6.115 Final Project Proposal: Chess Puzzles

Background/Introduction

This project allows players of varying experience levels to learn and improve their ability to solve chess tactics. It makes learning chess an interactive game for people of varying experience levels. Beginners are taught how each piece moves and the basic idea of checkmate, while more experienced players are given the ability to hone their skills with a diverse set of puzzles.

This is all done on a 4x4 mini chess board, where the learner is asked to set up a puzzle (using specialized pieces) via a prompt on an accompanying display. The display will show a replica of the board, keeping track of each piece and giving feedback to whether a puzzle is completed correctly or not.

How it works:
- The player is prompted via an LCD display to place pieces in a certain configuration. Once the board is set up properly, the player can begin solving the puzzle.
- The player is told how many moves are needed for checkmate (usually 2 moves since this is a small board).
- Once a piece is lifted off its tile, valid moves are lit up on the board. (This feature is primarily for beginners and can be disabled; it is meant as a teaching tool by actively showing how each piece can move.)
- Once the player picks up a piece and moves it to a new position, the display will respond by giving feedback on whether the move is correct.
- If the player has made the correct move, it gives its response on both the LCD display and physical board (through the LEDs).
- Once a puzzle is solved, this process begins again.

As many others, I have a special place in my heart for nostalgic board games, including chess. My motivation is to create an interactive (and frankly, pretty rad) puzzle teaching tool in a game I greatly enjoy.

Hardware description
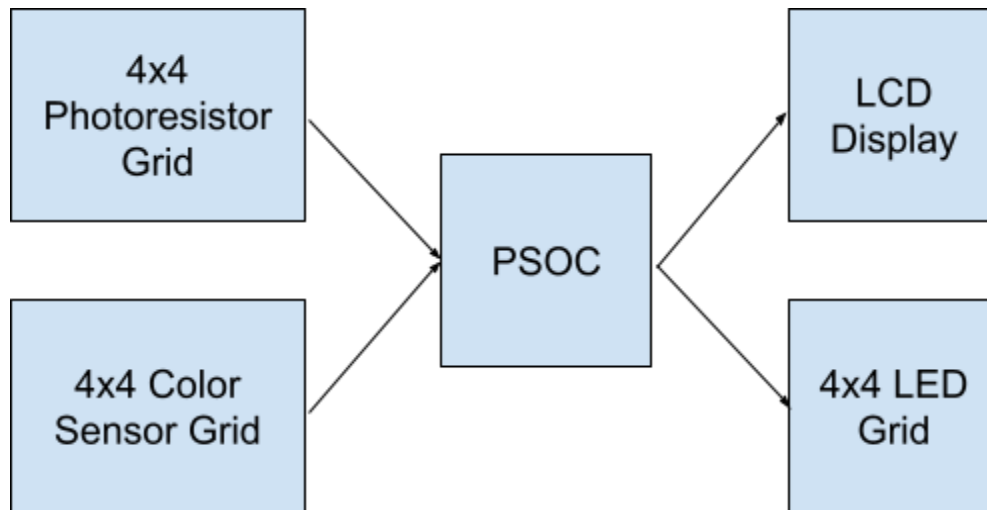
The central facilitator of all external hardware components will be the CY8CKIT-050 PSoC 5LP Development Kit (PSoC Big Board). It will handle all data coming in from the various sensors, as well as control the outputs to communicate with the player.

Each photoresistor will be used to identify whether a piece is occupying a specific tile. If the piece is flush on the tile (and the player is in a sufficiently lit room), it is trivial to determine whether a player has picked the piece up (resulting in an influx in light). There will be 4x4 = 16 photoresistors total.

Additionally, color sensors will be used to sense where pieces are. Each piece will have a certain colored tape (e.g., knights blue, queens red) attached to their bases. The sensors will identify which piece is on a certain tile. There will be 4x4 = 16 color sensors total.

The LED grid will be used to display possible moves once a piece is picked up. There will be 4x4 = 16 LEDs total.

An LCD display will be used to show the current state of the puzzle. It will be a live representation of actions on the board. For example, if a player makes a move on the board, the same move should appear on the display. It will also be the primary mode of communication to the user (e.g., prompting the user to set up the board, giving feedback on the user's move, etc.).

Software description
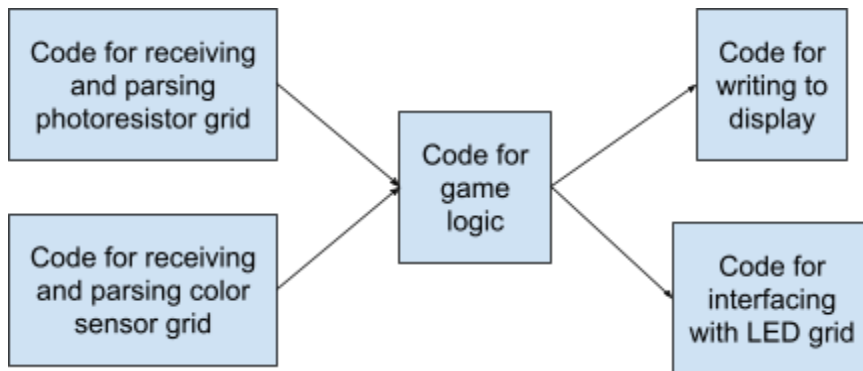
This game will be implemented in five blocks of code, with the heart of the program being the game logic code. The other four blocks will be used to interface with external sensors/chips. While the "interface" code will be able to run independently, the game logic code will bring the whole program together.

Project scope and management

First:
- Create a fully working game solely on the PSoC.
- Play the game by hard coding moves (basically testing for bugs and such)

Second:
- Create a physical board with color sensors and LEDs. Test each grid of components (i.e., have the ability to know where each piece is; be able to light up any set up LEDs on the grid).
- Have the ability to solve a puzzle with minimal mechanics.

Third:
- Add photoresistors under each tile and have the ability to measure any tile's luminosity.
- Add the ability to pick up pieces and show possible moves on the relevant LEDs.

Special Component Needs (outside of what 6.115 offers)

Name	Where
240 x 320 RGB Pixels 2.8" TFT LCD for Microcontrollers	https://www.mpja.com/240-x-320-RGB-Pixels-28-TFT-LCD-for-Microcontrollers/productinfo/35628+MP/