

Interests and Background Relevant to Self-Aware Computer Systems

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1 Interests

I am interested in self-aware, natural language (NL) competent autonomous agents/cognitive robots. This interest derives from my long-term interest in knowledge representation and reasoning in support of NL competence, and the grand goal of AI to produce systems that have human-level intelligence. To me, human intelligence largely exhibits itself through people's abilities to communicate in NL, not only about intellectual topics, but also about behavior, including giving and accepting instructions about how to perform various tasks.

2 Background

For the past 16 years, I have been interested in the interaction of reasoning and acting, where both, of course, are subject to NL discussions. For the past 12 years, this has expanded to include questions of what beliefs come from interactions with other agents, what from reasoning, and what from an embodied agent's own body. These latter beliefs, contribute to a sense of self-awareness.

Cassie [1, 6, 7, 8, 9, 12, 13, 14, 15, 17, 18, 19], is the name of our cognitive robot. She is implemented in the GLAIR architecture [4, 5, 16] and the SNePS knowledge representation and reasoning system [18, 20, 21]. The following shows an interaction with Cassie in the role of a FEVAHR (Foveal Extra-Vehicular Activity Helper-Retriever) robot [2, 3, 15]. She is in a room with several people and several other robots. This is a transcription of an actual interaction, slightly reformatted, and with labels added to show the source of each sentence.

Stu: Come here.	Cassie: I went to the green robot.
Cassie: I came to you, Stu.	Cassie: I am near the green robot.
Cassie: I am near you.	Cassie: I found Bill.
	Cassie: I am looking at Bill.
	Cassie: I went to Bill.
Stu: John went to the green robot.	Cassie: I am near Bill.
Cassie: I understand that John went to the green robot.	
	Stu: Where are you?
Stu: Go to the green robot and then to Bill.	Cassie: I was near you and I was near the green robot and I am near Bill.
Cassie: I found the green robot.	
Cassie: I am looking at the green robot.	

Stu: Help Bill.

Cassie: I am talking to you, Bill.

Cassie: I came to you.

Cassie: I am near you.

Cassie: I am following you.

Bill: Who are you?

Cassie: I am the FEVAHR
and my name is 'Cassie'.

Bill: Who went to the green robot?

Cassie: John went to the green robot
and I went to the green robot.

Bill: Who have you talked to?

Cassie: I talked to Stu
and I am talking to you.

Notice that Cassie has beliefs about herself and others, knows whom she is talking with, can remember and report on her actions using appropriate tense and aspect, can be informed about the actions of others, and can understand and use certain deictic terms such as *I*, *you*, and *here*. Some of the features of SNePS/GLAIR/Cassie that facilitate Cassie's current level of self-awareness are:

- a SNePS term represents Cassie herself, and is used in all her beliefs about herself;
- a mind/body distinction is made in the GLAIR architecture; most beliefs enter the mind via NL interaction or other sense organs, but beliefs about what Cassie, herself is doing, are entered directly by the body level as it performs primitive actions;
- there is a temporal model, consisting of temporally related time-denoting terms; each event Cassie has beliefs about are associated with a time, and thus related to each other in time;
- a set of registers are located at the body level containing mind-level terms to give Cassie a point of view, including an I register containing Cassie's self-term, a YOU register containing the term representing the individual Cassie is conversing with, and a NOW register containing the term representing the current time.
- when the body level inserts a belief into the mind that Cassie is performing some action, the NOW register is advanced to a new time term, that term is temporally related to old time terms, and the event that this action is being performed is associated with the new time; the sequence of time terms that have been the value of NOW form the temporal spine of an episodic memory;
- the representation of acts that are to be done, that have been done, that are expressed in imperative NL sentences, and that are expressed as predicates of NL sentences is the same, facilitating NL discussion of acts including NL instructions about new acts.

In some recent versions of Cassie [1, 13], the mind and upper body level run on one computer while lower body levels run on other machines. They are connected by IP sockets: different sockets for different modalities, so that, for example, Cassie can talk and move at the same time. One of these versions [1] has a self-perception socket from the lower levels to the upper levels that allows Cassie to hear herself talking. This is important for timing sequences of actions, so her mind doesn't outrun her mouth.

3 Proposed Contributions

I would like to discuss my previous and on-going work on self-aware systems with the other participants, and hear what others are doing on this topic. I believe I could make contributions to all three of the themes listed in the workshop call.

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