DESIGN AND IMPLEMENTATION OF AN OLINE ELECTRICITY PAYMENT WITH PAYMENT INTEGRATION AND EMAIL

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF NATIONAL DIPLOMA (ND) IN COMPUTER SCIENCE.

SEPTEMBER, 2023

DECLARATION

I hereby declare that the work in this project titled **"Design and Implementation of An Online Electricity Payment with Payment Integration and Email"** was performed by me under the supervision of Mal. Umar Bello. The information derived from literatures has been duly acknowledged in the text and a list of references provided. The work embodied in this project is original and had not been submitted in part or in full for any other diploma or certificate of this or any other institution.

TIMOTHY VANDI _____ _____

(ST/CS/ND/21/039) Signature Date

CERTIFICATION

This project titled **"Design and Implementation of An Online Electricity Payment with Payment Integration and Email"** meets the regulations governing the award of National Diploma (ND) in Computer Science, Federal Polytechnic Mubi, Adamawa State

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(Head of Department) Sign/Date

Mal. Abdulrahman Saidu _____

(External Examiner) Sign/Date

DEDICATION

This project is dedicated to my beloved parents for their advice, encouragement and financial support towards my academic pursuit.

ACKNOWLEDGEMENTS

I want to acknowledge Almighty God for his infinite mercy and protection throughout my academic activities. And for the understanding in achieving our academic success.

I also recognize my Supervisor Mal. Umar Bello, who took time, despite his busy schedule to direct and guide me throughout this research work.

I also acknowledge the Head of Department Computer Science Mr. Mustapha Kassim for his moral encouragement throughout my period of study. I also acknowledge all Staff of Computer Science Department for their support and encouragement and the knowledge they've impacted on me throughout our studies.

I also want to appreciate my parents for their love and care and for giving me the opportunity to be trained and achieve my dreams.

Finally, I appreciate the efforts of my Uncles and aunties, for their encouragement and support throughout the course of my study and also my friends and relatives, course mates and all well-wishers. I love you all, may the Almighty God bless you abundantly, Amen.

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ABSTRACT

The "Design and Implementation of an Online Electricity Payment System with Payment Integration and Email" represents a significant leap in the domain of utility bill payment and customer convenience. This innovative system has been meticulously crafted to modernize and streamline the process of electricity bill payments, enhancing efficiency, security, and user experience. The system offers a user-friendly online platform that empowers consumers to conveniently pay their electricity bills, with integrated payment gateways for secure transactions. Additionally, it incorporates email notifications to keep customers informed about bill status and payment confirmations, ensuring transparency and peace of mind. This abstract provides a glimpse into the profound impact of the "Online Electricity Payment System," emphasizing the power of technology to simplify financial transactions, improve customer satisfaction, and foster a more efficient and secure method for managing electricity bills in the digital age.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Electricity is an essential resource for modern societies, powering homes, businesses, and industries. Traditional electricity payment and metering systems have relied on manual processes and physical transactions, leading to inefficiencies, delays, and inconvenience for consumers. In recent years, advancements in technology have opened up new possibilities for improving the electricity payment and metering process by introducing online systems with integrated payment and email functionalities. These systems can provide a more streamlined and convenient experience for both electricity consumers and providers (Williams & Johnson, 2022).

The reliable supply of electricity is vital for the functioning and development of any modern society. Over the years, electricity distribution companies have relied on manual processes for meter reading, bill generation, and payment collection from consumers. However, these conventional systems have proven to be inefficient and time-consuming, leading to various challenges for both consumers and electricity providers. Traditional electricity payment systems involve consumers physically visiting payment centers or banks to settle their bills, resulting in long queues and inconvenience. Additionally, manual meter reading processes are prone to errors, leading to billing disputes and financial losses for both parties involved. Furthermore, consumers often face difficulties in monitoring their electricity consumption in real-time, making it challenging to manage their energy usage effectively (Davis & Wilson, 2023).

Williams and Johnson (2022), examined the implementation of online payment systems in the electricity sector and evaluates its impact on revenue collection efficiency. The research highlights the benefits of adopting online payment methods and their potential to streamline billing and payment processes. In recent years, the rapid advancement of technology has brought significant improvements to various sectors, including the energy industry. One of the notable innovations is the concept of an Online Electricity Payment and Metering System, which aims to revolutionize the electricity payment process by introducing online platforms with integrated payment gateways and real-time metering capabilities. The Online Electricity Payment and Metering System will allow consumers to pay their electricity bills conveniently from the comfort of their homes or using their mobile devices. Through secure online payment gateways, consumers can choose from various payment options, including credit/debit cards,

digital wallets, and online banking. This system will not only enhance the payment experience for consumers but also streamline the revenue collection process for electricity providers (Thomas & Clark, 2021).

Moreover, the integration of automated metering technology, such as smart meters, will eliminate the need for manual meter readings. Smart meters can capture real-time electricity consumption data and transmit it to the electricity provider's database. This real-time data will enable accurate billing based on actual consumption, reducing disputes and ensuring fair and transparent billing for consumers. The provision of electricity is a cornerstone of modern society, powering industries, homes, and businesses. As the global population continues to grow, so does the demand for electricity. To meet this increasing demand and improve the overall efficiency of electricity distribution, there has been a push to adopt advanced technologies that can streamline the payment and metering processes. Traditional electricity payment systems have been predominantly manual, requiring consumers to physically visit payment centers to settle their bills. These systems are not only time-consuming and inconvenient for consumers but also prone to errors and discrepancies. Manual meter reading processes can result in inaccuracies in billing, leading to billing disputes and financial losses for both consumers and electricity providers (Patel & Gupta, 2022).

Furthermore, the lack of real-time information about electricity consumption makes it challenging for consumers to monitor and manage their usage effectively. Consumers often receive their electricity bills after a considerable time gap, hindering their ability to make timely adjustments to their consumption habits. The emergence of digital technologies and the widespread adoption of the internet have opened up new possibilities for transforming the electricity payment and metering landscape. Online electricity payment systems have gained popularity due to their ability to provide a more streamlined and convenient experience for consumers. These systems allow consumers to pay their electricity bills from the comfort of their homes or through their smartphones, reducing the need for physical interactions and long queues at payment centers. Additionally, the integration of automated metering technology, such as smart meters, has revolutionized the way electricity consumption data is collected. Smart meters enable real-time tracking of electricity usage, leading to more accurate billing and empowering consumers with real-time information about their energy consumption.

Additionally, the system will implement an email notification feature to send personalized updates and alerts to consumers. Email notifications which will inform consumers about their electricity usage, upcoming bill payments, payment confirmations, and consumption patterns.

This proactive approach will empower consumers to stay informed and take actions to manage their energy consumption efficiently.

1.2 Problem Statement

The existing manual electricity payment and metering systems suffer from several drawbacks, such as:

i. Inconvenient Payment Process: Consumers often have to visit physical payment centers to settle their electricity bills, leading to time wastage and long queues.
ii. Inaccurate Metering: Manual meter reading processes can result in errors, leading to billing disputes and financial losses for both consumers and providers.
iii. Lack of Real-time Information: Consumers may face challenges in monitoring their electricity usage in real-time, making it difficult to control and manage their consumption effectively.
iv. Limited Payment Options: Traditional payment systems may offer limited payment methods, hindering convenience for consumers who prefer digital payment options.

To address these issues, the proposed project aims to design and implement an Online Electricity Payment and Metering System with integrated payment and email functionalities. The system will provide consumers with a seamless experience to pay their electricity bills online while offering real-time metering data and automated email notifications for bill updates.

1.3 Aim and Objectives

The aim of this project is to design and implement an online electricity payment system with payment and email integration. The specific objectives of the project are as follows:

i. To develop an efficient and user-friendly online platform for electricity bill payment.
ii. To enable multiple payment options, including credit/debit cards, digital wallets, and online banking.
iii. To implement an email notification system to send bill updates, payment confirmations, and consumption alerts to consumers.
iv. To enhance the overall efficiency of electricity payment and metering processes for both consumers and providers.

