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PROJECT PRESENTATION

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Project title	Personalised recovery through a multi-user environment: Virtual Reality for Rehabilitation
Project Acronym	PRIME-VR2
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Additional main contributors (Name, Partner)	
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1 SUMMARY OF THE CONTEXT AND OVERALL OBJECTIVE

Virtual Reality (VR) concepts have existed for more than three decades, however the industry has only recently started to demonstrate its potential use in a variety of markets. The largest VR market is currently the entertainment world. However, VR environments are now increasingly being used in areas such as manufacturing, training, heritage, and architecture. The healthcare sector is another prominent market that is beginning to make use of virtual and augmented reality for training, administering of surgical procedures, mental health, and rehabilitation practices. The support of patient recovery is an application particularly well suited to VR, and there are a number of emerging applications that address brain injury assessment, orthopaedic rehabilitation, balance exercises and cognitive fidelity. While these vary in configuration, most use 'off-the-shelf' controllers with limited scope for adaptation, and concern single users interacting only with the practitioner.

The H2020 PRIME-VR2 project - *Personalised recovery through a multi-user environment: Virtual Reality for Rehabilitation* - involves the creation of an end-to-end integrated digital development platform to facilitate collaboration across stakeholders in the VR ecosystem, and to produce effective VR rehabilitation environments*.*

The research result will be a **Platform** that can deliver bespoke physical access hardware and psychologically-sensitive digital environments. The platform will be applied and tested with rehabilitation patients with upper body motor impairment particularly of the hands, fingers, wrists and forearms. Its effectiveness will be measured against key recovery success indicators and the engagement of end users at three living labs across Europe. While this application will provide a highly challenging physical and psychological context, the principles of customisation, participation, and digital integration will be agenda-setting for the enhancement of VR experiences in other demanding areas such as sports rehabilitation, wider disability access, high-end gaming, and industrial applications.
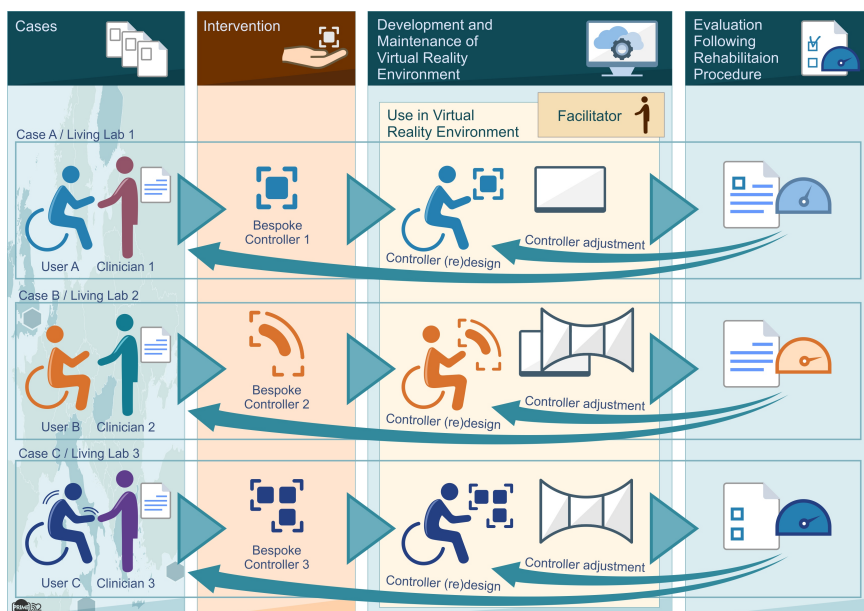
The PRIME-VR2 project started on October 1st 2019, will last 3 years and has been granted 4Ml Euros.

The overall objective of the project is to deliver a development platform that integrates bespoke VR hardware and physically- and socially-optimised gaming in order to deliver enhanced VR experiences. This will be developed for the area of rehabilitation through three use cases, and will demonstrate new standards of accessibility, control, feedback and engagement for users. In order to achieve this, the specific project objectives are to:

1. Generate a VR environment for 'serious' gaming rehabilitation exercises that allows users to socialise, play and compare progress to aid motivation in rehabilitation.

2. Develop new approaches for non-invasive, accurate anatomical and mobility data collection that retains user dignity, is viably facilitated by a carer, and uses appropriate technology to deliver accurate data.

3. Use a variety of advanced methods to build a biomechanical profile of patient injury in order to develop bespoke VR gaming controllers aligned with specialised rehabilitation approaches.

4. Create new principles of mechanical switch actuation through additive structures, and apply these in the generation of novel controller designs that blend external physical requirements with internal actuation properties.

5. Use advanced Human-Centred Design (HCD) techniques to create a framework for the development of control requirements and subsequent device assessment in relation to emotional, cognitive, aesthetic and social requirements.

6. Extend the principles of design for manufacture and Assembly (DfMA) for additive structures, addressing component reduction, electrical assembly, mounting, and external surface treatments to deliver practical and viable controller housings.

8. Implement and test the proposed platform through three distinct case studies involving different participants.

2   MAIN EXPECTED RESULTS AND PROGRESS BEYOND THE STATE-OF-THE-ART

At the end of the project the PRIME-VR2 project will deliver an advanced VR rehabilitation platform, named VRHAB-IT, configured for used in clinical settings. It will combine integrated data capture for user's profile and VR bespoke controller specification, hardware construction and software optimisation.

