The Automated Chess Board (ACB) is a novel device that integrates the benefits of playing chess on a computer with those of playing on a physical board. It uses an array of electromagnetic coils underneath a glass playing surface that can be activated individually or in groups. This allows one or more physical wooden chess pieces with affixed permanent magnets to be moved around the board. These coils are controlled by an internal computer running a chess engine, allowing the user to play chess against the computer on a physical board.

### Benefits
- Novel design with no internal moving parts
- Ability to quickly move multiple pieces simultaneously
- Real wooden pieces for a tactile user experience
- Adjustable difficulty levels
- Portable design
- Automatic board reset after game
- Trainer mode, move validation, and hints

### Materials and Methods

The ACB has a portable design consisting of an aluminum frame that houses all the coils, the control system, and an internal battery. It also holds a series of user interface buttons, switches, and LEDs for a variety of interactive features.

The control system consists of a Raspberry Pi along with a series of GPIO port extenders that communicate with coils, LEDs, and other user interface devices. The Pi runs the Stockfish chess engine to determine its moves based on the set difficulty level.

The coils and most of the LEDs are arranged in a grid that allows them to be activated using an X and Y coordinate system. The grid area also contains a set of magnetic sensors under each chess square to detect when a chess piece is present.

### Results

The control system, user interface, and coil/LED grid subsystems are functional. This allows the basic movement of chess pieces and user interaction through buttons, switches, and LEDs. The magnetic sensors, however, are not functional because of magnetic interference throughout the system. Due to this issue, the ACB cannot detect the movement of chess pieces, and therefore cannot complete a game of chess.

### Conclusion

In conclusion, the Automated Chess Board performs well at chess piece movement, user interaction, and choosing competitive chess moves. Most of the original design goals were met, however, future work on the sensor subsystem is required for full functionality. Overall, the ACB is a novel, fun, and useful device.

### Fun Facts
- The ACB is made up of over 1500 electrical components.
- The ACB contains over 13 miles of enamel coated magnet wire.
- The ACB can move up to eight chess pieces at a time.

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