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# 3D ROOM SCANNING AND FURNITURE PLACEMENT IN VIRTUAL REALITY

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**Abstract**
This paper focuses on the development of a web application using A-Frame, which is a tool for creating 3D and virtual reality experiences. The application lets users walk around a two-story virtual house and play with different furniture items in a 3D space, helping them with their interior design ideas.
It's designed to be easy for everyone to use. Users can move, rotate, and place furniture, and they see how their changes look right away. This way, they can better understand their design ideas.The application includes many 3D furniture models from websites like Sketchfab and Sweet Home 3D, offering a variety of styles and options. The main goal is to help users turn their design ideas into real layouts, making home decoration fun and easy. This app encourages creativity, allowing users to create unique living spaces that show off their personal style.
**Keywords-**interactive 3D models,user interface Design,web based VR,Immersive User Experience,A-Frame Framework

## 1. Introduction

In today's busy world, being able to visualize and design living spaces is incredibly important. The "3D Room Scanning and Furniture Placement in Virtual Reality" Paper aims to address this need by providing users with an innovative platform that allows them to explore and arrange furniture within a virtual environment. This paper utilizes cutting-edge technology to create a realistic and interactive experience that enhances the way people approach interior design.
The application allows users to navigate through a meticulously designed 3D room, giving them the freedom to experiment with various furniture layouts and decor styles. Users can walk around the virtual space as if they were in a real room, which helps them get a better sense of how different pieces of furniture will look together. The app features a diverse library of 3D models, offering a wide range of furniture items from sofas and tables to decorative accessories. This variety ensures that users can select items that truly reflect their individual tastes and preferences, making the design process more personal and enjoyable.
Moreover, this Paper not only simplifies the interior design process but also empowers users to make informed decisions about their living spaces. By visualizing different arrangements in real-time, users can see firsthand how furniture placement affects the overall aesthetics and functionality of a room. This immediate feedback helps them understand the impact of their choices, leading to more thoughtful and creative designs. Ultimately, this innovative approach to room design fosters creativity and confidence, transforming the often daunting task of home decoration into an engaging and accessible experience for everyone. Whether someone is redecorating a single room or planning an entire home, this tool makes it easier and more fun to bring their ideas to life.

## 2. Literature survey

We looked through the Google play store and found some apps that are similar to our application. Some related works are mentioned below with a short detail:

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- SketchUp VR: A popular 3D modeling tool that can be integrated with VR platforms, allowing users to create and visualize rooms and furniture in a virtual environment.
- Home styler: This online tool enables users to create room layouts and visualize them in 3D. It offers a library of furniture and decor items for realistic arrangements.
- Floor planner: This web-based tool lets users design floor plans and arrange furniture in a 3D environment. It's user-friendly and ideal for quick visualizations.
- Room styler 3D Home Planner: This is an online tool for designing and visualizing interiors in 2D and 3D. It offers a user-friendly drag-and-drop interface and a wide selection of furniture and decor. Users can customize layouts and materials to effectively plan their spaces.

## 3. Proposed Methodology

This paper aims to create an interactive web-based virtual reality (VR) house using the A-Frame framework, which is a powerful tool for building VR experiences on the web. The primary goal is to allow users to explore a detailed two-story house where they can interact with various items, such as a TV, light switches, and even a whimsical time machine. The incorporation of sound effects will further enhance the immersive experience, making the virtual environment feel more alive and engaging.

One of the main challenges in developing this VR house is ensuring that users can easily interact with the objects within the space. This involves designing intuitive controls and interactions that are user-friendly, allowing for seamless engagement with items like turning on the TV or flipping a light switch. Additionally, managing the visibility of different items will be crucial; certain objects may need to be hidden or shown based on user actions, which requires careful programming and logic to ensure a smooth experience.