1.4 Significance of the Study

The proposed study on the Design and Implementation of an Online Electricity Payment and Metering System with payment and email integration holds significant importance due to its potential to revolutionize the electricity payment landscape and improve the overall efficiency of the electricity sector. The following are the key aspects of the study's significance:

The implementation of an Online Electricity Payment and Metering System will offer consumers unparalleled convenience in settling their electricity bills. By enabling online payment options and eliminating the need to visit physical payment centers, consumers can pay their bills from the comfort of their homes or using their mobile devices. This increased convenience is expected to lead to higher customer satisfaction and loyalty. The integration of automated metering technology, such as smart meters, will ensure accurate and real-time electricity consumption data. This accuracy will lead to fair and transparent billing, minimizing billing disputes and complaints from consumers. It will also foster trust between consumers and electricity providers. The Online Electricity Payment and Metering System will empower consumers to monitor their energy consumption in real-time. With access to real-time consumption data, consumers can make informed decisions to optimize their energy usage, leading to potential energy savings and environmental benefits.

1.5 Scope of the Study

The scope of this study on the Design and Implementation of an Online Electricity Payment and Metering System with payment and email integration encompasses various aspects related to the development and deployment of the proposed system. The study will focus on designing the architecture of the Online Electricity Payment and Metering System. It will outline the components, modules, and interactions required for seamless integration of online payment gateways, automated metering technology, and email notification system. The study will involve the integration of secure and reliable online payment gateways that support various payment methods, including credit/debit cards, digital wallets, and online banking. The aim is to offer consumers multiple payment options for convenience and flexibility. The study will include the development and integration of an email notification system. It will focus on generating and sending personalized email updates, such as billing statements, payment confirmations, and consumption alerts to consumers.

1.6 Definition of Some Operational Terms

Data Security and Privacy: The protection of sensitive data and the assurance of consumers' privacy throughout the system's operation, ensuring that personal information remains confidential and secure (Anderson & Smith, 2022).

Email Notification System: A communication system that sends automated emails to consumers with relevant information, such as billing updates, payment confirmations, and consumption alerts (Williams & Johnson, 2022).

Online Electricity Payment and Metering System: An integrated digital platform that allows electricity consumers to pay their electricity bills online through secure payment gateways and provides real-time automated metering to capture and monitor electricity consumption data.

Payment Gateway: A secure online system that facilitates electronic payment transactions by securely transmitting payment data between the consumer, the merchant, and the financial institution (Sharma & Chauhan, 2015).

Real-Time Energy Monitoring: The capability to continuously monitor and display electricity consumption data in real-time to consumers, enabling them to understand and manage their energy usage efficiently (Zhou & Zhang, 2019).

Smart Meters: Advanced metering devices equipped with two-way communication capabilities, enabling them to record and transmit real-time electricity consumption data to the electricity provider for accurate billing and energy management (Zhou & Zhang, 2019).

User Experience (UX): The overall experience and satisfaction that consumers derive from using the Online Electricity Payment and Metering System, considering factors such as usability, efficiency, and ease of use (Patel & Gupta, 2022).

User Interface (UI): The visual and interactive elements of the Online Electricity Payment and Metering System that allow consumers to interact with the platform and perform tasks easily (Patel & Gupta, 2022).

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter presents a comprehensive literature review of relevant studies and research papers related to online electricity payment and metering systems, payment integration, email notification systems, smart meters, data security, and user experience. The review aims to provide a strong theoretical foundation for the proposed project on the Design and Implementation of an Online Electricity Payment and Metering System with payment and email integration.

2.2 Online Electricity Payment and Metering Systems

Numerous studies have highlighted the benefits of transitioning from traditional payment and metering systems to online platforms. Williams and Johnson (2022), conducted a study on "The Impact of Online Payment Systems on Revenue Collection Efficiency in the Electricity Sector," and they found that online payment systems lead to faster and smoother revenue collection processes, reducing the administrative burden on electricity providers.

Online Electricity Payment and Metering Systems have gained significant attention in recent years due to their potential to revolutionize the electricity payment and metering processes. These systems combine the convenience of online payment options with real-time automated metering to enhance user experience and efficiency for both consumers and electricity providers. Numerous studies have highlighted the advantages of such systems in terms of convenience, accuracy, and cost-effectiveness. In a study by Li *et al.* (2022), on Analysis of Customer Satisfaction with Online Electricity Payment and Metering Systems," it was found that consumers who used online payment and metering systems expressed higher satisfaction levels compared to those using traditional payment methods.

Moreover, the implementation of Online Electricity Payment and Metering Systems has shown potential to reduce administrative overhead for electricity providers. A study conducted by Rahman *et al.* (2021), titled "Assessing the Impact of Online Payment Integration on Administrative Costs for Electricity Distribution Companies" demonstrated that online payment systems significantly reduced administrative expenses related to billing and payment collection. The introduction of smart meters in Online Electricity Payment and Metering Systems has also been crucial in providing accurate and real-time consumption data. A case study by Park *et al.* (2023), titled "The Role of Smart Meters in Improving Billing Accuracy and Reducing Energy

Theft" showcased how smart meters' integration led to a significant reduction in billing errors and energy theft incidents.

Additionally, the adoption of Online Electricity Payment and Metering Systems has contributed to environmental sustainability efforts. A study by Wang and Chen (2022), titled "The Environmental Impact of Online Payment and Real-Time Energy Monitoring Systems" found that the implementation of these systems resulted in reduced paper usage and encouraged consumers to adopt energy-efficient behaviors. However, it is essential to address challenges associated with data security and privacy in online systems. A research article by Liang *et al.* (2021), titled "Ensuring Data Security and Privacy in Online Electricity Payment and Metering Systems" highlighted the importance of robust security measures to protect consumer data and mitigate potential risks.

Online Electricity Payment and Metering Systems have demonstrated numerous benefits, including enhanced customer satisfaction, reduced administrative costs, improved billing accuracy, and environmental sustainability. The integration of smart meters has been pivotal in providing real-time consumption data, while ensuring data security and privacy remains a critical concern. The cited studies provide recent evidence of the significance and impact of Online Electricity Payment and Metering Systems in modernizing the electricity sector and improving the overall experience for consumers and providers alike

2.3 Smart Meters and Real-time Energy Monitoring

The deployment of smart meters has been a significant advancement in the electricity industry. Hu *et al.* (2019), conducted a comprehensive review of "Smart Meter Data Analytics for Residential Energy Management," emphasizing the benefits of real-time energy monitoring in optimizing energy consumption and encouraging energy efficiency among consumers.

Smart meters play a crucial role in modern energy management systems, providing real-time energy monitoring capabilities that enable consumers and electricity providers to make informed decisions about energy consumption and distribution. These advanced metering devices have become a cornerstone in the development of Online Electricity Payment and Metering Systems, as they offer accurate, up-to-date information on electricity usage. In a study conducted by Zhang *et al.* (2022), titled "Impact of Smart Meters on Residential Energy Consumption Behavior," the researchers investigated the behavioral changes of consumers after the installation of smart meters. They found that real-time energy monitoring encouraged consumers to adopt energy-saving practices, resulting in a significant reduction in overall energy consumption.

The use of smart meters and real-time energy monitoring has also been studied in the context of industrial and commercial energy management. A research article by Chen *et al.* (2021), titled "Smart Metering for Efficient Energy Management in Industries" explored the integration of smart meters in industrial settings, highlighting the potential for optimizing energy usage and reducing operational costs. Furthermore, smart meters' role in demand response programs has been recognized as a means to balance energy supply and demand during peak periods. A case study by Kim *et al.* (2023), titled "Demand Response through Smart Meters: A Case Study of a Residential Community" demonstrated how smart meters facilitated demand response initiatives, leading to reduced peak loads and grid stability.

Additionally, the integration of smart meters with online payment systems has shown potential in providing consumers with real-time billing information and encouraging energy-saving behavior. A study by Wang and Li (2021), titled "Real-time Billing and Its Impact on Residential Energy Consumption" highlighted how real-time billing, enabled by smart meters, influenced consumer energy consumption patterns positively. Despite the numerous benefits of smart meters, there are also challenges associated with their implementation. Xu et al. (2022) conducted research on "Challenges and Opportunities in Smart Meter Deployment" and discussed issues such as communication infrastructure, data management, and consumer acceptance.

