3D COLLEGE NAVIGATION APPLICATION

A MINI-PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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ABSTRACT

The 3D Navigation System is an interactive virtual platform designed to provide users with a seamless and intuitive way to explore a detailed 3D representation of an environment. The system features realistic 3D buildings and landscapes, allowing users to interact with the scene using pan, zoom, rotate, and drag controls. Each building is labeled, ensuring clear identification and easy navigation within the virtual space.

The primary goal of this system is to offer a realistic, efficient, and user-friendly navigation experience that enables users to explore and understand complex environments with ease. By integrating smooth interaction controls and optimized rendering techniques, the system ensures high performance without lag or disruptions. It serves as a valuable tool for education, campus navigation, urban planning, and architectural visualization, offering an effective way to experience large-scale environments in a digital format.

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CHAPTER 1

INTRODUCTION

The 3D Navigation System is an interactive digital platform designed to provide users with a realistic and immersive way to explore a virtual environment. This system features a detailed 3D representation of buildings and landscapes, allowing users to navigate seamlessly using pan, zoom, rotate, and drag controls. Each building is labeled for easy identification, enhancing user understanding and accessibility.

With advancements in 3D visualization and interactive navigation, this system offers an efficient and user-friendly solution for exploring complex environments without physical constraints. By enabling smooth interactions and optimized rendering, the system ensures a responsive and engaging experience.

This project is particularly useful for campus navigation, architectural visualization, urban planning, and educational applications, where users can freely explore a virtual space with clarity and ease. The 3D Navigation System provides a structured, efficient, and highly interactive approach to understanding and interacting with digital environments.

CHAPTER 2
LITERATURE REVIEW

2.1 Technologies Used

- **Interactive 3D Visualization**: Research shows that real-time 3D navigation with pan, zoom, rotate, and drag controls improves user experience and spatial awareness, making virtual exploration more intuitive.

- **3D Modeling for Navigation**: Studies highlight the importance of optimized 3D models for smooth performance, with techniques like Level of Detail (LOD) and occlusion culling enhancing efficiency.

- **User Experience in Virtual Navigation**: Research in HCI indicates that responsive controls, clear labels, and smooth transitions improve usability, engagement, and ease of navigation in digital environments.

- **Applications in Urban and Campus Planning**: Studies suggest 3D navigation systems aid in campus tours, urban planning, and real estate visualization, enhancing spatial understanding and accessibility.

2.2 Importance of 3D Model Viewers

3D Model Viewers are essential in various industries

- **E-commerce**: Customers preview products in 360-degree views.
- **Education & Training**: Medical, engineering, and scientific models help in learning.
- **Gaming & AR/VR**: Interactive 3D assets enhance realism in games and virtual reality.

2.3. Existing Solutions & Limitations

Solution	Advantages	Disadvantages
Google Model Viewer	Web-based, supports AR	Limited customization, no Unity integration
Sketchfab Viewer	High-quality rendering	Requires online access, limited mobile interactivity
Unity 3D Viewer	Full customization, cross-platform	Requires manual setup and scripting

CHAPTER 3

SOFTWARE USED

(AUTODESK MAYA 2025 & UNITY)

AUTODESK MAYA 2024

This project was developed using a combination of Autodesk Maya 2025 and Unity, two of the most widely recognized tools in the 3D modeling and game development industries. Each software played a crucial role in different aspects of the project, ensuring a smooth and interactive 3D viewing experience.

3.1 3D Modeling & Asset Creation

Autodesk Maya 2025 was used for creating and refining the 3D model displayed in the application. Maya was chosen due to its powerful modeling tools, precise UV mapping, and high-quality rendering capabilities, making it the preferred choice for detailed hard-surface and organic modeling.

Key Features Utilized in Maya 2025

- Polygonal Modeling: Maya’s advanced polygonal tools allowed for efficient hard-surface modeling, ensuring the 3D object maintained a smooth yet optimized structure for real-time rendering.
- UV Mapping & Texturing: Proper UV unwrapping ensured textures were applied accurately, avoiding stretching or distortion in Unity.

- Optimization for Unity: Maya's built-in game asset export tools helped optimize the model for real-time rendering, reducing polygon count without sacrificing visual quality.
- FBX Export Pipeline: The model was exported in FBX format, ensuring seamless integration with Unity, maintaining the correct scale, pivot points, and material data.
- Since Maya supports real-time previews and game engine compatibility, it was an ideal choice for designing assets meant for Unity.

