

2. General Methods & Materials

2.1. Apparatus

Several pieces of apparatus were used in this study to form an integrated system. The system consisted of a stationing and response device (SRD), a sound projector, and a computer-video/audio production system (CVAPS) which included an Apple PowerPC 8500, an Alessis DM5 Drum Machine, a Roland SC7 Midi sequencer, an Opcode Studio 3 Midi Board, a Mackie 1202 Pre-Amp/Mixer, two TV-screens, a Sony Hi-8 VCR, two video cameras and a Panasonic Digital AV-Mixer. The SRD was suspended underwater in the dolphins' tank in front of a 1.6-m deep viewing window (see Figure 4). A television and video recording system were located behind the window. The part of the system that generated all stimuli and recorded responses was located in a remote room overlooking the dolphin's tank (see Figure 5). These three system parts worked together to allow the presentation of stimuli created in the remote room to be presented to the dolphin under water and responses of the dolphin to be monitored and recorded from the remote room. Details of how system components functioned together are presented below. Figure 4 (A and B) shows a front view and a side view respectively of a computer rendering of the SRD suspended under water. A rectangular frame (1) fitting the inner dimensions of the underwater window (104 x 56 cm (2)) was constructed out of Schedule 80 3.8-cm diameter Poly-Vinyl-Chloride (PVC) pipe and fittings. An 8.8-cm diameter cylindrical transducer (3) attached to the PVC frame served as the underwater sound projector. A 26.6-cm long lever was attached to this frame via a hinge and served as the response paddle (4). A pipette bulb (5.72 cm in diameter, (5)) was placed below the lever and connected to a plastic tube. A stainless steel bolt (6) was attached perpendicular to the lever with its head located directly above the pipette bulb. A deflection of the paddle compressed the pipette ball and the pressure change was transmitted through the plastic tube (7) to a washing machine water level switch outside the tank. The water level switch was in turn connected to a Midi input device (Alessis DM5) in the remote room (Figure 5) and functioned as a momentary switch. The signal was then transmitted via the serial port of the DM5 to the Apple PowerPC 8500 where the signal was recorded.

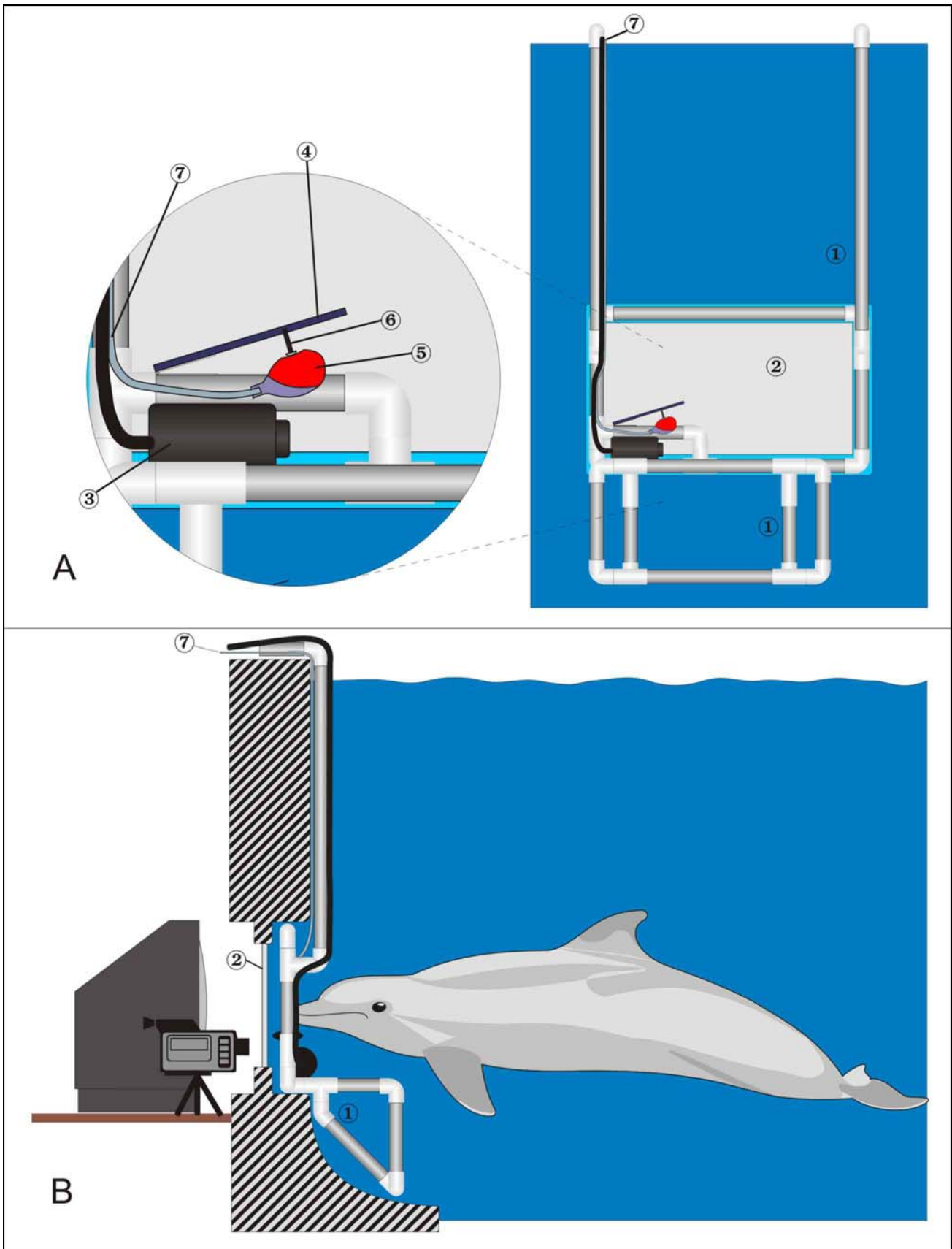


Figure 4: Computer rendering of the stationing device and the paddle setup used in the experiment: A = front view, B = side view.

