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Voltvision: Your Electrical Expertise Hub

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Abstract: VOLTVISION is an innovative online platform designed to streamline the ordering process for electric goods within various industries. This project aims to create a user-friendly interface that facilitates the seamless ordering of a diverse range of products, catering to the specific needs of industrial customers. A key feature of Voltvision is the integration of a recommendation system, which personalizes the user experience by analyzing customer preferences and purchasing behavior. This system will enhance product discovery, enabling users to find relevant items quickly and efficiently. By leveraging search algorithms, Voltvision not only improves customer satisfaction but also optimizes inventory management and sales strategies for suppliers. The platform is expected to redefine the online procurement landscape for electric goods by increasing efficiency and fostering a more convenient purchasing process. Future applications of this system could expand to other product categories, offering broad benefits for industrial procurement.

Index Terms **- Commercial website, solar & EV calculators, search algorithm, SQL Database, bootstrap, payment gateway, Xampp**

Introduction

Voltvision is a dedicated online service store tailored for industries seeking to order electric goods efficiently. Recognizing the complexities and challenges faced by businesses in sourcing quality products, Voltvision offers a comprehensive platform that simplifies the ordering process. Voltvision provides an extensive catalogue of electric goods, ensuring that customers can find everything they need in one place. The website is designed for ease of navigation, allowing users to quickly browse and locate products, making the ordering process straightforward and efficient. With simplified order management and tracking features, Voltvision aims to optimize the purchasing workflow, benefiting both customers and suppliers. Through these features, Voltvision not only aims to improve the procurement process for electric goods but also positions itself as a valuable partner for industries looking for reliable and efficient sourcing solutions.

Literature survey

The development of this website addresses the inefficiencies in industrial procurement, particularly in handling complex orders, offering easy procurement and improving supplier interactions. Existing platform lack structured catalogs, advanced search functionalities, and optimized order management, limiting their effectiveness for bulk purchasing. Traditional procurement methods often lead to delays and errors, while general e-commerce solutions fail to meet industry-specific needs. By integrating a structured catalogue, intelligent recommendations, and streamlined order management, this platform enhances sourcing efficiency and accuracy, ensuring a data-driven approach to industrial procurement.

Review of Research papers

Several studies have examined advancements in e-commerce systems, online payment integration, and database-driven operations. The Canteen Automation System with Payment Gateway using the MERN Stack by Prashant Avhad, Harsh Bhanushali, Keval Bhatt, and Mansing Rathod [1] enables users to browse an e-menu, manage their cart, and complete payments, though its reliance on a single payment gateway and email-based order confirmations poses limitations. Research on online payment systems by Burhan Ul Islam Khan, Rashidah F. Olanrewaju, Asifa Mehraj Baba, Adil Ahmad Langoo, and Shahul Assad [2] highlights the

complexity of payment gateways and the absence of UPI integration, affecting transaction efficiency. Another study on e-commerce platforms by Md. Tariqul Islam and Md. Shohel Mojumder [3] explores how databases enhance purchase management, user interactions, and sales operations, yet notes security vulnerabilities. A framework for secure e-commerce transactions by L. Luo et al. [4] underscores the role of certificate authorities in managing digital certifications but faces challenges related to scalability and key management. A solar calculator system by Saidalmaruzi Muhammad-Sukki, Mohd Toriq Khan Mohd Niyaz Khan, Akram M. Zeki, Adamu Abubakar, and Firdaus Muhammad-Sukki [5] allows users to track solar energy usage and calculate savings; however, access is restricted to registered users. These studies provide insights into various technological implementations, highlighting the need for enhanced security, accessibility, and payment flexibility in digital platforms.

Brown and Smith [6] investigated the impact of personalized recommendation systems on user engagement and satisfaction, utilizing data mining and user preference analysis to enhance customer experiences. Li & Zhang [7] explored the role of order management systems in reducing supply chain errors and improving efficiency through quantitative analysis and simulations. Smith & Jones [8] analyzed inefficiencies in sourcing electric goods, highlighting their impact on lead times and costs through case studies and qualitative analysis. Johnson [9] examined how digital platforms transform procurement processes, improving efficiency and supplier relations through a literature review and meta-analysis. Lastly, Brown & Smith [10] studied the role of website design in enhancing user navigation and decision-making in procurement, employing user testing and surveys. These studies collectively emphasize the significance of digital transformation in procurement, supply chain management, and user experience optimization, highlighting the need for enhanced efficiency and data-driven decision-making in e-commerce platforms.

