Multimodal Virtual Environment Subserving the Design of Electronic Orientation Aids for the Blind

Slim Kammoun
IRIT, CNRS & Univ. of Toulouse
slim.kammoun@irit.fr

Marc J-M Macé
IRIT, CNRS & Univ. of Toulouse
marc.mace@irit.fr

Christophe Jouffrais
IRIT, CNRS & Univ. of Toulouse
christophe.jouffrais@irit.fr

(a) (b) (c)

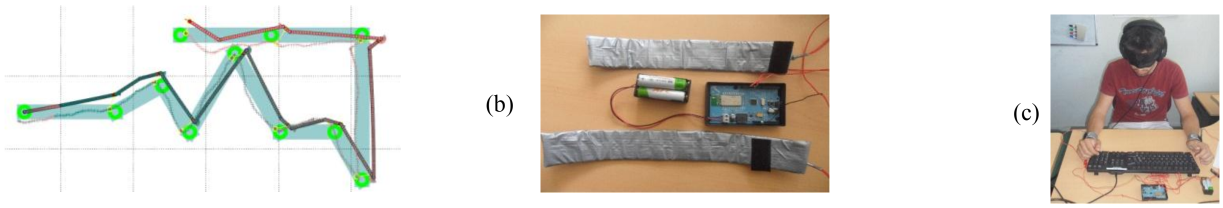

Figure 1: (a) Representation of a recorded trajectory, (b) The BT Arduino board and bracelets, (c) A blindfolded subject during a test session

Categories and Subject Descriptors

H.5.1 [**Information Interfaces and Presentation**] Multimedia Information Systems – *Artificial, augmented, and virtual realities, Evaluation/methodology.*

General Terms

Experimentation, Human Factors

Keywords

Virtual environment, Multimodal interaction, Blind, Guidance.

1. INTRODUCTION & MOTIVATION

In the last few decades, a growing number of Electronic Orientation Aids (EOA) has been developed with the purpose of improving the autonomy of visually impaired people. However, the majority of those systems are not used by the blind due to limited usability. The main challenges to be addressed are about interaction and guidance. To address these issues, we designed a multimodal (input and output) Virtual Environment (VE) that simulates different interactions that could be used for space perception and guidance in an EOA. This platform subserves two goals: help designers to systematically test guidance strategies (i.e. for the development of new EOAs) and train blind people to use interactive EOAs, with an emphasis on cognitive mapping enhancement. In a multimodal VE, both objectives are assessed in a controlled, cost-effective, safe and flexible environment.

2. OVERVIEW OF THE SIMULATOR

The platform presents two distinct modes: a *Control* mode and an *Exploration* mode. The *Control* mode is used by designers, researchers, and O&M instructors. This mode allows designers to create and modify VEs. A key feature of the Control mode is the ability to import an XML file from Open Street Map to create a new 3D virtual map and to manually or automatically select a path between two points. This makes it easy to import maps of different places. The Control mode also includes a feedback editor to assign arbitrary tactile & auditory feedbacks to any event in the VE. The *Evaluation* mode allows researchers and O&M instructors to record and replay the events and user's behavior.

During a session, the system logs in a text file all the information concerning the interaction (keystrokes, joystick, audio, haptic stimuli), as well as the avatar position, orientation and speed. In a real environment, a blind pedestrian who intends to move along a straight path typically deviates about 10% to the right or to the left. An adjustable drift has been added to the avatar's displacement to simulate this behavior. EOAs usually rely on GNSS positioning. An adjustable error was also added to the location of the avatar in the VE to account for positioning inaccuracy. The visual output of the VE (for the experimenter only) displays different textures applied to the surfaces (building, etc.) or the objects (e.g. tar texture for roads) encountered in the VE. Fig 1a shows a representation of a recorded journey. The platform was implemented in C++ and the rendering was performed with OGRE 3D engine.

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3. GUIDANCE AND FEEDBACK EDITOR

In EOAs, guidance consists in rendering instructions and descriptions that help the user to understand the environment and reach a desired destination. Several strategies can be adapted depending on two main factors: 1/ it is easier to guide the user when the global positioning accuracy is good; 2/ the verbosity can be adapted to the task and the user. It is easy to systematically modify these factors in the VE to evaluate different strategies.

The interaction between the user and the VE is managed through a feedback editor. Single/combined auditory and somatosensory feedbacks (a BT Arduino board and bracelets, see Fig 1b, c) were triggered depending on the actions performed by the avatar (e.g. a footstep sound related to the walking surface and speed, etc.). The guidance instructions were triggered according to the desired strategy. For instance a virtual 3D sound may be positioned on the next point to reach, and TTS or spatialized TTS may be used to describe points of interests, etc.

4. CONCLUSION & PERSPECTIVE

In this paper, we proposed an experimental platform to subserve the design of EOAs for the Blind. Such platform is not absolutely realistic but allows the systematic evaluation and benchmark of several guidance strategies in a controlled, cost-effective, safe and flexible manner. A first evaluation has been conducted for the NAVIG system [1].

5. REFERENCES

[1] Katz, B.F.G., Kammoun, S. Parseihian, G., Gutierrez, O., Brilhault, A., Auvray, M., Truillet, P., Denis, M., Thorpe, S., Jouffrais, C . Augmented reality guidance system for the visually impaired: Combining object localization, GNSS, and spatial audio. Virtual Reality, in press, DOI:10.1007/s10055-012-0213-6, 2012.