stored in physical documents or unsecured spreadsheets. Unauthorized access to such records can compromise employee confidentiality.

2.3.4 Limited Reporting Capabilities

Manual payroll systems make it difficult to generate detailed financial reports. Administrators often need to manually compile payroll summaries, which increases workload and delays financial reporting. Due to these limitations, organizations increasingly adopt automated payroll systems to improve efficiency and accuracy.

2.3.5 Fragmented Data Storage.

Traditional payroll systems often suffer from fragmented or decentralized data storage, where payroll-related information is kept in different locations such as attendance registers, finance records, and personnel files. This lack of centralized data management leads to inconsistencies, duplication of records, and difficulties in verifying employee information.

According to Laudon and Laudon (2018), information systems without centralized databases often face challenges in data integration, which affects accuracy, efficiency, and decision-making

2.4 Automated Payroll Systems

Automated payroll systems are software applications designed to handle payroll operations electronically. These systems perform salary calculations automatically based on predefined rules and employee data.

According to Alvi and Ahmad (2017), automated payroll systems significantly improve payroll processing efficiency by reducing manual intervention and minimizing computational errors. Automated payroll systems provide several advantages.

2.4.1 Improved Accuracy

Automated payroll systems use predefined algorithms and validated business rules to compute salaries, deductions, and allowances with a high degree of consistency and precision. This significantly reduces human errors associated with manual calculations, ensures uniform application of payroll policies, and enhances the overall reliability and integrity of payroll data.

2.4.2 Faster Payroll Processing

Payroll tasks that previously required several hours or days to complete can now be processed within minutes using automated systems, significantly improving efficiency and reducing administrative workload.

2.4.3 Improved Compliance with Regulations

Automated payroll systems can automatically calculate and apply statutory deductions such as Pay As You Earn (PAYE) tax and National Social Security Fund (NSSF) contributions, thereby ensuring consistent compliance with government regulations and reducing the risk of calculation errors or non-compliance.

2.4.4 Enhanced Record Keeping

Automated systems store payroll records in centralized databases, enabling efficient storage and easy retrieval of historical salary information. This enhances data integrity, supports auditing processes, and ensures that payroll records are readily available for compliance verification and administrative review.

2.4.5 Improved Reporting

Payroll systems can generate structured and detailed reports, including payroll summaries, deduction reports, and salary analysis reports, which support effective financial monitoring, auditing, and decision-making. In addition, audit logs can be maintained to record system activities and changes, such as salary adjustments, payroll processing actions, and user access events. This enhances transparency, accountability, and traceability within the payroll system.

2.5 Web-Based Payroll Systems

Web-based payroll systems are payroll management applications accessed through internet browsers. These systems allow users to interact with payroll software remotely without installing additional programs. According to Sommerville (2015), web-based systems offer flexible access because users can interact with centralized databases through web browsers from different locations using any device with internet connectivity, such as computers, tablets or smartphones

Web-based payroll systems provide several advantages such as:

Accessibility. Users can access the system from any location with internet connectivity, using devices such as computers, tablets, or smartphones, which enhances flexibility and convenience.

Centralized Data Management. All payroll data is stored in a centralized database, ensuring consistency, reducing data duplication, and improving the accuracy and reliability of employee records. This centralized approach also simplifies data management and retrieval processes.

Real-Time Updates. Any changes made within the system by authorized users are updated instantly and reflected across all modules. This ensures that payroll information remains current, accurate, and synchronized for all users.

Improved Collaboration. The system supports multiple users such as administrators, accountants, and teachers who can interact with the platform simultaneously based on their assigned roles. This improves coordination, communication, and efficiency in payroll operations.

Enhanced Accountability through Audit Logs. Web-based payroll systems improve transparency and accountability by maintaining audit logs that record all system activities, including payroll processing actions, salary adjustments, and user access events. These logs enable administrators to track changes, monitor user actions, and detect unauthorized activities, thereby strengthening system integrity and supporting auditing and compliance requirements.

These characteristics make web-based payroll systems particularly suitable for educational institutions where different users require different levels of access to payroll information.

2.6 Role-Based Access Control in Payroll Systems

Role-Based Access Control (RBAC) is a fundamental security mechanism used in modern information systems, particularly in payroll systems where sensitive financial and personal data is handled.

Payroll systems store critical information such as employee salaries, bank details, and tax records. Unauthorized access to such data can lead to financial loss, privacy violations, and fraud. Therefore, strong access control mechanisms are essential (Stallings, 2018).

RBAC is a security model that restricts system access based on predefined user roles. According to Sandhu et al. (1996), RBAC simplifies security management by assigning permissions to roles rather than individual users, making it easier to enforce organizational policies and maintain system integrity.

In a typical payroll system, users are grouped into roles, each with specific permissions:

Role	Responsibility
System Administrator	Manages system configuration, user accounts, and overall system control
Human Resource (HR)	Manages employee records, approves payroll, and handles leave and salary advance requests
Accountant	Processes payroll, calculates salaries, and generates financial reports
Teacher	Views personal salary information and downloads payslips

Each user is assigned a role, and the system ensures that users can only perform actions permitted within that role. For example, a teacher cannot access other employees' salary data, while an accountant cannot modify system configuration settings, and HR personnel cannot perform system-level administrative tasks.

The implementation of RBAC in payroll systems provides several benefits:

- Enhances data security by limiting unauthorized access
- Reduces the risk of internal misuse of sensitive information

- Simplifies user management through role assignment
- Supports accountability by clearly defining user responsibilities

Overall, RBAC plays a critical role in ensuring that payroll systems remain secure, organized, and compliant with data protection requirements (Ferraiolo, Kuhn & Chandramouli, 2007).

2.7 Database Management Systems in Payroll Applications

Payroll systems require reliable data storage mechanisms to maintain employee records and financial information. Database Management Systems (DBMS) provide structured data storage and efficient data retrieval capabilities.

According to Elmasri and Navathe (2016), relational database systems organize data into tables connected through relationships using primary and foreign keys.

Benefits of using database systems in payroll applications includes, Improved data consistency, Reduced data redundancy, Enhanced data integrity and Efficient querying of payroll information

PostgreSQL is one of the most widely used open-source relational database systems due to its reliability, scalability and support for advanced SQL queries.

Using a relational database enables payroll systems to manage large volumes of employee data efficiently.

2.8 Security Considerations in Payroll Systems

Payroll systems store sensitive financial information including employee salaries, tax deductions, and personal identification data. Therefore, implementing strong security measures is essential.

According to Stallings (2018), secure information systems should incorporate authentication, encryption, and access control mechanisms.

Important security practices in payroll systems includes:

Password Encryption. Passwords should be stored using secure hashing algorithms such as bcrypt to prevent unauthorized access.

Authentication. Authentication verifies the identity of system users before granting access.

Authorization. Authorization determines what actions users are allowed to perform within the system.

Audit Logging. Audit logs record system activities such as payroll processing and user login attempts. The logs help administrators track system usage and detect suspicious activities.

Implementing these security mechanisms improves the reliability and trustworthiness of payroll systems.

