

Sound Design in Interactive Environments

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Abstract. As message transmitters, all acoustic signals - natural or constructed - are perceived as having specific information. However, a little amount of research has been directed to the study of what is heard by people about the world around them and how it occurs, especially with regard to its interrelationship with interactive environments applications. Based on the universe of hypermedia, this study aims to explain the main applications of sound in a broad perspective with regard to its features of content, form and function, which are manifested through the use of dialogue, ambience and sound effects.

Keywords: sound design, game sound, dynamic audio, interactive sound.

1 Hearing and Experience: A Sound Design Perspective

When hearing, memories are aroused and their meanings associated with the auditory event. Jekosch (2006) suggests that the listener has an acquisition system of sounds and meaning, or, in technical terms, a lexical set of sounds. This lexical set contains invariant auditory resources, such as the shape of the sound (like the typical sound caused by a hammer hitting metal), its contents of experience (strong sound of something crashing into another), and their inter-relationships of functions (use the blow of the hammer to forge the metal). These lexical items are important aspects of information that is used in order to obtain the associative meaning of the corresponding sound. Based on the individual stored meanings, a satisfactory correspondence between perception data, experience data and expectation will attach meaning to the sound event. So, to hear certain types of sound, systems of meanings are activated and used as a reference, being the auditory stimulus a signal carrier that associates these memorized events. As a result, a meaning is assigned to the sound stimulus. Such associations and meanings are also activated when an unknown sound is heard: the perceived characteristics of what is heard are correlated with an internal system of meanings, that contains all that was experienced by the individual, and this new information is then seized.

A significant scope for improvement in the field of sound design is given when the sound is analyzed in a broad perspective with regard to its features of content, form and function. The central question, then, focuses on pointing out how listeners process the acoustic events when they're taken as information carriers. This question can be systematically examined making specific use of modern paradigms of psychoacoustics

and semiotics. Jekosch (2006) suggests a new direction of research that understands and interprets the perceived auditory events as carriers of meaning, and calls it Semioacoustics, defined as the science of auditory signs.

Except for a few studies (BALLAS, 1993; GAVER, 1993 *apud* SUSINI et al., 2006), little research has been directed to investigate what is heard by individuals in the world and how this occurs. However, most part of studies have focused in the perception of sound attributes in terms of location, such as size and shape, leaving an empty space regard to sound and its properties related to emotional responses.

The perceived sounds in everyday life have emotional connotations which precede their cognitive interpretation, and these connotations influence how individuals perceive them. According to Tractinsky, Adi & Ikar (2000), studies have shown that emotional system modifies the operating level of the cognitive system. Emotions enable rapid decision-making, while cognition allows us to interpret and understand it. Thus, measuring the emotional quality of a product can provide access to the characterization of their function in terms of sound design. A systematic approach to affective reactions to sounds should increase the ability to predict human responses to products with sound properties.

2 Sound in Interactive Environments: Speech, Ambience and Sound Effects

Jekosch (2006) states that, in principle, each acoustic event can be perceived as a signal sending system by which certain information is transmitted. This is a well-established fact when it concerns sounds made by the human voice, through the spoken language. However, other types of sounds - such as music or sound effects - emitted by digital devices also communicate. In this context, the importance of sound is in the ability to capture the user's attention at different levels. Tong and Wong (2006) argue that without the use of sound into interactive systems, the impact of a narrative is significantly reduced, and it may even become incomprehensible.

Jorge (2002) uses the term soundtrack to define all perceived sounds by the human ear. The soundtrack is a mix of different elements that can be divided into dialogue, ambience and sound effects. Apart from Jorge (2002), Serafin (2004) and Moses (2010) define that the acoustic events that occur in interactive systems can also be divided as follows:

- a) Dialogue, representing the sounds that express the spoken language;
- b) Ambience, divided into background music and sound environment;
- c) Sound Effects, also called by *Foley sounds*.

Iuppa & Borst (2010) say that to create a realistic interface, an especial attention must be given to sounds. If there is not a basic level of music and background sounds in the interactive environment, an insufficient atmosphere will be perceived by users. The soundtrack can provide an environment for the narrative context of the application, and its elements can serve to guide users and improve their overall experience.

In dialogues, human speech is intended to be informative. The background music sets the mood and pace of the narrative, being connected to emotional interpretation, and thus causing distinct reactions in the users. Ambient sound is the sound of natural background of a given environment. The sound effects are brief and have the function to highlight some point of the message by increasing its impact.

