ETA Wizard App: Make Design and Evaluation of Accessible Electronic Travel Aids Easy

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Abstract. To support designers and researchers a touch-screen based Wizard-of-Oz application is demonstrated. It can be used to develop electronic travel aids for blind and visually impaired people and allows evaluating audio and haptic user interfaces in an early development stage. A scenario for presentation of obstacles combines sonification and feedback from vibration of a tactile belt.
Keywords: Electronic travel aids, user-centered design, auditory and haptic user interface, Wizard of Oz.

1 Introduction

More and more innovative electronic travel aids (ETAs) are proposed in order to overcome the disadvantages of traditional assistive mobility tools, like white canes and guide dogs. Both the larger and the narrower context are important to improve mobility. For example, users cannot use the white cane to detect obstacles above knee level, specifically for dangerous obstacles at head level (Manduchi and Kurniawan, 2011). Besides numerous technologies studied for capturing contextual information, the design of multimodal output is crucial in order not to overload users in everyday scenarios.

Aiming at presenting spatial information about obstacles and hazards in an accessible way, ETAs employ auditory output, haptic/tactile output or a combination of them (Meijer, 1992; Dakopoulos and Bourbakis, 2009; Zeng et al., 2012). However, for the developers it is challenging to acquire users' feedback on their user interface design in an early stage of an ETA development (i.e., before the obstacle detector module is available), specifically when a user-centered design method is employed for designing an accessible user interface.

In this paper, we demonstrate a touch-screen based Wizard of Oz (WoZ) app (namely ETA Wizard App) for helping researchers and designers to evaluate their ETA's user interface design in an early development stage. In addition to setting up test environments (e.g., room size and distribution of obstacles) and importing virtual

and real obstacles, the ETA Wizard App offers an auditory and haptic interface which allows researchers and designers to implement their own design easily.

2 ETA Wizard App

When the user-centered design approach is adopted for designing and developing an ETA, in addition to collect user requirements at the beginning, it is important to acquire user feedback about the prototypes at an early stage. As illustrated in Figure 1, the proposed ETA Wizard App supports developers and researchers to design two parts of an interactive demonstration:

- **WoZ Test Preparation**: the module helps researchers quickly setting up a test environment, consisting of obstacles and their spatial distribution. It supports augmenting the scene by adding real or virtual obstacles.
- **WoZ Field Test**: the module can simulate localizing the user by tapping and trigger actions from gestural input to perform researchers' user interface designs and deploy them in a WoZ field test easily.

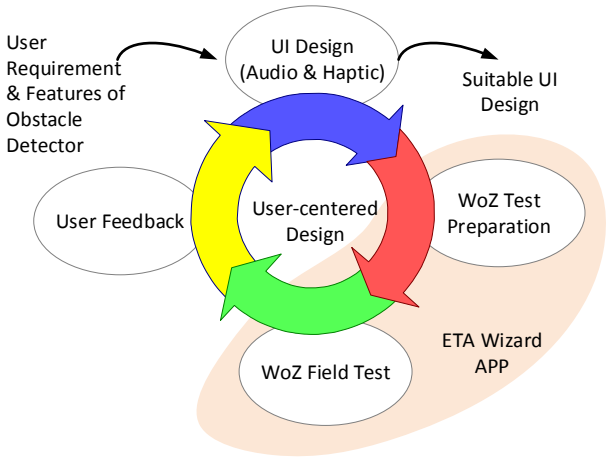

Figure 1. EAT Wizard App in the life circle of a user-centered design

In the two modules, several features have been implemented:

1. **WoZ Test Preparation Module**
   (a). *Test Room Setting*: Set the test room size, including the size of visual grid which is helpful to update subjects' position quickly and easily.
   (b). *Real & Virtual Obstacle Setting*: In addition to specify different types of obstacles (e.g., doors and grounded obstacles), the feature allows to add virtual obstacles which might be dangerous in a real world, like drop-offs and descending

stairs, and add special obstacles at fixed sites, such as a real hanging paper board.

