Evaluation of Site-Independent Creativity Consistent Support System for Actual Work Environment

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Abstract - In recent times, it has become increasingly important not only to maximize the knowledge and expertise gained at work, but also to create new knowledge from those. Creativity methods such as the KJ method[1] are suitable for addressing these challenges and effectively developing creative ideas. For effective application of knowledge at a work site, without constraints on time and place, we propose a site-independent creativity consistent support system based on Quiccamera and GUNGEN-SPIRAL II. Further, we present the results of experiments to evaluate the system and demonstrate its effectiveness.

Keywords: KJ method, photograph, creativity support system, tablet device

1 INTRODUCTION

In recent times, the growth of information and communication technologies has highlighted the realities of globalization in economics and business competition. Companies must foster continuous innovation through short-cycle product development, business efficiency improvement, cost reduction, and rapid decision making in order to accommodate the diversity of markets and technologies. Therefore, it becomes increasingly important not only to maximize the knowledge, experience, and expertise accumulated in the organization but also to create new knowledge from those.

Further, in the event of natural disasters such as floods, earthquakes, and tsunamis, people may provide additional information through social media. Various studies have analyzed this behavior and have attempted to utilize it for disaster management measures [1], [2]. Such information includes knowledge, experience, and expertise from victims or experts, and it will be useful in designing crisis management measures for similar disasters in the future. Major disasters also highlight the importance of risk assessment for events that are rare but have great impact [3]. Such information is difficult to extract without a range of divergent opinions.

Various creativity methods [4]-[8] and their support systems [9]-[11] have been proposed. However, the application of idea generation methods requires a certain level of practice, and a specific amount of time is necessary in order to achieve results of good quality. Many organizations encounter the dilemma of satisfying the requirements for gathered knowledge and dedicating enough time to gather the required knowledge. Creativity methods for developing creative ideas effectively are suitable for addressing these challenges.

Most creativity methods and their support systems are designed to be applied in meetings that require the participants to be present within a single room. In order to gather the ideas of those concerned, particularly in the actual work environment, the creativity methods should be applicable irrespective of time and place.

In this study, we propose a consistent support system for creativity in the actual work environment. This can support the entire process of a creativity method on-site, without imposing any restriction on the actual work site. Further, we describe the implementation of this system using tablet devices with cameras. Our experiments demonstrate the effectiveness of the proposed system.

2 RELATED WORK

The KJ method developed by Jiro Kawakita [5] is a creativity method based on the theory of problem solving and teamwork, and is also referred to as the affinity diagram and is included in the Seven Management and Planning Tools [8] used in total quality control. The process typically used in the KJ method, which is based on the human thinking process for creative problem solving [9], is as follows:

(P-0) Data gathering
Data (ideas, opinions, issues, etc.) with a specific theme are gathered.

(P-1) Label creation (divergent thinking)
While selecting data and brainstorming, each idea is recorded as a label

(P-2) Category creation (convergent thinking)
The labels are organized into groups based on the natural relationships between labels, and each group is given a title.

(P-3) Chart creation (idea crystallization)
Each group is spatially allocated to a chart (affinity diagram) according to the natural relationships between groups. Steps (P-2) and (P-3) are processes typical of the KJ method, and we refer to these as the narrowly defined KJ method in this paper.

(P-4) Conclusion (idea verification)
Concluding sentences are added to express the meaning of the diagram.

[1] The KJ method is a registered trademark of Kawakita Research Institute.

PAN/KJ [10] is a KJ method support system that can utilize multimedia data such as images or audio data. This system uses multimedia data as hyperlinks for card labels, but does not use multimedia data directly in the form of labels.

GUNGEN-SPIRAL II [11] enables the consistent process of the KJ method to be implemented as a Web application, thus facilitating idea generation using multiple devices such as PCs or smart phones with modern Web browsers.

Geographical Location Information-Based Bulletin Board System (GLI-BBS) [12] is a groupware system that can share geographical location information among communities. This system enables the data uploading of photographs from a GPS-equipped cellular phone to a BBS, which shows the photographs with the related geographical information.

