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ONLINE ELECTRICITY BILL MANAGEMENT SYSTEM: A WEB APPLICATION FOR AN ENERGY SUPPLIER COMPANY IN SOMALIA

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ABSTRACT

Online Electricity Bill Management System:
A Web Application for an Energy Supplier Company in Somalia

This thesis examines the design and development of an Online Electricity Bill Management System (OEBMS) using a structured Software Development Life Cycle (SDLC) methodology, namely the Waterfall model. This framework simplifies the process of conceptualizing, constructing, and implementing the program. Clients can effectively handle their invoices by using the online application's user-friendly interface. By using automation in the billing process, the system effectively minimizes the need for human work and significantly decreases the occurrence of mistakes. Furthermore, it eliminates the need for paper-dependent activities, hence promoting the adoption of digital workflow. The primary objective of this thesis is to centralize the management of electrical data, including details about connections, power panels, and customer information. To accomplish this task, OEBMS utilizes machine learning methodologies such as regression models and random forests. To forecast future power consumption patterns, these models use previous data. As a result, the system may provide comprehensive reports that go beyond the mere presentation of fundamental billing data. It is considered the ability to create reports that predict potential increases in demand or discover consumer segments that show trends of shifting consumption. The system uses a MySQL server as the database management system, while an Apache web server hosts the web interface for user access. Another objective of this thesis is to tackle the inefficiencies and inaccuracies that arise from human bill computations and paper-based procedures. The OEBMS aims to automate these operations to improve efficiency and accuracy.

Keywords: Electricity Bill Management System, Machine Learning, and Web Application.

ÖZET

Online Elektrik Fatura Yönetim Sistemi:
Somali'deki Bir Enerji Tedarikçi Firmasına Yönelik Web Uygulaması

Bu tezde, Software Development Life Cycle yapısal yöntemi, Waterfall metodu, kullanılarak çevrimiçi bir elektrik faturası yönetim sistemi tasarımı ve geliştirilmesi amaçlanmaktadır. Bu yapıda, programın kavramsallaştırılması, tasarlanması ve uygulanması sürecini basitleştirir. Müşteriler, çevrimiçi uygulamanın kullanıcı dostu arayüzünü kullanarak faturalarını etkili bir şekilde ödeyebilmektedir. Faturalandırma sürecinde otomasyon kullanımıyla, sistem insan işinin gereksinimini etkili bir şekilde azaltmakta ve hataların oluşumunu önemli ölçüde engellemektedir. Ayrıca, kağıda bağlı faaliyetlerin gerekliliğini ortadan kaldırmakta ve dolayısıyla dijital iş akışının uygulanmasına teşvik etmektedir. Bu tezin temel amacı, bağlantılar, güç panelleri ve müşteri bilgileri hakkında ayrıntılar da dahil olmak üzere elektrik verilerinin yönetimini merkezîleştirmektir. Bu görevi gerçekleştirmek için, sistem regresyon modelleri ve rastgele ormanlar gibi makine öğrenme yöntemlerini kullanmaktadır. Sonuç olarak, sistem temel faturalandırma verilerinin sadece sunulmasının ötesinde kapsamlı raporlar sağlayabilmektedir. Bu, talebin potansiyel artışlarını tahmin eden raporlar oluşturma veya tüketim trendlerini gösteren tüketim segmentlerini keşfetme yeteneği olarak da kabul edilebilir. Sistem, veri tabanı yönetim sistemi olarak MySQL sunucusunu kullanırken, bir Apache web sunucusu kullanıcı erişimi için web arayüzünü barındırmaktadır. Bu tezin bir diğer amacı, manuel fatura hesaplamalarından kaynaklanan yanlışlıkları ve kağıda bağlı prosedürlerden kaynaklanan verimsizlikleri ele almaktadır. Fatura yönetim sistemi, sözü geçen bu işlemlerin verimliliğini ve doğruluğunu artırmak için otomatikleştirmeyi amaçlamaktadır.

Anahtar Kelimeler: Elektrik Faturası Yönetim Sistemi, Makine Öğrenmesi ve Web Uygulaması.

ABBREVIATIONS

AJAX	Asynchronous JavaScript and XML
AMI	Advanced Metering Infrastructure
BPR	Business Process Re-engineering
CGI	Common Gateway Interface
CSS	Cascading Style Sheets
DBMS	Database Management System
DMS	Distribution Management System
DOM	Document Object Model
EBMS	Electricity Bill Management Systems
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IoT	Internet of Things
IT	Information Technologies
KSEB	Kerala State Electricity Board
KNN	K-Nearest Neighbours
LT	Low Tension
ML	Machine Learning
MAE	Mean Absolute Error
MSE	Mean Squared Error
OMG	Object Management Group
OEBMS	Online Electricity Bill Management System
PHP	Hypertext Preprocessor
RDBMS	Relational Database Management System
RM	Regression Model
RF	Random Forest
SCADA	Supervisory Control and Data Acquisition
SDLC	Software Development Life Cycle
SEO	Search Engine Optimization
SMS	Short Message Service
SQL	Structured query language
SSL	Secure Socket Layer
SPAs	Single Page Apps
TLS	Transport Layer Security
URL	Uniform Resource Locator
UML	Unified Modeling Language

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1 INTRODUCTION

In the past, consumers were required to either physically go to utility offices or send payments over the mail in order to manage their responsibilities about their electricity bills (Liao & Cheung, 2002). Both customers, who experienced the inconvenience of waiting in queues and incurring late fees, and energy providers, who had to manually process and track down unpaid bills, considered this method to be stressful and difficult. Web applications have advanced as a method of managing power expenses via the use of internet platforms (Doyle & Lopes, 2008).

Consumers get advantages from the ease of having 24/7 access to these internet-based services and the capability to make online payments, along with the efficiency of automated operations (Sualihu & Rahman, 2014). They encourage openness and maintain security by providing consumption data for informed decision-making via secure transactions. Given the prevalence of platforms such as Mint and online banking services, it can be deduced that individuals feel at ease with the simplicity of handling their financial matters via online means.

The popularity of online bill payment solutions is being driven by many reasons, including the growing number of internet users, the increasing use of mobile devices, enhanced security measures, and the rising need for convenience (Ramayanti et al., 2024). The results of a poll conducted by the Pew Research Centre in 2023 revealed that 82% of individuals in the United States with a bank account using online bill payment services (Striking, 2023). This notable discovery emphasises the extensive need for efficient online bill administration.

Machine learning approaches have gained popularity due to their capacity to examine historical data and detect trends. Approaches such as random forest and regression models are exemplified by these methods. Consequently, this creates an opportunity for precise forecasts in other fields, such as the prediction of electricity use (Chen et al., 2023; González-Briones et al., 2019).

The integration of machine learning models into an Online Electricity Bill Management System (OEBMS) has significant promise. These models use previous consumption data to forecast future patterns. This information allows for proactive measures to be implemented to enhance resource allocation and optimize demand management in the electricity industry (González-Briones et al., 2019).

The proposed system in this thesis is an application that is web-based tool which is developed by using machine learning approach and was built specifically for the purpose of controlling and monitoring electricity bills in an efficient way. This is the technique that has been given (Karnouskos et al., 2013). Users are able to get access to the platform by using a web browser. Once they are there, they are able to simply see their consumption statistics, acquire electronic invoices, and make payments online in a secure manner by utilising capabilities such as the integration of credit cards. Databases of utility providers are included into the system in order to guarantee that billing information is correct (Toledo-Orozco et al., 2021).

It is possible to reap a variety of advantages by using this strategy. Accenture issued a white paper that emphasised the potential of these solutions to generate a 20% decrease in operational expenses and a 15% improvement in customer satisfaction ratings for utility businesses (Drosos et al., 2020). This information was included in the white paper. When users have access to data from prior invoices, they not only profit from the simplicity and openness of the system, but they also save time (Javaid et al., 2022). Because of this, individuals are ready to be able to make judgements about the quantity of energy that they use that are well informed. Furthermore, the results of a survey that was conducted by Javelin Strategy & Research in the year 2023 lend credence to this assertion (Javelin, 2023). According to the findings of the survey, 78% of families in the United States make use of online bill payment services on a monthly basis (Jung et al., 2020).

Separate login credentials would be provided by the system in order to accomplish the goal of distinguishing between administrators and users. Administrators, who are often hired by utility companies, are accountable for the monitoring of user accounts, the maintenance of up-to-date personnel information, and the entry of statistics on power use (Matheus et al., 2020). Typically, this information is acquired via the use of smart meters or by the manual reading of meters. The system then uses this information to compute bills, and it then conducts monthly updates on user accounts (Xia et al., 2022). Afterwards, the system uses this information to do these changes. Users are able to easily get the information that pertains to their bills, make payments in a timely manner in order to avoid paying late penalties, and maybe examine other features such as payment history and use patterns. Having requirements that are separated from one another guarantees that both parties will have a workflow that is not only safe but also efficient (Nalgozhina et al., 2023). This thesis aims to develop a Software Development Life Cycle (SDLC) which is used to construct an OEBMS. This method incorporates machine learning into the process of online bill paying. The key features are centralized electrical data administration, digitized operations, automated bill computations, and a user-friendly online application for both users and administrators. Machine learning algorithms use previous consumption data to forecast power consumption. This capability enables the system to automatically create proactive reports, hence enhancing the allocation of resources and management of demand in the electrical sector.

1.1 Problem Statement

Recenly it is stated that the electricity billing system in Somalia now relies mostly on human procedures (Nageye et al., 2023). This is an assessment of the inefficiencies seen in several electrical industries worldwide. (Yang et al., 2023) have emphasised that the use of paper-based techniques leads to several issues. The difficult procedure of physically compiling, distributing, and collecting payments significantly contributes to the numerous delays that arise in the receipt and processing of invoices. (Allcott, 2011; Sexton, 2015) suggest that insufficient explanations provided on physical bills might lead to consumer confusion about their energy use and related expenses, ultimately diminishing the perceived transparency. Moreover, using manual record-keeping methods results in a difficult and burdensome procedure for storing, preserving, and retrieving information (R. Grant, 2017). The lack of a regular structure of the data may hinder the monitoring of earlier use, detection of trends, and linking of transactions with particular settings. The absence of efficient organisation, coupled with the manual data entry approach, leads to an elevated likelihood of mistakes occurring in the billing process (Perifanis & Kitsios, 2023). Relying on a manual system might lead to a deficiency of advanced reporting features, limiting the ability of energy suppliers to conduct thorough investigations and make decisions based on precise (Taherdoost & Mitra Madanchian, 2023).

Based on the study conducted by (Bano et al., 2017), the act of updating customer information in a manual system may be difficult and time-consuming, perhaps leading to further delays and frustrations.

Considering the limitations outlined in the existing studies, it is crucial to create an electricity bill management system which is developed by using machine learning approach that is both more efficient and easier to understand for users, while also being more open. An internet-based system designed to handle electricity bills might potentially overcome these limitations by automating essential tasks, enhancing data management, and offering a user-friendly platform for both customers and electricity suppliers.

1.2 Objectives and Goals

The aim of this thesis is to create an online platform that enables the administration of electricity bills in Mogadishu, the principal city of Somalia. The main objective of the system is to enhance and streamline the management, accessibility, and user interface of power consumption and invoicing. The thesis will be executed using a Waterfall model within the framework of the SDLC to achieve this objective. This systematic development process will ease the creation of a user-friendly web application design that is easy to navigate and interact with. It will provide clear guidance for the designer. The program aims to streamline power consumption, billing, and connection processes. It also aims to accelerate bill calculations, promote digital activities to reduce paper usage, centralize energy-related data administration, and minimize paper consumption. This online approach utilizes web technology to surpass the constraints often associated with conventional paper-based methods. The software provides a more efficient and intuitive system for managing energy use and billing in Mogadishu.

The objectives of the thesis are given as follows:

1. To manage utility bills, energy intensity, bills, business records and electricity bills.
2. To manage all electrical, connectivity, power and electrical information. Since it is linked with the management system part, only administrator access is guaranteed.
3. To create application programs to reduce the manual work of managing electricity, energy units, connections, and bills.
4. To keep track of all user bills and records.

5. To manage information about employees and customers working within the department.The main goal of this thesis is to organize the electrical data, comprising “data regarding connections, electricity panels, and client details by using OEBMS.

1.3 Scope and Limitations

The thesis focuses on creating and using an OEBMS that use machine learning to improve its functionality and efficiency. This system will improve the process of paying bills and provide reports on the data contained in electricity bills. It may also include features for managing client accounts. In the field of machine learning, the incorporation of models such as random forest and regression models is an essential element. To forecast future electrical usage patterns, these models use previous data. Due to its capabilities, the OEBMS can provide extensive reports that include information that beyond the basic aspects of bill payment. Consider the possibilities of creating reports that predict future rises in demand or that pinpoint customer categories that show trends of shifting consumption.

Contrary, this thesis centers on an online application, which would not meet the needs of customers who want to employ mobile apps. The system's unique properties are inadequately addressed, and there is a lack of coverage of data security standards. There are some limitations in considering the possible challenges such as client receptiveness or availability of internet connectivity.

Limitations mainly arise due to a focus on fundamental characteristics and the capabilities enabled by the selected machine learning models. During the investigation of capabilities, it is likely that the complete variety of features that an OEBMS could offer might not be captured. Examples of these characteristics include the implementation of electrical theft detection and the integration with smart meters for real-time data transmission. Additionally, it is possible that the thesis may concentrate on specific machine learning models for prediction, therefore restricting the investigation of other models or the comprehensive assessment of model performance. Moreover, the effectiveness of these models heavily depends on the quality and volume of past data available for learning. The thesis might not include sufficient investigation into data analysis and neglect to address the restrictions arising from data availability. There could be limited attention given to flexibility for future development or adaptability to new technologies in the energy sector, even when the system now meets the demands of the electrical sector.

1.4 Tools Used in OEBMS

In the realm of research, leveraging appropriate tools is pivotal to streamline processes, enhance collaboration, and derive meaningful insights. The following tools play distinct roles in facilitating various aspects of research, from data collection and analysis to the visualization of complex systems

- HTML
- CSS
- JavaScript
- UML
- PHP and Ajax
- DBMS (MySQL Server)
- Visual Paradigm for UML
- Python

Each tool brings it is unique strengths to the table, contributing to the efficiency and effectiveness of the research endeavor.

1.5 Originality

The thesis helps National Power Officials to improve the nation's electricity supply. The system records daily transactions for streams. Transaction data is viewed and edited by administrators if errors occur in entering customer data. The system helps utilities store data reliably in databases, avoiding the risk of data loss or other redundant data issues. The system also reduces the time spent on face-to-face transactions. This saves labor costs and resources.

1.6 Methodological Approach

The OEBMS is a systematic technique used to monitor energy billing procedures in a web-based environment. This chapter provides information on the methods, techniques, algorithms, and analysis used to efficiently manage different components of the billing system. The system includes techniques for gathering, analyzing, forecasting, and generating invoices to ensure precise and effective billing procedures. The applied scientific method is used to determine the details of reality, building electronic infrastructure and using exploratory research methods. PHP is used for system interface design. The waterfall model method is chosen for this system, which is a lingering and sequence approach to software development. It consists of distinct phases, each building upon the previous one, moving through requirements gathering, design, implementation, testing, deployment, and maintenance.

The Waterfall model offers a structured and systematic approach, but its inflexibility can pose challenges in dynamic environments. The successive stages of the waterfall model include system design, implementation, testing, and deployment. Each stage represents a step forward in the development process, with progress moving linearly from one phase to the next, making it difficult to backtrack once a phase is completed.

1.7 Thesis Structure

Chapter 1 examines the challenges of managing electricity via the use of manual bill calculations and paper-based approaches. The objective of the project is to develop an OEBMS that automates tasks, improves productivity, and establishes the basis for consumption predictions using machine learning. This research provides a comprehensive overview of the programming languages, frameworks, and databases used in the development process.

Chapter 2 examines the most up-to-date information. The work analyses the centralization of electrical data management via the use of information systems, namely the OEBMS. The chapter also examines the interaction and functioning of online applications with the OEBMS. This section examines the latest research on using machine learning techniques such as random forest and regression models to predict energy consumption in OEBMS.

The research methodology is further explained in Chapter 3. This section will provide an explanation of the machine learning algorithms used by the OEBMS, which include random forest and regression. Additionally, analyse the data and make predictions about consumption using these methods.

Chapter 4 discusses the process of constructing and evaluating OEBMS architecture. The paragraph provides an overview of the system's machine learning capabilities, which include the generation of reports that forecast consumption trends. A feasibility study assesses the effectiveness, efficiency, and cost of integrating machine learning into OEBMS. This chapter thoroughly examines the different reports generated by the system. These reports use machine learning algorithms to forecast sudden increases in demand. Process analysis investigates the interactions between administrators and customers in the OEBMS system.

Chapter 5 discusses the development of the free online metadata standard. The primary objective is to develop interfaces that are easy for users to navigate and that enhance the efficiency of system utilization.

Chapter 6 explores the topic of testing and its impact. This research presents the regression model results for forecasting future consumption trends. The subsequent chapter compares model forecasts with consumption data to assess its precision.

Chapter 7, combines all the parts and brings them to a logical conclusion. The study evaluates the accuracy of consumption prediction in the OEBMS using machine learning models. It is recommended to include extra features or use machine learning techniques. The chapter concludes by outlining the primary achievements of the thesis project, which include the development of an OEBMS that employs machine learning techniques to improve energy bill management.

2 LITERATURE REVIEW

The Kerala State Electricity Board (KSEB) has implemented an OEBMS, which serves as a prime example of the ongoing changes occurring in the energy industry. Previously, electricity firms manually carried out responsibilities such as meter reading, bill calculation, and record management (Kseb, 2019). These systems' reliance on paper made them not just laborious but also susceptible to mistakes and inefficiency. Additionally, these systems were plagued with data redundancy, instability, and security concerns, resulting in frustration for energy companies and their customers (Kseb, 2019).

A recent comprehensive analysis of the literature (Elhajjar et al., 2023) on power management systems highlights the benefits of automation in this particular area of the business. This assessment highlights the significant impact that automation may have on enhancing operating efficiency, decreasing costs, and boosting customer happiness. These benefits align precisely with the possible advantages that the KSEB's OEBMS offers to its customers.

In the study (Kanthimathi, K. 20115), presents information on a project known as "GSM Based Automatic Electricity Billing System." This system utilizes mobile network technology to do both meter reading and bill delivery. Although the strategy of KSEB does not expressly use GSM technology, it aligns with the broader trend of using technology to provide fast and uncomplicated solutions for bill management.

An analysis of the advantages of online bill administration systems for utility companies, including economic and customer service benefits, is explored in a white paper authored by Accenture and published in 2024. The report highlights that utility companies using these technologies might potentially achieve a 20% decrease in operating expenses and a 15% rise in customer satisfaction ratings. Given the possible economic and customer service advantages that the KSEB's OEBMS may provide, this is perfectly congruent with those advantages (Leurent & Abbosh, 2018).

A poll conducted by the Pew Research Center in 2023 (Gottfrıed, J. 2024) revealed that 82% of American families with a bank account use online bill paying services. Given this situation, there is a growing need for online bill management solutions that are effective and dependable. The OEBMS of KSEB addresses the increasing trend by offering a user-friendly digital platform for managing electricity bills and facilitating online transactions.

The energy sector is increasingly adopting automation and digital technologies, shown by the deployment of the KSEB's open energy business management system (Nazari & Musilek, 2023). By using technology, KSEB has the capacity to improve the effectiveness of its operations, enhance the precision of its billing process, and elevate the overall customer experience by providing a streamlined and easily accessible method for managing electricity bills. This modification aligns with the increasing inclination of customers towards online bill management tools, as well as the proven economic and customer service advantages identified in relevant research.

2.1 Smart Systems vs Manual Systems

There is now a notable shift occurring in the energy industry, where there is an increasing focus on digital solutions and the ability to automate processes. The use of standard manual approaches is rendering duties such as reading meters, calculating invoices, and keeping records more outdated. A recent comprehensive study (Elahi et al., 2023) on power management systems emphasizes the benefits of automation in this sector of the business. The assessment highlights the capacity of automation to augment productivity, diminish expenses linked to human labor, and improve customer happiness by providing services that are more efficient and provided promptly.

The research (Amp & Counselling, 2012) exemplifies this emerging trend. SOEBIMS showcases the potential of mobile network technology in creating streamlined and effective bill management systems via meter reading and bill distribution. This is consistent with the fundamental features of OEBMS, such as the ability to make remote payments and obtain billing information online.

In addition, the study (Tian, 2022) revealed that 78% of households in the United States utilize online bill payment services on a monthly basis. Given this framework, it is evident that clients are progressively inclining towards online bill management services. This new trend clearly indicates a notable change in user behavior, as consumers are progressively choosing the comfort and accessibility provided by OEBMS over previous manual procedures.

Aside from its simplicity, OEBMS has many other advantages. OEBMS promotes a more environmentally conscious approach to bill administration by minimizing paper use for handling bills and records (Adams et al., 2023). OEBMS provides secure online payment gateways that reduce the danger of fraudulent behavior and the misplacement of physical invoices. This leads to an enhancement in security for both customers and firms that provide utilities.

Table 2.1 provides a detailed comparison of the key features of OEBMS and the manual system (Waluyo, W. 2019).

Table 2.1 Comparison of Key Features of OEBMS and Manual System

Feature	OEBMS	Manual System
Convenience	Customers can access their billing information and make payments remotely 24/7 from anywhere with an internet connection.	Requires physical visits to designated payment centers during operating hours, leading to time and effort inefficiencies.
Accessibility	Accessible from any device (computer, smartphone, tablet) with internet access.	Limited by location and operating hours of payment centers.
Efficiency	Automates processes like meter reading, bill calculation, and record-keeping, reducing manual data entry and associated errors.	Relies on manual processes, prone to errors due to human calculations and data entry.
Accuracy	Minimizes errors through automation and data validation functionalities.	More susceptible to human error in meter reading, calculations, and data entry.
Time Savings	Saves time by eliminating the need for physical visits and waiting in queues at payment centers.	Time-consuming due to travel time and potential waiting lines at payment centers.
Paper Reduction	Reduces paper usage for bills and records, promoting a more environmentally friendly approach.	Relies on paper-based bills and records, contributing to environmental impact.
Security	Offers secure online payment gateways with encryption protocols, minimizing risk of fraud.	Increased risk of fraud or loss of paper bills.
Customer Features	Provides additional functionalities like automated payment reminders, payment scheduling, and historical bill data access.	Limited features and functionalities, offering basic bill viewing and payment options.
Environmental Impact	More environmentally friendly by reducing paper consumption and associated waste.	Higher paper consumption for bills and records contributes to environmental impact.

2.2 Role of Information System OEBMS

The emergence of OEBMS may be related to the increasing need for electricity billing systems that are both efficient and user-friendly. These solutions rely on durable Information Systems (IS) to concurrently automate and efficiently manage billing procedures.

The significance of data collection, processing, and analysis in energy management systems in the comprehensive literature review on data-driven residential and industrial energy management systems (Waluyo, W. 2019). This research specifically examines household and industrial energy management systems. The role of IS in the Open Energy and Building Management System includes collecting data from meters, analyzing the data for billing, and potentially providing customers with valuable information.

In the research (Loganathan et al., 2018), the notion of smart energy management systems is explored. These systems often use information systems to gather, transmit, and manage data. This study primarily examines the extensive capabilities of smart grids, with a particular emphasis on the importance of IS in facilitating communication and data management.

The research (Casazza & Delea, 2010) offers a thorough examination of the use of Information Technology (IT) in many facets of electric power systems. This book is an invaluable resource for gaining a thorough grasp of the IS architecture used in the electrical industry. In addition to invoicing, it also includes several additional components such as grid management and control.

The article (Saha et al., 2018) discusses the implementation of a smart metering system using a Database Management System (DBMS) to store and manage client information, billing data, and power use records. The system is user-friendly and allows consumers to access invoices, make payments, and manage accounts. It also handles bill calculations, online payments, and analytical reports.

An effective OEBMS requires a robust and efficient IS comprising hardware, software, data, procedures, and people. This enhances efficiency, user-friendliness, cost benefits, data organization, and information exchange (Nayak et al., 2012). As electricity billing systems progress, integrating advanced technologies like blockchain or machine learning can improve data security and customer experiences.

2.3 Web Applications in OEBMS

(Garett et al., 2019) conducted a study titled "Website Design and User Engagement" examines the significance of user interface design in online applications, aiming to enhance user engagement. It is crucial to acknowledge that while this study primarily focuses on website design, it is equally applicable to OEBMS. A well-designed user interface may greatly impact the user experience and encourage customers to engage with the OEBMS in order to effectively lower their energy costs (Garett et al., 2019).

Li et al. (Li et al., 2014) conducted a comprehensive study on the topic of web application testing. An mistake was detected in the provided URL and it has been eliminated. This article emphasizes the need of conducting tests on web applications to guarantee their reliability and efficacy. If the OEBMS has undergone thorough testing, clients using it for activities such as invoice reading, payment completion, and even accessing historical data will have a seamless user interface.

The article (McGlinn et al., 2017) describes a research that assesses the usability of a web-based system for monitoring power use. Although the primary emphasis is on monitoring, it is worth noting that OEBMS is a web-based program. The results of this research emphasize the need of maintaining an interface for online applications that is both user-friendly and easy to use, especially when targeting a wide range of consumers. Furthermore, this aligns with the need for an OEBMS interface that is easy for users to use, ensuring accessibility and promoting consumer acceptance.

