# CaraClock: An Interactive Photo Viewer Designed for Family Memories

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### Abstract

*CaraClock* is an interactive photo viewing device which allows for the sharing of "Collective Memory" among family members. The server-based algorithm uses a Bayesian Network that employs probabilistic computation to model each user's interpersonal relationships. When multiple *CaraClock* devices are synchronized, they display related photos according the settings. This often results in serendipitous discoveries for the whole family by reminding them of their collective experiences through images of their past.

# Keywords

photography, memory, family, annotation, tagging, Bayesian Networks, interaction design, participation design

# **ACM Classification Keywords**

H5.2. User Interfaces: Interaction styles; H.5.3 Group and Organization Interfaces: Synchronous interaction.

# Introduction

*CaraClock* is an interactive photo viewer for family members. Each Internet connected *CaraClock* is mounted with an LCD display and knobs for changing settings. There are typically two modes for *CaraClocks*; synchronous and asynchronous. In the synchronous mode, multiple *CaraClocks* can interact with each other. [See Figure 1, 2] For example, when each family



Figure 1: Current Prototypes of *CaraClock* on the synchronous mode



Figure 2: Using *CaraClock* at the synchronous mode among Family members

member brings their *CaraClocks* together, they can enjoy viewing photographs of each other sorted by age or year. With a twist of a setting knob, a family of three can view a picture of the mother, father, and child at the same age of 23 on each of their screens respectively. In asynchronous, or "single mode", the device serves as a digital picture frame which stores each individual's digital memories.

*CaraClock* attempts to create what Paul Recouer [5] terms "Collective Memory" through synchronizing photos belonging to individuals and communities. Recouer discusses the need for crossover between "Personal Memory" and "Collective Memory" among groups in society, especially among those with close relationships. For family members this results in richer communication of family history by enabling individuals to see the similarities and differences between generations. The process of the photo selection algorithm of the *CaraClock* itself becomes a metaphor for Collective Memory by taking into account the various relationships between each person.

The photo selection algorithm is based on the Bayesian Networks [4] that employs probabilistic computation to model each user's interpersonal relationships such as family, friends, and other acquaintances by analyzing photo tags including names of subjects appearing in images, photographers, user added favorites, etc. This enables the *CaraClock* to provide photos that evoke past memories based on each person's relationship to others as well as photos that they have tagged as favorites regardless of the photographer or the content of the photo.

As an Internet-connected interactive device in the synchronous mode, the *CaraClock* makes for some serendipitous discoveries. One person may be learning about their ancestors for the first time, while another may find a completely unexpected similarity between themselves and their grandparent. Still another may experience, with a deceased loved one's *CaraClock*, what they would have seen had they still been alive since the algorithm continues to work even after the owner has passed on. This gives family members invaluable insight into a loved one's "Personal Memory" which then shapes and influences the mapping of the "Collective Memory" of the family.

# **Related Studies**

#### Changing of Using Photograph

*CaraClock* provides a new way to use photo with using online photo-sharing technologies. Miller [3] reported the difference between traditional communication using analog photo and digital photo sharing on Flickr. Miller noted users of Flickr communicate with strangers around the world. But they do not have private communication such as one using family's analog photo album. *CaraClock* realizes intimate communication among familiar relationships as if using analog family album with utilizing online photo sharing technologies.

#### Digital Photo with Interaction Design

As an interactive system using photos, *CaraClock* supports interaction among multiple users and provides topics to remember some memories. In the paper "Storytelling with Digital Photographs", a device storing photos annotated with narratives (sounds) about each photo, is introduced. [2] This device provides an experience that users can leave their memories on each photo and will be able to talk about the memory to



Figure 3: Functions of CaraClock

others after many years. *CaraClock* makes an experience of remembering past memories by merely browsing photos with interactive devices.

# Design

#### Motivation

*CaraClock* derives its name from the carapace, or shell, of a turtle combined with "clock". We chose an animal shape because we wanted the owner to feel a connection like one would have with a living thing. A turtle is also often associated with longevity, which refers to the *CaraClock*'s ability to store its owner's memories throughout their life. In addition, the shape of the device lends itself to the layout of the functions.

