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BASED ON UNITY3D, TWO-PLAYER COOPERATION CAPTURES THE DESIGN AND IMPLEMENTATION OF THE GOBLIN GAME "INK WALKER"

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Abstract: This paper takes *Ink Walker*, a Chinese-style two-player cooperative goblin-catching game developed based on the Unity3D engine, as the research object. Combining practical experience from Game Jam competitions, it explores the design and implementation process of the game. The research centers on three core goals: the visual design of Chinese-style elements, the innovation of two-player collaboration mechanisms, and the cross-platform technical implementation. It unfolds from aspects such as artistic concept design (including the setting of world view and plot, the visual design of characters, goblins, scenes and UI), technical indicators and research methods (covering technical foundations and development toolchains, the technical implementation of core gameplay, system architecture and performance optimization), and performance optimization strategies. By integrating Chinese-style culture with game design, innovating two-player collaboration mechanisms, utilizing Unity3D to realize cross-platform development and conduct performance optimization, it provides technical solutions and creative paradigms for the development of similar Chinese-style games, and has certain theoretical and practical significance.
Keywords: *Ink Walker*; Unity3D; Two-player cooperation; Goblin catching; Chinese style; Game design and implementation

1 INTRODUCTION

1.1 Research Background and Significance

At a time when digital media art and game design technology are deeply integrated, two-player cooperative games have become a popular field in the game industry with their unique social attributes and creative gameplay. As players' requirements for gaming experience continue to improve, games that integrate multicultural elements and innovative interaction mechanisms are becoming more and more popular. As a treasure of the traditional culture of the Chinese nation, national style culture contains rich artistic value and cultural connotation, providing a broad source of creativity for game design. Integrating national style elements into two-player cooperative games can not only meet players' pursuit of cultural diversity, but also spread and promote the excellent traditional Chinese culture through the medium of games.

Based on the author's practical experience in participating in Game Jam competitions, this study takes the self-developed game "Ink Walker" as a specific case to explore how to use the Unity3D engine to achieve a two-player cooperative game with national style to catch goblins. As a widely used game development engine, Unity3D has strong cross-platform development capabilities, rich plug-in resources, and a convenient operation interface, providing efficient technical support for game development. By analyzing the design and implementation process of "Ink Walker", it aims to provide technical solutions and creative paradigms with reference value for the development of similar games, and promote the development of national style theme games in technological innovation and cultural expression.

1.2 Research Objectives and Content

This study focuses on the three core goals of "visual design of national style elements", "innovation of two-person collaboration mechanism" and "cross-platform technology realization", and constructs a complete research framework covering art concept design, gameplay logic development, and system architecture construction. In terms of art concept design, we will dig deep into the artistic elements in the national style culture, such as green landscapes, traditional mythological creatures, etc., and transform them into character images, scene design and special effects in the game, showing the unique charm of the national style culture; In terms of gameplay logic development, the two-person cooperation mechanism is innovatively designed, combining the five elements and the goblin capture gameplay to bring players a novel gaming experience; During the system architecture construction process, the characteristics of the Unity3D engine are used to achieve stable operation of the game on multiple platforms, optimize game performance, and improve the smoothness of the game.

The specific research content includes: analyzing the application of national style elements in game art design, and explaining how to visualize national style culture from the aspects of character design, scene construction, and special effects production; Explore the innovative design of two-player cooperation mechanism in gameplay, such as skill cooperation between players and division of tasks. Research game development technologies based on the Unity3D

engine, including scripting, physics system application, resource management, etc. Evaluate the creativity, interactivity and technical implementation effect of the game, analyze the advantages and disadvantages of the game through player testing and feedback, and put forward improvement directions and future prospects.

