Towards Supporting Remote Cheering during Running Races with Drone Technology

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Abstract
The increasing availability of drones produces a number of opportunities for integrating them in everyday settings and using drones to create engaging experiences for users. In this paper, we investigate how drones can support amateur runners in their endeavours. We explore the possible roles for drones during amateur running races. Through two field studies and multiple semi-structured interviews, we gain new insights on how drones could augment the experience of both runners and supporters during organised races. Finally, we contribute a set of future directions for integrating drones into the sports experience.

Author Keywords
Quadcopter; sports; cheering.

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

Introduction
Drones are becoming more and more accessible and the vision of autonomous drones appears to be getting closer to reality [7]. With the proliferation of drones, Human-Computer Interaction (HCI) faces the challenge of understating the implications of the increasing number of unmanned aircraft that users can see everyday. Furthermore, research should

investigate how drones can serve meaningful purposes that are aligned with the needs of the users [2]. For example, Avila et al. [1] proposed to use drones guide visual impaired people.

Another emerging technology is developing new systems to support physical activity which is a response to the society's increased understating of how regular training positively impacts health [10]. The HCI and sports domain has recently been receiving increased attention and there is an emerging need of understanding how technology can help augment the user experience of physical activity.

As a response to both those challenges, we propose to investigate how drones can be effectively used to support participation in organised running races. As competitions for amateurs change the urban landscape and involve more and more participants, technology can help making racing a more holistic experience. Training for an organised race involves weeks of preparation that affect private life and involve the people around the runner. Yet, on race day, friends and family can barely cheer for several seconds as the runner passes by on a busy running track. We believe technology can provide new opportunities for increasing supporter involvement on race day and make the entire experience of running[1] a more social endeavour.

Here, we focus on how supporters and runners can be more engaged in their activities supported by drones. We ask how drones can fit into the race day event and how they facilitate participation. Specifically, we explore how drones can enable remote communication for cheering, enhance the social runner-supporter bond and make participating in a running race a more enjoyable experience. Our inquiry addresses both those co-located and remote partners. For this purpose, we employed a number of field studies and interviews to explore the design space of remote cheering through drones. This paper contributes the following: (1) Insights from two field studies during which we deployed drones at externally organised races; (2) User accounts of interactions with drones during races gathered through semi-structured interviews; (3) a set of future directions for research in deploying drones during running races.

Related Work

Our work addresses designing for runners, which is a known topic in the field of HCI. However, most developments focused on training-day settings. Notably, Mueller et al. [12] explored the social aspects of running through an application that enabled running with a remote partner. De Oliveira et al. [5] conducted early work on how mobile applications can support training routines. Similarly, RunNav [9] explored how spontaneous directions can enhance the running experience. While these works certainly expand HCI's understanding of running as a design setting, they did not address the difference between training and races, which was postulated by Knaving et al. [6]. That distinction is core to our work.

Curmi et al. [3] address race-day technology by investigating the role of biometric data in providing real-time information about race status. The data was collected using a mobile device. The RUFUS system [13] proposed a remote cheering solution where users wore a watch-like device. Supporters could send signals that were communicated through light and vibration. Another proposed solution for remote cheering was augmenting the baton in relay races [4]. Our work is interestingly different from the aforementioned research as it investigates the possibility of remote cheering without any devices to be worn on the run-

[1] i.e. running that follows a regular schedule leading to an organised race.

Figure 1: Users communicating during co-located cheering in a race. The footage recorded using the drone enabled users to recall those moments and the role of cheering in race performance.

ner's body. We investigate a scenario where the cheering comes for the environments of the run — just as in traditional co-located cheering.

Drones have been previously investigated in the context of running. Mueller et al. [11] explored how a drone on a pre-programmed path can affect runners practising in a park. While this work inspires our inquiry, we are investigating a case where users can steer a drone and we focus on race-specific interactions.

