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Auditory Atmospherics in Games: Beyond the Visuocentric Paradigm

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Abstract: The videogame industry has always put visual components at the forefront in its design and analytical processes while following a visuocentric approach. This paper contends that a new perspective is needed to appreciate how auditory atmospherics play a vital yet underestimated role in creating immersive and captivating gaming experiences. This study demonstrates how sound can create player presence and evoke emotions to guide them through video game environments confirming sound design as essential for developing immersive virtual worlds. According to existing research the paper investigates how detailed soundscapes enhance player immersion and improve the total gaming experience. The paper investigates how auditory elements affect psychological states and emotions through their influence on immersion levels, emotional reactions, cognitive abilities and examines potential health consequences. The paper describes the technical implementation of immersive audio within game development software while projecting the evolution of game audio through innovations in spatial audio technology and procedural sound creation supported by AI-driven sound design and biometric integration. This paper proposes a comprehensive multi-sensory game design strategy that positions auditory atmospherics as an essential core element for the progression of interactive entertainment.

Keywords: Auditory Atmospherics, Game Sound, Immersion, Emotional Response, Visuocentric Paradigm

1 Introduction

The videogame industry showcases significant expansion in its audience size and financial gains which highlights the importance of understanding what affects player experiences. Game development has traditionally emphasized visual elements like high-quality graphics and realistic rendering but sound offers a powerful tool to enhance gameplay through emotional impact and altered player perception beyond visual capabilities. This paper examines auditory atmospherics as a fundamental element in game design to shift away from a traditional visuocentric approach toward sound-based immersion for enhanced gaming experiences. The auditory landscape created by game designers plays a major role in generating immersion defined as complete involvement in the game world with loss of time awareness and external world connection. This paper investigates sound design's role in establishing presence within games while evoking emotions and directing players throughout the gaming experience based on existing research.

2 Literature review

Game studies as a field has traditionally followed a visuocentric approach which focuses primarily on visual

components when examining game design and player experience. Foundational principles of game audio and sound design demonstrate sound's immersive capabilities in interactive spaces through techniques and practical game engine implementations^[1]. Exploration of game sound working practices reveals audio's importance by examining technological methods and integration challenges in game development pipelines^[2]. The case study of sound design analysis in "Transistor" reveals how expertly created soundscapes function collaboratively with game art and mechanics to generate emotional responses and enhance player involvement^[3]. Research into game design reveals the necessity for a holistic design philosophy that treats auditory atmospherics as essential elements for creating player experiences and narratives in virtual worlds.

Research studies delve into how sound influences player immersion by examining its effects on gaming experiences. Studies demonstrate stereo sound improves both player immersion and narrative believability when used in first-person game settings^[4]. Auditory immersion and the believability of a first-person perspective in computer games: Do gamers feel stronger immersion with mono or stereo foley and does one type appear more realistic than the other? Researchers have investigated how soundscapes generate specific emotions like tension and fear especially in horror genre games where sound cues play a crucial role in building the atmosphere.^[5] Research on audio's wider role in computer gaming demonstrates the ways different game audio categories help engage players while building immersion. Research into computer game audio demonstrates its essential role in creating player immersion^[6]. Recent research investigates how ambient sounds and character sounds affect player avatar identification and immersion differently^[7]. This collection of research urges game studies to shift their paradigm from visual dominance toward appreciating how sound atmospherics extensively influence player experience and game design.

3 The Power of Auditory Atmospherics

The deployment of crafted soundscapes within game design functions as a fundamental element because these soundscapes work in harmony with visual elements to create immersive gaming experiences. By attending to the nuanced auditory environment, developers are empowered to significantly amplify player immersion, thereby forging a gaming experience that is not only more engaging but also profoundly memorable^[8].

3.1 Creating Presence and Immersion

The proper use of auditory elements establishes a strong sense of presence inside virtual gaming environments. The detailed simulation of real-world sound elements together with the intentional placement of environmental audio signals helps to firmly connect players to the game's reality^[9]. Developers use sound to connect players to virtual worlds thus creating a strong sense of presence in-game. The precise sound design of footsteps reverberating inside a virtual cavern helps create a sense of depth and space through its echoing effects. The remote but audible crashing of waves against a virtual shore adds depth to the game soundscape and defines the game world boundaries which improves player spatial understanding and creates a more realistic experience that merges virtual and physical perception. By layering detailed audio cues developers create an immersive soundscape which enables players to experience a realistic connection to their virtual surroundings.

