On Social Human-Animal Interaction in Augmented Reality

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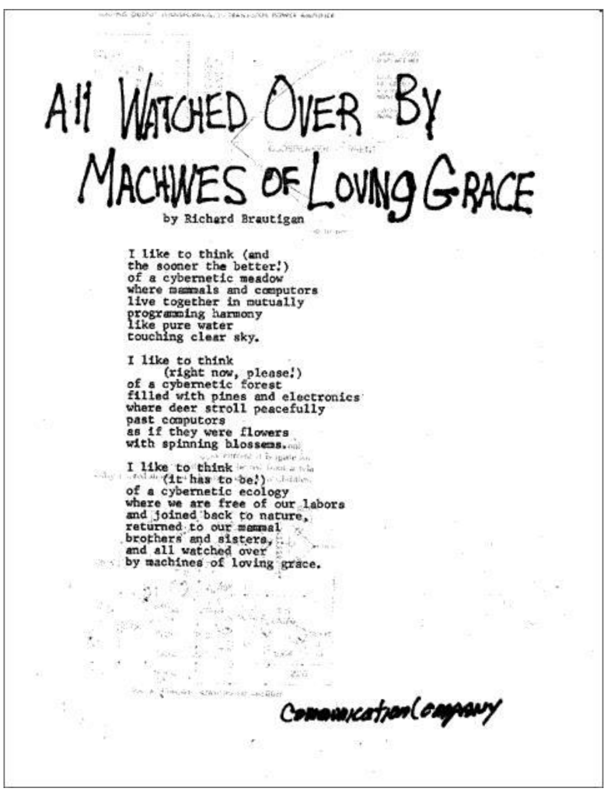
Strolling Peacefully

The usual and often cited definition of augmented reality is that of Azuma (1997). Slightly adapted, it says: augmented Reality (AR) (1) combines real and virtual objects in a real environment, (2) registers (aligns) real and virtual objects, (3) and runs interactively, in three dimensions, and in real-time. Usually, it is also mentioned that AR should not be limited to specific technologies and that it does not address sight only. No limitations on the type of technology, nor specific to visual information. AR applies to all senses. We have AR systems that provide visual, auditory, tactile, olfactory, and gustatory experiences or combinations of these experiences. In vision-oriented AR we can distinguish between video see-through, optical see-through, mirror, and projection-based AR. Each of these systems can have stationary and mobile variants. We can also distinguish between head-attached, handheld, monitor-based, and spatial AR. Some new developments include pass-through AR and the embedding of AR, whether it is sight, sound, touch, smell, or taste oriented, in the IoT (pervasive computing, ambient intelligence), that is, the use of sensors and actuators that enhance the AR experience and that are not intrinsic to the AR technology that is used.

In 1967 poet and writer Richard Brautigan wrote the poem “All Watched Over By Machines Of Loving Grace.” At that time computers were mostly room-sized and in this poem we are watched over by them and deer can stroll past them as if they were flowers. Although at that time in the Science Fiction literature we have cyborgs and human- and animal-like robots, we had to wait until more recent times before we could see computers stroll peacefully past deer and flowers. We can do so with computers embedded in smartwatches, smartphones, and smart glasses. Can we also stroll past deer and flowers while we are accompanied by a virtual human or animal partner? And can that be done as natural as with a real human or a real animal partner? Can we enjoy walking our virtual dog in the park in our neighborhood? And will the virtual dog enjoy that?


All Watched Over By
Machines of Loving Grace
by Richard Brautigan

I like to think (and
the sooner the better!)
of a cybernetic meadow
where mammals and computers
live together in mutually
programming harmony
like pure water
touching clear sky.

I like to think
(right now, please!)
of a cybernetic forest
filled with pines and electronics
where deer stroll peacefully
past computers
as if they were flowers
with spinning blossoms.

I like to think
(it has to be!)
of a cybernetic ecology
where we are free of our labors
and joined back to nature,
returned to our mammal
brothers and sisters,
and all watched over
by machines of loving grace.

Communication Company

From an AR point of view, what kind of virtual content (visuals, sounds, touch, smell) has to be overlaid on the real world to obtain the social experience of walking a dog in a similar or an even more enjoyable way than walking a real dog in real life? We need to answer the following questions. What kind of virtual layer is overlaid on the real world? What is the content of the virtual layer and how has it to be aligned with the real world? How does real-time interaction make use of virtual content? With answers to these questions, we can also investigate the difference in the AR interactive experience compared with the known real-world experience.