Evernote [2] is a memorandum sharing system based on cloud computing. This system enables submissions of text memos, freestyle drawings, and photographs easily by using PCs or smartphones, and it facilitates sharing among devices. Some case studies have demonstrated the effectiveness of the functionality of Evernote in the collaboration process [13].

Digital Card Cabinet [14] was featured in a special exhibition of the work of Tadao Umesao at the National Museum of Ethnology in Osaka, Japan. Tadao Umesao was known for his special B6-size paper cards (known in Japan as Kyoto University cards) that improve intellectual productivity [15]. The Digital Card Cabinet system allowed visitors of the exhibition to create personal Umesao-style cards, store them in digital form in a digital cabinet, and share them with other visitors by using a tabletop touch screen panel. Each digital card was created with text, photographs, and freestyle drawings by using an iPhone [3] native application, or scanning a paper card.

3 REQUIREMENTS

There are two kinds of work sites in the actual work environment; the head office site and the actual work site. The personnel at the head office site gather data from the actual work site, analyze those, and make decisions to solve problems. At the head office site, there are also executives, staff, and external experts who eventually judge the decisions. The personnel at the actual work site gather data there and send this to the head office site for a decision. At the actual work site, there are actual workers who have various amounts of knowledge and experience of the work environment. In a disaster situation, there are also victims and volunteer staff to rescue the victims.

Most previous creativity support systems merely supplied the process at the head office site with sufficient facilities such as PCs, networks, and hot-wired meeting rooms. In order to obtain an effectual decision with a creativity method, it is important for the people at the head office site to collaborate with those at the actual work site by combining their different set of implicit knowledge for each thought process. However, it is difficult to gather both groups of people simultaneously because of the restrictions of time and place, especially the restrictions on infrastructure at the actual work site.

In this study, we propose a consistent support system for creativity on-site, which enables users to perform an entire creativity process under restrictions of time and place but independent of the actual work site. A conceptual model of our proposal is shown in Fig.1. The solid arrows in the figure show the flow of the human thought process for a creativity method such as the KJ method. The dashed arrows in the figure show the flow of data for collaboration between the head office site and the actual work site. The purpose of our proposed system is consistent support for the creativity process at the actual work site, which is under many restrictions and in collaboration with the head office site consistently.

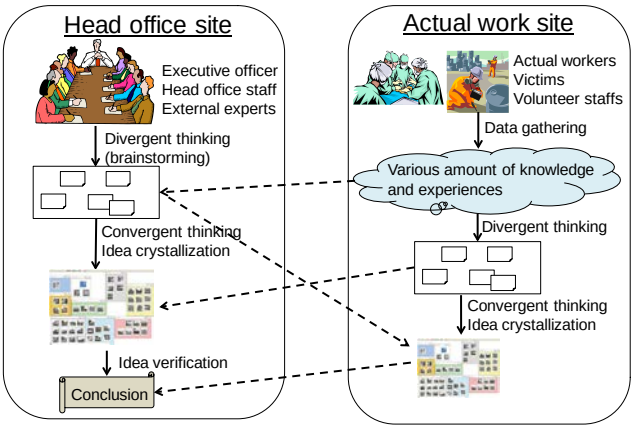

Figure 1: Conceptual model of site-independent creativity consistent support system.

The requirements of the system are as follows:

(1) System users
In order to collect a diversity of useful opinions, a variety of people should join the system and implement creativity methods as a team. In addition to head office staff, the group must consist of external experts or staff from the actual work site (e.g. industrial plants, construction fields, or disaster site).

(2) Time and place
The system should be accessible from any place and at any time, thus enabling the participants to implement the creativity method whenever necessary.

(3) Target process
As described above, a variant of the KJ method has a sequence of processes (from divergent thinking to convergent thinking or conclusion) to obtain results using creativity methods. Each process may be executed at a different place or time.

(4) User abilities
People with a variety of skills may use the system and creativity methods; hence, a simple user interface is required. In addition, most creativity methods need a large workplace in order to gather a large number of ideas and obtain an overview.

