

# AudioBattleship: Blind Learners Collaboration through Sound

**Jaime Sánchez, Nelson Baloian,  
Tiago Hassler**

Department of Computer Science  
University of Chile  
Blanco Encalada 2120, Santiago, CHILE  
+ 56 2 673 1280  
{jsanchez, nbaloian, thassler}@dcc.uchile.cl

**Ulrich Hoppe**

Institute for Computer Science  
University of Duisburg  
Lotharstr. 65, 47048, Duisburg, GERMANY  
+ 49 203 379 3553  
hoppe@informatik.uni-duisburg.de

## ABSTRACT

A growing number of audio-based applications for blind learners have been produced in the last few years. Many of them focus on the development of 3D audio interfaces to map the entire surrounding space. Other studies center on the impact of sound interaction on cognition by evaluating the usability of these applications. No previous work has centered on using spatialized sound to develop collaborative skills in blind learners. This ongoing research study introduces AudioBattleShip, an interactive audio-based environment to enhance collaboration and cognition in blind learners. AudioBattleship mimics the traditional game battleship for sighted people but without visual cues. A preliminary pilot study has been implemented showing that blind children collaboration can be enhanced through the interaction with spatialized sound.

## Keywords

Virtual acoustic environment, blind children, collaborative learning, audio-based navigation, usability, spatialized sound

## INTRODUCTION

Diverse audio-based applications for blind children have been produced in the last few years [1, 2, 3, 4, 5, 6, 7]. Many of them focus on the development of 3D audio interfaces to map the entire surrounding space as proof of concept concerning audio-based interfaces. Other studies center on the effects and impact of sound on the development of cognitive skills of blind people by evaluating the cognitive usability of these applications. No previous work has centered on using spatialized sound to develop collaborative skills in blind learners.

This ongoing research study introduces AudioBattleship, an interactive audio-based environment to enhance collaboration, abstract memory, spatial abstraction, and haptic perception in blind learners. AudioBattleship is a similar version of the traditional game battleship for sighted people but without visual cues. A preliminary pilot usability study has been implemented showing that blind learners collaboration skills can be enhanced through the interaction with spatialized sound.

## AUDIOBATTLESHIP

AudioBattleShip was built in Java SDK 1.4.1, using a collaborative platform, MatchMaker, which allows synchronizing a tree of distributed objects. Java Media Framework was used to synchronize multimedia events. The environment was divided in three classes: communication, sound, and the main program. AudioBattleShip has objects that store the information of players, the state of the game (turns), and the coordinates of a given point with the corresponding state (ship, water, destroyed ship, shooting to water). By using these objects a synchronization tree (Matchmaker) is created with nodes that store information about the players which also contains objects corresponding with the size of the board. AudioBattleShip contains a directory of sounds that can be easily modified to change language and sounds.

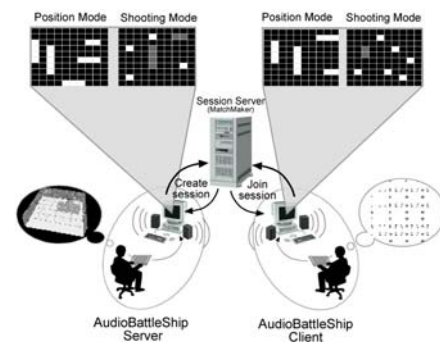


Figure 1. Schematic representation of the interaction with AudioBattleShip

### Playing modes

AudioBattleShip can be played between blind to blind, blind to sighted, and blind to computer. Blind to blind mode presents the same interface to both players. Blind to sighted mode provides a variety of tools to the blind learner to minimize the disadvantages in comparison with sighted learners who can have in any moment snapshots of the state of actions. Blind to computer mode gives intrinsic advantages to the computer over the blind learner because of computer memory and probability calculations, but this can be diminished by limiting the algorithm and creating different levels of complexity.

### Development

AudioBattleShip was developed in three steps: 1. Design and implementation of the basic objects, and creation of the MatchMaker tree and internal models, 2. Input, interface, and feedback operations, and 3. Turn-taking and control. We created two interfaces for both blind and sighted learners. The interface for blind learners consists of a board and help buttons. Sound feedback is provided to inform about a specific spatial location on the board and the occurrence of certain actions. We use as input interface a tablet device and built upon it a grille to represent an exact copy of the visual interface. The tablet can map the entire screen and by using a pen-based pointing device diverse events can be triggered. The interface for sighted learners consists of two boards, one per each player, as well as a text area that provides feedback for actions.

### Software modes

AudioBattleShip has three modes: Ship positioning mode, creating a new session or joining to an ongoing session mode, and shooting mode. Both players can manipulate matrix with the board's state (see Figure 1).

### PRELIMINARY USABILITY TESTING RESULTS

AudioBattleShip was usability pilot tested with four blind learners, two legally blind and two with residual vision. They played the game and answered questions during six sessions. Most questions were related to the audio interface, graphic interface (for the residual vision learners), and the use of input devices such as the tablet. They were also observed in all sessions by two people from the research team. Comments were registered. The evaluation for cognitive achievement is under way right now. As a result of the preliminary testing, learners helped to redesign the software by making insight and meaningful contributions about the sounds used, intensity and quality, volume, feedback, sound synchronicity, sound overlapping, sound help, color contrast, size of the cursor, position identification number, and tablet mapping.

The four learners enjoyed interacting with AudioBattleShip (see Figure 2). There were diverse forms of interaction between them. This is especially important for blind learners because they are accustomed to do individual work with little social interaction when using digital devices. Collaboration skills with obvious constrains can be enhanced with audio-based applications such as AudioBattleShip. We need to know what type of skills can be enhanced most and ways of improving them through the interaction with sound. A current full field study will give us detailed insights and knowledge about how cognition and collaboration can be enhanced by the interaction with sound.



Figure 2. On site interaction with AudioBattleShip between two blind learners

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