Check, Mate, Vision

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Product Pitch

Check, Mate, Vision is an **adaptive chess assistant** designed to enable individuals with limited upper body mobility to engage fully in the traditional, in-person chess experience.

It allows a user to play a full game of classic chess in person without using any part of their upper body. This is accomplished by leveraging machine learning to allow the user to select pieces on the board by simply looking at a computer screen. An automated gantry hidden below the table unobtrusively executes the user's move by using magnets to manipulate the desired pieces.

Check, Mate, Vision **delivers the authentic, unencumbered experience of chess**, fostering accessibility without compromising the integrity of the game.

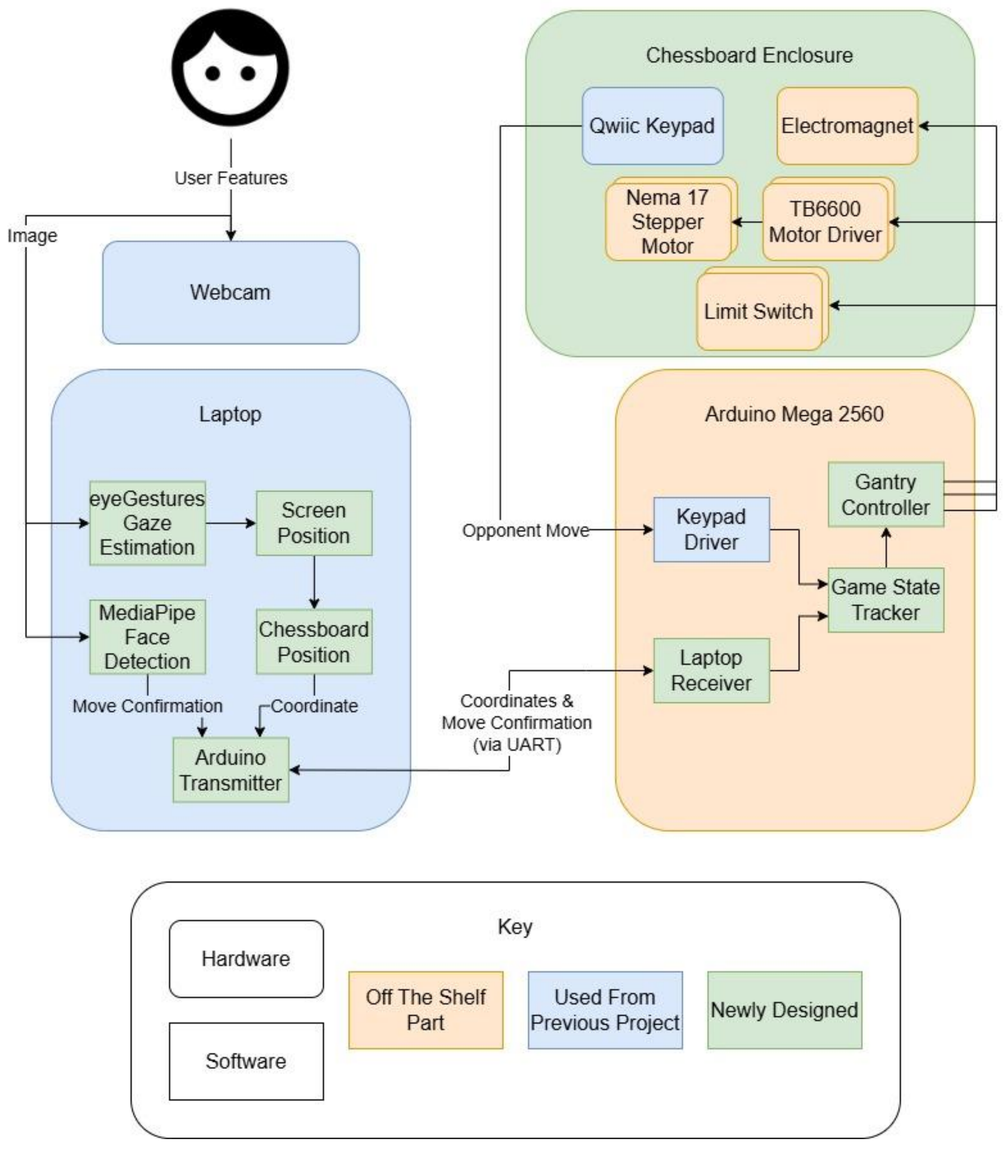
System Description

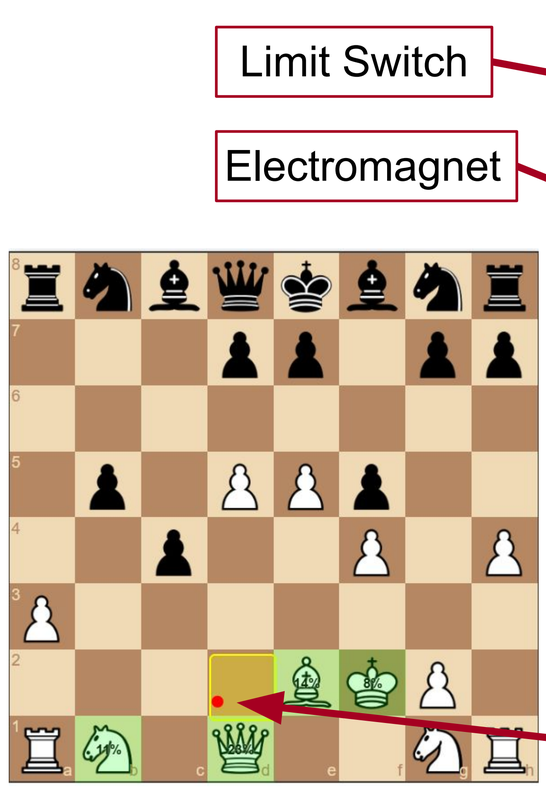
Gantry: This component acts mainly as the piece movement mechanism. It is composed of a pulley system, step motors, and a electromagnet trolley that can move a chess piece between any two squares on the board.

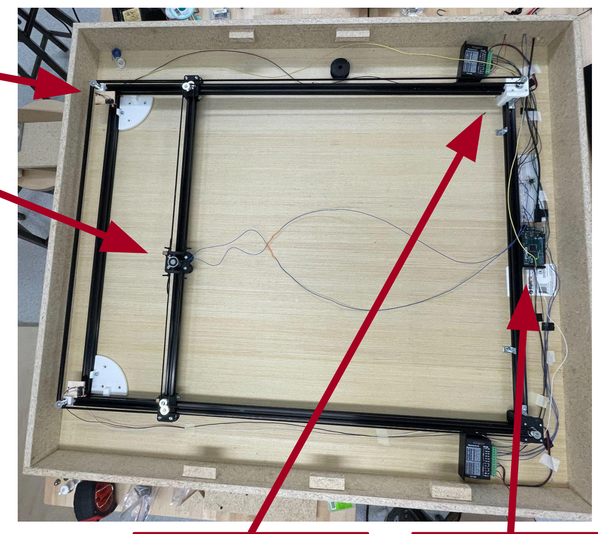
Embedded Control: All electronics, either directly or indirectly, are controlled by an Arduino Mega 2560. The device precisely handles all gantry coordination, as well as interfacing between all peripheral components.

Gaze-Tracking: Webcam technology that precisely tracks a user's visual focus on screen. This subsystem interacts directly with the user and extracts the desired chess move.

