Tangible E-Textile Interface for Digital Patternmaking with Soft Goods

Olaitan Adeleke, Heidi Woelfle, Lucy Dunne
adisa007@umn.edu, woel0055@umn.edu, ldunne@umn.edu
Wearable Technology Lab, University of Minnesota

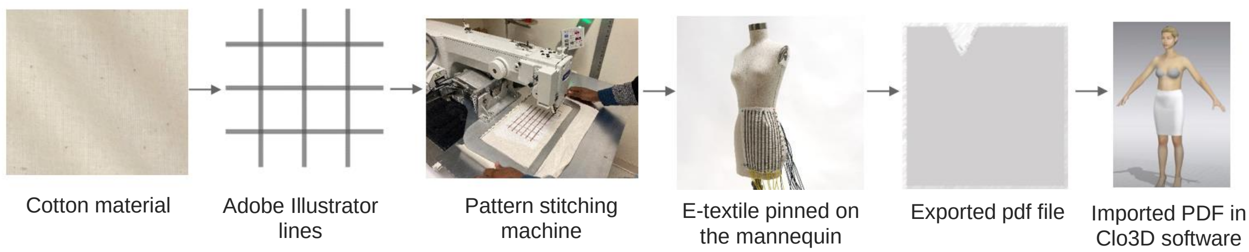

Figure 1: E-textile Interface Workflow

INTRODUCTION

Apparel designers often prefer the tangible process of creating garment patterns by draping fabric on a mannequin rather than the more abstract process of drafting patterns in 2D using CAD software. The current workaround is to drape a pattern, then digitize it on a digitizing table to transfer the shape to the CAD environment. This project explores augmenting the fabric used to drape patterns with e-textile components, such that pinning the fabric to the form directly digitizes the shape made by the designer. The e-textile interface uses a keypad matrix approach with rows and columns on opposite sides of the fabric. Passing a metallic pin through a row/column intersection creates a circuit connection that a microcontroller reads and maps to a 2D spatial layout on the screen. The proof-of-concept device developed here is a first step toward an automatic digitizing system that allows designers to preserve manual skills and processes better while integrating with digital systems.

BACKGROUND

Pattern digitizers are a tool used in the fashion industry to allow analog patterns shapes to be stored, reused, and manipulated in CAD software. Current digitizing methods (such as mouse-based table and roll digitizers (N-hega, 2023), scanners, and camera-based methods (AutoMetrix, 2023)) are labor-intensive and time-consuming. Camera-based methods can be less difficult than a manual mouse-based input processes, where pattern images are digitized by extracting contours and information, like notches, darts, etc., from the captured image. However, camera-based methods have high purchase costs and require an optimized environment and lighting setup for pattern capture.

Work in the human-computer interaction field has also approached the problem of creating virtual shapes using physical objects. Leal et al.'s Fabric3D system used optical motion capture markers affixed to fabric structures to capture shapes made by designers (Leal et al., 2011). However, this approach relies on an expensive optical motion capture system. Our approach incorporates e-textile

ITAA Proceedings, #80 – https://itaaonline.org

components into the fabric used for draping and leverages the 2D structure of the fabric itself to plot pattern coordinates. Electrical connections made by pins during draping are used to record pattern coordinates connected to form pattern outlines. Input is performed on the draped mannequin and exported as a .pdf file which can be imported into any CAD software environment like CLO3D or Adobe Illustrator for further usage.

METHODOLOGY

A proof-of-concept device (Figure 1) was fabricated by forming a "keypad matrix" circuit with silver-coated Nylon conductive thread traces (Shieldex) stitched on two sides of a woven fabric. The matrix's rows and columns were connected to an Arduino microcontroller. Passing a metal pin through the fabric at a row/column intersection completes a circuit, and the input is read by the microcontroller. The keypad matrix approach allows the microcontroller to know which row and column are active and, therefore, the x/y position of the pin. The input is then logged as a point on the digitized piece's contour. Contour points are input sequentially in a clockwise or counterclockwise fashion, and a closed shape is built from those input points on the screen. The shape can be saved to a standard .pdf format when the input is complete and imported into common CAD software packages.

A key challenge in forming the rows and columns of the matrix was balancing the thread machine tension to avoid short circuits between the two sides of the fabric. The system relies on rows and columns being isolated by the fabric substrate, and we use an unbalanced lockstitch to keep the conductive thread on one side only. For thicker fabric and smaller matrices, a 4mm stitch was successful. For larger matrices and thinner fabric, it was necessary to use two pieces of fabric joined with a fusible adhesive. To improve ease of locating row/column intersections, we increased the width of the traces by stitching each row and column six times. Because of the masking effect that keypad matrices experience with simultaneous inputs, we adopted a serial-input paradigm where only one pin connection is made at a time. The diode-based approach commonly used to circumvent masking is not feasible in our textile layup, as diodes must be connected between the rows and columns during input.

DISCUSSION

This proof-of-concept device demonstrates that digitizing patterns during draping and using draped textile and pins directly is possible. As an initial prototype, there are many areas of necessary improvement. The textile used here is stiffer than traditional muslin fabric due to the multi-layer laminate and thick traces. More research is needed to circumvent the short-circuit problem, which appears to be due to fiber migration through the textile substrate. A more tightly twisted yarn with longer filaments may facilitate trace isolation on one layer. However, the usability problem of locating intersections with a pin increase as traces become less perceptible. A printed or other surface approach to applying traces may allow wider traces without additional stiffness. The current prototype has only 12 rows and 12 columns, which significantly limits its resolution (as shown in the relatively crude pattern shape shown in Figure 1). This resolution can be increased significantly: hardware limitations govern the maximum number of rows and columns. While microcontrollers can support very large numbers of inputs and outputs with more advanced multiplexing, the number of connections to the microcontroller can get unwieldy. Further, the current processing software only registers one type of point, and cannot distinguish curves, darts, or notches. These attributes can be modified after import in the CAD system, but the ability to directly record different point types during draping would improve usability. Finally, many draping techniques rely on cutting into the draped fabric to form a flared shape. Depending on the cutting direction, this may destroy or disable portions of the input system. Further development is needed to understand how clipping could be accommodated with this approach and how this approach might translate to stretch/knit fabrics.

REFERENCES

AutoMetrix. (2023). Pattern Digitizing Scanner Software & System | Garment Pattern Digitizer. https://www.autometrix.com/solutions/photo-digitizing/

Leal, A., Schaefer, L., Bowman, D., Quek, F., & Stiles, C. (2011). 3D sketching using interactive fabric for tangible and bimanual input. Proceedings - Graphics Interface, 49–56.

N-hega. (2023). Pattern Digitizing. https://www.n-hega.com/digitizing-table