



HiDef Textiles: Reviving Tradition with Innovation

Empowering Creativity and Sustainability in Textile Production through Digital Transformation

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Reykjavík DataBeers: January 25, 2025

INDUSTRIAL ENGINEERING

The HiDef Textiles Project

This project made STEAM¹ fields accessible through innovation in textiles by combining artistic creativity and sustainability. The interdisciplinary collaboration involved the [University of Iceland](#), the [Iceland University of the Arts](#), and domestic companies and institutions.

- ▶ **90s Knitting Machine:** Transformed for modern users. The renewal process was used to teach technical literacy innovatively.
- ▶ **Objective:** Preserved traditions and brought them into a digital context.
- ▶ **Demonstration Tool:** Created a functional machine showcased locally and ready for further development.

¹S: Science, T: Technology, E: Engineering, A: Arts, M: Mathematics.

Knitterstream

An art performance at the C2-MTL conference in 2012, where tweets with the hashtag [#knitterstream](#) were knitted for the attending audience.

- ▶ Same type of knitting machine as my grandmother's.
- ▶ Software available on [GitHub](#).
- ▶ Drafts for improvements made at [FabLab Reykjavík](#) in 2014.
- ▶ Proper research project funded by the [Icelandic Student Innovation Fund](#) in summer 2024.



Participants |

Instructors

Hafliði FABLAB, UI

Hafsteinn Computer Science,
UI

Helga Industrial Eng., UI

Hörður Computer &
Electrical Eng., UI

Ragna Fashion Design, IUA

Students

Elli Mechanical Eng. and
Computer Science, UI.

Gísa Fashion Design, IUA.

Snæja Applied Mathematics and
Computer Science, UI.

Collaborators

Icelandic Textile Center A digital textile workshop in Blöndós, providing spare parts.

Ístex Supplies locally sourced yarn.

The Icelandic Handicraft Association and National Museum of Iceland Jointly published *Sjónabók*, which we use as base patterns for our work.

Marel A leading manufacturer of equipment for fish processing plants, offering expertise in industrial mechanics and technology.

Ýrúrarí Ýr Jóhannsdóttir, a renowned knitting designer, formerly worked with Passap but now works with Kniterate.

Owen Mace Retired electrical engineer from South Australia.

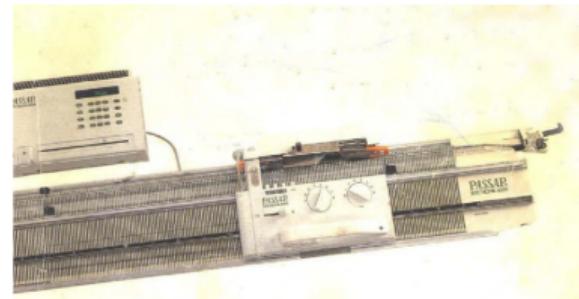
Machinery

PASSAP (PAtent Schnell Strick AParat), founded in Switzerland in 1939, was a leader in hobby knitting machines. They ceased production around the turn of the millennium.



Passap Duo 80

- ▶ **Motor:** Electra 3000
- ▶ **Color:** Manually switches 4 colors



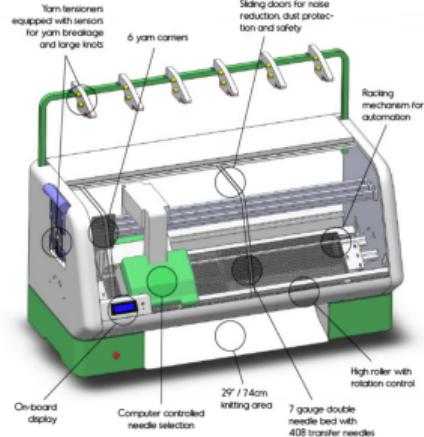
Passap E6000

- ▶ **Motor:** Electra 4600
- ▶ **Auto Color:** Automatically switches 4 colors

Kniterate, a digital knitting machine from Spain, designed for small-batch manufacturers and designers. Only two such machines in Iceland.

Advantage Originally a “hack” of similar 80s/90s knitting machines, it was launched on [Kickstarter](#) in 2017 (then priced at €4,500).

