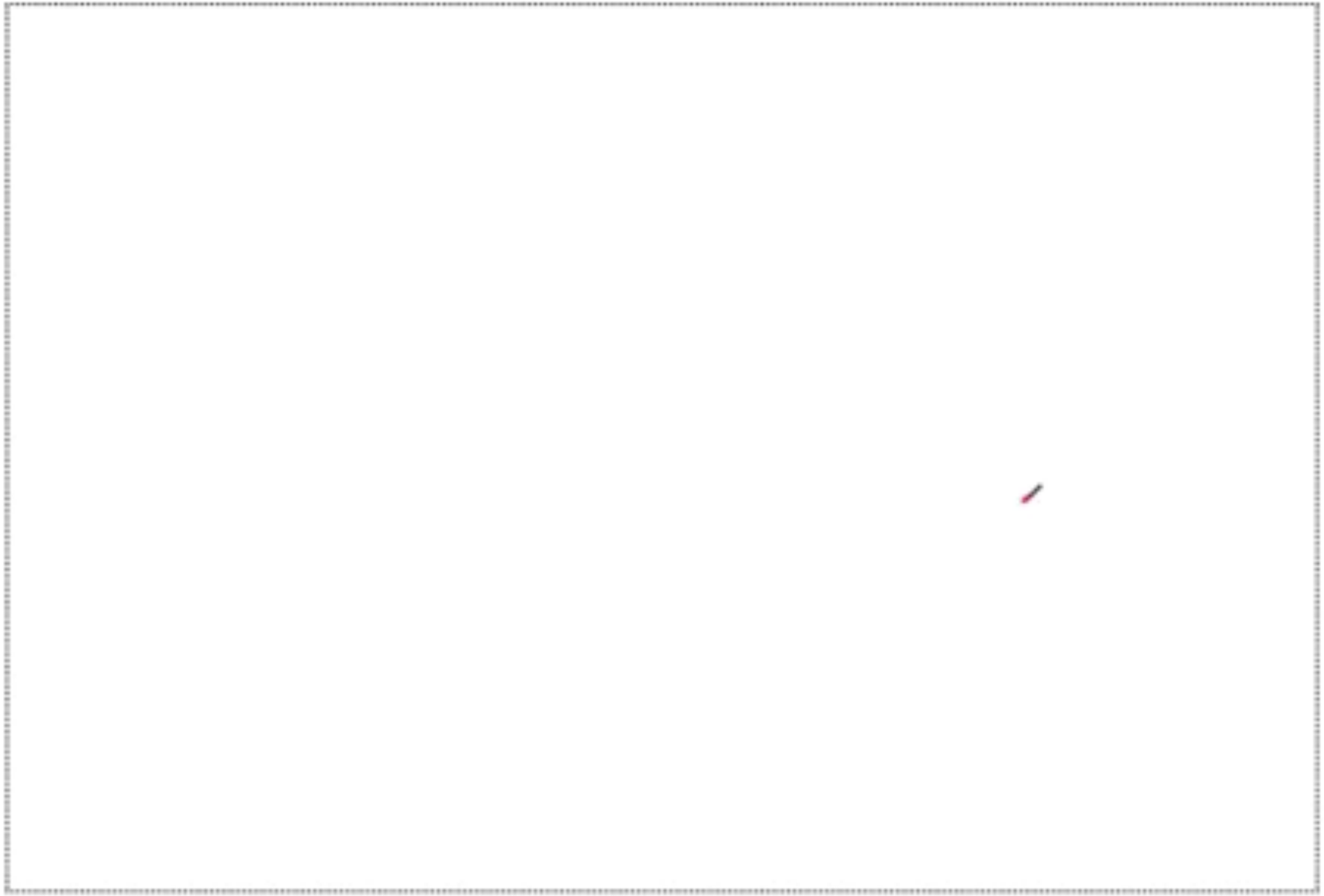
Interacting with [Textile] Fabrication Machines

with Lea

Blender embroidery renderer…



…embroidered mechanisms…

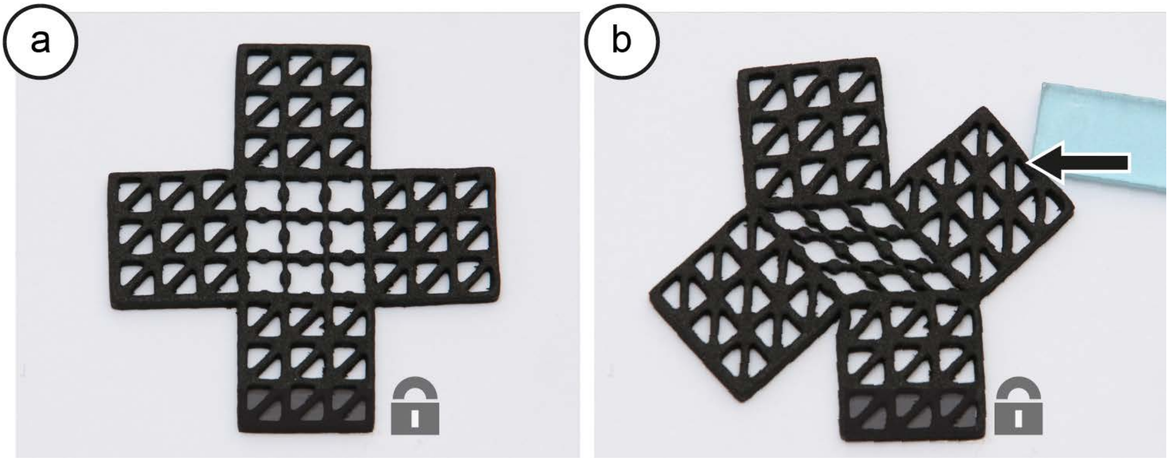


Figure 9: A metamaterial *four-bar*.

"Metamaterial Mechanisms"
Alexandra Ion et al, UIST 2016

+

"chemical lace" freestanding embroidery
(pieces shown here are by Meredith Woolnough)

=

?

Threadsteading

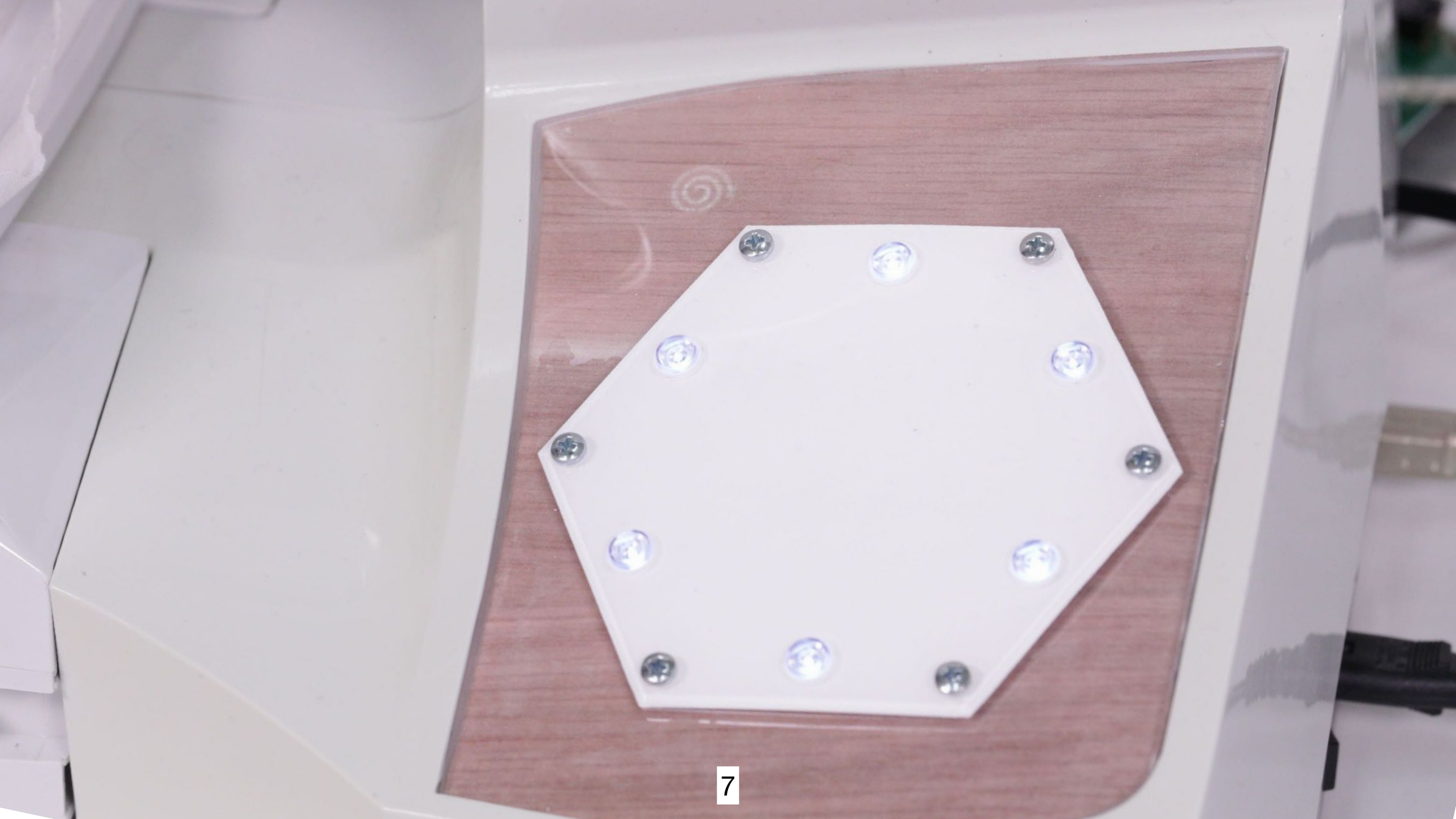
exhibited at the GDC

Threadsteading

IndieCade “Best Innovation”

Threadsteading

“a two-player territory control game for quilting and embroidery machines”

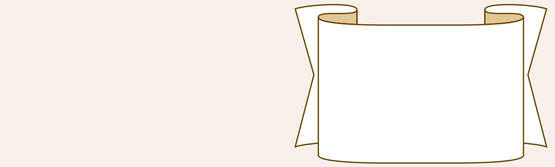


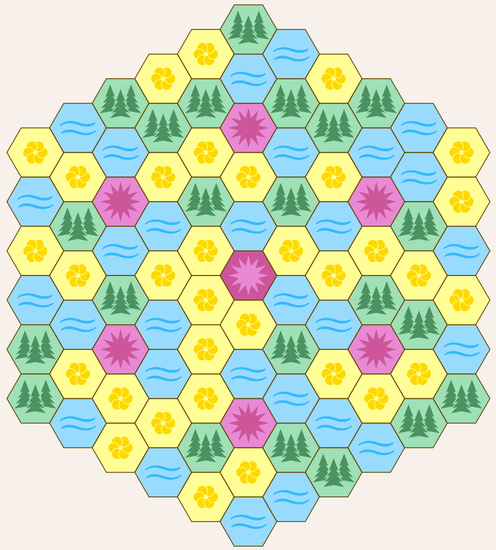

Threadsteading!


Threadst

Threadsteading

a two-player, single-line, territory control game
for quilting and embroidery machines





Threadsteading!

http://www.disneyresearch.com/project/threadsteading

1. Getting a physical thing out of a game is fun and interesting.

1. Altering the physical world with a computer game is fun and interesting.

“Destructive Games: Creating Value by Destroying Valuable Physical Objects”

David Eickhoff, Stefanie Mueller, and Patrick Baudisch, 2016

Figure 1: Destructive games are games that result in valuable physical objects being damaged or destroyed. To play destructive *Tug-of-War*, each player places a money bill into the laser cutter, and then tries to direct the laser into the other player’s bill. Surprisingly, we found that 8 out of 12 players would play again.

