Using Optical Tomography to Teach Chess

1. Introduction

Chess is an incredibly popular board game, and one of the most widely played in the world [citation]. The rules of chess are simple; a player needs only to learn how to move their pieces and what the victory conditions are available. The strategy of the game, on the other hand, takes a lifetime to master. From hundreds of complex openings to sharp midgame tactics, getting a handle on the strategy of chess can be difficult for new players.

We propose a physical game system for teaching new players the ins and outs of chess strategy using a modified board. The board is an LCD monitor display outfitted with IR sensors used to map the physical pieces on the board using 2-D optical tomography. Using the collected board state information, the system provides the player with advice on next moves. Additionally, the system detects when a piece is picked up by a player and highlight all squares that are legal moves for that piece.

1. Methodology

The chessboard is displayed on an [model, size] LCD monitor. The monitor output is controlled by an Arduino RedBoard unit, detailed in [Appendix A, citing source].

The frame for the board is constructed from laser-cut cardboard. The frame is modeled using SolidWorks to fit the dimensions of the LCD and contain surrounding sensor bank, as well as the peripheral components, including the Arduino units, LCD power and control units. An input panel is included to allow user control over the board inputs, including on, off, and mode select.

A bank of [number] IR transmitter and receiver pairs line each of the sides of the board. The IR transmitter/receiver pairs are described in [Appendix B]. In quick succession, each transmitter is send a signal and shortly thereafter, the reflected signal is measured at each of the [number] receivers [Appendix C]. Using tomographic methods [detail, or citation needed], the system converts the raw optical readings into a representation of the board.

Using the board representation, the system determines which piece is selected (if any) and determines how to appropriately highlight squares on the board. If a piece is picked up, the system highlights legal squares for the piece to move into. If there is a strategy the player is practicing (for example, the Queen’s Gambit), the system will instead highlight the piece and square corresponding to the next correct move in the strategy’s sequence.

The board updates are communicated between Arduino units using an SPI protocol [Appendix D].

1. Project Retrospective

Team:

Significant prototyping effort went towards designing the IR transmitter receiver bank [Appendix B]. Designing the circuitry for correctly collecting information from all [number] of sensor pairs, and correctly determining the layout of the board based on sensor information was a significant portion of the electronic component prototyping.

Additional effort went into designing the frame in SolidWorks. The design was made to factor in several units, including the LCD display, LCD power unit, LCD control, two Arduino units, and four IR sensor banks.

Due to time constraint, it was decided to complete the project on a smaller game than chess, to reduce amount of IR unit production that needed to be done. The game of tic- tac-toe was chosen, which reduces the board size from 8x8 to 3x3.

Ben:

I spent a large part of this project prototyping the IR sensor pairs. I applied knowledge gained from class to

1. Future Work

Given more time, the system can be extended to chess and other board games.