WHIOCE PUBLISHING PTE. LTD.
PROVIDING
FIRST-CLASS SCIENTIFIC INFORMATION
FOR TOP SCHOLARS

2026 Volume 11, Issue 1
Journal of Medicines Development Sciences
ISSN: 2382-6371(Online) ISSN: 2382-6363(Print)

Overview of Technology for Hemiplegia Rehabilitation Gloves Based on Augmented Reality Interaction

Haohan Wang, Hao Zeng, Xuanrui Song, Yuting Lin*
School of Medicine, Hainan Vocational University of Science and Technology, Haikou 571126, Hainan, China

**Author to whom correspondence should be addressed.*

A**bstract:** Advancements in rehabilitation medicine have created demand for hemiplegia recovery. Traditional methods suffer from monotony and low compliance. Augmented Reality (AR) technology provides immersive training and real-time feedback, enhancing patient engagement. AR-integrated devices like rehabilitation gloves enable personalized training for impaired hand functions.

Keywords: Hemiplegia; Rehabilitation glove; Augmented reality; Motor function recovery; Patient compliance

Online publication: March 16, 2026

1. Introduction

Hemiplegia, often caused by stroke, significantly impacts patients' daily living and quality of life. Traditional rehabilitation methods, including physical and occupational therapy, can enhance motor functions but suffer from monotonous content and low patient compliance, resulting in inadequate outcomes [1]. In recent years, Augmented Reality (AR) technology has emerged as a vital tool in rehabilitation medicine, providing immersive training and real-time feedback, which enhances patient engagement and compliance, and is more practical than Virtual Reality (VR) for daily applications [2,3]. In hemiplegia rehabilitation, AR-integrated devices like rehabilitation gloves enable personalized training for impaired hand functions, collecting motion data through sensors and offering diverse tasks that enhance limb functionality and cognitive engagement [4,5]. Recent studies have explored gamification and remote monitoring with AR technology to enhance patient compliance in rehabilitation, improving training frequency and motor functions while increasing satisfaction [6]. Remote rehabilitation and mobile app-assisted training have shown positive results in resource-limited situations [7,8].

2. Pathophysiology of hemiplegia and rehabilitation status analysis

2.1. Pathophysiology of hemiplegia

Hemiplegia is primarily caused by brain injury, particularly due to cerebrovascular accidents (such as ischemic or

hemorrhagic strokes) that lead to unilateral brain hemisphere dysfunction, manifested as reduced or lost motor function of the contralateral limbs [9,10].

Damage to motor neural pathways, especially the corticospinal tract, causes muscle weakness and motor impairment, worsened by pathological synergy patterns like the flexion synergy in upper limbs post-stroke, leading to difficulties in independent fine movements [11]. Motor function impairment is often accompanied by sensory deficits, cognitive and language impairments, with complex pathological mechanisms involving neuroinflammation [12].

2.2. Limitations of traditional rehabilitation

Traditional rehabilitation methods mainly include physical therapy, occupational therapy, and assisted functional training, typically relying on the guidance and supervision of professional rehabilitation personnel. Such training processes tend to be monotonous and lack effective real-time feedback mechanisms, resulting in insufficient patient motivation and poor compliance [13,14].

Additionally, the time cost and human resources required for traditional rehabilitation are significant, limiting its accessibility. The content and intensity of training are often difficult to dynamically adjust based on patients' specific conditions, lacking personalization and intelligent support [10,15].

For example, control of muscle spasms and improvement of movement coordination often rely on mechanical repetitive training and manual therapy in traditional therapies, which have limited effectiveness and slow recovery [14,16]. Furthermore, traditional training struggles to fully engage patients' subjective initiative, impacting training compliance and effectiveness [17].

2.3. Development trends in rehabilitation technology

Given the deficiencies of traditional rehabilitation, the current trend in the development of rehabilitation technology emphasizes enhancing patient engagement and improving training compliance. The introduction of emerging technologies such as Augmented Reality (AR), Virtual Reality (VR), and robotic-assisted training can create immersive and highly interactive training environments for patients, thereby stimulating their training interest and initiative [18,19].

Simultaneously, the demand for remote rehabilitation and home rehabilitation is growing, especially in situations where medical resources are limited or patients have mobility restrictions, where technological means can effectively expand the coverage of rehabilitation services [20,21].

