AudEye 2 - A Chess Assistant System

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Abstract

Audeye 2, a chess player analyzer and helper using eye tracking glasses[1], is an extension of the previously implemented project Audeye[2]. The former project included features like live game analysis, sonificated hints to the user and interaction via gesture control. Developing upon this base, in our project new features have been added. Furthermore we are fixing major shortcomings like no mechanism for real figure- and chess board detection. New features included this year chiefly are individualized assistance based upon a classification of players using the 'Structural Dimensional Analysis of Mental Representation'[3] and a ranking mechanism. Our ranking mechanism looks quiet promising for the categorization of players. Additionally, we are working on a template matching approach for board detection and also a contour extraction approach for figure detection. Initial findings from the chess board- and the figure detector suggest that for a standard chess board it is possible to detect real chess figures in the near future with further additions to the current approach.

Introduction

Chess, due to its complexity, can be challenging for players of all levels. In this project we aim to develop a comfortable chess assistance system for players without interrupting the flow of the game. Modern eyetracking glasses, which allow highly interactive human-machine interaction, were used in the previous project. The system recognizes the chessboard and the current state of the game with a front-mounted video camera in the glasses and the aid of computer vision. This allows the creation of hints for the next move, that can be deployed to the user via a sonification module and earphones. The eyetracking data, i.e. information about the eye movement, is used to interpret predefined gestures and fixations, which are used to communicate with the system.
Theoretically allowing a fluid and comfortable use of the assistance system, several simplifications were made in AudEye to the playing environment:
To allow an easier recognition of the board and especially the current state of the game, flat tokens (pokerchips) were used to represent the chess figures. Additionally, the system has to follow the game from the beginning, as it is not capable of detecting the actual figures. To make the detection possible, the consecutive moves imply unique positions for each chess piece by the means of chess rules. While providing an actual running system, the use of flat tokens instead of real figures and the need of detecting each subsequent move makes AudEye cumbersome to use.

The AudEye 2-Project addresses these shortcomings by introducing new approaches for both the board and the figure-detection. We are currently using a template-matching approach to find characteristic features of the chessboard. This information is used to determine the position of the board.
In addition, we want to allow individualized assistance, depending on the needs of the player by means of his level of chess expertise. For this the user needs to be classified. It is done using Structural Dimensional Analysis of Mental Representation (SDA-M)[3] to measure the mental representation for chess of an individual player.

Main Objectives

1. More robust detection of the chessboard
2. Detection of chess pieces and thus allow the use of real (if possible: arbitray) chessfigures
3. Individualized assistance depending on the level of expertise of the user
4. Classification of the chess player with the SDA-M

Hardware

In this project we are using the SMI Eyetracking-Glasses 2.0[1] with two eyetracking sensors and a front-mounted camera. The glasses are comfortable to wear and offer a high resolution video input (720p), which can be broadcasted live via a C++ API. The software is running on a laptop with a multicore CPU.

Methods

The C++ API and RSB are used to supply all the components with the video input from the front mounted camera. In our project we are using OpenCV to cover the computer vision part.