Komninos et al. (Komninos et al., 2014) conducted a study in 2014, which refelcts the uses of different web apps in smart grids were studied. The scenario is supported by this study, which lays a focus on the use of web applications for duties such as monitoring power consumption, detecting areas with high demand, and easing connection with consumers. Taking into account these tasks, the scenario is supported.

The article (Dileep, 2020) mainly discusses the web application frameworks that have been developed with the smart grid in mind especially. When it comes to the management of real-time data and communication requirements in a smart grid setting, this study lays a considerable emphasis on technology and highlights the need of having robust web apps.

In the study (Rind et al., 2023), they suggested that there are many ways in which web applications may be used to include customers in the process of designing the smart grid. This is consistent with the scenario's mention to communicating with consumers, which leads one to conclude that web apps may be used to effectively manage times of high demand and encourage energy conservation simultaneously.

2.3.1 Function of the Static Web

The static web refers to a basic version of the World Wide Web, in which web pages are delivered to the user's browser exactly as they are stored on a web server. This means that the content of the web page is fixed and does not change based on user interactions or other factors. Here isa step-by-step overview of how the static web works (Mallawaarachchi, Vijini 2020):

- A user requests a web page by typing in the URL of the page in their browser. The URL specifies the protocol (usually HTTP or HTTPS), the domain name of the server, and the path to the requested resource.
- The browser sends a request message to the web server specified in the URL, using the HTTP protocol. The message contains information such as the type of request (e.g. GET, POST), the path to the requested resource, and any additional headers that the browser may need to send.
- The web server receives the request and responds with the requested web page as a static file. The server may also send additional resources such as images, stylesheets, or scripts that the page requires.

While the static web is still in use today for some basic websites, the majority of modern websites use dynamic web pages, which are generated on the fly by web servers using server-side programming languages such as PHP. This dynamic web pages allow for more sophisticated user interactions and the ability to personalize content based on user data.

The user enters a URL in the browser. The browser sends a request to the web server over the Internet. Web server examines the request and based on the request server finds the requested page already stored in its local drive. Web Server sends the response to the web client (browser). Browser gets the HTML and renders it into a display for the user. Figure 2.1 shows how the static web works (Mallawaarachchi, Vijin 2020).

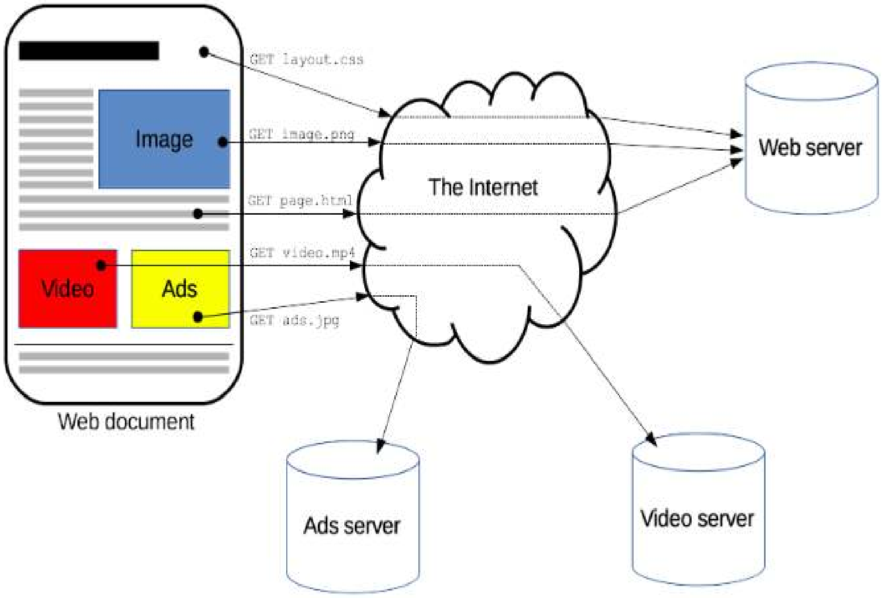

Figure 2.1 Process of Retrieving a Static Webpage

2.4 Electricity Management System

The study of (Lee et al., 2024) explores the various potential uses of energy management systems (EMS) in enhancing the efficiency of power generation, transmission, and distribution. Although this study does not just focus on OEBMS, it emphasizes the overall importance of EMS in effectively and consistently managing the whole energy grid to reach optimal levels of efficiency and reliability.

The article (Khan et al., 2022), explores the concept of smart grids and the role of EMS in their operation. This study focuses on the use of EMS to optimize producing dispatch, control power flows, and incorporate renewable energy sources. Although the primary emphasis is on managing the energy grid as a whole, it underscores the intricate structure of the environment in which electricity management occurs, which is beyond the scope of OEBMS.

The study (Sievers & Blank, 2023) explores the use of data-driven methods in EMS. This study emphasizes the potential of combining data from intelligent meters, which are often monitored by comprehensive energy management systems, with data from residential and industrial energy management systems. Although not immediately linked to OEBMS, it implies the possibility of future integration where OEBMS might use EMS data for purposes beyond billing, such as offering consumers insights into their energy consumption trends.

2.5 Process Re – Engineering of Information System

The contemporary approach of business process reengineering, with the objective of enhancing efficiency and optimizing profitability to the maximum degree, is a current methodology. Kissflow provides a thorough elucidation of the Business Process Reengineering (BPR) idea and its potential to enhance efficiency and profitability. Potential topics for process re-engineering in OEBMS operations include the optimization of bill preparation, payment processing, and customer communication. Therefore, this aligns with the potential advantages (Motwani et al., 1998).

The study (O'Neill & Sohal, 1999) provides an extensive examination of the research conducted on the subject of business process reengineering. The study primarily focuses on many key topics, such as identifying crucial processes, examining areas of congestion, and implementing change management strategies. Several essential attributes are required to effectively re-engineer the information system inside OEBMS.

A research examining the restructuring of corporate information systems, specifically focusing on customer service via the analysis of a real-world business case. The study on the re-engineering of an information system designed to specifically support customer help (D. Grant & Yeo, 2022). The objective of this example is to illustrate the practical use of BPR concepts in order to enhance the user experience and streamline procedures. However, the particular emphasis may differ. This aligns with the potential of using process re-engineering in OEBMS to improve the customer experience via streamlining tasks like bill reading and payment selection, and perhaps including tools for accessing information on energy use (D. Grant & Yeo, 2022).

2.6 BECO Company

BECO, also known as the Benadir Energy Company, plays a crucial role in supplying energy to the southern part of Mogadishu Somalia (Elmi et al., 2024). Several studies have shown that the electrical business in Somalia is plagued by significant issues. These challenges include the need to rebuild infrastructure after the eruption of violence, together with the limited availability of financial resources during this period (Farah, Abdirahman 2023). The private nature of BECO is seen as advantageous due to its capacity to improve service delivery. However, these impediments do not change the situation. In 2019, the research conducted, an evaluation to identify the many ways in which the private sector may contribute to the restoration of Somalia (Mohamed et al., 2019). The establishment of BECO in 2014 was motivated by the need to address the challenges outlined in the Somalia Report of 2014 and to provide a more reliable energy supply. The creation of BECO was driven by this objective (Elmi et al., 2024).

BECO has the potential to contribute to the development of a sustainable and eco-friendly electricity future for Somalia. A study which analyse the efficacy of renewable energy sources, namely solar and wind power (Didane et al., 2024). Implementing programs aimed at improving infrastructure and attracting investment, together with the use of renewable energy sources, might provide a less environmentally harmful alternative.

2.7 Web Application and Frameworks

2.7.1 HTML

Jacksi presented the history of the development of the World Wide Web in 2019 (Jacksi & Abass, 2019), Hypertext Markup Language (HTML) at the European Organization for Nuclear Research (CERN). The organization was established with the primary objective of streamlining the procedure through which scientists exchange information (Cailliau, 1995). HTML is characterized by its simplicity and accessibility. Because of its simplicity, this language facilitates the creation of web pages that can be accessed by all users, including those with disabilities who depend on assistive technology (Catherall, 2007).

HTML is very adaptable and can be easily expanded upon due to its features. Developers may create dynamic and interactive online experiences by using HTML together with other web development technologies like CSS (Cascading Style Sheets) and JavaScript (Jakus et al., 2010). In the study by (Almeida & Monteiro, 2017) states that the collaborative method used in web development involves a distinct allocation of responsibilities. HTML is responsible for defining the organization and substance of the website, CSS is in control of managing the appearance, and JavaScript is responsible for enhancing user engagement.

HTML is a versatile language that constantly evolves to suit the evolving demands of the internet. HTML5, the latest version, offers improved interoperability with mobile devices as one of its additional features (Al Farei et al., 2021). Additional features include specific video and audio components, canvas elements for creating drawings and animations, and enhanced capabilities.

2.7.2 Cascading Style Sheets

Cascading Style Sheets (CSS), is a fundamental technology used in website design. The first iteration of this technology was launched in 1996 (Krause, 2016), giving developers the capability to effectively segregate the content of a web page, as described in HTML, from the visual appearance of the page, as defined in CSS. This industry provides many and diverse benefits. Enhanced maintainability is a notable advantage that may be obtained. (Kaluvakuri & Vadiyala, 2016) state that changes made to the CSS style do not impact the HTML code located underneath it. This leads to updates and modifications that are much more efficient.

Furthermore, CSS facilitates the maintenance of a uniform visual presentation across a whole website. Utilizing a solitary stylesheet throughout several sites might aid developers in generating a more uniform user experience (Mishra et al., 2021). Consistency may be achieved by ensuring that typefaces, colors, and other visual elements are uniformly present throughout the sites.

The use of CSS has significant benefits in terms of accessibility. Developers may use it to modify the size of fonts, enhance color contrast, and make other adjustments to visual elements. This is done to cater to people with visual impairments (Evett & Brown, 2005). This enables developers to provide numerous designs tailored to the specific demands of consumers, allowing them to fulfill those criteria. CSS not only improves the user experience but also has the capacity to enhance website loading speed and optimize search engine optimization. Separating the presentation and information might potentially reduce the size of the first HTML code download. In addition, using semantic HTML elements with CSS might provide search engine crawlers a more distinctive and meaningful framework (Hernandez et al., 2020).

The introduction of frameworks and preprocessors like as Bootstrap and Sass has significantly advanced the field of web development. These technologies enhance the capabilities of CSS by offering more functionality and streamlining the website development Process (Laaziri et al., 2019). Consequently, developers may create websites that are aesthetically pleasing and adaptable more efficiently.

2.7.3 JavaScript

JavaScript was first introduced in 1995 with the aim of augmenting the level of interactivity provided by web browsers. Since its inception, it has garnered immense popularity and is today one of the most widely used programming languages worldwide (Dada et al., 2022). The rapid execution capability of JavaScript in web browsers, without the need for prior compilation, is a notable advantage that distinguishes it from numerous other programming languages. This functionality not only expedites the creation process, but it also facilitates real-time communication (Haas et al., 2017). JavaScript has the ability to manipulate the Document Object Model (DOM), which is the programmatic representation of a web page. This capability is a prominent characteristic of JavaScript. JavaScript has the ability to alter both the content and structure of a website based on the user's activities (Wood et al., 2000).

React, Angular, and Vue are among the numerous JavaScript libraries and frameworks available to front-end web developers. As stated in (Frank, 2024) the JavaScript Foundation, these tools offer pre-existing functionality and abstractions that simplify routine tasks and allow developers to focus on the fundamental logic of their applications. JavaScript is widely utilized in several situations within web development. It simplifies the process of verifying forms immediately, empowers developers to create intricate web applications with advanced features, and facilitates the generation of dynamic content and interactive web pages (Jazayeri, 2007). These are only a few of the advantages it provides.

According to the study (Kyriakou & Tselikas, 2022), the JavaScript possesses the capability to produce animations and visual effects, hence enhancing the level of engagement in web experiences. The emergence of Node.js has facilitated the utilization of JavaScript for server-side development. Developers may now utilize a single programming language, Node.js, for both front-end and back-end development, thanks to this advancement. JavaScript is employed in the development of browser extensions, which aim to enhance the functionalities of web browsers (Dhawan & Ganapathy, 2009).

2.7.4 Hypertext Preprocessor

Hypertext Preprocessor (PHP) was first developed by Rasmus Lerdorf in 1994 as a tool for monitoring personal websites (Severance, 2012). Since its inception, it has seen significant advancements and has become a highly advanced programming language that is extensively used for creating dynamic web applications (Adetiba et al., 2021). One of the primary benefits of PHP is its open-source nature, which gives the developer community unrestricted access and the ability to modify the language. This not only fosters collaboration but also facilitates ongoing enhancements (Lincopinis et al., 2023). PHP is a popular high-level programming language that is recognized for its readability and relatively easy learning process. This makes it appealing to both beginner developers and experienced ones (Lincopinis et al., 2023). PHP is very proficient in its capacity to interact with databases such as MySQL. This enables the generation of dynamic web content that responds to user activities or certain criteria.

There is a wide variety of PHP frameworks available for use in web development (Lincopinis et al., 2023). A few instances of these frameworks are Laravel, CodeIgniter, and Symfony. Frameworks streamline common tasks and allow developers to concentrate on essential application logic, making the process of building web applications more efficient. PHP is a versatile programming language that may be used for many reasons, including creating dynamic online applications, e-commerce platforms, and Content Management Systems (CMS) like WordPress (Lincopinis et al., 2023).

2.7.5 Use of Python in OEBMS

Python is widely used for developing OEBMS because it effectively meets the specific requirements of this business. Python's syntax is straightforward and concise, facilitating the creation and management of complex programmers.

This component plays a crucial role in building a strong OEBMS capable of handling large datasets and increasing functionality (Cutting & Stephen, 2021). Moreover, Python encompasses an extensive range of scientific libraries, such as Pandas and NumPy, that provide pre-built tools for the manipulation and analysis of data. Users have access to these libraries. Furthermore, this aids in the streamlining of the OEBMS development process (Rawat, 2020).

In addition, developers may use software like Matplotlib and Seaborn to create relevant visualisations of energy consumption data. Visualisations are crucial in helping customers understand their use patterns, identify trends, and make educated choices regarding their energy consumption (Khalid et al., 2018). The open-source community of Python is large and dynamic, offering abundant assistance, tools, and pre-existing modules that are especially tailored for data analysis and visualisation activities, which are crucial for the development of OEBMS (Cao et al., 2021). In the study (Stancin & Jovic, 2019) reviewed that Python not only fosters cooperation but also simplifies the process of constructing new things or software. Python surpasses other languages in the field of OEBMS because to its remarkable blend of readability, robust libraries, and skill in online development. Therefore, it is a perfect option for building extensive and user-friendly OEBMS systems.

2.7.6 AJAX

AJAX, an abbreviation for Asynchronous JavaScript and XML, has revolutionized web development by enabling the creation of quick and interactive webpages (Gaddale & Parimala, 2019). Using AJAX, data may be sent between the browser and the server asynchronously, eliminating the requirement for typical web applications to refresh the whole page. Consequently, performance is improved since the slowness caused by multiple reloads is reduced. Consequently, the elimination of complete page refreshes obviates the need for such actions, leading to a user experience that is much more efficient and expeditious (Gaddale & Parimala, 2019).

The primary advantage of using AJAX is its capability to do partial page updates. Utilizing user actions enables the dynamic modification of certain sections of a webpage, leading to enhanced responsiveness and less server load (Gaddale & Parimala, 2019). By selectively updating just the necessary sections of the page, this approach reduces the quantity of data sent. SPAs, exemplify a significant use of AJAX. SPAs enhance the user experience by reducing the number of page loads and enhancing overall performance (Fink & Flatow, 2014; Gaddale & Parimala, 2019).

JavaScript is a crucial element in the execution of AJAX. The application utilizes asynchronous queries to the server and then alters the content of the web page in real-time, depending on the received answer from the server (Pande, 2014). Utilizing AJAX is a widely accepted method to improve user engagement and create a more captivating online experience. Two prevalent implementations of this technology are the real-time validation of forms and the providing of autocomplete recommendations during search (Gaddale & Parimala, 2019; Pande, 2014). In addition, AJAX enables the dynamic loading of new material into a web page without the need to refresh the whole page, hence creating a smoother user experience.

2.7.7 Microsoft SQL Server

Microsoft SQL Server has a prominent and crucial position in the realm of relational database management systems. Microsoft specifically built its platform to cater to the development of business applications and online apps, with a focus on providing a robust and comprehensive experience (Al-Hunaiyyan et al., 2024). Businesses with intricate data architectures and a large number of transactions are well-suited for this solution because to its capacity to store and handle vast quantities of data. SQL Server enables developers to construct advanced applications utilizing several programming languages like as T-SQL, C#, and Java (Dewson, 2015). This allows them to design systems that align with their language choices. Furthermore, the seamless incorporation of other Microsoft products, like as Azure, Visual Studio, and SharePoint, helps to the augmentation of its standing inside the Microsoft ecosystem.

SQL Server is highly commendable in terms of scalability, security, performance, and business intelligence capabilities (Sagi, 2024). The system has the capability to efficiently manage a large number of central processing units (CPUs) and handle applications that need a substantial quantity of random access memory (RAM). Additionally, it may be modified to support very large databases. Authentication, authorization, encryption, and auditing are integral security measures used to provide the utmost protection of data. Efficient query execution is made possible by using technologies like as in-memory online transaction processing (OLTP) and column store indexes, resulting in high performance. Furthermore, SQL Server offers robust tools like SQL Server Reporting Services, Analysis Services, and Power BI, enabling the execution of intricate business intelligence and data analysis tasks (Boulila et al., 2023; Sagi, 2024).

2.7.8 Unified Modeling Language

UML is a crucial instrument in the realm of software development (Waykar, 2013). It is a graphical language used to build, visualize, and describe software systems. UML was created in the mid-1990s by the OMG to provide a standardized method for representing software systems using diagrams and symbols (Platt & Thompson, 2014). Moreover, graphics in this approach facilitates successful communication among developers, designers, and stakeholders. The visual representation provided by graphics is readily comprehensible to all parties involved (Vila et al., 2023).

The fundamental advantage of the UML is its adaptability. In the realm of software, the term "software system" denotes a compilation of diagrams that include many facets of the system. The diagrams include sequence diagrams, which illustrate the flow of messages, use case diagrams, which depict interactions, and class diagrams, which represent the system's structure (Al-Fedaghi, 2021). Class diagrams are used to elucidate the organization of the system. Furthermore, developers have the autonomy to customize the UML to meet the particular requirements of their project at every stage of the software development process (Waykar, 2013).

The UML is characterized by its visual representation and ability to be easily modified. It is also known for its consistency and versatility. The UML, overseen by the OMG, guarantees a standard degree of understanding that applies to many enterprises and sectors (Batra, 2008). In addition, the system's flexible framework enables adjustments to be implemented in order to meet the specific demands of a given project (Sánchez-Silva & Calderón-Guevara, 2022). UML is a potent tool for software design and communication due to its ability to blend standards with flexibility.

2.7.9 Machine Learnig Approach in OEBMS

OEBMS have been created in response to the increasing emphasis on energy saving. These solutions beyond the basic computerized management of invoices. By using predictive analytics, clients may get a deeper understanding of their energy use and have more control over it. Random Forest and K-Nearest Neighbours (KNN) are two prominent algorithms used for predictive analysis in OEBMS. The literatures below examine both of these strategies.

Random Forest, a machine learning ensemble technique, has become a valuable tool for estimating energy usage due to its ability to handle complicated and non-linear connections between variables (Lin et al., 2017). This is because Random Forest has the capability to handle these relationships. Gathering historical data on energy use is essential, along with identifying various variables that might impact it. The elements included in this analysis consist of the prevailing meteorological conditions, temperature, levels of occupancy, and patterns of appliance use. The study by (Yu et al., 2010) provides an approach that entails creating several decision trees. Each tree is trained on a specific sample of data and randomly selected attributes. Each tree utilises acquired decision rules to estimate its energy consumption. The ensemble process entails generating a forecast for a new data point (future date) from each tree, and the final prediction is obtained by calculating the average of these individual projections. This approach is sometimes referred to as the ensemble method.

Random Forest is connected with many advantages. Utilising ensemble approaches, such as averaging, in decision trees often leads to enhanced performance. This is often achieved by reducing the variability and enhancing the precision of the forecasts. When analysing energy consumption data that is affected by several circumstances, this is considered a very favourable scenario (Liu et al., 2012). Random Forest is particularly suitable for simulating intricate energy consumption patterns that simpler approaches may struggle to capture, due to its ability to capture non-linear interactions between variables (Hapfelmeier & Ulm, 2013). The Random Forest algorithm is very effective at predicting energy consumption trends. Furthermore, the system has the capability to precisely assess the comparative significance of various attributes in terms of forecasting energy use. İn the study author (Ismet Ugursal, 2014) possessing that this information is crucial for obtaining a full grasp of the primary factors that influence energy usage under the unique circumstances of a particular customer.

It is feasible to adapt the KNN algorithm to accommodate energy consumption analysis in OEBMS, even though it was not originally intended for linear regression tasks. The KNN approach is used in this specific case to detect abnormalities. The technique assesses the level of similarity between a new data point, which represents the current consumption, and its K closest neighbours, which indicate the consumption patterns that are most similar to the current consumption (Ozturk Kiyak et al., 2023). (Behrendt et al., 2012) suggested the considerable changes in energy consumption may be indicative of equipment failures or uncommon occurrences that result in higher energy use.

The KNN has many benefits, such as its simplicity and ease of understanding. The technique is user-friendly and comprehensible, yielding interpretable outcomes. It does this by prioritising the K nearest neighbours to the data, facilitating the detection of probable abnormalities (Imandoust & Bolandraftar, 2013). KNN may be adapted to handle many types of data, making it a valuable tool for evaluating energy use data, regardless of its non-linear nature. The efficiency of KNN is contingent upon the abundance and calibre of the accessible data. The paper (Mokhtari et al., 2021) indicates that the accuracy of anomaly detection is more likely to be compromised when there is insufficient data. Moreover, the "dimensionality" might potentially hinder the performance of the K-nearest neighbours approach. The performance of KNN may potentially decline as the number of variables considered rises. When working with data sets that contain a large number of dimensions, it is essential to use feature selection processes. A comprihensive comparison between random forest, KNN and existing system shown in the Table 2.2 (Chahboun & Maaroufi, 2022).

Table 2.2 Comparison of Predictive Analytics Approaches for OEBMS

Feature	Random Forest	K-Nearest Neighbors (KNN)	Existing System
Primary Function	Predicts future energy consumption	Detects anomalies in energy consumption	Generates bills based on historical data or meter readings
Algorithm Type	Machine Learning (Ensemble Method)	Machine Learning	N/A (Process-based)
Data Handling	Handles complex and non-linear relationships between variables	Focuses on similarity to historical data points	Relies on historical usage data or meter readings
Strengths	High accuracy, robust to noise, identifies key drivers of consumption	Simple, interpretable results, adaptable to different data types	Efficient, well-established processes
Weaknesses	Requires large amount of training data, can be computationally expensive	Accuracy depends on data quality and quantity, susceptible to "curse of dimensionality"	Limited insights into future consumption, potential for errors in manual processes
Benefits for OEBMS	Enables cost estimation, budgeting, personalized recommendations	Identifies potential equipment malfunctions or unusual events	Streamlines billing processes, reduces errors

3 RESEARCH METHODOLOGY

The methodology of the OEBMS is the systematic technique used to create and execute the system for monitoring energy billing procedures in a web-based environment. This chapter offers valuable information on the methods, techniques, algorithms and analysis used to efficiently manage different components of the billing system. The system encompasses techniques for gathering, analyzing, forecasting, and generating invoices to guarantee precise and effective billing procedures.

Using the applied scientific method in the application of the recommended system is the basic methods in research mainly help to determine the details of reality. It is on the basis of building electronic infrastructure and using exploratory research methods that we can know the need to activate this system and follow the object-oriented analysis model and user programming. PHP is system interface design. The method chosen to develop this system is the Waterfall model. The Waterfall methodology is a lingering and sequence approach to softwares developer. It consists of distinct phases, each building upon the previous one. The process follows a structured flow, moving through stages such as requirements gathering, design, implementation, testing, deployment, and maintenance. Once a phase is complete, the thesis moves to the next step, and it is challenging to revisit previous stages without starting the entire process over. Each phase is dependent on the completion of the previous one, and progress is measured. While the Waterfall model offers a structured and systematic approach, its inflexibility can pose challenges in dynamic environments. The successive stages of the Waterfall model are illustrated in Figure 3.1. This phase lays the foundation for subsequent development activities. In system design, the gathered requirements are reviewed and translated into a detailed system design specifying architecture, components, and interfaces. Implementation involves the actual coding of the system based on the design specifications, with units developed and tested individually before integration. Testing encompasses the validation of the entire system to ensure it meets the defined requirements, identifying and rectifying any errors or defects. Finally, deployment involves the installation and rollout of the developed software into the client's environment for operational use. Each stage represents a step forward in the development process, with progress moving linearly from one phase to the next, making it difficult to backtrack once a phase is completed.

