Augmented collar for assistance dog

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Abstract
In this paper we present briefly our reflexion on how to communicate with a dog using embedded devices. We also present the prototype collar we made in order to improve the communication between an assistance dog and his disabled master.

Author Keywords
Dog, Canine Augmented technologies, Embedded

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction
The interaction between man and machine is widely studied and also how technology can strengthen the bond between people [3, 4]. Our team is interested how machines can improve the communication between an animal and a person especially with a dog. Indeed dogs are loyal companion of humans since 14000 years. Humans and dogs have evolved together [1]. Man have first trained dogs in order to help him in is task, hunting dog, shepherd dog. Relatively recently appeared a new type of working dog, the service dog. The first ones was trained after WWI for blind soldiers; they are the guide dogs that we know today. And more recently dogs are

trained for assisting person with reduced mobility. These dogs can help people in their daily life; they are also an extraordinary psychological support. The dog is also with the cat the most popular companion animals. He is considered as a member of the family or as a close friend. In this paper we present our works one how we can communicate with dog through high-tech equipment.

Related works

The development of technology for animals is just starting. Several products for localization begin to appear on the market. Paldanius et al. [8] conducted a study to understand the experiences and expectations of dog owners for communication technology. The studied shows that people are most interested in technologies to be sure of the well being of there dog when they are alone. Golbeck et al. [2] studied the possibility to communicate with our pets through video and sounds interaction. They found that it is quite possible to do it over distance but it's lack of physical interaction. Ribeiro et al. [9] proposed a method to detect the pose of USAR dogs. It uses two 1- axis accelerometer to find the poses of USAR dogs. There method detects the transition between the poses. Results on static activity are really encouraging. Miller et al. [7] in their work build a harness for a dog in order to control his movements. They create an Maximum Effort Controller algorithm to automatically guide the dog to waypoints using a tracking device. It works quite successfully for two way point but for more complex path the dog stop to listen because a lack of reward. Vernay et al. [10] have imagined scenario for assistance dog. Our team works with this type of dog and our work is based these scenarios. We studied the detection of the activity of a dog and we have done a preliminary experiment on how dog can respond to a audio device playing order with the voice of the master [6].

Context

Our team works in conjunction with the French association Handi'Chien. The Handi'Chien association has trained more than 1,000 dogs in 20 years and getting more and more requests each year. These dogs are trained from birth, and the training lasts two years. The first 18 months of their life, they spend it in a foster family where they socialize and learn basic commands. Then, for 6 months, they are trained in specialized centers where they learn fifty orders. At the end of their training, they are given for free to their new owner. Due to their lack of mobility, it be really interesting for them if they can communicate with their dogs if they are to far from them. For example if the dog is in playtime and he must come back or if the owner wants to give an order to the dog which are in an other room. In this situations the robotic system must be carried by the dog in order to communicate with him wherever he goes.

Communication with a dog

Communication is something that is done in both directions. First, the transmission of informations from the dog to the owner. The localisation of the dog is essential in remote communication. We think that knowing what the activity of the dog is also important, if we want to have a feedback on how the dog react to the given instructions. We develop an algorithm based on our previous work [5].

Then the transmission of informations from the dog to the owner. In order to send information to the dog, we thought of the 5 channels which are the five senses: view, hearing, smell, touch, taste. These were our first ideas on how to interact with a dog.

- Smell : lemongrass spray to inhibit a comportment.
- Hearing : vocal order or ultrasound to give directive.

- View : laser pointer to indicate.
- Touch : cuddle or vibration for reward.
- Taste : food for reward.

The order of importance of the senses in dogs is different from the order in humans. But hearing is our common second best sense and we both use it to communicate. The touch is also a strong channel when it come to bonding with a dog. So these are on these two senses we choose work at first in order to communicate with the dog.

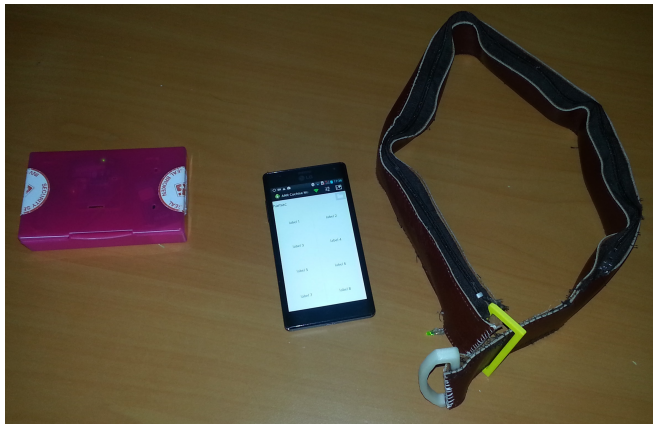

Figure 1: Collar with the bridge box and the smartphone

Augmented collar
After the interesting result of our preliminary work that shows that a dog can respond to order which are playback from their master[6]. We decide to build an augmented collar to interact with the assistance dogs. The future users of the equipments we develop are person with reduced mobility. After some discussions with the educators of Handi'Chien, which are in close relation with these people, we understand that the equipment must be simple to handle by a disabled person. Most of the time a harness is complicated to put on the dog. In the other hand a collar is much more simple and the dogs have even an order to put their head in the collar. So we decide to build a collar instead of a harness.

Our prototype uses radio frequency to communicate. It is controlled by a custom Android application run on a smartphone. The box on Figure 1 (bridge box) is here to convert the radio signal in a Bluetooth signal, which allow us to increase the range of communication between the smartphone and the collar. We have a reliable range of 50 meters and use our own light protocol for the communication. The prototype have the following features:

- A GPS for the localisation, displayed using a map on the smartphone.
- An Inertial measurement unit to detect the activity of the dog.
- Speakers to play audio orders which are recorded, embedded on the collar and triggered by the smartphone.
- Vibrating motors in order to add an haptic stimuli for some audio orders.

Experiments and Result

We are currently testing our prototype with four dogs at the Handi'Chien facilities, two Golden Retriever and two Labrador Retriever. These dogs just started the 6 month training at Handi'Chien after the 18 month in their foster families. We have recorded the voice of the educators pronouncing 8 orders and we stored them in the collar. The collar is tested during training session where the collar are put on the dog and the educator carried the bridge box and the smartphone. The educator give orders

to the dog only through the collar and didn't use their voice. During the sessions we have already done, the four dogs respond almost immediately to the submissive orders (sit and lay down). The orders where played at most 2 times the first time for the dog to respond, then the responds were immediate. These results are comparable to orders directly given by voice. For the others orders, longer training is needed.

Conclusion

In this paper we presented the prototype we built. The first results show that a dog can respond to a recorded order coming from his collar. In the future experiments we will show if it is possible to a dog to respond without the presence of the master and how to handle order where the source of the sound is important. Example the order "Come", the dog come to the source of the sound. We are also currently working on a system to cuddle remotely the dog in order to have a remote reward.

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