[2] http://www.evernote.com/
[3] http://www.apple.com/iphone/

4 APPROACH

4.1 Basic Design

We developed Quiccamera as a support system that enables rapid data gathering and label making in the actual work environment [16]. By means of Quiccamera, comments using text, pictographs (emoji), or handwriting can be added to photographs captured at the location. Then, the photographs can be sent directly to GUNGEN-SPIRAL II [11] as idea labels for implementing the KJ method.

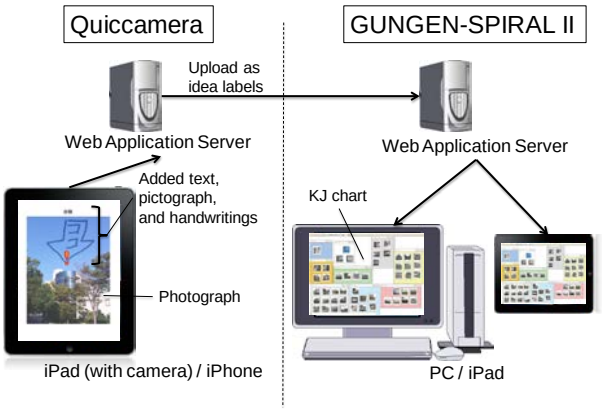

Figure 2: Overview of creativity consistent support system based on Quiccamera and GUNGEN-SPIRAL II.

An overview of our complete implementation of a creativity consistent support system based on Quiccamera and GUNGEN-SPIRAL II is shown in Fig.2.

4.2 Function Design

The main functions of Quiccamera are as follows:

(1) Use of client terminal with touch panel and camera
The system should support a short handwritten note with a photograph. Hence, this client function is enabled for a smartphone or tablet device with a touch panel and camera, such as the iPhone or iPad[4] (except the first model).

(2) Single button for image submission
With a smartphone or tablet device, an image can be uploaded to a server by several methods such as e-mail or ftp. However, these methods are not simple because multiple applications or operations are required. Hence, the entire operation (capturing, editing, and uploading the photograph) is implemented through an application that requires minimum operating effort.

(3) Freestyle comments on the photograph
Handwriting is one of the simplest methods for adding comments to a photograph. However, sometimes handwritten letters are difficult to read or manage. Therefore, a more useful method is the text input function that is provided. In addition, a variety of pictographs can be used to convey feelings related to the target object in the photograph [17].

(4) Direct use of photographs with comments as idea labels in GUNGEN-SPIRAL II
Photographs uploaded to the Quiccamera server are converted and uploaded directly to the GUNGEN-SPIRAL II server as XML-style idea labels. Thus, we can implement the entire KJ method as one consistent process with our proposed system.

4.3 System Implementation

We developed Quiccamera as a native iPhone or iPad application written in Objective-C and a server application written in PHP for receiving photographs.

GUNGEN-SPIRAL II is a Web-based server application written in PHP and JavaScript. It enables the KJ method on all terminals having modern Web browsers, such as PCs, smart phones, and tablet devices.

We chose an iPad2 (second generation iPad) as the client terminal for Quiccamera and GUNGEN-SPIRAL II, because the iPad2 has a camera and a wide display (similar to those of a notebook PC).

