Supporting Virtual Reality in an Adaptive Web-based Learning Environment

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Problem Statement

Starting Point

Virtual Reality (VR) may be of great value for some learning situations and topics :

- VR provides ways to use 3D visualizations with which the user can interact.
- The physical counterpart may not be available, too dangerous or too expensive.

However

Its richness in representation and manipulation possibilities may become one of its weaknesses, as some learners may be overwhelmed and be easily lost in the virtual world.

Solution

Dynamic adaption of the virtual world to the personal preferences, prior knowledge, skills and competences, learning goals and the personal or social context of the learner.

Approach

Extension of an adaptive Web-based learning environment developed in the context of GRAPPLE, an EU FP7 project.
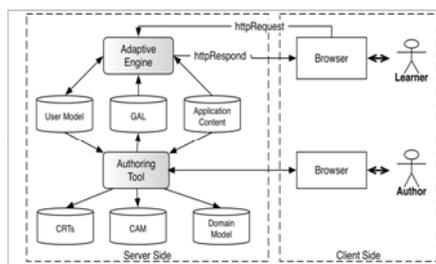
Adaptive TEL: GRAPPLE

Figure 1: GRAPPLE Architecture

Authoring Tool

Allows a course author to define a course at a conceptual level and in a graphical way. Using a *Domain Model* (DM) and *pedagogical relations* (CRTs), a *Conceptual Adaptation Model* (CAM*)* is composed that specifies the adaptive course.

Adaptive Engine

The graphical CAM is translated into GAL (Generic Adaptation Language) code.

The GAL code is processed by the adaptive engine and the result is displayed in a browser.

Adaptive VR in the context of GRAPPLE

To provide adaptive VR material, extensions are necessary for the authoring tool and for the adaptive engine.

VR Authoring tool

Allows to:

1. Define different adaptation states for VR material.

    Figure 2 shows an adaptation state for a planet-object that semi-hides the object.
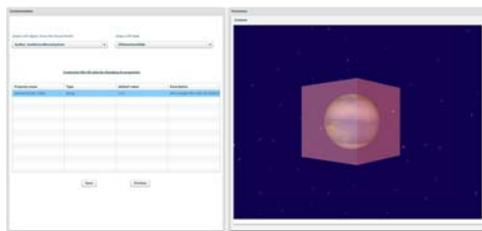

Figure 2: VR Adaptation State

2. Define when an adaption should happen.

    Figure 3 defines *DisplayAfter* specifying that a VR object should be displayed after a certain time.
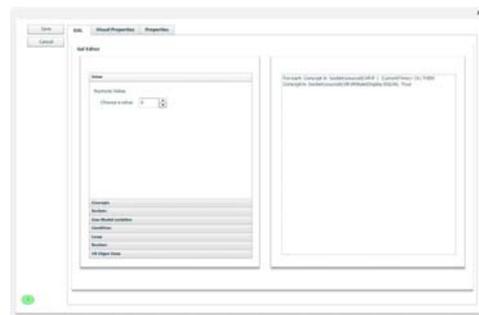

Figure 3: VR CRT

3. Compose the actual adaptive VR Course (VR-CAM).

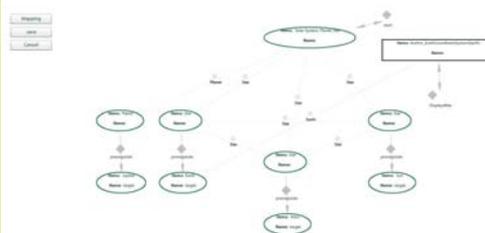   Figure 4 shows the VR-CAM for a course on the Solar System.

Figure 4: VR CAM

VR Adaptive Engine

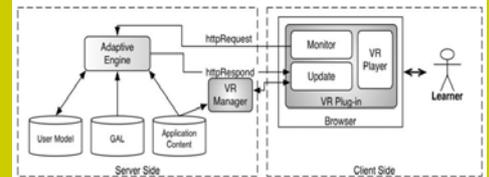The extension of the adaptive engine for VR is done through a browser plug-in (see figure 5).

Figure 5: Adaptive VR Delivery

The VR Plug-in has three components:

(1) An existing *VR player* responsible for updating the virtual world at runtime
(2) The *Monitor* responsible for monitoring the learner's behavior
(3) The *Update* component responsible for informing the Adaptive Engine about the learner's behavior.

Figure 6 shows an example of an adaptive VR course on the Solar System.

- The course is a mixed of text and VR material.
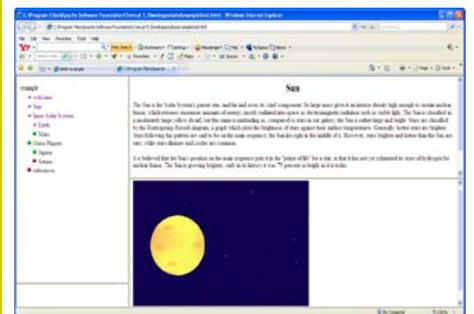- The text as well as the VR material adapts to the progress made by the learner.

Figure 6: Studying the sun using the adaptive course

Conclusion

- An approach has been developed to support the adaptive delivery of VR learning material inside GRAPPLE.

- The approach is innovative as

    1. It includes a graphical authoring tool for specifying the adaptive strategy for the VR material.

    2. The adaptation of the virtual world is done at runtime.

    3. The learning activities performed by the learner in the virtual world can be monitored and the effect in terms of adaptation can be directly reflected in the virtual world.