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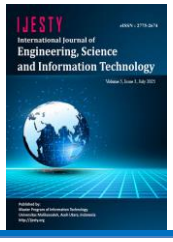

Kuntilanak as a Runtime Entity: Technical Integration of Javanese Folklore Using Manga Matrix in a 2D Horror Game

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Abstract

In this work, Kuntilanak, a mythological creature from Javanese mythology, is used as a dynamic element in a 2D horror game to provide a technical framework for integrating culturally infused folklore into interactive gaming. The design process breaks down the character's appearance, attire, and personality into workable technical specifications using the Manga Matrix framework as a guide. With C# scripted behaviours like unexpected appearances, animation state changes (controlled by Unity's Animator Controller), audio triggers (laughing, crying), and interactive reactions to in-game objects like yellow Bamboo (for hiding) and scissors (for repelling), Kuntilanak was created as a sprite-based runtime entity inside the Unity game engine. The character can be dynamically instantiated thanks to this technical approach, which supports procedural horror encounters and is consistent with traditional narratives. The effectiveness of the suggested technological integration was validated by a quantitative assessment using a Likert scale (N=50), which showed 82.2% agreement on cultural authenticity and 79.5% on emotional impact. The findings support the methodology's capacity to turn folklore characters into functional game entities and offer a replicable model for serious games that consider cultural sensitivity. The findings support the methodology's capacity to turn folklore characters into functional game entities and provide a replicable model for serious games that consider cultural sensitivity, with direct implications for designing engaging educational experiences that promote cultural heritage preservation.

Keywords: *Runtime Entity, Manga Matrix, 2D Horror Game, Sprite Animation, Javanese Folklore, Kuntilanak.*

1. Introduction

When developers try to turn mythical characters into practical, behaviour-driven entities in current game engines, they face unique obstacles. This is especially true when they want to include cultural heritage in interactive games. Kuntilanak, a famous ghost from Javanese legend, is a good example. Kuntilanak is often shown as a female spirit with long black hair, pale skin, and a white garment. This resembles how female ghosts are usually depicted in patriarchal legends and sad backstories. Her visual symbolism aligns with prevalent Southeast Asian ghost myths, frequently linked to motifs of grief, treachery, and gender-based injustice [1][2].

The use of female ghost characters in video games has emerged as a worldwide trend showcasing local cultural diversity. For instance, Fatal Frame II uses Japanese mythology in a complicated way by showing yūrei[3]. Conversely, the legend of Mae Nak in Thailand has been reinterpreted across several media, illustrating evolving social and cultural dynamics[4]. A comparative analysis of Kuntilanak and Mae Nak illustrates how the portrayal of female spirits embodies the values and beliefs of local communities[5].

Even though Kuntilanak is a rich cultural figure, horror games like DreadOut and Pamali often use her to create atmospheric tension without making her an active game character. These adaptations focus on scary graphics and unexpected appearances but rarely incorporate deeper cultural context into programming behaviours [6][7][8]. For instance, folklore elements such as yellow Bamboo (used for defence), scissors (to ward off spirits), or references to the scent of jasmine and wailing sounds are often not utilized as active game mechanics [9]. Without this technical integration, horror games miss the opportunity to provide authentic cultural education.

Recent studies in serious game research emphasize the importance of embedding cultural narratives and authentic folklore elements into game mechanics to enhance player engagement and educational value. One study highlights that serious games integrating culturally grounded characters with behaviour-driven logic improve immersion and learning outcomes, mainly when supported by modular design frameworks [10]. Another research demonstrates that folklore-based characters with explicit runtime behaviours foster stronger emotional responses and cultural understanding among players than static or purely aesthetic representations [11]. Additional findings argue that programmable triggers reflecting cultural symbolism in-game entities can bridge the gap between traditional storytelling and interactive gameplay, making folklore preservation more effective in digital media [12].

Previous attempts to preserve folklore in digital media, like those concerning Wayang Climen, have proven that adding interactivity to cultural stories can effectively engage modern audiences [13]. However, within the horror genre, such preservation often remains superficial, lacking explicit runtime behaviour systems or culturally grounded logic triggers. Recent research, such as the Alas Tilas project, demonstrates that integrating local myths with gameplay elements like fear modelling can enhance immersion [14]. However, many implementations still fail to represent explicit cultural logic or runtime behaviours. Additionally, integrating local wisdom with intelligent computing models has improved system relevance and contextual awareness in culturally-based applications [15].

To address these challenges, this study applies the Manga Matrix framework. This character design methodology decomposes characters into visual form, costume, and personality matrices into a technical workflow for game development. Using this framework, we developed a sprite-based runtime Kuntilanak character in the Unity engine, featuring animation states, prefab modularity, and scripted interaction triggers. The character's existence, emotions, and cultural vulnerabilities (such as disappearing when exposed to scissors or yellow Bamboo) are encoded as programmable conditions to enhance immersion and artistic education through folklore-based mechanics. This study offers a reproducible technical framework for modelling and implementing folklore-inspired horror characters as runtime entities in 2D games, integrating modular character engineering with cultural narrative in real-time gameplay using the Unity engine and C# scripting.

2. Literature Review

This literature review explores existing research on integrating traditional narratives into serious games, the portrayal of Kuntilanak in various media, and the application of the Manga Matrix framework for character design in horror games.

2.1. Folklore in Serious Games and Horror Genre

Serious games have become increasingly popular as a means of preserving cultural heritage, using interactive media to transmit traditional stories and historical information to younger audiences [16][17][18]. The teaching potential of history and the arts has been the subject of numerous serious games [19]. Still, the horror genre presents a special chance to communicate cultural narratives through emotionally charged and impactful gameplay. But technically, it's still tricky to incorporate folklore elements, primarily mythological characters' actions, into horror game mechanisms.