3.2 Evoking Emotions

A gamer's emotional state becomes deeply affected by sound which operates at an instinctive level. Music stands out as an effective means for influencing players' emotions because it establishes particular moods while building tension in a nuanced way to trigger a full range of emotional responses. Dynamic upbeat scores implemented into action gameplay sequences generate excitement and energy which strengthens player engagement and involvement. When developers strategically implement slow, dissonant or eerily melodic musical sections they create suspense and anticipation which leads players to experience increased alertness and emotional sensitivity. Sound design and music elements purposefully chosen and meticulously applied stand as core components that boost emotional resonance during critical game events and shape players' emotional experiences through their gaming journey. This careful orchestration of sound allows developers to tap into the player's emotional landscape, creating a more resonant and impactful experience^[10].

3.3 Guiding the Player

Sound cues extend beyond emotion and immersion to become essential elements for guiding players and delivering information within games. The intentional use of sound design guides players through intricate virtual worlds while providing essential real-time information about their environment. Distinct enemy footsteps create an auditory alert for players which signals potential danger and prompts them to take strategic actions. The use of subtle auditory signals like faint chiming sounds or directional rustling enables developers to discreetly reveal hidden items and secret paths which rewards players who pay attention to their soundscape. Through sound-based information delivery and dynamic feedback game developers build immersive player experiences that surpass visual communication while incorporating essential audio elements into the gameplay.

4 Examples of Games with Effective Auditory Atmospherics

Multiple games have created unforgettable experiences through the expert use of sound-based atmospherics. Some notable examples include:

- Alien: Alien: Isolation uses sound effectively to maintain a continuous feeling of fear and suspense throughout this survival horror experience. The spaceship's creaking, the alien's hissing sounds and the eerie silence together create a terrifying and immersive atmosphere^[11].
- The Last of Us: The action-adventure game uses music and sound effects to intensify the emotional resonance of pivotal story moments. The soundtrack transitions between gentle melancholy and intense action-packed sequences to reflect the characters' emotional progression^[12].
- Ori and the Blind Forest: The platformer game creates an atmosphere of wonder through its hauntingly beautiful soundtrack. The soundtracks work in harmony with the visuals and emotional storytelling to produce a deeply engaging and memorable experience.
- Hellblade: The action-adventure game Hellblade: Senua's Sacrifice incorporates binaural audio to recreate psychosis experiences while delivering an immersive and unsettling sound environment that illustrates the protagonist's mental state.
- Red Dead Redemption 2: The open-world western game Red Dead Redemption 2 employs a dynamic soundscape to deliver realism and immersion to players. The combination of nature sounds with bustling town noises and ambient music creates a believable and enchanting game world^[13].
- Subnautica: The underwater exploration and survival game Subnautica employs sound to generate feelings of mystery and wonder. The whale calls reverberating through water alongside submarine noises and the sounds of deep ocean create an unforgettable immersive experience.
- Gris: This puzzle-platformer adventure game uses its sound design to evoke various emotions and strengthen players' connection to the protagonist's adventure. The player's actions and narrative progression cause the music to swell and change thereby delivering a profound atmospheric experience.

The following cases illustrate how sound design creates various atmospheric states that range from feelings of tension and terror to sensations of peace and tranquility^[14]. These examples demonstrate that sound can be utilized to deepen immersion while evoking emotions and guiding players to produce a more complete and captivating gaming experience.

5 Psychological and Emotional Impact of Auditory Atmospherics

Research in interactive entertainment now acknowledges how auditory atmospherics deeply affect psychological and emotional responses among players which makes it an emerging field of academic study. Research currently demonstrates that sound plays a powerful role across multiple dimensions of player experience rather than serving as just an additional element. The research focuses on how background and character sounds affect player experience in video games^[15]. The metrics extend to player immersion depth while measuring emotional response intensity during gameplay and how cognitive performance changes within virtual spaces.

