Chess Observation Based Operable Technology (COBOT)

Brandon Goerz, Jeremy Hay, Luke Jacobsen, Sean Kalkiewicz, Logan Steele

Faculty Advisor(s): Dr. Lee Caraway, Dept. of Electrical and Computer Engineering, Florida Institute of Technology

Problem Statement

This project aims to develop an autonomous robotic chess system capable of interpreting board state and physically executing moves. With a focus in real time against a human opponent. Utilizing integrating computer vision, game logic, user friendly GUI, and a robotic arm.

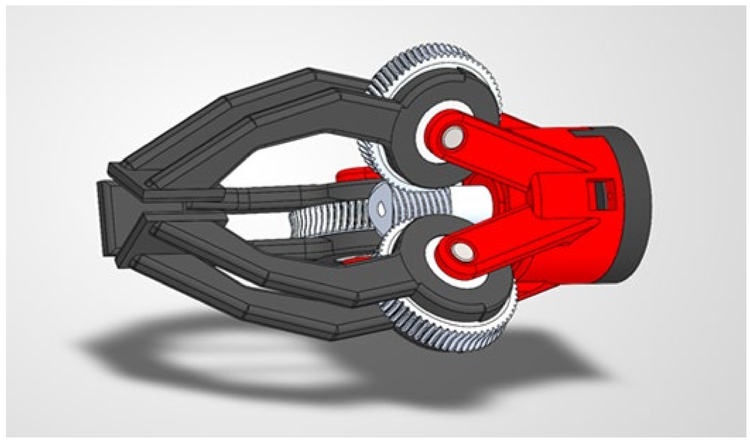
Achievements

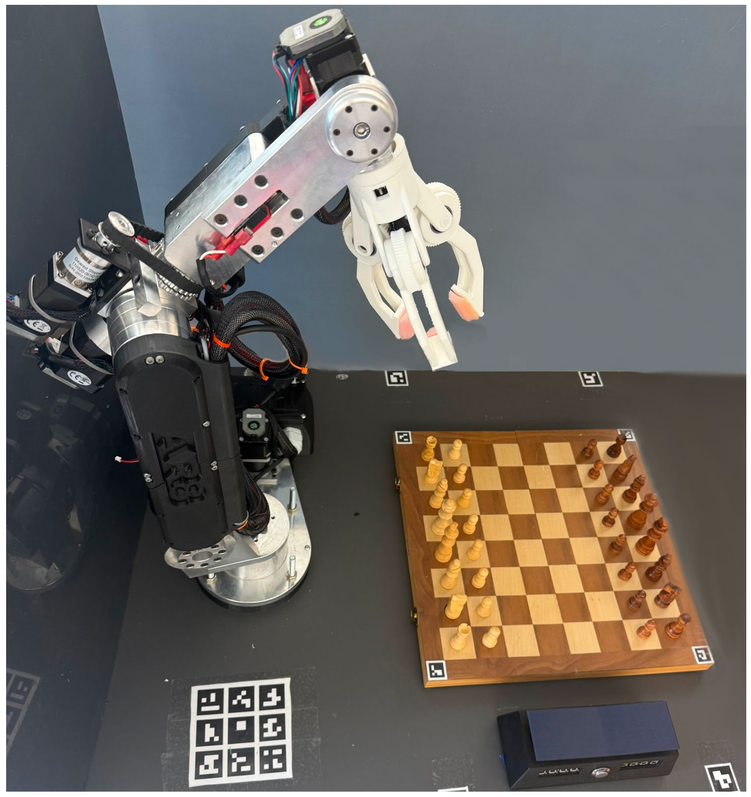
Custom User Interface Development:
Designed and implemented a user friendly graphical user interface (GUI) that enables intuitive control of the system and seamless interaction with the robotic platform.

Enhanced Claw Design:
Developed and integrated a new, research driven claw mechanism to improve reliability and precision in piece grasping and manipulation.

Depth Based Vision Integration:
Incorporated an Intel depth sensor to provide more accurate close range perception for improved piece retrieval and placement verification.

Upgraded Overhead Board Vision System:
Replaced the original Xbox Kinect with a higher resolution USB camera to achieve clearer board state recognition and more reliable move detection.





System Overview

An **AR3** robotic arm performs physical moves while continuously updating its understanding of the board state in real time.

Vision System: An overhead camera detects board state and human moves over USB, while an Intel depth camera on the gripper enables precise piece localization and placement.

Robotic Control: A ROS3 based framework coordinates motion planning and execution, translating chess engine moves into physical actions.

Game Logic: Board states are represented using FEN strings, allowing Stockfish to generate valid moves and maintain game progression.

End Effector: A custom grabber improves grasp reliability and consistency when handling pieces.

User Interface: A custom, user friendly GUI provides real time board visualization, move tracking, and system interaction.

User Interface

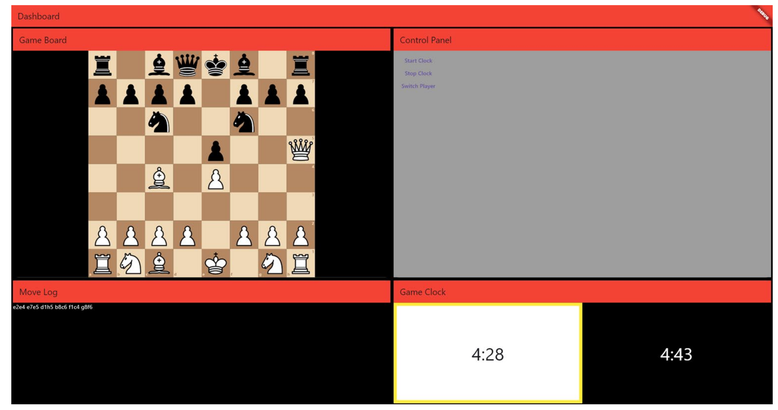
The system includes a custom GUI that lets users view the game and control the robotic chess system in real time. It is designed to be easy to use so users can easily follow what is happening during the game and interact with the system.

Game Board: A Lichess style board displays the current game state as interpreted by the system.

Move Log: Displays all moves and system actions in real time using standard UCI notation.

Control Panel: Provides user controls for the cobot, such as starting and stopping the game clock.

Game Clock: Displays separate timers for each player, clearly indicating remaining time and active player.



Future Work

Improved Board Detection: Make the overhead camera work better in different lighting so it can more reliably recognize the board and pieces.

Two Camera Vision System: Add a second side camera to help double check what the board looks like and improve accuracy.

Faster Robot Movement: Improve how the robot arm moves so it works faster and more smoothly when picking up and placing pieces.