Disadvantage Long waiting list and expensive (priced from €16,000).



Knitting Patterns

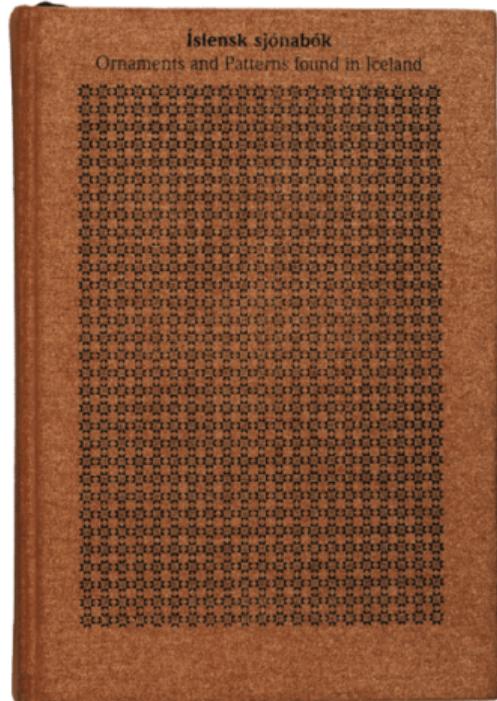


The Icelandic Sjónabók |

What is Sjónabók?

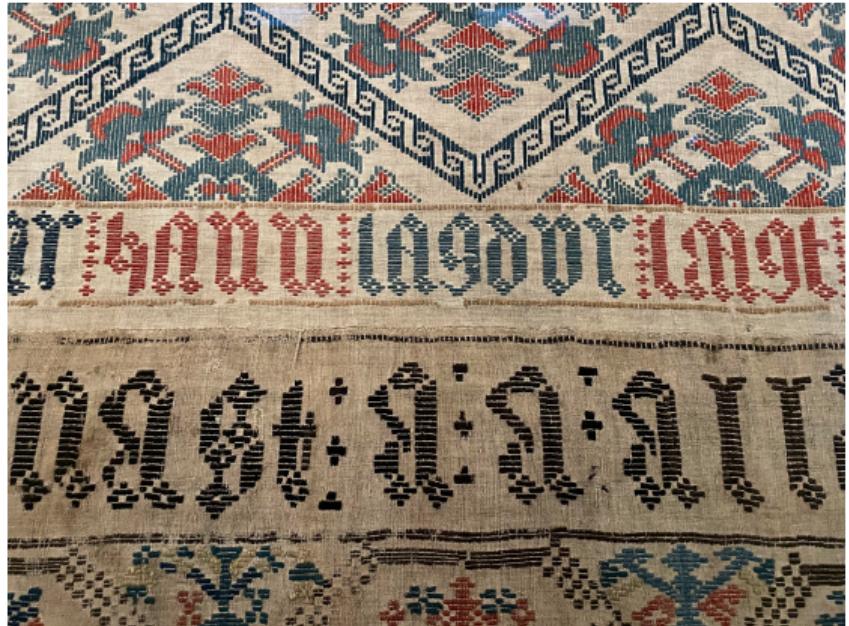
It is a culturally significant collection of traditional Icelandic patterns used in various handcrafted items throughout Icelandic history. This manuscript includes patterns from the 16th, 17th, and 18th centuries. Published in 2009, it contains 10 preserved manuscripts and is unfortunately out of print.

- ▶ **Translation:** The term “Sjónabók” can be translated as “Book of Visual Patterns.”
- ▶ **Content:** Contains patterns and motifs used in textiles, with text in both Icelandic and English.



