iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IV **Month of publication:** April 2026

DOI: https://doi.org/10.22214/ijraset.2026.79482

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IV Apr 2026- Available at www.ijraset.com

Design Studio – AI-Powered Real-Time 3D Merchandise

Amol Gurbhele[1], Bhargav Ghodichor[2], Dhananjay Katre[3], Harshal Dhumane[4], Janvi Kolhe[5], Jayant Solao[6], Dr. Ruchi Kadwane[7]

[1, 2, 3, 4, 5, 6]*Student, Department of Computer science & Engineering, G. H. Raisoni University, Amravati*
[7]*Assistant Professor, G. H. Raisoni University, Amravati*

Abstract: ***The rapid growth of digital technologies has transformed e-commerce into a more interactive and personalized experience; however, traditional platforms still rely on static product visualization and offer limited customization, creating uncertainty for users when purchasing customized merchandise. To address these limitations, this paper presents "Design Studio – AI Powered Real-Time 3D Merchandise", a web-based platform that integrates artificial intelligence with real-time 3D visualization. The system enables users to generate designs using AI-based text-to-image technology, while also providing manual customization options, including color, text, and image placement. It utilizes WebGL and Three.js to deliver real-time 3D rendering, allowing users to interact with products through rotation, zooming, and instant updates. Additionally, the platform features key e-commerce functionalities, including category-based browsing (e.g., T-shirts, hoodies, caps), add-to-cart functionality, secure payment integration, and an AI-powered chatbot for user assistance. Built using React, Node.js, Express.js, and MongoDB, the system enhances user engagement, improves decision-making, and provides an effective solution for modern, customized e-commerce platforms.***

Keywords: Artificial Intelligence, Customization, Merchandise Design, Real-Time Rendering, Three.js, WebGL, 3D Visualization

I. INTRODUCTION

The evolution of e-commerce has transformed how consumers interact with products, yet significant limitations remain in product visualization and customization. Most traditional platforms rely on static images, which fail to accurately represent customized products and reduce user confidence [1]. Recent advancements in Artificial Intelligence (AI) and 3D visualization technologies offer new opportunities to enhance online shopping experiences, where AI enables intelligent design generation and 3D rendering allows users to interact with products in a realistic manner [3][4]. The Design Studio platform leverages these technologies to provide an advanced solution for personalized merchandise design. It enables users to create designs using AI prompts and perform manual customization, including color adjustments, text additions, and image uploads. The system supports multiple product categories, including T-shirts, hoodies, and caps, and provides real-time 3D visualization for enhanced product understanding. Integrated e-commerce features, such as cart management and payment processing, ensure a seamless transition from design to purchase

II. PROBLEM STATEMENT

Despite the widespread adoption of e-commerce platforms, significant challenges remain in the areas of product customization and visualization. Most existing systems rely on static images, which fail to accurately represent customized products, making it difficult for users to clearly visualize the final outcome before purchase [1][3]. This limitation becomes more critical in personalized merchandise platforms, where users expect an accurate representation of their designs. Additionally, limited customization options and the absence of intelligent design assistance reduce user engagement and creativity [4]. The lack of seamless integration between design, visualization, and purchasing processes further complicates the user experience. As a result, users experience uncertainty while making purchase decisions, leading to dissatisfaction and reduced trust in online platforms. Therefore, there is a need for an advanced system that provides real-time 3D visualization, AI-driven design support, intuitive customization features, and a secure integrated environment.

III. PROPOSED SYSTEM

The proposed system, Design Studio – AI Powered Real-Time 3D Merchandise, is developed to overcome the limitations of traditional e-commerce platforms by integrating advanced technologies into a unified solution. It enables users to design, customize, visualize, and purchase products within a single platform. The system supports both AI-based and manual design approaches, allowing users to generate designs using text-to-image technology or customize products by modifying colors, adding text, and uploading images [2][3]. It provides real-time 3D visualization with interactive controls such as rotation and zoom, helping users better understand the final product.

