

**St. Paul's University**

DEPARTMENT OF COMMUNICATION AND COMPUTER STUDIES



A PROJECT REPORT

ON

**Water Billing & Customer Management System for  
Efficient Revenue Collection**

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Submitted in partial fulfilment of the requirements for the award  
of the degree of

**BACHELOR OF SCIENCE  
IN  
COMPUTER SCIENCE**

**Date**

August 19, 2024

## 0.1 Introduction

### 0.1.1 Background Study

Throughout history, the evolution of water billing has mirrored the complex relationship between societies and this essential resource. From basic communal systems in ancient civilizations to the development of municipal water supply networks during the industrial revolution, the management of water has continuously evolved. However, challenges related to equitable distribution, accurate measurement, and efficient revenue collection have persisted. In the 20th century, the advent of metering technologies and automated billing systems addressed some of these issues. Today, as the world faces modern challenges like water scarcity and sustainability, new approaches such as tiered pricing structures and digital solutions are emerging to promote conservation and equitable access. The history of water billing reflects humanity's ongoing efforts to balance the necessity of water with the demands of sustainability and fairness.

### 0.1.2 Problem Statement

The water billing sector faced numerous challenges that hindered its effectiveness and efficiency. Inaccurate meter readings often led to disputes between customers and water utilities, exacerbated by outdated infrastructure and insufficient investment in advanced metering technologies. Billing errors, such as incorrect charge calculations and misclassification of customer accounts, further complicated the situation, leading to customer confusion and mistrust. Additionally, issues like water theft, illegal connections, and meter tampering undermined the integrity of billing systems, resulting in lost revenue for utilities and unfair cost distribution among customers. These challenges collectively contributed to financial strain for customers, operational inefficiencies for water utilities, and difficulties in achieving equitable and sustainable water management.

### 0.1.3 Objectives

#### General Objective

The general objective was to develop a water billing and customer management system that facilitated efficient revenue collection for the water utility company.

#### Specific Objectives

The specific objectives of the project aimed to address key challenges and achieve targeted outcomes:

- Develop an intuitive and user-friendly interface to enhance accessibility and improve the user experience for both customers and utility personnel.
- Implement advanced metering technologies and automated billing processes to ensure accurate water consumption measurement and minimize billing errors.
- Enhance transparency in billing structures to provide customers with clear and detailed breakdowns of charges, fostering trust in the billing process.
- Develop robust security measures to safeguard customer data and financial transactions, ensuring compliance with regulations and standards.
- Integrate payment gateways and self-service features, such as account registration and paperless billing options, to streamline processes for customers and the utility company.

- Provide monitoring and analysis tools to enable data-driven decision-making and continuous improvement.
- Conduct thorough testing and quality assurance to ensure system reliability before deployment.
- Offer comprehensive training and support for staff members to ensure effective system utilization and troubleshooting.

#### **0.1.4 Justification**

The water billing and customer management project provided significant benefits to various stakeholders. Customers benefited from a user-friendly interface, transparent billing structures, and convenient payment options, fostering trust and satisfaction. Utility companies gained operational efficiencies and financial stability through advanced metering technologies and automated billing processes. Regulatory authorities benefited from enhanced compliance with regulations and standards governing water utility operations, promoting fairness and accountability. This project indirectly supported environmental conservation and economic development by promoting water conservation and ensuring sustainable resource management. Overall, the project addressed customer expectations, enhanced operational efficiency, ensured regulatory compliance, and contributed to sustainability objectives, making it a necessary and beneficial endeavor for all stakeholders.

#### **0.1.5 Scope**

The project encompassed a wide range of activities aimed at modernizing and optimizing water utility management processes. It included the development and implementation of a robust billing system with an intuitive interface for customers and utility personnel. The integration of advanced metering technologies ensured accurate water consumption measurement, while automated billing processes minimized errors. Transparent billing structures provided customers with clear charge breakdowns, and robust security measures safeguarded customer data and financial transactions. The project also included payment integration, self-service features, monitoring tools, and staff training and support. Comprehensive testing and quality assurance were conducted to ensure system reliability before deployment, with the overall aim of enhancing customer experience, streamlining operations, and improving revenue collection for the utility company.

#### **0.1.6 Limitations**

Despite its comprehensive scope, the project faced certain limitations. Metering technologies might have been affected by calibration errors or environmental conditions. While transparency in billing structures was a key objective, challenges in providing perfectly clear billing statements, especially for complex scenarios, remained. Security measures, though robust, might still be vulnerable to emerging cybersecurity threats. The integration of payment methods and self-service features might not accommodate every customer preference or technological capability. External factors, such as regulatory changes, economic conditions, or unforeseen events, could also impact the project's implementation and outcomes. Despite these limitations, the project aimed to mitigate risks and maximize benefits through careful planning, monitoring, and adaptation.

