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Multimodality in Game-based Learning Environments

Game-based learning environments represents one particular type of edutainment applications that have the great potential to support learning contexts, as they provide a new form of engagement that is participatory and collaborative. In these environments, multimodal interfaces play a fundamental role for the achievement of a high degree of interactivity during the learning process. Multimodal interfaces, indeed, by enabling the combined use of speech and gesture and various physical and virtual avatars and metaphors, allows the learner to directly interact with the learning objects. This active involvement has the great potential to produce good results in terms of motivation, understanding and long-term acquisition of contents, compared to the traditional learning methods based on the passive reading of books. In fact, the use of integrated multiple input modes provides users to benefit from flexible and powerful dialogue approaches, as how an our previous work (Caschera et al., 2007) has underlined through the analysis and formalization of the main features of multimodal interaction and systems.

Nowadays, game-based learning environments have been used in many different modes for supporting learning experience (Herz, 2001). Games have been used to support learning communities by using interaction paradigms based on metaphors in order to allow people to experiment and explore real world, such as Grangeton (http://www.grangeton.com/web/) and The Sims (http://thesims.ea.com/). Moreover, games have been applied to simulate microworlds, where people can interact in the game holding roles and operating activities that can be transferred in real life contexts, for example Revolution (http://www.gamerevolution.com/).

On the other hand, games can be played on several devices, such as personal computers, game consoles, handled devices and using mixed interfaces (i.e. augmented reality and mobile devices). The use of these interactive technologies has given advantages to game-based learning due to the flexibility and the possibility to give immersive learning experience (De Freitas, 2007). In addition, some researches on game-based learning environments have been focused on the use of multimodal interaction as the medium for conveying educational material (Jovanovic et al., 2008). This approach aimed at identifying and constructing profiles of user interfaces for educational games using motivation as the key ingredient in the learning process. The investigation of existing game-based learning environments leads us to believe that a distributed architecture, networking technologies, and multimodal facilities have to be integrated into this kind of environments in order to enable an interactive and participatory learning experience to learners. Therefore, we propose an Advanced Multimodal Platform for game-based LEarning (AMPLE), which enables the interaction in a gamed-based learning environment through a multimodal interface. This platform allows efficiently managing multimodal communication between people participating in the virtual learning environment.

AMPLE is based on a client-server architecture as depicted in Figure 1. Each person (i.e. learners and teachers) can access to AMPLE from its own device that is equipped with a multimodal interface. Therefore, an AMPLE client includes specific I/O devices, such as, for example, display, cameras, microphone, and loudspeakers, as well as the components for extracting features from the received signals. The feature extraction occurs on the client side, since it requires limited amount of memory and computational power, whilst the remaining recognition process, which consists in matching the extracted features with a predefined set of patterns, is completed on the server.

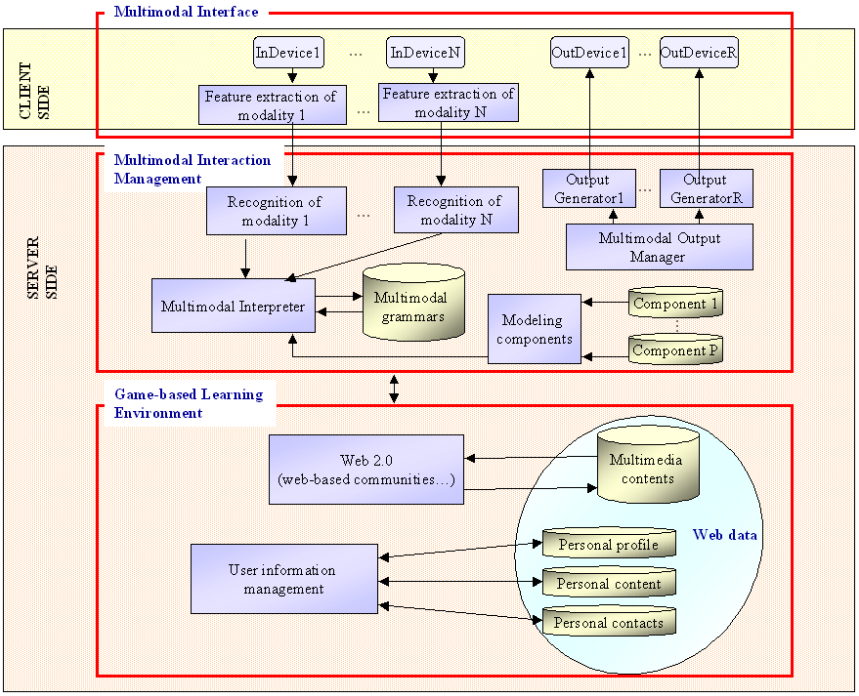

Figure 1: Architecture of the AMPLE environment

The AMPLE server consists of the *multimodal interaction management* and the *game-based learning environment*.

The *multimodal interaction management*, whose architecture has been proposed in an our previous work (D'Ulizia et al., 2008), is responsible for recognizing unimodal input coming from the features extractors of each modality, appropriately interpreting these inputs, integrating these different interpretations into a joint semantic interpretation, and understanding which is the better way to react to the interpreted multimodal request by activating the most appropriate output devices. To do that, this component includes:

- the unimodal input recognizers, such as, for example the Automatic Speech Recognizer and the gesture recognizer, and the output generators, such as the Speech Synthesizer;
- the multimodal interpreter that integrates the recognized inputs, assigning them the appropriate values for the attributes, as required by the multimodal grammar notation, and applies the production rules stored in the Multimodal Grammar Repository, to parse the multimodal input;
- the modeling components, that are aimed at capturing some information used during the interpretation phase for leading up to the most probable interpretation of the user input. Examples of modeling components that can be integrated in the framework can be the user, content and context modeling components.
- the multimodal output manager for generating appropriate output information, through the available output modalities (multimodal fission).

The *game-based learning environment* consists of two main components:

- the Web 2.0 module, that provides social networking services, such as web-based communities, for supporting online gaming of multiple players;

- the user information management, that is devoted to store and manage personal data of network members. In particular, it provides controlled access to the network and to user information, such as personal profile, contents and contacts. These data are contained in three networked repositories.

In conclusion, the use of multimodal interfaces in game-based learning environments can help to enhance learning processes as it makes the interaction with the game more easy, participative and less workload consuming than standard graphical interfaces.

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