2.9 Empirical Review of Related Studies

Several studies have examined payroll automation in organizations. Okello (2020) conducted a study on computerized payroll systems in educational institutions and found that automated payroll systems significantly reduce salary-processing time and improve financial record management.

Nsubuga (2019) studied payroll management systems used in small organizations and concluded that automated payroll systems improve transparency and reduce payroll errors.

Similarly, Kato (2021) evaluated payroll systems used in private companies and reported that automated payroll solutions improve reporting capabilities and simplify financial auditing processes. While these studies demonstrate the benefits of payroll automation, many existing systems are designed for corporate environments and may not address the unique requirements of educational institutions such as private secondary schools.

2.10 Research Gap.

Although several payroll systems exist, many of them are designed for large organizations and require significant financial investment and technical expertise. Private secondary schools often operate with limited administrative resources and therefore require simpler and more affordable payroll systems tailored to their operational needs. Additionally, many existing payroll systems lack integration with teacher-specific requirements such as salary scale management, teacher payroll reporting, and secure access to payslips.

Therefore, there was a need to design and develop a customized payroll management system that addresses the specific payroll management challenges faced by secondary schools.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the research methodology used in the development of the EduPay Web-Based Teachers' Payroll Management System. It outlines the research approach, system development methodology, data collection techniques, system requirements, system design, and technologies used in the implementation of the system.

The methodology explains how the study was conducted to achieve the objective of developing a secure, reliable, and efficient payroll management system for teachers in secondary schools. It also describes how system requirements were identified, how the system was designed, implemented, and tested.

3.2 Research Design

The study adopted a system development research design, which focuses on designing and implementing a technological solution to solve a specific organizational problem.

According to Creswell (2014), research design refers to the overall strategy used to integrate different components of a study in a logical and coherent manner. In this study, the research design involved analyzing existing payroll systems in secondary schools and developing an automated web-based solution to improve efficiency, accuracy and transparency.

The research design included the following activities.

- Studying the existing payroll systems used in Bishop's Senior Secondary Mukono.
- Identifying challenges associated with manual payroll processing
- Designing an improved automated payroll system
- Implementing and testing the developed system

This approach enabled the development of a practical and functional solution to payroll management challenges.

3.3 System Development Methodology

The development of the EduPay system followed the Agile Software Development Methodology. Agile is an iterative approach that emphasizes incremental development, collaboration, flexibility and continuous improvement (Sommerville, 2015).

Agile was selected because it allows the system to be developed in smaller modules, tested frequently and improved based on feedback during development.

3.4 Advantages of Agile Methodology

The Agile methodology was suitable for this project because it supports gradual system development, enables continuous testing and improvement, allows quick identification and correction of errors and provides flexibility to adapt to changing requirements

Agile Development Phases Used Requirements Analysis, System Design, System Development, System Testing and System Deployment. Each phase contributed to the successful implementation of the system.

3.5 Data Collection Methods

Data collection was conducted to understand existing payroll management practices in secondary schools like Bishop's Senior Secondary Mukono.

3.5.1 Interviews

Interviews were conducted with school administrators, HR personnel, and accountants responsible for payroll management. The interviews focused on salary calculation methods, types of allowances provided, salary deductions (PAYE, NSSF, loans) and challenges faced in manual payroll processing. These interviews provided insights into real-world payroll challenges.

3.5.2 Observation.

Observation was used to study how payroll processes are carried out in schools. It was observed that payroll processing involved manual data entry and spreadsheet-based calculations. This revealed inefficiencies such as repetitive calculations, errors, and lack of structured workflows.

3.5.3 Document Review.

Payroll-related documents such as salary records and spreadsheets were reviewed to understand salary structures. The documents provided information about; Salary scales, Allowances and Deduction policies. This information helped define system requirements.

3.6 System development phase.

Phases of EduPay System Development

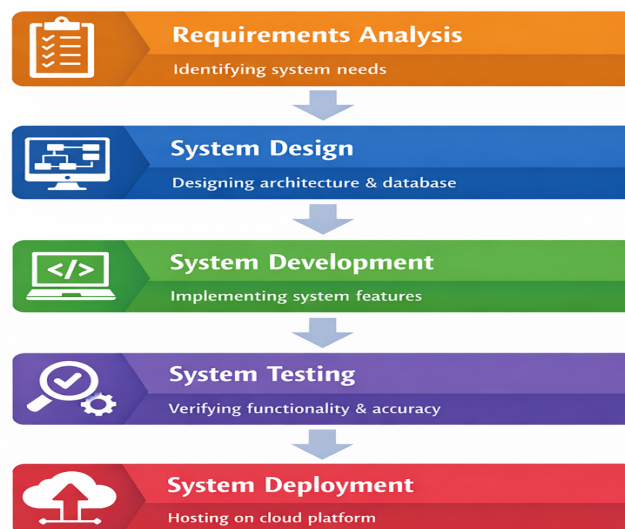


Figure 1 Showing system development phases

3.6.1 Functional Requirements

Functional requirements describe the operations the system must perform.

User Management. The system allows administrators to create user accounts (Administrator, HR, Accountant and Teacher), Edit user information, Reset passwords and Activate or deactivate accounts

Human Resource Management. The system allows HR officers to register teachers, update teacher records, assign salary structures and manage leave and salary advance requests

Teacher Management. The system allows authorized users to add teacher records, update teacher information and delete teacher records

Payroll Processing. The system allows accountants to process monthly payroll, automatically calculate salaries, apply deductions such as PAYE and NSSF and submit payroll for approval

Payroll Approval. The system allows HR officers to review and approve processed payroll before finalization.

Payslip Generation. The system generates digital payslips in PDF format for teachers.

Reporting. The system generates payroll reports including payroll summaries, Excel reports and PDF reports

Notification System. The system sends notifications when Payroll is approved, Payslips are generated and Salary updates occur

3.6.2 Non-Functional Requirements

Security.

The system must support secure authentication using JWT and Multi-Factor Authentication (MFA) and enforce role-based access control.

Performance. The system should efficiently process payroll for multiple teachers.

Reliability. The system must ensure accurate payroll records and prevent data loss.

Usability. The system interface must be user-friendly for all roles.

Scalability. The system should support increasing numbers of users and teachers.

3.7 System Design

This section describes the structural design of the EduPay system, including its architecture, database structure, and interaction between system components. The design ensures that the system meets functional and non-functional requirements such as scalability, security, and performance.

3.7.1 System Architecture

The EduPay system follows a three-tier architecture:

Presentation Layer: The user interface developed using HTML, CSS, and JavaScript, accessed through web browsers.

Application Layer: Implemented using Node.js and Express.js, this layer handles business logic, authentication (JWT), MFA verification, and payroll processing.

Data Layer: Uses PostgreSQL to store user accounts, teacher records, payroll data, salary structures, notifications, and audit logs.