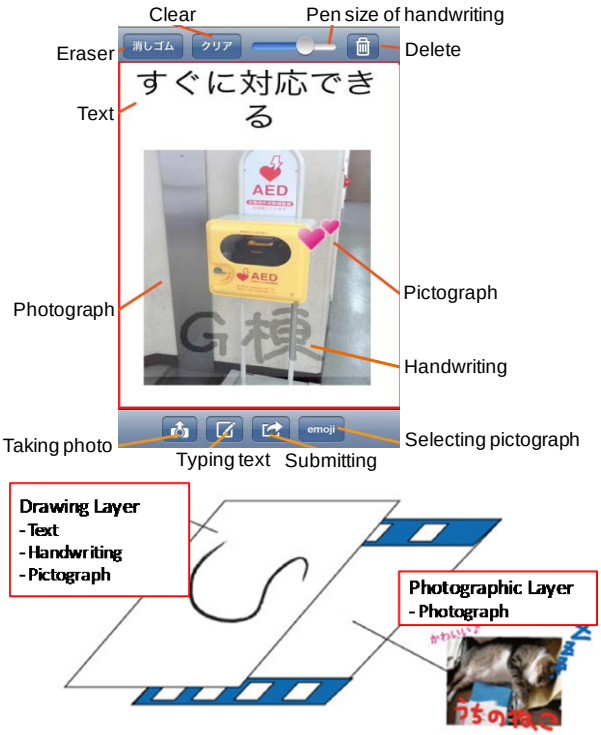

Figure 3: Overview of main screen of Quiccamera application.

First, the user launches the Quiccamera application and captures a photograph using the built-in camera of the iPad 2. The captured photograph is displayed on the main screen of the Quiccamera application, and the user can add several freestyle comments on the photograph by using text, various pictographs, or handwriting with multiple pen sizes. Four

[4] http://www.apple.com/ipad/

pictographs were implemented for comments of laughing, crying, surprise, and love. Figure 3 shows the main screen of the Quiccamera application. The comments are stored in the drawing layer, which is separate from the photograph layer, and the user can edit these freely. In our experiments we prepared the four pictographs shown in Fig.4.

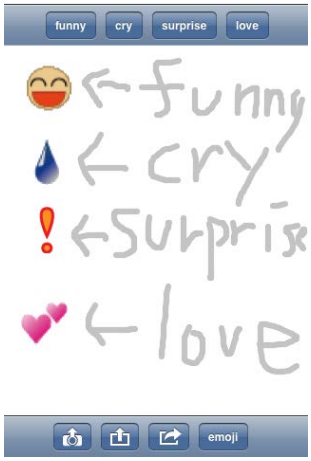

Figure 4: Variety of pictographs.

Once the editing is complete, the user presses the upload button to save the data in the PNG format by combining the layers and submit the result to the Quiccamera server. The data is automatically uploaded to the GUNGEN-SPIRAL II server in the form of idea labels. Then, the user launches the GUNGEN-SPIRAL II application to initiate the categorizing and charting process of the KJ method by using the uploaded idea labels (photographs with several freestyle comments).

5 EXPERIMENTS AND DISCUSSION

5.1 Experimental Environment

The experiments were conducted with six groups of participants: each group consisted of three students from Wakayama University. The theme of the KJ method was "ultimate methods for adopting measures to deal with the occurrence of a disaster or tsunami." As the actual work site, we selected Arita County (the towns of Yuasa and Hirokawa) in Wakayama Prefecture, which is known for an old tsunami story [18] [5]. Wakayama University was simulated as the head office site. The participants executed all the steps of the KJ method (from data gathering (P-0) to conclusion (P-4)), and four other individuals evaluated the quality of the result sentences by Yagishita's method [19], which expands the application scope of the traditional Analytic Hierarchy Process (AHP) [20]. We adopted six evaluation factors (originality, usability, appeal, concreteness, possibility of realization, and possibility of application) to calculate the satisfaction scores of result sentences.

Our experiments were conducted and evaluated on the basis of three aspects:

(1) Evaluating the effect of photographic idea labels (Groups A and B)
The participants each took an iPad 2 or iPhone to the actual work site (Arita County), gathered data by taking photographs (data gathering), and created idea labels by drawing several memorandums with Quiccamera. After several days, they performed the remaining processes of the KJ method (category creation, chart creation, and conclusion) with GUNGEN-SPIRAL II at the head office (Wakayama University) using a PC. For the purposes of comparison, they also created textual idea labels (without using Quiccamera) just before creating the categories. We evaluated the number of idea labels generated at (P-1) and the number of categories generated at (P-2). We also evaluated the processing time of the narrowly defined KJ method from (P-2) to (P-3) and the satisfaction score of the concluding sentence at (P-4). The time gap between label creation and category creation as well as the difference between the devices emulates an inconsistent creativity process.

