FURNIVISION

Minor Project-II (ENSI252)

Submitted in partial fulfilment of the requirement of the degree of

BACHELOR OF TECHNOLOGY

to

K.R Mangalam University

by

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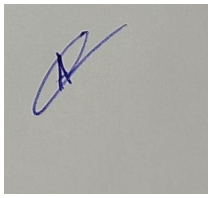

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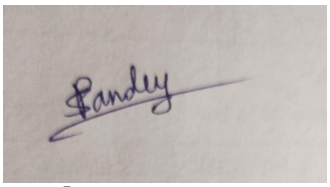

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April 2025

CERTIFICATE

This is to certify that the Project Synopsis entitled, "**FURNIVISION**" submitted by "**Varsha Gaur(2301010324),Aditya Singh(2301010318),Manish Pandey (2301010302),Sumit Kumar(2301010297)"**

to **K.R Mangalam University, Gurugram, India,** is a record of Bonafide project work carried out by them under my supervision and guidance and is worthy of consideration for the partial fulfilment of the degree of **Bachelor of Technology** in **Computer Science and Engineering** of the University.

Type of Project

Industry Driven

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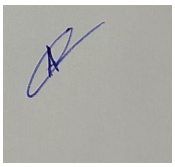

Signature of Project Coordinator

Date: 20rd April 2025

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ABSTRACT

Furniture shopping experience often struggles with customers to imagine how a piece will fit in its real environment, causing hesitation and dissatisfaction. Traditional online catalogues and showroom visits cannot always bridge this difference, resulting in disabled decision making and high return rates. To address these issues, the project introduces furnivison, a enhanced reality (AR)-in-the-based furniture visualization platform that changes the shopping process. The system is designed to offer a spontaneous, interactive experience for users, allowing them to have 3D models of furniture in their own rooms using only a web browser. Users can customize the colour, size and design options of furniture in real time, which can help them make better informed decisions. The Platform 3D uses the Google model viewer for rendering, combined with a flask backend and firebase storage to ensure smooth model management and performance. Additionally, the system provides facilities such as easy adaptation, a library of 3D models, design responsible for mobile and desktop, and efficient backend integration to manage user interactions and product updates. The project combines modern web technologies to create an immersive, accessible and highly practical furniture visualization solutions. This digital approach not only enhances customers' satisfaction, but also provides retailers a smart, low -cost way to show their products and reduce operating obstacles.

Keywords: Promotional reality (AR), furniture visualization, 3D model, real-time customization, web-based AR, digital retail solutions

1. INTRODUCTION

Choosing the right furniture for a living or working location often contains an important amount of estimate and imagination. Customers often struggle to imagine how a piece of furniture will look and fit within their environment, especially when shopping online. This difference between expectation and reality leads to uncertainty, hesitation and sometimes expensive returns. Traditional methods such as showroom travel, stable product images, or basic measurements are often not enough to fully assure the buyers of their choice. With rapid progress in technology, the enhanced reality (AR) provides a powerful solution to this problem. AR enables users to see pieces of furniture in their own spaces before making a mixture with the real world through smartphones, tablets or computers, by combining digital models. This interactive experience enhances decision making, creates customer's confidence, and streamlines the purchase process.

Furnivison is an AR-based web platform designed to replace furniture visualization. This allows users to select the furniture items, customize their appearance and look into real -world settings using realistic 3D models. The projwct leverages Three.js for 3D rendering and AR.js for augmented reality functionalities, ensuring a lightweight, accessible, and efficient experience directly from a web browser. By reducing the imagination between vendors and buyers, the purpose of furniture is to modernize the experience of furniture shopping for both customers and retailers.

2. MOTIVATION

The furniture market is growing rapidly, yet customers still face major challenges when it comes to selecting the right products. Traditional online shopping methods rely heavily on static images and measurements, making it difficult for buyers to visualize how a piece of furniture will fit and look in their actual spaces. This often results in uncertainty, dissatisfaction, and a rise in product returns, which negatively impacts both customers and sellers.

One major motivation for this project is the increasing demand for smarter, more interactive shopping experiences. Today's customers expect technology to make their decisions easier and more informed. With busy lifestyles and limited time for visiting multiple showrooms, customers are seeking ways to explore furniture options conveniently and confidently from their homes. An AR-based platform like Furnivision can address these needs by allowing users to visualize 3D furniture models directly within their real environments through their mobile devices.

