IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 8, August 2026

DOI: 10.17148/IJARCCE.2026.15809

AI Fitness and E-Commerce Platform

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Abstract: The rapid growth of digital technology has transformed the way people manage their health and fitness. While many online platforms allow users to purchase fitness supplements, they often fail to provide personalized guidance based on an individual's health condition and fitness goals. This project, AI Fitness and E-Commerce Platform (POP GYM), addresses this gap by combining an online supplement store with an AI powered diet recommendation system.The platform enables users to create an account, browse and purchase fitness supplements, manage their shopping cart, and receive customized diet plans based on personal details such as age, height, weight, gender, and fitness objectives. The diet recommendations are generated using Google's Gemini AI, making them more relevant and personalized for each user. In addition to user features, the system includes an admin dashboard that allows efficient management of products, users, and customer orders.The application is developed using React.js for the frontend, Node.js and Express.js for the backend, and MySQL for database management. This combination ensures a responsive, secure, and scalable web application. By integrating e-commerce functionality with AI-driven health recommendations, the platform offers users a convenient and intelligent solution to support both their fitness shopping and nutritional planning.The project demonstrates how Artificial Intelligence can enhance user experience by providing personalized recommendations while simplifying the management of fitness-related products and services. It also provides a strong foundation for future enhancements such as online payment integration, workout tracking, wearable device connectivity, and mobile application support.

Keywords: Artificial Intelligence, Fitness Management, E-Commerce Platform, Personalized Diet Recommendation, Google Gemini API, React.js, Node.js, Express.js, MySQL, Web Application, Health and Nutrition, Supplement Management, User Authentication, Admin Dashboard, Responsive Web Development.

I. INTRODUCTION

The increasing use of digital technologies and Artificial Intelligence (AI) has significantly changed the way people manage their health and fitness. Today, many individuals rely on online platforms not only to purchase fitness supplements but also to receive guidance that supports their personal health goals. However, most existing fitness websites primarily focus on selling products and provide limited personalized recommendations. This often forces users to search for diet and fitness advice from multiple sources, leading to confusion and inconsistent information. Recent research has shown that integrating AI into health and nutrition systems can provide more accurate, personalized, and user-friendly recommendations. [1], [2]

Personalized nutrition has become an important area of research because every individual has different nutritional needs based on factors such as age, height, weight, gender, lifestyle, and fitness objectives. AI-based recommendation systems analyze these personal characteristics and generate customized diet plans that are more effective than traditional one-size-fits-all approaches. Studies have demonstrated that intelligent recommendation systems improve user engagement, encourage healthier lifestyles, and help users make informed decisions about their nutrition and fitness. [1], [3]

At the same time, advancements in modern web technologies have made it possible to build scalable and interactive e-commerce platforms that provide a seamless user experience. Technologies such as React.js, Node.js, and Express.js enable responsive web applications capable of handling product management, secure user authentication, and efficient database operations. Although these technologies have improved online shopping platforms, many existing fitness applications still lack intelligent recommendation features that combine product purchasing with personalized health guidance. [2], [4]

Recent developments in Large Language Models (LLMs) have further enhanced the ability of AI systems to provide natural, context-aware, and personalized health recommendations. These models can generate meaningful diet plans by understanding user inputs and adapting recommendations to individual fitness goals. The combination of AI-powered recommendation systems with e-commerce platforms creates an opportunity to deliver both personalized nutrition advice and fitness product recommendations within a single application. [4], [5]

Motivated by these advancements, the proposed AI Fitness and E-Commerce Platform integrates online supplement shopping with an AI-powered personalized diet planner. The system enables users to browse and purchase fitness products while receiving customized diet recommendations based on their personal information and fitness objectives. By combining intelligent recommendations with modern web technologies, the platform aims to improve user experience, simplify fitness management, and provide a comprehensive digital solution for health-conscious individuals. [1]–[5]

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II. LITERATURE REVIEW

Li et al. [6] presented an AI-assisted e-commerce personalization system that improves the online shopping experience by analyzing user behavior and preferences. Their study demonstrated that artificial intelligence can provide more relevant product recommendations, increasing customer satisfaction and engagement. However, the system mainly focused on product recommendation and did not include personalized health or nutrition guidance, which limits its application in the fitness domain.