*CaraClock* is shaped like a turtle [See Figure 3] to allow users to synchronize their devices. While each *CaraClock* can function as standalone personal browser for each owner's photo collection, its shape is designed for the synchronous mode where users can browse photo collections together. Users synchronize their *CaraClocks* by placing the head of their "turtle" to the legs of another as shown in Figure 1. Although the figure shows the synchronization of 3 devices, the system allows for the synchronizing of many more.

The clockface of the device has LED backlit numbers with an LCD display that which shows the photo with the date, time, and year. The head and legs of the "turtle" are knobs to control the settings. The WHEN knob is used to select the date of the photos to be viewed. The TIME knob is used to select the duration of the slideshow.

*CaraClock* has two photo browsing modes. The first mode is the default mode where users can view photo

one at a time by turning the OPERATION knob. The second mode is the slideshow mode where each photo is displayed at a rate of one per second and continues for the duration the selected on the TIME knob. The slideshow begins when the user presses the START BUTTON.

In both modes, *CaraClock* provides the ability for users to change the "speed" and "granularity" at which past memories are presented to them by adjusting the WHEN and TIME knobs. For example, a user can see their lifetime memories by viewing a slideshow lasting 10 seconds, 1 minute, or 3 minutes as if changing the speed at which they look back across time. At the same time, if the user sees photos taken in 2000, they can explore the time period at various time scales, e.g., exploring January 2000 or January 1, 2000. They can then switch back to 2000 or even turn to Lifetime to see photos captured at larger intervals.

In the synchronous mode, a user can select a SYNC POINT which determines the way *CaraClocks* are synchronized. The "YEAR" mode shows all photos taken in the same year. The "AGE" mode shows photos of each owner taken at the same age. Lastly, the "NORMAL" mode shows the same photo on each device, as in the single mode. *CaraClock* therefore provides ways for users to share and compare their personal memories.

#### Operation

Sitting on a shelf or desk, *CaraClock* performs as a normal clock. To begin viewing photos using *CaraClock*, the owner adjusts the knobs and pushes the RESET BUTTON. [See Figure 3]



Figure 4. Appearance of *IMOZUKE* 

rers Phot	ographer Uriu	
	name	value
•	Photographer	Uriu
	ShownPeople	Mika
	ShownPeople	Uriu
	ShownPeople	Haha
4	ShownPeople	Chika 🔰

Recommend

	name	value
•	RecommendPers	Other
	RecommendPers	Uriu
	RecommendPers	Haha
*		

Using *IMOZUKE*, users can annotate photographs with information such as the photographer's name, what is on the picture and picture rating. In the single mode, *CaraClock* provides photos according to the knob settings on the device. First, they adjust the WHEN and TIME knobs. In order to see a 10-second slideshow of today's photos, they turn the WHEN knob to "DAY" and the TIME knob to "10 Sec" and push RESET. After a few seconds, 10 of the photos taken today will then be selected and displayed. When the WHEN knob is turned to "LIFE", photos are selected from all of the photos of their life. If the TIME knob is turned to " $\infty$ ", all the photos taken during the term selected by WHEN are displayed. At any time, the user can change the setting of WHEN and TIME, reset *CaraClock*, and it will reload photos according to the new parameters.

In the synchronous mode, *CaraClock* displays different photos on each device according to the SYNC POINT settings. To enable this mode, users place the leg of one "turtle" to the head of another. In the case of three *CaraClocks* [See Figure 7]: mine [I], my mother's [M], and my grandfather's [G]. When the heads of [M] and [G] are place next to the legs of [I], [I] becomes the parent of [M] and [G], and thus are controlled by [I]'s settings. Next, the SYNC POINT on [I] is set to "YEAR", "AGE", or "NORMAL". If "YEAR" is selected, different photos taken in or closest to the same year are shown on each device. If "AGE" is selected, users are shown photos of each of the three users at the same or closest to the same age.

# **Technology and Architecture**

#### The Bayesian Networks Engine

*CaraClock* operates on a Bayesian Networks model suggested by Judea Pearl *et al.* in the late 1980s. [4] The Bayesian networks model behind *CaraClock*, called "*Ocarina*", does probabilistic computation by analyzing

each person's interpersonal relationships and tags of each photo. *Ocarina* selects photos related to the individual from a large database of photos by using data produced by two applications, "*Imozuke*" and "*Relationship Manager*" as related in the following section. Before devices can be used for the first time, "*Imozuke*" and "*Relationship Manager*" have to go through their initial set up.

