# LOL — Laugh Out Loud

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Laughter is an important social signal which may have various communicative functions (Chapman 1983). Humans laugh at humorous stimuli or to mark their pleasure when receiving praised statements (Provine 2001); they also laugh to mask embarrassment (Huber and Ruch 2007) or to be cynical. Laughter can also act as social indicator of in-group belonging (Adelswärd 1989); it can work as speech regulator during conversation (Provine 2001); it can also be used to elicit laughter in interlocutors as it is very contagious (Provine 2001). Endowing machines with laughter capabilities is a crucial challenge to develop virtual agents and robots able to act as companions, coaches, or supporters in a more natural manner. However, so far, few attempts have been made to model and implement laughter for virtual agents and robots.

In our demo, **LoL**, a user interacts with a virtual agent able to copy and to adapt its laughing and expressive behaviors on-the-fly. Our aim is to study copying capabilities participate in enhancing user's experience in the interaction. User listens to funny audio stimuli in the presence of a laughing agent: when funniness of audio increases, the agent laughs and the quality of its body movement (direction and amplitude of laughter movements) is modulated on-the-fly by user's body features.

The architecture of LoL is showed in Figure 1 and exploits two main modules: the *Detection Platform* is implemented with EyesWeb XMI, a modular application that allows both experts (e.g., researchers in computer engineering) and non-expert users (e.g., artists) to create multimodal applications in a visual way (Mancini et al. 2014); the *Virtual Agent* is designed using the Greta agent platform (Niewiadomski et al. 2009). The two modules communicate via ActiveMQ messages.

## Detection Platform

In the LoL demo, EyesWeb XMI is used to play an audio file, to send triggers for laughter at predetermined times, and to detect the user's body features. Since it was not possible for us to automatically compute which features of the music stimuli should trigger a laughter, and how funny it is supposed to be, we use script files containing time markers to



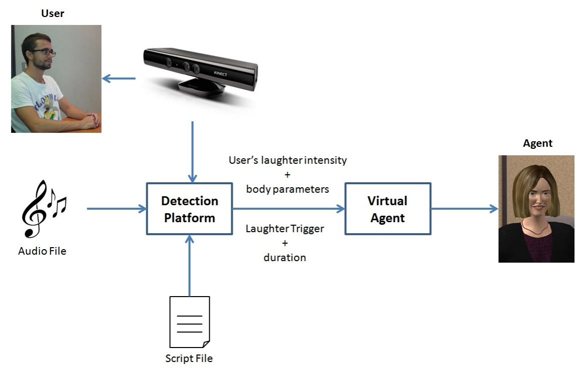


Figure 1: the architecture of our laughing agent.

know when to trigger laughter and its intensity.

For the demo, we take two parameters into account to drive the agent's behavior: (1) user's body leaning and (2) user's laughter intensity. The user's body leaning is directly mapped to the agent's body leaning: if the user leans forward, the agent leans forward as well. User's laughter intensity has a global influence on the agent's body movements. A high intensity augments the amplitude of the agent's movements, whereas a small intensity reduces this amplitude.

Body features are computed on the user's silhouette extracted from the BW depth map (an image in which each pixel is a 16 bit value indicating the distance from camera) captured by a Kinect sensor. Head's and shoulders' positions are determined by recursively segmenting the user's silhouette in our system. Figure 2 shows the result of this process, where H, LS, and RS are the head, left shoulder, and right shoulder positions, respectively.

Front/back leaning is estimated by computing the mean color of the depth image of the user provided by Kinect. We split the user's silhouette in two halves separated by the horizontal line passing through the user's barycenter. For both halves, we compute the mean color of the pixels belonging to each area. Finally, the front/back leaning is the ratio between these 2 values.

Left/Right leaning is approximated by the left/right symmetry of user's body silhouette. The vertical projection $H'$ of the head position $H$ on the segment joining right and left shoulder $\overline{RS, LS}$ is computed. The triangle $H, \widehat{H'}, LS$ is

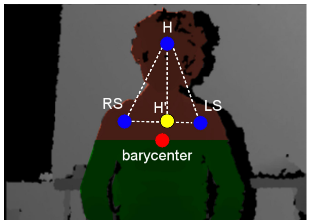


Figure 2: input RGB and depth images are pre-processed to isolate user's body upper/lower part (red and green areas) and head/shoulder centroids (blue dots).

mirrored with respect to the vertical axis and then subtracted from the triangle $H, \widehat{H'}, RS$. The area of the resulting shape is normalized in the range $[0, 1]$ by dividing it by the sum of the area of the 2 triangles.

## Virtual Agent

During laughter the whole body moves. Our synthesized animation model computes facial expressions, head and torso motions. It relies on our previous data-driven works (Ding et al. 2014). Our laughter animation generator takes as input laughter audio signals, such as its transcription into pseudo-phonemes (in reference to speech phoneme) including their duration and their intensity, as well as two speech prosodic features, namely pitch and energy. Our method allows us to generate facial expression including lip shape of laughter as well as 3 types of motions: (1) modeling shaking-like movement (for shoulder and torso movements); (2) emphasizing prosodic features influence on the synthesized animation; (3) taking into account the dependencies between the movements across modalities (head and torso).

The Greta agent is able to adapt its laughter according to the user's behavior. While there is a direct mapping between the user's and the agent's leaning, the user's laughing intensity has an overall influence on the laughter animation. If the user does not laugh at all and/or does not move at all, the agent's behavior will be inhibited, and the agent will stay still. On the other hand, a user laughing out loud will lead the agent to move even more.

To modify the generated animation of the agent on-the-fly, we designed a graphical tool allowing us to manipulate different inputs and to blend them to obtain a new animation as output (see Figure 3). Here, we blend two types of inputs: (1) animation parameters generated by our laughter animation model and (2) user's parameters (body leaning and laughter intensity). These inputs are respectively represented in Figure 3 by green circles and blue circles. The red circles represent the final animation parameters that will be played by the agent.

User's laughter intensity influences not only the spine animation parameters, but also all the other body animation parameters generated by our laughter synthesis model: if the user laughs with large movements, the amplitude of the agent's movements is increased. On the other hand, if the user does not laugh at all or perform small motions, then the amplitude of the agent's laugther motions is decreased;

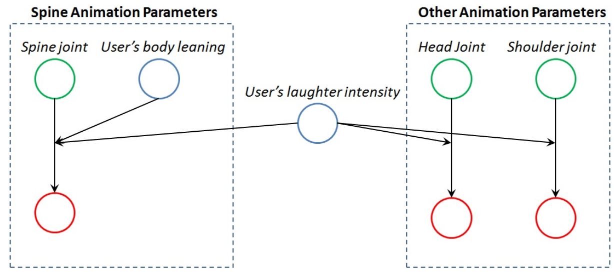


Figure 3: In green, animation parameters generated from our model. In blue, user's parameters. In red, final animation parameters

it could decrease up to extremely low amplitude making the agent appears to stay still.

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