

Teaching by Means of a Technologically Augmented Environment: The Stanza Logo-Motoria

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Abstract. The Stanza Logo-Motoria is an interactive multimodal environment, designed to support and aid learning in Primary Schools, with particular attention to children with Learning Disabilities. The system is permanently installed in a classroom of the “Elisa Frinta” Primary School in Gorizia where for over a year now, it has been used as an alternative and/or additional tool to traditional teaching strategies; the on-going experimentation is confirming the already excellent results previously assessed, in particular for ESL (English as a Second Language). The Stanza Logo-Motoria, also installed for scientific research purposes at the Engineering Information Department (DEI) of University of Padova, has sparked the interest of teachers, students and educationalists and makes us believe that this is but the beginning of a path, which could lead to the introduction of technologically augmented learning in schools.

Keywords: Stanza Logo-Motoria, interactive and multimodal environment, augmented reality, augmented environment for teaching, Learning Disability.

1 Introduction

The Stanza Logo-Motoria [1] consists of an empty room equipped with input and output conventional peripheral devices such as a standard webcam, two speakers and a video projector. The user’s body movements and gestures are captured by the webcam positioned on the ceiling and the video signal is processed by a EyesWeb patch to derive low-level features [3], used to define a) how the user occupies the space and b) the quality of gestures the user performs.

Finally, an Adobe Air application is used to render interactive audio-video contents. In the Stanza Logo-Motoria it is possible to subdivide the room in several areas. By entering the various areas and performing previously arranged gestures the user activates the connected auditory and/or visual content. Sounds, segments of spoken language, and complete sentences are used to enhance the motor-auditory experiences through which the user acknowledges non-linguistic communicational tools: body, images, sound and symbols as for their transcultural value. The main applications of the Stanza Logo-Motoria are aimed to support and aid learning in Primary Schools and children who experience severe disabilities or suffer from specific Learning Disabilities (used as a compensatory and dispensation tools in the case of LD) [2]. The system, by using standard hardware and simple strategies of mapping, has sparked the interest of students and teachers in more innovative ways of learning and teaching. The Stanza Logo-Motoria is suitable for the school environment thanks to its easy implementation; moreover, teachers are immediately involved in the design of activities due to the simplicity of mapping, which makes it immediately comprehensible. In fact, for over a year now, the use of the Stanza at school has shown that, by using the same basic scheme, it has been possible to develop in collaboration with teachers a great deal of educational activities involving several school subjects, such as English, History, Science, Music. In the following paragraphs we will explain two applications of the Stanza Logo-Motoria, called Resonant Memory and Fiaba Magica, in detail.

2 Resonant Memory Application

The Resonant Memory application allows the creation of a technologically augmented environment [5] to be used within all the subjects taught at school. The use of body movement associated with the sound widens the range of possibilities to access knowledge from an enactive point of view [6]. Teaching contents, by becoming “physical events”, which occur around the child by means of the child, activate the motor aspect of knowledge [7]. By means of the Resonant Memory application the space, acquired by the webcam, is subdivided in nine areas: eight peripheral and one central. The user’s presence within a specific area triggers the audio reproduction of the corresponding content. The child explores the “reactive space” by freely moving without using sensors:

- Noises, music and environmental sounds are synchronized to the peripheral areas.
- The central area is synchronized instead with an audio reproduction of the contents to be taught that contain the elements to be connected with sounds positioned in the various peripheral areas.

When the user enters the reactive space for the first time the application is in *exploration mode*: whenever the user reaches one of the eight peripheral areas, activating the connected sound content, the application stores this information and, if during this phase, the user reaches the central zone no sound event is triggered. When the user reaches the central area the Resonant Memory application

triggers the *story mode*: the system starts the audio reproduction of a story. The child listens to the content reproduced in the central area, reaches the different peripheral areas experimenting the sounds and finally, enjoying the game, “composes the soundtrack” of the lesson. If, during the listening, the user widens their arms the system pauses the playback of the story, which is interrupted until the user lowers their arms.

The Resonant Memory application creates a sound augmented space: in agreement with the teachers, who have work with the system, we think that, in general, children need to improve their listening ability experiencing the interactive space without being distracted by any visual references connected to the sound. The main aim is to achieve heightened awareness of the body movement in space. The sounds synchronized with the peripheral areas can be words, syllables, sentences, noises, music, etc.; these sounds do not change collocation in space: the same sound always corresponds to the same spatial area. Every sound is triggered by the presence of the user in the corresponding area. The child is motivated to carefully listen in order to insert the proper sound at the right time. The mere movement of the body in space, performed to activate the sound, stimulates the child to spontaneously mime situations, actions, characters and feelings. School children love to use the Resonant Memory application in pairs: together they decide where to go, how to move and what to say. It is also possible to use the application with a group: one child is the “explorer”, the others are the sounds; the explorer performs the exploration phase and, during the story phase, swaps his/her position with that of the children standing near the peripheral area containing the sound.