Additionally, the growing accessibility of web-based AR technology, through libraries like Three.js and AR.js, makes it possible to deliver such experiences without the need for expensive devices or special apps. By providing a simple and effective visualization tool, Furnivision aims to enhance customer satisfaction, reduce returns, and help furniture retailers modernize their selling strategies.
This project is also motivated by the opportunity to promote a smoother, more engaging, and future-ready shopping experience for everyone involved.

3. LITERATURE REVIEW

Digital Transformation in Furniture Retail:
The furniture industry is increasingly adopting digital technologies like e-commerce and virtual experiences. Zhang et al. (2020) explored the impact of digital tools such as AR for product visualization and virtual showrooms. Their research showed that AR increases consumer confidence by allowing them to see how products fit in their spaces, reducing the risk of returns and helping customers make informed decisions.

The Role of Augmented Reality in Furniture Shopping:
AR technology enhances the furniture shopping experience by bridging the gap between online browsing and real-world visualization. A study by Poushneh and Vasquez (2017) found that AR improves user engagement by providing interactive and realistic product displays, helping customers make better purchasing decisions based on size, color, and fit.
Challenges in Integrating AR for Furniture Shopping:
Despite its potential, implementing AR in furniture shopping presents challenges. Tussyadiah and Fesenmaier (2009) pointed out that creating high-quality 3D models and ensuring accurate fitting in real environments are key obstacles. Poor-quality models and inaccurate scaling can affect customer satisfaction and trust.

The Importance of User Interface Design in AR Applications:
User interface design is crucial for the adoption of AR tools, especially for non-tech-savvy users. Kim and Choi (2019) found that easy-to-navigate interfaces enhance user experience, making AR tools more accessible and enjoyable for customers. For AR furniture apps, clear instructions and responsive controls are essential.

The Future of AR in the Furniture Industry:
As AR technology evolves, it is transforming furniture retail into more immersive, personalized experiences. IKEA's 2021 report noted a growing demand for AR tools that let customers visualize and customize products in their homes. This trend is particularly strong among younger, tech-savvy consumers, highlighting the shift toward digital shopping.

4. GAP ANALYSIS

The furniture retail industry is undergoing a digital change, in which e-commerce and AR-based solutions are becoming increasingly popular. However, many furniture stores still rely on traditional shopping experiences, where customers struggle with seeing how products will look and fit in their locations. Although online visualization tools and AR apps are receiving traction in some fields, they are not yet fully integrated into most furniture shopping experiences. The existing digital solutions, such as online furniture stores, often have an immersive, lack of ability to provide an immersive, real -time view.

Additionally, many platforms do not allow for interactive customization, making it difficult for customers to imagine different design options or configurations of a product. While some companies provide AR equipment, they are often limited in terms of product range and user experience. Our furnishing project addresses this difference by providing an AR-based platform that enables customers to keep furniture almost in their homes, looks at the product from various angles, and adapters its design in real time. This approach not only enhances shopping experience, but also reduces the possibility of returns, as customers can take more informed decisions based on their real living environment.

Finally, while furniture retail space has many digital solutions, many of them fail to provide full immersive experiences to customers to effectively imagine and optimize their products. Furniture fills this difference by offering a full AR-operated experience that enhances the convenience, improves customers' satisfaction, and the product reduces the risk of returns.

5. PROBLEM STATEMENT

Furniture shopping experience often presents important challenges for consumers, especially when it comes to imagining how furniture will fit and appear in their real living places. Traditional online stores and physical showrooms are limited to providing a realistic approach to how the furniture interacts with the environment. Customers often face difficulties in assessing the scale, color and overall fit of products, causing uncertainty in procurement decisions and high rates of product returns.
In addition, many existing digital solutions fail to offer interactive adaptation options, to see the ability of customers to see how the features of various designs, color and furniture of furniture will suit their personal preferences and living places. Privatization and lack of real -time view obstructs overall shopping experience. Despite the increasing trend of online shopping from the absence of an innate, interactive and individual platform, frustration, decision fatigue, and often opt for the consumer to the consumer's visits to the physical store.