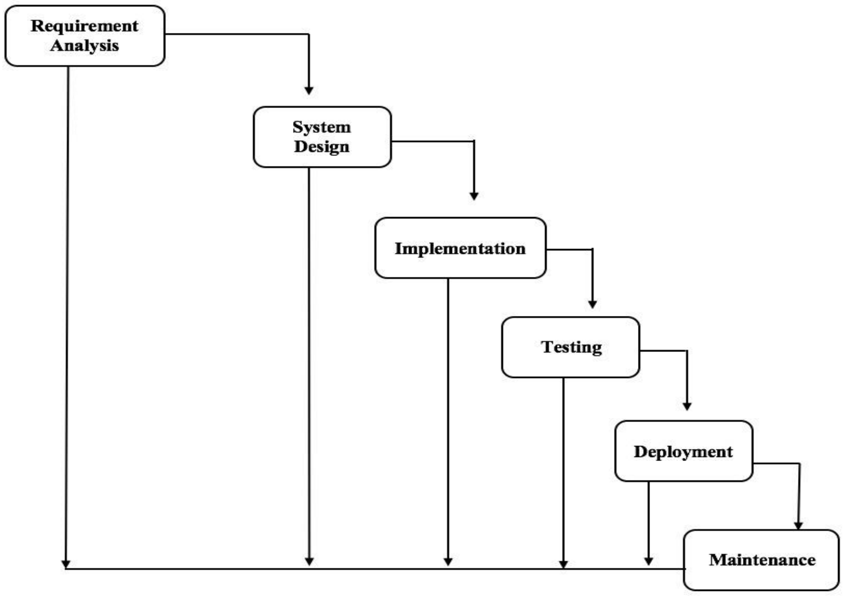

Figure 3.1 SDLC Waterfall Model

In requirements phase, all possible conditions of the system to be developed are recorded and proved in specifications.

System Design: In this phase the conditions specification from the first phase is reviewed and the system design is prepared. This system design specifies the tackle and system conditions and helps define the overall system armature.

Implementation: With input from system design, the system is first developed in small programs, so- called units, which are integrated in the coming phase. Each unit is developed and tested for functionality called unit testing.

Testing: All units developed during the perpetration phase are integrated into the system after each unit is tested. After integration, the entire system is tested for crimes and failures.

Deployment: Once functional testing is complete; the product is stationed in the client's terrain or retailed.

Maintenance: There are some issues we're passing in our customer terrain. some better performances will be released to ameliorate the product. conservation will be performed to emplace these changes to client surroundings.

3.1 Methods to Use Machine Learning Algorithms

The OEBMS utilizes machine learning techniques such as Random Forest and Linear Regression to forecast energy use and optimize billing procedures. The system intends to enhance accuracy, efficiency, and customer satisfaction in handling online electricity billing operations by using these algorithms together with effective data gathering and processing methodologies. The data collection procedure shown in the Figure 3.2.

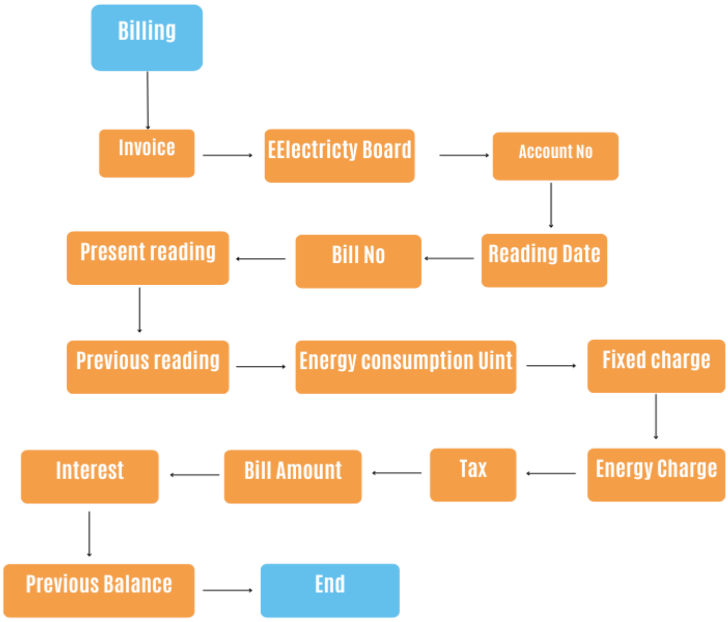

Figure 3.2 Flowchart of Data Collection Procedure

To forecast energy consumption for the next year using machine learning, we first collect past data on energy use, as well as relevant factors such as weather conditions, time of day, and any other aspects that might potentially impact energy consumption. Once the data has been pre-processed to address missing values and outliers, it is divided into separate training and testing sets. We use the training data to train both Random Forest and Linear Regression models. The Random Forest model constructs a collection of decision trees using subsets of the training data, while the Linear Regression model establishes a linear equation to understand the correlation between characteristics and energy use.

We assess the performance of both models by using measures such as Mean Absolute Error (MAE) and Mean Squared Error (MSE) on the testing set to see whether one yields superior predictions. After training and evaluating the models, we use them to forecast energy usage for every time interval in the next year. Through the analysis of projected energy consumption patterns, we may get valuable information about fluctuations in energy demand due to seasonal changes, weather conditions, and other external variables. This knowledge can be used to make informed decisions on energy management and resource distribution. By consistently monitoring and refining the predictive models, the goal is to enhance the precision of future forecasts and maximize energy use efficiency.

The research used a viable and adaptive way of integrating machine learning algorithms, namely Random Forest and Linear Regression, into the online electricity billing system. Initially, a thorough understanding of the system's needs and goals is achieved by engaging with stakeholders and doing a literature review. Subsequently, the study methodology proceeds with the careful gathering of data, including both previous billing data and external variables such as weather fluctuations and client behavior.

After the data collecting procedure is finished, a systematic approach is used to choose the algorithm and build the model. When evaluating the suitability of Random Forest and Linear Regression algorithms for predicting energy consumption, we analyze their unique characteristics, scalability, and performance measures. Subsequently, the selected algorithms are included into the framework of the billing system, seamlessly linked with the current data processing pipelines and user interfaces.

Both Random Forest and Linear Regression algorithms include a series of crucial phases in their respective processes. The Random Forest approach is a technique used in collective learning. This approach involves the creation of several decision trees using random selections of the training data. Each decision tree conducts autonomous forecasting of energy use, and the ultimate forecast is a synthesis of all the trees' projections. Conversely, linear regression provides a direct correlation between the characteristics of the input and the quantity of energy used. To do this, it employs methods like gradient descent to optimize the model's parameters.

During the research phase, a rigorous assessment methodology is used to analyze the accuracy, strength, and scalability of the algorithms developed in the billing system. Evaluating the effectiveness of the proposed strategy and assessing the accuracy of predictions involves using performance indicators such as MAE and Root Mean Squared Error (RMSE). Furthermore, the system's design and algorithmic models are constantly improved by actively seeking input from stakeholders and end-users. This iterative method ensures that the system meets the criteria of the real world and fulfills the expectations of the users.

3.2 Mathematical Formulation

3.2.1 Random Forest Regression

Random Forest Regression is an ensemble learning method that builds Multiple decision trees and aggregates their predictions to make a final prediction. The formula

$$predicted\ paid\ amount_{RF} = \frac{1}{N}\sum_{i=1}^{N} tree_i\ (cust_{id}, bill_{amount})$$

represents this aggregation, where $predicted\ paid\ amount_{RF}$ is the predicted paid amount by the Random Forest model, N is the number of trees, and $tree_i$ represents the i^{th} decision tree's prediction for a given customer ID and bill amount. Random Forest Regression is robust and effective for handling complex nonlinear relationships in data.

3.2.2 Linear Regression

Linear Regression models the relationship between a dependent variable (outcome) and one or more independent variables (predictors) by fitting a linear equation. The formula

$$y^{\wedge} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n$$

represents this linear relationship, where $y^{\wedge}$ is the predicted value, β_0 is the intercept term, and $\beta_1, \beta_2, \dots, \beta_n$ are the coefficients for each feature $x_1, x_2, \dots, x_n$, respectively. Linear regression is widely used for making predictions and understanding the relationship between variables in fields such as economics, finance, and social sciences.

4 DESIGN ARCHITECTURE AND ANALYSIS

The analysis phase of an OEBMS is a crucial stage in the development of a software application or system designed to efficiently manage and handle electricity billing processes. This phase involves a comprehensive examination of the current billing system, gathering requirements from stakeholders, and understanding the challenges and objectives of implementing the new system. The main goal of this phase is to gain a clear understanding of the existing processes and to identifying opportunities for improvement through a new and automated EBMS.

4.1 Current System Description

In the electricity primer systems illustrated in Figure 4.1, operation workers do electricity cadence reading for electricity operation, billing from home to home, and structure to structures. Operation workers are prone to reading error as the houses electric cadence is placed where it is not fluently accessible. Labor billing job is also confined and braked down by bad environmental condition. The increased development of domestic casing and artificial structures in the developing countries require further operation workers and longer working hours to complete the operation- reading task. These increase the energy provider's operation costs for cadence reading.

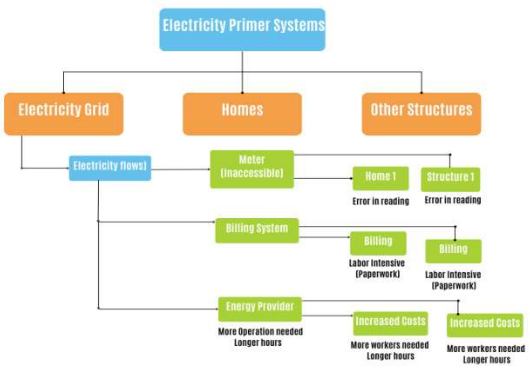

Figure 4.1 Primer Electricity Systems

4.2 Proposed System Description for OEBMS

Figure 4.2 is a web-based operation illustration where addicts can get instant electricity bills and pay them online via credit card. The system has two login pages for admin and user login. Admin can view user account details and add or update goods in their account. Admin has to feed the system with electricity operation data into separate addict's regard. The system also calculates the electricity bill for every user and updates the information in their account every month.

On the other hand, user can view their electricity bill and pay on the spot for emoted. However, it also calculates a fine for each posterior day. If a user is unable to pay the bill before the end of moth. It is support to get good data to give more information. The collection is obvious, simple, and sensible. It helps a person to know the operation of passed time perfectly and vividly. It also helps to keep all the work related to the electricity payment system up to date. ıt will also reduce the cost of collecting the operation and collection procedure go on fluently. The proposed design aims at business process automation.

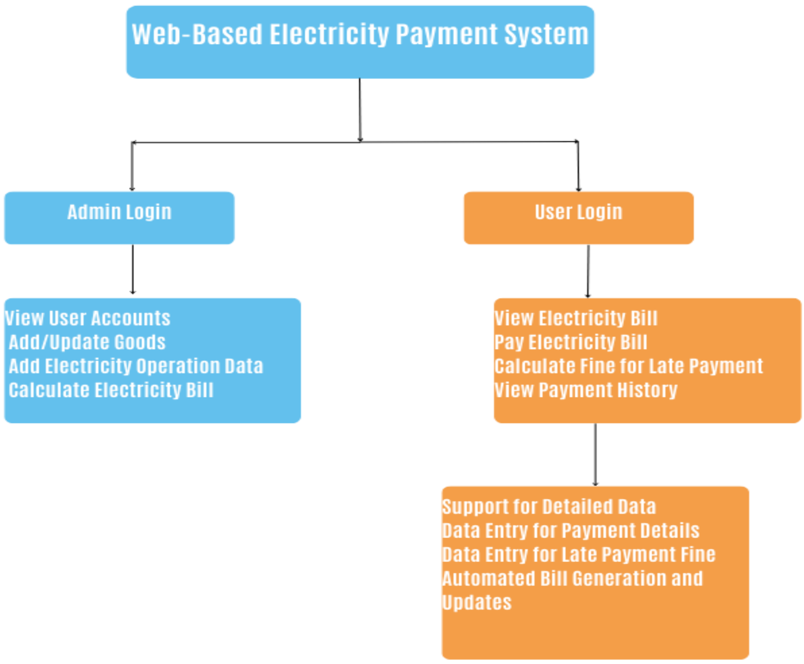

Figure 4.2 Web-Based Electricity System

The flowchart in Figure 4.3 depicts the system structure of an OEBMS, which includes features for managing client accounts and processing bills. The system may handle two sorts of users: consumers and administrators.

Customers may avail an option to establish new accounts, authenticate their identity by using their existing login credentials, and access their account details, which may include their names, contact information, and history or usage statistics. Users have the option to create additional accounts inside the system, maybe for the purpose of overseeing several properties or service connections. This feature has the potential to be included into the system. Furthermore, users can see their invoices, perhaps monitor their total energy consumption habits via the utilization of reports, and conveniently make electronic payments. They may have access to a feedback mechanism that enables them to submit comments or seek assistance.

Administratively, the system empowers users to oversee and control staff accounts. This encompasses the capability to do tasks such as adding new personnel, retrieving information about current personnel, and even changing passwords. Administrators can get client information, often used for data research or delivering customer care.

The major objectives of the suggested system are to streamline client account maintenance, enhance the efficiency of bill payments, and provide tools for assessing energy use data. It is crucial to acknowledge that the skills and characteristics accessible to any user group may differ based on the ultimate execution. This is an undeniable fact that must be fully recognized.

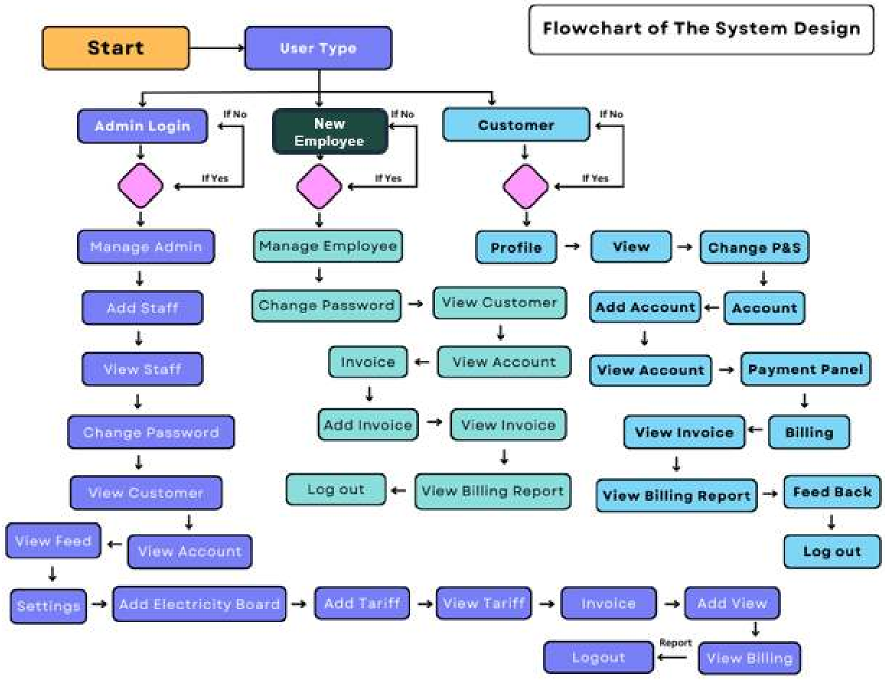

Figure 4.3 Flowchart of The System Design

4.2.1 Objectives

The objective of researching developing EBMS in the capital city of Somalia, Mogadishu. The objectives of EBMS are presented as follows:

- To manage the details of electricity, unit of energy, bill, store record and electricity board.
- To manage all the information electricity, connections, electricity board, and electricity.
- To build at administrative system part, and thus to guarantee only the administrator is access.
- To build an application program to reduce the manual work for managing the electricity, unit of energy, connections, bill.
- To track all the details about the bill, store record, and electricity.
- To manage the information of customers and employees working in the department.

4.2.2 Architecture

The system user with a home page and this page the user is asked to login into the system. Once the user, on the login button, the login page is seen and the user enters the username and password, if the user is a consumer and the username and password are correct, then the user will be displayed three options: view bill, bill payment, and provide feedback. After that, the consumer can view the bills and also pay the monthly bill by clicking on the bill payment and filling in the information required, the user also provide feedback or complaint to the system administrator by clicking on the feedback button. If the user is Admin, then the admin panel will be displayed. In the Admin section, the Admin has full permission to control the system; i.e registering a new consumer, calculating, viewing the bills, or updating the electricity per unit cost (Mukherjee & Roy, 2017).

4.3 Feasibility Study

A feasibility study in Software Engineering is a study to estimate the feasibility of a proposed design or system. Feasibility study is one of the stages among four important stages of the software project management process. As the name suggests feasibility, study is the feasibility analysis or it is a measure of the software product in terms of how important beneficial product development will be for the association from a practical point of view. A feasibility study is carried out grounded on numerous purposes to dissect whether software products is right in terms of development, deployment, donation of design to the association. Depending on the results of the original disquisition, the check is expanded to a more detailed feasibility study. It is a crucial part of the primary disquisition that reviews anticipated costs and benefits and tests of 36 software systems according to their plasticity, impact of the association, capability to meet requirements, and effective use of the coffers.

It is more important for a system that it clarifies the objects of the proposed system it provides a better understanding of associated problems. The main idea of the feasibility study phase is to determine the specialized and profitable functional feasibility and change the current system.

4.3.1 Technical Feasibility

Specialized feasibility is the process of figuring out how admin is going to produce product or service to determine whether it is possible for your company. Before launching immolations, every part of the operations should be planned: from first sourcing product accouterments all the way to tracking your deals. By looking at all the logistics of this process, determine implicit challenges and figure out ways to overcome them. The new proposed system is developed with an expert labor force, software technology, and the current outfit. According to the feasibility analysis procedure; the specialized feasibility of the system is an atomized and the specialized conditions similar to software, tackle installations, procedures, and inputs are linked. It is also one of the important phases of the system development conditioning. What kind of tackle and software will be needed? We have just mentioned above that specialized conditions will be demanded to develop the new system. But before that, it is a good scheme to propose or design what to do (this means what order of software and tackle we need and their minimum and maximum quantity). So, Table 4.1 illustrates the hardware requirements

Table 4.1 The Description of Technical Feasibility

No	Name	Description	Software
1	Computer (Server)	Type: Dell/PHP Intel: Core i7 HDD: 1TB GB RAM: 8GB CPU: 3.0 GHZ Printer: Laser Input Tools: Keyboard/mouse	OS: Windows server 2014, Application: SQL Server database, Web server: Apache web server, Utilities: Anti-virus, Firewall
2	Computer (Client)	Type: Dell/PHP Intel: Core i7 HDD: 500 GB RAM: 4GB CPU: 2.0 GHZ Printer: Laser Input Tools: Keyboard/mouse	OS: Windows 10 Web browser: Chrome, Firefox Utilities: Firewall, Anti-virus,
3	Network	Transmission Media Routers, Switches, Cables	OS: Network operating system

4.3.2 Operational Feasibility

Operational feasibility is the extent to which a proposed system solves problems and makes use of linked openings during compass explanation. In addition, how it satisfies the requirements identified in the requirements analysis phase of system development. It is assessing whether a proposed system is effectively implemented and operations, considering, training, availability and ability of employees to adapt new system. Here is a way to train the new employee in the company so the following are required:

- Trainers whose job is to train the employees inside the center on the optimal use and maintenance of the system.
- Employees dealing with the system.
- Establishing a computer unit to supervise the operation and maintenance of the system and to communicate with the system programmer for maintenance
- Purposes in case of any problem in the system.
- Providing the users, the ability to use the new system by using documentation guidelines in help.
- The proposed system will provide a better working environment in which.

4.3.3 Economic Feasibility

Economic feasibility analysis is the process of determining whether a new adventure is worth the cost and time investment. It is also known as cost benefit analysis. This kind of analysis takes into consideration the cost of both developing and operating the new adventure. Perpetration is a way to reduce the threat of trying new gambles. A wide array of factors is considered, and if show that the idea is cost effective, also it espouses. profitable feasibility is the most important part of the feasibility study of this design. This involves questions similar as whether the scholars of the university can go to make the system, whether its benefits should mainly exceed costs and whether the design has an advanced precedence than other systems that could use the same coffers. New budget demand of the new system is shown in Table 4.2, Table and 4.3

Table 4.2 Description of the OEBMS Development Cost

Phase	Time	Cost
Initial Study	3 Weeks	$900
Analysis	2 Weeks	$1,000
Design	3 Weeks	$1,000
Implementation	4 Weeks	$4,000
Training	2 Weeks	$1,000
Total	14 Weeks	$7,900

Table 4.3 The Description Operational Costs

Unit	Monthly Cost	Yearly cost
Software	$3,000	$36,000
Periodic maintenance	$1,500	$18,000
Training	$1,000	$12,000
Others	$500	$6,000
Total	$6,000	$72,000

4.4 Output Analysis of the System Design

The proposed system contains the following reports and queries.

4.4.1 Reports

Customer: This stores information about the system's registered customers.

Each record contains:

cust_id (primary key): Unique identifier for each customer within the system.
cust_name: Customer's full name.
account_type: Type of customer account (e.g., residential, commercial).
address: Customer's complete address.
Phone number: costomer's phone number
state: State where the customer resides.
city: City where the customer resides.
pincode: Postal code of the customer's address.
email_id: Customer's email address for communication.
password: Customer's login password (encrypted for security).
status: Indicates the customer account's activation status (e.g., active, inactive).

Account: This stores details about individual customer accounts linked to the electricity board. Each record contains:

Account_id (primary key): Unique identifier for each customer account.
cust_id (foreign key): References the customer ID in the "Customer" table, linking the account to a specific customer.
account_no: Unique account number assigned by the electricity board.
electricityboard_id (foreign key): References the ID of the electricity board associated with the account.
name: Name associated with the account (may differ from customer name for joint accounts).
address: Address associated with the account (may differ from customer address for billing purposes).
rr_number: Reference number assigned by the electricity board (optional).
status: Indicates the account's activation status (e.g., active, inactive, disconnected).

Admin: This table stores information about system administrators. Each record contains:

Admin_id (primary key): Unique identifier for each administrator.
admin_name: Full name of the administrator.
login_id: Username used by the administrator for login.
password: Administrator's login password (encrypted for security).
admin_type: Denotes the administrator's access level and permissions (e.g., super admin, billing admin).
status: Indicates the administrator account's activation status (e.g., active, inactive).

Billing: This tracks billing information and transactions for each customer account. Each record contains:

Bill_no (primary key): Unique identifier for each electricity bill.
cust_id (foreign key): References the customer ID in the "Customer" table.
account_id (foreign key): References the account ID in the "Account" table.
payment_mode: Method used for bill payment (e.g., credit card, debit card, net banking).
payment_date: Date on which the bill payment was made.
payment_time: Time of the bill payment.
rr_number: Reference number associated with the payment (optional).
bill_amount: Total amount payable for the electricity bill.
paid_amount: Amount actually paid by the customer towards the bill.
excess_paid: Any excess amount paid over the bill amount.
status: Indicates the payment status of the bill (e.g., paid, pending, overdue).

Electricity Board: This stores information about the electricity boards participating in the system. Each record contains:

Electricityboard_id (primary key): Unique identifier for each electricity board.
electricityboard: Name of the electricity board.
logo: (Optional) URL or reference to the electricity board's logo image.
note: Any additional information or notes related to the electricity board.
status: Indicates the electricity board's participation status within the system (e.g., active, inactive).

Bill Invoice: This provides a detailed breakdown of individual electricity bills. Each record contains:

Invoice_id (primary key): Unique identifier for each bill invoice.
electricityboard_id (foreign key): References the ID of the electricity board associated with the bill.
account_no: Account number linked to the invoice.
tariff_id (foreign key): References the ID of the applicable tariff plan used for billing.
readingdate: Date on which the meter reading was taken.
bill_no (foreign key): References the bill number associated with the invoice.
present_reading: Current meter reading for the billing period

4.4.2 Queries

Query of Consumers Recorded in the System: This collects information about registered consumers. You may search all customers, pick clients by ID, or filter by characteristics like city or account status.

Query about Billing: This focuses on numerous aspects of billing information. You may search overdue invoices, individual bills by number, or compute total bill amount for a client.

Query of Accounts: This seeks information about client accounts. You may reveal active accounts for an electrical board, search account data by number, or discover the number of accounts associated with a customer.

Query of Bill Invoices: This gives comprehensive information about certain invoices. You may obtain the current invoice for an account, calculate total consumption for a client over a period, or acquire data about bills with a specified tariff plan.

Query About Feedbacks of the Consumers: This retrieves feedback submitted by consumers. You may find all feedback recordings, filter by individual consumer, or search unresolved feedback.

4.5 Process Analysis of the System Design

The process analysis outlines the key roles and their functionalities within the online electricity bill management system:

Admin: The system administrator manages user accounts, electricity board information, system settings, data (tariffs, feedback, reports), and resolves customer billing issues.

Consumer: The registered user can manage their account, view and download bills, make online payments, potentially self-report meter readings, and submit feedback.

Employee (Optional): Depending on the system design, an employee role might exist for customer support and potentially data entry tasks.

4.5.1 Definition tasks of User Types

This section describes the main functionalities of each user role (Admin, Employee, and Consumer) in the online electricity bill management system, utilizing the concept of Use Cases in UML.

Admin: The Admin has the most comprehensive set of functionalities represented by the following Use Cases:

Manage Users: Login, Register Consumer, Add Admin/Employee

View System Data: View Customer Accounts, View Feedbacks, View Electricity Accounts

Manage Electricity: View Electricity Tariff Rates, Generate and view Invoice

Manage Billing: View Billing Report, Update Unit Cost Logout

Employee (Optional): The Employee role, if present, has a limited set of functionalities compared to the Admin.

View System Data: View Customer Accounts, View Electricity Accounts, View Electricity Tariff Rates

Generate Invoice, View Billing Report

Logout

Consumer: The Consumer interacts with the system for managing their electricity bills:

Manage Electricity Bills: View Electricity Bill, Make Electricity Bill Payment, View Bill Payment Report

Manage Account: Add Electricity Account, View Electricity Account

Provide Feedback: Post Feedback

Logout

4.5.2 Usage Case Diagram

Use case diagram is a visual representation in the Unified Modeling Language (UML) that helps illustrate how a system interacts with external entities, referred to as actors, to accomplish specific tasks or goals. In this diagram, use cases depict distinct functionalities or features provided by the system, outlining the various ways users or external systems can interact with it. Actors, representing external entities, are connected to use cases, illustrating their involvement in the system. The relationships between actors and use cases, depicted through lines, convey associations, generalizations, dependencies, providing a comprehensive overview of the system's functionality and interactions. Use case diagrams play a crucial role in system design, aiding in early-stage visualization, communication among stakeholders, and ensuring a shared understanding of system requirements.