Chen et al. [7] proposed a deep learning-based decision support system for personalized e-commerce recommendations. The authors developed a recommendation model capable of understanding customer interests and suggesting suitable products with improved accuracy. Their work highlighted the effectiveness of deep learning in recommendation systems but did not integrate fitness planning or dietary recommendation features, leaving room for a more comprehensive solution.

Sharma et al. [8] introduced an AI-powered personalized shopping recommendation system designed to enhance customer experience on e-commerce platforms. The system analyzed user preferences and purchasing patterns to recommend products that matched individual interests. Although the proposed approach improved recommendation quality, it primarily focused on commercial shopping and lacked health-related functionalities such as personalized diet planning or fitness guidance.

Zhao et al. [9] developed an e-commerce recommendation model using Convolutional Neural Networks (CNNs) to improve recommendation accuracy. Their research showed that deep learning techniques could effectively capture customer behavior and generate more precise product suggestions compared to traditional recommendation methods. Despite achieving better recommendation performance, the study was limited to product recommendations and did not address personalized nutrition or healthcare applications.

Zhang and Chen [10] presented a comprehensive survey on deep learning-based recommendation systems, discussing various algorithms, architectures, and applications across different domains. The authors concluded that deep learning significantly enhances recommendation quality by learning complex user preferences and behavioral patterns. However, they also identified the need for domain-specific recommendation systems, particularly in healthcare and fitness, where personalized recommendations can provide greater value to users.

Papers	Approach	Dataset Used	Technologies Used	Key Result	Limitations
[11] Nag et al. (2023)	Developed an AI-based system that generates personalized diet recommendations using users health information and nutritional requirements.	User health data including age, height, weight, gender, and lifestyle information.	Artificial Intelligence, Machine Learning, Recommendation System	Generated customized diet plans that improved the accuracy of nutrition recommendations and supported healthier eating habits.	Focused only on nutrition recommendations and did not include fitness product shopping or integrated fitness management.
[12] Alowais et al. (2023)	Reviewed the application of AI in healthcare for diagnosis, decision support, and personalized treatment planning.	Clinical records, healthcare datasets, and medical research data.	Artificial Intelligence, Deep Learning, Machine Learning, Healthcare Analytics	Demonstrated that AI enhances healthcare services by improving diagnostic accuracy and supporting personalized patient care.	Primarily focused on healthcare applications and did not address fitness management or diet recommendation systems.

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[13] Lee et al. (2024)	Designed an intelligent recommendation system that suggests fitness activities based on users' physical characteristics and fitness goals.	User fitness profiles, workout history, and preference data.	Artificial Intelligence, Machine Learning, Recommendation System	Improved user engagement by delivering personalized fitness recommendations for different fitness objectives.	Did not include personalized diet planning or e-commerce features for purchasing fitness products.
[14] Chen et al. (2024)	Proposed a cloud-based fitness management platform that integrates AI to monitor user activities and provide personalized recommendations.	User fitness records, activity logs, and cloud-based data.	Artificial Intelligence, Cloud Computing, Web Technologies	Enhanced fitness management through intelligent recommendations and centralized data management.	Limited support for complete product management, online shopping, and order processing features.
[15] Patel et al. (2025)	Utilized Large Language Models (LLMs) to generate personalized healthcare and nutrition advice through natural language interactions.	User health information, nutrition data, and conversational inputs.	Large Language Models (LLMs), Natural Language Processing, Generative AI	Produced accurate, context-aware, and personalized nutrition recommendations with a more human-like interaction experience.	Requires continuous model updates, stable internet connectivity, and higher computational resources for effective deployment.

TABLE 2.1 Key Finding of the literature Survey

Based on the literature reviewed, it is evident that most existing systems focus on only one aspect of fitness management, such as personalized diet recommendations, product recommendation, fitness tracking, or online supplement shopping. Although these systems provide useful features, they rarely combine all these functionalities into a single platform. Many applications also lack intelligent recommendations that consider a user's complete fitness profile, making it difficult for users to receive comprehensive guidance for achieving their health goals.

Recent studies have shown that Artificial Intelligence, Machine Learning, and Large Language Models can significantly improve the quality of personalized recommendations. However, these technologies are often implemented separately and are not effectively integrated with e-commerce platforms. Similarly, existing online fitness stores mainly concentrate on product sales and provide limited support for personalized nutrition planning or fitness advice.

