HUMAN-INTERACTIVE ANNEALING PROCESS WITH PICTOGRAM FOR EXTRACTING NEW SCENARIOS FOR PATENT TECHNOLOGY

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ABSTRACT

The latent structure behind an observation often plays an important role in the dynamics of visible events. Such latent structure is composed of invisible events named dark events. Human-interactive annealing is developed to visualize and understand dark events. This paper presents an application of human-interactive annealing for extracting new scenarios for patent technology using the latent technology structure behind current patented technology.

Keywords: Chance discovery, Human-computer interaction, Annealing, Pictogram, Scenario

1 INTRODUCTION

Patents have taken an important role in business enterprises because they provide exclusive status for 20 years in their industries and can be licensed, sold, and transferred as property. Therefore, a patent is considered as the most valuable intellectual property in a business's tangible assets and should be created strategically. In addition, the patent design is considered when designing new services or final products which satisfy customers` demands.

A *chance discovery* (Ohsawa & McBurney, 2003) is defined as detecting, understanding, and using events that are significant for a decision by human-being. The process of chance discovery and scenario design is in a mutually-evolving relationship between human process and computational process (Ohsawa & McBurney, 2003; Ohsawa, 2003). In chance discovery, tools for visualizing the relation among events/items based on data such as *KeyGraph* (Ohsawa & McBurney, 2003) have been introduced. By looking at the diagram as an event map, a user is supposed to understand the meaningful sequence of events by connecting closely located items, and furthermore to discover new findings and/or create new scenarios.

In a chance discovery, it is newly recognized that a latent structure behind an observation often plays an important role in the dynamics of visible events. Such latent structures are composed of invisible events, named *dark events*, and can be visualized by a break through method *Data Crystallization* (Ohsawa, 2005) in which dummy nodes may potentially correspond to these structures. In addition, a new method called *human-interactive annealing* (Maeno & Ohsawa, 2006a) has been developed to reveal the latent structure along with a simplified stable crystallization algorithm. In real business applications, emerging new scenarios for patent technology are designed with human-interactive annealing in cross disciplinary communication.

In this paper, we address how to understand the data crystallization method with human-interactive annealing process. We propose a new method of *Pictogram*, which is composed of picture, chart, and text data, for aiding human understanding of a visible structure through data crystallization and for aiding human identification of the latent structure in order to discover new scenarios for patent technology.

2 HUMAN-INTERACTIVE ANNEALING AND DATA CRYSTALLIZATIONS

The human-interactive annealing process is designed to combine human interpretation and the data crystallization algorithm (Ohsawa, 2005; Maeno & Ohsawa, 2006a; Maeno a&Ohsawa, 2006b). The two elements are illustrated in Figure 1 with five event graph examples (Maeno & Ohsawa, 2006b). The dark events are turned to be visualized by the data crystallization algorithm. The horizontal axis is the number of iterations. The vertical axis corresponds to temperature. The more understanding of the degree of context in the event map, the more complex hidden structures will be revealed by increasing the temperature. This will lead to the discovery of unique and unexpected scenarios. The iteration in the human-interactive annealing process is continued until the human converges into complete posterior understanding.