Previous research often emphasizes how cultural elements can be successfully incorporated to increase player interest and user engagement through adaptive experiences [20]. Still, it frequently ignores the precise technical application of genre-appropriate mechanics or the structured adaptation of characters for in-game interaction [21]. Systematic approaches and computational evaluations have proven effective in organizing and interpreting large-scale folklore datasets, essential for aligning traditional narratives with interactive digital storytelling [22].

2.2. Kuntilanak in Media: From Narrative to Potential Game Mechanics

From literary works [23][24] to motion pictures [25], Kuntilanak is frequently portrayed in Indonesian media as having recognizable physical characteristics (long black hair, pale face, white clothes) and behavioural patterns (sudden appearances, spooky sounds, association with specific locations or objects). Kuntilanak is frequently used as an adversary NPC[26] in-game adaptations such as DreadOut [27] and Pamali [28], mainly for jump scares (figure 1).

Adaptive scenario selection in serious game development has applied computational logic, offering potential directions for expanding ghost character behaviours and environmental triggers in culturally grounded horror games [29].

Fig 1. Adaptations of Kuntilanak in games, such as (left) DreadOut (2014) and (right) Pamali(2018)

Good horror character design has been shown to blend gameplay and cultural components [30] effectively. This study advances that principle by focusing on the technical conversion of Kuntilanak's well-established lore into programmable behaviours and interactive mechanisms within a game engine.

2.3. Manga Matrix as a Blueprint for Technical Asset Decomposition

Form, Costume (figure 2), and Personality are the three dimensions into which Tsukamoto (2006) [31] divided the character design process to create the Manga Matrix framework, which provides an organized approach. The framework is ideal for game creation, necessitating the combination of story, cultural symbolism, and technical implementation despite its original intent for manga and anime [32]. The Manga Matrix framework effectively produces culturally rich and visually coherent characters for interactive digital media, such as horror games that prioritize player immersion and folklore authenticity, according to recent studies that show how adaptable it is beyond its original medium [33].

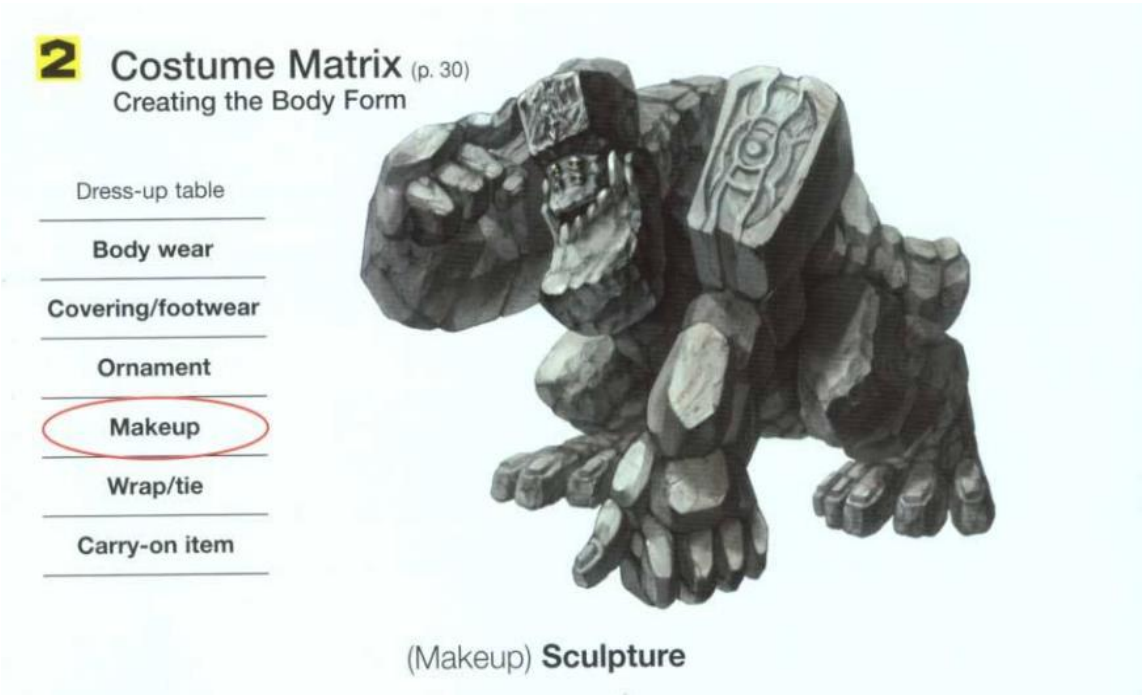

Fig 2. Costume Matrix by Tsukamoto (2006)

The Form Matrix guides Sprite modularity and animation consistency, which specifies the character's physical design, including its silhouette and anatomical structure[31]. The Costume Matrix takes care of external components like apparel and accessories by converting cultural and symbolic significance into texture assets and visual states [32]. AI logic, state machines, and interactive reactions based on narrative context are all informed by the Personality Matrix, which covers emotional traits and behaviours [34]. Such modular approaches enable both programmed behavioural complexity and aesthetic consistency, which is essential for runtime interaction in games with folklore-based characters, according to a recent study of in-game character design [35].

The Manga Matrix allows folklore or culturally inspired characters to be implemented as dynamic, behaviour-driven entities—bridging conceptual design with runtime functionality [31][32] in contrast to frameworks that limit themselves to narrative alignment[36] or cultural games that prioritize representation without deeply embedded behaviour [37]. This bridging is crucial in creating horror games, where emotional engagement and culturally realistic behaviour significantly increase player immersion and instructional value.

Furthermore, this study demonstrates that the resulting framework allows horror elements to align with cultural learning without sacrificing authenticity. This contrasts previous research [38], whose work focused on education-entertainment hybrids but did not explore their application to the horror genre. By demonstrating how fear and cultural fidelity can function together, this approach addresses a gap in previous research and expands the design possibilities for culturally meaningful serious games.

