CALIFORNIA STATE UNIVERSITY
BAKERSFIELD

WIP:Automated Chess Player Using a 4-DOF Robotic Arm

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Project Overview

This project focuses on building a simple robotic arm that can recognize and move chess pieces on a board. The system will use a basic camera for detecting the board and pieces, a pre-trained chess engine for decision-making, and motorized joints to execute moves. The goal is to develop a functional prototype, ensuring ease of implementation while maintaining accuracy in piece movement

Goals/Objectives

- Design & Assemble the Robotic Arm: Build a 4-DOF robotic arm with a gripper capable of picking and placing chess pieces.
- Integrate Computer Vision & Chess Engine: Use a camera to detect board positions and integrate a chess engine (e.g., Stockfish) for move decisions.
- Implement Motion Control & Automation: Develop a control system that allows the arm to execute legal chess moves accurately.

Benefits and Application

Accessibility for Disabled Players: Enables individuals with physical disabilities to play chess by using voice commands or other accessible inputs

Remote Chess Playing: Players can compete from different locations making physical board chess accessible over the internet. Allows for world tournaments without the worry of traveling

Research and Development Platform

Serves as a testbed for research into robot planning, and human-robot interaction, particularly in the context of delicate tasks.

Sponsor

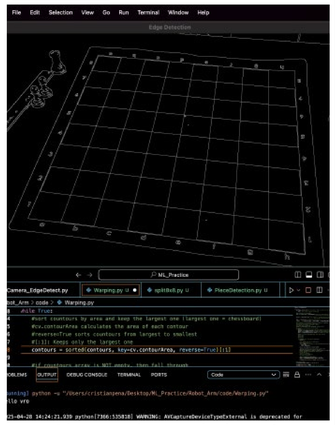
Chevron

Photos/Diagrams

Figure 1

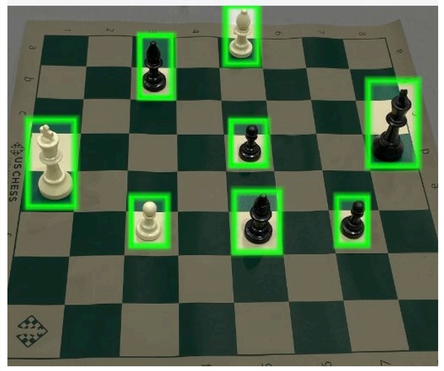
Shows the warped chessboard taken directly from the video feed.

Figure 2



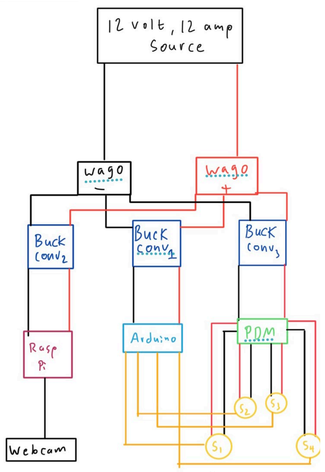
Shows board that is preprocessed

Figure 3



CNN detecting chess pieces

Figure 4



Wiring Diagram of System

Figure 6 (Future Design)

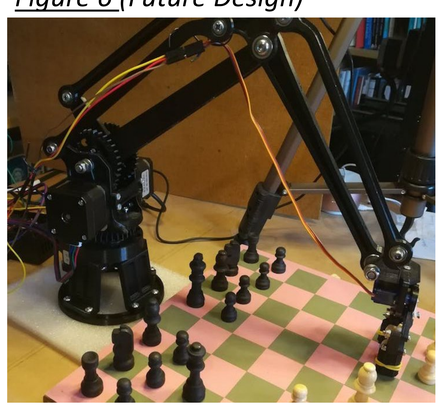
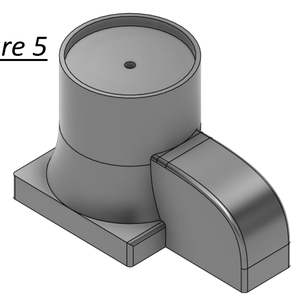


Figure 5



Rotary Base in Fusion 360

Electronics

- A 12 volt, 12 amp. wall adapter will connect to two wago connectors, these will act as positive and negative leads.
- 3 buck converters will step down the 12 volts to 5 volts, Buck Converter 2 will be solely for the Raspberri Pi and the webcam, Buck Converter 1 will be solely for the Arduino, Buck Converter 3 will be solely for the Mg996R motors.
- The motors will be plugged into a power distribution module and will be powered by it, but the signal cables will be plugged into the Arduino
- We chose 3 buck converters to better monitor voltage and current drops

Computer Vision

- This team decided on using Python for its fast-learning curve and understanding.
- Used an open-source library called OpenCV that helps with preprocessing video feed.
- Includes functions that make the video gray, blurred, and display edges and contours, can be seen in *Figure 2*
- After preprocessing, warp the video feed so that it is on a 2D plane, since it will be useful for YOLO algorithm.
- This can be seen in *Figure 1*, showing the warped video feed.
- Begun to research specific YOLO algorithms and datasets specifically for chess piece detection so that we can get a result like *Figure 3.*

3D Modeling

- This Team is continuing to look into different designs for the Base, Arm, and Claw
- The base is using a rotary design that will be controlled by a single motor Figure 5
- The measurements of the Arm is calculated based on size of the chessboard

Dimensions of Arm

-Base Length: 250mm -Base Width: 150mm
-Base Height: 150 mm -Chessboard is 355x355 mm