A Client Model in Everyday Language Computing

Shino IWASHITA†, Toru SUGIMOTO†, Noriko ITO†, Ichiro KOBAYASHI†‡,
Michiaki IWAZUME†, Yusuke TAKAHASHI† and Michio SUGENO†

†Brain Science Institute, RIKEN
2-1 Hirosawa, Wako, Saitama 351-0198 JAPAN
E-mail: iwas@brain.riken.go.jp

‡Faculty of Economics, Hosei University
4342 Aihara-machi, Machida, Tokyo
194-0298 JAPAN

Abstract-**This paper proposes the client model, which is a model of a computer user in everyday language computing paradigm. When a user operates a computer by everyday language through the client's secretary agent, the client model is used to help understanding and generating texts. The client model consists of profile information and property specific information. Profile information has two elements. One is the linguistic information, in which the linguistic tendency is specified for the user. The other is the property information, which is the private information of the user. Some persons will have the similar properties, so they can be categorized by the tendency of property information, which is stored as the property specific information. In this paper, the structure of the client model is explained. An example of the conversation scenario between a user and the client's secretary is shown, and then the importance of the client model is discussed.**

I. Introduction

Everyday language computing is a new paradigm that anybody can access and use computers with his/her own everyday language[1]。 It aims at developing computing systems like home electrical appliances so that we can use the computer without using some expert knowledge about computer, i.e., technical term, keyboard arrangement, or software. Because *everyday language computing* treats the language that we ordinarily use, it is necessary to consider the individuality of user's language use.

In this study, we consider the situation that a user operates the computer through the dialogue with the secretary agent. There are many studies on agents or user interfaces, e.g., an information extraction agent that learns how to search the useful information for the user in WWW[2], learning agent that predicts the WWW page user browse next[3], anthropomorphic agent that is realized by the phonetic dialogue or facial expression synthesis module[4], and so on. The secretary agent in this study is individualized by learning knowledge about the user through the communication with the user in the situation limited to the computer work. This secretary agent plays the role of not only the interface for the user but also the learning module of the user's personality.

We can communicate with others by recognizing the situation and using the resource available for the situation. The secretary agent is expected to do different actions corresponding to different situations. We are developing the linguistic knowledge resource called the *semiotic base*[5]. The semiotic base is systematized by the language use based on the systemic functional linguistic theory (SFLT), which deals with the relationship among the context of situation, meaning and wording[6].

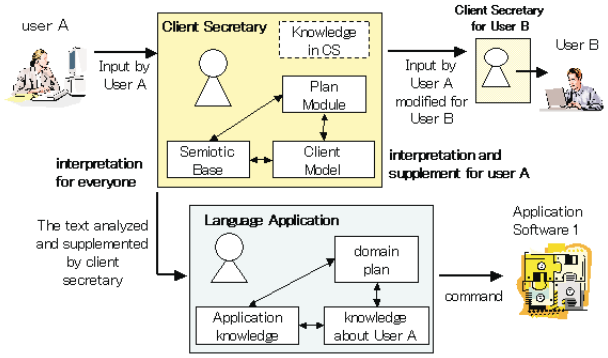
The semiotic base is the resource of language. To understand the user's input or to generate texts for the user, it is necessary for the secretary agent to learn the user's personality. In this study, we propose the *client model*, which contains information about the user, and is used to help the semiotic base in the case of understanding the meaning of user's everyday language, or generating the text for the user, and also used for decision making of the client's secretary. The human has two kinds of cogitation, one is the linguistic level, and the other is image (emotion or impression) level. Both of these factors are important for developing the everyday language computing so that we consider how to express the user's impression or emotion with linguistic expressions. There are some studies about the user model in human interface, however they have many problems[7].

In this paper, we explain the structure of the client model. We mention the subject experiment to extract the tendency of the user groups. Furthermore, we also explain the examples how to use the client model, and the importance of the client model is discussed.