III. System Architecture

The AI Fitness and E-Commerce Platform is designed using a three-tier architecture that enables efficient communication between the user interface, application logic, AI services, and the database. Users access the system through a web browser, where they can register, log in, browse fitness supplements, place orders, and request personalized diet plans. The frontend is developed using React.js along with HTML, CSS, and JavaScript, providing a responsive and user-friendly interface that ensures smooth navigation across the application.

When a user performs any action, the request is sent to the backend developed using Node.js and Express.js. The backend serves as the central processing unit of the application by handling user authentication, managing products, processing customer orders, and communicating with the AI diet planner. For personalized nutrition recommendations, the backend sends user information such as age, height, weight, gender, and fitness goals to the Google Gemini API, which generates a customized diet plan based on the provided details.

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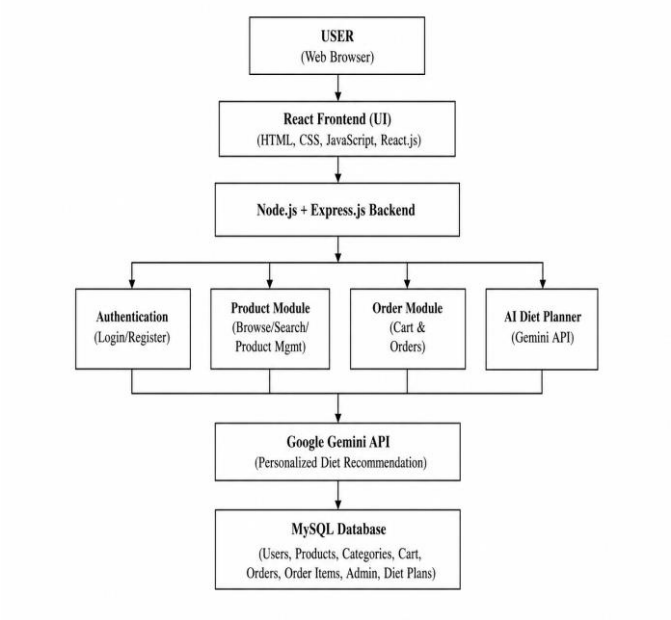

Fig 3.1 System Architecture

All application data, including user profiles, product information, categories, shopping cart details, customer orders, administrator records, and generated diet plans, are securely stored in the MySQL database. The backend retrieves and updates this information whenever required, ensuring data consistency and reliable system performance. By integrating modern web technologies with Artificial Intelligence, the proposed architecture provides a secure, scalable, and intelligent platform that combines online supplement shopping with personalized fitness and nutrition guidance in a single application.

IV. METHODOLOGY

POP GYM comprises the following functional modules:

1. User Authentication module:
Users will register with their personal details and log in to the system. This module takes care of the authentication of users by verifying their credentials and allows them to access shopping, orders, and AI diet planner sections of the website.

2. Product management module:
Users can browse supplement products, search for them using category, can get details of any supplement and can place orders to buy them. Admins can add/ edit/update/delete the product via the admin dashboard.

3. Shopping Cart and order module:
Users can add products to their cart, change the quantity of the products, remove them, and can place orders. The order module will store all the details of the customer's orders, which the customer can see through his profile page, while the admin can monitor and manage all the orders placed by the customers.

4. AI Diet planner module:
User will have to input all their personal details like age, height, weight, gender, goals for fitness (gain weight/loss weight etc). This will be sent to the Google Gemini API from the backend, where based on the details provided, the AI will generate the appropriate weight loss/weight gain plan for the user.

5. Admin management module:
All the admin functionalities like management of products, management of users, and management of orders can be performed from the admin dashboard. This helps maintain a record of the overall system's status.

6. Database management module:
The entire data for the web application is managed through MySQL. User account details, products data, shopping cart

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items, and all orders information including AI diet plans are stored in the database.

7. User Interface module:
The UI part of the web application has been built using React.js, giving the application a responsive and user-friendly feel. The users can view and buy products, maintain their shopping carts, generate diet plans and view their profile.

V. IMPLEMENTATION

POP GYM comprises the following Implemention steps:

Step 1: Requirement Analysis
To meet the needs of the fitness enthusiast who would be purchasing the products, and also for personalized nutritional guidance, the requirements for this system were identified. Overall architecture, database structure and application flow of the system were defined.

