PRIME-VR2 - H2020 Project
Personalised recovery through a multi-user environment

September 2021 - Issue #07

NEWSLETTER

VR for Rehabilitation

WELCOME TO OUR QUARTERLY NEWSLETTER

PRIME-VR2 Ethics in experimentation

The research groups continue the prototype testing phase together with the rehabilitation centre at the Living Labs. Accurate ethical protocols have been prepared and approved by the competent committees to conduct the experiments according to the rules of conduct, which aim at protecting the patients from harm. Particularly articulated is the ethical protocol for the research of the GDIH Living Lab in London, that has to do with children and young people.

Undertaking an ethical research study

The London living labs: Global Disability Innovation Hub (GDIH), University College London (UCL), and The Evelina Children's Hospital, have submitted a research protocol investigating how children and young people with dystonia can use standard virtual reality (VR) controllers and headsets. There will be parallel studies to test the usability and efficacy of our 3D scanning technology with the dystonia user group and recording and analysing the dynamic characteristics of involuntary movement. We will also study how co-piloting (having a second person help a user with an aspect of the gameplay) might affect the gaming experience.

As we will be working with the National Health Service (NHS) patients and clinicians, our protocol needs to be approved by the UCL Joint Research Office (JRO) and the UK Health Research Authority's (HRA) Research Ethics Committee. These independent organisations help researchers conduct ethical studies that "protect the rights, safety, dignity and well-being of research participants and facilitate(s) and promote(s) ethical research that is of potential benefit to participants, science and society" . These applications are reviewed and scrutinised to ensure that the research is appropriate. It has benefits to both the patients and the National Health Service. The participants' needs and well-being need to be considered, with any potential risks mitigated where possible. The committee will highlight any potential issues the research team must resolve before the study can begin.

Informed consent/assent
One of the fundamental principles of ethical studies is to make sure the participants can give informed consent. Where consent is not possible due to age or capacity, we shall obtain informed assent with the consent of a parent or guardian. To help potential participants understand the study, we have written a specially designed information sheet that is easy to read and understand, describes the process involved and the study's goals. We will be available to answer any questions from the participant, their family, friends or anyone who might help them with the decision-making process. As part of the process, we also must inform the participant how we plan to collect and handle their data during the study.

Data protection
A further check is provided by the UCL data protection team, who make sure the study is compliant with the data protection principles set out by the GDPR, (General Data Protection Regulation). Our protocol design demonstrates how we met the six principles set out in the GDPR on the processing of data:

Principle	Implementation
Lawfulness	Researchers have undergone the correct checks and have appropriate experience to undertake the study. Protocol is checked and approved by an independent Research Ethics Committee (REC)
Purpose Limitation	We only collect data we need for our research goals
Data minimisation	We do not collect unnecessary personal data from our participants
Accuracy	We make every reasonable effort to ensure the accuracy of our data through data checking and collection procedures.
Storage Limitation	We only store data for a set period of time, and we will delete any data that is no longer necessary for our study

Following the feedback that we hope will be returned in the coming months, we intend to begin recruiting children and young people with dystonia into our study to inform the ongoing development of the VRHAB-IT bespoke controllers and games.

Sensing for capturing therapeutic interactions

A range of options exists for choosing an appropriate sensing mechanism to capture therapeutic interactions or exercises to enable the development of the bespoke VR controller. Various sensors can collect the position, orientation and acceleration measurements of the upper limb segments, shoulder, elbow, and forearm.

The developed bespoke controller for paretic or injured hand consists of different types of sensors and actuators. The operation of this controller allows for detecting the set of therapeutic interactions of the hand. Consequently, this data is used to carry out the interaction in the Virtual Environment (VE).

To capture therapeutic wrist and finger movements, the PRIME-VR2 project explored (1) an array of Force-Sensitive Resistors (FSRs) to capture both therapeutic wrist and finger movements, and Inertial Measurement Units (IMUs) to capture upper arm movements, and (2) single-dimensional potentiometers to measure the angles. The first option allows for indirect measurement of the interactions, while the second can be used for direct angle measurement and an indication of the torque for angled forces. A direct angle measurement option is implemented in the bespoke controller in order to meet the requirements of the therapies.

