Lure the Drones: Falconry Inspired HDI

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ABSTRACT

The following paper proposes a concept regarding Human Drone Interaction (HDI) based on the traditional profession of falconry. For more then 2500 years humans already practice the interaction with flying agents for hunting and caretaking tasks. Based on the metaphor of the falconer we propose the following system which enables gaze control of drones utilizing a wearable eye-tracker. By taking the "looking at the watch"-pose, which is reminiscent of the "falconer luring its bird"-pose, the eye tracker gets implicitly positioned in front of the user's face. A combination of body posture and eye gaze allows for GUI-free interaction in the field and during physically demanding tasks.

CCS CONCEPTS

• **Human-centered computing → Interaction design**.

KEYWORDS

human drone interaction, falconry, interaction metaphor, eye gaze, smartwatch

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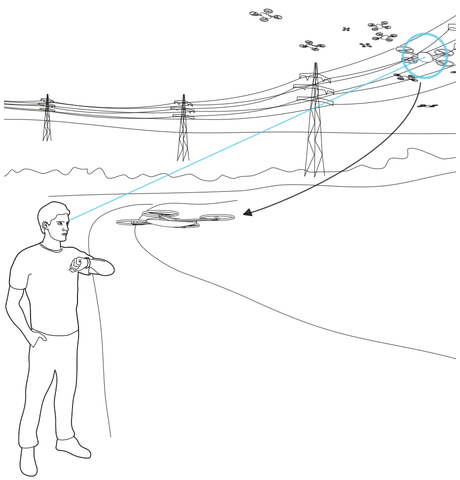

Figure 1: Interacting with individual units in a swarm of drones can be challenging. This paper proposes an interaction metaphor derived from falconry to provide GUI-free control over drones in the field.

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Figure 2: Trained birds have been an important element of hunting for many centuries. This craft originated from China and spread all over the world and various cultural contexts. In addition to the practical character of the bird, it also functions as a status symbol representing the power and influence of the owner. | Joseph Strutt "The sports and pastimes of the people of England from the earliest period" (1801). wikimedia.org

TIMELINE

680 BC: First records for falconry in China.
200-400 AC: Goths learned falconry.
500 AC: Roman mosaic pictures falconry.
700 AC: Falconry established in Arabia.
2010: Falconry accepted as Intangible Cultural Heritage of Humanity by the UNESCO.

INTRODUCTION

In the near future mobile agents or drones could be a substantial aspect of many jobs and everyday tasks. From supervising swarms performing maintaining tasks or coordinating agents in inaccessible territories or dangerous situations drones will broaden the capabilities of such professions and lead to safer and more effective work conditions. When looking back in time, one can see parallels to an ancient profession that also widened capabilities by taking advantage of mobile agents. Hunters and caretakers used trained birds to assist their tasks (see Figure 2). This craft is called falconry and is still used today for hunting purposes but also for keeping public spaces free of vermin and thus pollution or to frighten away swarms of birds from airports to prevent collisions with planes. In this paper the authors propose a HDI concept that builds upon this traditional way of interacting with mobile agents. Furthermore, scenarios are described in which such new interaction techniques could turn out to be beneficial compared to established GUIs.

RELATED WORK

Human Drone Interaction is an expanding field of research in the Human Computer Interaction (HCI) community. Many projects investigate intuitive ways of interacting with drones. Cauchard et al. [3] already explored natural interaction with drones based on gestures participants performed intuitively. Their findings show that a lot of persons automatically tend to interact with drones similarly as they would do with pets or humans using e.g. gestures for beckoning.

In addition, other research projects explored how to use gaze [5] as a potential input technique for the interaction with drones. Yu et al. [8] implemented a system that allows for direct remote control of a drone via gaze input. Gaze in this project was used to control the movement comparable to a remote control allowing for the manipulation of the absolute position (move: right, left, up, down) and not to send to specific locations (go to: desk, door, wall, ...). In contrast, Alapetite et al. [1] implemented a system that uses gaze to control a drone from 1st person perspective using point of regard on a screen that pictured the drone's live stream.

A comprehensive overview of the current state of HDI techniques such as gestures, gaze direction and speech is given by Peshkova et al. [7]. Also the combination of input techniques such as gestures and speech with GUIs was already explored by Fernández et al. [4] in the context of in indoor scenarios.

