EyeChess: A Tutorial for Endgames with Gaze-Controlled Pieces

O. Spakov (University of Tampere, Department of Computer Sciences, Kanslerinrinne 1, 33014 University of Tampere, Finland. E-Mail: oleg@cs.uta.fi), D. Miniotas (University of Tampere)

Advances in eye tracking have enabled the physically challenged to type, draw, and control the environment with their eyes. However, entertainment applications for this user group are still rare. We present EyeChess: a PC-based tutorial to assist novices in playing endgames. The player always starts first and is to checkmate Black King in three moves. To make a move, the player first selects a piece and then its destination square. A square with a green highlight indicates a valid move, whereas red denotes invalidity. There are three options for selection: blinking, eye gesture (i.e., gazing at off-screen targets), and dwell time. If the player does not know how to proceed, or starts making mistakes, the tutor provides a hint. This shows up as a blinking green highlight when the gaze points at the right square. Preliminary user studies revealed that dwell time was the preferred selection technique, and that the tutorial was rated helpful in guiding the decision-making process.

Introduction (why games?)

- [Gips, 1996], [Nelson, 1992]: primitive games to train participants to control the gaze before they were involved in testing the gaze-controlled interface.
- Games could be used as a tool to evaluate efficiency of an interaction methods
- There are no real gaze-based games on the market available yet.
- Due to the problems of eye-tracking devices, the gaze-aware interfaces must deal with the objects large enough to eliminate the accuracy gap. Cell-based games seems ideal for this purpose.

Goal

- To develop a PC-based tutorial to assist novices (no or very little experiences) in playing chess endgames and to carry out a pilot evaluation of the efficiency of the proposed technique.

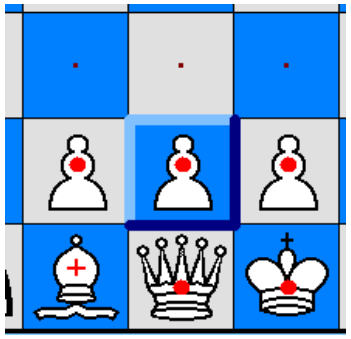
- Chess game was chosen as the one, which satisfies all conditions mentioned above. Moreover, this game looks promising from other research aspects (for example, for studying the processes of mental activity).

17 - White to play and checkmate in 3 moves

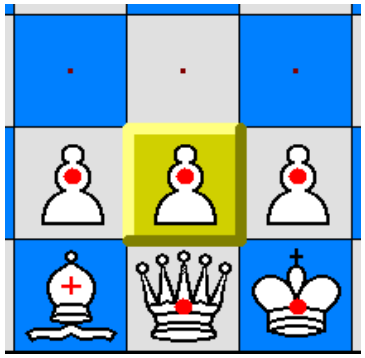
Software design 1/4

- Visual feedback (static)

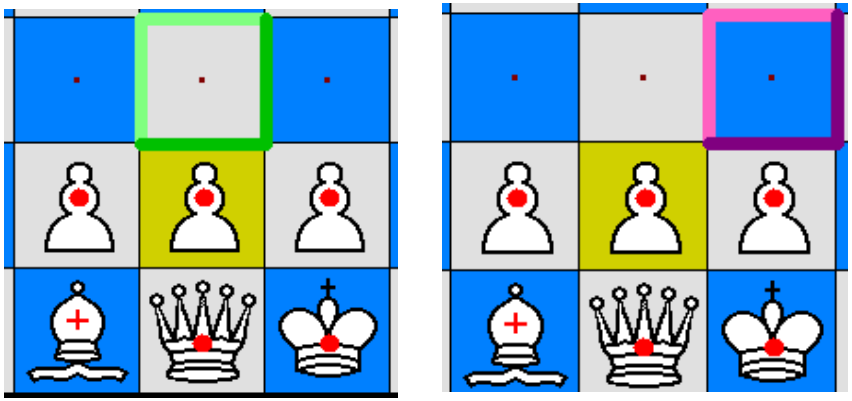
1. What the user is looking at (3D)



