A

Mini Project Report

on

ElectroPay : Smart Bill Management System

Submitted in partial fulfillment of the requirements for the

degree

Second Year Engineering – Computer Science Engineering (Data Science)

by

Atharv Parab	**23107084**
Abbas Sangameshwari	**23107116**
Adarsh Panigrahi	**23107117**
Jagdishkumar Nayak	**23107138**

Under the guidance of

Ms.Rajashri Chaudhari

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING (DATA SCIENCE)

A.P. SHAH INSTITUTE OF TECHNOLOGY

G.B. Road, Kasarvadavali, Thane (W)-400615

UNIVERSITY OF MUMBAI

Academic year: 2024-25

CERTIFICATE

This to certify that the Mini Project report on **ElectroPay : Smart Bill Management** has been submitted by **Atharv Parab(23107084)**, **Abbas Sangameshwari(23107116)**, **Jagdishkumar Nayak(2310718), Adarsh Panigrahi(23107117)** and who are bonafide students of A. P. Shah Institute of Technology, Thane as a partial fulfillment of the requirement for the degree in **Computer Science Engineering (Data Science)**, during the academic year **2024-2025** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

Ms. Rajashri Chaudhari

   Guide

  Ms. Anagha Aher   **Dr. Uttam D. Kolekar**

HOD, CSE(Data Science)   **Principal**

  External Examiner   **Internal Examiner:**

  1.   **1.**

  Place: A. P. Shah Institute of Technology, Thane

  Date:

ACKNOWLEDGEMENT

TABLE OF CONTENTS

Chapter 1

Introduction

Electricity billing is an essential but often cumbersome process for both customers and utility providers. Manually tracking consumption, calculating bills, and processing payments can lead to confusion, errors, and delays. To address these challenges, ElectroPay - Smart Billing System was developed to automate and simplify the electricity billing process.

Inspired by the need for modernisation in utility billing systems, ElectroPay enables users to seamlessly manage their electricity bills with features such as bill calculation based on units consumed, receipt generation, and an integrated payment portal. The system caters to both customers and administrators, making it easier for customers to track their consumption and pay their bills, while allowing administrators to manage customer data and monitor payment statuses.

This report explores the design, development, and functionality of ElectroPay. It highlights key features such as customer registration, bill calculation, payment integration, and admin capabilities for customer management. Additionally, the report covers the system's technical architecture, the user interface design, and challenges encountered during the development process. It concludes with insights on the scalability and future enhancements to make the system more robust and adaptable to evolving user needs.

1.1. Purpose:

The decision to develop ElectroPay - Smart Billing System was driven by the need for a more efficient and accessible way to manage electricity billing, both for customers and administrators. In many traditional electricity billing setups, customers face challenges in tracking their energy consumption, generating bills, and making timely payments. Admins, on the other hand, struggle with handling large volumes of data, bill generation, and customer management. Existing solutions may not fully address these challenges, leading to delays, inaccuracies, and inconvenience.

Addressing Common Pain Point: Managing electricity bills, calculating charges based on unit consumption, and ensuring timely payments are regular challenges in everyday life. This project aims to alleviate these issues by providing a simple, intuitive system that allows users to handle their

electricity billing in a more efficient manner. By allowing customers to calculate their bills and admins to manage customer data, ElectroPay ensures both transparency and ease of use.

Technological Relevance: The ElectroPay - Smart Billing System leverages modern technologies such as Java for the backend and MySQL for database management. By focusing on secure and scalable software development, the project offers valuable experience in areas like database design, user authentication, and system security. Although the system does not involve complex API integrations, it emphasizes core development skills, ensuring a deeper understanding of robust backend architecture and data management.

Potential for Real-World Application: With the growing reliance on digital solutions for everyday utilities, ElectroPay has clear potential to be adopted in real-world scenarios, such as utility companies, housing societies, or even small-scale energy providers. The system could be scaled for broader adoption, serving customers and administrators with its user-friendly interface and automated billing functionalities. It could simplify the electricity billing process, reducing manual errors and delays in payment, making it a viable commercial product for electricity providers.

User-Centered Design:The project places strong emphasis on usability and user experience, ensuring that even non-tech-savvy users can efficiently interact with the system. ElectroPay focuses on creating a simple, intuitive user interface that is easy to navigate, allowing both customers and admins to complete their tasks without complications.

1.2.Problem Statement:

Managing electricity billing is a common challenge for both customers and utility providers. Traditional methods of bill calculation and payment, which often rely on manual entry, paper bills, and offline payments, are prone to errors, inefficiencies, and delays. These outdated systems create several key problems:

1.Complexity in Bill Calculation For customers, calculating electricity bills based on units consumed can be a complicated task, especially when different rates or tariffs are applied. Manual methods of calculating bills are often prone to errors, which can result in overcharges or undercharges. This leads to customer dissatisfaction and confusion due to inconsistent billing amounts.

2. Inefficient Bill Management Electricity providers often face challenges in managing large volumes of customer data and generating accurate bills on time. Existing systems may involve manual, time-

consuming processes to calculate bills and manage customer accounts. Delays in bill generation can result in delayed payments, affecting the utility provider's cash flow and the overall customer experience.

3. Difficulty in Payment Processing Coordinating the payment of bills can be tedious for both customers and providers. Customers may have limited options for making payments, often relying on manual or in-person methods, which can be inconvenient. Additionally, without proper tracking of payment history, settling unpaid bills and keeping accurate records becomes difficult, leading to delayed payments and confusion over payment statuses.

