



“ Dear reader, SUN project has just completed its first two years of operation, and we are ready to approach the third and last year. ”

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Introduction

During the first two years, SUN partners attended 38 international conferences and published 32 scientific papers.

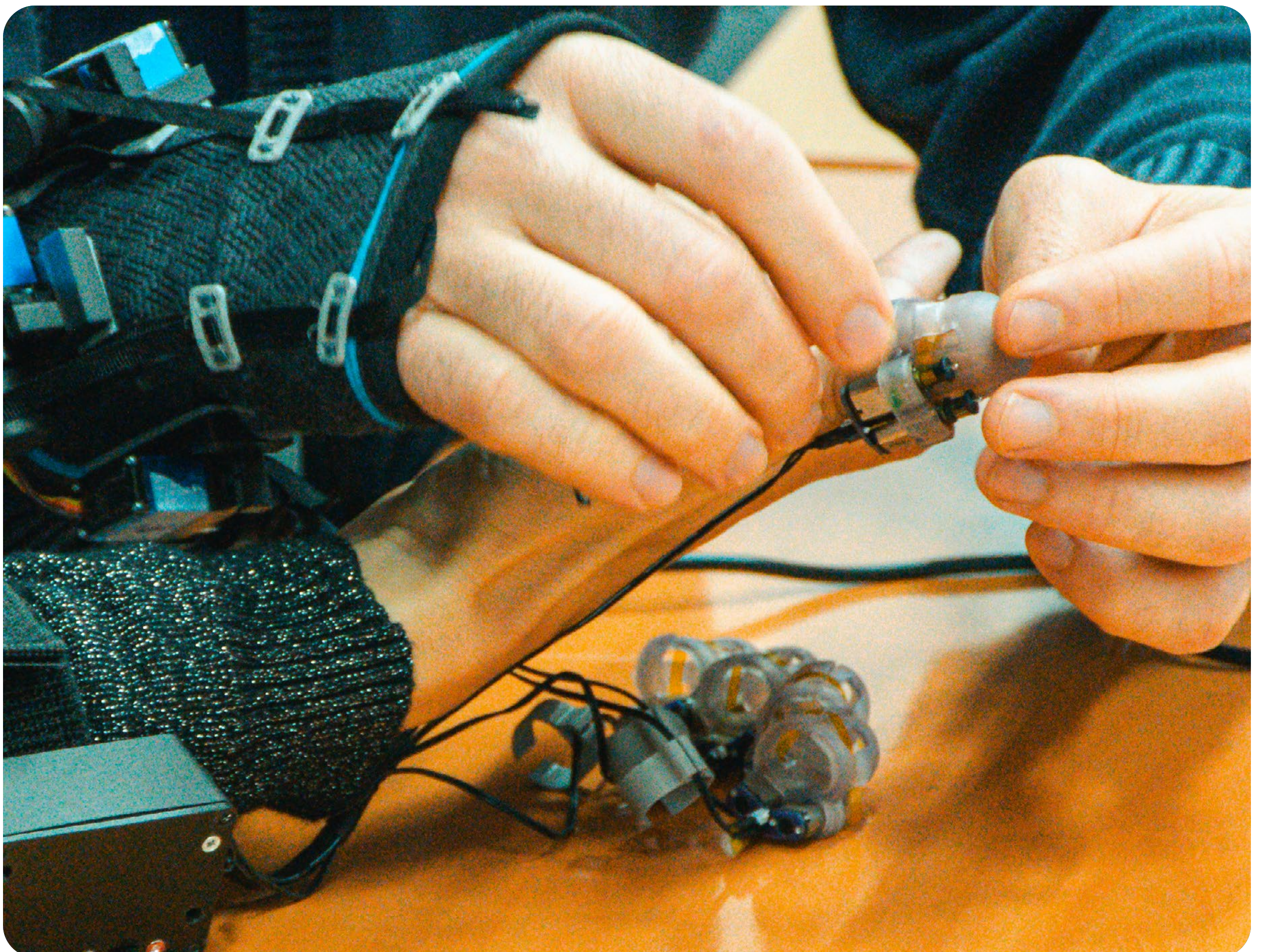
Many innovative technologies have been developed by our technical partners in close cooperation with partners representing the users, and now it is time to approach the Pilot phase to conduct the integration and validation pathway.

An objective of SUN Project is to Validate new XR technologies through real-world experimentation in three key scenarios:

1. *eXtended Reality for Rehabilitation;*
2. *eXtended Reality for Safety and Social Interaction at Work;*
3. *eXtended Reality for People with Serious Mobility and Verbal Communication Diseases.*

This Newsletter offers an overview of the three pilot areas: Physical Rehabilitation, Workplace Safety, and Neurological Rehabilitation.

