



P O R T F O L I O
O F
P R A C T I C E

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Master of Research 2019
The Glasgow School of Art



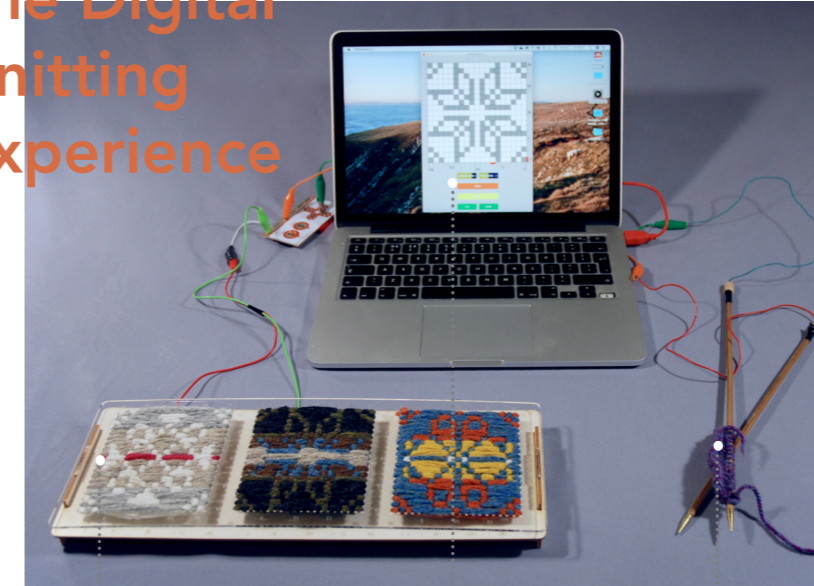
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The Digital Knitting Experience



THE KNITERATOR:

DIGITAL KNITTING NEEDLES:

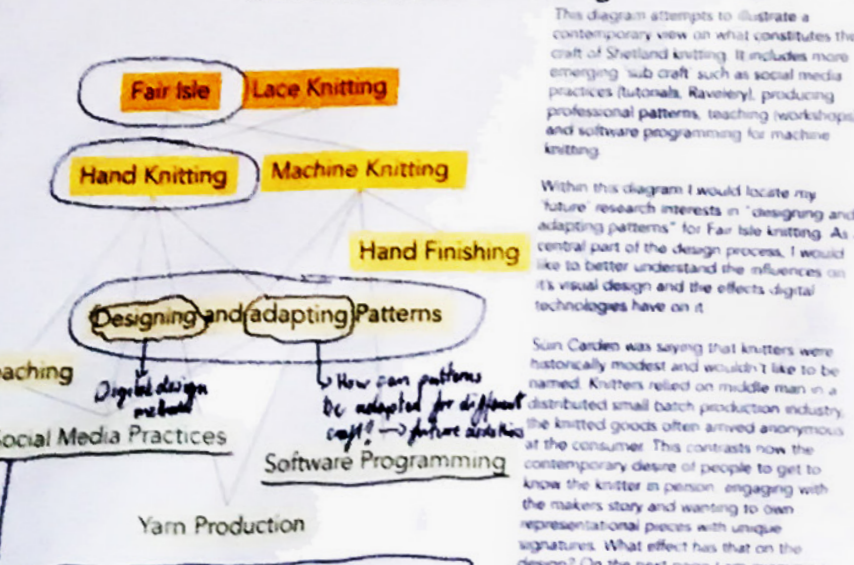
INTERACTIVE FAIR ISLE SWATCHES

1. Reading the Portfolio

The point of departure in the thesis is the analysis of the first engagement on Shetland. This portfolio intends to show the design process of the prototypes next to the research insights that they embody. Together they form a digital knitting experience which challenges the traditional design process and provide a playful way of exploring future design approaches for digital tools in Fair Isle knitting. The development is shown chronologically from ideation, to a design and development phase, to the point where they are reintroduced to the context in Shetland. This linear order is chosen for greater clarity when reading the portfolio although some design stages occurred at slightly different times during the research process. If this is the case, I will direct the readers attention to it. Nonetheless, it will be possible to read the portfolio in one go without referring to the thesis. At the end of the portfolio on page 29 is an USB stick, which contains materials such as a copy of the knitting software and a short video demonstration of the prototypes. After this the reader can resume with the thesis.

RESEARCH & PROTOTYPING

Where in His List does innovation take place? Craft Skills of Shetland Knitting



This diagram attempts to illustrate a contemporary view on what constitutes the craft of Shetland knitting. It includes more emerging 'sub craft' such as social media practices (tutorials, Ravelry), producing professional patterns, teaching (workshops) and software programming for machine knitting.

Within this diagram I would locate my 'future' research interests in 'designing and adapting patterns' for Fair Isle knitting. As a central part of the design process, I would like to better understand the influences on its visual design and the effects digital technologies have on it.

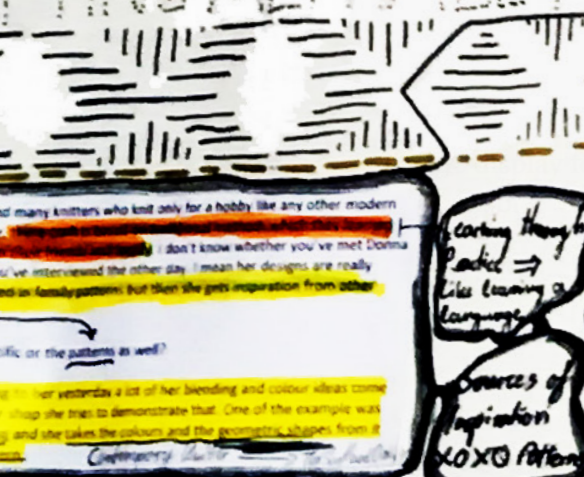
Sun Garden was saying that knitters were historically modest and wouldn't like to be named. Knitters relied on middle man in a distributed small batch production industry. The knitted goods often arrived anonymous at the consumer. This contrasts now the contemporary desire of people to get to know the knitter in person, engaging with the makers story and wanting to own representational pieces with unique signatures. What effect has that on the design? On the next page I am examining possible influences on Shetland design.

