Spatial Sounds (100dB at 100km/h) in the Context of Human Robot Personal Relationships

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Abstract. Spatial Sounds (100dB at 100km/h) is an interactive installation that focuses on man-machine interaction and plays with the question whether we control machines or machines control us. This paper gives a description of the installation and creates a context around the work from the perspective of human robot personal relationships. The used examples and comparisons are made from a personal perspective and meant to stimulate the current debate in the f eld.

Keywords: interactive art, robot art, human-robot relationships, man-machine interaction.

1 Introduction

In our daily lives we are using many machines and tools. Some of them function mechanically and others are a hybrid of a physical interface and a computer controlled virtual process. In most situations we believe that we control a machine and accidentally there are moments where we loose the control over it. The installation Spatial Sounds (100dB at 100km/h), developed by Marnix de Nijs [1] and Edwin van der Heide [2], is focusing on the topic of control and taking it one step further. It is an attempt to make a machine that includes the ability to control people. When we def ne a robot as an independent machine with its own behavior it is important that the robot not only follows instructions from people but also surprises them. Such a moment of surprise is a moment where the robot is initiating the communication and therefore in control of the situation. It is this context that makes Spatial Sounds (100dB at 100km/h) an interesting installation to study from the perspective of human robot personal relationships.

2 The Installation

Spatial Sounds (100dB at 100km/h) consists of an arm with a loudspeaker on one end and a counter weight on the other end. It is mounted perpendicular on a freestanding base with a motor driven vertical axis inside. A motor controller determines the rotational direction and speed of the arm (Figure 1).

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There are two ultrasound sensors build into the speaker. They measure the distance from the speaker to objects and people in front of it. Since one of them is positioned to the left of the center and the other to the right of it, it is possible to apply a straightforward form of triangulation and thereby calculate the relative position of a person to the speaker. Using this information it is also possible to determine on which side the person was detected last and therefore make an assumption on which direction the person disappeared as ‘seen’ from the perspective of the speaker.

On the bottom of the vertical axis there is an angle measurement sensor. It is used to measure the current angle of the arm and calculate the speed and direction of the arm. When the arm is accelerating or decelerating the actual measured speed can vary from the values send to the motor controller because of the arm’s inertia.

Fig. 1. The f rst prototype Spatial Sounds (100dB at 100km/h). This version is equipped with only one ultrasound distance measurement sensor.

The motor controller, ultrasound sensors and the angle sensor are connected to a computer that is running a custom developed program using the MaxMSP programming environment. The software is responsible for the interactive movements of the arm and in addition the software also generates the sound for the speaker in real-time.

3 The Experience

Since Spatial Sounds (100dB at 100km/h) is setup in an exhibition space, it is truly experienced in a social context instead of just an isolated personal context. The visitors to the exhibition space interact with the installation and at the same time also with each other. When the visitors are present in the space the installation alternates between interaction modes two, three and four. It oscillates between giving a single visitor control, group interaction and the machine controlling the visitors. The audience seems to rapidly go through a series of experiences and emotions including joy, fear, sensation of control, disappointment, wanting to show off, surprise and jealousy. While a part of the people feels that they are rewarded for what they do, others feel ignored by the machine. Because this happens simultaneously and in a social context, the ignored ones sooner or later want to ‘take revenge’ and try to get in control themselves. As it turns out the visitors stay for a reasonable time and try to control and interact with the installation over and over.