Each player interacts with sound differently under different physiologies and cultures

5.1 Augmenting Immersion and the Sensation of Presence

Current research demonstrates how sound significantly boosts player immersion and strengthens their sense of presence in the detailed virtual environment of a game. In this sense, immersion defines the mental state where players become completely absorbed in the game world while losing awareness of their real-world surroundings. The concept of presence indicates the player's personal experience of existing in the virtual space while they remain physically outside of it.

A compelling empirical study at the University of York highlighted the essential function of sound in producing immersive experiences. Game participant engagement levels dropped along with their sense of experiential realism when they played games that lacked auditory stimuli. The fundamental study demonstrates that sound plays an essential role in building virtual worlds that maintain both consistency and realism while offering an engaging experience that fully captures players' attention. Without sound the illusion of reality breaks down which prevents players from engaging with the virtual world in a meaningful way as they struggle to fully immerse themselves.

5.2 Emotional Modulation through Auditory Design

Gaming sound design uses auditory elements to trigger various emotional responses in players which span both positive states like excitement and joy as well as negative ones such as fear and sadness. Music stands as an effective tool for emotional manipulation which creates an immersive mood throughout the game while guiding the player's emotional journey. Effective sound design depends on the strategic use of both musical scores and detailed sound effects to generate emotional reactions that harmonize with the game's narrative and interactive elements. Auditory hallucinations serve as an effective tool for emotional manipulation in horror games through strategic application. Developers generate strong feelings of unease and fear in players through the deliberate use of disembodied vocalizations and enigmatic whispers that seem to come from nowhere. The approach skillfully merges the game world and player reality to create a deeply immersive atmosphere that introduces disturbing uncertainty. Auditory illusions dramatically enhance the psychological intensity of horror-based interactive games by driving players into deeper layers of anxiety and suspense. The effectiveness of this approach generates important ethical questions about the possible lasting psychological harm that comes from intentionally creating fear and anxiety in gamers. When audio tools with significant power are employed they require a careful evaluation of both player health effects and their long-term consequences.

To fully grasp the implications of immersive audio requires studying its possible negative impacts including Game Transfer Phenomena (GTP)^[16]. Game Transfer Phenomena (GTP) represents the continuation of gaming experiences through intrusive sensory, cognitive, and motoric experiences after gameplay ends. Auditory intrusions constitute an essential component of GTP where players experience involuntary memories of in-game audio elements and complete auditory hallucinations including voices and sound effects from the game world after stopping gameplay. Some anecdotal evidence claims that GTP experiences remain harmless and enjoyable for numerous players but it remains essential to understand that certain people with increased sensory sensitivity or established psychological vulnerabilities can find these intrusions extremely troubling. The occurrence of frequent and intense auditory GTP events in clinical settings can reflect or lead to reduced psychological health which highlights the necessity for further investigation into the lasting impacts of immersive sound-based gaming environments.

5.3 How Auditory Cues Affect Cognitive Performance in Interactive Gaming Environments

Recent studies reveal how specific sound elements in video games play a significant role in changing players' cognitive abilities. Multiple studies suggest that rich auditory game environments help develop specific cognitive abilities. Research findings indicate that people who spend significant time playing video games show improved auditory processing speeds. The cognitive benefits observed in gamers are believed to originate from the intricate auditory demands presented by the dynamic sound environments found in modern games^[17]. The complex nature of these auditory environments requires instant and precise interpretation of multiple simultaneous sound events which might lead to neuroplastic adaptations that improve the processing efficiency of auditory information. Engaging with immersive game audio produces cognitive advantages which enhance players' ability to process

auditory information faster and more precisely across various situations and possibly outside gaming scenarios.

The intentional use of music in game sound design provides a sophisticated method to influence player cognitive processing. Scientific studies have shown that different musical elements such as tempo, rhythm, and instrumentation can affect attention and cognitive resource distribution in distinct ways^[18]. Research shows that musical genres and compositions with slower tempos and predictable harmonic structures help promote focused attention while decreasing cognitive distractions. Music featuring fast tempos and intricate rhythms or lyrics can unintentionally shift attention away from cognitive tasks that demand prolonged focus. The dichotomy between different sound design elements reveals that developers can use audio strategically to enhance player performance through various gameplay objectives. To help players concentrate on analytical thinking during puzzle-solving segments game developers utilize calming ambient music to create a mental environment that promotes problem-solving abilities. The use of high-energy, upbeat music during action-packed sequences can improve player arousal and reaction time which enhances performance in fast-paced reflex-based gameplay.

