

## A SURVEY ON SOUND-BASED GAMES

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### ABSTRACT

*This paper aims to explore the realm of sound-based games and to discover this field originality, challenges and advancements. Fully discovering and enjoying a sound-based game does not mean only to pay attention to the various sounds that “surrounds” the player, but to try to construct in player’s imagination the world that generated them.*

*This is a world where imagination, music composition, sound generation, imaginative plots and a lot of modern technologies intersect.*

*In recent years, a consistent list of titles from all the game territories (action, adventure, survival thriller, stealth thriller, mystery, horror, psychological, first-person shooter, and puzzle-based adventure) have emerged. The paper at hand tried to make a novelty-based selection of the representative games and will try to understand their main concept, and their contributions to the genre.*

**KEYWORDS:** *Sound-Based Games, Sense Substitution, Binaural Audio, Sonic Landscape, Soundscape, VR Headset, Doppler Effect.*

### 1. INTRODUCTION

#### 1.1. About sound-based games

While having sound in a game is common nowadays, when referring to sound-based games, one means that these games put an emphasis on the sound and use it as one of the main mechanisms of the game. One example is using sound intensity to guide the player towards its source in a dark environment.

#### 1.2. Action game

As explained in the book *Fundamentals of Game Design*, by Ernest Adams, an action game is a game in which the player’s physical skills and coordination are tested [1]. These games usually require quick reactions and good hand-eye coordination. Various challenges, such as puzzles, conflict, and quick-time-events (during which the player must press the correct buttons at the right time) arise during gameplay [1].

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## 2. STATE OF THE ART

This chapter introduces notions that regard sound-based games and presents examples of such games.

### 2.1. Lurking

*Lurking* [2] is a sound-based survival thriller game, created by a team of four students from the DigiPen Institute of Technology Singapore. The game uses sound to create audio pulses, which reveal the environment surrounding the player, for a limited amount of time. [2] This is the only way to discover the aspect of the surroundings.

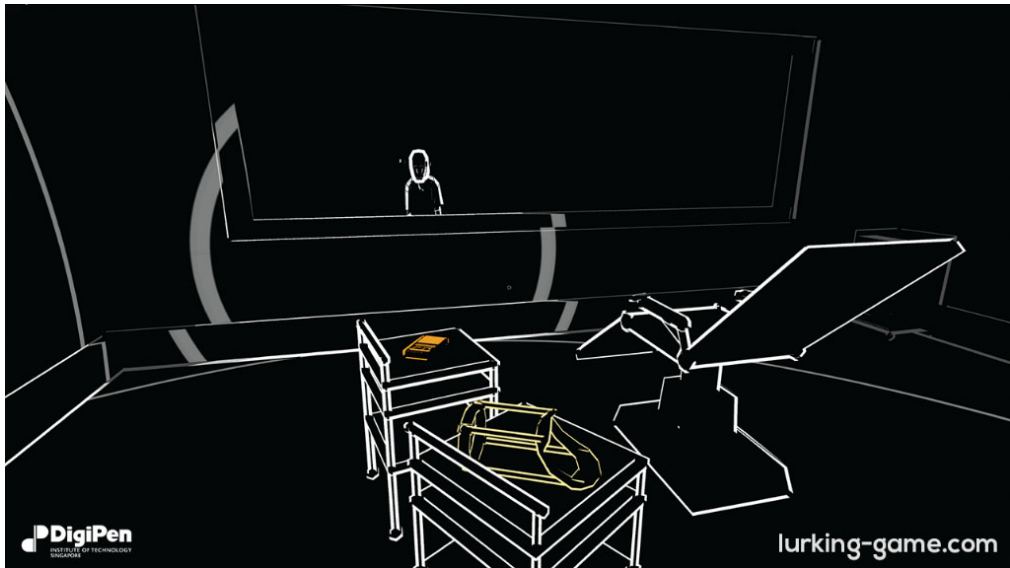


Figure 1. The graphics of the game. The circular shapes depict audio pulses. Image taken from [2].

