

Computer Mediated Remote Touch Communication for Humans and Animals

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Abstract: Touch-based remote communication is a relatively new field of research. Traditionally, remote communication emphasizes on voice communication. Recently, with the proliferation of the IT sector, video communication is increasingly being used for remote communication. Communication based on touch is especially important for humans and animals to communicate remotely. As humans become increasingly busy at work or away from home, pets are increasingly neglected. Methodologies need to be developed to enable humans to assure their pets and keep in contact with them. Such systems should not only allow humans to see their pets, but also to allow pets to feel the presence of the owner. Patents reviewed here suggest inventions that attempt to bridge this gap, or have methods that can be used to achieve a better remote touch communication for humans and animals.

Keywords: Pets, animals, communication, remote, touch, haptic, tangible, interaction, computer-mediated.

INTRODUCTION

In this Information Age, it is common for humans to communicate through the Internet using computers and mobile devices. Applications such as video conferencing and instant messaging are no longer alien to us. New methods are constantly being developed for humans to stay in touch via the Internet or mobile network. For example, nowadays we can have a video call to another person on our mobile phones.

However, the incorporation of haptic interaction as a method for remote communication is still very much unheard of. We have not yet seen a device or application that predominantly allows users to send touch based interaction to one another. In the real world, touch and physical manipulation play a key role in understanding and affecting our environment. Touch is a key advantage for human beings to interact, understand, and feel affected by the real environment. The use of the Internet as a medium for transferring human touch could be the next innovative application in interaction technology, as it provides haptic sensation of touch for remote users.

One particular area which haptic interaction is important and could potentially be revolutionary is the remote communication between humans and animals. In bygone days most people lived off the land, or were hunter-gatherers, or nomads. People would spend many hours with their animal friends and helpers. For example, cowboys and their dogs on the prairie, aborigines hunting with dingoes in Australia, and Asian villagers keeping chickens in their homes. However, in our modern age, globally, city people are too busy to spend time with their pets. This is part of the phenomenon of modern life, where people are getting farther from each other and from nature as well. The society's uncontrolled development can result in feelings of isolation, loneliness and a lack of sense of value [1]. Nowadays, one of the few

things that bring warmth to our hearts and homes are pets. They are the symbol of the nature, with absolutely non-mechanistic behaviors. We can express our affection by stroking or patting them. Thus, in our modern lives, we need a mechanism to feel the presence of our pets, no matter where we are, at play or at work. Unfortunately, we are not allowed to bring pets to our offices, and leaving them alone in the backyard makes us constantly worry about them. Therefore, we need inventions that bridge the gap between humans and animals while we cannot be at home with them.

Pet monitoring systems [2] which are mainly based on using video cameras to allow pet owners to see their pets are a step towards connecting humans and animals. However, most of these systems do not provide for tangible or any form of physical interaction. In our opinion, tangible interaction provides a very significant meaning for remote interaction between humans and animals. In general, animals do not respond to human linguistic or verbal expressions in a straightforward manner, so there is one less mode for interaction. Visual communication helps in identifying the communicating subject and understanding the current physical state the subject is in. However, we believe that the strong neurological and psychological impact related to touch places touch-based interaction as the future of remote communication between humans and animals.

TOUCH-BASED INTERACTION FOR HUMANS

The main motivation for the research in using touch as part of communication is to support social interaction. Haptic information forms an important channel of the part of human brain called the Parietal Cortex and plays an important role in the cognitive aspect in human's daily activities. This has been shown in various psychological studies exploring how touch is essentially not just important for complex sensory-motor tasks but offers a deeper neural sensation evoking for recognition and judgment. Such neurological consciousness thus aroused through available haptic information are important for humans to make

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decisions pertaining to their surrounding and interaction with others [3].

Furthermore, it has been shown in the proprioception (a process of correlations amongst the multimodals) of Parietal the Cortex, even when sometimes a touch is reproduced with the right representation (for example a rubber hand in place of a real hand) to create a suitable mindset (make the audience understand the rubber hand is representing the real hand), self-attribution of the audience will make them believe that the touch is real (they believe the real hand is being touched instead of the rubber hand) [4]. This presents a strong argument for making use of touch (even if it is remote and reproduced) as a communication channel in events where real touch is not possible.

Besides that, from a psychological standpoint, humans obtain many benefits from interaction with pets. Pets have been cited as providing social support which has some advantages compared to the social support given by humans. Pets can make people feel unconditionally accepted, whereas fellow humans will judge and may criticize. Ros [5] stated that social support by other humans can be threatening.