3.7.2 Database Design

An ERD showing entity relationships

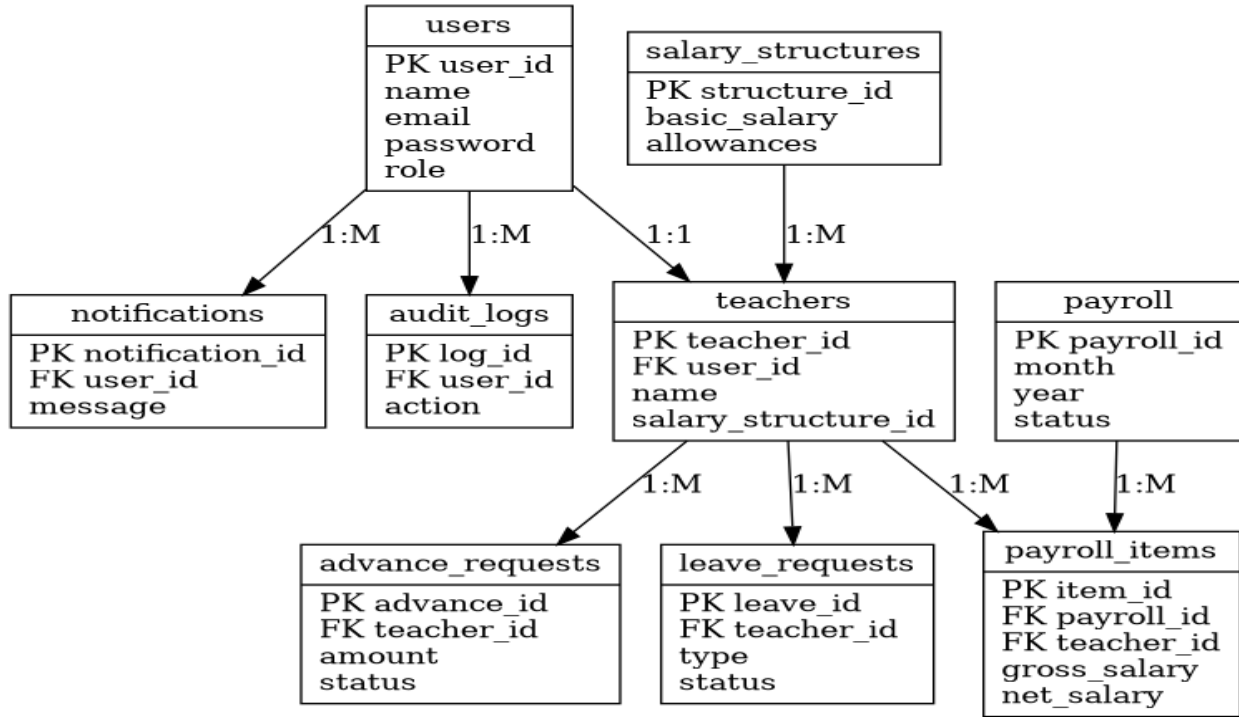


Figure 2 Showing ERDs designs

The system uses a relational database structure with the following tables

Table	Description
Users	Stores all system users and roles
Teachers	Stores teacher information
Salary Structures	Stores salary configurations
Payroll	Stores payroll records
Payroll Items	Stores salary breakdown
Notifications	Stores system notifications
Audit Log	Stores system activity logs
Leave Requests	Stores leave applications
Salary Advances	Stores salary advance requests

3.7.3 Use Case Design

The system includes four main actors: Administrator, HR Officer, Accountant, and Teacher.

System Administrator Functions: Manage users, Configure system settings, Monitor audit logs

Perform backups

HR Officer Functions. Manage teacher records, Configure salary structures, Approve payroll

Manage leave and salary advances

Accountant Functions. Process payroll, Apply salary calculations and Generate reports

Teacher Functions. View profile, View salary details, Download payslips and Submit leave and salary advance requests.

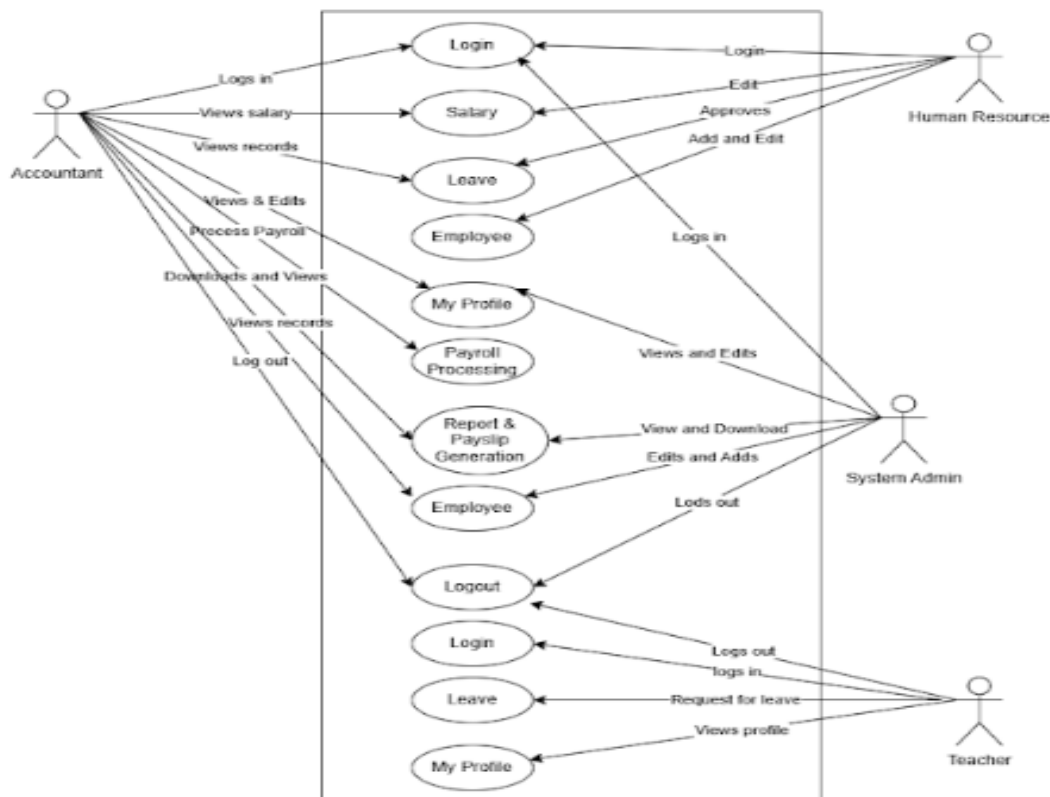


Figure 3 Showing use case diagrams

3.8 System Development Tools and Technologies

Technology	Purpose
Node.js	Backend runtime
Express.js	Web framework
PostgreSQL	Database
JavaScript	Client-side scripting
HTML	Structure
CSS	Interface design
DigitalOcean	Hosting platform

Figure 4 Table showing development tools and technologies

3.9 System Implementation

The system was implemented as a web-based application using Node.js and Express.js for backend development. RESTful APIs were used to handle communication between frontend and backend. The frontend was developed using HTML, CSS, and JavaScript. PostgreSQL was used for data storage. The system was deployed on DigitalOcean, making it accessible via the internet.

3.10 System Testing

The following testing methods were used:

Unit Testing. Individual components such as payroll calculations were tested.

Integration Testing. System modules were tested together to ensure proper interaction.

User Acceptance Testing. Sample data was used to verify system functionality and accuracy.