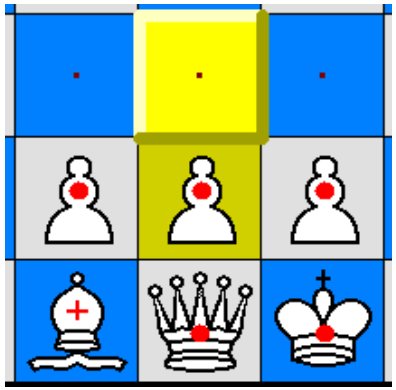
2. Motion target (dark-yellow)



3. Motion validity (red/green 3D)



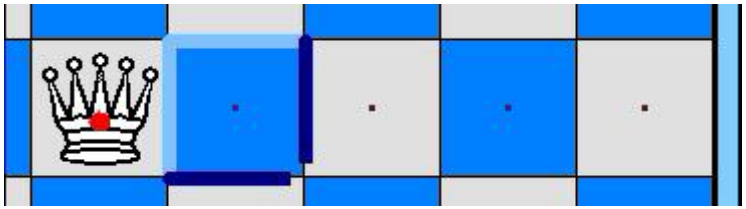
4. Motion target (light-yellow)



Software design 2/4

- Visual feedback (dynamic)

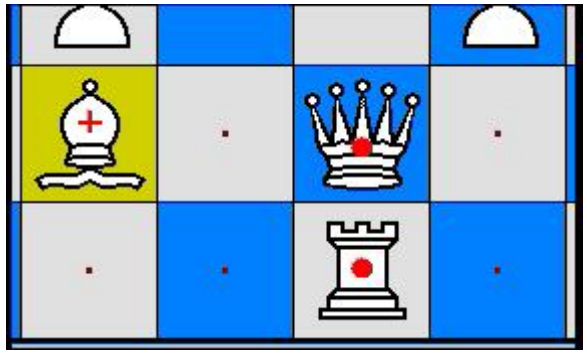
1. Animation of the piece movement

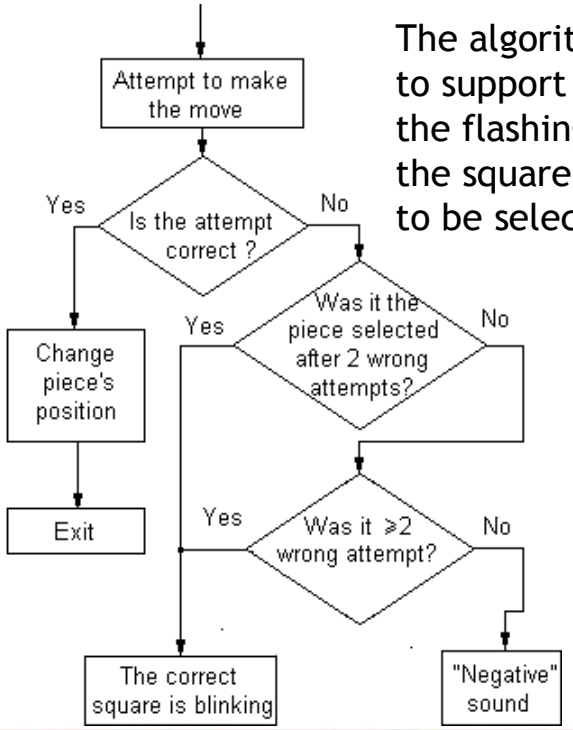


- Sound feedback
  - Alert sound at the attempt to move to forbidden square
  - Congratulations as reward when the task was completed

Software design 3/4

- Support of tutoring: flashing 3D border
  - is applied to the square (if it is in focus), which is supposed to be selected next, after the player made 2 attempts to make a wrong move (the tutorial does not support wrong movements).
  - is applied to either the piece to move or the destination square – it depends on whether the player found the correct piece to move or not
  - if the player has found the correct piece to move due to flashing 3D border, the destination square will flash only when s/he makes an attempt of wrong move once more.