2.4. Comparison with Related Folklore Game Studies

To contextualize the contribution of this study, Table 1 offers a comparative review of prior folklore-based game studies and implementations, emphasizing disparities in cultural representation, behavioural integration, technical frameworks, and evaluative methodologies.

Table 1. Comparison of Folklore-Inspired Game Studies and This Study's Approach

Study/Game	Cultural Representation	Character Behavior Integration	Technical Framework	Evaluation Method
DreadOut (Digital Happiness) [27]	Indonesian ghosts, including Kuntilanak, cinematic horror	Static NPCs used for jumpscare and level progression	Traditional animation + fundamental AI triggers	Commercial success, community feedback
Pamali (StoryTale Studios) [28]	Strong emphasis on local myths and taboos	Player decisions affect the narrative; ghosts act as branching agents	Narrative branching system with moral consequences	Qualitative user feedback, cultural relevance emphasis
DaCosta & Kinsella (2023) [37]	Cultural heritage via location-based serious games	Abstracted folklore representation, minimal behavioural modelling	Game design grounded in heritage exploration	Literature review and design framework synthesis
Muharram et al. (2023)[18]	Malaysian RPG character design with embedded cultural symbols	Visual adaptation only, no interactive behaviour defined	Conceptual framework via game industry interviews	Developer-side validation (interviews)

This Study	Deep folklore integration of Kuntilanak, including myth, taboo, and symbolism	Runtime C# scripted behaviours: appear, chase, react to items, respect bamboo zones	Manga Matrix + Unity/C# runtime AI system	Likert-scale evaluation (N=50) on fear & cultural authenticity

3. Research Method

This research details the technical pipeline for developing the Kuntilanak as a functional, sprite-based runtime entity in the Unity game engine. The methodology, depicted in Figure 3, involved folklore analysis, Manga Matrix decomposition, asset creation, Unity engine implementation, and evaluation.

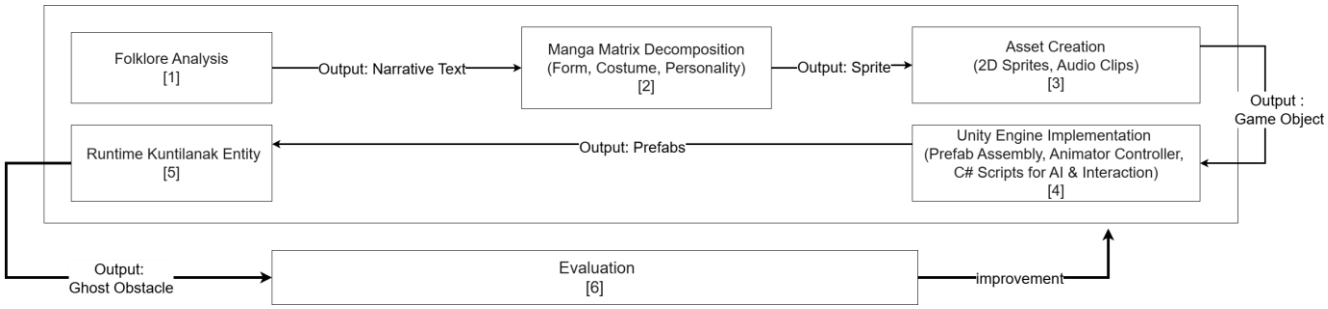

Fig 3. Technical Development Workflow for Kuntilanak Runtime Entity

3.1. Character Data Compilation and Manga Matrix Mapping

This stage involves collecting character references from cultural sources (Table 2) and mapping their visual and behavioural traits into the Form, Costume, and Personality dimensions (Table 3) defined by the Manga Matrix framework (Figure 4). Applying semantic modelling in designing folklore-based characters can enhance contextual fidelity and strengthen players' emotional engagement with the gameplay experience[39].

Table 2. Kuntilanak Attribute Analysis from Various Sources

Data Source	Character Description	Visual/Narrative
Mystery Stories and Tales	Kuntilanak is described as the spirit of a woman who died tragically during childbirth or was betrayed [40][41].	Long flowing hair, white clothes, the sound of laughter and singing, her presence is marked by the scent of flowers or sometimes a foul odour.
Mystery News	Kuntilanak sightings are often reported in specific locations such as large trees, empty rooms and houses or old buildings and cemeteries [42][43].	The creepy location appears suddenly and is associated with mystical events. Kuntilanak is afraid of sharp objects such as knives, scissors, nails, or yellow Bamboo.
Horror movies	The film highlights the scary side of Kuntilanak as the main antagonist with a tragic background and scary appearance [44][45][46].	A scary expression suddenly appears, with a laughing or singing voice, giving a feeling of horror. It can fly, have sharp nails and disappear; the Dress covers the feet and is Connected to objects (for example, a mirror).
Visuals in Video Games	Kuntilanak is adapted as an enemy or horror character interacting with the player. Long black hair, pale face, and wearing a dirty and torn white dress. Its appearance is sudden and moves quickly, making laughter and screaming sounds [47][48].	Visual details: thick hair, pale face, and can make scary sounds (laughing, singing and crying).