“Destructive Games: Creating Value by Destroying Valuable Physical Objects”

David Eickhoff, Stefanie Mueller, and Patrick Baudisch, 2016

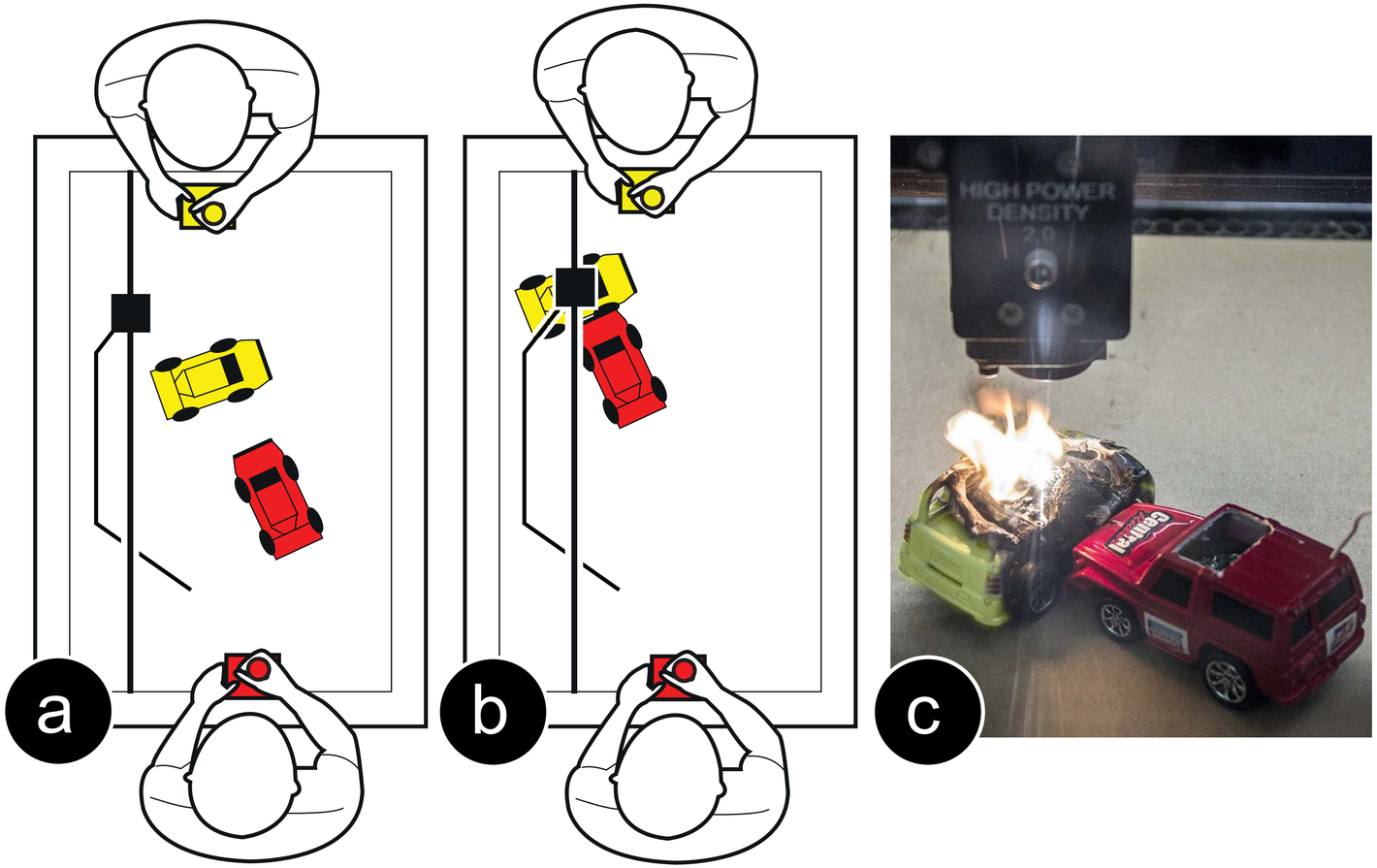
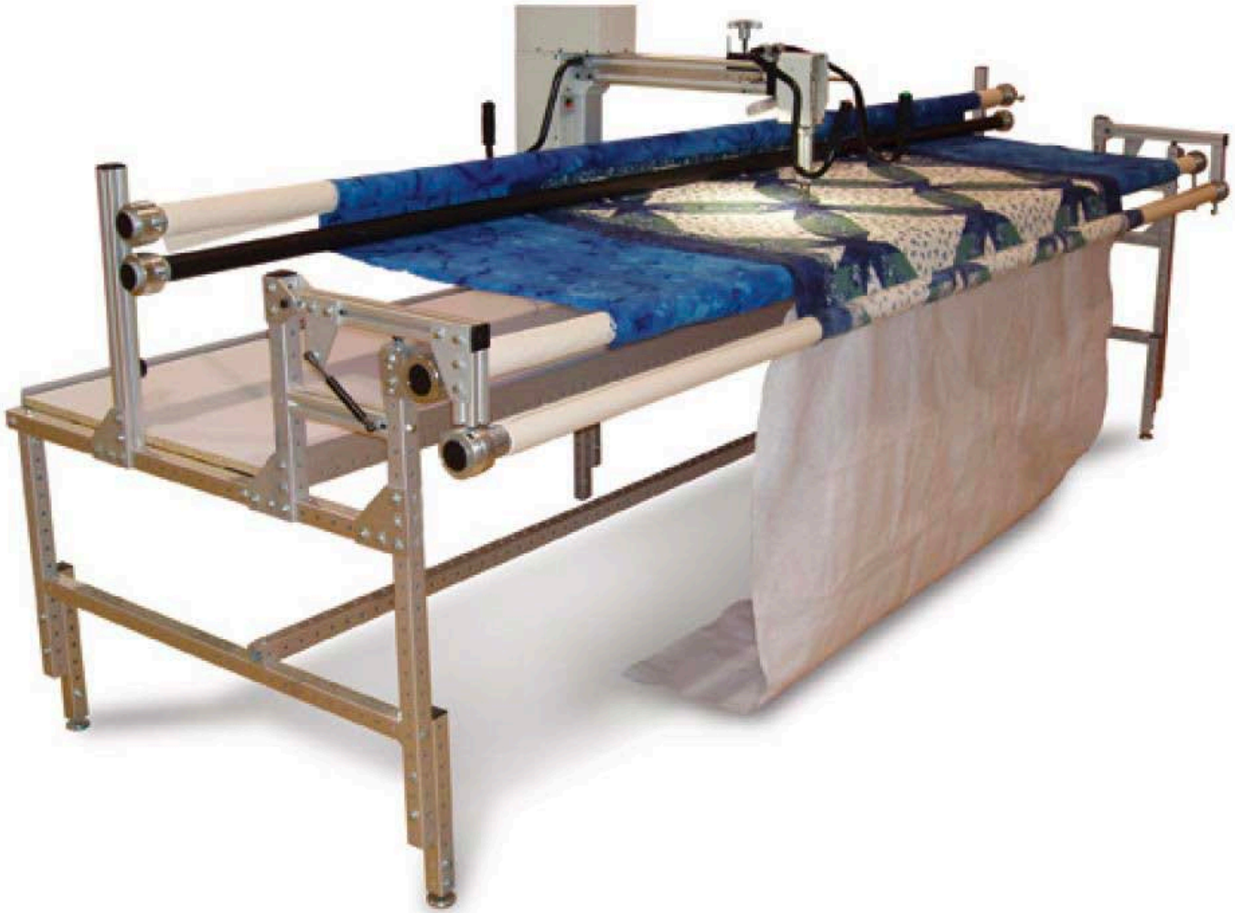


Figure 2: *CarSumo:* red is trying to push yellow’s car into the laser.

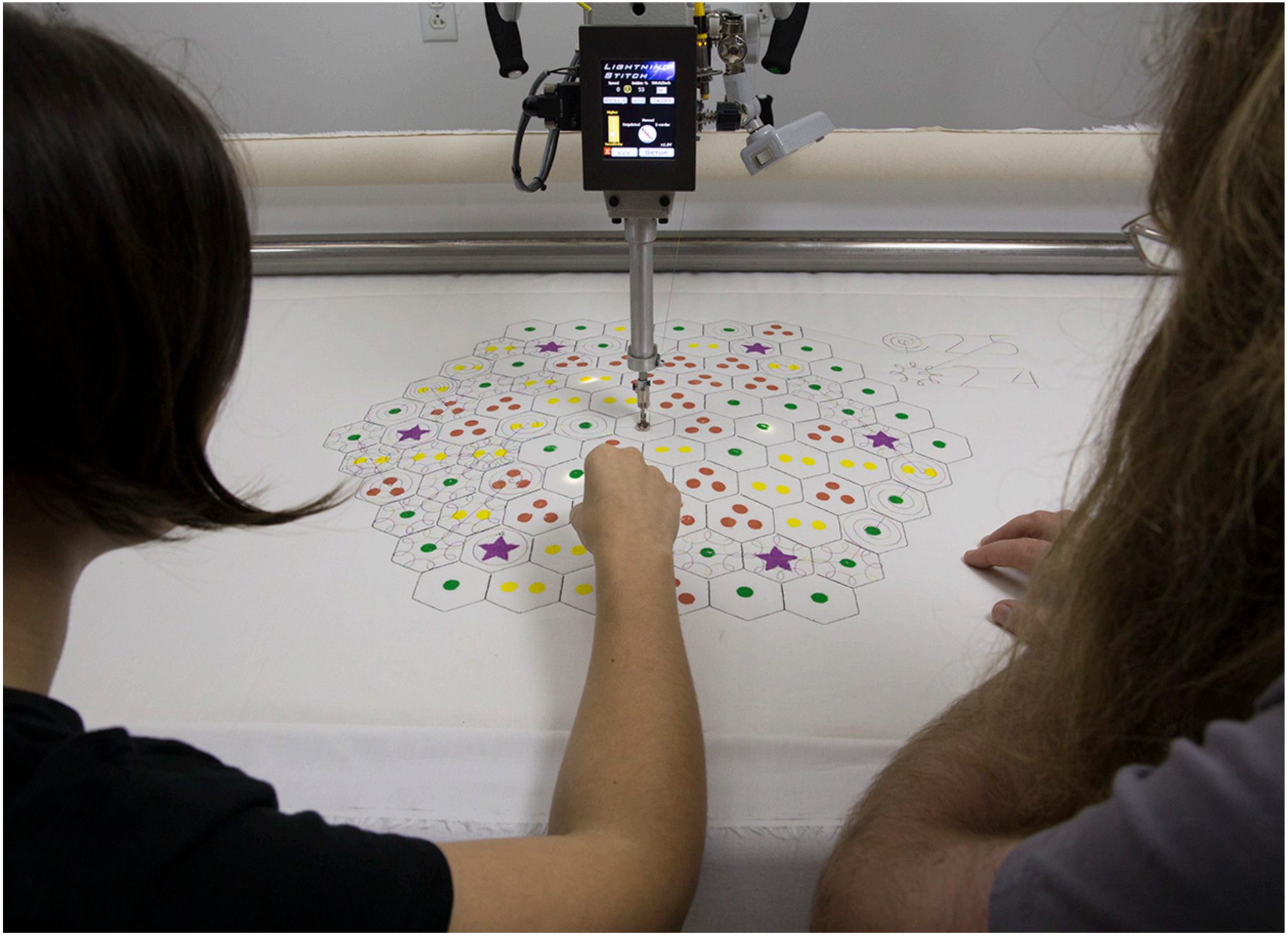
Threadsteading

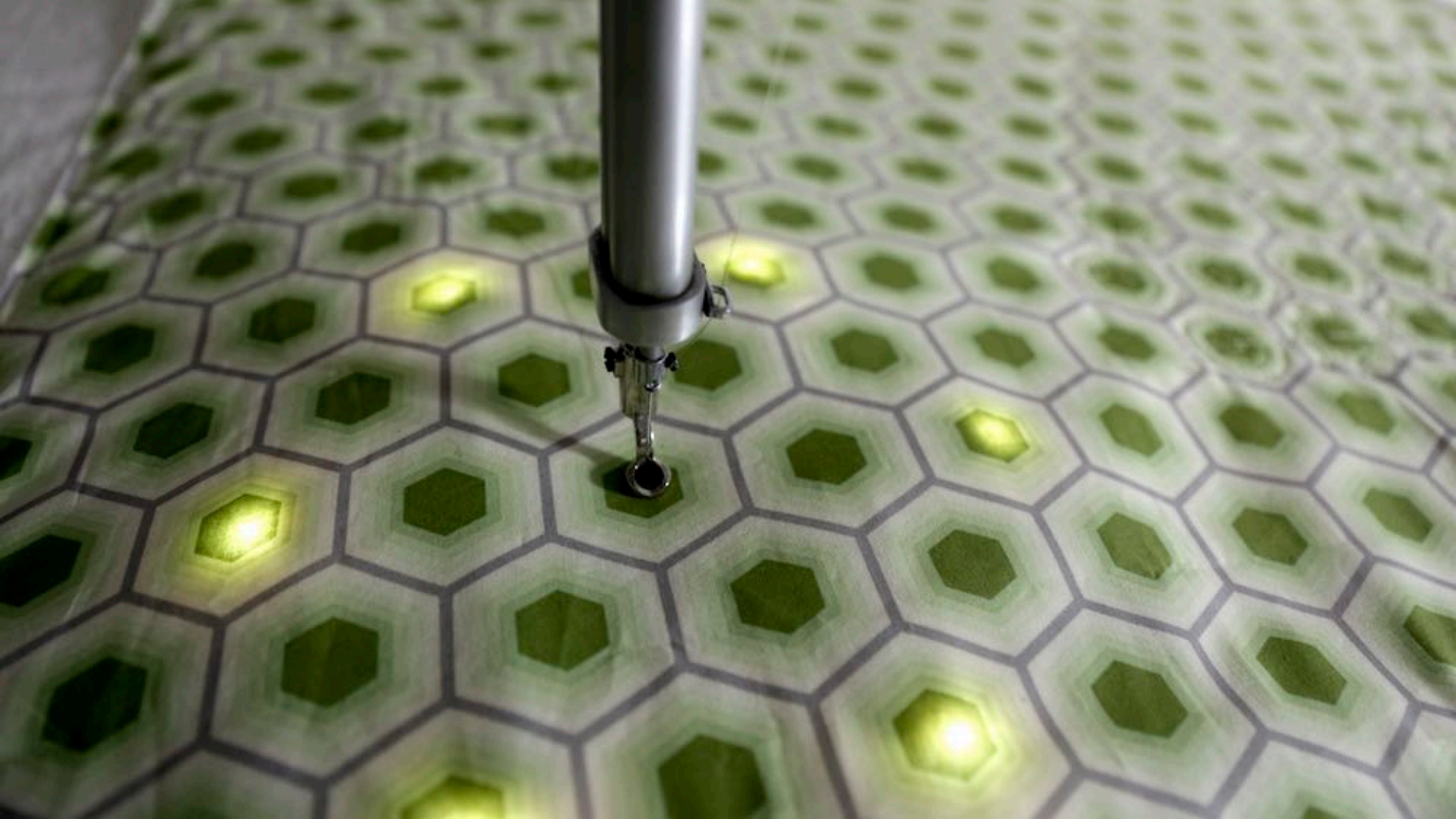
"a two-player territory control game for **quilting** and embroidery machines"



A longarm quilting machine

Some rando standing inside a quilting machine, for scale


LIGHTNING
STITCH



1. Altering the physical world with a computer game is fun and interesting.
2. Interacting directly on materials is also fun and interesting.

