

[Poster Presentation] A methodology of dynamic topics creation for dementia counseling system exploiting internet resources

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Abstract A methodology of dynamic topics creation for dementia counseling system exploiting internet resources
Abst: Exploiting the virtual agent, IoT, and cloud technologies, we have been studying a dementia counseling system, with which a person with dementia can talk to the agent at any time at home. In this research, we propose a method that dynamically creates topics of counseling in combination of dementia patient's life history and internet resources such as Linked Open Data and Wikipedia.

Key words Elderly Care, Home Care, Human Agent Interaction, Open Data, Web Service

1 Introduction

Japan is currently entering a hyper-aging society. The Japanese Ministry of Health, Labour and Welfare estimates that the number of elderly people over the age of 65 will increase to 36.57 million, which is 30.3 % of the total population[1]. Due to the increase of the elderly, more and more people will suffer from *dementia*. The number of people with dementia grows to 7 million in 2025, which is one-fifth of all elderly. Thus, assistive methods and technologies for preventing, nursing and supporting people with dementia are strongly required. Most symptoms of dementia can be divided into one of two categories: core symptom or BPSD (Behavioral and Psychological Symptoms of Dementia). A core symptom is a confrontive symptom caused by destruction of nerve cells in the brain. The typical symptoms of core symptoms are memory disorders, disorientation and aphasia. Memory disorders are the result of damage to neuroanatomical structures that hinder the storage, retention and recollection of memories. Disorientation is the opposite of orientation. It is a cognitive disability in which the senses of time, direction, and recognition of items (things), people and places become difficult to distinguish/identify. Aphasia is an inability to comprehend and formulate language because of damage to specific brain regions. BPSD is an umbrella term used throughout the healthcare system to describe a wide range of dementia-related symptoms. BPSD is caused by many complex things such as environment in which patient finds himself, human relationship and patient's character. BPSDs may manifest as: wandering, agitation, depression, anxiety, abnormal motor behavior, elated mood, irritability, apathy, disinhibition and impulsivity, delusions or hallucinations, changes in sleep or appetite. It is difficult for care giver to respond more fully to dementia because of individual difference in symptoms.

There are drugs and non-drug therapy for dementia

symptoms. The drug therapy can help lessen a person's symptoms but they cannot cure dementia completely. The aim of Non-drug therapies is to improve the abilities remaining to the patient, activate brain and develop Quality of Life. Non-drug therapies include cognitive rehabilitation, reality orientation, validation therapy, reminiscence therapy, music therapy, animal-assisted therapy. For example, validation therapy respects and empathize the behavior of the person with dementia to restore self-worth, reduce stress, and increase verbal and nonverbal communication. Reminiscence therapy respects the life and experiences of the individual with the aim to help the patient maintain good mental health. For dementia care, **continuous communication** with patients is especially important.

In this paper, we define general non-drug therapy as **dementia counseling** which communication by **conversation respecting patient** and keep patient emotionally stable. The dementia counseling is normally operated by a professional counselor and a speech therapist. However, more casual (but practical) counseling can be performed by a family caregiver. Preferably, the dementia counseling should be performed on a daily basis. However, it is expensive to receive professional treatment every day. It is also difficult for a family caregiver to spare sufficient time and effort just for the counseling. Thus, in reality, it is quite challenging to achieve daily and on-demand dementia counseling.

Our research group has been studying smart services that exploit the *virtual agent* (VA) technology to assist elderly people at home. In a project, we are developing a system, called *Virtual Care Giver* (VCG) [2], where the VA integrates smart home and cloud services to provide home care. Figure 1 shows a screen shot of VCG. The VA appears in the left. The VA is an animated human-like chatbot program, implemented with the speech recognition and synthesize technologies. A user can interact with the VA via voice. Connected with behaviors of the VA, the VCG can display supplement-