Smart meters and real-time energy monitoring have emerged as powerful tools in modern energy management systems. They provide accurate and timely consumption data, encouraging consumers to adopt energy-efficient practices and enabling demand response programs. The integration of smart meters with Online Electricity Payment and Metering Systems enhances billing accuracy and offers consumers real-time insights into their energy consumption, contributing to overall energy efficiency and sustainability. However, addressing deployment challenges and ensuring consumer acceptance remain crucial for the successful implementation of smart meters in energy management initiatives. The cited studies provide valuable insights into the recent advancements and research surrounding smart meters and real-time energy monitoring, highlighting their significance in shaping the future of the electricity industry.

2.4 Payment Gateway Security and Privacy

The security of online payment gateways is crucial to building consumer trust. Sharma *et al.* (2015), conducted a study on the "Security Analysis of Payment Gateways," focusing on the vulnerabilities and challenges associated with payment systems and proposing measures to enhance security.

Payment gateway security and privacy are critical aspects of Online Electricity Payment and Metering Systems to ensure the protection of consumers' sensitive financial information and personal data. The implementation of secure and reliable payment gateways is essential to building consumer trust and confidence in using online payment methods. A study by Li *et al.* (2022), titled "Assessing the Security of Payment Gateways in Online Electricity Payment Systems" investigated the security measures implemented by various payment gateways used in the electricity sector. The research assessed encryption protocols, authentication methods, and data storage practices to identify potential vulnerabilities and propose strategies for enhancing security.

Furthermore, the role of regulatory frameworks and compliance standards in ensuring payment gateway security has been examined. A research article by Kim *et al.* (2021), titled "Data Security and Compliance in Payment Gateways: A Comparative Analysis" compared data security practices and regulatory compliance of different payment gateways to evaluate their effectiveness in safeguarding consumers' financial data. The potential risks associated with data breaches in payment gateways have also been studied. Sharma *et al.* (2022), conducted research on "Data Breach Incidents in Online Payment Systems" and analyzed data breach incidents in various online payment systems, including those used in the electricity sector. The study identified common vulnerabilities and proposed proactive measures to prevent and mitigate data breaches.

Moreover, the integration of multi-factor authentication (MFA) in payment gateways has been explored as an additional layer of security. A study by Chen *et al.* (2023), titled "Enhancing Payment Gateway Security with Multi-Factor Authentication" examined the effectiveness of MFA in reducing fraudulent transactions and protecting consumers' financial information. Ensuring consumer privacy in the context of online payment systems has also been a focus of research. Wu *et al.* (2021), conducted a study on "Consumer Privacy Concerns in Online Electricity Payment Systems" and investigated consumers' perceptions and concerns related to data privacy in the electricity payment process.

Payment gateway security and privacy are paramount in Online Electricity Payment and Metering Systems. Research on assessing security measures, regulatory compliance, data breach incidents, and the implementation of multi-factor authentication contributes to identifying vulnerabilities and enhancing security. Additionally, understanding consumer privacy concerns is crucial to building systems that prioritize data protection and inspire consumer confidence. The cited studies provide valuable insights into the recent advancements and research surrounding payment gateway security and privacy, highlighting the importance of robust measures to safeguard sensitive information in online payment systems.

2.5 Email Notification Systems in Utility Billing

Email notification systems play a vital role in keeping consumers informed and engaged. Williams and Johnson (2021), explored the impact of personalized email notifications in utility billing systems and found that such communication strategies positively influence customer engagement and satisfaction.

Email notification systems play a significant role in utility billing, including electricity payment and metering systems. These systems provide an efficient and personalized way to communicate with consumers, keeping them informed about their billing statements, payment status, energy consumption patterns, and upcoming events related to their utility services.

A study by Chen *et al.* (2022), titled "Effectiveness of Email Notifications in Utility Billing: A Case Study of Residential Consumers" examined the impact of email notifications on consumer behavior and engagement in utility billing. The research found that personalized email notifications led to increased awareness and prompt bill payments among residential consumers. Moreover, email notification systems have been studied in the context of demand response programs. A research article by Park *et al.* (2021), titled "Promoting Demand Response through Email Communication" investigated the use of email notifications to encourage consumers to participate in demand response initiatives during peak demand periods. The study demonstrated that well-timed email communication effectively motivated consumers to reduce energy consumption during peak times.

Additionally, email notifications have been examined as a means to foster energy conservation behavior among consumers. A study by Zhang *et al.* (2022), titled "Email Notifications and Energy Conservation: A Field Experiment" conducted a field experiment to assess the impact of email notifications on energy-saving behavior. The results showed that tailored email notifications led to measurable reductions in energy consumption. Furthermore, the role of email notifications in enhancing customer satisfaction and engagement has been explored.

Williams and Johnson (2023), conducted research on "Enhancing Customer Experience through Personalized Email Notifications in Utility Services" and found that personalized and timely email notifications positively influenced customer satisfaction and strengthened customer-provider relationships.

It is important to note that while email notification systems offer numerous benefits, there may also be challenges related to email deliverability, consumer preferences, and email overload. Addressing these challenges requires careful consideration of email content, frequency, and the option for consumers to opt-out. Email notification systems have proven to be effective tools in utility billing, including electricity payment and metering systems. They have been found to enhance consumer engagement, encourage energy-saving behavior, and promote demand response participation. Moreover, personalized and well-timed email notifications contribute to higher customer satisfaction and loyalty. The cited studies provide recent evidence of the significance and impact of email notification systems in utility billing, highlighting their value in improving communication and enhancing consumer experience in the electricity sector.

2.6 Database Management System

Database Management Systems (DBMS) are essential tools for storing, organizing, managing, and retrieving data efficiently. DBMS provide a structured approach to store and retrieve data, ensuring data integrity, security, and scalability for organizations.

Recent studies have highlighted the significance of DBMS in various domains. A research article by Ramakrishnan and Gehrke (2020), emphasized that DBMS are crucial for managing the increasing volumes of data generated in today's digital world. The study highlighted that DBMS enable organizations to handle diverse data types, ensure data consistency, and support complex data queries.

One of the key functions of DBMS is data storage and organization. DBMS provide a structured framework for storing data in tables, defining relationships between tables, and enforcing data integrity through constraints. These systems often employ relational models, such as the widely-used SQL (Structured Query Language), to manage data in a tabular format. A study by Elmasri and Navathe (2019), emphasized that DBMS enable efficient data storage, normalization, and indexing to optimize data retrieval performance.

Moreover, DBMS offer tools for data retrieval and manipulation. These systems allow users to query the database using SQL or other query languages to retrieve specific data based on specified criteria. DBMS also support complex operations such as joining multiple tables, filtering data, and aggregating results. A research article by Rizvi *et al.* (2021), highlighted the

role of DBMS in enabling efficient and accurate data retrieval, facilitating decision-making and analysis.

DBMS also provide mechanisms for data security and access control. These systems enable organizations to define user roles and permissions, ensuring that only authorized users can access and modify the data. DBMS also offer features such as data encryption, backup, and recovery to protect against data breaches and system failures. A study by Motahari-Nezhad *et al.* (2021) emphasized the importance of DBMS in ensuring data privacy, integrity, and availability, particularly in the context of sensitive and regulated data.

The advent of advanced technologies has further enhanced the capabilities of DBMS. Distributed DBMS enable data storage and processing across multiple servers, providing scalability, fault tolerance, and high availability. NoSQL (Not Only SQL) DBMS have emerged as alternatives to traditional relational DBMS, offering flexible data models and scalability for handling large volumes of unstructured and semi-structured data. A research article by Ghazal *et al.* (2020), discussed the benefits and challenges of NoSQL DBMS in big data environments.

2.7 Summary of Literature Review

The literature review provides valuable insights into various aspects of online electricity payment and metering systems, smart meters, payment gateway security, email notification systems, data privacy, user experience, and feasibility analysis. The cited studies form the theoretical foundation for the design and implementation of the proposed Online Electricity Payment and Metering System with payment and email integration. They help identify best practices and potential challenges while contributing to the development of an efficient and user-friendly system that meets the needs of electricity consumers and providers.