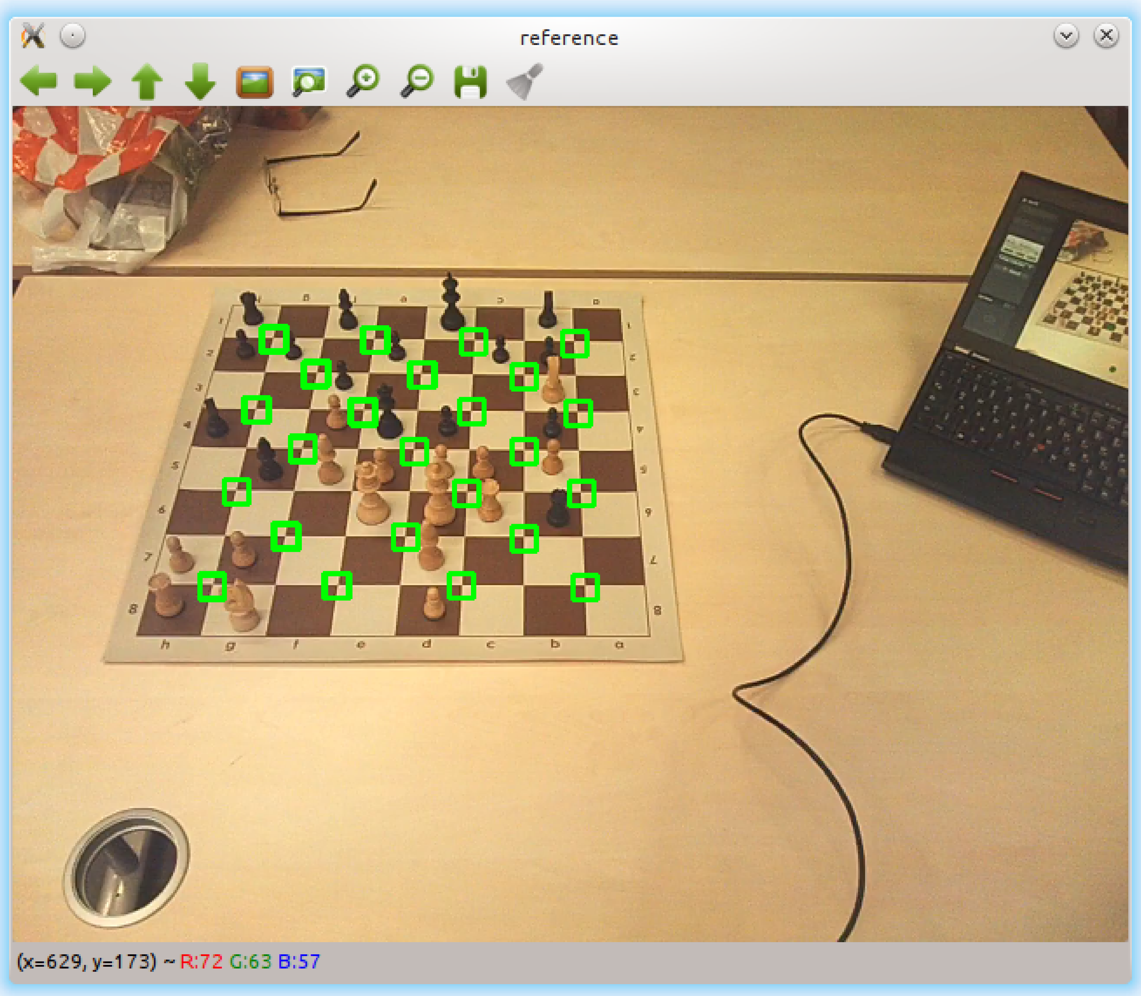

Figure 1: Detection of characteristic features to indicate the boards position.

Detect the Board

The current approach uses template matching to find characteristic features of the chessboard to retrieve the boards position. Because the template matching is heavily dependend on the orientation of the scene, we are using two slightly rotated templates simulataneously, which can be extracted out of a sample image automatically.

Classification of Chess Player

We present the test player a classification set to clusterize, using the Split program. It performs a Structural Dimensional Analysis of Mental Representation (SDA-M). Comparing the clusters of a test player with a reference (expert) player we get a numerical value for the level of the player. At the same time we are testing the applicability of the SDA-M to Chess.

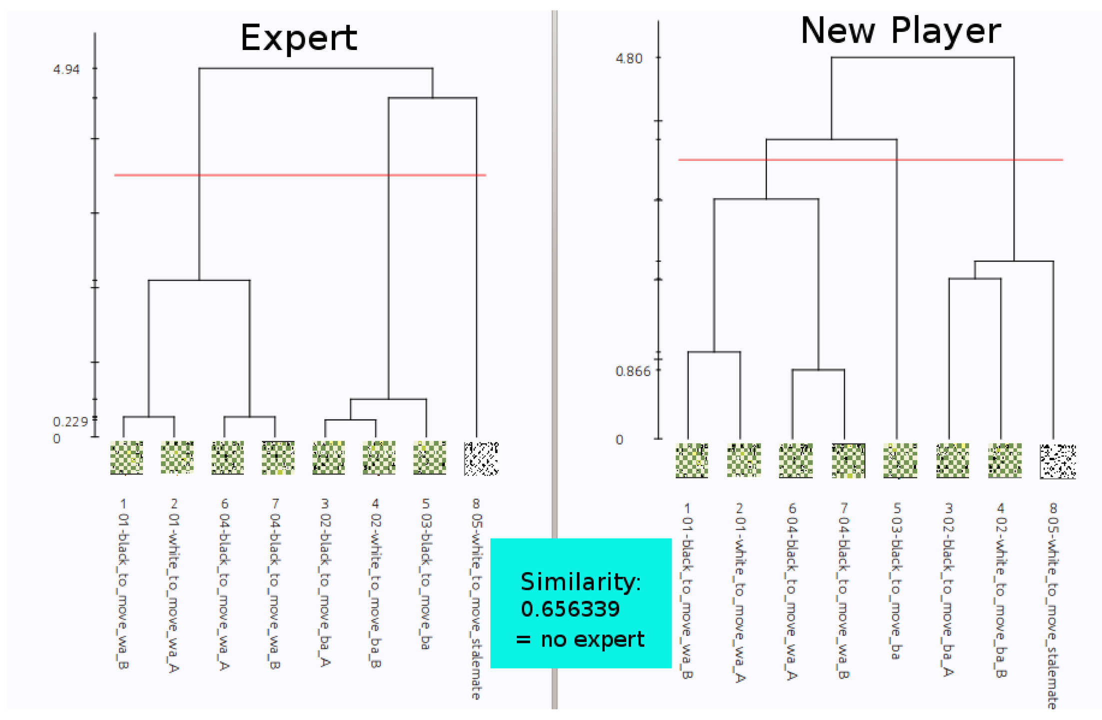

Figure 2: Comparison of two player dendrograms after doing the SDA-M procedure.

Figure Recognition

Using contour information, we extract the relevant pixels from the input. A Hugh Line Transformation is applied to distingish between figure- and board contours.

Results

The exact board position is indicated, by using features of particular board patterns. In figure 1 we see the result of the board detection algorithm using the template-matching approach. However, the approach still needs further finetuning to deal with more extrem angles.
For the classification, the dendrogram of a test player is compared to a dendrogram from a reference (expert) player . The similarity value of the two dendrograms represent the level of the player. The result of the classification procedure chiefly depends upon the classification set used for the procedure.

Figure 3: A real world scenario.

Conclusions and Future Work

The board detection and the figure detection have produced promising results but even under simplifications, the computer vision challenges we are facing in this project are inherently difficult to perform. It turned out, that even with knowledge about the objects, we still need constraints to develop a feasible system in terms of usabillity. In the coming semester we look forward to purify the approaches further to make them robust and usable in the real scenario. The new feature of player classification with the SDA-M has produced good results. However, our approach first needs further evaluation to find a suitable classification set.
In the future, we are looking forward to increase the comfort even further to create an invisible and easy-to-use assistance tool.

Acknowledgements

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References

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