3. Augmented reality and its application in hemiplegia rehabilitation

3.1. Augmented reality technology in rehabilitation

Augmented Reality (AR) technology enhances users' perception by overlaying virtual information on the real world, using sensors and cameras for real-time scene capture, which creates an immersive interactive environment beneficial for rehabilitation training [22,23]. AR technology immerses patients in simulated training, enhancing neural plasticity and recovery. Unlike traditional rehabilitation, AR offers multi-sensory stimulation and real-time feedback to improve movement and training outcomes, while also providing personalized programs through complex scenario simulations [24,25].

3.2. Application of AR in hemiplegia rehabilitation

AR technology combines gamification with rehabilitation training in engaging virtual scenarios, enhancing patient motivation and adherence through task goals and feedback mechanisms. Research indicates that gamified training not only increases patient participation but also promotes neural pathway remodeling, accelerating the recovery of motor function. The diverse and personalized AR interaction modes enhance training by aligning it with patients' needs, enabling difficulty adjustments based on progress and providing real-time feedback that boosts self-efficacy.

Recent advancements in augmented reality (AR) for hemiplegia rehabilitation have significantly improved hand

function, motor coordination, and muscle strength, with clinical studies showing enhanced sensory integration and balance. AR training's immersion and interactivity increased patient engagement and adherence. The combination of AR systems with rehabilitation glove technology enabled precise guidance for hand movements. AR technology enhances motor coordination, muscle strength, activity, and self-care, with AR-assisted rehabilitation devices integrating sensors and algorithms to personalize training [26].

3.3. Integrated technology applications

Firstly, the greatest advantage of integrated technology lies in enhancing the personalization and interactivity of training, thereby increasing patient engagement and rehabilitation outcomes. Soft robotic rehabilitation gloves, as a safe and promising technology, can significantly improve finger flexibility and hand function, and most studies confirm that patients have high satisfaction levels. Pneumatic rehabilitation gloves with brain-machine interface technology recognize imagined movements via EEG.

4. Conclusion

The integration of Augmented Reality technology with rehabilitation gloves represents a significant advancement in hemiplegia treatment. This approach addresses key limitations of traditional methods by providing personalized, engaging, and data-driven rehabilitation solutions. Future developments should focus on improving user experience, ensuring data security, and expanding accessibility to maximize patient outcomes.

Funding

2025 Hainan Provincial Undergraduate Innovation and Entrepreneurship Training Program

Disclosure statement

The authors declare no conflict of interest.

References

[1] Bowden MG, Monsch ED, Middleton A, et al., 2020, Lessons Learned: The Difficulties of Incorporating Intensity Principles Into Inpatient Stroke Rehabilitation. Arch Rehabil Res Clin Transl, 2(2): 100052.

[2] VH, Pk MPK, Mg R, 2024, Extended Reality in Revolutionizing Neurological Disease: A New Era for Chronic Condition Treatment. Cureus, 16(8): e67633.

[3] Liu Y, Zhang Q, Li W, 2025, Enhancing Lower-limb Rehabilitation: A Scoping Review of Augmented Reality Environment. J Neuroeng Rehabil, 22(1): 114.

[4] Kim WS, Cho S, Ku J, et al., 2020, Clinical Application of Virtual Reality for Upper Limb Motor Rehabilitation in Stroke: Review of Technologies and Clinical Evidence. J Clin Med, 9(10): 3369.

[5] Huber SK, Held JPO, de Bruin ED, et al., 2021, Personalized Motor-Cognitive Exergame Training in Chronic Stroke Patients-A Feasibility Study. Front Aging Neurosci, 13: 730801.

[6] Zhang B, Guo C, Hui V, et al., 2023, Evaluating the Effectiveness of Video-game Based Swallowing Function Training in Patients with Dysphagia: Study Protocol for a Randomized Controlled Trial. Trials, 24(1): 735.

[7] Aras N, Çalışkan N, Yılmaz B, 2025, The Effects of Clean Intermittent Catheterization Training with a Mobile Application on Quality of Life and Compliance in Spinal Cord Injury Patients: A Single Blind Randomized Controlled Study. Arch

Phys Med Rehabil, S0003-9993(25)01001-9.

[8] Xu D, Xu D, Wei L, et al., 2024, The Effectiveness of Remote Exercise Rehabilitation Based on the "SCeiP" Model in Homebound Patients with Coronary Heart Disease: Randomized Controlled Trial. J Med Internet Res, 26: e56552.