## 0.2 Literature Review

### 0.2.1 Theoretical Review

Theoretical frameworks underpinning water billing systems provided essential insights into the principles governing water resource management and billing practices. These frameworks encompassed concepts such as equitable distribution, accurate measurement, transparency, efficiency, and sustainability. By understanding these theoretical foundations, water utilities could design systems that effectively balanced customer needs with efficient revenue collection and sustainable water management practices.

### 0.2.2 Similar Projects

Three notable projects—MajiCould, MobiWater, and SchemeCloud—presented innovative solutions for transforming water billing and customer management processes. MajiCould focused on simplifying calculation and invoicing procedures for customers based on water usage, incorporating advanced analytics for decision-making and offering scalability for utilities of varying sizes. MobiWater introduced prepaid and postpaid smart meter solutions, automating billing and allowing upfront payments, enhancing accuracy, transparency, and reducing disputes. SchemeCloud, with its MPESA-integrated online system, was designed for rural water management, facilitating tasks such as meter reading, billing, payment collection, and real-time reporting, with features like customer registration, meter management, and GIS-enabled maps. These projects showcased diverse approaches to water billing, addressing specific challenges and introducing innovative features to improve efficiency, accuracy, and customer satisfaction in water utility management.

### 0.2.3 Conceptual Framework

The water billing process involved three main components: Inputs, Processes, and Outputs. Inputs encompassed the data and resources required for the billing process, including customer information, meter readings, and water usage data. The processes included the steps and activities involved in generating accurate bills, such as data collection, validation, calculation, and invoice generation. The outputs were the final products of the billing process, including the bills generated, payments received, and customer satisfaction achieved.

**Figure: Conceptual Framework**

Inputs
<ul style="list-style-type: none"><li>-client details</li><li>- Meter readings</li><li>- Tariff structures</li><li>- Payment methods</li><li>- Technological infrastructure</li></ul>
Processes
<ol style="list-style-type: none"><li>1. Billing calculation</li><li>2. Consumption calculation</li><li>3. Billing statement generation</li><li>4. Payment collection</li><li>5. Customer service</li></ol>
Outputs
<ul style="list-style-type: none"><li>- Accurate billing statements</li><li>- Payment receipts</li><li>- Financial reports</li><li>- Customer satisfaction metrics</li><li>- Efficient revenue management</li></ul>

## 0.3 Methodology

The project employed a mixed-methods approach, combining qualitative and quantitative research methods to ensure comprehensive data collection and analysis. Data sources included customer surveys, utility company records, and industry benchmarks. Data collection involved interviews, focus groups, and surveys, while quantitative data were gathered from system logs, usage records, and financial reports. Data analysis employed statistical methods, data visualization, and thematic analysis. The methodology also included ethical considerations, such as data privacy and informed consent.

### 0.3.1 Data Collection Tools

Data collection is facilitated through a combination of interviews, questionnaires, and observations. Interviews with key stakeholders such as utility company representatives, regulatory authorities, and customers provide valuable insights into their requirements, challenges, and expectations. Questionnaires may be distributed to a sample of customers to gather quantitative data on their satisfaction levels, preferences, and usage patterns. Observations of existing billing processes and customer interactions further inform the analysis.

## Questionnaire

### Demographic Information

- (a) Age: \_\_\_\_\_
- (b) Gender: \_\_\_\_\_ Male      Female      Other
- (c) Occupation: \_\_\_\_\_
- (d) Monthly Household Income: \_\_\_\_\_

### Water Usage

- (a) How satisfied are you with the accuracy of your water bills?
- (b) Do you believe your water consumption is accurately reflected in your bills?
- (c) How often do you experience billing discrepancies or errors?

### Billing Process

- (a) How convenient do you find the current billing process?
- (b) Are you satisfied with the clarity and transparency of your water bills?

### Payment Options

- (a) Which payment methods do you prefer for paying your water bills? (Select all that apply)
- (b) Do you encounter any difficulties or challenges when making payments?

## **Customer Service**

- (a) How satisfied are you with the customer service provided by the water utility company?
- (b) Have you ever experienced any issues or concerns with your water bills? If yes, how were they resolved?
- (c) Do you feel adequately informed about changes or updates related to water billing?

