



HINDSIGHT:

DEVELOPING A REAL-TIME TACTICS GAME USING AN OPTIMIZED COST- EFFECTIVE EYE-TRACKING DEVICE

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CONTEXT OF THE STUDY

Many motion sensing and tracking input devices are developed for consoles geared towards gaming.

- Microsoft's *Kinect* for Xbox 360
- Sony's *Move* for PlayStation 3
- Nintendo's *WiiMote* for Wii

Current studies in *Human-Computer Interaction* (HCI) on new modes of input:

- Brain wave activity
- Three-dimensional "air mouse"
- **Eye-tracking technology**, focus of this study.

CONTEXT OF THE STUDY — 2

Eye-tracking devices (ETDs) are currently mainly used for commercial applications

- Also in health, criminology, and public safety, among others
- Very limited references in a gaming context.

When properly utilized, the eyes can serve as a powerful new source of input for innovative gameplay.

SIGNIFICANCE

Eyes: “fastest and most fatigue-resistant muscles”

Promising candidates for obtaining efficient and accurate input

- Not just for gaming, but also for practical, everyday computing.
- Could potentially remove the need to physically manipulate a controller or mouse, or any strenuous physical ability.

SIGNIFICANCE — 2

Potential to not only facilitate behaviour in alternative forms of HCl's, but also produce appropriate applications for them.

Modern games offer rich content and immersive gameplay, and are constantly demanding more interaction.

ETDs can deliver.

SIGNIFICANCE — 3

Also can be used as reference for future work with ETDs and people with disabilities.

No mobility required—just looking and staring (probably blinking as well).

Most beneficial for recreation and/or rehabilitation for:

- Hand amputees
- Paralysis
- People with vision problems

A REAL-TIME TACTICS GAME (RTT)

Subgenre of Real-Time Strategy (RTS)

Limited/fixed number of units, no resource gathering

Focus on *tactics* rather than *strategy*

- **Tactics:** pertains to combat and techniques; short-term goals
- **Strategy:** use of political, economic, military resources to achieve a long-term goal

Examples: World in Conflict, Dawn of War II, Cossacks II.

EXAMPLE



Cossacks II: Napoleonic Wars

EXAMPLE



World in Conflict (2007), Warhammer 40,000: Dawn of War II (2009)

WHY AN RTT GAME?

Appropriate: on-screen events demand more attention from the player; less emphasis on figuring out controls (everything is displayed)

Pacing-friendly: RTTs have reasonable pacing to familiarize with interface, and at the same time deliver engaging play

WHY AN RTT GAME? — 2

Unique: never been done before; utilizing uncommon technology for an uncommon genre

Challenging: right amount of difficulty to develop given time constraints; not as extensive as most popular genres

RESEARCH QUESTIONS

1. How does one design a real-time tactics (RTT) game that utilizes an eye-tracking device?
2. What can be considered an appropriate mapping of eye movements to player actions in an RTT game?
3. How does one test the design of an eye-tracking-enabled RTT game?

DEVELOPMENTS IN ETD TECHNOLOGY

Algorithms for Different Data Types

Different eye-tracking devices (invasive/non-invasive, wearable)

Researches, however, are looking for cost-effective devices (e.g. **ITU gaze tracker**, openEyes)

APPLICATIONS OF ETDS

Eye Activity Rehabilitation/Exercise

Commercial Use

- Advertising Strategy Analyses
- Affect and Memory Analyses
- Games

GAMES THAT USE ETDS

Tobii's EyeAsteroid (Arcade Style)

Gaze-controlled Virtual Characters (Sundstedt)



THE 'MIDAS TOUCH' PROBLEM

From Midas, where everything he touches turns to gold

Eye-gazing interfaces: the problem of toggling between active or inactive states at will for selection or de-selection purposes

SOLUTION: SNAP CLUTCH

“snap” as selecting and de-selecting

“clutch” as if a manual-transition cars when shifting gears

Qualifying a good “clutch”

- Quick and easy to operate;
- Not increase the cognitive load unnecessarily;
- Not disturb the user’s gaze-pattern.