PERSONAL LEARNING

...the most of the learning on Shetland was done through word of mouth. ... I learned quite a lot of things from ...

Shetland knitters are being innovative in the use of new technologies and communication channels.

KNITTING ALPHABET



...sources of inspiration ... XOXO pattern ...

PRESENCE INSTANTLY OVERLAYS WITH PAST TEACHING PEEIE MAKERS

...I did avoid having never knitted he would have not known how to knit. It was woven work, but we going back to my mum, once you get started you wear sprays at home, you don't have a job, the house was your job and they've worked hard with the knitting and they've earned very little. It was the class labour basically. 10 55

...I would think we're the lady to make that belonged to that was so her pattern. It was her pattern as well. I had a friend who had a shop and she used to knit it, and that was her pattern and the colours. Everybody had their own style. But you certainly would have a good fair the generation before.

CONFLICT BETWEEN RURAL & URBAN CONTEMPORARY & TRADITION

TRADITION CHANGES OVER TIME

...I think it depends a lot on the reasons why people choose to do crafts, many do it once they are retired and it is some form of supplementary income. ...

DOING CRAFTS COMMERCIALY

I think it depends a lot on the reasons why people choose to do crafts, many do it once they are retired and it is some form of supplementary income. ...

FUTURE HAND-KNITTING

...I think for me the interesting bit was to get all the hand knitters together. ...

CRAFT TOURISM

The workshops are great, you can get full workshops and they are buying what you're selling too. ...

DESIGNER & MAKER

...I think they are mostly knitter, or interested in knitting. ...

DESIGN PROCESS

...there is an ad-hoc quality to it and that means you get individuals who kind of really are being famous for being good at this kind of stuff. ...

DISTRIBUTED DESIGN PROCESS

...one of the designers describes giving the knitters a bag of colour and a swatch and a back. ...

PASSING ON SKILLS

...and will tell you about the first thing they remember knitting and that's usually fair isle. ...

QUALITY WOOL WEEK VS. SOCIAL MEDIA

...wool week designs and in fact the whole wool week being quite important for some individuals who have become knitting pattern designers. ...

NEW ROLE OF KNITTERS

...you can see individual people, who have taken on a new role, which hasn't existed before. ...

ORIGINS / OFFLINE INTERACTION

...wool week designs and in fact the whole wool week being quite important for some individuals who have become knitting pattern designers. ...

DESIGNER?

...I think you could say that I find it a really interesting one because of course Shetland who use Ravelry and use YouTube to learn stuff. ...

Perspectives on Shetland Hand Knitting

Interview Bullet Points
Topics: History / Perspectives on Knitting Community, Learning/Teaching, Authenticity, Innovation and Tradition, Design Process, Inside vs. Outside Perspectives.

Local Knitter
Missing Perspective
Anecdotal Evidence

Researcher, Knitter
Contemporary Shetland Knitting Culture
What is being lost is more than technical skills. Oil and gas accelerated inevitable change. Design process was always ad-hoc, fluid, improvisational.

Museums Curator, Knitter
Craft Documentation and Preservation
Need to document specialised expertise. Digital archive as learning resource.

Design Process
History of Shetland Knitting
There is not definition of what 'authentic' Shetland knitting is.

Local Jeweler and Knitter
Contemporary Craft Experiences
Doing craft for a living
Teaching in workshops
Mainly selling to visitors and tourists
Wool Week has been a godsend
What is innovative and contemporary knitting?
Believes there is no forum to discuss the future of knitting
'Bored' of repetitively making things because of demand
Thinks knitting patterns and colours haven't changed much
Appropriating knitting techniques for jewellery making
Visitors seek small town belonging - want personal contact and familiarity - often get in touch via social media prior to visit

Believed knitting shouldn't be taught in schools -> only leads to wrong motivation.

Design Process
...there is an ad-hoc quality to it and that means you get individuals who kind of really are being famous for being good at this kind of stuff. ...

...one of the designers describes giving the knitters a bag of colour and a swatch and a back. ...

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/// The lairds, they'd never gi them cash, they'd take their stuff which was knitted and gi them goods from the shop. [...] And for the fisherman they were fishing for the laird but they never got the money either it was always just the goods. So basically they kept them where they wanted them, it was a bit like slaves really. And call them a different name but they were basically slaves to the laird. You had to sell it to them you didn't have an option. (Local Knitter Ida)

Although, this portfolio looks at possible roles for digital technologies in Fair Isle knitting and seeks to challenge the traditional design process, it is embedded in a wider narrative of insights that emerged during the first visit to Shetland. It is beyond the scope of this study to consider all of them. However, two relationships deserve brief elaboration. Firstly, the revival of Shetland knitting has brought opportunities for knitters to explore new roles and approaches in their heritage practice, but also introduced tensions with influences such as craft tourism and differing perceptions around the meaning of tradition, innovation and authenticity. Secondly, the fear of skill loss has been linked to losing the Shetland way of life. Suggesting, it is more than the technical skills but a common identity that is threatened by a decline of knitters. As someone from outside Shetland I tried to recognise these sensitivities while designing the provotypes and presenting them to Shetland knitters.