Methodology

As the area of using drones during races is relatively unexplored, we decided to employ a number of exploratory studies to investigate users' attitudes towards drones and look for possible designs. Firstly, we conducted a field study during an obstacle course race to investigate if users would accept the presence of drones during a race. Secondly, we recruited a group of runners and supporters participating in a midnight half-marathon to explore attitudes towards cheering with the help of a drone. We then conducted extended semi-structured interviews with the participants to capture their experience of remote cheering and running a race accompanied by a drone.

Field Study One: Attitudes Towards Drones During Races

Our initial activity involved contacting a local race organiser in order to get permission to collect drone footage during a winter obstacle run race. Figure 2 shows the participants of the race traversing a snowy road. The race included two laps of running combined with multiple obstacles centred around a fitness centre located in a forest. This allowed for relatively low drone travelling distances while still covering much of the race area.

On site, we approached users who came to support the race participants and informed them that they could observe the race from the perspective of a drone. When the fans moved within the main race area, we accompanied them with the drone controls and a table displaying the live video feed from the drone. We then edited the captured footage and asked participants for feedback via email.

The field study enable us to explore all the practical considerations of flying a drone during the race and verify if the presence of the drone produced any adverse effects. After qualitatively analysing the video footage, we observed no negative reactions for the users. The spectators would often look at the drone and wave at it occasionally. Some of the runners looked directly at the drone and none of them expressed dissatisfaction at its presence. This suggests that a drone may be acceptable in a race setting and that it is unlikely to distress participants (it is worth noting that the drone was flown high enough for its noise to be hardly noticeable in the overall sounds of a race under way). When asked in impromptu interviews, the spectators described the drone as an 'interesting distraction' and a 'possibly useful toy'. This led us to believe that while drones are welcome during a race, additional design work was needed to build an engaging experience for those cheering.

It is also worth mentioning that participants appreciating the usefulness of a drone a tool for creating memories and telling stories. When reflecting on the recorded footage, participants recalled particular events from the race (e.g. what they felt when entering a pool of ice-cold water). They were also satisfied to see evidence of on-site cheering and support. Figure 1 shows how participants interacted during the race. One participant said:

> Oh, now I remember how seeing their faces encouraged me before entering that cold water.

Figure 2: Video footage obtained from a drone hovering over the main race area, showing participants in a winter obstacle course race running through the snow.

Field Study Two: Cheering Through a Drone

Our next activity was recruiting a group of runners and their supporters who were planning to participate in a cross-country half-marathon. We recruited 7 runners (aged $28-40$, $M=30$, $SD=4.71$) and 7 supporters (aged $18-37$, $M=29$, $SD=6.34$) by using the race organiser's webpage and Facebook fanpage. The participants were volunteers; the only remuneration anticipated was an official thanks letter and acknowledgement of study participation issued by the Lodz University of Technology.

During the course of the race, supporters were provided with access to the drone (DJI Phantom 3) at chosen points of the race route. Those location were chosen to maximise the view from the drone and the number of possible interactions with runners. The group gathered at the start of the race and once the runners started running, we transferred the supporters to a chosen location on the course of the race, where they could control the drone. A skilled drone pilot was available at all times and the participants took turns in controlling the drone. Additionally, researchers were posted at 'lookouts', observing the race in stages before the view range of the drone in order to warn the drone operator when the participating runners would enter the range of the drone. Runners were seen through the drone cameras several times, with each runner being spotted a minimum of 2 times. Figure 3 shows an example of in-race footage where the runner is accompanied by a drone.

Figure 3: A drone following a runner and transmitting the current race view to the runner's supporters.