UNITY

3.2 Unity – Game Engine & Interactive Controls

Unity was used to create the interactive 3D viewer, allowing users to rotate, pan, and zoom the model on both PC and mobile devices. Unity was chosen because of its cross-platform support, optimized real-time rendering, and built-in physics and input systems.

Key Features Utilized in Unity

- New Input System: Implemented multi-touch gestures and mouse controls, making the model interactable with rotations, zooming, and panning.
- High-Performance Rendering: Used URP (Universal Render Pipeline) for optimized rendering on mobile devices, ensuring a smooth experience.

- Camera Control & User Interaction: Implemented custom C# scripts to allow users to drag to rotate, pinch to zoom, and two-finger pan the model.
- Touch & Mouse Compatibility: Unity's New Input System allowed for seamless gesture recognition, making it function well on both PC (Mouse) and Mobile (Touchscreen).
- Lighting & Shadows: Configured directional lighting and real-time shadows to enhance the depth and realism of the 3D model

3.3 Why Use Autodesk Maya & Unity Together?

The combination of Autodesk Maya 2025 for modeling and Unity for interactive viewing provided a powerful pipeline for developing a smooth, high-quality 3D Model Viewer. Maya ensured that the assets were visually appealing and optimized, while Unity provided a real-time interactive experience with efficient rendering and input handling.

This seamless integration of Maya and Unity allows for scalability, meaning the viewer can later be expanded into AR/VR applications or an interactive e-commerce platform.

CHAPTER 4

PRESENT TECHNOLOGY

4.1 3D Mapping and GIS Systems

Modern 3D mapping and Geographic Information Systems (GIS) provide interactive digital environments for navigation and exploration. Platforms such as Google Earth, CesiumJS, and ArcGIS allow users to visualize real-world locations in 3D, offering precise geographical data with tools for zooming, panning, and rotating. These technologies are widely used in urban planning, environmental studies, and virtual tourism, enabling users to interact with terrain, buildings, and infrastructure in a realistic manner.

4.2. Game Engines for 3D Navigation

Game engines like Unity and Unreal Engine are widely used for interactive 3D visualization due to their real-time rendering capabilities, physics-based interactions, and optimized performance. These engines provide built-in tools for camera controls, allowing users to pan, zoom, rotate, and drag within a 3D environment. Additionally, they support advanced lighting, texture mapping, and physics simulations, making them ideal for architectural visualization, virtual walkthroughs, and simulation-based training.

4.3. Web-Based 3D Visualization

Web-based technologies such as WebGL, Three.js, and Babylon.js enable browser-based 3D navigation without requiring dedicated software installations. These frameworks allow users to interact with 3D objects and environments in real time, providing features like dynamic rendering, smooth camera movement, and interactive

UI elements. Such technologies are used in educational platforms, online museum exhibits, and digital real estate showcases, offering accessible and lightweight solutions for interactive 3D experiences.

4.4 Navigation Systems in Urban and Campus Planning

Modern urban and campus planning tools integrate 3D navigation systems to help users explore large-scale environments efficiently. Technologies like CityEngine and BIM (Building Information Modeling) software create detailed 3D city models with interactive navigation capabilities. Universities and smart city projects utilize digital twin models to provide campus tours, facility management, and infrastructure planning, enhancing spatial awareness and decision-making processes.

These advanced technologies contribute to the evolution of interactive 3D navigation systems, providing efficient, scalable, and user-friendly solutions for a wide range of applications.

CHAPTER 5

PROPOSED DESIGN

5.1 3D Environment and Model Design

The 3D environment consists of a detailed and accurate representation of buildings, roads, and landscapes to provide an interactive and immersive experience. The models are optimized with a balanced polygon count to ensure smooth performance without compromising visual quality. Each building within the environment is assigned a distinct label, making it easier for users to identify structures while navigating through the system. This design ensures clarity and usability, allowing users to explore the virtual environment effectively.

5.2 User Interaction and Navigation Controls

The system incorporates intuitive navigation controls to allow users to interact smoothly with the 3D environment. Users can pan across the scene by dragging the screen, enabling movement in different directions. The zoom function lets users focus on specific areas or buildings by adjusting the camera distance. The rotate feature allows users to change their viewing angles, giving them a complete perspective of the surroundings. Additionally, the drag functionality ensures seamless movement across the space, making the navigation experience more dynamic and user-friendly. These controls collectively provide an interactive and flexible approach to exploring the 3D environment.

