Evaluating and Investigating Game Accessibility for Deaf Players with the Semiotic Inspection Method

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Abstract
Semiotic Engineering is a Human Computer Interaction theory which perceives software as a communication between its designers and its users. We present here how an inspection method from that theory – the Semiotic Inspection Method - has been used in the context of action games to evaluate their accessibility. In particular, we present a case study in which we investigated how sound and music were employed to convey information to players and the impact on game experience from not being able to receive that information.

Author Keywords
Semiotic Inspection Method; Semiotic Engineering; Game Evaluation; Game Accessibility; Deaf

ACM Classification Keywords
H.5.2 User Interfaces. H.5.3 Group and Organization Interfaces.

General Terms
Human Factors.

Five Steps of SIM

Step 1: *metalinguistic* signs are identified and the meta-message is reconstructed based on them. Similar signs are grouped in classes. Potential communication breakdowns are identified.

Step 2: same as step 1, but with *static* signs.

Step 3: same as step 1, but with *dynamic* signs.

Step 4: the segmented meta-messages generated on previous steps are contrasted and collated in search of ambiguous and/or contradictory parts.

Step 5: a final appreciation of the quality of the meta-communication is generated, considering the consolidated meta-message, the communication breakdowns and classes of signs identified.

Introduction

In the context of game design, we face the problem of evaluating game accessibility from the perspective of deaf and hard of hearing players. We want to know the impact on players' game experience when not receiving auditory stimuli. So, we investigate how sound and music have been used in games in order to communicate all kinds of information to players.

As the use of sound for communication may impose a barrier for those who have difficulties or cannot hear, the accessibility of games may be measured by the quality in which players receive that communication through other means. So, as we faced our problem in terms of assessing qualities about how *communication* takes place in a game, we resorted to Semiotic Engineering (SemEng) as a foundation theory. As stated by the theory's authors, Semiotic Engineering is a theory of Human-Computer Interaction that perceives interactive systems as a form of communication from their designers to their users [4].

One distinguished property that is of great relevance to SemEng is *communicability*, which is how effectively and efficiently communication from designers to users through an interactive system occurs [3, 6]. The theory provides two methods to evaluate software's communicability: the Semiotic Inspection Method (SIM), which is an inspection method with deep qualitative analysis, and the Communicability Evaluation Method, which involves user participation in a controlled environment.

In this study, we present an application of SIM in the context of first-person shooter (FPS) games intending to investigate the use of sound as a communication medium and to evaluate their accessibility for deaf and hard of hearing players. We present a brief description of the inspection method, a case study with the evaluation of the game Half-Life 2 and a discussion about the methodology used.

Semiotic Inspection Method (SIM)

SemEng defines any interactive system as a designers-to-users message regarding the designers' conception of who the users are, what are their needs and expectations and, more importantly, how they have designed the system to meet these requirements [4]. Users grasp the content of the designers' message as they interact with the system. Thus, since the system is itself the designers' message and is capable of exchanging messages with the users, it is perceived as a meta-communication artifact.

In Semiotics, messages are comprised of signs, which are anything that mean something to anyone [5]. SemEng classifies interface signs as metalinguistic, static and dynamic signs [3, 7]. Metalinguistic are interface signs that refer to other signs, e.g. text explanations, tooltips and help systems; static signs can be interpreted independently of temporal and causal relations, e.g. everything that can be seen in a screenshot; dynamic signs need user interaction or time to elapse to be understood, e.g. a behavior perceived on the interface when a button is clicked.

SIM's intent is to inspect the interface and detect potential breakdowns in the designers-to-users communication by examining each sign type and reconstructing the meta-message being conveyed by them [3, 4]. This process is divided in the five steps described in the sidebar from the previous page.

A Sample Auditory Sign Identified in Half-Life 2

Auditory sign: main character footsteps.

Information conveyed (a):

1. the speed of the character;
2. type of surface the character is walking on.

Sound features used (b): The *pace* in which the sound effect is repeated indicates (1), whereas the *timbre* of the footstep sound indicates (2).

Redundancy (c): (1) is redundant with the speed in which the camera moves in the game world, whereas (2) is redundant with the textures used to represent surfaces.

