Chess Playing Robot – Using AI and robotics to have a non-human opponent in chess matches

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Games such as chess where there needs to be two players, can become a problem when there isn't a second person available to play as we have seen in these times of isolation due to COVID-19. Inspired by other robotic chess playing agents, we propose a portable, with less additional equipment robot using an ubiquitous approach to the board as well as offering an expansion for other board games and a coaching component.

Key Words: Artificial Intelligence, robotics, image processing, computer vision

INTRODUCTION

Chess playing robots or Artificial Intelligent robots have been around for quite some time. We see them in numerous research projects [Golz and BiesenbachGolz and Biesenbach2015], mobile applications or even in video games. Unlike a video game, however, chess is a board game that is more suitable for a human companion. Two people can always play online on a screen, but there is something special when there is an interaction between a physical chess board and a companion [MartinsMartins2017]. This is not only because humans are social beings and as such this interaction becomes more enjoyable, but also the specifics of the face-to-face game, where the board could be seen in 3D dimensions at a physical level. But, what happens when our lifestyles impede us from having these companions or circumstances out of our control such as the COVID-19 pandemic ? This research focuses on answering this question by providing a human-like robot that can play chess in a physical format (i.e moving pieces in a physical board). Since there are several solutions implementing the robotic agent playing chess (e. g., [Chen and WangChen and Wang2019]), most of them are either not portable (e. g., [Groen, der Boer, van Inge, and StamGroen et al.1992]), or require additional equipment that might not be ubiquitous (e. g., [Rath, Mahapatro, Nath, and DashRath et al.2019]). Our goal is to design the robotic agent with a few DOF so that everyone would be able to use it. Having been influenced by [Chen and WangChen and Wang2019] and [DingDing2016], we use another equipment so that everyone could be able to use it. The design of this robot will be accomplished by using image detection technology to detect pieces and movements on any chess board, an AI to make the robot play chess, and a human aspect in which the robot will have a face and hands to move the chess pieces.

PROPOSED METHODS

The robot will use the image detection system to detect the changes in the move order (Figure 1). To avoid the extra work of the image processing, we need to have a detector which describes the order of move and if the game continues. To do this, we provide the switch having two buttons with different colors. It will be placed right from the player playing with Black so that the robot could distinguish the side. During the game, if it is white to move, the button on White side will have the green color, while if it is Black to move, the button on Black side will have the red color. The clock system will be turned on and off with a switch.

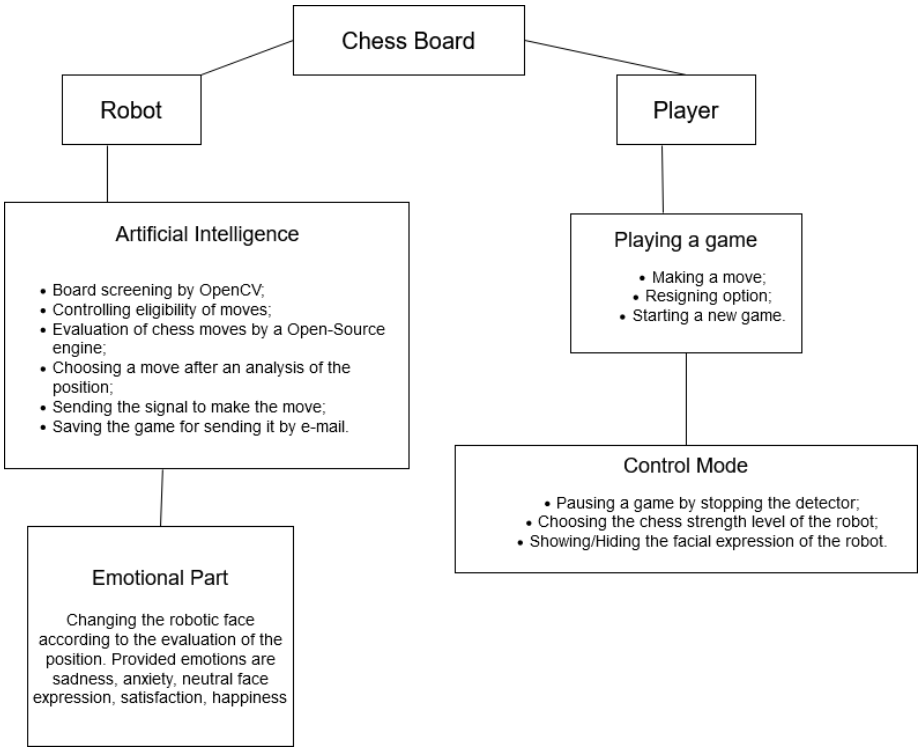

Fig. 1. Schematic Representation of Human Computer Interaction

The robot will use image processing to detect the position change after the button is clicked. First, the camera working on 15 FPS per second will take the 1280x720 photo after the button is clicked. After that, the image is converted to the grayscale for the easy processing. Then, the extra noise is removed and the board is detected. It allows to detect squares and pieces, which allows comparison with the previous position's image: the comparison is done by image subtraction. The result of image subtraction is firstly defined by the trained AI, then compared with the list of available moves. If the move is illegal, the proper speech informs this, restores initial position, and clicks the detector button back. Otherwise, the move is sent to the chess engine by UCI protocol. When the chess engine responds, the robotic agent plays the move and presses the detector, taking the image of the last position that is stored as the last position.

ANTICIPATED RESULTS

Our team expects these possible results:

- The accuracy of the board detection is directly dependent on the size of the board, i.e. when the board is small, the accuracy is small. The possible reason is the density between the lines and the size of the board squares that could affect the image processing.
- The accuracy of the position detection is reversely dependent on the size of the piece, i.e. when the piece is small, the accuracy is high. The possible reason is that when the piece is huge, it might cover some lines between the squares in the chess board, which makes the detection problematic.
- We expect that when the result is not processed or the legal position configuration occurs (for example, the piece placed between two squares), the robot should inform about the illegal made move and click the detector back and restore the initial position before the illegal move.
- A robot agent with the capability of socially interacting with people by playing a smooth match of chess using facial expressions with different modes and levels for teaching and learning.

Additionally, we provide the *survey* to know the opinion of participants regarding the robotic agent playing board games. The results of the survey will help in the design of the robotic agent and look into the socialistic parts in human computer interaction. We would like to know if people will like to play with this type of agent beforehand and study the responses in order to better serve the community and better understand what can be a success to this idea. We expect that the participants are going to be either loyal or neutral against the robotic agent, however, we have no prediction regarding the gender and creature interface of the robotic agent.

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