1.3.Objectives:

1.Simplify Electricity Bill Management: The primary objective is to provide a user-friendly platform where customers can easily calculate their electricity bills based on units consumed and manage their billing information efficiently. This will remove the need for manual calculations and simplify the entire billing process.

2.Enhance User Experience with Intuitive Design: To ensure that the system is accessible to all users, the interface will be intuitive, simple, and easy to navigate. Customers and admins alike should be able to interact with the platform without requiring any technical expertise.

3.Ensure Accurate and Transparent Bill Calculation: The system should automatically calculate bills based on the entered units consumed and predefined tariff rates, ensuring that all charges are accurate and clearly visible to the customer. This will eliminate manual errors and provide transparency in billing.

4.Facilitate Easy Bill Generation: Enable users (customers) to easily generate and download their bills after calculating their charges, allowing for easy record-keeping and tracking of payments. This feature will simplify the process of accessing billing information whenever needed.

5.Streamline Customer and Admin Roles: Provide admins with the ability to easily add new customers, manage existing customer data, and view customer billing history. This will streamline the administrative process and improve efficiency in handling customer accounts.

6.Secure Data Storage and User Privacy: Ensure that all customer and billing data is securely stored in a database, with proper encryption and security measures in place. Protecting sensitive customer information is a key priority, particularly when handling personal and financial data.

7.Scalability for Larger Customer Bases: Design the system to be scalable, able to handle a growing number of customers and larger volumes of data as needed. This ensures that the system can expand to accommodate future demands without compromising performance or reliability.

1.4.Scope:

The ElectroPay - Smart Billing System project aims to deliver a comprehensive and scalable solution for managing electricity billing for both customers and administrators. The scope of the project includes the technical aspects of system development as well as user-oriented features that ensure its functionality, ease of use, and reliability. The key areas covered by the project are:

1.Electricity Bill Calculation and Management: The core functionality of the system revolves around calculating and managing electricity bills based on the units consumed by customers. Users will be able to input their usage data and generate accurate bills according to predefined tariff rates. The system will also provide users with a history of their past bills, ensuring easy tracking and management of electricity expenses.

2.Customer and Admin Management: The system will support the creation and management of both customer and admin accounts. Admins will have the ability to add new customers, manage customer data, and view billing history. Customers will be able to sign up, log in, and manage their accounts independently, giving them full control over their billing information.

3.Bill Generation and Downloading: Customers will be able to easily generate and download their electricity bills after calculating the charges based on their energy consumption. This functionality will ensure that users can save and access their bills for future reference, providing transparency and accessibility.

4.Data Security and Privacy: A strong focus will be placed on data security, ensuring that sensitive customer and billing information is securely stored in the system. Proper encryption methods will be used to protect financial and personal data, ensuring that unauthorized access to user information is prevented.

5.Scalability and Flexibiltiy : The system will be designed to handle a wide range of customers, from small scale users such as individual households to larger customer, such as apartments complexes or commercial establishments. This scalability will allow the system to expand as needed, without affecting its performance or efficiency.

Chapter 2

Proposed System

The ElectroPay - Smart Billing System is designed to address the challenges of managing electricity billing by providing an intuitive, automated, and efficient platform. The proposed system includes several core components and features aimed at enhancing the user experience and simplifying the management of electricity bills. Below is an overview of the key features and functionalities of the proposed system:

1.User Accounts and Customer Management: Customers and admins can create individual accounts and securely log in using their credentials. This allows users to manage their electricity bills and access relevant data at any time.Admins will be able to manage the system, including adding new customers, managing customer information, and viewing their billing history. This feature ensures the admin has full control over customer accounts.

2.Electricity Bill Calculation and Management: Customers can enter their units of electricity consumed, and the system will automatically calculate the bill based on the predefined tariff rates. The system ensures that customers are charged accurately for their usage, minimizing the risk of errors in manual calculations. After calculating the bill, customers will have the op0on to generate and download their electricity bill for future reference. This simplifies bill tracking and provides transparency in the billing process.

3.Billing History and Payment Tracking: Customers will have access to their past billing information, allowing them to track their electricity usage and payments over time. This feature provides better financial management and helps users keep records of their payments.The system tracks payments made by customers and updates their accounts accordingly. Though no integration with external payment gateways is implemented, the system ensures that users can manually log payments, ensuring accurate and updated billing records.

4.User Interface and Experience: Intuitive Design: The system features a user-friendly interface designed for ease of use. The navigation is simple and straightforward, making it easy for both customers and admins to man-age their electricity billing tasks without requiring technical expertise.

5.Scalability and Flexibility: Support for Large Customer Bases: The system is designed to handle a large number of users efficiently, from individual customers to large customer bases, such as housing complexes or commercial establishments. The architecture is scalable, ensuring that the system can grow to accommodate more users as needed.

This proposed system provides a comprehensive solution to the challenges of managing electricity bills, focusing on simplifying the billing process for customers and streamlining administrative tasks for utility providers.

Chapter 3

Project Outcomes

The ElectroPay - Smart Billing System is an innovative solution designed to revolutionize the management of electricity billing for both consumers and service providers. With the increasing complexity of billing processes and the demand for accuracy and transparency, ElectroPay aims to simplify the experience of managing electricity bills through a user-centric application. By leveraging automated calculations, secure data handling, and an intuitive interface, the system empowers users to efficiently manage their billing information, track usage, and generate bills effortlessly. This project addresses common challenges associated with traditional billing methods, ultimately enhancing customer satisfaction and fostering trust in the billing process.

1.Streamlined Bill Management: Customers can efficiently calculate and manage their electricity bills, significantly reducing the reliance on manual calculations and minimizing errors associated with traditional billing methods.