5.3 Labeling and UI Features

To enhance user interaction, each building in the environment includes a label that appears when the user hovers over or selects the structure. These labels are designed to be clear and readable, adjusting dynamically based on zoom levels to maintain visibility.

This feature improves accessibility by providing quick information about buildings and locations. Additionally, an optional search or selection menu can be implemented, allowing users to find specific buildings efficiently without manually navigating through the entire environment. The UI elements are minimal yet effective, ensuring that the navigation experience remains engaging without unnecessary complexity.

5.4. Optimization and Performance Enhancements

To ensure smooth performance, the system employs various optimization techniques. The Level of Detail (LOD) method is used to dynamically adjust the complexity of 3D models based on their distance from the camera, reducing the rendering load. Occlusion culling is implemented to hide objects that are not currently visible to the user, further optimizing performance. Additionally, efficient texture mapping is used to maintain high-quality visuals while minimizing processing power and load times. These enhancements ensure that the navigation system remains responsive and efficient, even when handling complex environments.

5.5 System Architecture

The overall architecture of the system is designed to integrate 3D models, camera controls, and user interface elements seamlessly. The 3D models are carefully created and imported into the rendering engine, ensuring accurate representations of buildings and landscapes. A robust camera system is implemented to manage user interactions, including smooth transitions between pan, zoom, rotate, and drag functionalities. The user interface consists of labels and an optional menu system that provides additional navigation support. The integration of these components ensures that the 3D navigation system delivers a smooth and interactive experience, making it suitable for campus tours, architectural visualization, and virtual exploration of real-world locations.

CHAPTER 6

IMPLEMENTATION DETAIL

6.1. Scene Setup

- Import the 3D Model into Unity.
- Add a Main Camera focusing on the model.
- Attach `TouchController.cs` script to the 3D Model Object.
- Adjust Lighting & Environment for better visualization.

6.2. Input Controls

Action	Mouse (PC)	Touch (Mobile)
Rotate	**Left Click + Drag**	**1 Finger Drag**
Pan	**Right Click + Drag**	**2 Fingers Drag**
Zoom	**Scroll Wheel (Toggle with "Z")**	**Pinch Gesture**

CHAPTER 7

OUTPUT

Fig 1:Aerial View of Rajalakshmi Engineering College

This is a top-down aerial view of Rajalakshmi Engineering College captured from Google Maps. It provides a broad overview of the entire campus layout, including buildings, roads, and open spaces. This serves as a reference for the 3D models of the college.