Pets satisfy human being's need to nurture. There is evidence that self-esteem is an important aspect of social-emotional development of children. Bergesen [6] found that children's self-esteem scores increased significantly over a nine months period of keeping pets in their school classroom. Many parents admit that pets can be a source of valuable life experience skills for their children [7].

Since the 1980s, professionals who used animals in therapeutic settings began to make a distinction between animal-assisted activities (AAA) and animal-assisted therapy (AAT) [8]. AAA provides opportunities for motivational, educational, recreational and therapeutic benefits to enhance quality of life and is delivered in a variety of therapeutic environments by a specially trained professional in association with animals. AAT is a goal-directed intervention in which an animal is used as an integral part of the treatment process. Animals can be used in therapy setting to teach new skills or to reduce maladaptive behaviors [8].

In summary, touch based interactions between humans and animals provide benefits both from a psychological as well as a neurological perspective. This provides the motivation for research in this field that potentially has far reaching impact even on remote human communication.

TOUCH-BASED INTERACTION FOR ANIMALS

Many homes have companion animals, usually dogs or cats, and people enjoy stroking them. Animals often respond by closing their eyes and showing pleasure.

This shows that animals respond in a significant manner to touch. In a study by Jones [9], it was shown that poultry farmers could have more productive hens if they installed video screens showing chickens being stroked. It was found that hens that are deprived of human contact are likely to be more anxious and prone to poor egg-laying. However, it is not feasible for the farmer to handle every chicken in today's huge commercial flocks, and further tests showed that for a chicken to watch another one being stroked had almost the same effect. Therefore, a computer-mediated method for

humans to remotely touch poultry is a feasible solution to be considered.

In another study [10], it was shown that stroking suppresses stress-induced elevation of ACTH (secretion due to maternal deprivation) in animals. ACTH is secreted from the anterior pituitary in response to corticotropin-releasing hormone from the hypothalamus. Corticotropin-releasing hormone is secreted in response to many types of stress [11]. Therefore, this shows that touch based interactions are important for the benefits that they potentially bring to animals.

The above emphasizes that touch is very essential for both humans and animals. There might be situations in which physical touch interaction is not possible, for instance, when we are in the office, traveling or in hospital; therefore, sending a remote touch would be helpful when our real presence is not practical. Based on today's technology and the pervasiveness of the Internet, it is only natural that methods for touch communication are developed exploiting the capabilities and vast reach of the Internet.

Previous research thus provides the motivation for exploring a new form of computer mediated communication medium emphasizing touch between humans and animals. This review is focused on computer mediated remote tangible interaction between humans and pet animals reported in recent patents (2000-2006). The type of interaction, technical methods of implementation and their respective merits in enhancing remote interaction between humans and pets are discussed. It concludes with a discussion of possible future works and inventions that may contribute to enabling humans to better communicate and interact with their pets remotely.

PATENTS

As the field of computer mediated remote touch communication between humans and animals is relatively new, there are not many patents directly describing inventions that allow for humans to touch or interact tangibly with animals. Therefore, this review also includes inventions or methodologies that involve pets or animals which can be applied to the topic of review. The subsections that follow discuss the most relevant patents.

SUMMARY OF MOST RELEVANT PATENTS AND INVENTIONS

Remote Human-Pet Communication Devices

Patents that fall under this category have the similarity of establishing a communication structure and protocol for humans and pets to receive or send signals to each other, or both.

Patent US6441778 [12] claims a locating device for attachment to an animal and adapted to obtain and communicate location information about the animal to a fixed or mobile base station. The device comprises of a controller having a memory, an input for location data and a first communication port, a satellite navigation system receiver coupled to a first antenna and having a location data output coupled to the location data input of the controller. It also has a communication transceiver coupled to a second

antenna to receive and transmit communications between the locating device and the base station and having a second communication port coupled to the first communication port of said controller. It also has a GPS receiver and communication transceiver, configured to be attached to the animal. The controller upon activation operates automatically to obtain location data from the satellite navigation system receiver via location data output, and store the location data in memory. It then communicates this data to the base station which then can be relayed to devices own by humans. There is no communication by voice, and it is similar to a paging system used in the telecommunications system.

