Flexible and virtual travel training environments

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ABSTRACT

This paper describes the development and evaluation of a virtual travel-training environment for use by people with a learning disability in developing employment related skills. This environment has been designed to work in conjunction with a mobile agent to provide a comprehensive system to prepare and provide real time assistance to people with a learning disability. The evaluation of the virtual travel training environment via a series of case studies has allowed us to advance the development of previously published design guidelines for virtual environments for use by this user group. The next stage of this study is to obtain baseline assessment of the use of these environments before the design and implementation of a range of virtual tutoring agents. Subsequent evaluation of the enhanced environments will allow us to determine the efficacy of such tutoring agents.

1. INTRODUCTION

This is not the first virtual reality based travel-training environment to be developed. VIRTRAN was developed for a Supported Employment Scheme in the United States (Brown, 1997). This has been followed by a virtual learning environment developed within the Virtual City, to teach independent living skills to people with a learning disability (Brown, 1999), together with a number of other initiatives in the provision of independent travel support for people with a disability (Risser, 1993).

The Virtual Transport System within the Virtual City was designed as a way of physically linking the other three Virtual Learning Environments (VLEs) including the Virtual Café, House and Supermarket. Thus, the tester could take the bus from the house to the supermarket, or to the café, and so on. The bus route was not modelled on any actual location but the buses themselves were made to resemble Nottingham City buses. A snapshot from this virtual travel-training environment is shown in Figure 1.

Figure 1. *The virtual travel training component of the Virtual City.*

More recently a travel training package has been developed to train people with learning disabilities to use public transport to access employment in connection with the Mencap organised Enter2000 conference held at the Millennium Dome, London (Lewis et al, 2000). To achieve this aim a user group of people with learning disabilities was formed in South East London, the area from which the Mencap Employees were drawn. A snapshot of this virtual travel-training environment is shown in figure 2. This group were supported

by mentors and a facilitator, in line with the development of other adaptive learning environments for the disabled (Kurhila, 1998).

Figure 2. *The virtual travel training environment to the Millennium Dome (from Presence).*

One important feature of studies to investigate the efficacy of these and other related virtual training environments is evidence demonstrating that experience gained in using them can transfer to real world competencies, and that people with a learning disability are motivated to use them and can gain confidence in doing so (Standen et al 1998, Brooks et al 2002, Rose et al 2002).

The evaluation results from the Virtual City and Millennium Dome studies has led to the further application of this technology to the travel-training of people with learning disabilities. Systematic evaluation has also led to the distillation of design guidelines for the development of virtual training environments aimed specifically at this target group. These design guidelines feed the continual refinement of the user-sensitive design methodology employed in this project.

2. AIMS OF PROJECT

The current project recognises that travel training is an integral part of pre-employment training, but is lengthy and highly labour intensive. New electronic communication systems provide an opportunity to develop a much more cost-effective solution to helping people to travel to work independently. Two different, but integrated approaches to the use of such electronic systems are being developed and tested. The first involves the development of a virtual travel training environment; the second the use of handheld, portable computerised communication aids.

It is intended that the virtual travel-training component will be as constructivist in nature as possible. Many virtual training environments developed so far for use by people with learning disabilities have resorted to embedding a large number of procedural activities. Whilst breaking down important life skills activities into set sequences is important for a group of people who are frequently termed concrete thinkers, adherence to these principles can produce virtual learning environments which are over 'linearized'. Repetitive use of these training resources can result in disaffected learners. The aim of the current programme is to produce virtual training environments with global traffic variables, such as differing road layouts, traffic densities, and variable road crossing positions, so that each training session provides a truly new learning situation. In this way trainees will construct travel-training skills in collaboration with their mentors.