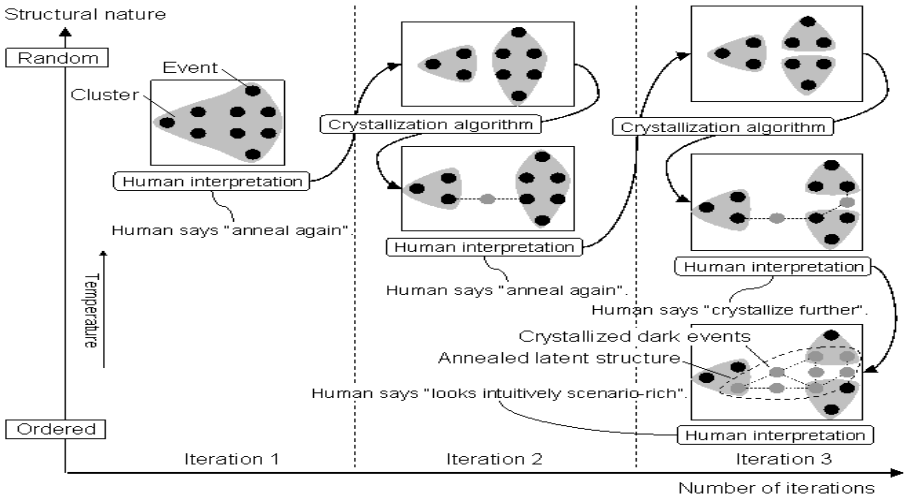

Figure 1. Human-interactive annealing**;** interpretation and crystallization

In crystallization, a generic data crystallization algorithm under specified number of clusters runs with the five steps listed below (Maeno & Ohsawa, 2006b).

- Step 1: Event Identification
- Step 2: Clustering
- Step 3: Dummy Event Insertion
- Step 4: Co-occurrence Calculation
- Step 5: Topology Analysis

The number of crystallized dark events between clusters of visible events increases on an event graph. The clusters are connected to each other with dark events.

3 APPLICATION OF HUMAN-INTERACTIVE ANNEALING TO PATENT TECHNOLOGY

3.1 Preliminary study and tasks

We executed a preliminary test with six Japanese patents for marking systems for defects detected by couple charged device (CCD) surface inspection systems. All claim portions of these patents are used for text data and processed by data crystallization with human-interactive annealing. After finishing iteration in human-interactive annealing process, an event map was shown on *Polaris* (Okazaki & Ohsawa, 2003) (Figure 2). We executed the preliminary test in two hours with four examinees: one sales manager, two sales engineers, and one

engineer. The result was that only one engineer could understand the context of all clusters and create scenarios. Neither new words corresponding to the dark events nor new scenarios emerged and were created.

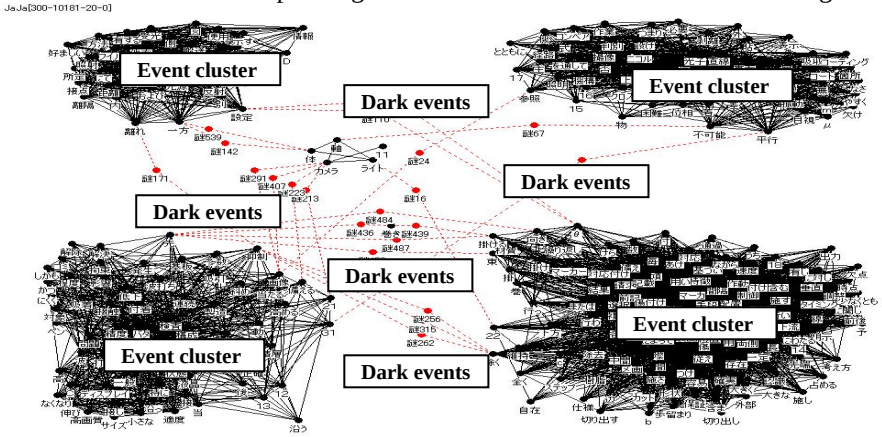

Figure 2. Event map after human-interactive annealing

We interviewed all examinees after the preliminary test and listed their problems below.

1. Very difficult to find the relationship among so many words in each cluster.
2. Too many black links behind words decreased the contrast, and words were hard to read.
3. Words in each cluster overlapped and were hard to read.
4. Too many dark events to predict and very difficult to imagine suitable words corresponding to dark events connecting other words in clusters because they are not only nouns or verbs but also adverbs or adjectives.
5. The patent is composed of multiple content such as purpose, implementation, problems, previous technology, detailed explanation of drawings, etc. and hard to interpret the relationship or meaning among words in multiple content.

3.2 New proposals for human-interactive annealing process

The countermeasures to those problems are listed below and are considered heuristically and proposed for the real test.