### **0.3.2 Findings and Discussions**

This section presented the findings and analysis of the water billing and customer management project, highlighting the key results and their implications for the water utility company.

### **0.3.3 Findings**

The project delivered significant benefits for both customers and the water utility company. Customers experienced a reduction in billing errors and disputes, leading to increased trust and satisfaction. The implementation of advanced metering technologies ensured accurate measurement of water consumption, resulting in fair and transparent billing practices. Additionally, the introduction of self-service features and automated payment processes improved customer convenience and streamlined operations for the utility company.

### **0.3.4 Analysis**

The analysis of the project outcomes revealed that the water billing and customer management system had a positive impact on both customer experience and revenue collection. Customers appreciated the transparency and accuracy of the billing process, leading to fewer disputes and a higher level of trust in the water utility company. The automated processes also contributed to operational efficiencies, reducing manual errors and improving the speed and accuracy of bill generation.

### **0.3.5 Challenges**

Despite the positive outcomes, the project faced several challenges. One significant challenge was the integration of advanced metering technologies with existing infrastructure, which required significant investment and coordination. Additionally, the introduction of new billing processes and self-service features necessitated extensive training and support for both customers and utility personnel. Finally, the project had to address data privacy and security concerns, particularly with the introduction of online payment methods and customer data management systems.

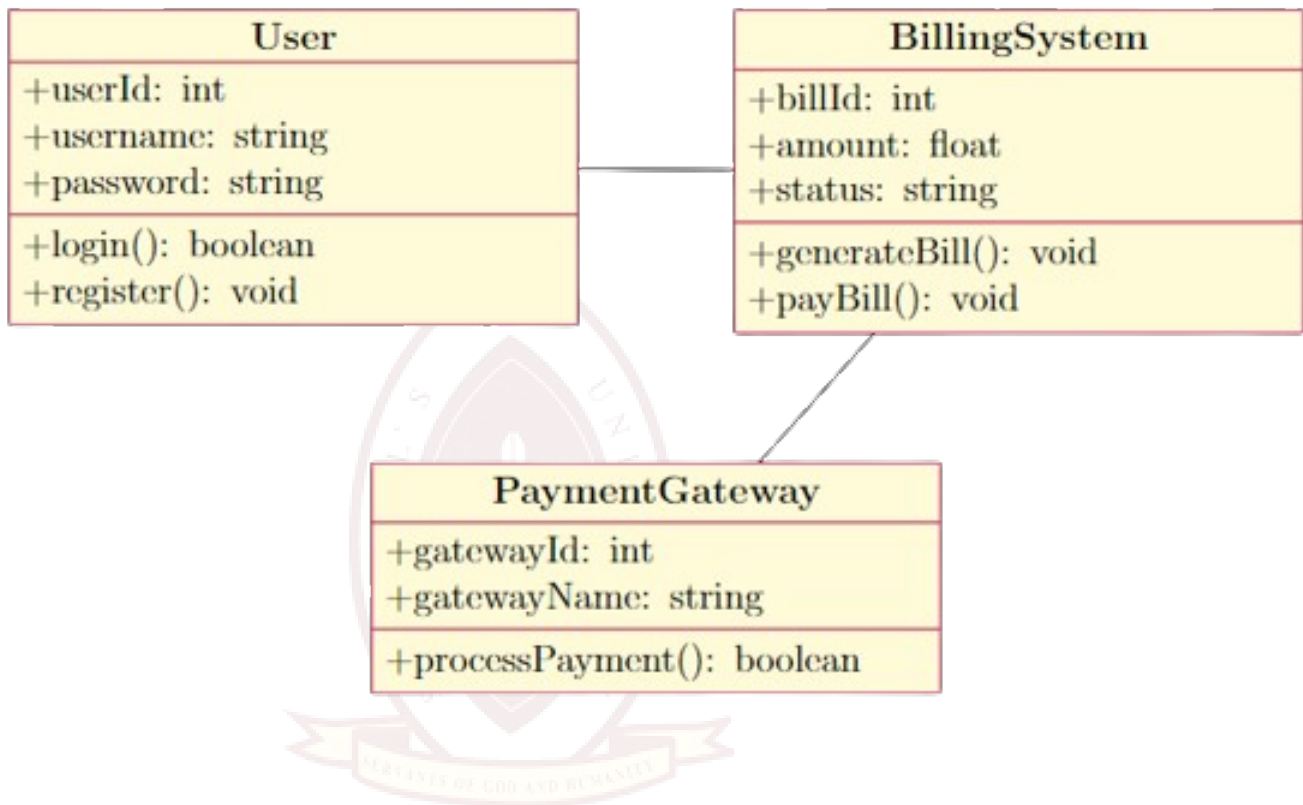
### **0.3.6 Conclusion**

The water billing and customer management project successfully addressed key challenges in the water utility industry, delivering significant benefits for both customers and the utility company. The project demonstrated the importance of transparency, accuracy, and efficiency in the billing process, and highlighted the value of advanced metering technologies and automated processes. While the project faced several challenges, the positive outcomes far outweighed the difficulties, and the lessons learned will inform future improvements in water billing and customer management systems.