Figure 4.4 provides a graphical representation of the interactions taking place inside the OEBMS, using the concepts of UML. This image use actors and use cases to illustrate the connections between different user groups and system functionality. Participants in this context may include consumers, administrators, or other bodies, such as electricity boards. Actors might also be considered as customers. In order to see their invoices, make payments, or amend their account information, customers are required to fulfill several conditions. Administrators have additional powers, such as the ability to create reports, implement new pricing schemes, and manage user accounts. An relationship would be formed between actors and the use cases they may engage with, use lines and arrows to indicate if the interactions are necessary or optional. This use case diagram provides a thorough overview of the many components of the system; however, the details may differ based on the system's architecture.

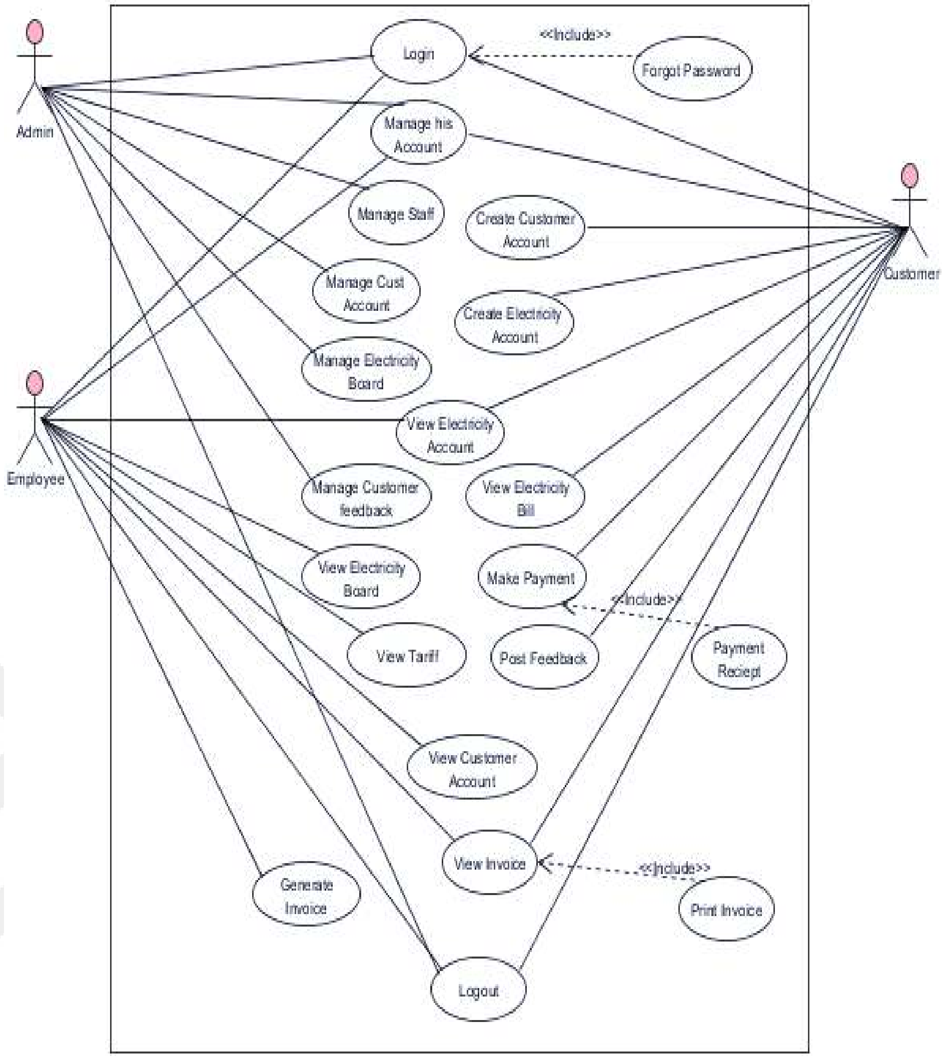

Figure 4.4 Use Case Diagram of the UML System

4.5.3 Description of Use Cases

Description of use cases for the operations that take place within the system. Table 4.4 – 4.7 show the descriptions for login process, forget password process, consumer registration process and change password, respectively.

Table 4.4 Description or Login Process

Process	Description
Use case number	1
Use case name	Login
Users	Admin, Employee and Customer
Short description	Login to the system
Precondition	Username and Password
Main Process flow	1. Click on the Login button 2. Enter Email ID 3. Enter Password 4. Click Enter button
Backflow	Entering to the main page
Final result	You have successfully logged in

Table 4.5 Description for Forget Password Process

Process	Description
Use case number	1
Use case name	Login
Users	Admin, Employee and Customer
Short description	Forget password
Precondition	Username and Password
Main Process flow	1. Entry email Id 2. Click recovery password 3. Enter new Password 4. Confirm Password 5. Click Enter button
Backflow	Click on Submit Button
Final result	You have successfully logged in

Table 4.6 Description for Consumer Registration Process

Process	Description
Use case number	2
Use case name	Consumer registration
Users	Admin
Short description	Create consumer account
precondition	The application should be a position
Main Process flow	1. Click on the register button 2. Costumer name 3. Address 4. State 5. City 6. Pin Code 7. Email Id 8. Mobile Number 9. Password 10.Confirm Password
Backflow	Entering to the main page
Final result	You have successfully registered a new Consumer

Table 4.7 Description for Change Password

Process	Description
Use case number	4
Use case name	Change password
Users	Admin and Customer
Short description	The system calculates the electricity consumed by the consumer
precondition	The system should generate bill according to the meter readings
Main Process flow	Click on change password Login Id Old Password New Password Confirm Password Click on Submit Button
Backflow	Entering to the main page
Final result	If the use case was successful then the Bill of the month will be sent to the consumer’s account

Table 4.8 shows the description for view customer account. Table 4.9 –4.12 present the description for view customer feedback, invoice, view billing report, and for view tariff. Table 4.13 shows the description for degenerate invoice.

Table 4.8 Description for View Customer Accounts

Process	Description
Use case number	5
Use case name	view customer accounts
Users	consumer
Short description	the system displays the consumer's accounts
Precondition	the system should display all customer accounts
Main Process flow	1. Click on the View Accounts 2. Display Accounts
Backflow	entering to the main page
Final result	if the use case was successful then the bill of the month will be displayed to the customer

Table 4.9 Description for View Customer Feedback

Process	Description
Use case number	6
Use case name	View Customer Feedback
Users	Admin
Short description	Admin Checks Customer feedbacks
precondition	Username and password
Main Process flow	1. Click on the View Customer Feedback 2. Display Accounts
Backflow	Entering to the main page
Final result	If the use case was successful then the system will update the unit cost of the kilo watt hour

Table 4.10 Description for View invoice

Process	Description
Use case number	7
Use case name	View invoice
Users	Consumer
Short description	This page is where the user pays the bill
Precondition	Bill amount
Main Process flow	Click on the View invoice Display Accounts
Backflow	Entering to the main page
Final result	If the use case was successful then the system will show a success paid message

Table 4.11 Description for View Billing Report

Process	Description
Use case number	8
Use case name	view Billing Report
Users	Consumer
Short description	This page is where the user pays the bill
Precondition	Bill amount
Main Process flow	1. Click on the view Billing Report 2. Display Accounts
Backflow	Entering to the main page
Final result	If the use case was successful then the system will show a success paid message

Table 4.12 Description for View Tariff

Process	Description
Use case number	9
Use case name	View Tariff
Users	Admin
Short description	This page is where the user pays the bill
Precondition	Bill amount
Main Process flow	1. Click on the view tariff 2. Display Accounts
Backflow	Entering to the main page
Final result	If the use case was successful then the system will show a success paid message

Table 4.13 Description for Generate Invoice

Process	Description
Use case number	10
Use case name	Add Tariff
Users	Consumer
Short description	This page is where the user pays the bill
Precondition	Bill amount
Main Process flow	1. Click on the view tariff 2. Display Accounts
Backflow	Entering to the main page
Final result	If the use case was successful then the system will show a success paid message

Table 4.14 shows the description for add electricity account. Table 4.15 shows the description for view electricity account. Table 4.16 and Table 4.17 show the description for electricity bill payment and for post feedback.

Table 4.14 Description for Add Electricity Account

Process	Description
Use case number	11
Use case name	Add Electricity Account
Users	Consumer
Short description	This page is where the user pays the bill
Precondition	Bill amount
Main Process flow	1. Account no 2. Electricity Board 3. Name 4. Address 5. RR Number
Backflow	Entering to the main page
Final result	If the use case was successful then the system will show a success paid message

Table 4.15 Description for View Electricity Account

Process	Description
Use case number	12
Use case name	View Electricity Account
Users	Consumer
Short description	This page is where the user pays the bill
Precondition	Login with username and password
Main Process flow	1. Click on the view Electricity Account 2. Display Accounts
Backflow	Entering to the main page
Final result	If the use case was successful then the system will show a success paid message

Table 4.16 Description for Electricity Bill Payment

Process	Description
Use case number	13
Use case name	Electricity Bill Payment
Users	Consumer
Short description	This page is where the user pays the bill
Precondition	Bill amount
Main Process flow	Account no Bill Month Payment Mode Card Number Cvv Code Expiry Date RR Number Bill Amount Paid Amount Express Paid
Backflow	Entering to the main page
Final result	If the use case was successful then the system will show a success paid message

Table 4.17 Description for Post Feedback

Process	Description
Use case number	14
Use case name	Post feedback
Actors	Consumer
Brief Description	This page allows the consumer to send feedback to the system or the company
Preconditions	Feedback
Main Flow	1. Click on Post feedback 2. Enter your feedback/complaints 3. Click on the submit button
Backflow	Entering to the main page
Post conditions	If the use case was successful then the system will display feedback submitted successfully

4.5.4 Sequence Diagrams

The sequence diagram of a user login is given in Figure 4.5, Figure 4.6 present to description of Sequence diagram of Create Account, Figure 4.7 present to description Sequence diagram of Post Feedback, Figure 4.8 present to description Sequence diagram of Generate Invoice, Figure 4.9 present to description Sequence diagram of Payment.

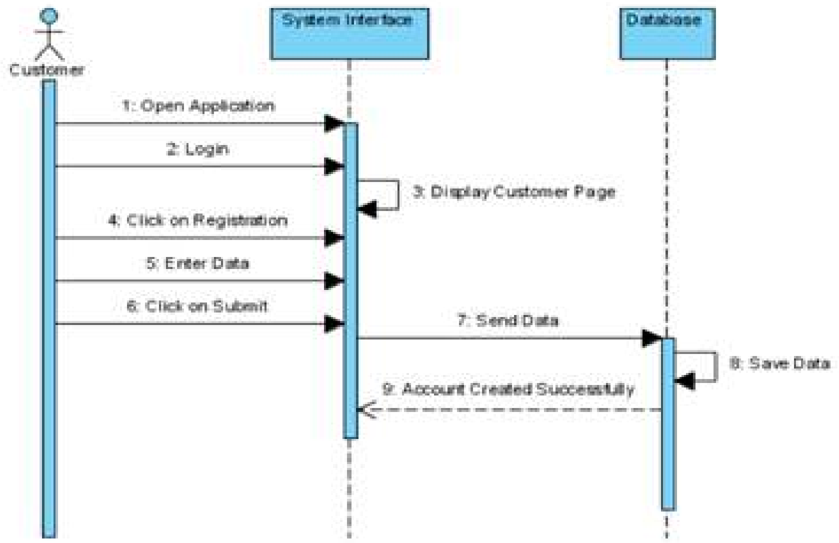

Figure 4.5 Sequence Diagram of User Login

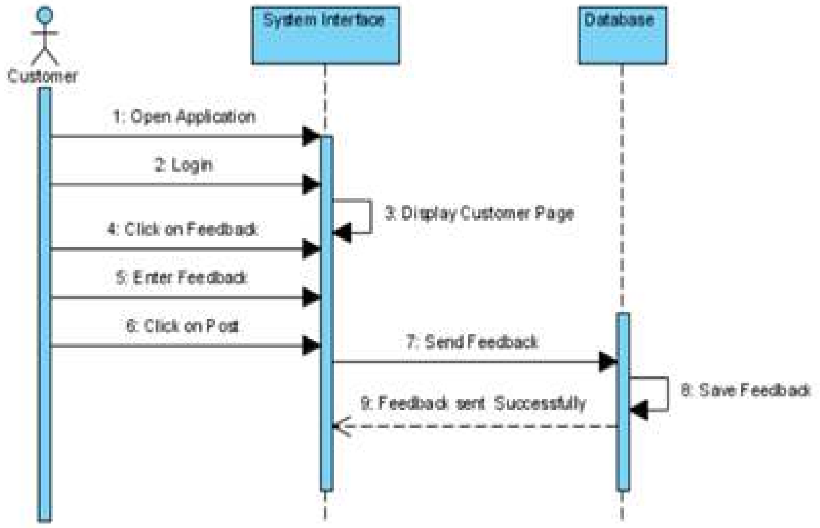

Figure 4.6 Sequence Diagram of Create Account

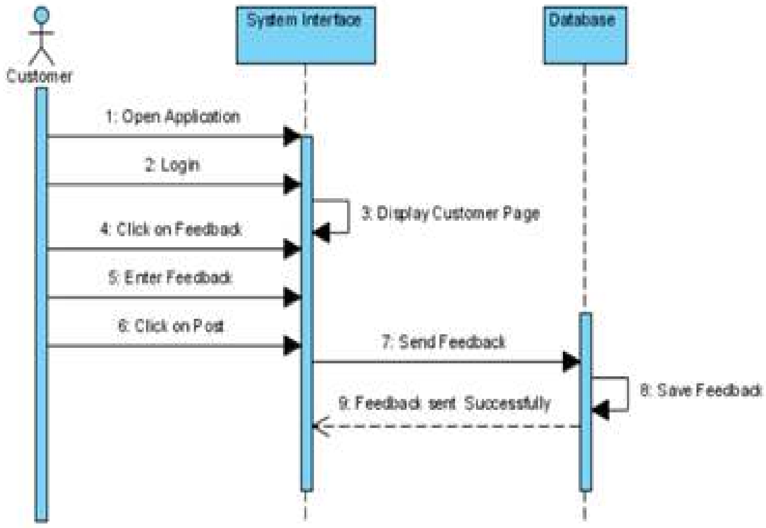

Figure 4.7 Sequence Diagram of Post Feedback

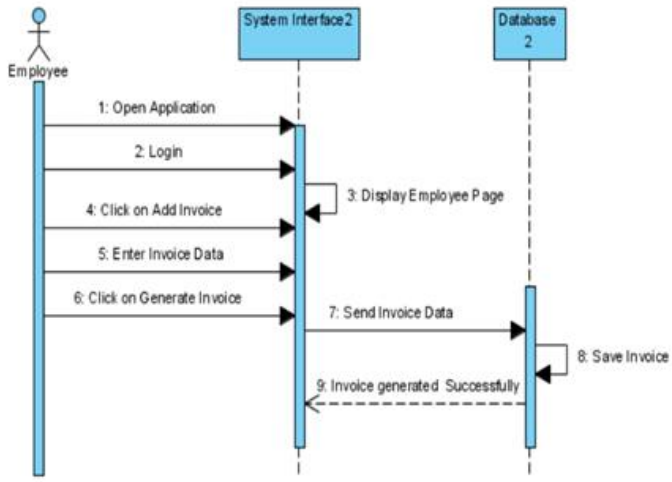

Figure 4.8 Sequence Diagram of Generate Invoice

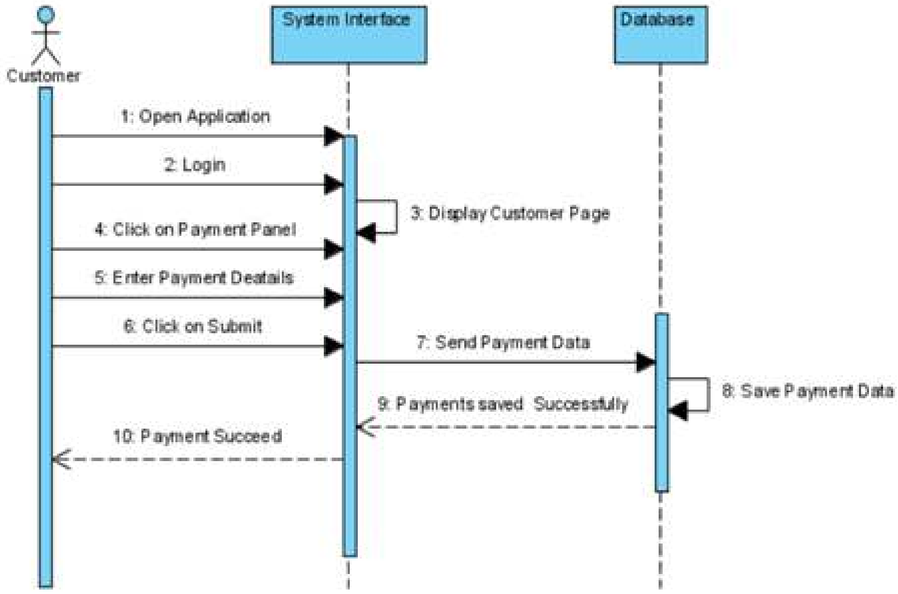

Figure 4.9 Sequence Diagram of Payment

4.6 Input Analysis of the System Design

The purpose of input analysis is to be largely certain that the input is to check for us all the needed labors and there are no inputs that are not used in the affair. The labors are collected, entered and stored in the system in a safe and easy manner.

4.6.1 Input Data

An OBMS is a digital platform designed to streamline the process of managing, and facilitating the payment of electricity bills for consumers. The input data for such a system would typically include information related to user accounts, electricity consumption, and billing details. It is contains the following categories:

User Information:

1. Usernames Passwords
2. Contact information (email, phone number)
3. Address

Meter Reading Data:

1. Electricity consumption data from meters
2. Date and time of meter readings Meter
3. Identification numbers

Billing Cycle Information:

1. Billing cycle start and end dates
2. Tariff rates for electricity consumption

Payment Information:

1. Credit/debit card details
2. Bank account information
3. Other payment methods

4.6.2 Class Diagram

Figure 4.10 likely represents a UML Class Diagram, which visually depicts the arrangement of classes in an OEBMS and the relationships between them. This diagram depicts the fundamental elements of the system, which include power boards, accounts, bills, and consumers. To provide a comprehensive understanding of the system's capabilities, the arrows connecting different components illustrate their interactions.

For instance, the diagram may display a "Customer" class with properties such as name and address. Additionally, it may depict a "Account" class that is associated with a "Service" class representing the customer's unique electrical service. The category "Electricity Board," which represents the service provider, will be linked to this account to provide accessibility. Bills will be logged in a "Billing" category on the customer's account, which might be associated with a "Tariff" category if several pricing plans are offered for selection. Users may provide feedback by using a "Feedback" class, which serves as an alternative choice.

The class diagram offers a concise graphical depiction of the fundamental components of a system, enabling effective communication between developers and stakeholders, and serving as a point of reference for system development and upkeep. Nevertheless, the absence of a comprehensive UML diagram and thorough attribute definitions hinders the ability to provide a comprehensive explanation.

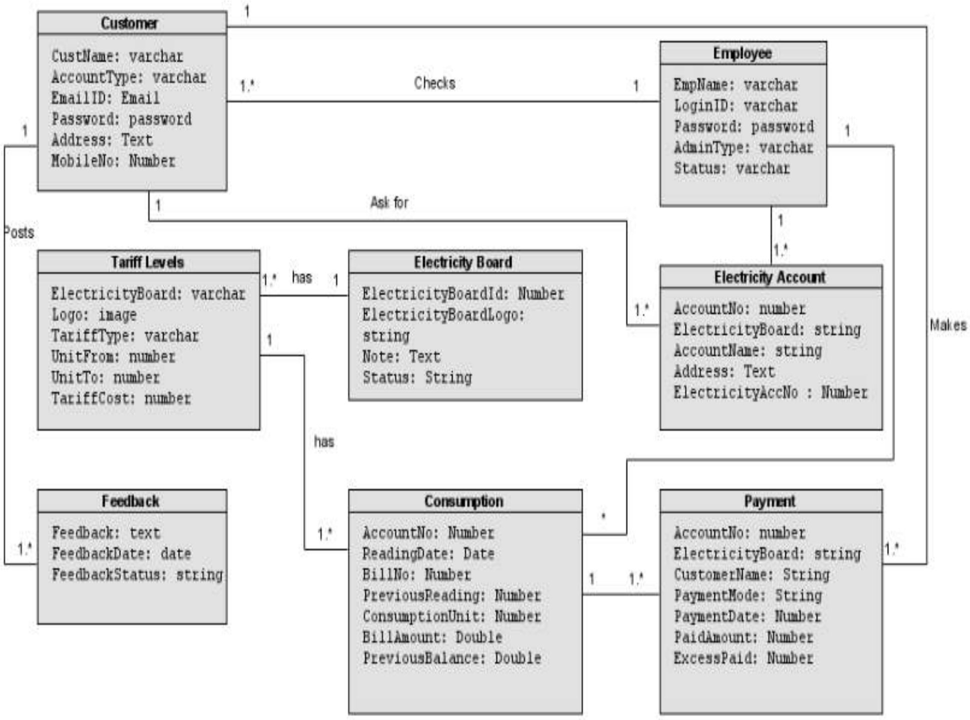

Figure 4.10 Class Diagram for the System

4.6.3 Relation Diagram

Figure 4.11 with the description "Relation Diagram for the Objects" probably shows the architecture of a relational database for an online tool made especially for handling electricity bills. The main data elements—customers, accounts, bills, and power boards, among related entities—are represented visually in this graphic. Every database has unique data, and foreign keys indicate how the tables are connected to one another.

A database called "Admin" is an example of this notion; it contains the particulars of people with administrative tasks, and a table called "Customer" is in charge of keeping track of the data related to customers who have registered. To improve the information's accessibility in the future, the design can, however, include unnecessary ties between these tables. To establish a link between customers and the specific electrical boards they are registered with, "Account" tables are used. The invoices that are created for these accounts are recorded in a "Billing" database. The database could be connected to a "Tariff" table with several pricing strategies that is hidden from view in the information above. Clients may use a "Feedback" table linked to their customer record to make comments on the service they have received.

Using a relational diagram to illustrate how data is arranged inside the system may be beneficial. This diagram gives the essential components a visual depiction, highlighting their attributes and the relationships that bind them together. This facilitates more efficient communication between developers and stakeholders, supports system development and maintenance, and lays the groundwork for gaining a thorough grasp of the OEBMS's whole data structure. The connection structure of the system is fully understood by this study; however future in-depth analysis may provide more details.

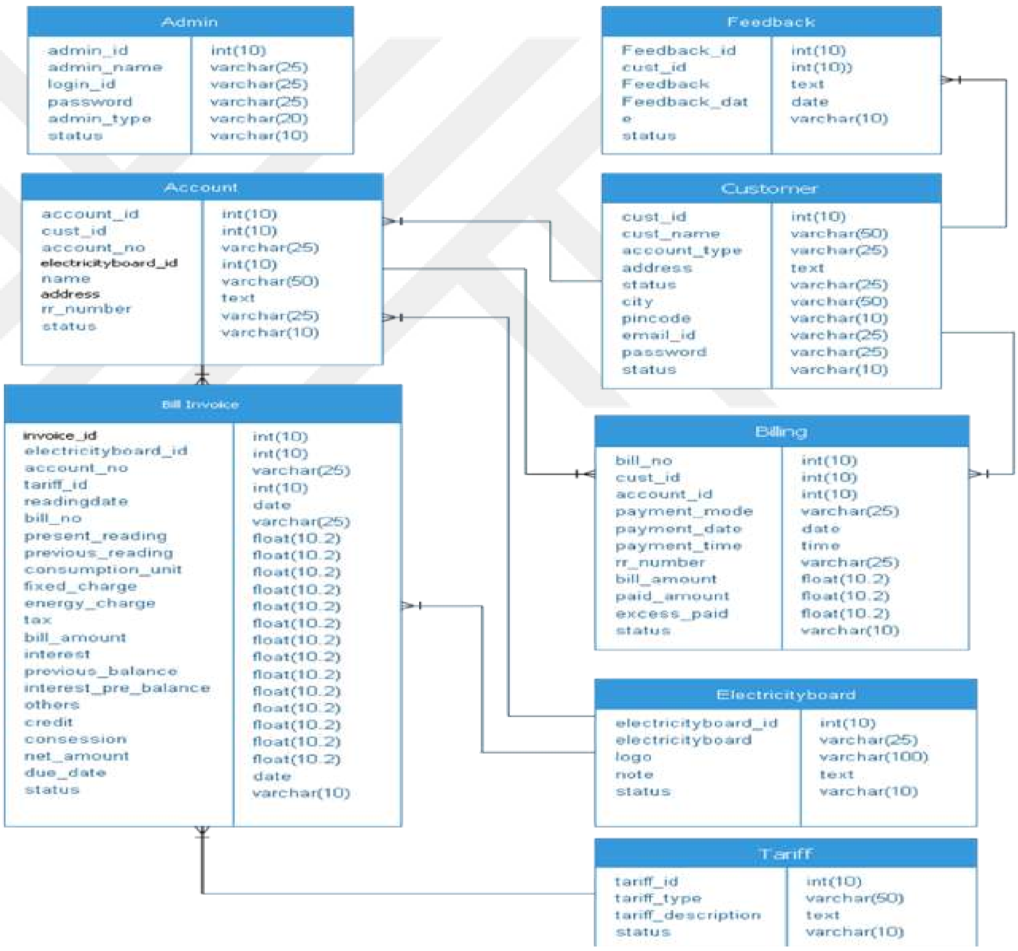

Figure 4.11 Relation Diagram for the Objects

4.6.3 Data Dictionary

A data dictionary is a centralized repository that provides a detailed description of the data used in a database or information system. It typically includes information about data elements, such as names, definitions, data types, lengths, and relationships with other data elements. Table 4.18 shows the description for specifies data dictionary for customer. Table 4.19 shows the description for specifies data dictionary for account.

