An Invisible Line: Remote Communication Using Expressive Behavior

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An Invisible Line is an installation focusing on the remote communication between 2 human users, based on the analysis of full-body expressivity. It aims at creating shared, networked, social experiences. It is the result of a scientific and artistic collaboration between Casa Paganini - InfoMus Lab (Genova, Italy), IRCAM (Paris, Italy) and The Hochschule für Musik und Theater (Hamburg, Germany).

The center of the experiment is an investigation on the resonance between the non-verbal motoric behaviors of two remote participants, mediated by computers. Instead of focusing on some form of realistic representation of the remote body, An Invisible Line studies how this relation could be achieved via abstract displays, expressing the way a computer is interpreting the relation between two people's movements. The visual feedback is purposely lacking: you cannot clearly see your remote partner, and the image of yourself is fragmented too. The audio feedback is a series of auditory displays, sometimes very basic and simple, sometimes more metaphorical, which sonify the machine's analysis of the two body's relations.

We describe the procedure followed by users interacting through the Invisible Line installation. Two installation environments are set up in separate locations. Each environment consists of: a camera running at 25 fps, a projection screen, a workstation running EyesWeb XMI (www.eyesweb.org) and Max/MSP (cycling74.com), see Figure 1. Let us consider two users, called Andrea and Barbara, acting in each of the locations:

- Andrea enters the first installation environments and places himself in front of the screen: he watches a full body image of himself on the screen; when he moves he hears sounds that respond to his movement's characteristics (e.g., if he moves in a jerky way then he hears discontinuous and harsh sounds). In the remote environment, where Barbara has not yet placed herself on front of the screen, the full body image of Andrea is projected as a white "silhouette".
- Barbara enters the second installation environment: each user watches an image, split into two halves along an invisible vertical line, one half

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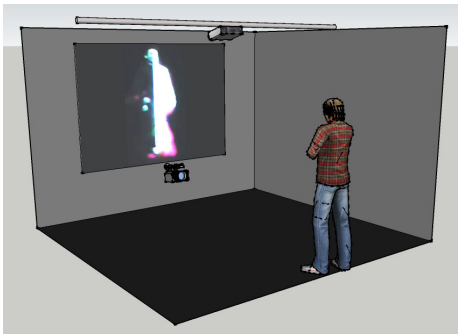

Fig. 1. A representation of the Invisible Line installation environment

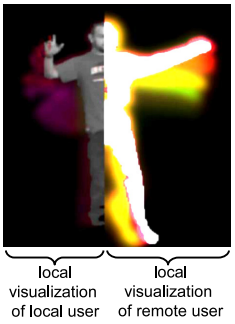

Fig. 2. An example of interaction in the Invisible Line installation

representing the user's mirror image and other half represents the other user's mirror image.

- Users' behavior is analyzed in realtime by specific modules of the EyesWeb XMI platform (the Expressive Gesture and Social Libraries) and the following movement features are computed:

  1. *Smoothness Index of the hand and foot* (SmI-h and SmI-f): distinguishes between continuous (smooth) versus discontinuous (jerky) movement.
  2. *Contraction Index* (CI): indicates whether arms are close to the body or stretched outside.
  3. *Symmetry Index* (SyI): indicates wether user's left and right silhouette halves are superimposable or not.
  4. *Quantity of Motion* (QoM): it represents the energy of movement computed as the pixel-based difference between two consecutive silhouette frames.
  5. *Synchronization Index* (SI) on QoM: it is computed between local and remote user's Quantity of Motion: SI is high when users' movement varies synchronously and SI is low in the opposite case. Only periodicity of movement is considered, ignoring the phase.

- Features 1-4 are mapped to 4 higher level semantic categories of *attitude*: *static*, *sweet*, *agitate*, *violent*. Simple rules have been established to determine attitudes from features: for example high Smoothness and low QoM correspond to the attitute *sweet*. In the near future we aim to further refine these rules.
- If, during a fixed time span, the users' attitude is the same and their movement is *synchronized* then the interaction is considered successful and users receive their prize: Barbara receives a picture of Andrea, and Andrea receives a picture of Barbara. Synchronization is estimated by observing if the two users' QoM varies in time in the same way or not.