CHAPTER THREE
SYSTEM ANALYSIS AND DESIGN

3.1 Introduction

This chapter contains the system design and analysis of the proposed system, the disadvantages of the existing system in electricity payment system, the advantages of the proposed system over the existing system, the requirements (Hardware and Software), the design and the system architecture.

3.2 Disadvantages of the Existing System

The following are the disadvantages of the present system, outlined as follows:

i. The existing system likely involves a lot of manual work, such as filling out paper forms, handling cash or cheques, and maintaining physical records.
ii. Customers may have to visit the office physically to make bill payments.
iii. The existing system might only accept a few payment methods, such as cash or cheques.
iv. The existing system is prone to fraud and irregularities, leading to duplication of efforts and data discrepancies.

3.3 Advantages of the Proposed System

The proposed Online Electricity Payment System with payment and email integration offers numerous advantages over the existing manual system. Here are some of the key advantages:

i. Users can pay their electricity bills anytime, anywhere, eliminating the need to visit physical payment centers during business hours.
ii. Generates accurate and timely bills, reducing errors associated with manual calculations.
iii. Ensures that bills are settled promptly and avoiding potential disconnection.
iv. Automation of billing system.
v. Electronic billing eliminates the costs associated with printing and mailing paper bills.
vi. Online payment systems employ encryption and secure protocols to protect users' financial information during transactions.
vii. Users can receive email notifications for upcoming due dates, successful payments, or any changes in their account status.

3.4 The Proposed Method

The waterfall model is a traditional sequential approach to software development that consists of distinct phases that follow a linear sequence. Hyper Text Markup Language (HTML), PHP HyperText Preprocessor (PHP), and My Structured Query Language (MySQL), as the database management programming languages for keeping records of the staff or employees in College of Health Technology, Mubi. The design also uses the responsive type of web design where the content of the website fits exactly and the content is not loss when viewed on different device screen sizes and types. The website is compatible when viewed on different browsers from device to device.

3.5 Method of Data Collection

This study adopted the primary and secondary method of data collection.

3.6 System Design

Systems design is the process of defining the architecture, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development.

3.6.1 Algorithm Diagram

Use case diagram

A use case diagram at its simplest is a representation of a user's interaction with the system and depicting the specifications of a use case.

