

XR2LEARN SOFTWARE ENABLERS

Enabler 1 : INTERACT authoring tool

INTERACT is a Unity plugin that allows users to create a human centric interaction with 3d objects in virtual reality. It helps the users with low technical knowledge to swiftly set up a 3D scene in UNITY, physicalize objects and gamify the scenario. The main features are :

- Embedded physics engine: This handles multi-body dynamics, collision detection, friction, and kinematics, providing realistic behavior for objects in a 3D environment.
- Cables: The software can simulate cables and flexible beams using finite element analysis, providing realistic representations of these elements in the 3D environment.
- Natural object interaction: This feature allows users to directly manipulate 3D objects with their own hands, providing a more natural and intuitive way to interact with the virtual environment.
- Scenarization: This is a module designed for creating and editing complex assembly scenarios. INTERACT provides the Scenario Graph to create a hierarchy of steps that create an assembly sequence.

Enablers 2-6 aim to provide tools for pre-training, fine-tuning, and integrating Affect Recognition models based on Deep Learning in VR training scenarios.

Enablers 2-5 focus on creating tools for a multimodal emotion classification system utilising Self-Supervised Learning (SSL):

- Tools for building emotion representations (pre-text task in SSL) (Enabler 2)
- Tools for using pre-trained emotion representations (Enabler 3)
- Tools for building emotion classifiers - per modality (fine-tuning task in SSL) (Enabler 4)
- Tools for fusing multiple modalities (Enabler 5)

Enabler 6 focuses on deploying a personalisation system based on the Theory of Flow, using tools created by Enablers 2-5.

Enablers 2-5 will encompass a complete end-to-end system with a modularised architecture developed to foster maintainability, expansion of functionalities and to support deployment, maximising their (re)usability. With this architecture, enablers can be easily used in demo and pilot applications.

The end-to-end system will be delivered in three open-source Github repositories:

- XR2Learn-Training (Preprocessing, SSL training, Features Extraction and Fine-tuning training components - Enablers 2, 3 and 4)
- XR2Learn-Inference (Emotion classification and multimodal fusion components - Enabler 5)



- XR2Learn-CLI (Command-Line Interface: A unified entry point interface for users to quickly and easily start utilising Enablers 2-5)

Enablers 6 will create a self-adaptive system for personalisation using components from Enablers 2-5. Enabler 6 will be delivered in one open-source Github repository:

- XR2Learn-Personalisation

Each component from Enablers is deployed with Docker containers to ensure:

- Easy-to-use components;
- Reproducible development and deployment environments;
- Consistent results.

Using Docker Compose, Docker containers are easily managed and orchestrated to ensure reliability. Our system architecture supports three primary operating systems (MacOS, Linux, and Windows), and we offer support for both CPU and GPU usage.

The enablers' architecture was created to encourage users to go beyond the supported functionalities, giving space for creating their novel enablers by expanding the components to include more modalities and downstream tasks (e.g., Classical Emotion Recognition, Activity Recognition, and others).