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ChessBot
VEX Future Foundation Design Challenge 2011

ChessBot

Our team built a robot that will entertain anyone who knows chess or help teach those who do not. To build the robot, we needed three components: a mechanism to determine the move made by the player, a mechanism to determine the best move to make in response, and a mechanism to move the pieces.

1. ***Determining the move made: board and pieces.*** In order to determine the move made by a player, we devised the following solution. Each square on the board will have a resistor attached to the bottom of the board with resistance from 1 to 128 kΩ in powers of 2, in series along a rank of the chessboard. The Cortex can read an analog input from this series of resistors. But each square is also wired to the other side of the board where, if a piece—which has a copper bottom—is placed, it will short-circuit that one resistor. Thus the total resistance can be converted into binary, and that sequence of ones and zeros corresponds to whether squares are occupied or not. Repeating this across eight ranks, the state of the entire board can be read. Since chess starts with the same initial state and every subsequent raising or lowering of a piece can be determined, every subsequent state can be determined as well by computing which piece must have been moved or captured (and by following a predetermined sequence of lifting when handling multiple pieces, e.g. for castling, capturing, etc.).

2. ***Determining the best move: AI code.*** We ported the most efficient open-source chess AI we could find but found even it required more RAM than the Cortex has, and thus determined that for the purposes of this demonstration, the robot would have to play a preset game instead of actually thinking. But the robot does demonstrate the principle that simply by allowing an even slightly more powerful processor, or e.g. communication with a computer that can do the processing, a robotic chess opponent is possible.

3. ***Moving the piece: robotic arm.*** The arm hovering over the chessboard can be moved in the plane parallel to the board on sliding racks, and an electromagnet to grab the pieces hangs from the arm on a pulley. The solenoid electromagnet has its own power supply to prevent damage to the Cortex, which uses a digital output to switch a transistor that in turn switches a relay to activate the magnet. Shaft encoders guarantee that the robot moves the arm to the correct square on the board and moves the electromagnet to the correct height to grab the piece.

The game against Chessbot develops as any human chess game would: a human makes a move on the board, after which the robot calculates its response and uses its arm to execute it. As it shows in the video by playing an actual FIDE Candidate Master, ChessBot can entertain novice and expert chess players alike.