There are some examples of interaction with virtual animals in augmented reality situations. A well-known example of interactive virtual animals in projection-based AR is the Urbanimals project from the LAX Laboratory in Wrocław, Poland. Projectors attached to walls projected animated virtual animals on street surfaces and walls, Kinect cameras tracked the positions, bodily movements, and gestures of passers-by to allow them to interact with these animals (Figure 1) according to various scripts (Dobiesz & Grajper, 2016). Other examples of human-animal interaction in augmented reality (video see-through, mirror-based, projection-based, and optical see-through) can be found in Nijholt (2020) and Nijholt (2021).

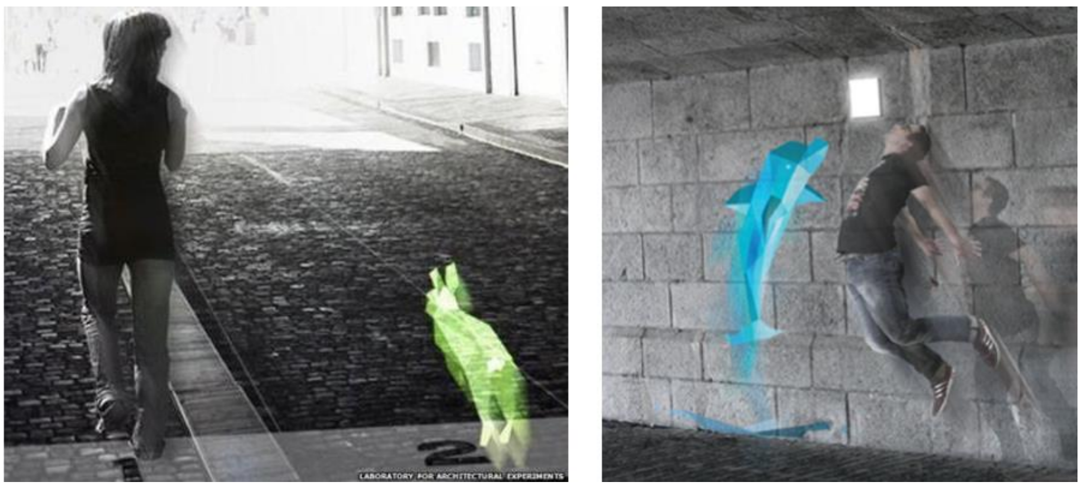


Figure 1. Urbanimals Playing in Playable City Brighton (UK).

In this example, the interactions between animals and humans happen in fixed locations. Cameras and projectors are in fixed positions. Can we provide more freedom for humans and animals? Nowadays handheld and head-attached projectors can be used. Cameras are wearable as well. Projection-based AR has the advantage that others can see the augmented world with virtual animals as well. Instead of projecting on walls and street surfaces mid-air projection of holographic images can be foreseen. The main problem remains of course, as for most of the AR applications, we need modeling of the environment where animals and humans play or where we want to walk the dog. A database filled with models of urban environments is something to work on, using techniques for on-the-fly modeling of urban environments is another possibility. Unexpected meetings and events and not in detail foreseen behavior of the human remain possible and dealing with them require some built-in intelligence for the virtual animals, rather than following scripted behavior.

The augmented reality that is used in our second example is optical see-through (HoloLens) and it is really about walking the (virtual) dog. See Figure 2. Details of this research can be found in (Norouzi et al., 2019a). Issues that are studied are proximity, collisions, and the presence of other passers-by that do not wear an HMD and are not aware of the virtual dog. This is a difference with the first example, but the other observations mentioned there are also valid in this 'walking-the-dog' example. As indicated in (Norouzi et al., 2019b) for AR applications like these, where the virtual content has to express animal and human-like behavior while interacting with real-world content (humans, animals), we need to integrate research from the areas of intelligent virtual agents, affective computing, artificial intelligence and augmented reality.

Peacefully Strolling and Conversing Together

Many aspects of human-human, human-animal, or human-agent interaction and activity are based on simultaneity rather than on a sequential model. For example, walking together, shaking hands, performing joint tasks, and cooperative and competitive games and sports activities. In (Nijholt et al., 2008) more observations and examples of what we called 'anticipatory synchronization' can be found. In an AR situation, optical see-through devices allow us to walk with a virtual partner, to walk a virtual dog (see again Figure 2), to have musical interaction with real and virtual partners, to move furniture together, and perform similar tasks, that is, social interactions where coordination by mutual adjustments is needed. How can AR support conversational interactions in general and support interaction activities that require a mechanism of mutual adjustments in particular? We can ask AR researchers to take up the challenge of using AR to support rather than disrupt affective and social human-human interaction behavior and other synchronized joint human activity, including human-agent interaction behavior and activity.

Figure 2. Walking a Virtual Dog.

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