ANOTHER SOLUTION: GAZE GESTURES

Gaze fixation: looking at a point of regard / area of interest in a significant amount of time

Simple eye movement to detect (compared to others, this being a first-order eye movement data type)

EYE MOVEMENTS

Gazes (a point of interest)

Saccades (a line of interest, much like how we follow a moving object)

Scan-paths (a series of gazes and saccades [GSGSGSGS...], much like how we read text/books or search)

EYE METRICS

Gaze

- Durations
- Overall Number of Fixations
- Fixations per Area of Interest

Saccades

- Overall Number
- Amplitude
- Regression (back reading)

EYE METRICS

Scan-paths (may be optional when A* pathfinding is used for AI)

- Durations and lengths
- Spatial Density

MEANINGFUL PLAY METRICS

Schell's elemental tetrad

- aesthetics, story, **technology**, **mechanics**
- mechanics (RTT) + technology (ETD)

Leblanc's taxonomy of game pleasures

- **sensation**, **fantasy**, narrative, challenge, fellowship, **discovery**, expression, and **submission**

PC HARDWARE REQUIREMENTS FOR DEVELOPMENT

Hardware	Minimum	Recommended
Video Card	Mobile Intel 4 Series Express Chipset Family	NVIDIA GeForce GTX 550 Ti
Processor	Intel Pentium Dual-Core Processor @ 2.00 GHz	Intel Core i3 Processor @ 2.10 GHz
RAM	2 GB	4 GB
OS	Windows Vista Home Premium	Windows 7
Resolution	1024 x 768 (4:3)	1440 x 900 (16:9)

GAME DEVELOPMENT TOOLS

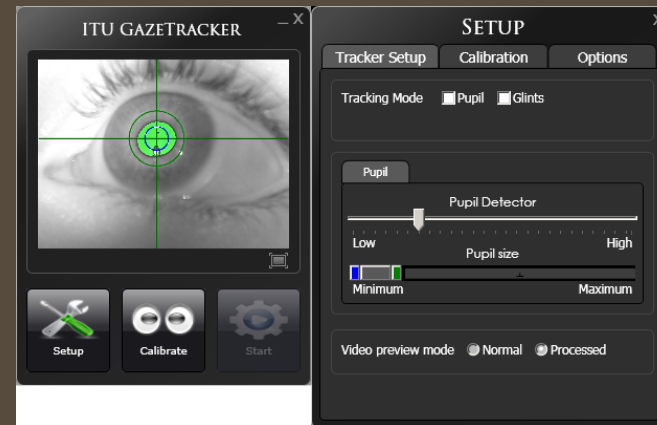
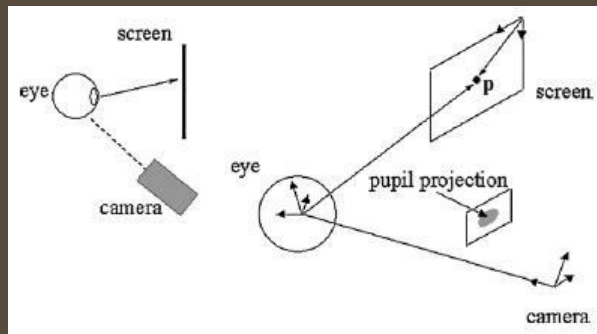
Unity Game Engine

Blender 3D

Programming Languages: C#, JavaScript

EYE-TRACKING SOFTWARE

ITU Gaze Tracker (2010 version)