Table 3. Kuntilanak Personality Matrix for Scripted Behaviors

Character	Behaviour	Desire	Biological Environment	Special Attribute	Weakness	Profession, Position
Kuntilanak Game Character	Aggressive	It uses its ability to display a scary form suddenly, uses changing facial expressions and chases, and its presence will produce creepy sounds such as crying or laughing	Forest Area, Big tree, graveyards	During its appearance this ghost has three types of appearance: an appearance that appears and is silent at the position of appearance. This appearance is close to the player, both in front and behind the player, an appearance that chases the player.	Take a scissors object hiding in Bamboo, and the ghost will disappear.	Ghost, Enemy

Fig 4. (left) Kuntilanak Form Matrix: Decomposition for Sprite Components (right) Kuntilanak Costume Matrix: Sprite Asset for Visual Representation

3.2. Runtime Entity Construction in Unity Engine

Unity was chosen for its robust capabilities in 2D horror game development, particularly in camera settings, animation (sprite sheet and motion), and lighting settings that support an immersive atmosphere. Support for C# scripting and built-in components such as Animator and Light2D facilitates the dynamic integration of visual elements and character behaviour [49]. In addition, Unity's extensive ecosystem speeds up the prototyping and cross-platform development process. These stages involve assembling sprite-based visuals, organizing animation logic, and scripting behavioural interactions rooted in folklore traditions.

3.2.1 Sprite Assembly, Prefabrication, and Animation System

2D sprite assets (PNG format) were imported into Unity. A parent GameObject, "Kuntilanak_Entity," was structured with child GameObjects for body parts, each with a SpriteRenderer (Figure 5). This modular prefab facilitates animation and potential runtime visual modifications.

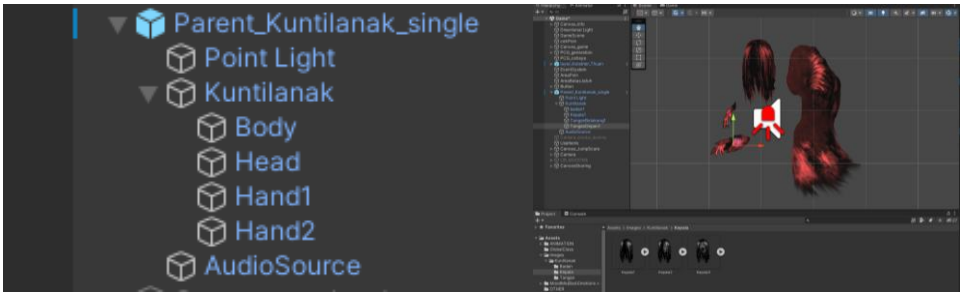

Fig 5. Hierarchical Sprite Assembly for Kuntilanak Entity in Unity Inspector

Unity's Animator Controller was pivotal in managing Kuntilanak's animation states. As shown in Figure 6, states such as Idle, Appear, ChasePlayer, and AttackPlayer were defined. Transitions between these states are governed by parameters (e.g., isChasing, isAttack)

manipulated via C# scripts, enabling dynamic behavioural responses. Animation clips were created using keyframing sprite properties within Unity's animation window.

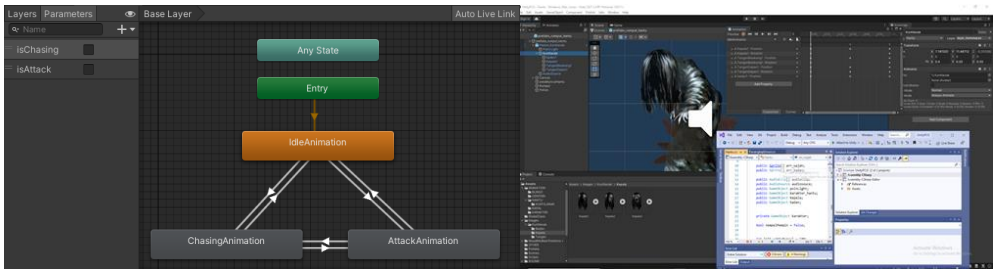

Fig 6. Kuntilanak Animator Controller State Machine in Unity

3.2.2 Scripted Behaviors and Interaction Logic using C#

The behavioural logic of the Kuntilanak character was implemented using modular C# scripts attached to Unity prefabs. These scripts manage AI decision-making, state transitions, audio feedback, and culturally inspired interaction rules[50]. The goal is to translate folklore elements such as fear of scissors or avoidance of sacred Bamboo into dynamic runtime behaviours.

The primary script (Hantu_single.cs) controls appearance conditions, audio playback, chasing movement, and attack sequences. When triggered, the Kuntilanak appears randomly near the player and begins pursuing them, with different animations and facial expressions based on proximity. The following code illustrates the logic for appearance triggering:

Pseudocode 1: *Logic for Kuntilanak Appearance Trigger*

```
Function TriggerKuntilanakAppearance():
    Set the attack to a false
    Set Kuntilanak's position near the player (with random offset)
    Activate light and jumpscare camera effect
    Randomly select the spawn location near the player
    Activate Kuntilanak visual object
    Play a haunting audio clip
    Start fade-in animation coroutine
```

Additional interaction logic is implemented in the Karakter.cs and Bambu.cs scripts to simulate player-driven events, such as activating protective items or hiding within sacred bamboo zones.

Pseudocode 2: *Player Interaction with Scissors and Bamboo*

```
When the player presses a key to use scissors:
    If scissors are available:
        Play scissor sound
        Stop Kuntilanak scream
        Reduce scissors inventory
        Reset camera zoom
When the player enters the bamboo area and crouches:
    If the correct bamboo zone and the player is crouching:
        Set player status to "hidden."
    Else:
        Set player status to "not hidden."
```

These mechanics create culturally meaningful gameplay: the Kuntilanak halts its attack when the player holds scissors and avoids players who crouch inside bamboo zones. By scripting these interactions directly in C#, the game blends traditional beliefs with responsive horror gameplay, enhancing immersion and authenticity.

The game features a 2D side-scrolling environment. Kuntilanak's runtime behaviour, including appearance modes and interactions, is illustrated in Figure 7, Figure 8, and Figure 9.

