Weaving Memories into Handcrafted Artifacts with Spyn

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Abstract

Handcrafted objects physically embody elements of the time and skill involved in their creation. Yet a handcraft artifact itself cannot convey the experience of its creation. We present the design, implementation, and interactivity of Spyn, a system for knitters to record, playback and share information involved in the creation of hand-knit products. Without altering the look and feel of the knit and process, Spyn uses computer vision techniques in combination with patterns of invisible infrared ink printed on yarn to correlate locations in knit fabric with events recorded during the knitting process. Knitters’ personal activities during the process of creation are captured as audio, image, video and spatio-temporal data. When knitters photograph yarn knits, Spyn system analyzes the ink patterns on the knit material and visualizes events over the photographs of the knit. In the design of Spyn we investigate the role technology can play in preserving and sharing the handcraft process over space and time.

Keywords

Interaction Design, Tangible User Interfaces, User Experience, User Interface Design

ACM Classification Keywords

H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems.
**Introduction**
Unlike machine-made objects, handcrafted objects often take significant time and skill to create. A handcrafted artifact can physically document the skill and time involved in its production. For example, the subtle unevenness of stitches in a hand-knit textile may be an indication of the rhythm and tension of the knitter at the particular point in time those stitches were created. Handcrafted objects are “charged” with the history, narratives, and memories of people who created them and the people with whom they interact [9, 4]. Yet a handmade object itself cannot tell personal stories of its making. Information associated with handcraft is linked through intangible means, such as tacit knowledge and social or cultural context.

Knitters often gift their finished knit and think of the gift recipient. The knitter can use Spyn to: 1) Knit, 2) Capture 3) View, and 4) Access; recipient of the knit uses Spyn to: 3) View and 4) Access.

**Figure 1.** Use-case of knitting with Spyn: 1) Knitting while Spyn is in the background keeping track of progress 2) Taking photos of environment, 3) Seeing the new layer of information by photographing the knit, 4) Accessing the information by touching the highlighted points on the knit when information was captured.
Spyn is our ongoing effort to augment the meaningful processes inherent in handcraft while maintaining the crafter’s creative goals. Without affecting the appearance or texture of a creation, Spyn records the knitter’s creative process via manual and automatic capture of information while knitting. During the knitting process, Spyn captures audio, image, video, and spatio-temporal data, and, upon photographing the knit, maps each record to locations on the knitter’s yarn. Spyn enables access the captured information by analyzing patterns of infrared ink printed on the knit yarn and visualizing the each record over a photograph of the artifact (see Figure 1). The knitter uses Spyn to control the codification of meaning within the physical textile and preserve both craft technique and personal memories. Preliminary evaluation of our prototype with twelve knitters suggests Spyn supports the crafting process while enabling new forms of creative expression.

**Background**

Seeped in cultural tradition, the process of handcraft is often considered at odds with advancements in modern technology. Yet ubiquitous computing techniques have been used to support existing cultural and religious practices as well as enable new possibilities for preservation and expression [7]. Devices designed to support historical cultural practices have the potential to motivate and extend the preservation of heritage, as well as offer new opportunities for creative exploration [17].

The design of Spyn is our effort to explore these concepts in the domain of knitting. Knitting is a portable craft that takes place over time in different locations, lending itself well to the exploration of capture and access techniques for spatio-temporal data (see Figure 4). A finished handwork project serves as a physical manifestation of a knitter’s effort, skill, and productive use of time [8]. The goal of this project is to connect these two parts of the knit: the *visible* (the artifact and physical attributes of the artifact) and the *invisible* (memory and social context).

**Related Work**

Our work extends previous research on capture and access and wearable computing techniques in several ways: First, in contrast to traditional note-taking in capture and access research [1,2,5,11,15,16], Spyn applies these techniques to a domain of work in which process is critical to its creation and motivation of the work. Moreover, Spyn connects specific areas of the artifact—the handmade knit—with multiple capture technologies. Spyn expands on previous work designed for children [3,12,13] by exploring the potential for new tools to foster creative storytelling and novel forms of expression through the extension of existing crafts. In the area of wearable computing, several projects add sensors and displays to clothing [10]. Our system should be distinguished from these “wearables” because it does not alter the look or feel of the artifact and can be used and worn in its original form.

**Implementation**

Our prototype is comprised of a mobile computing device (Asus Ultra Mobile PC) with touch screen interface and built-in GPS (see (1,3) in Figure 2). The device is connected through USB to a Phidget encoder, a USB mechanical rotary device that encodes the amount of yarn pulled from the basket (4) and an infrared enabled camera (2). The knitting yarn is...
preprinted with 1 cm dots of infrared ink such that the frequency of dots applied to the yarn decreases across the knit. The mobile device controls storage and access to GPS and encoder data, images and video.

Software
The core system and user interface were written in ActionScript 3.0. The system also uses SiRFDemo [14] for logging GPS data and Logitech® QuickCam software [6] for capturing images and video. Our image processing software was written in Java. The goal of the image processing is to map the percentage of infrared (IR) ink on the yarn to the percentage of yarn pulled from the rotary encoder. An IR camera first captures digital images in the IR band. We then use image-processing algorithms to identify the image’s IR components and threshold the image. Next, we perform local analysis of image regions to determine the pixels corresponding to IR reflective segments of the knit. We then output the percentage measures of ink on the yarn and map those percentages to a percentage of yarn pulled from the rotary encoder.