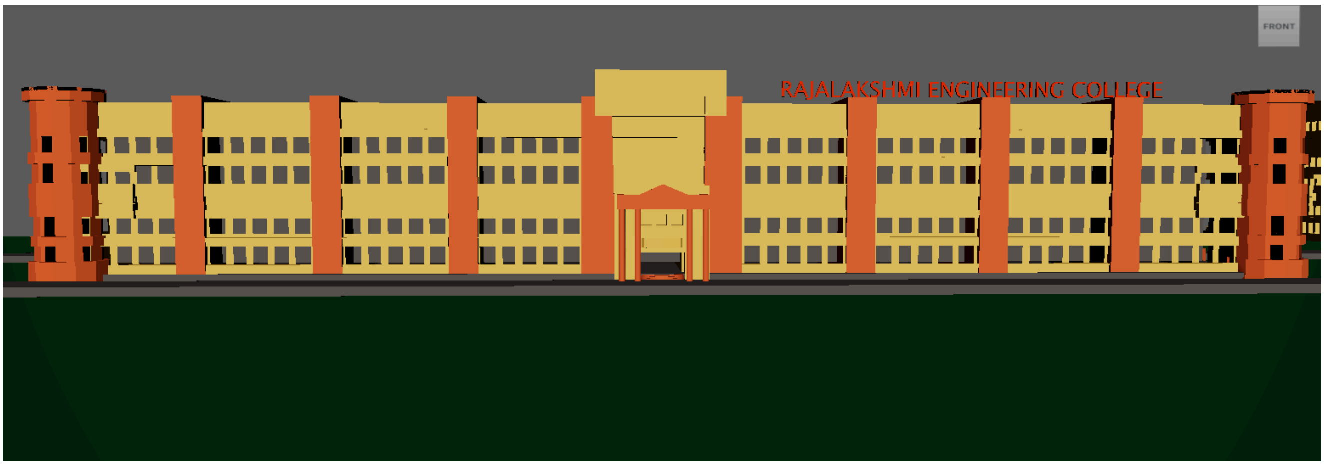

Fig 2: 3D Model of the Admin Block with Front Campus Environment

The Admin Block is the central hub of the college, housing key administrative offices such as Student Affairs, Accounts, Faculty Offices, and the Principal's Office. The block also includes classrooms, a seminar hall, staff rooms, and a server room. The surrounding environment is modeled to reflect the main entrance zone, which is the heart of the campus where students and faculty frequently gather.

Fig3: Perspective View of the Admin Block

- ***This perspective shot provides a detailed architectural visualization of the Admin Block, showcasing its structural design, entrance, and spatial layout. The model emphasizes the building's main facade, entrances, and surrounding areas, giving a realistic perspective of how it appears in real life.***

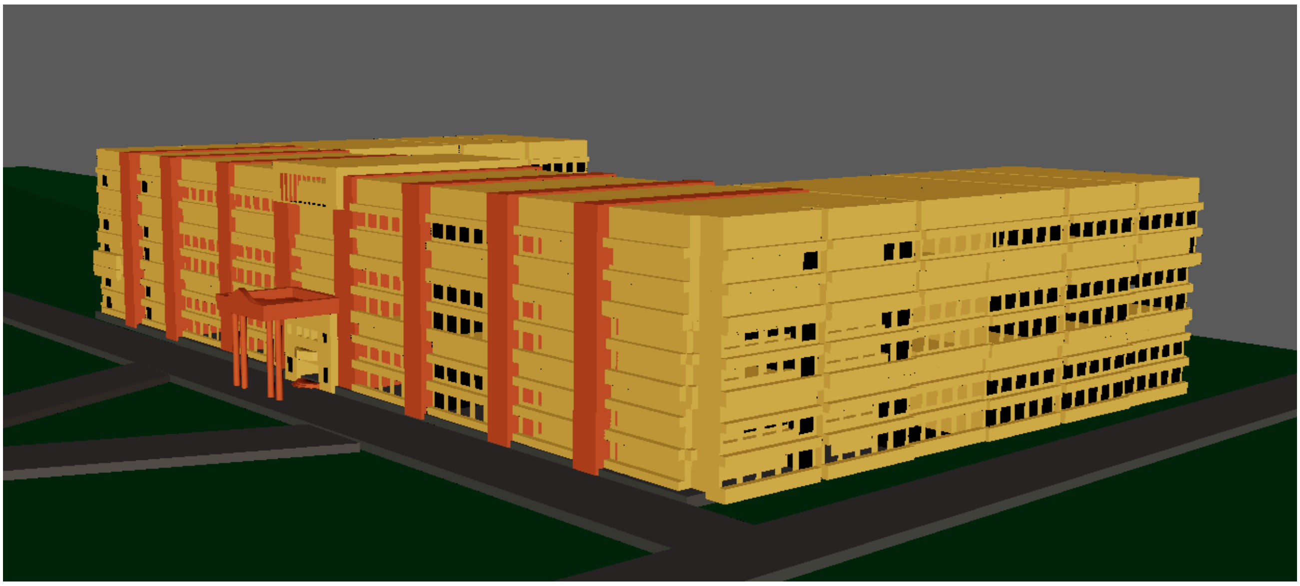

Fig 4: Perspective View of B Block (Workshop & ECE Block)

- ***This 3D perspective showcases B Block, which is the first and most prominent building visible upon entering the college. It serves as the Workshop & ECE Block, containing essential academic and administrative facilities such as:***

1. ***Seminar Hall***
2. ***ECE Department (Electronics and Communication Engineering)***
3. ***Staff and Faculty Offices***
4. ***Classrooms (spread across four floors)***
5. ***ECE Labs, Exam Cell, and Faculty Cabins***
6. ***This block is also the widest building on the campus, designed to accommodate a large number of students and faculty.***

