Live Video and Augmented Reality over Internet as Entertainment for Dogs

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ABSTRACT
In this paper, we investigate if video conferencing software, possibly enhanced with augmented reality games, could be used for remote interaction between dogs and their owners so they could communicate over internet during the master’s absence.

Categories and Subject Descriptors
H.4.3 [Information System Applications]: Communications Applications – computer conferencing, teleconferencing, and videoconferencing; H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems – artificial, augmented and virtual realities.

General Terms
Experimentation.

Keywords
Augmented reality, internet, animal behaviour.

1. INTRODUCTION
Worldwide millions of dogs suffer from more or less severe separation anxiety and these animals might benefit from being entertained interactively during their master’s absence. The aim of the present study is to investigate if video conferencing could be used for communication between dogs and their owners, not only to watch what their dogs do when alone at home, but also to entertain the dog during the master’s absence. Furthermore we propose augmented reality games as means to enrich the networked interaction between the dogs and their masters.

2. VIDEO STIMULI FOR DOGS
Many dog owners say that their dogs (Canis familiaris) watch TV, and there are already commercial DVDs available for entertaining dogs (see e.g. http://www.bowwovt.com). However, as stated by Graham et al. [1], surprisingly little is known of dogs’ ability to understand or respond to video images and sound. D’Eath [2] reviewed the limitations of video images in animal behaviour experiments. These limitations deal in the first place with mismatch between TV image and animal’s colour vision, flicker frequency, depth perception and visual acuity; TV and video systems are designed for humans with vision and perception abilities different from those of animals.

Besides the technical issues related to differences in vision between species, D’Eath [2] emphasises the lack of interactive properties as a source of error in video studies. The humans and animals on a video do not respond to the behaviour of the observing animal. This may at least partially explain the observed gradual loss of interest towards the videos [1].

3. EXPERIMENTS AND RESULTS
We carried out experiments with ten intact (except one) male dogs of nine breeds. The dogs were tested one at a time during two days in random order in a puppy room of the experimental kennel. All dogs were familiar with the room. The owner brought his/her dog to the cage, and left it there as they normally did when leaving the dog. The owner then went to a stimulus room in another building locating 150 m from the kennel.

An intranet connection between the stimulus room and the dog room enabled the owner and the experimenters see and hear the dogs and to give visual and auditory stimuli to the dogs. We used the NetMeeting software with 352x288 video image resolution, which would be easy to handle also with broadband internet. The visual stimuli were projected to the back wall of the cage, and there was a loudspeaker just above the projection to convey the auditory stimuli. We chose to use projector screen in order to have the human appear in real size to the animal. The projector also reduces flicker compared to standard PC display; in fact plasma display would perform even better. Use of data glasses for the dogs was not seriously considered although they would bring the benefit of stereo vision with augmented reality application.

The dogs had 25 min habituation time in the cage before they were exposed to six stimuli, each lasting for 5 min: picture of the control room (CTRL1), picture and voice of the owner (PICVOI), picture of the owner (PIC), voice of the owner (VOI), picture and voice of a person unknown to the dogs reading a book (UNKN), and picture of the control room (CTRL2). During PICVOI, PIC and VOI the owner tried to make contact with her/his dog as intensively as possible and respond to their dog’s responses, whereas the unknown person did not respond to dogs’ behaviour. The picture during habituation, CTRL1, VOI and CTRL2 was picture of the stimulus room without any movement or sound. CTRL1 was the first and CTRL2 the last stimulus. The remaining four stimuli were provided in random order and the order was different for each dog.
Behavioural categories analysed from video-recordings were resting or active (sitting, standing and moving). In addition the direction of dogs’ snout was recorded in order to record whether the dog was looking at the picture on the wall. The differences between the dogs’ responses to the different stimuli were analysed with the Linear Mixed Model. Further details of our experiment are presented in [3].

![Figure 1](image.png)

**Figure 1. The percentage of observations (mean±SE) when the dogs were looking at the picture wall or were active.**

Figure 1 summarises some of the main results. On average the control stimuli were clearly least interesting to the dogs, and the combination of the owner’s picture and voice was found most interesting. In closer study the results were characterised by great inter-individual variation in dog’s behaviour [3]. At best some individuals responded to the stimuli as if they were presented in true contact with the animal, whereas some other individuals seemed not to respond at all, or their reactions were independent of the expected relevance of the four stimuli with human voice and/or picture. Whether the inter-individual differences in dogs’ responses were due to differences in perception or temperament cannot be concluded yet.

4. AUGMENTED REALITY FOR DOGS?

Mixed Reality has previously been applied with animals with “Poultry.Internet” [4]. With this most impressive implementation, people can interact with chickens remotely through the internet using various sensors, haptics and cybernetics, as well as motion capture through live webcams. The system also includes an augmented reality component for the human user to see the chicken augmented on his/her desk; however no augmentation opportunity is provided for the chicken (e.g. to see the remote human). Here we propose networked augmented reality user interfaces as well as active game interaction also for animals.

According to our hypothesis, augmented entertainment for dogs could be implemented using game concepts similar to Sony EyeToy’s (cf. www.eyetoy.com). The user’s (dog’s or master’s) movements are derived by motion detection of the webcam video stream, and interpreted as gestures to control augmented virtual game elements. As model for similar networked augmented games, we have the CamBall table tennis game [5]. In CamBall, both players in the internet see each other video coded at the other side of a virtual table which is augmented “between” the players. The game is played with real rackets; movement of the rackets is detected from the video stream to control virtual rackets hitting a virtual ball in the game.

We did not implement such augmented networked games for dogs yet, but in the tests we imitated gestures such as throwing the ball and got promising reactions from the dogs. Accordingly in a basic augmented reality game for dogs, by means of motion detection the master “throws” a virtual ball to the dog at the remote location. The dog sees the ball flying, augmented on the projector screen with the master, and has to “catch” the ball. A successful catch would be indicated by showing the ball bounce back to the master. For further feedback, some kind of rewards would be useful to keep up the dog’s interest level. An electronic vibrating jacket such as with Poultry.Internet [4] might provide a solution also for dogs. Maybe an even better solution could be a biscuit box operated over the internet or a mobile phone link.

Besides the virtual ball, it might help the dog to see its own silhouette image augmented to the screen. The dog would actually control the silhouette with its body in the same fashion as real racket controls a virtual racket with the CamBall game. This as well as various other factors with the proposed game require of course extensive testing in practice. Furthermore, it is clear that other game concepts, game levels and other variations would be required to keep the networked communication continually interesting for both the dog and the human.

5. CONCLUSIONS

Networked live video shows clear potential for providing means for remote communication between a dog and the master. Augmented reality offers possibilities to enhance the interaction, to keep it interesting repeatedly and for longer periods of time. However it appears that only a small percentage of dogs react to live video stimuli. Further tests are required to confirm whether augmented reality games really work with dogs. We hope this article provides some ideas and a starting point for future work.

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7. REFERENCES