Falconry inspired interaction? [6]

INTERACTION METAPHOR

The falconer recalls its bird by using the lure and offering the bird its arm for landing. The lure is typically consisting of feathers as well as bird food and is used during the trainings-process to condition and later to trigger the bird by a motion pattern to return or signaling when to return to its

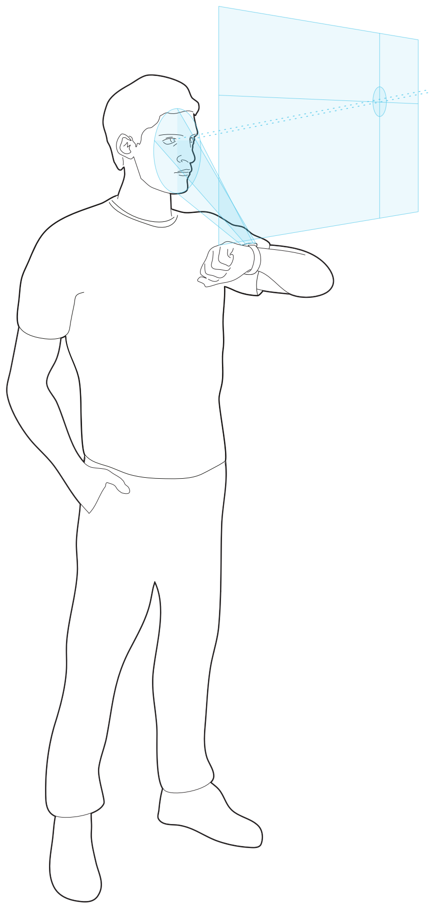

Figure 3: Via wearables, such as smartwatches, gaze direction is tracked and used to select single drones out of a swarm and lure it back to the operator. The position taken is reminiscent of a falconer luring one of its birds offering its arm for landing.

owner. Luring drones obviously does not need conditioning based on food rewards but nevertheless we can transfer the pose of offering the arm for landing as a sign for recalling the drone. In addition when interacting with multiple drones at once, the selection process of which drone to recall (by falconers typically done by using individual lures for each bird) could be achieved by looking directly at a specific drone. By the nature of the pose (see Figure 3) eye-tracking could be implemented with wearable devices such as smartwatches. Further, to allow the user to perform various gaze-based interactions with the drone, static hand poses can be used for task distinction. Such hand poses are differentiable by electrical impedance tomography as implemented by Zhang and Harrison [9] and are to be performed with smartwatches in the near future.

INTERACTION AND SCENARIOS

The following tasks can be performed with gaze combined with static hand poses (see Figure 4) and are based on or derived from the interaction metaphor:

- **Selecting from the Swarm**: Selecting a specific drone from a swarm to get further information on a handheld device. The drone will stay at its current position. Available options for operators include displaying status information on the mobile device or introducing further instructions for the drone. A gesture with the arm initializes a selection, see Figure 3.
- **Luring Home**: Selecting a specific drone from a swarm and recall it to the controller. The drone will leave its current position and return to the operator.
- **Sending to Position**: Selecting a specific drone from a swarm and sending it to a new position. The drone will leave its current position and head towards a new target.

The following three scenarios identify use cases where controlling drones with eye gaze could be beneficial. Some of the following scenarios could also benefit from combinations of gaze, postures and gestures:

- **Hands-free Interaction**: Activities as sport climbing but also industrial climbing often requires both hands of the user for handling equipment or securing. Thus, controlling a swarm of drones is not possible by touch-controlled GUIs displayed on hand-held devices such as tablets or phones. Interacting with the drones by visual contact keeps the hands free for other tasks.
- **Focus on Surrounding**: During tasks with a high security risk, such as firefighting or everyday tasks as driving, the user's visual focus should remain on its surrounding. GUIs can distract the user's attention for longer time spans than recommendable. Therefore, the possibility of controlling and commanding drones with gaze could be beneficial for keeping the surrounding in the user's peripheral field of view.
- **Hindered Orientation**: Drones already showed to be useful tools in the context of rescue missions [2]. But furthermore, catastrophes such as avalanches, floods or earthquakes can

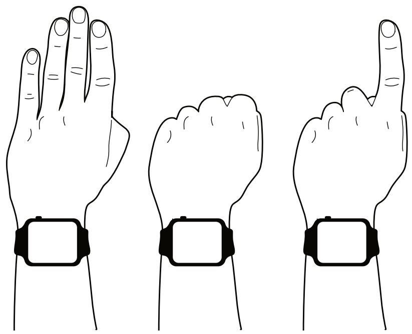

Figure 4: "Selecting from the Swarm" inspired by the "stay" hand signal performed with dogs, "Luring Home" inspired by falconry, "Sending to Position" inspired by typical pointing. (fLTR)