## 0.4 System Design

A system design plan will be developed based on the information gathered during the interview. This section will provide a visual representation of the system design, including diagrams, sequence diagrams and flowcharts.

### 0.4.1 UML Class Diagram



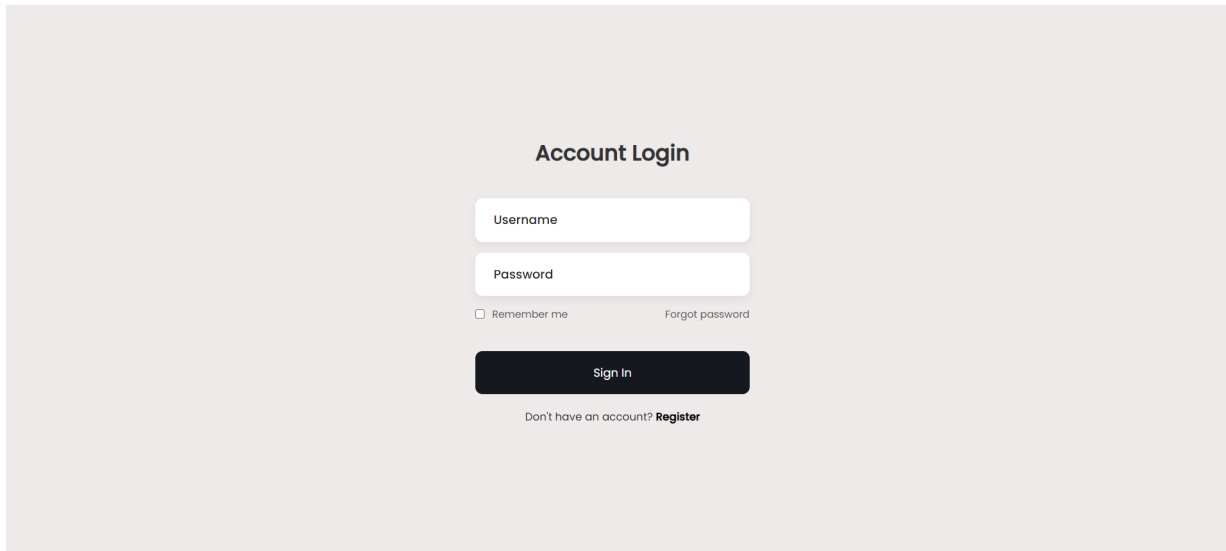


## 0.5 System Implementation

This section presents the graphical interface of the application.

### 0.5.1 User Login

All users access the system from here, using their username and password.



The login screen features a central form titled "Account Login". It includes input fields for "Username" and "Password", a "Remember me" checkbox, and a "Forgot password" link. A "Sign In" button is positioned below the inputs. At the bottom, a link states "Don't have an account? **Register**".

Figure 1: User Login Screen

### 0.5.2 User Dashboard

The main dashboard for users.