2.Accurate Bill Calculation: The system provides an automated calculation of bills based on units consumed, ensuring accuracy in billing and enhancing customer satisfaction by preventing overcharges or undercharges.

3.Intuitive Interface: The application's user-friendly design makes it easy for individuals with varying levels of technical proficiency to navigate and utilize its features effectively, enhancing the overall user experience.

4.Simplified Bill Generation: Customers can easily generate and download their electricity bills after inputting their usage, simplifying the process of accessing and managing billing information.

5.Comprehensive Billing History: Users have access to their past billing information, allowing them to track their electricity usage and payments over time. This feature promotes better financial management and provides clarity regarding their billing history.

6.Secure Data Handling: The implementation of robust security measures, including encryption for sensitive financial and personal information, ensures the protection of user data, thereby enhancing trust in the system.

7.Controlled Access: Customers and admins have control over their accounts, allowing them to manage their information securely. This ensures that personal data is only accessible to authorized users.

8.Scalability and Adaptable Design: The system is designed to support both individual customers and larger customer bases, such as housing complexes or commercial establishments. The scalable infrastructure accommodates growing user numbers and varying billing needs.

9.Enhanced User Satisfaction: By simplifying the billing process and providing accurate information, the system aims to improve overall customer satisfaction, making it a reliable tool for electricity billing management.

The ElectroPay system presents a practical solution for electricity billing challenges, providing users with an efficient, accurate, and secure method for managing their electricity bills.

Chapter 4

Software Requirements

To successfully develop and deploy the ElectroPay - Smart Billing System, a variety of software tools are essential. These components create a robust development environment that facilitates the creation of a reliable and user-friendly application for managing electricity billing. Key elements include the Java Development Kit (JDK) for coding, Visual Studio Code as the integrated development environment, and MySQL as the backend database. Additionally, technologies such as JDBC for database connectivity and JavaFX or Swing for the graphical user interface are crucial in ensuring smooth user interactions and efficient data handling. Together, these tools lay the foundation for an effective and scalable billing solution.

1.Java Development Kit (JDK) •Version: JDK 11 or higher:- The Java Development Kit is essential for writing, compiling, and running Java applications. It provides the necessary libraries and tools to build the frontend for the ElectroPay application. The JDK includes the Java Runtime Environment (JRE), which is critical for executing the Java application on various platforms.

2.Integrated Development Environment (IDE) •Tool: Visual Studio Code (VS Code):- Visual Studio Code is utilized as the IDE for coding and debugging Java programs. It offers features such as syntax highlighting, code completion, and integrated debugging, which streamline the development process and enhance productivity.

3.JavaFX/Swing:- JavaFX or Swing are employed for building the graphical user interface (GUI) of the application. This includes creating windows, buttons, input fields, and other visual elements that contribute to an interactive user experience.

4.MySQL Server Version: MySQL 8.0 or higher:- serves as the backend database for the ElectroPay application. It stores user information, billing details, and payment records. MySQL provides a relational database system that supports complex queries, transactions, and secure data handling.

5.JDBC (Java Database Connectivity):- JDBC is an API that enables Java applications to connect to relational databases such as MySQL. It is required to execute SQL queries from the frontend and retrieve data, ensuring seamless communication between the application and the database.

6.Operating System:- The ElectroPay application is platform-independent, but the development environment can be set up on any of the major operating systems. The choice of OS depends on the developer's preference.

Supported Platforms: Windows, macOS, Linux

These software requirements ensure a robust and effective development environment for the ElectroPay – Smart Billing System, facilitating the creation of a reliable and user- friendly application for managing electricity billing.

Chapter 5

Project Design

The design of the ElectroPay - Smart Billing System emphasizes a user-friendly and efficient approach to managing electricity billing for customers and utility providers. The application is structured into three main components: the frontend (Java), the backend (MySQL), and the database layer. This clear separation of concerns enhances maintainability and scalability for future updates. Below are the key aspects of the design.

5.1 System Architecture

The ElectroPay application follows a client-server architecture, where the Java-based frontend interacts with the MySQL database through a JDBC (Java Database Connectivity) layer. This architecture ensures effective handling of user inputs in the frontend while processing data in the backend for storage and retrieval.

Components of the Architecture:

1.Client (Frontend): Built using Java, this layer is responsible for managing the user interface and facilitating user interactions. Users can log in, sign up, input their units consumed, calculate their bills, and generate bill receipts. The Java application captures user inputs and communicates with the backend to perform necessary operations, ensuring a smooth user experience.

2.Backend (Logic & Database Access): The backend contains the business logic, which is also written in Java. It processes inputs from the user interface, connecting with the MySQL database using JDBC. This layer performs operations such as querying user data, calculating electricity bills based on units consumed, and returning results to the frontend for display. It manages the flow of data between the client and the database efficiently.

3.Database (MySQL): The MySQL database serves as the persistent data storage for the ElectroPay application. It maintains all relevant data, including user information, billing details, and payment

records. The database is organized into tables that facilitate efficient management of information, and SQL queries are utilized to interact with the data as needed for operations like bill generation and customer account management.

This design structure of the ElectroPay - Smart Billing System ensures a robust, maintainable, and scalable application that effectively addresses the challenges of electricity billing for both customers and utility providers.

