Project Title: Deep Blue and Gold

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EECS 149/249A Project Charter, Fall 2014

Project Goal

The overall goal of the project is to help beginning chess players learn the game or help more advanced players analyze games in a fun, structured, and interactive environment.
In this project, we will create a chess board in which has a number of features:

- When a player picks up a chess piece, the squares in which that player is legally allowed to move that piece to will light up by means of an LED (each square will have one LED).
- Connect online to a web or phone app to teach various openings or go through past games.
- The board will be able to keep track of which pieces are in play (and in what positions), and which pieces are out of play.

If time permits, we will implement automated chess piece movements using linear actuators and magnets.

Project Approach

Software: We intend on coding our project in the Arduino environment. We will rely heavily on strong object oriented programming with our “nouns” tentatively as players, pieces, and board composition, and a game object to encapsulate all of this. This high-level object model will make it easy for us to make modular adjustments and thus features. For example, for the same piece and board model, we could have Human vs. AI, or Human vs. Human players in a game.

Hardware: We still have to flush out our model for our hardware, but we would use various sensors to give us much control/transitions of our board as possible. For example, we will have sensors for each square of the board. The presence/absence of the piece will be read by the sensor and trigger transitions in our state model. Variables will be used to keep track of things such as which pieces are moving, which have been captured, and which squares are occupied which is where the software-hardware interface comes into play.

Resources

We plan to use the Arduino Mega as the brain of our smart chess board. The chess board will be either elevated or hollow, allowing us to attach the Arduino below or inside the board. The first step in the project will be to implement piece detection on the board, which we will accomplish either through the use of magnets on the bottom of each piece and magnetic reed switches underneath each square of the board. The magnetic reed switches will be attached to a multiplexer that attaches to the Arduino Mega, and will allow us to tell when any square has a piece over it. The first goal for this step will be to see if we can get a single square on a chessboard to detect whether or not a piece is currently residing on it. The second step will be extracting the data from the moving piece. The third step will involve wiring and signaling the LED to each square. The LED will go on the corner of the squares so as not to get covered up by pieces. Combining these steps, along with the knowledge of the original state of the board, we will be able to create a state machine that can keep track of whose turn it is, which piece is being lifted by a player, and which squares to light up (we will have a simple chess algorithm running on the Arduino to help us determine this last part).

Schedule (Note: We don't want individuals in our group to be responsible for individual schedule milestones)

- October 21: Project charter (this document)'
- October 22: Get access to FAB and supernode.
- October 23: Discuss with GSI on choice of platform.
- October 26: Finish building or buying chess board
- October 27: Finish chessboard layout and LED placements (drilling holes, etc)
- October 31: Mapping Input pins to the MUX and start wiring magnetic reed switches to bottom of board
- November 4: Sensor testing and a working piece identification system.
- November 7: Statecharts simulation model with logic for LEDs
- November 10: Get chess program running on Arduino that takes in a game state and whether it's black or white's turn and outputs legal moves
- November 18: ***Milestone:*** Demonstrate ability to light up squares on board
- November 25: Get partial functionality working (i.e. if I lift a piece, does something happen with the LEDs on the board, even if it's not 100% correct?)
- December 9: ***Milestone:*** Finish debugging majority of known issues
- December 9 - 19: Maybe implement automated movements for chess pieces (since we already will have magnets on the bottom of each piece)
- December 16: Demonstration video made, powerpoint prepared.
- December 17: Final presentation and demo.
- December 19: Project report and video turned in.

Risk and Feasibility

We might encounter an issue in which it would be helpful if the sensors on each square could determine for themselves exactly which pieces are above them (our current idea for implementation simply has each square knowing simply whether *any* piece is on it). If this becomes a problem, we were thinking about having RFID tags (and antennas under the board) instead of magnets on each piece, that way we can uniquely identify each piece.

If we do have time to implement the linear actuators, we have several challenges:

1. Magnets under the board, while moving a piece, might interfere with the placements of the other pieces. We need to either use an on-off electric magnet or adjust the orientation of the magnet.
2. Hard to align. To prevent positioning errors, we need to use a stepper motor and implement encoder feedback. Moreover, the actuators might get stuck so we need to align the bearings perfectly. We also have to make sure the stepper motors we chose have enough torque.