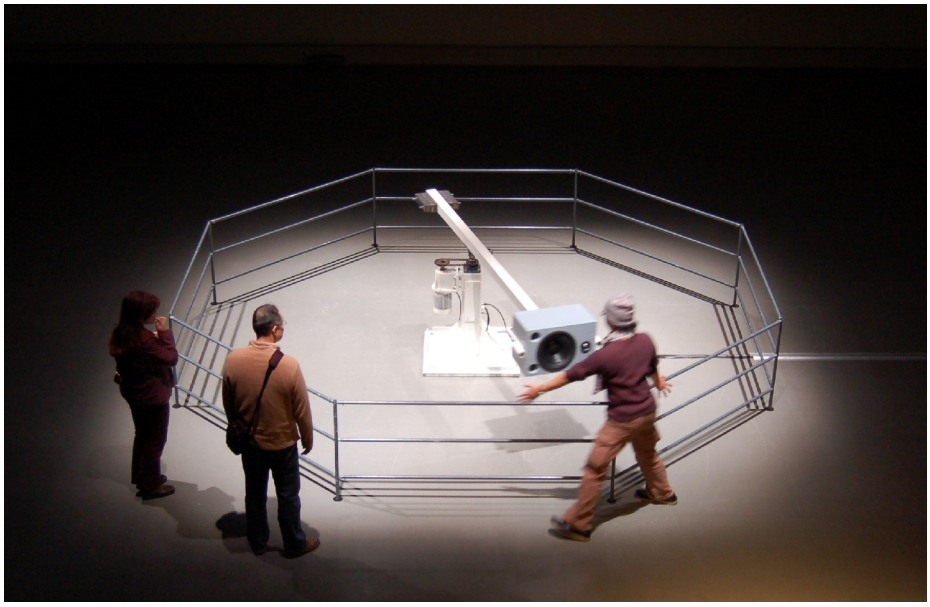

Fig. 2. Spatial Sounds (100dB at 100km/h) at DAF-Tokyo, 2006

4 The Interaction Modes

At initial setup of the installation is in a new space, the installation has to learn about the appearance of that space. For every angle of the arm distances are measured and these are stored in a table. After this procedure the installation is complete and the installation can recognize visitors in the space since presence of a visitor affects the distance characteristic of the shape; i.e. they result in shorter distances then those stored in the distance table of the space.

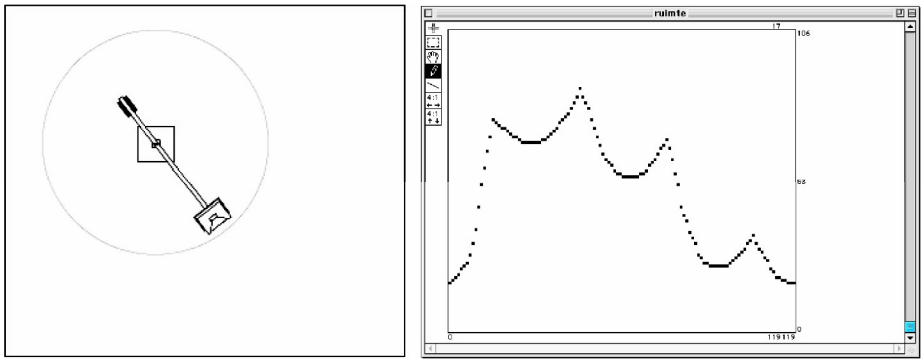

Fig. 3. The scanned map of the space. The horizontal axis corresponds to the angle of the arm and the vertical axis to the measured distance.

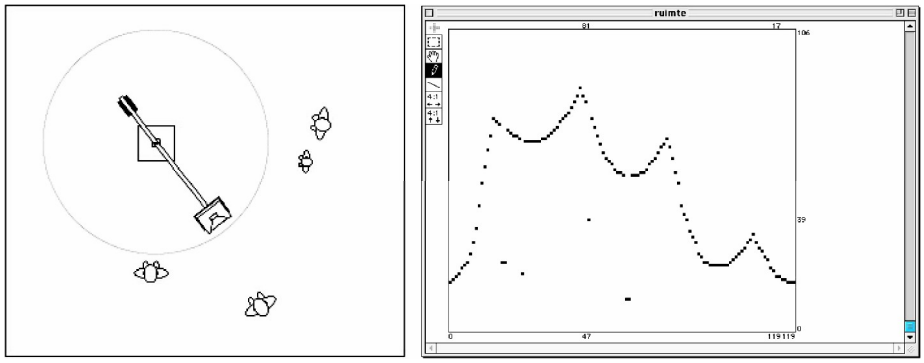

Fig. 4. The scanned map of the same room but now with 4 people in the space

Spatial Sounds (100dB at 100km/h) has four different modes for interacting with visitors.

4.1 Interaction Mode One

Mode one is active when the space is empty or nobody has been detected for a while. The installation rotates slowly and scans the space for people to enter. This movement is combined with a low humming sound that changes brieﬂ y when the installation detects a visitor that is relatively close to the installation. It is the recognition that is indicated by sound. Once someone has been detected it will continue the scanning for a little while and then change its behavior to mode two, a more active one where the visitor is invited to interact with the movement of the installation.

4.2 Interaction Mode Two

In mode two the arm f rst makes one full rotation and stores at which angles it detects people. After that it randomly chooses one of them and moves towards him or her.