2 GAME CONCEPT DESIGN AND CREATIVE CONSTRUCTION

2.1 World View and Plot Setting

(1) Mythological Worldview: "Ink Walker" builds a unique Guofeng mythological worldview, with "Ink Walker" as the core profession, integrating ink and natural elements into a unique spell system to create a fantasy world of Xianxia. In this world, painters are known as "inkwalkers" who have the ability to manipulate ink with natural elements, allowing them to merge the two to create magical spells. This setting cleverly combines the elements of pen and ink in traditional Chinese culture with natural philosophical concepts, giving the game a unique cultural heritage.
The main capture object in the game, the "Painting Spirit", is a creation spirit created by nature and ink, that is, the fairy. These fairies have a wealth of attribute settings, including five single attributes of "gold, wood, water, fire, and earth" and 10 dual attributes formed by combining two of them. This attribute setting not only enriches the gameplay of the game, but also echoes the traditional Chinese theory of the five elements, bringing players a more in-depth gaming experience. For example, the Gold Elemental Elves may have a hard shell and powerful attack power, while the Wood Elemental Fairies may be good at healing and controlling, and players need to use corresponding strategies and skills to capture them according to the attributes and characteristics of different Fairies.
(2) Level narrative structure: The game has five major levels, namely "Green Ridge", "Sunset Mountain", "Broken River", "Purple Shirt Ze" and "Youqu Path", each level has a unique scene style and fairy type, through the gradual unlocking of levels, gradually expand the game world view[1]. Map Level Design in the Game "Ink Walker" can be seen in Figure 1.

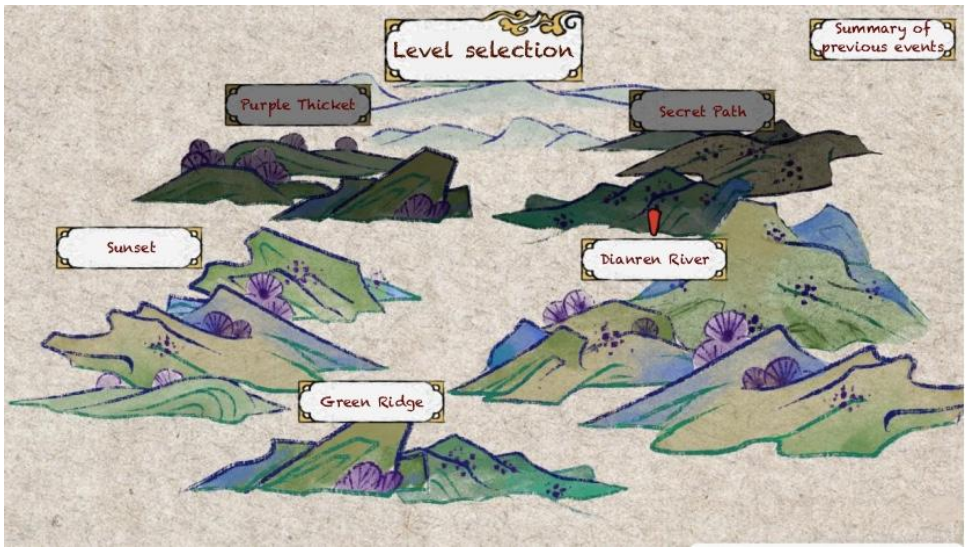

Figure 1 Map Level Design in the Game "Ink Walker"

As the starting level of the game, "Green Ridge" uses pastel ink to render the scene of cascading mountains, creating a fresh and tranquil atmosphere and presenting players with a natural world full of life. In this level, players mainly encounter wood and water fairies, which are integrated with the scene, such as vine-entwined wood element fairies and water element fairies, guiding players to have a preliminary understanding of the game's world view and gameplay.
As the level progresses, "Sunset Mountain" is set against the backdrop of the sunset maple forest, and the maple leaves are like fire, dyeing the entire mountain forest orange-red, creating a serene and slightly mysterious atmosphere. In this level, in addition to wood and water fairies, there will also be fire fairies, and their forms may be combined with burning flames, such as flame birds, fire foxes, etc., and their fiery attributes echo the afterglow of the sunset in the scene, adding to the visual impact and challenge of the game.
"Broken Renchuan" shows the steep terrain through the fractured canyon and flowing ink, the canyon is deep, the water is fast, and the flow of ink adds a bit of mystery and danger. Here, players will encounter metallic and earth-attribute fairies, which may appear in mechanical metal forms and have strong defense and attack power; Earth attribute fairies may be combined with rocks and soil, and are good at defending and controlling terrain, such as rock giants, earth element puppets, etc., and players need to deal with these goblins in complex terrain to further experience the richness and challenge of the game world.
In "Purple Shirt", the purple mist fills the swamp, mysterious and deep, as if hiding endless secrets. In this level, the types and numbers of dual-attribute goblins gradually increase, such as wood and water dual-attribute goblins, they may have the agility of water and the healing power of wood, and players need to use skills and strategies more flexibly to successfully subdue these goblins and explore this mysterious world in depth