Additionally, the platform includes category-based product selection, add-to-cart functionality, secure payment gateway integration, and an AI-powered chatbot for user assistance. OTP-based authentication and a user dashboard further enhance security and usability, while the system architecture ensures high performance, scalability, and reliability [5]

IV. FLOWCHART

The system flow of the Design Studio – AI-Powered Real-Time 3D Merchandise platform illustrates the complete process from user interaction to final product purchase. It begins with user authentication through OTP verification, ensuring secure access. After authentication, the user selects a product category and proceeds to the design phase, choosing between AI-based generation or manual customization. In the AI approach, designs are generated using text-to-image models, whereas manual customization enables the modification of colors, text, and images [2]. The design is then applied to a 3D model, enabling real-time visualization with rotation and zoom features. Once satisfied, the user adds the product to the cart and proceeds to checkout, where a secure payment gateway processes the transaction. After payment, the order is confirmed and updated in the dashboard. The system integrates frontend technologies such as React, backend technologies like Node.js and Express.js, and MongoDB for data storage, ensuring performance and scalability [5].

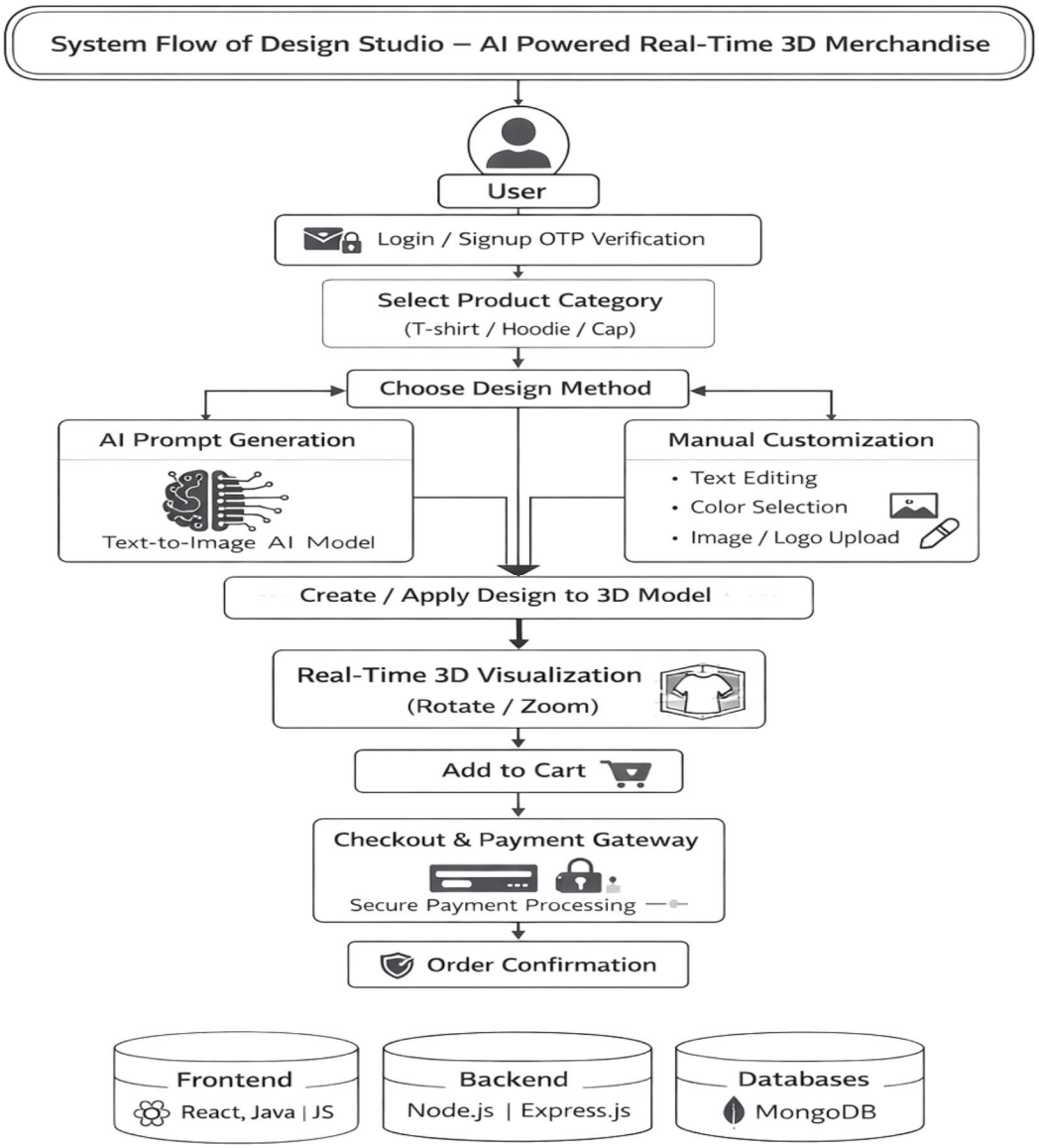


Fig 1 Block Diagram of Proposed System

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IV Apr 2026- Available at www.ijraset.com

V. METHODOLOGY

A. User Management System

The platform implements a secure authentication mechanism using OTP verification, where users are required to register and log in before accessing advanced features. This approach ensures secure access control and protects user data through encryption techniques and secure session management, thereby maintaining confidentiality and system integrity [5].