Figure 5: During catastrophes map material can differ drastically from the situation on site. Therefore, the assignment of drones indicated on GUIs with drones seen in the field may turn out to be difficult to almost impossible. Selecting drones with gaze could turn out to be beneficial in such situations.

cause map materials to become unrecognizable (see Figure 5). Missing landmarks, covered by water, snow or mud, as well as destructed reference points as prominent buildings hinder the orientation on GUI based systems. In such scenarios selecting, controlling and commanding drones by gaze direction can be useful as well as indispensable. A conceivable example would be the selection of a specific drone to watch its video stream on a portable monitor during rescue. This could be useful for searching for survivors of avalanches of floods in inaccessible areas.

CONCLUSION AND OUTLOOK

We propose to use gaze as modality for human-drone interaction. To that end, this work presents a novel interaction metaphor inspired by falconry. A wearable (e.g., smartwatch) detects and selects a drone corresponding to user's focus. An arm-gesture inspired by inviting a bird to land is therefore adopted from falconry. Furthermore, we suggest supporting luring, sending and selecting of drones via gaze control and optional hand gestures (fist, pointing and flat hand). Additionally, we motivate our interaction metaphor by listing three corresponding scenario settings which could benefit from implementing gaze controlled HDI (hands-free interactions, focusing on surroundings and scenarios with hindered orientation).

However, accuracy, selection speed and reliability are crucial aspects which need to be considered when implementing the concept. Since individual drones are moving constantly selecting a specific drone in a swarm requires a high level of accuracy. As of now, there is a lack of knowledge regarding appropriate specifications for selection speed and accuracy. Moreover, reliability, acceptance and comprehensibility should be investigated within future user studies. While we argue for a concept, a working prototype remains an open research challenge.

We state that our proposed approach could ease critical situations, e.g. industrial climbing, fire fighting or finding POIs in flooded areas. Besides, it could support sports e.g. climbing or everyday tasks such as driving. Hence, our concept might foster safety and comfort during safety-critical maneuvers as well as leisure time activities while applying a familiar interaction metaphor known from falconry.

REFERENCES

[1] Alexandre Alapetite, John Paulin Hansen, and I Scott MacKenzie. 2012. Demo of gaze controlled flying. In *Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design*. ACM, 773–774.

[2] Jonathan Cacace, Alberto Finzi, Vincenzo Lippiello, Michele Furci, Nicola Mimmo, and Lorenzo Marconi. 2016. A control architecture for multiple drones operated via multimodal interaction in search & rescue mission. In *Safety, Security, and Rescue Robotics (SSRR), 2016 IEEE International Symposium on*. IEEE, 233–239.

[3] Jessica R Cauchard, Kevin Y Zhai, James A Landay, et al. 2015. Drone & me: an exploration into natural human-drone interaction. In *Proceedings of the 2015 ACM international joint conference on pervasive and ubiquitous computing*. ACM, 361–365.

[4] Ramón A Suárez Fernández, Jose Luis Sanchez-Lopez, Carlos Sampedro, Hriday Bavle, Martin Molina, and Pascual Campoy. 2016. Natural user interfaces for human-drone multi-modal interaction. In *Unmanned Aircraft Systems (ICUAS), 2016 International Conference on*. IEEE, 1013–1022.

[5] John Paulin Hansen, Alexandre Alapetite, I Scott MacKenzie, and Emilie Møllenbach. 2014. The use of gaze to control drones. In *Proceedings of the Symposium on Eye Tracking Research and Applications*. ACM, 27–34.

[6] Wai Shan Ng and Ehud Sharlin. 2011. Collocated interaction with flying robots. In *2011 Ro-Man*. IEEE, 143–149.

[7] Ekaterina Peshkova, Martin Hitz, and Bonifaz Kaufmann. 2017. Natural interaction techniques for an unmanned aerial vehicle system. *IEEE Pervasive Computing* 1 (2017), 34–42.

[8] Mingxin Yu, Yingzi Lin, David Schmidt, Xiangzhou Wang, and Yu Wang. 2014. Human-robot interaction based on gaze gestures for the drone teleoperation. *Journal of Eye Movement Research* 7, 4 (2014), 1–14.

[9] Yang Zhang and Chris Harrison. 2015. Tomo: Wearable, low-cost electrical impedance tomography for hand gesture recognition. In *Proceedings of the 28th Annual ACM Symposium on User Interface Software & Technology*. ACM, 167–173.