Look, a guidance drone! Assessing the Social Acceptability of Companion Drones for Blind Travelers in Public Spaces

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ABSTRACT
Using assistance technology always comes with the challenge of social acceptability. While an accessibility device might have great implications for a person with disabilities, it might come with unpleasant social implications. In this paper, we want to assess the social implications of flying companion quadcopters for navigating persons with visual impairments. We conducted an acceptability study with 15 sighted and 5 visually impaired participants and report on the results.

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Human-Drone-Interaction; Visually Impaired Travelers; Guidance System; Drones

INTRODUCTION AND BACKGROUND
The development of assistive technologies represents a significant advantage in improving the quality of life for persons with disabilities. In the domain of assistive technology for persons with visual impairments, the technology evolved from walking canes or tags that are readable by touching to more sophisticated systems e.g. computerized screen readers. These systems have the potential to add or restore capabilities for persons who have lost their sight or who were blind from birth. Quadcopters were previously used to navigate persons with visual impairments while walking [2, 3] and running [1]. Further quadcopters were used to navigate sighted persons [4, 5, 6, 7, 11].

Although using quadcopters for navigating blind travelers lead to efficient navigation assistance, we also found that there are social implications when using this technology as a navigation aid that we did not explore so far. Related work has explored the social acceptability of assistive technology and new technology for some assistive technology already [8, 9, 10, 12]. Therefore, we want to add to this line of research by investigating the perception of the society of quadcopter-based navigation, and even more importantly, the self-perception of the users of these solutions facing social environments and daily life activities. Some assistive technologies offer meaningful improvements in efficiency for people who need them, however, some of these same solutions present a particular configuration, size, or deployment which can affect how the general public perceives the users of those technologies, moreover, the users might feel outcast or stigmatized when using a device which is supposed to improve their life quality. In this work we investigate the aspect of social acceptance of a person with visual impairment using a flying quadcopter as a navigation aid in a public environment. Therefore, we conducted a field study in different urban locations in Panama City, Republic of Panama.

ASSESSING SOCIAL ACCEPTABILITY: SIGHTED PASSERSBY
In order to assess the social acceptability of companion quadcopters for persons with visual impairments, we conducted a study in a public area in Panama city, Republic of Panama. As a study procedure, we had one of the authors of this paper using the leashed quadcopter navigation as it was introduced by Avila et al. [3]. We chose three different public areas for conducting our study: a food court in a mall, an outdoor urban park, and a college building. The field study consisted of the person with visual impairment who was using the quadcopter navigation, a sighted collaborator, who was operating the quadcopter and a third experimenter, who detected people in the location who showed interest in the person navigated by a leashed quadcopter. The walk of the experimenter with visual impairment took approximately ten minutes. Once the collaborator with visual impairment finished his walk, the other two experimenters approached the random passersby who were looking at the navigation aid. The persons that we interviewed were 15 persons (8 females and 7 males). They were 19 to 41 years old ($M = 27.5$, $SD = 6.3$). The experimental concept of a flying device to navigate users with visual impairment was explained to the subjects and they were invited individually to give a semi-structured interview. The interviews were conducted by the sighted experiment assistants. We did not include the author with visual impairments in the conduction of the interview to avoid opinion bias related to a experimenter with visual impairment.

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Results

After reading the transcriptions, we defined a set of seven concrete trends in the data set: 1. If it helps I agree with people using it. 2. It must dodge passersby and obstacles. 3. A flying device might catch passersby by surprise. 4. Maybe we need a non-flying alternative. 5. Is this legal in public spaces? 6. It's great to support persons with visual impairments with this. 7. Is it better than a dog or a cane? We performed a thematic analysis based on the transcripts of the interviews.