3.11 Ethical Considerations

Confidentiality of payroll data was maintained throughout the study. Simulated data was used during testing to avoid exposure of sensitive information. Security measures such as password encryption, JWT authentication, Multi-Factor Authentication, and role-based access control were implemented to protect system data.

CHAPTER FOUR

SYSTEM IMPLEMENTATION, PRESENTATION AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter presents the implementation of the EduPay Web-Based Teachers' Payroll Management System and discusses the results obtained after system development and testing. It explains how the system was implemented, the system architecture, user interfaces, core functionalities and evaluation results.

The chapter also demonstrates how the system addresses challenges identified in current payroll systems used in Bishop's Senior Secondary Mukono. Screenshots of system interfaces are used to illustrate how different users interact with the system. The EduPay system was designed to automate payroll processing, salary calculations, approval workflows, payslip generation, reporting, and administrative operations while improving security, accuracy and transparency.

4.2 System Implementation Overview

The EduPay system was implemented as a web-based application that allows users to access the system through a web browser without installing additional software.

The system follows a monolithic architecture, where both frontend and backend components are served from a single Node.js and Express.js application.

Technologies used include. Node.js (backend runtime), Express.js (web framework), PostgreSQL (relational database), HTML, CSS, JavaScript (frontend) and DigitalOcean App Platform (deployment)

These technologies were selected due to their scalability, performance, and suitability for modern web applications.

4.3 System User Roles.

The EduPay system supports four main users that include the following:

Administrator.

Responsible for overall system management including user account creation, system configuration and audit log monitoring, and data backup.

Human Resource (HR).

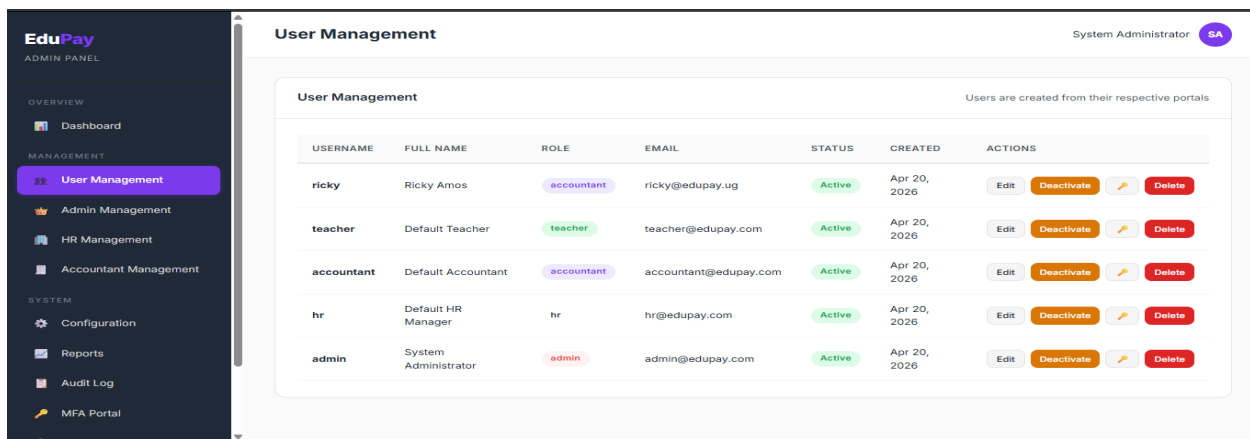
Responsible for managing teacher records, configuring salary structures, approving payroll, and handling leave and salary advance requests.

Accountant.

Responsible for processing payroll, applying salary calculations, managing payment status, and generating payroll reports.

Teacher.

Responsible for viewing personal payroll information, downloading payslips, accessing salary history and submitting leave or salary advance requests. This role separation ensures proper workflow control and enhances system security through role-based access control (RBAC).



USERNAME	FULL NAME	ROLE	EMAIL	STATUS	CREATED	ACTIONS
ricky	Ricky Amos	accountant	ricky@edupay.ug	Active	Apr 20, 2026	Edit Deactivate Delete
teacher	Default Teacher	teacher	teacher@edupay.com	Active	Apr 20, 2026	Edit Deactivate Delete
accountant	Default Accountant	accountant	accountant@edupay.com	Active	Apr 20, 2026	Edit Deactivate Delete
hr	Default HR Manager	hr	hr@edupay.com	Active	Apr 20, 2026	Edit Deactivate Delete
admin	System Administrator	admin	admin@edupay.com	Active	Apr 20, 2026	Edit Deactivate Delete

Figure 5 showing User Management and Roles

4.4 System Authentication.

The EduPay system uses secure authentication mechanisms to ensure that only authorized users can access system resources. Users log in using a username and password. Upon successful authentication, a JSON Web Token (JWT) is generated and used to authorize subsequent requests. Users are automatically redirected to their respective dashboards based on their roles.

4.4.1 Multi-Factor Authentication (MFA).

To enhance security, the system implements Multi-Factor Authentication (MFA). After entering valid login credentials, users may be required to verify their identity using a one-time password (OTP). The OTP can be generated via an authenticator application or sent via email. The important features include, Time-limited OTP validity, Maximum verification attempt limits and secure storage of OTP hashes. This significantly reduces the risk of unauthorized access.

4.5 System Administrator Dashboard.

The administrator dashboard provides a centralized interface for managing system operations. It displays key system metrics such as total number of users, total number of teachers, payroll statistics and recent system activities. The administrator can manage users, configure salary structures, monitor audit logs, and perform system backups.

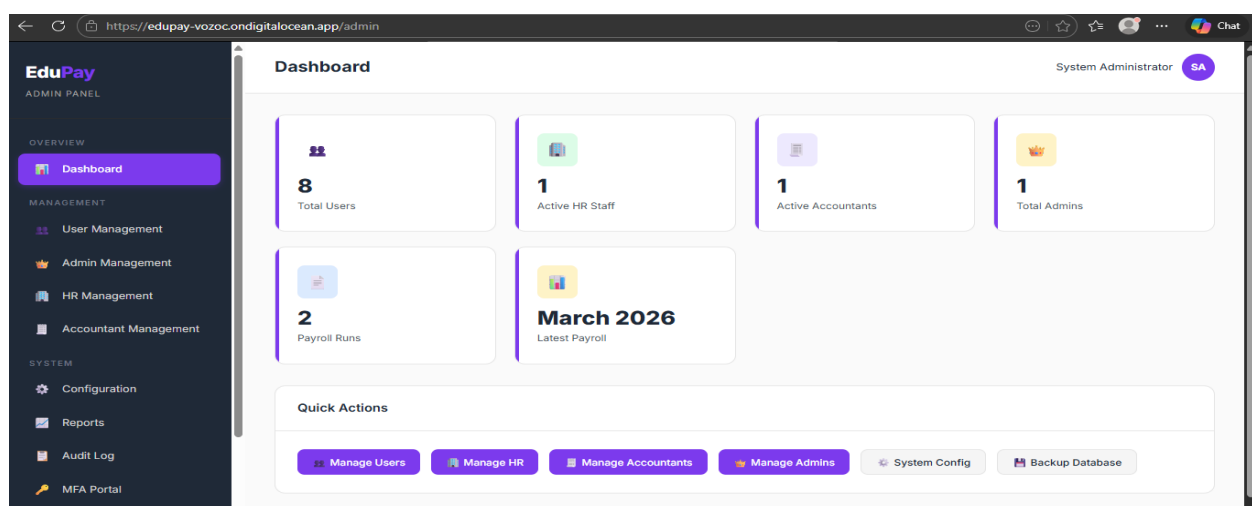


Figure 6 Showing System Administrator Dashboard.

