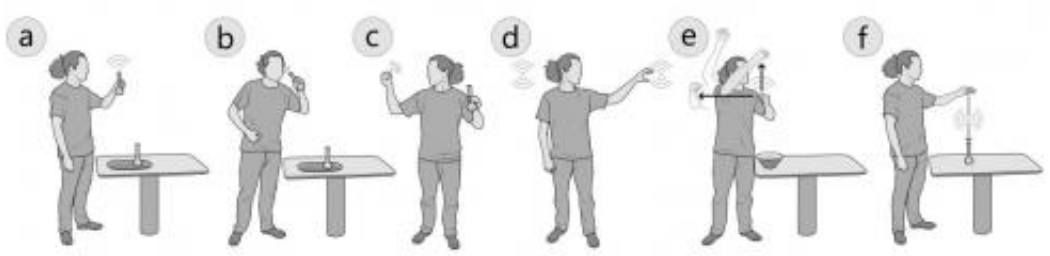
BoomRoom's sound by design uses array of loudspeakers

January 31 2014, by Nancy Owano



The BoomRoom allows to “touch”, grab and manipulate sounds in mid-air. Further, real objects can seem to emit sound (a), even when being moved (b). Sounds can be picked up (c) and placed in mid-air (d). We use real world objects to augment the auditory feedback. For example, by using a bowl as filter object (e). Finally, sounds can be dropped into objects to be found more quickly (f). Sounds can be heard anywhere in the room, and appear to originate from the location of the virtual sound source regardless of the listeners position. Credit: Jorg Muller et al. paper

(Phys.org) —Jörg Müller, a researcher at the Technical University of Berlin, thinks of ways to make effective use of sounds in human-computer interactions. He and his team explore how to direct sounds in a focused way, and their concept is called the BoomRoom. A report in *New Scientist* talks about the-audio-enabled "BoomRoom, where a ring of 56 loudspeakers allows sounds to be assigned stationary or mobile positions in the space around the person. In a paper for the upcoming ACM CHI Conference on Human Factors in Computing Systems, which will be held in April in Toronto, Muller, Matthias Geier, Christina Dicke

and Sascha Spors explained: "The BoomRoom allows for direct manipulation of virtual sound sources hovering in mid-air." The BoomRoom also enables ordinary objects to appear to emit sounds. Boom-Room uses Wave Field Synthesis (WFS), and optical tracking. "Loudspeakers and cameras can be at a distance from where the actual interaction takes place." The authors said they envision loudspeakers and cameras embedded into the walls and ceilings of arbitrary rooms.

The paper, titled "Mid-air Direct Interaction with Virtual Sound Sources," shows objects capable of auditory feedback. For example, there is a bowl of marbles in the living room: which is actually an answering machine. The user makes use of the marbles that have been specially programmed to make clicking sounds so the person knows the number of new messages that have come in. When a marble is removed from the dish, the marble might play the recorded message. Another scenario might involve the visually handicapped getting a better sense of the immediate surroundings. Helpful assistance would be rendered as a blind person enters a room and, with an announce function, all objects—such as keys, table, and chairs—would announce themselves. The blind person might also hear sounds for dropped objects and spilled liquids.

"We created a small room (3m diameter) where a circular array of 56 loudspeakers is hidden behind curtains," said the authors. A marker-based optical tracking system was used to simplify the computer vision part of gesture recognition, user tracking and object recognition and tracking.

"We show that sound localization is surprisingly accurate," they wrote. "The model-based spatial audio reproduction was realized with the open-source software SoundScape Renderer (SSR). The SSR provides, among several other reproduction methods, a very efficient real-time implementation of WFS." They said that loudspeaker driving signals are

generated in realtime by a computer running the Debian GNU/Linux operating system.

According to another paper from TU, "Perception of Focused Sources in Wave Field Synthesis," by Hagen Wierstorf, Alexander Raake, Matthias Geier, and Sascha Spors, WFS, or Wave Field Synthesis, "allows virtual sound sources to be synthesized that are located between the loudspeaker array and the listener."WFS, they added, is a prominent high-resolution sound field synthesis method both used and studied. "Unlike traditional stereophonic techniques, it offers the potential of creating the impression of a virtual point source located inside the listening area—between the loudspeakers and the listeners. These sources are known as focused sources, according to their strong relation to acoustic focusing."

More information: 1. Perception of Focused Sources in Wave Field Synthesis: www.aes.org/tmpFiles/elib/20140130/16663.pdf
2. The BoomRoom: Mid-air Direct Interaction with Virtual Sound Sources: joergmueller.info/pdf/CHI14MuellerBoomRoom.pdf