Table 4.18 Specifies Data Dictionary for Customer

Name	**Data type**	**Size**	**Constraint**
cust_id	int	10	Primary key
cust_name	varchar	50	not null
account_type	varchar	25	not null
address	text		Not null
state	varchar	25	Not null
city	varchar	50	Not null
pincode	varchar	10	Not null
email_id	varchar	25	unique
password	varchar	25	Not null
Status	varchar	10	Not null

Table 4.19 Specifies Data Dictionary for Account

Name	Data type	Size	Constraint
account_id	int	10	Primary key
account_no	varchar	25	Foreign key
electricityboard_id	int	10	Not null
name	varchar	50	Not null
address	text	50	Not null
Rr_number	varchar	25	Not null
status	varchar	10	Not null

Table 4.20 shows the description for specifies data dictionary for Admin and Table 4.21 shows the description for specifies data dictionary for billing. Table 4.22 – 4.24 present the specifies data dictionary for electricity board, data dictionary for feedback, and data dictionary for invoice. Table 4.25 shows the description for specifies data dictionary for tariff.

Table 4.20 Specifies Data Dictionary for Admin

Name	Data type	Size	Constraint
admin_id	Int	10	Primary key
Admin_name	Varchar	25	Not null
Login_id	Varchar	25	unique
Password	Varchar	25	Not null
Admin_type	Varchar	25	Not null
Status	Varchar	10	Not null

Table 4.21 Specifies Data Dictionary for Billing

Name	Data type	Size	Constraint
bill_no	int	10	Primary key
cust_id	int	10	Foreign key
account_id	int	10	Foreign key
payment_mode	varchar	25	Not null
payment_date	date		Not null
payment_time	time		Not null
rr_number	varchar	25	Not null
pill_amount	float	10.2	Not null
paid_amount	float	10.2	Not null
excess_paid	float	10.2	Not null
status	varchar	10	Not null

Table 4.22 Specifies Data Dictionary for Electricity Board

Name	Type	Size	Constraint
electricityboard_id	int	10	Primary key
Electricity board	varchar	25	Not null
logo	varchar	100	Not null
note	text		
status	varchar	10	Not null

Table 4.23 Specifies Data Dictionary for Feedback

Name	Type	Size	Constraint
feedback_id	int	10	Primary key
cust_id	int	10	Foreign key
feedback	Text		Not null
feedback_date	Date		Not null
status	varchar	10	Not null

Table 4.24 Specifies Data Dictionary for Bill Invoice

Name	Type	Size	Constraint
invoice_id	int	10	Primary key
electricityboard_id	int	10	Foreign key
account_no	varchar	25	Foreign key
tariff_id	int	10	Foreign key
readingdate	date		Not null
bill_no	varchar	25	Not null
present_reading	float	10,2	Not null
previous_reading	float	10,2	Not null
consumption_unit	float	10,2	Not null
fixed_charge	float	10,2	Not null
energry_charge	float	10,2	Not null
Tax	float	10,2	Not null
bill_amount	float	10,2	Not null
interest	float	10,2	Not null
previous_balance	float	10,2	Not null
interest_pre_balance	float	10,2	Not null
Others	float	10,2	Not null
concession	float	10,2	Not null
Credit	float	10,2	Not null
net_amount	float	10,2	Not null
due_date	date		Not null

Table 4.25 Specifies Data Dictionary for Tariff

Name	Type	Size	Constraint
tariff_id	int	10	Primary key
tariff_type	Varchar	50	Not null
tariff_discription	Text		Not null
Status	Varchar	10	Not null

4.7 Database Design of OEBMS

The OEBMS uses a database design that has a table structure, as seen in Figure 4.12. This figure organizes the information inside the system into eight linked tables Figure 4.13- Figure 4.20, each representing a separate entity within the OEBMS.

Each table's columns indicate the qualities under analysis. These characters provide relevant information about the entity they relate to. The "account" and "address" attributes inside the "account" database are two instances of potential scenarios. The data types used in this scenario would conform to standard database regulations. For instance, names and addresses would typically be represented using text data type, IDs would be represented using numbers, timestamps would be represented using dates, and bill amounts would be represented using decimals.

In a interactive database, the tables are often connected via the use of foreign keys. By establishing relationships with primary keys in other tables, these keys guarantee the accuracy and integrity of the data. An instance of this may be seen in the "account" table, where there exists a foreign key named "customer_id" that serves as a reference to the primary key in the "customer" database.

Table	Action	Rows	Type	Collation	Size	Overhead
account	Browse Structure Search Insert Empty Drop	1	InnoDB	latin1_swedish_ci	16.0 KiB	-
admin	Browse Structure Search Insert Empty Drop	2	InnoDB	latin1_swedish_ci	16.0 KiB	-
billing	Browse Structure Search Insert Empty Drop	8	InnoDB	latin1_swedish_ci	16.0 KiB	-
customer	Browse Structure Search Insert Empty Drop	3	InnoDB	latin1_swedish_ci	16.0 KiB	-
electricityboard	Browse Structure Search Insert Empty Drop	4	InnoDB	latin1_swedish_ci	16.0 KiB	-
feedback	Browse Structure Search Insert Empty Drop	3	InnoDB	latin1_swedish_ci	16.0 KiB	-
invoice	Browse Structure Search Insert Empty Drop	1	InnoDB	latin1_swedish_ci	16.0 KiB	-
tariff	Browse Structure Search Insert Empty Drop	6	InnoDB	latin1_swedish_ci	16.0 KiB	-
8 tables	Sum	28	InnoDB	utf8mb4_general_ci	128.0 KiB	0 B

Figure 4.12 Database Design of OEBMS

The titles of the tables may provide clues about certain characteristics or qualities. Figure 4.13, the account table primarily stores information such as accounts, addresses, and billing cycles. The customer table has customer IDs, which serve to establish a connection between consumers and the table.

account_id	cust_id	account_no	electricityboard_id	name	address	rr_number	status
0	0	EBS0000001	1	Ali	somalia guriga hoostiisa	6738398	Active
0	0	EBS0000002	1	asad	asda	1111	Active

Figure 4.13 Account ID

In Figure 4.14, the Admin directory is designated for the storage of information only intended for system administrators. This data may consist of identification numbers, usernames, and maybe encrypted passwords.

admin_id	admin_name	login_id	password	admin_type	status
1	Pratiksha	admin	adminadminadmin	Administrator	Active

Figure 4.14 Admin ID

Figure 4.15, It is possible that the billing section will include specific information on the creation of invoices. The specific information may consist of bill IDs, account IDs (which establish a connection to the account table), dates, due dates, and total amounts, in that order.

bill_no	cust_id	account_id	electricityboard_id	payment_mode	payment_date	payment_time	rr_number	bill_amount	paid_amount	excess_paid	account_no	status
45462	1	123456789	0	Debit card	2015-12-28	10:39:40	232545454	7444.00	8000.00	556.00	0	Active
45463	5	0	0	VISA	2016-01-13	12:03:31	22222	123.00	100.00	0.00	0	Active
45464	8	0	0	Debit card	2016-02-01	12:12:01		0.00	0.00	0.00	0	Active
45465	18	0	0	Debit card	2016-02-17	10:07:29	145236	250.00	0.00	0.00	0	Active
45466	18	0	0	Credit card	2016-02-17	10:07:51	586852242	250.00	300.00	50.00	0	Active
45467	19	0	0	VISA	2016-02-17	10:57:32	32343	200.00	100.00	100.00	0	Active
45468	9	0	0	Credit card	2016-02-17	11:22:34	77777	100.00	200.00	0.00	0	Active

Figure 4.15 Billing ID

Figure 4.16, the client/customer is accountable for the storage of crucial client data, such as names, contact details, and unique identifiers (primary key), along with other pertinent information.

cust_id	cust_name	account_type	address	state	city	pincode	email_id	mobno	password	status
3	lithin	Individual	Hirikara,Somwarpet	Karnataka	Somwarpet	571236	lithin2@gmail.com		222	Active

Figure 4.16 Customer ID

Figure 4.17, the Electricity Board maintains a record of relevant information pertaining to the utility firm, such as their identification number, name, and contact details.

electricityboard_id	account_no	readingdate	bill_no	present_reading	previous_reading	consumption_unit	fixed_charge	energry_charge	tax	bill_amount	interest
1	EBS0000001	2024-04-27	1	400	0	400.00	100.00	0.00	0.00	100.00	1.00

Figure 4.17 Electricity Board

Figure 4.18, the system's objective is to save diverse consumer feedback data, including IDs, customer IDs (which are associated with the customer database), timestamps, and the actual content of the feedback.

feedback_id	cust_id	feedback	feedback_date	status
3	3	This Website is really an exceptional one. It must...	2020-12-20	Approved
4	5	One of the best applications for online transactio...	2020-12-20	Approved
6	8	Great! Nice experience of transferring rent to the...	2016-01-25	Approved

Figure 4.18 Feedback ID

Figure 4.19, the invoice table has the capability to store comprehensive details about invoices, such as invoice IDs (which act as the primary key), account IDs (which establish a connection with the account table), billing period dates, individual charges, and total amounts (which can be linked to the billing table for a summary).

invoice_id	electricityboard_id	account_no	readingdate	bill_no	present_reading	previous_reading	consumption_unit	fixed_charge	energry_charge	tax	bill_amount	interest	previous_balance
0	1	EBS0000001	2024-04-27	1	560	0	560.00	100.00	250.00	36.25	386.25	1.00	0.00

Figure 4.19 Invoice ID

Figure 4.20. The tariff feature would include details on electricity tariffs. The provided information would consist of tariff IDs (primary key), effective dates, costs per unit of energy use, and perhaps distinct tiers or categories.

tariff_id	electricityboard_id	tariff_type	f_unit	t_unit	tariff_cost	tariff_description	status
13	35	ghgjhj25	1.00	10.00	1.50	bvbv	active
14	31	GDL20	1.00	100.00	1.50	fbfbfgb hmhbm	active
15	31	GDL20	1.00	100.00	1.50	fbfbfgb hmhbm	active

Figure 4.20 Tariff ID

4.8 Security Analysis for OEBMS

Adding to pay attention to furnishing the means to cover information systems and control their operations in order to ensure the durability of their work in the needed manner. These systems can be a source of serious problems if they fail to serve for any reason.

4.8.1 Output Security Analysis of OEBMS

In the security of the outputs, we first determine who will extract the reports from the system, which is the Admin, that is, it reviews the amount of electricity bills, the consumer's information, and the feedback. These types of reports are presented periodically or daily. The outputs in computerized systems are the basis of the system, in other words, the outputs of the system are considered the goal for which the system was designed. If the outputs of the system are correct and accurate, then the system is considered good or achieves its goals. However, if the outputs are incomplete and contain wrong information, the system is considered useless because the outputs we benefit from in the process of verifying the validity of the data, and therefore if the information is incomplete or inaccurate, this will lead to an error in the comparison, and therefore the system will be considered useless. From this, we conclude that the system's quality depends entirely on it is outputs. The outputs of this system are reports that are printed or displayed in the form of a table, and the most important of these are:

1. Report of consumer's detailed information.
2. Report of bill payments.
3. Report of accounts.
4. Report of consumer feedback.

4.8.2 Input Security Analysis in OEBMS

In the security of inputs, we specify the time in which the entry is made, where data is entered during work time, and we specify entering the data, which is the data entry (the Admin) where the Admin enters all the data of the consumers, bills, and saves consumers' feedbacks.

4.8.3 User Security Analysis in OEBMS

The system consists of users, consumers, and the Admin. Each of them has a different life function, it is a username and a password that determines the type of user, whether an Admin or a Consumer.

Admin of the system: Upon entering the system, it is the following privileges:

- Consumer registration
- View consumer
- Bill Calculation
- Update unit cost

Employee

- View consumer
- Bill Calculation
- View consumer

Consumer: Upon entering the system, it is the following privileges:

- View Billing
- View Invoice

- Create Account
- Payment
- Provide Feedback

4.8.4 System Security Analysis in OEBMS

System Security Analysis is a comprehensive evaluation process designed to ensure the robustness and integrity of an online electricity bill management system. This multifaceted analysis encompasses both software and hardware aspects, aiming to identify, mitigate, and prevent potential security vulnerabilities and risks. This section delves into the specifics of Software Security Analysis and Hardware Security Analysis to provide a thorough examination of the system's security posture. It is including the followings:

Software security analysis involves assessing and identifying vulnerabilities in a system to ensure it is resilience against potential threats. This process includes code reviews, penetration testing, and vulnerability assessments to enhance the overall security posture of the software.

Hardware Security Analysis as the physical security of the system is an important content, especially as it depends on the type of bias used in the system. That is needed to be defended, and where it is being defended, as well as the significance of the data stored in that system. It deals with the physical security of the system and its data, guarding it from the troubles of theft and others.

4.9 Individual and Environment Analysis in OEBMS

For individualities, the data entry is trained on the process of entering data into the system and making variations to it. As well as performing the database backup, process periodically. As for the terrain, the device on which the system is located must be kept in a room equipped with air exertion, and equipped with fire extinguishing bias, and they must be closed apartments to ensure that dust does not enter the bias.

4.10 Security System Payment

Rivest-Shamir-Adleman (RSA) is a widely used asymmetric encryption algorithm that is crucial in securing systems, including payment systems

(Sihotang et al., 2020). It involves two keys, a public key for encryption and a private key for decryption. RSA is utilized in a payment system for secure communication between parties. For example, during online transactions, the payer's sensitive information (like credit card details). It is encrypted with the recipient's public key, ensuring only the recipient, with the corresponding private key, it is decrypt and access the information. This cryptographic method adds a layer of security by preventing unauthorized access to sensitive payment data during transmission. Implementing RSA correctly and keeping private keys secure is essential to maintain the integrity and confidentiality of payment transactions. it is include the followings:

Use strong encryption: Use HTTPS (SSL/TLS) to encrypt data transmitted between the user's browser and the server. Encrypt sensitive data, such as user credentials and payment information, when stored in databases. This adds an extra layer of protection in case of a data breach. To protect sensitive data such as user credentials, and personal details, remains confidential during transit Secure.

User Authentication: Implement strong and secure user authentication mechanisms. Utilize multi-factor authentication to add an extra layer of security. This can include factors like passwords, One-Time Passwords.

Implement SSL/TLS protocols: to secure the communication between the client and the server, ensuring that data is transmitted securely.

Secure Payment Gateway: Integrate a reputable and secure payment gateway that complies with industry standards for online transactions. Ensure that the payment gateway supports Payment Card Industry Data Security Standard compliance.

5 DESIGN PHASE OF ONLINE ELECTRICITY BILL MANAGEMENT SYSTEM

The design phase follows the analysis phase, in which the system screens are designed. It is an innovative and creative process that the designer uses to create new forms of the system, the designer focuses on designing interfaces that are easy to understand and utilize by the user. In general, a group of important and influential elements in the design process is studied and evaluated. In this chapter, system screens and control panels are designed.

5.1 Network Design

The network design shows to description in given Figure 5.1 network design of the system.

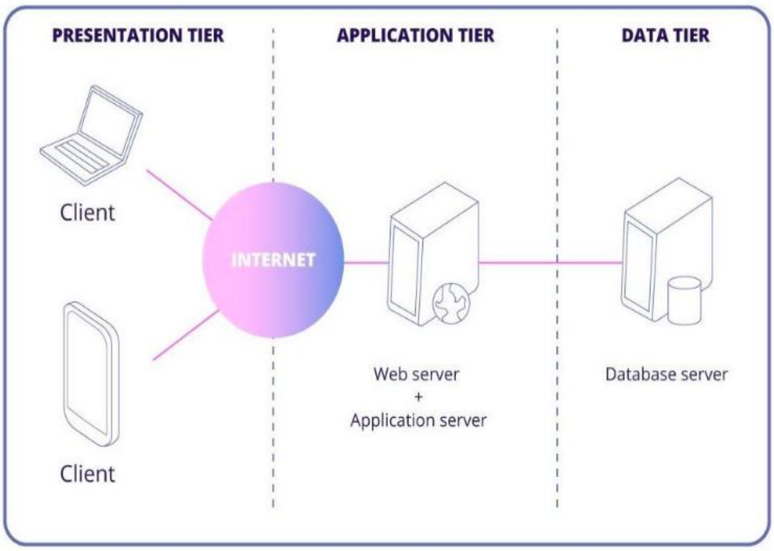

Figure 5.1 Network Design of the System

5.2 Language Design

5.2.1 User Interface Language

There are several benefits to the OEBMS user interface being in English. First of all, a larger audience will be able to readily access your application due to the fact that English is widely understood and used across the globe. Moreover, it simplifies correspondence and promotes collaboration between users and team members across borders.

5.2.2 Programming Language

PHP is a versatile and strong programming language; it is used for server-side development in the online electricity bill administration system. PHP is a computer language that makes it possible to create web applications with dynamic form input processing and database connectivity. For this reason, it is an excellent choice for creating dynamic and interactive web applications, like your billing system. A multitude of tools and frameworks are accessible for developing scalable and secure solutions because of the extensive library selection and popular use among web developers. Moreover, PHP's cross-platform adaptability and its fluid integration with other technologies provide easy contact with various system components. Data analytics, transaction processing, and user authentication are among the components. A dependable, efficient, and user-focused electricity bill management system may be created thanks to PHP. This system can successfully adapt to the ever-changing needs of administrators and end users, ensuring that the system will continue to function without interruption and that customer will be completely satisfied.

5.2.3 Database Language

My MySQL Server is an ideal option for an online electricity bill administration system due to its reliability and widespread use as a relational database management system (RDBMS). The system's ability to effectively store, arrange, and retrieve large amounts of data is its primary advantage. This functionality is essential for the management of client data, invoicing details, and historical use statistics. MySQL's strong architecture guarantees the preservation of data integrity and provides safe access control. Because the application is PHP-compatible, it seamlessly integrates with the database, leading to faster data processing and the development of dynamic content. The system's scalability allows it to handle a growing number of users without sacrificing speed. The use of open-source technologies and the presence of a vast community of developers greatly facilitate the development and upkeep of software systems.

5.3 Main Screen Design

In this section, the system's main screens are design where the user can navigate through the system.

5.3.1 Login Screen Design

The login screen design shows to description in given Figure 5.2 login screen design.

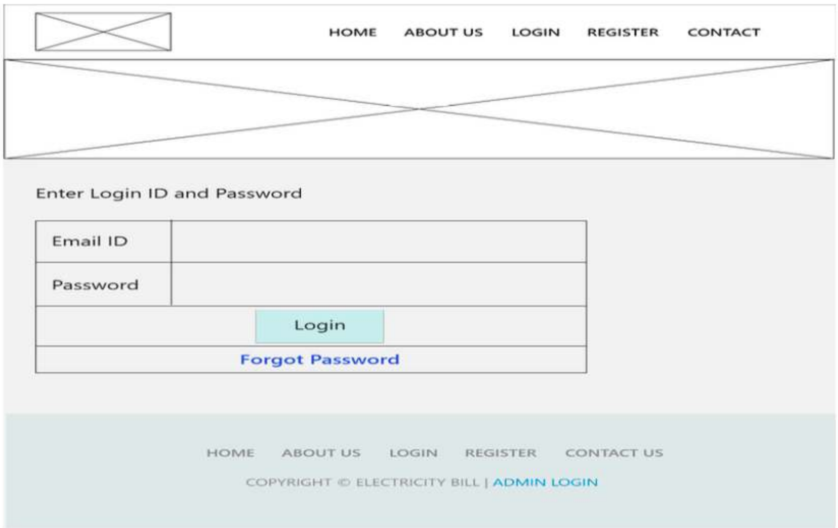

Figure 5.2 Login Screen Design

5.3.2 Design of the Main Page

The design of the main page shows to description in given Figure 5.3 main page design.

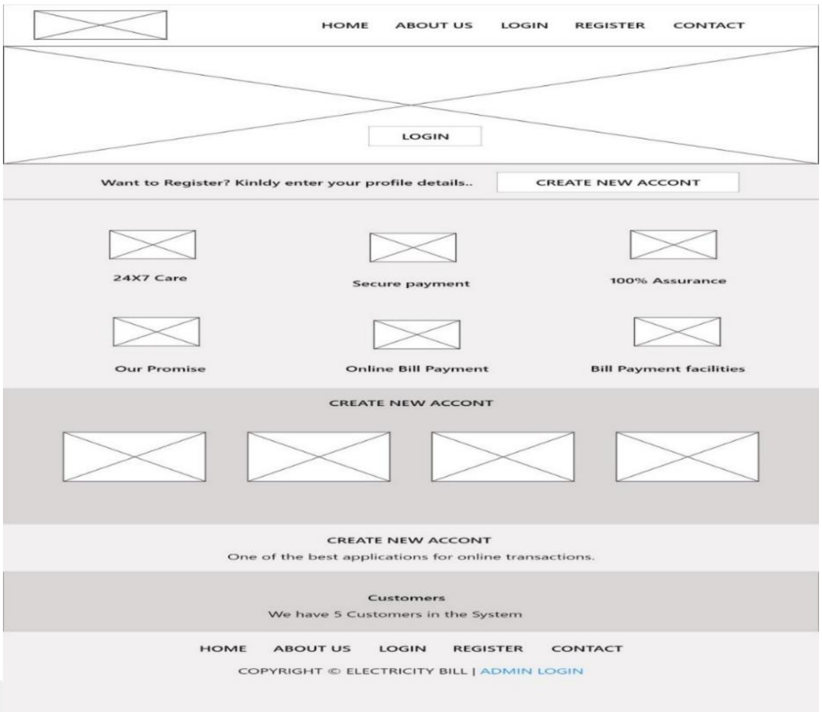

Figure 5.3 Main Page Designs

5.3.3 Design of Admin Main Page

The design of admin main page shows to description in given Figure 5.4 admin main page design.

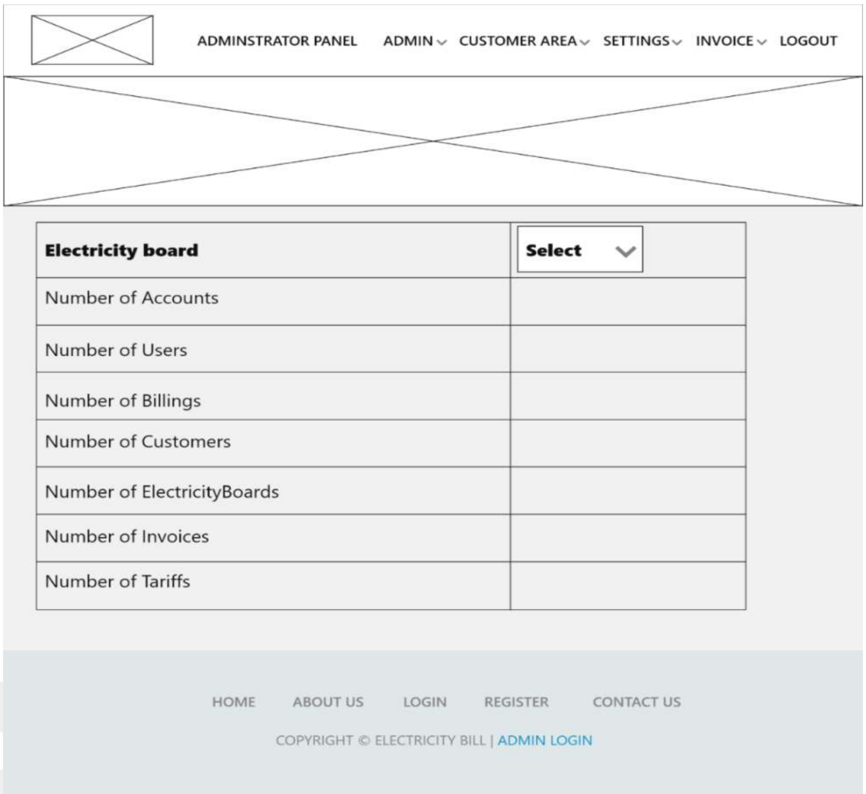

Figure 5.4 Admin Main Page Design

5.3.4 Design of Customer Main Page

The design of customer main page shows to description in given Figure 5.5 customer main page design.