B. AI-Based Design Generation

The AI module enables users to generate creative and unique designs by entering textual prompts. The system processes these inputs using advanced text-to-image generation models, producing visually appealing outputs. This functionality simplifies the design process, enhances creativity, and eliminates the need for professional design skills, making customization accessible to a wider range of users [2].

C. 3D Visualization Module

The 3D visualization module is developed using Three.js and WebGL technologies, enabling real-time rendering of products. It allows users to rotate products along multiple axes, zoom in and out for detailed inspection, and view design changes instantly. This module significantly improves realism and interactivity, providing users with a more immersive and accurate preview of customized products [3].

D. Customization Module

The customization module offers a comprehensive set of editing tools that allow users to modify product appearance according to their preferences. Users can change colors, add text with various font styles, upload images or logos, and adjust their position and scale on the product. All modifications are reflected in real time, ensuring precise and accurate visualization.

E. E-Commerce Integration

The platform incorporates a complete e-commerce workflow that includes product categorization, add-to-cart functionality, cart management, and order summary features. This integration ensures a seamless transition from product design to purchase within a single system, improving overall user experience and efficiency.

F. Payment Gateway Integration

A secure payment gateway is integrated into the system to facilitate online transactions. The platform ensures safe and reliable payment processing through secure protocols, thereby enhancing user trust and providing a smooth and efficient checkout experience [4].

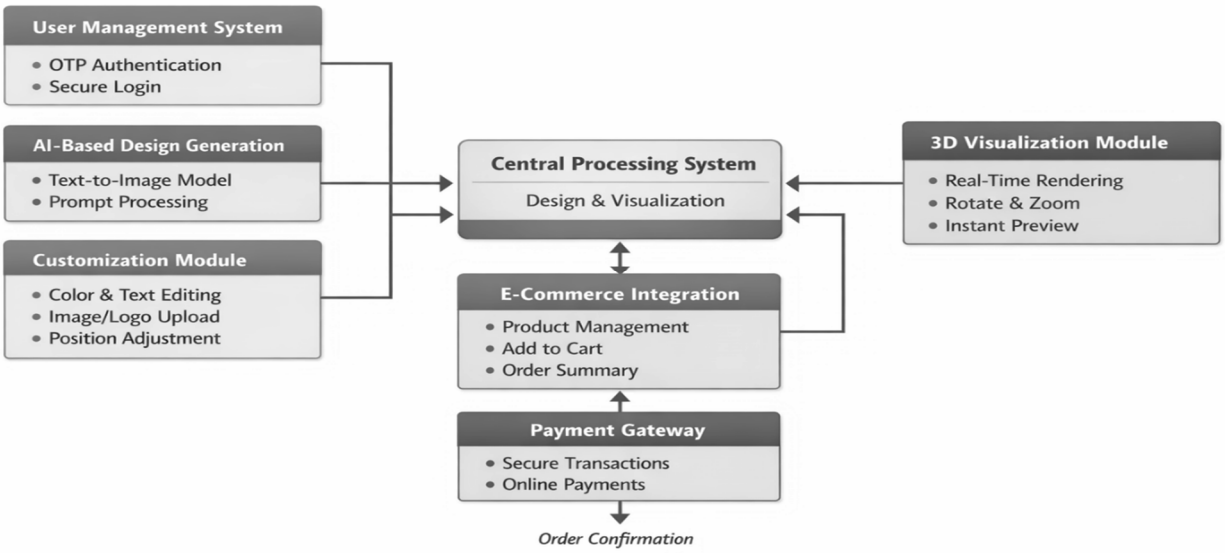


Fig 2 System Architecture of AI-Powered 3D Merchandise Customization Platform

VI. RESULTS

The implementation of the Design Studio – AI Powered Real-Time 3D Merchandise system shows clear improvements over traditional e-commerce platforms in terms of visualization and user interaction. The system provides real-time 3D rendering, enabling accurate product visualization and helping users better understand customized designs. The AI-based design generation enhances creativity and allows users to create unique designs easily.