(2) Evaluating the support for a consistent process (three Groups C, D, and E)
The participants each took an iPad2 to a location near the head office site (Wakayama University) as an actual work site with fewer restrictions on time, place, and equipment. They gathered data and created idea labels in a manner similar to that described in (1). Then, they returned to the head office and performed the remaining processes of the KJ method with the iPad2 consistently. We evaluated the processing time of the narrowly defined KJ method and the satisfaction scores of the concluding sentences. The number of idea labels was fixed at 21 (each participant created 7 labels) in each experiment to evaluate all idea labels under the same experimental condition, when considering the legibility on the screen size of the iPad2.

(3) Pre-evaluating the support for a consistent process in the real actual work site (one group: F)
The participants each took an iPad2 to the actual work site (Arita County), gathered data, and created idea labels in a manner similar to that described in (1). Then, they assembled at a suitable location within the site and performed the remaining processes of the KJ method with the iPad2 consistently. The evaluation criteria and the experimental condition (the number of idea labels) were the same as in (2).

Table 1 shows the environments for all the experiments. W and O represent the locations at which the participants executed the processes of the KJ method. W indicates the actual work site (Arita County) and O indicates the head office site (Wakayama University). In each experiment, the category creation, chart creation, and conclusion processes were simultaneously performed at the same place.

[5] The story was translated as "Inamura-no-Hi" by Tsunezo Nakai and used as a government-designated teaching material in Japanese elementary schools before World War II.

Table 1: Experimental environments.

Group		Data Gathering	Label Creation	Category Creation
A	A1	W	W (iPad)	O (PC)
	A2	W	O (Text)	O (PC)
B	B1	W	W (iPad)	O (PC)
	B2	W	O (Text)	O (PC)
C		O	O (iPad)	O (iPad)
D		O	O (iPad)	O (iPad)
E		O	O (iPad)	O (iPad)
F		W	W (iPad)	W (iPad)

Figure 5 shows an example of providing idea labels as input by using Quiccamera at the actual work site (Yuasa Town). Figure 6 shows an example of using Quiccamera to submit an idea label. The text in Fig.6 shows a short question about the addition of the dike in the photograph. The pictograph (exclamation mark to indicate "surprise") emphasizes the need to focus attention. The freestyle drawing (arrow) shows the size of the added dike.

Figure 5: Experiments at Yuasa.

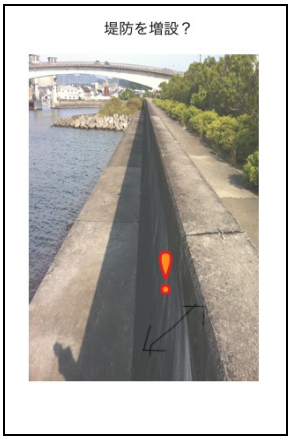

Figure 6: Example of photographic idea label with text, pictograph, and handwritings.

Figure 7 shows an example of the KJ method being performed using a PC at the head office (Wakayama University). KJ charts in GUNGEN-SPIRAL II were displayed on the wall by using a projector in order to share the entire workspace with all the participants. The submitted photographs were shown as idea labels in GUNGEN-SPIRAL II. The participants applied the KJ method by displaying the entire screen of GUNGEN-SPIRAL II using a projector.

Figure 8 shows an example of the KJ method being applied with an iPad 2 at the actual work site (a tearoom in Yuasa). The iPad 2 was connected to the GUNGEN-SPIRAL II server at the head office by using a 3G-WiFi router.

Figure 7: Performing the KJ method using a PC at the office.

Figure 8: Performing the KJ method using an iPad 2 at a tearoom in Yuasa.

5.2 Results

Figures 9 and 10 show the resultant KJ charts, considering the experiments of Group A as examples. Figure 9 shows the resultant KJ chart after the chart creation process using idea labels from Quiccamera. Each photographic idea label contains a photograph with text, pictographs, or handwriting. Figure 10 shows the textual (traditional) KJ chart.