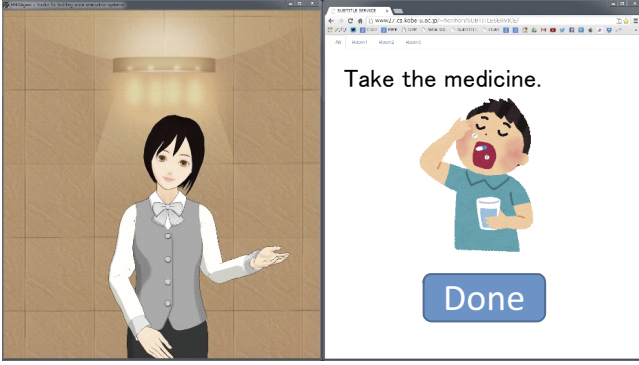


Figure 1: Screen shot of Virtual Care Giver

tary texts, pictures and movies in a Web browser, as shown in the right side of the figure. Using VCG, we have implemented elderly care services, such as daily greeting, routine reminder, and favorite song movie. The VCG can be a conversation partner of a user regardless of time, and it never gets tired. Therefore, the VCG is a quite promising and realistic solution for the daily dementia counseling. However, we have found it difficult to apply the VCG directly to the daily dementia care. Currently, every conversation of VCG relies on a *playscript*. The playscript is written as a program by a service developer, and it must be prepared before execution of the care scenario. During run-time, the VCG chooses a designated script and starts conversation. On the other hand, the dementia counseling requires person-centered topics and conversation attitudes. Therefore, to adapt individual people with dementia, the developer has to write the enormous number of playscripts to cover all possible situations.

Then, to realize daily counseling system for home dementia care, we propose a system which generates dialogue using life history and Linked Open Data and generate dialogue corresponding to user's age.

We also integrate the method with the system to see the feasibility of the interactions.

2 Virtual Counselor

The goal of this paper is to propose a method that generates person-centered dialogues essential for daily dementia counseling. In this paper, we define proposed system as **Virtual Counselor**.

2.1 Generating Personalized Dialogues Using Life History and LOD

When we let a system provide a dementia counseling, we have to consider carefully what topics should be appropriate. Due to the memory impairment, which is the core symptom of dementia, the person forgets recent events and information quite easily. Therefore, even if the system asks about timely news or recent topics, the person would not be able to follow the conversation.

This would lead to the loss of confidence or physiological anxiety of the person.

Moreover, the system should behave attentively according to what the person says. For example, suppose that the system asks a person with dementia about his/her birthplace. Depending on the person, of course, the answer varies like Hiroshima, Okayama, Tokyo or so on. In our previous VCG, the developer had to prepare playscripts that cover all possible birthplaces. Moreover, to expand the conversation associated with the birthplace, further scripts are needed. So, it is quite expensive for the developer to write such a lot of playscripts in advance.

To generate dialogues, we take the following three approaches.

A1: Extracting life history with Center Method

A2: Expanding conversation with LOD

A3: Generating personalized dialogues using life history and LOD

As for A1, we propose a method where a system obtains the personal background of a user (i.e., person with dementia) based on his/her *life history*. The life history is personal information of a person with dementia about how he/she has been living so far. It includes birthplace, family, school, work, reminiscence, hobby and so on. In the proposed method, the system obtains user's life history from the given care management sheets of the *Center Method* [3], or by asking questions so that the user fills data items of the sheets. In A2, we propose a method that can expand and enrich simple conversation, according to the response from the user. Specifically, when a user answers a word, the system tries to find other relevant words by exploiting the *Linked Open Data (LOD)* [4], and uses the new words for the next conversation. In A3, we propose a mechanism that dynamically generates personalized dialogues using the life history and the LOD. For this, we use *dialogue templates*, which specify common outlines of conversations. During run-time, the system chooses a dialogue template and fills it with personal topics obtained from the life history and the LOD to build a personalized dialogue.