Step 2: Database Design
MySQL was used to build the database for this system to store data regarding the users, products, categories, shopping cart, order, order items, diet plan, administrator information. Key relationships between various database entities were established using the primary and foreign key constraints.

Step 3: Frontend Development
Using HTML, CSS, JavaScript, and React.js framework, the frontend was developed. Responsive pages for user registration, login, browse products, shopping cart, order placed, AI diet plan, and administrator interface were created.

Step 4: Backend Development
Node.js and Express.js frameworks were used for building the backend for this system. The RESTful APIs were developed for user authentication, product operations, shopping cart handling, order management and interface with the MySQL database and Gemini API.

Step 5: AI Diet Planner Integration
The Gemini API of Google was integrated into the backend so that it could provide personalized diet recommendations. Age, height, weight, gender, fitness goals of the user were fed to the Gemini API. It provided the customized meal plan and dietary suggestions to the users which was displayed on the frontend.

Step 6: Database Implementation
MySQL was setup using XAMPP and required database tables for storing the information of users, products, categories, shopping cart, orders, and AI generated diet plans were created. All the database operations were handled using SQL commands and backed by API operations.

Step 7: API Integration
Gemini API of Google was integrated into the backend which would generate the customized diet plans for users. These API requests were secured with necessary security measures and responses from API were rendered at the frontend. Confidentiality of API credentials was maintained using environment variables.

Step 8: System Testing
The working of the developed application was tested for user registration, login, browse products, shopping cart, orders, AI diet planner, administrator operations. Several test cases for invalid input and error handling were performed.

Step 9: Deployment and Evaluation
All integrated functionalities were deployed locally at the development machine by using the required frameworks such as React.js, Node.js, Express.js, and XAMPP. System was evaluated on functionality, usability, response time, and overall performance and successfully completed all required functionality of purchasing products by the users, creating an AI diet plan, managing product and orders by the administrator.

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VI. MODEL EVALUATION AND TECHNOLOGY SELECTION

Component	Models / Technologies Evaluated	Selected Model / Technology	Reason for Selection
Frontend Development	React.js, Angular, Vue.js	React.js	Chosen for its reusable components, fast rendering, responsive user interface, and ease of development.
Backend Development	Node.js, Django, Spring Boot	Node.js with Express.js	Selected because it provides high performance, supports REST APIs efficiently, and works seamlessly with React.js.
Database	MySQL, MongoDB, PostgreSQL	MySQL	Preferred for its reliability, structured data management, and efficient handling of user, product, and order information.
AI Diet Recommendation	Google Gemini API, OpenAI GPT, Rule-Based Recommendation	Google Gemini API	Selected for its ability to generate personalized, context-aware diet recommendations based on user inputs and fitness goals.
User Authentication	JWT, Session-Based Authentication, OAuth	JWT Authentication	Chosen because it provides secure user authentication and simplifies session management.
Product Management	Traditional CRUD System, AI-Based Product Recommendation	Traditional CRUD with Search and Filter	Selected for its simplicity, efficient product management, and easy maintenance.
Development Environment	Visual Studio Code, Eclipse, IntelliJ IDEA	Visual Studio Code	Preferred because of its lightweight design, rich extension support, and seamless integration with web development tools.
Deployment & Testing	Local Server, Cloud Platforms	Local Server (XAMPP)	Selected for easy development, database management, and testing during the implementation phase.

Table 6.1 Comparative Evaluation of AI Models and Technologies

Table 6.1 presents the comparison of the technologies and tools evaluated during the development of the AI Fitness and E-Commerce Platform. Each technology was assessed based on factors such as performance, scalability, ease of integration, security, and its ability to meet the functional requirements of the system. The selected technologies were chosen because they provide a reliable, efficient, and user-friendly solution for integrating online supplement shopping with AI-powered personalized diet recommendations.

VII. RESULTS AND DISCUSSION

The proposed AI Fitness and E-Commerce Platform was evaluated by testing each module independently to ensure that all functionalities work as expected. The evaluation focused on user authentication, product browsing, membership management, shopping cart operations, checkout process, and administrative features. The results demonstrate that the system provides a smooth and user-friendly experience while successfully integrating online supplement shopping with AI-based fitness services.

