**KITAMOTO — Senga**

<5 figures>

**Senga: Participatory Curation and the Mathematical Model of Exhibition**

Kitamoto, A.

Senga is a Web-based participatory curation system designed for the general public. The Senga interface consists of four steps—search, collect, order, and share—to make an image sequence called a tour. We claim that these steps mimic the basic process of curation, so a tour can be considered as an exhibition. Senga is a type of crowdsourcing system similar to crowd annotation, but the uniqueness of Senga is in context-dependence, meaning that an interpretation of an image depends on the neighborhood of an image sequence. Through the analysis of more than 2,500 tours created on Senga since its release in 2007, we showed that it has potential to be used by curators to draw new ideas for the exhibition. We conclude the paper by proposing the mathematical model of exhibitions with a preliminary result on analyzing state transition diagrams and on synthesizing tours.

**What Is Senga?**

‘Senga’ (Japanese for ‘thousand images’)1 is a web-based participatory curation system that allows users to make a ‘tour’ of images and publish it on the Web as an exhibition. Senga is based on the idea of fragmentation and recombination of digitized books. We have digitized more than 200 academically relevant books about the Silk Road (Digital Archive of Toyo Bunko Rare Book2), but the academic atmosphere around those books was a barrier to the general public accessing the wealth of cultural heritage information inside the book. Our original motivation was to crop attractive parts of the book to make a collection of image fragments so that users could later collect and recombine them into a new collection for their purposes. Providing image fragments, however, is a common idea exemplified in the British Library’s million photographs at Flickr commons or the Mechanical Curator (Baker, 2013). Our contribution is in designing an interface to make a ‘tour’ of image collection.

Figure 1 shows four steps to make a tour on Senga—namely, search, collect, order, and share. A user first sets a theme, searches images by various criteria, collects appropriate images, orders them in a meaningful way, and shares them as a tour. We claim that these steps mimic an exhibition’s curation process, and a tour is a basic form of an exhibition. Hence we call Senga a participatory curation system for sharing exhibitions online.



Figure 1. Overview of Senga and four steps (search, collect, order, and share) to make a tour.

*Context-Dependent Annotation*

Senga can be regarded as a crowdsourcing system similar to crowd annotation. In crowd annotation, a user is asked annotate images with tags (Oomen et al., 2014) and named entities,3 and we call it context-independent annotation because metadata description is not affected by how we view the image. On the contrary, Senga deals with context-dependent annotation such as ambiguous or creative interpretations. For instance, a red rectangle is red if it is contrasted with other colors, but is a rectangle if contrasted with other shapes. An ambiguous situation also offers a chance for the exploitation of creative interpretations and contextualization. Senga asks a user to think about the meaning of an image in contrast with other images, which raises users’ interest to look into images.

*Motivation to Participate*

Senga does not offer a clear goal, however, and users of Senga are expected to find their own goals. After the release of Senga in August 2007 (Kamida and Kitamoto, 2007), we held several outreach events for the general public to use Senga and observed how they understand the concept of the system. The biggest challenge seems to be setting a goal from a pool of images on the interface, or in other words, setting the theme of a tour. Some people quickly decided on a theme and looked intrinsically motivated for improving the quality of the tour. An interesting observation is that the capability of goal-setting does not depend on age; even small kids can quickly find their themes, while some adults got lost and could not concentrate on making the tour. Since October 2011, Senga was permanently installed at Toyo Bunko Museum in Tokyo so that museum visitors can freely use it. To increase the value in the museum, we added the mechanism of extrinsic motivation, namely a free souvenir. A tour made in the exhibition room can be picked up at the museum shop after communicating with the staff to print their tours on postcards. Here a postcard serves as a tool to make a path to the museum shop and keep memories of the museum until the next visit.

**Analysis of User-Generated Tours**

*Basic Statistics*

As of 14 October 2014, Senga produced 2,579 tours. The system provides 3,772 image fragments, and 3,335 images (88%) appear at least in one tour. To analyze the collection of tours from the viewpoint of an exhibition, we first define an ‘exhibition’ as ‘an activity for the general public to arrange artifacts or events with an intention’ (Kawaguchi, 2009 [author’s translation]). This definition suggests that the most important factor of exhibition is ‘intention’, so we focus on two factors—arrangement and title—that are related to the intention of a tour. We check the arrangement and the title for intention and judge if both are consistent. Finally we mark a tour ‘creative’ as long as the arrangement and the title suggest interesting or unique ideas. Evaluation of 2,579 tours was performed by one woman who is not a domain specialist. Such subjective evaluation should be performed by multiple people, but evaluation by a single person is at least consistent and can be used as a good starting point for a preliminary evaluation. As a result, 34% of the tours were judged intentional and consistent, and 6% of the tours (most of them intentional and consistent) were judged creative. In contrast, 41% of the tours were judged intentional but not consistent.