Besides that, patent US6722318 [13] claims an animal communication device which is designed to solicit animal responses based on at least two of the five major senses. The device includes a module which allows animal to communicate a plurality of physically perceivable attributes related to the senses to the human listener. The animal activates the device by depressing a housing cover which activates a switch. Alternatively, a motion detector is used to detect the presence of the animal. The speech unit disposed within the housing has a playback device for storing and playing back a recorded message and a speaker for broadcasting recorded messages. The speech unit also has messages to be communicated by the animal to a human listener. The objective of the device is to allow animal to indicate to humans for example, when it is hungry or when it wants to go out.

Patent US6598563 [14] claims a pet training device comprising a wireless command module, a wireless receiver module connected to an adjustable collar assembly. The wireless command module is used to select a stimulation mode, stimulation duration, and a stimulation intensity level through the use of one-touch digital switches located on the wireless training device front panel. The selected functions are displayed on an LCD. Stimulation commands are transmitted to the wireless receiver module where they are demodulated into control signals that trigger a shock, a vibration, or a shock and vibration. When the wireless receiver module is placed in a no-bark mode, the wireless receiver module will generate a shock when triggered by a bark sensor. Power controllers built into both the wireless command module and wireless receiver module optimizes battery life by turning the training devices off after a period of inactivity. This invention mentions a vibration that is triggered to train the pet. Such a haptic feedback is useful and can be further researched upon to simulate remote touch in computer mediated communication.

Another Pet Training Device as described in Patent US6799537 [15] is closely related in terms of technical methodology. It claims a pet training device comprising a wireless receiving section worn by a pet, the wireless receiving section including a voice unit, a wireless receiving unit, a detection unit, a second microprocessor unit, a second display unit, a motor vibration unit, a high voltage low current discharge unit, and a decoder unit, and a wireless transmission section held by an owner. In a case of the pet continuously barking, the owner may activate the wireless transmission section to control the wireless receiving section to play a recorded message to order the pet to stop barking or if the above failed, even activate the motor vibration unit to

generate vibration on the pet or the high voltage low current discharge unit to generate high voltage low current to apply on the pet for stopping barking. Therefore in addition to vibration feedback, this device also has a voice record and playback, and also generating high voltage low current to provide a shock feedback to the pet.

Patent US7057515 [16] is unique in that its focus is to allow pets to signal or call out to humans. This differs from the patents discussed above. It claims a pet-activated signaling device to allow a pet to signal a human which includes a base, and a cover, associated with the base. A biasing element is operatively coupled between the base and the cover and is configured to provide a positive biasing force in between. It claims at least one audio signaling system is associated with the base and the cover and is activated in response to relative movement of the cover with respect to the base. Also, it claims at least one visual signaling system is associated with the base and the cover and is activated in response to relative movement of the cover with respect to the base. A selectively variable audio signaling system can be associated with the base and the cover and can be activated in response to the relative movement of cover with respect to the base.

Furthermore, patent US6910447 [17] claims a pet communication apparatus for allowing a user to communicate with a pet. The pet communication apparatus includes a housing member being designed for being selectively positioned on a support surface. A processing assembly is positioned in the housing member. The processing assembly is designed for being operationally coupled to a telephone jack whereby the processing assembly is operationally coupled to a telephone company. A speaker member is operationally coupled to the processing assembly whereby the speaker member is designed for audibly reproducing audio spoken by the user calling the pet. The speaker member is coupled to the housing member whereby the speaker member is designed for audibly reproducing sounds to be heard by the pet. This invention therefore allows human users to have voice communication with the pet. It allows the device to be connected to the normal telephone line jack at home, and messages from the human be communicated to the pet via a speaker system.

Besides that, patent US6885305 [18] describes a system for locating and sending messages to pets. Messages can be sent to a pet using a hand-held remote transmitter and a receiver that is attached to the pet. The receiver can record voice commands. When the transmitter sends a signal, the receiver picks up the signal and plays the recorded command to the pet. The receiver can also have one or more lights mounted on it that can be turned on by pushing buttons on the transmitter.

Pet Centered Devices

Patents under this category refer to inventions that are used specifically on the pets, usually without a communication structure with humans and without the need for real time input from humans that causes an output. These inventions suggest methods for reproducing haptic sensation on the pets as well as method of attaching the device onto the pets.

Patent US6369698 [19] claims a device for playing back messages recorded by a pet owner or the parent of an infant at selected time intervals so that the pet or infant is comforted in the owner's or parent's absence. The device includes a housing containing a voice chip that is utilized to record and play back the comforting messages. Accordingly, a microphone and speaker are in communication with the voice chip. A clock function is programmed into a microprocessor chip and is in communication with a switch and the voice chip so that the time interval for playbacks may be selected by a user. The device also features a number of indicator lights or a digital display to indicate the selected time interval for playback. The device here allows humans to communicate with their pets by voice. However, real time communication is not achieved. It is only a one way communication and users cannot activate the playback of messages as and when they want to.

