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## Smart EB Reading System App Based Real Time Monitoring of Electrical Usage

<sup>1</sup>B Asha and <sup>\*2</sup>A Thahasin Bee<sup>1</sup>Head & Assistant Professor, Department of Computer Science, Bon Secours College for Women (Autonomous), Thanjavur, Tamil Nadu, India.<sup>\*2</sup>Student of II Year M.Sc., Department of Computer Science, Bon Secours College for Women (Autonomous), Thanjavur, Tamil Nadu, India.

### Abstract

The Electricity Bill Calculator Web Application is a web-based system developed using Python and the Flask framework to automate electricity bill computation and management. The application allows users to register, log in securely, calculate electricity bills based on meter readings and consumer categories, and store billing records in an SQLite database. The system supports multiple categories including Domestic, Commercial, Industrial, Common Facility, and High Tension, each with specific billing logic and fixed charge calculations. The application eliminates manual calculation errors, ensures secure authentication through password hashing, and provides organized storage of billing history with timestamp records. The frontend interface, developed using HTML and CSS, offers a simple and user-friendly experience. This project demonstrates practical implementation of web technologies such as routing, session management, database integration, and secure user authentication to build a reliable and efficient billing system.

**Keywords:** Electricity Billing System, Python, Secure Authentication, Automated Billing, Energy Charge Calculation.

### Introduction

Electricity billing is an essential process in energy distribution systems as it determines the charges based on electricity consumption. In traditional systems, meter readings are manually recorded, and calculations are performed using predefined tariff charts. This manual approach is time-consuming and increases the risk of computational errors. Additionally, maintaining paper-based records makes data retrieval and management difficult. With the advancement of information technology, web-based applications have transformed traditional processes into automated systems. Automated billing systems reduce human intervention, improve accuracy, and ensure secure storage of consumer data. Web applications provide centralized access, making it easier for users to manage their billing information. The Electricity Bill Calculator Web Application is developed using Python and Flask as the backend framework, while SQLite is used as the database management system. The system includes secure user authentication, automated bill calculation, and bill history management. Password security is maintained using hashing techniques, ensuring that user credentials are protected. The main objective of this project is to design and implement a secure, accurate, and user-friendly electricity billing system that automates calculation and record management. The application demonstrates integration of web development concepts with database management to provide an effective billing solution.

**\*Corresponding Author:** A Thahasin Bee

### Review of Literature

Electricity billing systems have undergone significant development over the years, evolving from manual methods to advanced digital technologies. In the early stages, electricity boards relied on manual billing systems where staff visited each consumer location to collect meter readings. The collected data was then used to calculate electricity bills using printed tariff charts. Although this method was widely used, it was time-consuming and often resulted in human errors. In addition, consumer records were maintained on paper, which increased the chances of data loss, damage, and inefficient record management. With the advancement of computer technology, desktop-based billing systems were introduced. These systems automated the billing calculation process and allowed electricity boards to store consumer information digitally. Desktop applications improved accuracy and reduced manual work; however, they were limited to individual computers and lacked remote access capabilities. Multi-user access was also restricted, making it difficult for large organizations to manage data efficiently. Later, web-based billing systems were developed to overcome these limitations. These systems allow consumers to access their electricity usage details online, view billing information, and make payments through the internet. Web-based platforms use server-side programming and database technologies to store and manage consumer data securely. As a result, these systems provide improved transparency, accessibility, and

efficiency for both electricity providers and consumers. In recent years, research has focused on smart meter systems integrated with Internet of Things (IoT) technology. Smart meters automatically measure electricity consumption and transmit data to centralized servers, enabling real-time monitoring and automated billing. While these systems offer high accuracy and efficiency, they require advanced infrastructure and significant implementation costs. Compared to these large-scale industrial systems, the proposed project presents a simplified academic model that focuses on essential features such as core billing logic, secure authentication, and structured database storage while demonstrating the concept of real-time electricity monitoring. "Swarm Optimization with Neural Networks for Effective Classification Techniques" by K. Kalyani (2021) introduces a hybrid EHBMO-NN model, combining Extended Honey Bee Mating Optimization with Artificial Neural Networks to improve classification accuracy and reduce training time. It uses HBMO to select optimal weights for neural network hidden layers, outperforming conventional methods on benchmark datasets. The accurate cancer classification is very important task for cancer treatment. Recently the informative genes are identified from the thousands of genes for correct cancer classification. The collection of microscopic Deoxyribo Nucleic Acid (DNA) microarray is attached in the solid surface. In this study, DNA microarray data is used for cancer classification. The accurate cancer classification is very important task for cancer treatment. Recently the informative genes are identified from the thousands of genes for correct cancer classification. The collection of microscopic Deoxyribo Nucleic Acid (DNA) microarray is attached in the solid surface. In this study, DNA microarray data is used for cancer classification (6).