Another important aspect is the integration of fitting sound effects that correspond with user actions, such as the sound of a TV turning on or the click of a light switch. These audio cues will enhance the realism of the experience and contribute to the overall immersion. Furthermore, ensuring that the application runs smoothly across various devices is critical; this means optimizing performance to accommodate different hardware capabilities and internet speeds. Lastly, creating a simple and clear user interface is essential, as it will guide users through their actions and interactions within the VR house. The final product will be a fully functional VR house that not only showcases the capabilities of the A-Frame framework but also provides users with a fun and immersive experience that encourages exploration and interaction.

## 4. Overview

The paper aims to create a 3D room scanning and furniture arrangement application in virtual reality using A-Frame, HTML, CSS, and JavaScript. It will allow users to scan their physical rooms to generate accurate 3D models, enabling them to visualize and arrange virtual furniture within that space.

Using A-Frame, users can navigate the VR environment, while HTML and CSS will create an intuitive user interface. JavaScript will manage the room scanning and furniture interactions. Key challenges include ensuring accurate scanning, optimizing user experience, and supporting various devices. The final application will provide an engaging way for users to design and visualize their interiors before making purchases.

**Use Case Diagram**

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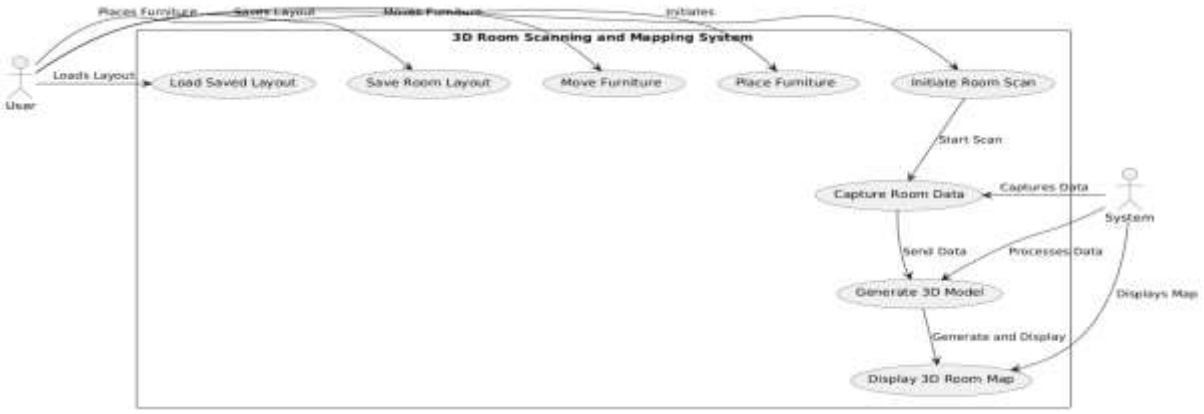


Figure 4.1

The use case diagram for the 3D Room Scanning and Mapping System outlines the interactions between the user and the system, showcasing the key functionalities required for scanning, mapping, and customizing indoor spaces. The system consists of two primary actors: the User, who performs tasks such as initiating scans, saving or loading room layouts, and arranging furniture, and the System, which processes data, generates 3D models, and displays the results. The core use cases include loading and saving room layouts, placing and moving furniture, initiating room scans, capturing room data, generating 3D models, and displaying the 3D room map. The workflow begins when the user initiates a scan, prompting the system to capture spatial data, process it, and generate a 3D representation of the room. Users can further customize the layout by interacting with features like furniture placement or adjustment, with options to save their modifications. This diagram is pivotal in defining the functional requirements of the system, ensuring clarity, modularity, and scalability in the design process. It provides a clear blueprint for aligning user needs with system capabilities, making it a valuable reference for system development and future enhancements.