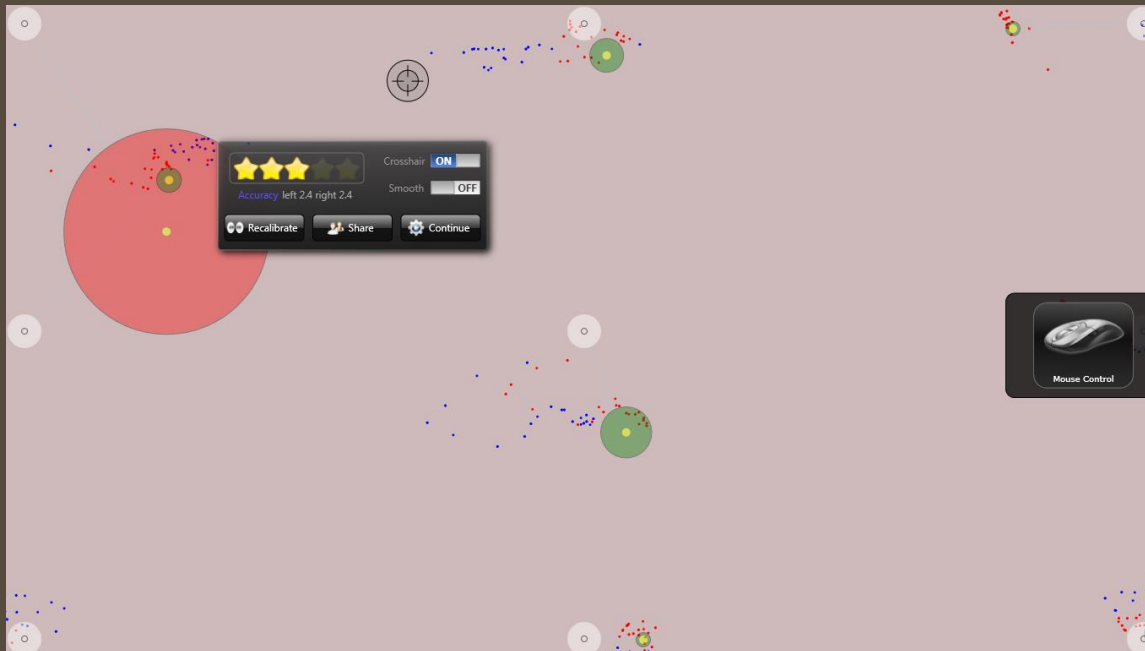


From De Santis and Iacovelli (2009)

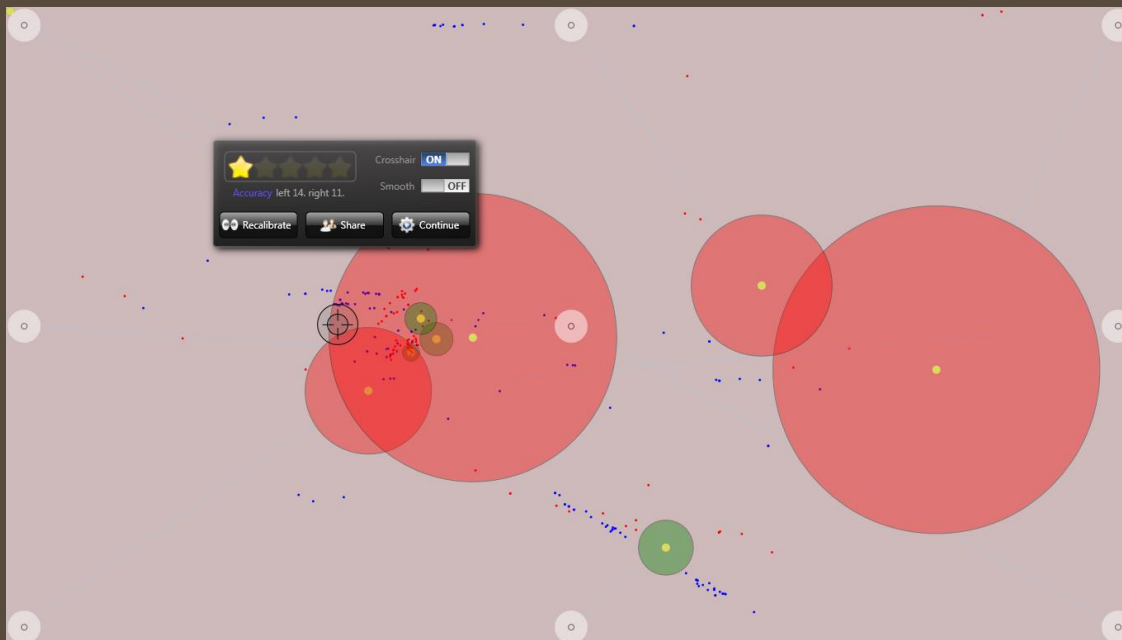
SCREENSHOTS: GAME



SCREENSHOTS: EYE-TRACKING



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