*Top-Down and Bottom-Up Approaches*

The first research question is why we have more inconsistent tours than consistent ones. Our hypothesis is that this difference originates in two different approaches to making tours: top-down and bottom-up approaches. In a top-down approach, the theme of a tour is defined in the beginning, so the title could be easily given. On the other hand, in a bottom-up approach, a user starts from collecting images and later tries to give a title that best describes the collection. This is not an easy task for image collections without explicit themes, so a typical solution is to give a title not related to the content, such as the date of the visit. The result suggests a hypothesis that the bottom-up approach is slightly more popular than the top-down approach, which is probably opposite the habit of professional curators.

*Variety of Contexts*

The second research question is to measure the variety of contexts at an image level. Figure 2 shows the analysis of image sequences in tours to count images that come just before or just after the target image. Here the leftmost image is the target image, and other images to the right are ordered according to the number of appearances in the neighborhood. In (a), the target image was used in the context of a colorful pattern, but in (b), the target image was used in the context of either animal, pairing, or circular. Multiple interpretations emerged through the comparison of multiple images, but this level of variety is limited to a local context.



Figure 2. Variety of contexts for a single image.

*Creativity of Users*

The third research question is to characterize users’ creativity at a tour level. Figure 3 shows an example of creative tours. The first tour has the title ‘couple’, suggesting that the intention is to arrange face images in alternating directions. This interpretation, left or right, is the most important meaning in this tour, but it may have no value in single-image annotation. The second tour has the title ‘fashion show’, suggesting that the intention is to arrange well-dressed people. These creative user-generated tours offer new interpretations for a global context and show potential for the professional curator to draw new ideas for their exhibitions.



Figure 3. Creative tours: (a) couple, (b) fashion show.

**Mathematical Model of Exhibition**

The final challenge is to represent the collection of tours using a mathematical model to enable deeper analysis. If we assume that an exhibition has meaningful context over a local image sequence in the neighborhood, the exhibition can be mathematically represented as a Markov chain. Here an image is a node, and transition from one image to another is a directed edge between nodes. The union of nodes and edges from all tours constructs a graph structure of all tours. This graph represents collective contexts that Senga has produced, and the analysis of this graph structure leads to the collective analysis and synthesis of tours. Figure 3 shows the state transition diagram of a Markov chain for (a) intentional and consistent tours and (b) others, visualized by Gephi 0.8.2beta (Bastian et al., 2009). Specific shapes depend on the layout algorithm, but it looks as if (a) has more structure than (b), and this impression could be validated by quantitative analysis of the graph.



——————————

Figure 4. State transition diagrams from (a) creative and consistent tours, (b) other tours.

The graph can also be used for synthesis. An example is a random walk on the graph that generates a synthetic tour. Frequency of state transitions is first converted into probability, and a self-avoiding random walk4 generates an image sequence as a tour. Figure 5 shows an automatically generated tour. It starts from a pattern image and gradually shifts toward Buddha and finally people, and it gives locally consistent state transitions.



Figure 5. Automatically generated tour using self-avoiding random walk.

**Conclusion**

The paper introduced a participatory curation system, Senga, and proposed a mathematical model of exhibition for analysis and synthesis. Future research challenges include detailed analysis of the mathematical model to characterize creativity.

**Notes**

1. Senga Silk Road, http://dsr.nii.ac.jp/senga/.

2. Digital Archive of Toyo Bunko Rare Books, http://dsr.nii.ac.jp/toyobunko/.

3. Your Paintings Tagger, http://tagger.thepcf.org.uk/.

4. Eric W. Weisstein, ‘Self-Avoiding Walk,’ from MathWorld—A Wolfram Web Resource, http://mathworld.wolfram.com/Self-AvoidingWalk.html.

**References**

**Baker, J.** (2013). The Mechanical Curator. Digital Scholarship, http://britishlibrary.typepad.co.uk/digital-scholarship/2013/09/the-mechanical-curator.html.

**Bastian, M., Heymann, S. and Jacomy, M.** (2009). Gephi: An Open-Source Software for Exploring and Manipulating Networks. *International AAAI Conference on Weblogs and Social Media.*

**Kamida, R. and Kitamoto, A.** (2007). Senga: A Participatory Archive Based on the Collection and Rearrangement of Images and the Sharing of Slideshows. *IPSJ SIG Computers and the Humanities Symposium 2007*, pp. 339–46 (in Japanese).

**Kawaguchi, Y.** (ed.). (2009). *Politics of Exhibition*. Suiseisha (in Japanese).

**Oomen, J., Gligorov, R. and Hildebrand, M.** (2014). Waisda? Making Videos Findable through Crowdsourced Annotations. In Ridge, M. (ed.), *Crowdsourcing Our Cultural Heritage*. Ashgate.