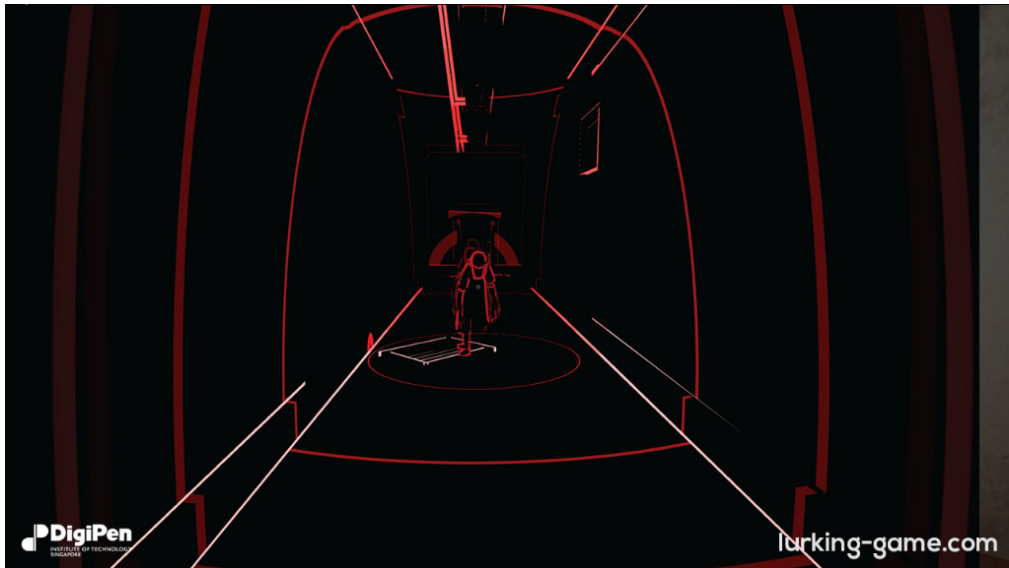


Figure 2. Red contours depicting danger. Image taken from [2].

The premise of the game is that the player must escape the location they start in, while avoiding some creatures that follow him or her based on the sounds made. The creatures' goal is to kill the player. When the player walks or runs, sounds of different intensities are emitted, which aid the player in seeing in front of themselves. The player can also create sound without moving, by pressing a button to create audio pulses or by using the microphone's input. One should be careful about the amount of noise made because noises help the antagonists figure out the player's whereabouts.

The graphics of *Lurking* is minimal [figures 1 and 2], using mostly white contours on a black background, red for signaling danger and light yellow for certain items that may be of interest to the player.

## 2.2. Stifled

The game, *Stifled* [2], a follow-up to *Lurking*, is a sound-based stealth thriller by *Gattai Games*, released in 2017, for the Playstation 4 and the Playstation VR. It maintains the same concept of sound being simultaneously an aid in exploration and a risk of attracting threats as its predecessor [3].

In addition to the familiar gameplay from *Lurking*, this game supports the use of the Playstation VR headset, which enables the player to "see" through the eyes of the character they're playing. Thus, a more immersive experience is created, as the player feels as if they are in the game.

*Stifled* uses the same minimal graphics as *Lurking* (a black background and white and colored lines to draw the environment), but also added 3D rendered and realistically colored objects throughout the game (as can be seen from official screenshots at [3] and in figure 3).



Figure 3. A location in *Stifled* using realistic 3D elements. Image taken from [3].

### 2.3. Perception

The game *Perception* [4], a first-person psychological game, developed by *TheDeepEndGames*, introduces the story of a visually-impaired woman, Cassie, who explores a haunted house. Using the premise of blindness, the developers introduced the echolocation mechanic to create a perception of the surrounding world, as anything that is reached by the emitted sounds lights up with a light blue tint (figure 4) [4].

As in the previously presented games, there is a downside to using audio signals as a replacement to vision, because it increases the risk of attracting creatures that the character is not prepared to face. This is summarized by the game's creative director, Bill Gardner, which said that the game is "about carefully weighing the risk and reward of creating noise", and about being aware of one's surroundings [5].

The character's only defense mechanisms are running, hiding, and using distractions. The game presents challenges like noise sources that need to be handled with care, such as a room full of bubble wrap, which requires careful navigation through it, or radios and talking dolls [5].

*Perception* contains 3D graphical elements in muted colors, which add more realism, as well as set the mood. The player's character being blind, the visuals are dimly colored, usually in very few different colors at a time (as can be seen in the game's trailers and screenshots) [4].



Figure 4. The use of echolocation revealing the surroundings of the player. Image taken from [4].

#### 2.4. BlindSide

A game by Aaron Rasmussen and Michael T. Astolfi, *Blindside* [6] is an audio-only horror game, which won in the “Most Innovative” category award at Games for Change festival in 2013 [7]. There is no visual environment, the surroundings being depicted by the sounds the players hear in their headphones.