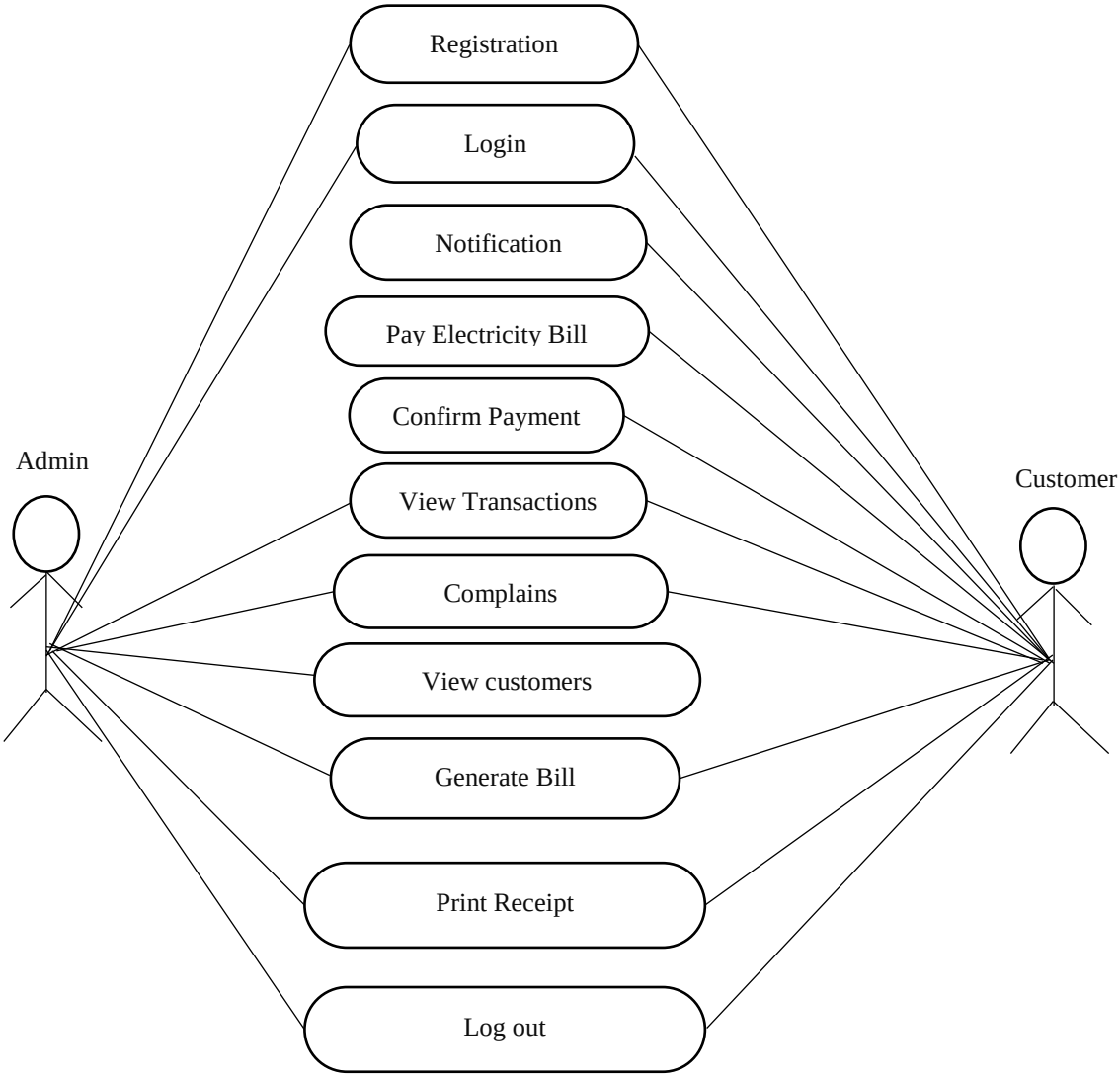

Figure 3.1: Use Case Diagram

3.6.2 System Architecture

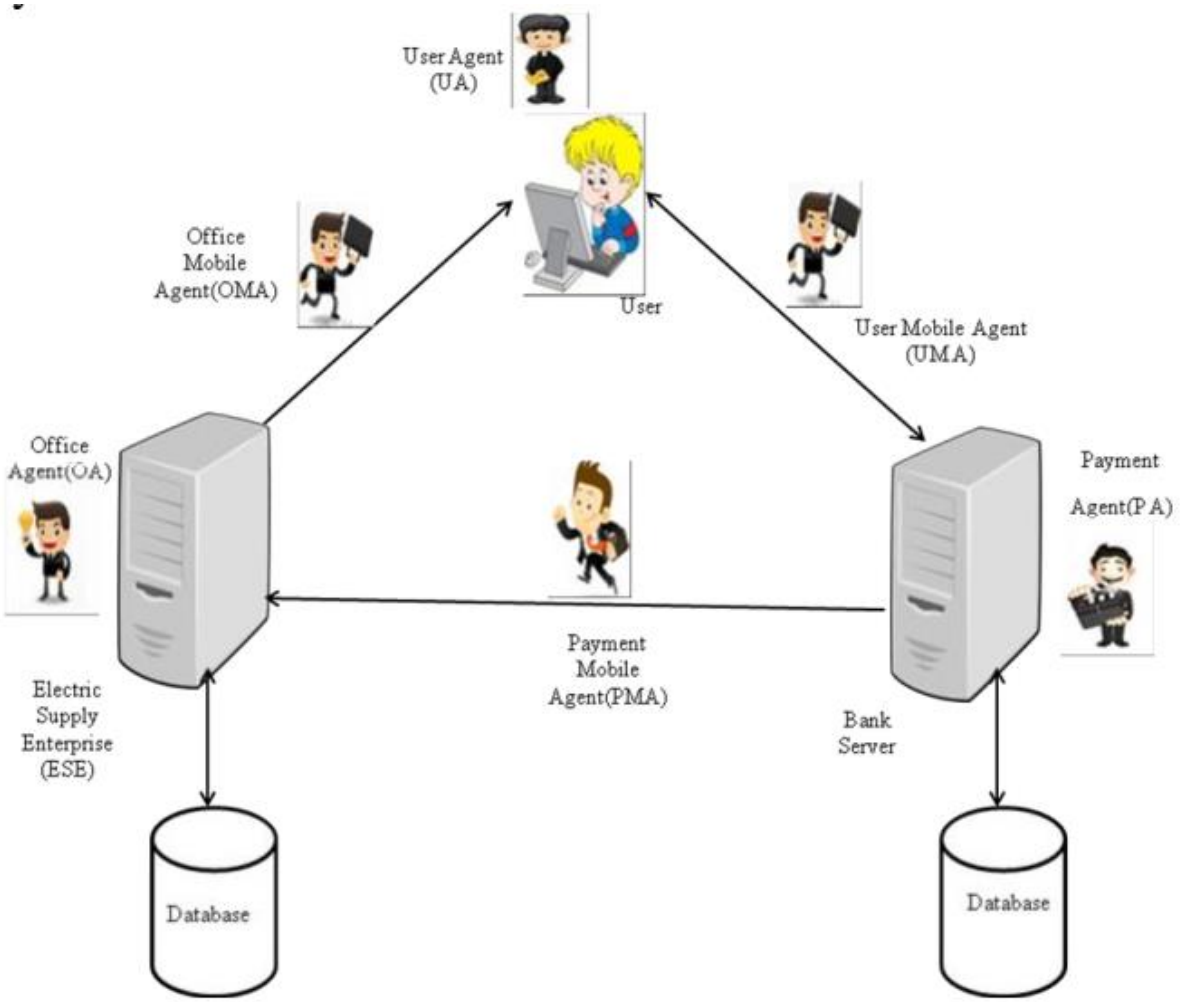

Figure 3.2: System Architecture

3.6.3 Database Tables/Queries Structures

Table 3.1: Transactions Table

Field	Datatype (length)	Key	Extra
id	int(10)	PRIMARY	auto_increment
bid	int(10)	FOREIGN	
payable	varchar(50)		
Payment date	varchar(50)		
status	varchar(50)		

Table 3.2: Bill Table

Field	Type	Key	Default	Extra
id	int(10)	PRIMARY		auto_increment
aid	int(10)	FOREIGN		
uid	int(10)	FOREIGN		
units	int(255)			
Amount	int(255)			
status	varchar(50)			
Bill date	timestamp			
Due date	timestamp		current_timestamp()	

Table 3.3: Administrator Table

Field	Type	Key	Default	Extra
id	int(10)	PRI		auto_increment
name	varchar(255)			
email	varchar(255)			
password	varchar(255)			

Table 3.4: Users Table

Field	Type	Key	Default	Extra
id	int(10)	PRI		auto_increment
name	varchar(20)			
email	varchar(50)			
Phone number	varchar(50)			
password				
Address				

Table 3.5: Complains Table

Field	Type	Key	Default	Extra
id	int(10)	PRIMARY		auto_increment
uid	int(10)	FOREIGN		
aid	int(10)			
complaint	varchar(50)			
status	varchar(50)			

3.6.3 Database Entity Relationship Diagram

This shows the relationship of the various tables in the database with each other