Another Patent US6675743 [20] describes a vibrator massage blanket for use with pets. It has a battery pouch having a battery pack located on the back of the animal, such as a dog, for energizing a plurality of small vibrators distributed within the blanket, for imparting vibration to various locations on the pet. The blanket has layers between which the vibrators and electrical wiring are installed, to keep the pet from damaging the vibrator system. A switch is used to select different levels of vibration. The blanket may be split at the belly and have buckles or Velcro to secure the blanket. The under-blanket is preferably at least one layer of insulated fabric upon which up to 50 vibrator motors are mounted per side of the animal below the backbone. This system provides a kind of massage simulation by way of vibration, and is closely related to the feeling of being touched by humans.

In addition, patent US6650243 [21] claims a pet affection indicator device which presents information regarding the quantity of affection a pet owner is giving to the pet. The device includes a sensing assembly with a sensor element worn by a pet, and produces signals based on sensing of a human's touching of the pet near the sensor element. A processor receives the signals from the sensing element and calculates data associated with at least one of an amount, frequency and duration of the sensed touching and elapsed time since the last of the sensed touching. A memory is in electrical communication with the processor for storing the data. The device also includes an indicator that communicates to a human an indication associated with the data based on the touches. With this device, the pet owner, by paying attention to the indicator, will know if and when the pet is due for more affection. The visual feedback provided by the pet affection indicator is important to allow humans to know the effect of giving attention to their pets. Another Patent US7234421 [22] claims an animal data gathering method and device. This device has a wireless radio transmitter and receiver, a processing unit and memory storage. It functions as an on-body status indicator and communicates this data to humans.

Electronic Pet Devices

Very little research has, until now, been done in the field of human-computer-pet interaction. Most of the work in this field is in electronic pet devices which are created to provide

entertainment for humans. In an electronic pet device, a representation of a virtual living animal is displayed as an electronic pet and a human keeper is notified of the state of the electronic pet such as the degree of starvation or fatigue by an image or a sound. The keeper feeds or plays with the electronic pet by operating the electronic pet device in accordance with the state of the pet. Thus, the electronic pet has its state changed on the basis of the keeper's actions and is thus bred. The electronic pet grows with the lapse of time and therefore the state of the electronic pet is changed with the lapse of time. One significant example is the Tamagotchi [23]. It was marketed as "the original virtual reality pet". It can be described briefly as a tiny handheld LCD video game that comes attached to a key chain or bracelet. The objective of the game is to simulate the proper care and maintenance of a "virtual pet", which is accomplished through performing the digital analogy of certain "parental" responsibilities, including feeding, playing games, scolding, medicating, and cleaning up after it. If it is taken good care of, it will slowly grow bigger, healthier, and more beautiful every day. But if it is neglected, the little creature may grow up to be mean or ugly.

In the case where the electronic pet is realized by means of, for example, a robot, which exists as a substance, the robot as the electronic pet actually exists in the real world. In such a case, with respect to the robot as the electronic pet, the keeper will feel the presence of the pet more compared with the electronic pet displayed in the electronic pet device. For instance, Sony had introduced a reconfigurable robot [24] called AIBO based on OPENR, a standard for robot entertainment systems with four legs and a head, where each leg has three degrees of freedom which can be reconfigured to a wheel-based mobile robot. The AIBO entertainment robot dog can be programmed using OPENR. AIBO has in-built artificial intelligence and has been used in many applications such as robot-assisted therapy in Japan [25]. To some scientists, robots are the answer to caring for aging societies in Japan and other nations where the young are destined to be overwhelmed by an increasingly elderly population. These advocates see robots serving not just as helpers (e.g. carrying out simple chores and reminding patients to take their medication) but also as companions, even if the machines can carry on only a semblance of a real conversation.

Patents reviewed in this category are relevant because such electronic pet devices are designed to be interactive to humans. Some devices have very advanced capabilities to process sensory information from humans such as speech and visual movements. Also, some robot pets are connected to the Internet and can be communicated with by the owner even while they are at work using the computer.

Also, the methods of storing input data, processing the data and causing state changes in the system are also strong points which can be applied to a system for remote touch interaction between humans and animals.

