Programming Embroidery with TurtleStitch

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ABSTRACT

TurtleStitch (turtlestitch.org) is a browser-based educational programming language descendent from Snap! and Scratch that supports creative computation to generate patterns for embroidery machines. It is easy to use, requiring no prior knowledge of programming, yet powerful in creating novel embroidery. It is used by designers to experiment with generative aesthetics and precision embroidery. It is also a vehicle for innovative workshops combining an introduction to programming with a haptic output. It has been used as part of semester long undergraduate courses in contextualize computing emphasizing textile crafting. This installation provides participants with an opportunity to develop expertise in using the web-based TurtleStitch software to create an embroidery pattern of their own. An embroidery machine is viewed as a robot that uses a stored algorithm to navigate a sewing needle on fabric to render a design. Attendees will have an opportunity to learn to use the available embroidery machines and become familiar with how simulated perfection translates to real-time machine robotics. Participants can take away a small embroidery 'patch' of their own design. Those interested in collaborative design may contribute to one or more large tapestry quilt projects to be completed during SIGGRAPH. Those with an interest in computation may explore foundational concepts such as the power of parameters, unraveling concurrency to efficiently support multiple colors, and path finding algorithms to produce designs without jump stitches.

CCS CONCEPTS

• Human-centered computing~Interaction design

KEYWORDS

Machine embroidery, creative computation, code crafting.

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1 Overview and Rationale

This installation introduces *TurtleStitch,* (turtlestitch.org), a blocks-based environment that extends *Snap!* (snap.berkeley.edu), that in extends *Scratch* [Resnick et al. 2018] (scratch.mit.edu). *TurtleStitch* was developed as a 'Maker' environment in which textile artists can build their own tools for precision embroidery and learn foundational programming concepts. Figure 1 shows how this simple environment provides easy entry into computational thinking via creative computation [Xu et al. 2018].

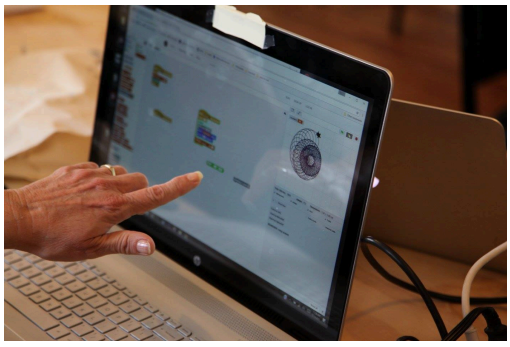

Figure 1: The TurtleStitch Environment

TurtleStitch has been used in a broad range of formal classrooms and informal studio settings in the United States and the European Union. Children as young as age 8 and senior tech-averse adults quickly produce satisfying embroidery as illustrated in Figure 2.

2 Innovation and Foundation Core

TurtleStitch fills both a design tool and pedagogical need. Machine embroidery requires access to expensive software using interfaces modeled on Photoshop. Designers are limited by the functionality of the tool in the best circumstances. In the worst, they have a limited repertoire of templates that can be combined. The open-ended design potential of programming is absent.

The classic 'turtle' from the Logo and Turtle Geometry [Abelson et al. 1981] tradition is the perfect vehicle for thinking about stitching with a needle, providing a rich environment in which to explore both embroidery and computer science topics. The latter include programming fundamentals, unwinding concurrent threads (for thread color change), and minimum path finding (for efficient sewing). The haptic nature of the experience provides

insight into the complexity of real-world, rather than simulated robotics at a rate at least an order of magnitude faster than 3D printers. The pattern shown in Figure 3, designed by a novice in less than 2 hours, took less than 10 minutes to render including thread changes on a single thread machine.

Figure 2: A Result after One Hour

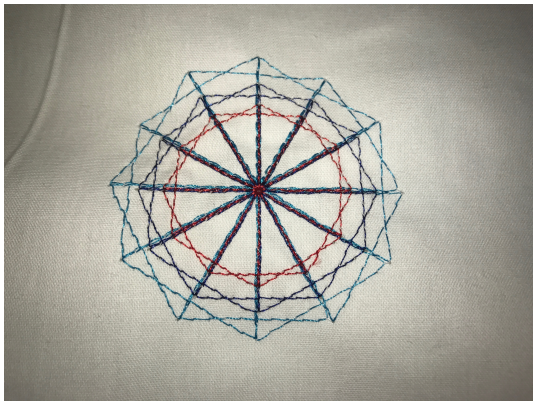

Figure 3: A Novice Design Quickly Rendered

3 Participation and Collaboration

We have presented our open studio at numerous venues ranging from after-school classes, to artist studios, to SIGCSE workshops [Wolz et al. 2018]. The SIGGRAPH attendees provide a level of digital design and computing expertise that we have not previously encountered. Via web-based reference cards and videos, attendees can quickly master the basics of TurtleStitch without formal instruction, using the TurtleStitch web-based interactive environment. They can choose to join our online community and share their work, or simply browse the existing submitted projects. Within the SIGGRAPH Studio, we anticipate the enthusiastic collaboration as evidenced in Figure 4.

Attendees can choose the degree to which they will interact with an actual embroidery machine: they can learn to thread and control it, they can have someone do it for them and take home a 4X6 inch pattern on material provided in the color(s) of their choice. They can work on their design away from the SIGGRAPH Studio and return to have it rendered on site. They can arrange to have it rendered by us, or other services after SIGGRAPH. The software and educational resources are available on-line for free. Rendering to textile is fee-based after SIGGRAPH.

To stimulate collaboration and demonstrate the potential to teach large project collaboration, we will offer attendees the opportunity to contribute to at least two large embroidered quilt (tapestry-quilt) projects. At least two themes will be established within which individual contributions will be placed. At the Studio the individual rendered contributions will be hung on a display board in their approximate position on the full piece. Full rendering of the resulting textiles will occur after the conference on a commercial grade embroidery machine. Attendees are also welcome to design and collaborate on their own tapestry-quilt. Attendees receive raffle tickets commensurate with their contribution to win one of the completed tapestries.

Figure 4: A Novice Design Quickly Rendered

4 Summary

TurtleStitch embroidery has proven to be a joyful gateway into computer-based design, haptic computing, and creative computing. We hope to share our enthusiasm for TurtleStitch with the SIGGRAPH community.

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