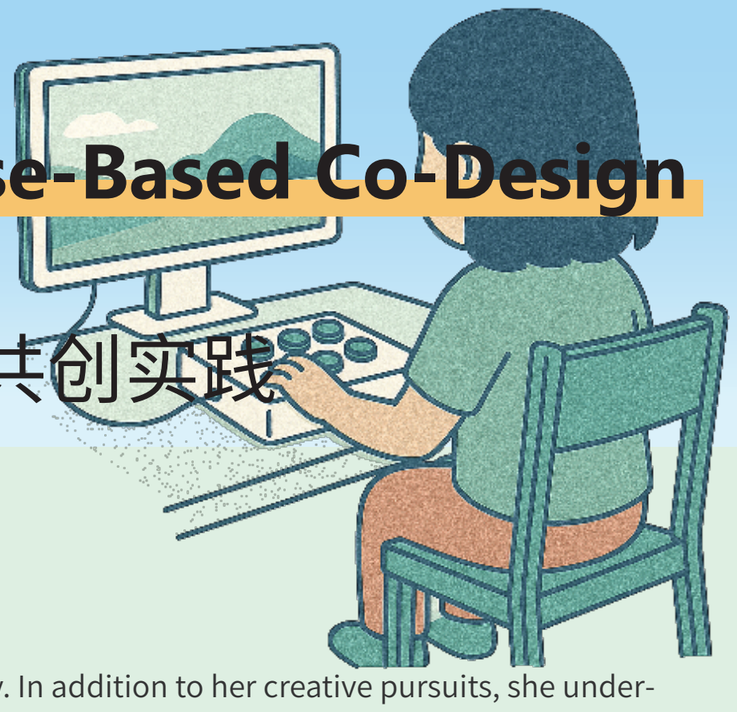
Gamer+ : SteadyGo

Rehabilitation Meets Accessible Gaming: A Case-Based Co-Design with a Young Gamer

康复遇上主流游戏的可接近性:与一位年轻玩家的共创实践



背景Background

SteadyGo is a custom-built assistive gaming and rehabilitation device designed for Siyi Li, a 22-year-old with cerebral palsy. In addition to her creative pursuits, she undergoes long-term rehab therapy. This project emerged from her desire to play more freely—while also supporting her rehabilitation journey.

SteadyGo 是一款为 22 岁脑瘫青年李思懿(Siyi Li)量身定制的辅助游戏与康复工具。她因出生缺氧导致脑瘫,长期坚持家中锻炼和偶尔的医院康复门诊。思懿热爱写作、诗朗诵、视频制作与游戏比如《原神》。项目的初衷是回应她“‘想要和派蒙更自由地飞翔”的愿望,也从现实角度对应她在日常康复训练中的辅助需求。

Technology & Structure 技术与结构

SteadyGo integrates posture-based control with custom input mapping. Built on Arduino Leonardo and Uno, the system uses pressure sensors to detect subtle shifts in seated balance, which are translated into game commands.

结合了姿态控制与按键映射。基于 Arduino Leonardo 与 Uno 微控板,设备通过压力传感器监测坐姿平衡,将身体重心的微小移动转换为游戏输入,从而鼓励用户在坐姿中主动控制躯干。

Co-Designing with Rehabilitation 康复共创设计

From the outset, design iterations were aligned with clinical goals. We joined Siyi in multiple rehab sessions, consulting therapists and doctors. Her rehabilitation needs included:

- ●High muscle tone requiring passive stretching
- ●Weak core control leading to compensatory full-body movements
- ●Stress-induced muscle spasms

Doctors recommended training modes that emphasized core stabilization with guided limb movement. SteadyGo was thus designed to promote pelvic and trunk stability during seated tasks. It serves as both an assistive controller and a functional rehabilitation tool.

