

Angle Recognition Cues using a new API dedicated to the VTPlayer Mouse

Benoît Martin — Isabelle Pecci — Thomas Pietrzak

LITA
Université Paul Verlaine — Metz, France

14 Mars 2007

Plan

- 1 Introduction
 - Micole
 - VTPlayer
- 2 Bibliography
 - Real representation
 - Icon representation
- 3 The VTPlayer API
 - Architecture
- 4 Tests
 - Presentation
 - Protocol
 - Results
- 5 Conclusion

Micole

Multimodal Collaborative Environment
for Inclusion of Visually Impaired Children
IST-2003-511592
<http://micole.cs.uta.fi>

Objectives

- studies about the needs, and identify the users
- experimental studies about multimodality
- experimental studies about collaboration
- development of a software architecture, and softwares
- tests and evaluations of the developments

VTPlayer



Properties

- tactile 2D mouse
- 4 buttons
- 2 pin matrices 4×4
- USB

Use

- "real" representation: pixels \longrightarrow pins
- icons

API

- official driver (Windows)
<http://www.virtouch2.com/>
- open source driver (Linux)
<http://vtplayer.sourceforge.net/>

Real representation

- geographical maps exploration: Jansson et Pedersen [JP05]
 - task: find a sequence of states on a USA map
 - helps: tactile feedback (VTPlayer) and speech
 - the tactile feedback didn't help
 - difficulties due to mouse use by a blind user
- charts exploration : Wall et Brewster [WB06a, WB06b]
 - task: recognize if a line goes down or up
 - goal: compare three techniques: relief paper, VTPlayer and force feedback mouse
 - the paper is the best, the second is the force feedback

Pixels to pins transcription is not sufficient to have a good recognition [Eri99]. We have to add some more information, like guidance or labels.

Icon representation

- directionnal icons: Pietrzak et al. [PPM06]
 - task: recognize the directions represented by the icons displayed
 - static and dynamic (animations) icons
 - static icons are easier to recognize
- maze exploration: Crossan et Brewster [CB06]
 - task: navigate in a maze and find the exit
 - exploration with force feedback with a PHANToM
 - guidance information with icons on the VTPlayer
 - the users manage to explore the mazes
 - the directionnal icons help the users to explore

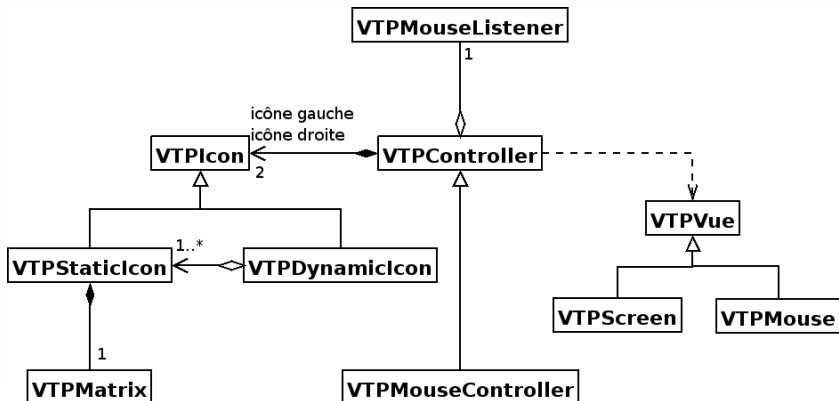
The VTPlayer API

- libusb library to communicate with the mouse through the USB port
 - easy to use
 - multi-plateform
 - official driver dll not documented
- SDL library for display and threads
 - display to debug without device
 - threads to update the patterns and get the mouse status

Features

- portable API
- get the movements and the buttons state
- static icons
- dynamic icons
- could be extended to other devices

MVC Architecture



Presentation

Angular information representation thanks to a tactile feedback on a 4×4 matrix.

Constraints

- representation with icons
- angles from 0° to 360°
- 15° step
- restrict to a quarter to make the tests easier
- use symmetries to get the 3 others
- keep a reference point to be able to identify the quadrant

Feasibility study: if the users don't manage to distinguish 90° , it is useless to try to recognize 360° .

Icons

Icons 1



- strong semantic link with the angle
- quarter reference: corner
- ambiguities: 45° , 135° , 295° et 315°

Icons 2



- quarter reference: point
- ambiguities: 45° , 135° , 295° et 315°

Icons 3



- semantic link with the angle not obvious
- quarter reference: point
- no ambiguities

the icons 3 has been chosen for the tests

Protocol

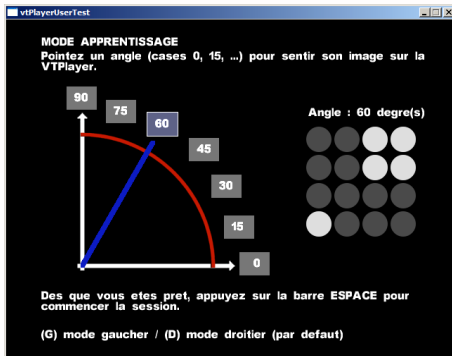
Goals

- analyze the session effect: recognition rate evolution
- identify the icons harder to recognize
- identify the icons easy to recognize

Users

- 12 sighted users (hidden hand)
- right and left handed → forefinger of the dominant hand
- 8 users made 5 sessions, 1 did 4, 2 did 2, and 1 did 1
- 5 minutes sessions, only the users who made 5 sessions are considered for the statistics

