

Remote Communication Support System on Smartphone by Enhancing Awareness - Application to long-distance relationships -

Tomoya Ohiro¹, Tomoko Izumi² and Yoshio Nakatani³

¹Graduate School of Information Science and Engineering, Ritsumeikan University, Shiga, Japan
(Tel: +81-77-561-2617, E-mail: is009086@ed.ritsumei.ac.jp)

²College of Information Science and Engineering, Ritsumeikan University, Shiga, Japan
(Tel: +81-77-561-2617, E-mail: izumi-t@fc.ritsumei.ac.jp)

³College of Information Science and Engineering, Ritsumeikan University, Shiga, Japan
(Tel: +81-77-561-2617, E-mail: nakatani@ed.ritsumei.ac.jp)

Abstract: Recently, the methods of conducting long distance communication have dramatically changed due to improvements in communication technology including TV phones, e-mail, and SNS (Social Networking Services). However, people still have difficulty in enjoying sufficient long distance communication because subtle nuance and atmosphere are difficult to be felt in a distant place. For example, there are many romantic partners with feelings of anxiety about long-distance relationships. This is because an environment that allows the partners to understand each other has not been sufficiently supported. The purpose of this study is to help people separated by a long distance to understand each other by enabling the sensing of a partner's feelings from the partner's behavior. Our target is long-distance romantic partners. When people feel, sense, or are conscious of another person's existence or state, this ability or state is called "awareness." Awareness is nonverbal communication. Awareness sharing among people is very important for managing relationships successfully, especially for people separated by a long distance. This is because a partner will develop feelings of unease if awareness sharing is not adequate. Our approach is as follows. First, examine what kind of action is useful for representing the feeling of love. Next, monitor these actions in partners. Third, summarize actions to quantitative indications. The prototype system was evaluated through evaluation experiments. Three pairs of partners used the system for two weeks. The result verified the effectiveness of this system as it promoted mutual communication.

Keyword: long distance communication, nonverbal communication, awareness

1 Introduction

The development of information technology in recent years has come to allow communication between remote places to be conducted smoothly. Up until recently, people had been used communicating via letters and telephones. However, methods of communication underwent significant changes with the development of e-mail and SNS (Social Networking Services). As a result, restrictions of time and a place have become lost. And through our improvement in information literacy, as long as an environment allowing connection to a network exists, anyone can perform remote communication easily. However, people still have difficulty in having sufficient long distance communication because subtle nuance and atmosphere are difficult to be felt in a distant place. This problem is generally found more in cases containing a strong emotional aspect than logical settings, such as business meetings. For example, there are many

romantic partners who have feelings of anxiety about long-distance relationships. This is because an environment that allows partners to understand each other has not been sufficiently supported. It is generally said that long-distance relationships are not often successful. The opportunity for partners in a long-distance relationship to engage in communication is restricted. Therefore, they are forced to depend on language-based communication such as phone calls, e-mails, and letters. However, these media do not help individuals in understanding their partners' feelings easier. This is especially true for Asian people, whose cultures tend to rely more heavily on picking up on non-verbal communication clues. And they cannot actualize a feeling of staying close. The purpose of this study is to help people separated by long distances to understand each other by enabling a sensing of the feelings of their partners from the behavior of their partners. Our

target is romantic partners involved in long-distance relationships.

1.1 Sharing of awareness

When people feel, sense, or are conscious of another person's existence or state, this ability or state is called "awareness." The awareness is nonverbal communication. For example, it is in a partner's existence, action, or state. Awareness sharing among people is very important for managing relationships successfully, especially for people separated by long distances. This is because a partner will develop feelings of unease if awareness sharing is not adequate. In remote communication, the sharing of awareness is important. This feeling is strongly transmitted to a partner who has an intimate relationship, such as the relationship that exists between families or a romantic couple. If one partner knows the other partner well, the partner will react to a "situation" or "action" with a level of sensitivity that differs from normal sensitively.

For example, if the sender cannot get a connection at the accessible time, the sender has anxious feelings about it. On the other hand, if the receiver is not aware of the attempt at connection, the receiver does not sense the sender's feeling. Because of insufficient awareness, partners cannot understand the emotional experiences that the other partner is feeling. Then, a different degree of interest develops and drives a wedge into the relationship. Such a situation can cause failure in a long-distance relationship. If "awareness information" can be sufficiently transmitted to the partner, the problems of long-distance relationships may be solvable. This study examines methods for supplementing the awareness that is generally obtained through face-to-face communication during times of non-face-to-face communication. And validity was verified via an experiment by building a prototype system.

