
How Drones Can Support Backcountry Activities

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Abstract

Recent technology advances allow larger groups of people to reach more remote places. However, threats like sudden changes in weather, dangerous animals, or rough terrain are still present and sometimes underestimated. We propose autonomous personal drones, specifically quadcopters, as a supportive ubiquitous interface during backcountry activities. Due to their flexibility, quadcopters have the potential to support nature activities like hiking, cycling, or climbing. Drones can assist mountaineers during pathfinding and photo taking and protect them from threats. Changes of weather, dangerous animals, or calling for emergency support are all possible applications. We provide an overview of current technologies supporting outdoor activity and recent progress in human-drone interaction. Further, we describe our vision of drones as a personal outdoor assistant, including a perspective on future scenarios as well as a discussion of related challenges.

Author Keywords

Human-drone interaction; UAV; drone; quadcopter; sports; outdoor; backcountry; support; pathfinding; rescue.

ACM Classification Keywords

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



Figure 1: Pathfinding using a light cone emitted from a drone while a runner follows through a forest (Image source: [14]).

Introduction and Background

With the proliferation of the Global Positioning System (GPS) and fitness trackers, a number of smart devices made their way into the lives of those practicing outdoor sports e.g. hikers, trail runners, or cross-country cyclists. These devices are mostly body-worn or attached to the equipment e.g. bike and support the outdoor sports person with their activity. Early works on outdoor navigation for persons used tactile approaches, e.g. a tactile belt [6], or vibration motors in the handles of a bike [12]. Also, app-based approaches to support navigation for hikers [13] was used. We see potential to tackle these human-computer interaction (HCI) problems with a drone. However, when designing systems for outdoor activities, it is important to augment the surroundings not to obstruct the outdoor experience [20].

Therefore, with recent advances in unmanned aerial vehicle (UAV) technology, we are now observing more and more projects using drones, especially quadcopters, for a variety of scenarios. Recent research used quadcopters as a device-independent privacy interface [15] or to deliver ad-hoc tactile feedback [8]. Especially in outdoor sports, quadcopters were recently employed to support running [10, 14], provide auditory [1], or visual navigation aids [17]. Drones can, however, also just serve as a companion for not having to walk alone and illuminating the way back home [7]. Additionally, drones can also passively support outdoor activities by taking a third person or bird-eye pictures [16]. With their ability to fly freely, and with being able to carry technology for the users, we believe that drones will have a great potential in even further supporting outdoor sports activities. In this position paper, we describe our vision for drones supporting outdoor activities. We provide scenarios for using personal companion drones for outdoor activities and elaborate on challenges and opportunities for using this technology.

Scenarios

In the following, we will highlight seven scenarios we envision a personal outdoor assistant drone to be beneficial to support outdoor activities. Especially, we envision a high benefit for backcountry activities since a drone can support the persons in regions which are hard to access, remote, or undeveloped without additional infrastructure.

Pathfinding

A common challenge while hiking or similar activities in backcountry areas is navigation. Today this challenge is tackled with dedicated mobile GPS navigation systems with a display to show the own location on a digital map. Relating the data on a small display to the real world is challenging. Thus, we envision drones performing this task instead. Drones can provide navigation by hovering in the right direction, not far from the users. The drone could have a display or direction indicator light, as shown in Figure 1. However, the flight direction itself could also indicate the path to follow.

Photo and video taking

Adventurers take plenty of pictures or videos during their backcountry activities [20]. Fast development of action cameras increased the quality and enabled even more users to create high-quality footage. These cameras allow only certain viewing angles when attached to the user or their equipment. Camera-equipped drones with automated target tracking¹ enable new perspectives [18] and high-quality recordings. If further developed, backcountry activities could be fully automatically documented, thus enabling the adventurer to focus and enjoy the nature.

¹[dji.com/intelligent-flight-modes](https://www.dji.com/intelligent-flight-modes) (last accessed: 06-06-2017)



Figure 2: A picture of a hiker in a forest taken from a birds-eye perspective. This can be used in case of a rescue situation as well as for live sharing to friends and family.

Emergency rescue

Especially in backcountry areas, mobile network coverage may not be available at all times to call for help. A drone can fly to the next cell tower to register an emergency call and even send GPS coordinates of the accident as well as images (cf. Figure 2). Afterward, the drone can fly back to show the exact location of the accident to the rescue team.

Early warning system

National parks are a habitat for wild animals like bears, wolves, lions, or elephants. Watching these animals is fascinating, but it also represents a potential risk especially during times of the year when the animals are taking care of their offspring. A drone equipped with a video and a thermal camera could scan the environment and inform users about potential animals in the vicinity. Since thermal cameras work correctly without any ambient lighting, the drone can monitor the surroundings and notify adventurers while they are asleep.

