Conversational Agents for Game-Like Virtual Environments

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1 Introduction

Insp. Gray: I'd like to ask you a few questions about last night.
Coln. Mustard: Fire away young man, I've got nothing to hide.
(Mustard uses phrase 'young man' - he feels a superiority in the social relationship with the inspector)
(Mustard is a defensive person - protests innocence straight away)
Insp. Gray: Were you in the ballroom at all last night?
Coln. Mustard: Yes. I was in the ballroom between 1945 hours and 2000 hours.
(Mustard is an army man - dictates choice of '1945 hours' over 'seven forty-five')
(Mustard is confident of himself - very affirmative tone used)
Insp. Gray: Okay. So where had you been before you went to the ballroom?
Coln. Mustard: I was in the Kitchen
(Abrupt. Dislikes the Inspectors questioning)
Insp. Gray: But Mrs. White was in the Kitchen at that time and said that she didn't see anyone else.
Coln. Mustard: Well she must be mistaken.
(Very defensive. Authoritative about the fact - commanding personality)
Insp. Gray: She seemed very confident she was right. Are you sure you've not made a mistake?
Coln. Mustard: I'm absolutely certain!
(Very defensive and angry - strengthens his claim with the use of the adverb)
Coln. Mustard: You should talk to Mrs. Peacock. I saw her heading towards the library at 1945 hours. She seemed very suspicious.
(Changes subject - dominant personality - disliked previous conversational direction)
Insp. Gray: Why do you say that?
Coln. Mustard: She hates reading, and never goes to the library.
(Authoritative - confident of his knowledge)
Insp. Gray: Okay. Thanks for your time.

Figure 1. Example Conversation from the Cluedo Game

This paper describes a project to develop conversational agents that incorporate shallow models of emotion and personality to produce virtual characters which exhibit believable conversational behaviour. Also described is the development of a game, based upon the board game 'Cluedo', which is to be used as a test bed for the development and implementation of the conversational agents.

The conversation shown in figure 1, between Inspector Gray and Colonel Mustard, is an example of the type of conversational behaviour required from the agents within the context of the Cluedo game. It illustrates that for *believable* conversational behaviour [6] the dialogue needs to be modified, not only to communicate relevant and appropriate knowledge, but also to display a unique character through linguistic choices.

An important part of this work is a conversational agent architecture that builds on an existing natural language generation system to incorporate conversational behaviours that are dependant upon the agent's personality, current emotional state and the agent's beliefs about the social relationship between the conversants.

The key development of this architecture is the introduction of a "Language Use Manager", which determines the relationship between the emotional status and personality type of the agent's character and the behavioural choices made in generating natural language.

2 The Cluedo Game

In the Cluedo game the conversational agents are used as the characters from the board game who are suspects for the murder of another character, Dr Black. The players must, via a text-based natural language interface, interrogate the characters to determine the details of the murder that occurred (Murderer identity, murder location and murder weapon). The game proceeds in two distinct phases.

2.1 Scenario Generation

Generated in accelerated time, the seven characters spend an hour in a virtual house, their behaviours generated according to simple motives. During this time one character commits the murder of Dr Black. Each suspect character builds an episodic memory based on their perceptions of the game world.

2.2 Character interrogation

The player is allowed to interrogate the suspect characters about their memory of the generated scenario. Each character's conversational behaviour and content is determined by the episodic memory structure, as well as the unique models of personality, emotion etc. given for that character.

The discourse manager shall need to allow for lying and forgetting / misremembering of events to maintain the believability of the character, especially the murderer.