从项目初期开始,我们即围绕康复目标进行设计,并陪同思懿多次参与门诊康复,听取医生与治疗师的建议。她的康复重点包括:

- ●肌张力高,需要持续被动牵拉
- ●核心控制弱,容易出现全身代偿
- ●情绪紧张时易产生肌肉痉挛

医生建议采用“固定核心→主动四肢动作”的训练模式。SteadyGo 的控制逻辑因此围绕“在坐姿中稳定骨盆与躯干”展开,既是游戏辅助工具,也是一种功能性康复装置。

Challenges & Trade-offs 困难与挑战

1. Personalized Control Strategy

- ●High tone & low motor separation: movement requires whole-body effort
- ●Must activate target muscles without reinforcing compensatory motion
- ●Safety and feedback must balance game logic with clinical practice

2. Responsiveness vs. Stability

- ●Over-sensitive input causes false triggers and frustration
- ●Under-sensitive input leads to lack of feedback and reduced motivation
- ●Varying daily condition: gameplay tasks must support flexible calibration
- ●Rehab progress may demand parameter updates over time

3. Design Decisions on Setup

- ●Seated pressure plate vs. standing board vs. yoga ball with walker
- ●Potential expansion: foot pedals or hand-held input modules require further evaluation

1. 如何定义适合她的控制方式?

- ●肌张力高 + 分离控制力弱:局部动作常需全身配合
- ●避免强化代偿模式,激活目标肌群
- ●平衡康复策略与游戏逻辑,确保物理安全

2. 响应性与稳定性的取舍

- ●控制过于灵敏:易误触,挫败感强
- ●控制太迟钝:反馈不足,影响动机
- ●每日状态不同:需设计适应性任务
- ●康复进程推进:未来需动态调整交互参数

3. 设备选择上的抉择

- ●坐姿压力板 vs. 站姿压力板 vs. 瑜伽球+助行器组合
- ●未来是否拓展为脚踏板/分体手柄?需评估可行性与康复适配性

Key Features 项目亮点

- ●**Rehab-Oriented**: Seated posture control activates the core gently over time
- ●**Game-Integrated:** Design considers muscle recruitment and cognitive focus
- ●**Adaptive:** Expandable functions based on rehab progression
- ●**Collaborative:** Co-designed with therapists, informed by real outpatient practice

- ●**康复导向:**坐姿控制激活核心肌群
- ●**游戏结合:**互动设计兼顾注意力与肌肉负荷
- ●**阶段适配:**支持随康复阶段调整功能与难度
- ●**专业协作:**多方共创,融合临床与家庭实践建议

Outcomes 实际成效

Siyi can now perform basic in-game actions using SteadyGo’ s seated control system. Her concentration and postural awareness have significantly improved.

“I feel like a tree taking root in the chair—firmly anchoring my trunk before moving freely.”

思懿目前已能通过 SteadyGo 实现基本游戏操作,注意力集中度与躯干控制力显著提升。

“感觉自己像小树一样扎根在椅子上,牢牢牵引住树干,然后可以去自由移动。”

Vision & Impact 未来展望

Gamer+: SteadyGo is not just a device—it's a prototype that merges accessible gaming with physical rehabilitation. We envision expanding Gamer+ to support more players at different ability levels, enabling them to engage with mainstream games and experience both joy and achievement through play.

Gamer+:SteadyGo 不仅是一个设备,更是一次将康复与主流游戏融合的探索起点。我们期望未来 Gamer+ 能拓展更多使用方案,让不同阶段、不同能力的玩家都能获得游戏的自由,并在康复过程中体会成就与乐趣。

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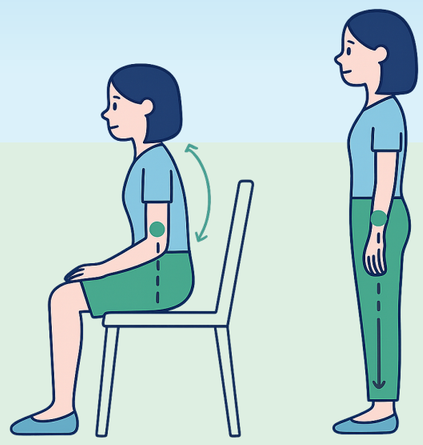
Understanding Postural Control and the Challenges of Cerebral Palsy Rehabilitation

坐姿重心与核心肌群的关系｜脑瘫康复的路径与现实困境



重心控制基础：坐着时我们如何“平衡”？
How Do We Stay Balanced While Sitting?