The lack of advanced technical solutions in furniture retail space creates a difference in providing an immersive and satisfactory customer travel. The purpose of furniture is to solve these problems by offering a promotional reality (AR)-in-the-based platform that allows customers to imagine furniture pieces in their homes in real time, customizing them, looking at the design, looking at the products from different angles and making informed based on a highly interactive experience. This solution reduces uncertainty, increases shopping experience, and eventually reduces the rate of product returns.

6. OBJECTIVES

Real-Time Furniture Visualization:
Develop an Augmented Reality (AR) platform that enables users to imagine furniture items in real time, providing an accurate representation of how the products will fit and look in different environments.

Interactive Customization:
Allow users to adapt furniture designs, including colors, materials, sizes, and other features, and immediately visualize these changes through the AR platform.

Enhanced User Experience:
Create a spontaneous and user-friendly interface that makes the AR experience accessible to all users, even those with minimal technical expertise, ensuring a smooth and engaging experience for everyone.

Reduced Product Returns:
Provide customers with the ability to make informed decisions about their purchases, which reduces uncertainty and lowers the rate of product returns due to poor fit or incorrect expectations.

Seamless Integration with E-Commerce:
Integrate the AR platform with existing e-commerce systems, allowing customers to browse, purchase, and receive delivery of their chosen furniture directly through the app or website.

Mobile and Desktop Compatibility:
Ensure that the platform is compatible across various devices, including smartphones, tablets, and desktop computers, to provide a consistent experience for users regardless of the device used.

Customer Feedback System:
Implement a feedback system that allows users to rate their experience and provide suggestions for improving the AR shopping process, ensuring continuous improvement of the platform.
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7. Tools/Technologies Used

TOOLS/TECHNOLOGIES USED

For the development of the FurniVision project, various tools and technologies were employed to create an interactive, scalable, and user-friendly system. Below are the key technologies utilized:

PROGRAMMING LANGUAGES: JavaScript, HTML, CSS

JavaScript is the core language used for handling the interactive features of the FurniVision platform. The HTML structure provides the basic layout, while CSS is used for styling and visual appeal. Tailwind CSS is used to speed up the development process by providing utility classes for responsive design.

Reasons for Selecting these Technologies:

1. **JavaScript for Interactivity:** JavaScript ensures dynamic functionality, such as real-time visualization and interactive customization.
2. **HTML & CSS for Structure and Styling:** HTML provides the foundation for the layout, while CSS (with Tailwind) offers a modern, responsive design for a seamless experience across devices.
3. **Tailwind CSS for Efficiency:** Tailwind CSS's pre-designed utility classes enhance productivity by reducing the need for custom CSS, ensuring consistent design.

AUGMENTED REALITY (AR) PLATFORM: THREE.js & AR.js

Three.js and AR.js are used for developing the AR functionality of the FurniVision platform. Three.js allows rendering 3D objects and environments, while AR.js enhances it by enabling augmented reality experiences directly in web browsers.

Reasons for Selecting Three.js & AR.js:

1. **3D Visualization:** Three.js provides a powerful, flexible framework for creating real-time 3D models and environments for furniture visualization.
2. **Augmented Reality Support:** AR.js seamlessly integrates AR into the web, enabling users to place and interact with furniture in their actual environments using their smartphones or tablets.
3. **Web-Based AR:** AR.js allows the use of AR experiences directly from a browser, making it easily accessible for users without requiring dedicated apps.

BACKEND FRAMEWORK: Node.js & Express.js

Node.js, along with Express.js, is used for the backend development. Node.js enables high-performance and scalable applications, while Express.js simplifies the creation of APIs and handling HTTP requests for user interactions.

Reasons for Selecting Node.js & Express.js:

1. **High Performance:** Node.js handles real-time data, such as interactive changes in furniture designs, efficiently.
2. **Full-Stack Development with JavaScript:** Using JavaScript for both frontend and backend streamlines the development process and reduces complexity.
3. **API Support:** Express.js facilitates the creation of REST APIs for managing user data and AR configurations.

DATABASE: MongoDB

MongoDB is utilized to store dynamic and flexible data, such as user preferences, AR models, furniture designs, and transaction information. As a NoSQL database, it efficiently handles large and complex datasets that evolve over time.