2 Associated research

Examples of previous studies on awareness shared systems do exist. Kajio's research is on a system for family members who lead separate lives [1]. This system uses a drawer as a device. The contents of this drawer synchronize with the

partner's user. In this system, the contents of one partner's drawer are displayed on the other partner-user's drawer as a photograph. This function has actualized virtual living together. Through the operation of opening a drawer, the user has achieved an intuitive operation.

Furthermore, research exists on long-distance romantic relationships. Tsujita says that the couple in a long-distance relationship needs a strong bond [2]. Therefore, Tsujita proposed a method wherein, for daily items which two persons possess, when one partner uses an item, the other partner synchronizes by undergoing the same action. Some synchronized daily items are prepared, such as a trash box, a lamp, and a television. Each of these is an item that is used in usual living. Thereby, the mapping of a partner's action becomes simple. For example, if the trash box in one location is opened, the trash box in the remote location will be opened. This method provided the user with the matter-of-fact feeling of being together with the partner. These studies have features which give the user an intuitive operation. This has the merit of giving the feeling of being together virtually. Moreover, since the two systems use daily items as a device, anyone can use them. However, since the devices are always synchronized, there is the problem of infringing on the partner's privacy. Furthermore, if a system is used when the relationship with a partner is bad, it may become worse. Therefore, for supporting a long-distance relationship, the present situation with the partner must be considered. A long-distance relationship may easily develop into a situation where a small misunderstanding develops into a larger problem. Therefore, long-distance relationship support requires the function in which a partner's feeling can be guessed.

3 The system proposal

In this chapter, an awareness sharing system for the couple involved in a long-distance relationship is proposed. Flexible correspondence which understands the condition with the partner and is appropriate in each individual instance is required for a long-distance relationship. Therefore, in long-distance relationship support, flexible support

which considers the conditions of both parties at the time of each communication is required.

3.1 Support using a smartphone

The feeling of living together virtually has been achieved in previous studies. However, the methods therein did not take privacy into consideration.

Furthermore, the partner's feeling is not transmitted. Moreover, as mentioned above, it is said that most couples who are involved in long-distance relationships do not engaged in awareness sharing well, and this is the cause which makes those relationships fail easily compared with couples who are not involved in long-distance relationships. Negative feelings, such as uneasiness and doubts, appear notably in long-distance relationships. So, this study proposes a method for supporting relationships using mobile terminals currently in general use. People may act unconsciously when thinking about someone. From such knowledge, unconscious action is also made applicable to evaluation in this study. Therefore, as a device used by this study, almost all persons thought that a mobile terminal that is always carried was optimal. In this research, a system which supports relationships by guessing the present condition of the self and the partner according to the usage situation of each function of a smartphone is proposed. A partner's uneasiness may be able to be canceled by showing the usage situation of the smartphone of the partner who is present in a remote place. Moreover, the act itself might become a cause which raises awareness. From the usage situation of the smartphone, this system evaluates and notifies nonchalantly about it. Thereby, the effect of promoting the sharing of awareness is also expected.

3.2 Selection of love action

"Love action" was selected based on opinions obtained by a questionnaire. Whether or not intimacy is felt regarding a certain action is different for different people. Therefore, in order to give subjectivity to the system, generality is given by taking and equalizing distribution based on the results obtained by the questionnaire.

3.2.1 Questionnaire

First, some actions performed when thinking of the partner from the function of the smartphone were extracted. Next, those actions were surveyed in a questionnaire designed to discover whether or not the respondents feel intimacy with the partner based on the actions. The following table lists the functions of a smartphone mentioned as the example.

- Make a call
- Send e-mail
- A past e-mail is read.
- Music with meaning to both partners is listened to.
- A photograph taken with the partner is viewed.
- A schedule with the partner is adjusted.

This questionnaire survey was conducted with 36 college students. The questionnaire evaluated in five steps whether or not the above mentioned actions would inspire a feeling of intimacy for a partner. This survey obtained the standard deviation and distribution, and it confirmed whether or not the actions mentioned above could be considered common.