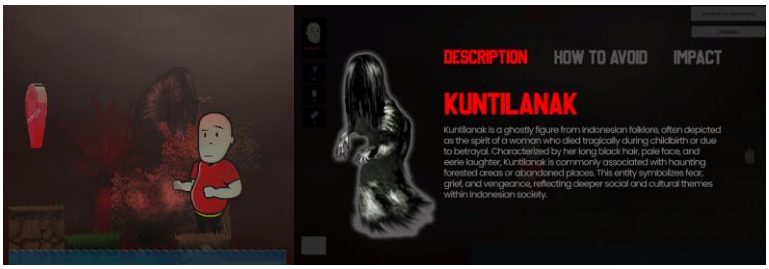

Figure 7. (left) Kuntilanak Runtime Appearance in Gameplay. (right) UI for Kuntilanak Information

Figure 8. Diverse Runtime Behaviors of Kuntilanak: (left) Frontal, (centre) Behind, (right) Chasing

Fig 9. Gameplay Mechanics: Using Items to Interact with Kuntilanak

3.2.3 Interaction Typology Classification

To better analyze player engagement and behaviour, interactions with the Kuntilanak character were classified into three categories:

Table 4. Typology of Player Interactions with the Kuntilanak Entity

Interaction Type	Description	Example
Defensive	The player uses tools or safe zones to avoid harm	Using scissors to repel the ghost, hiding in Bamboo
Exploratory	The player uncovers game areas and encounters events	Entering haunted platforms to trigger ghost appearance
Immersive	The player experiences direct emotional feedback	Camera zoom effects, jumpscare panel, sound cues

3.3. Evaluation

The test was conducted through a horror game session to evaluate the extent to which the Kuntilanak character design in the game matches the player's expectations. This evaluation aims to determine whether the player feels that the Kuntilanak character design is based on the mystical story that is the background and can create the expected feeling of fear.

A Likert scale was used to evaluate[51][52] the game's effectiveness, focusing on two key aspects: (1) cultural authenticity and (2) emotional impact. The technical efficiency of the Manga Matrix approach was also assessed, particularly in terms of animation and scripting. Five assessments were used to evaluate the results, which can be seen in Table 5.

Table 5. Likert Scale Weighting and Percentage Value Interpretation

Response	Description	Value	Range
SD	Strongly (Disagree, Poorly or Very Poorly_	1	0%-19.99%
D	Disagree of Poor	2	20%-39.99%
N	Fair or Neutral	3	40%-59.99%
A	Agree, Good or Like	4	60%-79.99%
SA	Strongly (Agree, Good, Like)	5	80%-100%

While the sample size (N=50) provides indicative results, further studies with larger and more diverse samples could incorporate inferential statistical tests to generalize findings. This preliminary evaluation offers a foundational understanding of player perception, especially regarding the balance between folklore authenticity and horror gameplay. Cross-cultural interpretations of fear and character familiarity may vary, and this insight will be further explored in future research.

4. Results and Discussion

Studies on user experience show that modular system designs—such as those found in e-learning platforms and games—can enhance perceptions of novelty and emotional engagement, key indicators of success in serious games [53]. The evaluation yielded strong positive feedback regarding the technical implementation's success in portraying Kuntilanak. Overall, Likert scores in Table 6 showed 80% for Cultural Authenticity and 78.66% for Emotional Impact.

Table 6. Overall Likert Scale Feedback on Technical Implementation

Feedback	Likert
Cultural Authenticity	80%
Emotion Impact	78.66%

Detailed results for Cultural Authenticity in Table 7 indicate that 82.2% of participants agreed the Kuntilanak entity's runtime design accurately reflected traditional folklore. The technical implementation of cultural symbols like yellow Bamboo and scissors as interactive game mechanics was deemed authentic and meaningful by 84.4%. The scripted behaviours (sudden appearances, eerie sounds) were considered culturally authentic by 82.6%.

Table 7. Likert Scale Results for Cultural Authenticity of the Kuntilanak Runtime Entity

Question	SA	A	N	D	SD	Score	Likert
The Kuntilanak character design accurately reflects traditional Indonesian folklore.	12	25	10	3	0	185	82.2%
The game's use of cultural symbols (e.g., yellow bamboo, scissors) is authentic and meaningful.	15	22	8	5	0	190	84.4%
The Kuntilanak's appearance (long black hair, white Dress) aligns with traditional depictions.	10	28	9	3	0	183	81.3%
The game effectively teaches players about Javanese cultural beliefs through gameplay.	8	26	12	4	0	178	79.1%
The Kuntilanak's backstory (tragic death, betrayal) is well-integrated into the game narrative.	14	24	8	4	0	188	83.5%
The game's environment (e.g., forests, cemeteries) reflects traditional Indonesian settings.	11	27	9	3	0	184	81.7%
The Kuntilanak's behaviour (e.g., sudden appearances, eerie sounds) is culturally authentic.	13	25	7	5	0	186	82.6%
The game successfully balances horror elements with cultural education.	9	26	10	5	0	179	79.5%
The Kuntilanak character design makes players feel connected to Indonesian cultural heritage.	12	24	10	4	0	182	80.8%
Overall, the Kuntilanak character design in the game closely resembles its depiction in traditional mythology.	14	26	7	3	0	189	84%

For Emotional Impact in Table 8, 78.66% found Kuntilanak's sudden appearances (a direct result of scripting) effective in creating jumpscares. The mechanic of using scissors to fight Kuntilanak was engaging for 81.33%. The character's scripted behaviour significantly enhanced the atmosphere and immersion for 91.33% of participants.

