

Immersive Authoring of Virtual Reality Training

F Cassola*
INESC TEC, FEUP

M Pinto†
INESC TEC

D Mendes‡
INESC TEC, FEUP

L Morgado§
INESC TEC, UAb

A Coelho¶
INESC TEC, FEUP

H Paredes||
INESC TEC, UTAD

ABSTRACT

The use of VR in industrial training contributes to reduce costs and risks, supporting more frequent and diversified use of experiential learning activities, an approach with proven results. In this work, we present an innovative immersive authoring tool for experiential learning in VR-based training. It enables a trainer to structure an entire VR training course in an immersive environment, defining its sub-components, models, tools, and settings, as well as specifying by demonstration the actions to be performed by trainees. The trainees performing the immersive training course have their actions recorded and matched to the ones specified by the trainer.

Index Terms: Applied computing—Education—Interactive learning environments; Computing methodologies—Computer graphics—Graphics systems and interfaces—Virtual reality

1 INTRODUCTION

In the industrial sector, the ability to adapt to requests with a high degree of customization and complexity implies longer cycle times. The application of virtual reality (VR) is a promising approach [1], helping operators minimize errors and to increase safety. Virtual reality environments are also used to perform operational tasks in industrial settings, as an experiential and situated learning approach, which has shown good results in areas such as work safety [2], medicine [3], mechanical maintenance [4] and mining [5]. Indeed, the use of a virtual environment to carry out learning activities presents a wide range of advantages when compared to training in a real context, namely reducing costs and risks [6, 7], higher control of training procedures (for example, scheduling training sessions and identifying action complexity), promoting experiential and situated learning, the ability to ensure the replication of the simulations carried out by trainees, the empowerment of self-learning processes [8, 9], and triggering emotions furthering the interest and engagement of learners [10].

However, the creation of training experiences in VR is limited, due to its expensive and time-consuming development process (e.g. Unity or Unreal Engine) that requires software development experts [11]. To mitigate this hurdle, authoring tools have been proposed for development of VR applications for training and certification (e.g. EON Reality and XVR Simulation). Current limitations of this approaches include: lack of integration with existing data: such tools do not allow the creation of VR scenarios from pre-existing data in organizations, such as engineering CAD files; desktop-oriented, non-immersive authoring processes that detach the immersive experience from its creation (users specify training procedures without experiencing the trainee task performance perspective).

*e-mail: fjcm@inesctec.pt

†e-mail: manuel.a.alves@inesctec.pt

‡e-mail: danielmendes@fe.up.pt

§e-mail: leonel.morgado@inesctec.pt

¶e-mail: antonio.coelho@inesctec.pt

||e-mail: hugo.paredes@inesctec.pt

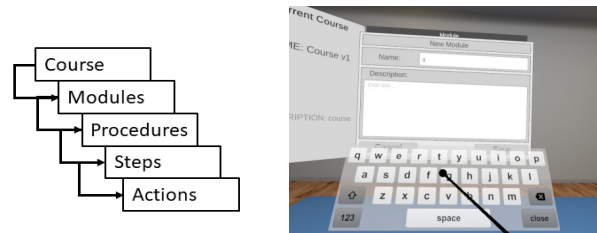


Figure 1: Left: Course structure; Right: Module creation panels.

We tackle these limitations with a VR authoring tool, enabling immersive authoring of immersive training. With an authentic VR environment from pre-existing CAD data (created by the Vestas Wind Systems Company team), digital representations are generated, following the concept of digital twins [12]. This authenticity brings trainers and trainees experience varied and rich experiential in learning for industrial maintenance scenarios.

2 VR AUTHORING TOOL

We developed an immersive authoring tool in VR for trainers to create immersive training courses. The actions that the trainee can perform in the virtual environment are executed by example on industrial machinery, and descriptive information is added. These actions are structured as procedures, as described in the next subsection. The tool was designed as a generic approach training procedures on engineering components, and is currently being applied with training of maintenance procedures on wind turbines.

Defining Course Structure In the VR environment, the trainer can create courses and specify their elements: training modules and their procedures, and the steps of each procedure (Fig. 1 Left). This information defines the context for the subsequent immersive actions, both for their creation and their editing. This is currently being done in a traditional windowed dialogue metaphor (Fig. 1 Right), only with the side-by-side information at a lateral pane, to support head-rotation viewing. We envision recreating this task in a more immersive mode of interaction.

Setting Up the Environment The tool allows the trainer to setup the training environment, specifying: the visual space for the training (Fig. 2 Left); the starting position of the trainee (Fig. 2

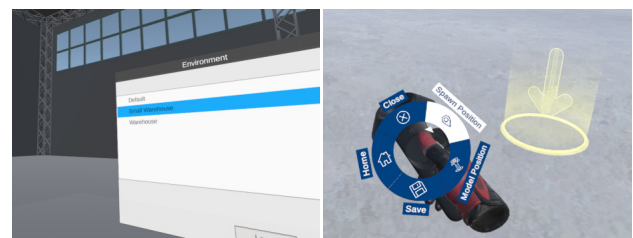


Figure 2: Left: Choosing an environment; Right: Defining the initial position for the trainee.

