Acoustic object identification signals in Electronic Travel Aids (ETAs) for blind and visually impaired people

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Within the thesis a framework of an acoustic system that requires a low cognitive impact with good communication between products and user in the field of ETA was designed.

The most common aid in locomotion for visually impaired people are the cane and the guide dog. On one hand, they are simple and relatively easy to use, but on the other hand, they show limitations in application. Since the last decades, technology in the field of electronic travel aids (ETA) has started to develop and improve constantly. Often ETAs are problematic because of high cost, usability, performance, complexity, and the cause of the cognitive overload.

One of the companies researching in this field is Tec-Innovation GmbH. Their vision is to develop a smart shoe to ease visually impaired people's locomotion, to serve them a safer and more enjoyable journey. The InnoMake II(Tec-Innovation 2020) with its built-in deep learning face includes the feature of object and path recognition. The thesis cooperating with Tec-Innovation investigates potential approaches to acoustic information transmission, being used to support the locomotion of blind and visually impaired people, with regard to creating substantial communication between product and user, to reduce the risk of cognitive overload resulting in a higher acceptance of the users. As the system was designed to serve the means of blind and visually impaired people the thesis was made in cooperation with 5 potential users. In the beginning, research was made about the general acceptance of existing products on the market. Next, an interview was investigated about the locomotion, safety, challenges, and orientation of the target in public space, followed by an ethnography to find out what information is required. Thanks to that, potential hazards that can cause injury (Objects in different heights (head, hip, and floor, e.g. causing stumbling), dynamic objects (bikers, pedestrians, e-scooters) and guidance (left-right, e.g. used at crossings) and objects of interest (Bin, Drinking fountain, Seating arrangements, Information points, etc.) where defined. Based on this information a system is developed, divided into active and passive signals. Where active signals influence the walking behavior (Abnormal and emergency: hazards that can cause injury and guidance) and passive signals (Notice: objects of interest) are used to provide the user with more specific information about the surrounding.

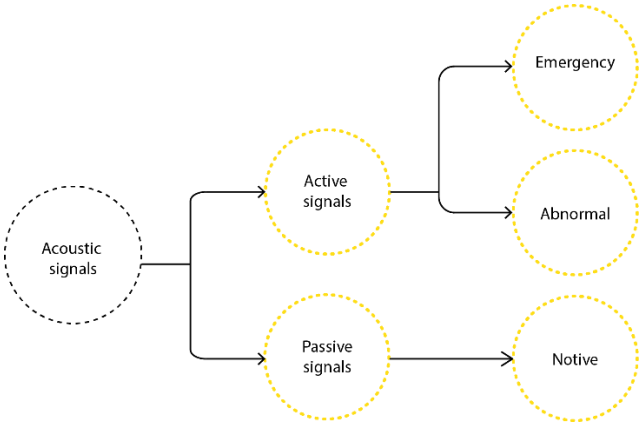

Figure 1 Setup of the acoustic system

This categorization does not only serves the purpose to further develop the system and signals when needed, but it should also help to define the signals of the final system.

The communication between the system and the user takes place via earcons and auditory icons. When applied correctly the learning phase of the system should remain short and the signals should not interfere with the everyday soundscapes. Based on the modes of listening (Worrel 2019) and the perceptual gestalt principles of sonification (Worrall 2019) the signals can be designed in a way that the attention required differs. This means that active signals will raise attention that the user can react in time, where passive signals can be designed in a way that they “blend in” to everyday soundscapes. Thanks to that, the passive signals will notify the user subconsciously about the surrounding where objects of interest will be identified more easily when needed since the user can scan the surrounding for the required signal when desired. Another crucial finding within the thesis was that not only the degree of the disease but also the situation has a crucial influence on the signals needed in a particular situation. Therefore different example Modi had to be developed that should serve the users’ needs in certain situations providing the user with the option to create manual modes based on their needs.

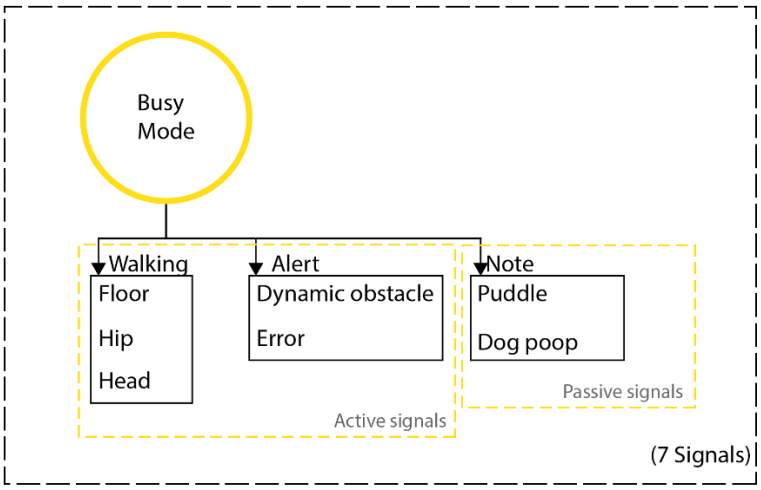

Figure 2 Example setup of a draft mode

After the framework of the acoustic system was fully defined, the individual acoustic signals got tested. The testing delivered promising results and showed whether the signals are appealing, intuitive, etc., here it is suggested to further develop each signal that they become more intuitive and clear to the user. To make clear conclusions about the success and the cognitive influence of the system on the user, further testing is required. The testing phase of the final system should include testing the system in combination with the product and long term testing to define missing signals and conflicts within the system.

References:

Worrall d. ,2019f; Sonification Design, From Data to Intelligible; Page 122-123, Table 4.4

Worrall d. ,2019g; Sonification Design, From Data to Intelligible Soundfields;; Page 121, Table 4.3

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