You can be updated on the next exciting activity by visiting our website www.sun-xr-project.eu and following us on social media [X](#), [LinkedIn](#), [Facebook](#) and [Instagram](#).



PILOT 1 : “eXtended Reality for Rehabilitation”

Pilot 1 (“eXtended Reality for Rehabilitation”) focuses on individuals requiring rehabilitative treatment for upper limb (case 1) and lower limb (case 2) motor disorders stemming from orthopaedic pathologies or lymphoedema as a complication of surgical procedures after breast cancer.

Pilot 1 addresses specific rehabilitation needs with tailored exercises:

Upper Limb Scenario: Patients practice stacking virtual objects to improve shoulder mobility and arm coordination.

Lower Limb Scenario: Exercises include knee flexion and extension in a seated position, followed by standing and walking tasks to restore mobility and strength.

Advanced XR Technologies for Immersive Rehabilitation

This pilot integrates innovative eXtended Reality (XR) solutions, combining an AR visor with wearable haptic devices developed by Scuola Sant’Anna, an advanced postural assessment system designed by ThinGenious, and

multimodal XR collaboration tools developed by the Technical University of Crete.

During the exercises all subjects wear an XR visor by which they are able to interact with both the real world and the virtual world, where virtual feedback will be available. Vision is not the only sense involved in the immersive experience: wearable haptic devices, worn at the hand and forearm, will simulate touch sensations with the virtual objects the patient is manipulating. In addition, these devices will use tactile perception to convey additional information about postural awareness. To this end for the lower limb rehabilitation scenario a postural assessment algorithm, which consumes motion and electromyography (EMG) data, has been developed to supervise the patients while executing their prescribed knee rehabilitation exercises, acting as a virtual coach.

Before the exercise, subjects will be guided by an avatar, previewing the correct movement. Realtime visual feedback about exercise correctness will be displayed exploiting the postural assessment



module, while the user’s movements will be mapped on the avatar in the lower limb scenario using real-time 3D pose estimation algorithms. Optionally, a collaborative mechanism will allow the therapist to immerse themselves in the same virtual environment as the patient for a more engaging therapeutic experience .

Pilot Validation

The validation phase has been carefully planned and it will be carried on in ASL Toscana Nord Ovest in Italy. Participants include individuals with knee or shoulder orthopedic impairments and women with upper limb lym-

phedema following breast cancer surgery. The considered scenarios target socially relevant challenges since:

the usual rehabilitative treatment of the shoulder is very long and it requires a lot of sessions resulting in a high resource’s consumption;
the upper limb edema is a very frequent side effect after breast cancer surgery affecting very strongly the women's quality of life;
there is a huge number of people who need rehabilitative treatment for walking disorders due to knee surgery (e.g., joint replacement).



PILOT 2 (“eXtended Reality for Safety and Social Interaction at Work”)

Factor, a leading company in the metal parts machining sector, is at the forefront of industrial innovation thanks to its participation in the SUN project. This ambitious project, focused on the application of Virtual Reality (VR) and Augmented Reality (AR), is transforming the way Factor approaches employee training and optimizes its production processes.

A new approach to industrial safety

One of the main challenges in the industrial sector is ensuring worker safety. Factor has identified in VR and AR a powerful tool to address this problem. Through immersive experiences, new operators can intuitively familiarize themselves with the correct use of Personal Protective Equipment (PPE). Thanks to realistic simulations, employees learn to identify the risks associated with each task and to select the appropriate PPE. In addition, AR allows real-time visualization, through smart glasses, of what PPE colleagues are using at each workstation. This functionality not only reinforces a safety culture but also facilitates the identification of poten-

tial non-compliance and the adoption of corrective measures.

Process optimization through Augmented Reality

The second scenario proposed by Factor demonstrates the potential of AR to improve operational efficiency. By integrating relevant information directly into the operator’s field of view, through smart glasses, the execution of tasks is accelerated. A prioritized task list, which includes everything from unloading raw materials to loading bars, is presented clearly and concisely, minimizing the time spent searching for information and maximizing productivity.

This solution not only reduces errors and downtime but also facilitates real-time decision-making, allowing operators to adapt quickly to changes in production.

Technological impact and industrial benefits

The implementation of VR and AR at Factor represents a milestone in the machining industry. From a technological standpoint, this project demonstrates how immersive technologies can be seam-

lessly integrated into complex industrial environments. The precise capture of the work environment, the creation of detailed 3D models, and the development of intuitive interfaces are key elements for the success of this initiative. In terms of industrial benefits, the application of VR and AR at Factor translates into:

● **Increased safety:** Reduction of work accidents thanks to more effective training and real-time monitoring of PPE use.

● **Increased productivity:** Process optimization, reduced downtime and improved decision making.