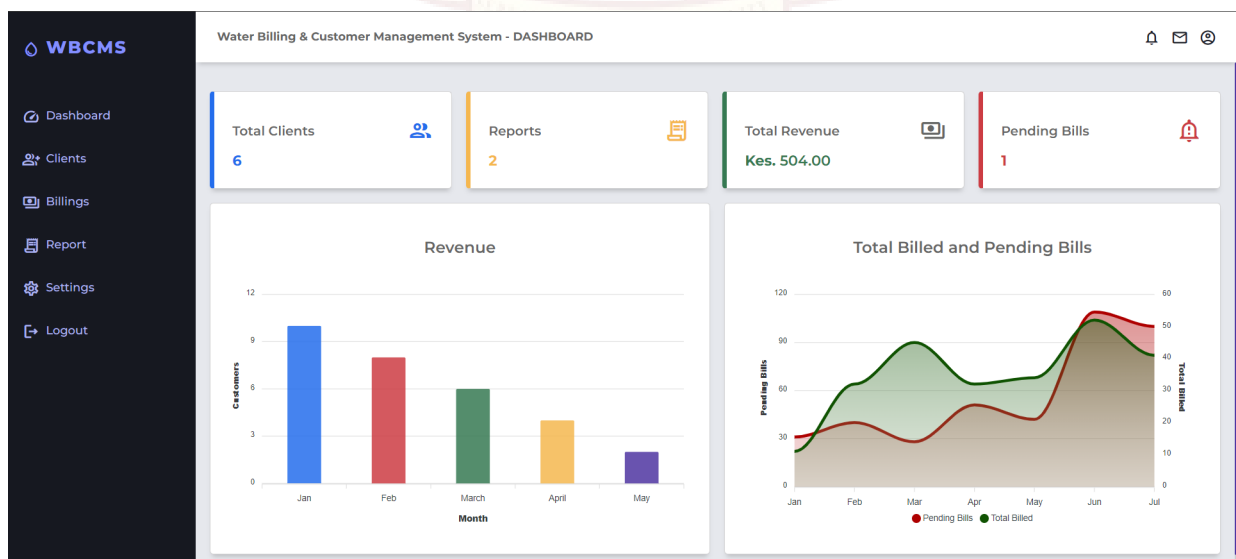


Figure 2: User Dashboard

### 0.5.3 Listing of Clients

A list of all registered clients from the database.

WBCMS

Dashboard

Clients

Billings

Report

Settings

Logout

Water Billing & Customer Management System - CLIENTS

Listing of Clients

+ Create New

Sn#	Data Created	Meter	Name	Status	Actions
1	2024-08-09 11:18:03	10001011	Test User	Active	Action
2	2024-08-09 11:40:21	10001012	Aimee York	Active	Action
3	2024-08-09 17:03:38	10001014	Leilani Holcomb	Inactive	Action
4	2024-08-09 17:09:22	10001015	Omollo Julio	Active	Action
5	2024-08-09 17:38:54	10001016	Lillian Chebet	Active	Action
6	2024-08-17 08:58:50	10001017	Hiroko Morrow	Active	Action

Figure 3: Client Listing

### 0.5.4 Register New Client

The registration screen for new clients.

WBCMS

Dashboard

Clients

Billings

Report

Settings

Logout

Water Billing & Customer Management System - Register

Register Client

Client's Name

Full name

Contact

Phone number

Address

1234, Katani

Meter Number

Meter number

Meter Reading

0.0

Status

Choose...

Register

Listing of Clients

+ Create New

Sn#	Data Created	Meter	Name	Status	Actions
1	2024-08-09 11:18:03	10001011	Test User	Active	Action
2	2024-08-09 11:40:21	10001012	Aimee York	Active	Action
3	2024-08-09 17:03:38	10001014	Leilani Holcomb	Inactive	Action
4	2024-08-09 17:09:22	10001015	Omollo Julio	Active	Action
5	2024-08-09 17:38:54	10001016	Lillian Chebet	Active	Action
6	2024-08-17 08:58:50	10001017	Hiroko Morrow	Active	Action

Figure 4: Register New Client

### 0.5.5 View Client Details

View details of a registered client.