The final "Youqu Trail" is a deep and winding trail as the main scene, lined with dense bamboo forests and ancient buildings, and moonlight shines on the ground through the bamboo leaves, creating a quiet and mysterious atmosphere. In this level, goblins of various attributes gather, and players need to give full play to their wisdom and operating skills, match skills reasonably, and work closely with teammates to complete the final challenge and reveal the secrets behind the game world. This kind of design that gradually enriches the game content and world view through the narrative structure of the level can attract players to continue to explore and deeply experience the mythical world of the national style created by the game.

2.2 The Creativity of Art Concept Design

2.2.1 Character and goblin visual design

(1) Protagonist design: As the protagonists of the game, the painter brother and sister use a very distinctive ink style character design. Their costume design cleverly incorporates elements such as brushes and rice paper, reflecting the professional characteristics of "ink walkers". For example, the senior brother's robe may have the texture of brush strokes drawn on it, and the cuffs and neckline are designed with the texture of rice paper, which seems to have the fragrance of ink when fluttering in the wind; The junior sister's costume may be based on light ink colors, with streamers made of rice paper, on which exquisite ink patterns are drawn, such as plum blossoms, bamboo, etc., showing the softness and agility of female characters(Figure 2).

Figure 2 "Ink Walker" Begins the Visual Design of the Game Interface

When the skill is released, the character will present the special effect of ink diffusion, which further strengthens the expression of national style elements. When the senior brother uses the gold skill, the golden ink will spread out from the brush tip like lightning, and after hitting the target, golden ink patterns will appear around it[2], as if the luster of metal shines in the ink color; When the junior sister uses the water skill, the blue ink will ripple like water waves, forming a circular water curtain that envelops the target, and a faint cuttlefish pattern will appear on the water curtain, vividly showing the agility and softness of the water. The design of this skill special effect not only increases the visual impact of the game, but also allows players to feel the unique spell charm of "Ink Walker" during operation.

(2) Fairy form innovation: The form design of the fairy combines the characteristics of the strange beasts of the "Classic of Mountains and Seas" with the modern Q version aesthetics, realizing the expression of "rejuvenation of traditional elements". Taking the "Golden Element Fairy" as an example, its shape borrows from some metallic beasts in the "Classic of Mountains and Seas", while incorporating the rounded lines and cute expressions of the modern Q version style, making it not only have the heritage of traditional culture, but also conform to the aesthetic taste of contemporary players. Its body surface is covered with mechanical metal patterns, which not only add to the sense of technology of the fairy, but also hint at the hardness and sharpness of the gold element. Its eyes may be designed as shimmering red gemstones, like burning flames, revealing the fiery heat and power of the gold element[3].

Figure 3 The Fairy Form Card that the Player needs to Capture
(Displayed in the Upper Left Corner of the Game Interface)

As shown in Figure 3, the "Wood Element Fairy" incorporates the forms of vines and flowers, showing the vitality and vitality of nature. Its body may be wrapped in vines, forming a cute animal shape, such as a rabbit, a fawn, etc., and bright flowers grow on the vines, gently swaying with the movements of the goblins, emitting a charming fragrance. Its ears or tail may be made of long vines dotted with crystal dewdrops, as if it were an elf who has just awakened in the forest in the early morning. This design that combines traditional elements with modern aesthetics makes the image of the goblin more vivid and interesting, and is easy to accept and love by players.