3. METHODOLOGY

The user-sensitive development and evaluation methodology used to ensure user participation in all stages of this project draws heavily from one used extensively in other, related projects (Brown, 2002). It is similar in

nature to the generic 'spiral' method used extensively in software engineering. The general steps are as follows:

1. Form Project User Group: Users from Sutton with learning disabilities will input their ideas on the design of the travel training package working together with a facilitator.
2. Storyboarding: The design ideas of the User Group will be converted to storyboards to guide the development of the travel training package. These draw heavily upon existing design guidelines (Brown, 2000).
3. Implementation: The storyboards will be converted into a Virtual Travel Training Package, using Macromedia Director 8.5 to create the virtual environment and 3D Studio Max to create the models.
4. Evaluation: The Virtual Travel training Package will be assessed by members of the Sutton User Group to evaluate programme usability and efficacy of embedded virtual tutoring agents.
5. Refinement: The results from the evaluation process will be used to refine the Virtual Travel Training Package to ensure that it will be fit for purpose. Further design guidelines may evolve.

4. IMPLEMENTATION

The Sutton travel-training package has been designed to assist people with learning disabilities to learn independent travel skills. These competencies can enhance their opportunities to access training or employment opportunities to promote their social inclusion. Figure 3 shows this training package's starting interface, facilitating constructivist learning. The learning objectives have been identified by the project User and Steering Groups as below:

- Crossing the roads safely
- Personal safety issues
- Route finding to various destinations.

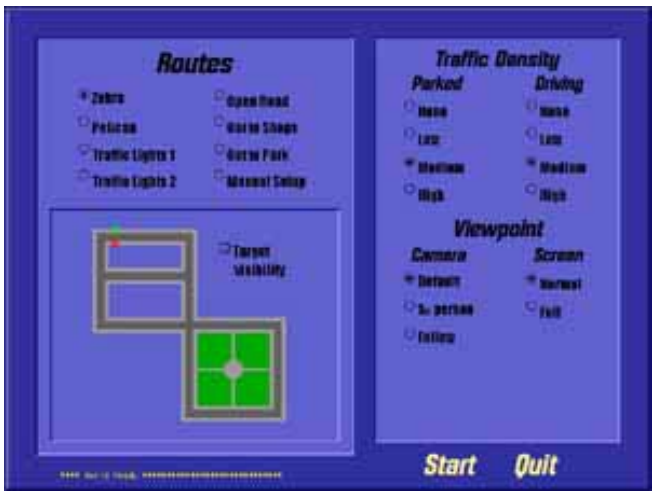

Figure 3. *Travel training interface.*

Members of the User Group undertake three tutorials in the following manner.

4.1 Tutorial one: Zebra crossing

In this tutorial, the learner can adopt first person or third person perspective (avatar) starting at the zebra crossing. (Figure 4). Keyboard, mouse or joystick control can be adopted. The learner should cross the road observing the safety routines, such as standing beside the road, looking left and right till the cars stop then crossing the road without stepping outside the zebra crossing.

4.2 Tutorial two: Pelican crossing

This tutorial has been identified as mid-level skill to help the learner to cross pelican crossings safely (Figure 5). The learner learns to cross the road to the opposite corner of the street by crossing two sets of pelican crossings, observing the procedures and safety rules, such as pressing the pelican button and waiting until the light turns green, then crossing the road without stepping outside the crossing.

Figure 4. *Virtual Zebra Crossing*.