Once it has reached that visitor it will try to follow it, even when the person is not continuously being detected. The sound is a combination of a crackling kind of sound and a tone with a pitch that depends on the average speed of rotation. The actual measured distance influences the nature of the sound. The detection and movement of visitors in front of the speaker have a direct influence on the produced sound and give the impression that the installation starts a kind of abstract dialog with the chosen visitor.

After a certain amount of time the interaction mode will change to mode three. This only happens when the installation keeps on detecting visitors. When no visitors were detected for more then half a minute the installation will revert to mode one.

4.3 Interaction Mode Three

In mode three the arm has a fixed rotation speed but changes direction when someone is being detected. The inertia of the arm makes it shoot over, return and then shoot over again. Although the rule is a simple one it leads to relatively complex behavior especially when there are multiple visitors in the space. It is a playful game that makes the visitors in the space interact with each other as if they play a ball from one person to another person or try to take away the ball from someone else. Where in mode two the installation focuses specifically on one of the people in the room, in mode three it interacts with multiple people in the room. The sound in this mode is more expressive. The actual speed of the arm is the main parameter that is used for the sound generation. The slowing down and reversing of direction is being enlarged by sound. Furthermore the detection of visitors in front of the speaker is expressed very directly by a pulse train.

4.4 Interaction Mode Four

Mode four can only take place when the installation receives too many triggers in mode three. When the installation can’t get rid of people standing in front of it and detects people permanently it will enter mode four. When this situation does not occur it will switch back from mode three to mode two. In mode four the installation dominates the space that it is in. The distance of each visitor together with the amount of visitors detected determines the rotational speed of the arm. The more people there are and the closer they stand the faster the arm rotates. When there is more then one person standing close to the installation it rotates so fast that it scares most of the people away and makes them stand on a safe distance. Since there are no people close to the installation anymore the arm will slow down. In this mode the sound is powerful and complex and helps to express that the installation has gotten wild. The rotational speed has a big influence on the timbral quality of the sound. It communicates a form of power even when the arm moves slower. Mode four has a limited duration and independently from the rotation speed it will switch back to mode three after a certain amount of time. The sound changes accordingly and it is now clear that the danger is over.

5 What Makes Spatial Sounds (100dB at 100km/h) a Robot?

Spatial Sounds (100dB at 100km/h) operates as an independent machine. It actively detects and reacts to people without them having to do anything specif c for it. The installation interprets the visitor's position and movements and reacts to it. At the same time it clearly makes its own decisions and portrays independent behavior. It seems easy to understand what the installation does and how to relate to it. Since the installation appears to choose whom to interact with, it also seems as if it shows affection for the visitors.

Spatial Sounds (100dB at 100km/h) is a computer-controlled installation that operates in the physical space. The behavior is a combination of physical laws and programmed rules within the computer. Many interactive installations include a separated experience of the input interfaces and the output interfaces. Spatial Sounds has the sensors build into the speaker and therefore there is no separation between the input and output interface. The installation functions as one independent communicating object.

6 Conclusions

Spatial Sounds (100dB at 100km/h) is an interactive installation focusing on the question whether we control machines or machines control us. The installation can be seen as a non-verbal abstract robot and does not imitate an animal or human-like look or behavior. It is a machine-like object but does not resemble existing machines. Nevertheless, it allows us to somehow identify ourselves with it. Spatial Sounds (100dB at 100km/h) is an example of a believable [3] robot in the sense that the visitors believe they understand the behavior of the installation and f nd it worthwhile to interact with. The aspect of believability is so strong that people accept the installation as a real being and want to interact with it over and over. Consistency in behavior is seen as an important factor in regards to the believability of a robot. In the case of Spatial Sounds (100dB at 100km/h) the behavior alternates between three main modes of interaction, each of them based on simple consistent rules. The approach to work with these main interaction modes, varying from control over the installation, group interaction and the installation controlling the audience, proofs to be a successful one. In a short moment of time the visitor goes through a large series of experiences and emotions. Switching between these modes does not reduce the believability of the installation and actually increases the involvement of the audience. Most of the visitors interact a considerable amount of time while trying to gain control over the machine. The installation allows this only up to a certain extend because when it gets triggered too often it will rotate fast and scare them off. It is surprising to see that the visitor recovers quickly and their eagerness for control is such that they keep on trying over and over.

We can conclude that Spatial Sounds (100dB at 100km/h) is a good example of a believable robot and therefore we can state that such a robot is a good form of exposing the man-machine control question. Robots are often seen as personal interactors but what happens if 'your' robot all of a sudden decides to interact with someone else?

Acknowledgements

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