
Dog-Drone Interactions: Towards an ACI Perspective

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Abstract

As drones are quickly becoming part of our everyday lives, dogs become inevitably exposed to them. Moreover, dog-drone interactions have far-reaching applications in search and rescue operations and other domains. This short note calls for taking an ACI, user-centric perspective on dog-drone interaction, informing the design of interactions which are safe, stressless and enriching for our canine companions.

Author Keywords

ACI, animal-computer interaction, dog-robot interaction, dog-drone interaction

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

Introduction

There is an increasing interest in the technology associated with unmanned aerial vehicles (UAVs), also known as drones. In recent years drones are becoming increasingly present in our everyday environments. They are used for outdoor activities, such as film capture, agriculture, search and rescue, entertainment, and delivery.

1] expects that drones will become partly, if not fully, autonomous, and they will be able to support people in their everyday lives, which leads to the need to explore *natural human-drone interactions*, e.g., using hand gestures or voice commands. As drones have different characteristics than ground robots, there is a need to adapt existing natural interaction techniques from robot-human interaction to the context of drones.

If drones become part of our everyday lives, dogs - our traditional companions sharing their home with us, become inevitably exposed to them. This leads to an important question on how to make their interactions with drones safe.

Interactions of dogs with drones are not only inevitable, but also have a variety of applications, which bring about new forms of ACI, the full potential of which is yet to be explored. One prominent application of dog-drone interaction is search and rescue (SAR) operations, where the advantages of rescue dogs (e.g. the ability to sense survivors) can be combined with the advantages of drones (e.g., the ability to enter small places, the use of sensors and communication capabilities) in emergency response systems (see, e.g., [23]). Another example is the domain of agriculture: e.g., combining the abilities of drones to spot changes in tree color with the ability of dog to sense infected trees, recently helped save avocados from the deadly redbay ambrosia beetle [4].

So far the main focus of dog-drone interactions has been on achieving some mission empowering humans. In this position paper we call for a more dog-centric perspective on dog-drone interaction, and highlight some issues that need to be considered in this context.



Fig.1 : A dog interacting with drone

Previous work

The majority of works addressing dog-robot interaction focus on mainly on SAR scenarios [5].

Gergely et al. [6,7] were the first to present evidence of the importance of interactive behaviour of an artificial agent in evoking canine social responsiveness. A later study [7] showed that dogs can rapidly form expectations about an agent's behaviour and utilize this understanding in subsequent interactions. A direct connection to drones is pointed out in [7]: "in Search and Rescue operations, drones could be used to search

areas and interact with SAR dogs. To follow a drone (i.e., respond to its “commands”), the dog would have to consider the information conveyed by the drone as having importance. The current work has generated a better understanding of crucial features of agents that promote dog social behaviour, which will facilitate the programming of robots for various cooperative tasks.”

Disaster areas offer some of the trickiest types of terrain for anyone (robots or humans) to safely navigate. Search-and-rescue dogs trained to search for earthquake survivors are often employed in such situations [5]. While dogs excel in finding places where humans might be buried, they are often too large to get down into nooks and crannies. In a project at Carnegie Mellon University [2] a robot snake deployed by a dog was developed: whenever the dog starts to bark (e.g., upon smelling a human), the robot jumps out of the dog's chest-pack and starts exploring.

In recent years drones are increasingly employed in SAR operations. In a project involving several institutions, a Smart Emergency Response System (SERS) has been developed, using a combination of ground and aerial autonomous vehicles, drones, and trained search-and-rescue dogs equipped with real-time sensors [**Error! Reference source not found.**3]. SWARMIX is another project laying the foundations for the design, implementation, and adaptive control of heterogeneous multi-agent systems that are composed of humans, animals, and drones, working in cooperation to solve distributed tasks that require a wide diversity of sensory-motor and cognitive skills [8].

Dog-Drone Interaction - An ACI Perspective

Previous works address dog-drone interaction from the perspective of allowing a dog to use a drone to achieve a particular task (usually by following or deploying it). However, we can think of drones also as a new platform for learning about dog behavior and their perception of the world by designing natural and meaningful interactions. Drones can also be a part of *playful* interactions of animals, which have the potential to improve animal welfare at homes, zoos and beyond by providing cognitive enrichment and physical exercise, as creating stronger bonds between humans and non-human animals [10,11,12,13,14]. A game with a drone can stimulate physical activity, as well as provide cognitive enrichment for the dog.

The main goal of this position paper is to call for a more dog-centric perspective in dog-drone interactions, as advocated by the ACI discipline. As proposed by C. Mancini in the ACI manifesto [1616], “ACI aims to develop a user-centred approach, informed by the best available knowledge of animals’ needs and preferences, to the design of technology that is meant for animal use. It also appropriately regards humans and other species alike as legitimate stakeholders throughout all the phases of the development process”.

In the design of dog-drone interactions, informed by the needs of the dog the following issues need to be considered.

Safety: Interactions should be safe for the dog. Currently drones are mainly used in open spaces, maintaining a safe distance from humans. This leads to

the questions how can safety considerations be adapted to the canine user? What is the minimal distance a drone should maintain from a dog at all times? How can we ensure a drone does not accidentally hit the dog?

Stress reduction: Our preliminary analysis of a collection of YouTube videos of dogs interacting with drones mainly show a dog in distress, either frightened of the drone or aggressive towards it. The sources of stress are the nature of movements of a drone, which are unpredictable for a dog, as well as the sound the drone makes while flying. While these will be present in any interaction, experimenting with form and sound of the drone may lead to better understanding on how to minimize stress.

Interactiveness: The importance of interactive environment for keeping the animal engaged is discussed in [12]. Ethological studies [6,7] presented empirical evidence of the importance of interactive behaviour of an artificial agent in evoking canine responsiveness. For promoting interactiveness, drones which are responsive to the dog's body language can be explored. This direction is particularly timely given the recent advances in body posture recognition technologies. However, the most challenging issue is capturing and representing the tacit knowledge of dog experts which can recognize and interpret complex dog behavior elements.

SUMMARY

With the increasing use of drones in different domains, there is a need for better understanding how dogs can

interact with this technology. In this position paper we have stressed the need for an ACI perspective on designing dog-drone interactions and discussed some issues that arise in this context. It is our hope that this note will start a discourse on the nature of dog-drone interactions, and considerations that inform the design of such interactions so that they are safe, secure and beneficiary both for dogs and humans.

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