2.2.2 Scene and UI visual language

(1) Scene composition: The game scene composition uses the technique of Chinese landscape painting "high, far-reaching, and flat" to build a multi-level explorable map, bringing players a rich visual experience and exploration fun. In the "Green Ridge" level, the layered mountains are rendered with pastel ink painting, using the high distance method, and the distant peaks are obscured by the tall mountains nearby, creating a sense of towering into the sky, making players feel like they are in the majestic mountains. The clouds and mist are swirling between the mountains, and the use of blank space to express the ethereal nature of the clouds and mist, leaving players with room for imagination. At the same time, some paths, streams and pavilions are cleverly arranged in the picture to guide the player's eye deep into the picture [4] and increase the sense of layering and depth of the scene.

The "Broken River" level expresses the steep terrain through the fractured canyon and flowing ink, using the far-reaching method. The cliffs on both sides of the canyon are towering and steep, shading each other and forming a deep canyon space. As players move forward through the canyon, they will see the canyon in the distance gradually disappear into the ink-colored fog, as if bottomless, adding to the mystery and danger of the scene. The water at the bottom of the canyon flows rapidly, expressing the dynamics of the water flow with flowing ink lines, and the splashing places are embellished with white ink dots, vividly showing the power and speed of the water flow.

(2)UI interaction design: UI interactive design adopts scroll-style menus and stamp-style buttons, and the skill selection interface is presented as a "nine-square grid inkstone", which strengthens the recognition of the national style. The design of the scroll-style menu is inspired by ancient Chinese calligraphy and painting scrolls, when the player opens the menu, the menu slowly unfolds like a scroll, and the text and icons on it are presented in quaint calligraphy fonts and traditional patterns, giving players the feeling of flipping through ancient books[5]. The stamp button imitates the shape and texture of traditional Chinese seals, and the buttons are engraved with simple patterns or text, such as skill icons, function names, etc., and when the player clicks on the button, the special effects under the seal will appear, increasing the fun and ritual of the operation.

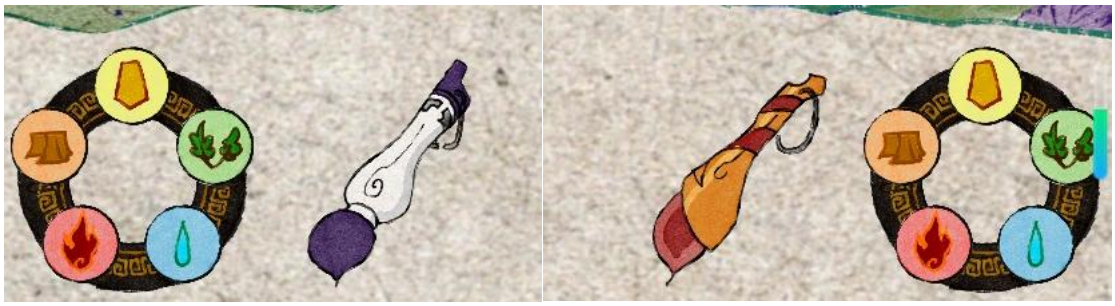

Figure 4 The Color Palette Props Operated by the Two Players Respectively (Player 1 Left, Player 2 Right)

As shown in Figure 4, the skill selection interface is presented as a "nine-square grid inkstone", placing the skill icons in the game in the nine grids of the inkstone, and there are also faint ink marks drawn around each grid, as if they are traces left by a brush that has just dipped ink. When the player selects a skill, the corresponding grid in the inkstone will light up, and the ink color will flow with it, creating an elegant and quaint atmosphere. This UI design not only aligns with the game's national style theme, but also brings players a unique interactive experience, allowing players to feel the charm of traditional Chinese culture during operation[6].

3 TECHNICAL INDICATORS AND RESEARCH METHODS

3.1 Technical Foundation and Development Tool Chain

3.1.1 Unity3D engine core feature application

(1) Cross-platform architecture: With the help of IL2CPP technology, "Ink Walker" realizes the compilation of multiple platforms such as Windows, Android, and iOS. IL2CPP compiles C# code into CIL intermediate language, then converts it into C++ code, and finally generates machine code by C++ compilers on each platform, greatly improving code execution efficiency and cross-platform compatibility[7].On different devices, through dynamic resolution adjustment, the resolution is automatically adapted according to the device performance and screen parameters, combined with the optimized resource loading strategy, to ensure that the game frame rate is stable above 60fps, providing players with a smooth gaming experience.