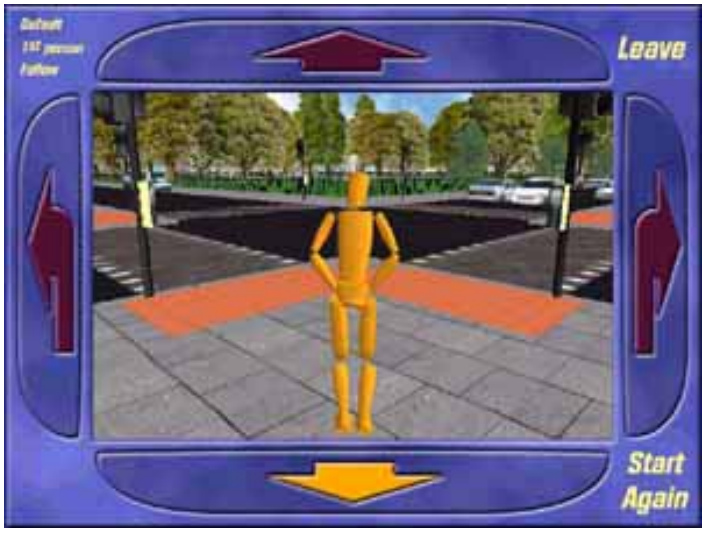

Figure 5. *Pelican Crossing*.

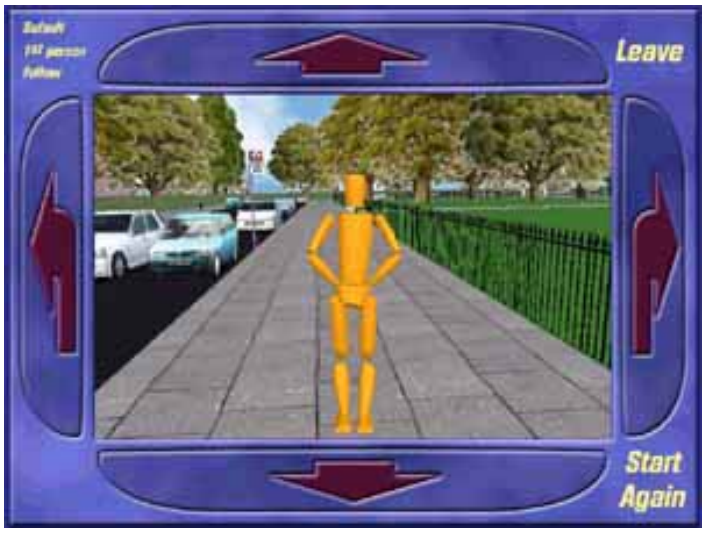

Figure 6. *Route Finding*.

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4.3 Tutorial three: Getting to the park

This tutorial aims to help the learner develop their own strategies, such as dealing with unexpected problems and route finding (Figure 6). It combines the previous two tutorials and also develops route finding skills by giving the learner an order from a simple map at beginning of the tutorial. The overall objective is to reach the park from a few blocks away independently.

5. EVALUATION

5.1 Overview

Of particular importance will be the evaluation of the transfer of skills from the virtual model to real world experience. Previous evaluation studies have shown that there is excellent transfer of virtually learnt skills to the real world in people with learning difficulties using the Virtual City (Brown, 1999). This type of study is, however, a long-term goal in this three-year project, and transferability will be determined in conjunction with researchers at Kings College, London. The results of such a study have potential implications for users in this project in terms of greater self-esteem, increased independent travel and greater access to work and training.

Before such a study takes place, two preliminary studies will occur. Study 1 is a case study with a small number of users to determine the usability of the system and Study 2 involves baseline assessment of the travel-training environment without embedded virtual tutoring agents. Reassessment of the environment after the design and implementation of such tutoring agents will allow their efficacy to be determined. Only preliminary results from Study 1 will be discussed in this paper. The members of the testing group for each of these studies will be drawn from a large day centre with over 200 residents situated within the London Borough of Sutton.

5.2 Procedure for Study 1

Traffic densities set at medium. Target set as invisible.

1. Zebra crossing, keyboard controlled – 2/3 repeats per tester
2. Pelican Crossing, keyboard controlled – 2/3 repeats per tester
3. Free wander in the park, joystick controlled – 1/2 minutes per tester
4. Zebra crossing, joystick controlled – 2/3 repeats per tester
5. Pelican crossing, keyboard controlled – 2/3 repeats per tester

6. RESULTS

The results from the case studies were as follows:

6.1 Case study results

Name: A

Age: 40's

Gender: Female

№ of encounters with package: 4 times of 10 minutes each. Total of 40 minutes of experience.