Table 2 lists the results of Experiments A1-B2. It shows the number of generated idea labels at (P-1), the number of generated categories at (P-2), the process time of narrowly defined KJ method from (P-2) to (P-3), and the average of satisfaction score of the result sentence at (P-4) calculated with Yagishita's method [19]. The time is given in minutes. Table 3 shows the results for label making by using text, handwriting, and pictographs at Experiments A1 and B1.

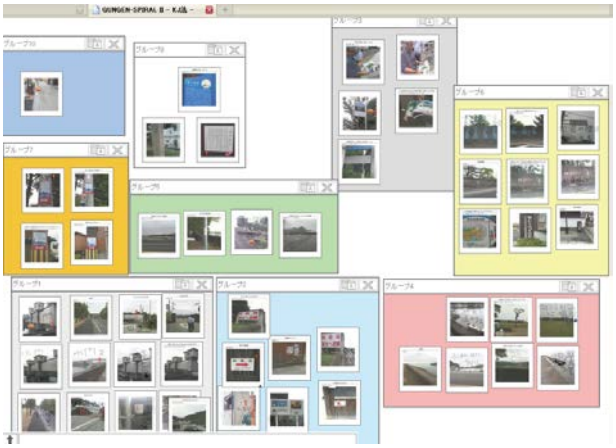

Figure 9: Example of KJ chart using photographic idea labels from Quiccamera (A1).

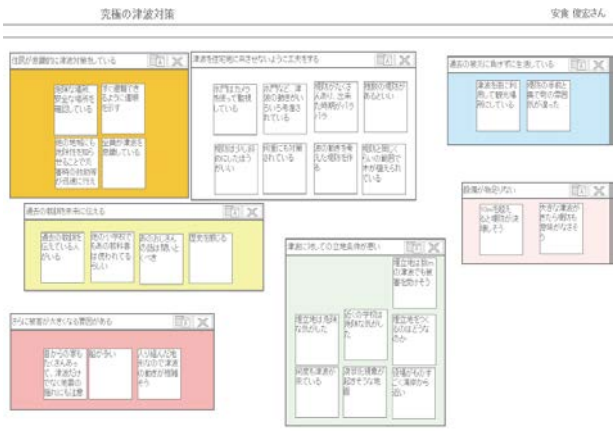

Figure 10: Example of KJ chart using textual idea labels (A2).

Table 2: Experimental results (A1-B2).

Group	Num. Labels	Num. Categories	Time (min.)	Avg. Score [19]
A1	53	9	40	4.0
A2	30	7	20	2.7
B1	31	6	52	4.3
B2	35	10	45	2.0

Table 3: Breakdown of making idea labels with Quiccamera.

Contents		A1	B1
Labels with text		24	28
Labels with handwriting		28	10
Labels with pictographs		11	11
Variety of pictograph	Funny	4	0
	Cry	1	0
	Surprise	9	11
	Love	1	0

Table 4 lists the results of Experiments C-F, which also shows the process time of narrowly defined KJ method, and the average of satisfaction score of the result sentence.

Table 5 lists the questionnaire regarding the usability of Quiccamera, and Table 6 lists the questionnaire regarding the usability of GUNGEN-SPIRAL II. Each score shows the average provided by each participant from 1 to 5 score.

Table 4: Experimental results (C-F).

Group	Time (min.)	Avg. Score [19]
C	50	3.9
D	25	2.8
E	56	4.9
F	41	2.8

Table 5: Questionnaire results for Quiccamera.

	Questionnaire	O (C-E)	W (F)
1	Did you feel it a burden to take and to submit a photograph with Quic-camera? *(1:Not a burden-5: A great burden)*	1.6	1.3
2	Was the addition of a memorandum by electronic handwriting simple? *(1:Did not feel so-5: Strongly felt so)*	3.9	4.0
3	Was the addition of memo written by text simple? *(1:Did not feel so-5: Strongly felt so)*	3.7	4.3
4	Was it effective to add the contents of electronic handwriting to your own memorandum? *(1:Did not feel so-5: Strongly felt so)*	4.0	4.7
5	Was it easy to upload photographs? *(1:Not easy -5:Easy)*	4.6	4.7
6	Did the pictographs help in adding information? *(1:Did not feel so-5: Strongly felt so)*	2.9	2.7
7	Was the variety of pictographs suitable? *(1:Too few-5: Too many)*	2.6	3.0
8	Do you think that electronically handwritten memorandum is effective even without photographs? *(1:Did not feel so-5: Strongly felt so)*	2.0	2.7

Table 6: Questionnaire results for GUNGEN-SPIRAL-II.