On-Machine Interaction

“RoMA: Interactive Fabrication with Augmented Reality and a Robotic 3D Printer”

Huaishu Peng et al, 2018

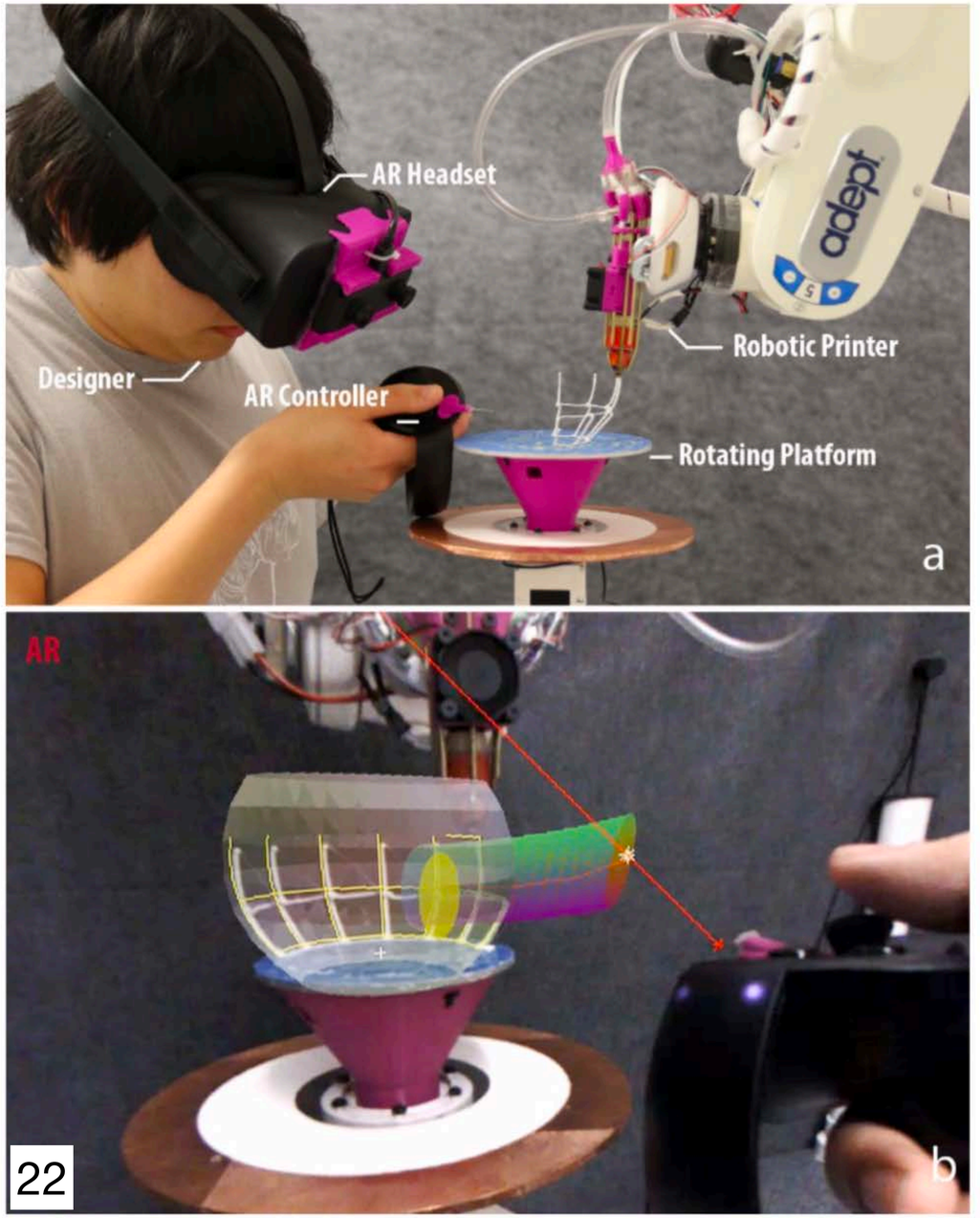
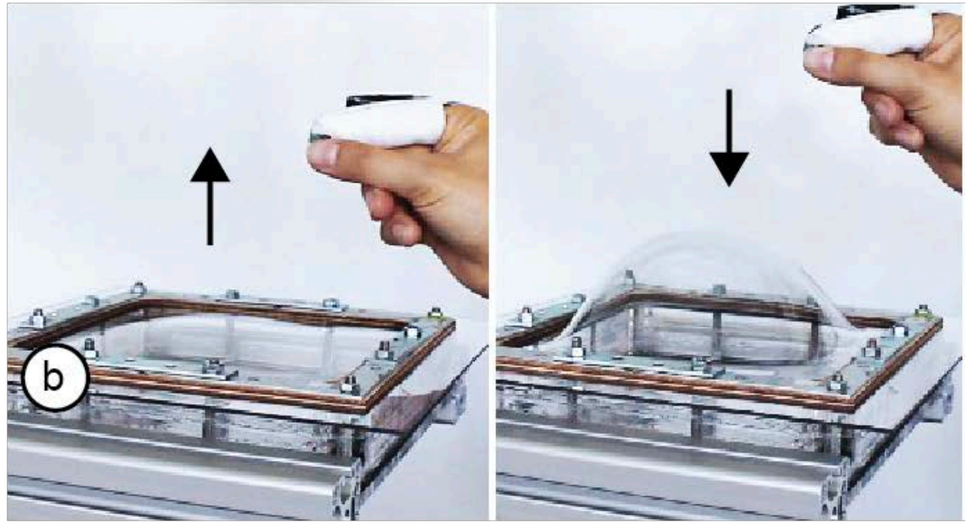
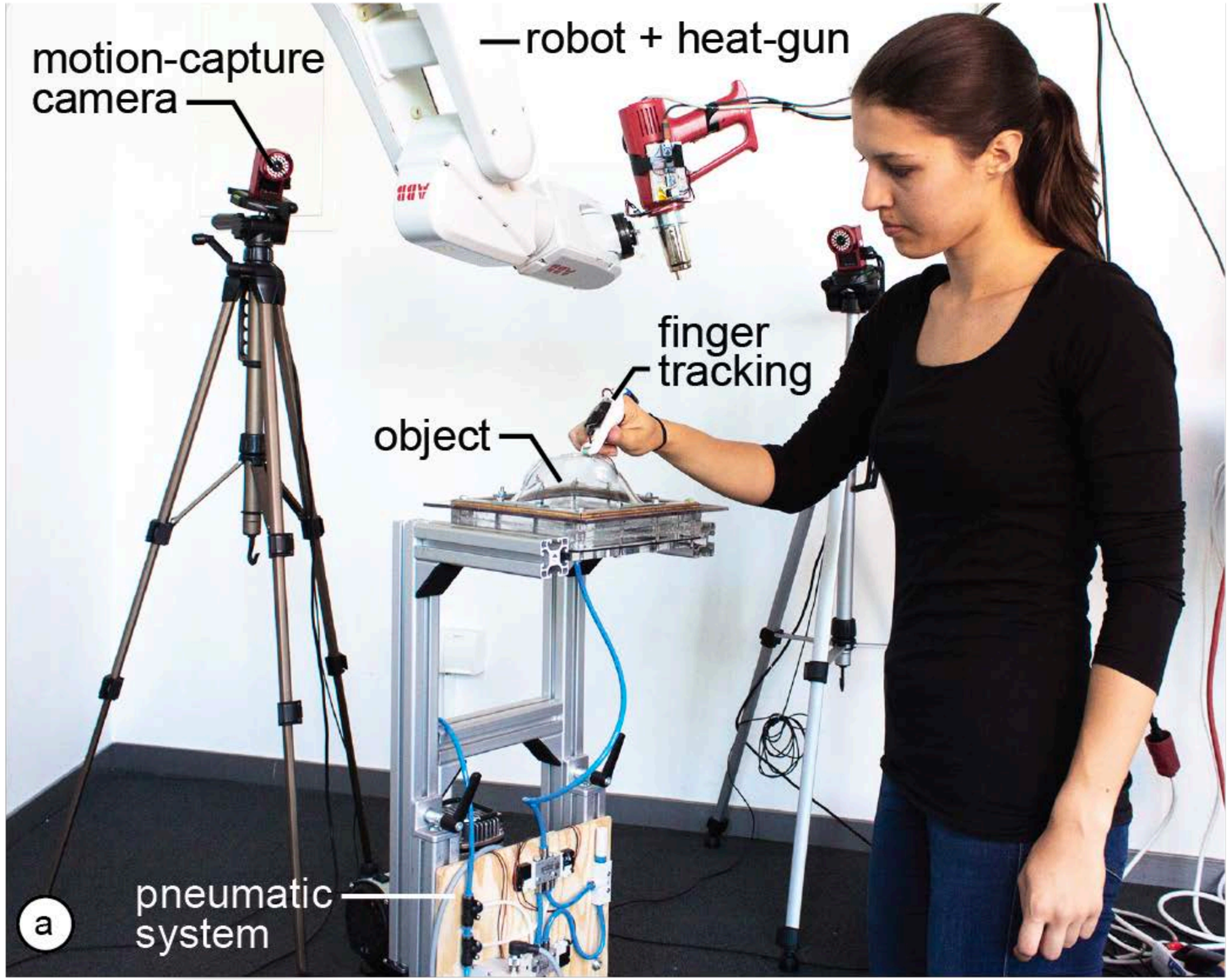


Figure 1: a) RoMA overview. b). Designer view from the AR headset. The designer creates a digital spout while the robot prints the teapot body. Digital model is overlaid onto the physical model.