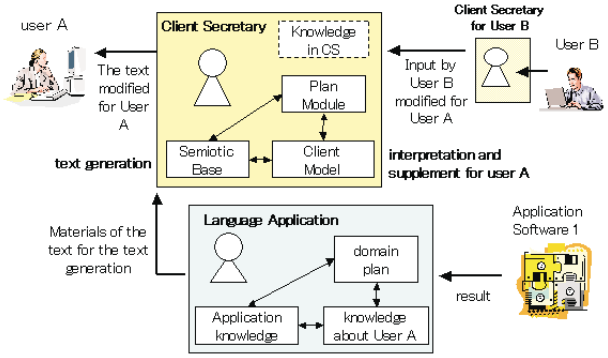
II. Everyday Language Computing

Fig. 1 shows the flow for understanding and generating the texts in everyday language computing. When user A input a text for client's secretary as shown in Fig. 1(a), the client's secretary understands the meaning of the text by using linguistic knowledge resource, i.e., the semiotic base and the client model. The text understood by the client's secretary is transmitted to the language application, or another user B in the form of the language protocol [8]. Language application translates the text to the command [9].

In the case of transmitting the text from the language application or user B to user A as shown in Fig. 1(b), the



(a)Text understanding



(b)Text generation

Figure 1: Everyday Language Computing

text should be paraphrased to another text in order to be easily understood by user A.

III. Client's Secretary

In everyday language computing, the user communicates with the computer through the medium of the client's secretary agent. The user can input requests or questions to the client's secretary with his/her own language, because the client's secretary can understand the user's linguistic characteristics and user's original linguistic expression.

When the user inputs the text to the client's secretary by using voice or keyboard, the text is understood by semiotic base considering the context, the meaning and the wording. Then, the information by the client model is added, and the individualized understanding of the text is realized.

The client's secretary has also the plan module as shown in Fig. 1. The client's secretary uses three kinds of knowledge for text understanding, text generation and dialogue planning. The first is the common sense knowledge of the client secretary, the second is the user specific knowledge (that is the client model), and the third is the knowledge about other agents (i.e., language applications).

IV. Semiotic Base

The semiotic base is a collection of meaning resources and knowledge to deal with meanings of social semiotic

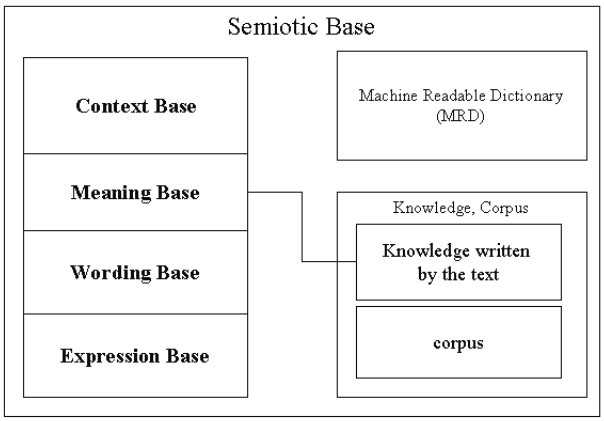


Figure 2: Structure of the Semiotic Base

symbols, especially language [1]. The data of this resource has four components, i.e., the context base, the meaning base, the wording base, and the expression base. In addition to these bases, it accommodates a machine-readable dictionary (MRD) and corpus. Fig. 2 summarizes the structure of the semiotic base.

The context base stores the features characterizing a given situation of dialogue. Situation types are characterized in terms of "what is happening (Field)", "who are taking part (Tenor)", and "what part the language is playing (Mode)". These features of Field, Tenor and Mode are represented in the form of system networks based on the SFLT. When the situation type is identified, the lexicogrammatical and semantic analysis is performed.

V. What is the Client Model?

The information about the user is stored in the client model, and it can be extracted whenever the client's secretary needs. At first, the inputted text is understood using semiotic base, and it is supplemented or translated to another text that is adapted to the user. For example, "yesterday's file with Word Processor" is translated to "the file of the trip report that is written yesterday with Java Word Processor".

The client model consists of two kinds of information, one is profile information which is the user specific information (linguistic information and property information), and the other is property specific information which is the property information of the user groups. The structure of the client model is shown in Fig. 3.