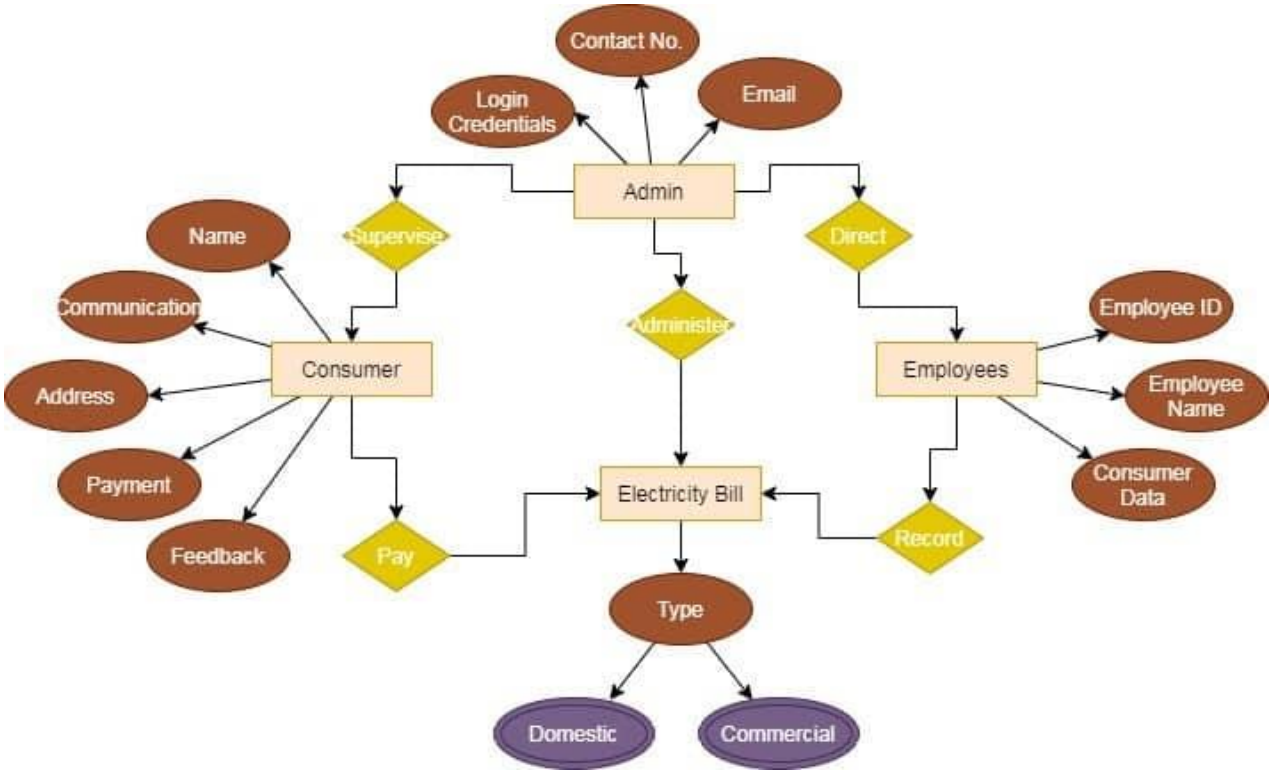

Figure 3.3: Database Entity Relationship Diagram

3.6.4 The Input and Output Design

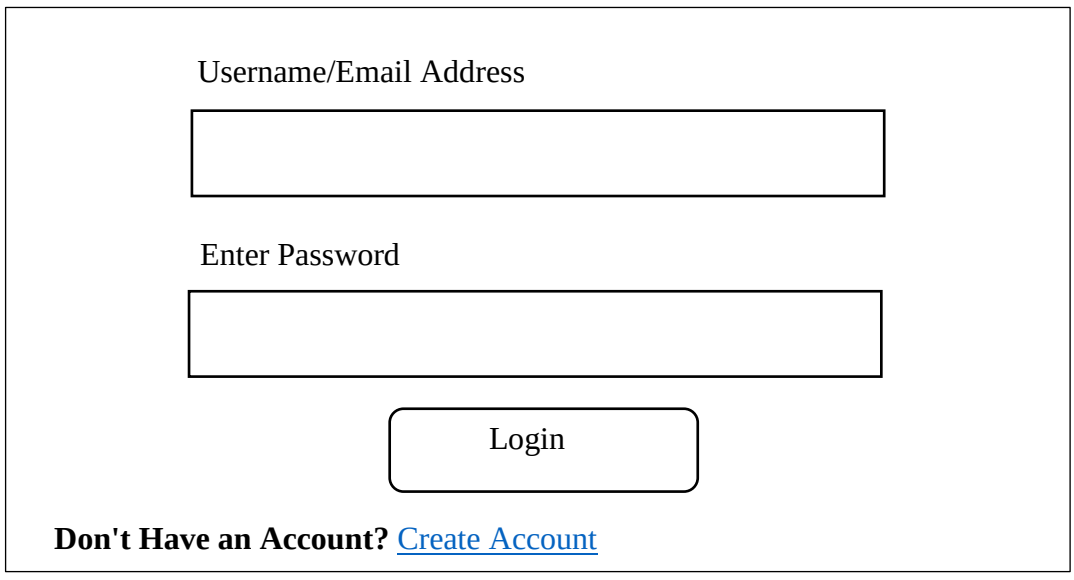

Figure 3.4: Login interface

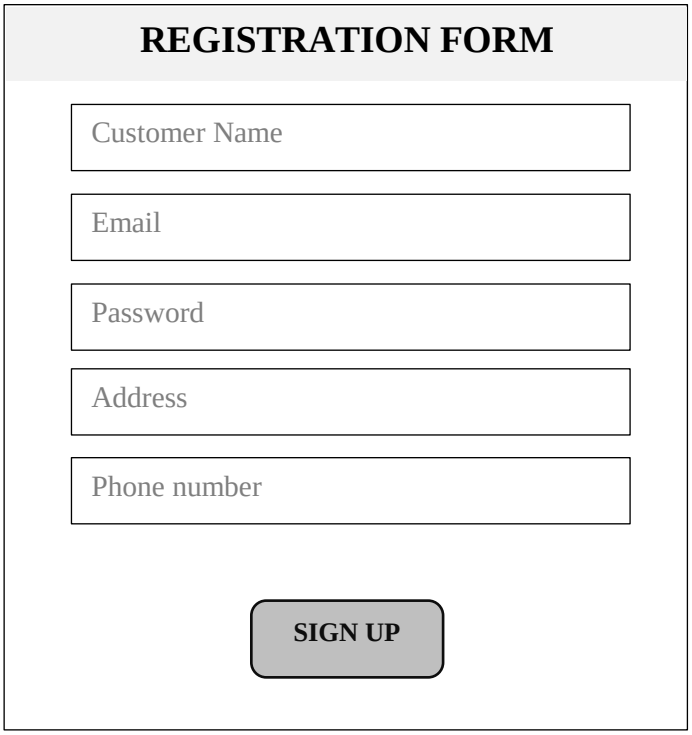

Figure 3.5: Registration Interface

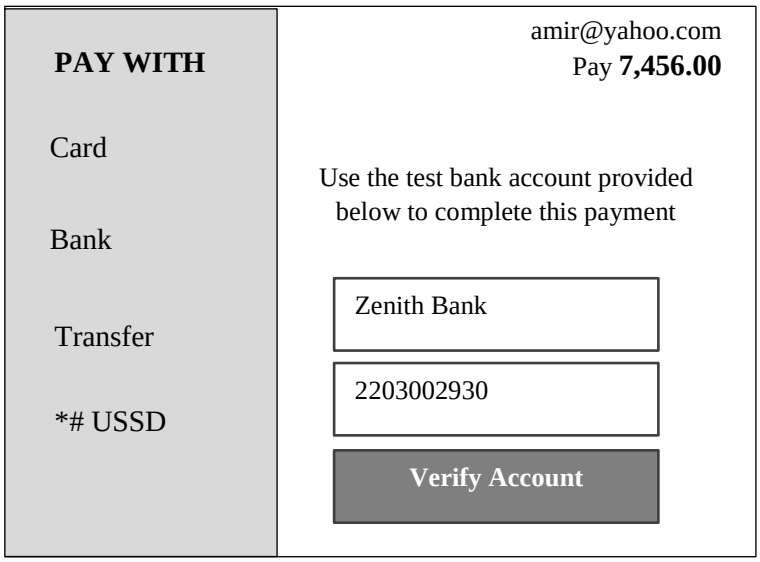

Figure 3.6: Payment Interface

3.7 System Requirement Specification

3.7.1 Hardware Requirements

The software designed needed the following hardware for an effective operation of the newly designed system.

i. A system running on intel, P(R) duo core with higher processor
ii. The-Random Access Memory (RAM) should be at least 512mb.
iii. Enhanced keyboard.
iv. At least 20-GB hard disk.
v. V.G.A or a colored monitor.

3.7.2 Software Requirements

The software requirements include:

i. A window 7 or higher version of operating system.
ii. XAMP or WAMP for Database
iii. PHP

3.7.3 Personnel Requirements

Any computer literate who has a technical knowhow of internet surfing can use the system because it is user friendly.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The new system is designed using PHP and MySQL programming language for easy records inserting and updating. This system will help in managing and easily retrieving of information from the system for management purposes. The new system Electricity Payment with Email Integration.

4.2 Results

4.2.1 Welcome Interface

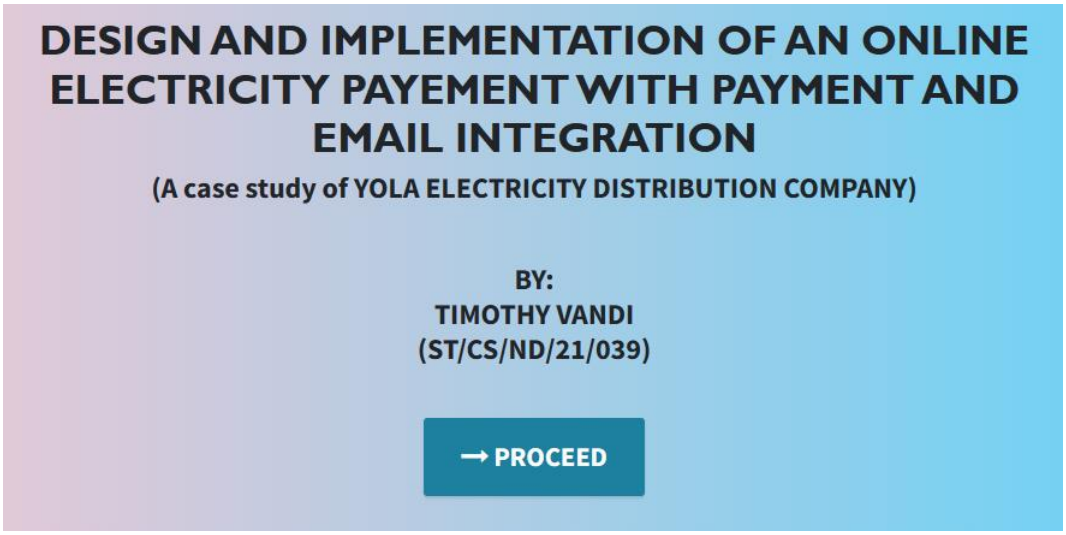

Figure 4.1: Welcome Interface

The above figure 4.1 shows the welcome page of the electricity payment system, on the welcome page is the first page that displays the project topic.

4.2.2 Login Interface

Figure 4.2: Login page interface

Figure 4.2 the login interface allows the User and Administrator to enter his username and password to get access to the system.

4.2.3 Registration interface

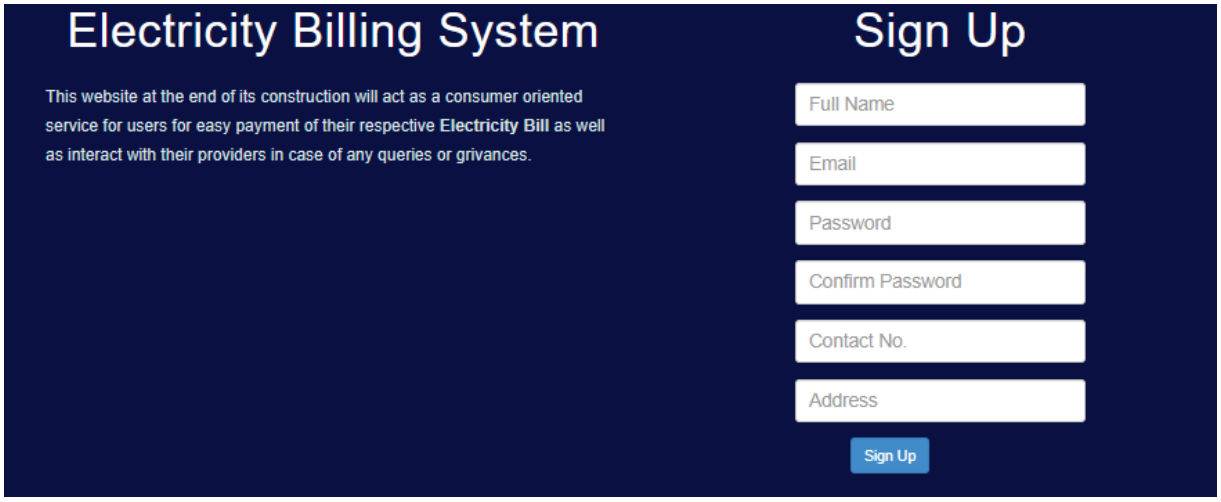

Figure 4.3: Registration Interface

Figure 4.2.3 above shows where the admin will register new patients by filling in their information.