Shimizu and Obo describe that "intensity" and "diversity" are the important things for keeping a relationship positive [3]. In this study, "frequency" is used for evaluation in addition to "intensity" and "diversity." A couple's condition is quantitatively evaluated using these three elements.

- ① Frequency: The sum total value of the frequency in which the couple performed the love action.
- ② Intensity: The evaluation value of the love action computed by the questionnaire.
- ③ Diversity: The kind of love action performed within the measurement period.

The evaluation result was evaluated using these three variables. The formula is given in ① below.

$$\text{Intensity of love action} \times \text{Frequency of love action} \div \text{Total of the frequency of the two persons' love action} \dots \textcircled{1}$$

3.3 The method of notifying users

Users can be made to feel a sharing of awareness by receiving notifications in a casual manner. The partner's feelings are notified to the user by color

changes. Specifically, the present state is indicated by changing the background color of the home screen of the system. This allows an awareness which cannot be obtained through conventional communication to be felt by the user.

4 Details of the system

This system is provided as an iPhone application. Therefore, Objective-C was used as the development language. Regarding the usage situation of the user's iPhone, if a user performs love action, the system will record an action history. The history acquired by the system is evaluated. The partner is notified of this result. The user guesses the partner's feelings and the present condition of the partner according to the evaluation value received from the partner-user. Fig. 1 is a composition figure of this system.

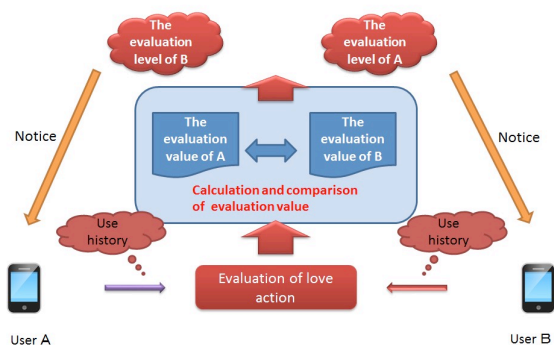


Figure 1 System configuration diagram

4.1 Calculation of evaluation values

The system will perform an evaluation from the history after 1 day passes from commencement of use. The system calculates each user's sum total value. The value of the difference of the two sum total values is calculated. It finds the gap between the two persons' feeling by taking the difference of the two persons' sum total value. If the evaluation value of the two persons differs greatly, this means there is a gap in their feelings. Since the sum total value of this evaluation changes with couples, generality is lost. Therefore, the result of dividing the difference and average value of the sum total value of evaluation is the evaluation value. The evaluation level is calculated from this value and each user is notified of their partner's value. By being notified of the partner's evaluation level, the user can guess the partner's feelings. Users are notified of their partner's

previous day evaluation level. The system changes the color of the background of the system with an evaluation level. This evaluation level is expressed in five steps.

For example, if the evaluation value of the system is low, it will display and carry out red. This is a report that the relation with the partner is not good. Conversely, a blue background will be displayed if the evaluation value is high. This is a report that the relation with the partner is good. Thus, it is surmised that the relationship of couples will improve because users check the transfer of dependence with their partner mutually daily. This is why the system has reported to the user the evaluation result of the previous day.

It is conjectured that notifying of changes in a partner's feelings that are difficult to sense in long-distance relationships raises a couple's level of awareness.

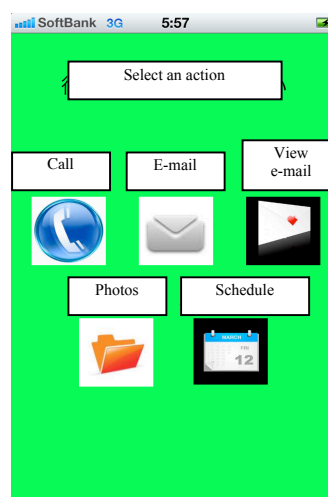


Figure 2 Level 1 (safety phase) home screen

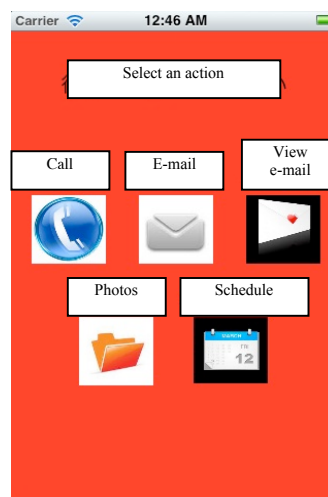


Figure 3 Level 5 (danger phase) home screen

5 Evaluation of the system

5.1 Hypothesis

Before performing the experiment, we hypothesized the effect upon the user that can be expected through the use of this system.