Research investigating character-specific audio cues in game soundscapes has provided significant insights beyond the general impact of game music. The research examining video game soundscapes discovered that character-specific auditory elements linked to player actions directly affected multiple important aspects of player experience in a positive way. The dimensions under consideration showed increased player immersion together with stronger avatar identification which means players felt more connected with their in-game characters and they experienced more enjoyment overall^[19]. Research shows that purposeful inclusion of player-character-specific auditory feedback within game environments greatly improves player presence and world connection which leads to more immersive and enjoyable gaming experiences.

6 Technical Aspects of Implementing Auditory Atmospherics

The latest game development software supplies developers with numerous choices to build and apply immersive sound designs. Wwise and FMOD audio middleware enables developers to build responsive soundscapes that adjust based on the player's activities and environmental shifts. The available tools provide developers with real-time sound adjustments capabilities along with event-driven sound triggers and interactive music systems to achieve unparalleled control over the audio experience.

6.1 Real-Time Sound Adjustments

Developers can instantly modify sound features including volume, pitch, and effects using Wwise and FMOD. Developers can adjust audio elements on the fly which helps match the soundscape with gameplay dynamics to evoke specific emotional reactions. Game developers could implement real-time audio adjustments to progressively amplify unsettling whispers and creaking noises whenever players move toward suspenseful zones within a horror game to boost tension and fear.

6.2 Triggering Sounds with Gameplay Actions

Wwise and FMOD both use an event-driven method which connects sounds with specific actions within the game. Through this feature developers achieve a sound environment where audio effects respond to player movements and gameplay interactions. The sound of footsteps becomes activated by player movement speed and surface type, resulting in a more lifelike and engaging gaming environment.

6.3 Dynamic Audio Transitions

Developers have the ability to move between various sounds smoothly during gameplay using audio states and switches. When players enter combat the background music transitions from calm and atmospheric sound to intense and action-packed tones which enhances the encounter's emotional impact. The game "Dead Space" features music that changes dynamically when an enemy approaches which generates a feeling of imminent danger and urgency for players.

6.4 Interactive Music Design

Developers can use Wwise to build music tracks that dynamically react to both player movements and

narrative developments within the game. The musical experience becomes more interactive and captivating because the music stays alive and directly responds to the player's actions during gameplay. In action games the music intensifies and gains additional layers when players execute combos or defeat enemies to offer an immersive audio reward.

6.5 Optimized Audio Management

Successful audio management guarantees seamless performance while preventing excessive sound buildup. Game developers must manage audio elements by controlling their simultaneous playback and determining playback priorities according to their significance in the game experience. Audio occlusion and prioritization techniques enable developers to maintain audible clarity by preventing critical sounds from being overshadowed by less important audio elements.

6.6 Creating Spatial Audio Effects

Through binaural audio and ambisonics spatial audio technologies simulate 3D sound perception to produce realistic and immersive auditory environments. These audio technologies generate depth perception alongside directional sound cues which together create environmental presence and improve player immersion.

7 Studying the Future of Audio Environments in Game Development

Audio atmospherics in gaming today stand at the forefront of a landscape rich with transformative possibilities. The latest developments in fundamental audio technologies such as spatial audio rendering, procedural sound generation and AI-driven sound design methodologies are establishing new possibilities for creating profoundly immersive and dynamic experiences for players. Advancements in game audio technology are transforming sound from a secondary component into the fundamental structure that supports interactive world-building and enhances player involvement.

