Deep Green

System for real-time tracking and playing the board game *Reversi*

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Reversi
Game Rules
Game Rules
System Overview

- Capture Frame
  - Standard webcam
  - Simple setup
  - Flexible
System Overview

• Capture Frame
• Detect Board area
  o Segmentation by colors
  o Corner detection
  o Homography
System Overview

- Capture Frame
- Detect Board area
- Detect Discs
- Send acquired board state to game AI
  - Game representation
  - Technique for AI
System Overview

Capture Frame
Detect Board Area
Detect Discs
Reversi AI

Nadav Erell, Intro to Computational and Biological Vision 2013
System Overview

- Classic segmentation problem
- Best clue in the image for identifying the board? It’s green!

It’s a start, but really not good enough...
System Overview

• Solution: Thresholding on each channel
System Overview

- Solution: Thresholding on each channel
- Combining the masks
System Overview

• Solution: Thresholding on each channel
• Combining the masks
• Corner identification
System Overview

- Homography
System Overview

• Discs from background: Red channel thresholding
• Filtering connected components
  o Total area
  o Eccentricity
• Matching remaining discs to grid
• Separating white and orange discs using blue channel
System Overview

• Perfect Detection!
Artificial Intelligence

• Final detected board state is represented as an 8x8 matrix
• Game is fully independent of the past – can analyze only current state without saving data
• Game tree search
  o Minimax algorithm
  o Pruning
Artificial Intelligence

- Suggested moves by AI:
Highlights

• Reversi is a fun game. Give it a try if you never played!
• System is easy to set up, simple hardware
• Robust and flexible in camera angle and distance
• Acceptable latency for real-time game tracking
Questions?