The Icelandic Sjónabók II

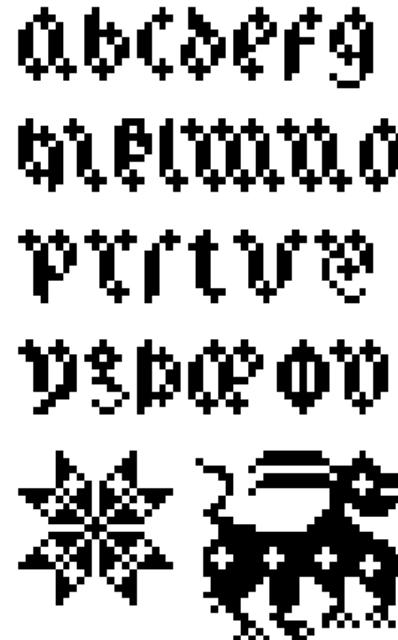
Figure: Passage from Hallgrímur Pétursson's *Passion Hymns*



The Icelandic Sjónabók III



The Icelandic Sjónabók IV



<https://github.com/HiDefTextiles/Sjonabok>

The background of the image is a collage of various hand-knitted swatches and traditional Icelandic tapestries. On the left, there are several panels of tapestry in shades of blue, yellow, and gold, featuring intricate geometric and floral patterns. On the right, there are numerous small, colorful knitted squares in various colors like orange, green, purple, and red, some with stripes or textured patterns.

Knitting Swatches



What better way to say we've arrived in the world of digital knitting than...

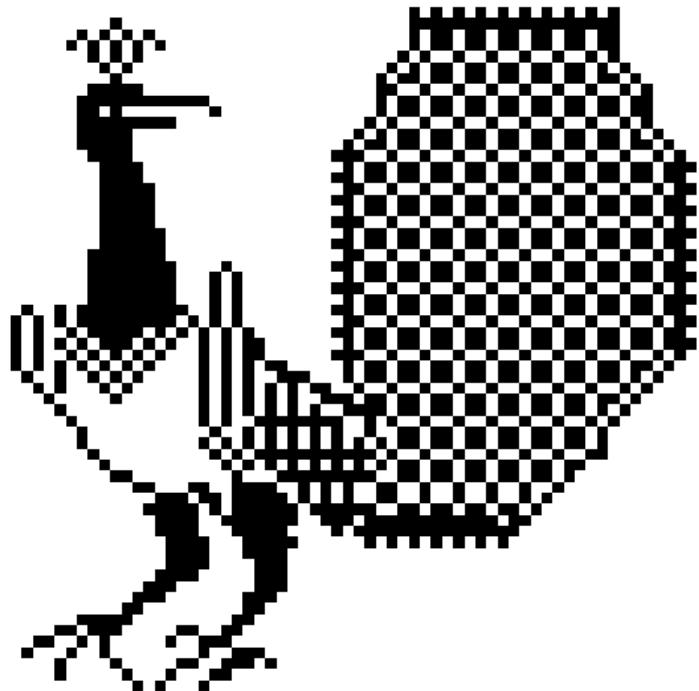
Figure: First try



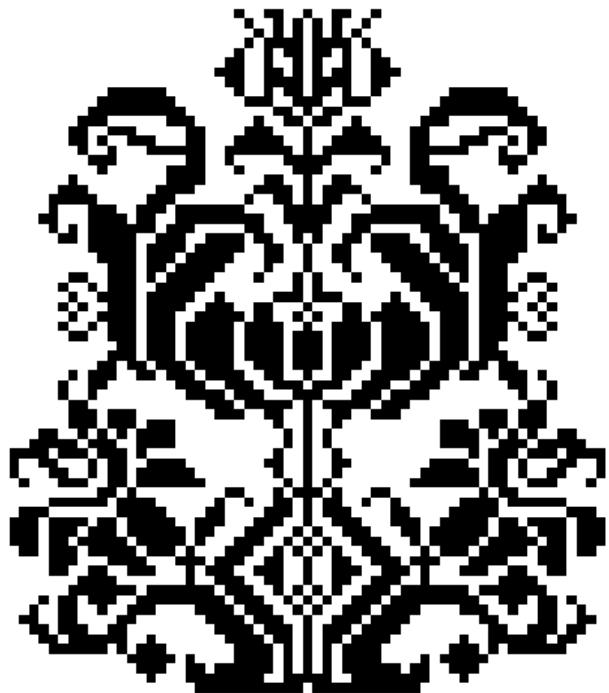
Figure: Second try (after mirroring)