Impacts game play (d): Yes. The surface where the character is standing may indicate different types of enemies that can be encountered. The visual redundancy may not be perceived as quickly as the auditory sign.

Technical vs. Scientific Approach of SIM

Those steps describe the process for evaluating the communicability of software, which is called a technical use of SIM. However, [3, 4] presented how SIM could be used scientifically, with the goal of generating new knowledge in HCI or other areas – like Game Design.

In the scientific approach, the method's application is oriented by a research question stated in a preparation phase. The five steps must be executed accordingly, but there is a sixth step comprised of a triangulation of results with other sources of information.

Case Study: SIM in FPS Games

We conducted an evaluation of the FPS game Half-Life 2 (HL2) using the scientific approach of SIM [2]. The research question we wanted to answer was "*what audio communication strategies do FPS games use?*". As we were interested in the information conveyed through audio, we investigated, for each auditory sign: (a) what information it conveys; (b) what features of the sound effect were used to communicate that information; (c) whether there was redundancy of that information in other signs; and (d) to what extent could missing that information impact game experience. An instance of the identified signs can be seen on the sidebar on this page.

As previously said, the main objective of the evaluation was to investigate how sound and music had been used to transmit information to players. But, as the scientific approach of SIM involves a technical evaluation, we also had as a result an evaluation of the game according to its communicability and accessibility for deaf and hard of hearing players.

Results

The segmentation and later reconstruction of the meta-message revealed potential communication breakdowns in the game, most of which due to the use of sounds with no visual redundancy, but none imposing definitive barriers to game play. However, the main results of the application of the method came from the classification of signs.

After the identification of auditory signs, we grouped those with similar properties into classes that represented what features of the sound effects were used to convey information, like volume, timbre etc. We also identified *how* the classes of sound features were used to communicate and grouped them into *strategies*. These classes and strategies are listed on the sidebar on the next page.

One strategy used throughout the game, for instance, is to enable players to infer approximate locations of enemies with information from sounds, without having to make visual contact, e.g., while fleeing or before encountering them. That information is conveyed by sound volume and its distribution in stereo channels.

The possibility of inferring enemies' location combined with the information conveyed by sounds timbre – roughly how sounds differ from each other –, players can also infer which types of enemies (e.g., alien, human, machine) are coming their way, enabling them to choose better strategies for the imminent encounter. That constitutes the use of sound to communicate the amount of threat affecting players.

Another example of strategy is the use of different timbres to make game objects distinguishable (e.g. a character's voice, sound of rain, a train horn etc). The purpose of that strategy is to create a consistent and

Results from the Application of SIM in Half-Life 2

Classes of sound features:

1. Volume
2. Distribution
3. Timbre
4. Timing
5. Speech
6. Tempo
7. Music
8. Perceived Frequency

Strategies of communication:

1. Inference of approximate location of sound sources
2. Characterizing game elements
3. Communication of threat
4. Interaction feedback
5. Transmission of information through speech
6. Instigation of sensations and emotions
7. Inference of approximate velocity of sound sources

convincing game atmosphere, which is an important aspect of players' immersion [1].

Triangulation

The inspection was later applied to two other FPS games, so we could triangulate the results – classes and strategies – we had found. The games were Call of Duty: Modern Warfare 3 (CoD MW3) and XIII.

In both games, we identified the same classes of sound features and strategies of communication from HL2. However, in CoD MW3, we identified another class of sound features: the perceived frequency of a sound indicating the position of a moving object (like a rocket) relative to the player and the use of tempo to indicate a sound source's approximate velocity.

Conclusions

In our case study, SIM provided consistent results when applied to first-person shooter games. Furthermore, the method could be applied directly and did not require any adaptation to the game domain.

Considering the technical approach of the method, we could assess the games' accessibility for deaf and hard of hearing players by evaluating their communicability. Nevertheless, the inspection could also have been targeted at players with other profiles.

With the scientific approach, we were able to answer our research question by identifying what strategies for communication through sound had been used. In fact, we better understand how sound and music can be used in first-person shooter games to convey information. Based on this understanding we are able to suggest improvements in order to provide better accessibility for deaf and hard of hearing users by being aware of which auditory signs need visual redundancy, thus generating new knowledge in Game Design.

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