While standing, our center of gravity is usually located around the pelvis. But in a seated position, it's higher—roughly between the lower sternum and the middle back. Subtle shifts forward or backward can impact stability and comfort. This control comes not from the limbs but from the deep “core muscles”—the transverse abdominis, multifidus, diaphragm, and pelvic floor—which work together to stabilize posture.

站立时重心多位于腹部与骨盆之间，而坐姿时重心则较高，位于胸骨底部与背部之间。根据 Up With Gravity 的研究，身体前后轻微的移动即可显著改变重心感受，这种意识是控制和平衡的关键。
控制坐姿时的身体重心，依赖的并不是四肢，而是深层的“核心肌群”——包括腹横肌、多裂肌、膈肌和骨盆底肌群。这些肌群共同维持脊柱稳定，是身体最重要的“中控系统”。

“核心稳定性”训练为何关键？
Why Core Stability Training Matters in Rehab

Core training is widely used in neurorehabilitation. A 2015 study confirmed that trunk stabilization exercises improve seated balance in stroke patients. In SteadyGo, posture-based input isn’ t just a control method—it’ s an active workout. The player must engage their core to stay centered and move precisely, making gameplay a subtle form of therapeutic training.

核心稳定性训练已被广泛应用于中风、脊髓损伤和脑瘫的康复研究中。例如一项研究表明，核心稳定训练显著提升了中风患者的躯干控制与坐姿平衡（Lee et al., 2015）。
在 SteadyGo 项目中，坐姿控制本身就是一种训练手段。通过压力传感器反馈，系统要求用户不断调整重心，以达到稳定坐姿，这不仅有助于游戏操作，也是核心肌群的日常激活。

脑瘫症状与康复挑战
Cerebral Palsy: Symptoms and Barriers to Rehabilitation

Cerebral palsy (CP) is a movement disorder caused by early brain injury. High muscle tone and low selective motor control are common symptoms, making simple tasks exhausting and inefficient. Over time, compensatory movements can cause pain, misalignment, and further restrict independence.

脑瘫是一种因出生或幼年早期的脑损伤所致的运动障碍，常伴随肌张力异常、姿势控制困难与协调障碍。李思懿属于肌张力偏高、控制力低的情况，日常生活中容易用全身代偿来完成局部动作。
肌张力问题会带来复杂的连锁反应，比如长期姿势不当→疼痛与骨骼变形→活动受限→参与社会活动减少。这些后果远不止20%的症状，而会引发60%以上的连锁性功能下降。

成年脑瘫康复现状：一段孤独的旅程
Rehabilitation for Adults with CP: A Hidden Gap

In China and many other countries, rehab services for cerebral palsy focus heavily on children. Adults often face a steep drop-off in support, with limited outpatient services and few age-appropriate tools. Despite having potential for progress, adult CP patients are often left with self-guided routines lacking feedback or motivation.

国内脑瘫康复资源主要集中于儿童期，许多成年人在成年后很难继续接受高频率的专业康复治疗。
家庭康复往往缺乏工具与反馈机制，加之经济与交通的现实负担，形成康复“断层”。
虽然成年患者的身体仍具备可塑性，持续训练依然有效，但缺乏合适的辅助设备和康复激励机制，使得很多人陷入“知道该练、但无从下手”的困境。

SteadyGo的尝试：在游戏中找回控制感
SteadyGo’ s Response: Regaining Control Through Play

By integrating posture-based control into gameplay, SteadyGo offers adult CP users a structured, feedback-driven way to train their core daily. It’ s a small but significant step toward bridging the rehabilitation gap—by making therapy feel like a game, and progress feel personal.

通过将核心训练融入游戏，SteadyGo 为成年脑瘫患者提供了一种有反馈、有目标的日常康复方式。这种以“坐姿控制”为入口的设计，不仅提升了可接近性，也帮助他们逐步重建身体的信任与掌控感。