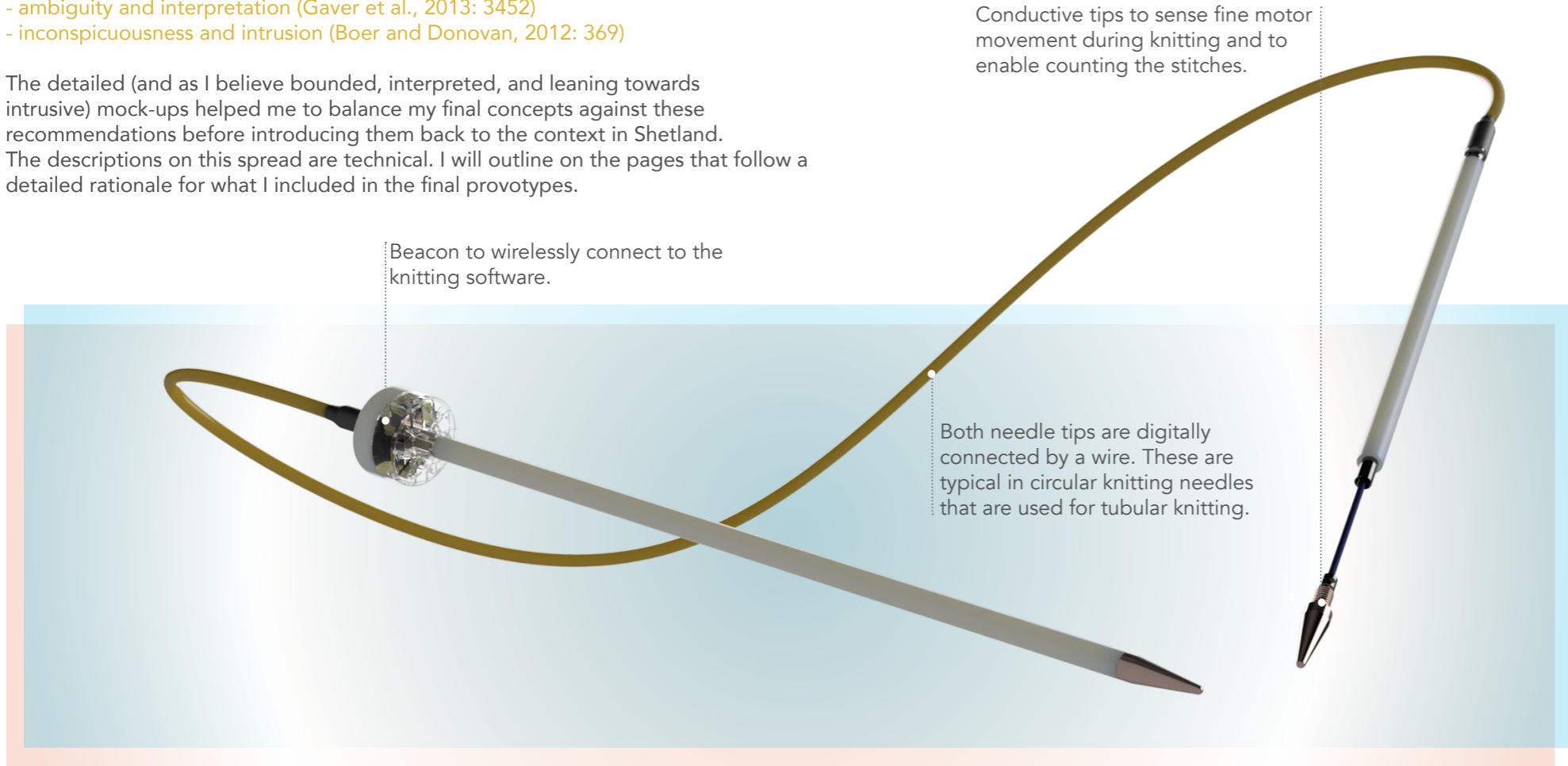


4 PROVOTYPING

After the initial phase of ideation, I developed detailed concepts for the digital knitting needles and for the Fair Isle software. As outlined in the literature review 3.3 *Two Accounts of Prototypes as Means of Inquiry*, I intended to consider especially the design recommendations of balancing;

- openness and boundedness (Wallace et al., 2013: 3444)
- ambiguity and interpretation (Gaver et al., 2013: 3452)
- inconspicuousness and intrusion (Boer and Donovan, 2012: 369)

The detailed (and as I believe bounded, interpreted, and leaning towards intrusive) mock-ups helped me to balance my final concepts against these recommendations before introducing them back to the context in Shetland. The descriptions on this spread are technical. I will outline on the pages that follow a detailed rationale for what I included in the final provotypes.



Beacon to wirelessly connect to the knitting software.

Conductive tips to sense fine motor movement during knitting and to enable counting the stitches.

Both needle tips are digitally connected by a wire. These are typical in circular knitting needles that are used for tubular knitting.



Size of motif in stitches.