The customization tools are simple and efficient, with instant updates on the 3D model. The add-to-cart and payment modules work smoothly, ensuring a seamless purchasing process. The AI chatbot further improves user experience by providing guidance and support. Overall, the system effectively bridges the gap between user imagination and actual product representation, leading to improved user satisfaction.

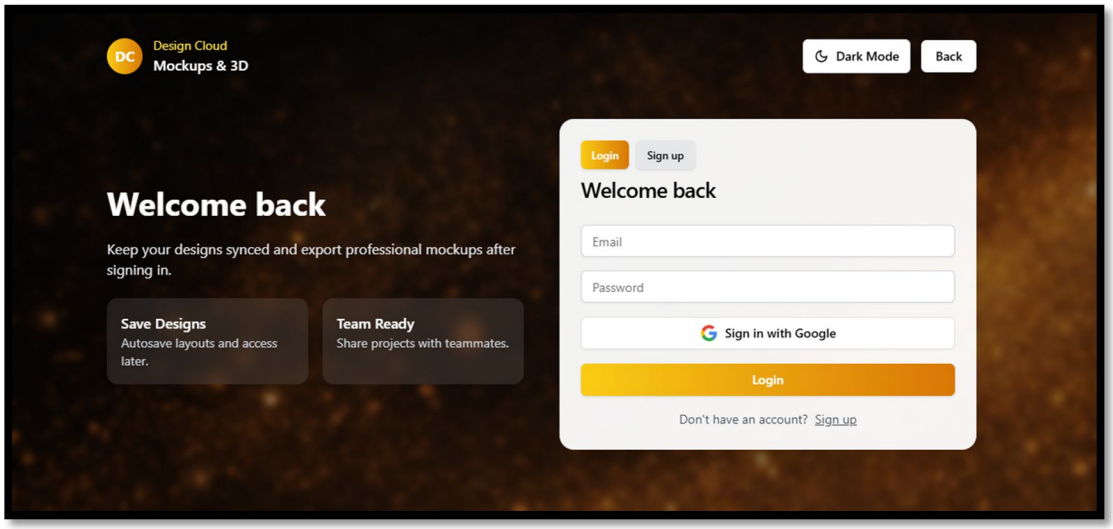


Fig 3 Login Page

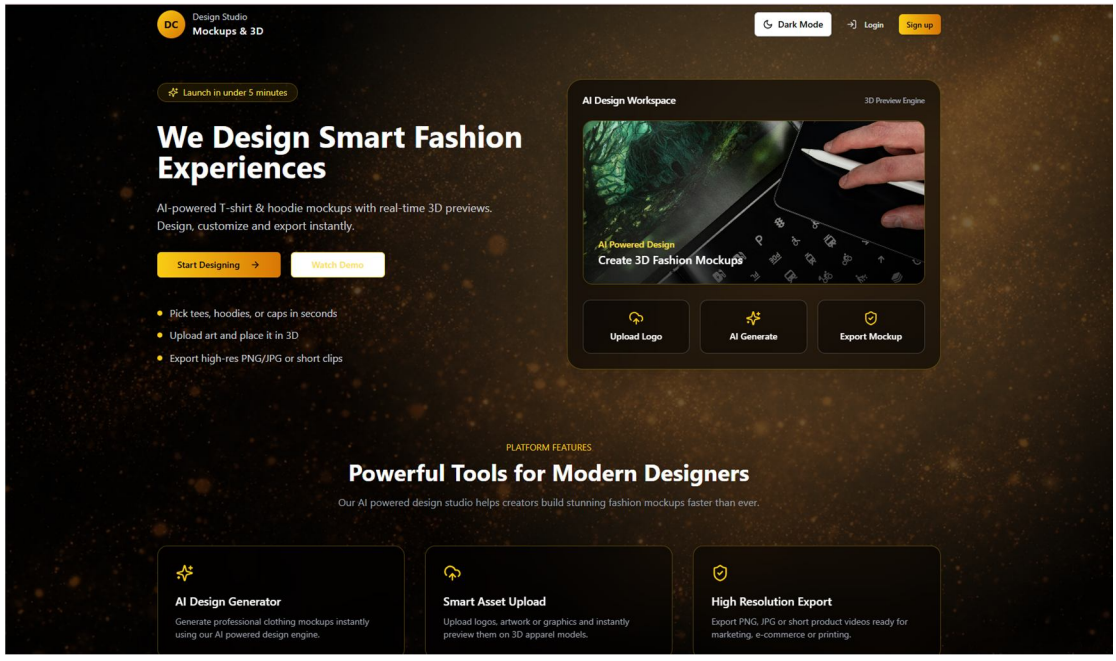


Fig 4 Dashboard

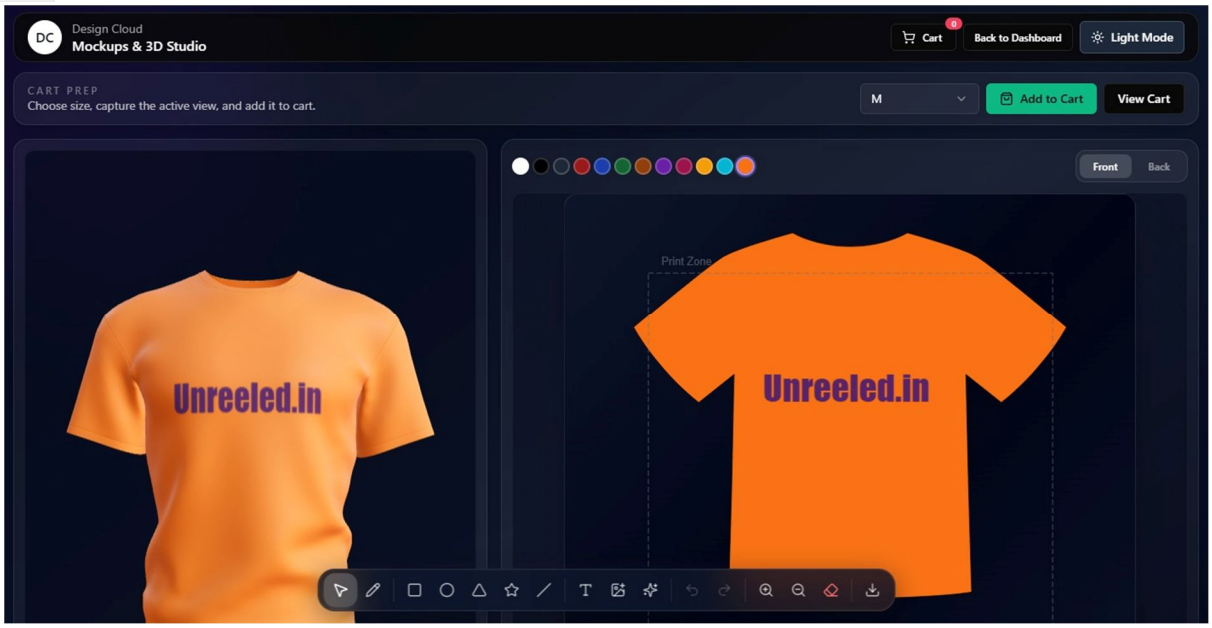


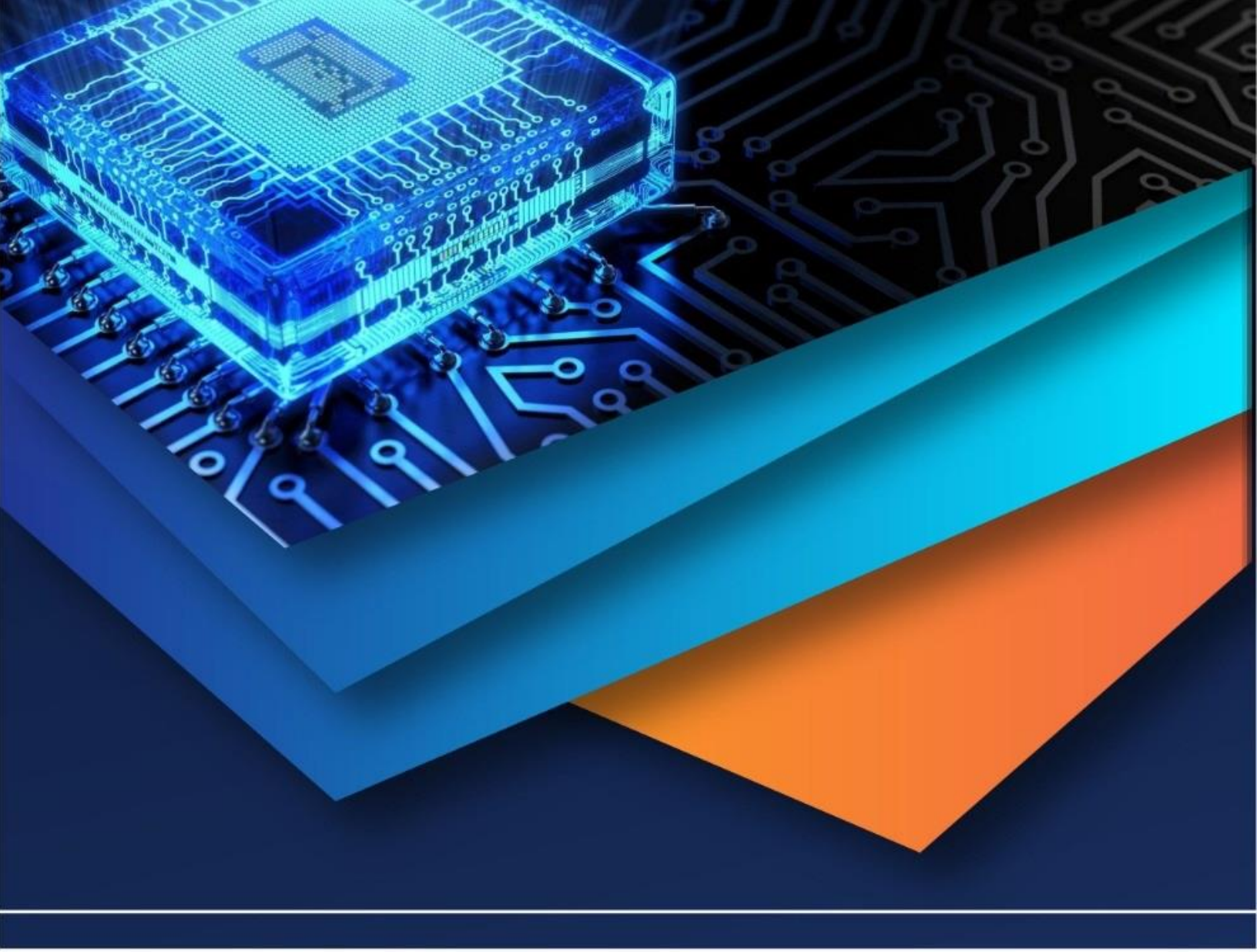
Fig 5 Canvas Page

VII. CONCLUSION

The Design Studio – AI-Powered Real-Time 3D Merchandise Customization System enhances user experience by integrating real-time 3D visualization, AI-based design generation, and interactive customization features into a unified platform. The system enables users to view products