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Development of a Web-Based First-Person Game of the Legend of Toar and Lumimuut Using Three.js

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Abstract: The legend of Toar and Lumimuut is a foundational Minahasan narrative that is increasingly unfamiliar to younger digital audiences. This research develops Toar & Lumimuut: Legend of Minahasa, a browser-based first-person puzzle adventure game that adapts the legend into an interactive 3D experience using Three.js. The study applied an iterative Game Development Life Cycle consisting of initialization, pre-production, production, alpha testing, beta testing, and release. The game contains two narrative levels: the Coast of Mount Wulur Mahatus and Mount Lolombulan. Each level integrates puzzle mechanics with story progression, including sacred torch activation, stone pillar sequencing, prophecy fragment ordering, sacred seed planting, and eternal flame activation. Technical implementation includes procedural terrain generated with Perlin noise, animated GLB characters and props, an NPC dialogue and quest system, inventory management, bilingual English-Indonesian text support, and browser-based deployment without installation. Functional validation used black box testing with 68 test cases covering movement, interface controls, dialogue, puzzles, timers, game-over states, and level transitions. All test cases passed, producing a 100% functional success rate. User acceptance testing with 15 respondents aged 19 to 21 produced an overall score of 84.44%, categorized as very good. Compatibility testing on Google Chrome, Mozilla Firefox, and Microsoft Edge showed that the game remained playable across three laptops without dedicated GPUs. The results indicate that Three.js can support accessible cultural game development while preserving local folklore through meaningful interactive gameplay.

Keywords: Three.js; First-Person Game; Folklore; Toar and Lumimuut; Web-Based Game;

1. INTRODUCTION

The legend of Toar and Lumimuut is one of the foundational myths of the Minahasa people in North Sulawesi, Indonesia. It has traditionally been transmitted through oral storytelling and is associated with the origin of Minahasan lineage and cultural identity [6]. However, as digital entertainment becomes stronger among younger audiences, traditional

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folklore faces the risk of becoming less familiar to the generation that most actively consumes digital media [2], [5].

Digital games have been studied as a medium for cultural preservation and interactive learning. Theodoropoulos and Antoniou (2022) reviewed immersive games in cultural heritage contexts and found that game-based experiences can increase user motivation, engagement, and cultural knowledge [16]. When cultural content is embedded into game mechanics, players interact with the material through participation rather than passive reading, which supports a more active form of storytelling [8]. Nijdam (2023) showed a similar effect in indigenous digital games, where narrative-driven gameplay helped preserve cultural identity in communities where traditional knowledge was at risk [9]. This research applies the same principle, where the puzzle mechanics and NPC dialogue are designed to carry the Toar and Lumimuut narrative rather than exist separately from it.

At the same time, web-based interactive entertainment has made it possible for games to be accessed directly from a browser without installation. Three.js, which abstracts WebGL complexity into a practical JavaScript library, enables real-time 3D scenes, lighting, materials, animation, and interaction to be created for modern browsers [7], [11], [15]. This makes web-based 3D games a suitable medium for cultural storytelling because the access barrier is lower than native application deployment.

Several previous studies have used games to preserve and present Indonesian folklore. Suardika et al. (2024) developed a 3D MMORPG as a learning medium for folklore using the iterative GDLC, which showed that game-based approaches can effectively present cultural content in an engaging format [14]. Aprilianto et al. (2025) developed the Game Adventure of Cakra as an interactive learning medium based on Indonesian folklore, using a role-playing game framework [3]. Nijdam (2023) developed indigenous digital games focused on cultural storytelling for communities with at-risk traditions [9]. However, these studies use platform-specific engines that require installation, cover different folklore traditions, or do not combine a first-person perspective with browser-based deployment. None of them specifically adapt the Toar and Lumimuut legend into a first-person game that can be accessed directly from a browser.

