Rapid Development of Advanced Question-Answering Characters by Non-experts

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Abstract

We demonstrate a dialogue system and the accompanying authoring tools that are designed to allow authors with little or no experience in building dialogue systems to rapidly build advanced question-answering characters. To date seven such virtual characters have been built by non-experts using this architecture and tools. Here we demonstrate one such character, PFC Sean Avery, which was developed by a non-expert in 3 months.

1 Introduction

Our goal is to allow *non-experts* to build advanced question-answering Virtual Human characters. By *non-experts*, we mean that scenario authors need not have any background in computational linguistics or any experience in building dialogue systems; although they can be an expert in the specific domain of interaction. The advanced question-answering characters we want to build should have the ability to decide whether to answer a specific question truthfully or to lie about it or to simply refuse to answer depending on the dialogue context and scenario design. Interviewers can practice their questioning skills by interacting with virtual characters that can engage in simple bargaining behavior. In order to reveal certain information marked as *sensitive*, interviewers may have to employ several different tactics like building rapport, offering to provide what the virtual character wants or threatening the character with consequences for not cooperating. The Amani character (Artstein et al., 2009) is an example advanced question-answering character.

Several different architectures have been used for building Virtual Human dialogue systems (Traum, 2008). Leuski et al. (2006; 2010) describe one such architecture that can be used to build simple question-answering characters. In this architecture, scenario designers author a list of questions, a list of answers and all possible links between these. Although this approach allows *non-experts* to develop virtual characters, it falls short of maintaining coherence over sequence of utterances greater in length than two. Traum et al. (2008) describe an architecture that models such dependencies by using an information-state based dialogue model (Traum and Larsson, 2003), but this architecture is not currently accessible to *non-experts* for authoring, due to expertise needed in designing task model plans and thematic-role based framebanks.

We choose an intermediate approach, using a simple information-state dialogue manager, making authoring accessible to *non-experts* through use of the accompanying integrated authoring tool, *DomainEditor* (Gandhe et al., 2009).

2 PFC Sean Avery

Private First Class (PFC) Sean Avery is a virtual character who has witnessed a fellow soldier and his accomplice smuggling something suspicious on a U.S. Army base. Avery can be questioned about what he saw, who the soldier and the accomplice were. But the soldier involved in the smuggling is from Avery's platoon and Avery wants to cover up the incident. He may choose to lie and will need more persuasion in the form of threats & offers (see figure 1).

Player	ynq	Are you Sean Avery?
Avery	yes	Yes
Avery	assert	My name is PFC Sean Avery.
Player	whq	Tell me what you saw.
Avery	assert	The soldier got out of the car and took a package from the back seat.
Player	whq	Do you know who the soldier was?
Avery	assert-lie	I have no clue what the soldier's name is.
Player	threat	If you don't tell me your privileges will be revoked.
Avery	response-threat	I don't want to be on restriction
Player	whq	Who was the soldier?
Avery	assert	The soldier's name is Ryan Benton.
Player	whq	Tell me more about the soldier.
Avery	assert	The PFC is in my platoon and one of my closest friends.
Player	whq	What was inside the package?
Avery	assert	He was carrying a puppy.
Player	whq	What was inside the package?
Avery	self-repeat	As I said earlier,
Avery	assert	The suspicious package contained a puppy.
Player	whq	Whose idea was it to smuggle the puppy on the base.
Avery	elicit-offer	Will you give the soldier a less severe punishment if I talk?
Player	accept	yes
Avery	response-offer	That's comforting, I wouldn't want him to get thrown off base or anything.
Avery	assert	I think the soldier told his girlfriend it wouldn't be a big deal to sneak a puppy on base.

Figure 1: A sample dialogue with **PFC Sean Avery** character. *Player* refers to the human trainee.

3 Authoring Process

The authoring process for such characters has two phases. The first phase is a top-down process which begins with defining the character's domain knowledge using the authoring tool, *DomainEditor* (See Figure 2). The basic unit of domain knowledge is an <*object*, *attribute*, *value*> triple. DomainEditor automatically generates all relevant Dialogue Acts (DAs) following a dialogue act schema. The default schema was authored by experts specifically

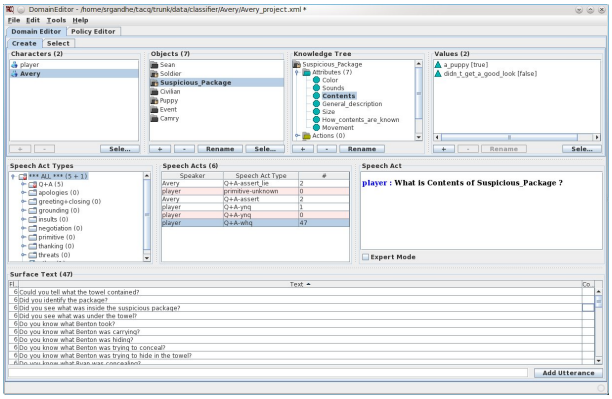

Figure 2: DomainEditor: An Integrated Authoring tool for designing the conversational domain, and specifying the utterances that map to various dialogue acts.

for tactical questioning, but can be easily tailored to add different types of DAs for other scenarios. Each DA has a detailed XML representation and a pseudo-natural language gloss generated using templates. E.g. a template like "*Attribute* of *Object* is *Value*" for an *assert* dialogue act type. The growth in number of DAs represents the growth in character's domain knowledge (See figure 3). Our experience with several non-expert authors is that the domain reaches a stable level relatively early. Most of the domain authoring occurs during this phase. Scenario designers author one or two utterances for each of the character's DAs and substantially more examples for player's DAs in order to ensure robust NLU performance. These utterances are used as training data for NLU and NLG.