[9] Deshmukh MS, Harjpal P, Thakre VM, et al., 2024, Comprehensive Rehabilitation of a Patient with Right Hemiplegia: A Case Report. Cureus, 16(1): e52065.

[10] Xiong J, Wang JT, Lin S, et al., 2025, Advances in Hemiplegia Rehabilitation: Modern Therapeutic Interventions to Enhance Activities of Daily Living. Front Neurol, 16: 1555990.

[11] Liu G, Chia CH, Jia HJ, et al., 2025, Taking Food to Mouth: Correlation Between Repetitive Movement and Upper Limb Flexion Synergy After Stroke. NeuroRehabilitation, 56(3): 384–393.

[12] Lu W, Ji H, Wu D, 2023, SIRT2 Plays Complex Roles in Neuroinflammation Neuroimmunology-associated Disorders. Front Immunol, 14: 1174180.

[13] Kurosaki M, Tosaka M, Ibe Y, et al., 2022, Functional Recovery after Rehabilitation in Patients with Post-stroke Severe Hemiplegia. Prog Rehabil Med, 7: 20220039.

[14] Fu J, Song L, Wang R, et al., 2020, Effect of Comprehensive Rehabilitation Nursing Intervention on Hemiplegia Patients in Sequela Stage of Stroke. J Pak Med Assoc, 70(Special Issue): 38–44.

[15] Liu G, Cai H, Leelayuwat N, 2022, Intervention Effect of Rehabilitation Robotic Bed Under Machine Learning Combined with Intensive Motor Training on Stroke Patients with Hemiplegia. Front Neurorobot, 16: 865403.

[16] Liu J, Meng X, He Y, et al., 2025, Clinical Efficacy of Electroacupuncture Antagonistic Muscles Combined with Rehabilitation Training in the Treatment of Spastic Hemiplegia after Stroke: A Systematic Review and Meta-analysis of Randomized Controlled Trials. Front Neurol, 16: 1634845.

[17] Anderlini D, Wallis G, Marinovic W, 2019, Language as a Predictor of Motor Recovery: The Case for a More Global Approach to Stroke Rehabilitation. Neurorehabil Neural Repair, 33(3): 167–178.

[18] Hatwar V, Samal S, Harjpal P, et al., 2023, Integrative Approach for Rehabilitation of an 11-Year-Old Child with Bilateral Hemiplegia. Cureus, 15(10): e47950.

[19] Jo S, Jang H, Kim H, et al., 2024, 360° Immersive Virtual Reality-based Mirror Therapy for Upper Extremity Function and Satisfaction Among Stroke Patients: A Randomized Controlled Trial. Eur J Phys Rehabil Med, 60(2): 207–215.

[20] Shen S, Chu T, Wang J, et al., 2025, Progress in the Application of Motor Imagery Therapy in Upper Limb Motor Function Rehabilitation of Stroke Patients with Hemiplegia. Front Neurol, 16: 1454499.

[21] Shambushankar AK, Jose J, Gnanasekaran S, et al., 2025, Cost-Effectiveness of Telerehabilitation Compared to Traditional In-person Rehabilitation: A Systematic Review and Meta-analysis. Cureus, 17(2): e79028.

[22] Jayavel P, Karthik V, Mathunny JJ, et al., 2024, Hand Assistive Device with Suction Cup (HADS) Technology for Poststroke Patients. Proc Inst Mech Eng H, 238(2): 160–169.

[23] Zhang Y, Li Z, Zhang Y, et al., 2024, Application of Novel Wearable Self-Balancing Exoskeleton Robot Capable for Complete Self-Support in Post-stroke Rehabilitation: A Case Study. Cureus, 16(7): e63831.

[24] Sun X, Xu K, Shi Y, et al., 2021, Discussion on the Rehabilitation of Stroke Hemiplegia Based on Interdisciplinary Combination of Medicine and Engineering. Evid Based Complement Alternat Med, 2021: 6631835.

[25] Long Y, Ouyang RG, Zhang JQ, 2020, Effects of Virtual Reality Training on Occupational Performance and Self-efficacy of Patients with Stroke: A Randomized Controlled Trial. J Neuroeng Rehabil, 17(1): 150.

[26] Tang Z, Wang H, Cui Z, et al., 2023, An Upper-limb Rehabilitation Exoskeleton System Controlled by MI Recognition Model with Deep Emphasized Informative Features in a VR Scene. IEEE Trans Neural Syst Rehabil Eng, 31: 4390–4401.