FormFab: Continuous Interactive Fabrication

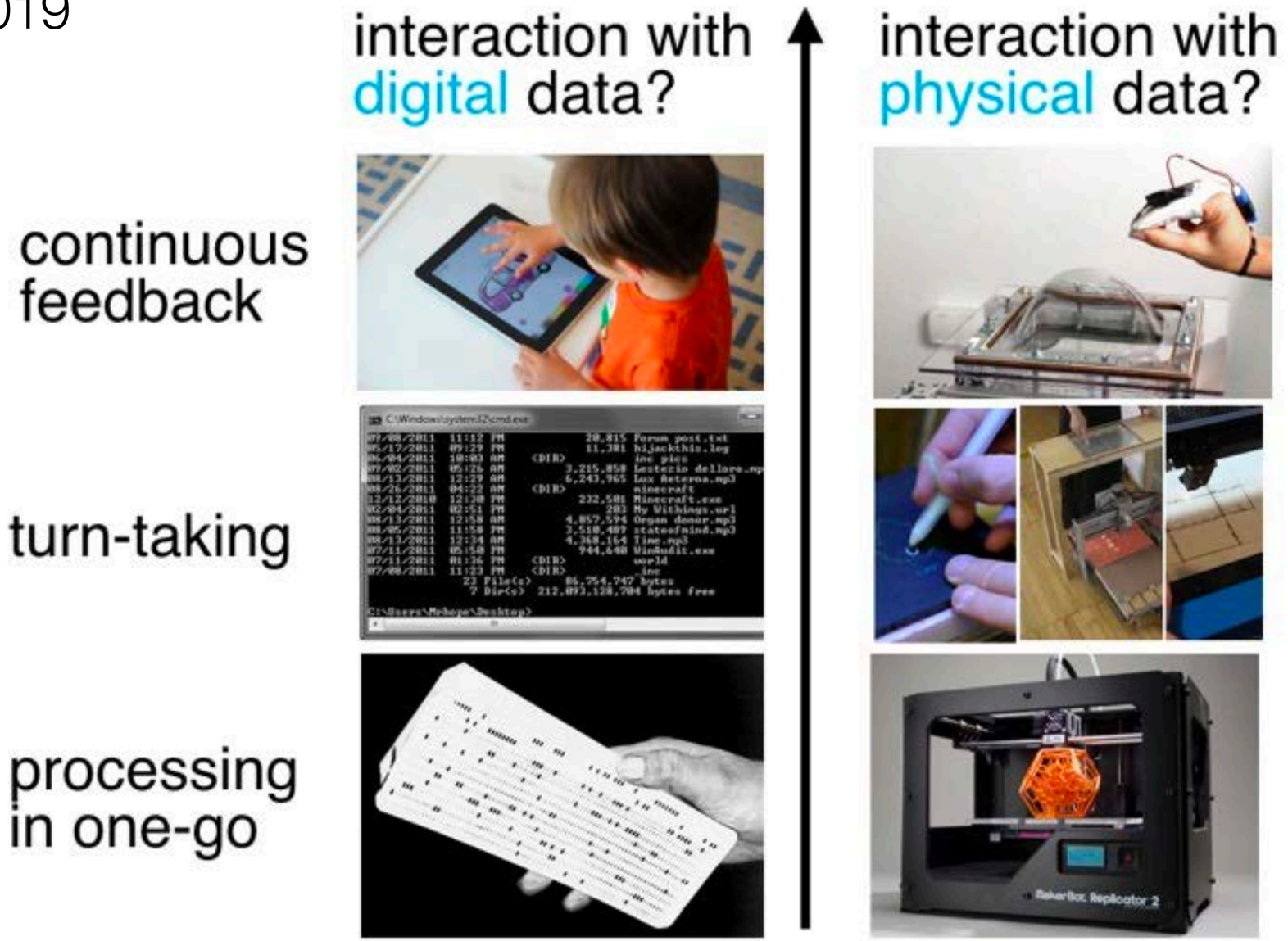
Mueller et al, 2019





FormFab: Continuous Interactive Fabrication

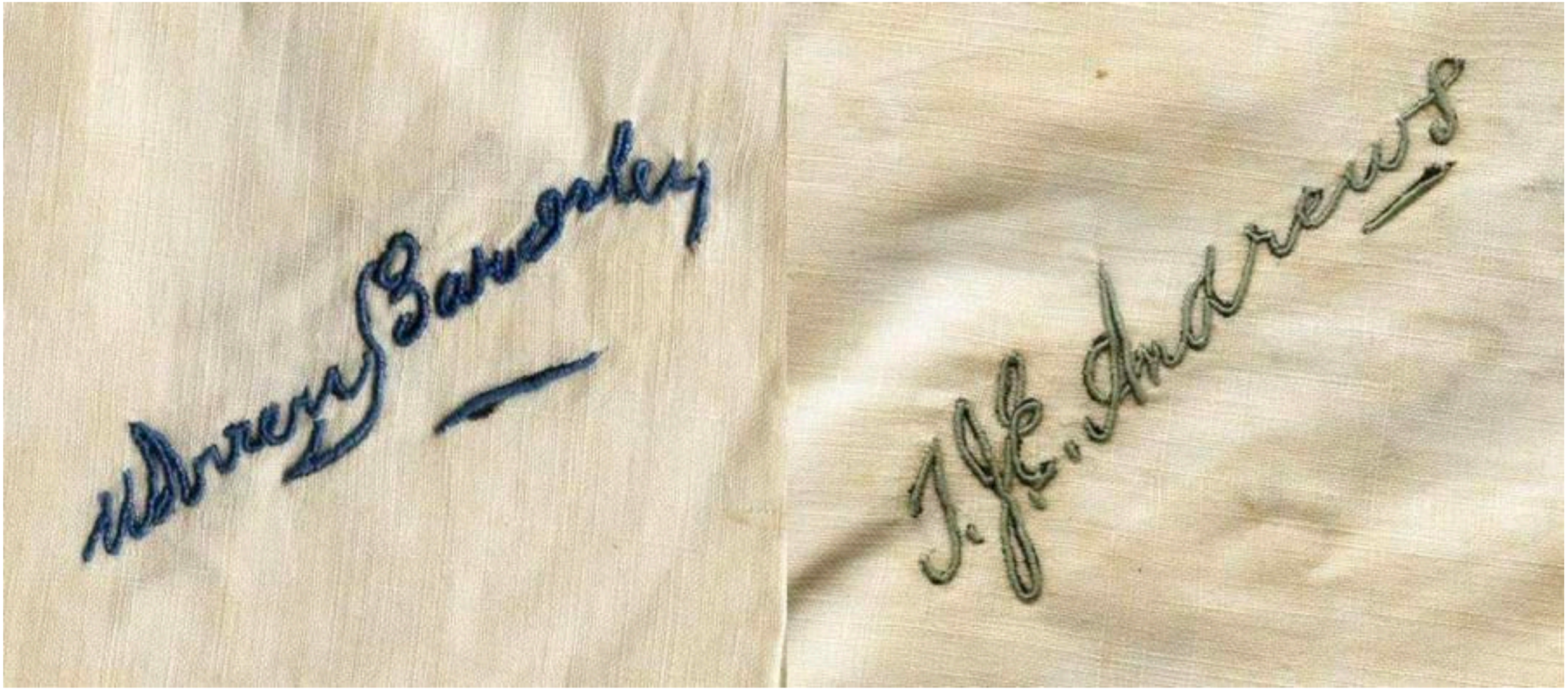
Mueller et al, 2019



Sketch&Stitch: Interactive Embroidery for E-Textiles

Nur Al-huda Hamdan et al, CHI 2018

Figure 1. Sketch&Stitch workflow: 1. The user sketches an artwork directly on the fabric, 2. she uses *Circuitry Stickers* to plan the circuit layout, 3. she draws circuit traces to connect the stickers, 4. the system takes a picture of the sketch, converts it to embroidery patterns, and sends them to an embroidery machine for stitching using conductive and non-conductive threads, 5. the user replaces Circuitry Stickers with real electrical components and attaches them to the fabric.


Andrew Barnsley
J. E. Andrews

Sketch&Stitch: Interactive Embroidery for E-Textiles

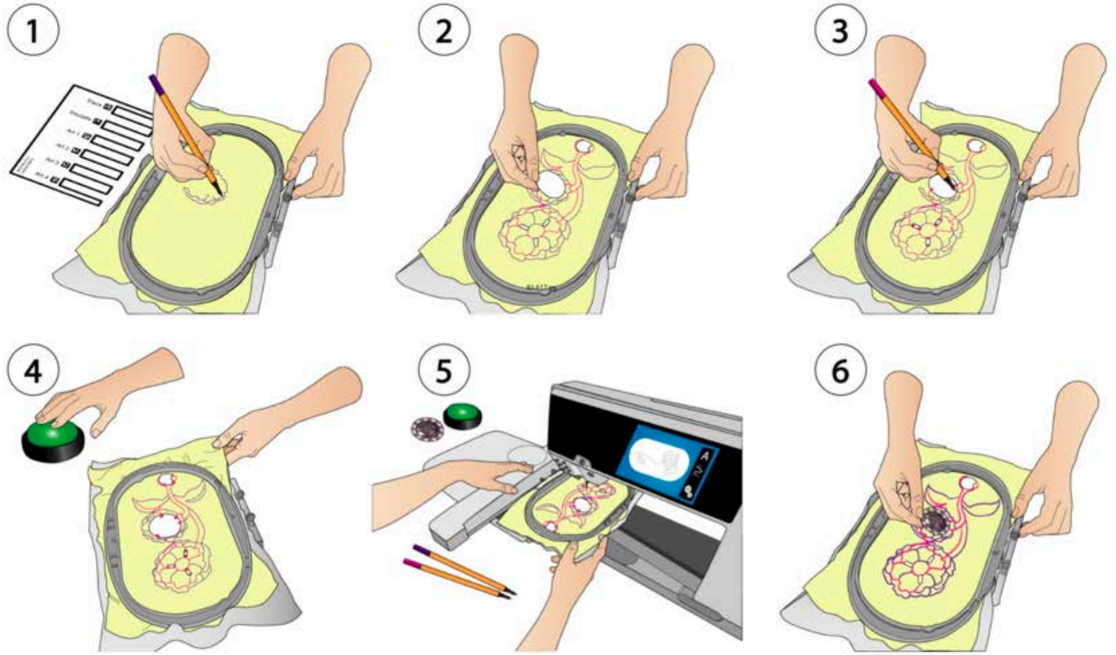


Figure 9. Basic workflow: 1. Sketch a design on fabric, 2. adhere Circuitry Stickers, 3. draw the circuit and electrical connections, 4. capture a picture of the sketch, 5. insert the fabric into the embroidery machine for stitching, and 6. replace the stickers with hardware components.

Sketch&Stitch: Interactive Embroidery for E-Textiles
Nur Al-huda Hamdan et al, CHI 2018

Figure 3. 1. Component Stickers represent electrical components in a hand-sketch circuit. Pin grooves designed to enlarge component contact area. 2. Stickers replaced with hardware counterparts after embroidery.

Understanding Uncertainty in Measurement and Accommodating its Impact in 3D Printing
Jeeeun Kim et al 2017

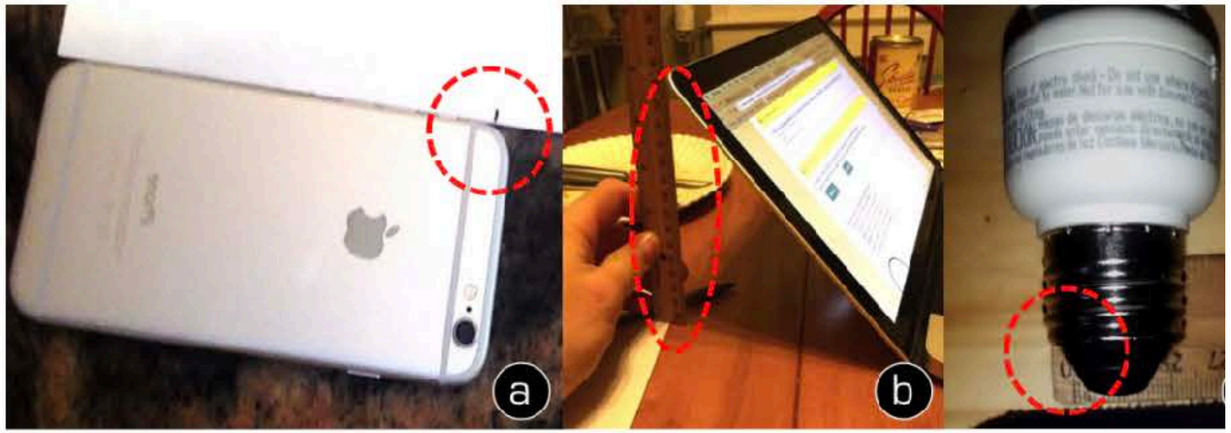


Figure 5: Examples of human choices that might increase error including: *(a)* measuring with paper instead of a ruler; *(b)* measuring angle with multiple lengths rather than a protractor; and *(c)* misalignment of the object with the ruler's tick.