Evaluation
We conducted focused half-day sessions with four knitters, and half-hour sessions with 10 knitters (two of whom also participate in the half-day sessions) to give us insights into how our system can support the documentation of knitting practice as well as open up new possibilities for creative expression. Participants used features from our system to record unique aspects of their experience of creation, weaving personal meaning into their physical knits. By enabling the connection of traditionally separate concepts and customs within a single physical form, Spyn inspired new types of creative practice.

After an initial evaluation of our first prototype with ten participants, we evaluated our system with four knitters, two whom were already introduced to the system in our initial evaluation. The knitting sessions involved: 1) semi-structured interviews regarding personal knitting practices, 2) a first-use trial period in which the participant learned to use our system to capture and access data, and 3) a knitting session in which the participant created a knit article using our system. The participants were female knitters ranging in age from late twenties to late seventies. Each session typically lasted a half-day and took place in three or more locations in which the participant normally knits. For three of the four participants, one location included the participant’s home.

Participants’ engagement with our system demonstrated its use as a tool for preservation, reflection, and creative inspiration. While such uses were witnessed in multiple sessions, we highlight specific anecdotes in order to illustrate each use in more detail.

Preservation
A participant in her late 80s demonstrated her use of Spyn to annotate meaningful and particularly challenging areas of her creation. Sitting in the back den of her house, she revealed her interest in preserving the religious significance of a gift for her granddaughter’s wedding. While knitting, she placed Spyn by her foot, aware that it was keeping track of her knitting progress. She briefly took brakes from her knitting to pick up Spyn and annotate her project orally. Contemplating on her use of narration as annotation, she determined: “written notes would not do it.” After knitting with Spyn in different locations in...
her home, she moved to her bedroom where the light was most suitable for viewing her handcraft. Using Spyn to recall her previous annotations, she spoke of the rareness in which she appraised her handwork as “beautiful.” Spyn began to elicit her attention to detail.

In anticipation of completing a “beautiful” handcrafted project, she annotated her knit again with a spoken description of an area of her knit she was having trouble finishing. She reported that her struggle was important to record in case her craftwork was beautiful enough to be passed on to future generations. Using Spyn, her memories and unique personal meaning could be embedded in her handcraft.

Another knitter described the knit she began creating with Spyn as like “emotional blackmail.” She intended to use her creation to inspire younger, more fortunate members of her family to appreciate physical, skilled labor. Using Spyn to record her process in over the course of an afternoon, she photographed her knit to reveal a timeline of visual images she collected. She described the knit as a reflecting the time and effort she devoted to her creation. Her knit was imbued with the story of her knit as recorded by images of her outdoor knitting environment. Accessible from the knit, the images illustrated the context surrounding her handcraft process. Using Spyn, she could embody journey of her process within her knit artifact.

**Reflection**

After knitting in multiple locations on a university campus, we observed one participant use Spyn to connect images she collected while knitting with her recent transition to graduate school. Sitting in a grassy pasture on her university’s campus, she took breaks from knitting to use Spyn to photograph her physical environment. After returning to the building on the campus in which she began her knitting, she viewed the records of her process with Spyn. By photographing her knit, she used Spyn to recall the images she collected while knitting outdoors. She described her knit as a “scrapbook” of her memories. “I’ve been so busy that I haven’t had time to realize that I’m in this new place.” Her knit became an explicit reminder of her relatively foreign environment, embodying aspects of her recent transition.

**Creative Inspiration**

One participant in her late-twenties associated both knitting and baking with the concept of “comfort.” She took breaks from her knitting to use Spyn to capture images and video of baked goods and her process of baking. While familiarizing herself with the system, she decided to use Spyn to create a gift for her brother in Montréal. She began knitting a scarf with Spyn at a small café in which a cupcake sat beside her knitting basket on the table. She photographed the cupcake with Spyn, remarking that her brother would also appreciate the recipe for this baked good. Familiar with the functionality provided by Spyn, she decided to document recipes within the scarf so that her brother’s gift would be two crafts that to her represented “comfort”. Putting down her knitting, she documented her process of baking sugar cookies through photographing her baking process, ending the session by using Spyn to capture her narration of her recipe for the cookies. Using Spyn, she formed an explicit connection between two traditionally separate gifts: her baked cookies and her knit scarf. Her knit became a new canvas on which she could impart personal meaning to her brother.
Future Work
We plan to expand the design and evaluation of our system in several ways. First, we intend to extend our evaluations to explore the life of the knit product “in the wild.” Due to the duration of our evaluation sessions, our evaluation of Spyn did not reveal how the recipient of the knit appreciates the creation process by learning the creator’s stories. We would like to continue to explore the life of hand-knit products once the knit is in complete. Additionally, we would like to investigate the potential of applying our design techniques to crafts other than knitting, such as embroidery or crochet, as well as explore the design of technologies to support crafts that extend the functionality of our system (such supporting the preservation of experiences during in bookbinding or carpentry).

Conclusion
We have presented the design of Spyn, a system to enable the preservation and sharing of experience through knit artifacts. Spyn supports the collection, preservation and retrieval of explicit and implicit data surrounding knitting processes. Spyn addresses a largely unexplored domain of design: the infusion of technology into the production of handcrafted artifacts. Tension between these two seemingly incongruent domains—handcraft and computing—introduces many questions for the designer. Without unduly reconfiguring existing creative practices, Spyn provides opportunities for twining contextual information with the artifact. In our design of Spyn, we enable new avenues for creative exploration in handcraft.

References