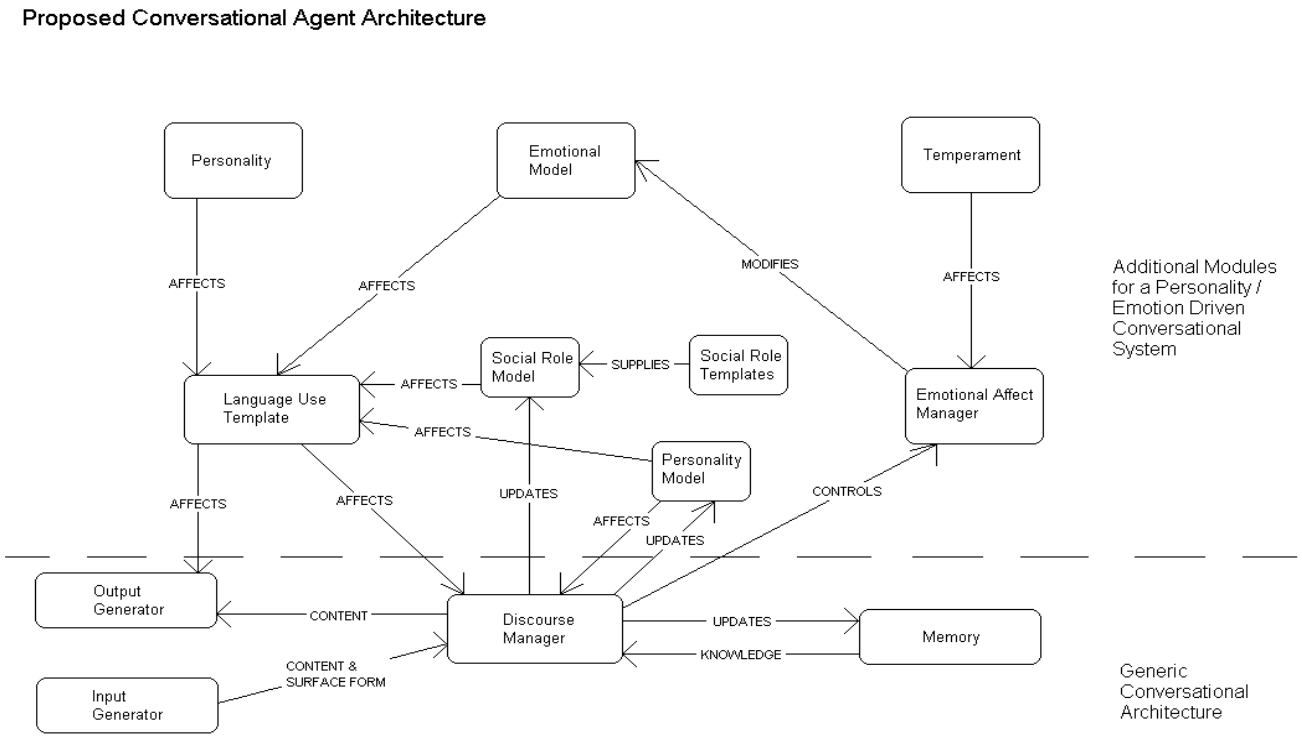

Figure 2. Conversational Agent Architecture

3 Conversational Agent Architecture

To produce the required conversational behaviour I propose an architecture that builds upon and integrates with a generic natural language generation system to incorporate models of emotion, personality and social role awareness. This architecture is to be modular to allow incremental development of all aspects of the system and to simplify overall system design. The architecture is shown in fig2.

- **Personality Model.** Maintains a shallow model of personality, such as the Five Factor model [2]. The exact dimensions of personality to include depends upon an investigation of personality factors that have marked or specific effects upon conversational behaviour. This will lead to a hybrid model of personality that includes features most relevant to language use.
- **Emotional Model.** Uses a shallow model of emotion to maintain simple interaction with conversational behaviour (e.g. OCC model [1]).
  The emotional model will be modified in response to conversational actions to reflect the emotional impact of the current conversation upon the agent's character.
- **Emotional Affect Manager.** Determines the specific emotional change caused by a given conversational action. As such, this module covers personality factors including short-temperedness, tolerance etc. and consults the temperament module to determine these personality factors.
- **Temperament.** Specifies, via a shallow model, personality parameters controlling the agent's reaction and response to conversational utterances. This module is used be the Emotional Affect Manager to modify the emotional model in conjunction with the underlying NLG system.
- **Social Role Model.** Specifies the conversational agents belief about the social status of the two conversants, as well as the social relationship between them [8].
  Including concepts such as age, social position and level of authority, this module affects the degree of confidence and dominance displayed by the agent in its language generation.
- **Other Agent Model.** Specifying the conversational agents beliefs about the personality and emotional state of the other conversant, this module is used by the Language Use Template to allow the resultant conversational behaviour to account for the potential emotional impact upon the hearer.
- **Language Use Manager.** Determines the choices in conversational behaviour such as word choice, sentence structure and turn taking (described below). Consults the personality / emotion / social role and other-agent models to decide the exact choices to be made. Will be a rule-based system.
- **Generic Conversational Architecture.** The natural language processing system at the heart of the architecture. This system will be an existing, third party architecture such as the FUF / SURGE package [3, 5].
  The system should be flexible to allow the otherwise 'arbitrary' behavioural choices in language use to be determined from the personality / emotion / social role and other-agent models in the fuller architecture.