The inspiration of the game comes from the experience of one of the game’s co-developers, Aaron Rasmussen, with temporary blindness that resulted from an explosion during a high school chemistry class [6].

In this game, the player identifies as Case, an assistant-professor, who, along with his girlfriend, wake up blind in a dangerous city, which they must get out of [6]. The environment offers only auditory feedback alongside simplistic light signals that signify the direction of the sound source. By using the pitch of the sound to signal danger to the player, the game takes advantage of the Doppler Effect [7].

A notable technical detail, available in the iOS version of the game is the use of the phone’s gyroscope to sense the direction the player wants to head in [8].

#### 2.5. Dark Echo

*Dark Echo* [9], developed by *RAC7 Games*, is an atmospheric, adventure puzzle game, available for the Android, iOS, and PC platforms [10]. It consists of 80 levels [10] in which the player’s end goal is to find the exit, while being engulfed in complete darkness. The following description of the game is based on the authors’ personal experience after playing 11 levels of the game on an Android mobile phone.

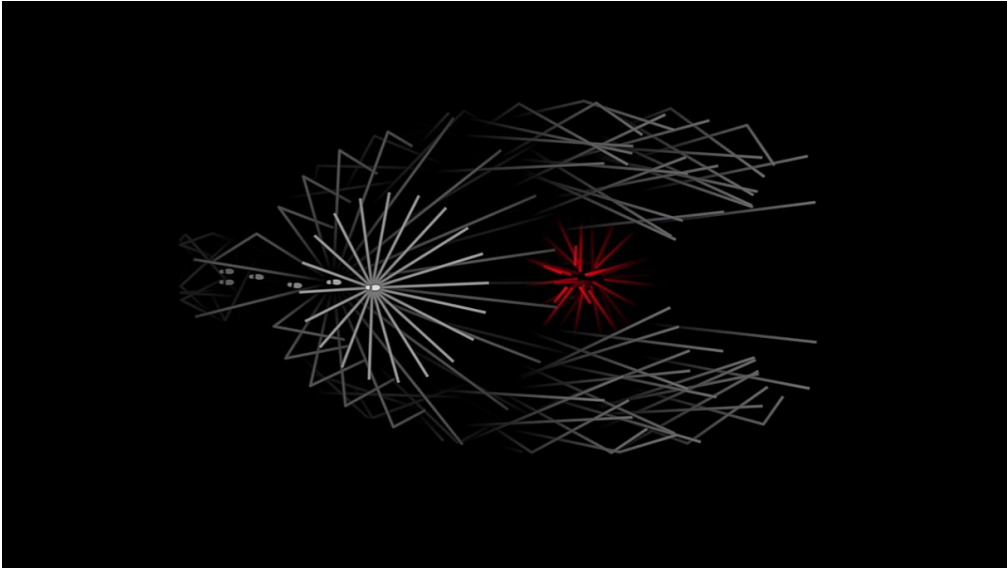


Figure 5. The player's movement is illustrated by footsteps, while the white lines represent the noise made by the walking player. The red lines depict danger. Image taken from [9].

The game is in 2D space and the player sees everything from above. As there is no light available, at first, one can see only two footprints, representing the player's character. Playing on an Android system, the player can tap in the center of the screen to create a sound. The resulting sounds are depicted as white lines that reflect and bounce off the walls, thus revealing the surroundings. If the player holds and then releases the finger, a louder sound is created, which travels further and therefore, reveals more.

By moving, the character's footsteps also create sounds, but they are not as strong as those created by tapping or holding and releasing in the center of the screen. The character moves towards where the player holds their finger on the screen. If the player just taps in one direction, the character moves one step per tap, thus making less noise. Sometimes, the player encounters objects depicted by yellow lines, which trigger an event, like a pathway opening.

The player must be careful about the amount of noise created because creatures are trying to kill him or her, and they sometimes follow their target by the noise coming from his or her direction. Red lines illustrate the creatures' noise, so that one can know where danger lies.

## 2.6. The Papa Sangre series

*Papa Sangre* [14] is a horror sound-based game for the iOS, developed by *Somethin' Else* and released in 2010 [15]. It was described as "the first binaural real-time, 3D audio engine implemented on a handheld device" [15]. The game features no visuals except for a 2D user interface, being based entirely on sound, and must be played with headphones on. A description of the game follows, after the authors watched a video of the gameplay [16].