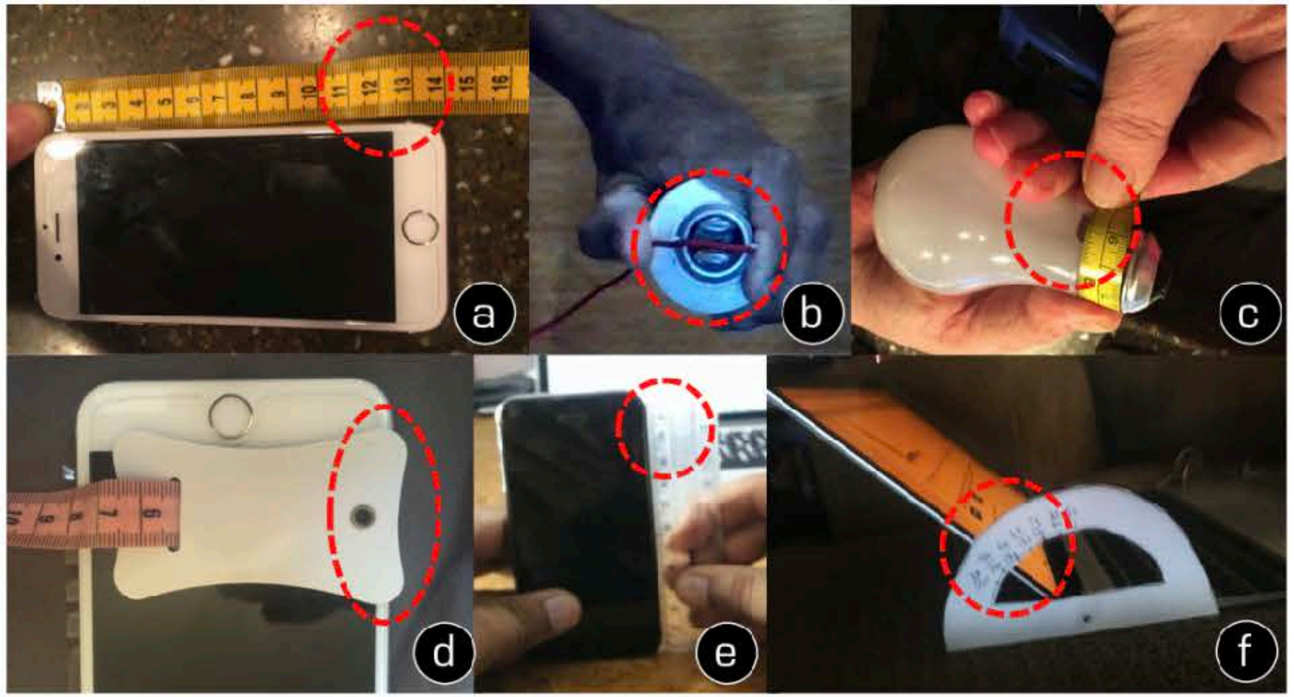
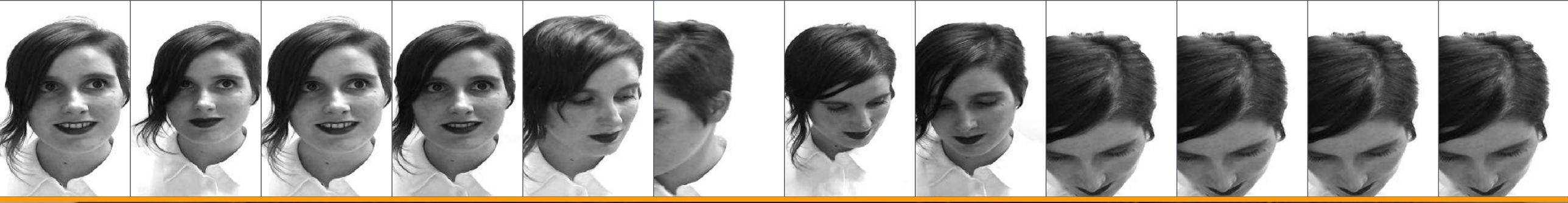
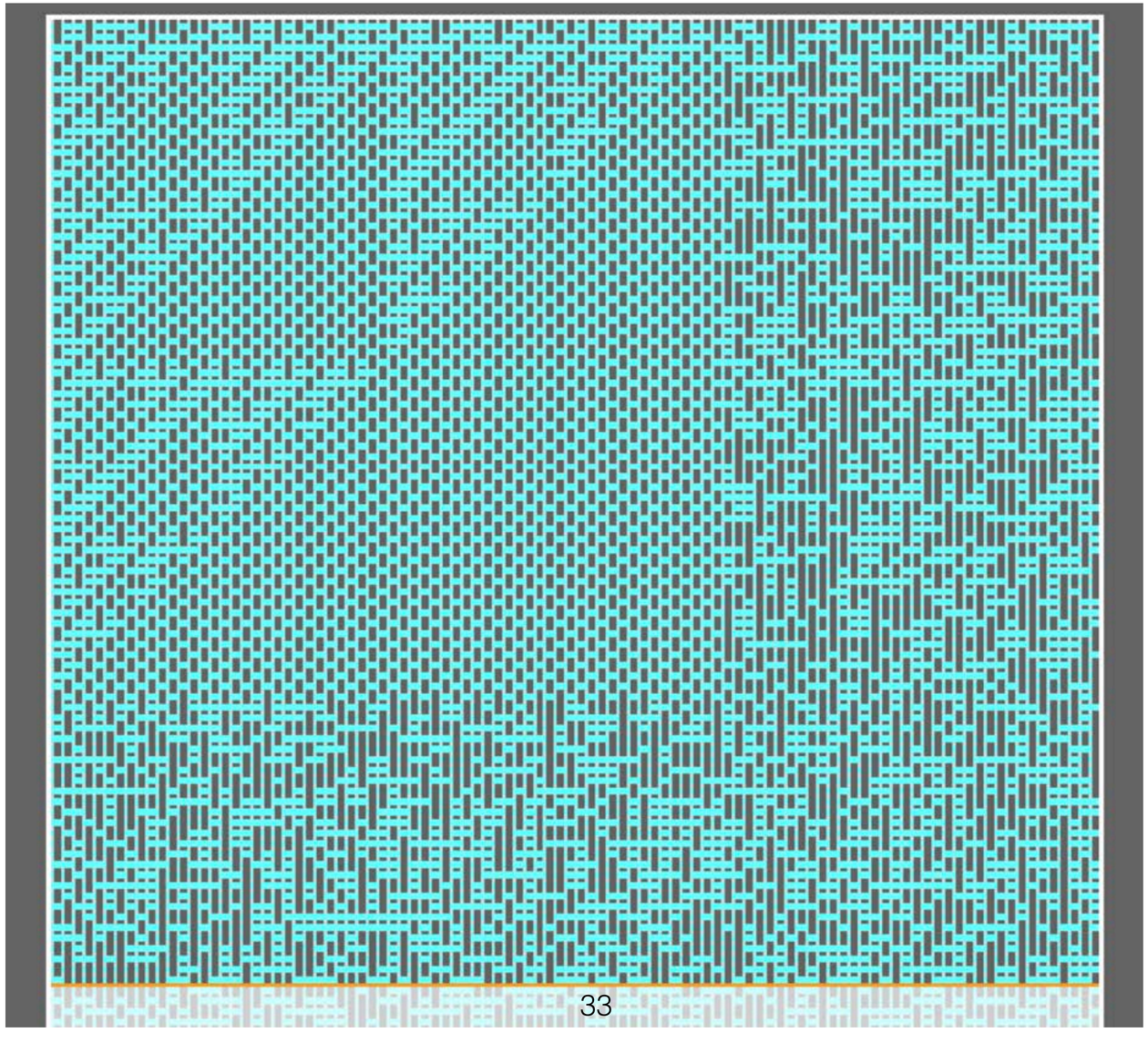


Figure 6: Measurement instruments limitations can increase the chance of error, including: *(a)* tape that is not naturally flat; *(b)* stretchy string; *(c)* requiring calculation (diameter derived from circumference); *(d)* hidden 'zero' tick, making correct alignment difficult; *(e)* shorter than the item being measured (introducing potential gaps or overlap); *(f)* difficult to align precisely.





Hybrid Embroidery Games: Playing with Materials, Machines, and People

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University of Michigan
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Lea Albaugh
Human-Computer Interaction Institute,
Carnegie Mellon University
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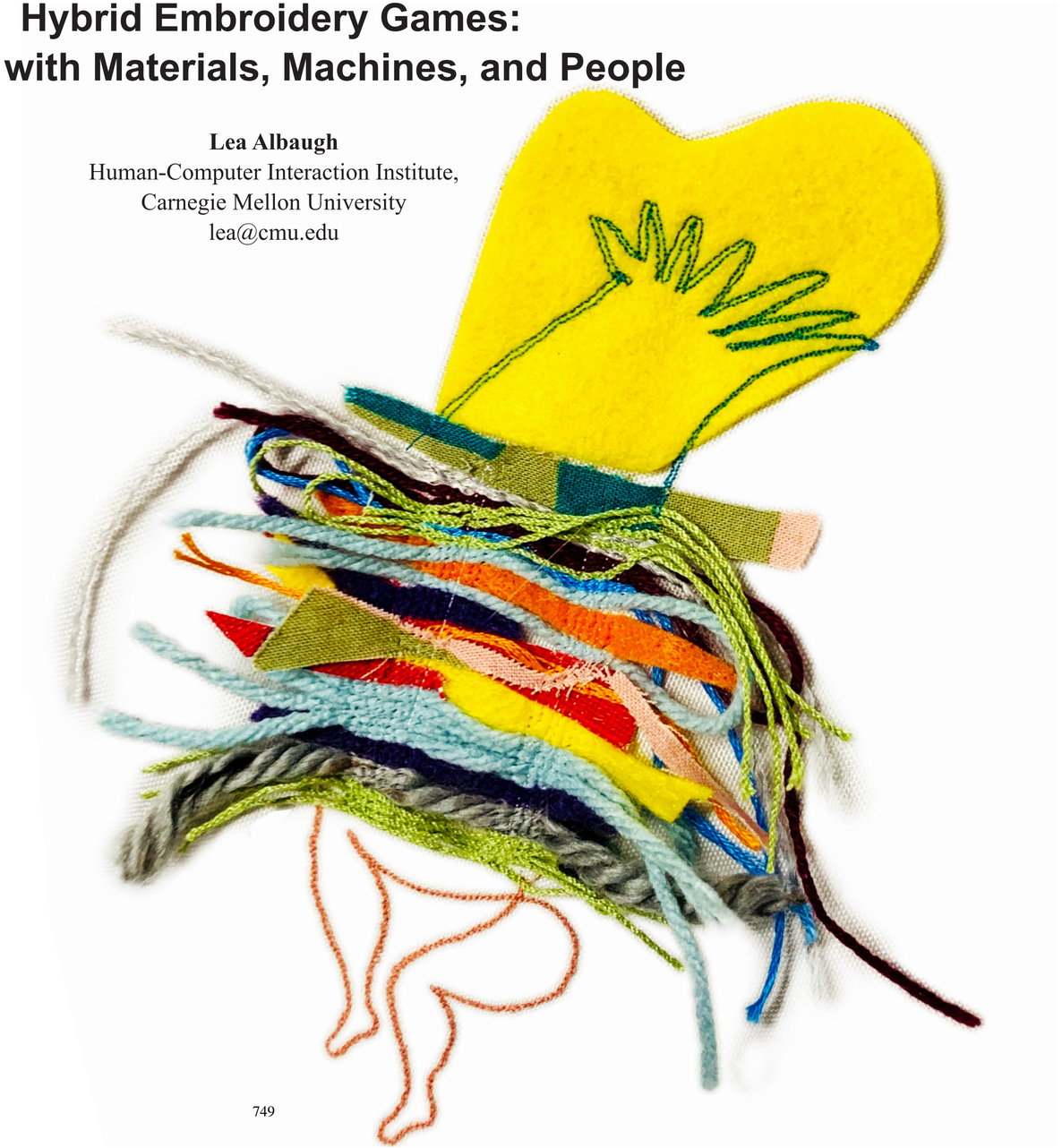
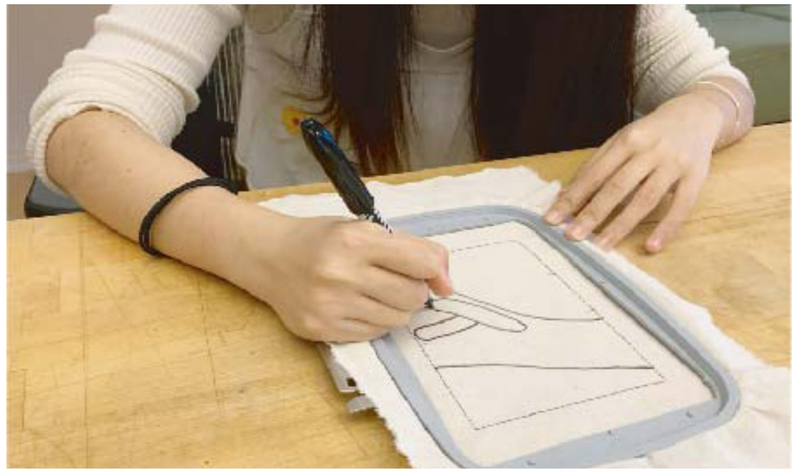
ABSTRACT

Our work centers on aspects of crafting creativity that are often overlooked in digital fabrication: playfulness, and possibilities for social engagement. We draw from precedents in both crafting (e.g. quilting bees) and gameplay (e.g. "Exquisite Corpse") to inform the design of a set of turn-based collaborative games which center a computer-controlled embroidery machine as a "player" in games for one or more crafters. We prototype these games using our own computational input/output embroidery pipeline and observe how they can guide crafter-players to engage with physical, digital, and social affordances. We summarize our findings on how creative focus can shift over a playful experience of fabrication and how technology can mediate social crafting.



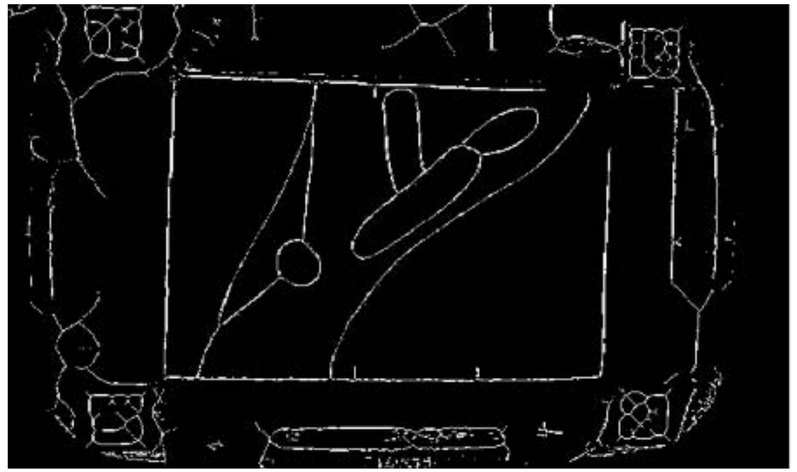
Hybrid Embroidery Games:
Yi-Chin Lee (and Lea), DIS 2021

Hybrid Embroidery Games

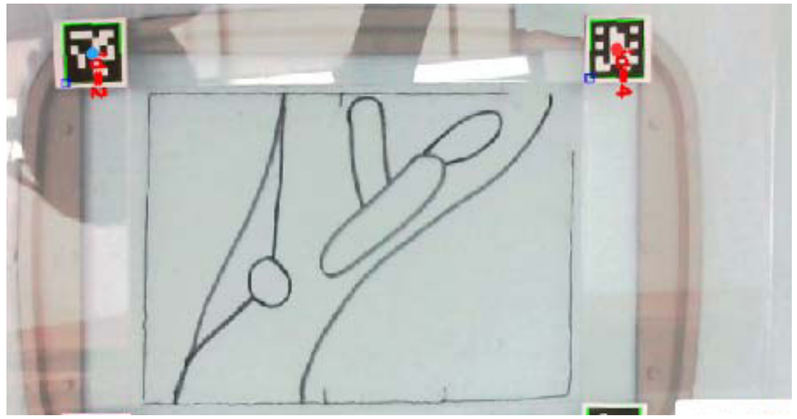


(a) A player sketches within embroidered canvas boundaries. Markers show the player how their design will connect to others'.

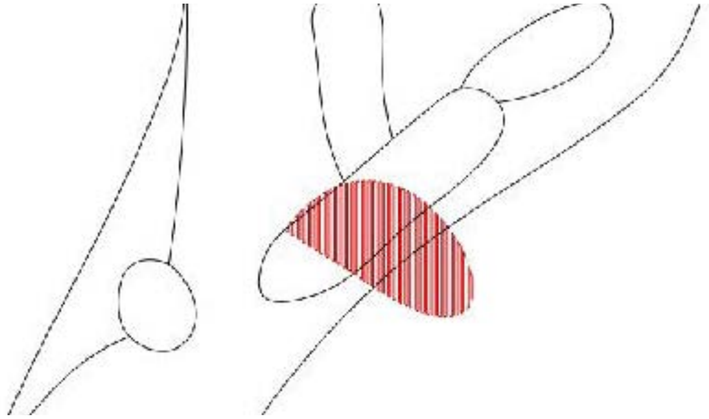
(b) The swatch scanner camera captures the sketch.



