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智慧聯網六軸復健裝置
Intelligent Internet Six-axis Rehabilitation Instrument

隊伍名稱　智控聯隊 Intelligent Control
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研究領域
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研究領域
穿戴式智慧技術、人工智慧與深度學習、智慧型控制與系統識別與自動化感測與量測。

作品摘要

腦血管疾病名列臺灣十大死因第二位（臺中榮總腦中風中心，2017），患者容易腦中風，導致行動不便，嚴重影響家中氣氛和經濟分配，且需要長期復健和龐大醫護費用，更造成家庭不可承受的負擔。若能把握中風後六個月復健黃金期，將提高患者恢復獨立生活的可能性。專業物理治療必須至醫院或診所接受治療師和醫生的動作指導，但往返醫院的路程，加上等待治療的時間，都對病患和照顧者造成身心折騰，導致忿惱的治療心態，而錯失治療黃金期。

一般簡單運動組態的復健機構操作，存在許多缺點：因長期枯燥的動作，易使患者半途而廢；無法完整收集病患生理資訊和紀錄復健資料，失去較佳的復健效益；照顧者難以全程關注復健過程；醫生無法得知患者在家復健狀況，更無法進行即時高效率的復健輔導。

本專題完成智慧聯網六軸復健裝置設計與控制研究，研製肩肘關節的手臂復健機構，建立即時醫傷雙向訊號傳輸控制平台，改善傳統單向單一動作的復健機。本研究建構新型互動式機電復健系統，含可控制多姿態復健動作機械手臂、生理訊號分析模組、感測數據藍芽傳輸和復健即時監控平台。互動機制透過網際網路連結醫護人員與病患，醫生端設計動作指導式對耦控制結構，藉由感測數據分析手臂復健動作參數，發送操控信號至雲端伺服器；病患端可隨時存取復健動作指令，依智慧操作模式進行正確復健動作。

本系統完成軟硬結構整合，提供復健監控多感測器分析、即時監測復健狀況、紀錄數據資料、建立資料庫，提供較佳治療調整方針。患者可藉長期收集分析資料，瞭解自我復健狀況。即時量測各軸向復健動作和回授補償角度，經往復動作與定位測試，驗證顯示相對誤差小於5%。系統設計多重安全機制，使硬體機構可操作於正常範圍，若復健響應異常或使用者生理感測訊號超出正常範圍，可於0.5秒內啟動終止程序，快速中止復健動作驅動，使機構動作完全停止，並同步發出警報通知使用者和照顧者，立即中斷復健裝置，以確保系統使用安全。

圖1. 本智慧聯網六軸復健裝置之子系統設計架構

Abstract

Cerebrovascular disease was the second among cause of death in Taiwan in 2017. The long-term rehabilitation and medical expense hits domestic economy. However, if one could seize the golden treatment period, the possibility of recovery from disease will highly increase. Professional physiotherapy must be conducted by doctors in the hospital or clinic. Patients and their families spend lots of time and money on therapy. Its causes them to feel both physically and mentally exhausted and be prone to give up the treatment.

Conventional rehabilitation mechanisms have some drawbacks. The repetitive and boring action increase the possibility for patients to give up training easily. It couldn't collect patients' physical data and the rehabilitation records. Doctors can't monitor and improve the training process in real time when the patients rehabilitate at home.

The intelligent internet six-axis rehabilitation instrument has been accomplished by constructing the coupled-exoskeleton arms with shoulder-and-elbow joints. The mechanism allows patients to rehabilitate with multi-directional movements. Bidirectional communication between doctors and patients has been set up for remote controlled rehabilitation. The novel features of the interactive mechatronic rehabilitation system contain a physiological signal analysis module, a Bluetooth data transmission module, and a rehabilitation monitoring interface, as well as an information storage website. The interactive mechanism allows medical practitioners and patients connect each other through the internet. By analyzing sensed data of the training movement angle, a doctor can store better rehabilitation movement information in the cloud server to instruct patients rehabilitation correctly.

The system has been designed and set up for storing multi-sensed data and recording information in a database. Related analyzed information help doctors and trainers to adjust medical policy for best rehabilitation. Patients could comprehend their own rehabilitation condition by perusing their long-term data. The system with multiple security mechanisms has been created for safety operation. The robotic rehabilitation arms have been tested and verified to operate in arranged allowable ranges. Abnormal action and unusual physiological signal can be detected with real-time alarms. A designed smart control function can stop rehabilitation mechanism immediately to avoid abnormal and harmed action for ensuring safety both operator and instrument.

Fig.2 The developed interactive mechatronic rehabilitation system