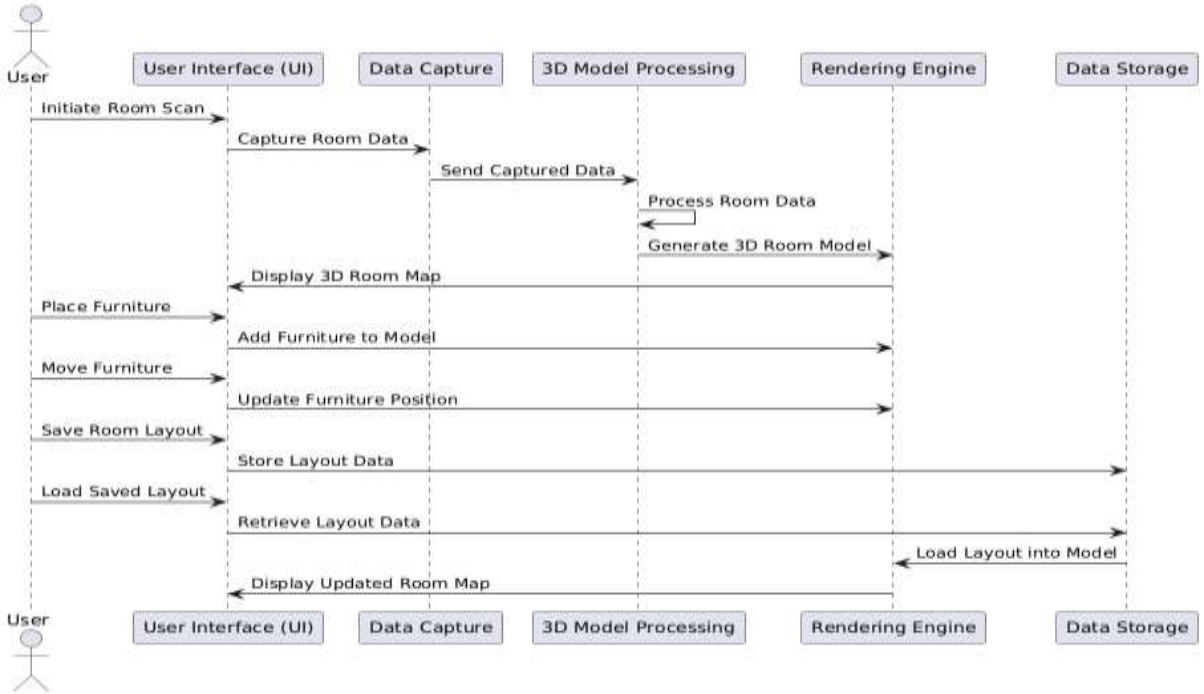


Figure 4.2

The sequence diagram illustrates the workflow of the 3D Room Scanning and Mapping System, highlighting the interaction between the user and system components, including the User Interface (UI), Data Capture, 3D Model Processing, Rendering Engine, and Data Storage. The process begins with the user initiating a room scan through the UI, which triggers the Data Capture module to collect spatial data and send it to the 3D Model Processing module for generating a 3D room model. This model is then displayed to the user via the Rendering Engine. The user can further interact with the system by placing or moving furniture, where the Rendering Engine updates the 3D model dynamically. The system also supports saving the room layout to the Data Storage for future retrieval

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and loading previously saved layouts for editing or visualization. Each component has a distinct role: the UI facilitates user interaction, Data Capture gathers room information, 3D Model Processing creates accurate models, Rendering Engine manages visualization, and Data Storage ensures layout persistence. This diagram provides a clear representation of the sequential flow of operations, enabling developers to understand system dependencies and data exchanges, ensuring effective design and implementation.

**5.Proposed Metholody**

The proposed methodology for developing the 3D room scanning and furniture arrangement application in virtual reality can be structured into several key phases:

- Research and Planning: Begin by researching existing technologies and methods for room scanning. Identify the best approaches for using smartphone cameras and sensors to capture room dimensions and layouts. Create a paper plan outlining the timeline, resources, and milestones.
- Development of Room Scanning Feature:
  - Utilize smartphone camera capabilities to capture images and depth data of the room.
  - Implement algorithms to process this data and generate a 3D model of the scanned space. This may involve using libraries or APIs that specialize in computer vision and 3D modeling.
- Building the VR Environment:
  - Use A-Frame to create a virtual reality environment where users can navigate their scanned room.
  - Develop the 3D model representation of the room using the data obtained from the scanning process.
- User Interface Design:
  - Design an intuitive user interface using HTML and CSS. Ensure that it is visually appealing and easy to navigate.
  - Include features such as buttons for selecting furniture, rotating, and placing items within the scanned space.
- Furniture Library Integration:
  - Create or source a library of virtual furniture models that users can choose from.
  - Implement functionality that allows users to drag, drop, and arrange these models within the scanned room.
- User Interaction and Logic Development:
  - Use JavaScript to handle the logic for user interactions, such as selecting furniture, moving it around, and saving arrangements.
  - Ensure that the application responds smoothly to user inputs, providing a seamless experience.
- Testing and Optimization:
  - Conduct thorough testing to ensure accurate scanning and functionality of the application.
  - Gather feedback from users and make necessary adjustments to improve the user experience and performance.
- Deployment and Maintenance:
  - Deploy the application on suitable platforms (e.g., web, mobile).
  - Plan for ongoing maintenance and updates based on user feedback and technological advancements.

**6.conclusion**

The Mini Paper effectively showcases a 3D room visualization and furniture placement in virtual reality, utilizing A-Frame to create an immersive and interactive experience. Users can navigate through a richly detailed environment featuring various interactive elements, such as a TV that can be turned on and off, a time machine that alters the room's layout, and light switches that change the ambiance. The integration of 3D models, textures, and audio enhances the realism and engagement of the space.Additionally, the use of teleportation buttons allows for seamless movement within the room. Overall, thisPaper demonstrates the potential of virtual reality as a powerful tool for interior design, enabling users to visualize and manipulate their environments in a dynamic and user-friendly manner.

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**References**

1. >https://www.researchgate.net/publication/380595922_Enhancing_Furniture_Manufacturing_with_3D_Scanning (Research)
➢ Bao, Q.; Faas, D.; Yang, M.: Interplay of sketching & prototyping in early-stage product
2. design. International Journal of Design Creativity and Innovation, 6(3-4), 2018, 146-168.
3. https://doi.org/10.1080/21650349.2018.1429318
➢ Chang, Y. S.; Chou, C. H.; Chuang, M.-J.; Li, W.-H.; Tsai, I. F.: Effects of virtual reality on
4. creative design performance and creative experiential learning. Interactive Learning
5. Environments, 2020, 1-16. https://doi.org/10.1080/10494820.2020.1821717
➢ Mille, C.; Christmann, O.; Fleury, S.; Richir, S.: Effects of digital tools feature on creativity
6. and communicability of ideas for upstream phase of conception. 4th International Conference
7. on Computer-Human Interaction Research and Applications, 2020. studios.
➢ Obeid, S.; Demirkan, H.: The influence of virtual reality on design process creativity in basic
8. design Interactive Learning Environments, 2020, 1-19. https://doi.org/10.1080/10494820.2020.1858116
➢ Okeil, A.: Hybrid design environments: immersive and non-immersive architectural design.
9. Journal of Information Technology in Construction (ITcon), 15(16), 2010, 202-216.
➢ Pallot, M.; Dupont, L.; Fleury, S.; Araque-Tellez, G.; Richir, S.: Investigating the Impact of
10. Visual Representations during Ideation: Towards Immersive eXperience Design. Immersive
11. and Collaborative Environment, 2021, https://doi.org/10.1109/ICE/ITMC52061.2021.9570244
➢ Shih, Y.-T.; Sher, W.-D.; Taylor, M.: Using suitable design media appropriately:
12. Understanding how designers interact with sketching and CAD modelling in design processes.
13. Design Studies, 53, 2017, 47-77. https://doi.org/10.1016/j.destud.2017.06.005
➢ Siegle, D.: I Have an Idea I Need to Share: Using Technology to Enhance Brainstorming.
14. Gifted Child Today, 43(3), 2020, 205-211. https://doi.org/10.1177/1076217520919967
15. >Stroebe, W.; Nijstad, B.-A.; Rietzschel, E.-F.: Beyond productivity loss in brainstorming groups: The evolution of a question. Advances in experimental social psychology: Vol. 43 (pp. 157–203). Academic Press, 2010, https://doi.org/10.1016/S0065-2601(10)43004-X