A. Profile information

Profile information is the information about the user. Though the user has various kinds of tendency, we consider here the tendency of the user's language use, and the user's property that is for example the name, the age, and so on. Table 1 shows an example of the profile information.

A.1. Linguistic information

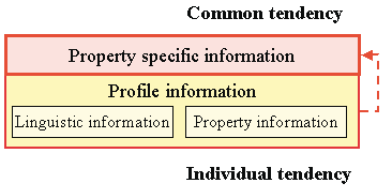


Figure 3: Structure of the Client Model

Table 1: Profile Information

(a)Linguistic information

kind	examples
user word	stick (refer to the character " - "), worm (refer to the character "~")
image word	pop, pretty, bright, warm
adverb	slightly, a little more

(b)Property information

slot	examples
name	Hanako Riken
gender	female
birthday	Oct 24, 1970
hometown	Tokyo, Japan
character	worrier
knowledge level	competent
schedule	party, bussiness_trip
personal relation	company, friend, event

Linguistic information stores the user language, the tendency of the use of image words and degree adverbs. User langauge consists of the user's original words and linguistic expressions. Correspondence between these words and their intended meanings is stored and used for text understanding. As for image words, the tendency of the user's impression for the adjective word is stored. Different persons may have different impressions for the same image word, so it is difficult to deal with the semantics of these words. In the client model, image words are expressed by the combination of physical features, i.e., brightness, largeness and so on. Besides, it is considered that the user may use a new image word, e.g., "*pop* font". The client model stores the meanings of image words in its past record, so that the meaning of the new word can be understood by the combination of the stored words. For example, the client's secretary can ask the user "Here, did you use the word *pop* as stylish and urban?" Fig. 4 shows that the word *pop* is expressed by the intersection of stylish and urban.

Similarly to image words, degree adverbs have different meanings for different users. For example, we consider the adverb "*quite*". When a user says "Please search the file that is written *quite* a long time ago", the secretary searches the file written not only a long time before but

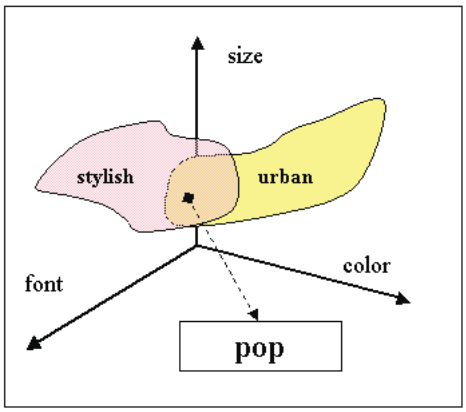


Figure 4: Combination of Stored Image Words

also recently, in the case that user has the tendency to exaggerate about the time. To treat adverbs, we adopt the method of *standardization*. The equations for standardization are as follows:

$$\tilde{x} \circ \tilde{R} = \tilde{y} \quad (1)$$

$$\tilde{y} \circ \tilde{R}^{-1} = \tilde{x} \quad (2)$$

where $\tilde{x}$ is the meaning of adverb A, $\tilde{y}$ is the meaning of adverb B, and $\tilde{R}$ means the tendency of the user's expression for adverbs like *exaggerate about the time*. Eq. (1) means that the meaning of the adverb A ($\tilde{x}$) has the approximately same meaning as the adverb B ($\tilde{y}$) when the user exaggerates ($\tilde{R}$) it. Eq. (2) means that the meaning of the adverb A ($\tilde{x}$) is the result of de-exaggerating ($\tilde{R}^{-1}$) the meaning of the adverb B ($\tilde{y}$).

A.2. Property information

The user's property can be extracted by two means, by asking the questionnaire before the user uses the computer, and by learning from the dialogue between the user and the secretary[7]. Property information is stored from the questionnaire data, and modified to fill the gap between the information from the dialogue and the data stored before. Property information consists not only the attributes of the user but also the knowledge level, the user's schedule, the functions of the software that the user usually use, the frequency of the use of the software, and so on. User's schedule can be referred widely by using fuzzy sets as shown in Fig. 5.

Furthermore, property information includes the expectation for the secretary, that is, how autonomously the secretary works by its own thinking, or how frequent the secretary reports its action. This expectation is mostly used for the decision of the dialogue plan [10].