PRIME-VR2 will require innovation beyond current state-of-the-art in three principal areas: physiological data capture and feedback, controller housing and interface design, and VR gaming environments for rehabilitation. In PRIME-VR2 the patients' biomechanical profiles and advanced additive manufacturing technology will be used to create bespoke controller designs. By combining these elements with a customised VR space purely for rehabilitation, we will advance state-of-the-art medical practices and offer new avenues for research into biometrically-informed design. The controller design will be guided by biometrical data. This approach will be novel and will build a detailed 'profile' of patient injury. This is a very systematic human-centred-design approach that seeks to gain a detailed picture of the ergonomic and physical capabilities of each patient. This data will be applied algorithmically to generate a bespoke controller design and then fabricated using advanced 3D printing technology. The resulting VRHAB-IT platform will facilitate a novel, state-of-the-art, user-centred digital manufacturing approach grounded in the principles of Industry 4.0.

3   PUBLIC WEBSITE

This is the URL of the project website: http://prime-vr2.eu/

4   PARTNERS

The PRIME-VR2 Consortium is multi-disciplinary, encompassing expertise in Virtual Reality, Additive Manufacturing, 3D geometrical form generation, User Interface design, User-Centred design, electronics design, systems integration and rehabilitation.

The Consortium includes:

| five **academic partners** who will drive the research agenda |
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| • Università di Pisa (Italy) (coordinator of the project) - www.unipi.it
• University of Strathclyde (Scotland) - www.strath.ac.uk
• University of Malta (Malta) - www.um.edu.mt
• University of Oulu (Finland) - http://www.oulu.fi/; http://ubicomp.oulu.fi/
• University College London (UK) - www.ucl.ac.uk |

six **SME partners** who will focus on technological implementation
• Loud1Design Ltd. (Scotland) - www.loud1design.co.uk • Kerubiel (Hungary) - www.kerubiel.com • Flying Squirrel Games (Malta) - www.flying-squirrel- games.com • Capitola Digital BV (the Netherlands) - www.capitola.nl • Crowdhelix Network (Ireland) – www.network.crowdhelix.com • Inlecom (Greece) - www.inlecom.eu

three **Living Labs** who will provide distinct test beds
•   Saint James Hospital (Malta) - www.stjameshospital.com
•   Kinisiforo (Cyprus) - www.nicomedrehab.com; www.kinisiforo.com
•   Global Disability Innovation Hub (UK) - www.DisabilityInnovation.com
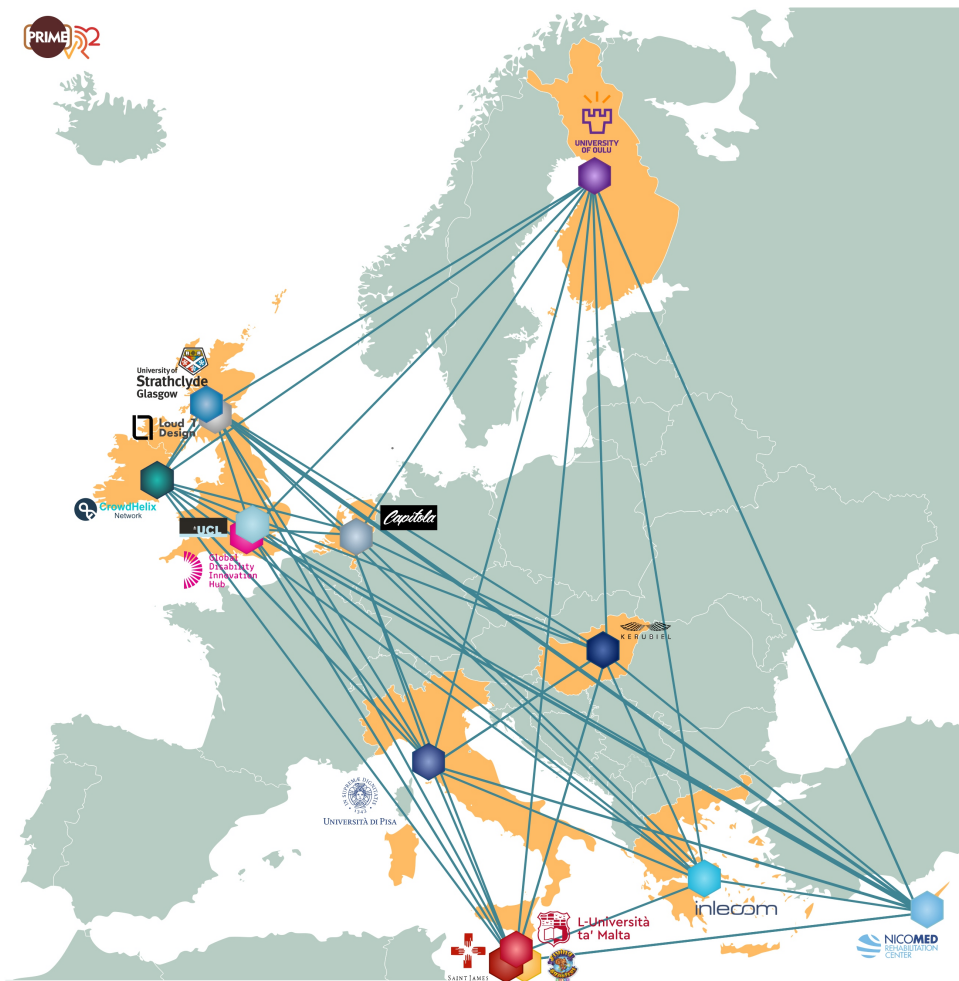
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