The algorithm to support the flashing of the square to be selected

Software design 4/4

- Game modes
  - Training (no restrictions)
  - Tutoring (only reserved moves are allowed))
  - Game via Internet with an opponent
  - Game with computer (to be developed)
- Selection methods:
  - By dwell
  - By gaze gesture (from the object to select to any off-screen button (placed in each corner of the monitor), and returns to the same object.)
  - By blink
- The game is playing in full-screen mode. Implemented as a plug-in for iComponent application [O. Špakov[1]]
- The pilot study was conducted to find the best gaze-based selection method for this game.

[1][http://www.cs.uta.fi/~oleg/light/icomp.htm]

Pilot study

- **Hardware**: SMI iView X RED III eye tracker
- **Methods settings**: 1) Dwell time: 1.8 s, 2) Gaze gesture: 0.3 – 1 s over an off-screen button, 3) Blink: 0.35 - 1 s
- **Dependent variables**: 1) selection time, 2) players' opinions
- **Procedure**: 4 subjects moved any 10 pieces they liked to any position
- **Results** (the average time and player rating):
  Dwell time: 3.3 s, quite OK for this task
  Gaze gesture: 2.8 s, less convenient, especially for permanent selection
  Blink: 2.5 s, worst, very annoying
- **Conclusion**: the dwell time selection method was chosen. However, the gaze gestures could be used as well since in a real chess game the selection itself does not occur very often

Evaluation

- **Subjects**: 4 players (no or little experience in playing chess)
- **Hardware**: Tobii 1750 eye tracker from Tobii Technologies
- **Procedure**: Players played Whites and solved 20 endgames in 3 moves
- **Dependent variables**: 1) completion time [*CT*], 2) number of wrong attempts to move [*WA*] and 3) number of times the flashing 3D border were noticed [*FB*]
- **Results**:

  CT_{AVG} = 71.4s (σ=19.3s),
  WA_{AVG} = 18% (σ = 6%), mainly for the first move (34%).
  FB_{AVG} = 9% (all for the first move).

  Players were stressed during first 7 tasks; they analyzed the task carefully and this resulted in long thinking. Then they relaxed and *WA* increased (trials 9-13). At the end all players solved tasks faster than at the beginning.

Conclusions

- The pilot study revealed that dwell time was the preferred gaze-based selection method.
- The visual and sound effects provide a good level of interaction.
- The following study revealed that the tutorial was helpful in guiding the decision-making process. However, the tasks were too easy and the EyeChess tutoring support was rarely used.
- Overall, the game is eye tracker-friendly and thus easy to play, as the pieces and squares on the chessboard are large enough to accommodate calibration drifts.

Future work

- Support of both novice and expert players (done)
- Player vs computer (done)
- Template for further development of board games (checkers, backgammon, etc.) to play by eyes

Screenshot of the last EyeChess version

Thank you for attention!

References

Gips, J., Dimattia, P., Curran, F.X. and Olivieri, P., Using EagleEyes – an electrodes based device for controlling the computer with your eyes – to help people with special needs, in J. Klaus, E. Auff, W. Kremser & W. Zagler (eds.), Interdisciplinary Aspects on Computers Helping People with Special Needs, Oldenburg, pp. 77-84, 1996

Nielsen, J., Noncommand User Interfaces. Communications of ACM 36, pp. 83-99, 1992

O. Špakov's home page: iComponent software, at http://www.cs.uta.fi/~oleg/light/icomp.htm, 2005

The project was developed as the student project in G. Evreinov's course "Alternative Access: Feelings and Games" 2005. WWW: http://www.cs.uta.fi/~grse/