Personal relation as shown in Table 1 stores the information related to the user's attribution, that is, the company the user belongs, the user's friends, events and so on.

B. Property specific information

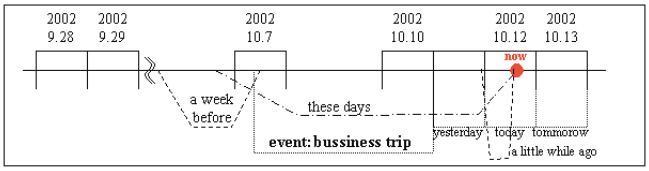


Figure 5: Schedule

Each user has different properties, but the users can be categorized to some groups in terms of the similarity of the property information. The tendency and feature of the groups of the users are stored as the property specific information. The client's secretary can infer the user's action or expectation from the property group that the user may belong. Storing the user's properties as the property specific information may lighten the burden to infer the user's expectation.

Because the property specific information stores the tendency in some users' groups, some of them can be extracted from subject experiments or questionnaire data. We have performed a subject experiment to extract the tendency about the knowledge level. The detail of this experiment is described in Section VII.

VI. How to Use the Client Model?

A. Three Ways to Utilize the Client Model

The client model plays many roles in the process to realize the communication between the user and the client's secretary. There are three ways to utilize the client model, i.e., rephrasing, supplement and inference, which work on the input text from the user, that is analyzed and tagged by the semiotic base. Here, we outline these functions by considering an example of the dialogue as shown in Table 2.

A.1. Paraphrase

Referring to the linguistic information and property specific information, a part of the input/output text is paraphrased according to the tendency of the user's language use. In everyday language computing paradigm, a text is understood with a consideration of its sender, and a text is generated with a consideration of its receiver.

Table 2: Example of the Dialogue

1	U → S	I'd like to write the trip report.
2	S → U	I have started the word processor.
3	S → U	You'll write the trip report for Tsukuba, dont' you?
4	U → S	Yes. The title is "Trip report of SCIS conference" with the *attractive* font.
5	S → A	The title is "Trip report of SCIS conference" with the *bold* font.

U: User, S: Secretary, A: Application

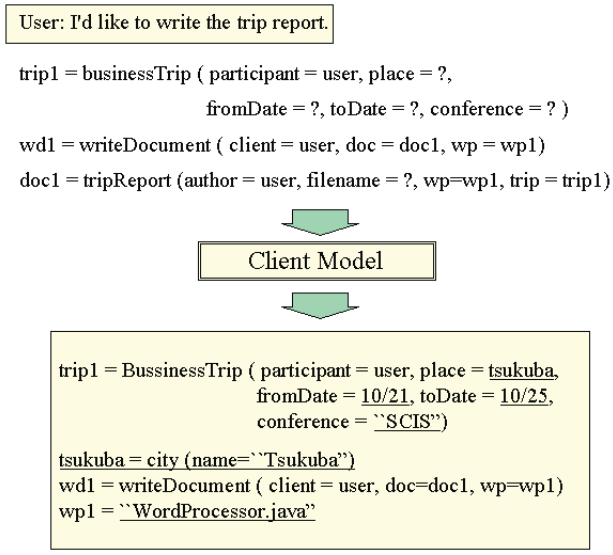


Figure 6: Supplement

The user wants to use the attractive font for the title in the line 4 in Table 2, and the secretary paraphrases the word *attractive* to *bold* for the application in line 5, using the image word information in the client model.

A.2. Supplement

Fig. 6 shows a part of the result of the analysis for line 1 in Table 2 by the semiotic base. The information in the client model that "the kind of word processor that the user often uses to write a document is Java Word Processor" and "the trip that the user went recently is the SCIS conference in Tsukuba" supplements the meaning of the analyzed text with the information shown with underlines in Figure 6.

A.3. Inference

In line 2, the client's secretary reports to the user that "I have started the word processor". But, some users may not need such a report because they can see the word processor has been started on the screen. The client's secretary should infer the user's expectation to make decision whether it should report the action to the user in each time.