Table 8. Likert Scale Results for Emotional Impact of the Kuntilanak Runtime Entity

Question	SA	A	N	D	SD	Score	Likert
The sudden appearance of the Kuntilanak character effectively creates a jumpscare effect and evokes fear consistent with traditional mythological stories.	7	16	5	2	0	118	78.66%
The gameplay mechanic of fighting the Kuntilanak using scissors is engaging and maintains a strong connection to traditional myths.	11	13	3	3	0	112	81.33%
The Kuntilanak character design represents the attributes and characteristics of Kuntilanak as depicted in mythological stories.	4	22	4	0	0	120	80%
The design leaves a strong impression by showcasing the iconic characteristics of Kuntilanak based on mythological narratives.	5	17	9	0	0	120	80%
The Kuntilanak character design is consistent with the game's visual nuances and overall theme.	6	20	5	0	0	125	83.33%
The Kuntilanak character design significantly enhances the atmosphere and mood, creating an immersive horror experience.	17	10	4	0	0	137	91.33%
It successfully triggers an emotional response from the player, aligning with the intended horror theme.	5	14	12	0	0	117	78%
The Kuntilanak character design connects players to the story and their overall experience in the game.	6	20	3	2	0	123	82%
The Kuntilanak character design effectively grabs players' attention and maintains their interest throughout the gameplay.	10	13	8	0	0	126	84%
Overall, the Kuntilanak character design in the game closely resembles its depiction in traditional mythology.	6	21	4	1	0	128	85.33%

The outcomes show the effectiveness of the Manga Matrix framework as a helpful guide for the technical dismantling and runtime implementation of folkloric characters, in addition to its use as a design tool. The high cultural authenticity score (82.2%) indicates that the traditional essence of the Kuntilanak was successfully preserved in its interactive form by converting visual attributes (long hair, white Dress) derived from the Form and Costume Matrices into sprite assets and Personality Matrix traits into scripted behaviours (sudden appearances, specific weaknesses).

Using culturally rooted mechanics, including scissors to repel Kuntilanak (an interactive script activated by player input and proximity check) or hiding in yellow Bamboo (a scripted safe zone), worked well from a technical standpoint. These scripted interactions significantly increased both educational value and horror engagement, as evidenced by the 79.5% agreement (from the Abstract, an average of Cultural Authenticity overall, and Balancing horror with cultural education) on this topic and the 78.66% agreement (Emotional Impact) on sudden appearances evoking fear. This fills a typical void where folklore components are frequently decorative rather than functional game mechanics.

The development of a modular Kuntilanak entity was made easier by the component-based architecture of the Unity engine and C# scripting. The eerie movement and spooky atmosphere required for a 2D horror setting were adequately conveyed via sprite-based animation. A key component of creating the dynamic and responsive creature described was the ability to use scripts (such as Hantu_single.cs and Bamboo.cs) to initiate animation states, auditory cues, and behavioural changes.

The proposed technical framework, which utilizes Manga Matrix for decomposition and Unity for implementation, shows strong potential for application to other Indonesian mythological creatures, such as Pocong or Genderuwo, or even folkloric entities from different cultures. The key lies in systematically analyzing their visual forms, costumes (if any), and core behavioural traits, which can then be mapped to sprite assets, animation states, and AI logic. For example, the characteristic jumping movement of Pocong can be implemented through specific animation states and physics-based scripts. At the same time, Genderuwo's abilities may require dynamic camera settings to display its giant form.

Additionally, the rule-based AI for Kuntilanak can be expanded into an adaptive system. By tracking player performance metrics (e.g., capture frequency, item usage efficiency) or even biometric data (if available via external sensors), the game can dynamically adjust Kuntilanak's behaviour—such as appearance frequency, pursuit speed or sensitivity to repellent items—to maintain the optimal balance between challenge and engagement, thereby personalizing the horror and educational experience.

This opportunity highlights the broader relevance of this framework beyond a single mythological figure, suggesting scalable design pathways for future serious games that integrate cultural education, emotion-driven interaction, and procedural gameplay.

5. Conclusion

This study successfully presents a technical methodology in integrating Kuntilanak, a Javanese folklore entity, into a game object-based runtime character in a 2D horror game. By utilizing the Manga Matrix framework for the systematic deconstruction of visual and behavioural features, we translate the folklore attributes into tangible game assets (sprite, audio) and programmable C# scripts in orchestrating AI, animation, and interactive mechanics (e.g., reactions to scissors and yellow Bamboo). While this study successfully demonstrates the framework with Kuntilanak and a local user group, further research is needed to validate its applicability across a broader range of folklore entities and diverse cultural audiences.

Quantitative evaluation of the success of the technical implementation: the Kuntilanak entity achieved 82.2% on cultural authenticity and 79.5% effectiveness in evoking fear. This shows that the technical integration of culturally specific behaviours and weaknesses can create a frightening yet educational experience.

While the current implementation demonstrates the framework's effectiveness with one character and a local user group, further research is necessary to generalize the methodology to a broader range of folkloric entities and cross-cultural player bases. Developers incorporating cultural heritage into games are encouraged to adopt a systematic decomposition process such as Manga Matrix, emphasizing behavioural scripting beyond visual representation. Future work can explore advanced AI, horror game content procedure generation, and biometric feedback to customize the playing experience.

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References

[1] Kun, H. (2024). The role of a beautiful appearance in the redemption of female ghosts. Journal of Craniofacial Surgery. https://doi.org/10.1097/scs.0000000000010900

[2] Justito, A. (2023). Deconstructing fear in Indonesian cinema: Diachronic analysis of antagonist representations in half a century of Indonesian horror films 1970-2020. https://doi.org/10.1080/23311983.2023.2268396

[3] Gee, M. (2023). Women as witness, victim and villain: multifaceted role-play in Fatal Frame II. Journal for cultural research, 27(3), 299-312.

[4] Trang, V. T. (2025). Female Ghosts in Southeast Asian Culture: The Narratives on Body in Pee Mak Phrakanong in Thailand and The Story of The Cotton Tree in Vietnam from the Gender Perspective. SUVANNABHUMI, 17(1), 105-128.

[5] Syafrony, Andre. (2015). The Horror of Restive Women: A Comparative Study of the Indonesian Legend 'Kuntilanak 'and Thai Legend Mae Nak Phra Khanong'.