	Questionnaire	W PC (A1,B1)	O iPad (C-E)	W iPad (F)
1	Were the idea labels completely readable? *(1:Did not feel so-5:Strongly felt so)*	3.3	3.0	4.0
2	Was it more convenient to perform the KJ method with the proposed system than with the paper-based method? *(1:Did not feel so-5:Strongly felt so)*	4.0	3.6	4.7

5.3 Discussion

In the experiments above, we observed the following results:

(1) Evaluating the effect of photographic idea labels

In Table 2, the average score for concluding sentences is higher with photographic idea labels than with textual labels, although there are no significant differences between the numbers of labels or categories generated.

Table 7 shows portions of the concluding sentences of Group A as examples. The underlined portions indicate the significant differences between the photographic idea labels and the textual idea labels. With the photographic idea labels, the concluding sentences include more specific expressions such as examples of actual scenarios. This would help in the generation of more practical output for actual work environments.

Table 7: Examples of concluding sentences.

Concluding sentences with photographic idea labels (A1)
The ultimate action to prepare measures for dealing with a tsunami is to exploit the review of past experiences. For example, a conscious measure was taken by locating a sign for people living in the area to escape to safety upland away from a tsunami, or by locating a sign about how dangerous the place is during a tsunami.
Concluding sentences with textual idea labels (A2)
The ultimate action to prepare measures for dealing with a tsunami is to hand on the past lessons to the future generations. That makes it possible to take conscious measures by indicating the way for inhabitants to escape immediately, or by checking the safety of places.

Table 3 indicates that textual comments were predominantly used. The number of comments using pictographs was less than the number using text or handwriting, respectively. In the pictograph comments, the pictograph for surprise was typically used.

(2) Evaluating the support for a consistent process

In Tables 2 and 4, we compare the average scores of concluding sentences between inconsistent processes (A1 and B1) and consistent processes (C, D, E, and F). The results show that there are no significant differences between these.

Table 5 shows that the score for uploading a photograph is high (4.7) and that the effort to submit photographic idea labels is low (1.6). This result indicates that the main function of Quiccamera is achieved.

Although Table 6 shows that the readability and operability are slightly higher when a PC is used than when an iPad 2 is used, there are no significant differences between these.

(3) Pre-evaluating the support for a consistent process at the actual work site

The experimental results of Group F show that there are no significant differences in the scores of concluding sentences between Groups C–E and Group F, although the average score of concluding sentences is lower for Group F. This indicates that there were no dependences on where experiments were performed. Hence, the system was able to support the whole KJ method consistently at both the head office and the actual work site.

6 CONCLUSION

In this study, we proposed a site-independent creativity consistent support system, which can apply creativity methods without constraints on time and place. We also demonstrated the effectiveness of our proposal by conducting experiments.

The proposed system consists of Quiccamera and GUNGEN-SPIRAL II. Quiccamera supports divergent thought processes and GUNGEN-SPIRAL II supports convergent thinking for conclusions. This system can consistently support the entire process of a creativity method at any time and at any place by using a tablet device (iPad 2) as a client terminal.

Experimental results showed that the use of photographic idea labels is easier with Quiccamera. Further, the quality of the resultant conclusion is better when photographic idea labels are used than when textual idea labels are used, owing to the more concrete idea generation. In addition, there were no significant differences in the quality of concluding sentences between using a PC and using an iPad 2 or between working at the head office and working at the actual site.

In future studies, we will increase the variety of freestyle comments by including multicolored handwriting and additional pictographs to support the creativity method more effectively.

