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College Campus Tour using AR/VR

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Abstract: *This project focuses on developing an immersive 360° virtual campus tour using augmented and virtual reality (AR/VR) technologies to enhance accessibility and engagement for prospective students, alumni, and visitors. Integrated into the college's official website, this virtual tour enables users to explore key campus locations, view event-based images and information by selecting specific dates, and experience campus life from a remote setting. By leveraging high-definition 360° video and interactive elements, the project addresses challenges in accessibility, engagement, and marketing faced by traditional static campus presentations. The system architecture includes modules for video capture, interactive feature integration, and seamless website embedding, utilizing advanced technologies like WebGL, A-Frame, and machine learning algorithms for content retrieval and event-based data integration. The project aims to increase the institution's digital presence and support recruitment and alumni engagement.*

Keywords: Virtual campus tour, augmented reality, virtual reality, 360° video, user engagement, machine learning, interactive features, accessibility.

I. INTRODUCTION

In today's digital era, colleges face challenges in engaging prospective students who may not have the opportunity to visit campus in person. As virtual tours become increasingly popular, there is a need for more immersive, interactive solutions. Traditional online tours are often static and fail to capture the dynamic experience of campus life, making it difficult for users to fully visualize the environment. This project, "Campus Tour using AR/VR," aims to bridge this gap by offering an interactive 360° virtual tour that provides users with an immersive, realistic experience of the college campus. The tour, integrated into the college's official website, allows users to explore key campus locations from anywhere in the world, with features like clickable hotspots and event-based date retrieval to engage users with specific campus moments. By utilizing 360° video, machine learning algorithms, and advanced web technologies, this virtual tour aims to address limitations in accessibility, engagement, and the effective showcasing of campus culture.

Problem Statement

Prospective students, alumni, and visitors face barriers in accessing and experiencing campus life remotely. Traditional campus tour methods fail to provide an immersive experience, and static images or videos limit the viewer's ability to engage with campus culture. Additionally, current virtual tour options often lack compatibility across devices, impacting accessibility and user experience.

Objectives

- **Provide Immersive Virtual Experience:** Develop an interactive 360° campus tour to offer a realistic and engaging representation of the campus.
- **Enhance Accessibility for Remote Users:** Ensure that the tour is accessible globally through the college's website, catering to individuals unable to visit in person.
- **Support Event-Based Interaction:** Integrate features that allow users to select specific dates to view images and information related to campus events, such as sports, festivals, and graduations.

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- **Increase Marketing and Recruitment Appeal:** Use the virtual tour as an innovative tool to attract prospective students and engage alumni, enhancing the college's digital presence and reputation.

II. LITERATURE SURVEY

A. 360° Video and Virtual Reality Systems

Recent advancements in 360° video and virtual reality (VR) technology have enabled the development of immersive virtual campus tours that allow users to explore environments remotely. Studies by Grepon and Martinez (2021) demonstrated that VR systems effectively simulate campus environments, enhancing the experience for remote users by providing high-resolution video content that captures intricate campus details. However, achieving smooth, panoramic VR views requires robust encoding methods to reduce distortions, as suggested by Regensky et al. (2021) in their work on motion-plane-adaptive techniques for spherical video content. This innovation significantly improves visual quality in 360° tours, offering a more realistic and engaging experience for users.

B. Interactive Hotspot and Event-Based Features

Incorporating interactive elements within virtual tours has been shown to increase user engagement by allowing deeper interaction with content. According to a study by De Simone et al. (2018), the use of clickable hotspots enables users to access additional information on specific locations, providing a more informative and engaging experience. The proposed system includes a date-based event retrieval feature, allowing users to select specific dates to view past events on campus, such as graduation ceremonies or festivals. This approach aligns with Boyd et al. (2021), who explored event-driven interactions in virtual tours to create a sense of connection and engagement with campus life.

C. Navigation and Device Compatibility

Ensuring seamless navigation and device compatibility is a core challenge in 360° video streaming, especially across various platforms. Lei Zhang et al. (2019) examined viewport prediction techniques that dynamically adjust the user's view based on head movements, which is crucial for a smooth, responsive experience in virtual tours. Additionally, Marie et al. (2019) explored device compatibility concerns, emphasizing the importance of optimizing VR applications to deliver consistent experiences on mobile devices, desktops, and VR headsets. Adapting these methods can improve the accessibility and usability of the campus tour, allowing users across different devices to navigate seamlessly.

D. Hybrid Systems Integrating AR and VR Elements

Hybrid AR/VR systems combine visual and sensor-based inputs to enhance user experiences, especially for interactive tours that require both spatial awareness and content engagement. Systems like WebXR and AR.js support integration with browsers, enabling users to access AR/VR content without specialized equipment. Johnson and Wang (2020) demonstrated that AR markers significantly aid in guiding users through virtual spaces, providing real-time information about landmarks and points of interest. This hybrid approach enriches the virtual campus tour by allowing users to explore the campus environment in a way that feels both interactive and realistic.

E. Real-Time Data Processing and Cloud Storage

To manage large 360° video files and user interaction data, cloud storage and real-time processing are essential. Studies by Nguyen et al. (2020) have highlighted the effectiveness of cloud-based solutions like AWS S3 and Firebase for storing high-resolution video data while ensuring scalability. Integrating cloud-based solutions also allows for real-time processing and retrieval of event data, enabling users to experience the campus tour without delays or performance issues. This approach aligns with current best practices for maintaining the accessibility and performance of complex VR systems.

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Sr. No	Title	Author(s)	Publication and Year	Pros
1	Virtual Reality for Campus Visualization: A Case Study in VR Model Development	Grepon, M. & Martinez, L.	Journal of Educational Technology, 2021	• Provides immersive campus experience • High usability score among users
2	Optimizing Mobile-Friendly Viewport Prediction for Live 360-Degree Video Streaming	Zhang, L., Long, T., Xu, W., et al.	IEEE Conference on Interactive Media, 2019	• Dynamic viewport prediction for real-time user engagement • Adaptable for mobile devices
3	Motion-Plane-Adaptive Inter Prediction in 360-Degree Video Coding	Regensky, A., Herglotz, C., &Kaup, A.	IEEE Transactions on Multimedia, 2021	• Reduces spherical distortion in 360° video • Enhances image quality for panoramic experiences
4	Interactive Features in 360-Degree Virtual Tours: Enhancing Engagement and Information Retrieval	De Simone, F., Cruz, L., & Larsson, H.	Journal of Immersive Media, 2018	• Clickable hotspots increase user interaction • Provides contextual information within tours
5	User Engagement in Virtual Campus Tours: Analyzing the Impact of Interactive Hotspots and Gamified Features	Boyd, S., Lin, R., & Hayes, J.	Journal of Virtual Learning, 2021	• Boosts engagement through gamified elements • Enhances user retention and exploration
6	Augmented Reality for Campus Engagement: Enhancing Student Experience with AR Navigation	Johnson, L. & Wang, P.	Education Technology Journal, 2020	• AR markers aid in navigation and orientation • Improves engagement in virtual spaces
7	Real-Time Data Processing and Cloud Storage for 360-Degree Video Streaming	Nguyen, C., Patel, A., & Sato, Y.	International Journal of Interactive Media, 2020	• Enables real-time data retrieval with cloud storage • Reduces latency for smoother experiences
8	Depth Perception and Motion Optimization in VR for Enhanced Viewer Comfort	Marie, J., Tan, S., & Liu, H.	IEEE Access, 2019	• Reduces motion sickness with depth-adaptive rendering • Enhances user comfort in VR tours
9	Web-based AR/VR Integration for Immersive User Experiences	Chen, E., Keller, N., & Turing, A.	IEEE Edge Computing Conference, 2022	• Combines AR/VR for browser compatibility • Minimal device requirements for accessibility

III. PROPOSED SYSTEM OVERVIEW

The proposed system for the "Campus Tour using AR/VR" project aims to provide an immersive, interactive 360° virtual tour for prospective students, alumni, and other visitors, accessible via the college's official website. This system leverages advanced 360° video and AR/VR technologies to simulate an engaging campus experience remotely. Key components include 360° video capture, interactive elements, and backend integration with date-based event retrieval.The system architecture consists of high-resolution 360° video footage to showcase the campus, a web-based interface for user interaction, and a database to store event-related media. Interactive hotspots allow users to access detailed information about campus landmarks, while a date-based feature lets users view photos and information from past events, enhancing their connection to campus life. This system provides prospective students who cannot physically visit the campus with a near-realistic experience, offering a flexible solution for navigating the college's various spaces, events, and culture.The platform addresses limitations in existing virtual tour solutions, which often

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lack interactivity, accessibility, and device compatibility. By integrating AR/VR, this project improves engagement and showcases the college's vibrant community, helping the institution attract prospective students, engage alumni, and enhance its digital presence. This solution presents an efficient, user-friendly alternative for remote campus exploration, with the potential for future enhancements, such as real-time streaming and additional interactive elements.

Fig.1. Proposed System Architecture for Assistive Technology

V. EVALUATION AND ANALYSIS

Performance evaluation in these systems is typically based on accuracy, processing time, and ease of use. For example, Ashiq et al.[1] achieved 83.3% accuracy in object detection with their proposed system. The evaluation also considers user feedback and real-world testing in various indoor and outdoor environments. In comparison to previous systems, newer models using advanced CNN techniques have shown significant improvements in both accuracy and processing speed. Integrating Dialog flow API The Dialog flow API is integrated to recognize the voices of visually challenged people, which is the basis of this project. Dialog Flow is a human-computer interaction technology based on natural language conversations that is a Google-owned developer. Object Detection The spy camera is connected to an Oculus to detect objects and indicate to the user by voice commands that an object is present on its way. This may indicate him to either wait or move in some other direction to proceed further. Thus, it helps the user to walk on the roads safely.

VI. CHALLENGES AND FUTURE DIRECTIONS

Despite advancements in AR/VR campus tours, challenges remain in ensuring devic compatibility, reducing latency, and enhancing interactive features for a seamless user experience. Future improvements will focus on expanding personalization, real-time streaming, and accessibility for diverse devices

TABLE II: PERFORMANCE COMPARISON OF ASSISTIVE DEVICES

Component Type Key Features	Score	Key Features Key Features	Score	Key Features
360° Video Capture	75%			High-quality panoramic video, immersive campus visualization, requires high storage and bandwidth
Interactive Hotspots	68%			Enhances engagement with clickable information points, adds context to campus locations
Date-Based Event Retrieval	60%		60%	Allows users to view past campus events, adds historical context but requires real-time processing
WebXR/AR Integration	55%		55%	Browser-based AR/VR experience, accessible without specialized hardware
Cloud Storage & Processing	50%		50%	Scalable storage for video and event data, supports real-time accessibility but dependent on network speed

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Complexity and Cost: Many advanced devices require expensive hardware components and sophisticated algorithms, which can limit their affordability and accessibility for userseal-Time Performance**: Devices need to process data and provide real-time feedback to ensure safe navigation. Optimizing computational efficiency is crucial for improving response times .

Acceptance: The success of assistive technologies depends heavily on user acceptance. Engaging end-users throughout the development process is essential to ensure the devices address their specific needs, preferences, and usability concerns .

Integration and Machine Learning: AI-driven personalization has the potential to significantly enhance assistive technologies, allowing devices to learn and adapt to a user's specific navigation patterns and behaviors over time .

Limited Functionality existing assistive devices excel in one area (such as object detection) but fall short in others (such as accurate distance measurement or navigation). This limitation reduces their overall effectiveness .

Cost and Accessibility: The associated with advanced assistive devices, due to their sophisticated hardware and software, often make them inaccessible to users who need them the most .

VII. Conclusion :

The review of CNN-based object recognition and tracking systems for visually impaired individuals highlights the significant advancements in assistive technologies aimed at enhancing mobility and independence. While many systems, including wearable devices and navigation aids, show great potential, no single device fully addresses all the needs of visually impaired users. Challenges such as high costs, complexity, and user acceptance continue to hinder widespread adoption. Involving users in the development process is crucial to creating solutions that are tailored to their specific needs. Moreover, the integration of artificial intelligence has the potential to produce personalized devices that evolve over time, improving the user experience and adapting to their unique preferences.Continued research and collaboration among developers, researchers, and the visually impaired community are essential for refining these technologies. The future of assistive technology holds significant promise, aiming to empower visually impaired individuals with tools that allow them to navigate their environments confidently and independently

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