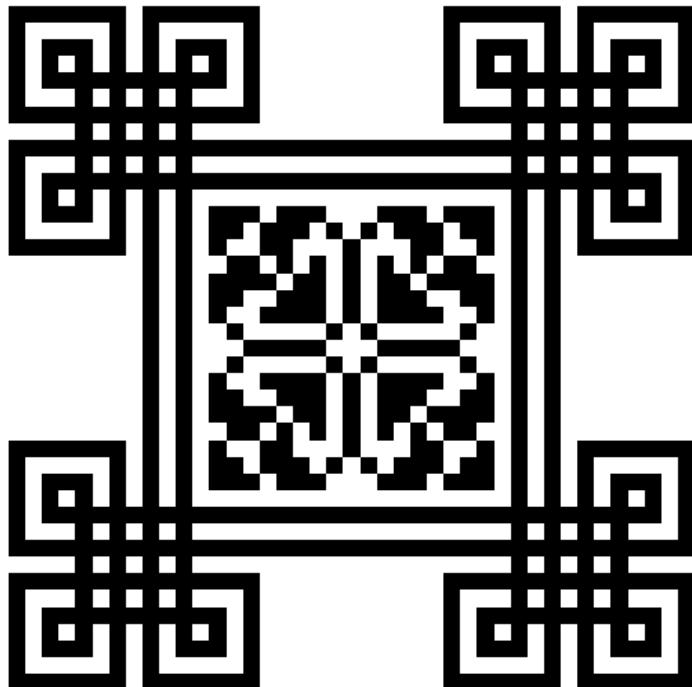
Icelandic Peacock



Icelandic Flower



Repeated Motif



Pets



Ragnheiður Jónsdóttir (1646–1715)



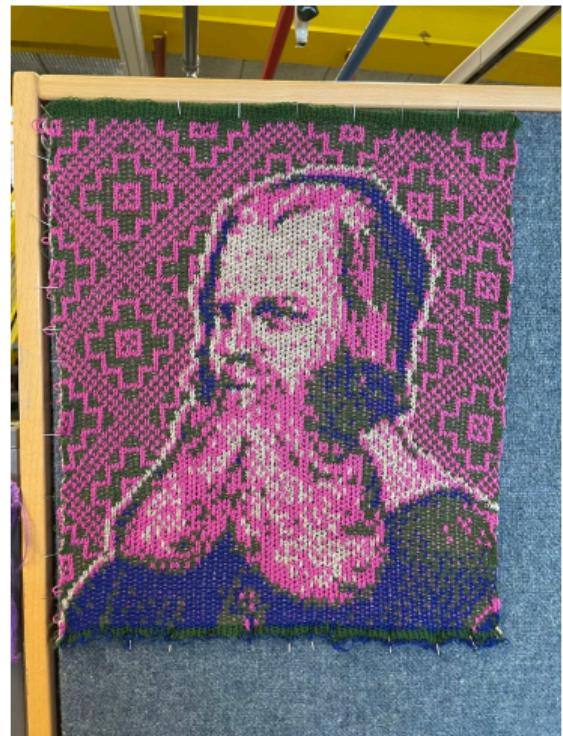
Bishop's Wife

Ragnheiður was a patron of the arts and crafts and played a pivotal role in preserving traditional Icelandic patterns.



Bishop of Skálholt

Brynjólfur was the Lutheran Bishop, renowned for his efforts in preserving Icelandic literary heritage. He contributed to the collection of Old Norse manuscripts, including **Book of Flatey**, and played a key role in naming the **Edda** collection.



The background of the slide features a collage of various traditional Icelandic tapestries and knitted items. On the left, there's a large blue tapestry with a yellow reindeer and a geometric pattern. In the center, several panels of a blue and yellow tapestry are visible. To the right, there are numerous small, colorful knitted squares in shades of orange, green, and red, some with intricate patterns. A few larger items, like a green striped garment and a red patterned cloth, are also part of the collage.

What Next?



- ▶ **Hardware Improvements:** While the machine is functional, there are kinks in hardware control, especially in color changes, requiring upgrades.
- ▶ **Pattern Workflow:** Experimentation with generative AI superimposed with **Sjónabók** patterns shows promise, but the workflow needs further refinement.
- ▶ **Future Vision:** Hardware upgrades to make the more common Duo 80 model as capable as the E6000 would be a significant advancement.

