EXAMPLE AND SITUATION BASED DIALOG MANAGEMENT FOR SPOKEN DIALOGUE SYSTEM*

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ABSTRACT

In this demonstration, we present POSSDM (POSTECH Situation based Dialogue Manager) for a spoken dialogue system using a new example and situation based dialogue management techniques for effective generation of appropriate system responses. Spoken dialogue system should generate cooperative responses to smoothly lead the dialogue with users. We introduce a new dialogue management technique incorporating dialogue examples and situation-based rules for EPG (Electronic Program Guide) domain. For the system response inference, we automatically construct and index a dialogue example database from dialogue corpus, and the best dialogue example is retrieved for a proper system response with the query from a current user utterance and a discourse history. When dialogue corpus is not enough to cover the domain, we also apply manually constructed situation-based rules mainly for meta-level dialogue management.

1. INTRODUCTION

Most of the previous spoken dialogue systems have been developed with state-transition based approach. In this approach, a system response is determined by the fixed state transition using a finite state model. This approach guarantees fast system built-up and easy dialogue modeling. However, this approach is not flexible to handle various natural language dialogue phenomena, because the next state of the dialogue is strictly determined by the fixed state-transition network. The domain portability is also poor because we have to re-design the whole finite state model for a new domain. To overcome these restrictions, we suggest a situation-based dialogue management which is free from rigid state transitions. We have also developed an example-based technique to automatically build and index an effective domain dialogue model.

2. SPOKEN DIALOGUE SYSTEM OVERVIEW

An overview of the whole dialog system is shown in Fig. 1. Our speech recognizer was developed based on open source HTK (Hidden Markov Model Toolkit) [1]. The ASR (Automatic Speech Recognizer) generates n-best recognition list for our SLU (Spoken Language Understanding) module.

The SLU module was constructed by a concept spotting approach [2] which aims to extract only essential factors for predefined meaning representation slots (e.g. channel, program, and genre for an EPG guide domain). Although this method was regarded as a partial understanding approach, we can acquire necessary information to lead the dialogue from the extracted semantic slot values because the slots are properly designed for a specific domain-oriented understanding task.

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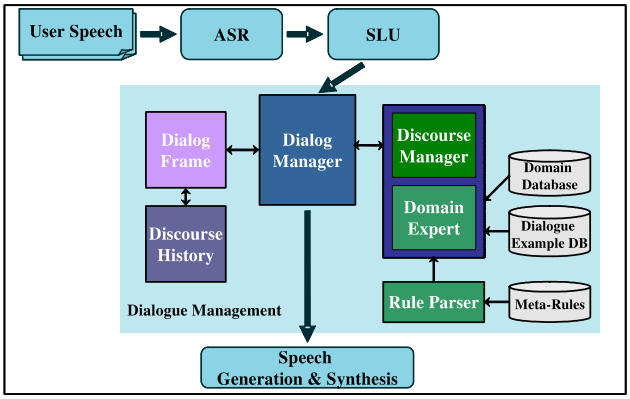


Fig. 1. Overview of POSSDM System Architecture.

The dialogue manager module achieves a task completion goal of specific domain task through a series of interactions with users using the results of the SLU dialog frames. Dialogue manager makes system concepts to generate system responses using a discourse manager and domain expert modules based on a current situation of the dialogue. After determining the correct system concepts, the language generation module makes generic system responses including slot names. Then, the system utterances are generated by filling slots in a domain-specific generation module linked to the domain expert.

3. SITUATION-BASED DIALOGUE MANAGEMENT

To determine the system responses, instead of relying on a finite state transition network, we consider the current situation of the dialogue including a user's intention (dialog act and main action), a semantic frame, and a discourse history. Inspired by O'Neil et al.'s work [3], the situation-based dialog management leads the dialog using the rules which reflect the current situation of the dialog and was implemented as an object-oriented architecture for easy domain extension and portability. The situation-based rules will be one of the three kinds:

- Situation-action rules : rules for describing system's actions under the current situation.
- Constraints-relax rules : rules for relaxing some constraints on database queries.
- Frame-reset rules : rules for restarting a new dialogue frame for the case of domain switching and dialogue closing.

As shown in Fig. 1, using these rules, the discourse manager decides only generic dialogue strategy which is domain-independent. This generic strategy is inherited to the domain expert which has its own dialogue history, semantic frame, and situation-based rules to manage domain specific dialogs.

4. EXAMPLE-BASED DIALOGUE MODELING

For effective situation-based dialog management, we need to construct enough rules manually for domain specific dialog models and it is often time consuming. For more efficient and domain portable dialog model construction, we devised an example-based technique which is able to automatically generate system responses from dialogue corpus. It alleviates the human labor effectively.

