Chess Playing Robot

Sean Vibbert - Electrical Engineering
Faculty Advisor: Dr. Mohsen Lotfalian

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UNIVERSITY OF EVANSVILLE

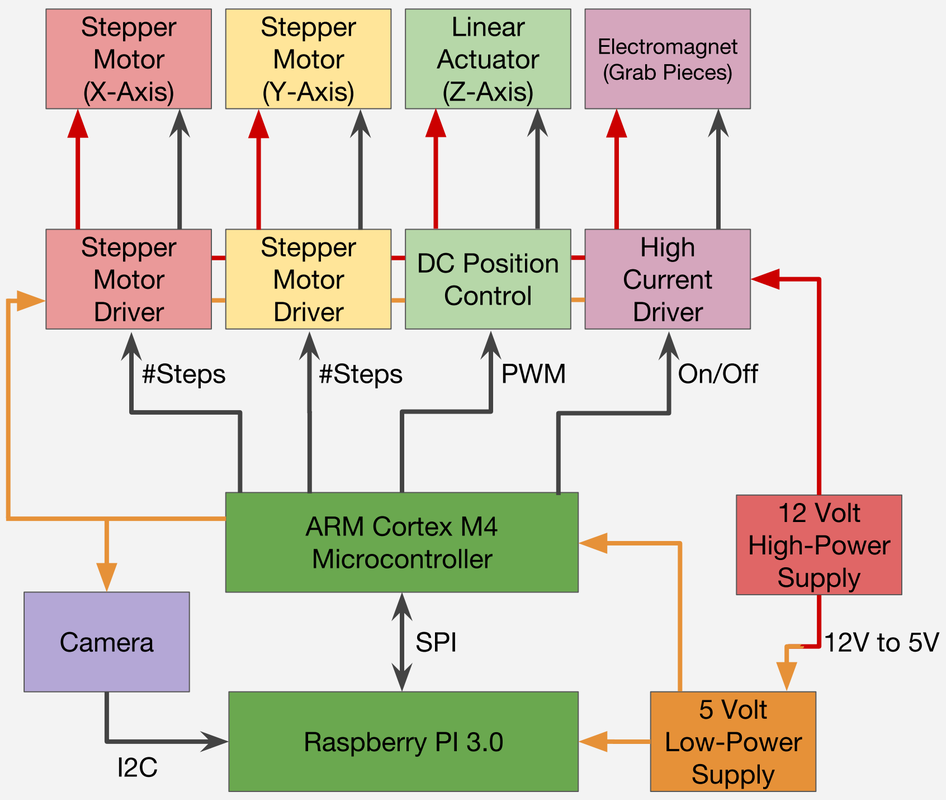
Abstract

Modern advances in software have allowed chess players to find the best possible moves with their computers. These number crunching programs, called chess engines, can be used for analysis or even be played against. However, their utility ceases past software. The Chess Playing Robot aims to take the ability of chess engines and bring it into reality over a physical board as an opponent who can move pieces and make decisions.

Electrical Design

Problem: A chess engine must interface with a physical board and remember where pieces are located

Solution: Use an ARM M4 Microcontroller to control the motor drivers and communicate with a Raspberry PI 3.0

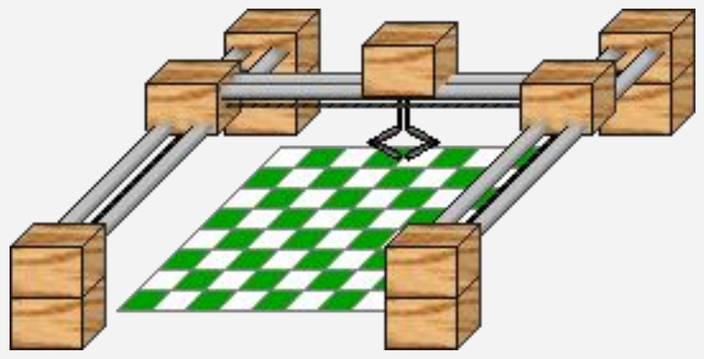


The ARM Cortex M4 functions as an integrated circuit that can control every aspect of the robot. The Raspberry PI 3.0 is an external machine that can theoretically run any chess engine or software.