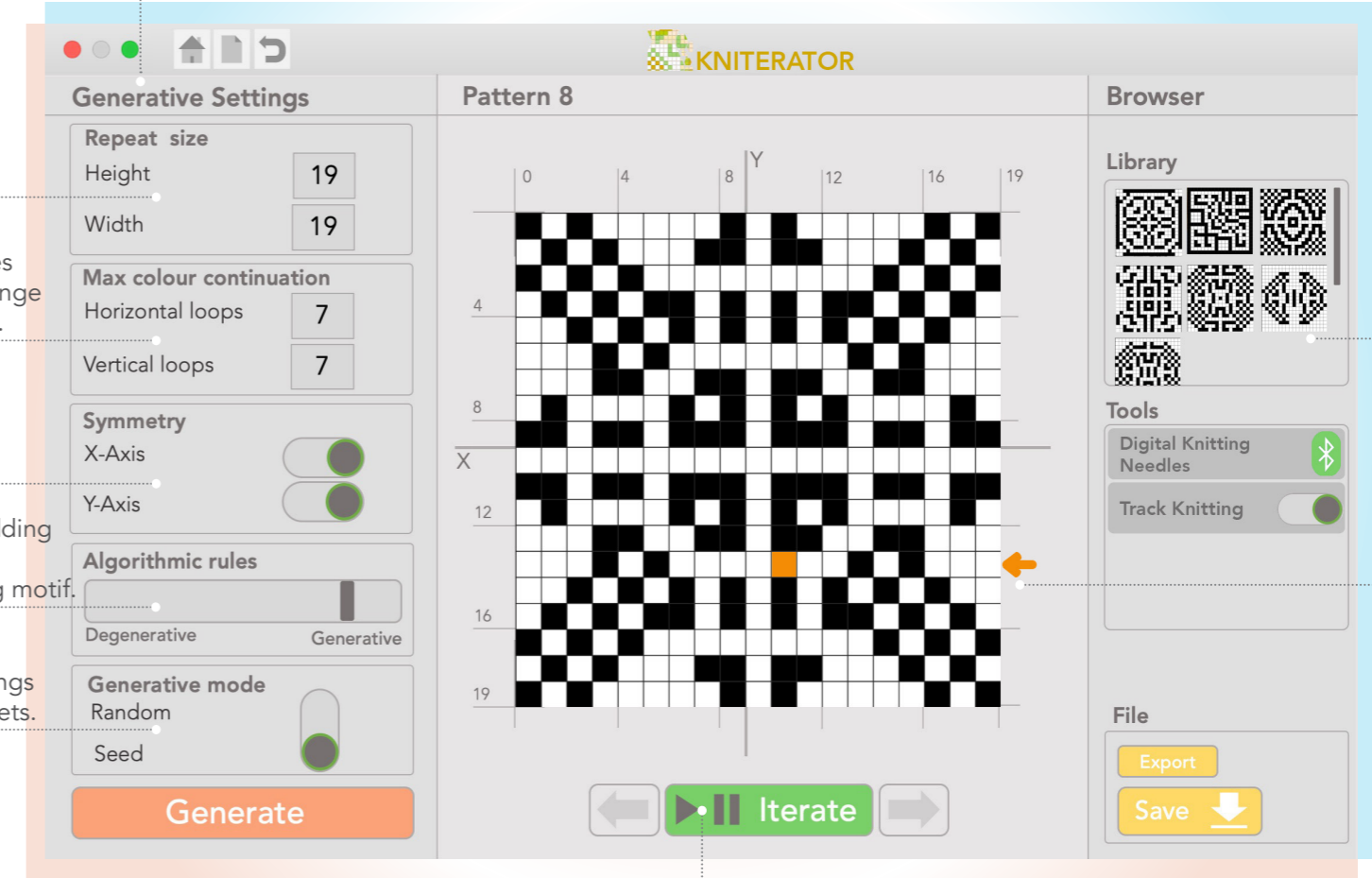
Number of stitches after which to change colour of the yarn.

Horizontal and vertical symmetry of the motif.

Algorithmically adding or removing more cells of an existing motif.

Generating motif with random settings or based on pre-sets.

I added an algorithmic method for exploring new motifs for Fair Isle patterns. The rationale is provided on page 16.



A library of motifs designed with the software.

The concept included the previously described interface that shows the current position in a knitting pattern.

Iterating a motif based on the generative settings.



It is the knitting in the round and the long double pointed needles, the Fair Isle is two colours in the row and not any more than that. [...] in Fair Isle the traditional way is you hold one colour in each hand. (Shetland Knitter Claire)

The first prototype of the digital knitting needles used a wire and conductive copper tape wrapped around the tips.

An experiment of combining traditional Shetland wool with solder wire.

A sample swatch that I knitted to better understand the technique of stranded knitting.

I prototyped the concept of a device that would tap a pattern on the hand while knitting. However, I disregarded it due to complexity and because it would have foregrounded a product development approach.

As aforementioned, the needles were made prior to the first visit to Shetland and led to the emergent prototyping approach that frames with this inquiry. I designed the needles during a phase of experimentation in which I engaged as I was readjusting the research focus. In this phase I played with the traditional techniques, tools and materials. Some of these Fair Isle experiments are shown in this page and give insight into this process.

Bamboo Rod Thin Steel Wire Laced Metal Tips

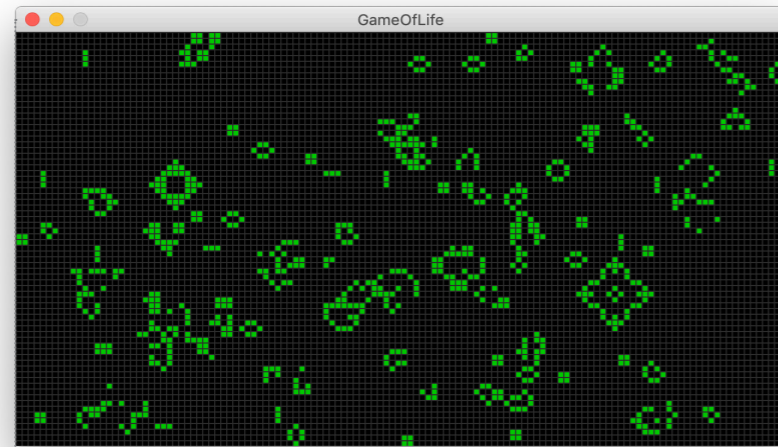


4.2 Kniterator Evolution ////////

/// [...] a lot of those designs are really based on family and were handed down from mother to daughter. Some would go way back! [...] They've seemed to be around forever. (Knitting Academic Aine)