System Architecture







System Evaluation

Use-Case Requirements:

Metric	Target	Actual
Gaze-Tracking Accuracy	> 80%	80%
Piece Movement Accuracy	> 70% of base surface area in target square	85%
Overall Move Latency	< 10s	7s (average)

Design Requirements:

Metric	Target	Actual
Gaze-Tracking Latency	≥ 30 FPS	30 FPS
Motor Response Time	< 2s	1s
Magnet Disturbance	No disturbance when > 0.75" away	No interference at any distance
Keypad Accuracy	≥ 90%	95%

Conclusions & Additional Information

While our end-product was not exactly the project we envisioned 4 months ago, the amount of learning that happened far surpassed our expectations.

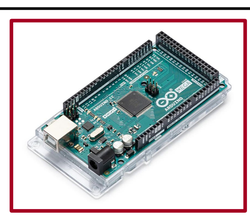
Our goal was to build a system that "invisibly" tracked eye position as you looked at the board. After arduous amounts of research, testing, and pivoting, we realized this was easier said than done. Though this was not incorporated into the final product, this taught the team a great deal about computer vision applications in real user-centered systems.

Overall, we are very proud of the work we have put into this project and feel our final product reflects our hard work. We hope to one day put *Check, Mate, Vision* in the eyes of real customers.

https://course.ece.cmu.edu/~ece500/projects/s25-teamc8/

Embedded Design Trade-off Factors:

- Ease of Use
- Toolchain
- I/O Pins
- Performance



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