For example, both the user's anxiety degree and knowledge level in property information are used to decide whether to report or not. If the user's anxiety degree is high and knowledge level is low, almost all information had better be reported, while few information, only which the user cannot see on the screen, had better be reported if the user's knowledge level is high. These kinds of information are used by the plan module in the client's secretary as shown in Fig. 1 [10].

B. Learning

The client's secretary should know about the user in order to communicate with the user. The client model

can learn the rules in the user's input text, and they are used in rephrasing, supplement and inference. The user will change his/her property, so the client model should add new information from the user's input text, and then modify the old information if it is inconsistent with new one.

In line 4, the user's input text is "The title is 'Trip report of SCIS conference' ". This text is anlyzed to learn that the title of the conference is "Trip report of"+ "*the name* of the conference" . If there is another case like it, e.g., "The title is 'Trip report of ABC conference' ", the confidence degree of this rule about the title will be raised. In this case, the client's secretary can input the title automatically if it is inferred that the user expects to do so.

VII. Subject Experiment

As mentioned above, some users have similar properties so that they are categorized to some groups, and the information about these groups is stored as property specific information. One of the effective methods to extract the property specific information is a subject experiment for many people. We performed the subject experiment about the dialogue between the user and the instructor, and property specific information about the knowledge level was extracted.

The outline of the experiment is shown in Fig. 7. The user are instructed to create the same document as the sample by using the software *Microsoft WORD 2000*. The sample document is about a notice for circulation about the volleyball game in a neighborhood association, which is created by *Microsoft WORD 2000* and printed out by color printer. This sample includes several tasks, i.e., input the text, change font size and font kind, insert the figure, insert the table and give kana (ruby). The user can inquire how to operate the software function to the instructor who is in another room through the microphone whenever he/she has difficulty. However, the instructor cannot look at the screen of the computer that the user operates, and the sample of the document.

The subjects are 17 persons (10 males and 7 females) who are from teen-ager to 50's. The instructor fills the form as shown in Fig. 8 about the result of judgement for the knowledge level of the user in the five degrees from novice to expert and the reason for the judgement, when he/she is asked a question from the user.

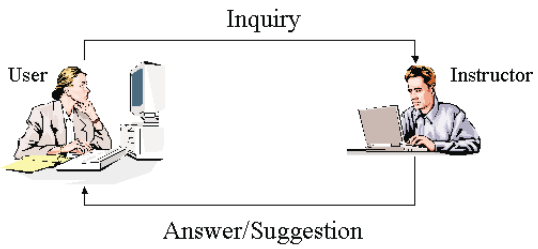


Figure 7: Subject Experiment

knowledge level judge form

name: User 1

knowledge level	reason to judge so
novice, beginner, competent, skilled, expert	The user couldn't insert the figure.
novice, beginner, competent, skilled, expert	The user has not enough technical terms.
novice, beginner, competent, skilled, expert	Same questions occurs many times.
novice, beginner, competent, skilled, expert	The user doesn't understand Japanese input mode.
novice, beginner, competent, skilled, expert	

Figure 8: Write Form for the Instructor Judgement

After the experiment has finished, the instructor judges the overall knowledge level of the user. The subjects judged to the same knowledge level are summarized, and the tendency of each knowledge level is analyzed. The result is shown in Table 3.

VIII. Discussion

In this section, we discuss how useful the client model will be in everyday language computing.

In the case of text understanding, a text is analyzed and the situation type in which the text is located is guessed. The context base in the semiotic base has a set of situation types, and the meaning of the text for the current situation is adapted. Then, the meaning of the text will change in each situation. Because the client model has information about the user, it can be used to get the meaning adapted to the user. Here, we consider an example that the user inputs the text "I'd like to emphasize *it*". The situation is identified using the semiotic base, i.e., "the situation that the user has inputted the title", or "the situation that the user has inserted the figure". In the case of the former situation, the word *it* indicates the title so that the client secretary may emphasize the title by changing the font to the red color and bigger size using the linguistic information for the word "emphasize" stored in the client model. In the case of the latter situation, *it* indicates the figure so that the client's secretary adds the red frame to the figure in order to emphasize it.