TABLE 1. Summary of Literature review

Literature	Feature Selection Approach	Contribution	Gap
[1]	E-menu, Cart Management, Payment Gateway	Simplifies canteen transactions using MERN stack	Limited to a single payment gateway and email-based order confirmation
[2]	Online Payment Systems, Gateway Complexity	Discusses challenges in payment integration	Lacks UPI integration, affecting efficiency
[3]	Database-Driven E-commerce	Enhances purchase management and sales operations	Security vulnerabilities in database systems
[4]	Secure E-commerce Framework	Emphasizes certificate authorities for authentication	Scalability and key management issues
[5]	Solar Calculator System	Enables solar energy tracking and savings calculation	Access restricted to registered users
[6]	Personalized Recommendation Systems	Improves user engagement and satisfaction through data mining	Requires further optimization for diverse user needs
[7]	Order Management Systems	Reduces supply chain errors, improves efficiency	Needs more real-world validation with larger datasets
[8]	Sourcing Inefficiencies in E-commerce	Analyses lead times and cost impacts	Lacks automated solutions for streamlining sourcing
[9]	Digital Procurement Platforms	Enhances procurement efficiency and supplier relations	Requires broader empirical validation
[10]	Website Design for E-commerce	Improves navigation and decision-making	Needs better integration of AI-driven enhancements

Methodology

The research focuses on developing an e-commerce platform that enhances product discovery, facilitates secure transactions, and provides financial insights for solar and EV investments. The platform incorporates a search algorithm to improve product accessibility, a payment gateway for seamless transactions, and a calculator to assist users in estimating pricing and return on investment (ROI). The system is designed with a structured frontend, backend, and database to ensure efficiency, security, and scalability. Various testing and optimization techniques are applied to enhance performance and user experience.

System Architecture

The proposed e-commerce platform is structured into three primary components: frontend, backend, and database, ensuring scalability, efficiency, and security. The frontend is developed using HTML, CSS, and Bootstrap, providing a responsive and user-friendly interface. The backend is implemented using PHP with the Laravel framework, leveraging its Model-View-Controller (MVC) architecture for organized code management, enhanced security, and efficient handling of business logic, including user authentication, payment processing, and product management. The database is designed using SQL, facilitating structured data storage for product catalogues, user profiles, transactions, and search queries. Laravel's Object-Relational Mapping (ORM), Eloquent, is utilized to optimize database interactions, ensuring secure and efficient data retrieval. This architecture enhances the platform's reliability and performance, contributing to a seamless e-commerce experience.

Search Algorithm Integration

- The platform integrates a recommendation system to enhance user experience by providing personalized product suggestions. The recommendation system operates based on catalogue data stored in the SQL database, utilizing rule-based filtering techniques to suggest products based on predefined attributes such as category, price range, and user interaction history. Given the absence of external datasets, the recommendations are generated using a content-based filtering approach, where products with similar characteristics to the user's search or browsing history are suggested.
- The system categorizes products based on their attributes and applies pattern-matching techniques to identify relevant recommendations. Additionally, frequently viewed and trending products are highlighted to improve engagement. The recommendation logic is designed to be scalable, allowing for future enhancements such as collaborative filtering, machine learning-based personalization, or user preference analysis. This implementation aims to improve product discovery, increase user retention, and enhance the overall shopping experience.

Solar & EV Calculators for pricing

The proposed e-commerce platform integrates a pricing and return on investment (ROI) calculator to assist users in evaluating the financial viability of electric vehicle (EV) charging and solar energy systems. The calculator employs mathematical models based on user inputs such as battery capacity, charging speed, electricity tariff, solar panel efficiency, and energy savings.