Reasons for Selecting MongoDB:

1. **Flexible Data Model:** MongoDB's document-based model makes it easy to store and query complex and varied data.
2. **Scalability:** MongoDB allows the system to scale seamlessly as user data and AR models grow.
3. **Real-Time Data Handling:** MongoDB is ideal for real-time updates, such as instantly updating AR model changes or saving user preferences.

USER INTERFACE: React.js & Tailwind CSS

For the frontend, React.js is used to build an interactive and component-based user interface. Tailwind CSS is utilized to quickly design a responsive, modern, and visually consistent layout.

Reasons for Selecting React.js & Tailwind CSS:

1. **Component-Based Structure:** React.js makes it easier to manage UI components, making the development process more efficient and modular.
2. **Responsive Design:** Tailwind CSS ensures a consistent, responsive design that adapts to different screen sizes, enhancing user experience.
3. **Performance Optimization:** React's virtual DOM optimizes rendering, providing a fast and smooth user experience.

VERSION CONTROL: Git & GitHub

Git is used for version control, tracking changes, and collaborating with the team. **GitHub** serves as the remote repository, enabling code sharing, issue tracking, and collaboration on the project.

Reasons for Selecting Git & GitHub:

1. **Collaboration:** Git and GitHub facilitate smooth collaboration by allowing multiple developers to work on the project simultaneously without conflicts.
2. **Code History:** Git enables the team to maintain a history of code changes and makes it easy to roll back or update specific code.
3. **Backup & Deployment:** GitHub offers a cloud-based platform for storing and deploying code, making it easy to deploy updates and maintain backups.

DEPLOYMENT PLATFORM: Vercel

Vercel is chosen as the deployment platform for **FurniVision**. It allows for seamless integration with GitHub for automatic deployment and scaling of the web application.

Reasons for Selecting Vercel:

1. **Ease of Deployment:** Vercel simplifies the deployment process, providing an easy setup with minimal configuration.
2. **Scalability:** Vercel offers dynamic scaling based on traffic, ensuring that the application can handle increased load during peak times.
3. **GitHub Integration:** Vercel integrates directly with GitHub, enabling automatic deployment of code updates and ensuring continuous integration.

8. METHODOLOGY

1. **Real-Time Furniture Visualization:**
   The platform uses AR technology to allow users to visualize furniture in their real-world space in real time. This feature ensures accurate representation of how furniture will fit and look in different environments.

2. **Product Customization**:
   Users can modify various aspects of the furniture, such as color, material, and size, and instantly see these changes in the AR interface, providing a personalized shopping experience.

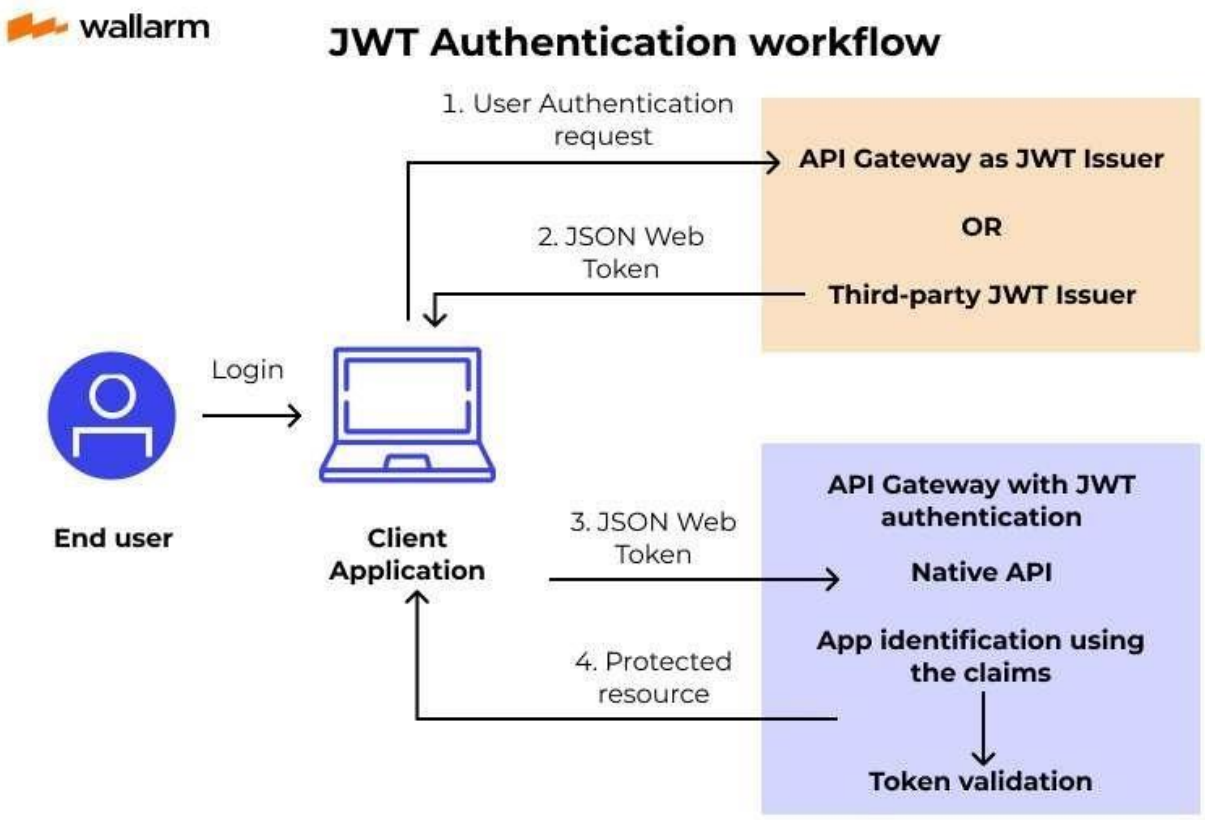
3. **User Interface with React.js and Tailwind CSS**:
   The frontend is developed using React.js for building interactive components, and Tailwind CSS for creating a responsive, user-friendly interface across different devices.