4.6 Teacher Management Module

This module allows HR personnel to manage teacher records such as:

Teacher Registration:

The system provides a form for entering teacher details such as name, employee ID, contact information, and salary structure.

Teacher Record Management:

Authorized users can update, delete and view teacher records. This ensures accurate and centralized storage of teacher information for payroll processing.

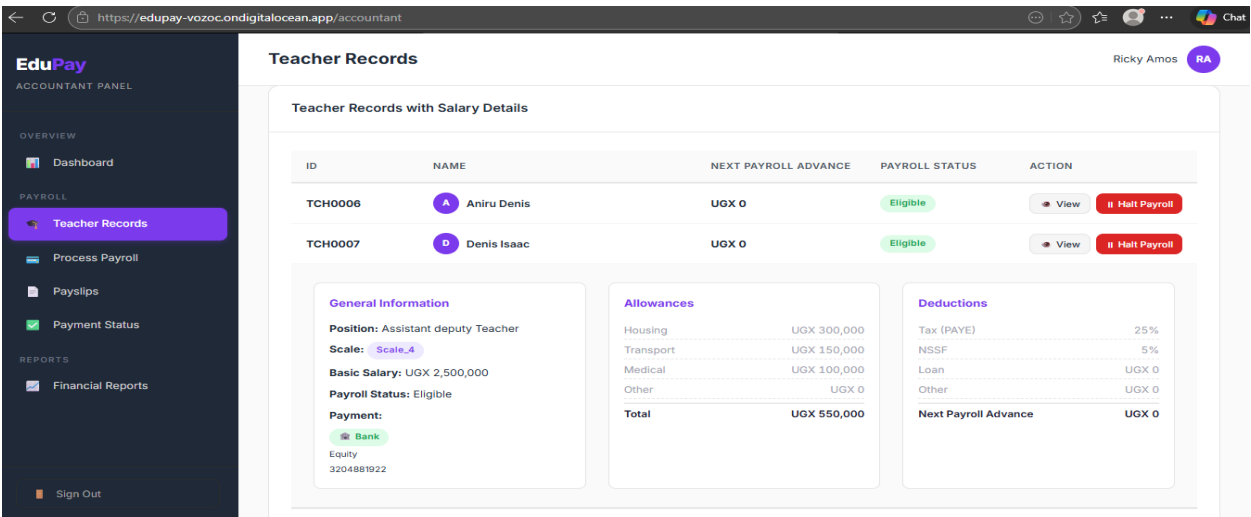


Figure 7 Showing Teacher Management Records

4.7 Salary Structure Configuration.

Salary structures define how salaries are computed. HR personnel can configure basic salary, allowances (housing, transport, medical, etc.), tax percentage and NSSF contributions. These structures are automatically applied during payroll processing, ensuring consistency and reducing manual errors.

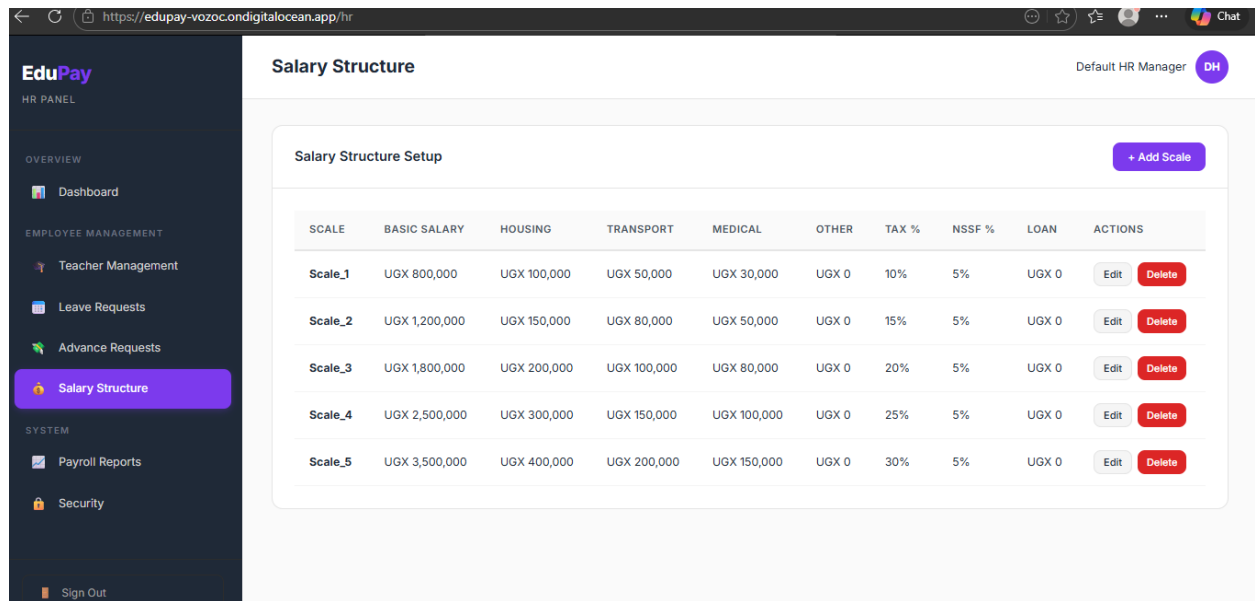


Figure 8 Showing Salary Structure Configuration

4.8 Payroll Processing Module.

The EduPay system uses a structured algorithm to compute teacher salaries during payroll processing. The algorithm ensures consistent and accurate calculation of gross salary, total deductions and net salary.

The input data includes; Basic Salary, Housing Allowance, Transport Allowance, Medical Allowance, Other Allowances, Tax Percentage (PAYE), NSSF Percentage, Loan Deduction, Other Deductions and Approved Salary Advances

Algorithm steps.

Calculate Gross Salary

Gross Salary is the sum of all earnings;

Gross = Basic Salary + Housing + Transport + Medical + Other Allowances

Calculate Statutory Deductions

Tax (PAYE) is calculated as;

$\text{Tax} = \text{Basic Salary} * (\text{Tax Percentage} / 100)$

NSSF Contribution is calculated as;

$\text{NSSF} = \text{Basic Salary} * (\text{NSSF Percentage} / 100)$

Calculate Salary Advance Deduction

Advance Deduction = Sum of all approved but not yet deducted salary advances

Calculate Total Deductions

Total Deductions = Tax + NSSF + Loan Deduction + Other Deductions + Advance Deduction

Calculate Net Salary

Net Salary = Gross Salary – Total Deductions

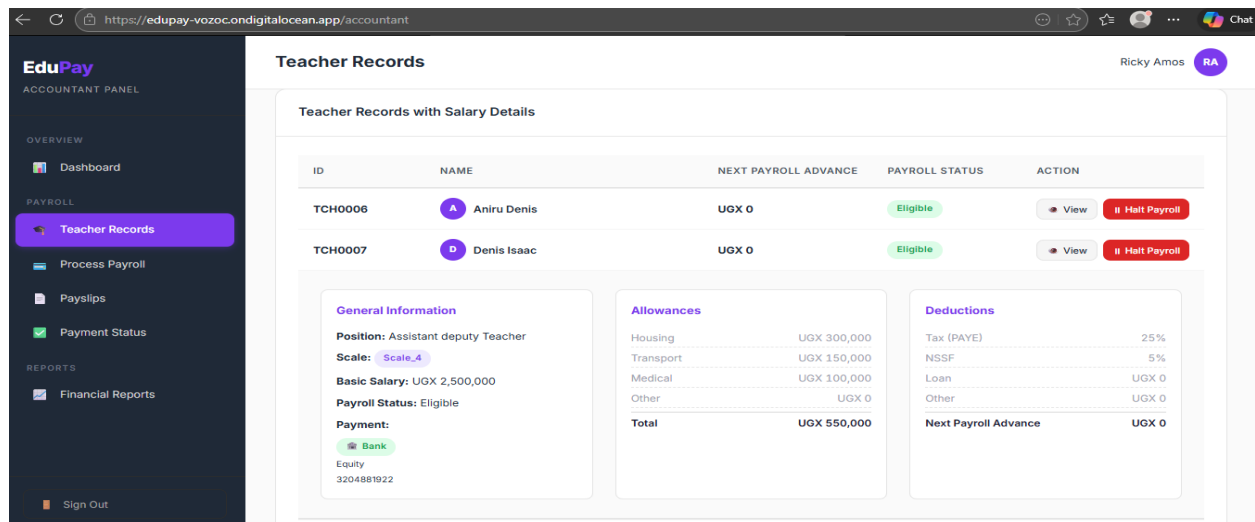


Figure 9 Showing the Salary Breakdown

4.9 Payslip Generation

The system automatically generates digital payslips after payroll processing. Teachers can download payslips in PDF format, which include salary breakdown, deductions, and net pay. This eliminates manual payslip preparation and improves efficiency.

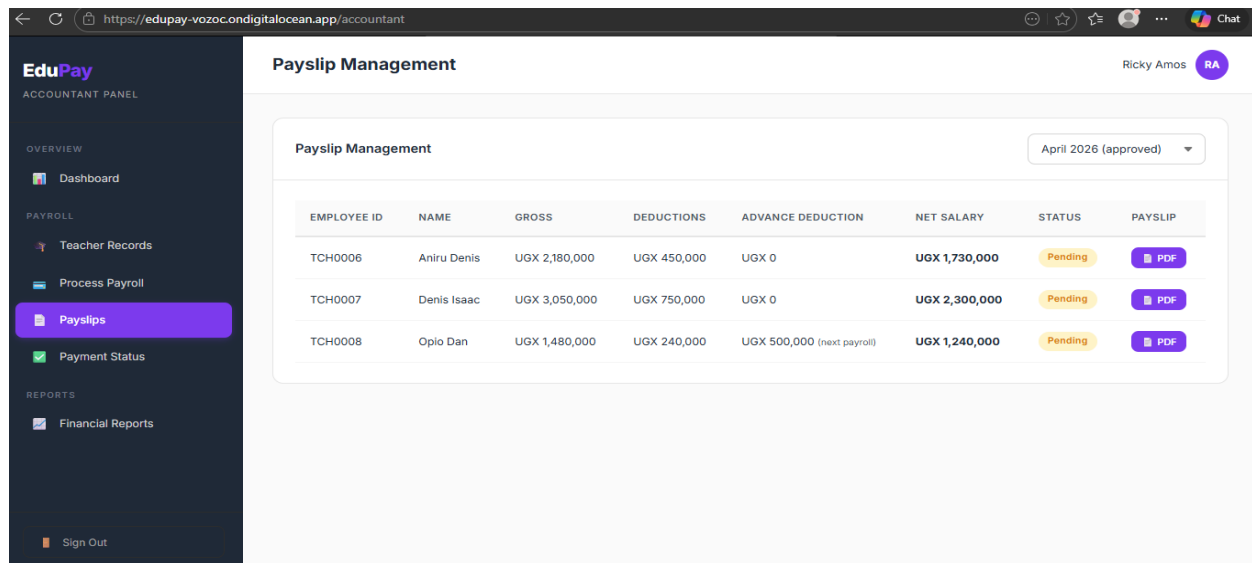


Figure 10 Showing Payslip Generation and management

4.10 Payroll Reporting

The system provides comprehensive reporting capabilities including monthly payroll summaries, salary expenditure reports and individual teacher salary breakdowns. Reports can be exported in Excel format and PDF format. These reports support financial analysis and decision-making.

4.11 Notification System

The notification system informs users about important events. Teachers receive notifications when payroll is approved and salary payments are marked as paid. Notifications are stored in the system and displayed in the user interface.

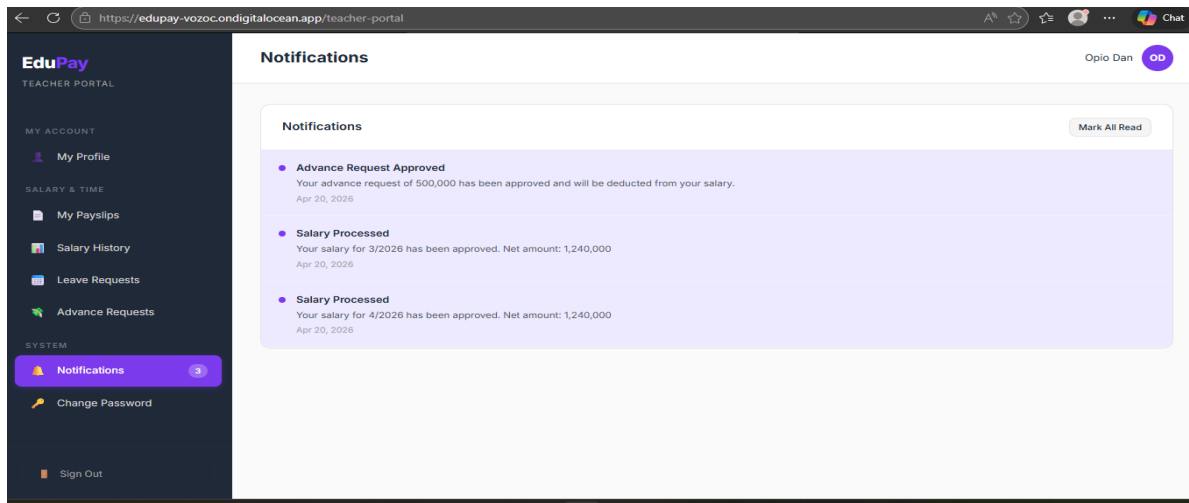


Figure 11 Showing the Notifications

4.12 Leave and Salary Advance Management

The system includes modules for managing leave requests and salary advances. Teachers can submit requests through the system, which are reviewed by Human Resource.

Approved salary advances are automatically deducted during payroll processing. This improves financial tracking and transparency.

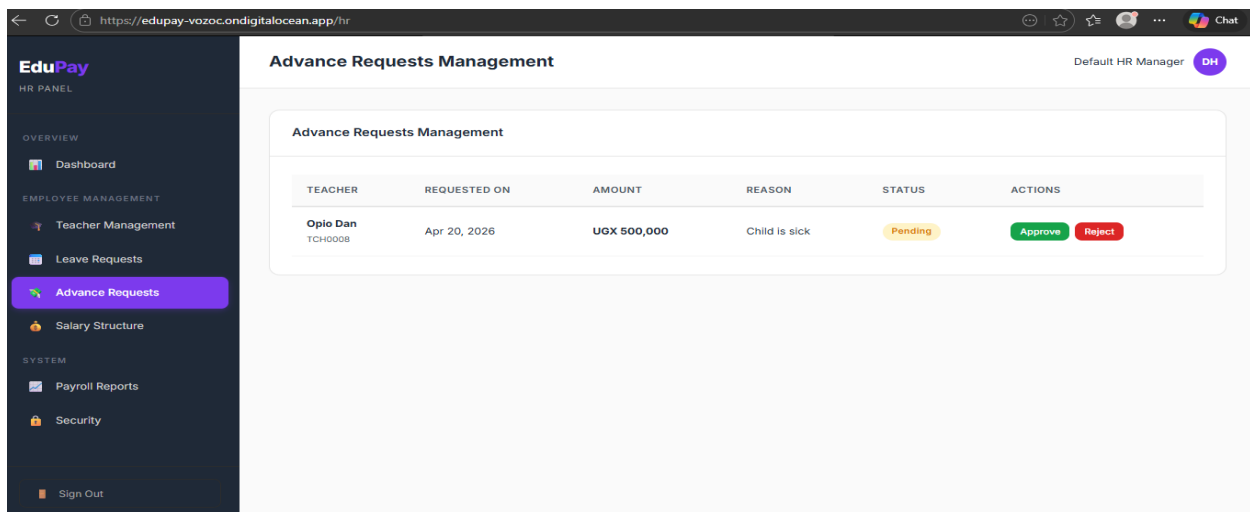


Figure 12 Showing Salary Advance Management for the teachers

4.13 System Testing Results.

System testing was conducted to verify functionality, security, and reliability.

Test Case	Expected Result	Actual Result	Status
User Login	Successful login with valid credentials	Login successful	Passed
Invalid Login	Access denied	Access denied	Passed
MFA Verification	Correct OTP grants access	Verified successfully	Passed
Unauthorized Access	Access restricted	Blocked	Passed
Add Teacher	Record saved correctly	Record saved	Passed
Process Payroll	Accurate calculations	Correct results	Passed
Reprocess Payroll	Old data replaced correctly	Successful	Passed
Generate Payslip	PDF generated	PDF generated	Passed

Figure 13 Showing Testing Results

4.14 Discussion of Results

The implementation of the EduPay system demonstrates significant improvements over manual payroll systems. Automated payroll processing reduces computational errors and improves efficiency. The centralized database enhances data organization and accessibility. The introduction of role-based workflows ensures proper separation of duties, improving accountability. Features such as MFA, audit logging, and secure authentication enhance system security. The ability to generate reports and payslips automatically significantly reduces administrative workload. Overall, the EduPay system successfully addresses challenges associated with manual payroll management by improving efficiency, accuracy, transparency, and security.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the study, conclusions drawn from the research findings, limitations encountered during the development of the system, and recommendations for future improvements.

The main objective of this project was to design and develop a Web-Based Teachers' Payroll Management System (EduPay) to automate payroll processing in Bishop's Senior secondary Mukono. The system was intended to address challenges associated with manual payroll management, including calculation errors, delays in salary processing, poor record keeping, and difficulties in generating payroll reports.

5.2 Summary of the Study

Payroll management is an essential administrative function in educational institutions. In many secondary schools, payroll processes are still handled manually using spreadsheets or paper-based systems. These methods often lead to inefficiencies, including inaccurate salary calculations, loss of payroll records, and delays in generating salary reports.

The aim of this project was therefore to develop a web-based payroll management system that simplifies and automates salary processing for teachers.

The study began with an investigation of existing payroll management systems and challenges faced by school administrators. Through literature review and system analysis, it was identified that manual payroll systems create difficulties in maintaining accurate salary records and generating payroll reports efficiently.

To address these problems, the EduPay system was designed and implemented using modern web technologies including Node.js, Express.js, PostgreSQL, HTML, CSS, and JavaScript. The system was developed following the Agile software development methodology which allowed the system to be developed in stages with continuous testing and improvement.

The system provides several key functionalities such as user authentication and role-based access control. Teacher information management, Salary structure configuration, Automated payroll processing, Automatic payslip generation, Payroll reporting and data export, Notification management and Audit logging for system activities

The system was tested to ensure that all functionalities perform correctly. Testing results showed that the system successfully processes payroll, generates payslips, and produces accurate payroll reports. Overall, the system provides a reliable solution for managing teacher payroll in secondary schools.

5.3 Achievement of Project Objectives

The project successfully achieved the objectives that were set at the beginning of the study.

Objective 1. To study the existing payroll management processes used in secondary schools

This objective was achieved through literature review, observation, and interviews with individuals involved in payroll processing. The study revealed that many schools still rely on manual payroll management systems which are inefficient and prone to errors.

Objective 2. To design a web-based payroll management system

A system architecture was designed to support the development of the EduPay system. The design included database structure, user interfaces, system modules, and security mechanisms.

Objective 3. To implement the payroll management system

The EduPay system was successfully developed using modern web technologies. The system integrates multiple modules including teacher management, payroll processing, reporting, and notifications.

Objective 4. To test the developed system

System testing was conducted to ensure that the system functions correctly. The results confirmed that the system can accurately calculate salaries, generate payslips, and manage payroll records efficiently.

5.4 Conclusion

The development of the EduPay Web-Based Teachers' Payroll Management System provides an effective solution to the challenges associated with manual payroll management in secondary schools.

The system automates payroll processing and improves the accuracy of salary calculations. It also enhances efficiency by reducing the time required to generate payroll reports and payslips.

By centralizing payroll data in a secure database, the system improves data management and ensures that payroll records are easily accessible when needed.

Additionally, the system improves transparency and accountability in payroll administration through the use of audit logs and automated reporting.

However, the current system does not fully incorporate all institutional factors that influence payroll processing, particularly teacher attendance. In many educational settings, attendance plays a critical role in determining salary adjustments. The absence of this functionality limits the system's ability to fully reflect the institutional context in which payroll operations occur

Overall, based on the results obtained from system testing and evaluation, the EduPay system can be considered a reliable and effective tool for managing teacher payroll, with potential for further enhancement.

5.5 Limitations of the Study

Despite the successful implementation of the system, several limitations were encountered during the development of this project.

Limited Access to Real Payroll Data

Due to privacy and confidentiality concerns, real teacher payroll data could not be used extensively during system testing. As a result, simulated data was used to test system functionality.

Time Constraints

The project was developed within a limited academic timeframe. This restricted the implementation of additional advanced features that could further enhance the system.