Generative Patterns

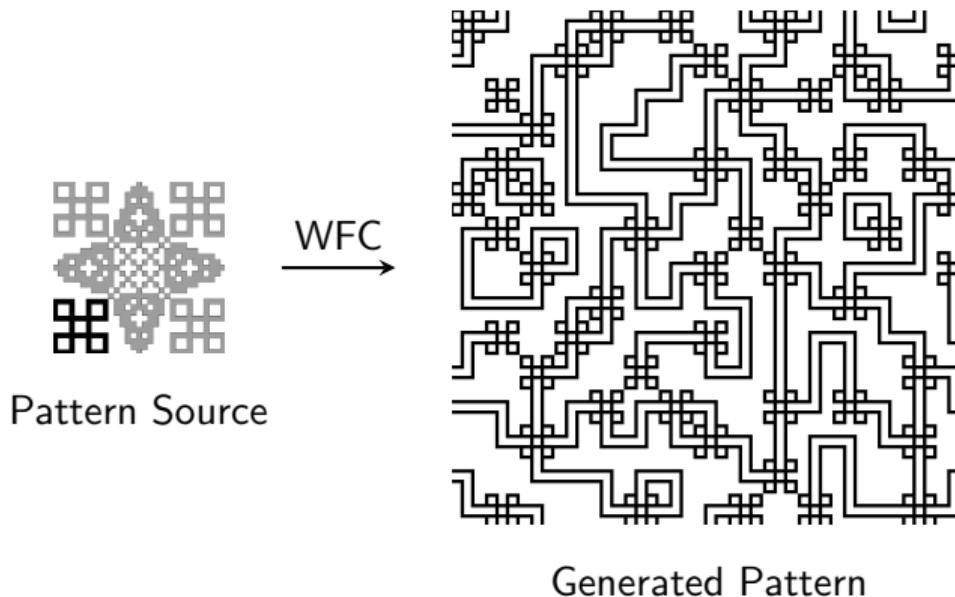


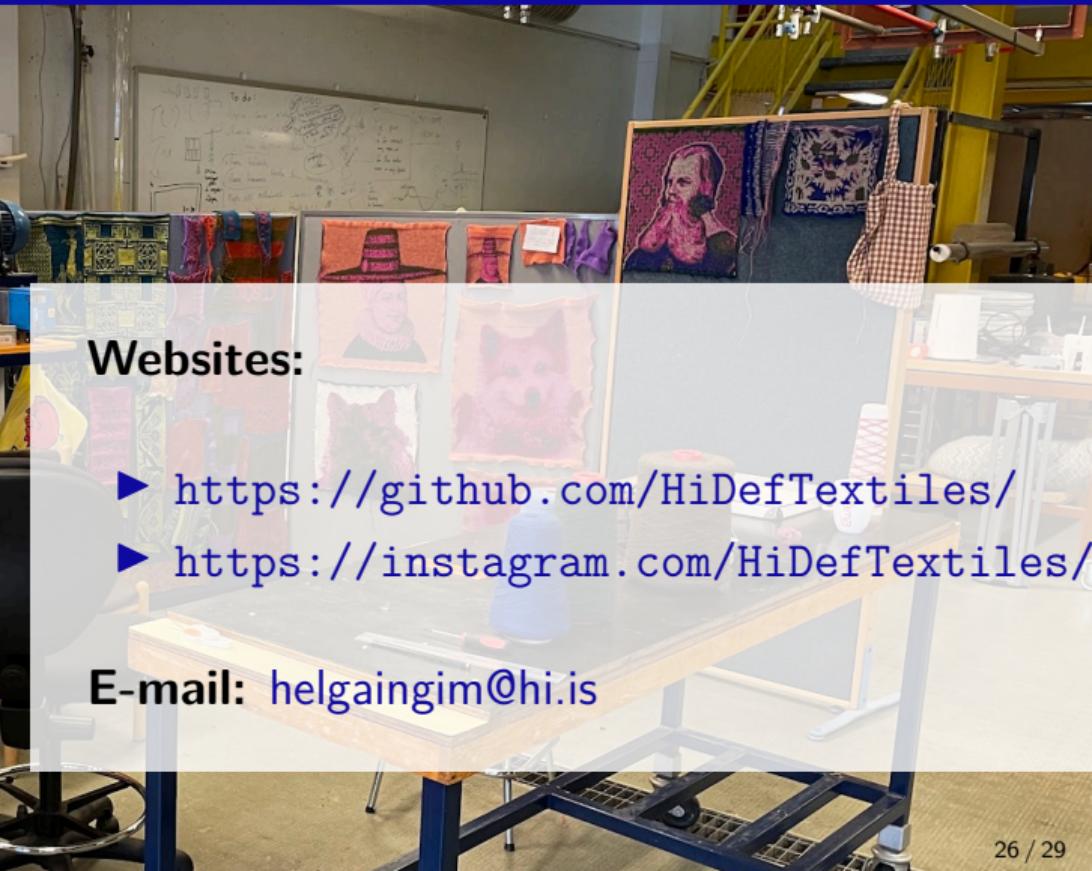
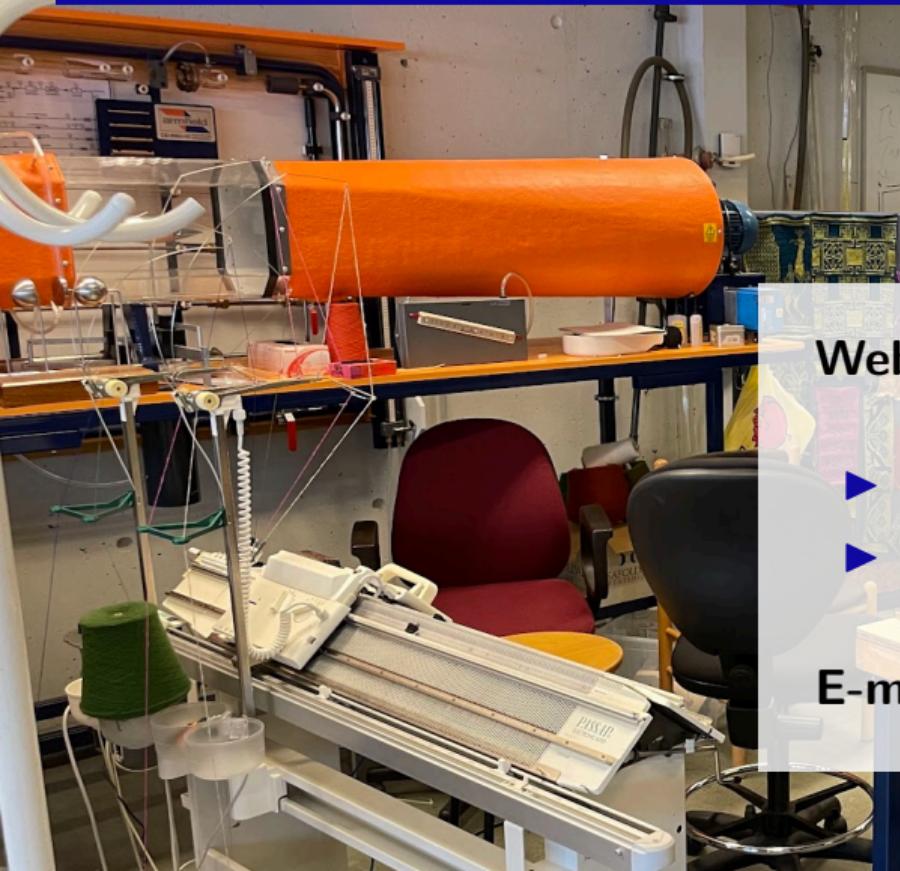
Figure: Preliminary experiments using generative algorithms, like *Wave Function Collapse* (WFC), to create novel patterns inspired by traditional *Sjónabók* motifs.

Where Can You See the Machine in Action?

- ▶ **2024:**  Visindavaka
- ▶ **2025:**  UT|messan.
- ▶ **2026:** Planned for Design March and a summer residency at The Museum of Design and Applied Art.



