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Fight with Your Body!! The Virtual Reality Game Combined Gesture Recognition and Skeleton Tracking

用身體去戰鬥！！結合手勢辨識與骨架追蹤之虛擬實境遊戲

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作品摘要

這幾年各種新型態的人機互動方式如雨後春筍出現，其中 Kinect 深度感應器的骨架追蹤和手勢辨識在推出後廣為流行了一陣子，但是對於操作距離要求的不同，同時使用的應用並不多見。

近幾年，虛擬實境技術快速興起，電玩界每隔數月就會有好幾款新遊戲推出，各種吸睛虛擬實境眼鏡也常常造成話題，但是人機互動上一直以來大多還是以鍵盤和滑鼠操作為主，導致玩家不能達到理想的沉浸感，以遊戲為例，就算內容風格迥異，遊戲機制卻最終屬於幾種模式，而基於骨架追蹤或手勢辨識來操作的遊戲，雖然引進了新的元素，但若遊戲指令複雜，操作上必須特地記得特殊的動作或手勢，導致操作不靈活且不直覺，若遊戲簡單，雖然體感操作能變直覺，卻常因此犧牲樂趣和耐玩度。

有鑒於另一個熱門的領域—擴增實境，是利用將虛擬的資訊帶入現實的場景中，模糊現實和幻想的界線，因此本團隊創新思考如果將人類的各種姿態，手勢能否轉換成為一種新資訊，可融入於虛擬場景中，成為另一種操控遊戲的新模式。

因此本作品目的乃希望藉由結合手勢辨識和骨架追蹤技術，進行虛擬場景人物操控，做出操作靈活且直覺，同時擁有高精細度沉浸感的虛擬實境系統。

本虛擬實境遊戲系統由以下架構組成：

（一）、肌電訊號手勢辨識裝置：
藉由判斷手勢的變換，根據肌電訊號實驗與分析得到的數據，形成各種指令，手勢造成肌電訊號明顯變化的情況有兩種，一種是肌肉極度用力時會造成肌電訊號振福明顯上升，另一種是手勢改變時，會造成肌電訊號有明顯的波型，分析後發現這種波型變化主要反映在一種低頻的波，相較於高頻波的除了振幅增加之外，並無明顯波型，需要特殊的數學工具才能分類，這種低頻波很適合作為手勢變換的判斷基礎，又由於高頻的波能反應手腕肌肉出力情況，結合高頻和低頻的訊號能作出更簡單準確的手勢變換追蹤。

（二）、Kinect 骨架追蹤：
骨架追蹤使用 Zigfu 團隊開發的套件與 Kinect 套件追蹤玩家骨架，雖然玩家的體格會有差異，但由於動作是基於關節的角度所構成，因此人物模型也運行腳本使其關節的角度和玩家同步，做出相同的動作。

（三）、全新體驗虛擬實境遊戲：
客製化的虛擬實境遊戲場景製作，主要利用骨架追蹤系統，玩家可用真實世界的動作同步遊戲人物的動作，再運用手勢變化決定遊戲人物要使用的招式和攻擊，實現操作更直覺且更具高度沉浸感的虛擬實境遊戲。

（四）、嵌入式系統輔助搖桿：
由於實際測試人物的移動和視角的移動至今仍受玩家實際位置的限制偵測，若用於操作遊戲角色會使遊戲體驗降低，因此本團隊利用 Arduino 晶片結合嵌入式系統設計出輔助操控搖桿，幫助玩家控制遊戲角色的移動與視角操作。

圖 1 / 情境示意圖

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2007 年取得交通大學電機與控制工程研究所博士學位，2009 年至 2011 年擔任交通大學生物科技學系助理研究員，並於 2010 年起擔任 UCSD 之訪問學者。2012 年起進入交通大學生物科技學系擔任助理教授，2014 年升任交通大學生物資訊及系統生物研究所副教授至今，2010 年至今擔任 IEEE Transactions on Neural Networks and Learning Systems 期刊副編輯。

研究領域

神經工程、腦機介面、計算神經科學、生醫訊號處理、醫療照護系統、模糊類神經網路、機械學習。

Abstract

Variety of new applications based on human-computer interactions has been grown up in recent years. The most famous of the skeleton tracking and gesture recognition is Kinect which is developed by Microsoft for Xbox 360 and Xbox One video game consoles and Windows PCs. Kinect has been widely applied to many video games for a while. However, the major limitation of the Kinect as the input device control is how to precisely detect the different distance in manipulation. Therefore, it still has rare applications that can be integrated with the Kinect.

In addition, new virtual-reality (VR) technologies are also growing up rapidly. Lots of different new games which are developed based on these novel VR technologies are always catching professional players' eyes. Unfortunately, the main control device of these games is still based on the keyboard or joystick such that players cannot always be involved into the games for a long time, especially when playing such exciting battle or adventure games. Hence, we design a whole new concept of the control device which is integrated with the Kinect for tracking skeleton, embedded joystick system, and EMG- for developing a new style of VR-based videogame in this project. We do hope using our developed innovative control device can let the player absolutely enjoy manipulating the role in the game by his/her body language. It also can open a new insight in the future development of human computer interaction. We will introduce each component of our proposed control device in the following sections.

I)EMG-based gesture recognition device:
We developed an EMG-based Gesture recognition device which can capture and recognize the different gestures when moving rapidly. Based on our past EMG experiments and gesture detection algorithm, there were two significant different patterns can be detected when the current gesture was changed. One pattern is that the amplitude of the EMG channel will be activate when muscle is contracting, and the other pattern is that we can observe a specific EMG waveform when the gesture is changed. Therefore, combining these two patterns of EMG signals, our proposed EMG-based gesture recognition device can detect and recognize the gesture precisely.

II) Kinect for tracking skeleton:
We integrate the commercial Kinect unit with our developed control device which can synchronize tracking the measurement of the player's motion behavior and understand the player's current skeleton.

III)New Virtual-reality based video game:
Our proposed new control device will be applied to developing a new VR-based video game. The developed new game is combined with the skeleton tracking technology to synchronize measuring the motion behaviors of the player and the gesture analysis algorithm to recognize which skill that virtual player wants to apply.

IV) Embedded joystick system:
After the system integration testing, we found that the player's moving position and viewing vision are still limited in the real playing situation. It would reduce amount of immersive playing experience when the player needs to move or look around to control a specific virtual character in the real playing situation. Therefore, we design an embedded joystick system based on the development kit of Arduino controller to assist the player controlling the moving and viewing virtual characters.

Fig.2 / System Structure