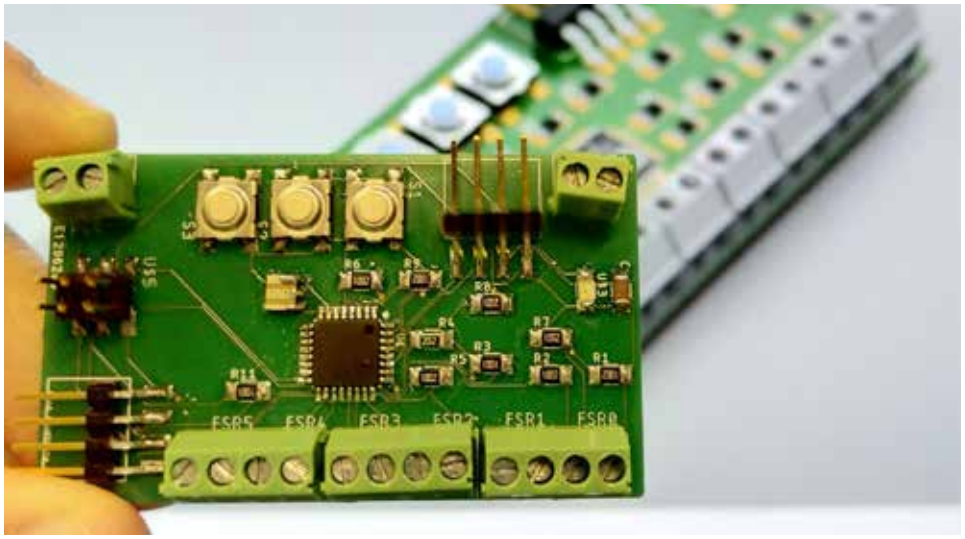

Fig. 1: Custom electronics for the bespoke controller

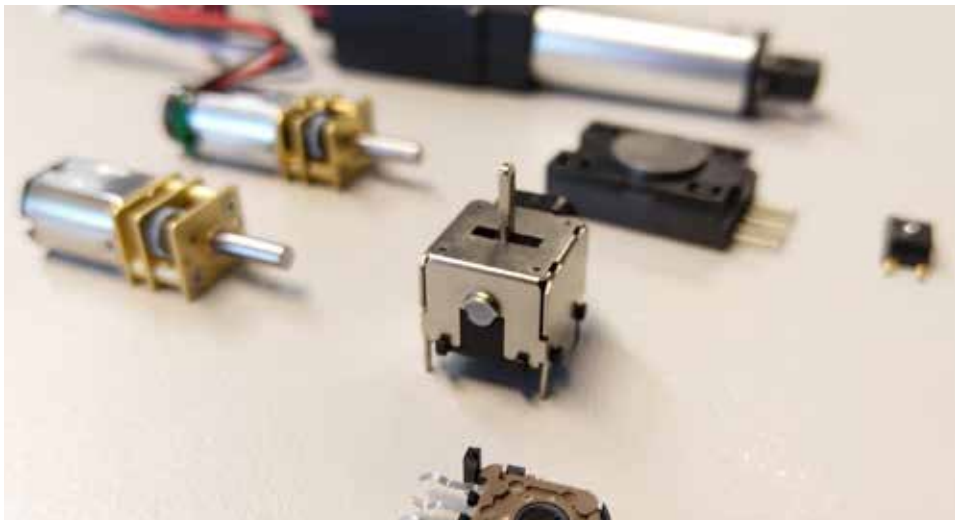

Fig. 2: Exploring different sensing options for capturing interactions

Sensor Architectures and Technologies for Upper Limb 3D Surface Reconstruction: A Review

Alessandro Paoli, Paolo Neri , Armando V. Razionale, Francesco Tamburrino and Sandro Barone

