Interpersonal Attitude of a Speaking Agent in Simulated Group Conversations

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Abstract. Embodied Conversational Agents have been widely used to simulate dyadic interactions with users. We want to explore the context of expression of interpersonal attitudes in simulated group conversations. We are presenting a model that allows agents to exhibit a variety of nonverbal behaviors (e.g gestures, facial expressions, proxemics) depending on the interpersonal attitudes that they want to express within a group while talking. The model combines corpus-based and theoretical-based approaches and we present a preliminary implementation of this model.

1 Introduction

While embodied conversational agents (ECAs) have been mainly studied in dyadic interaction settings, there is also a growing interest for small group situations. A dyadic interaction is a 2-interactant configuration, whereas a small group situation implies generally three to twenty interactants [1]. We propose an agent's model that allows them to adapt and exhibit different nonverbal behaviors when talking, depending on the interpersonal attitudes that they want to express. Interpersonal attitude is an "affective style that can be naturally or strategically employed in an interaction with a person or a group of persons"[2]. We are using the representation from Argyle to manipulate agent's interpersonal attitudes [3]. In order to model the influence of such interpersonal attitudes on an ECA's nonverbal behavior, our approach is based on a combination of behavior models coupling a data-based model of conversational gestures and a rule-based model of group formation that simultaneously influence the ECAs' nonverbal behavior from the literature of Human and Social Sciences. Previous work with similar setting was either missing the influence of interpersonal attitudes on agent's exhibited behavior [4–6] or was not considering group formation behavior (i.e. simulated group conversation) [7–9].

2 Our Augmented *Behavior Planner*

Our model works as a *Behavior Planner* but instead of considering only a set of possible nonverbal behaviors for an intention, we propose an augmented model

that takes into account the interpersonal attitudes the agent wants to express in order to select the most appropriate behavior. Interpersonal attitudes can be expressed with nonverbal behavior in both dyadic [10, 11] and small group interactions [12]. A more dominant person tends to do more gestures [10] and mutual gaze is a sign of dominance or friendliness [11]. In [12], Mehrabian describes eye gaze, posture and distance as important behaviors that impact the evaluation of attitude in small group interactions.

2.1 Two-stage influence

Central to our model is the Behavior Planner component. On one hand we are influencing the nonverbal behavior related to conversational and performative intents (e.g. facial expression, gestures, head orientation). On the other hand, we are influencing the behavior related to group formations and cohesion (e.g. gaze behavior, interpersonal distance and body orientation). We limited the generated conversational nonverbal behavior only for the ECA that is speaking but we plan to consider other conversation roles in the future. As we are integrating two models that both influence the nonverbal behavior of an agent, we define the following mechanism to combine them: on each modality, the two stages are given a weight (which sum equals to 1) to indicate the degree of influence each model has on the modality. We are now presenting the first stage. The nonverbal conversational behavior that we are considering in our model is the following: presence of gestures and head movements, type of facial expressions, head orientation, presence of gaze avoidance, spatial extent and power of the gestures. Depending on the speech act and the desired expressed attitude, the nonverbal behavior generated should vary. In order to do this we integrated the model developed in [13] with the current model. We are manipulating the probabilities to select particular values for our parameters following this network. A possible outcome for a dominant attitude would be for instance wide and powerful gestures and an upward head, no gaze avoidance and a neutral facial expression. For a friendly attitude, the agent might perform the speech act using a smiling face, tilting his head on the side with wide and smooth gestures. The second stage of our Behavior Planner is the influence of the attitude on the ECA behavior that manages the group formation and cohesion, in particular the interpersonal distance, the gaze behavior and the body orientation. Based on Hall's proxemics [14] and Kendon F-Formation [15] theories, our model adds on top of these a set of rules to configure this spatial organization depending on the social attitude. When performing a speech act, the model chooses for the speaking agent which other member (human or agent) is its preferred target for a glance, the importance of maintaining an body orientation related to the group or to the adressee and how close it wants to stand to each other member within its social space. For instance, the agent should have a higher probability to glance at the group member towards which it expresses submissiveness or friendliness, stand closer with group members towards which it expresses friendliness or a neutral status level and it should orient its body more directly towards group members with which it expresses submissiveness [12].

Combining the models This Behavior Planner takes as input the interpersonal attitudes of the agent towards all the other agents. The first stage computes the upper body nonverbal behavior (facial expression, presence of gestures and head movement, head orientation, spatial extent and power of gestures) for this speech act and the interpersonal attitude towards the adressee. The other stage, computes the body orientation, the interpersonal distance and the group member which is looked at within an F-Formation. On top of this, the combined model computes the preferred target, the weights for the body orientation modality (more weight from the group formation model resulting in an orientation more consistent with the group and less towards the adressee) and the desired interpersonal distances between all characters in their social spaces.

3 Implementation

This paper describes a preliminary implementation of our model extended to small group of ECAs in a simulated conversation. The implementation relies on two separate technologies, the VIB platform and the Impulsion AI engine. VIB is a SAIBA compliant platform for the generation and realization of multimodal behavior for ECAs. In [13], we extended the *Behavior Planner* of this platform with our bayesian network to generate the agents' nonverbal behavior to express different social attitudes in dyadic interactions. The Impulsion AI engine is a software platform developed to improve ECAs nonverbal behavior in social simulations with particular emphasis on F-formation systems (i.e. group conversations) and gatherings (e.g. multiple groups sharing the same environment). The engine is grounded on Scheflen's human territories and Kendon's F-Formation [15] theories and it provides ECAs with autonomous generation and realization of gaze, proxemics and body orientation behavior supporting a simulated group conversation. Both VIB and Impulsion have been deployed within the Unity3D game engine. In this preliminary implementation of our model we geared up a set of ECAs with an integrated version of VIB and Impulsion. On a software engineering perspective, we have coordinated this integration by allowing VIB to control the upper body part of our characters (gestures and facial expressions, the head orientation is not handled by VIB in this implementation), while Impulsion is controlling the character's interpersonal distance, body orientation and gaze behavior. This integration is still work in progress and presents two challenging issues that we need to address. First the whole orchestration of nonverbal behavior needs to be consistent with the intended social attitudes that we aim to express. Secondly, at a lower level, we are working on blending the resulting animations corresponding to the behaviors exhibited.

4 Conclusion

In this paper, we have presented a model for conversational groups of humans and agents and a preliminary implementation of the Behavior Planner of this model. We have used an approach combining two models of social interaction,

one dedicated to conversational nonverbal behavior and the other for small group formation and territorial cohesion. This is a novel approach, however it introduces some challenging issues that we need to address: on a theoretical level, we need to assess if two separate models of social behavior are compatible when combined together to generate believable and consistent behavior. We are aware that the model for attitudes in dyadic interactions cannot simply be migrated to small group interactions. This new social context has different requirements due to the different spatial arrangements of the ECAs involved and the need to clearly define the addressee for each separate nonverbal modality (e.g. body oriented towards a participant while gazing at another).

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