5.2 Database Design

The database is structured using the relational model and includes several tables to manage the various functionalities of the Electropay application. The main entities and their relationships are captured in an Entity-Relationship (ER) Diagram, emphasizing the key components necessary for efficient billing and customer management. Key Entities and Their Relationships:-

Table 5.1 Login Table

Field	Type	Description
meter_no	Varchar(50)	meter no of user
username	Varchar(50)	username
name	Varchar(50)	Name of the user
password	Varchar(50)	Password of user
role	Varchar(50)	to identify if admin or customer

To manage user authentication for login and sign-up.

Table 5.2 Emp Table

Field	Type	Description
name	Varchar(255)	name of customer
meter_number	Varchar(20)	meter no of customer
address	Varchar(255)	address of customer
state	Varchar(100)	state of customer
city	Varchar(100)	city of customer
email	Varchar(100)	email of customer
phone	Varchar(15)	Phone No of customer

To store information about customers (employees).

Table 5.3 Tax Table

Field	Type	Description
meter_location	Varchar(255)	location of meter
meter_type	Varchar(100)	type of meter customer uses
phase_code	Varchar(100)	Type of electricity
bill_type	Varchar(100)	type of bill
days	int	days in a month
meter_rent	double	rent for meter
mcb_rent	double	rent for mcb
service_rent	double	standard service charges

To manage tax rates applicable for bill calculations.

Table 5.4 Bill Table

Field	Type	Description
meter_number	Varchar(20)	meter no of customer
month	Varchar(20)	Month of usage
units	int	units consumed by the customer in a month
amount	double	final bill amount

To store detailed information about each electricity bill.

5.3 Frontend Design

The frontend of the Electropay application is designed to be user-friendly and efficient, enabling users to seamlessly navigate through various functionalities. The user interface is built using Java Swing/JavaFX and consists of the following key screens:

1. Splash Screen: Serves as the introductory screen for the application, displaying the Electropay logo and tagline while loading essential resources.

2. Login Screen: Allows users to enter their credentials (username and password) to access their accounts. Features options for password recovery and redirecting to the signup screen.

3. Signup Screen: Provides a registration form for new users to create an account by entering their personal information, including name, email, username, and password.

4. Main Screen: Acts as the central hub for navigation, displaying key functionalities such as viewing customer details, managing bills, and accessing other essential features.

5. Add New Customer Screen: Enables administrators to input details for new customers, including name, address, contact number, and email, ensuring easy management of customer records.

6. Customer Details Screen: Displays comprehensive information about a selected customer, including their billing history, contact details, and status of payments. It also provides options to edit or delete customer records.

7. Pay Bill Screen: Allows users to view their outstanding bills and make payments.provides payment methods and confirmations for successful transactions.

8. Calculate Bill Screen: Enables users to enter the necessary data (such as usage and applicable taxes) to compute their electricity bill accurately. The calculated bill amount is displayed for review.

9. Last Bill Screen: Shows the details of the most recent bill issued to the user, including the amount due, due date, and payment status.

10. Generate Bill Screen: Provides functionality for creating a new bill based on customer information and usage data. Users can review the bill before finalizing it.

Each screen within the electropay frontend is interconnected through event -driven programming, Ensuring smooth navigation and interaction. User actions, such as button clicks, trigger corresponding functionalites that interact with the backend, enhancing the overall user experience and facilitating efficient bill management .

5.4 Flow of Operations

1. User Registration/Login: Users register or log in to the app. Their credentials are stored and verified using the MySQL database.

2. Customer Management: Administrators can add new customers by entering their details, such as name, address, contact number, and email. This information is saved in the database for future reference.

3. Bill Management: Users can view their outstanding bills or access the last issued bill. The system retrieves this information from the database, allowing users to stay informed about their payment status.

4. Bill Calculation: Users input the necessary data to calculate their electricity bills, including usage and applicable taxes. The application computes the bill amount based on this data.

5. Payment Processing: Users can make payments for their bills. The application updates the payment status in the database to reflect successful transactions, ensuring accurate record-keeping.

6. Data Persistence: Throughout the operation flow, all user actions and data are managed within the MySQL database, ensuring that customer records, billing information, and payment histories are securely stored and easily retrievable.