Insights from Interviews

We conducted semi-structured interviews with two runners (R1 and R2) and two supporters (S1 and S2) in pairs (R and S). We asked about their overall experiences of the race, the level of engagement and reactions to the hovering drones. We endeavoured to ellicit feedback on how the interaction with the drone could be improved. One participant remarked that the drone made the race experience more exciting than expected:

> I expected this to be boring, like most of the running stuff. (S1)

They also felt that the drone helped communicate their presence during the race to the runner:

> For her, [my presence] was definitely important. It must have helped her gain energy. (S1)

Surprisingly, they noticed that the group of users sharing the drone for the purposes of cheering formed an impromptu cheering community:

> We cheered on the whole group, even the strangers. I appreciated the group and the opportunity to support other people who were not anonymous [any more]. (S2)

On the negative side, we found out that the darkness during the race did not augment the experience of supporters despite the extensive light feedback provided by the drone:

> I disliked the fact that it was dark.

Participants also suggested that they would like to follow the runner over extended periods of time:

> I'd like [the drone] to be more personal, with a longer battery life, hovering over here for the whole time. (S1)

Runners confirmed that they noticed the drone and tried to interact with it. They revealed that they agreed on communication strategies with the supporters before the race:

> When I first saw the drone, after a hill on km four, I though 'Oh, great, they're here.' We agreed I'd wave, so I waved. [...] A lot of people saw the drone. (R1)

Runners that did not participate in our study also saw the drone and some attempted to interact:

> When I waved, others would do the same thing. (R1)

Another runner reported that the drone made them think about those controlling it and viewing the video feed:

Figure 4: A possible future scenario where a drone provides visual projection feedback during a race.

> I wondered how many people were looking out for me and whether they we having fun.

Future Directions

Based on our preliminary studies, we propose four suggestions for future work that will help unleash the full potential of supporting remote cheering through interacting with drones.

Projection. Drones offer the potential for providing additional in-race data to runners through projection. Past designs have shown that visual attention during a race is an open design issue and providing additional data on body-worn devices can be a distraction [13]. Drones offer the opportunity to provide data in an ambient format. Figure 4 proposes a solution where a drone provides unobtrusive pace feedback during a race.

Communication. The feedback provided by our participants suggests that supporters see a need for increased means of two-way communication during races. Future systems

Figure 5: A possible scenario to deliver support to the runner is through a blinking torchlight signals projected by a drone.

should explore what kind of feedback drones could provide in order to strengthen the link between runners and supporters. Possible solutions include auditory feedback (recorded and live voice), projection, on-drone light or various objects carried by the drones (e.g. traditional cheering signs). Figure 5 shows one real-time in-race scenario where a drone uses a blinking torchlight to communicate support to runners directly on to the track. Further the runner could use a video transmission to reply e.g. with a gesture.

Personalisation. Both runners and supporters expressed that drones could strengthen the personal connection between the two parties. Future systems should explore how drones could be modified to be offer a more personalised experience. We believe that future developments will enable developing personal cheering drones with features unique to a given runner. Given that the number of drones during races is likely to increase, personalising drones could help users discern which drones represent their personal supporters.

Enhancing existing cheering tools. Another direction in effectively utilising drones for cheering is investigation how they can be used in unison with existing remote cheering methods. As a number of currently available mobile applications enable remote GPS tracking (e.g. Runkeeper [2]), future work should explore how drones can benefit from that data. Supporters could use positional data to effectively steer the drone to reach the runner at the most critical moments of the race. This could be especially useful given the current limitations in drone battery life. Furthermore, one could explore how drones can be and additional output channel for unobtrusive feedback and support existing devices such as wearables [13] or smart clothing [8].

Conclusions

In this paper, we presented our initial insights and preliminary studies into the engaging use of drone for remote and co-located cheering during organised running races. We conducted two field studies in which we observed attitudes towards drones during races. In the first study, we flew a drone during a winter obstacle course run and observed the reactions of runners and supporters. In our second study, we recruited a group of runners and supporters and offered them access to a drone during a race. This paper contains our qualitative observations form the video footage recorded by the drones and semi-structured interview we conducted after our second field study. Our work shows that users are positive towards drones and they find them intriguing, which potentially creates an engaging experience. Finally, we provide four possible directions for future work in drone-based cheering support.

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[2]http://runkeeper.com

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