For a dialog model, we should make the query key to search the matched dialog examples. The constraints of the search consist of the current dialog situation such as user intention, semantic frame and discourse history. However, in some cases, we need to relax the constraints to do a partial match. The relaxed constraints only involve user intention from the SLU module.

When the retrieved examples are not unique, we choose the best one using the utterance similarity. The utterance similarity values include the lexico-semantic similarity and the discourse history similarity. The lexico-semantic similarity is defined as an edit distance between utterances of users and the examples. The degree of the discourse history similarity is a cosine measure between the binary vectors that are assigned the value 1, if the slot is filled, and 0, otherwise. Fig 2 illustrates an overall strategy of the example-based dialogue modeling.

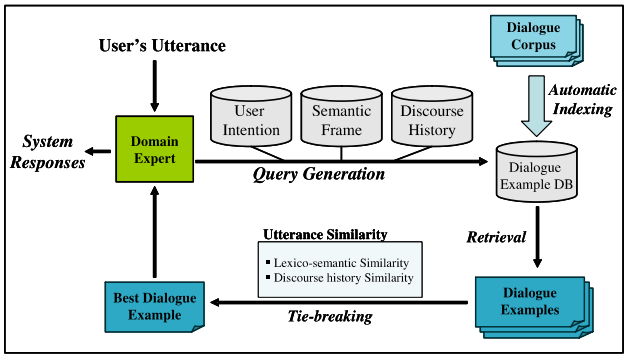


Fig. 2. A strategy of an example-based dialogue modeling.

Although the dialogue examples are able to generate appropriate responses for most of the dialogue situations, some situations require the meta-rules for leading the dialogue. For example, if the retrieved dialogue example result is absent, the system should give an alternative suggestion. To deal with these special situations, some manually designed situation-based meta-rules were used together.

5. POSSDM IMPLEMENTATION

The POSSDM framework was implemented using a C++ and visual studio. The snapshot of the POSSDM operation is shown in Fig. 3 including the dialogue processes and scenario example of an EPG Task.

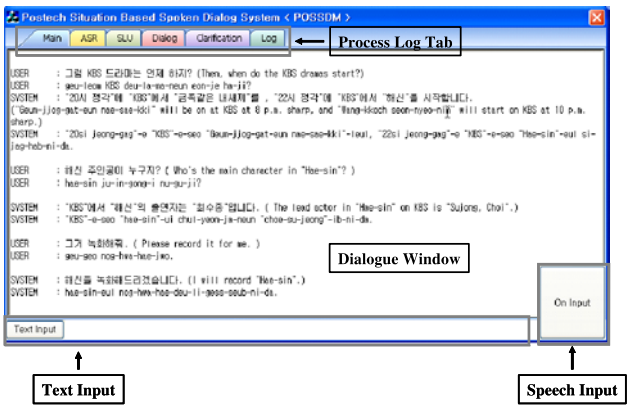
Dialogue Turn #1

User	Utterance	지금 TV에서 뭐 하지? (Ji-geum ti-bi-e-seo mwo ha-ji?) What's on TV right now?
	Dialog Act	Wh-question
	Main Action	Search_program
	Slots	[start_time = 지금]
System	Utterance	"MBC"에서 "슬픈 연가"를 , "SBS"에서 "SBS 8 뉴스"를 방송 합니다. ("MBC"-e-seo "Seul-peun yeon-ga"-leul, "SBS"-e-seo "SBS 8 nyu-seu"-leul bang-song-hab-ni-da.) "Seul-peun yeon-ga" is on at MBC and "SBS 8'o clock News" at SBS.
	Utterance	채널을 골라주십시오. (Chae-neol-eul gol-la-ju-sib-si-o.) Please select a channel.

Dialogue Turn #2

User	Utterance	그럼 SBS 드라마는 언제 하지? (Geu-leom SBS deu-la-ma-neun eon-je ha-ji?) Then, when do the SBS dramas start?
	Dialog Act	Wh-question
	Main Action	Search_start_time
	Slots	[channel = SBS, genre = 드라마]
System	Utterance	"22시 정각"에 "SBS"에서 "유리화"를 시작합니다. ("22si jeong-gag"-e "SBS"e-seo "Yu-li-hwa"-leul si-jag-hab-ni-da.) "Yu-li-hwa" will start on SBS at 10 p.m. sharp.

(a) A scenario example of EPG task.



(b) POSSDM framework

Fig. 3. The snapshot of POSSDM operation.

6. REFERENCES

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