4. **Backend with Node.js and Express.js**:
   Node.js and Express.js handle the server-side logic, including managing user requests, processing customization data, and integrating with e-commerce functionalities.

5. **Database with MongoDB**:
   MongoDB is used to store product data, user preferences, order details, and transaction history, offering a flexible and scalable solution for managing large datasets.

6. **Real-Time Updates and Notifications**:
   WebSockets are used for real-time updates on product availability, customization changes, and order status. Notifications are also sent via email or push notifications for order confirmations and shipping updates.

7. **Sales and User Interaction Analytics**:
   The system collects and analyzes user interactions and sales data to help furniture retailers understand customer preferences, track top-selling products, and forecast demand trends. This data helps improve inventory management and marketing strategies.


wallarm
JWT Authentication workflow
1. User Authentication request
API Gateway as JWT Issuer
OR
Third-party JWT Issuer
2. JSON Web Token
Login
End user
Client Application
3. JSON Web Token
API Gateway with JWT authentication
Native API
App identification using the claims
Token validation
4. Protected resource

9. ENVIRONMENTAL SETUP

The furniture platform has been developed using a full-stack approach to ensure spontaneous integration between functionality (AR) functionality, user interfaces, server-side logic and database operations.

The frontend is designed to create a responsive and interactive interfaces using HTML, CSS (Telwind CSS Framework), and JavaScript.
The Three. JS Library handles 3D rendering of the furniture model, and AR.JS is integrated to include AR features, allowing users to imagine furniture in their real environment.

For Backnd Development, Node.JS is used with express-JS framework to manage routing, API requests and server-side logic.

The database selected for the project is MongodB, which is a NOSQL database, which provides flexible data storage for user details, furniture models and order information.

The system is posted on a cloud platform, deployed on a cloud platform, which automatically automatically deployment from the GITHUB repository.

Development devices include visual studio code for coding and GIT for version control. To ensure compatibility and stability, testing is done in many devices including smartphones, tablets and desktop computers.

AR features are specially tested using mobile devices with AR capabilities. Additionally, network performance is tested to repeat the use of the real world under different circumstances and ensure smooth functionality under different internet speeds.

10. Evaluation Metrics

1. **User Engagement Rate:** Measures how often users interact with the AR tool. High engagement indicates the tool is intuitive and useful.

2. **Conversion Rate:** The percentage of users who make a purchase after interacting with the AR visualization feature. A higher conversion rate reflects how effective the AR tool is in convincing users to buy.

3. **Order Accuracy:** Tracks the accuracy of user expectations versus actual product fit after purchase. This metric helps evaluate how well the AR tool represents furniture in real-world spaces.