When the paddle was deflected more than 2 cm, a short click-sound was produced by the Alesis DM5 drum machine and played back to the dolphin through the underwater speaker. The paddle response signal was recorded in the computer program that also controlled the display of the stimuli.

A 35-inch television (Monitor 1) placed behind the underwater window was used to present the stimuli. Adjacent to the TV monitor was a Sony Hi8 video camera (Camera 1) that faced towards the window to record the position and movements of the dolphin during the trials. The image from this camera was fed through a Sony Hi8 videocassette recorder (VCR) to tape each session, and then it was also fed to a TV display (Monitor 2) in the remote control room. The primary computer monitor in the remote control room displayed the control menu of the program while another TV-monitor in the remote room (Monitor 3) was used by the computer as a secondary screen for the display of the stimuli. This image was then fed into a Panasonic digital AV-mixer and from there to the TV monitor behind the underwater window. A second input into the AV mixer came from a DV-camera (Camera 2) placed in front of a screen that recorded the gestures of a “video trainer” who interacted with the dolphin at the beginning of each trial.

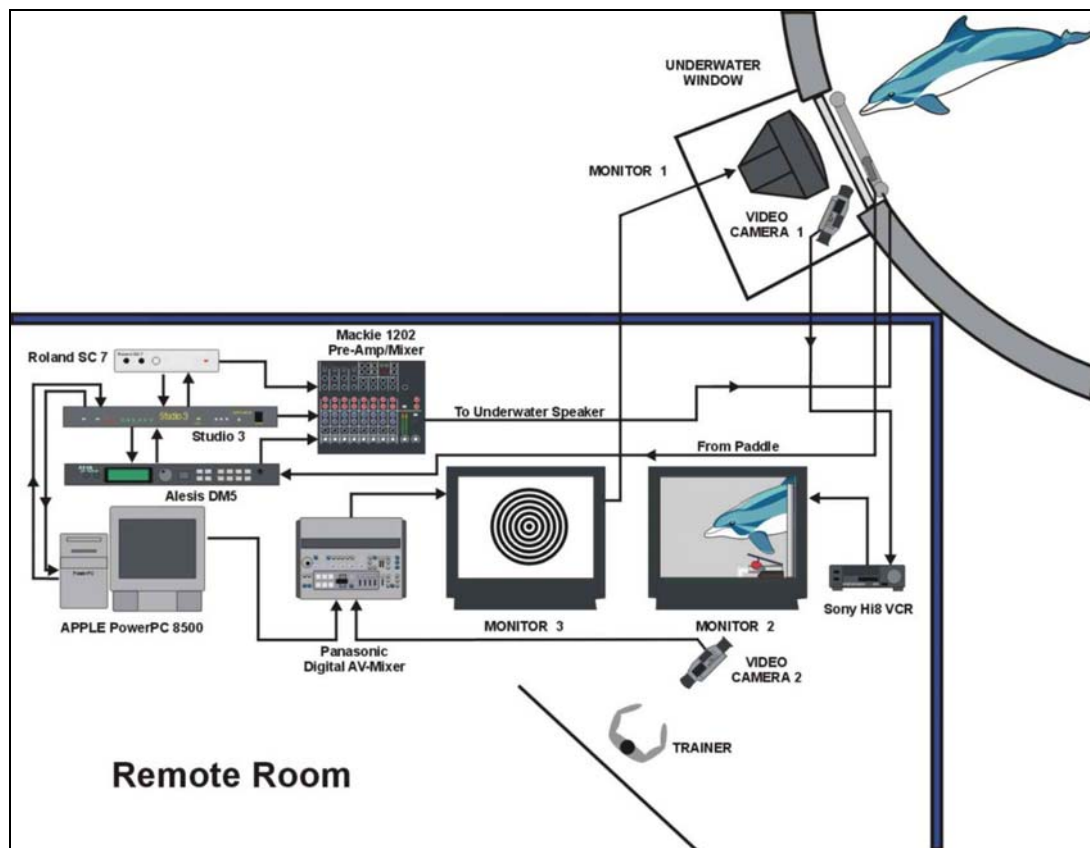


Figure 5: Diagram of the setup as used in all visual and auditory experiments

2.2. Software:

All applications used for the experiment were written in the object oriented programming language MAX 3.5. Two different types of programs were designed: the first program was used for the creation of trials before the actual test session (visual and auditory random creator, see Appendix B: Software code). The second program was used to display the stimuli during the tests (Visual and Auditory Player) and record the dolphin's responses. In these applications, the data flow is represented by lines that connect objects, which can stand for mathematical functions or operations.