I intended to challenge the family and placed based origin of knitting motifs. This provocation aimed at an aesthetic level but also at the parameter of time and the feeling of designs being 'around forever'. I therefore decided to explore the use of algorithmic design approaches to generate new aesthetics, but also to challenge the component of time by rapidly producing alternatives of a motif. The algorithm was meant to symbolise a "placeless" origin of designs and encourage negotiation of new meaning by being contradictory to the Shetland based approaches. Central to the design considerations was following a playful approach that would encourage experimentation and limit the perception of being intrusive in a negative sense.

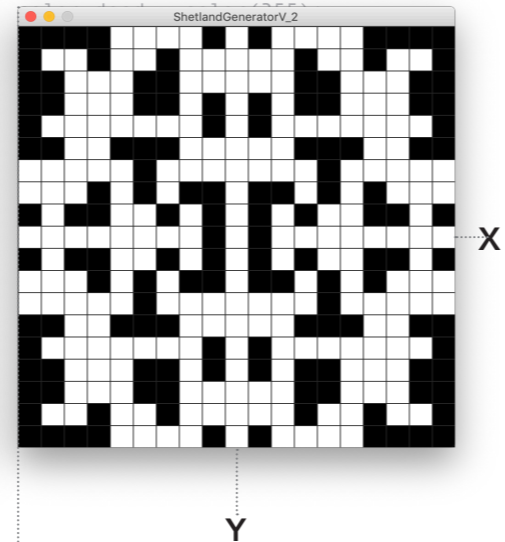
```
import controlP5.*;
int offset = 30;
ControlP5 cp5;
int GenerativeValue = 2;
int IterativeValue = 2;
int square = 475;
int myFairIsle = 1;
int myReset = 1;
int mySave = 1;
int myReload = 0;
```



First, I explored an algorithm called "Conway's Game of Life", a piece of open source software, which creates random populations of cells and then calculates based on the amount of neighbours which population of cells multiplies or dies. As done with mechanical artefacts in my PDE practice, I reverse engineered the algorithm by separating it in its subcomponents. I then reassembled them in a way to make the concept of generative design meaningful for Fair Isle knitters.

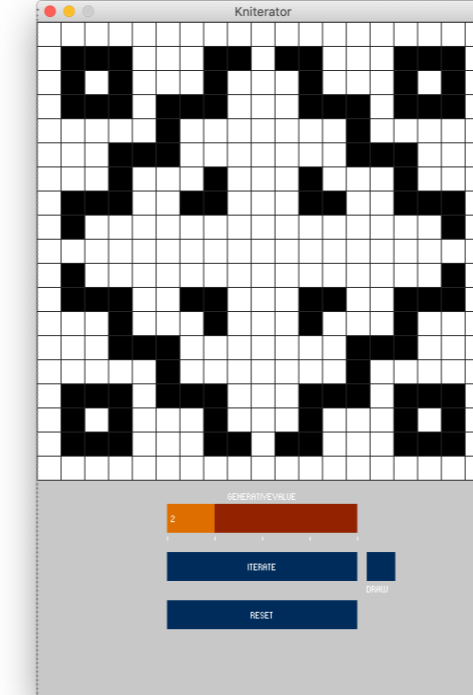
```
int cellSize = 25;
int interval = 500;
int lastRecordedTime = 0;
int imageCount = 0;
int stitchCount = 0;
int rowCount = 0;
ControlWindow controlWindow;

Canvas cc;
color alive = color(150);//36,108, 155
```



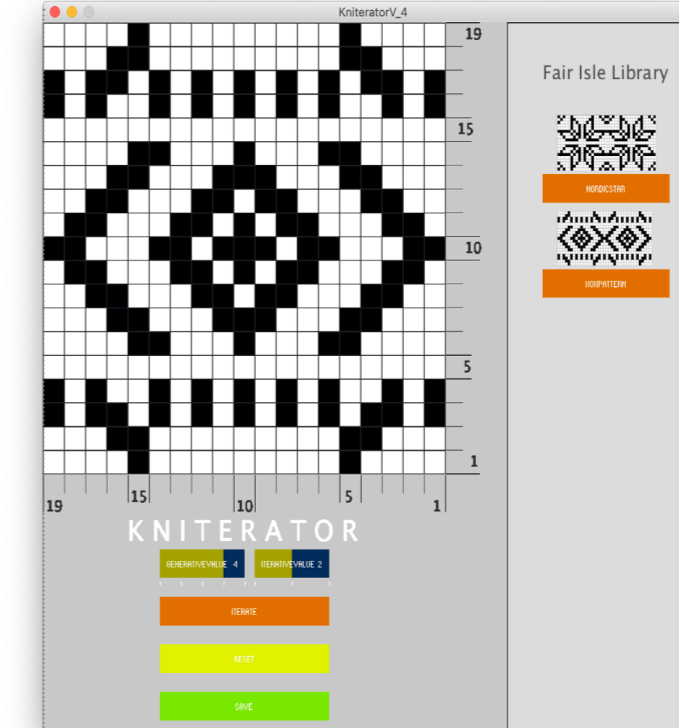
I limited the columns and rows of the matrix to a number that would be suitable for a single repeat motif of a Fair Isle pattern. In the Fair Isle knitting practice, repeat patterns would not always be square and of different sizes but I limited myself to this approach to communicate the principle rather than propose plenty of functionality. I then picked an uneven number of stitches to allow symmetry around the centre X and Y axis and removed the randomness in the algorithm.

```
if (cellsBuffer[x][y]==1) {
    int generateValue = 6-generativeValue;
    if (neighbours < 2 || neighbours >
        generateValue) {
        cells[x][y] = 0; // Die unless it
            has 2 or less than generateValue
    }
}
```