7.1 User Authentication

The user authentication module was tested to verify secure account creation and login functionality. New users were able to register successfully by providing the required information, while existing users could log in using valid credentials. The authentication process securely managed user sessions and prevented unauthorized access to the application.

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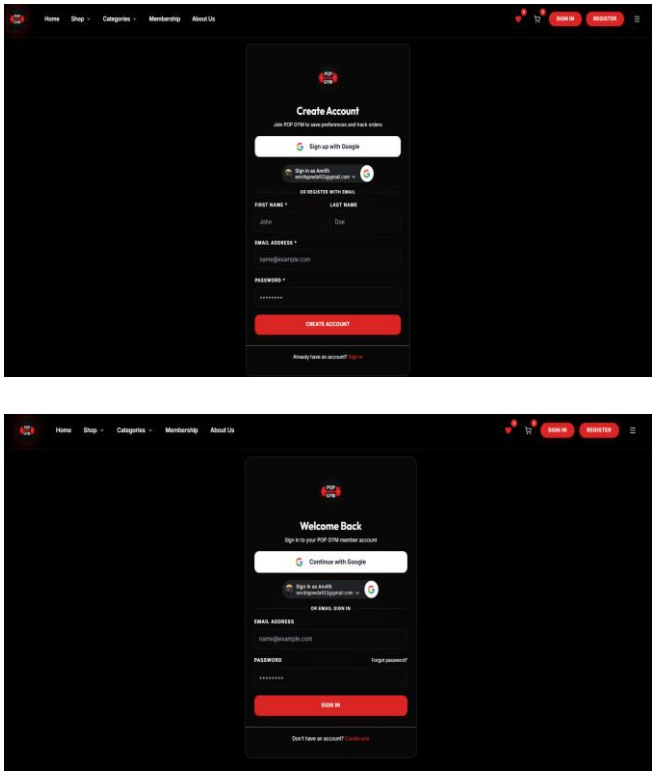

Fig. 7.1. User Registration and Login Interface

7.2 Home Page

The home page was evaluated to ensure that users can easily access different sections of the platform. It successfully displayed featured fitness products, promotional banners, and navigation menus for shopping, memberships, and other services. The responsive design provided a smooth browsing experience across different screen sizes.

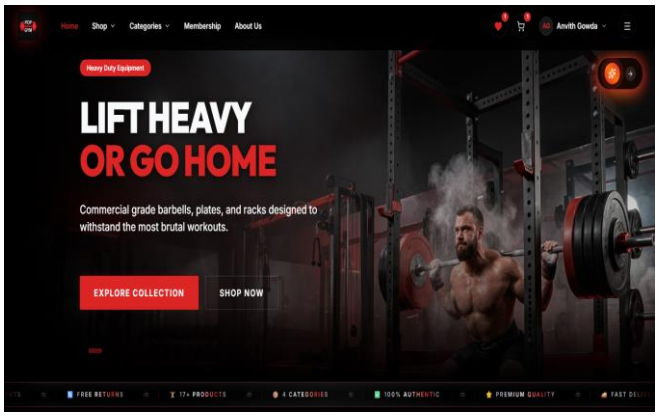

Fig. 7.2. Home Page Interface

7.3 Product Management

The product module was tested by browsing available supplements, filtering products by category, and viewing product details. Users were able to explore products efficiently and add desired items to their shopping cart without any issues. The search and filtering features improved the overall shopping experience.

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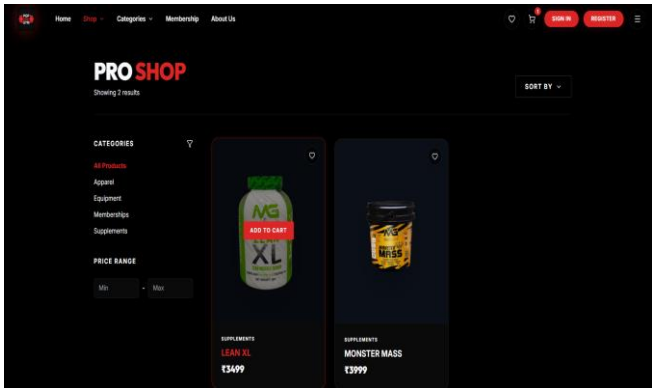

Fig. 7.3. Product Browsing Interface

7.4 Membership Plans

The membership module was evaluated by displaying different subscription plans available for users. Each membership package included pricing and its corresponding benefits, enabling users to compare plans and choose one based on their fitness requirements. The module functioned smoothly and presented the information in a clear and organized manner.