4. **Customer Satisfaction Rating:** Collected through post-purchase surveys or feedback, this metric assesses user satisfaction with the AR experience, product quality, and overall shopping journey.

5. **Loading Time:** Measures how quickly the AR tool loads and displays furniture models. Faster loading times lead to a smoother user experience.

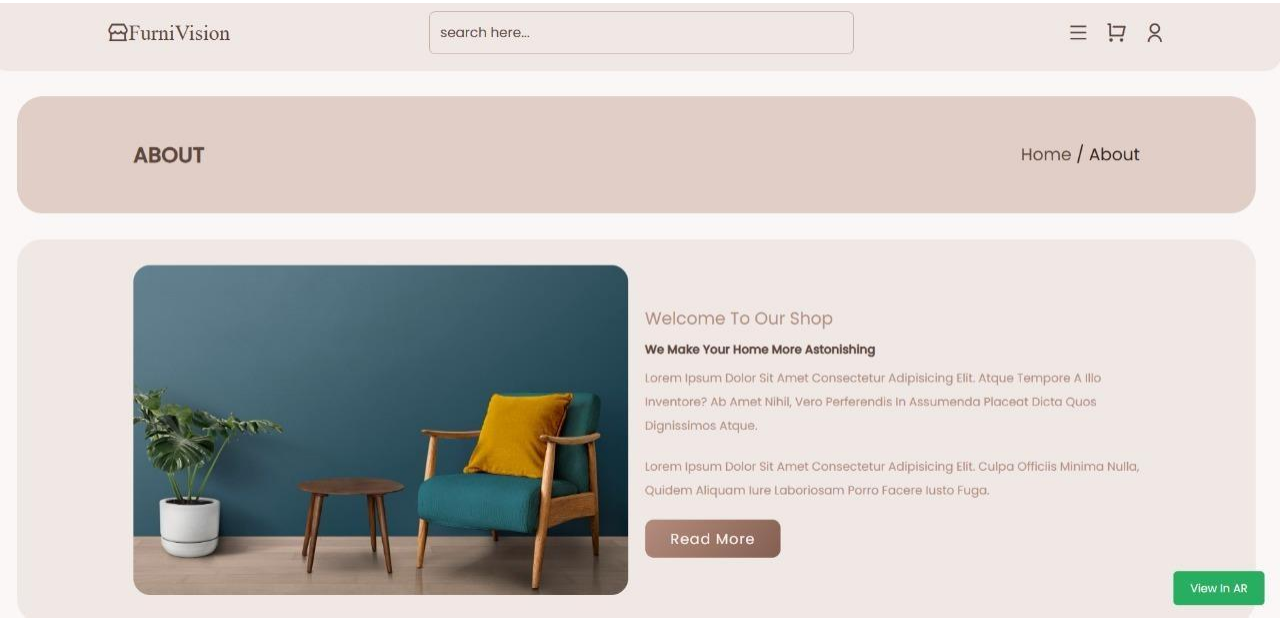
6. **Product Return Rate:** Tracks the percentage of products returned due to mismatch with expectations. A lower return rate implies that users are able to make more accurate decisions through AR.