(c) A Python script extracts the visible features.



(d) Image processing, including sampling, clustering, and sorting, derives a representation of the input as a sequence of drawing strokes.



(e) Closed, filled shapes are generated to relate to the provided input.

(f) These shapes are then converted to the continuous line paths necessary for CNC embroidery.

Hybrid Embroidery Games

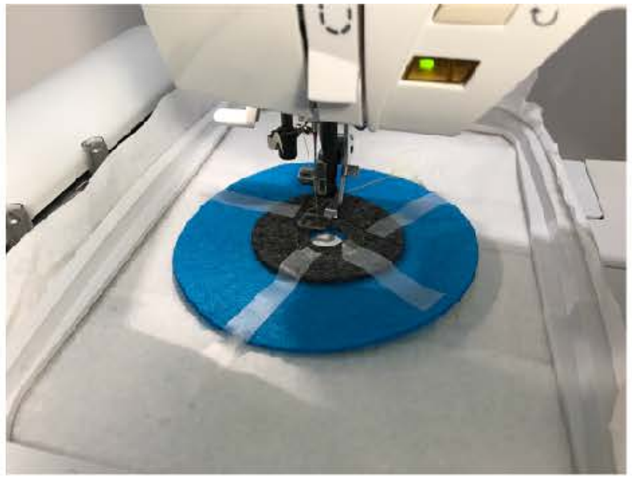
“In-the-hoop” construction with embroidery machines

https://weallsew.com/give-in-the-hoop-projects-a-try-your-embroidery-machine-does-all-the-work/

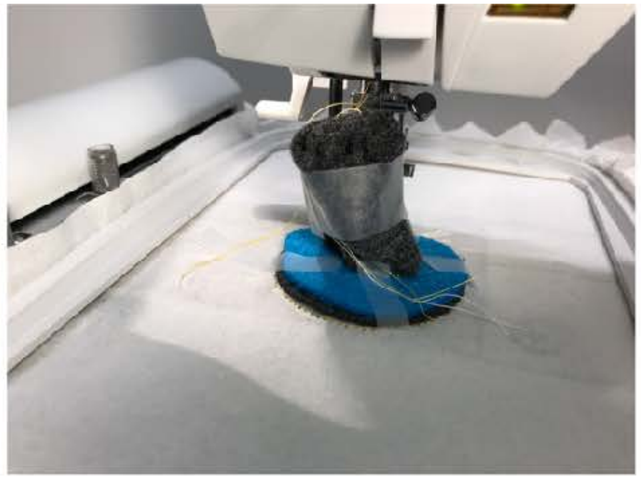
Layer-Based Fabrication of Sewn 3-D Objects

Yi-Chin Lee and Lea Albaugh, SCF 2019

Modules are built onto a tear-away substrate — here, a paper towel. First, the machine sews an outline of the first module onto the substrate.



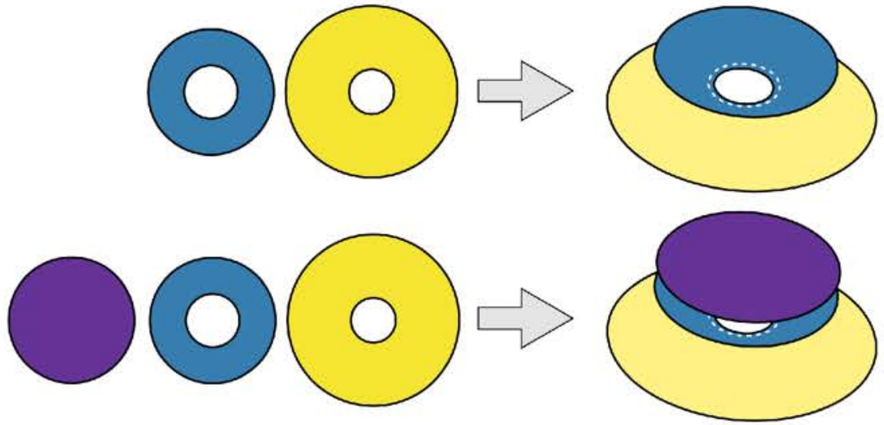
The user aligns the fabric cut-outs to the outline and tapes them in place. The machine sews the module together.



Once the modules are built, each is sewn to its neighbors. The larger module can be taped out of the way of the needle.

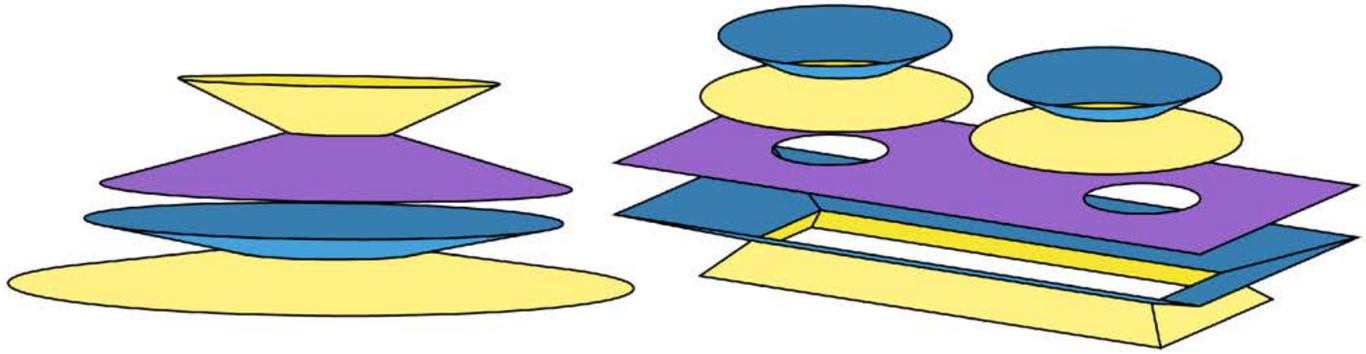
The finished sphere with the substrate torn away.

Layer-Based Fabrication of Sewn 3-D Objects

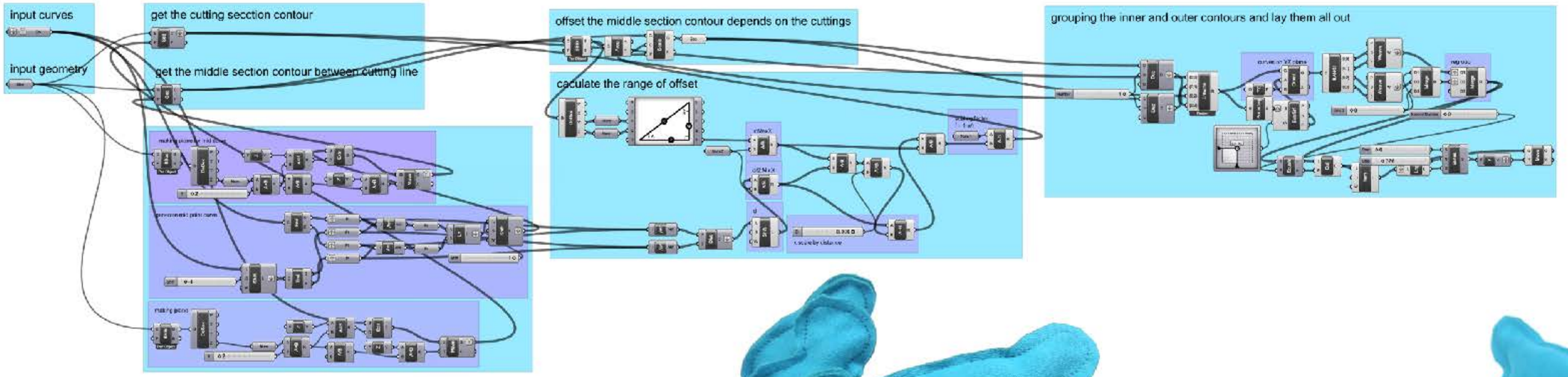


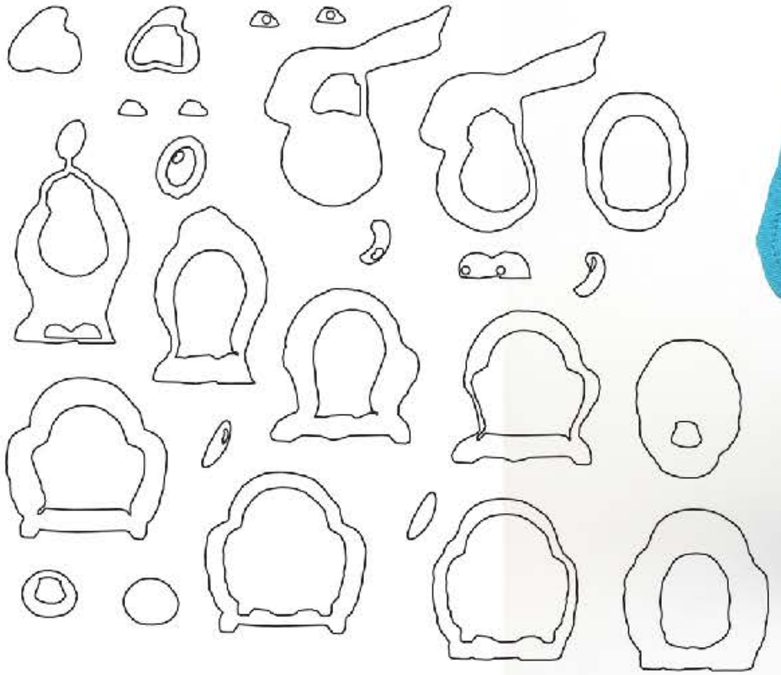
A single module consists of two pieces of cut fabric attached by sewing along their matching internal contours. The module can be closed with an endcap.

Modules are then attached to other modules by their matching external contours. To split from one enclosed area to two, an endcap is used.