2.2 Generating dialogues corresponding to user's age

To provide dialogue of familiar things, living and favorite which is not in the life history sheet, we generate dialogues corresponding to user's age. When we know user's age, we can presume turning points and main stage of the user. Also utilizing life history of user can identify accurate year. By using Open data including Wikipedia, we can obtain much information such as what happened and what became fashionable in specific year. With this information, we generate dialogues corresponding to user's age. More specifically, we develop the method with the following three steps.

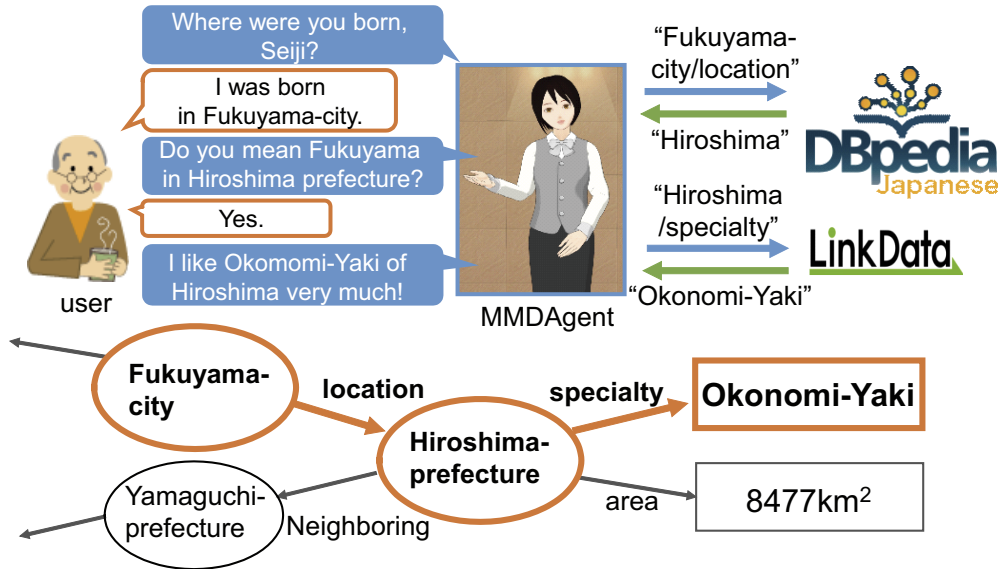


Figure 2: Personalized dialogue generated by prototype system

STEP1 : Identifying date of turning point based on user's age

STEP2: Acquiring events and fashions of each turning point with open data

STEP3 : Generating dialogues using acquired events and fashions

As for STEP1, system identifies date of user's turning point based on each user's age. System take three ways: using general fact such as year of graduating school, using information of life history and using answer of question by agent. As for STEP2. system acquire events and fashions of each date from Web resources. The events and fashions of particular date are unchangeable **facts** and it does not depend on specific individual. In recent years, such information is available on many websites. System operator creates parse programs for HTML pages to acquire sentences and necessary key words. As for STEP3, system operator prepares category-by-category **dialogue template** such as music template, movie template, sport template and social situation template. Then system dynamically fills data in on the template to generate dialogues corresponding to user's age.

2.3 Implementation

Based on the proposed method, we have implemented a prototype system of virtual counselor. Technologies used in the implementation are as follows:

- System Language: Java 1.8.0.25, Ruby
- Web Server: Apach Tomcat 7.0.69
- Web Service Framework: Jersey 1.19, Apache Axis2 1.6.3
- Virtual Agent: MMDAgent version 1.4

- LOD: DBpedia Japanese[5], LinkData[6]

This prototype implements the personalized dialogue for the user's birthplace. The dialogue template specifies conversations, where the VA first asks a birthplace and then talks about the specialty of the birthplace.

Figure 2 shows an example conversation generated by the prototype. First, the VA asks the user: "Where were you born, Seiji?" Suppose that the user Seiji answers "I was born in Fukuyama-city." Now, the answered birthplace is not a prefecture, the system looks up DBpedia to find a prefecture where Fukuyama-city exists. The VA confirms that "Do you mean Fukuyama in Hiroshima prefecture?" Then, the user says "Yes." As the prefecture is confirmed to "Hiroshima", the system looks up LinkData to retrieve "Okonomi-Yaki" as a specialty of Hiroshima. Finally, the VA says that "I like Okonomi-Yaki of Hiroshima very much!"