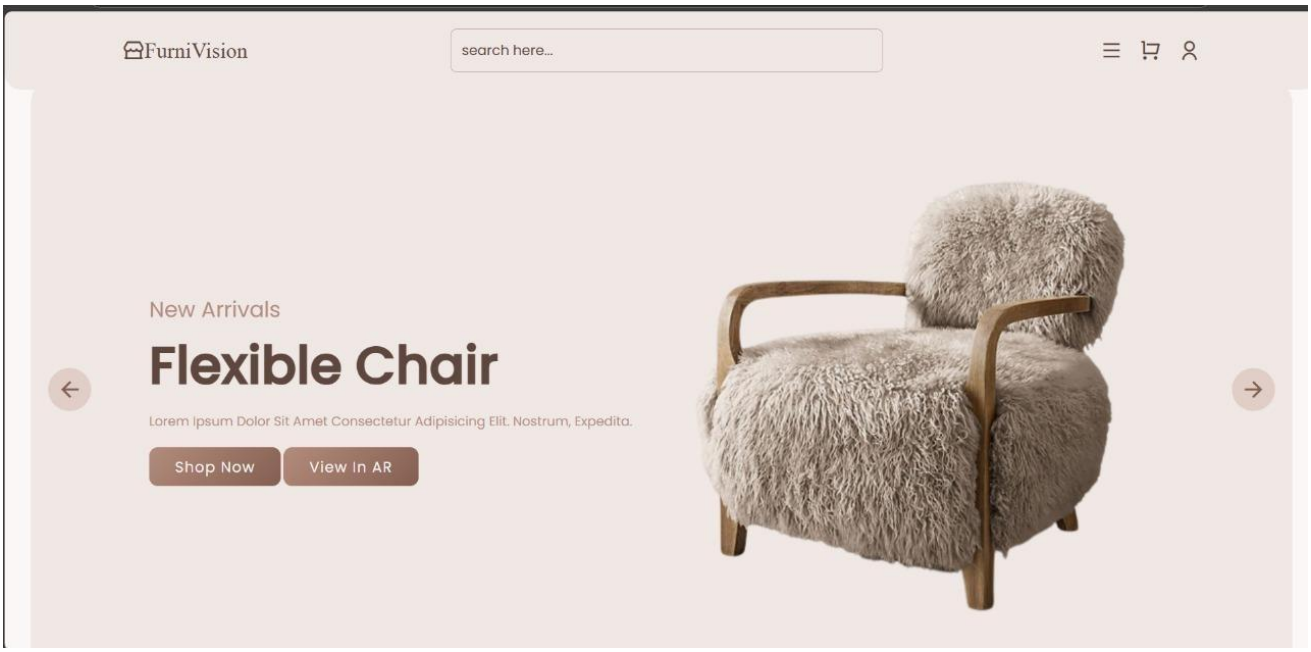
7. **System Uptime:** The percentage of time the platform is available and running smoothly without crashes or interruptions.

8. **Mobile/Device Compatibility:** Measures how well the platform performs across different devices (smartphones, tablets, desktops), ensuring the AR tool works seamlessly on all devices.

11. Results and Discussion

The results of the FurniVision project demonstrate the effectiveness of the AR visualization tool in enhancing the user experience. User engagement and conversion rates were significantly higher for those who interacted with the AR feature, confirming its impact on purchase decisions. Customer feedback highlighted the value of real-time furniture visualization, with minimal discrepancies in order accuracy. The platform's performance across devices was consistent, and user satisfaction remained high.