1. The system was expected to enhance awareness by receiving information that is usually not transmitted from partner to partner.
2. The user is expected to be able to resolve uneasy feelings of wondering what the partner is thinking and wondering if the partner is really thinking about the user.
3. This system is expected to be used as a new medium of communication.

In order to validate these hypotheses, we performed experiments and examined the hypotheses through the survey results.

5.2 Examination method

We conducted the evaluation experiment for approximately one week among three couples who are involved in long-distance relationships.

The 1st set consists of the couple made up of Examinee A (a 21 year old male student who lives alone in Shiga) and Examinee A' (a 22 year old female student who lives with her parents in Okayama). This couple has been in a relationship for 5 years and 8 months. This is the 4th year that they have been in a long-distance relationship. The 2nd set consists of the couple made up of Examinee B (a 26 year old male who worker who lives alone in Kagawa) and Examinee B' (a 22 year old female student who lives with her parents in Okayama). They have been in a relationship for 2 years and 5 months. This is the 2nd year of their long-distance relationship. The 3rd set consists of the couple made up of Examinee C (a 22 year old male student who lives with his parents in Okayama) and Examinee C' (a 21 year old female student who lives alone in Fukuoka). They have been in a relationship for 6 months. They have been in a long-distance relationship for 6 months. The examination method

employed the system for one week after notifying the examinees of the background and the purpose of this research. The examinees filled out a questionnaire after using the system. Moreover, the log data of the evaluation values of action under investigation and evaluation levels were constantly recorded, and we investigated whether the system was being used effectively.

5.3.1 Analysis of log data

Next we will discuss the log data that the server recorded during the experiment period. Figure 10 shows the log data for the couple composed of Examinees A and A', Figure 11 shows the log data for the couple composed of Examinees B and B', and Figure 12 shows the log data for the couple composed of Examinees C and C'. The horizontal axis shows the amount of time lapse from the commencement of the experiment and the vertical axis shows the shift in evaluation level. For the couple composed of Examinees A and A' and the couple composed of Examinees C and C', perhaps because the members of both couples were students, the sum total of love actions was high and the total value of actions were also high. In contrast to this, the tendency for the couple composed of Examinees B and B' was low for both members regarding the sum total of love actions and low for the total value of actions as well. The couple composed of Examinees A and A' showed a high evaluation level regarding the result for the first day of use, and the relationship was not in a good state at that point. However, the evaluation level showed a trend of converging on a low value from the second day onward, and it can be said that the members of the couple began to communicate more with a focus on sensing the feelings of each other based on the values generated by the system. Also, the couple composed of Examinees C and C' experienced a convergence towards low values for each other as well, and the same level was recorded for 6 days out of 1 week. As mentioned later, this was a result of the couple composed of Examinees C and C' using this system as a new medium of communication and attempting to synchronize their evaluation levels in the spirit of playing a game. Examinees B and B' do not correspond with each other very much in general, and the total value of love actions was low with an overall high evaluation level. Examinee B is very busy at his job, and there were many days when Examinee B' engaged in love actions on her own. Also, Examinee B did not pay much attention to this system, and as a result, not much of an effect was seen from this system in his case.

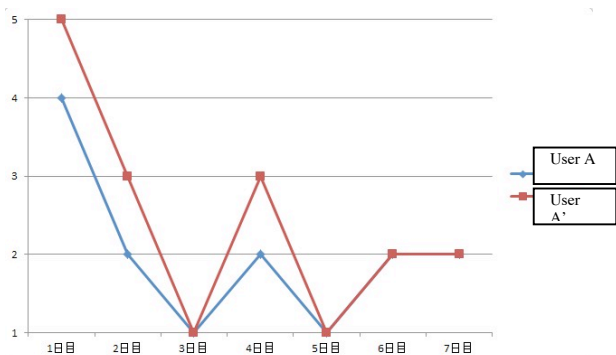


Figure 4 Shift in the evaluation level for the couple composed of Examinees A and A'