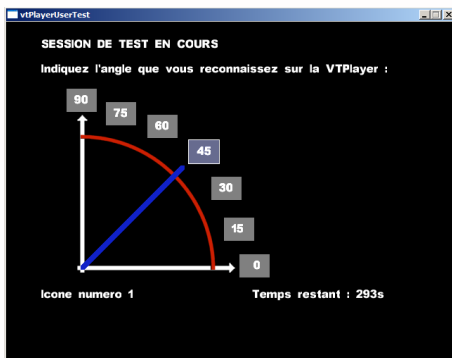
Protocol



Training step

- the users get used to the icons
- no time limit
- visual feedback

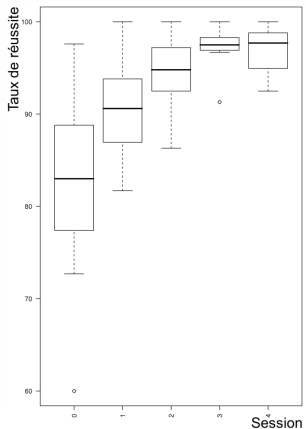
Protocol



Test step

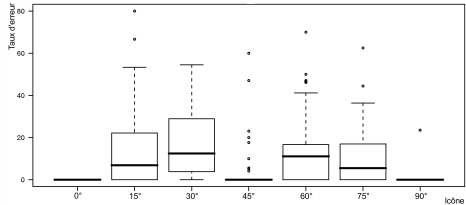
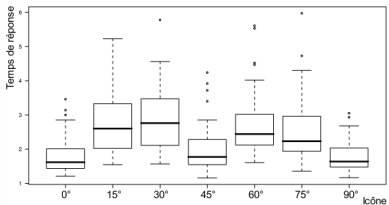
- random icons to be recognized
- recognize as many icons as possible in 5 minutes

Session effect



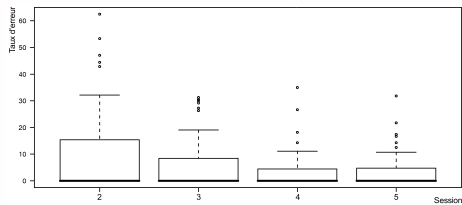
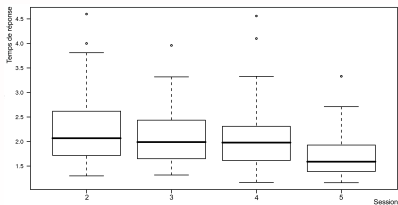
- Anova analysis
 - session effect on the first 3 sessions
 - no session effect on the last 2 sessions
- Student test
 - the medians of the last two sessions are similar

Icon effect



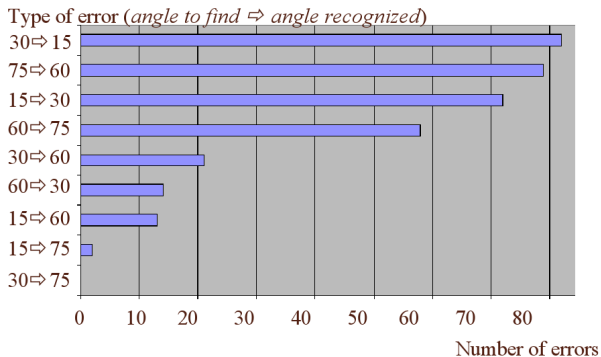
- icons 0°, 45° and 90°
 - no errors
 - quickly recognized
- icons 15°, 30°, 60° and 75°
 - recognition errors
 - longer to recognize

Per sessions analysis



- session 1 removed to get the normality
- the users recognize the icons faster and faster
- the users do less and less recognition errors

Icons comparaison



- lots of confusion with the icons of 15°, 30°, 60° and 75°
- the icons giving the more confusion are the closest ones :
 - 15° et 30°
 - 60° et 75°

Conclusion

Results

- the users manage to recognize icons representing angles from 0° to 90° , with a step of 15°
- there is a short learning effect
- the learning allows to recognize better the icons, and quicker

Future works

- optimize the icon sets
- extend to 360°
- formalise the notion of icon

Many thanks for your attention



Andrew Crossan and Stephen A. Brewster.

Two-handed navigation in a haptic virtual environment.

In *CHI 2006: Proceedings of the SIGCHI conference on Human factors in computing systems*, Montréal, Québec, Canada, April 2006. ACM Press.



Yvonne Eriksson.

How to make tactile pictures understandable to the blind reader.

In *Proceedings of the 65th IFLA Council and General Conference*, Bangkok, Thailand, August 1999.



Gunnar Jansson and Patrik Pedersen.

Obtaining geographical information from a virtual map with a haptic mouse.

In *International Cartographic Conference*, La Coruña, Spain, July 2005.



Thomas Pietrzak, Isabelle Pecci, and Benoît Martin.

Static and dynamic tactile directional cues experiments with vtplayer mouse.

In *Proceeding of the 6th International Conference EuroHaptics 2006*, pages 63–68, Paris, France, July 2006.



Steven A. Wall and Stephen A. Brewster.

Sensory substitution using tactile pin arrays: Human factors, technology and applications.

Special Issue of Signal Processing on multimodal interfaces, 2006.

to appear.



Steven A. Wall and Stephen A. Brewster.

Tac-tiles: multimodal pie charts for visually impaired users.

In *4th Nordic Conference on Human-Computer Interaction*, pages 9–18, Oslo, Norway, October 2006. ACM Press.