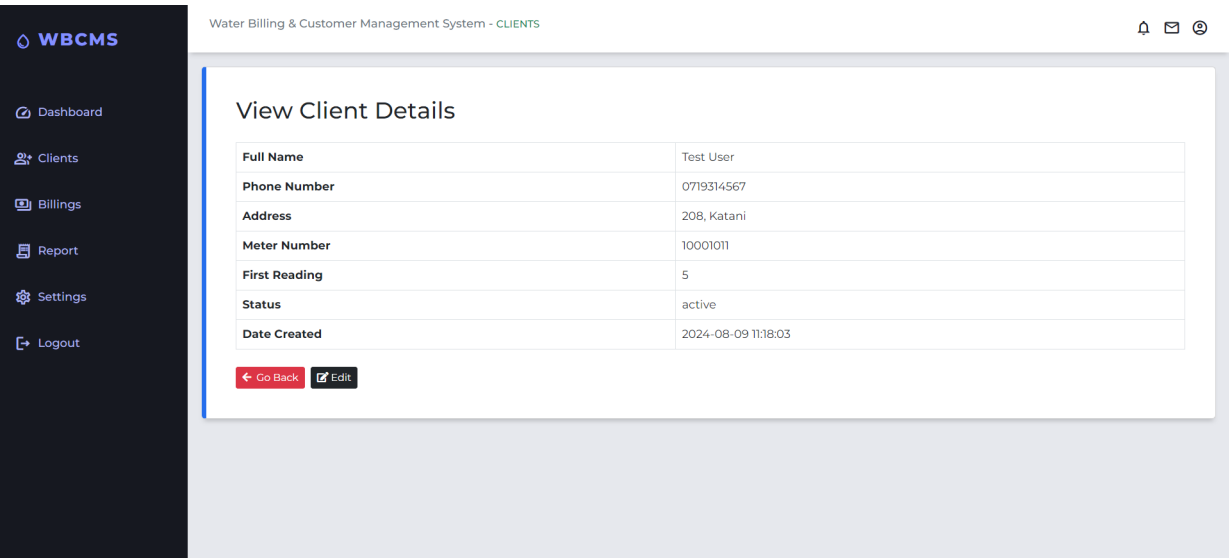


Figure 5: View Client Details

### 0.5.6 Delete Client Record

Deleting client record data permanent

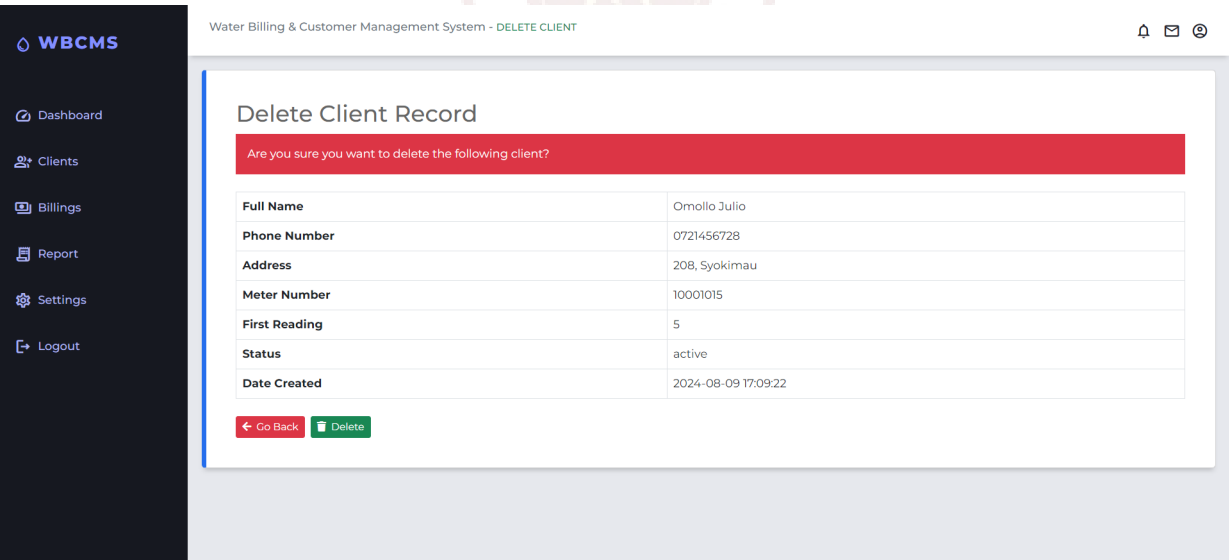


Figure 6: View Client Details

### 0.5.7 Listing of Billing

All billed client account are listed here.

WBCMS

Dashboard

Clients

Billings

Report

Settings

Logout

Water Billing & Customer Management System - Billing

Listing of Billing

+ Create Bill

Sn#	Reading date	Client Name	Total Amount <sup>(Kes)</sup>	Due date	Pay Status	Actions
1	2024-08-15	Test User	98.00	2024-08-20	Pending	Action
2	2024-08-15	Aimee York	140.00	2024-08-20	Pending	Action
3	2024-08-15	Ornollo Julio	154.00	2024-08-20	Pending	Action
4	2024-08-17	Hiroko Morrow	140.00	2024-08-21	Pending	Action

Figure 7: Listing of billings

### 0.5.8 Create Bill

Craete new bill for a registered client

WBCMS

Dashboard

Clients

Billings

Report

Settings

Logout

Water Billing & Customer Management System - Billing

Listing of Billing

+ Create Bill

Sn#	Reading date	Client Name	Total Amount <sup>(Kes)</sup>	Due date	Pay Status	Actions
1	2024	Test User	98.00	2024-08-20	Pending	Action
2	2024	Aimee York	140.00	2024-08-20	Pending	Action
3	2024	Ornollo Julio	154.00	2024-08-20	Pending	Action
4	2024	Hiroko Morrow	140.00	2024-08-21	Pending	Action