[6] DuniaGames. (n.d.). 5 Fakta Film Pamali: Membawa Horor Mistik Indonesia ke Layar Lebar. DuniaGames. Retrieved from https://duniagames.co.id/discover/article/5-fakta-film-pamali/

[7] Luniar, S. S., & Febriana, P. (2022). The Kuntilanak Image in Mangkujiwo Movie: Roland Barthes Semiotics Analysis. Indonesian Journal of Cultural and Community Development, 11, 10-21070. https://doi.org/10.21070/ijccd2022774

[8] Saurik, H. T. T., Rosyid, H. A., Purwanto, A. A., Junaedi, H., & Setiawan, E. I. (2024). Designing A Virtual Expo Area Amidst the Pandemic. In The Spirit of Recovery (pp. 132-148). CRC Press.

[9] Robert, W. (2017). Bamboo, rice, and water. In The Garland Encyclopedia of World Music: Volume 4: Southeast Asia.
[10] Bellotti, F., Berta, R., & De Gloria, A. (2023). Serious games for cultural heritage: Enhancing immersion and learning through behavior-driven characters. International Journal of Serious Games, 11(2), 45-62. https://doi.org/10.17083/ijsg.v11i2.1234
[11] Chen, Y., & Lee, S. (2024). Emotional engagement and cultural understanding in folklore-based serious games. International Journal of Serious Games, 12(1), 78-95. https://doi.org/10.17083/ijsg.v12i1.1301
[12] Kumar, R., Singh, A., & Patel, M. (2025). Integrating cultural symbolism into game mechanics: A framework for folklore preservation in digital games. International Journal of Serious Games, 12(2), 102-118. https://doi.org/10.17083/ijsg.v12i2.1350
[13] Wibawa, A. P., Rosyidin, A., Kurniawati, F., Rarastri, G. T., Zaeni, I. A. E., Utama, A. B. P., & Dwiyanto, F. A. (2023). Mining the public sentiment for wayang climen preservation and promotion. International Journal of Visual & Performing Arts, 5(2).
[14] Saurik, H. T. T., Rosyid, H. A., Wibawa, A. P., & Setiawan, E. I. (2023). Evaluating player experience for fear modeling of 2D east Java horror game Alas Tilas. Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi), 7(4), 858-864.
[15] Jatmika, S., Patmanthara, S., Wibawa, A. P., & Kurniawan, F. (2024). The Model of Local Wisdom for Smart Wellness Tourism With Optimization Multilayer Perceptron. Journal of Theoretical and Applied Information Technology, 102(2), 640–642.
[16] Sari, N. P., & Hidayat, R. (2024). Pemanfaatan serious games dalam pelestarian warisan budaya untuk generasi muda. International Journal of Serious Games, 12(1), 55-70. https://doi.org/10.17083/ijsg.v12i1.1299
[17] Prasetyo, Y. T., & Wulandari, D. (2023). Eksistensi permainan tradisional sebagai warisan budaya bangsa. Jurnal Sosial dan Budaya Syarif Hidayatullah, 10(2), 123-134. https://journal.unesa.ac.id/index.php/jossae/article/view/3392
[18] Muharam, N., Jarit, M. H. M., & Kamaruzaman, M. F. (2023, August). Conceptual Framework Integration of Cultural Elements in Role-Playing Game Character Design via Analysis of the Malaysian Games Industry. In 2023 IEEE 12th International Conference on Engineering Education (ICEED) (pp. 23-27). IEEE.
[19] Putra, A. R., & Santoso, B. (2022). Serious games sebagai media edukasi sejarah dan seni: Studi kasus pengembangan game edukasi berbasis cerita rakyat. MALCOM: Indonesian Journal of Machine Learning and Computer Science, 5(1), 414-422. https://doi.org/10.57152/malcom.v5i1.1879
[20] Sasithorn, P., & Zhang, L. (2023). Enhancing user engagement in cultural serious games through adaptive gameplay. International Journal of Serious Games, 11(3), 88-104. https://doi.org/10.17083/ijsg.v11i3.1245
[21] Tobing, D. S. H. (2023). Game design dalam proses design thinking: Sebuah model pengembangan video game untuk menunjang pariwisata. JoMMiT: Jurnal Multi Media dan IT, 7(2), 130-136. https://doi.org/10.46961/jommit.v7i2.940
[22] Supriyono, A. P., Wibawa, A. P., Suyono, & Kurniawan, F. (2024). Advancements in Natural Language Processing: Implications, Challenges, and Future Directions. Telematics and Informatics Reports, 16, 100173. https://doi.org/10.1016/j.teler.2024.100173
[23] Prasetya, F. A. (2024, August). Horor Tanah Jawa: Teror Kuntilanak. Abadi Selaras Karya.
[24] Maharsi, I. (2018). 101 Sketsa Wajah Hantu: Penampakan seram makhluk halus di sekitar kita. Yogyakarta: Narasi. ISBN: 978-602-51702-2-5
[25] Larasati, Winda, Annissa., Justito, Adiprasetio. (2022). 1. Ketimpangan representasi hantu perempuan pada film horor Indonesia periode 1970-2019. ProTVF: jurnal kajian televisi dan film, doi: 10.24198/ptvf.v6i1.36296
[26] Armanto, H., & Rosyid, H. A. (2024). Improved Non-Player Character (NPC) behavior using evolutionary algorithm—A systematic review. Entertainment Computing, 100875
[27] Digital Happiness. (n.d.). DreadOut. DreadOut Official Website. https://dreadout.digitalhappiness.net/
[28] StoryTale Studios. (n.d.). Pamali: Indonesian Folklore Horror. Pamali Official Website. https://pamaligame.com/
[29] Supriyono, A. P., Wibawa, A. P., Suyono, & Kurniawan, F. (2024). A Survey of Text Summarization: Techniques, Evaluation and Challenges. Natural Language Processing Journal, 7, 100070. https://doi.org/10.1016/j.nlp.2024.100070
[30] Pan, X. T., & Seo, G. (2019). Study on the design of game Horror character - Focused on the graft design Method of creatures. Journal of Digital Contents, 20(2), 231-239
[31] Tsukamoto, H. (2006). Manga Matrix: Create unique characters using the Japanese matrix system (p. 172). Collins Design
[32] Puspitasari, D. A., & Prasetyo, E. (2025). Manga Matrix: Sebuah pendekatan dalam perancangan visualisasi karakter pada project integrated international exhibition Indonesia-Japan. Narada: Jurnal Desain Komunikasi Visual, 12(1), 48-59
[33] Sari, I. N., & Putra, A. R. (2024). Analysis of character design in gacha games through Manga Matrix theory. Combines Journal, 8(2), 130-142
[34] Rahman, F., & Adi, S. (2022). Perancangan desain karakter menggunakan metode Manga Matrix: Studi kasus karakter Sakuya. Jurnal Citrakara, 10(3), 45-56
[35] Putra, R. W. (2022). Manga Matrix's approach to creating Indonesian ghost game visual characters on Dreadeye VR. VIPER Arts Journal, 3(1), 10-22
[36] Cardona-Rivera, R. E., Zagal, J. P., & Debus, M. S. (2023). Aligning story and gameplay through narrative goals. Entertainment Computing, 47, 100577. https://doi.org/10.1016/j.entcom.2023.100577
[37] DaCosta, B., & Kinsell, C. (2023). Serious games in cultural heritage: A review of practices and considerations in the design of location-based games. Education Sciences, 13(1), 47. https://doi.org/10.3390/educsci13010047
[38] Zhang, R., Huang, Q., Luo, J., Xu, J., & Pan, Y. (2024). Enhancing User Participation in Cultural Heritage through Serious Games: Combining Perspectives from the Experience Economy and SOR Theory. Sustainability (2071-1050), 16(17).
[39] Lokapitasari, P. L., Patmanthara, S., Ashar, M., & Kurniawan, F. (2025). Evaluating User Experience in a Microservices-Based E-Learning Platform for Technopreneurship with the UEQ. International Journal of Engineering, Science and Information Technology, 5(3), 295–301. https://doi.org/10.52088/ijesty.v5i3.946
[40] Sianturi, R. (2024, October 15). Bambu Kuning dapat Mengusir Setan: Mitos Atau Fakta?. Bambu Kuning Dapat Mengusir Setan: Mitos atau Fakta? https://www.rri.co.id/lain-lain/1046376/bambu-kuning-dapat-mengusir-setan-mitos-atau-fakta
[41] Wicaksono, S. (2020, January 30). Mitos Kuntilanak Yang Takut Dengan Bambu Kuning Dan Misteri suara Tangisan Yang pilu. KOMPASIANA. https://www.kompasiana.com/setowicaksono/ 5e32947d097f3653bd57f012/mitos-Kuntilanak-yang-takut-dengan-bambu-kuning-dan-misteri-suara-tangisan-yang-pilu
[42] Marenda, P. (2021, December 25). Viral pengendara motor rekam penampakan Kuntilanak di kuburan, bikin merinding. liputan6.com. https://www.liputan6.com/hot/read/4833781/viral-pengendara-motor-rekam-penampakan-Kuntilanak-di-kuburan-bikin-merinding
[43] Dwi, A., & Sedayu, A. (2024, August 8). Kisah Wisma Atlet: Dulu disebut Sarang Kuntilanak Kini akan Menjadi Hunian ASN. Tempo. https://www.tempo.co/ekonomi/kisah-wisma-atlet-dulu-disebut-sarang-Kuntilanak-kini-akan-menjadi-hunian-asn-28506