● **Cost reduction:** Shorter training time, fewer errors and more efficient use of resources.

● **Attracting and retaining talent:** The implementation of innovative technologies such as VR and AR helps create a more attractive work environment for employees.

In conclusion, the SUN project at Factor is an inspiring example of how immersive technologies are transforming the manufacturing industry. By combining traditional training with immersive experiences and real-time visualization of information, Factor is laying the foundation for a safer, more efficient and competitive factory.



Pilot 3: Revolutionizing Digital Rehabilitation and Interaction for Individuals with Severe Motor Disabilities

We are excited to provide an update on our transformative third pilot project, which is dedicated to enhancing digital rehabilitation and immersive virtual interactions for individuals with severe motor disabilities. Our mission in this phase of the SunXR project is to integrate advanced technologies that allow users to overcome physical barriers, connect with familiar spaces and loved ones, and experience a virtual world that feels as close to reality as possible.

Advanced Virtual Reality for Digital Rehabilitation

This pilot focuses exclusively on the use of Virtual Reality (VR) to create a fully immersive experience for users with profound mobility limitations, particularly in the upper body. By harnessing technologies like electromyography (EMG) to capture residual muscular signals, we can decode and interpret the user's intentions. These signals allow us to translate even minimal physical input into meaningful interactions within the VR environment. This system is designed to empower users to interact with the virtual world with a sense of autonomy, despite

physical limitations.

Sensory Feedback and the Illusion of Touch

In addition to movement, sensory experience is essential for immersion. Our VR system integrates sensory feedback, specifically thermal feedback, to simulate the sensation of touching objects at different temperatures and textures. By providing feedback that mimics the feel of various materials—each with unique thermal profiles—we create a realistic sense of touch. For instance, two materials at the same temperature may feel distinctly different due to their thermal properties, adding depth and realism to the user experience. This sensory immersion aims to enhance presence, making the virtual world feel more tangible and responsive.

Connecting with Loved Ones in a Virtual Space

A crucial aspect of this project is addressing social isolation, which can be particularly challenging for individuals with severe disabilities, especially those in long-term care. Through SunXR, we enable users to re-

connect with loved ones via realistic avatars in a virtual space. These avatars, created with a high degree of detail, represent familiar people in the user’s life, making interactions feel natural and comforting. This allows users to engage with family and friends in a meaningful way, even if they are physically distant, bridging emotional and social gaps that physical disabilities can create.