2. WoZ Field Test Module

(c). *Update Subject's Position & Heading Orientation*: Touch-based interaction allows to update subject's position and heading orientation, see Figure 2.

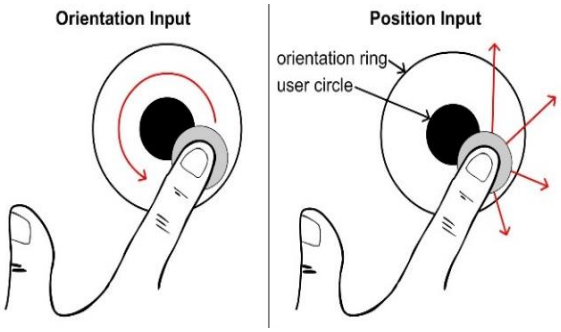

Figure 2. The touch interaction to simulate subject's position and heading orientation

(d). *Support Auditory User Interfaces*: Regarding to the auditory output, in addition to playback basic sounds (e.g., WAV files) the ETA Wizard App also support playing spatial sounds, via the Open Audio Library (OpenAL)[1]. It is possible to extend by adding other auditory library, like Libpd[2].

(e). *Support Haptic User Interface:* Obstacles' spatial information is presented also by haptic (vibrotactile) output. In this App, a tactile belt with 8 vibrators[3] is supported, which is connected to the host tablet via a Bluetooth interface (see Figure 3). It can be extended to support other haptic/tactile devices.

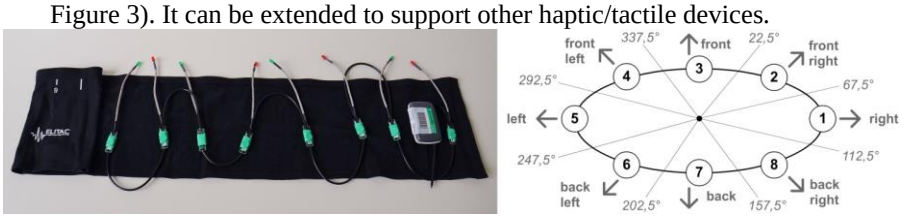

Figure 3. The tactile belt with 8 vibrators (the interval angel of each vibrator is 45°)

(f). *Experiment Log Data*: The main experimental data will be recorded in detail, including subject's position and heading orientation, and a time stamp.

Figure 4 illustrates a screenshot of the ETA Wizard App. A red point indicates the subjects' position, and a black line leaving this point indicates the subject's heading

[1] OpenAL Soft: http://kcat.strangesoft.net/openal.html
[2] Libpd: http://puredata.info/downloads/libpd
[3] Elitac Science Suit: http://elitac.nl/products/sciencesuit.html

orientation. Figure 5 shows a typical scenario where a wizard evaluates audio/haptic user interfaces in a real test environment, via the ETA Wizard App.

Figure 4. The screenshot of the ETA Wizard App on a tablet

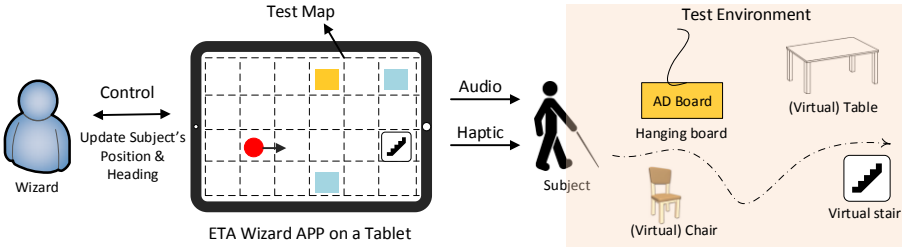

Figure 5. A typical scenario about the ETA Wizard App for a WoZ field test

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