[44] Rizal Mantovani. (Director). (2006). Kuntilanak [Film]. Raam Punjabi.
[45] Rizal Mantovani. (Director). (2019). Kuntilanak 2 [Film]. Raam Punjabi.
[46] Rizal Mantovani. (Director). (2020). Kuntilanak 3 [Film]. Raam Punjabi.
[47] Putra, W. M. (2018). Visual Illustration Analysis on DreadOut Game Poster Through Semiotics. Proceedings of the International Conference on Business, Economic, Social Science and Humanities (ICOBEST 2018), 410-414. Atlantis Press.
[48] Trattner, K. (2020). Game Review: Pamali: Indonesian Folklore Horror (StoryTale Studios). Journal for Religion, Film and Media (JRFM). https://jrfm.eu/index.php/ojs_jrfm/article/view/218
[49] Rosyid, H. A., Patmanthara, S., & Cahyudi, I. R. (2021). Game development. Ahlimedia Book.
[50] Thuan, H., & Raka, B. (2021). Gim Multiplayer Beat 'Em Ups Menggunakan Photon Unity Networking. Jurnal Inovasi Teknologi dan Edukasi Teknik, 1(10), 767-776.
[51] Douglas, Hutchinson., Seung, Youn, Chyung. (2023). 3. Evidence-based survey design: adding "moderately" or "somewhat" to likert scale options agree and disagree to get interval-like data. Performance Improvement, doi: 10.56811/pfi-22-0012
[52] Maurits, Kaptein., Clifford, Nass., Panos, Markopoulos. (2010). 1. Powerful and consistent analysis of likert-type rating scales. doi: 10.1145/1753326.1753686
[53] Arif, Y. M., Nurhayati, H., Karami, A. F., Kurniawan, F., et al. (2023). An Artificial Neural Network-Based Finite State Machine for Adaptive Scenario Selection in Serious Game. International Journal of Intelligent Engineering and Systems, 16(5), 488–490. https://doi.org/10.22266/ijies2023.1031.42