# Tagging Software

The Windows C# based tagging software "*Imozuke*" enables users to add tags about relationships to others for each photo. Some photo sharing services enable users to tag photos so they can be searched for by keywords or tags. [1, 3] *Imozuke* is similar to other tagging systems, however it has two additional contributions. First, it is designed to focus on human relationships by allowing users to label the, subjects in the photo, who recommended the photo, and so on, as well as the people appearing in the photo. [See Figure 4] Secondly, *Imozuke* is designed to provide information which will be used by *Ocarina* to organize photos according to human relationships and preferences using probabilistic analysis.

Software for Mapping Interpersonal Relationships "Relationship Manager" was made through the integration of Adobe Flash and Ruby on Rails and generates a database of information about each user's interpersonal relationships. Using the *Relationship Manager*, each user creates a model of their relationships by operating a web-based GUI interface. [See Figure 5] Users adjust the distance between themselves and other people by dragging and dropping names in their network. *Relationship Manager* then



Figure 5: Relationship Manager

rates probabilities about each user's relationships, and sends these values to *Ocarina*.

Processing of The Bayesian Networks The Bayesian Networks Engine "Ocarina" organizes the photos in descending relevance to the user's past memory based on his/her interpersonal relationships.

*Ocarina* recognizes suitable photo as past memory of user from organizing two main nodes that are "Recommendation" and "Memory". [See Figure 6, top] The *Recommendation node* models which *CaraClock* owner recommended the photo. It shows, for example, if the photographer, the person shown in the photo, or other people recommended the photo. The *Memory node* models some interpersonal relationships about the photo. For example, it shows what kind of person took the photo, and who is shown in the photo.

Additionally, Ocarina computes probability values from analyzing tags on photos added by *Imozuke* and the users' database about interpersonal relationships generated by the Relationship Manager. [See Figure 6, bottom] Ocarina recognizes who added a recommendation and who is shown in the photo by referencing some tags added by *Imozuke*. Photos including many recommendations, especially those recommended by the clock's owner, have a higher rating. Moreover, Ocarina computes the ratings according to the recommendation of people close to the owner of the clock (according to the map drawn in the Relationship Manager). For example, if the photographer is very close to the person shown and if the person who added a recommendation is a close person, the photo has a higher rating.



Figure 6. The Bayesian Networks Model Working on Ocarina.

Integration between Interactive Devices and Bayesian Networks on the Networked System CaraClock devices are operated by the integration of serial communication on each machine's physical switches and sensors, and XML socket communication. Serial communication is operated by connection between Flash and Wiring I/O Board [6] as an electric circuit. The Flash then sends orders about synchronization received by Ocarina to the Wiring. Through the XML socket communication between Flash and Ocarina, Flash requests photos to Ocarina, which returns to List of suitable photos. Then, Flash downloads the photos from the server by referencing the List. [See Figure 7]

# The Synchronous Mode

*CaraClock* enables the synchronous mode to work by linking the physical sensors and the networked communication between multiple devices through the *Ocarina*. Each *CaraClock* device is mounted with sensors for recognizing synchronization among devices. The top of the device is fitted with a magnet sensor, while the bottom knobs (the turtle's legs) are fitted with magnets. If the magnet-triggered sensor in the head is activated, the device will synchronize with the other and will be controlled by the "parent" device. In this mode, *CaraClocks* send photo requests to Ocarina according to criteria of the selected SYNC POINT setting [See Figure 3]. This mode allows users to browse photos for each synched user respectively in absolute time (year) or relative time (when I was 18 years old).



Figure 7. System Architecture.

# Conclusion

In this paper, we described *CaraClock* a device for browsing personal photo collections incorporating a new technological architecture with a unique kind of interaction. *CaraClock* selects photos based on its user's social network in order to conjure up memories for each individual in a group setting in order to create a new "Collective Memory". *CaraClock* uses *Ocarina*, a Bayesian Networks model that uses interpersonal relationships and tags to select interrelated photos. The real magic of *CaraClock* is that it creates serendipitous experiences for communities (e.g. family, friends, coworkers) by recalling memories shared exclusively by their group.

# Acknowledgements

This project is granted by CREST., JST.

We would like to thank Yann Riche and Matthew J. Nisselius for their invaluable feedback and assistance in producing the final version of this document.

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