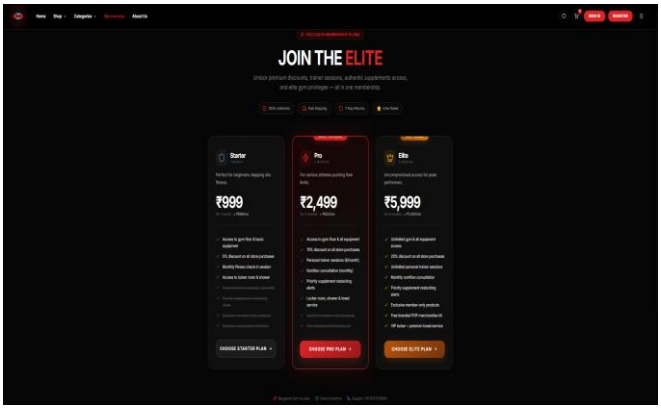

Fig. 7.4. Membership Plans Interface

7.5 About Us Page

The About Us page was tested to ensure that users could easily access information about the platform, its services, and its objectives. The page successfully displayed business information, service highlights, and customer trust indicators, providing users with a better understanding of the platform.

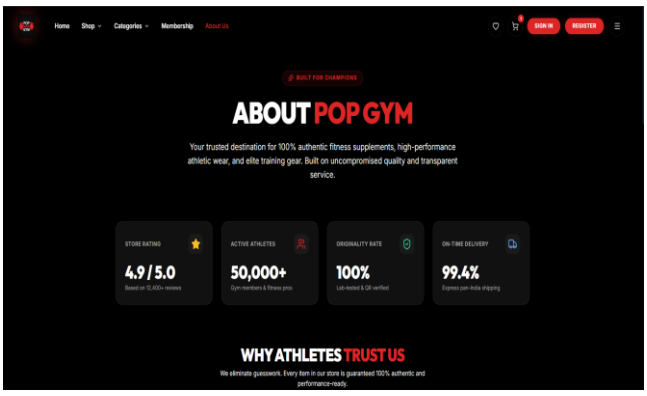

Fig. 7.5. About Us Interface

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7.6 Shopping Cart

The shopping cart module was evaluated by adding products, updating quantities, and reviewing selected items before checkout. The cart correctly calculated the total amount and allowed users to modify their selections easily. The module provided a convenient way to manage purchases before placing an order.

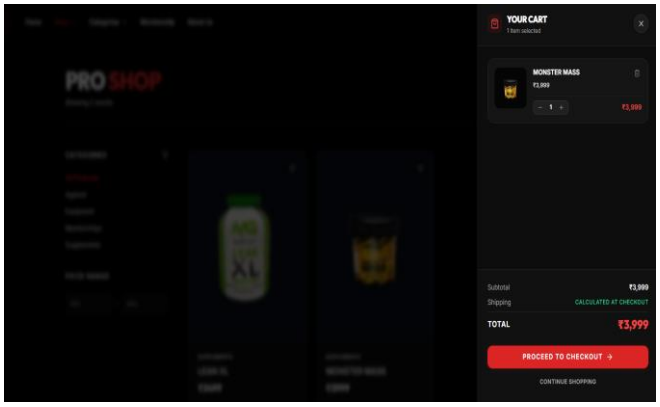

Fig. 7.6. Shopping Cart Interface

7.7 Admin Dashboard

The admin dashboard was tested to verify product, customer, and order management functionalities. Administrators were able to monitor platform activities, manage inventory, and access important business information through a centralized dashboard. The module simplified overall system administration and improved operational efficiency.