1. Choose only two purposes and implementation from patent claims for text data so as to focus on limited topics.
2. Add each patent number to the end of the corresponding claim as tags.
3. Prepare Pictograms (Figure 2) of each patent number, which contain charts, drawings, and all claims and another Pictogram of each dark event number, which contain the same but only related claims. Paste each of them to the corresponding nodes on an event map by Polaris.
4. Change the presentation timing of Pictogram to examinees, i.e., first show the Pictogram of patent numbers for reinterpretation after interpreting each cluster and then creating scenarios and then show another Pictogram of dark events when new scenarios are about to considered (Eris, 2004).
5. Reduce the number of links from 10,181 to 3,000 and coefficient of springs between words and fix key words on an event map, though the number of words (300) is the same as before.
6. Reduce the number of dark events from 20 to15, which keep 85-90 % of their precision (Maeno & Ohsawa, 2006b).
7. Instruct examinees to give a large number of dark events between clusters their priority attention to create new scenarios and also create images or concepts between these clusters towards a better creation of new scenarios.

3.3 Application of human-interactive annealing with pictogram

We adopted the new procedures for the application of a human-interactive annealing process to 106 patents of marking systems and executed the real test by the five steps listed below in two hours with five examinees: one sales manager, two sales engineers, and two engineers.

Step 1: Show examinees the event map by Polaris after human-interactive annealing and data crystallization (Figure 3).

Step 2: Instruct examinees to interpret the event of each cluster and write the titles on a white board through group discussion.

Step 3: Instruct examinees to create scenarios with words in each cluster and write them on a white board through group discussion (Figure 3).

Step4: Show examinees a Pictogram pasted to the corresponding patent numbers and have them reinterpret the cluster referring to them (Figure 4), when the group discussion starts slowing.

Step5: Show examinees other Pictograms pasted to the corresponding dark event numbers and instruct them to create new scenarios by giving a large number of dark events between clusters their priority attention (Figure 4).

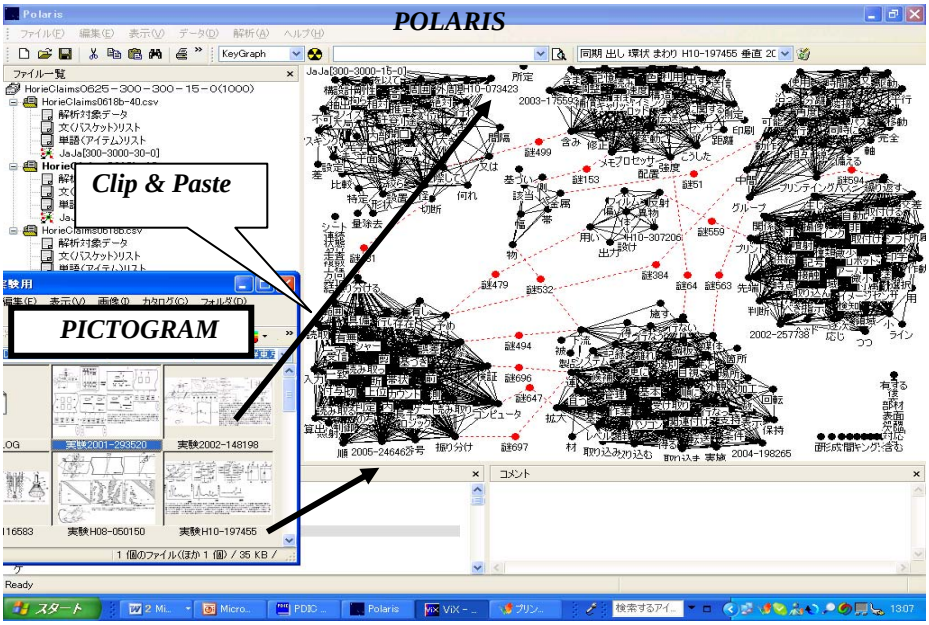

Figure 3. Pasting Pictogram on event map after human-interactive annealing

Each cluster on the event map (Figure 3) was easily interpreted and titled by the generic names (Figure 4). Each scenario was reinterpreted with Pictogram on patent number in each cluster (Figure 4), and some of them were corrected. Six new scenarios emerged from Pictograms of dark events on the event map. Two of them, listed below, were selected by all examinees in novel and marketing feasible view points.