7.1 Spatial Audio: Immersive Soundscapes and the Illusion of Presence

The modern game development sector sees widespread adoption of spatial audio technologies which mark a transition to perceptually realistic and immersive soundscapes. Audio systems including Dolby Atmos and Sony 3D Audio demonstrate this movement through their advanced techniques which recreate sound travel and perception in multi-dimensional environments. Spatial audio technology advances beyond conventional sound systems by allowing developers to position individual sound objects within a complete 360-degree sound environment. The improved spatial fidelity enables developers to produce soundscapes that deliver enhanced auditory depth along with precise sound directionality and a robust sense of environment presence. Players experience deeper immersion because sound elements effectively match the virtual space and strengthen the sensation of being part of the game world.

Technology	Description	Example in Games
Dolby Atmos	Creates a 3D soundscape by simulating how sounds would be heard in a real-world environment.	Call of Duty: Modern Warfare, Cyberpunk 2077
Sony 3D audio	Uses Head-Related Transfer Function (HRTF) technology to create a personalized spatial audio experience.	Marvel's Spider-Man: Miles Morales, Returnal
Binaural audio	Uses two microphones to record sound in a way that simulates how humans hear.	Hellblade: Senua's Sacrifice, Resident Evil Village
Ambisonics	A full-sphere surround sound technique that captures sound from all directions.	Half-Life: Alyx, Star Wars: Squadrons

State-of-the-art spatial audio rendering methods depend heavily on progress in basic audio processing

techniques such as Head-Related Transfer Functions (HRTF), convolution reverb, and ambisonics. These technologies collaborate effectively to create authentic three-dimensional audio spaces in games.

- **Head-Related Transfer Function (HRTF) Technology:** HRTF modeling functions on the basis of replicating how a person's head shape and outer ear structure affect sound coming from various spatial directions. Through detailed acoustic measurements and computational modeling HRTF technology produces filters for game audio that can be personalized or standardized to users. Effective HRTF processing achieves precise sound source positioning around a listener in all three dimensions including above and below the listener which produces enhanced verticality and realistic three-dimensional sound localization. The ability to communicate subtle spatial cues through audio processing plays an essential role in creating realistic auditory experiences.
- **Convolution Reverb:** Convolution reverb presents a major step forward beyond conventional algorithmic reverb methods. The system works by recording impulse responses from actual or virtual spaces and uses these recordings to modify game audio as it plays back. The system precisely models sound reflections and reverberations in various environments by analyzing room dimensions and surface acoustic characteristics. Developers who use convolution reverb technology produce realistic acoustic spaces in virtual settings such as expansive cathedrals with echoes or confined metallic corridors with tight reverberations that result in a more immersive environment for players.
- **Ambisonics:** Ambisonics represents a complete spherical surround sound technique that captures and reproduces audio from all directions within a three-dimensional space unlike channel-based surround sound systems. The Ambisonic encoding method records the complete sound field from one specific location which enables flexible and immersive audio reproduction across multiple speaker setups or headphone systems. Ambisonics serves as an influential innovation in game development enabling developers to craft intricate sound environments which respond to player movements and perspectives within virtual spaces. This technique successfully delivers an authentic sensation of sound immersion which makes the distinction between the game world and the player's perception almost disappear.

Advanced audio processing techniques and spatial sound technologies move game sound design to more sophisticated immersive audio experiences, paving the way for sound to become increasingly essential in enhancing player engagement and virtual world believability.

7.2 Procedural Audio Generation

Procedural audio generation breaks away from sample-based sound design by using algorithmic processes to create sounds during gameplay. This method enables the creation of a much broader range of complex auditory experiences which surpasses the limitations of pre-recorded sound assets. Procedural audio systems create sound in real time through specific rules and parameters instead of using fixed sound files which enables infinite variations that respond to in-game events. The natural dynamic qualities of procedural audio make it exceptionally effective for developing responsive soundscapes that adapt seamlessly to player interactions and environmental shifts while intensifying a game world's immersion and realism. Expansive open-world games can use procedural audio to produce authentic and dynamic natural sounds including wind patterns and wildlife noises. A virtual forest exists where every leaf rustle and raindrop along with animal sounds is produced distinctly from environmental factors and player location to generate a detailed and continuously fresh auditory experience. Procedural audio techniques enable dynamic sound element creation across multiple categories including real-time adaptive footstep sounds on various surfaces and weapon noises that change with distance and environmental factors. Procedural audio systems produce complex soundscapes with minimal memory requirements because compact algorithms replace large sample libraries.