Chapter 6

Project Scheduling

A schedule outlining planned start and finish dates, durations, and allocated resources for each task, ensuring tasks are completed on time and within budget for effective task and time management.
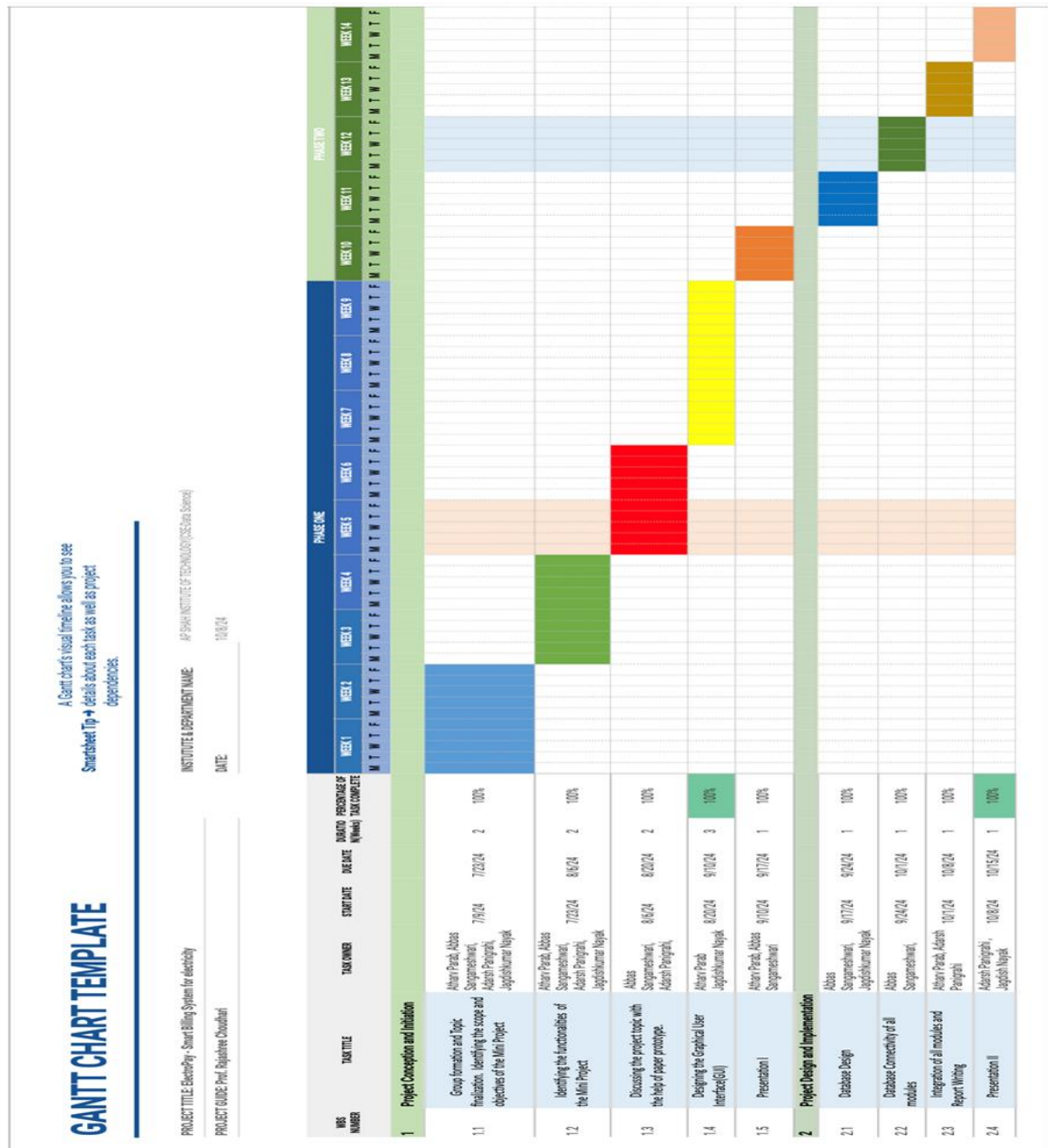
Figure 6.1 GANTT CHART

During the project timeline, the group members undertook various tasks to ensure the successful completion of the Mini Project. In the first two weeks of July, Jagdishkumar Nayak and Atharv Parab focused on group formation and topic finalization, identifying the project's scope and objectives. Following this, from the last week of July to the first week of August, Atharv Parab and Abbas Sangameshwari identified the key functionalities needed for the Mini Project.

From the second week to the last week of August, a collaborative effort involving Atharv Parab, Abbas Sangameshwari, and Adarsh Panigrahi was made to discuss the project topic, utilizing a paper prototype to visualize ideas. Concurrently, Jagdishkumar Nayak, Atharv Parab, and Adarsh Panigrahi worked on designing the Graphical User Interface (GUI) during the last week of August to the first week of September, focusing on creating a user-friendly layout.

In the first two weeks of September, the team, including Jagdishkumar Nayak, Atharv Parab, Abbas Sangameshwari, and Adarsh Panigrahi, prepared for Presentation I. Abbas Sangameshwari then took the lead from the second week to the last week of September, concentrating on database design, which was crucial for the project's functionality.

By the last week of September, Abbas Sangameshwari completed the database connectivity for all modules, ensuring seamless integration. In the first week of October, Atharv Parab, Abbas Sangameshwari, and Adarsh Panigrahi worked together to integrate all project modules and began report writing, while Jagdishkumar Nayak joined them for Presentation II in the same week. This structured approach allowed the team to efficiently collaborate and advance their project systematically.

Chapter 7

Results
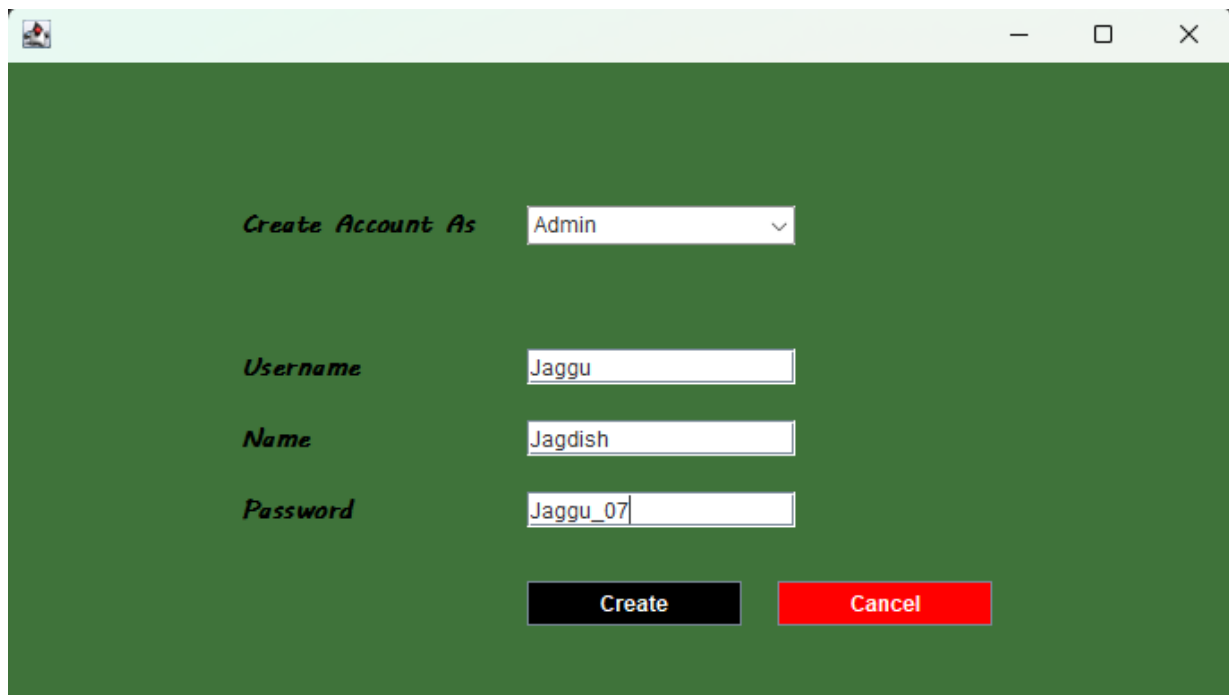
The ElectroPay - Smart Billing System successfully achieves its core objective of providing a streamlined platform for users to manage their electricity bills efficiently. Below is a detailed summary of the results obtained from the development and testing phases:

Figure 7.1 Login Page

User can login either as admin or as customer.
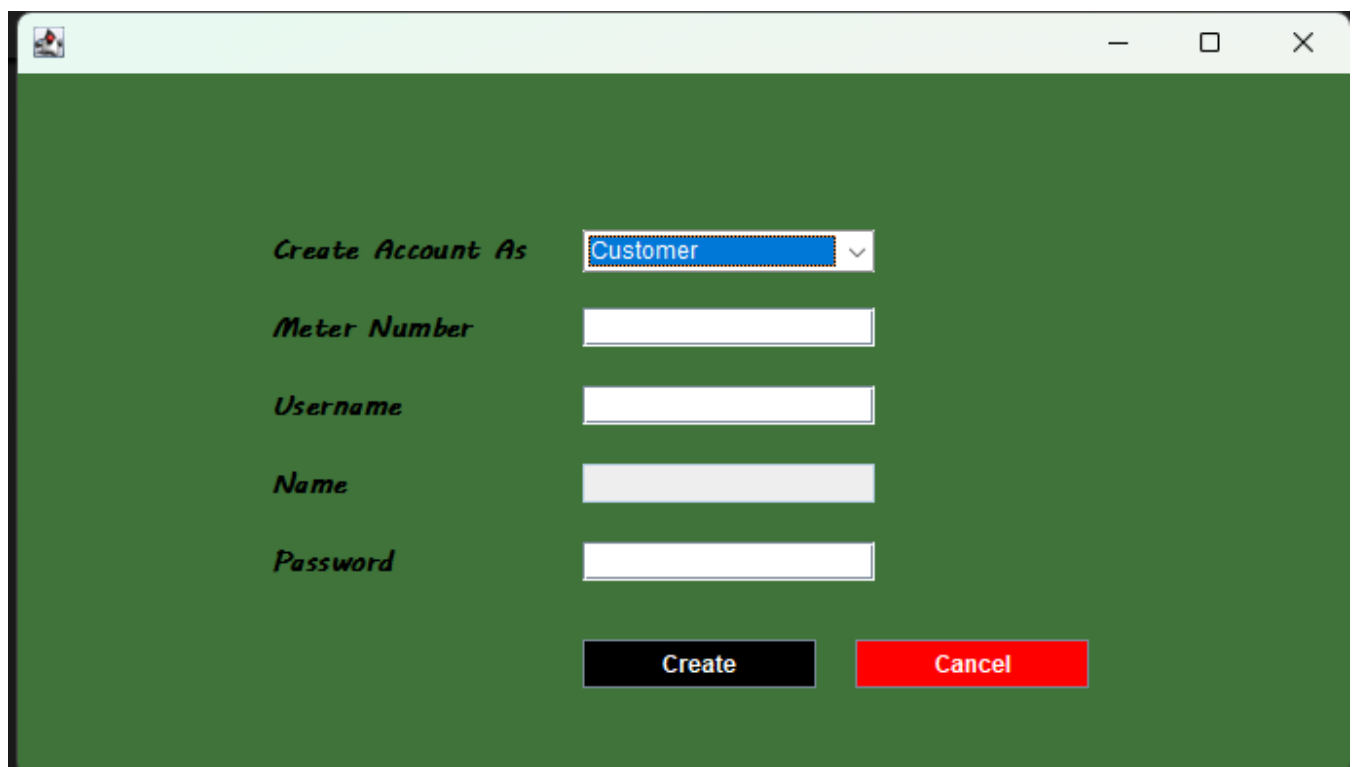
Figure 7.2 Create Account as Admin