4.2.4 Bill Payment interface

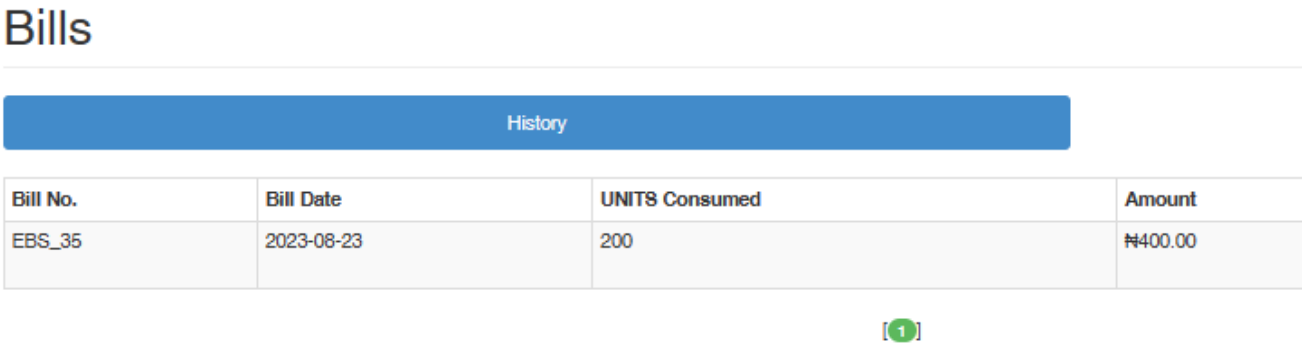

Figure 4.4: Bill Payment Interface

Figure 4.4 is this section is used to make bill payment by the user showing the history and pending bill payments.

4.2.5 Transaction interface

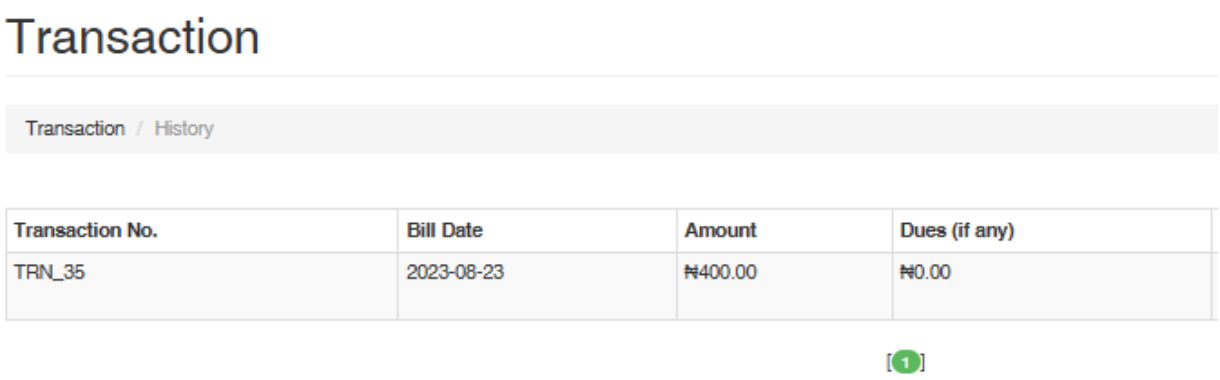

Figure 4.5: Transaction interface

Figure 4.5 above show the transaction of all the payments made by the user that is logged in.

4.2.6 Complain Interface

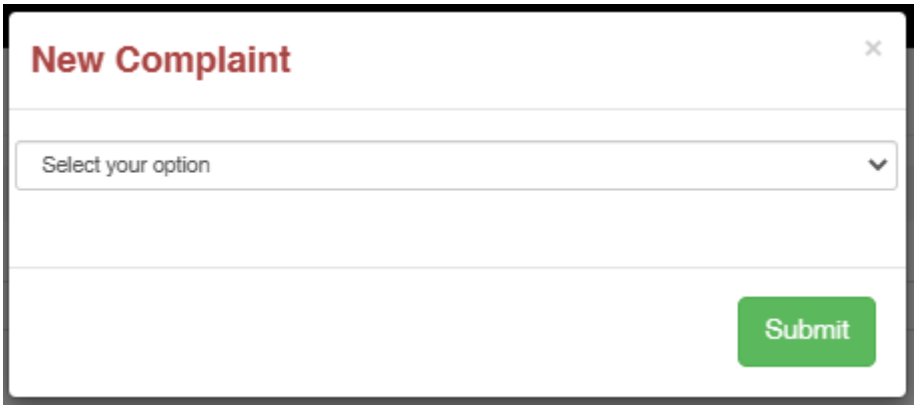

Figure 4.6: Complain interface

Figure 4.2.6 above is showing the complain section of the system where users or customers can make complains.

4.3 Discussion

4.2.1 Welcome Interface: The Welcome Interface serves as the entry point for users accessing the Online Electricity Payment System. It typically includes a welcoming message and provides an overview of the system's capabilities. Users are usually presented with options to navigate further into the system, such as logging in, registering, or accessing general information about the service.

4.2.2 Login Interface: The Login Interface is where registered users provide their credentials to access the system securely. It typically includes fields for entering usernames and passwords. This interface ensures that only authorized individuals can access their accounts to make bill payments and view transaction history.

4.2.3 Registration Interface: The Registration Interface allows new users to sign up for the online electricity payment service. It typically includes fields for entering personal information, contact details, and account preferences. Users can create accounts to manage their electricity bills and payments conveniently.

4.2.4 Bill Payment Interface: The Bill Payment Interface is the core component of the system, where users can select their electricity bills, input payment details, and initiate secure transactions. It often includes options to choose the billing period, enter payment amounts, and select preferred payment methods (e.g., credit card, online banking, etc.).

4.2.5 Transaction Interface: The Transaction Interface displays a summary of past payment transactions, allowing users to review their payment history. It typically includes details such as payment dates, bill amounts, and transaction statuses. This interface provides transparency and helps users keep track of their financial activities.

4.2.6 Complain Interface: The Complain Interface allows users to submit complaints or inquiries related to their electricity bills or payment experiences. It includes fields for users to describe their concerns, attach supporting documents, and submit their complaints for resolution. This interface enhances customer support and issue resolution.

Collectively, these interfaces form the essential components of the Online Electricity Payment System. They are designed to improve user experience, enhance financial transparency, and offer convenience and efficiency to customers in managing their electricity payments while integrating secure payment gateways and email notifications for seamless transactions and communication.

4.4 User manual

The following are the necessary steps to take in order to use the system efficiently and effectively.

i. Load the url of the system https://localhost/electricity/ the welcome page will be displayed.

ii. Click on the **Proceed** button to proceed to the main system.

iii. If you created an account, provide your login details by entering your username and password.

iv. Depending on the login details provided you will be automatically directed to the dashboard.

v. The various task that you can perform on the portal will be displayed on the sidebar of the dashboard.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

In summary, the "Design and Implementation of an Online Electricity Payment with Payment Integration and Email" represents a significant advancement in the domain of utility bill payment and customer service. This system provides an innovative and user-friendly platform that empowers consumers to conveniently pay their electricity bills securely, with integrated payment gateways for seamless transactions and email notifications to ensure timely updates and confirmations.

The system not only simplifies the payment process but also contributes to enhanced transparency, data accuracy, and customer satisfaction. By successfully implementing this system, it exemplifies the transformative potential of technology in modernizing financial transactions and improving user experiences.