Binaural audio consists of sound recorded by two microphones placed in ear-like cavities on the right and left sides of a dummy head [13]. Through this technique, sounds are recorded exactly as human ears would hear them. As a result, the listener can localize the sounds in a 360° space [13].

The game starts with the following premise: the player must save his or her loved one from the kingdom of Papa Sangre, by leaving the world he or she lives in. Afterwards, an eerie sound engulfs the player and it can be heard as the player crashes to the ground and reaches the “land of the dead, the land ruled by Papa Sangre” [16], where it is pitch black dark [15].

The voice of an entity then instructs the player how to move and turn around [16]. The 2D user interface is used to delimit the screen in zones that can be touched to input a certain action. Moving is realized by tapping the left and right sides of the screen, taps which are turned into steps. Tapping quickly makes the player run, but running too fast makes the character trip. Turning right or left can be done by swiping the upper half of the screen in the desired direction. One can get accustomed to this by turning around to face the entity, guiding themselves by the direction of her voice.

The game introduces chambers in which one must collect “the trail of music” [16] that leads them to Papa Sangre. The musical notes indicate their position by emitting a short repetitive sound, like a “beep”. The player must collect them by walking towards them. After collecting all the notes, the “sound of the light” appears, which represents the exit of the chamber. The “sound of the light” [16] resembles a twinkle, a sound that loops until the player goes through the exit.

Monsters also lurk in the chamber. The guiding voice presents each monster’s sound, so the player can recognize and avoid it. If the player runs into a monster, one can hear the terrified sounds of the player’s character as him or her dies [16].

By listening to the gameplay with headphones on [16], the game proves to be an interesting and immersive experience because of the quality binaural audio. The sound designer of *Papa Sangre*, Nick Ryan, explained that they had to limit the number of sounds heard at a time to three, because otherwise “it was too confusing” [15].

*Papa Sangre II* is the sequel to the game, released in 2013 [17]. It uses the same concepts as the first game, while also introducing new features: by tapping the top of the screen, the player can use the character’s hands for actions such as opening doors, clapping to scare monsters and firing a gun [17]. These new abilities therefore give the player the opportunity to also defend themselves against danger instead of always running away from it [17]. The other new feature of the game involves the use of the mobile device’s gyroscope to link the physical turns of the device to the player’s character turning in the game [17].

## 2.7. Shades of Doom

*Shades of Doom* [18], developed by *GMA Games* and released in 2001 [19], is both a first-person shooter and an audio game, aimed at visually impaired people. It features dynamic and multi-layered sound and “3D sound with up to 32 simultaneous sounds” [18]. It also uses the Doppler Effect to create a “realistic movement sound” [18]. The

authors of this paper experienced a small demo of the game and will use that experience to briefly describe it.

The player finds themselves in a top-secret military base, where they must shut down an “ill-fated experiment” [18]. The player’s character is equipped with weapons, a medical kit, and a computer, which can analyze the surroundings and guide the person playing the game [18].

The game is self-voicing [18]: a robotic voice reads aloud the menu and options. That voice also gives indication to the player during the game (e.g. to use the arrow keys to select the difficulty level of the game or to indicate a nearby obstacle).

The echo of the character’s footsteps gives the player the indication that they’re moving, while the sound of the wind and of equipment are also designed to guide the player in the right direction [18]. Bumping sounds were made whenever the character ran into an obstacle.

The authors of this paper found the game difficult to play, as it was not clear what the game’s controls were. Furthermore, the authors could not easily understand what the voice meant to guide the player was saying because of its robotic trait. However, the game version experienced by the authors is a demo, version 1.2. Based on a gameplay video [20] of the game’s 2.0 version, the developers replaced the robotic voice with an improved, clearer one.

## 2.8. Game design concepts

In their paper [11], Friberg and Gärdenfors talk about the TiM project (Tactile *Interactive Multimedia*), in which the *Stockholm International Toy Research Centre (SITREC)* developed three audio games aimed at visually impaired people. Their goal was to develop games that were both suitable for blind people and aesthetically pleasing through the audio used [11]. Therefore, they developed three games, two of which (*Mudsplat* and *Tim’s Journey*) are of interest to my research because of the design concepts they employ.

*Mudsplat* [11] is a game in which the player must defeat monsters that throw mud at them. They can do so by using a hose of water to attack the monsters. The game comprises 25 levels, divided into 5 different settings, also known as „worlds”, which distinguish themselves through the background music [11]. In the last level from each setting, the player must defeat the „boss”, „an extra tough and difficult monster” [11].