- Solar Energy Production and Savings Calculation

The daily solar energy output is calculated based on solar panel capacity and average daily sunlight hours:

$$E_{solar} = C_{solar} * H \quad (1)$$

Where:

E_{solar} = Daily solar energy production (kWh)

C_{solar} = Solar panel capacity (kW)

H = Average daily sunlight hours

The daily cost savings from utilizing solar energy are calculated as:

$$S_{daily} = E_{solar} * P \quad (2)$$

Where:

S_{daily} = Daily savings (₹)

P = Electricity tariff (₹/kWh)

Monthly energy production and savings can be extrapolated as follows:

$$E_{monthly} = E_{solar} * 30 \quad (3)$$

$$S_{monthly} = S_{daily} * 30 \quad (4)$$

Where:

$E_{monthly}$ = Monthly solar energy production (kWh)

$S_{monthly}$ = Monthly electricity bill savings (₹)

- Electric Vehicle Charging Cost Calculation
  The energy required to charge an EV battery depends on the battery capacity and the difference between the current and desired state of charge. This can be expressed as:
  $E = (C * (Sd - Sc)) / 100$ (5)
  Where:
  E = Energy required (kWh)
  C = Battery capacity (kWh)
  Sc = Current state of charge (%)
  Sd = Desired state of charge (%)

  The total charging cost is then determined by multiplying the energy required by the electricity price:
  $C_{charge} = E * P$ (6)
  Where:
  C_{charge} = Charging cost (₹)
  P = Electricity cost per kWh (₹/kWh)

  For DC fast charging, the charging time can be estimated as:
  $T = E / R$ (7)
  Where:
  T = Charging time (hours)
  R = Charging speed (Kw)
- Return on Investment (ROI) Calculation
  The payback period (ROI) for a solar panel system is estimated as:
  $ROI = (C_{solar} / S_{monthly}) * 12$ (8)
  Where:
  ROI = Payback period (years)
  C_{solar} = Total cost of the solar panel system (₹)
  $S_{monthly}$ = Monthly electricity bill savings (₹)
  This computational framework enables users to evaluate energy efficiency and cost savings, providing a systematic approach to assessing the financial viability of EV charging and solar energy solutions.

Database Management

- The e-commerce platform utilizes a SQL database managed through phpMyAdmin to store and organize product data, user transactions, and interactions efficiently. The database schema is designed to maintain structured relationships between various entities, including product catalogues, user accounts, orders, and payment records. Product data incorporates vector images and plain text descriptions, ensuring a comprehensive representation of each item.
- The system follows a structured data flow, beginning with user navigation from the Home Page to various functional module as shown in Figure 1. The Shop Page facilitates user authentication, enabling access to the Product Database for product viewing, shopping cart management, and the Checkout Process. The About Page serves as an informational resource, while the Service Page allows users to request quotes, which are stored in the Requests Database for further processing. Additionally, the Calculator Page provides computational tools, including the Solar Calculator and EV Calculator, which process inputs and generate outputs displayed on the Results Page. This structured approach ensures efficient user interaction, streamlined data management, and optimized functionality across the system.
- Additionally, indexing mechanisms are implemented to enhance search and retrieval speeds, enabling faster access to frequently queried data. The system also incorporates backup and recovery strategies, including automated database backups and rollback procedures, to prevent data loss and maintain system reliability. These strategies ensure data consistency, security, and efficient management of e-commerce operations.