4 Emotional / Personality Modification of Conversational Behaviour

The central theme of this paper is the importance of, and the appropriate determination and subsequent implementation of the relationship between agent parameters covering its emotional status, personality etc. and its choices in conversational behaviour.

The determining parameters include the following areas:

- **Emotional Status.** A shallow model, such as that proposed by Ortony, Collins and Clore [1] will be used. Parameters include happiness, angriness etc.
- **Personality Model.** A shallow model, such as the Five Factor model [2] (Openness, Conscientiousness, Extroversion, Agreeableness, Neuroticism).
- **Social Role Model.** A shallow model incorporating beliefs about the social status of the two conversants, and social relationship awareness [8]. Parameters include authority, respect, awe (for beliefs about social status) and age-relationship, vocational-relationship etc. (for social relationship awareness).
- **Other Agent Model.** A model which incorporates the shallow models of emotion and personality described above, but which determines this agents beliefs about the other conversants personality type and emotional status.

The parameters of conversational behaviour, or 'features', include choices made to determine conversational behaviour at the following levels:

- **At the logical level.** Type and specifics of information to communicate, when to elaborate or give further, related information, when to withhold information (or give false information)
- **At the word level.** Synonym choice, complex noun-phrase choice, use of slang and of canned utterances, etc.
- **At the sentence level.** Sentence form, voice (passive? active? interrogative?), confidence, etc.
- **At the turn level.** Redundancy and repetition, ordering of information conveyed etc.
- **At the dialogue level.** Turn management (covering taking of turn, relinquishing of turn and maintaining turn) and topic introduction (introducing new concepts, ideas and information, as well as changing the current focus of the conversation) [7].

In the architecture discussed above, this relationship between agent parameters and behavioural choices made during the generation of natural language conversation is governed by a construct called the 'Language Use Manager'. I propose that this construct should be a rule-based system which consults other modules of the architecture maintaining emotional status, personality model etc. to control a generic natural language generation system and supply the appropriate parameters for conversational behaviour. Some example, prototype rules are given to illustrate the nature of the relationship:

- Rule Parameters: Emotion 'Anxiety' => Word Level 'Use of Slang'
  If conversant A is feeling anxious then she is more likely to revert to the use of slang terminology.
- Rule type: Personality 'Extrovert' => Sentence Level 'Dominant Voice'
  If conversant A has an extrovert personality then she is more likely to use a dominant or commanding voice.
- Rule type: Social Role 'Superior' => Dialogue Level 'Turn Taking Initiative'
  If conversant A has superior social status to conversant B (the co-conversant) then she is more likely to take control of the conversation according to her own conversational motives.

5 Future Developments

Determination of Rules for Language Use Template
Through a study of the methods by which artists such as novelists, playwrights, cinema scriptwriters and computer game designers build and convey the personality and emotional state of their characters through scripted dialogue, I shall be developing a greater understanding of the interplay between these parameters and conversational behaviour. This understanding will be implemented in the rules of the Language Use Manager.

Implementation of the Proposed Agents Architecture
The architecture proposal described above shall be fully implemented in software. This will require an appropriate selection of the generic NLP system to be used (currently the FUF/SURGE package developed by Michael Elhadad [3, 5]) and determination of the data structures and techniques used to develop the remaining modules.

Development of the Cluedo Game
Already well developed and implemented in software, the Cluedo game requires further work to refine the scenario generation phase, thus leading to richer and more interesting character memory structures. The interrogation phase of the game will be built around the conversational agents architecture, and the game will be fully integrated to produce a self-contained and playable product.

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