3D digital models of the upper limb anatomy represent the starting point for the design process of bespoke devices, such as orthoses and prostheses, which can be modeled on the actual patient's anatomy by using CAD (Computer Aided Design) tools. The ongoing research on optical scanning methodologies has allowed the development of technologies that allow the surface reconstruction of the upper limb anatomy through procedures characterized by minimum discomfort for the patient. However, the 3D optical scanning of upper limbs is a complex task that requires solving problematic aspects, such as the difficulty of keeping the hand in a stable position and the presence of artefacts due to involuntary movements. Scientific literature, indeed, investigated different approaches in this regard by either integrating commercial devices, to create customized sensor architectures, or by developing innovative 3D acquisition techniques. The present work is aimed at presenting an overview of the state of the art of optical technologies and sensor architectures for the surface acquisition of upper limb anatomies. The review analyzes the working principles at the basis of existing devices and proposes a categorization of the approaches based on handling, pre/post-processing effort, and potentialities in real-time scanning. An in-depth analysis of strengths and weaknesses of the approaches proposed by the research community is also provided to give valuable support in selecting the most appropriate solution for the specific application to be addressed.

MDPI - Sensors 2020

https://www.mdpi.com/1424-8220/20/22/6584/html

Virtual Reality for Neurorehabilitation and Cognitive Enhancement

Georgiev, Danko D.; Georgieva, Iva; Gong, Zhengya; Nanjappan, Vijayakumar; Georgiev, Georgi V.

Our access to computer-generated worlds changes the way we feel, how we think, and how we solve problems. In this review, we explore the utility of different types of virtual reality, immersive or non-immersive, for providing controllable, safe environments that enable individual training, neurorehabilitation, or even replacement of lost functions. The neurobiological effects of virtual reality on neuronal plasticity have been shown to result in increased cortical gray matter volumes, higher concentration of electroencephalographic beta-waves, and enhanced cognitive performance. Clinical application of virtual reality is aided by innovative brain–computer interfaces, which allow direct tapping into the electric activity generated by different brain cortical areas for precise voluntary control of connected robotic devices. Virtual reality is also valuable to healthy individuals as a narrative medium for redesigning their individual stories in an integrative process of self-improvement and personal development. Future upgrades of virtual reality-based technologies promise to help humans transcend the limitations of their biological bodies and augment their capacity to mold physical reality to better meet the needs of a globalized world.

MDPI - Brain Sciences 202

https://www.mdpi.com/2076-3425/11/2/221

PRIME-VR2 at ICED and the Design Society

The 23rd International Conference on Engineering Design (ICED) was held Gothenburg, Sweden at Chalmers University of Technology from 16th-20th August and included a strong representation from the PRIME-VR2 consortium. The ICED conference is the flagship event of the Design Society, an international academic network covering the area of engineering design, and to which many members of the PRIME-VR2 are affiliated. Attendees included consortium members from Strathclyde, Malta and Oulu who presented five papers as part of the conference programme. This year's conference theme was 'Design in Motion' and the conference ran in a hybrid mode due to the Covid-19 pandemic with the majority of activities running in online sessions. Nevertheless, the PRIME-VR2 team shared five papers on a number of different topic themes including: a novel testing rig for the examination of auxetic components; perspectives of clinicians on patient experiences; a testing framework for medical devices; and an experimental design for VR tracking.

In another Design Society linked information event, Philip Farrugia (Malta) and Georgi Georgiev (Oulu) hosted an online chat room entitled "PRIME-VR2 VR Ecosystems and rehabilitation systems" on 27th July. This provided an overview of how PRIME-VR2 aims to develop a state-of-art digital environment for VR rehabilitation at home and in clinic through a virtual gaming space that will provide effective therapy and friendly competition. It also encompassed Q&A on its innovations for people with neuro-motor disability such as stroke and cerebral palsy and sports injuries, and how the findings and principles can be applied more widely. A link to the session can be found at: https://youtu.be/wywZb9dkiDk .

PRIME-VR2 presenting young researchers

Emanuel Balzan - University of Malta

Hello, I am Emanuel and I work as a Research Support Officer with the University of Malta on the PRIME-VR2 project. My work mainly focuses on the activities being done in Work Package 4 of the project where we are manufacturing, assembling and testing the bespoke controller. Additionally, I have also supported other workpackages of the project.

Regarding the platform requirements and data capture, my task was to develop a software tool that would take in the data captured by the hand scanner and force assessment module and visualise them into a dashboard such that the clinician is able to see the ergonomics requirements and capabilities of the patients. The tool was also equipped with other features to enhance the experience of patients and clinicians/therapists.