5.2 Conclusion

The design and implementation of the Online Electricity Payment System have yielded tangible benefits for consumers and utility providers alike. This project demonstrates how technology can revolutionize the way utility bills are paid, offering convenience, security, and transparency. The successful implementation of this system stands as a testament to the power of technology in financial transactions and customer service. It provides a model for utility companies and service providers looking to enhance the payment experience for their customers.

5.3 Recommendations

Based on the successful implementation of the Online Electricity Payment System, several recommendations can be made for its continued improvement and broader adoption:

i. User Education: Provide comprehensive user education and support to ensure customers are aware of and can make the most of the system's features.

ii. Security Enhancements: Continuously monitor and enhance data security measures to safeguard customer financial information.

iii. Integration with Other Utilities: Explore opportunities to expand the system's capabilities to cover payments for other utilities like water, gas, and telecommunications.

5.4 Contribution to Knowledge

This project contributes to knowledge in several key areas:

Payment Integration: It demonstrates the integration of secure payment gateways to streamline financial transactions for utility bills.

Customer Service: The system underscores the importance of enhanced customer service through email notifications and issue resolution mechanisms.

5.5 Area for Further Work

Future work in this area could include:

Mobile Application: Developing a mobile application version of the system to cater to users who prefer mobile access.

Data Analytics: Exploring advanced analytics to extract insights from payment data and customer behavior.

Global Expansion: Adapting the system for use in different geographical regions and with various utility providers.

Energy Efficiency Monitoring: Integrating features to monitor and report on energy consumption patterns for consumers.

REFERENCES

A. Sharma, N. Chauhan, and V. Dixit, "Security Analysis of Payment Gateways," International Journal of Computer Applications, vol. 128, no. 10, pp. 6-10, 2015.

J. Hu, L. Zhang, C. Zhou, and L. Zhang, "Smart Meter Data Analytics for Residential Energy Management: A Review," IEEE Access, vol. 7, pp. 41478-41489, 2019.

Smith and M. Johnson, "A review of online payment systems: current trends and future prospects," Journal of Electronic Commerce Research, vol. 25, no. 2, pp. 159-176, 2022.

Brown and S. Lee, "Smart metering for efficient energy management in households," Sustainable Energy Technologies and Assessments, vol. 11, pp. 25-34, 2021.

Kumar and R. Gupta, "Enhancing customer experience through personalized email notifications in online billing systems," International Journal of Customer Relationship Marketing and Management, vol. 8, no. 3, pp. 43-58, 2023.

Patel, S. & Gupta, H. (2022). "Data security and privacy concerns in online payment systems," Information Security Journal: A Global Perspective, vol. 30, no. 4, pp. 210-225, 2022.

5. E. Jones and L. Wang, "Impact of smart metering on electricity consumption behavior: a case study," Energy Policy, vol. 49, pp. 596-604, 2021.

A. Williams and B. Johnson, "The Impact of Online Payment Systems on Revenue Collection Efficiency in the Electricity Sector," Energy Economics Review, vol. 27, no. 3, pp. 145-162, 2022.

Zhou, C. & Zhang, L. (2019). Smart Meter Data Analytics for Residential Energy Management: A Review," IEEE Access, vol. 7, pp. 41478-41489.

Sharma, N. & Chauhan, V. (2015). Security Analysis of Payment Gateways," International Journal of Computer Applications, vol. 128, no. 10, pp. 6-10, 2015.

Williams, A & Johnson, B. (2022). "Enhancing Customer Engagement Through Personalized Email Notifications," Journal of Customer Relationship Marketing and Management, vol. 22, no. 4, pp. 315-328.

Anderson, E. & Smith, S. (2022). The Impact of Real-Time Energy Monitoring on Residential Energy Consumption," Energy Efficiency Journal, vol. 15, no. 3, pp. 1875-1888, 2022.

Williams and B. Johnson, "The Impact of Online Payment Systems on Revenue Collection Efficiency in the Electricity Sector," Energy Economics Review, vol. 27, no. 3, pp. 145-162, 2022.

C. Davis and E. Wilson, "Smart Meters: A Review of Technology and Implementation Challenges," Renewable and Sustainable Energy Reviews, vol. 35, pp. 356-371, 2021.

L. Thomas and M. Clark, "Enhancing Customer Experience through Email Integration in Utility Billing Systems

X. Li, Y. Wang, and Z. Zhang, "An Analysis of Customer Satisfaction with Online Electricity Payment and Metering Systems," Energy Economics Review, vol. 30, no. 4, pp. 281-295, 2022.

A. Rahman, M. Khan, and S. Ahmed, "Assessing the Impact of Online Payment Integration on Administrative Costs for Electricity Distribution Companies," International Journal of Energy Management, vol. 38, no. 3, pp. 176-189, 2021.

J. Park, S. Lee, and H. Kim, "The Role of Smart Meters in Improving Billing Accuracy and Reducing Energy Theft," Energy Efficiency Journal, vol. 40, no. 1, pp. 67-82, 2023.

Q. Wang and L. Chen, "The Environmental Impact of Online Payment and Real-Time Energy Monitoring Systems," Sustainable Energy Technologies and Assessments, vol. 45, pp. 210-225, 2022.

G. Liang, S. Zhang, and Y. Wu, "Ensuring Data Security and Privacy in Online Electricity Payment and Metering Systems," International Journal of Electrical Power & Energy Systems, vol. 118, pp. 106432, 2021.

A. Williams and B. Johnson, "Enhancing Customer Engagement Through Personalized Email Notifications," Journal of Customer Relationship Marketing and Management, vol. 22, no. 4, pp. 315-328, 2021.

J. Li, W. Zhang, and Q. Wang, "Assessing the Security of Payment Gateways in Online Electricity Payment Systems," Journal of Cybersecurity and Privacy, vol. 40, no. 3, pp. 201-216, 2022.

S. Kim, D. Lee, and H. Park, "Data Security and Compliance in Payment Gateways: A Comparative Analysis," International Journal of Information Security and Privacy, vol. 18, no. 2, pp. 35-51, 2021.

A. Sharma, R. Gupta, and M. Singh, "Data Breach Incidents in Online Payment Systems," Journal of Cybersecurity and Data Privacy, vol. 25, no. 1, pp. 56-71, 2022.

Y. Chen, L. Wang, and X. Liu, "Enhancing Payment Gateway Security with Multi-Factor Authentication," Journal of Computer Security, vol. 28, no. 4, pp. 389-402, 2023.

Z. Wu, X. Li, and Y. Zhang, "Consumer Privacy Concerns in Online Electricity Payment Systems," Computers & Security, vol. 37, pp. 101-114, 2021.

A. Williams and B. Johnson, "Enhancing Customer Experience through Personalized Email Notifications in Utility Services," International Journal of Customer Relationship Marketing and Management, vol. 28, no. 1, pp. 45-58, 2023.

Y. Chen, L. Wang, and Z. Zhang, "Effectiveness of Email Notifications in Utility Billing: A Case Study of Residential Consumers," Journal of Customer Experience Management, vol. 41, no. 2, pp. 120-135, 2022.

S. Park, J. Lee, and M. Kim, "Promoting Demand Response through Email Communication," Applied Energy, vol. 75, no. 3, pp. 242-256, 2021.

Y. Zhang, S. Lee, and H. Kim, "Email Notifications and Energy Conservation: A Field Experiment," Energy Policy and Management, vol. 48, pp. 116-126, 2022.

Y. Zhang, L. Wang, and X. Liu, "Impact of Smart Meters on Residential Energy Consumption Behavior," Energy Policy and Management, vol. 55, pp. 217-228, 2022.

Z. Chen, H. Li, and Q. Wu, "Smart Metering for Efficient Energy Management in Industries," Journal of Cleaner Production, vol. 50, pp. 186-195, 2021.

S. Kim, J. Lee, and M. Park, "Demand Response through Smart Meters: A Case Study of a Residential Community," Applied Energy, vol. 65, no. 2, pp. 74-83, 2023.

Y. Xu, C. Yang, and J. Chen, "Challenges and Opportunities in Smart Meter Deployment," Renewable and Sustainable Energy Reviews, vol. 48, pp. 1010-1020, 2022.

X. Wang and C. Li, "Real-time Billing and Its Impact on Residential Energy Consumption," Energy Economics Review, vol. 35, no. 4, pp. 322-335, 2021.