(2) Visual development toolchain: Based on the Unity Editor, developers can efficiently build scenes. Using the Tilemap component, 2D level maps such as "Green Green Ridge" and "Sunset Mountain" are quickly constructed by splicing tiles, and its rich editing tools and flexible tile combination methods greatly improve the efficiency of map creation. The Animator controller is used to manage the character action state machine, and by defining different animation states and conversion conditions, it realizes the natural switching of character actions, such as from standing to walking, running, and skill release actions, etc., which improves the development efficiency by more than 30% compared to traditional animation management methods.

3.1.2 Technology stack and resource management

(1) Art resource pipeline: Art resource production adopts the "Blender modeling→ Substance Painter texture→ Unity resource library management" process. In Blender, polygon modeling, sculpting, and other techniques are used to create high-precision characters, goblins, and scene models. Then, in Substance Painter, use intelligent materials and drawing functions to generate realistic texture maps; Finally, the Unity resource library was imported, and a standardized asset naming convention and version control process were established, achieving a 40% reuse rate of art assets and reducing duplicate production workload.

(2) Scripting system design: Use C# language to write core logic and implement role control based on MonoBehavior components. Take character movement control as an example, achieve 8 directions of movement, set skill cooldowns, and limit the frequency of skill releases to ensure the balance and strategy of the game. Introduce object pool technology to manage goblin generation, create a certain number of goblin objects in advance and store them in the object pool, directly obtain them when needed, and put them back after use, effectively reducing memory peaks by 25% and improving game performance.

3.2 Implementation of Core Gameplay Technology

3.2.1 Development of two-person collaboration mechanism

(1) Network synchronization solution: A client-server architecture is built based on the Unity Networking module, where the server controls the overall state of the game, and the client is responsible for displaying information and sending operation instructions. Key operations such as skill release and goblin capture are synchronized with the help of RPC remote procedure call mechanism to ensure the consistent state of all clients. In response to the network latency problem, a predictive compensation algorithm is introduced, and the client locally predicts the operation results and displays them, and at the same time sends instructions to the server for verification and correction, and finally sends the synchronization information back to the client for adjustment, successfully controlling the synchronization delay of two-player operation within 150ms to ensure smooth game interaction.

(2) Division of labor and cooperation system: Clarify the role positioning of "ink attack" high output and "stick" strong control. Through the visualization of the skill range, the skill release range is clearly displayed in the game interface, which is convenient for players to cooperate. Real-time location tags keep players informed about the location of their teammates. Designed combined skills such as "Elemental Resonance", which require the overlapping skill areas of the two characters to trigger, such as "Water and Fire Blending", Ink Attack Fire Attribute Skills, and Stick Water Attribute Skills, combined with steam generating areas to cause damage and interference, greatly improving the depth of game strategy(Figure 5).

Figure 5 Player 1 is Capturing the Operation Screen of the Fire Elementary Fairy

3.2.2 Element and level system implementation

(1) Five elements mutual restraint algorithm: Construct an attribute restraint matrix, single-attribute goblins follow the basic rules of "gold and wood, wood and earth, earth and water, water and fire, and fire and gold", and dual-attribute fairies need to be covered by dual attributes to successfully capture. For example, when a metallic skill attacks a wood-attribute fairy, the ray detects whether the skill range covers the goblin, and combines the collision algorithm to determine whether it hits or not to achieve accurate capture judgment.

(2) Dynamic difficulty curve: Dynamically adjust the difficulty according to the player's historical clearance time, and the proportion of dual-attribute goblins will gradually increase to 60% after the 3rd level, while increasing the

movement speed of goblins. With the increasing complexity of the terrain, such as the dynamic water flow collision detection in the "Broken River" level, when players cross the river, the water flow will affect the movement of the character, so it needs to be carefully dealt with, forming a gradient experience from beginner-friendly to expert challenges to meet the needs of players of different levels.