REFERENCES

[1] D. Yates, and S. Paquette, “Emergency knowledge management and social media technologies: A case study of the 2010 Haitian earthquake,” International Journal of Information Management, Vol. 31, Issue 1, pp. 6-13 (2011).

[2] S. Doan, B. H. Vo, and N. Collier, “An Analysis of Twitter Messages in the 2011 Tohoku Earthquake,” Electronic Healthcare, Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, Vol. 91, pp. 58-66 (2012).

[3] K. J. Hole, “Toward Risk Assessment of Large-Impact and Rare Events,” IEEE Security & Privacy, Vol. 8, Issue 3, pp. 21-27 (2010).

[4] A. F. Osborn, “Applied Imagination: Principles and Procedures of Create Problem Solving (Third Edition),” Charles Scribner’s Son, New York, (1963).

[5] J. Kawakita, “The Original KJ Method (Revised Edition),” Kawakita Research Institute (1991).

[6] T. Buzan with B. Buzan, “The Mind Map Book,” BBC WorldWide Limited (1993).

[7] M. Brassard, and D. Ritter, "The Creativity Tools Memory Jogger," Goal/QPC (1998).
[8] M. Brassard, "The Memory Jogger Plus+ Featuring the Seven Management and Planning Tools," Goal/QPC (1996).
[9] S. Kunifuji, and N. Kato, "Consensus-making support systems dedicated to creative problem solving," International Journal of Information Technology Decision Making, Vol. 6, No. 3, pp. 459–474 (2007).
[10] Y. Ohmi, K. Kawai, and H. Ohiwa, "A Card-handling Tool for Multimedia," Proc. 1999 IEEE International Conference on Multimedia Computing & Systems, IEEE CS, pp. II-250–254 (1999).
[11] J. Munemori, H. Fukuda, and J. Itou, "Application of a Web Based Idea Generation Consistent Support System," Proceedings of the 16th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems (KES2012), pp. 1827–1836 (2012).
[12] A. Abe, T. Sasaki, and N. Odajima, "Development and Operational Evaluation of the Groupware Based on Geographical Location Information for Local Community Activities," IPSJ Journal, Vol. 45, No. 1, pp. 155–163 (2004) (in Japanese).
[13] F. Geyer, and H. Reiterer, "Experiences from Employing Evernote as a Tool for Documenting Collaborative Design Processes," Proceedings of the ACM Conference on Designing Interactive Systems (DIS 2012), Workshop: Supporting Reflection in and on Design Processes (2012).
[14] T. Takahashi, H. Vermeulen, H. Ueda, and Y. Konagaya, "Digital Card Cabinet - Gathering and Sharing Impressions about a Exhibition with both Analog and Digital Ways," Proceedings of the VRSJ the 16th Annual Conference, pp. 550–553 (2011) (in Japanese).
[15] T. Umesao, "The Art of Intellectual Productivity," Iwanami-shoten (1969) (in Japanese).
[16] T. Ajiki, H. Fukuda, T. Kokogawa, J. Itou, and J. Munemori, "Application to the Disaster Data of an Idea Generation Consistent Support System," Proceedings of the 7th International Symposium on Frontiers of Information Systems and Network Applications (FINA 2011) in conjunction with IEEE AINA 2011, pp. 153–158 (2011).
[17] J. Munemori, T. Nishide, T. Fujita, and J. Itou, "Development of a Distributed Pictograph Chat Communicator IV," Proceedings of the 15th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems (KES2011), Vol. 6883, pp. 77–85 (2011).
[18] L. Hearn, A Living God, "Gleanings in Buddha-Fields," Houghton Mifflin Company (1897).
[19] K. Yagishita, J. Munemori, and M. Sudo, "A Proposal and an Application of an Evaluation Method for Sentences of B Type KJ Method Based on Contents and Structures," IPSJ Journal, Vol. 39, No. 7, pp. 2029–2042 (1998) (in Japanese).
[20] T. L. Saaty, "The Analytic Hierarchy Process," McGraw-Hill (1980).

(Received October 19, 2012)
(Revised December 4, 2012)

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