Create New Bill

Client

Test User

Reading date

16/08/2024

Previous reading

5

Current reading

23

Rate per m<sup>3</sup>

14

Total bill<sup>(Kes)</sup>

252.00

Due date

20/08/2024

Status

Pending

Close

Save

Figure 8: Listing of billings

# 0.5.9 View Billing

View details of billed single user

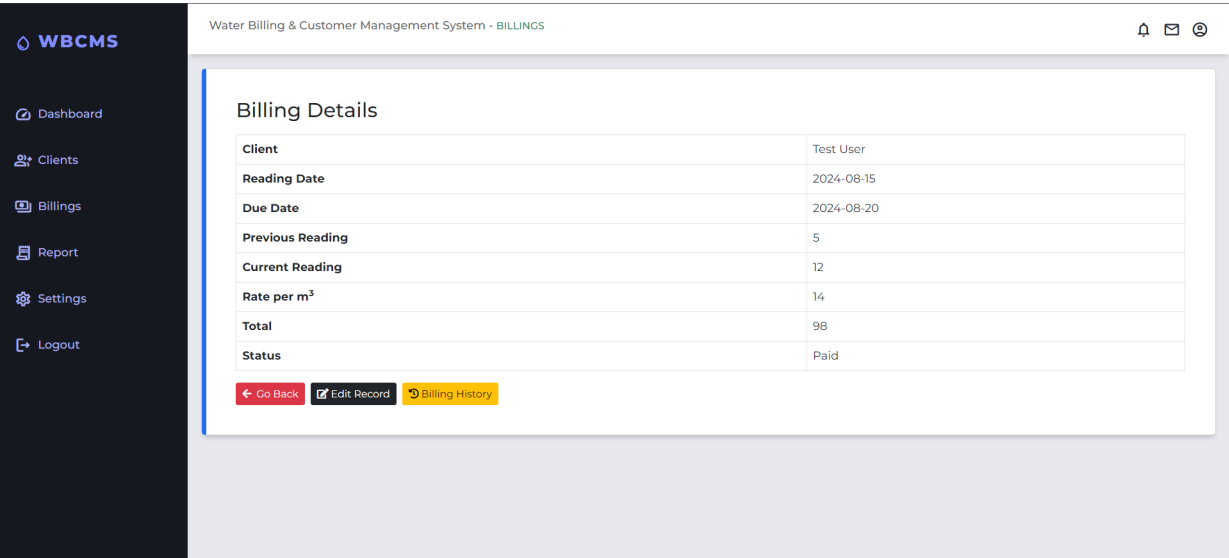


Figure 9: Listing of billings

# 0.5.10 Client Billing History

Listing of all the billed month of a client

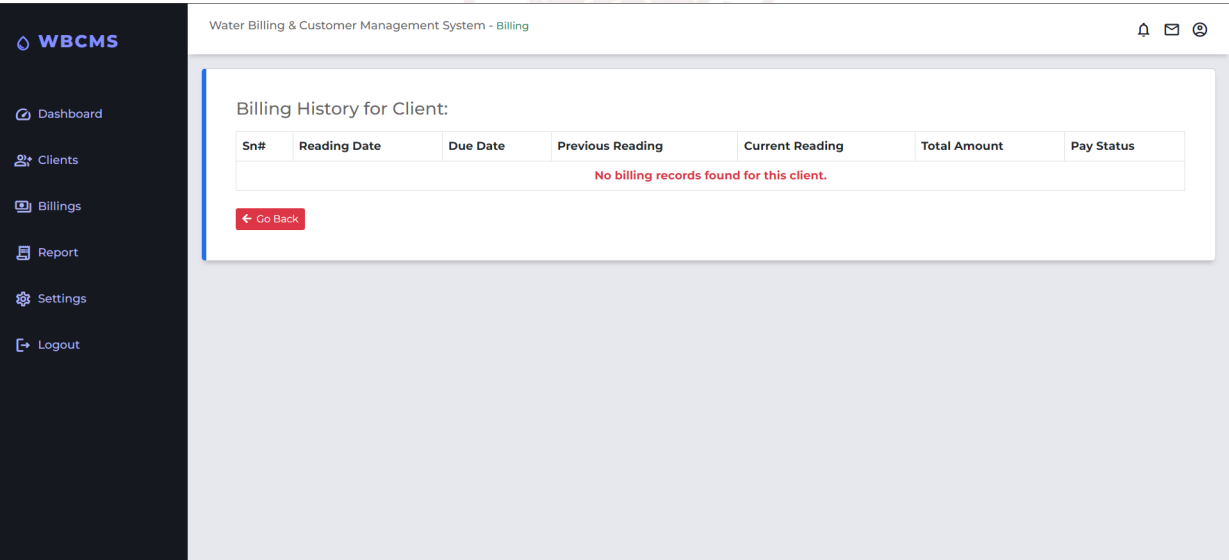


Figure 10: Bill History

### 0.5.11 Monthly Reports

Reports generated, based on month of billing and status, ‘pending or paid’

WBCMS

Dashboard

Clients

Billings

Report

Settings

Logout

Water Billing & Customer Management System - Monthly Report

Generate Report

Month

.....