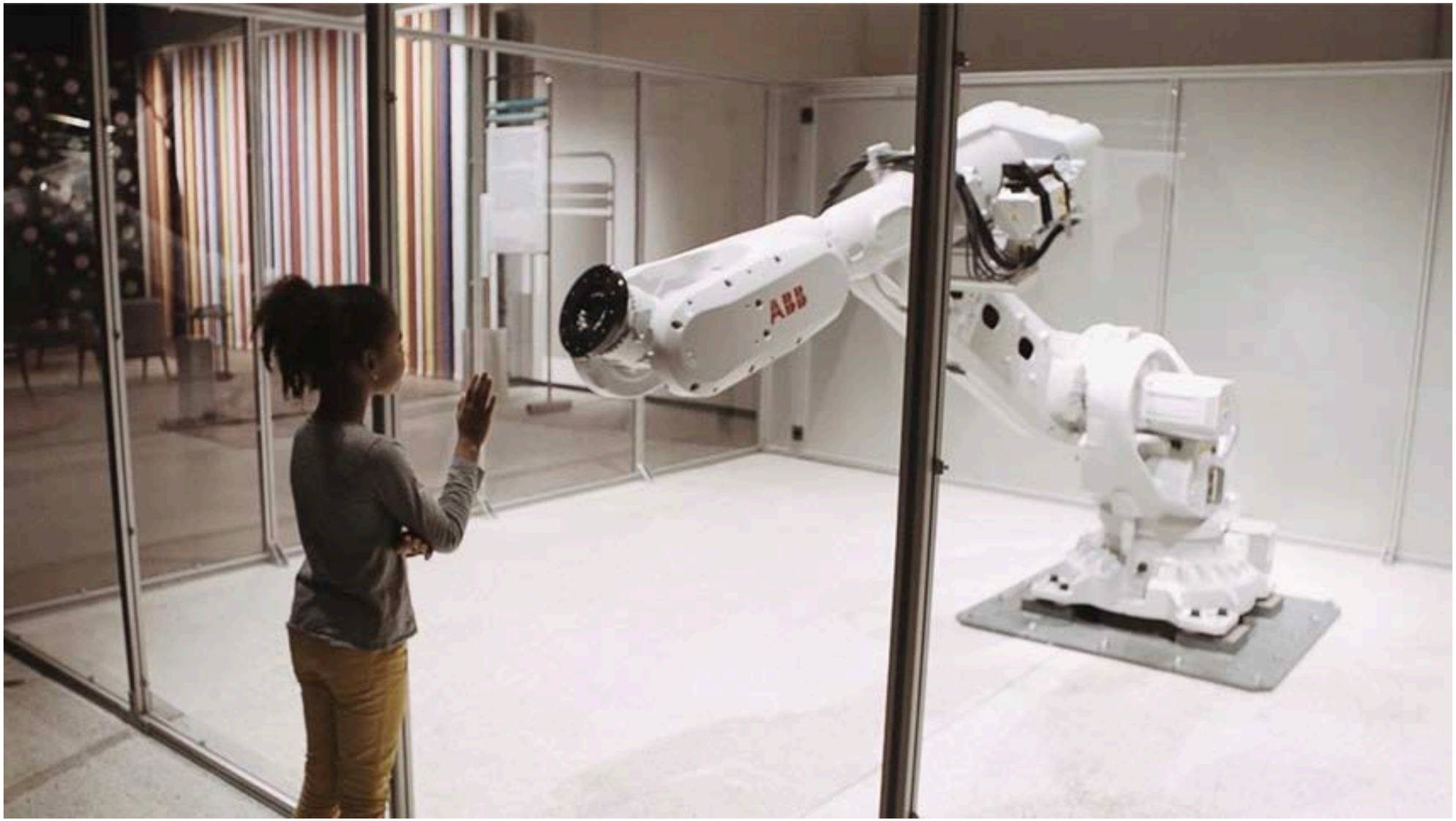


Layer-Based Fabrication of Sewn 3-D Objects



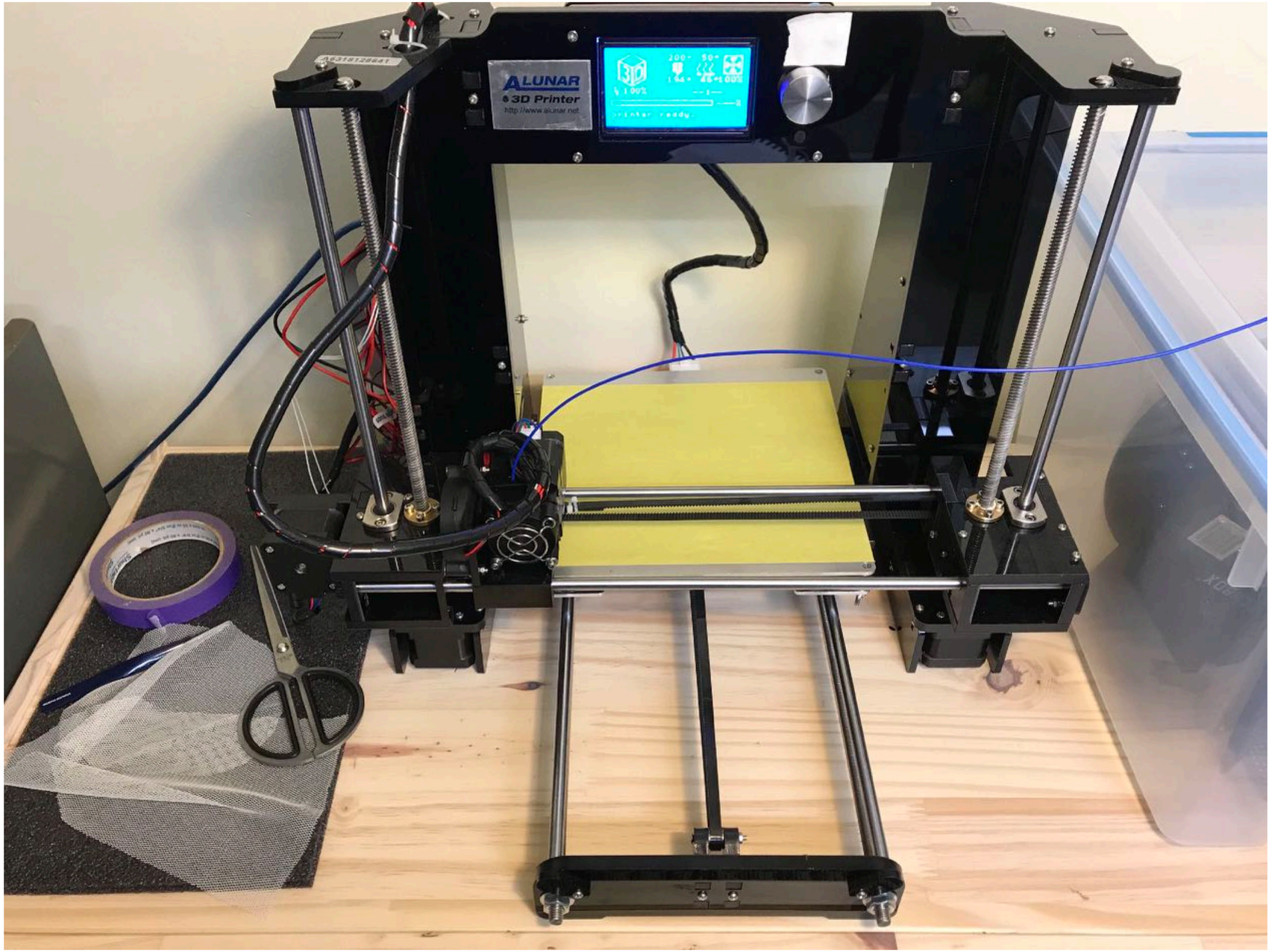


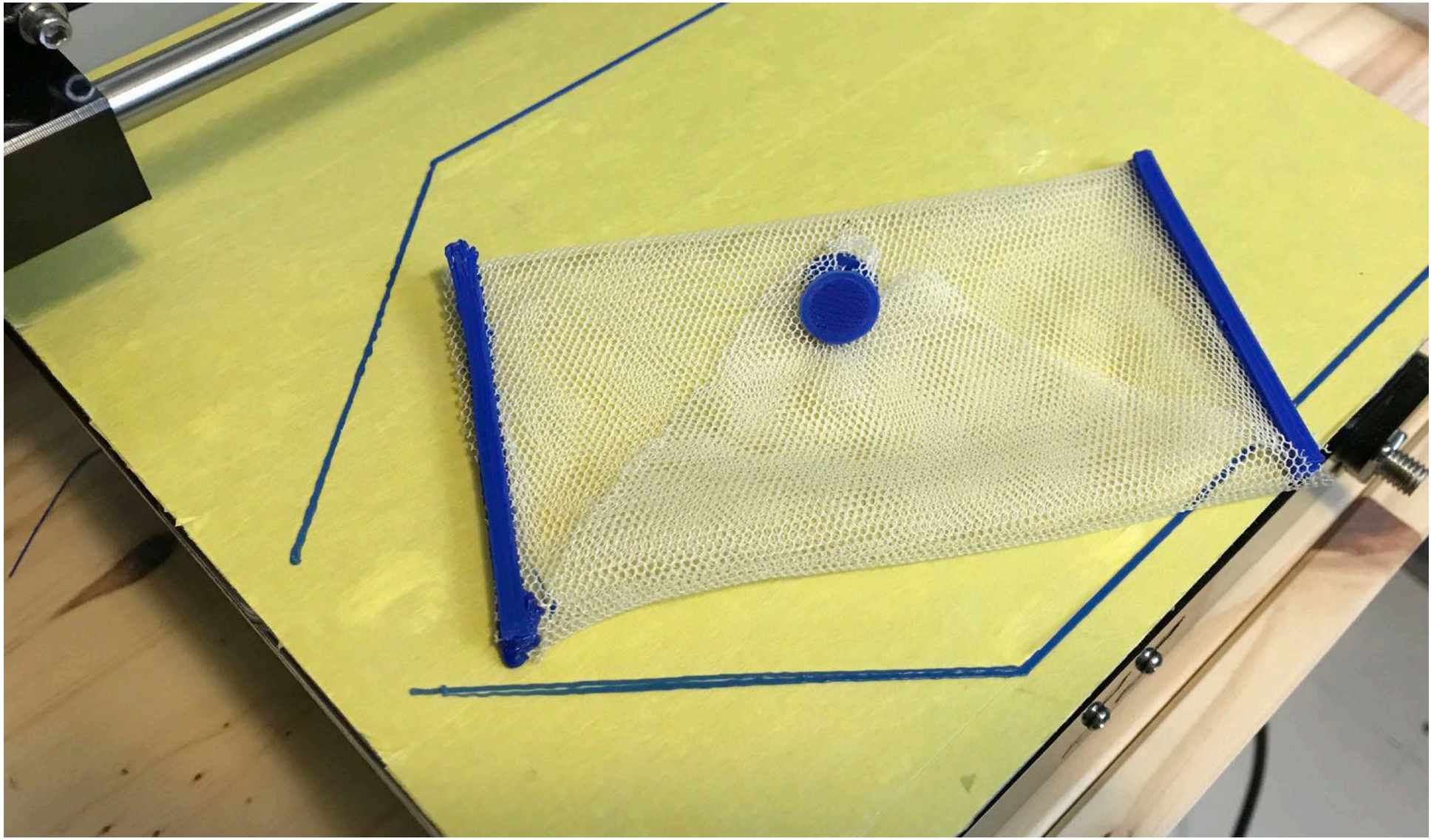
Layer-Based Fabrication of Sewn 3-D Objects

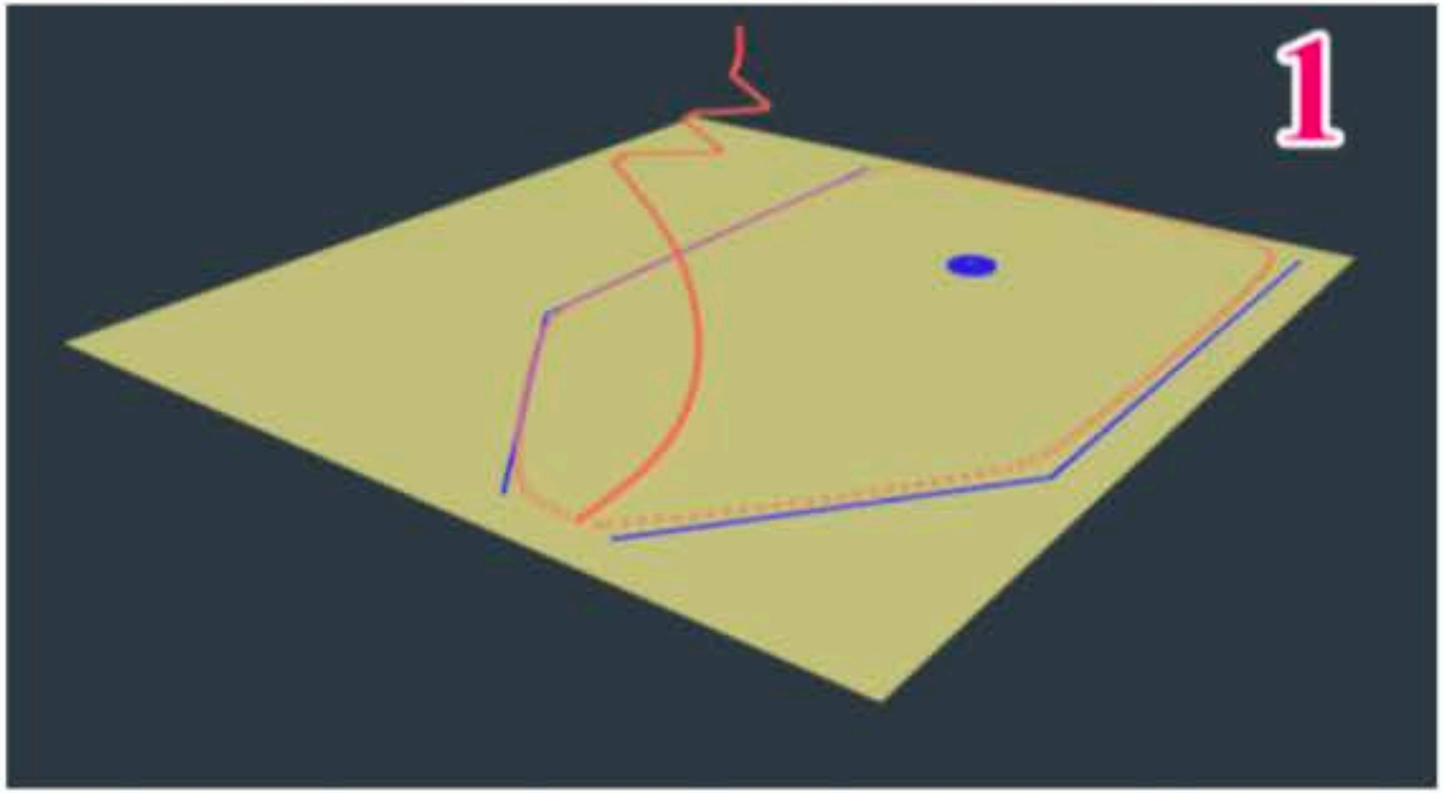


Mimus, Madeline Gannon

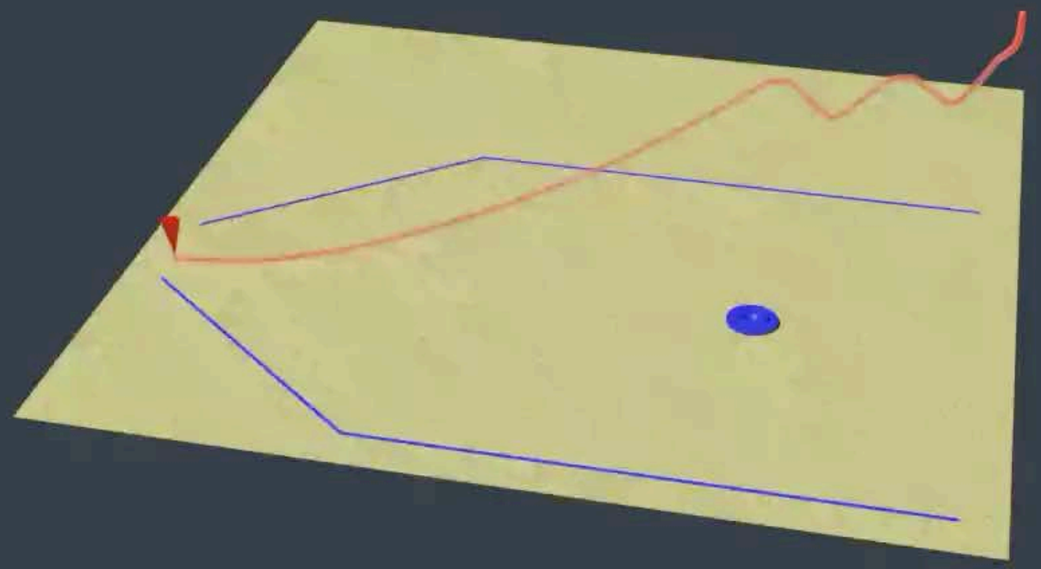
Kelly Dobson, Blendie (2004)

