Universiti Teknologi MARA
Cawangan Melaka

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College of Computing, Informatics, and Mathematics
Universiti Teknologi MARA Cawangan Melaka, Kampus Jasin
77300, Merlimau, Melaka Bandaraya Bersejarah

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EDITORS

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PREFACE

Welcome to the inaugural volume of the **Progress in Computing and Mathematics Journal (PCMJ)**, a publication proudly presented by the College of Computing, Informatics, and Mathematics at UiTM Cawangan Melaka.

This journal represents a significant step in our commitment to fostering a vibrant research culture, initially providing a crucial platform for our undergraduate students to showcase their intellectual curiosity, dedication to scholarly pursuit, and potential to contribute to the broader academic discourse in the fields of computing and mathematics. However, we envision PCMJ evolving into a beacon for researchers both nationally and internationally. We aspire to cultivate a space where groundbreaking research and innovative ideas converge, fostering collaboration and intellectual exchange among established scholars and emerging talents alike.

The manuscripts featured in this first volume, predominantly authored by our undergraduate students, are a testament to the hard work and dedication of these budding researchers, as well as the guidance and support provided by their faculty mentors. They cover a diverse range of topics, reflecting the breadth and depth of research interests within our college, and set the stage for the high-quality scholarship we aim to attract in future volumes.

As editors, we are honored to have played a role in bringing this journal to fruition. We extend our sincere gratitude to all the authors, reviewers, and members of the editorial board for their invaluable contributions. We also acknowledge the unwavering support of the college administration in making this initiative possible.

We hope that PCMJ will inspire future generations of students and researchers to embrace research and innovation, to push the boundaries of knowledge, and to make their mark on the world of computing and mathematics.

Editors
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UiTM JASIN GO: A NON-IMMERSIVE VIRTUAL REALITY WALKTHROUGH FOR CAMPUS TOUR

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Abstract

This Final Year Project is aimed to develop a non-immersive virtual reality walkthrough aimed at changing the way college tours are completed. The project's goal is to give potential students of the Universiti Teknologi MARA campus Jasin a simple yet entertaining manner to learn about the institution online. From the current method, two problems have been identified which are lack of engagement for new and prospective students and lack of accessibility and mapping. For this project, waterfall methodology has been applied which consists of four phases which are requirement, design, development, and testing phase. A list of activities has been executed in each phase and each activity comes with the deliverables. UiTM Jasin Go: A Non-Immersive Virtual Reality Walkthrough for Campus Tour is a software that needs to download and play it using own personal computer platform. This project provides features that can solve the problem mentioned. Regarding the first problem, the software manages to engage students more to explore UiTM Jasin virtually without needing to move anywhere. Next, the project also has an interactive map that can show the actual building place and information about the building. Hopefully, this application will help in getting to involve more especially new and current students in getting to know more deeply and in detail every building on campus and knowing the true function of each facility. The overall findings in the testing phase can be seen where the average user who tried this project liked it and gave encouraging feedback of 81.43% mean value demonstrates the level of engagement. Lastly, the recommendation for future work for this project is to improve the accuracy and applicability of the information displayed inside the project to ensure there is no information that contradicts the facts. Future work also should improve the detail and can display the actual environment inside the facility.

Keywords: Virtual reality walkthrough; Campus tour; Non-immersive; Engagement; Universiti Teknologi MARA (UiTM) Jasin

INTRODUCTION

UiTM Jasin, one of Malaysia's largest universities, faces challenges in engaging prospective students and providing accessible campus navigation. Traditional methods like brochures and campus tours fall short in engaging today's tech-savvy generation and fail to address accessibility issues. To tackle these problems, this project proposes a non-immersive

virtual reality walkthrough. By leveraging Virtual Reality (VR) technology, it aims to offer an immersive and interactive platform for exploring UiTM Jasin's campus remotely. The project's objectives include designing a walkthrough storyboard, developing the VR walkthrough, and evaluating its engagement. Using the Unity game engine and various technologies, it seeks to provide an informative and user-friendly experience accessible across different platforms.

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LITERATURE REVIEW

Understanding the unique context of UiTM Jasin is essential for grasping the challenges and opportunities inherent in campus tours and the UiTM Jasin Go project. As a branch of Universiti Teknologi MARA (UiTM), Malaysia, UiTM Jasin is committed to providing accessible and quality education to a diverse student body. The campus boasts a range of academic programs and facilities, contributing to its distinct identity within the higher education landscape. However, traditional methods of campus orientation, such as still images and brochures, often fall short in adequately navigating the university's complex layout, leading to challenges for students, particularly newcomers, in finding their way around campus.

These challenges in campus navigation underscore the need for innovative solutions like virtual reality walkthroughs to enhance the overall campus experience. By addressing navigation difficulties and providing an interactive means for students to explore campus, the UiTM Jasin Go project aims to make navigation more accessible and user-friendly. Through a comprehensive understanding of these challenges and the campus environment, the project endeavors to create a welcoming and informative atmosphere for all members of the university community.

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Campus Tour

As technology continues to reshape educational experiences, campus tours have evolved to offer more immersive and engaging virtual experiences. Three primary methods are commonly employed: 360 Virtual Tours, Virtual Reality (VR), and Interactive Maps. 360 Virtual Tours utilizes panoramic images to provide users with a dynamic and interactive exploration of campus surroundings. While offering a visually immersive experience, users have the freedom to navigate and focus on specific areas of interest, catering to individual preferences. Virtual Reality takes campus tours to the next level by immersing users in computer-generated environments, simulating a real-life presence on campus. Through VR headsets, users can explore academic buildings, courtyards, and engage with the campus environment in ways not possible with traditional methods. Interactive Maps complement immersive experiences by providing practical and user-friendly navigation tools, allowing users to engage with dynamic elements and customize their exploration of the campus layout and services.

Upon comparing the three platforms, Virtual Reality emerges as the most suitable choice for the development of UiTM Jasin Go. VR Campus Tours offer a highly immersive and engaging experience, aligning with the project's goal of providing a cutting-edge and user-centric exploration of UiTM Jasin. While Interactive Maps and 360 Virtual Tours serve useful purposes, VR stands out for its realism, interactivity, and ability to create dynamic and memorable college tours. Embracing Virtual Reality technology reflects the project's commitment to innovation and delivering an immersive campus exploration experience for prospective and current students alike.

Virtual Reality

Virtual reality (VR) emerges as a groundbreaking technology in transforming the landscape of campus tours, offering users immersive and interactive experiences within digital environments. VR enables users to step inside a three-dimensional world and interact with it, providing a more engaging exploration of campus surroundings compared to traditional user interfaces (Research Online, 2017). Within the realm of VR, there exist different degrees of immersion, ranging from Non-immersive to Semi-immersive and Immersive Virtual Reality, each offering unique experiences and capabilities.

Non-immersive Virtual Reality allows users to experience computer-generated worlds while remaining aware of their physical surroundings, typically through standard devices such as computers or gaming consoles (Zhu et al., 2023). This type of VR, commonly used in everyday experiences like video gaming, offers a level of engagement that balances virtual immersion with real-world awareness. Semi-immersive Virtual Reality provides users with a partially virtual environment, where they perceive being in a different reality while remaining connected to their physical surroundings (Lorusso et al., 2020). Utilizing high-resolution displays and advanced graphics, Semi-immersive VR offers enhanced realism and is often employed in educational or training contexts.

Immersive Virtual Reality offers the highest level of virtual experience, fully immersing users in digital environments through hardware like VR headsets and motion-tracking devices (Dudley et al., 2023). This immersive experience creates a sense of presence within the virtual space, making it ideal for applications requiring high user engagement, such as interactive learning and exploration. Considering the three types of VR, Non-immersive Virtual Reality emerges as the most suitable choice for the development of the UiTM Jasin Go project, prioritizing simplicity and accessibility while offering an engaging virtual tour experience for a diverse audience. This decision aligns with the project's goal of providing a user-friendly and inclusive campus exploration platform.

Walkthrough in Virtual Tour

In the virtual campus tour of UiTM Jasin Go, the walkthrough serves as a friendly guide, leading users through various areas of the university while sharing interesting stories about key locations such as classrooms, libraries, and sports facilities. This walkthrough is designed to offer both structure and flexibility, allowing users to explore at their own pace while providing detailed information about each place. By weaving storytelling into the tour, users can connect with the campus on a deeper level and feel more familiar and engaged with its offerings. Ultimately, the walkthrough acts as a digital companion, making the campus exploration experience personalized and accessible to all users.

Existing Applications

The examination of existing Virtual Campus tour applications reveals valuable insights into their strengths and areas for improvement. UPSI 360 Dynamic VR Tours stands out for its

immersive approach, allowing users to navigate through Universiti Pendidikan Sultan Idris (UPSI) using dynamic 360-degree views, fostering interactive exploration. Colorado State University VR goes beyond basic tours, integrating informative overlays and interactive elements to provide a comprehensive and engaging experience. Meanwhile, Rice University's Explore Rice emphasizes storytelling to create a deeper connection between users and the institution, showcasing the potential of virtual tours to convey history, culture, and academic offerings. These applications offer important lessons for the development of UiTM Jasin Go, highlighting the need for a balance between interaction and information, the incorporation of storytelling elements, and a design that caters to diverse user preferences and technological proficiency levels. By integrating these insights, UiTM Jasin Go aims to deliver an immersive, user-centric, and inclusive virtual tour experience for all users.

Existing Applications

The methodologies employed in software development play a critical role in ensuring the successful execution of a project. Among the various models available, three prominent ones have been considered for the development of UiTM Jasin Go: User-Centered Design (UCD), Agile Model, and Waterfall Model. User-Centered Design places a strong emphasis on meeting user needs by incorporating comprehensive research and iterative design cycles, resulting in an intuitive and user-friendly product. In contrast, the Agile Model prioritizes flexibility and collaboration, breaking down the project into manageable iterations to facilitate continuous improvement based on user feedback. Meanwhile, the Waterfall Model follows a structured and sequential approach, ensuring clarity and predictability throughout the development process.

Upon comparing these methodologies, the Waterfall Model emerges as the most suitable choice for the development of UiTM Jasin Go. Its structured and linear approach aligns well with the project's requirements, providing a systematic framework for progressing through well-defined development phases. The Waterfall Model offers predictability and control, ensuring that each stage is completed before advancing to the next, which is crucial for creating a comprehensive and well-executed virtual campus tour experience. While User-Centered Design and Agile Model emphasize adaptability and iterative development, the stability of project requirements and the desire for a systematic development process make the Waterfall Model the preferred methodology for this project.

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METHODOLOGY

The Waterfall Model stands out as a structured and sequential approach to software development, offering a systematic workflow through distinct phases. Each phase builds upon the completion of the previous one, ensuring a clear progression from requirements gathering to implementation and testing (Petersen et al., 2009). This methodology is particularly suitable for projects with well-defined and stable requirements, such as UiTM Jasin Go, as it provides a comprehensive framework for meticulous planning and execution.

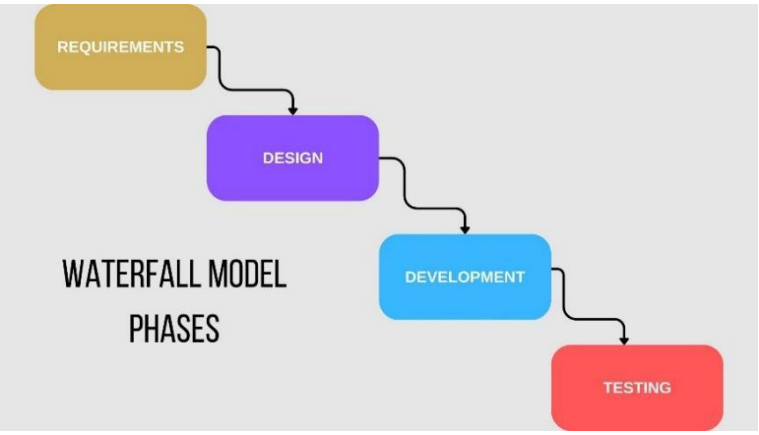

Figure 1: Waterfall model phases

Phases of waterfall model phases

In the Requirements phase of the Waterfall Model, the focus is on gathering and documenting project goals, functionalities, and specifications. For UiTM Jasin Go, this involves understanding the desired features of the virtual campus tour and user expectations. Clear and detailed documentation at this stage lays the foundation for subsequent phases, guiding the entire development process (Leloudas, 2023). Following this, the Design phase utilizes flowcharts and storyboards to outline the project's structure and flow. Flowcharts visually depict the process flow, guiding developers from the beginning to the end, while storyboards illustrate the sequence of events and scenarios within the game (Algorithms, Flowcharts and Pseudocodes, 2018). This phase ensures a clear roadmap for the project's development.

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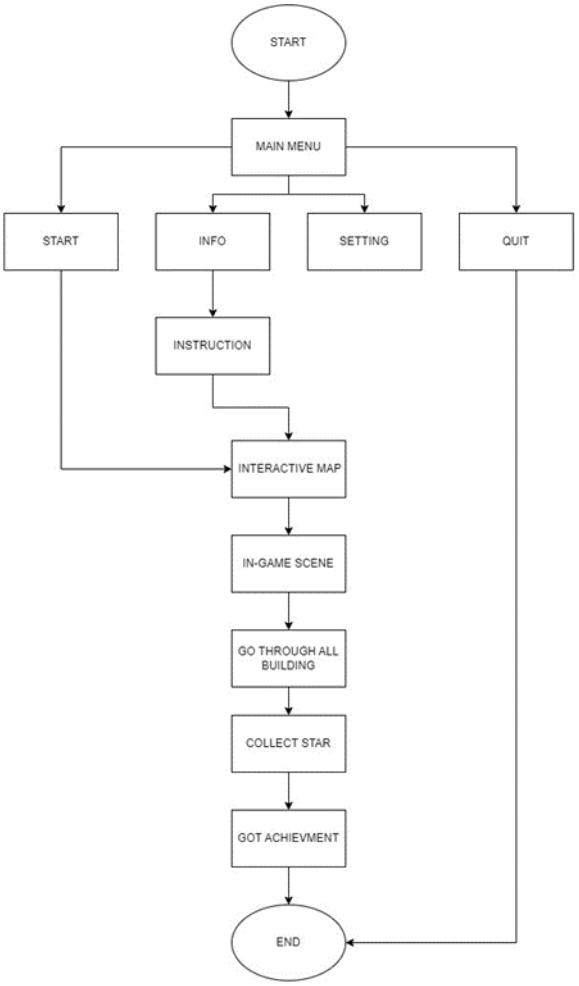

Figure 2: Flowchart of the project

The low-fidelity storyboard for UiTM Jasin Go provides a graphical representation of the project's narrative flow, aiding in the visualization and creation process. It outlines the main menu options, interactive map functionality, and in-game scene progression, offering a comprehensive overview of the user experience (Petersen et al., 2009). By following the structured approach of the Waterfall Model and leveraging visualization tools like flowcharts and storyboards, the development team can effectively plan and execute each phase of the project, ensuring the successful delivery of UiTM Jasin Go.

The Development phase of UiTM Jasin Go involves the actual coding and implementation of the project, bringing the design to life according to the specifications outlined in earlier phases. Development teams use Unity, a versatile game development engine, to create the virtual campus tour environment and integrate various features and functionalities

(Unity, 2023). Additionally, Blender is utilized for 3D modeling and animation, Adobe Photoshop for graphic design and asset production, and Visual Studio Code for writing and editing source code (Blender, Adobe, Visual Studio, 2023).

In the subsequent Testing phase, two crucial forms of testing are conducted: functionality testing and engagement testing. Functionality testing ensures that UiTM Jasin Go operates seamlessly, with all features performing as intended. Testers evaluate various game elements to uncover any bugs or issues that might affect smooth functionality. Engagement testing assesses the game's ability to captivate players and immerse them in its virtual environment. Factors such as gameplay mechanics, storyline, and visual aesthetics are scrutinized to enhance the overall player experience (Functionality Testing, Test for Engagement, 2023). These testing stages play a vital role in refining UiTM Jasin Go to deliver an engaging and glitch-free virtual campus tour experience.

DESIGN AND DEVELOPMENT

The project's design and development phases are crucial as they are when the real game production starts. A thorough flow plan is essential to preventing issues, hence some assessments need to be completed. The developer conducts analysis of the project requirements, game flow, implementation, and assessment; specifics of these procedures are outlined below.

Hardware Requirements

Hardware requirements for UiTM Jasin Go are listed, detailing the devices and equipment needed for optimal performance.

Table 1: Hardware Requirements

Hardware	Requirements
Device	Personal Computer or Laptop
RAM	8GB
CPU	Intel(R) Core(TM) i5-6400 CPU
GPU	Intel HD Graphics 530
STORAGE	5GB

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Software Requirements

The software requirements for developing the non-immersive virtual reality (VR) walkthrough for UITM Jasin's campus exploration encompass a carefully selected suite of tools to ensure functionality and seamless integration. The key software components include:

Blender: Blender is utilized for 3D model development, allowing for the creation and modification of intricate three-dimensional models that represent UITM Jasin's campus elements within the VR environment

Unity: Unity serves as the core development platform for constructing the VR walkthrough, offering a comprehensive suite of tools for game development, rendering, physics, and interaction, ensuring a smooth and immersive user experience

Adobe Photoshop: Photoshop is employed for image editing and manipulation, enabling the creation of high-quality textures, graphics, and visual elements to enhance the overall aesthetics of the VR walkthrough.

Visual Studio Code: Visual Studio Code acts as the integrated development environment (IDE) for coding and scripting within the Unity framework, facilitating efficient code writing, debugging, and collaboration to ensure the seamless integration of functionalities into the VR walkthrough.

These software tools collectively contribute to the creative and functional aspects of the VR walkthrough, enabling the development of an engaging and immersive exploration experience for users.

Design Phase

The design phase of the project outlines the overall process and visualizes the game flow through a flowchart and a high-fidelity storyboard.

The overall project process begins with an analysis of project requirements, followed by brainstorming key features and design elements using software tools like Blender, Unity, Photoshop, and Visual Studio Code. Blender is utilized for creating and manipulating 3D models, Unity serves as the central hub for development, Photoshop contributes to enhancing

aesthetics, and Visual Studio Code facilitates efficient coding and scripting within the Unity framework.

The project flowchart illustrates the game's flow, starting from the main menu where players can choose to play or quit. Selecting the play leads to the tutorial level, followed by the UiTM Jasin scene where the walkthrough begins. The high-fidelity storyboard provides a detailed visualization of the game's look, enhancing understanding of the final product and aiding in the design process.

Development

During the development phase of the project, various platforms including Unity, Blender, Adobe Photoshop, and Visual Studio Code were utilized. Objects and components obtained from the internet were modified to create a unique version of the project. Adobe Photoshop was used for graphic components, while Blender was employed for creating 3D models.

In 3D model development, Blender was used to create and manipulate three-dimensional models, ensuring an accurate representation of UiTM Jasin's campus elements. The environment development involved translating campus layouts and landmarks into a digital version to craft an immersive virtual space using the Unity engine.

Gameplay development focused on creating interactive elements such as campus maps and informative pop-ups to enhance user engagement. Menu development played a crucial role in user navigation and interaction, with intuitive and user-friendly menus seamlessly integrated into the VR walkthrough.

The scripting process involved using C# to create functionalities such as player movement, dialogue, and gameplay. Scripts were developed using Visual Studio Code, allowing for customization according to project needs.

Application Implementation

During the application implementation phase, the focus shifts to seamlessly integrating interactive elements and gameplay mechanics into the UiTM Jasin Go project. This involves carefully adding user interactions, controls, feedback systems, and engaging components to enhance the overall user experience. Emphasis is placed on creating intuitive tools for user navigation and incorporating feedback mechanisms like visual cues to make the interface

responsive and user-friendly. The goal is to ensure that the virtual tour remains enjoyable and easy to use for all users.

The integration of game scenes is a crucial step where different parts of the virtual campus tour are merged to create a smooth and logical experience. Technical challenges associated with combining scenes are addressed, with a focus on maintaining a seamless transition to enhance the flow of the game. Methods used to create a unified and immersive experience are discussed, aiming to improve the overall quality of the user's journey through UiTM Jasin Go.

TESTING & EVALUATION

Functional Testing

Functional testing ensures that UiTM Jasin Go works smoothly and meets its intended purpose. This involves checking every feature to ensure they operate well together, including navigating the virtual tour and accessing information. We also examine interactive elements to ensure seamless functionality. Any issues identified during testing are addressed to ensure UiTM Jasin Go provides a reliable and user-friendly experience. The results of this testing guide us in making necessary improvements for an optimal virtual campus tour.

Engagement Testing

Engagement is crucial for creating an effective learning experience, especially in the context of the UiTM Jasin Go project. To measure users' level of interest and absorption in this educational journey, we use the Game Engagement Questionnaire (GEQ). The GEQ assesses factors like Immersion, Absorption, Flow, and Presence, guiding our evaluation of the walkthrough's engagement level. This evaluation aligns with our objective of creating and evaluating an immersive and captivating learning experience within the UiTM Jasin environment.

Findings

Demographic findings indicate that the majority of participants (94.2%) are aged between 18-22, with a smaller proportion (5.8%) falling in the 23-30 age range. In terms of gender distribution, 67.3% of participants are male, while 32.7% are female. Semester-wise

representation reveals that most participants (71.2%) are from Semester 1, followed by Semester 2 (26.9%), and Semester 3 (1.9%).

The Game Engagement Questionnaire (GEQ) is instrumental in evaluating user experience within UiTM Jasin Go. It measures engagement across dimensions such as Immersion, Absorption, Flow, and Presence. These dimensions assess aspects like users' involvement in the simulated environment, their concentration, the seamless interaction experience, and their feeling of being part of the virtual environment. The GEQ not only evaluates user engagement but also provides demographic insights, helping tailor UiTM Jasin Go to a diverse audience.

Results from the GEQ reveal that Immersion, Absorption, Flow, and Presence are key components of UiTM Jasin Go's engagement. Participants report high levels of immersion (7.19) and agreement with absorption factors (4.90). Flow and Presence also contribute positively to engagement, with mean values of 5.77 and 4.78, respectively. Overall, the engagement level of UiTM Jasin Go is rated at 5.70, exceeding the GEQ norm of 81.43%.

In summary, UiTM Jasin Go successfully achieves its objective of providing an engaging educational experience. The project caters to a diverse audience and effectively immerses users in the virtual campus tour, resulting in high engagement levels across key dimensions.

CONCLUSION AND RECOMMENDATION

The completion of the UiTM Jasin Go project marks a successful endeavor in creating a non-immersive virtual reality (VR) tour aimed at educating users. By integrating key elements like Immersion, Absorption, Flow, and Presence, the project achieved its primary objectives of providing an engaging exploration experience. The Game Engagement Questionnaire (GEQ) confirms that the VR tour effectively immersed players in an educational adventure, enhancing their understanding of various subjects. This project underscores the potential of merging technology and education in an immersive and informative manner.

Despite its success, the project faced certain limitations and weaknesses that warrant attention. Technical constraints, such as hardware compatibility issues and performance variations, may have impacted the consistency of the user experience. Future iterations should

prioritize addressing these technical challenges to ensure a more uniform and optimized performance. Additionally, the predefined scope of the project limited the depth of coverage for certain topics. Expanding the scope could offer users a more comprehensive experience, and future iterations may explore ways to broaden coverage for a deeper exploration of relevant concepts.

Looking ahead, there are opportunities for further advancement and growth in the UiTM Jasin Go project. Addressing identified limitations, including hardware compatibility and scope constraints, is essential for future improvements. Collaborating with experts and educators can enhance the accuracy and relevance of the educational content. Exploring additional gamification elements and enhancing user interaction can further enrich the immersive learning environment. This chapter underscores the project's commitment to innovation and continuous improvement, serving as a foundation for future developments.

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