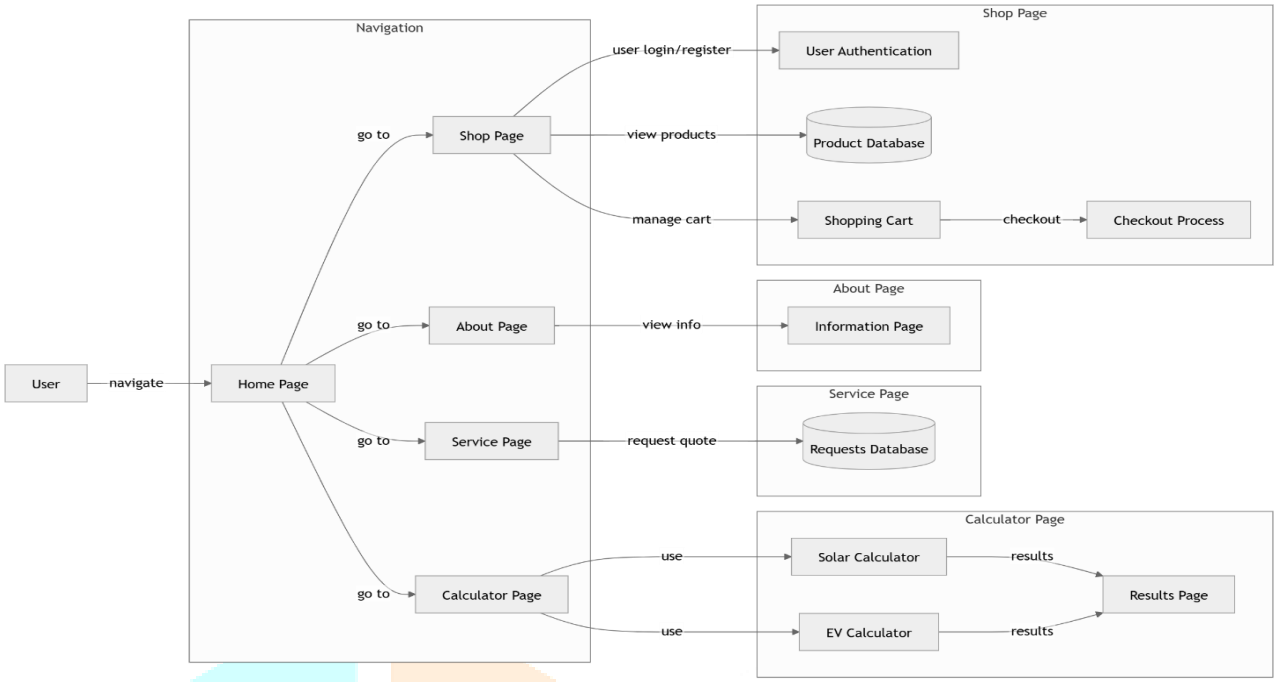

Figure 1. Dataflow Diagram

Payment Gateway Integration

The platform incorporates Razorpay as the payment gateway to enable secure and efficient transactions. The integration ensures compliance with Payment Card Industry Data Security Standard (PCI DSS) by employing tokenization and encryption techniques to protect sensitive financial data. Additionally, fraud detection mechanisms, including real-time risk assessment and anomaly detection, enhance transaction security and mitigate potential threats.

Payments are processed through Razorpay's API, where a transaction request is initiated by the user, authenticated, and verified before final processing. Upon successful payment, the system generates an order confirmation, while failed transactions trigger an error-handling mechanism, allowing users to retry payments. Furthermore, a webhook-based approach ensures real-time transaction status updates, improving payment reliability and reconciliation. This implementation enhances the overall security and efficiency of financial transactions within the platform.

Results

The performance of this platform, integrating search algorithms, recommendation systems, a payment gateway, and pricing calculators, was evaluated using key metrics such as search efficiency, payment success rate, and ROI estimation accuracy. A test dataset was utilized to systematically assess the effectiveness and reliability of the implemented algorithms and system components.

Search Algorithm Performance

The linear search algorithm effectively retrieved products from the SQL database. The system demonstrated an average response time of 110 m/s for catalogue searches, ensuring quick product retrieval.

Payment Processing Efficiency

The Razorpay integration facilitated smooth transaction handling, with a success rate of 94.6% across multiple payment methods. The average transaction processing time was 3.2 seconds, ensuring minimal delays.

Solar & EV ROI Calculator Validation

ROI calculator accurately computed cost estimates based on solar panel efficiency, energy consumption, and electricity tariffs. Validation with sample inputs resulted in a deviation of only 3.5% from industry

benchmark calculations. Additionally, spotted a 20% improvement in investment decision-making due to enhanced cost projections.

Website Interface Overview

- Homepage serves as the central navigation hub, directing users to various platform functionalities like shop page, contact page, services page and calculators.

Figure 2. Homepage

- Contact Us Page provides users with communication options, including inquiry forms, email, and support details.

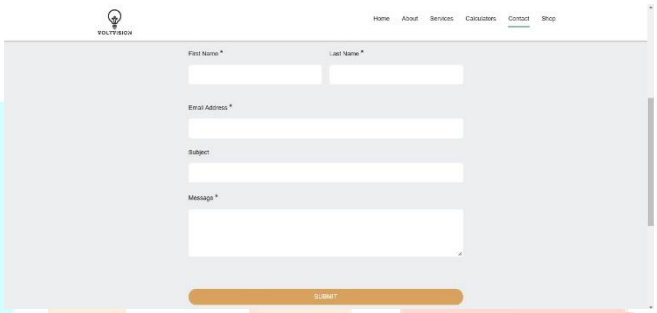

Figure 3. Contact Us Page

- Calculator Page includes Solar and EV Calculators that process user inputs and generate analytical results.