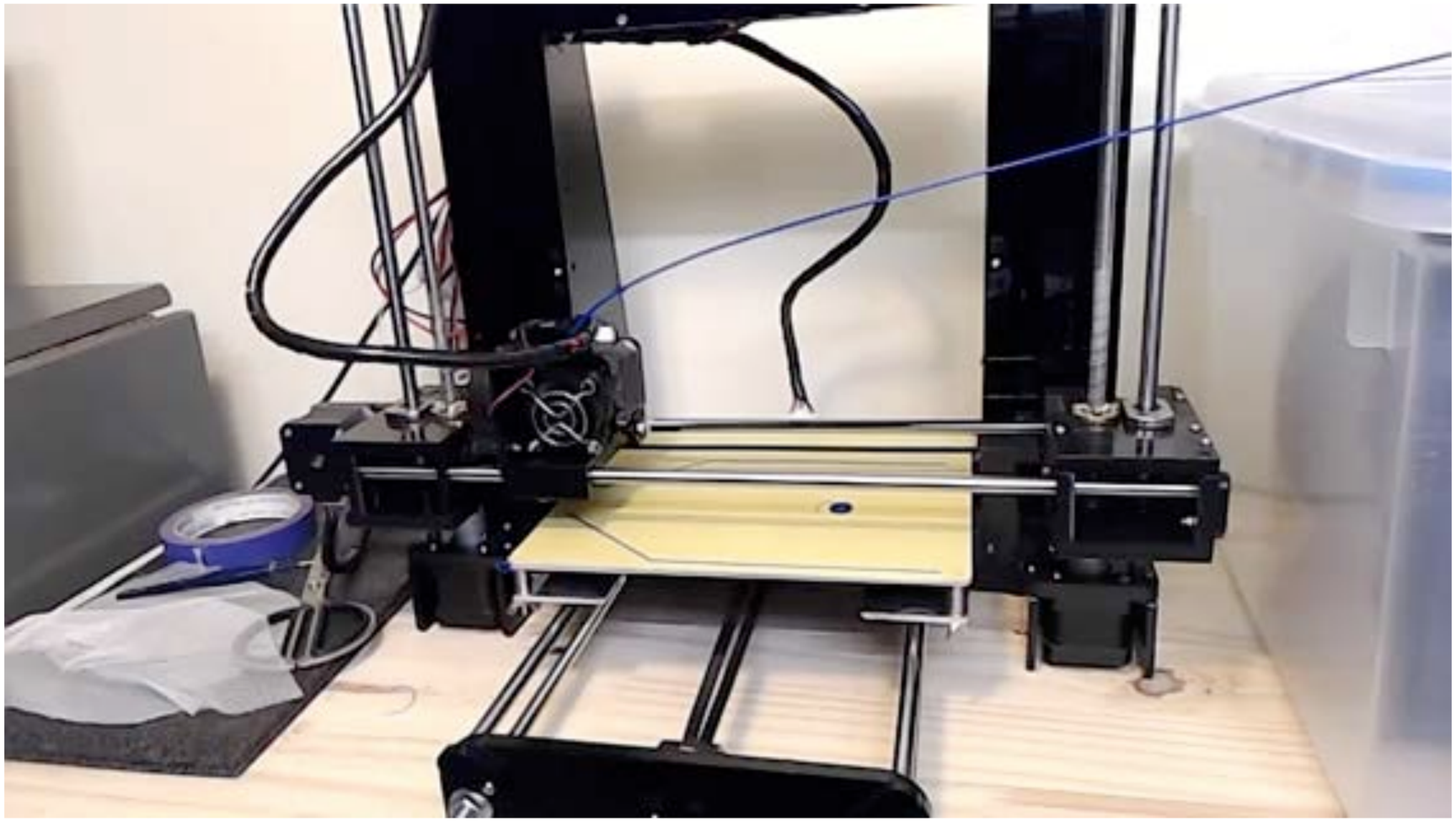

ALUNAR
3D Printer
http://www.alunar.net
printer ready.

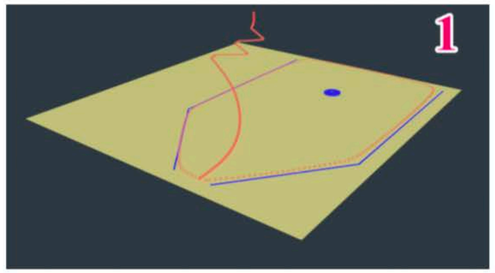




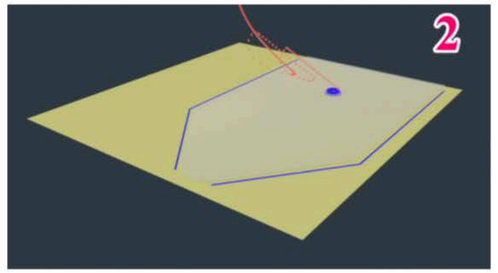
(a) The printer prints the bottom half of a snap and some guide rails. *Gesture 1* circles the area where fabric should go, the brings the print head up and to the back corner, double-nudging the print bed forwards near the end.



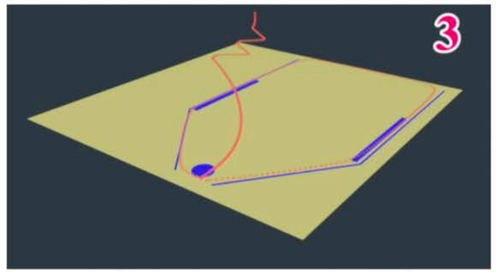




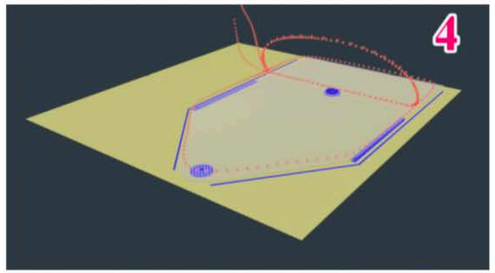
(a) The printer prints the bottom half of a snap and some guide rails. *Gesture 1* circles the area where fabric should go, the brings the print head up and to the back corner, double-nudging the print bed forwards near the end.



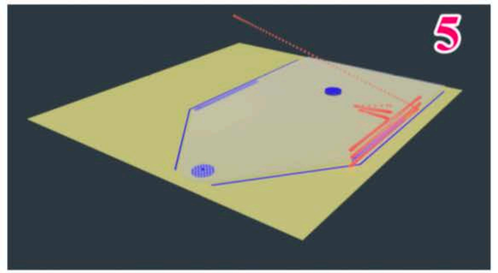
(b) The user places the fabric. The printer prints the top half of the snap. *Gesture 2* is a "scram" or "sweep" to indicate that the user should remove the fabric.



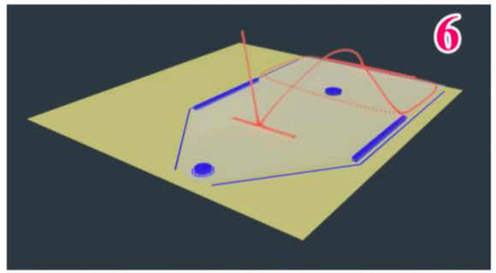
(c) The user removes the fabric. The printer prints the bottom half of the second snap and the bottom of the bars that will join the edges of the purse. *Gesture 3* is the same as Gesture 1, with a slightly different starting place.



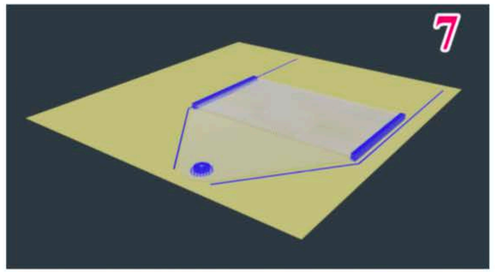
(d) The user puts the fabric back. *Gesture 4* tells the user to flip the fabric over.



(e) The user flips the fabric over. *Gesture 5* tells the user to go away – the next bit of printing takes longer than the others.



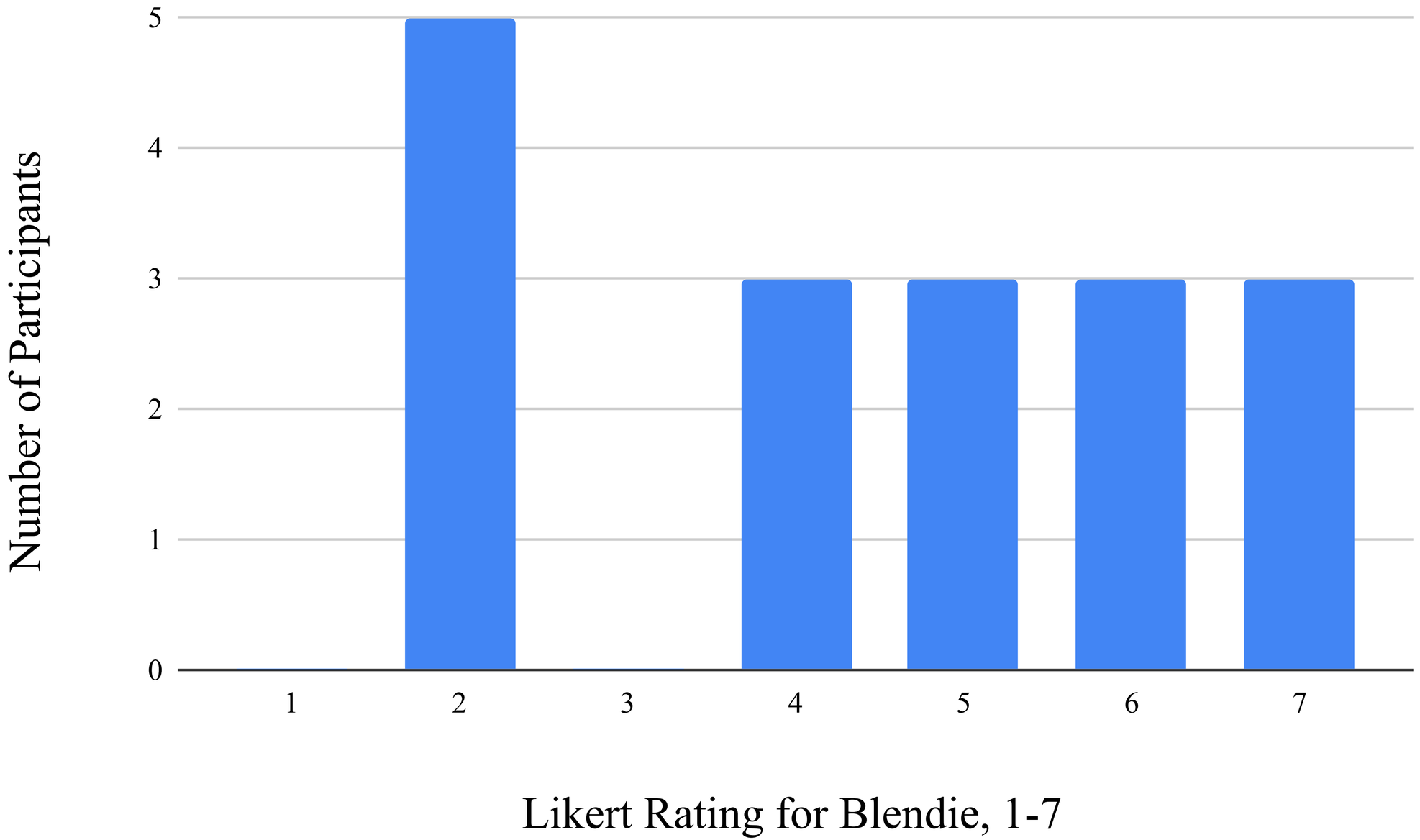
(f) The printer finishes the second snap and prints the thicker middles of the joining rails. *Gesture 6* tells the user to fold the loose edge of the fabric over onto the joining bars.



(g) The user folds the fabric and the printer prints the top half of the joining bars. The object is complete. *Gesture 7* is the printer's default "end of job" behavior.

#	Name	Gesture Type[s]	Strategy
1	Place Fabric	Iconic	Circle, Nudge bed
2	Remove Fabric	Metaphor	Sweep
3	Place Fabric	Iconic	Circle, Nudge bed
4	Flip Fabric	Deictic	Z-axis pointing
5	Wait	Metaphor	Retract bed, Shake "no"
6	Fold	Deictic	Tangent pointing
7	Job Over	(un-designed)	(un-designed)

(h) Table summarizing gesture types and strategies.


Number of Participants
5
4
3
2
1
0
1
2
3
4
5
6
7
Likert Rating for Blendie, 1-7

1. Fabrication machines can be interactive.
2. Interactive fabrication has a range of advantages from pragmatic to experiential.
3. Machine interaction can have character or narrative beyond the most efficient/ default way to produce something.