Acceptance based on helpfulness: Participants demonstrated to be concerned about the safety of the general public and the users with visual impairments. They commented about the possibility that the quadcopter might hit passersby or fly on private properties. The participants also highlighted the importance to offer assistance to the population with visual impairments, however the concrete acceptance of a guidance quadcopter is dependent on the correct functioning of the navigation system. Further, participants link the level of acceptance to the level of suitable assistance that the device would be able to give to the users with visual impairments. The level of acceptance includes the risk of possible failures in the system and their consequences.

Information decreases surprise and increases acceptance: Most of the participants commented about the surprise which the use of a quadcopter to navigate persons with visual impairments presents. They added that if the public is well informed about the purpose, functioning, and benefits of the navigation quadcopter, the surprise factor will be reduced and a higher level of acceptance can be encouraged in the public.

Perception of people with visual impairments and their assistive elements must be supportive: This theme was mentioned by all the participants. Participants were concerned about the possibility that public perception might block somehow the development of assistive technologies. Some of the participants commented on their preference for a non-flying device instead of the flying quadcopter. But even the persons disliking the idea of a flying companion, agree that public perception and social acceptance should not be a reason tho stop the development of assistive technologies.

Themes like *legal implications related to fly a quadcopter in public spaces*, *improvements to the prototype* or *the inconvenience of a flying device* were defined by the participants, but with a lesser emphasis than the three main themes already described.

ASSESSING SOCIAL ACCEPTABILITY: VISUALLY IMPAIRED PERSONS

Further, we asked five persons with visual impairments, 2 females and 3 males with an age range from 23 to 30 years old ($M = 27$, $SD = 3.1$) to use the prototype for a short walk. To get participants, we visited two different organizations dedicated to support people with visual impairments in several activities. In those places we approached to some of the users of those facilities, all people with visual impairments. We explained to them the experimental concept of a flying device to navigate users with visual impairment. We introduced the five participants to the prototype and its functionality, later these participants were invited to take a short 10 minutes walk being navigated by the quadcopter. After the walk, we asked the participants to also take part in a semi-structured interview.

Results

In this study we got the feedback of five subjects with visual impairment who commented about elements of self-perception, standing out from the crowd and balance between other people's perception and benefits of an assistive technology which might looks strange. We conducted a content analysis based on the prevalence of concrete ideas mentioned by the participants.

The most shown concept in the data set is *"I care a lot about usefulness"*. This is supported with sentences like *"No matter if the gadget looks weird, if it shows me the way I will use it"*, *"My cane already makes me stand out, a bit more of notoriety will not kill me"* or *"I will use the option which works better for me, doesn't matter if can be unusual, we are blind people, we already are unusual."* These kind of ideas were predominant through all the semi-structured interviews.

In contrast, the second most shown concept was *I am concern about looking weird*. This idea was supported by sentences like *"I would use the quadcopter, but I would not take it to a date or to a job interview"*, *"It's tricky to carry something that makes people to get curious, it might be beneficial or harmful* or *"Using this stuff I'll be more than notorious everywhere and I am not sure if I am ready for that."* All the participants mentioned that they prefer to have at least one hand free, they used statements like *"I like the device, but it might be difficult if I should carry it in one hand and my cane in the oter, Might be possible to attach the drone to my cane?"* also *"I need one of my hands free to open doors, say hello or carry my drink, both hands busy are not so much recommendable."* or *"I would like it more if the drone can be attached to my cane because I prefer to have one hand free."*

The general prevalence defines a genuine concern about the personal image and public perception, nevertheless, the necessity of functional and useful solutions presents more weight in the mindset of our participants.

CONCLUSION

In this work we aimed to gauge the perception of general public and people with visual impairments related to the use of the navigation assistance based on a leashed quadcopter. We collected opinions from 15 sighted persons and five visually impaired persons. We conclude that a quadcopter navigation comes with benefits but also social acceptability challenges. Overall, the general public should be well informed about the solution's usefulness and helpfulness. This will set a foundation for an adequate social acceptance for the target group and the people who will coexist with them.

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