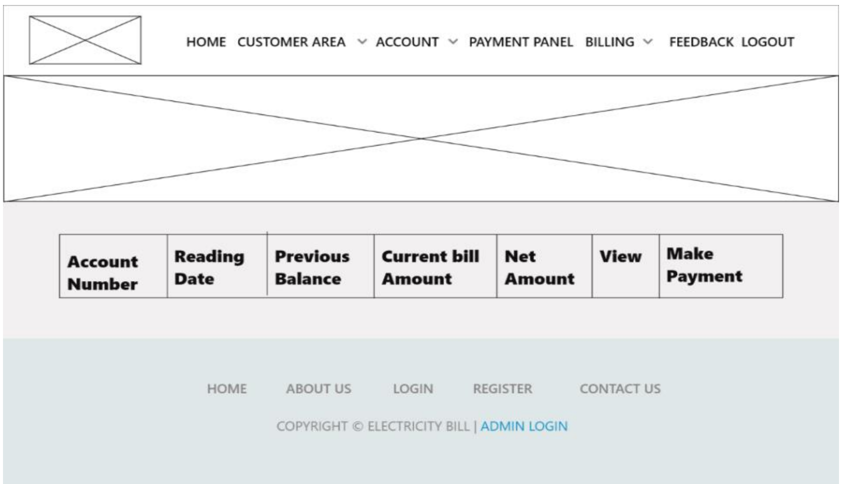

Figure 5.5 Customers Main Page Design

5.4 Sub Screen Designs

In this section from Figures 5.6-5.12, the sub-screens will display relevant information and functionalities based on the user's role and permissions.

Diagram 5.6 displays a visual representation of a section of the user interface for an online system designed to handle electricity bill management. Only administrators have access to this specific portion of the user interface. Additional tariff options have been introduced, and this particular panel is dedicated to displaying them. The administration dashboard has a prominently displayed header indicating its location. The objective of the action is well conveyed by the conspicuous usage of a word such as "Add Tariff." Typically, a form would include details such as the specific tariff, the thresholds for unit consumption that determine the applicable range, the cost per unit, and sometimes an explanation for client reference. Ultimately, the "Submit" button is the trigger for the integration of the new tariff plan into the system.

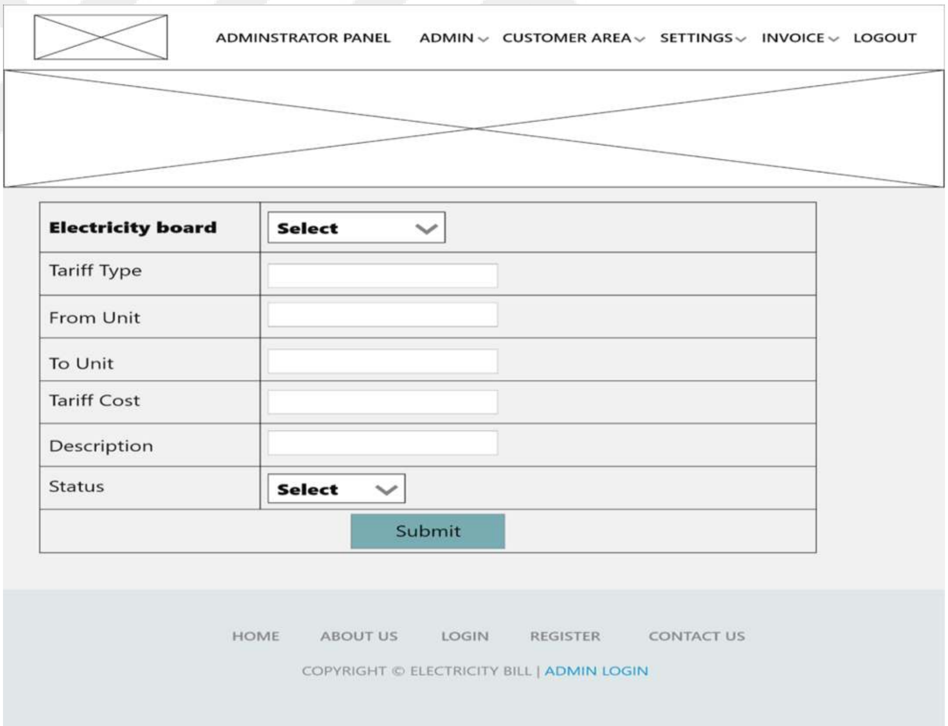

Figure 5.6 Admin Sub Screen For Add Tariff

Figure 5.7 displays a sample strategy for integrating bill invoices. The form may include sections where consumers may input details about their account, choose an electrical provider, indicate a reading date, and provide information about the amount of their bill. To start the generation of the invoice, just clicking on the "Submit" button will be enough.

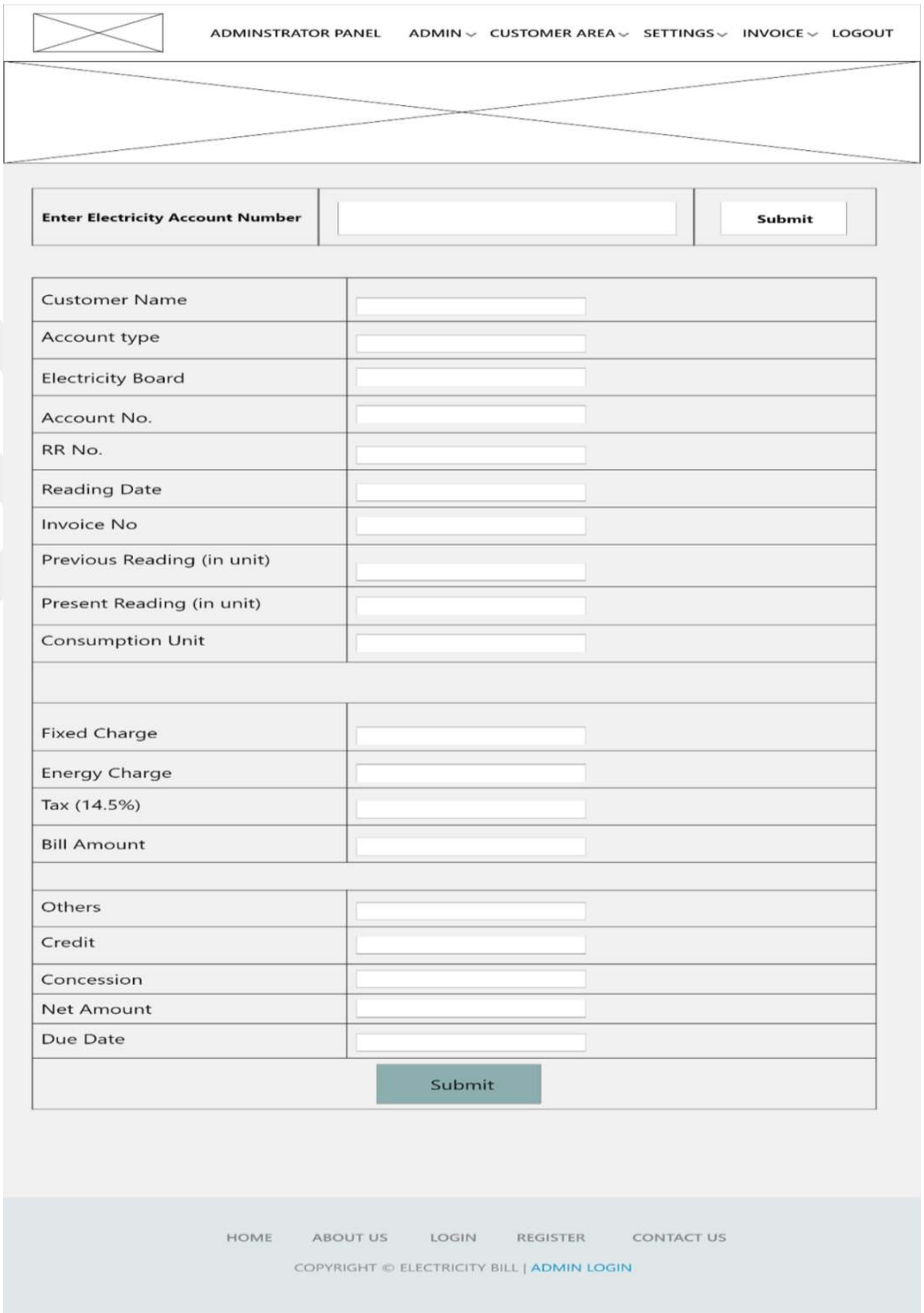

Figure 5.7 Admin Sub Screen For Add Bill Invoice

Figure 5.8, the goal of this sub-screen is to streamline the process of creating new user accounts, accessible to both administrators and staff members. The form potentially includes fields for the user to input their name and login credentials, as well as a selection for their user status, which may be either administrator or employee. Upon clicking the "Submit" button, the process of creating a new user account will begin immediately.

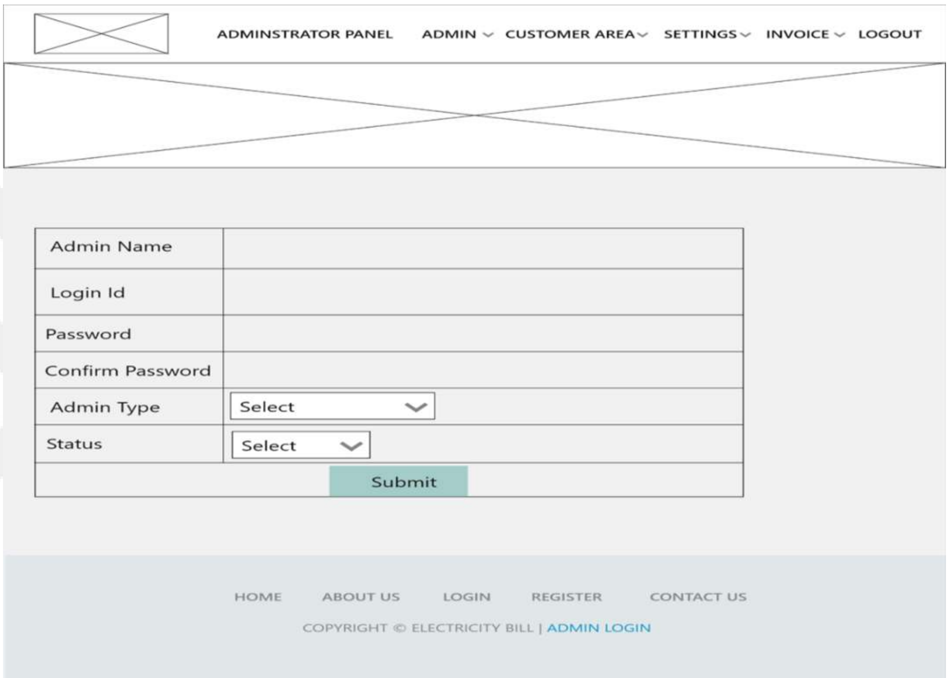

Figure 5.8 Admin Sub Screen For Add Admin or Employee

Figure 5.9 presents description for customer sub screen for profile; Customers possess the capability to access and perhaps modify their personal information inside this section. The interface may provide essential details such as the individual's name, address, and contact information. In addition, the interface may have editable areas or buttons to facilitate modifications. It is possible that a supplementary section may display data associated with the account. In addition, a navigation menu might provide access to other features that are available to the consumer. The objective of this sub screen is to provide users a centralized platform inside the system where they can oversee and control the information relevant to their profiles.

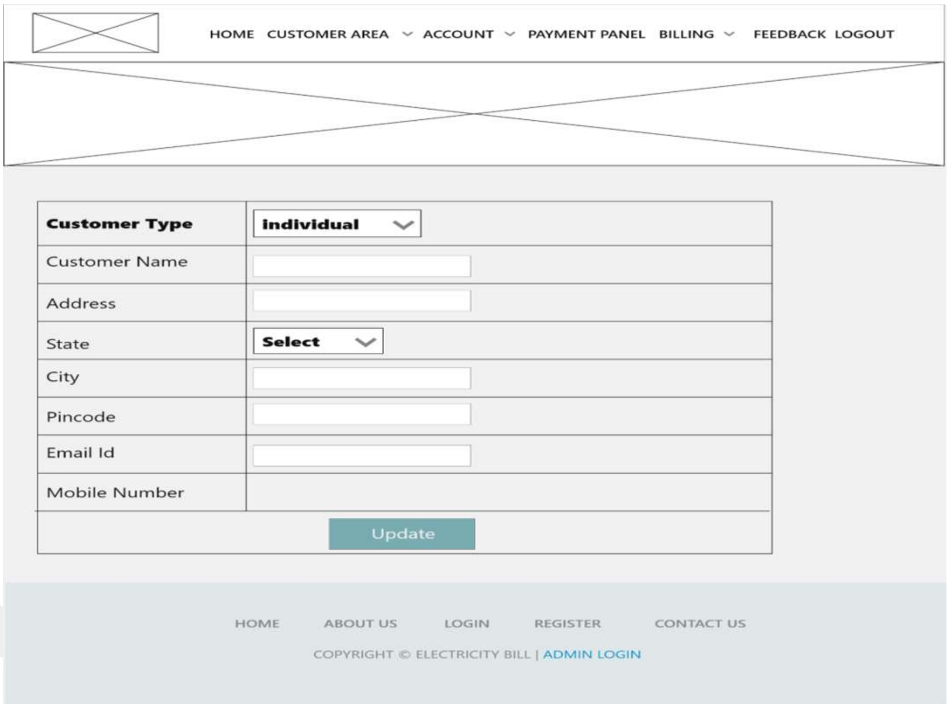

Figure 5.9 Customer Sub Screen for Profile

Figure 5.10 presents description for customer sub screen for add bill payment, This enabling users to make electronic payments for their bills. It is possible that the attributes of the customer's account will be shown for reference. The main elements of the system are expected to consist of a payment information section, where customers can input the required amount and select a payment method (such as a credit card or bank transfer), along with a "submit" button to finalize the payment procedure. This sub screen provides a convenient online solution to facilitate bill payment for consumers.

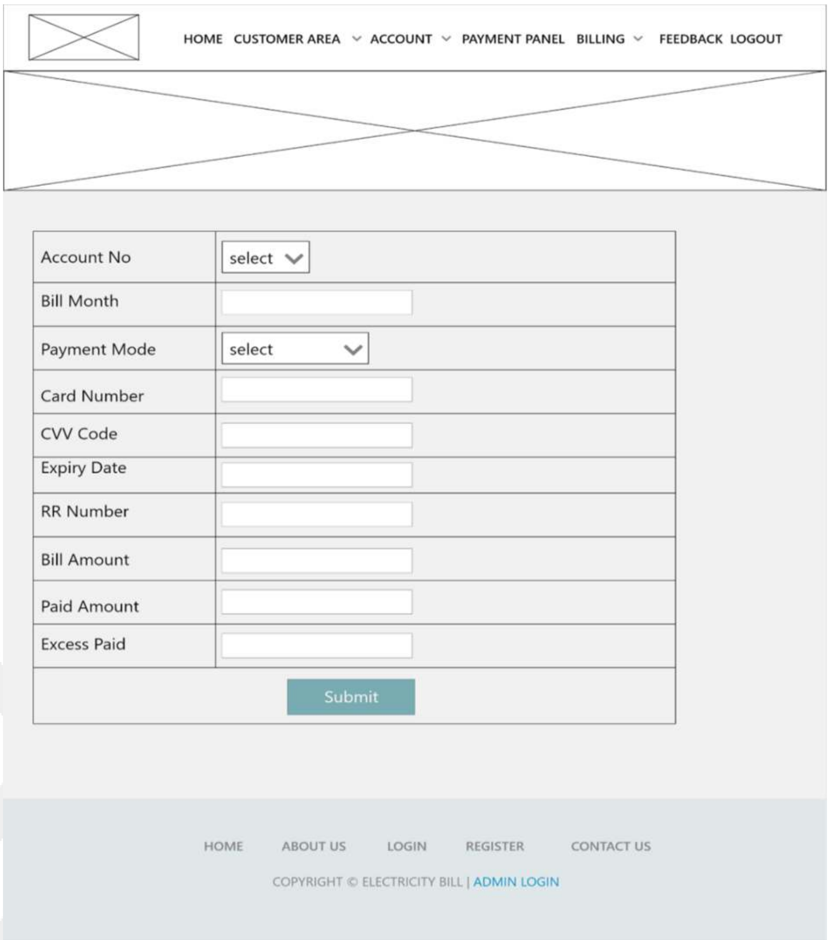

Figure 5.10 Customer Sub Screen For Add Bill Payment

Figure 5.11 presents description for customer sub screen for add account, This section include options for choosing the electricity provider, inputting the account number, and maybe the customer's address (which might be automatically derived from the customer's profile). The addition of the new account to the customer's profile is expected to occur upon clicking the "Submit" button. Customers may easily link new energy service accounts to their current profile inside the system using the access given on this subpage.

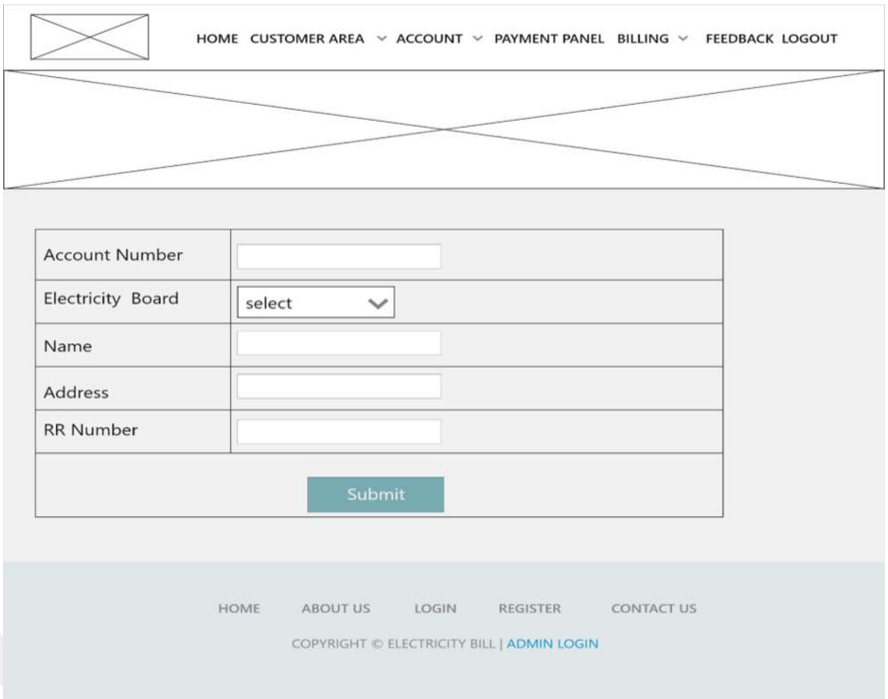

Figure 5.11 Customer Sub Screen For Add Account

Figure 5.12 presents description for customer sub screen for change password. This empowers users to modify their login credentials. The interface may contain a confirmation form, input fields for the user's existing password, and a new password. This would authenticate if the user's password has been typed accurately. The process of updating the password will begin after choosing the "Change Password" option. In order to effectively ensure the security of their accounts, clients have the option to change their passwords using this subpage, which provides a straightforward procedure for doing so.

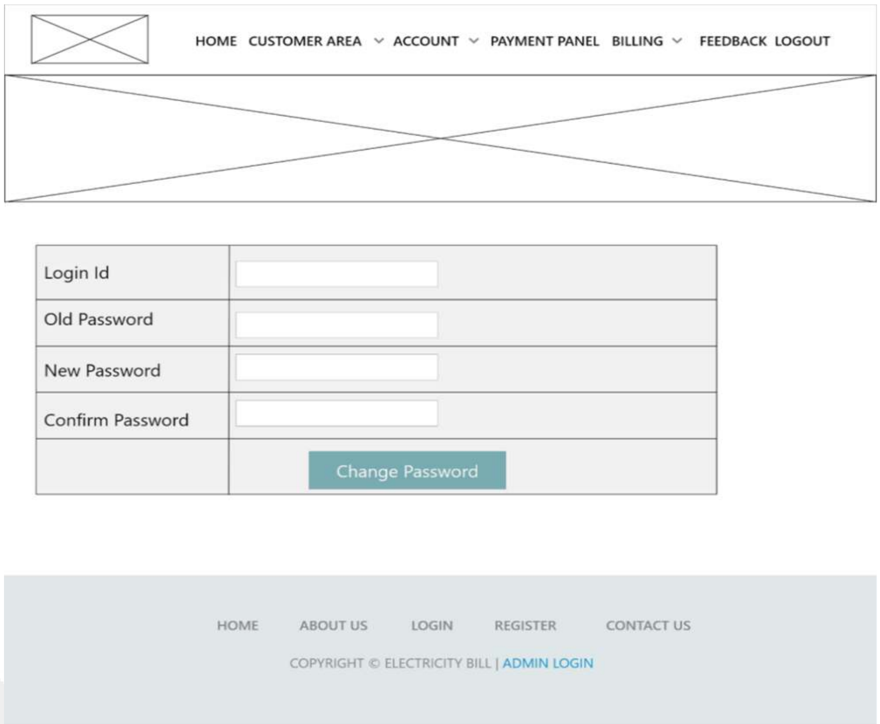

Figure 5.12 Customer Sub Screen for Change Password

5.5 Reports Design

The reports design shows to description in given Figure 5.13 report screen for billing.

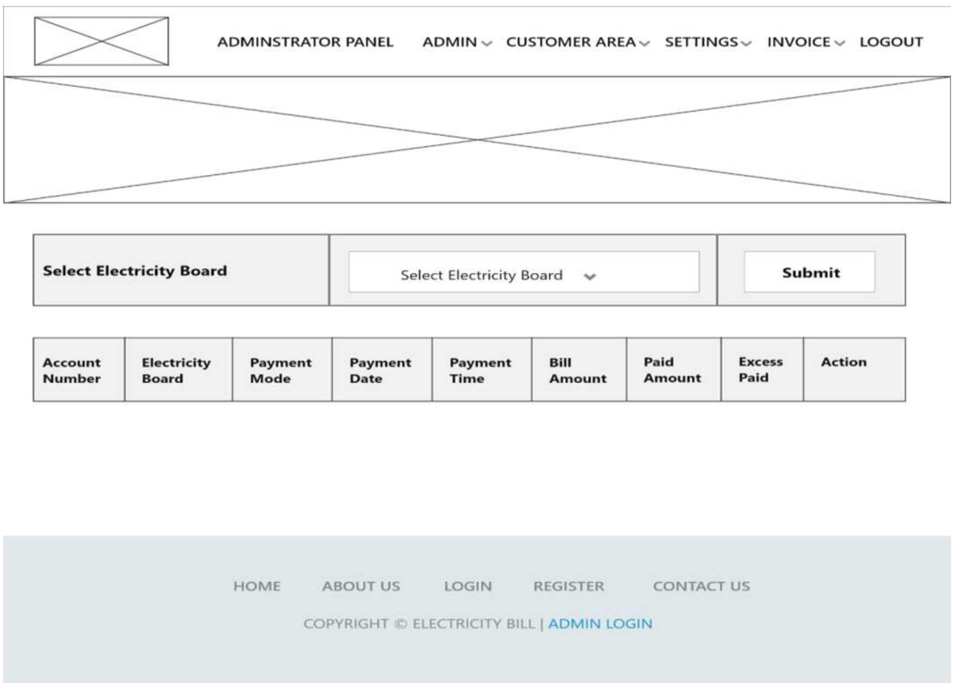

Figure 5.13 Report Screen for Billing

5.6 Process Design

The process design shows to description in given Figure 5.14 activity diagram for create, account, Figure 5.15 presents description for activity diagram of login, Figure 5.16 presents description activity diagram for generate invoice.

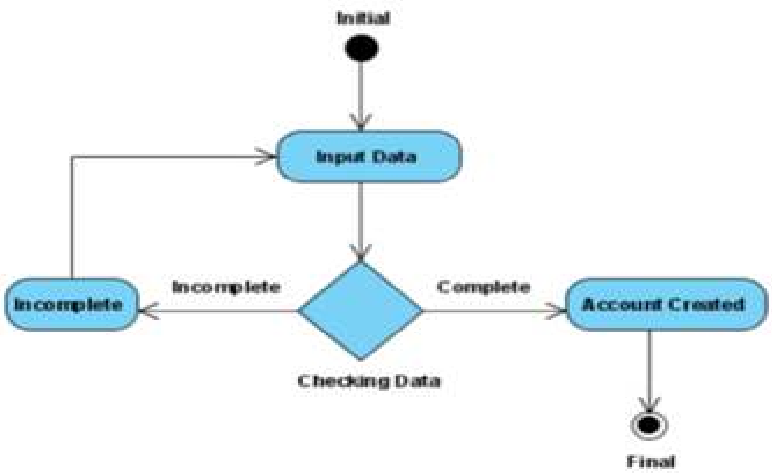

Figure 5.14 Activity Diagram for Create Account

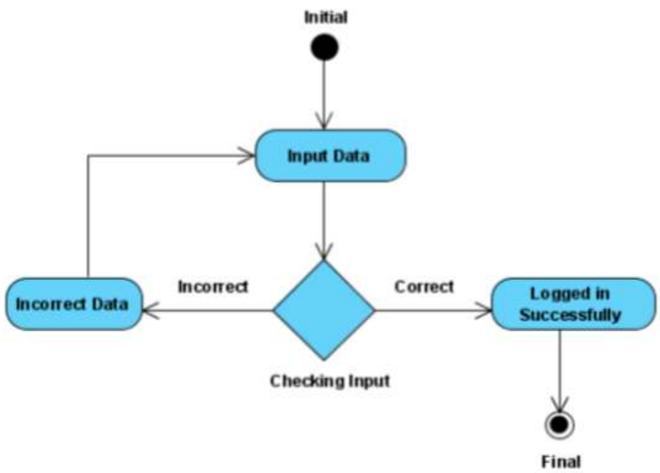

Figure 5.15 Activity Diagram of Login

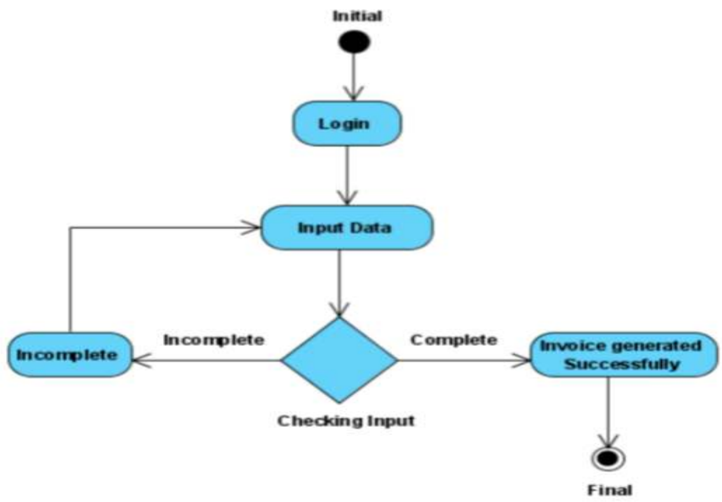

Figure 5.16 Activity Diagram for Generate Invoice

6. TESTING SET UP AND OUTPUT RESULTS

In this phase, the factual development begins, and the programming is erected. The perpetuation of design begins concerning writing law. inventors have to follow the rendering guidelines described by their operation and programming tools like compilers, practitioners, debuggers, etc. are used to develop and apply the law.