User can create a new account for admin.
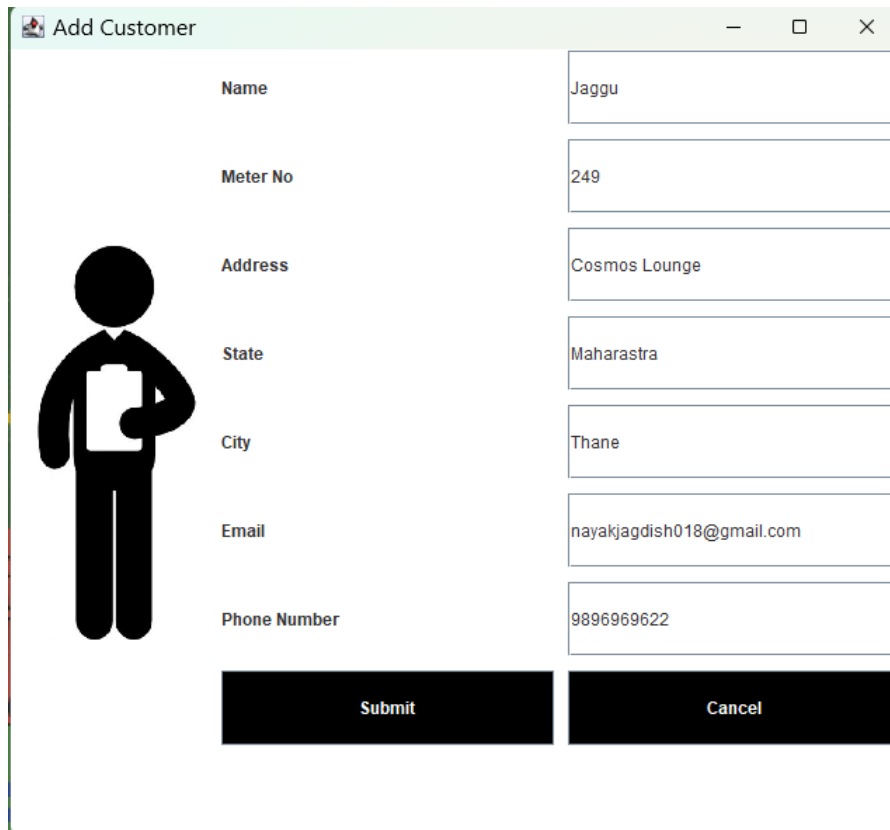
Figure 7.3 Create Account as Customer

User can create a new account for Customer.
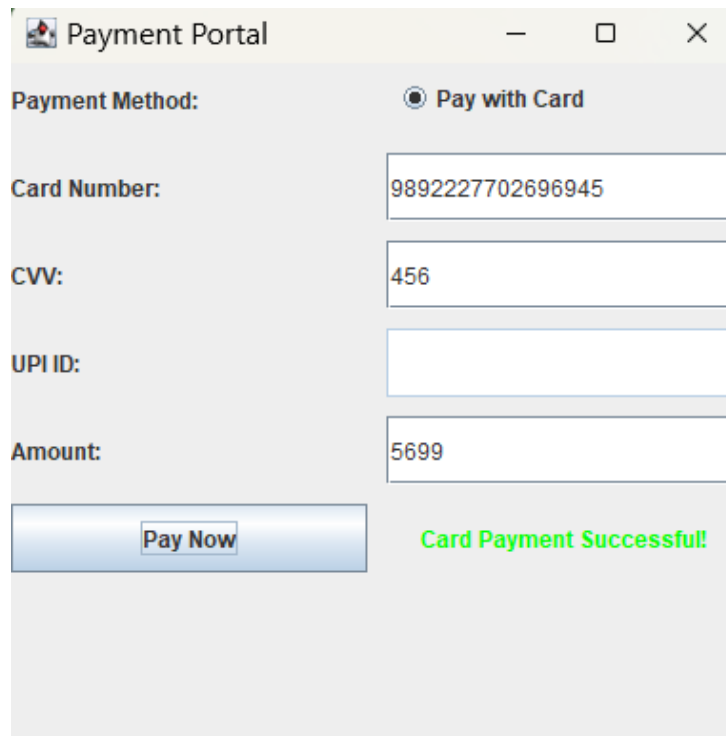
Figure 7.4 Add A Customer Information

Admin can add a new customer (requires customer's details)

