# Chess Board and Pieces Detection and Prediction using YOLO

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## Application

This project offers a unique opportunity for human players to engage in chess matches against the Stockfish engine, a powerful AI opponent renowned for its strategic prowess. By taking on the role of the white pieces while Stockfish controls the black pieces, players can experience the challenge of competing against an advanced AI opponent in a familiar and accessible setting.

Through gameplay sessions with Stockfish, players can:

- Hone their chess skills by testing their strategies and tactics against a formidable opponent.
- Explore the capabilities of AI technology in the context of a classic board game, fostering a deeper understanding of machine intelligence.

Overall, this project provides a captivating and educational experience for players of all levels, blending the traditional game of chess with cutting-edge AI technology to create a compelling platform for learning, entertainment, and skill development.

## Problem Statement

Traditional chess analysis lacks dynamic interaction and real-time input, which impedes skill growth and understanding. Players frequently struggle to locate challenging opponents for practice sessions, which limits their progress. Furthermore, correctly recognizing the chessboard and pieces for automated analysis remains a technological challenge. Many gamers struggle to gain access to powerful AI technologies for gaming interactions. This project intends to overcome these concerns by incorporating YOLO-NAS for exact chessboard and piece recognition, allowing human players to effortlessly challenge the Stockfish engine. This integration allows for skill development, learning, and enjoyment in an immersive chess playing experience.

## Impact

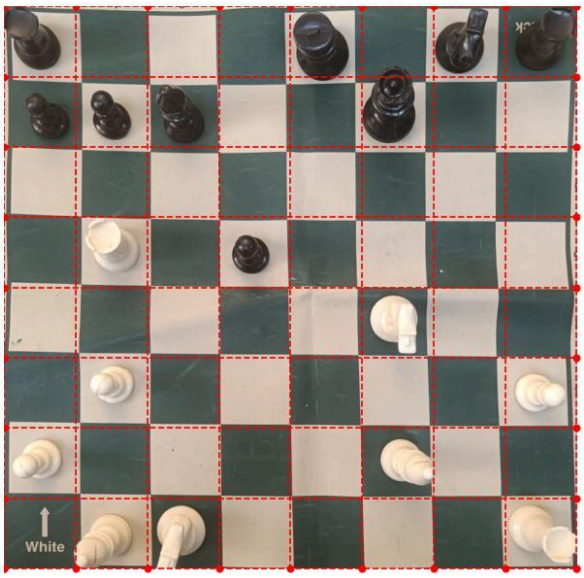
- Skill Enhancement: Players improve strategic thinking and adaptability by facing Stockfish.

- Learning Experience: Insights into AI algorithms spark curiosity and understanding.
- Entertainment: Engaging human-AI matches offer thrilling gameplay.
- Research Contribution: Analysis of matches aids in advancing AI gaming and human-computer interaction.

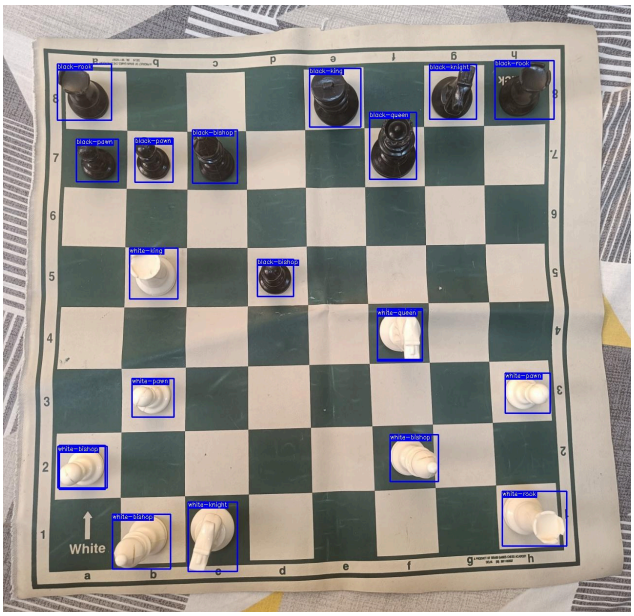
## Results

Two YOLO-NAS models have been trained to make the detections possible on the chessboard.
First one being where it detects the corners of the chessboard.


Then the image is cropped taking the corners into consideration so that now only the chess board is seen and the remaining stuff can be ignored.(as seen above).
After this we distribute the whole image into a 8*8 grid and then we start our pieces detection.




Now, the second model comes under use which is trained to detect pieces and then when it returns the output we match its coordinates with that of the grid and then make a chess FEN(A single line format which gives the current positions of pieces on a board) which is used to make a chess board.




The above image just shows how the pieces detection model works.

## Scope For Enhancement & Future Work

While the current implementation provides a solid foundation for human-AI chess gameplay using YOLO-NAS for board and piece detection and Stockfish for move prediction, there are several avenues for further improvement and exploration:

- Refinement of Detection Accuracy: Continuously improving the accuracy and efficiency of the YOLO-NAS model for detecting chessboard and pieces can enhance the overall gameplay experience. Fine-tuning the model architecture and training on larger and more diverse datasets can help achieve better detection performance in various lighting conditions and chess board configurations.

- Integration of Advanced AI Techniques: Exploring advanced AI techniques such as reinforcement learning or neural network-based move prediction algorithms can enhance the strategic capabilities of the AI opponent. Integrating these techniques with Stockfish or developing custom AI agents can provide more challenging and dynamic gameplay experiences for human players.

- The current application made has a lot of limitations like dataset availability then the angle from which the chessboard is shown, lighting problems. So, this model can be made more efficient by using bigger datasets which can eliminate the limitations discussed above. Also this can be made into a live working application which can give instant replies to the user and also tracks the moves that the human moved and Stockfish moved for further analysis.

Overall, the scope for enhancement and future work encompasses technical improvements, gameplay enhancements, and broader accessibility initiatives to create a more immersive, engaging, and inclusive human-AI chess gaming experience.