6.2 Main Screen Implementation

The implementation of all screens is defined in this section. Figure 6.1 shows all the information that describes the login button for customers, creating a new account, and login for admin or staff.

Figure 6.1 Main Screen Implementation

6.2.1 Login Screen Implementation

Figure 6.2 presents an entry for the costumer user name and password login screen implementation.

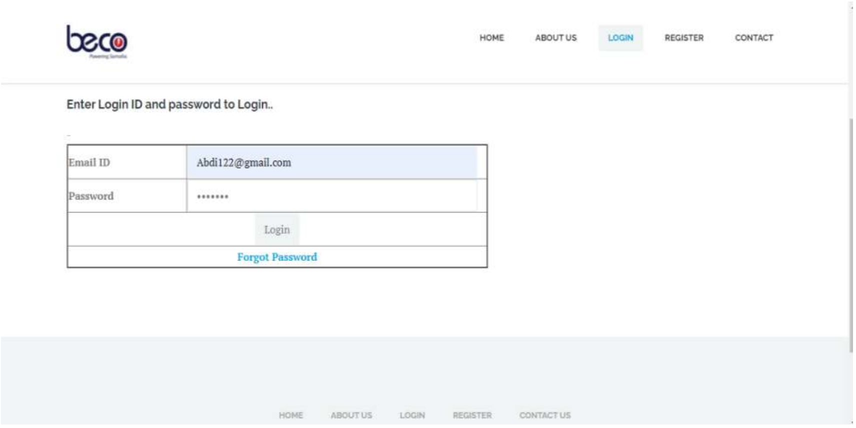

Figure 6.2 Login Screen Implementation

1.2.2 Admin Main Screen Implementation

Figure 6.3 shows to description of adding new staff, view staff, change password, customer account, view account, settings, adding electricity broad, view electricity broad, add tariff, view tariff, invoice, adding invoice, view invoice, view billing reports and logout.

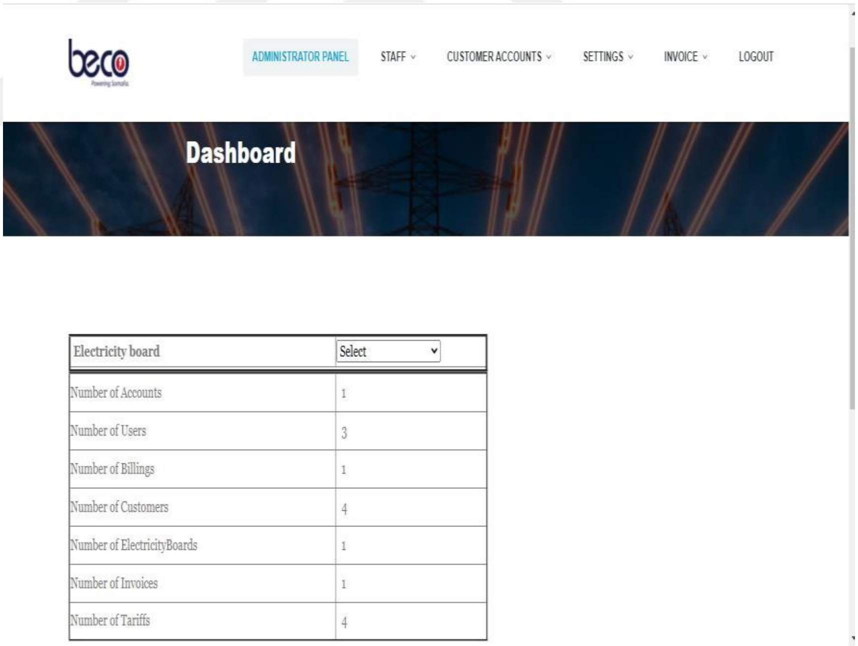

Figure 6.3 Admin Main Screen Implementation

1.2.3 Customer Main Screen Implementation

Figure 6.4 presents all the information about the customer adding a new account, viewing the account, viewing the profile, payment panel, viewing an invoice, viewing billing, printing invoice, feedback, and logout.

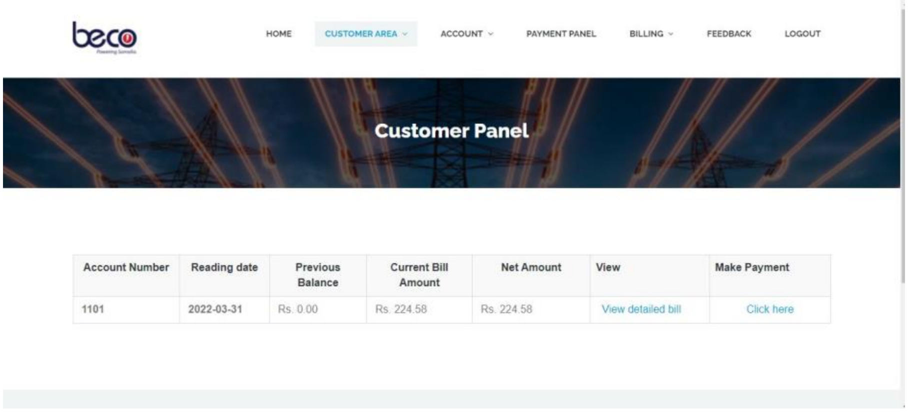

Figure 6.4 Customer Main Screen Implementation

6.3 Sub Screen Implementation

6.3.1 Admin Sub Screen Implementation

Figure 6.5 presents creating a new customer adding customer type, customer name, address, state, city, pincode, email ID, mobile number password, and confirm password. Figure 6.6 present adding electricity board, tariff type, from unit, to unit, tariff cost, Description, status and submit. Figure 6.7 presents adding admin name, login ID, password, confirm password, admin type, status and submit

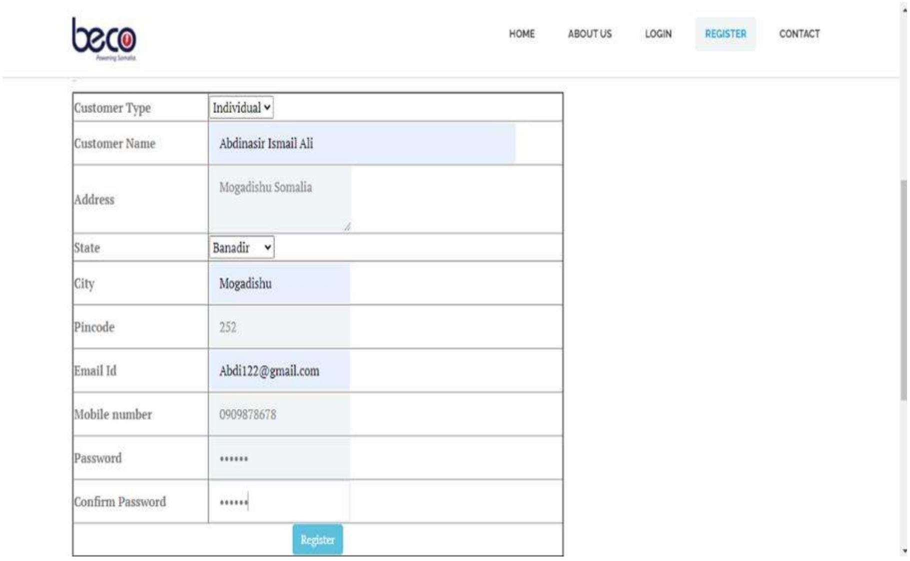

Figure 6.5 Register Screen Implementation

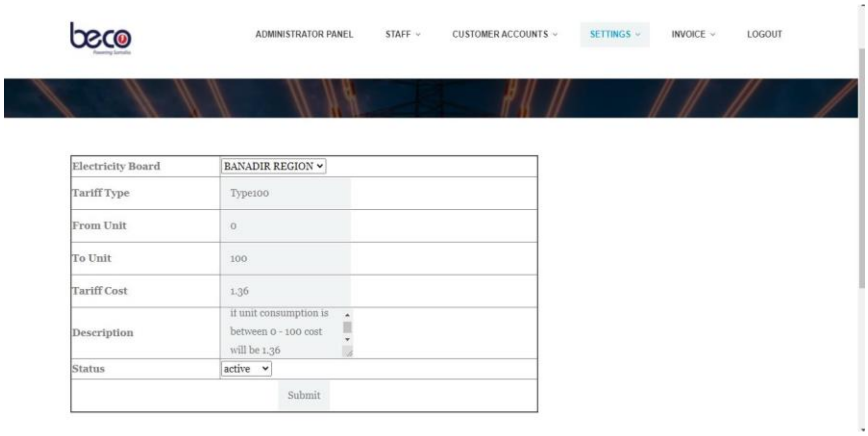

Figure 6.6 Add Tariff Screen Implementation

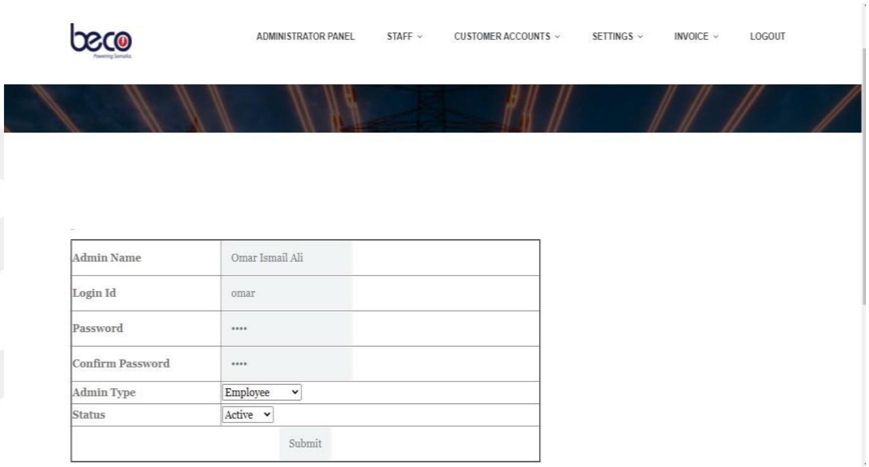

Figure 6.7 Add Admin Or Employee Screen Implementation

6.3.2 Customer Sub Screen Implementation

Figure 6.8 present account number will give automatically generate, electricity board, name, address, RR number and submit. Figure 6.9 presents account number automatically generate, bill month, payment mode, card number, CVV code, expiry date, RR number, bill amount, paid amount, excess paid and submit. Figure 6.10 presents customer type, customer name, address, state, city, pincode, email id, mobile number and update. Figure 6.11 presents to description of print invoice screen implementation

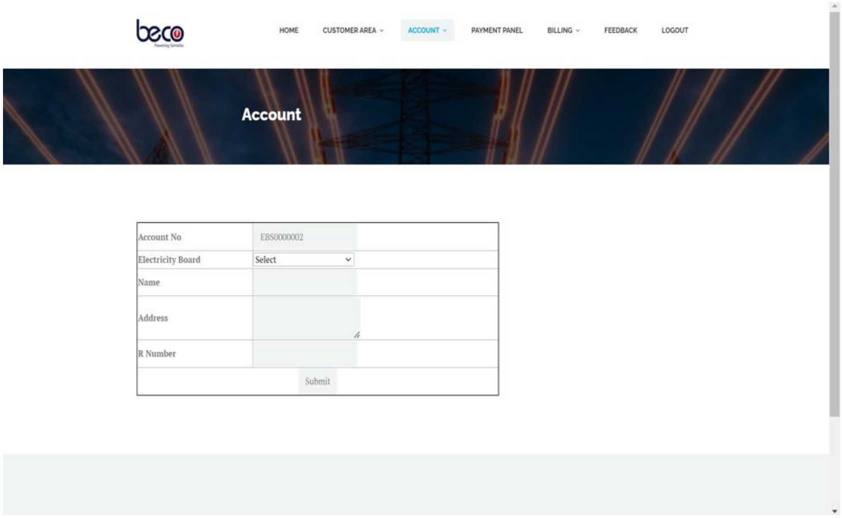

Figure 6.8 Add Account Screen Implementation

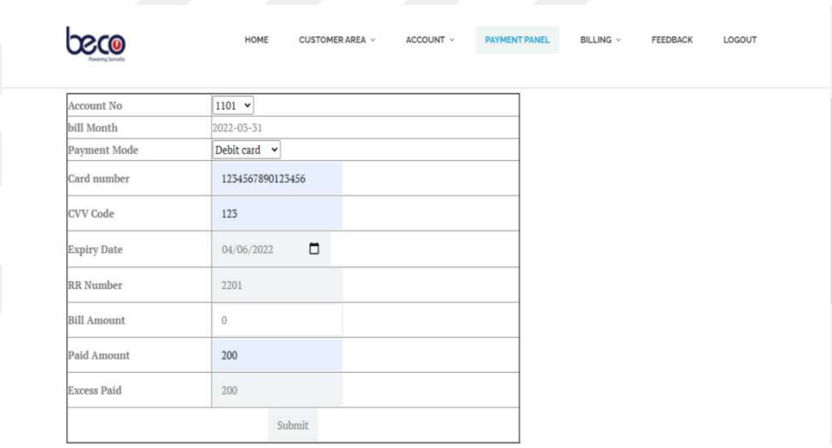

Figure 6.9 Bill Payment Screen Implementation

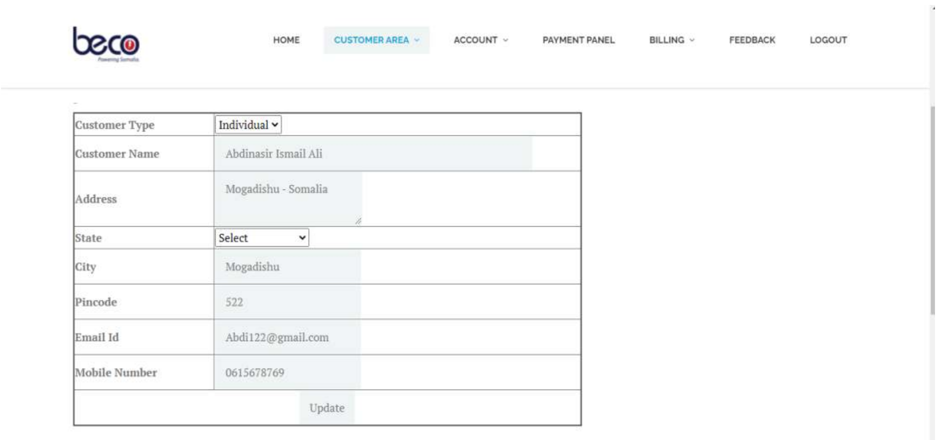

Figure 6.10 Profile Screen Implementation

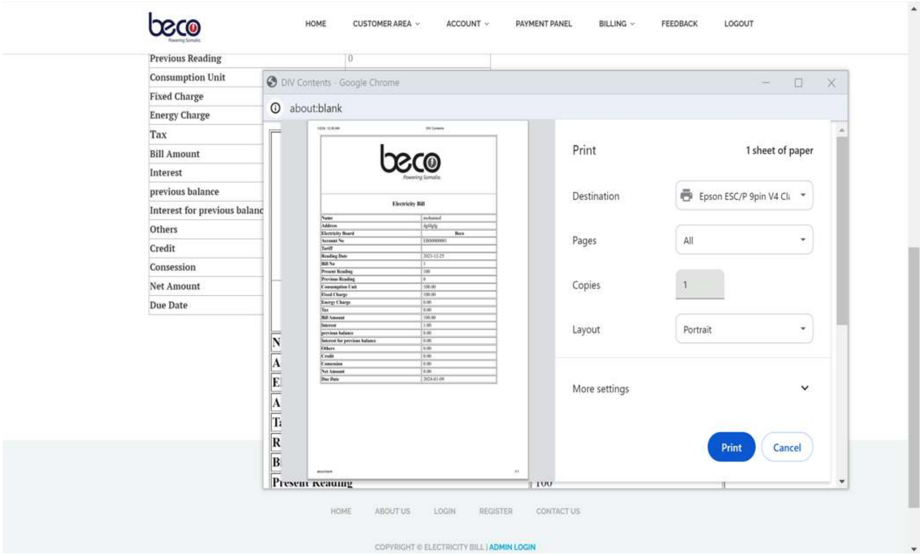

Figure 6.11 Print Invoice Screen Implementation

6.4 Report Implementation

Figure 6.12 shows to description all information about billing report.

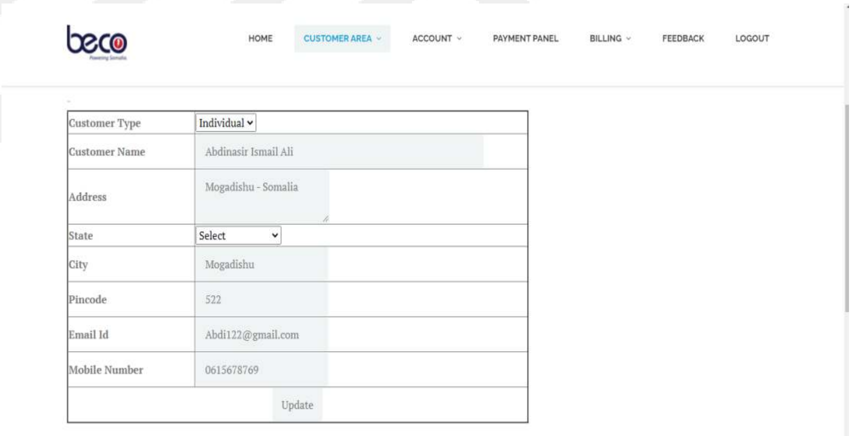

Figure 6.12 Billing Report Screen Implementation

Figure 6.13 shows to description all information about billing report. created by the OEBMS. Upon careful examination, it is evident that the document closely resembles a computer-generated invoice that is now being prepared for printing.

This report is being accessed via a web interface, as shown by the URL "localhost/e-bill/viewbilling.php" displayed in the upper left corner, which can be seen upon closer examination. This is in keeping with the ability of people to see their bills online inside an OEBMS.

The relevant details about an electrical bill are included in the central portion of the page. The customer may have access to various pieces of information, such as the account number ("EBS0000"), the billing month dates (potentially "2023-10-19" and "12:23"), and a section titled "Select El" that likely provides a detailed breakdown of electricity usage charges (with disguised numbers). The "Consumption Charges" section displays a conspicuous total of "120.00," which presumably represents the whole amount to be invoiced for the specified duration.

Supplementary details consist of abbreviations like "beco" shown in the upper right corner of the screen. Additionally, there are choices to either "Print" (now chosen) or "Cancel" the printing procedure. The lower portion of the interface has resemblance to a typical printing interface. Users are provided with the option to choose the desired number of copies, the layout orientation (portrait or landscape), and a search bar is also included.

Based on the visual representation of the report, it is evident that the OEBMS has the capability to produce reports or physical invoices for our clientele. The invoices are expected to include details on the account, the duration of the billing cycle, a potential breakdown of expenses, and the total outstanding amount. This function aligns with the main objective of an OEBMS, which is to enable the transmission of billing information to consumers in a way that is clear and thorough.

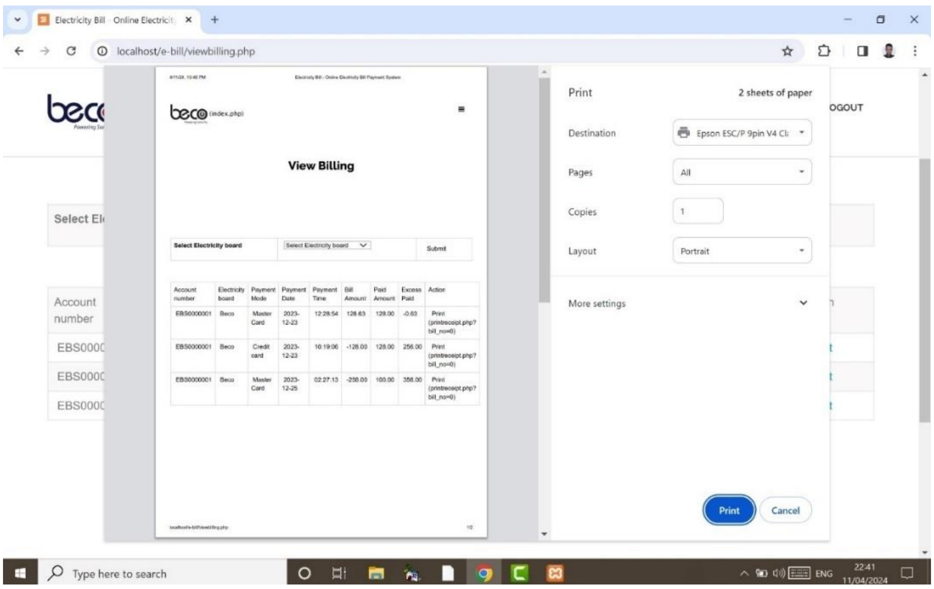

Figure 6.13 Report Sample Output of the Proposed System

6.4 Output of the Report after Implementation of Regression Model

Figure 6.14 displays an example of a client billing report. This report showcases the outcomes of predictions that were produced using random forest and linear regression models. The report is necessary for the OEBMS. Machine learning methods, such as random forest and linear regression, are included into the OEBMS to predict future power usage of clients. The table shown in the Figure 6.14 is used as the major source for acquiring historical data during the training of these models. Hence, it is imperative to include essential data elements such as "customer," "account," and maybe even historical use records. The models may acquire the capacity to forecast future power consumption by assessing past trends and pertinent variables.

A crucial element of this report is a consumer categorization it offers, which involves classifying clients into separate groups based on their consumption habits or payment patterns. Segmentation may greatly enhance the effectiveness of prediction models. A good example of this may be seen in the case where a random forest model is more suited for consumers that have a significant level of unpredictability in their consumption, but a linear regression model would provide more accurate results for customers with stable use patterns.

In essence, the data shown in the image is used as the basis to develop the prediction models. By integrating these models into the OEBMS, the utility company may use this data to forecast future power consumption, customize bill estimates for clients, and enhance overall resource allocation.

cust_id	account_id	electricityb	payment_mod	payment_date	payment_t	rr_number	bill_amour	paid_amou	excess_paid	account_no	status	one_year_expense_linear_reg	one_year_expense_rf_reg
1	1	1	Master Card	25/12/2023	02:27:13	1111	458	100	356	EBS0000001	Active	582.03	481.89
2	2	2	Credit card	25/04/2024	10:26:30	6738398	458	356	712	EBS0000002	Active	706.34	481.89
3	3	3	Master Card	25/04/2024	10:28:27	6738398	458	1223	1935	EBS0000003	Active	830.65	1155.88
4	4	4	Master Card	26/04/2024	11:28:27	6738399	458	1224	1936	EBS0000004	Active	954.96	1201.27
5	5	5	Master Card	27/04/2024	12:28:27	6738400	458	1225	1937	EBS0000005	Active	1079.27	1224.59
6	6	6	Master Card	28/04/2024	13:28:27	6738401	458	1226	1938	EBS0000006	Active	1203.58	1225.62
7	7	7	Master Card	29/04/2024	14:28:27	6738402	458	1227	1939	EBS0000007	Active	1327.89	1227.09
8	8	8	Master Card	30/04/2024	15:28:27	6738403	458	1228	1940	EBS0000008	Active	1452.2	1227.59

Figure 6.14 Output of the Report After Implementation of Regression Model

6.5 Comparison of Actual vs. Predictive Values in Regression Models

The Figure 6.15 illustrates the difference between the actual values of the target variable and the values predicted by the Linear Regression model. Each point in the test set has a corresponding data point. In some scenarios, the observed values coincide with the forecasted values, indicating the precision of the forecasts. The diagonal red dashed line represents these instances. The scatterplot allows for a visual assessment of the model's accuracy in capturing the real values. In the scatterplot, points that are in closer proximity to the diagonal line indicate improved performance of the model.