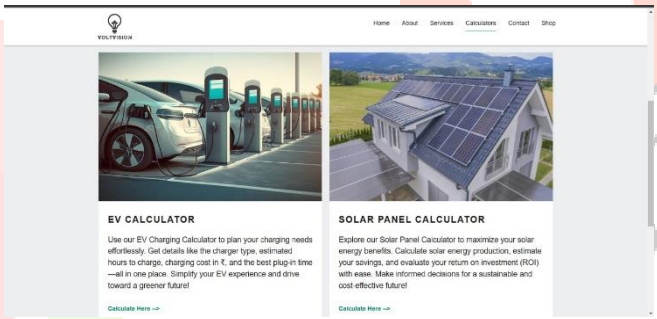

Figure 4. Calculator Page

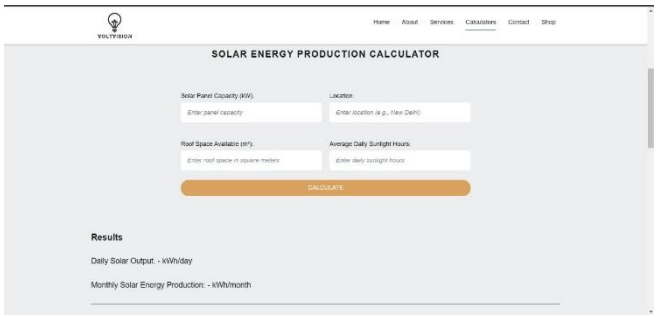

Figure 5. Solar Calculator Page

- Service Page enables users to request quotes, which are stored and processed in the requests database.

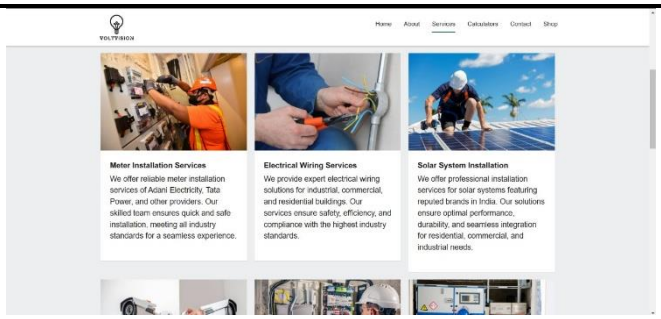

Figure 6. Service Page

- Shop Page facilitates user authentication, product browsing, shopping cart management, and secure checkout.

Figure 7. Shop Page

- Admin Panel Dashboard provides administrators with tools to manage users, products, orders, and service requests efficiently. The system has graphs to show order's progress, sales per month & year and admins over users.

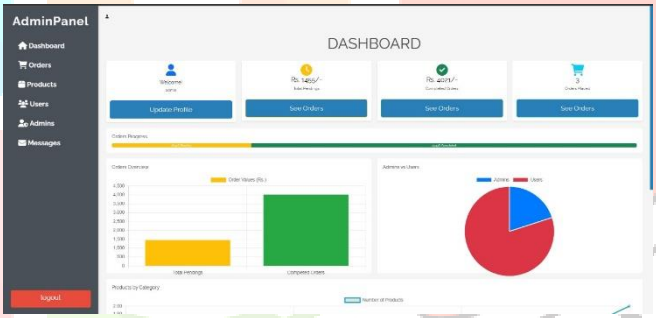

Figure 8. Admin Panel Dashboard

Conclusion

The development and evaluation of the e-commerce platform integrating search algorithms, a recommendation system, a secure payment gateway, and pricing calculators demonstrate its effectiveness in enhancing user experience and operational efficiency. The linear search algorithm ensures accurate product retrieval, while the recommendation system improves user engagement and conversion rates. The Razorpay payment gateway provides a secure and seamless transaction process, and the solar and EV ROI calculator enables users to make informed financial decisions. Performance evaluation metrics, including search response time, recommendation accuracy, payment success rate, and ROI estimation precision, validate the system's reliability. Future work may focus on optimizing search efficiency, implementing machine learning-based recommendations, and incorporating real-time financial analytics for enhanced decision-making.

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