Observations

- Tendency to over steer when using the keyboard.
- Found use of mouse difficult (pressed both buttons).
- Attempted to press screen to activate Pelican.
- Joystick - slow start (actions too gentle), but rapidly improved performance as confidence grew.
- By end of session, voiced preference for joystick

Name: B

Age: 40's

Gender: Male

№ of encounters with package: 4 times of 5 minutes each. Total of 20 minutes of experience.

Notes: B has a severe tremor, making many manual tasks slow and clumsy.

Observations

- Found keyboard control very difficult.
- Using keyboard, completed Zebra with very little prompting.
- Found using the mouse/pressing a mouse button very difficult (pressed both buttons).
- Very quickly picked up control via joystick (with no known previous experience).
- Almost instant success using joystick on Zebra.
- Preferred viewpoint – 3rd person (avatar)

Name: C

Age: 26

Gender: Male

№ of encounters with package: 3 times of 10 minutes each. Total of 30 minutes of experience.

Observations

- Confused verbal queues of "left" and "right".
- Confused verbal queues of "forward" and "back".
- Keyboard tasks completed successfully.
- Did not really get to grips with the joystick – kept getting stuck going round in circles (see Additional Notes 6.2.)
- May not have been using his "best" hand.
- Preferred viewpoint – 3rd person (avatar).

6.2 Additional Notes

The following additional observations were made on the experimental procedure:

1. Joysticks had not been presented to the users before; all previous encounters had been made using the arrow keys.
2. Joystick changed between B's first go and C's go, from long travel to shorter travel and more sensitive joystick. Both had difficulty with the 2nd joystick.
3. Training began one month before testing, most users having 1 session per week.
4. Usage very much tied to the first, basic tasks.
5. Trainer supported users with prompting and physical demonstration and assistance.
6. Trainer often asked users "Is it safe to cross the road?"
7. All users enjoyed the sounds associated with successfully completing a task.
8. Although mouse was difficult to use, the positive reinforcement associated with its use for pressing the WAIT button was felt to be useful by the trainers.

6.3 Technical Notes (possible interim modifications)

The following technical notes have been made regarding the performance of the travel-training environment during the experimental phase and are presented as possible interim modifications:

- Z-buffering of the pedestrian lights: red and green man are not always working. Important visual queues therefore disappear.

- Z-buffering of the textured pavement surface is also intermittent.
- Turning of the avatar is too sensitive. Straightening up can be a very difficult manoeuvre for many users. It may be possible to constrain the rotation to steps of 30 or 45 degrees (as an option).

7. FUTURE CONSIDERATIONS AND CONCLUSIONS

The aim of this project was to produce a flexible travel training environment to support constructivist training of people with learning disabilities. Results of an initial study and the reaction of trainers working directly with people with a learning disability have shown a promising degree of usability of the package. Later studies will evaluate the efficacy of embedded virtual tutoring agents within the package and the effectiveness of the package in terms of the transfer of skills into real world competencies.

Through analysis of results from the initial case study on usability, a number of design modifications are now suggested. Their implementation will improve the usability of the package and ultimately its effectiveness:

- Increase size of red and green men.
- Add User Records to allow users to preserve personal settings, facilitate data collection on performance and export (perhaps to .XLS) success and failure rates.
- Stop cars closer to the crossings, or widen the field of view, so that they are more visible from the stationary avatar.
- Add pedestrian islands.
- Add staggered islands.
- Add a subway (with multi-exit?)
- Add a footbridge.
- Add a wider range of road signage.
- Add buses with changeable livery, numbers (and destinations); single and double deckers.
- Add emergency vehicles.
- Disable joystick buttons.
- Scaffold interactions to a higher degree.
- Add an avatar of selectable gender: neuter (default), male and female options.

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