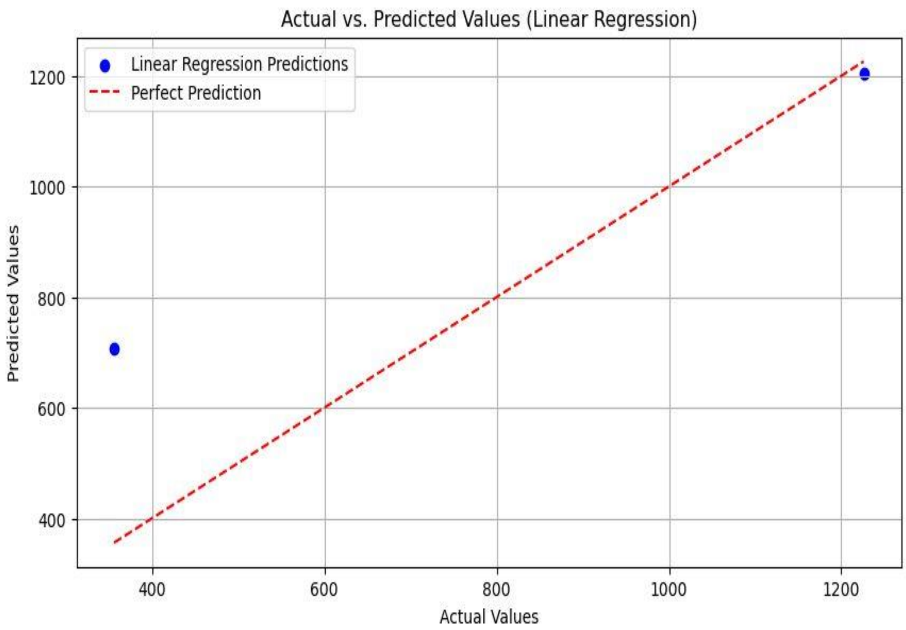

Figure 6.15 Actual vs Predicted values of Linear Regration

Figure 6.16 is the comparative analysis of observed and forecasted values using Random Forest Regression: The graph in figure 6.15, like previous one, presents a comparison of the real values and the forecasts given by the Random Forest Regression model. Each data point from the test set is shown as a point on the graph, and the diagonal line on the graph reflects predictions that are completely accurate. By examining the scatterplot, we may ascertain the level of accuracy shown by the Random Forest model in relation to the real data.

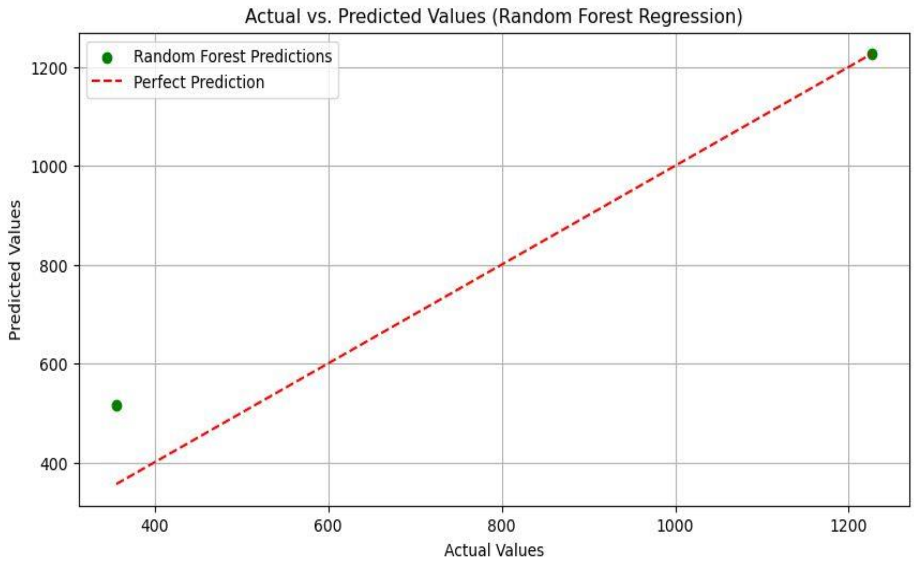

Figure 6.16 Actual vs. Predicted Values for Random Forest Regression

Residual Distribution in Linear Regression in Figure 6.17: This histogram depicts the distribution of residuals, which represent the differences between the observed values and the values predicted by the Linear Regression model. A distribution that closely resembles a gaussian curve and has its highest point centered at zero is indicative of the model's predictions being mostly objective. As a result, most of the residuals, which are the differences between the projected values and the actual observed values, are concentrated around zero.

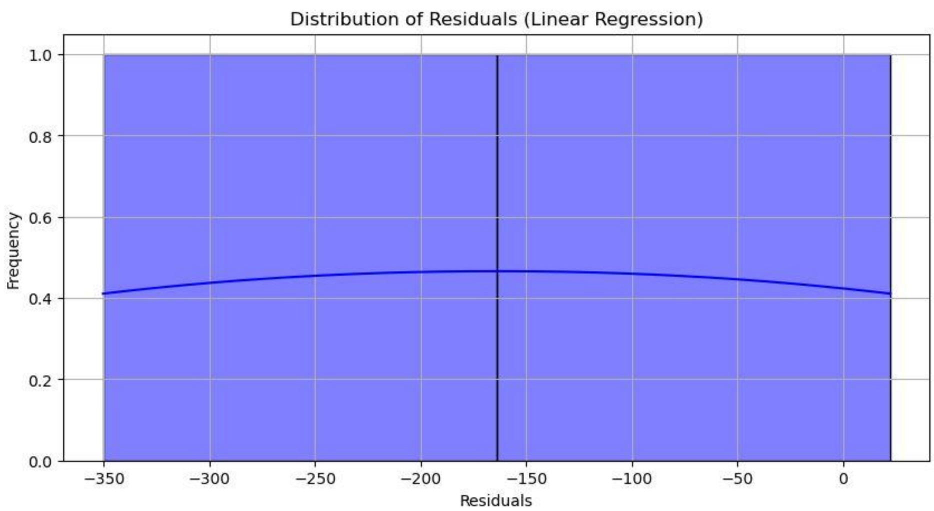

Figure 6.17 Distribution of Residuals for Linear Regression

Figure 6.18 illustrates the dispersion of residuals for the Random Forest Regression model, which is comparable to the figures seen before. A distribution that resembles a Gaussian curve with its centre at 0 suggests that the model's predictions are fairly unbiased, with residuals clustered around zero. To assess the model's performance and detect any consistent errors, it is beneficial to examine the spread and form of the distribution.

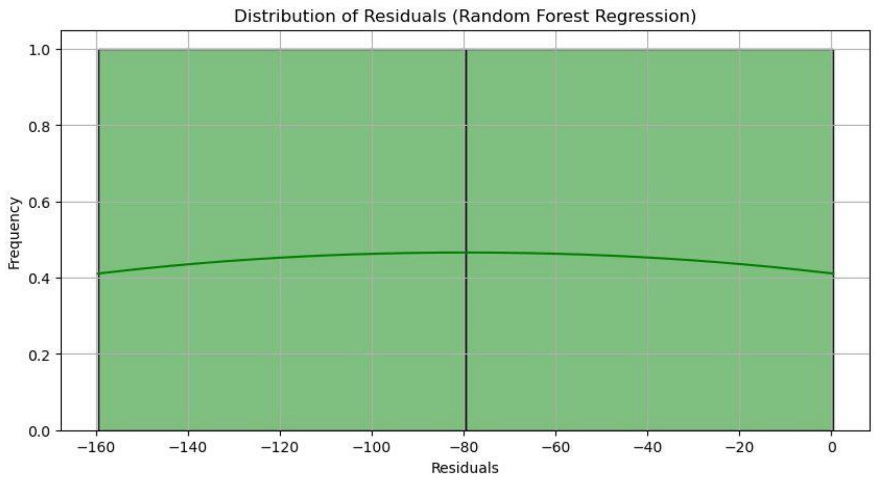

Figure 6.18 Distributions of Residuals for the Random Forest Regression

7. RESULTS, RECOMMENDATIONS AND CONCLUSION

7.1 Results

The technology greatly enhances the speed and efficiency of generating reports. Unlike previous systems that may take a day or more to do the same task, the OEBMS is an advanced system that can provide financial reports for electricity bill payments within seconds using easy-to-use interfaces. To ensure the proper functioning of this system, a carefully planned database structure and very efficient searching mechanisms have been developed. However, there is other information to consider. The system employs many machine learning approaches, such as regression models and random forests. To forecast future patterns in electricity use, these models utilise data from the past. Due to its capabilities, the OEBMS can provide extensive reports that include information that beyond the basic aspects of bill payment. Imagine the ability to create reports that predict increases in demand or identify customer segments experiencing significant fluctuations in usage. These developments result in considerable time savings and a huge reduction in paper needs. Instead of manually sifting through actual documents, the use of on-screen queries has become the preferred approach for obtaining current information. This eliminates the need of manually examining actual documents. The system ensures data protection by storing information in an electronic format on servers and regularly performing backups to external storage. User permissions are strictly controlled and distinct user roles (such as administrator, employee, and customer) are granted access only to specific data that related to their assigned duties.

7.2 Recommendations

Periodic maintenance of the system and the computer operating system by means of anti-virus and firewall to protect them from Penetration. A backup copy must be made on an ongoing basis, and kept in safe. Programmers can be used to maintain the system. There must be cooperation between the client and a group of developers (engineers) of the system, which leads to a broader understanding of the nature of the system and it is development to meet the client's needs in a way. It is recommended to users of the software application in general that when they leave the office, they do an exit from the application for security reasons (confidentiality and privacy) and the user in particular. Follow up the procedures in the company on an ongoing basis to find out what is new in the procedures, and include them in the new system and update them. The possibility of connecting the electronic system of the result system; which can be expanded and integrated with related systems, and its linkages also linked to customers through their phones from the important events at the company.

7.3 Conclusion

In this thesis online system for handling electricity bills uses machine learning models, including random forest and regression models, to ensure precise data input and achieve a high degree of accuracy. The accuracy rate has been validated based on the findings of comprehensive testing. By using this technology, the electrical department has the capacity to substantially decrease the occurrence of mistakes caused by human involvement, leading to a streamlined billing procedure. The system has the capacity to both decrease anomalies and predict future energy use for individual consumers or groups, owing to the incorporation of machine learning algorithms. With the use of this feature, users may effectively manage their consumption and budget for future expenses by customising precise bill estimates. In addition, the electricity department may get advantages from enhanced resource management capabilities by using forecasts on future power demand.

Moreover, the system exhibits a high level of adaptability due to its modular architecture. The capacity for adaptation, thoroughly examined throughout the development phase, allows for future modifications to satisfy unanticipated user requirements or departmental expansion. This capacity was thoroughly evaluated during the whole procedure. Consequently, the system has the capacity to expand and develop in accordance with the requirements for the electricity bill management.

We like to convey our profound appreciation to all those who, in whatever capacity, made a contribution to the successful conclusion of this thesis, whether it was via direct or indirect means. We have high confidence that our online bill management system will effectively and consistently accomplish its intended purpose for an extended duration, hence providing a seamless and precise billing procedure for all involved parties.

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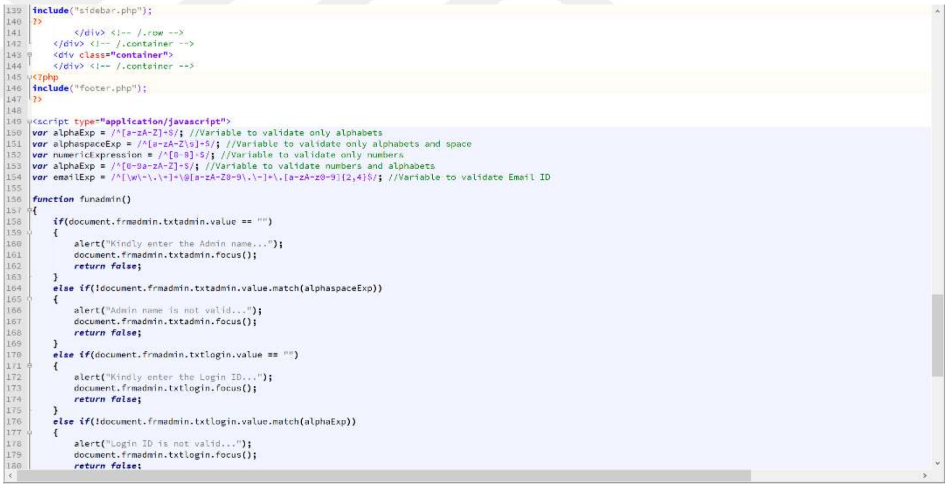
APPENDIX A

Users Interface of Software

```
                                $arr = array("Administrator","Employee");
                                foreach($arr as $val)
                                {
                                    if($val == $rsedit['admin_type'])
                                    {
                                    echo "<option value='$val' selected>$val</option>";
                                    }
                                    else
                                    {
                                    echo "<option value='$val'>$val</option>";
                                    }
                                }
                                ?>
                        </select></td>
                      </tr>
                      <tr>
                        <th scope="row">Status</th>
                        <td><select name="selectstatus" id="selectstatus">
                              <option value="">Select</option>
                                <?php
                                $arr = array("Active","Inactive");
                                foreach($arr as $val)
                                {
                                    if($val == $rsedit['status'])
                                    {
                                    echo "<option value='$val' selected>$val</option>";
                                    }
                                    else
                                    {
                                    echo "<option value='$val'>$val</option>";
                                    }
                                }
                                ?>
                        </select></td>
                      </tr>
                      <tr>
                        <th colspan="2" scope="row" ><center>
                          <input type="submit" name="submit" id="submit" value="Submit" >
                        </center></th>
                      </tr>
                    </tbody>
                  </table>
```



```
include("sidebar.php");
?>
        </div> <!-- /.row -->
    </div> <!-- /.container -->
    <div class="container">
    </div> <!-- /.container -->
<?php
include("footer.php");
?>

<script type="application/javascript">
var alphaExp = /^[a-zA-Z]+$/; //Variable to validate only alphabets
var alphaspaceExp = /^[a-zA-Z\s]+$/; //Variable to validate only alphabets and space
var numericExpression = /^[0-9]+$/; //Variable to validate only numbers
var alphaExp = /^[0-9a-zA-Z]+$/; //Variable to validate numbers and alphabets
var emailExp = /^[\w\-\.\+]+\@[a-zA-Z0-9\.\-]+\.[a-zA-z0-9]{2,4}$/; //Variable to validate Email ID

function funadmin()
{
    if(document.frmadmin.txtadmin.value == "")
    {
        alert("Kindly enter the Admin name...");
        document.frmadmin.txtadmin.focus();
        return false;
    }
    else if(!document.frmadmin.txtadmin.value.match(alphaspaceExp))
    {
        alert("Admin name is not valid...");
        document.frmadmin.txtadmin.focus();
        return false;
    }
    else if(document.frmadmin.txtlogin.value == "")
    {
        alert("Kindly enter the Login ID...");
        document.frmadmin.txtlogin.focus();
        return false;
    }
    else if(!document.frmadmin.txtlogin.value.match(alphaExp))
    {
        alert("Login ID is not valid...");
        document.frmadmin.txtlogin.focus();
        return false;
```

```php
<?php
include("header.php");
if(!isset($_SESSION['adminloginid']))
{
    echo "<script>window.location='index.php';</script>";
}
if(isset($_POST['submit']))
{
    if(isset($_GET['editid']))
    {
        $sql=" UPDATE admin SET admin_name='$_POST[txtadmin]',login_id='$_POST[txtlogin]',password='$_POST[txtpassword]',admin_type='$_POST[select]',status='$_POST[selectst
        if(!$qsql = mysqli_query($con,$sql))
        {
            echo "<script>alert('Error in mysqli code.');</script>";
        }
        else
        {
            echo "<script>alert('Record updated successfully.');</script>";
        }
    }
    else
    {
        $sql ="INSERT INTO admin(admin_name,login_id,password,admin_type,status) VALUES ('$_POST[txtadmin]','$_POST[txtlogin]','$_POST[txtpassword]','$_POST[select]','$_POS
        if(!$qsql = mysqli_query($con,$sql))
        {
            echo "<script>alert('failed to insert record');</script>";
        }
        else
        {
            echo "<script>alert('Admin record inserted successfully..');</script>";
        }
    }
}

if(isset($_GET['editid']))
{
    $sql = "SELECT * FROM admin where admin_id='$_GET[editid]'";
    $qsql =mysqli_query($con,$sql);
    $rsedit = mysqli_fetch_array($qsql);
}
?>
    <div class="first-widget parallax" id="blog">
```

```php
    $sql = "SELECT * FROM admin where admin_id='$_GET[editid]'";
    $qsql =mysqli_query($con,$sql);
    $rsedit = mysqli_fetch_array($qsql);
}
?>
    <div class="first-widget parallax" id="blog">
        <div class="parallax-overlay">
            <div class="container pageTitle">
                <div class="row">
                    <div class="col-md-6 col-sm-6">
                        <h2 class="page-title">Admin</h2>
                    </div> <!-- /.col-md-6 -->
                </div> <!-- /.row -->
            </div> <!-- /.container -->
        </div> <!-- /.parallax-overlay -->
    </div> <!-- /.pageTitle -->

    <div class="container">
        <div class="row">

            <div class="col-md-8 blog-posts">
                <div class="row">
                    <div class="col-md-12">
                        <div class="archive-wrapper">
                          <ul class="archive-list">
                              <li>

                              <form method="post" action="" name="frmadmin" onSubmit="return funadmin()">
                                <table width="739" border="2">
                                  <tbody>
                                    <tr>
                                      <th width="178" scope="row">Admin Name</th>
                                      <td width="379"><input type="text" name="txtadmin" id="txtadmin" value="<?php echo $rsedit['admin_name']; ?>"></td>
                                    </tr>
                                    <tr>
                                      <th scope="row">Login Id</th>
                                      <td><input type="text" name="txtlogin" id="txtlogin" value="<?php echo $rsedit['login_id']; ?>"></td>
                                    </tr>
                                    <tr>
                                      <th scope="row">Password</th>
                                      <td><input type="password" name="txtpassword" id="txtpassword" value="<?php echo $rsedit['password']; ?>"></td>
                                    </tr>
```

```php
    $pendingamt = $rs1acinvoice[0] - $rs1acbilling[0];
}
?>
    <div class="first-widget parallax" id="blog">
        <div class="parallax-overlay">
            <div class="container pageTitle">
                <div class="row">
                    <div class="col-md-6 col-sm-6">
                        <h2 class="page-title">Payment Panel</h2>
                    </div> <!-- /.col-md-6 -->
                    <div class="col-md-6 col-sm-6 text-right">

                    </div> <!-- /.col-md-6 -->
                </div> <!-- /.row -->
            </div> <!-- /.container -->
        </div> <!-- /.parallax-overlay -->
    </div> <!-- /.pageTitle -->

    <div class="container">
        <div class="row">

            <div class="col-md-8 blog-posts">
                <div class="row">
                    <div class="col-md-12">
                        <div class="archive-wrapper">

                              <form method="post" action=""  name="frmpaypanel" onSubmit="return funpaypanel()">

                                <table width="739" border="2">
                                  <tbody>
                                    <tr>
                                      <th width="178" scope="row">Account No</th>
                                      <td width="379"><select name="draccountno" id="draccountno" onChange="loadinvoicedetail(this.value)">
                                      <option value="">Select</option>
            <?php
           $sql1 ="SELECT * FROM account where status='Active' and cust_id='$_SESSION[customerloginid]' ";
                $qsql1= mysqli_query($con,$sql1);
                while($rs1 = mysqli_fetch_array($qsql1))
                                {
                                    if($rs1['account_id'] == $_GET['accid'])
                                    {
                                    echo "<option value='$rs1[account_id]' selected>$rs1[account_no]</option>";
```

```
                        if($rs1['account_id'] == $_GET['accid'])
                        {
                        echo "<option value='$rs1[account_id]' selected>$rs1[account_no]</option>";
                        }
                        else
                        {
                        echo "<option value='$rs1[account_id]'>$rs1[account_no]</option>";
                        }
                    }
                    ?>
</select></td>
                  </tr>
                    <tr>
                      <th scope="row">Bill Month</th>
                      <td><?php echo $rslacinvoice1['readingdate']; ?></td>
                    </tr>
                    <tr>
                      <th scope="row">Payment Mode</th>
                      <td><select name="drpayment" id="drpayment">
                      <option value="">Select</option>
                        <option value="Credit card">Credit card</option>
                        <option value="Debit card">Debit card</option>
                        <option value="VISA">VISA</option>
                        <option value="Master Card">Master Card</option>
                      </select><br>

                      <!-- <img src="images/payments.jpg" width="339" height="24" alt=""/></td> -->
                    </tr>
                    <tr>
                      <th scope="row">Card number</th>

                      <td><input type="text" name="cardnumber" id="0000-0000-0000-0000" placeholder="0000-0000-0000-0000"></td>

                    </tr>
                    <tr>
                      <th scope="row">CVV Code</th>
                      <td><input type="text" name="cvvnumber" placeholder="0-0-0"></td>
                    </tr>
                    <tr>
                      <th scope="row">Expiry Date</th>
                      <td><input type="date" name="expirydate" id="expirydate"></td>
                    </tr>
```

```
                  </tr>
                  <tr>
                    <th scope="row">Card number</th>

                    <td><input type="text" name="cardnumber" id="0000-0000-0000-0000" placeholder="0000-0000-0000-0000"></td>

                  </tr>
                  <tr>
                    <th scope="row">CVV Code</th>
                    <td><input type="text" name="cvvnumber" placeholder="0-0-0"></td>
                  </tr>
                  <tr>
                    <th scope="row">Expiry Date</th>
                    <td><input type="date" name="expirydate" id="expirydate"></td>
                  </tr>
                  <tr>
                    <th scope="row">R Number</th>
                    <td><input type="text" name="rrnumber" id="rrnumber" value="<?php echo $rslac['rr_number']; ?>" readonly></td>
                  </tr>
                  <tr>
                    <th scope="row">Bill Amount</th>
                    <td><input type="text" name="txtbillamt" id="textbillamt" value="<?php echo $pendingamt; ?>" readonly></td>
                  </tr>
                  <tr>
                    <th scope="row">Paid Amount</th>
                    <td><input type="text" name="txtpamt" id="txtpamt" onKeyUp="calculateexcess()" onChange="calculateexcess()" ></td>
                  </tr>
                  <tr>
                    <th scope="row">Excess Paid</th>
                    <td><input name="txtepaid" type="text" id="txtepaid" readonly></td>
                  </tr>
                  <tr>
                    <th colspan="2" scope="row" ><center>
                      <input type="submit" name="btnsubmit" id="btnsubmit" value="Submit" >
                    </center></th>
                  </tr>
                </tbody>
              </table>
              <input type="hidden" name="electricityboard_id" value="<?php echo $rslac['electricityboard_id']; ?>">
            <input type="hidden" name="accno" value="<?php echo $rslac['account_no']; ?>" />

          </div>
```

```
<?php
include("header.php");
if(!isset($_SESSION['customerloginid']))
{
    header("Location:customerlogin.php");
}
if(isset($_POST['btnsubmit']))
{
    $dt = date("Y-m-d");
    $tim = date("h:i:s");
    $sql ="INSERT INTO billing( cust_id, account_no,electricityboard_id, payment_mode, payment_date, payment_time, rr_number, bill_amount, paid_amount, excess_paid, status)
            if(!$qsql = mysqli_query($con,$sql))
            {
                echo "<script>alert('failed to insert record');</script>";
            }
            else
            {
                $lastinsid=  mysqli_insert_id($con);
                echo "<script>alert('billing record inserted successfully..');</script>";
                $sql = "SELECT * FROM customer WHERE cust_id='$_SESSION[customerloginid]'";
                $qsql = mysqli_query($con,$sql);
                $rsrec = mysqli_fetch_array($qsql);
                $msg ="Dear $rsrec[cust_name] , We have received payment of Rs. $_POST[txtpamt] for $_POST[accno] .. Thanks for making payment.. " ;
                echo "<script>window.location='printreceipt.php?bill_no=$lastinsid';</script>";
            }
}

if(isset($_GET['editid']))
{
    $sql = "SELECT * FROM billing where account_id='$_GET[editid]'";
    $qsql =mysqli_query($con,$sql);
    $rsedit = mysqli_fetch_array($qsql);
}
if(isset($_GET['accid']))
{
    $sqllac="SELECT * FROM account WHERE account_id='$_GET[accid]' ";
    $qsqlac=mysqli_query($con,$sqllac);
    echo mysqli_error($con);
    $rslac=mysqli_fetch_array($qsqlac);
    $sqllacinvoice1="SELECT * FROM invoice WHERE account_no='$rslac[account_no]' AND electricityboard_id='$rslac[electricityboard_id]'";
    $qsqlacinvoice1=mysqli_query($con,$sqllacinvoice1);
    echo mysqli_error($con);
```

APPENDIX B

Machine Learning Algorithm

```
linear_reg_pred = linear_reg.predict(X_test)
rf_reg_pred = rf_reg.predict(X_test)

linear_reg_rmse = mean_squared_error(y_test, linear_reg_pred, squared=False)
rf_reg_rmse = mean_squared_error(y_test, rf_reg_pred, squared=False)

print("Linear Regression RMSE:", linear_reg_rmse)
print("Random Forest Regression RMSE:", rf_reg_rmse)
```

```
# Predicting one-year expense for each customer
# Assuming one year equals 365 days
one_year_expense_linear_reg = linear_reg.predict([[cust_id, 365 * bill_amount] for cust_id, bill_amount in zip(X['cust_id'], X['bill_amount'])])
one_year_expense_rf_reg = rf_reg.predict([[cust_id, 365 * bill_amount] for cust_id, bill_amount in zip(X['cust_id'], X['bill_amount'])])

data['one_year_expense_linear_reg'] = one_year_expense_linear_reg
data['one_year_expense_rf_reg'] = one_year_expense_rf_reg

output_file_path = r"C:\Users\user\Desktop\python\predictions.csv"

data.to_csv(output_file_path, index=False)
```

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error

file_path = r"C:\Users\user\Desktop\python\E-billing.csv"
data = pd.read_csv(file_path)

X = data[['cust_id', 'bill_amount']]
y = data['paid_amount']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

linear_reg = LinearRegression()
rf_reg = RandomForestRegressor()
```