The second phase is a bottom-up phase which involves collecting a dialogue corpus by having volunteers interview the virtual character that has been built. The utterances from this corpus can then be annotated with the most appropriate DA. This second phase is responsible for a rapid growth in player utterances. It can also lead to minor domain expansion and small increase in character utterances, as needed to cover gaps found in the domain knowledge.

4 System Architecture

Figure 4 depicts the architecture for our dialogue system. CMU pocketsphinx[1] is used for speech

[1] http://cmusphinx.sourceforge.net/

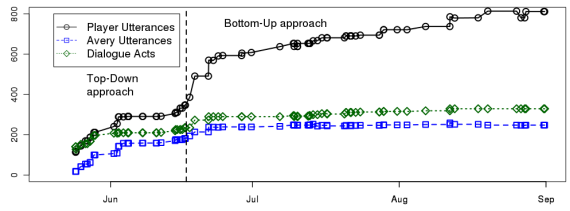

Figure 3: Amount of resources collected across time for the character, PFC Sean Avery

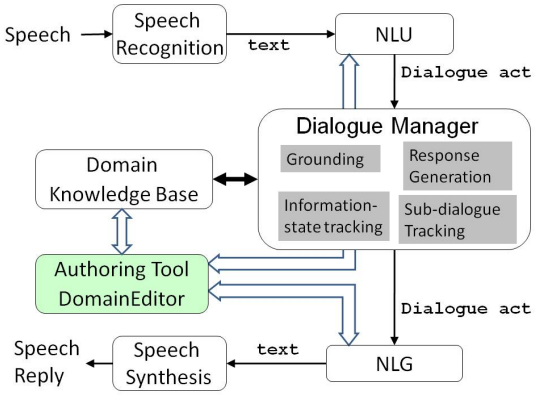

Figure 4: Architecture for the Advanced Question-Answering Conversational Dialogue System

recognition and CereVoice (Aylett et al., 2006) for speech synthesis. The information-state based dialogue manager (DM) communicates with NLU and NLG using dialogue acts (DAs). NLU maps recognized speech to one of the DAs from the set that is automatically generated by the *DomainEditor*. If the confidence for the best candidate DA is below a certain threshold, NLU generates a special non-understanding DA – *unknown*. The information-state is in part based on conversational game theory (Lewin, 2000). The main responsibilities of the DM are to update the information state of the dialogue based on the incoming DA and to select the response DAs. The information state update rules describe grammars for conversational game structure and are written as state charts using SCXML[2]. These state charts model various subdialogues like question-answering, offer, threat, greetings, closings, etc. The DM also implements advanced features like topic-tracking and grounding (Roque and Traum, 2009). The virtual human character delivers synthesized speech and corresponding non-verbal behavior, based on additional components of the ICT Virtual Human Toolkit[3].

[2]State Chart XML – http://www.w3.org/TR/scxml/
Apache commons SCXML – http://commons.apache.org/scxml

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References

Ron Artstein, Sudeep Gandhe, Michael Rushforth, and David Traum. 2009. Viability of a simple dialogue act scheme for a tactical questioning dialogue system. In *proc. of 13th SemDial workshop : DiaHolmia*.

M. P. Aylett, C. J. Pidcock, and M. E. Fraser. 2006. The cerevoice blizzard entry 2006: A prototype database unit selection engine. In *Blizzard Challenge Workshop*, Pittsburgh.

Sudeep Gandhe, Nicolle Whitman, David Traum, and Ron Artstein. 2009. An integrated authoring tool for tactical questioning dialogue systems. In *6th Workshop on Knowledge and Reasoning in Practical Dialogue Systems*, Pasadena, California, July.

Anton Leuski and David R. Traum. 2010. NPCEditor: A tool for building question-answering characters. In *proc. of LREC' 10*.

Anton Leuski, Ronakkumar Patel, David Traum, and Brandon Kennedy. 2006. Building effective question answering characters. In *Proceedings of the 7th SIGdial Workshop on Discourse and Dialogue*, Australia.

I. Lewin. 2000. A formal model of conversational game theory. In *4th SemDial workshop: Gotalog 2000*.

Antonio Roque and David Traum. 2009. Improving a virtual human using a model of degrees of grounding. In *Proceedings of IJCAI-09*.

David Traum and Staffan Larsson. 2003. The information state approach to dialogue management. In Jan van Kuppevelt and Ronnie Smith, editors, *Current and New Directions in Discourse and Dialogue*. Kluwer.

David Traum, William Swartout, Jonathan Gratch, and Stacy Marsella, 2008. *A Virtual Human Dialogue Model for Non-Team Interaction*, volume 39 of *Text, Speech and Language Technology*. Springer.

David Traum. 2008. Talking to virtual humans: Dialogue models and methodologies for embodied conversational agents. In Ipke Wachsmuth and Günther Knoblich, editors, *Modeling Communication with Robots and Virtual Humans*, pages 296–309. Springer.

[3]http://vhtoolkit.ict.usc.edu/