Patent US7089083 [26] claims a virtual electronic pet and a pet-type robot that changes emotional state and instinct state according to surrounding information and internal information. The electronic pet behaves according to the emotional state and the instinct state. Transmission/reception

of the internal state of the electronic pet (pet characteristic information) is made possible among the virtual electronic pet, the pet-type robot, and a personal computer. Thus, the action of the electronic pet is implemented by each device in accordance with the internal state of the electronic pet affected by other equipment.

Patent US7139642 [27] describes a robot system and robot apparatus control method. It aims to provide an improved entertainment property. In a robot system where a plurality of robot apparatus act autonomously, each robot apparatus has wireless communication means, and when the robot apparatus make conversation between themselves, the contents of the conversation are transmitted to and received by the robot apparatus as a command and/or a semantics through the wireless communication means of both.

Finally, patent US5966526 [28] describes a simulation device for fostering a virtual creature. It claims a device with a purpose of fostering a virtual creature where a virtual creature is grown while disciplining or training the virtual creature when a player conducts a corresponding treatment in response to a call or a request from the virtual creature in a screen. This patent is closely related to the virtual pet device as described earlier whereby they are similar in form and functionality.

All the above-related work did not use real animals, and instead they used robot or virtual pets. We have looked at several related human–robotic–virtual pet interactions in the previous subsection. There are advantages of such systems in providing companionship, communication, and interactions between humans and virtual/robot pets. However, there are some disadvantages in such robotic-virtual pet systems, and lacking features in the interaction with humans, which have been found in research studies. Behrens [29] criticizes the fact that Tamagotchis never die (in fact they do, but they are born again and again as long as batteries are fresh), unlike a real pet. Therefore, people, especially children, can become confused about the reality of the relationship. Children will no longer treasure the companionship with their pets because even if the pet ‘dies’, it can be brought back to life by changing the battery. The lack of such moral responsibility will cultivate a negative psychology which eventually will do harm to the society. After few times children will lose their interest in such a repetitive game; however, a real pet will show new and different behaviors everyday based on its owner’s actions. This makes the real pet more engaging in the long term than a virtual, or robotic, pet.

Another related psychological study was done using Furby (a realistic, interactive ‘‘animatronic’’ plush pet that interacts with the environment through sight, touch, hearing, and physical orientation). Turkle and Audley [30] studied a group of young children who owned a Furby. It was found that when the robotic animal broke, the children felt betrayed, taken in and fooled. It had revealed its nature as a machine and they felt embarrassed and angry. They were totally unwilling to invest that kind of emotional relationship in an object again. This showed that there is a fundamental difference in perception even in young children, when they know they are dealing with non-biological living pet companions.

Studies also found that robotic dogs such as AIBO could provide the elderly with some of the physiological, cognitive, and emotional benefits. However, it was shown that although there is a kind of psychology of connection, it was not the same as real companionship that grows between human and real pet animals.

Hence, it can be seen that if the interaction between the human and animal is replaced with an equivalent system with a human and virtual or robotic animal, there are definite disadvantages and differences in the emotional response and feeling of companionship. It is thus proposed that it is critical to develop a remote interactive system between humans and biological living animals to promote the human response of true companionship with the animal. Furthermore, this work is equally aimed at promoting positive feelings of enjoyment in the animal, which cannot be done if only virtual/robot animals are used.

CURRENT & FUTURE DEVELOPMENTS

It is clear from the patents reviewed above that currently the area of computer mediated remote touch communication for humans and animals is in its infancy. While there are inventions that attempt to provide some form of communication between humans and pets who are separated, the majority of them are based on voice and visual feedback. It is important for researchers and developers to realize that touch based interactions can play a very significant role in enhancing remote communication between humans and animals.

In the meantime, ideas can be obtained by looking at devices that are specifically designed for pets such as the patents for massage blanket for pets [20] and pet affection indicator [21]. This category seems to provide methods which can be expanded upon to develop a better touch reproduction mechanism on the animal.

Finally, we looked at patents which describe electronic pet devices. The strength of such devices lies in their interactivity and also the data storage and communication structure. Though not based on real pets, these systems usually have sophisticated artificial intelligence which mimics a real pet. Studies can be done to draw the relative strengths and weakness of such systems and be applied to the design of systems for touch interactions between humans and pets.

In the near future, we think that systems which are designed with the main purpose of allowing humans to send touch and animals to feel the touch will be developed. There is already a research project which aims to enable humans to send touch to poultry pet [31]. Also, methodologies developed for this field can be easily extended for remote touch based interaction between humans. It is envisioned that in the near future, we can pat our pets whenever we miss them.

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