In-Situ-DisplayDrone: Facilitating Co-located Interactive Experiences via A Flying Screen

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ABSTRACT
This demo paper describes a drone-based display that has a projector and a canvas mounted to one and the same drone. It is aimed for indoor in-situ deployments, enabling new forms of interactive entertainment and visual experiences in co-located settings. In addition the paper describes a large size flying display with a diameter of 3,5 meters for outdoor use. We discuss technical setups and early test deployments of the displays.

Author Keywords
Drones, projection, in-situ display; co-located experiences; flying display, DisplayDrone; Free-floating Dsiplay.

ACM Classification Keywords
H.5.m [**Information Interfaces and Presentation**]: Misc.

INTRODUCTION
Facilitating co-located interactive entertainment experiences through static public displays [3] have been researched for quite some time. Drone-based displays have started to emerge in recent years to make screens appear at any possible point in space. Scheible et al. presented the DisplayDrone [2], a projector-augmented drone that is able of projecting user-generated short messages on arbitrary surfaces and objects in the physical space. They argue that DisplayDrones have the potential of becoming a future enabler of new kinds of interesting social group interactions in the physical space, turning that space gradually into highly location and context specific interaction environments. Nozaki developed Flying Display [1], a novel movable public display system consisting of two drones. The authors of Midair-Displays [4] see large potential in drone-based free-floating pervasive displays, both indoors and outdoors. In contrast to statically deployed displays, drone-based displays allow information to be brought to the user anytime and anywhere. The contribution of this demo-paper is demonstrating a prototype of a drone which has both, a projector and a canvas mounted to one and the same drone (see Figure 1), to be used for indoor in-situ deployments, enabling new forms of interactive entertainment and visual experiences in co-located settings.

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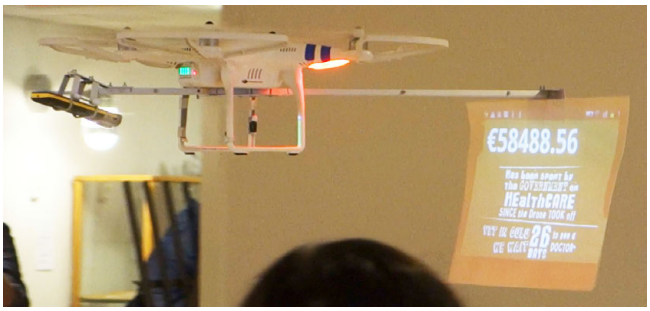

Figure 1. Drone-based flying display with a mounted canvas and mobilephone with a built-in minibeamer.

Besides that, the paper describes a drone-based display of large size with a diameter of 3,5 meters for outdoor use.

Figure 2. Drone-based flying display with a mounted canvas and mobilephone with a small built-in projector.

TECHNICAL SETUP
Prototype 1. Our prototype number one is made mainly for indoor use, however it can be used outdoors at night if weather conditions are good. We use a standard DJI 2 drone, a Samsung GALAXY Beam mobile phone with a 15 ANSI Lumen built-in projector. As a canvas we chose an A3 sized paper. Both, mobile phone and canvas are attached on the opposite ends of a 4 mm square-sized aluminum stick (see Figure 1). The stick is mounted at the bottom of the drone. In our first use case we built an app for projecting user-generated short messages as moving text onto the canvas, similar to the one described in [2]. For our second use case we built a dynamic info graphic app that

renders data received from a database in real-time. The flying time of this setup is around 6-8 minutes. While the drone is stably hovering, surprisingly it is still conveniently maneuverable. The contrast of the projection is sufficiently good for perceiving content in an indoor use case.

Figure 3. Drone serving as a flying display showing info graphics during an indoor exhibition.

Prototype 2. As a second prototype we present an outdoor scenario for presenting digital content in the sky at night. For this scenario, we are using two standard DJI Phantom 2 drones. One drone serves as holder of a 2mx3m canvas made of a mosquito net (see Figure 2), serving as a large flying canvas for projection. The canvas is attached to the drone via threads. The second drone carries a 300 ANSI Lumen projector for projecting content onto the flying canvas. Both need to hover in close vicinity and projecting in orthogonal direction (see Figure 4). Both drones are operated separately by a pilot.

Figure 4. A Drone is pulling up a 2mx3m canvas and a second drone is hovering close by. The second drone is holding the projector for displaying content on the canvas.

TEST DEPLOYMENTS

Our prototype number one was deployed in two occasions, a conference banquet setting with 200 persons and an exhibition opening with 30 persons (see Figure 3). At the banquet the drone was used as an ad-hoc interactive entertainment element between two dining courses. For this we used the user-generated short messages app. The drone was hovering in approx. 4m height above people along an aisle between rows of chairs. It was changing its flying direction frequently so that everyone was able to read the displayed content. Dinner participants were then able to sent messages to the drone and the co-located audience could read the shared display. Thus, the DisplayDrone system allowed multiple users to cast individually anonymous messages for a common outcome, which seemed to contribute towards a strong social experience as a group. Many of the conference participants knew each other, and were posting jokes and funny things about each other. The reactions of the audience during the flight underline the social interaction of the co-located groups: Nearly after every new message people laughed, clapped and shouted. This indicates, that people reacted positively and joyful to the in-situ DisplayDrone experience.

Our second prototype was deployed to test the flying behavior in an outdoor setting at night (see Figure 4). The interactive display content was generated via a remote app, which allowed users to make simple colorful drawings into the night sky. In order to fly safely, the weather conditions must be good. In case of wind the large 2mx3m canvas may move strongly and turn around, making the two drones hard to fly in sync.

CONCLUSION

In this demo paper, we presented In-Situ-DisplayDrone – a system providing a ubiquitous flying display that can provide spatially aligned in-situ content. We envision that our system can also be used outside an entertainment use case e.g. for navigation and providing contextual information. We believe that presenting this demo will foster discussion about pervasive displays at the conference.

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