1. "*Adhere thermal cured resin around defects on the surface of film and change the color of it with laser or thermal element for marking resin.*"
2." *Make multiple marking ink jet heads against travel direction of works to improve slippage loss of defects inspection.*"

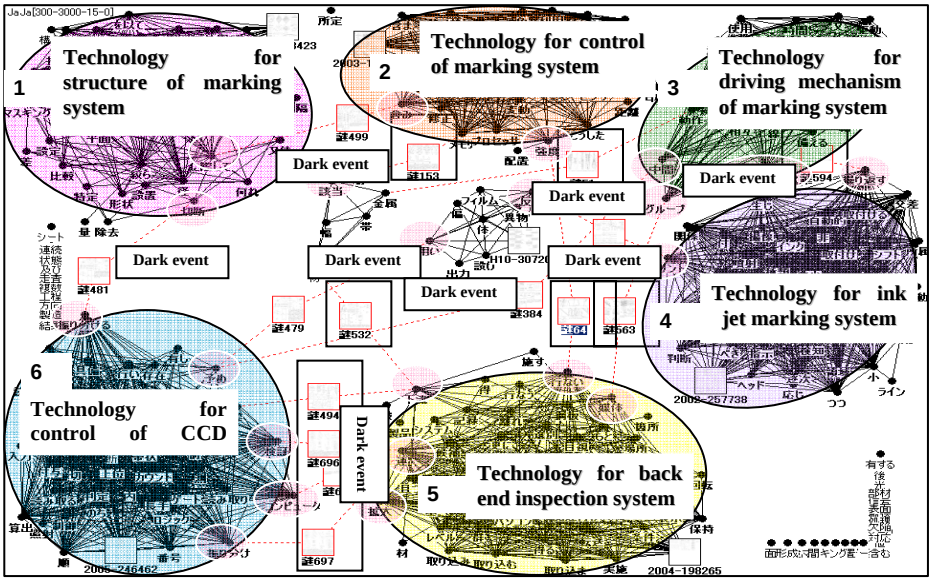

Figure 4. Event map with Pictogram after human-interactive annealing

4 CONCLUSION

We applied the data crystallization technique with human-interactive annealing to the process of product design in a real company. The results show the effect on real industrial decision making. In this paper, the data crystallization with human-interactive annealing process performed well in creating new scenarios for new products from patent technology and aiding in making a significant decision to develop them in real business. The issues below, however, should be solved in order to increase the efficiency of creating scenarios.

- Improve the visualization of words on each cluster to show their relationships more easily.
- Prepare multilateral data of nodes on clusters, which are connected to hidden events to narrow the degree of ambiguity of the hidden events.
- By modifying and improving these tasks of data crystallization with human-interactive annealing process, other applications for real businesses can be expanded to patent analysis, analysis of consumer behaviors in marketing, and the analysis of disciplinary boundaries in science.

5 REFERENCES

Carroll, J.M. (2000) *Making Use: Scenario-Based Design of Human-Computer Interactions*, MIT Press

Eris, O. (2004*) Effective Inquiry for Innovative Engineering Design*, Kluwer Academic Publisher.

Maeno, Y. & Ohsawa, Y. (2006a) Understanding of dark events for harnessing risks. In *Chance Discoveries in Real World Decision Making*, Springer-Verlag, to be published.

Maeno, Y. & Ohsawa, Y. (2006b) Human-computer interactive annealing for crystallization of invisible dark events. *IEEE transactions on industrial electronics*, to appear.

Ohsawa, Y. &. McBurney, P. (Eds.) (2003) *Chance Discovery (Advanced Information Processing*), Springer-Verlag

Ohsawa, Y. (2003) KeyGraph: Visualized Structure Among Event Clusters. In Y. Ohsawa, Y. & McBurney, P. (Eds.) *Chance Discovery*, Springer Verlag.

Ohsawa, Y. (2005) Data crystallization: chance discovery extended for dealing with unobservable events. *New Mathematics and Natural Science 1*, pp. 373-392.

Okazaki, N. & Ohsawa, Y. (2003) Polaris: An Integrated Data Miner for Chance Discovery, In *Proc. of The 3rd Int'l Workshop on Chance Discovery and Its Management,* Crete, Greece