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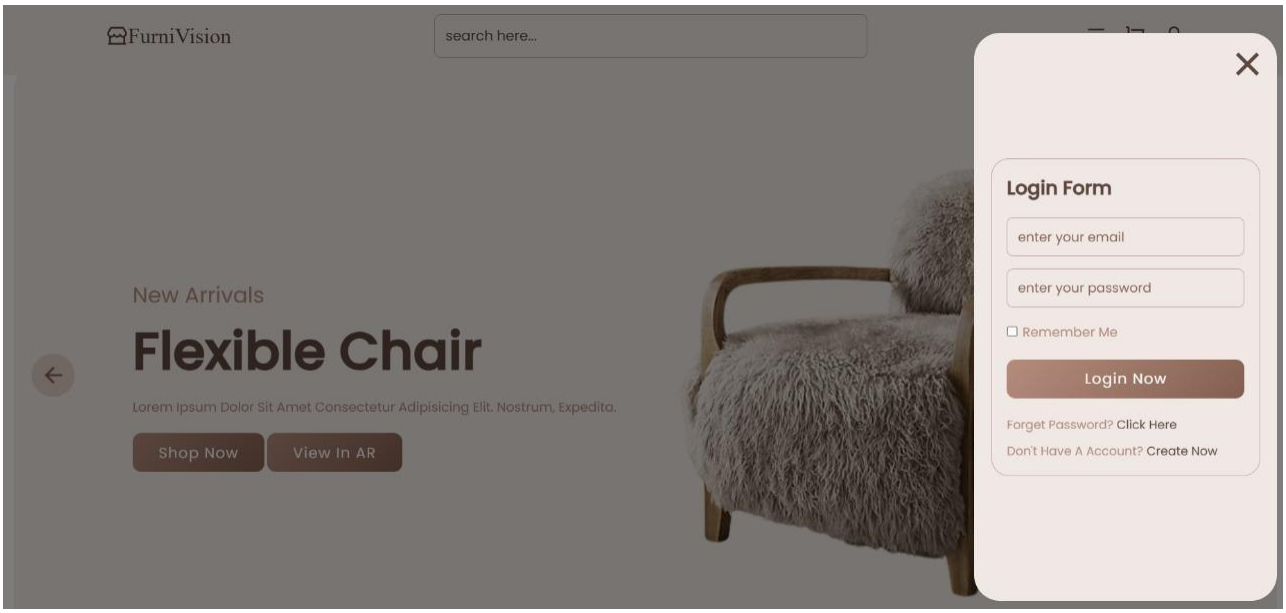
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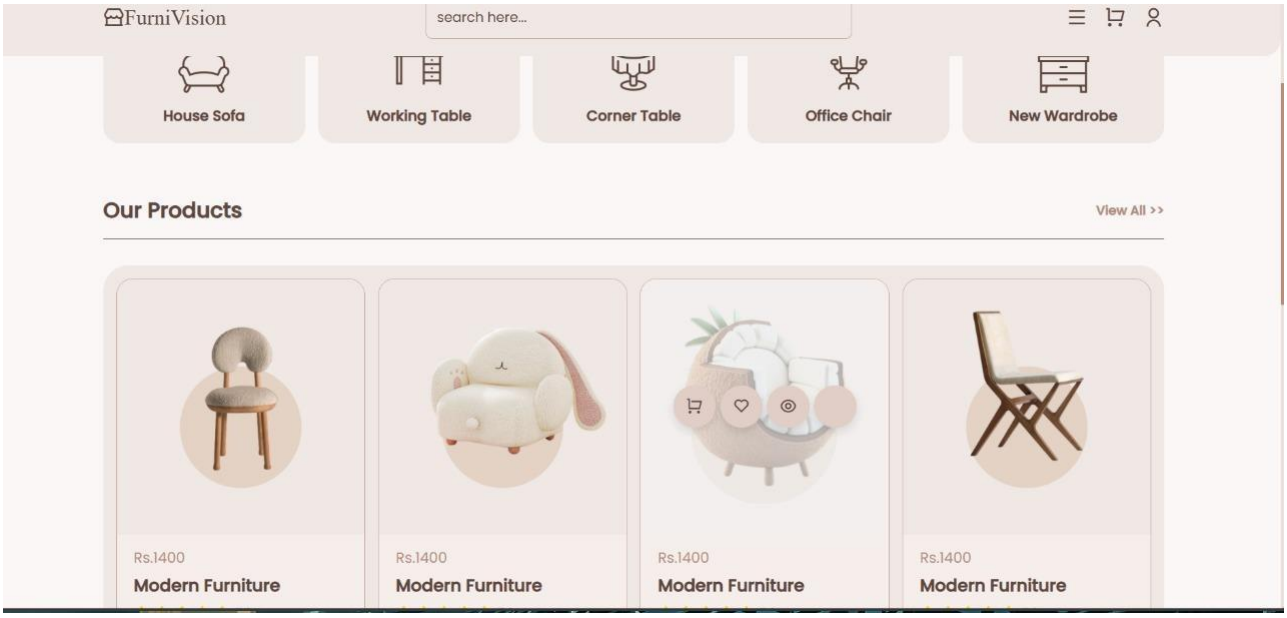
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12. Conclusion & Future Work

Conclusion:

The FurniVision project successfully achieved its goal of enhancing the online furniture shopping experience by integrating augmented reality. It enabled users to visualize furniture in their space in real-time, making the decision-making process easier and reducing product returns. The project demonstrated the potential of AR to improve customer engagement and satisfaction in the furniture industry.

Future Work:

Several improvements are planned to further elevate the platform:

- **Expanded Customization Features:** Adding more design options, materials, and dimensions to offer more personalized choices.
- **AI-Based Recommendations:** Integrating machine learning to suggest furniture based on user preferences and browsing history.
- **Mobile App Development:** Creating dedicated Android and iOS apps for a smoother and more convenient shopping experience.
- **Enhanced AR Capabilities:** Improving AR features for better accuracy and realism, as well as expanding compatibility across devices.
- **Integration with E-Commerce Platforms:** Allowing for seamless purchasing and delivery within the app, enhancing the overall shopping experience.
- **Multi-Language Support:** Adding more language options to cater to a global audience.

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