Weather forecast

A reliable weather forecast is essential for safe backcountry activities. However, the reliability of weather forecasts is still an issue, particularly in mountainous areas. These areas are known for quick weather changes which can be a real threat. For hikers or ski mountaineers, it is hard or impossible to observe the weather while below the timberline or if there is a need to check behind a ridge. A camera-equipped drone could rise high up to the sky to gather current weather information by taking pictures of cloud coverage for a visual inspection. Users could then analyze the collected information, which would in turn support the risk management and decision-making processes.

Awareness to others in the area

Occasionally, it is important to indicate one's position while enjoying outdoor activities. Divers, for example, are using a

surface marker buoy to indicate their position to other boat traffic. A drone hovering or circling above the sports persons will also generate the same awareness for others in the area. The awareness due to the drone is beneficial to either not disturb others, to socialize, or avoid endangering others by triggering an avalanche above them. Finally, in an emergency situation, the drone could help make the first contact in a remote area.

Remote support

Friends and family directly involved in outdoor activities could participate remotely using drones. They can provide support during a trip as well while as experiencing the outdoor together, remotely (e.g. Figure 2). Past work has shown that outdoor activities shared over a distance can produce a sense of contagion and remote presence [21]. We envision that drones will help strengthen social ties through a communal experience of outdoor activities.

Challenges & Limitations

The presented scenarios comprise a number of challenges. First, we address the technical challenges and then tackle the social challenges.

Technical challenges

As a result of the proposed scenarios, quadcopters become ubiquitous in nature. Hence, the generated noise of each quadcopter should be minimal. The current noise emitted by quadcopters might distract animals, which are living in the backcountry. Developing quadcopters with low noise signatures is a future challenge and is necessary to higher the social acceptability in particular in nature. Current off-the-shelf quadcopters have a limited flight time due to weight and size limitations. When deploying quadcopters in real life scenarios, battery life needs to be increased for compelling usage. Alternative energy sources, wireless

charging stations, or intelligent battery replacement [5] could solve this problem. A lack of network coverage can be overcome using a quadcopter since it can autonomously ascend or fly to a place with a sufficient coverage and then call for help. On the other hand, any remote support also relies on network availability. Due to natural circumstances surrounding backcountry activities, natural obstacles are ubiquitously available. Although, Burri et al. [2] proposed methods for mapping, re-localization, and planning of autonomous UAVs navigation in unknown environments, the guidance, and pathfinding using drones in backcountry areas is still an open research challenge. In particular, more work is needed to reliably prevent collisions with trees or navigating in caves. Assuming that these challenges are tackled in the near future, UAVs can become a part of our outdoor activities if we also consider the social challenges that are accompanied by this.

Social challenges

The social challenges that need to be addressed in the area of human-drone interaction are mostly interaction design and social acceptability. Considering interaction design, related work already suggested using gestures and provided a few examples of intuitive gestures for everyday actions [3, 9, 11]. However, for using gestures, a clear line of sight between the UAV and the user must be available at all times. Another approach would be to outsource all interaction to an external device (e.g. a remote control), which has to be carried by the user. But, especially in outdoor activities, carrying additional devices is seen as problematic as they might affect the experience of the core activity. Considering the social acceptability of UAVs in backcountry areas, we see a risk of a polluted airspace and privacy concerns of passersby [19]. However, with UAVs getting smaller, they are also less visible to others which might tackle the perception of the airspace pollution. Considering

the privacy issues, we either need to create more awareness for the positive aspects of using drones or design designated geo-fenced drone areas [4].

Conclusion

Overall, we see great potential, but also a number of challenges for personal outdoor assistant drones supporting backcountry activities. These potentials and challenges are especially valid for backcountry activities, where there is no infrastructure or network coverage. In this paper, we provided an overview of how drones can support different outdoor activities. We state the importance of improving the experience for these scenarios and provide an account of the challenges that come along when using drones for outdoor activities. We consider this position paper as a summary of the state-of-the-art in this topic from a research perspective, which will provide an overview for other researchers and practitioners who are interested in using drones for outdoor activities.

Our goal in the future is to further extensively study the potential benefits and challenges through prototyping. Our major goal is to build a drone which functions as a personal outdoor assistant to study its social acceptability and the experience of exploring the outdoors with a drone.

Acknowledgements

This work is partly financially supported by the German Research Foundation (DFG) within Cluster of Excellence in Simulation Technology (EXC 310/2) at the University of Stuttgart and the German Federal Ministry of Education and Research as part of the project Be-greifen (Grant No. 16SV7527). Part of this research was supported by the European Union's Horizon 2020 Programme under ERCEA grant no. 683008 AMPLIFY.

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