The semiotic base is a large language resource that grows through the dialogue between the user and the client's secretary. The dialogue includes not only the user's information but also the user's language use. It will be useful for the client model that the client's secretary can utilize both the language resource and the information about the user's character in each situation.

IX. Conclusions

In this paper, we propose the paradigm of the client model, which is necessary to realize the everyday language computing. The client model stores the user's information, i.e., the user's character or tendency, and the client's secretary utilizes it to individualize its understanding and

Table 3: Knowledge Level for the Word Processor

element	knowledge level				
	novice	advanced beginner	competent	skilled	expert
How to ask	abstract	concrete			
Ask frequency	same questions many times	many times	few times		never
Technical Term	don't know	only basic terms	know almost all terms		
Mistake	many		few		
Speed	slow		quick		
Method	step by step			planned	
Application	impossible		possible		
Solution	impossible	with support	sometimes with support	with few support	all by themselves
Others	don't know how to use keys	interested in the functions	stick to the details of the sample	know more than one solution	do all kinds of manipulations

generation of the texts, and its behavior. A subject experiment was performed to extract the property specific information in the client model. From the result, the tendency of users in each knowledge level was obtained. Furthermore, three methods of the client model are explained with the example dialogue.

For the future, we should develop the procedures to realize these three methods in many situations. The client's secretary will supplement or paraphrase the texts to adapt the user, using these procedure. Because human keeps changing, the information about the user will become old soon, even if the client model was complete. Therefore, it is important for the client model to learn about the user and update its contents constantly.

Moreover, it is also important to understand a vague expression as an image word, or to estimate the degree of an adverb. It is a delicate but indispensable theme to realize the everyday language computing.

References

[1] Michio Sugeno, "Verbalizing Computers - A Way to Everyday Language Computing", *Proc. of 2002 AFSS International Conference on Fuzzy Systems*, pp.117-120, 2002.

[2] Mark Craven, Dam DiPasquo, Dayne Freitag, Andrew McCallum, Tom Mitchell, Kamal Nigam and Sean Slattery, "Learning to Extract Symbolic Knowledge from the World Wide Web", *Proc. of the 15th National Conference on Artificial Intelligence (AAAI-98)*, pp.509-516, 1998.

[3] Henry Lieberman, Neil W. Van Dyke, Adriana S. Vivacqua, "Let's Browse: A Collaborative Browsing Agent", *Knowledge-Based Systems*, Vol. 12, pp. 427-431, 1999.

[4] H. Dohi and M. Ishizuka, "A Visual Software Agent: An Internet-Based Interface Agent with Rocking Realistic Face and Speech dialogue Function", *Proc. of AAAI-96 Workshop on Internet-Based Information Systems*, pp.35-40, 1996.

[5] Noriko Ito, Ichiro Kobayashi and Michio Sugeno, "The Semiotic Base as a Resource in Text Processing Systems", *JASFL Occasional Papers*, Vol.2, No.1, pp.63-71, 2001. (in Japanese)

[6] Michael A. K. Halliday, *An Introduction to Functional Grammar*, 2nd edn. Edward Arnold, London, 1994.

[7] Kristina Höök, "Steps to take before Intelligent User Interfaces become real", *Journal of Interaction with Computers*, Vol.12, No.4, pp.409-426, 2000.

[8] Ichiro Kobayashi, Michiaki Iwazume and Michio Sugeno, "Language Protocol for Everyday Language Computing", *Proc. of 10th IEEE International Conference on Fuzzy Systems (FUZZ-IEEE'01)*, pp.1299-1302, 2001.

[9] Michiaki Iwazume, Ichiro Kobayashi and Michio Sugeno, "Everyday Language-based Computer Resource Management", *Proc. of 2001 IEEE International Conference on Systems, Man, and Cybernetics (SMC 2001)*, pp.543-548, 2001.

[10] Toru Sugimto, Noriko Ito, Hiroko Fujishiro and Michio Sugeno, "Dialogue Management with the Semiotic Base: A Systemic Functional Linguistic Approach", *Proc. of 1st International Conference on Soft Computing and Intelligent Systems (SCIS 2002)*, 2002.