Status

All

Filter

Sn#	Client	Reading Date	Due Date	Previous Reading	Current Reading	Total Amount
1	Test User	2024-08-15	2024-08-20	5	12	98
2	Aimee York	2024-08-15	2024-08-20	7	17	140
3	Omollo Julio	2024-08-15	2024-08-20	5	16	154
4	Hiroko Morrow	2024-08-17	2024-08-21	2	12	140

Print PDF

Export CSV

Figure 11: Bill History

### 0.5.12 System Settings

All system updates, billing rates, users are created here

WBCMS

Dashboard

Clients

Billings

Report

Settings

Logout

Water Billing & Customer Management System - System Settings

System Settings

Company Name

Water Billing Customer Management System

Company Email

wbcms@sys.mail

Billing Rate

14.00

☒ Enable Email Notifications

Save Settings

Figure 12: System Settings

## 0.6 Appendices

Technology used

1. Back-end (PHP and MySQL)
2. Front-end (HTML, CSS/Bootstrap, JavaScript)

### 0.6.1 Source Code

### 0.6.2 App Development

Screenshot of the development

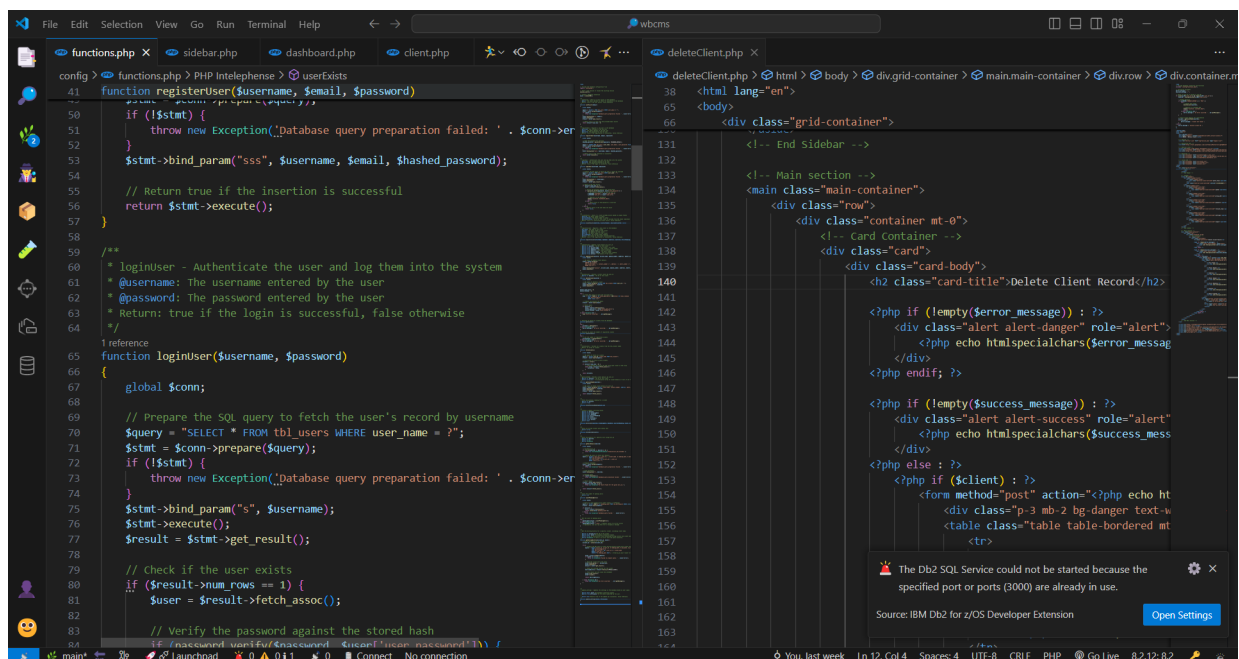


Figure 13: Vs-code screen

### 0.6.3 App Development

Screen shot of the development