I have been supporting the development of additive controller structures with analysis of the evolving design from a Design for Assembly (DfA) perspective and potential failure modes and effects of the design (DFMEA) in relation to the Additive Manufacturing process being utilised. Decisions taken during design stage will heavily impact the subsequent product development phases. Therefore, it is important to analyse and understand the risks associated with each sub-component or part of the final product. Through a tear down analysis carried out on three major VR controllers available on the market and insight gained while manufacturing and assembling one of the initial version of the controller, lessons learned on the design and joining mechanisms for plastic parts and electronic parts were proposed to inform the work being carried out in the other work packages.

Whilst each joining mechanism has its benefits and disadvantages, multi-nozzle 3D printers opened up the possibilities to fabricate seamless, multi-material functional parts, objects with enhanced performances, or 4D printing structures without the need of bonding. Multi-material parts being designed by Loud1Design (L1D) will be tested to ensure that the required performance levels are attained as part of the testing strategy and Verification and Validation Testing (VVT) framework that was developed for such European funded projects. In the next months, the team at UOM will finalise the overall VVT plan and start testing on individual parts. As part of WP8 my duties were developing the dissemination strategy and producing various artwork for the website, newsletter, flyer and posters.

The PRIME-VR2 project is composed of a large and talented team. Every week I look forward to see new developments from every partner in their respective field, it being product design, game development or feedback from the Living Labs. Seeing the team's combined effort has been truly satisfying and one step closer to the realisation of the final product.

FOLLOW US

www.prime-vr2.eu

https://twitter.com/primevr2

https://www.linkedin.com/groups/8879498/

https://www.facebook.com/PrimeVR2/

https://www.youtube.com/channel/UCPjq7rUwjbCNuDbiWl0XK8w

PRIME-VR2
Personalised recovery through a multi-user environement
VR for Rehabilitation

NEXT ISSUE: December '21

In the next issue, we will talk about the VR Helix event at TechConnect, publish the abstracts of our conference papers presented at ICED21. We will meet one more young researcher and share our progress.

NEXT EVENTS

VRDAYS EUROPE
Amsterdam
November 13-17, 2021

PRIME-VR2 is planning on working closely together with the internationally well-known event **VR-Days**. This year, the 5-day virtual event will take place from **13 - 17 November.**

TechConnect EUROPE
INNOVATION CONFERENCE & EXPO
MALMÖ SWEDEN
NOV 15-17, 2021
Crowdhelix

The PRIME-VR2 Consortium is pleased to announce that the next ***VR Helix event*** will take place on **15-17 of November in Malmo, Sweden**, as part of the first edition of TechConnect Europe. With a focus on AI & Digital and Medical & Biotech, this conference represents a great opportunity for the PRIME-VR2 project to showcase our technology and the excellent work that the Consortium has done and will continue to do. The PRIME-VR2 project's aim is also to bring our work closer to the public, and we believe that TechConnect Europe is a great step towards making our technology more available, and making a difference in the upper body limb rehabilitation process.
Here is the link to the conference's website: https://events.techconnect.org/Europe/about/

The **Workshop** 'Design for Additive Manufacturing (DfAM): Future Interactive Devices (**DEFINED**)', will be held on the **17th and 18th of March, 2022**. We have a number of keynote invited speakers and a special session during which participants can disseminate their research interests and network to potentially form consortia for Horizon Europe proposals.
Registration is free of charge. Further details are available here.

CHECK THE WEBSITE REGULARLY FOR MORE NEWS, DOWNLOADABLE CONTENT AND INFORMATION!

ADDRESS

PRIME-VR2 Project Manager
Dipartimento di Ingegneria Civile e Industriale,
Università di Pisa.

CONTACT

+39 5022 18064
info@prime-vr2.eu
www.prime-vr2.eu

PRIME-VR2 is on the Virtual Reality Helix

powered by: Crowdhelix

This project has been funded by the European Commission as part of the H2020 program, under the grant agreement 856998

This Project is being co-ordinated by:
UNIVERSITÀ DI PISA