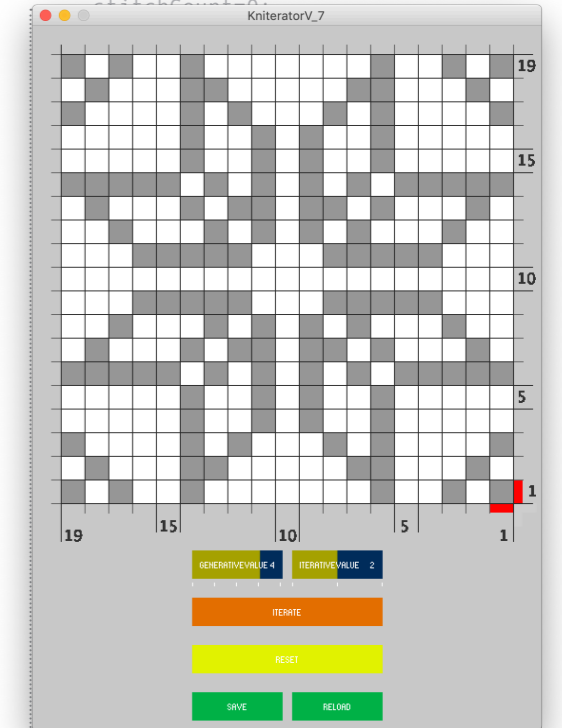
In this iteration, I added a visual interface including a slider with which the mathematical rule of the algorithm could be changed. This was done to illustrate to knitters that the algorithm can be modified and is open for adaptation.

```
public void Reload(int theValue) {
    println("a button event XOX: "+theValue);
    myReload = theValue;
    if (myReload == 1){
        for (int x=0; x<square/cellSize; x++) {
            for (int y=0; y<square/cellSize; y++) {
                cells[x][y] = fairIsle[x][y];
            }
        }
    }
}
```



Aside of improvements to the visual interface, I added a library of traditional Fair Isle motifs. These could be loaded into the matrix. The intention was to show that the generative algorithm could not only be used to create motifs from scratch but also to modify existing ones.

```
if (key == CODED) {
    if (keyCode == UP) {
        stitchCount ++;
        if (stitchCount == 18){
            rowCount++;
            if (rowCount == 19){
                rowCount = 0;
            }
        }
        if (stitchCount == 19){
            stitchCount = 0;
        }
    }
}
```



The final iteration of the software includes an interface that counts the stitches and rows by being connected to the digital knitting needles. The Fair Isle pattern library was removed in favour of a tangible interface consisting of the interactive Fair Isle swatches. The swatches will be elaborated on in the pages 19-23. I also simplified the library interface to make it more open for interpretation. A manual of the software is provided on the next page.

4.2.1 Kniterator Manual

This page provides a user manual for the Kniterator alongside a detailed description of the individual functions. Please refer back to this page when using the software which is provided on a USB stick in page 29.

LOADING A TRADITIONAL PATTERN

A traditional motif can be loaded into the matrix by touching the interactive Fair Isle swatches, as elaborated later on, or by pressing the key 'a' for an example motif.

MODIFYING MOTIF

Cells can be added or removed from the matrix as long as the program is not iterating. This is can be manually done by clicking on the individual cells or by using the algorithmic iterate function.