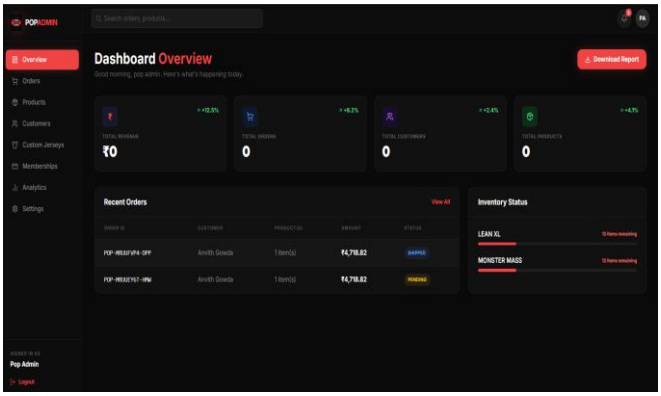

Fig. 7.7. Admin Dashboard

7.8 Analytics Dashboard

The analytics module was evaluated by monitoring revenue trends, customer statistics, product performance, and order summaries. The graphical reports provided meaningful insights into business performance, helping administrators analyze sales trends and make informed decisions.

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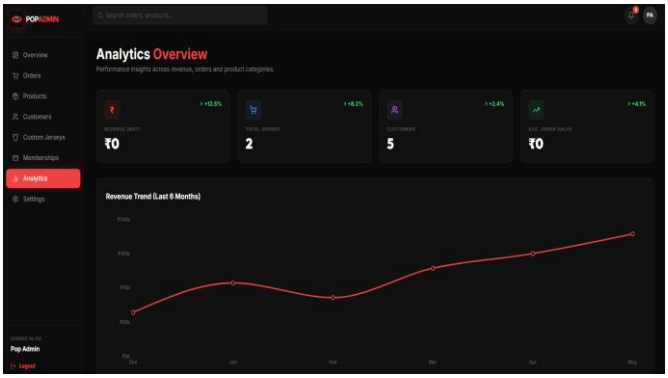

Fig. 7.8. Analytics Dashboard

7.9 Checkout Module

The checkout module was tested by selecting delivery addresses, reviewing the order summary, and confirming purchases. The system successfully calculated the total amount, including taxes and shipping details, and completed the order placement process. The secure checkout workflow ensured a smooth purchasing experience for users.

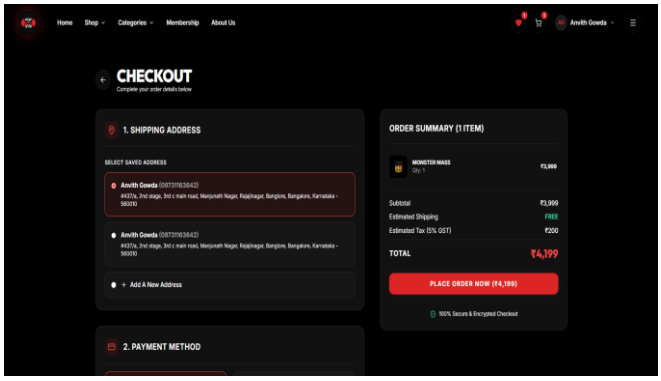

Fig. 7.9. Checkout Interface

7.9 Discussion

The experimental evaluation demonstrates that the proposed AI Fitness and E-Commerce Platform successfully integrates online supplement shopping with AI-powered personalized diet recommendations into a single web application. Unlike conventional fitness platforms that focus only on product sales or basic fitness guidance, the proposed system provides a complete solution by combining secure user authentication, product browsing, membership management, shopping cart functionality, order processing, and administrative features. The integration of the Google Gemini API enables users to receive personalized diet plans based on their health information and fitness goals. The successful execution of all modules confirms that the platform is reliable, secure, user-friendly, and capable of delivering an efficient digital solution for fitness management and online supplement shopping.

VIII. CONCLUSION

The AI Fitness and E-Commerce Platform successfully combines online supplement shopping with AI-powered personalized diet recommendations into a single web application. The system enables users to securely register, browse fitness products, purchase supplements, manage their orders, and receive customized diet plans based on their age, height, weight, gender, and fitness goals. By integrating the Google Gemini API with modern web technologies such as React.js, Node.js, Express.js, and MySQL, the platform provides a smooth, responsive, and user-friendly experience.

The successful implementation and testing of all modules demonstrate that the proposed system is reliable, secure, and efficient in meeting the needs of fitness enthusiasts. It simplifies the process of purchasing supplements while offering

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personalized nutritional guidance, helping users make informed decisions about their health and fitness. Overall, the project provides a practical and scalable solution that bridges the gap between e-commerce and intelligent fitness management, with the flexibility to support future enhancements such as online payments, workout tracking, wearable device integration, and mobile application support.

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