Project Details	
Project Code	PHS27Ca Al-Amri
Title	Adaptive Virtual-Reality Exergaming for Physical and Cognitive Health in Older Adults
Research Theme	Population Health Sciences
Project Type	Dry lab
Summary	Can virtual reality help older adults maintain physical and cognitive function? This project will develop and test SPIN-VR, an interactive exercise game that combines movement, cognitive challenges and wearable sensors. You will work with older adults, clinicians and carers to make the system safe, engaging and accessible. You will then develop real-time personalised feedback and evaluate the system in laboratory studies, measuring usability, balance, mobility, attention and executive function. The project offers interdisciplinary training in virtual reality, gait analysis, cognitive testing, mixed-methods research and data-driven personalised rehabilitation.
Description	As populations age, scalable rehabilitation approaches are needed to maintain physical and cognitive function, preserve independence, and reduce pressure on health and social care systems. Exergaming, which combines physical exercise with cognitively demanding game tasks, can target balance, lower-limb function, attention, processing speed, and executive control. However, current evidence is limited by reliance on commercial systems that offer little personalisation, limited feedback, and poor alignment with rehabilitation principles. SPIN-VR is a clinically informed dual-task exergame platform that uses wearable sensors to deliver customised exercise with real-time feedback and has demonstrated feasibility, acceptability, and safety in people with knee osteoarthritis. This studentship will extend SPIN-VR for ageing populations by developing adaptive feedback and personalisation mechanisms and generating feasibility, usability, and preliminary outcome data to support future translational studies. The primary research question is whether an adaptive SPIN-VR system can be optimised to provide safe, acceptable, and engaging physical-cognitive training for older adults, and how real-time feedback, gamification, and adaptive task progression influence usability, adherence, performance, and preliminary physical and cognitive outcomes. Study 1: User Requirements and Usability Study 1 will use a mixed-methods approach to define requirements for adapting SPIN-VR for older adults. Interviews and focus groups with older adults, clinicians, carers, and relevant stakeholders will explore barriers and facilitators to use, accessibility requirements, safety perceptions, preferences for feedback and progression, and the acceptability of different game mechanics. These findings will be complemented by structured usability sessions in which participants complete onboarding and basic training tasks using a SPIN-VR prototype. Quantitative measures will include the System Usability Scale, user-experience ratings, perceived exertion, and task confidence, together with observational measures such as navigation errors, assistance required, and onboarding completion time. The student will contribute to participant recruitment, qualitative data

	collection and analysis, usability evaluation, and development of a requirements specification for interface design, onboarding, feedback delivery, and progression systems. Study 2: Technical Development and Optimisation Study 2 will focus on technical development of SPIN-VR informed by findings from Study 1. The student will contribute to the implementation and refinement of adaptive features that use behavioural and sensor-derived data to personalise training. Potential developments include real-time knowledge-of-performance and knowledge-of-results feedback, dynamic adjustment of physical and cognitive task difficulty, and refinement of gamification features such as rewards, progression cues, and challenge calibration. The project will also explore whether artificial intelligence or machine-learning approaches can identify performance patterns and support adaptive decision-making. Evaluation will focus on behavioural and sensor-derived metrics including in-game accuracy, response latency, movement quality, error rates, dual-task cost, and progression through game levels. The student will assist in defining adaptive rules, selecting outcome measures, and leading testing cycles with healthy adults to ensure technical development remains aligned with user and clinical requirements. Study 3: Feasibility Evaluation in Healthy Adults Study 3 will undertake a laboratory-based feasibility evaluation of the optimised SPIN-VR system in healthy adults. This phase will examine the performance of adaptive feedback and gamification features under controlled conditions and determine whether the system supports acceptable, engaging, and tolerable training across repeated sessions. Outcomes will include usability and acceptability measures, adherence to scheduled sessions, task completion rates, adverse events, and behavioural performance indicators such as accuracy, response time, postural control, and performance trajectories over time. Preliminary physical outcomes may include gait speed, Timed Up-and-Go, Five Times Sit-to-Stand, and balance measures. Preliminary cognitive outcomes will assess domains relevant to ageing and dual-task performance, including attention, processing speed, working memory, and executive function. Qualitative feedback will explore participant experiences of real-time guidance, perceived challenge, and the usefulness of adaptive feedback. The student will lead data collection and mixed-methods analysis and use the findings to identify which platform features should be retained, modified, or removed before testing in older adults. Study 4: Evaluation in Older Adults Study 4 will evaluate the refined SPIN-VR system in older adults within a supervised laboratory setting. The study will assess feasibility, usability, tolerability, and preliminary physical and cognitive outcomes in the target population while maintaining standardised testing conditions. Particular emphasis will be placed on calibrating adaptive feedback and task difficulty to accommodate diverse functional and cognitive abilities and evaluating whether gamified elements enhance engagement without increasing burden or confusion. Outcomes will include recruitment and retention rates, attendance, adverse events, assistance

	required, System Usability Scale scores, user-experience ratings, and training performance trajectories. Preliminary physical outcomes will focus on balance and lower-limb function, while cognitive outcomes will emphasise attention, executive function, and dual-task performance relevant to everyday activities. Qualitative interviews will explore perceived challenge, confidence, acceptability, and the perceived relevance of the intervention to daily life. Collectively, the four studies will provide an evidence base for designing an adaptive exergaming intervention tailored to ageing populations. Findings will inform subsequent home-based feasibility studies and larger translational trials investigating effectiveness, implementation, and health-economic impact.
Can be completed part time?	Yes
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