This research fills that gap by developing a browser-based first-person puzzle adventure game based on the Toar and Lumimuut legend using Three.js. The novelty of this research is in three areas: the use of Three.js as the main framework for a first-person cultural game, browser-based deployment that removes the need for installation, and the adaptation of the Toar and Lumimuut legend into a first-person interactive format for the first time. The objective is to design and develop a web-based first-person game that presents the legend through puzzle mechanics, NPC dialogue, and environmental design using the iterative GDLC. This research contributes a browser-accessible cultural game that shows Three.js can support cultural game development, and provides a reference for similar folklore-based web game projects in Indonesia.

2. RESEARCH METHODOLOGY

This research used the iterative Game Development Life Cycle, consisting of initialization, pre-production, production, testing, beta testing, and release. The iterative model was selected because cultural adaptation, puzzle design, and game usability required repeated refinement during development [13]. Figure 1 shows the iterative GDLC used in this research.

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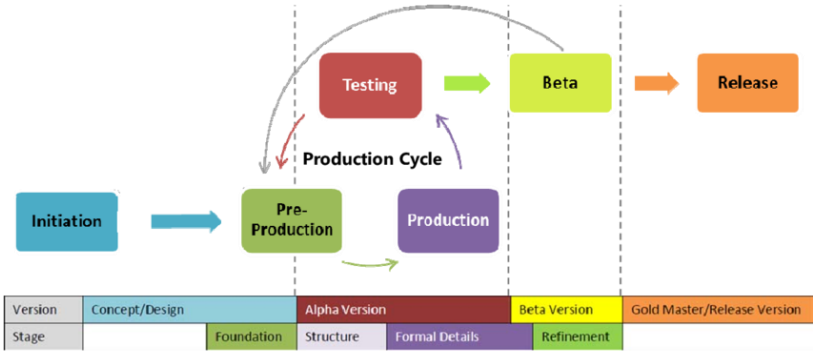

Figure 1. Iterative GDLC flowchart.

The figure shows the six phases of the iterative GDLC arranged in a repeating cycle, where each phase can return to the previous one if issues are found during development.

During initialization, the legend of Toar and Lumimuut was selected as the narrative source and Three.js r128 was selected as the rendering framework. In pre-production, the story was mapped into two playable levels and supporting cutscenes. The first level represents the Coast of Mount Wulur Mahatus, while the second level represents Mount Lolombulan. Production implemented the 3D world, character models, NPC dialogue, inventory, quest log, bilingual text system, puzzle mechanics, and audio system. Testing involved black box functional testing, user acceptance testing, and compatibility testing across three major desktop browsers. The story mapping for both game levels is shown in Figure 2.

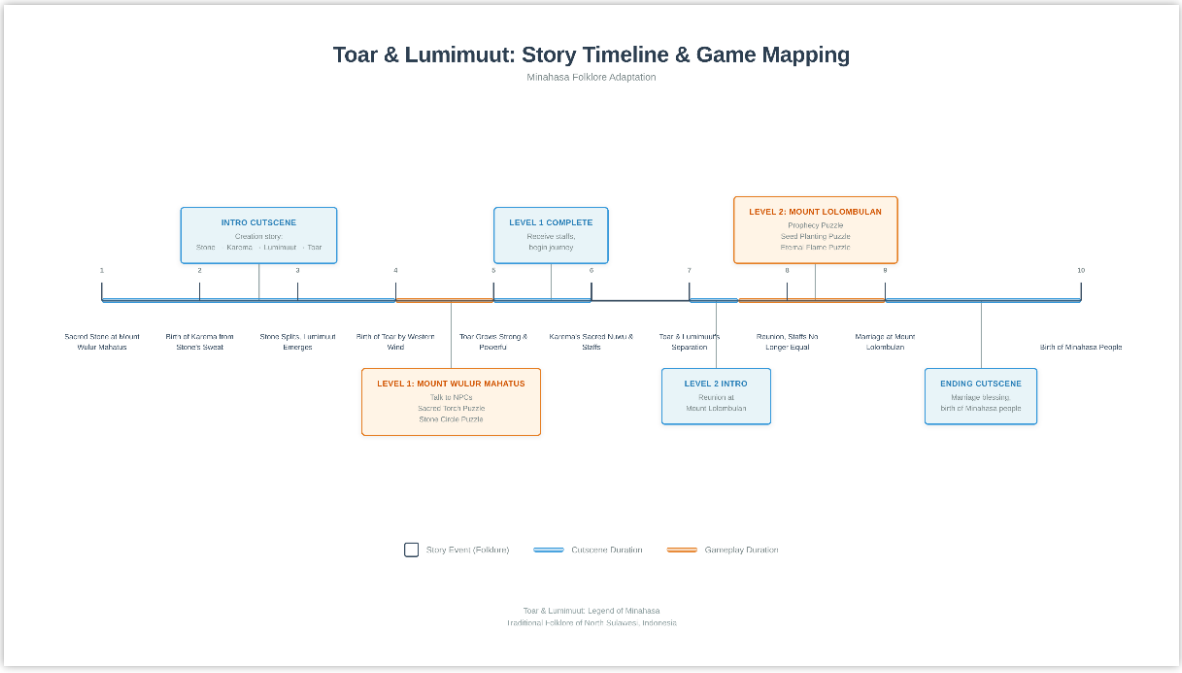

Figure 2. Story timeline and game mapping.

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The figure shows how the key events of the Toar and Lumimuut legend were mapped into Level 1 and Level 2, including the puzzle sequences and cutscene transitions planned for each level.

The development used procedural terrain generated with seeded Perlin noise, raycasting-based terrain collision, and optimized rendering through instanced meshes. All main characters and ambient NPCs were represented as GLB models with animation states, while interface text and narrative messages were stored in a centralized translation map to support English and Indonesian language switching.

Table 1. Summary of the iterative GDLC implementation

Stage	Main Activity	Output
Initialization	Define narrative source, target users, technology, and platform	Game concept and technical scope
Pre-production	Design story flow, levels, puzzles, UI, and asset requirements	Two-level design blueprint
Production	Implement 3D environment, NPCs, puzzles, inventory, audio, and bilingual system	Playable web-based game
Testing	Conduct 68 black box test cases	Functional validation results
Beta testing	Collect user feedback and Likert-scale responses from 15 users	User acceptance score
Release	Package game as HTML and asset directory for static web hosting	Browser-accessible game package

3. RESULT AND DISCUSSIONS

3.1 Game Implementation

The final product is a web-based first-person puzzle adventure game titled Toar & Lumimuut: Legend of Minahasa. The player controls Toar and progresses through two levels connected by cutscenes. The game includes a main menu, disclaimer screen, legend overview, tutorial screens, HUD, quest log, inventory, dialogue boxes, timers, and game-over states. These components were designed to make the cultural narrative understandable while keeping the player guided through the game world. Figure 3 shows the main menu and tutorial screens of the game.

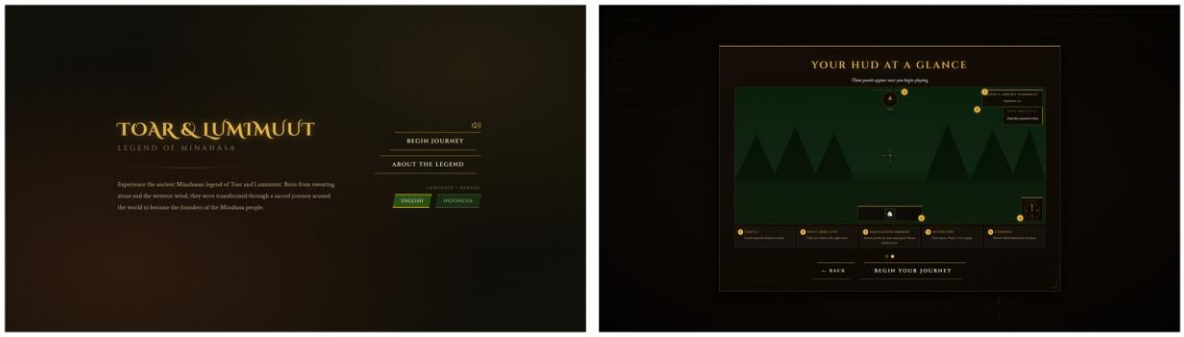

Figure 3. Main menu and tutorial/HUD explanation screens.

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The left side shows the main menu with options for starting the game, selecting a language, and viewing the legend overview. The right side shows the tutorial and HUD explanation screens that appear before gameplay begins, covering movement controls, the quest log, inventory, and compass.

Level 1 focuses on the birth narrative around the Coast of Mount Wulur Mahatus. The player talks with Lumimuut and Karema before completing sacred trials. The level introduces timed exploration, NPC dialogue, torch activation, and stone pillar sequencing. Figure 4 shows the Level 1 environment and the NPC dialogue system.

Figure 4. Level 1 coastal environment and Lumimuut dialogue system.

The left side shows the coastal environment of Mount Wulur Mahatus with its fog and lighting. The right side shows the dialogue box during Lumimuut's conversation with the player, which introduces the first quest objectives. Figure 5 shows the two puzzle mechanics in Level 1.

Figure 5. Sacred torch and stone pillar puzzle implementations.

The left side shows the sacred torch activation puzzle, where the player lights torches in the correct order through proximity interaction. The right side shows the stone pillar sequencing puzzle, where pillars must be activated in a specific order to continue the narrative.

Level 2 represents Mount Lolombulan and expands the puzzle structure through prophecy fragments, seed planting, and eternal flame sequencing. The fog warning and time pressure reinforce the urgency of the final ceremonial stage, while the puzzle mechanics connect gameplay progression with the legend narrative. Figure 6 shows the Level 2 environment and its puzzle systems.

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Figure 6. Level 2 environment and main puzzle systems.

The figure shows the mountain environment of Mount Lolombulan alongside the three puzzles in Level 2: prophecy fragment ordering, sacred seed planting, and eternal flame sequencing.

The quest log and inventory system were implemented to help players track objectives and use collected items. The ending sequence presents the founding of the Minahasa people after all levels and puzzles are completed. Figure 7 shows the quest log, inventory, and ending sequence of the game.

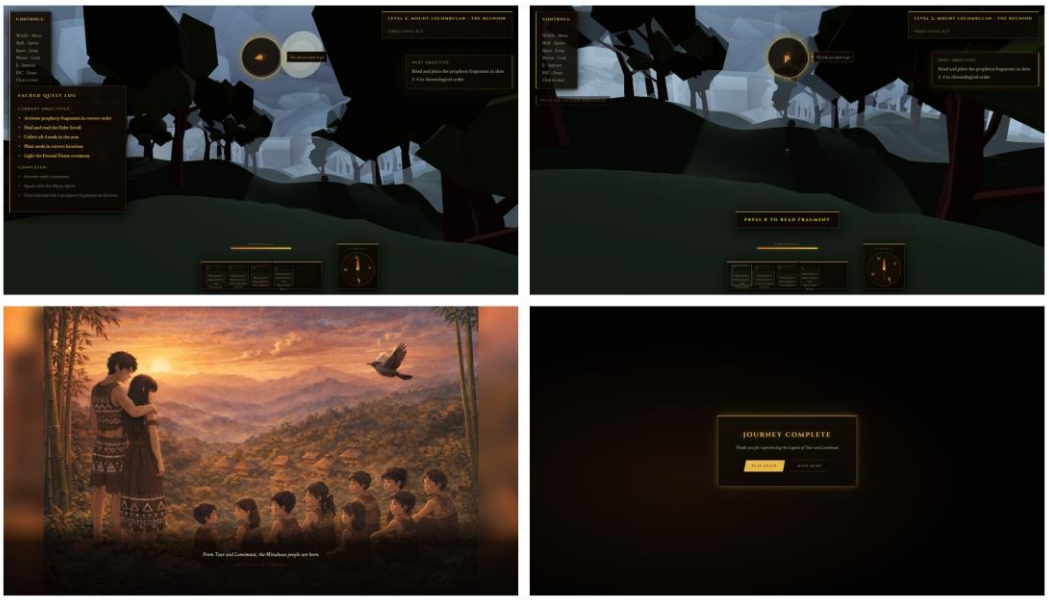

Figure 7. Quest log, inventory, ending cutscene, and completion screen.

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The figure shows the quest log used to track active objectives, the inventory for managing collected items, the ending cutscene that plays after all puzzles are completed, and the game completion screen.

3.2 Functional Testing

Black box functional testing was conducted from the user's perspective. The test cases covered movement and controls, UI toggles, NPC dialogue, puzzle mechanics, timers, game-over conditions, and level transitions. All 68 test cases passed, showing that the implemented features matched the expected outputs.

Table 2. Black box functional testing summary

Test Category	Cases	Pass	Fail
Core movement and controls	9	9	0
UI controls and toggles	11	11	0
NPC dialogue system	8	8	0
Puzzle mechanics	29	29	0
Timer and game-over conditions	6	6	0
Level transitions	5	5	0
Total	68	68	0

3.3 User Acceptance and Browser Compatibility

User acceptance testing was conducted with 15 respondents aged 19 to 21 using a five-point Likert scale. The overall score was 84.44%, which falls into the very good category. The highest score was obtained for clarity of the Toar and Lumimuut story, while the lowest score was related to compass and quest-log navigation, indicating a potential future improvement area.

Table 3. User acceptance testing selected highlights

Aspect	Selected Result	Interpretation
Functionality	Feature correctness scored 89.33%	Very good
Usability	Inventory ease of use scored 90.67%	Very good
Content	Story clarity scored 92.00%	Very good
Overall experience	Recommendation score reached 88.00%	Very good
Overall UAT	Average score 84.44%	Very good

Compatibility and performance tests were conducted on Google Chrome, Mozilla Firefox, and Microsoft Edge using three laptops without dedicated GPUs. The AMD Ryzen 3 7320U laptop achieved average frame rates of 58 FPS in Chrome, 50 FPS in Firefox, and 58 FPS in Edge. The Intel i3-1005G1 laptop achieved 34 FPS in Chrome, 28 FPS in Firefox, and 33 FPS in Edge. The Intel i3-1115G4 laptop ahieved 33 FPS in Chrome, 53 FPS in Firefox, and 39 FPS in Edge. These results show that the game remained playable across all tested browsers and devices.

Table 4. Compatibility and performance testing summary

Device	Browser	Average FPS	Result
AMD Ryzen 3 7320U, 8GB RAM	Chrome / Firefox / Edge	58 / 50 / 58	Playable

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Intel i3-1005G1, 4GB RAM	Chrome / Firefox / Edge	34 / 28 / 33	Playable
Intel i3-1115G4, 8GB RAM	Chrome / Firefox / Edge	33 / 53 / 39	Playable

3.4 Discussion

The implementation demonstrates that Three.js is capable of supporting a culturally oriented first-person game in a browser environment. The use of procedural terrain and instanced meshes reduced dependency on heavy pre-modeled assets, while the centralized bilingual system allowed narrative and interface text to be switched dynamically. From the cultural perspective, the puzzles were not treated as isolated game obstacles; they were linked to the story setting through sacred torches, stone order, prophecy fragments, seed planting, and ceremonial flame activation. The testing results indicate that the core mechanics were reliable, while the user feedback suggests that navigation guidance can be improved in future versions.

4. CONCLUSION

This research successfully transformed the legend of Toar and Lumimuut into a web-based first-person puzzle adventure game using Three.js. The game integrates local folklore, two culturally themed levels, NPC interaction, bilingual narration, item-based puzzles, procedural 3D environments, and browser-based deployment. Black box testing produced a 100% pass rate across 68 test cases, user acceptance testing produced an overall score of 84.44%, and compatibility testing confirmed that the game remained playable on Google Chrome, Mozilla Firefox, and Microsoft Edge across three laptops without dedicated GPUs. These findings show that browser-based 3D games can be used as accessible cultural media for preserving and presenting local folklore. Future work should improve navigation guidance, expand mobile compatibility, add richer audio-visual polish, and involve cultural experts in deeper validation of the folklore adaptation.

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