Multi-Party Interaction With Self-Contained Virtual Characters

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Abstract

We describe a layered approach for coordinating interactions of human users and virtual characters in a multi-modal dialogue system.

1 Introduction

Contributions in face-to-face conversations convey not only propositional but also interactional content. Interactional information contributes to the structural organization of the conversation. It regulates the transitions between speaker and hearer, helps to avoid overlapping speech, and supports the identification of intended addressees of a contribution. We illustrate some aspects of multi-party discourse by an example of a quiz dialog. It includes a virtual moderator, a human user (Chris) and a virtual character (Frank):[1]

(1) *Moderator*: [⊙ both candidates] “The next question: Who scored the last goal at the world championship 1990?”

(2) *Chris*: [⊙ moderator] “Franz Beckenbauer”

(3) *Moderator*: [⊙ Chris; Frank shakes head and raises finger] “well, no . . . ” [⊙ Frank]

(4) *Frank*: [⊙ Chris] “Oh dear, no” [⊙ moderator] “He was the coach.” [Moderator nods] “The correct answer is Andreas Brehme.”

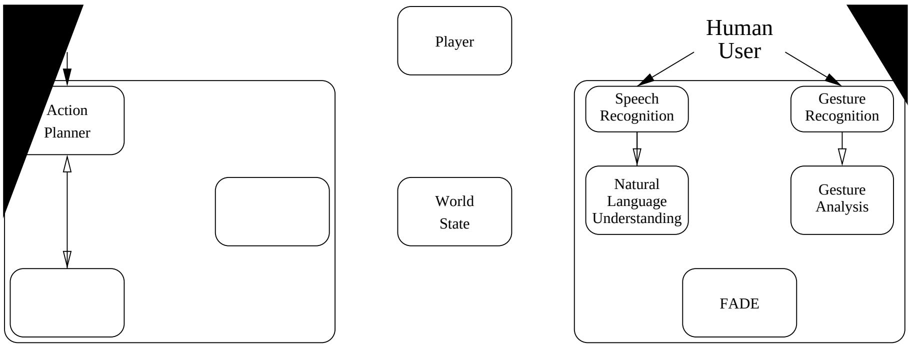
(5) *Moderator*: [⊙ Frank] “Yes, that will be one point” [points at Frank] “for Frank!”

[1] ⊙ means “looks at”.

Following (Duncan, 1972), conversations are organized in turns where participants coordinate their actions in order to achieve a smooth turn exchange. This takes place by means of a rule based signaling of what the individual participants want to do next. A hearer wanting to take the speaking turn can e. g. signal this by an upraised finger, sometimes accompanied by an audible intake of breath, see the beginning of turn (3). Even though there are several other ways to encourage a speaker to finish talking, a speaker who perceives these signals is able to infer the intention of the hearer and react accordingly (the moderator yielding the turn at the end of (3)). We model dialog exchange as being structured in rule-governed game-like sequences of dialog moves. When being addressed in a game move, a character has a choice of legal reply or followup moves, among which it selects one based on the current situation and its current goals. In turn (4), Frank determined that Chris has answered incorrectly. He decides to take over the pending response move; the moderator agrees by gazing at him.

2 Conversational Dialog Engines

Modules called Conversational Dialog Engines (CDEs) interact to realize the dialog capabilities of our system. All actions of a single virtual character are controlled by a dedicated CDE representing it. Human users of the system are also represented by their own CDEs, resulting in two classes of CDEs: CDEs creating the behavior of the virtual characters (*Character-CDEs*) and CDEs recognizing and analyzing the contributions of a hu-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a result of the internal state of characters, (e. g. complaining that questions are too difficult). Dialog management usually adopts one of several established approaches, with specific advantages and disadvantages. Common variants are based on planning and/or logical inference, finite-state machines, and forms, in order of decreasing representational power, flexibility, but also computational complexity (see (Larsson, 2002)). The suitability of an approach depends on the characteristics of the application. The interactions for a simple ticket-ordering application might map quite naturally to form-filling fixed data structures, but complexer scenarios call for more versatile interactions and representations. Our domain shows mixed characteristics, and we also use a combination of methods. Our scenario contains elements that have little variation and can be scripted (e. g. greetings), but the user interaction and autonomous behavior by the virtual characters also allow for flexible deviations interweaved into the story controlled by the narration engine. Both types of tasks share a common task model, the process, but the dialog games can be initiated using either a finite-state model, or a plan-based approach which is adapted from the system described in (Wahlster, 2003) to work with multi-party dialogs.

