CS365- Artificial Intelligence
Project Proposal

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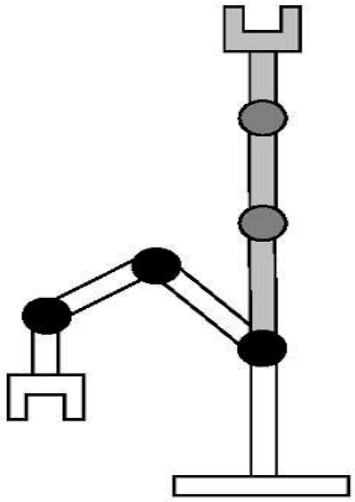
Chess-playing Robot based on LEGO Mindstorms

Motivation

Chess being one of the most popular games in the world, development of chess playing programmes and machines has been a challenge of great interest to engineers since decades. Even though excellent chess playing programs have been designed which can easily beat grandmasters under normal conditions, autonomous robots playing chess on real life chess boards are still hard to find. Our aim is to implement a robotic arm that can play chess with humans on a normal chess board just as humans do. Most chess playing robots that currently exist use sensory chess boards to decipher the moves of the players and separate chess engines to generate further moves. We wish to design a robot that can identify the moves by processing images captured through a camera, thus creating a machine that could play chess on any normal chess board without additional requirements.

Brief Description



Basic Design of the Arm [1]

Our aim is to design an autonomous chess playing robot that uses a chess algorithm and vision to decipher moves. The robot consists of three components:

- A computer vision components to detect the moves of the user and help robot in making its move
- A chess algorithm to compute new moves and deciding which move to take
- Robotic arm to make the desired move

The design we wish to implement consists of 4 degrees of freedom- an arm consisting of three hinges and a gripper to pick up the pieces [1]. We will use an overhead camera to capture images that would be processed to figure out the moves. Then new moves would be calculated using an algorithm [2] and accordingly send voltages to the motors to move the piece from one position to another.

Implementation

We will be using Lego Mindstorms kit to implement the mechanical part of the robot. Each of the hinges would have roller bearings to facilitate rotatory motion. Servo motors will have to be placed at each of the hinges to control the motion of the arms and another one will be used to control the gripper to move the pieces. To calculate moves we will be using an open source chess program called Chessterfield [2]. We will also be using a webcam to capture images of the chessboard and then using image processing (OpenCV) to decipher moves made by the human player. Since identification of black pieces on black squares is difficult due to limitations of computer vision, we will compare states before the move and after the move to detect which pieces have moved.

References

1. *Autonomous Chess-playing Robot*: Timothe Cour Romy Lauranson Matthieu Vachette (2002).
2. *Chessterfield*: Chess playing program by Matthias Lüscher
3. MarineBlue: A Low-Cost Chess Robot: *Cynthia Matuszek, Brian Mayton, Roberto Aimi, Marc Peter Deisenroth, Liefeng Bo, Robert Chu, Mike Kung, Louis LeGrand, Joshua R. Smith, Dieter Fox*
4. Autonomous Chess-playing Robot: *Timothée Cour, Rémy Lauranson, Matthieu Vachette.*