7.3 AI-Driven Sound Design

Artificial intelligence now stands to transform many aspects of game development while sound design serves as a prime example of this transformative potential. The audio pipeline now benefits from AI technologies that automate demanding tasks like sound asset creation and the processes of mixing and mastering. The automation

process enhances development efficiency while enabling sound designers to focus on creative and conceptual sound design work. AI technology provides robust solutions for improving specialized areas of game audio including dialogue production and synchronization of lip movements. Modern AI technologies enable developers to build dialogue systems that produce contextually relevant character speech which responds dynamically to story pathways and player decisions. AI-based lip-syncing systems produce lifelike facial animations that match either generated or pre-recorded dialogue to improve the realism of virtual characters in interactions^[20]. AI demonstrates significant potential for developing soundscapes that uniquely match individual player behaviors and preferences. Consider an AI system that performs real-time analysis of player gameplay styles by recognizing movement patterns and combat decisions before adjusting game audio to match these detected behaviors. Players who prefer stealth and exploration will experience enhanced ambient sounds and atmospheric music while action-oriented players will encounter heightened combat music and sound effects through AI-driven dynamic adaptations that deliver immersive audio experiences tailored to each player's unique style.

7.4 Biometric Audio

The field of game audio is experiencing a revolutionary trend as it incorporates biometric data to build soundscapes that respond both interactively and physiologically. The innovative biometric audio system uses real-time physiological data streams that monitor heart rate, respiration rate, electrodermal activity, and neurological signals to adjust the game's sound environment dynamically. The primary idea involves establishing a connection between the player's physical state and the game world's soundscape which enables the audio to change dynamically based on the player's emotional and physiological feedback. A horror game could use biometric sensors to detect when a player experiences fear and stress through increased heart rate and skin conductance to activate more intense music and sound effects which heightens the game's tension. A puzzle-solving game system that detects player frustration or cognitive overload through biometric data automatically transitions to a soothing ambient soundscape which helps foster relaxation and improved focus on problem-solving tasks. The use of biometric audio extends its usefulness beyond horror games to multiple different genres. Action games could achieve heightened physical engagement by adjusting music tempo and intensity according to player arousal measurements. Narrative-driven games use changes in environmental sounds and character vocal tones to mirror the player's emotions during their interactions with intricate story arcs and character bonds. The connection between players' physiological reactions and the game's sound environment will enable biometric audio to deliver deeply personal gaming experiences that merge physical and virtual realities like never before.

7.5 Health Considerations for Auditory Atmospherics

The benefits of immersive audio experiences in gameplay should be weighed against the health hazards of continuous exposure to loud game sounds. Research demonstrates that prolonged exposure to high sound levels in video games can cause permanent hearing damage and tinnitus among players.

Developers have multiple strategies available to them to mitigate risks.

8 Conclusion

Through this paper we sought to reveal how auditory atmospherics can transform interactive gaming environments. Our arguments promote a fundamental shift away from traditional visual focus to emphasize sound as a critical element for creating gaming experiences that deeply engage players emotionally while providing dynamic immersion. By adopting auditory design principles developers can surpass visual-only limitations to access new creative possibilities while achieving deeper player involvement in virtual environments.

The continuous forward push of audio technology through advances in spatial audio rendering and procedural sound generation along with AI-driven design and biometric integration signals the beginning of an unprecedented audio revolution in gaming. These developments go beyond simple enhancements and signal essential changes that will transform interactive sound at its core. The future auditory dimension of gaming will become central and more impactful through personalized three-dimensional soundscape creation along with dynamic auditory environments generated by algorithms which respond to the player's physiological state.

Advancements in graphical fidelity and visual realism do not solely determine the future trajectory of gaming technology. The direction toward truly immersive and emotionally resonant interactive experiences shows a clear shift toward comprehensive multi-sensory game design approaches. Game designers must fundamentally reconsider sound as a primary element of game creation because it provides essential functions beyond enhancing visuals by shaping player perception and evoking deep emotions while guiding them through virtual environments with unmatched precision and effectiveness. The future direction of gaming must consider not just visual elements but also the substantial impact of auditory elements.

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