Get in Touch



Websites:

- ▶ <https://github.com/HiDefTextiles/>
- ▶ <https://instagram.com/HiDefTextiles/>

E-mail: helgaingim@hi.is

Knitting One Row: Translation Function

$$[1, 2, 2, 3, 4] \xrightarrow{\text{translated}} \begin{bmatrix} [1, 0, 0, 0, 0], [1, 0, 0, 0, 0], \\ [0, 2, 2, 0, 0], [0, 2, 2, 0, 0], \\ [0, 0, 0, 3, 0], [0, 0, 0, 3, 0], \\ [0, 0, 0, 0, 4], [0, 0, 0, 0, 4] \end{bmatrix}$$

Explanation:

- ▶ Numbers 1, 2, 3, 4 specify the active color for knitting (max 4 supported).
- ▶ A 0 indicates a passive needle position (stitch not knitted in that pass).
- ▶ Each row requires 8 passes: one round trip for each color.

Stitch Pattern to Machine Commands II

HelgaDef PASSAP-API

tenging virk
api
[Búa til munstur](#)
[Streyma munstrum](#)

Núverandi munztur

| nr | -10 | -9 | -8 | -7 | -6 | -5 | -4 | msg |
|----------|----------|----------|----------|----------|----------|----------|----------|-----|
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 2 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |
| 3 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 5 | 0 | |
| 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |

Línu númer: **4/10** Búnar
Númer línu
5

Breyta

Fjöldi munstra: 1

Eyða munstri

Start:Byrjunarnál

Sækja streymi úr gagnagrunni

Figure: Administrator interface of the controller

Motor Circuit Integration

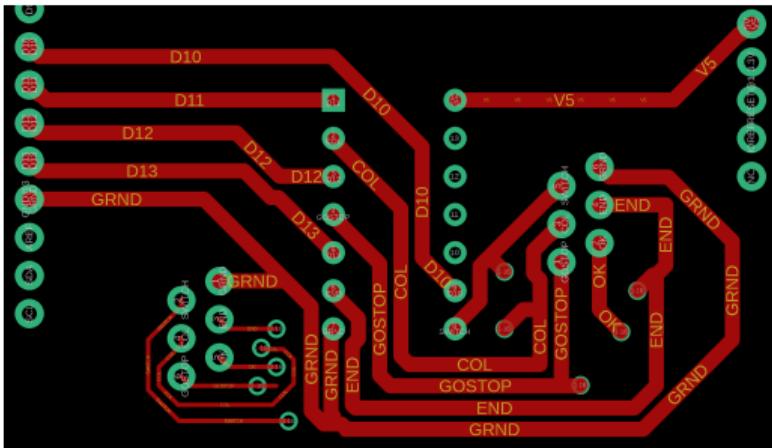


Figure: Circuit diagram connecting an *Arduino* to a 7407N chip, which interfaces with a 6-pin RJ12 connector to control the motor.

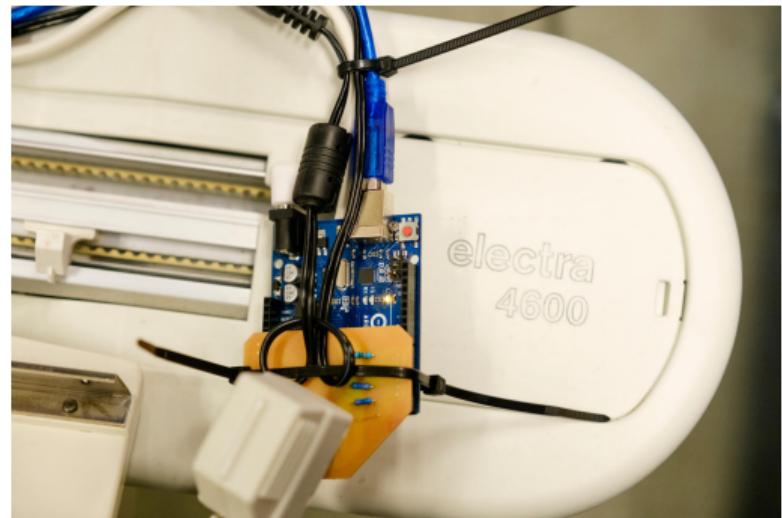


Figure: The physical circuit implementation on the knitting machine.