Figure 7.5 Payment Portal With Credit Card

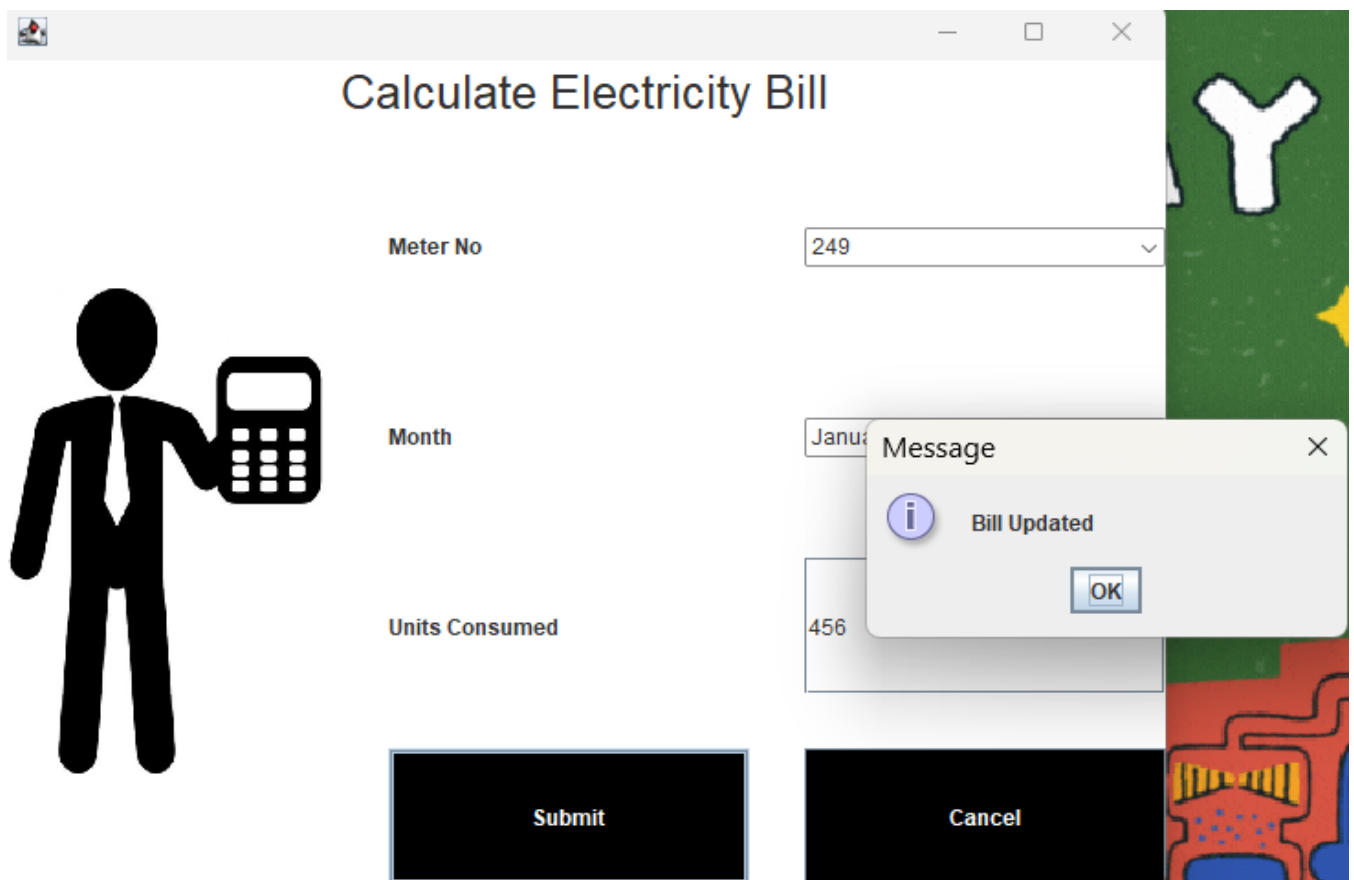The added Customer can pay their bill.

Figure 7.5 Payment Portal with Credit Card

Customer can pay the bill by credit card or UPI.

Figure 7.7 ElectroPay Features like Master , Users, Reports, Utility, and Exit

The admin or customer can access the features in the system.

Figure 7.8 Simple Calculator In-build

Customer can access the calculator directly through the system.

Chapter 8

Conclusion

The Electropay application successfully achieves its primary objective of streamlining the process of managing electricity bills and customer accounts. By leveraging a Java-based frontend alongside a MySQL backend, the application provides an intuitive and efficient solution for customers to manage their billing information and process payments.

8.1 Project Success

Key functionalities of the application, including user registration, customer management, bill calculation, and payment processing, were successfully implemented. Users can easily register, access their billing information, and make payments, while the application efficiently stores and retrieves data from the backend. The clear separation between the frontend and backend, coupled with MySQL's robust data handling capabilities, ensures that customer data is securely maintained and managed.

The project underwent testing across various scenarios, including different customer accounts and billing calculations, showcasing its reliability and effectiveness in real-world applications. The system architecture and database design offer a strong foundation for potential future enhancements.

8.2 Challenges and Learning Outcomes

During development, challenges arose primarily regarding database integration and ensuring data integrity among customer records and billing data. These challenges were addressed through the application of relational database design principles and the establishment of error-handling mechanisms, enhancing the overall user experience. Working with JDBC provided valuable insights into managing Java-to-database communication and optimizing database interactions.

8.3 Future Work

While the Electropay application effectively manages basic bill calculations and customer details, there is considerable potential for expanding its functionality. Future versions could include:

1. Advanced Billing Options: Incorporating customizable billing methods based on usage patterns or specific customer agreements.

2. Billing History: Allowing users to access detailed historical billing records for better financial tracking.

3. Mobile and Web Versions: Developing mobile and web applications to enhance accessibility and usability across various platforms.

4. Notifications and Reminders: Implementing notifications to alert users about upcoming bills or payment deadlines.

5. Data Analytics: Providing visual reports or summaries of billing trends, which would assist users in understanding their consumption patterns better.

8.4 Final Thoughts

Overall, the Electropay project has been a valuable educational experience, integrating concepts of Java programming, database management, and user interface design. The successful implementation of core features illustrates the effectiveness of the chosen technologies and the robustness of the system design. Looking ahead, the application's solid foundation presents numerous opportunities for further development, enhancing both its functionality and user experience.

References

1. Oracle. "Java SE Documentation." :-URL: https://docs.oracle.com/javase/

2. MySQL Documentation. "MySQL 8.0 Reference Manual." :-URL: https://dev.mysql.com/doc/refman/8.0/en/

3. Oracle. "JDBC Guide – Java Database Connectivity." :-URL: https://docs.oracle.com/javase/tutorial/jdbc/

4. GeeksforGeeks. "Introduction to JavaFX." :-URL: https://www.geeksforgeeks.org/javafx-tutorial/

5. Stack Overflow. "Various Java and MySQL Development Queries." :-URL: https://stackoverflow.com/

6. Baeldung. "Guide to JDBC in Java."

7. JavaTpoint. "JDBC MySQL Tutorial." :-URL: https://www.javatpoint.com/java-mysql-tutorial

8. Visual Studio Code Documentation. "Using Visual Studio Code for Java Development." :-URL: https://code.visualstudio.com/docs