### Existing System

The traditional electricity billing system is mainly based on manual processes for recording meter readings and calculating electricity consumption. In this method, electricity board staff periodically visit consumer locations such as homes, offices, or industries to collect meter readings. They record both the previous meter reading and the current meter reading from the electricity meter. The total number of units consumed is then calculated manually by subtracting the previous reading from the current reading. After calculating the number of units consumed, the electricity bill is determined by applying the tariff rates specified by the electricity board. These tariff rates are usually available in the form of printed charts or manuals. Staff members refer to these charts and manually calculate the total bill amount based on the units consumed. Once the bill amount is calculated, paper bills are generated and distributed to the consumers either by hand or through postal services. All consumer information, billing details, and payment records are maintained using physical registers and files. These records are stored in offices for future reference and auditing purposes. Although this system has been widely used for many years, it requires significant manual effort and time to complete the entire billing process. Managing large volumes of paper records also becomes difficult for electricity board offices as the number of consumers increases. In addition, the traditional system does not provide real-time monitoring of electricity usage. Consumers are not able to track their daily or hourly electricity consumption, which makes it difficult for them to manage their energy usage effectively. The system also lacks digital integration, making it difficult to share or access data quickly when required.

### Proposed System

The proposed system modernizes electricity billing by providing a fully automated, secure, and user-friendly platform. Unlike traditional manual systems, it eliminates calculation errors and maintains all records digitally. Built using Flask for the web interface and SQLite for database management, it is cost-effective and suitable for small-to medium-scale electricity providers. One of its main features is real-time bill generation. Users can input current meter readings and instantly view units consumed, energy charges, and fixed charges based on their category, promoting energy conservation and eliminating delays from monthly manual processing. The system also ensures security through hashed passwords and session management, restricting access to authenticated users and safeguarding sensitive billing information. The Bill Calculation Module applies tariffs accurately for Domestic, Commercial, Industrial, and High Tension users while validating inputs to prevent negative readings or invalid data. The Database Module stores user and billing records securely, enabling easy retrieval, analysis, and reporting of consumption trends. The Bill History Module provides transparency by allowing users to track usage, compare bills, and resolve disputes efficiently. Designed for scalability, the system can be upgraded to larger databases and integrated with mobile apps or IoT-enabled smart meters, making it compatible with modern smart grids. By automating billing, securing data, and maintaining organized records, the system reduces operational costs, improves efficiency, and enhances customer satisfaction.

### Experimental Results

The proposed web-based electricity billing system was rigorously tested to assess its accuracy, efficiency, and security under various scenarios. Functional testing demonstrated that the system consistently generated correct bills when valid inputs were provided. For instance, meter readings, units consumed, energy charges, and fixed charges were calculated accurately for all user categories, including Domestic, Commercial, Industrial, and High Tension. The system also handled invalid or inconsistent inputs effectively: negative readings, zero values, or cases where the current reading was less than the previous reading were automatically rejected, and clear error messages were displayed to guide the user. This ensures that users cannot inadvertently enter incorrect data, maintaining the integrity of billing calculations. Performance testing confirmed that the system responds rapidly to user inputs, with minimal delays in calculating bills and retrieving records from the database. Database operations, such as inserting new billing entries and retrieving historical bill data, were executed efficiently, even when multiple records were accessed simultaneously. Session management was stable, allowing users to remain securely logged in while accessing their billing history or generating new bills without interruptions or system errors. These results highlight the system's capability to handle real-time operations smoothly, which is critical for practical implementation. Security testing further validated the robustness of the system. Passwords are stored in hashed form using secure algorithms, and authentication mechanisms prevent unauthorized access to sensitive data. Attempts to manipulate the database through SQL injection attacks were blocked using parameterized queries, and restricted pages were inaccessible to unauthenticated users. This ensures that user data and billing information are fully protected against common security threats. Overall, the experimental results

indicate that the proposed system is highly reliable and efficient. It combines accurate functional operations, high-performance processing, and strong security measures to provide a modern solution for electricity billing. Users can confidently generate real-time bills, monitor their electricity usage, and access historical billing records, while electricity providers benefit from streamlined operations, reduced manual work, and minimized errors. Compared to traditional manual billing systems, this automated system significantly improves accuracy, efficiency, and transparency, making it a practical and effective tool for modern electricity management.

### Conclusion

The Electricity Bill Calculator Web Application successfully automates the process of electricity billing using modern web technologies. The system replaces manual methods with a secure, database-driven approach that ensures accuracy and efficiency. By integrating Flask, SQLite, and secure authentication mechanisms, the application provides reliable bill computation and structured record management. Testing results confirm that the system handles various input conditions effectively while maintaining security and performance. The project demonstrates practical implementation of web development concepts and highlights how automation can improve traditional billing systems. Overall, the system fulfills its objective of developing a secure, accurate, and user-friendly electricity billing solution.

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