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智慧式下肢協行機械裝置

Intelligent Lower Limb Walking Assistant Robotic Device

隊伍名稱｜肝功能退化
Hepatic Insufficiency

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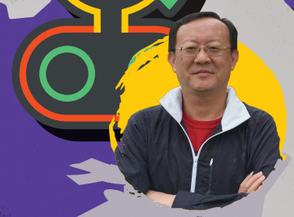

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研究領域

微機電系統、半導體微製程、感測與量測自動化、工程科技教育

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研究領域

穿戴式智慧技術、人工智慧與深度學習、機電系統整合、智慧復健輔具

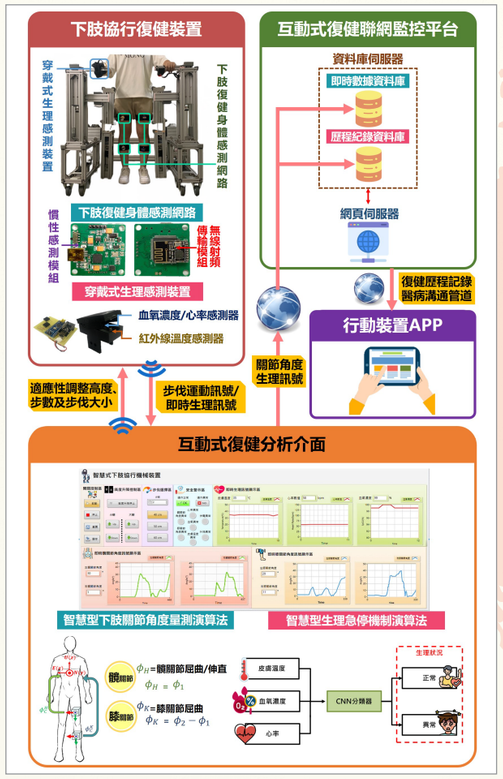
作品摘要

世界衛生組織 (WHO) 統計資料顯示，2019年來腦中風已是全球第二大死因，每年約有610萬人死亡；而到了2022年已達到流行病的程度。臺灣衛生福利部統計顯示，2016年以來腦血管疾病已位居國人十大死因之一。腦中風患者往往會因為中樞神經系統受損，造成肢體控制障礙，經常會產生下肢關節僵硬、變形、肌肉無力及缺乏行走協調性等症狀，導致下肢行走功能受損，進而增加步行時跌倒的機率。當腦中風患者發生下肢行走功能損傷時，將導致日常生活功能性動作失能，進而造成生活品質下降及家庭照護問題。

然而，目前下肢復健裝置多為單一形式或單一關節的復健機構，重複執行枯燥的復健動作，讓復健病患時常半途而廢，失去較佳的康復時機。傳統的復健裝置無法完整的自動收集病患復健過程的動作及生理資訊，使得照護者難以協助完整的復健過程，醫生也無法快速評估病患復健的療效。因此，我們發展智慧式下肢協行機械裝置，具低成本、多功能、高效率、高安全性且即時監控等優良特性，改善現有的臨床醫學復健裝置，以科技化的方式實現具下肢行走完整步態週期動作之智慧復健設備與應用。

本系統整合了下列智慧機構：下肢協行復健裝置、含智慧關節角度量測演算法的下肢復健身體感測網路、含智慧生理感測模組的穿戴式生理感測裝置、安全生理參數監控之智慧控制、互動式復健分析介面、以及智慧復健聯網平台。病患可以透過本作品帶動下肢執行行走完整步態週期動作之訓練，以達到下肢行走動作復健的功能。病患行走復健療程的關節角度及生理訊號等紀錄，儲存於智慧復健聯網平台，用以建置病患完整的復健歷程，提供醫護評估復健成效之參考。此外，本系統設計多重可控安全機制，於復健響應或生理訊號異常時，能夠即時快速的停止機構作動，以確保使用者安全。

本智慧式下肢協行機械裝置已經完成智慧協行復健輔具、穿戴式多參數感測裝置及智慧復健聯網平台，具適性化調整功能，記錄並提供完整的醫病互動式復健資訊，可執行高效能行走復健照護應用。



圖一 本智慧式下肢協行機械裝置之系統功能架構。

Abstract

According to statistics from the World Health Organization (WHO), stroke has become the second leading cause of death worldwide in 2019, with approximately 6.1 million deaths each year. By 2022, stroke has reached epidemic levels. The cerebrovascular diseases have been among the top ten causes of death in Taiwan since 2016. Stroke patients often impaired limb control because of damage to the brain central nervous system to leave symptoms of joint stiffness, deformation, muscle weakness, and incoordination of the lower extremities. As a result, their walking ability is impaired and consequently increases the risk of falling during walking. Once stroke patients experience impairment in lower limb walking function, it can lead to a loss of functional mobility in daily life, resulting in a decline in quality of life and posing real challenges for family caregiving.

However, stroke patients currently use single joint rehabilitation devices to do boring rehabilitation exercises that makes rehabilitation patients give up halfway to lose opportunities for recovery. Traditional rehabilitation devices lack the ability to automatically and comprehensively collect patient's motion and physiological information during the rehabilitation processes, so that doctors cannot quickly diagnose the patient's recovery status. Therefore, we have developed an intelligent lower limb walking assistant robotic device for stroke patients with excellent features such as low cost, multifunction, high efficiency, high safety, and real-time monitoring, which can perform training of the complete lower limb walking gait cycle movements. We look forward to improving existing clinical rehabilitation equipment.

The system integrates many smart mechanisms including: a lower limb walking assistant device, a lower limb body sensing network with the smart joint angle measurement algorithm, a wearable physiological sensing device with the smart physiological sensing modules, automatic safety mechanisms, an interactive analysis interface, and an intelligent IoT rehabilitation platform. Patients can utilize the rehabilitation device to perform training of the complete lower limb walking gait cycle movements, aiming to achieve rehabilitation tasks of lower limb walking movements. The rehabilitation records are stored on the intelligent IoT rehabilitation platform to build the patient's rehabilitation history as references for doctors to evaluate the effectiveness of rehabilitation. In addition, the system is designed with multiple automatic safety mechanisms to protect user safety.

The intelligent lower limb walking assistant robotic device has been developed by integration of a lower limb walking assistant device, wearable multifunctional sensing devices, and an intelligent IoT rehabilitation platform. It features adaptive adjustment capabilities, records comprehensive rehabilitation information between doctors and patients, and enables efficient walking rehabilitation applications.

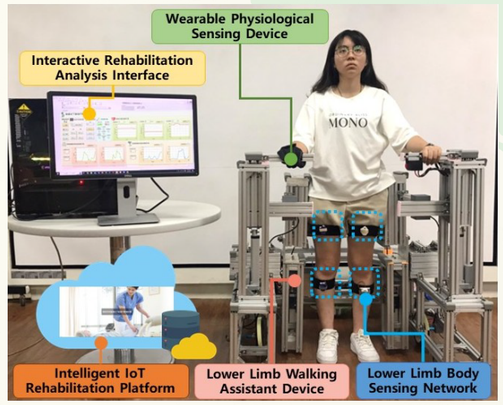


Fig.2 Intelligent lower limb walking assistant robotic device.