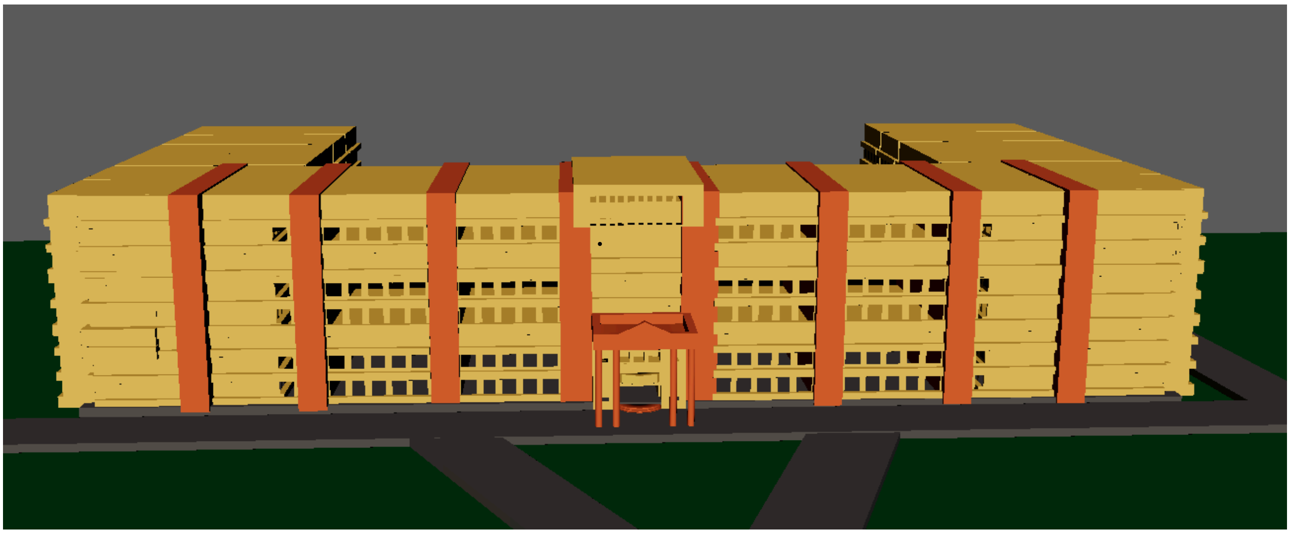

Figure5:- Front View of B Block

- ***A frontal view of B Block, showcasing its grand entrance and architectural layout. This view highlights the main access points, pathways, and building elevation, giving a clear representation of how the block integrates into the college landscape.***

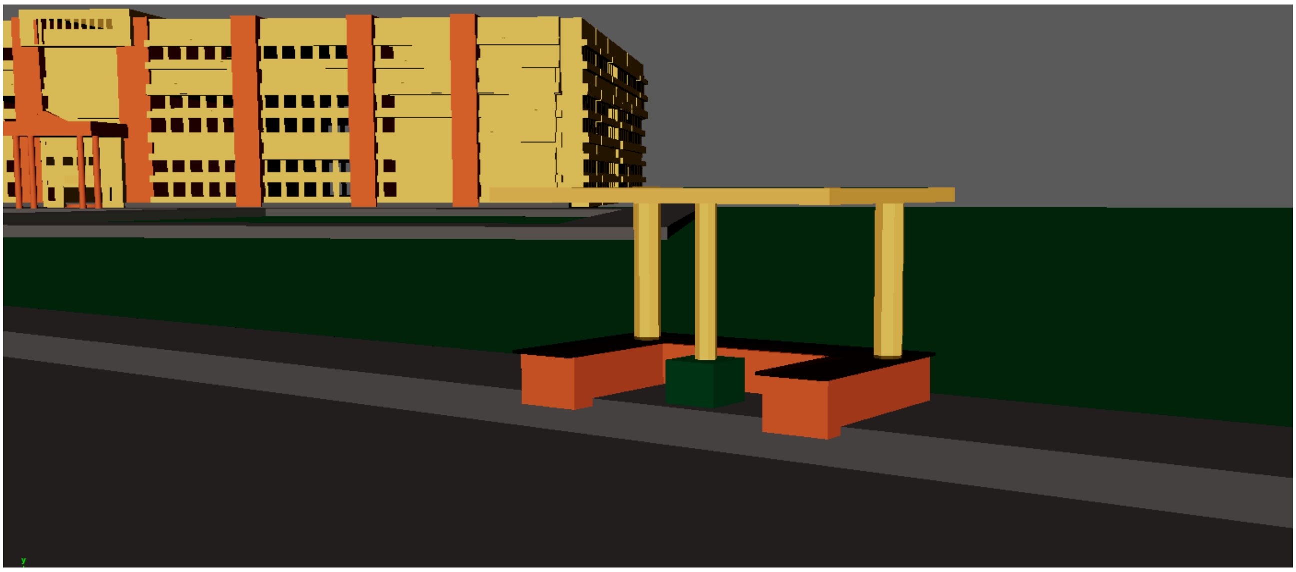

Fig 6:Aesthetic Spots for Students (Seating & Study Areas)

