Human-Interaction with Computer Vision and Electromyography:Rock-Paper-Scissors

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ABSTRACT

This paper presents an implementation of the game rock-paper-scissors to display human interaction with computer vision or electromyography depending on the selected mode in the application. In optical mode, the player makes one of the possible moves (rock, paper or scissors) in front of the camera. Afterwards, the program recognizes his move using computer vision libraries and the computer plays a move arbitrarily. Subsequently, the result is determined about who wins and the player receives optical feedback from the interface of the application and haptic feedback from a Myo armband that he wears. In haptic mode, the player makes a hand gesture, which is classified through a support vector machine, and the result is displayed both optically and through armband vibrations.

Index Terms: Human computer interaction (HCI)— Computer vision— Haptics— Myo armband

1 INTRODUCTION

In recent years, computer vision has emerged as a cornerstone of modern technology, enabling machines to interpret and analyze visual data from the world around them. This capability has revolutionized various fields, from autonomous vehicles and medical diagnostics to entertainment and smart home systems. A key aspect of computer vision's transformative potential lies in its ability to facilitate seamless and intuitive human-computer interaction (HCI) [1].

Another technology which enables communication between humans and computers is haptics. Haptics use touch feedback in a plethora of ways, such as motion, vibration or application of forces. These technologies enhance the user experience by adding physical interaction. Applications of haptic technologies appear in various research domains including medical training, virtual reality, neurorehabilitation and sensory substitution. In the context of human-computer interaction, haptic technologies create a responsive and engaging interface for users.

Therefore, we have implemented the game rock-paper-scissors as a case study to explore the dynamic interplay between computer vision, haptics and human interaction. With gesture recognition and multimodal feedback, the application demonstrates the potential of computer vision in interactive systems. Specifically, this application extends the common Rock-Paper-Scissors game found in [2] by adding haptic feedback and gesture recognition from electromyography signals.

2 OPTICAL IMPLEMENTATION

First, the graphical user interface is created by placing the visual feed from the user camera on top of a designated spot on a background image (Figure 1). The program starts when the player presses the keyword “S”, which triggers a countdown starting from three seconds and ending at zero. During this time, the player performs one of the possible moves with their hand in front of the camera. Afterwards, the player move is determined using the hand tracking module of the library cvzone [3]. This library recognizes which fingers are shown in the camera. Based on this information, the player’s move is identified: "paper" is represented by all five fingers being extended, "rock" is represented by no fingers being extended, and "scissors" is represented by the middle and ring fingers being extended. Subsequently, the program determines who wins following the typical rules of the game: rock wins scissors, scissors win paper and paper wins rock. Afterwards, the player receives optical feedback about the result and the score changes. Moreover, the player receives haptic feedback from the armband, which vibrates differently based on the result of the game.

Figure 1: Example of graphical user interface of optical mode.

3 HAPTIC IMPLEMENTATION

In the context of the application, the haptic technologies applied are vibration for feedback and electromyography signals for user input. The application uses the Myo armband, which is a gesture control device and consists of eight metal contacts that measure electrical activity in the user’s forearm muscles. For its integration in the application, the myo-python library [4] made by Niklas Rosenstein was preferred as it’s the most popular and complete library for the armband.

Using this library we were able to implement the vibration and some gesture recognition for starting new rounds of the game or closing the application completely. Specifically, the double-tap gesture initiates a new round, and the wave-out gesture closes the application. Moreover, each gesture has a unique vibration pattern and for the stand-alone haptic mode, another library was utilized for its classification examples in order to enable recognition of Rock-Paper-Scissors. This was the Myo toolbox for Ecole Centrale de Nantes [5], which uses myo-python as its base. After some changes in the code of the classification examples, a dataset was created with 200 electromyography signal recordings of 3 seconds each for every class (rock, paper and scissors). For the training of the model, a support vector machine, which was included in the library, was used, with an estimated accuracy of 85%.

For the haptics mode, the trained model was used to classify the live feed of electromyography signals. After the start of the counter the electromyography signals are saved in a double-ended queue with the values and a timestamp. The class is decided by the dominant class during the countdown and the result is displayed on the screen and there is a vibration depending on the result.

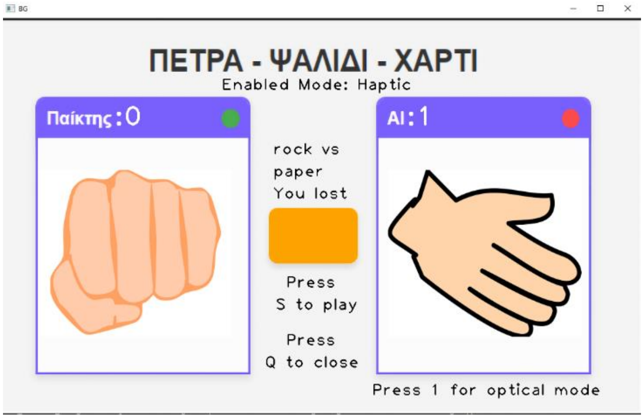

Figure 2: Example of graphical user interface of haptics mode.

4 CONCLUSIONS

This application demonstrates how the combination of computer vision and haptics enhances the responsiveness and the user experience. Even in such a simple application their implementation achieves the goal of a seamless and intriguing human-computer interaction, which could be extended in future projects.

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