Figure 3 shows flow of the service which generate dialogue corresponding to user's age. When the service is executed, the system picks up a dialogue template prepared by categories and starts a conversation. First, in STEP1, system identify date of turning point of user with three ways. Next, in STEP2, access to Open Data using year as a key and acquire events and fashions of the year by category. Last, in STEP3, fill dialogue template with acquired data and generate dialogue corresponding to user's age.

Figure 4 shows screenshot of system when provides dialogue via web browser. In this case, user's age is 70 years old and year of graduating from junior-high school is 1962, then agent talks about music and movie of the year.

3 Conclusions

We find it difficult to cover wide range of topics and individual hobbies or preferences only by using DBpe-

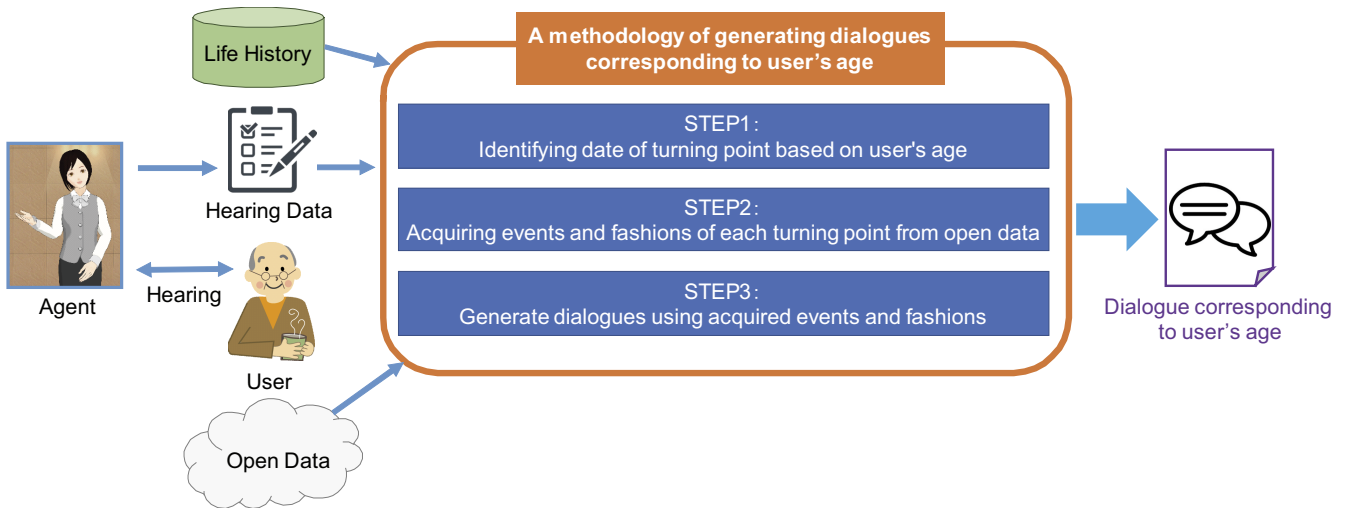


Figure 3: A method of generate dialogue corresponding to age



Figure 4: Screenshot of proposed system

dia and LinkData. Therefore, we have to consider way to search LOD dynamically appropriate to the topics. During operation, we faced error that system cannot acquire data from the website. This reason was that Wikipedia changed composition of HTML tag on target web page, so parse program did not deal with data appropriately. Also, acquiring data from web page executed on real-time, analysis time depend on amount of information on page, so sometimes agent provides dialogue laggardly. One of the methods to resolve this issue is using database which holds necessary data such as events and fashions to provides dialogues without web connection. In this method, we have to develop new system which update database automatically according to update of Open Data. In our future work, we plan to conduct the experimental evaluation with actual people with dementia.

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