Being a game without any visual aid, the player must be able to create a mental image of the level, based only on the audio of the game. In order to achieve this, „the sounds are heard from a first-person perspective” [11] and there is adaptive variation of volume and panning to enable the player a sense of movement in space. Not all sounds are self-explanatory. Therefore, links between sounds and concepts, such as how big and dangerous a monster is, must be established early in the game [11].

*Tim’s Journey*, the second game of interest developed by SITREC, creates a complex world out of sounds, a sound landscape and encourages its exploration, its goal being that of „unravelling a mystery” [11]. The world is an island, with different „scenes”, such as a forest or a mill [11].



Unlike other games for visually impaired people, that avoid blending different sounds together and ornamental soundtracks „to facilitate navigation” [11], *Tim’s Journey’s* sounds contribute to a pleasant soundtrack. Each sound is treated as a musical component: by their position, sound objects “reflect musical structures such as themes, choruses and bridges, and all sounds fit into percussive and melodic patterns” [11]. Important sounds stand out by their usage frequency in the soundtrack, perceived intensity and majestic “presence” [11].

The game provides navigational aids to help the player discover the world, such as foghorns positioned at predefined locations in all 4 cardinal directions, non-player characters that “provide information or clues to the plot”, footstep sounds that indicate the “kind of surface the player is currently walking on” and a device called the “Ambience Reductor”, which can temporarily lower the volume of all sounds that the player cannot directly interact with [11].

SITREC suggested a categorization system for the sounds used in the games developed by them. They can be divided into [11]:

- Avatar sounds – sound effects emitted by the actions of the player’s character (e.g. footsteps, touching objects)
- Object sounds – used to indicate an object’s presence to the player; can be short and recurring or long and continuous
- Character sounds – made by non-player characters
- Ornamental sounds – do not convey gameplay information, but are used to enhance the atmosphere of the game (e.g. ambient music)
- Instructions – recorded speech used to help the player solve tasks

The paper mentions two well-established auditory interfaces design methods: the “auditory icon” and the “earcon” [11]. The former employs the use of sounds that are “as recognizable as possible”, mostly based on authentic recordings, while the latter creates a link between short musical phrases and a concept [11].

The presence of objects in a sound game can be represented either by a continuous, looped sound emitted by each object or by associating the brief sound of an object with a form of impact [11]. The first method would create a confusing environment with many sounds overlapping, while the second one is usually not sufficient to provide the player with an accurate spatial localization of the object [11]. SITREC’s game, *Tim’s Journey*, uses a middle ground between the two methods: static objects emit brief sounds that are looped rhythmically [11].

Because these games have no graphical elements, some sounds could be mistakenly interpreted as an object. Therefore, it is important to make the objects that allow for user interaction stand out through the kind of sound they emit [11].

Friberg and Gärdenfors also refer to the film sound theories of Michel Chion, which can provide a useful framework to design game audio upon. Chion presents ways in which humans listen: reduced, casual, semantic listening [11].

Casual listening means that one is trying to identify the source of the sound, while semantic listening is used when deciphering speech or other coded information, like the

Morse code) [11]. Reduced listening refers to the way people listen when they analyze the qualities of the sound (pitch, rhythm, harmonies), disregarding the source [11].

These modes of listening can be coupled with the types of sounds described above. Casual listening is useful for identifying the source of object sounds, semantic listening for understanding instructions and reduced listening for enjoying ornamental sounds, like music [11].

#### **4. CONCLUSION**

Based on the games introduced in the state-of-the-art section and the game design concepts, sound-based games employ sound to both explore and describe the environment. Sounds that describe objects, characters, setting and events should be carefully chosen so that they achieve their purpose of immersing the player and creating a sonic landscape or “soundscape” [11] for the player.

Paul Bennun [17], the CCO (Chief Compliance Officer) of *Somethin’ Else* (the developer of the *Papa Sangre* games), said “the graphics card in your head is way better than anything you can get on any computing device” [17]. He emphasizes how powerful of a tool one’s imagination can be. Sound-based games engage the player’s imagination to enhance, and in some cases, create the game’s world. As mentioned in Connor’s, Yazzolino’s, Sánchez’s and Merabet’s paper [21], sounds can be employed to aid people in creating a 3d map of the space around them.

In conclusion, as demonstrated by the games and design concepts presented in this paper, sounds can be used, through a variety of techniques, to create fun and interesting experiences for both sighted and non-sighted users.

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