When individuals express themselves through speech, the attention is explicitly given to the words that are said, but also clings implicitly on how these words are spoken. Thus, the meaning is not exercised solely by verbal content, but also the vocal qualities that are imposed during the speech. Van Leeuwen (1999) divided human voice and classified it into different properties, which carry culturally formed communicative meanings, namely:

- a) tension: tight or tense;
- b) roughness: hoarse or guttural (being more associated with men, harsher tones);
- c) aeration: aerated or intimate (in Western cultures generally more airy voices are considered less authoritarian);
- d) sonority: expansive or mild;
- e) pitch: high or low (in terms of frequency spectrum, how high or low this voice may be);
- f) vibration: which tension level (in terms of vocal cords vibrationa, associated to the technical term *vibrato*).

Among all the items that compose the soundtrack, music can be considered one of the key elements to establish mood inductions. Music is categorized not only by its structure, but by the abstraction of events and cultural, social and psychological experiences, as well as by its subjective processes. Ilari (2006) suggests that music is a social phenomenon that has maintained traditional roles and own meanings in different societies throughout history: in Western world, the music has specific functions in human activities such as dancing, storytelling, celebrating special dates, praying, entertaining, and also selling products. These and the many other functions of music in everyday life are clearly related to interpersonal relationships and, based on this premise, regarding to species' evolution, the music plays an important role. According to the author, to the African Yorubas, for instance, the use of music implies the idea of kinship, religion, politics and economics. As for Brazilian Capoeiras, music is associated with body movement, a ritual of freedom.

According to Martinez (2000), music refers to a variety of acoustic and non-acoustic objects, and may be associated with other forms of expression, belonging to visual and verbal fields. Forms such as dance, theater, multimedia and hypermedia itself constitute languages that canalize their meanings through the two main human senses, hearing and vision, which are the main aesthetic senses. The efficiency of these aesthetic forms of expression - that make music their base or share it with their properties in various types of connective structures - is the way they process complex signs, addressing the two main human senses and enabling a wealth of meaning and interpretation.

To Parker & Heerema (2008), the sound effects have multiple functions, being frequently used as a confirmation feedback to a requested activity. To this end, sound effects need to be representative of the sounds that are part of the things in the world, since the metaphorically represented objects in interface resemble the real objects. Another important function of the sound effects is to add a sense of reality and presence to an ambient.

Using volume levels it is possible to classify which sounds are important and which are less – this is the dynamic volume control that is mentioned in Gibson (1997). A constant balance between all sound effects does not direct any focus to a narrative particular aspect, but nevertheless, when a sound abruptly changes its volume, attracts attention, ie, becomes more important. Tong and Wong (2006) indicated that it is possible to use parameters of equalization to make a sound become “closer” to the user. Accentuating the frequencies around 3.000 Hz in a dialogue will result in a much more clearer and audible sound. The playback speed of a sound can also change its property. For a rhythmic sound, like the sound of an automobile engine ignition, reducing its time will result in a feeling of losing potency. On the other hand, by increasing its speed, there is a impression of a strong structure. By changing the speed of the sound, a different interpretation about the amount of power produced by the engine is achieved.

As pointed out, the sound in interactive environments is mainly comprised of three elements: dialogue, ambience and sound effects. However, McKee (2006) suggests that silence, or almost no sound, also need to be part of any considerations about sound in interactive systems. The silence was, until recently, the default setting for any interactive web display, given that its reproduction was very fragmented and the methods to insert sound files were also very complex. However, in recent years, such conditions have changed, and silence is no longer necessarily the default setting of interactive environments. Being able to hear sound, it is also possible to hear silence, ie, its use become purposeful. Silence is no longer a default, but a choice, and hypermedia designers need to make a conscious use of this element. Perceiving silence is complex, it involves listening to an absent presence – the silence legitimizes their break and the sound legitimate the silence in such a way that there is not a split between them - hence the importance of silence in all discussions about sound. Silence should not be considered in isolation, but as an important and integral element of sound, whose relationship with the other elements, such as dialogue, ambience and sound effects, must be promptly investigated .

3 Final Considerations

In terms of perception, these sound synthesis parameters are difficult to estimate with high accuracy. Interactive processes give rise to an equivalent perception that only corresponds to an approximate factual physics reality. Especially where interaction is a key issue, the sound design should consider the most advanced requirements of the user experience design to achieve tangible results. However, there is still a relative absence of analysis tools with sufficient functional and aesthetic potential to extract relevant information about the impact of sound in the context of interactivity.

Sound design applied to interactive environments is a relatively new area in the academic field, yet not sufficiently able to develop strong theories without a substantial empirical research, which will examine the practice of audio productions in this area. So, it is important to proceed with the discussion of audio into objects and interactive systems, as a way to evidence the need of a new group of knowledge that will point out the important role played by sound into interactive systems.

By showing the sound structures present in an interactive system, there is a relevant starting point to designing sounds in hypermedia in a consistent and systematic manner. Interactive environments mobilize distinct perceptual modes and quickly transform our symbolic structures and signification systems. Proposing more organic ways to organize the user cognitive structure becomes indispensable.

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