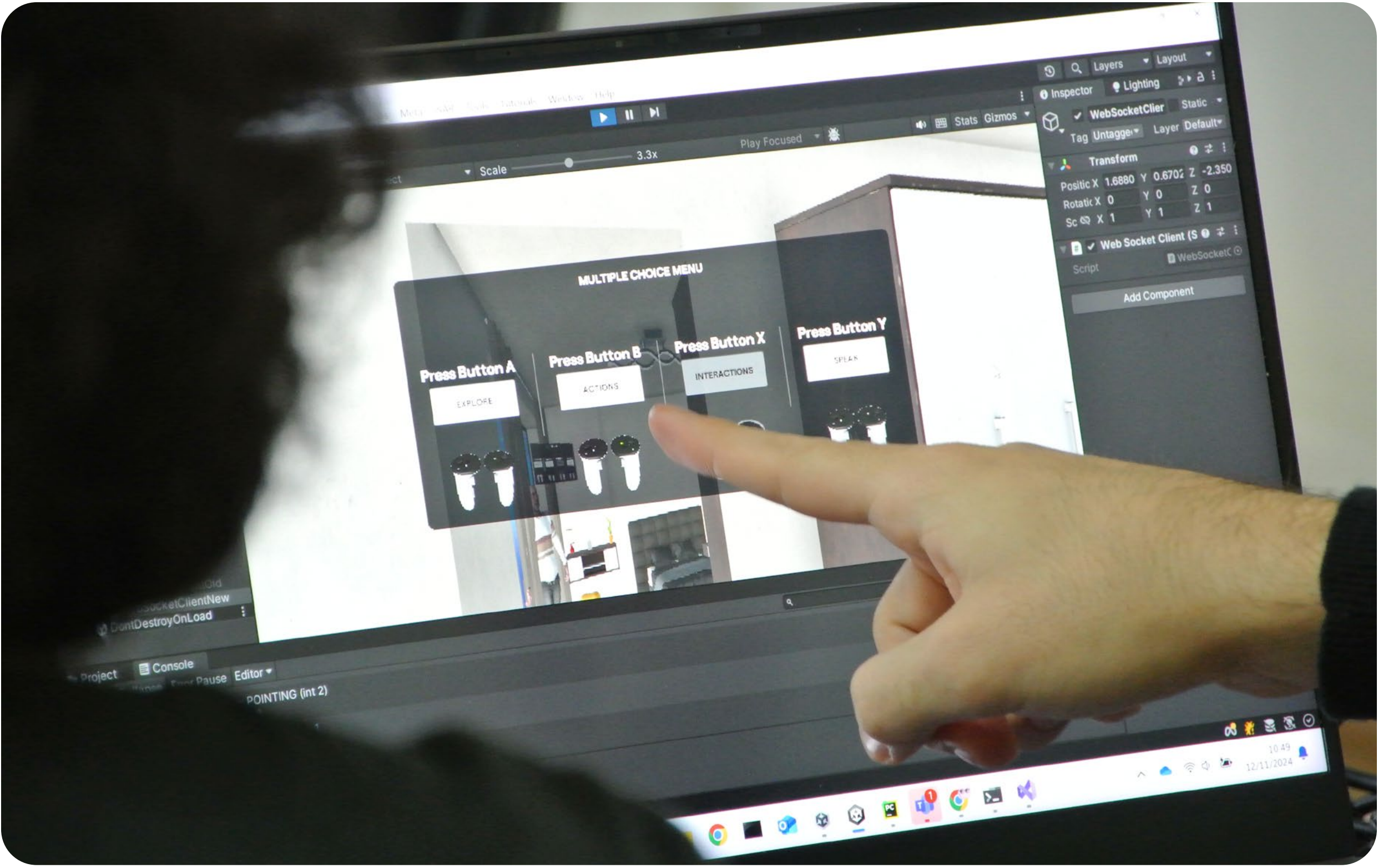
Recreating Familiar Environments

One of the standout features of this pilot is its ability to bring the user “home” or to other meaningful places. We are working to accurately recreate familiar spaces, like a user’s home or favorite local park, within the virtual environment. By replicating these settings with a high degree of precision—down to objects, layouts, and textures—

we foster a sense of comfort and belonging. This personalized virtual environment allows users to inhabit a space that feels genuinely familiar, which can positively impact mental well-being and create a deep sense of place and identity.

Upcoming Clinical Testing in Sion in June 2025

We’re pleased to announce that testing for this pilot is set to take place in June 2025 at the Clinique Romande de Réadaptation (CRR SUVA) in Sion, Switzerland. For this phase, we’ll be working with at least three patients with incomplete tetraplegia to test our system in a real clinical setting. This stage will allow us to evaluate the technology’s effectiveness, refine the user experience, and gain insights into how our approach can be further optimized.



Our Current Focus

Right now, our team is actively integrating the various components essential to this project. We're refining EMG-based intent recognition for intuitive user control, enhancing the sensory feedback system to provide realistic thermal sensations, and perfecting our VR environment's fidelity to ensure familiar settings feel authentic and immersive.

Looking Ahead

This pilot represents just the beginning of what we envision as a new approach to digital rehabilitation. SunXR's mission is to leverage VR and advanced feedback technologies to create digital spaces that empower individuals to transcend physical limitations. We're excited to continue refining this system and to open up new possibilities for interaction, connection, and personal empowerment for those with severe mobility challenges.



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The project started on the 1st of december 2022
and will end on the 30th of november 2025



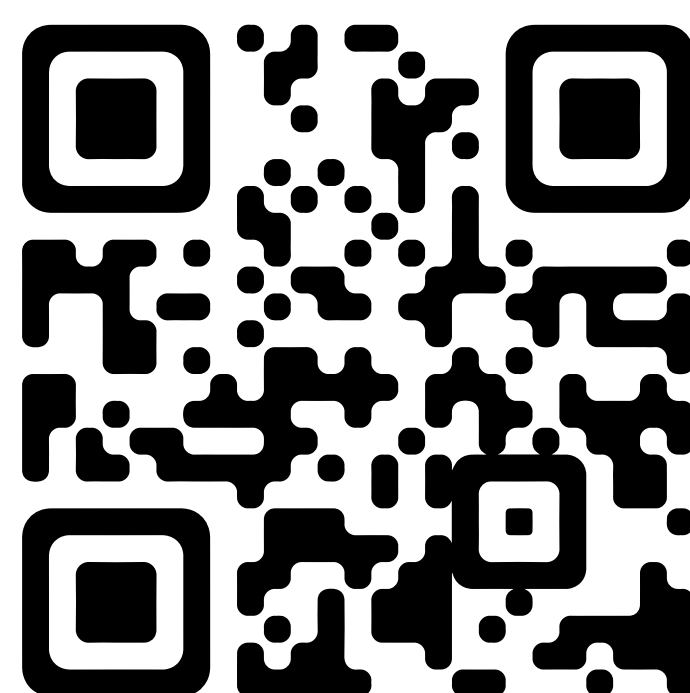
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