

# Computer Vision System for Executive Function Training

## Cognitive and Quickness Training Utilizing a Projector, Four Cameras, and a Neural Network for Pose Estimation

### Students



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**Introduction:** The purpose of this thesis was the development of a demonstration setup for executive function training (EFT) based on an existing neural network for human pose estimation and using a projector with a projection screen and four cameras as a physical setup.

EFT is the simultaneous training of body and mind, aimed at improving reaction speed and decision-making under pressure. It is vital for athletes like ice hockey players.

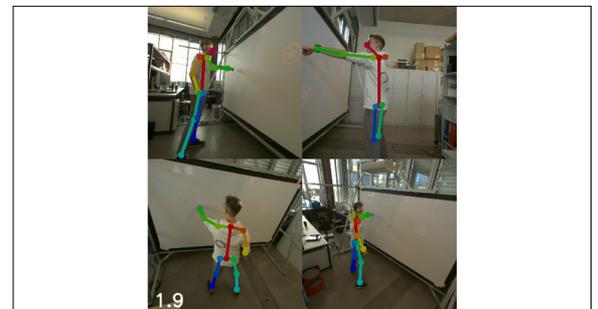
In contrary to traditional EFT systems that use physical actuators, the presented approach is much more flexible and can dynamically adapt to the user's performance.

**Approach / Technology:** The system was mainly implemented in Python and uses several libraries, e.g. for computer vision and mathematical tasks, as well as code provided by the ICAI to extract the images from the cameras and to find the human pose using a full-convolutional neural network. The main parts of the project were the intrinsic and extrinsic calibration of the cameras, the triangulation of the person in 3D space, and the development of an EFT game for demonstration purposes.

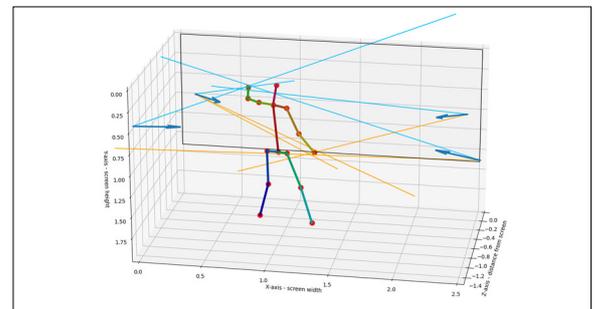
**Result:** Within the scopes of this thesis it was possible to show that an EFT setup can indeed be created on the basis of a human pose tracking system and that a good quality of the triangulation of a user in 3D space can be achieved using reasonably adequate hardware. On the other hand, reaching a good fps rate has proven to be more challenging. The developed EFT game also shows that the possibilities with a system implemented in software are sheer endless, as it can track the entire body pose of a player. The results of this project indicate that an EFT system

using computer vision and artificial intelligence is possible, and that there is great potential in pursuing the idea.

**Views of all four cameras of the player, with the detected pose from the neural network overlaid.**  
Own presentation



**3D plot of the player's triangulated pose, with lines showing the cameras' views of each of the player's wrists.**  
Own presentation



**A player playing the developed EFT game, with a screen showing the tracked pose of the player on all four camera images.**  
Own presentation



### Advisors

Hannes Badertscher,  
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### Subject Area

Artificial Intelligence,  
Digital Signal  
Processing, Image  
Processing and  
Computer Vision