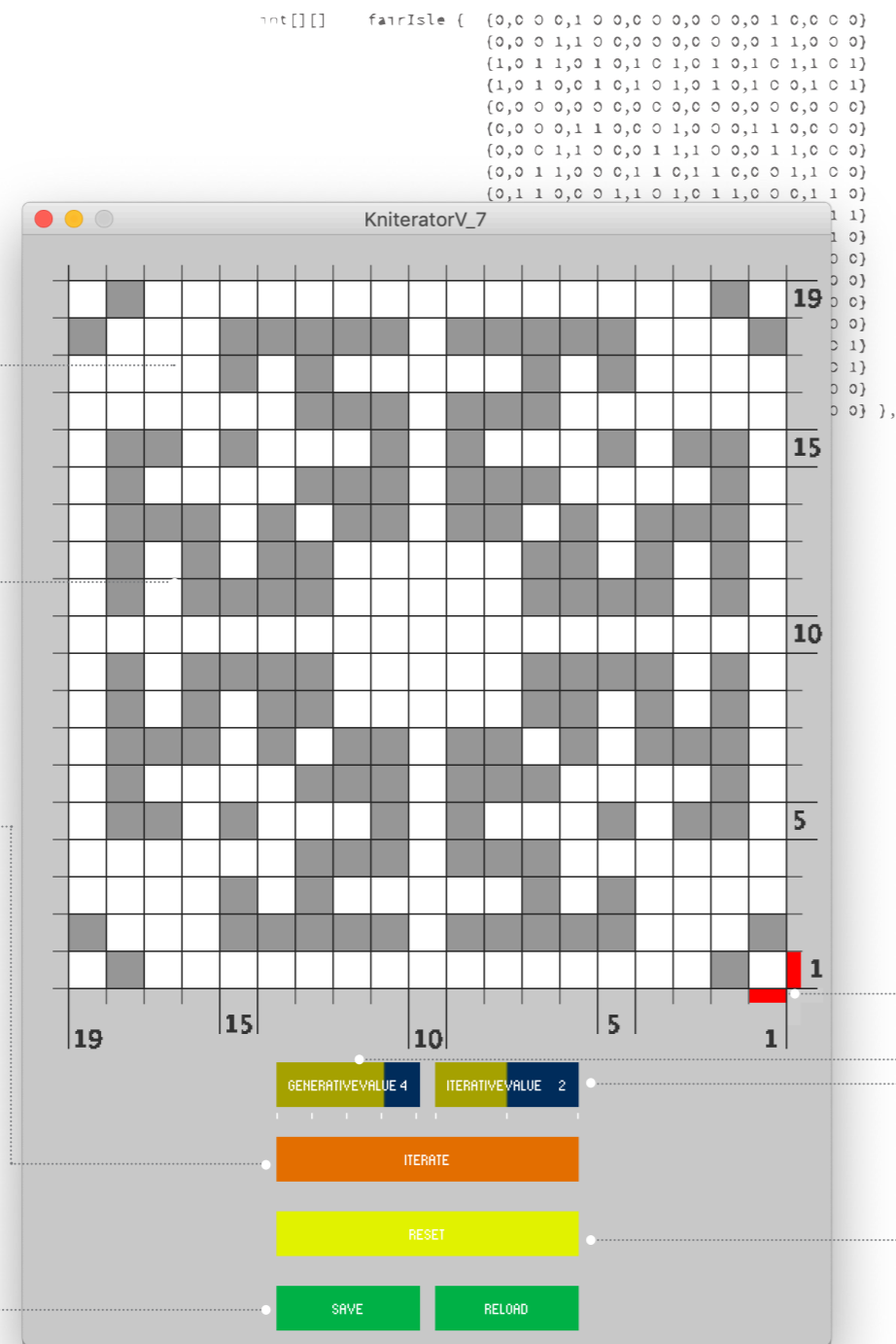
ITERATE BUTTON

Pressing the iterate button is used to start or stop the iteration process. In order to draw with the mouse in the matrix, the process has to be paused. Alternatively, one can press 'spacebar' to iterate and pause.

SAVE & RELOAD BUTTON

By pressing save the current pattern will be stored and can be reloaded at any given point by pressing reload. Pressing save again will result in the previous pattern being overwritten.

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STITCH AND ROW COUNT

The red bars will move along the columns and rows when knitting to help navigating a pattern. This can be also be simulated by pressing the UP ARROW.

ITERATIVE VALUE SLIDER

The higher the iterative value the longer the program will keep on changing the motif. A low iterative value will result in a quickly resolved motif.