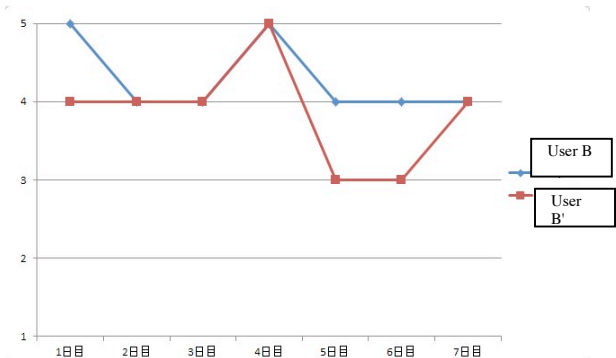


Figure 11 Shift in the evaluation level for the couple composed of Examinees B and B'

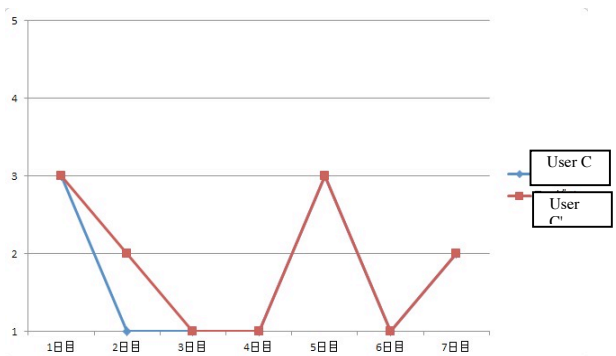


Figure 12 Shift in the evaluation level for the couple composed of Examinees C and C'

5.3.2 Analysis through questionnaire results

In order to validate the beneficial nature of the system, examinees were asked to fill out questionnaires after the survey period. The questionnaires consisted of 6 items and a free area to write opinions and feedback about the system. In response to Question 1 (Were there any changes in

the frequency of love actions before and after using this system?), we received many responses stating that the number of times of engage in love actions increased through the use of this system. We received feedback that reported that using the system led to engaging in actions that were not engaged in before using the system, such as looking at photos again or rereading e-mail messages, and that a feeling of newness that existed during the beginning of the relationship had been recaptured.

In response to Question 2 (Did you make phone calls or send e-mail messages as a result of this system?), we received many responses stating that communication had increased as a result of this system. Feedback was also received stating that this system became a topic of interest in and of itself, and that checking on the partner's evaluation level by phone or checking to see the type and number of actions the partner had engaged in during the day were conducted. Examinees C and C' used this system in the spirit of playing a game, each checking to see how many love actions the partner engaged in in order to synchronize their evaluation levels. This system can be considered to have acted as a new medium leading to increased communication.

In response to Question 3 (How did you feel about this system?), we received favorable evaluations from most of the examinees. Regarding examinees who answered that they felt relieved or experienced feelings of happiness, a feeling of security can be thought to have arisen from the ability to assess what the partner is feeling about the examinee. The Examinee who answered that the system was irritating reported a feeling that the evaluations were all bad, and that was upsetting.

In response to Question 4 (Did this system enable you to feel close to your partner?), we received many responses stating that the examinees were able to feel close. From this we can suppose that awareness toward each other was enhanced through the system's displaying of awareness information that is not generally transmittable to partners in distant locations. Also, we received feedback stating that the act of speculating about a partner's feelings in and of itself provides a chance to feel close to the partner.

In response to Question 5 (Did communication increase through this system?), all Examinees stated that it increased or increased somewhat. This can be attributed to the system leading to an enhancement in communication because the frequency naturally increases due to the fact that the system uses calling and e-mail messaging as evaluation criteria. Also, the reasons obtained from Question 2 also play a large role in this.

Regarding Question 6 (Were the changes in emotion as indicated by color changes in the system communicated to you effectively?), the questionnaire feedback indicates that the changes were communicated effectively, and the method of notification can be considered useful.

5.4 Verification of the hypotheses

Hypothesis 1: The system may enhance awareness through the communication of information that is generally not able to be communicated between partners.

From responses to Question 5 in the previous section, this system can be considered to have enhanced awareness of the users through usage. The reason that this system was the cause for enhancing awareness is that users accepted the displaying by the system, through the format of smartphone usage conditions, of atmosphere information that cannot generally be assessed through long-distance communication. Also, as mentioned above, awareness can be considered to have been further enhanced by making it easy for the user to infer the feelings of the partner through not displaying evaluation values directly to users but instead notifying users through the method of evaluation levels. These considerations verify the usefulness of this system as an awareness sharing system.