dynamically, create personalized designs using simple prompts, and seamlessly proceed through product selection, cart management, and secure payment processing, ensuring an efficient and user-friendly workflow. Its modular architecture and intuitive interface contribute to improved performance, scalability, and usability. In the future, the system can be extended by incorporating augmented reality for real-world visualization and virtual try-on capabilities, integrating more advanced AI models for better personalization, expanding support to mobile platforms and additional product categories, and implementing recommendation systems and analytics to enhance user engagement and overall system effectiveness.

REFERENCES

[1] C. Balakrishnan, M. Mohamed Hajith, K. Aravind, and S. Sharath Kishan, "3D E-Commerce Customized Website Powered by AI," International Journal of Innovative Research in Technology (IJIRT), vol. 11, no. 10, March 2025.
[2] Y. Sonvane, A. Pannaswar, and H. Limje, "Study on AI-Powered Body Scanning and 3D Avatar Creation for Personalized Virtual Shopping Experiences," International Journal of Modern Science and Research Technology (IJMSRT), vol. 3, no. 5, May 2025.
[3] U. Srivastava and S. Siddiqui, "AI Powered 3D E-Shop," International Journal of Progressive Research in Engineering, Management and Science (IJPREMS), vol. 4, no. 5, May 2024.
[4] L. Choudhary, M. Kumawat, C. Rotkar, P. Panchal, and D. S. Dhakar, "AI-Powered 3D Product Website," International Journal of Enhanced Research in Science, Technology & Engineering, vol. 13, no. 4, April 2024.
[5] A. Massaro, V. Vitti, A. Mustich, and A. Galiano, "Intelligent Real-Time 3D Configuration Platform for Customizing E-Commerce Products," International Journal of Computer Graphics & Animation (IJCGA), vol. 9, no. 4, October 2019.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY