Detailed Program of XR lab visits at the Delft University of Technology

EuroXR 2023

Version 2

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Great thanks to the **Human-Robot Interaction** group and the **NewMedia Centre XR-ZONE** of the **Delft University of Technology** to welcome the **XR lab visits of EuroXR 2023** international conference.

Starting date and time: **Wednesday, November 29**, from **9am** to **noon** (CET).

Meeting point: TU Delft, 3mE faculty, **Mekelweg 2, 2628 CD, Delft**

Directions:

Contact and map

The website 9292.nl is an online tool, also available as an app, which will help you choose the best transport option to reach your destination.

You can walk from Delft Central station (train from Rotterdam Central) to 3mE (around 15-20 min) or take the bus 40 to Delft, Jaffalaan, or the 69/455 to Delft, Aula. An alternative route from Rotterdam Central is the bus 40 to Delft, Jaffalaan.

Human-Robot Interaction group program

The **Human-Robot Interaction (HRI)** section strives to ensure that humans and robots understand each other's behavior to move and act together in a shared space. The group studies the fundamentals of human control and cooperation with robot systems and engineers interface prototypes by exploring different interaction design principles and experimentally testing them through human-in-the-loop studies, from simulator studies to real-world testing. Two main research areas are addressed: (i) cognitive HRI based on gaze, gestures, and body/vehicle motions; and (ii) physical HRI, based on

shared control, human-robot collaboration, and haptic and tactile feedback. Practical applications can be found in the automotive domain as well as in production robots, remotely controlled robots, soft robotics and rehabilitation technology.

Some demo examples:

FeelPen is a multimodal haptic stylus that transcends the limitations of conventional touchscreens by incorporating haptic feedback that simulates sensations of warmth, softness, slipperiness, and roughness, enabling users to experience tangible textures while navigating the digital landscape. Here are the links for the scientific paper and video.

FeelSurf is an electrostatic surface haptic device that can simulate realistic texture feels to bare fingertips. We will demonstrate the texture rendering capability of this device using data-driven time series models for various surfaces.

WearableRing is a ring-shaped haptic device that can deliver texture feels on the proximal phalanx of the finger while keeping the fingertips free for future XR applications. We will demonstrate the texture rendering capability of this device with three different rendering algorithms with varying complexity. Here are the links for the scientific paper and video.

PRIDE is a novel robotic platform for sensorimotor upper-limb stroke neurorehabilitation developed together with clinical partners. We designed an end-effector device consisting of a robotic delta platform and a custom hand module with three degrees of freedom that allow a wide variety of grasps such as cylindrical grasp or pinch grip. We combine the robotic solution with virtual rehabilitation exercises that provide high-fidelity haptic interactions with virtual tangible objects.

Portable Hand trainer: Our low-cost portable hand trainer enables the training of finger and thumb movements and forearm prono-supination in unsupervised environments, such as the patients' homes. The finger and thumb flexion/extension are realized via an actuated compliant shell that deforms following the natural movement of the fingers during a cylindrical grasp. We combine the device with a gamified exercise that motivates participants to train fine haptic manipulation in a motivating and engaging way.

Themes:

Tele-impedance: interfaces that enable the human operator to command the impedance of the remote robot in real-time during teleoperation. Furthermore, we develop methods where tele-impedance can be used as a way to teach the remote robot complex interaction skill.

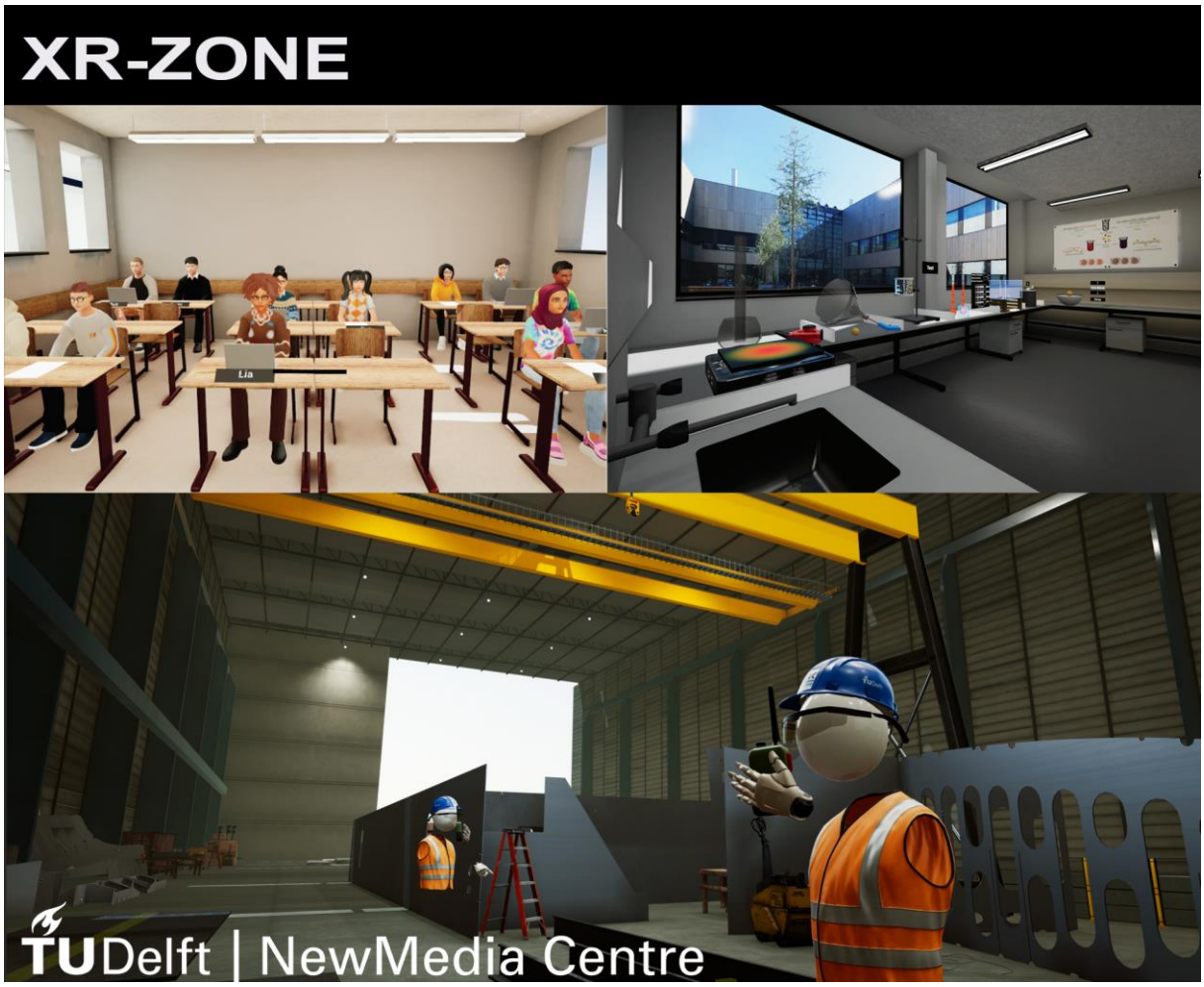
Biomechanics-aware therapy: collaborative robots as a tool for the physical therapy of musculoskeletal injuries. The key innovation in this direction is to create an abstraction of a complex biomechanical model that can be included in the robot control system and used in real-time to facilitate safe and effective physiotherapy.

Combining robotic devices with Immersive Virtual Reality (IVR): The combination of robotic devices, such as exoskeletons, for upper/lower limb rehabilitation and IVR enables patients to have fully-immersive experiences that can improve their motivation

and engagement during training. Additionally, this combination enables other advantages, such as gamification or embodied virtual avatars.

Manipulation of a virtual environment: Traumatic brain injuries can seriously limit the cognitive stimulation a patient can endure. By utilizing immersive VR, a virtual environment can be tailored to the specific patient's capabilities, by, for example, modulation of visual and auditory stimuli.

NewMedia Centre XR-ZONE program



We extend the possibilities of reality with the use of Virtual Reality, Augmented Reality and Mixed Reality technologies. We are here to become your portal to the immersive world of XR (extended reality) and to assist students, lecturers and researchers in using, building and exploring this tech in education and research.

The XR lab is situated on the campus at the TU Delft Library. You are always welcome to get personal guidance for your project, test the latest hardware/software or just to explore existing VR solutions for research, learning & development.

VR Maritime

Learning some procedures required for working on a ship wharf is usually a difficult and costly process due to limited access to an actual location and lots of risk involved. Still, students of the faculty of 3mE (Mechanical, Maritime and Materials Engineering) have to practise some assembly and logistics ship operations.

In order to help students learn easily and safely, the NewMedia Centre created a multiplayer VR application where they can learn multiple disciplines on a ship wharf in a virtual environment. Once in VR, the students perform different tasks from identifying and locating the required parts of the ship to transporting them and assembling the hull of the ship with a crane. During the whole experience they work in a team and perform these practical tasks while learning to navigate through the ship together. All the team members communicate through virtual walkie talkies, created specifically to increase the realism of their communication in VR.

Pop-up book XR: exploring materiality with XR

Ever wondered how Pop-up books are digitalized? Well, most often they make some pictures while lying flat and one or two pictures while folded out. This does not capture the soul of an pop-up book. Together with Willemijn Elkhuizen and the Koninklijke Bibliotheek (KB), we showcased an immersive XR pop-up book at the DH Benelux conference. The goal of the pop-up book was to explore how to digitalize pop-up bookstand still keep some of the materiality that makes pop-up books so interesting and fun to read. The experience offered a mixed reality experience of 'Tip+Top boven de wolken'

Teacher-Classroom Simulator using AI

The Classroom setup consists of a teacher (the player in VR) and virtual students with some AI functionality. The virtual students are supposed to work on their individual assignment, while some other are getting distracted and doing other things like talking. The goal of the teacher is to keep the peace in the classroom by saying some- thing to the distracted students. This application captures the audio message from the teacher and uses that information to filter and generate an output behaviour and response of the virtual students. By using LLM’s and speech/text-generators (and proper game-design) the responses are realistic and intuitive, like you’re talking to a real person.

Sarah - AI driven MetaHuman

Sarah is our first MetaHuman with an AI-brain. Our goal was to create a intuitive and realistic virtual person to interact with. With the combination of the latest technology like large language models (LMMs), speech/text AI-generators and powerfull game-engines it’s possible to create such fun interactions. Sarah’s brain is powered by OpenAI, the creaters of ChatGPT and the player voice input is also filtered by them. Personally I think that the strength of OpenAI is the ability of “interpretation”, which is

the basis of human-interaction. However it doesn't stop here. We aim te develop our own AI-system as well to give Sarah more custom data, like

HANDZONe

TU Delft researcher: Serdar Asut

HANDZONe will explore how can we utilize VR for more flexible and inclusive hands-on learning methods on designing and making with robots. It will provide a hybrid workspace which integrates a collaborative robot in a virtual platform that is also immersive and tangible with the support of VR and HRI technologies.

The physical educational infrastructures, which are needed to accommodate hands-on learning activities, can be made more efficient and flexible to answer the increasing interest of the students and respond to the paradigm shifts in education. In this regard, this project aims to develop a hybrid learning platform and associated learning methods by using Extended Reality (XR) technologies. The implementation is being developed in a course on robot programming and operation in the Building Technology MSc program of Delft University of Technology. The outcomes of the project will help to improve this course in a blended format towards being more flexible, inclusive, and efficient. Moreover, it will contribute to the field by demonstrating the possible uses of the XR technology to support education with a focus on hands-on learning exercises which require spatial, tangible, and material infrastructures.

Virtual Lab: Physic Transport Phenomena

This application was developed as an interactive learning tool for about 100 Bachelors students of Applied Sciences. In addition to the lecture series of theoretical concepts of physics transport phenomena, students are invited to perform the relevant laboratory experiments in this virtual lab as a means to improve their understanding of the theory. The implementation of VR has enabled large number of students to experience close-to-real laboratory experiment within the limited time availability of the course schedule with zero risk of laboratory hazards.