3.3 System Architecture and Performance Optimization

3.1.1 Core module development

(1) Character control system: supports keyboard/controller dual operation adaptation, and realizes cross-platform input management through the Input System component to adapt to different player operating habits. Keyboard operation uses W, A, S, D to control movement, and number keys 1 - 5 release skills; The handle operation uses the left joystick to control the movement, the right joystick adjusts the viewing angle, and the function button releases the skill. Introducing the "Ink Energy Bar" mechanism, skill release consumes energy, and energy recovers over time, limiting players' high-frequency operations and prompting players to reasonably plan the timing of skill release(Figure 6).

Figure 6 Player's Operation Prompt Key Interface

(2)Collision and physics system: Combines Box Collider 2D and Polygon Collider 2D components to achieve complex terrain interaction. Box Collider 2D is used for collision detection of regularly shaped objects such as rectangles, while Polygon Collider 2D creates colliders with a conforming shape for irregular objects such as rocks and trees. Utilize the PhysX engine to simulate physical blocking effects in ink areas, such as player-drawn ink barriers that block goblin action, ensuring smooth feedback of character movements and skill releases, enhancing game realism.

4 PERFORMANCE OPTIMIZATION STRATEGIES

(1) Rendering optimization: Use occlusion culling technology to mark occlusion and occlusion objects in the scene to avoid rendering completely occluded objects and reduce invalid rendering objects. Through LOD (Level of Detail) hierarchical processing, the model detail level is dynamically switched according to the camera distance, high-detail models are displayed at close range, and low-detail models are used at a distance to improve scene loading speed, reducing rendering time by 40% in complex mobile scenes.

(2) Memory management: Use object pool technology to reuse goblins and skill special effects objects to avoid performance overhead caused by frequent creation and destruction; Coordinate with the Profiler tool to monitor memory allocation in real time, detect memory leaks and irrational allocations in a timely manner, and strictly control the peak memory usage of mobile devices within 500MB to ensure stable game operation(Figure 7).

Figure 7 The Game Screen of the Player Playing the Game

5 CONCLUSION

This study conducts an in-depth analysis of the design and implementation process of "Ink Walker", a two-player game based on Unity3D that captures fairies, and constructs a game development framework that integrates national style aesthetics and two-player collaborative gameplay, providing a technical solution and creative paradigm with reference value for the development of similar games.

In terms of art concept design, through the modern translation of national style elements, the low-poly ink rendering style was created, and the Q version of the goblin image was designed, realizing the organic combination of tradition and modernity. Using the scene-based expression of visual narrative, the game world view and plot are integrated into the details of the level scenes, bringing players an immersive narrative experience. In terms of gameplay design, the innovative two-player cooperation mechanism and dynamic difficulty adaptation system increase the strategic depth and playability of the game, meeting the gaming needs of different players.

At the technical implementation level, the characteristics of the Unity3D engine are used to realize core functions such as cross-platform development, character control, scene construction, collision detection, and two-player collaboration, and ensure the smooth operation of the game and a good user experience by optimizing the network synchronization mechanism and improving performance.

Through player testing and feedback, the feasibility and effectiveness of the game in terms of art creativity, gameplay design and technical implementation are verified. However, the game still has some shortcomings, such as the intelligence of AI behavior needs to be improved, and the difficulty balance of later levels needs to be further optimized.

In the future, with the continuous development of artificial intelligence, virtual reality and other technologies, Guofeng digital games are expected to achieve greater breakthroughs in technological innovation and cultural expression. The application of AI intelligence in games can be further deepened, such as developing smarter goblin AI, which can respond more flexibly based on player behavior; Strengthen UGC content creation, allowing players to participate in the generation of game content, and increase the fun and social nature of the game. explore the integration with more cultural IPs, expand the cultural connotation and market influence of games, and promote the global dissemination of national style digital games.

To sum up, this study not only provides a direction for the subsequent optimization and development of "Ink Walker", but also provides a useful reference for the exploration of technological innovation and cultural inheritance of national style games, which has certain theoretical and practical significance.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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