Supporting Stroke Rehabilitation with Modular Electronics Prototyping Toolkits

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Abstract. Wearable, modular and mobile prototyping ecosystems offer a promising route to deployable, reconfigurable digital rehabilitation devices. We conducted an exploratory focus group with six NHS clinicians using hands-on and virtual demonstrations of the micro:bit, Jacdac, and BITalino platforms as design provocations. Reflexive inductive thematic analysis produced five themes: *Feedback*, *Beyond the Physical*, *Discontinuity of Rehab*, *Usability for Patients*, and *Usability for Staff*. These were translated into six concrete design directions for a wearable, plug-and-play modular toolkit for stroke care. We believe our findings can inform toolkit design that enables clinicians to build and deploy devices customised to specific patients, settings, and recovery trajectories.

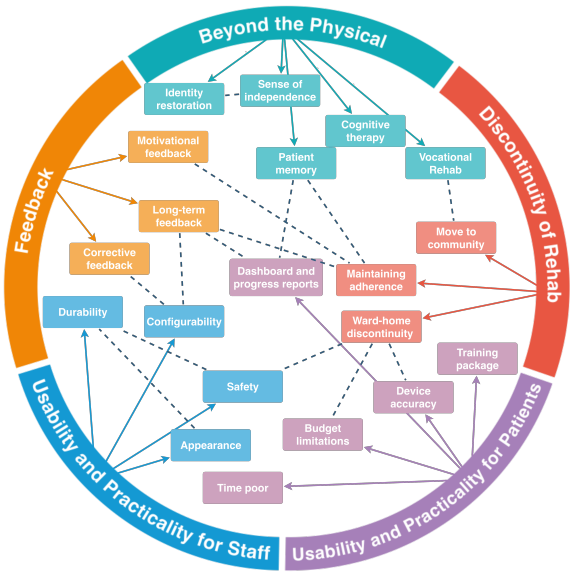

Figure 1: Inductive thematic map derived from the focus group.

1. Introduction

Stroke affects 100,000 people per year in the UK alone, demanding sustained rehabilitation across motor, cognitive, and psychosocial domains [5]. NHS guidance calls for three hours of rehabilitation daily [4], yet movement practice in supervised sessions often falls short of this, motivating interest in digital devices that extend practice beyond face-to-face care [3]. Yet no existing work has directly asked expert clinicians what they require from a low-cost, plug-and-play modular electronics toolkit for stroke rehabilitation [2].

2. Method

A 90-minute semi-structured focus group was conducted with six NHS expert clinicians (physiotherapists and occupational therapists) actively delivering post-stroke rehabilitation. Two researchers facilitated in-person discussion, grounded in hands-on and virtual examples of modular devices including the *micro:bit* with Jacdac modules, the *BITalino*, Arduino, and Raspberry Pi. Reflexive inductive thematic analysis following Braun and Clarke [1] was applied, with two researchers coding independently and themes refined through structured discussion.

3. Findings

Five themes emerged. **Feedback** — the most coded concept — comprised three types: *motivational* (real-time, multimodal cues and gamification), *corrective* (detecting whether movements meet clinical criteria to prevent compensation), and *long-term* (session logging and progress over weeks). **Beyond the Physical:** clinicians stressed that effective rehab addresses independence, return to work, and psychosocial wellbeing, making cognitive scaffolding and assistive input devices legitimate toolkit outputs alongside motor training. **Discontinuity of Rehab:** the ward-to-home transition is where the rehabilitation chain most commonly breaks; devices must be clinician-configured in-hospital and deployable at home without technical re-setup. **Usability for Patients:** exposed electronics are incompatible with spills, rough handling, and the need not to appear clinical; enclosed hygienic housings and plug-and-play reconfigurability were valued. **Usability for Staff:** time pressure, training burden, and cost are cross-cutting; a "tech champion" model was described as a current workaround, pointing to toolkits legible enough for one team member to master and distribute knowledge from.

4. Design Directions

Six directions for toolkit design follow from the themes: (1) template-first setup with clinician-adjustable defaults; (2) hygienic, enclosed housings tolerant of spills and repeated cleaning; (3) sensing of *movement quality*, not merely task completion; (4) automated progress logging with interpretable, goal-aligned summaries; (5) workflow-fit configuration with lightweight training support; and (6) cost-aware design prioritising easy repair and replacement.

5. Conclusions

Our clinician-derived themes provide a grounded design envelope for modular rehabilitation toolkits, specifying what feedback, housing, portability, and workflow integration must concretely deliver in stroke care. The next step is low-to-mid fidelity prototypes evaluated in situ with clinicians, stroke survivors, and carers.

References

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