3 Three Levels of Processing

Purely Unconscious Behavior The lowest level of behavior comprises reactive actions of the characters. If, e. g., a character perceives another character has just started to speak, it should react by gazing at the spea[illegible] 1250 Td (also)Tj 20 tions, e.g. conforming to a dialog game, or to honor internal (e.g. emotional) state. Deliberative behavior itself decomposes into three levels: Dialog acts, dialog games, and processes.

The lowest level comprises a set of *dialog acts*, the atomic communicative units between CDEs. We use a set of acts similar to those in (Poesio and Traum, 1998); examples are *opening* (greeting), *info-request* and *answer*. The propositional content of dialog acts refers to ontological object instances. The dialog acts themselves do not carry interlocutor obligations. *Dialog games* form the middle level. They specify exchanges of dialog act moves governed by rules, and the alternative moves legal in a situation. An *InformationSearch* game, for example, states that an initial *info-request* may allow for an *answer* making an assertion in response, a statement that one does not know the answer, or a refusal to answer. Dialog games can be combined by several operations, e.g. appended or nested, to form composite games (see e.g. (McBurney and Parsons, 2002)). Dialog game specifications need not be the same across characters (e.g. an unfriendly character need not know how to respond to an *opening*, and may ignore it). If a character participates in a game, it accepts the obligation to make only legal moves according to (its own version of) the rules of the game. The conventional part of the game definition—stating which moves are legal to make at any point of the game—is shared among all characters, and takes the form of a finite-state-automaton, where transitions are labeled with preconditions and postconditions. From the narration engine's point of view, a *process* appears as a parametrized black box. A *QuizQuestion* process, for example, would be parametrized by (i) instances of ontological objects filling *roles* specifying the moderator, the contestants, the subject, and possibly the presentation style, (ii) narrative constraints, e.g. a timeout, (iii) the content of the dialog history, (iv) the character's private world view, and (v) a set of *traits* for the character, which can be static (e.g., an intelligence value) or dynamic (e.g., the affective state). The process also needs a method of evaluating the appropriateness of answers. As stated before, the internal process implementation can use a finite-state representation for simpler tasks, or be plan-based if more flexibility is necessary. A process goal from the narration engine can result in several sub-processes for other participating characters, as in our example. The contestants are obliged to answer the moderator: The question in turn (1) is not directed towards a specific character. Any dialog participant can decide to join the game, and *Chris* does so first.

4 Conclusion

Our four-year project has passed its halfway point, for which we completed a demonstrator system implementing our first scenario. In the second project phase, more than one human user will be able to simultaneously participate in the dialog, using separated input devices.

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References

Starkey Duncan. 1972. Some Signals and Rules for Taking Speaking Turns in Conversations. *Journal of Personality and Social Psychology*, 23(2):283–292.

Staffan Larsson. 2002. *Issue-based Dialogue Management*. Ph.D. thesis, Department of Linguistics, G¨oteborg University, Sweden.

Peter McBurney and Simon Parsons. 2002. Games that agents play: A formal framework for dialogues between autonomous agents. *Journal of Logic, Language and Information*, 11(3):315–334, Summer.

Massimo Poesio and David Traum. 1998. Towards an Axiomatization of Dialogue Acts. In J. Hulstijn and A. Nijholt, editors, *Proceedings of TWENDIAL workshop*, Enschede.

Harvey Sacks, Emanuel A. Schegloff, and Gail Jefferson. 1974. A Simplest Systematics for the Organization of Turn-Taking for Conversations. *Language*, 50(4):696 – 734.

Wolfgang Wahlster. 2003. Towards Symmetric Multimodality: Fusion and Fission of Speech, Gesture, and Facial Expression. In A. G¨unter, R. Kruse, and B. Neumann, editors, *Proceedings of the 26th German Conference on Artificial Intelligence*, pages 1 – 18. Springer.