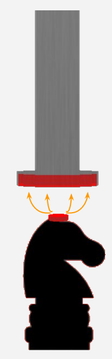
Mechanical Design

Problem: Moving chess pieces requires a great amount of precision

Solution: Use an X-Y-Z movement approach, where stepper motors rotate pulleys that move platforms on the X and Y axis, and a linear actuator moves an electromagnet on the Z axis



The mechanical design is similar to that of a claw machine, or more recently, a 3D printer. The use of stepper motors ensures the location of the "claw."

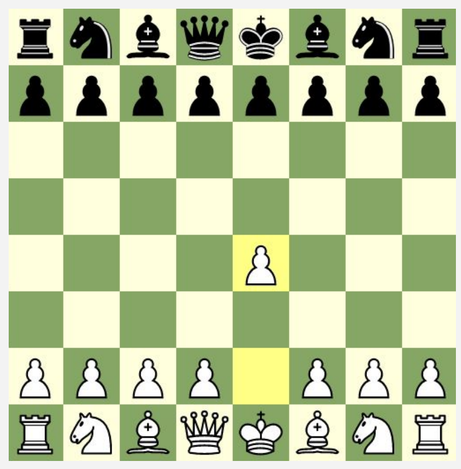


The "claw" is simply an electromagnet. The pieces are modified by planting ferrous metal on top of each piece.

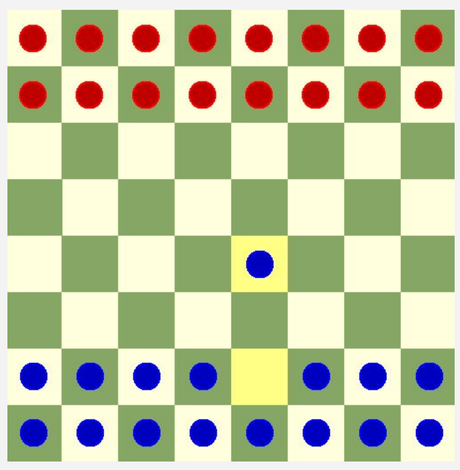
Logic Design

Problem: To simulate an opponent, the robot must be able to keep track of the board state

Solution: A game of chess must follow legal moves, meaning that only changes in piece locations are required to follow each move. This convenience allows for the use of a camera



The game always has the same starting position with white to move.

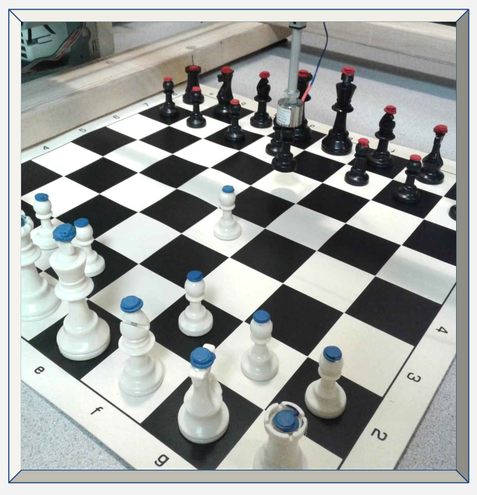


By coloring white pieces with blue dots and black pieces with red dots, the overhead camera can detect piece locations and interpret a move.

Results

The robot can be placed over a chess set and is calibrated to the location of the board.

The Chess Playing Robot's electrical, mechanical, and logical designs have been successfully implemented. The robot will consistently move pieces to their desired locations based on commands sent by the ARM board. The Raspberry PI's overhead camera will detect human moves, allowing the chess engine to formulate a response. With this cycle, a full game of chess can be played.



The robot can move any piece with precision.