Limited System Integration

The current system operates as a standalone payroll management platform. Integration with other school management systems such as attendance tracking or human resource management systems was not implemented.

5.6 Recommendations

Based on the findings of this study, several recommendations can be made for future improvement of the system.

Integration with Attendance Systems

Future versions of the system should integrate attendance tracking to more comprehensively address the Institutional Context of payroll management. In many educational institutions, teacher attendance directly influences salary calculations through allowances, deductions, or absenteeism penalties. Incorporating attendance data into the system would enable automatic salary adjustments, thereby improving accuracy, transparency and alignment with real institutional practices.

Mobile Application Development

A mobile version of the system could be developed to allow teachers and administrators to conveniently access payroll information through smartphones, improving accessibility and usability.

Integration with Banking Systems

Future enhancements could include integration with banking systems to enable automatic salary payments directly to teachers' bank accounts, reducing manual intervention and improving efficiency.

Enhanced Data Analytics

The system could be improved by incorporating advanced analytics and dashboards to help administrators analyze payroll trends, monitor expenditures and support decision-making.

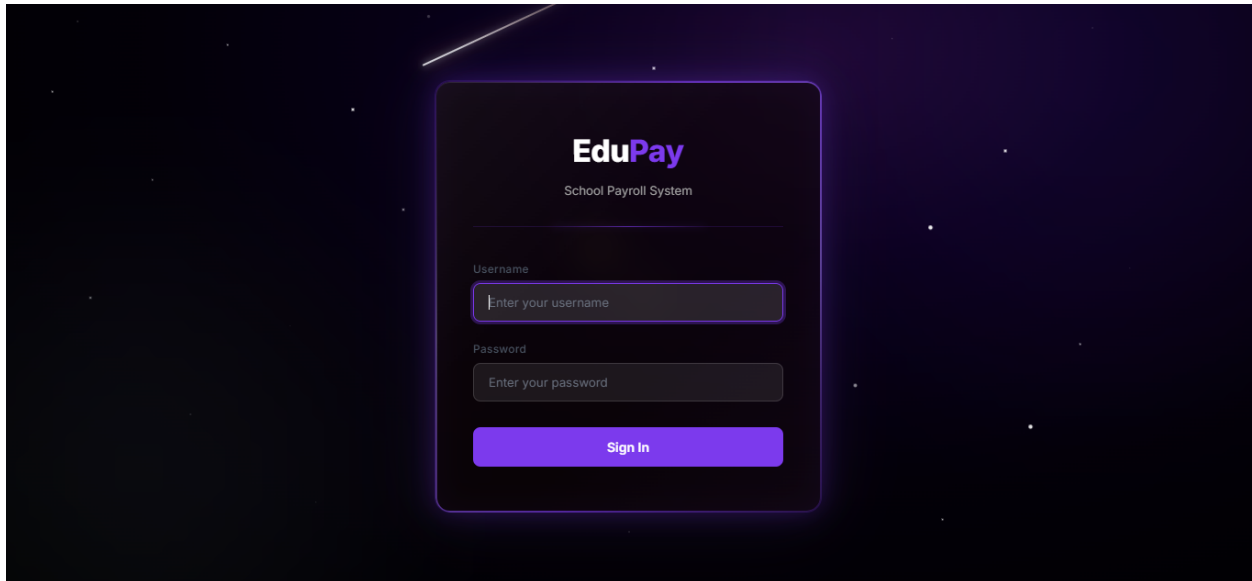
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7.0 APPENDICES.

Appendix 1 Login page



The login page features a dark purple background with a subtle space-themed pattern of stars and a comet. A central white card contains the 'EduPay' logo in white and purple, with 'School Payroll System' written below it. The login form includes a 'Username' label, a text input field with the placeholder 'Enter your username', a 'Password' label, a text input field with the placeholder 'Enter your password', and a prominent blue 'Sign In' button.

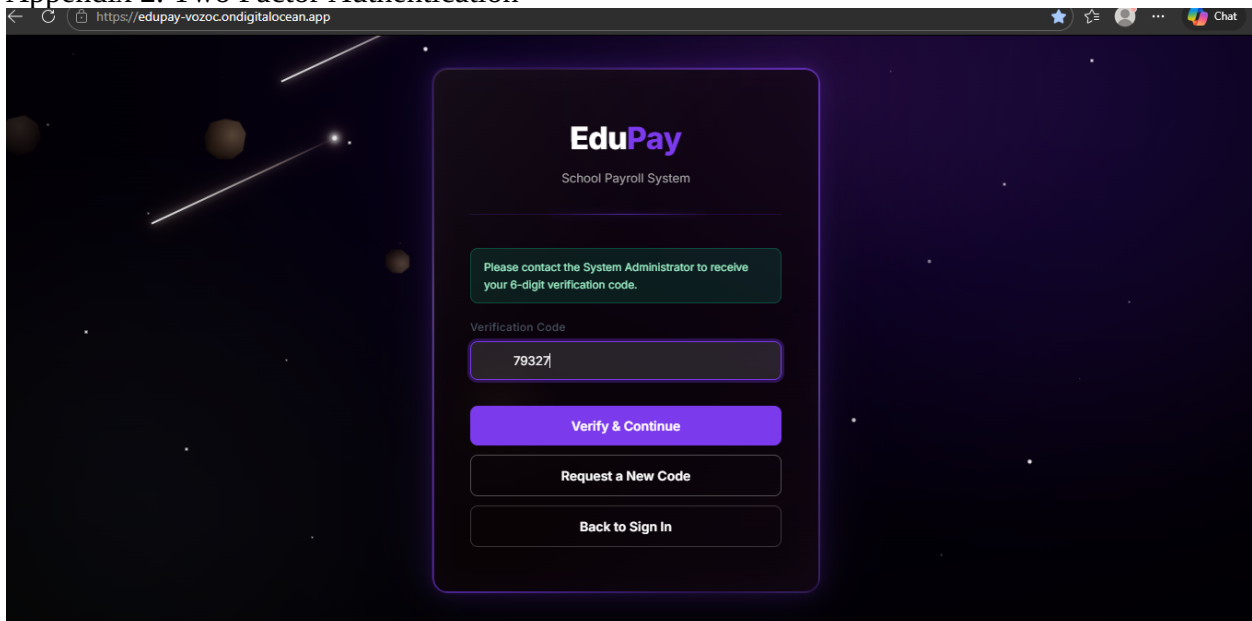
EduPay
School Payroll System

Username
Enter your username

Password
Enter your password

Sign In

Appendix 2. Two Factor Authentication



This page is a browser window showing the two-factor authentication process. The URL bar displays 'https://edupay-vozoc.ondigitalocean.app'. The page layout is consistent with the login page, featuring the 'EduPay' logo and 'School Payroll System' text. A green message box instructs the user to contact the system administrator for a 6-digit verification code. Below this, there is a 'Verification Code' label, a text input field containing '79327', and three buttons: 'Verify & Continue' (blue), 'Request a New Code' (white), and 'Back to Sign In' (white).

EduPay
School Payroll System

Please contact the System Administrator to receive your 6-digit verification code.

Verification Code
79327

Verify & Continue

Request a New Code

Back to Sign In