Fig 7:Hashtag Logo of Rajalakshmi Engineering College ("#REC")

- *A trendy and modern branding element, this hashtag logo prominently displays "#REC" (short for Rajalakshmi Engineering College). This is the first noticeable landmark at the college entrance, making it an iconic spot for students and visitors.*

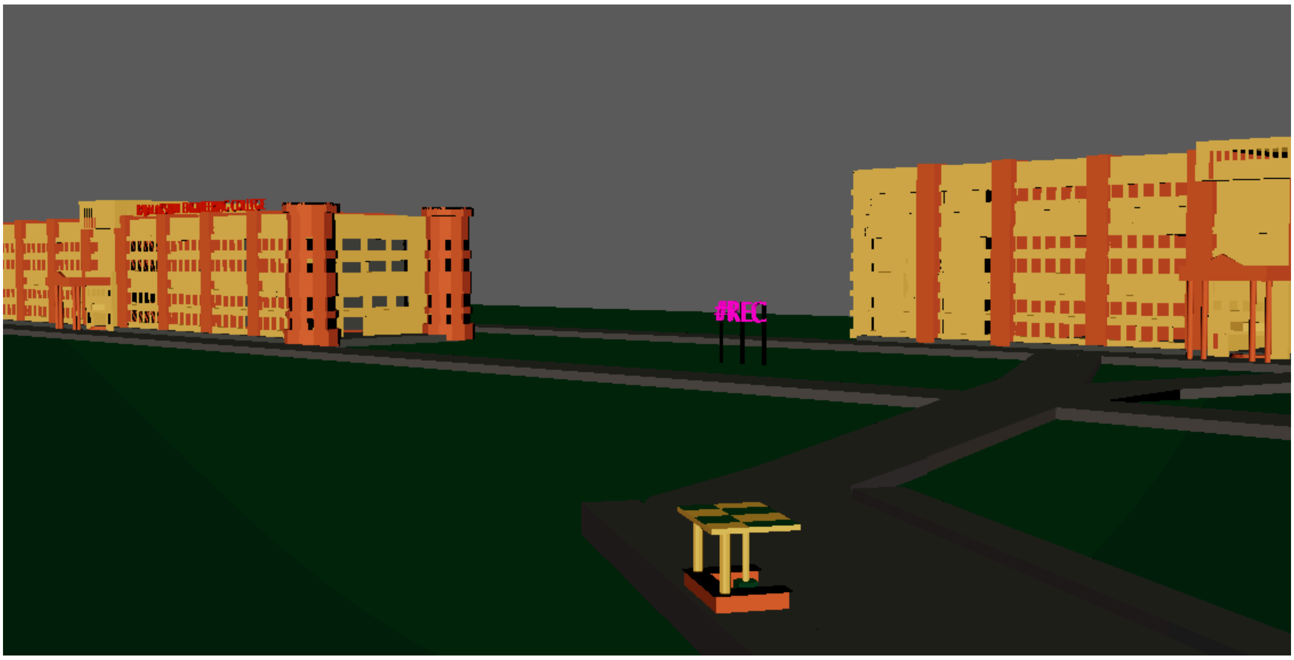

Fig 8:Overall View from Bench Spot to Admin and B Block

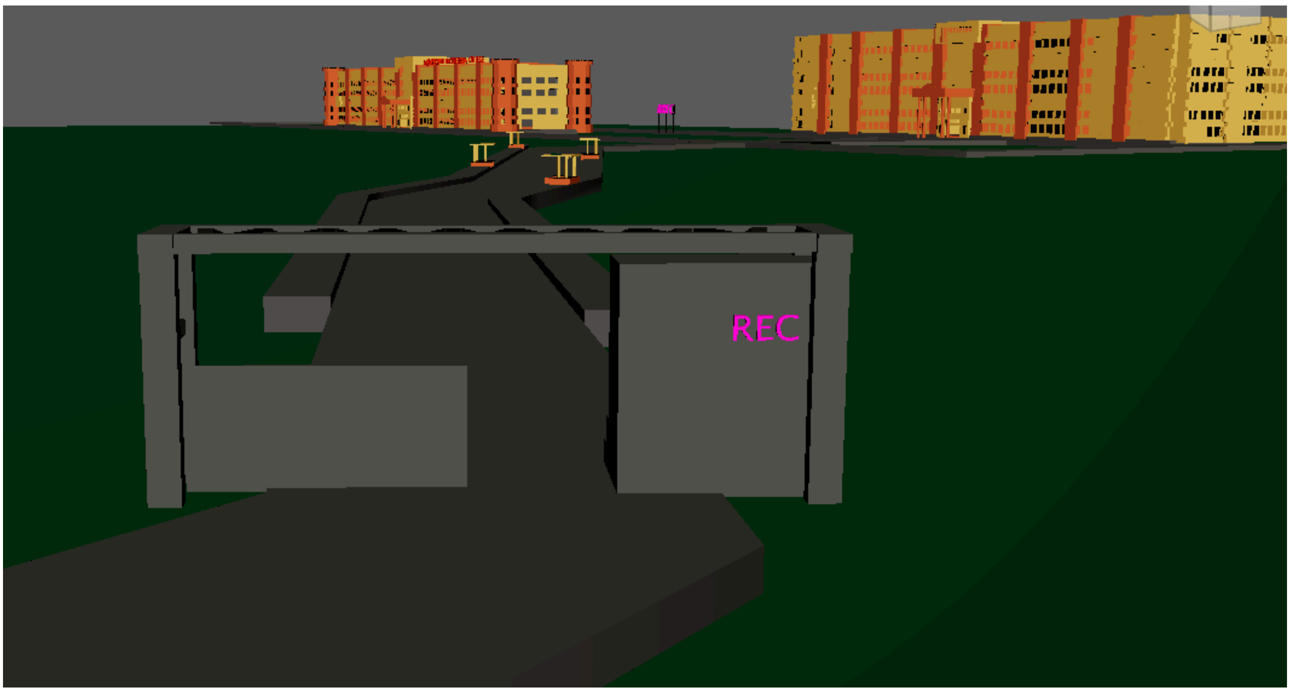

Fig 9:Main Gate of Rajalakshmi Engineering College

CHAPTER 8

FUTURE SCOPE

The 3D Navigation System has significant potential for future enhancements and expanded applications. One of the key advancements could be real-time data integration, allowing for dynamic updates such as construction changes, event locations, or traffic information within the environment. This would make the system more adaptable for urban planning, smart city applications, and large-scale facility management.

Another possible improvement is the implementation of AI-driven navigation assistance, which could provide users with personalized route suggestions, location-based insights, and automated building recognition. By integrating machine learning algorithms, the system could enhance user experience by offering predictive navigation and intelligent search functionalities.

Incorporating multi-user interaction is another future development that can transform the system into a collaborative virtual space. Users could interact with each other, share navigation insights, or conduct guided virtual tours in real time. This feature would be beneficial for educational institutions, corporate campuses, and tourism applications.

The system can also be expanded to support cross-platform accessibility, including web-based and mobile applications, ensuring a seamless experience across different devices. Optimization techniques such as cloud-based rendering and streaming could further enhance performance, enabling smooth interaction with large-scale 3D environments without requiring high-end hardware.

Overall, the future scope of this project includes real-time updates, AI-driven assistance, multi-user collaboration, cross-platform compatibility, and cloud-based optimizations, making it a highly scalable and adaptable system for various industries.

CHAPTER 9

CONCLUSION

The 3D Navigation System provides an intuitive and interactive platform for exploring a virtual environment with detailed 3D buildings and landscapes. With features such as pan, zoom, rotate, and drag, users can seamlessly navigate through the digital space, while labeled buildings enhance clarity and usability. The system is designed with optimization techniques to ensure smooth performance, making it an effective tool for applications like campus tours, architectural visualization, and urban planning.

With the potential for future enhancements, such as real-time updates, AI-driven navigation, multi-user interaction, and cross-platform accessibility, the system can evolve into a more advanced and scalable solution. Overall, this project demonstrates the effectiveness of 3D visualization in navigation, offering a user-friendly and immersive experience for virtual exploration.

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