Hypothesis 2: Usage of this system may be able to eliminate feelings of anxiety about what the partner is thinking or if the partner is really thinking about me.

From the responses to Question 4 in the previous section, it can be assumed that users were put at ease by using this system. Examinee feedback stating that, "our feelings were more in sync than I thought, and I was relieved," and, "I was happy to receive an evaluation showing that my partner was thinking about me," indicates that using this system put users at ease. We also received feedback stating that, "the evaluation was never good and the system itself was irritating." The system puts users at ease when the evaluations are positive, but can be annoying and irritating when the evaluations are negative. However, another examinee reported in the free feedback area that, "When evaluations were negative, talking with each other about why they were negative eliminated anxiety." This indicates that the system is useful as a tool for eliminating feelings of anxiety.

Hypothesis 3: This system could be used as a new medium of communication.

Responses to Questions 1, 2, 3, and 6 indicate that this tool was actively used as a communication tool. Among the responses to Question 1, a couple that did

not normally engage in love actions, which are the criteria for evaluation in the system, stated that they began to engage in them frequently due to using the system and restored the feeling of newness that existed at the beginning of the relationship. And, as in the case of Examinees C and C', there were users who used this system with the goal of achieving a high evaluation through cooperating with each other. This indicates that the system successfully functioned as a new communication tool.

The observations mentioned above all indicate that hypotheses 1 through 3 can be considered verified and that the system can be considered useful as an awareness sharing system with the purpose of supporting long-distance relationships.

6 Issues and future prospects

As mentioned above, several areas that could be improved in the system were discovered through the survey experiment.

The current experiment surveyed couples who normally engage in communication and a couple with a low frequency of communication. For the couples with a high frequency of communication (the couple composed of Examinees A and A' and the couple composed of Examinees C and C'), the log data analysis indicated that the system is useful. However, for the couple with a low frequency of communication (the couple composed of Examinees B and B'), the total value of love actions was low at times, making the importance of each action high, and large gaps in total values emerged. Because of this, the actual evaluation values and the evaluation levels converged at a high value for most of the days. However, there were also many days on which the evaluation levels converged towards the same level, and it seems that the emotions of the partners were in sync with each other. The same criteria values were set for all couples in the experiment, but in reality, the methods and frequency of communication is not the same for all couples. Thus, a function that can adjust the criteria for evaluation levels for each couple after conducting a pre-experiment survey is considered necessary. In the future, it will be necessary to create a flexible system that can adjust to the characteristics of the users.

Also, we received feedback stating that, "It was inconvenient to have to select love actions through

the system screen each time." The system was designed to be an application for the iPhone, and due to restrictions for developing iPhone applications, it was difficult to give this system the functionality of recording the history of love actions automatically by having it operate in the background of the iPhone operating system. Because of this, the system was designed with the functionality of recording action history by allowing the home screen for this system to act as a quasi iPhone home screen. That feature did not give users a very good impression, and as a result, it made it difficult for the system to provide a feeling of casualness. Though this problem is somewhat irresolvable due to the choice of making the system an iPhone application, imbedding the system as an application in other android terminals that allow easier interaction with applications would probably solve the problem. Also, the current experiment was limited to an iPhone application in terms of the device for measuring love actions, but in the future we are considering a method wherein tags are attached to furnishings and items on or around the body to measure evaluation values from daily life activities.

Regarding the prospect for the future, based on an awareness of points for improvement obtained through conducting these experiments, we want to improve the system so that it can provide flexible support that couples with various different types of communication styles can use and a more casual type of support that feels effortless to the user.

REFERENCES

- [1] I. Kajio Jim Rowan, Elizabeth Mynatt : Digital Décor : The interaction by the strengthened furniture, The Information Processing Society of Japan symposium series, Interaction 2003 collected papers, Vol. 2003, No. 7, pp. 41-42 2003,(in Japanese).
- [2] H.Tshujita K.Tsukada, I,Kajio : Appliances to Arouse Mutual Awareness between Close People Separated by Distance, "SyncDecor", Computer s oftware academic journal, Vol. 26, No. 1, pp25-37 2009(in Japanese).
- [3] Y. Shimizu, I. Obo : The structure of interaction in romantic relationships: hierarchical data analysis of inter-subjectivity between partners, Th e Japanese Journal of Psychology, Vol. 78, NO.6, pp575-582 2008 (in Japanese).