Project No.	Project Title	
2021-01-110	Drone Search and Rescue: interaction with injured people	
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Abstract

In search and rescue operations, drones are used to locate injured or lost individuals. As drones become increasingly autonomous, they can be used to approach and communicate with victims. To do so, the drone needs to first establish a connection from a distance with the victim. It should then maintain non-verball communication throughout the initiation of the interaction.

In this work, we explore the use of expressive lights as visual feedback for the drone to convey its intentions to interact with a victim. These visual signals are designed to elicit four states of the drone, based on human-human communication, which are searching, spotting, approaching, and ready to interact. We built an arduino-based embedded system and assembled programmable lights (LEDs) adapted in two different shapes fitted on the drone. The first, a strip-shape made of 30 LEDs, and the second an eye-shape, made of two rings of 12 LEDs each. We then designed and implemented a total of 26 expressive light displays by controlling the color, brightness, and shape of the LEDs, which we tested in an online study (N=176).

Our results show that for each of the four states of the drone, some animations illustrate the state better than others. These findings suggest that expressive lights on a drone can convey different pieces of information to a passerby. Additionally, we sought the optimal animation for each state. We found 12 animations that met our criteria, 8 of which suitable for the searching state and the remaining four for spotting state. No animations met the requirements for approaching or ready to interact states. This implies that some of the drone's states appear easier to visually represent than others.

We conclude with guidelines for the design of light-based drone interfaces. With an emphasis on the stages of initiating an interaction with a person, we demonstrate how expressive lights can be used to visualize different states of interaction with an autonomous drone.

Keywords: Human-Drone Interaction, Non-verbal Communication, Search and Rescue, Expressive lights