At school we have been testing the Stanza Logo-Motoria in Resonant Memory modality since February, following a quasi-experimental design (between subjects) with two comparable classes: two Third Classes. The quasi-experimental design requires a pre-test (February) and post-test (June) for a treated (experimental) and comparison (control) group. We intend to verify (experimental hypothesis) if students, by using the Stanza Logo-Motoria as a listening tool for learning English as a second language, improve significantly in word recognition and language comprehension than those who use passive listening by means of headphones or the 5.1 sound system.

3 Fiaba Magica Application

The aim of Fiaba Magica is to support a strengthening path of gestural intentionality of children with multi-disabilities. These children often are able to express communicative intentionality only by means of simple gestures and vocalizations, which can be enhanced and extended thanks to technology. Fiaba Magica is the opportunity to augment gestures with visual and sound stimuli bringing out all the intentional features. Fiaba Magica responds to the need to communicate of a child with limited speech abilities associated with motor impairments.

The Fiaba Magica application allows the user to reconstruct the sound and images of a tale by performing a simple gesture such as widening arms and moving within a specific space. Using Fiaba Magica a child enters a specific area of the Stanza and activates a) the audio reproduction of the first part of the story and b) the projection on the screen of the corresponding image (for example two characters). Once the audio reproduction of the first part of the story is played, by widening their arms, the user can play with the characters projected, animating them. Moving to the next area the child activates a) the projection of a new sequence of the story which includes another set of characters and b) the audio reproduction of the narrative sequence itself. The third advancement in the story is performed in the same way as the other two.

In this particular instance, it is mainly important to have the child understand that the audio/visual feedback is triggered by his/her movement. In a further evolution of the system the opportunity to make a choice could be decided: the gesture of lifting either the right or the left arm could be synchronized to two different developments of the story. The application could take the choice in account by offering two different continuations of the story within the second and the third area. In this way it would be possible to offer a, limited but important, option to change the plot of the story.

4 System Architecture

The Resonant Memory application is based on a software patch developed in the EyesWeb environment; the EyesWeb patch performs the video analysis and sound rendering tasks. In the input stage the signal from the webcam is processed in order to extract several low-level features related to the user's movements. Features extracted include the trajectory of the centre of mass, the motion index, and the contraction index. Background subtraction is achieved via a statistical approach: the brightness/chromaticity distortion method [4]. In the mapping stage the patch analyses these features and runs transitions among four states: exploration, story, pause, and reset. Finally, the output stage controls the playback of a set of pre-recorded audio files. In Fiaba Magica the real-time control and processing of the audio/video material is performed by an Adobe Air application that also provides a user GUI to configure the system. A Flosc server allows the communication between EyesWeb and Adobe Air.

The setup of the Stanza Logo-Motoria (fig. 1) consists of an empty room measuring a minimum of 5x5 metres; a webcam is installed in the centre of the ceiling at a height of minimum 4 metres. The webcam is connected to the computer by means of a USB 2.0 cable. The computer runs the EyesWeb applications, such as Resonant Memory or Fiaba Magica, which, analyzing the video signal coming from the webcam in real time, shape the space by means of sounds and images. The audio feedback is provided by two loudspeakers while the video feedback is given by means of a video projector. The environment has to be lighted by diffused lighting in order to avoid shadows on the floor.

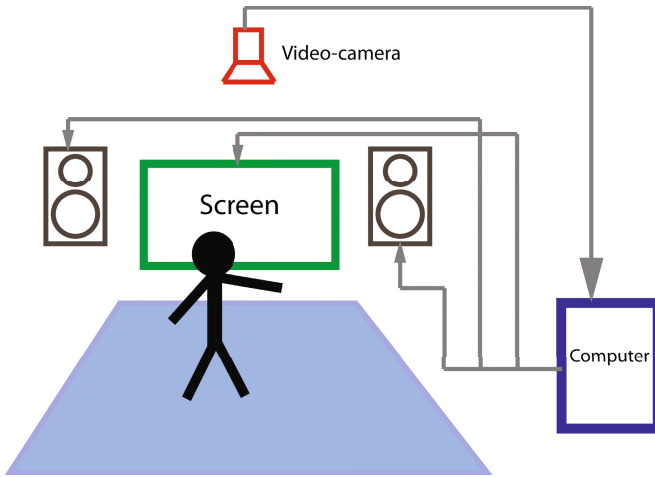


Fig. 1. The setup of the Stanza Logo-Motoria in Fiaba Magica modality

5 Future Developments

The great interest aroused by the Stanza as a teaching tool, testified also by the first results of the on-going experimentation, motivates us to further develop the system a) by introducing sound spatialization techniques in order to enhance the ability of sound localization, in particular for children with visual impairments and b) by integrating the Pittore Vocale [8] in the system, as a tool for increasing the knowledge of sound features starting from voice itself.

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