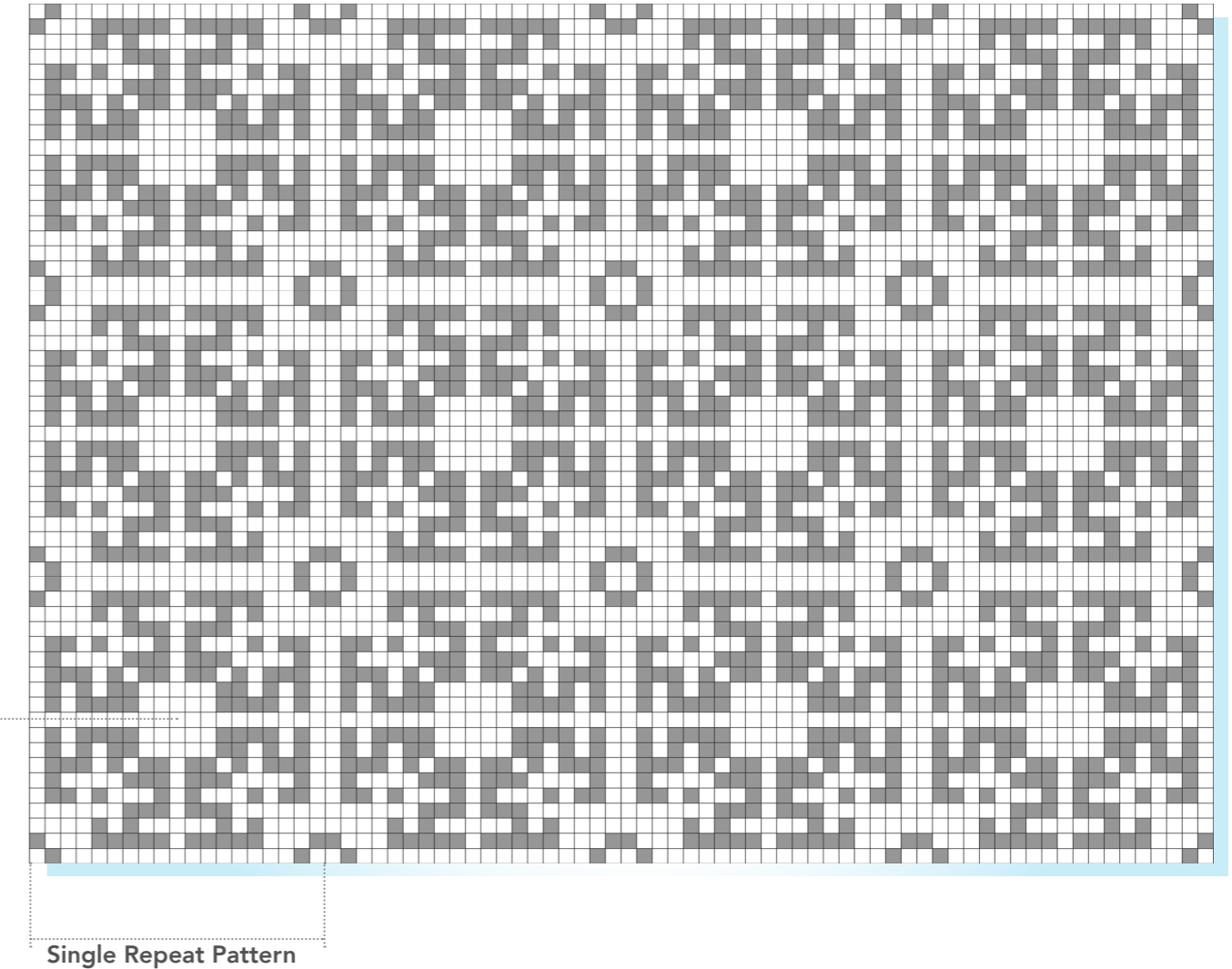
GENERATIVE VALUE SLIDER

A high generative value will add more cells to the matrix in proportion to existing ones. A low generative value will remove cells from the matrix.

RESET BUTTON

Pressing the reset button will empty the matrix. Alternatively you can press the key 'c'.

/// [...] if people did make charts, made motifs on paper, they did it in black and white because they didn't want to be influenced in a particular colourway, so they used the same motif over and over in perhaps 10 different colourways. That freed them up design wise to just see XOX. (Knitting Academic Aine)



19

4.3 User engagement //////////////

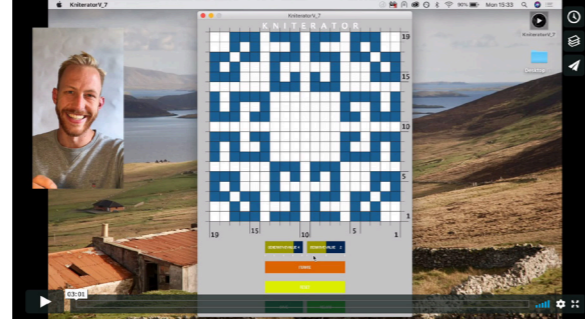
USER ENGAGEMENT IN GLASGOW

In order to evaluate intermediate steps of development, I had a local knitter in Glasgow testing the software while knitting samples as shown below. In her feedback she describes how she found designing new motifs with the software as relaxing but that she struggled with choosing colours as she was not an experienced Fair Isle knitter.



FEEDBACK FROM SHETLAND KNITTER

Further, I made a video demonstration of the software which allowed me to share it with knitters in Shetland remotely. The link or barcode leading to the video are provided next to the screenshot on the right. The screenshot below shows the email correspondence with one of the Shetland based knitters. She also mentions knitters difficulty with colourways.

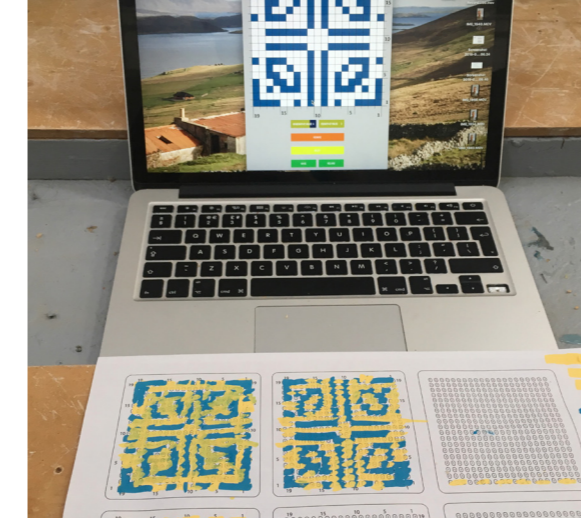


<https://vimeo.com/352240082>

Hi Christopher
Sorry to be slow to answer - I had grandsons staying when your email arrived so delayed looking at it till I had time. When I saw your video I was reminded of a class I did with Carla Meijsen; she had a computer programme she used to demonstrate; I think it was one she created for her own use but I may be wrong. <https://breidag.nl/uncategorized/carla-meijsen-boekpresentatie-magische-motieven/?lang=en>
Knitmastery also has a programme which, I believe, turns the dots on the chart into words. <https://www.knitmastery.com/>
Answers to your questions are below.

- 1) What do you like about the software/what would you improve? **appears to be easy to use, easy to change to get what's wanted. I don't often look for new charts now but sometimes create 'fillers' when knitting panelled garments so it could be useful for that.**
- 2) What could the piece of software become? **Useful for planning a garment; could be used for charts in knitting patterns.**
- 3) Have you seen anything similar? **see above**
- 4) Are you using digital technologies in your practice, if so for what? **I use Excel for my charts and do a lot of copying and pasting. I have been considering buying Stitchmaster as my technical editor uses it, it is widely used by knitting pattern writers.**
- 5) Do you think such an approach of designing Fair Isle patterns would come at cost of authenticity? **I had to check the dictionary for definition of authenticity but I'm none the wiser as to an answer to your question! For me, designing is about finding patterns to suit the number of stitches needed for whatever project. I think the authentic way for knitters to design a cardigan, for example, is to ascertain how many stitches are needed, decide whether patterns will be horizontal or panelled. Using software could be helpful.**
- 6) Anything else you would like to add? **experience tells me that people have more trouble with choosing colours than they do with pattern/motif choice. Charts to be followed by others need to be in colour but too much colour (too little contrast) often means that the shape of the pattern is lost when charted on paper.**

I hope that is a help. You chose one of my favourite views in Shetland for your vimeo page. I often take a walk up to the top of that hill to enjoy the view but preparations are being made for a windfarm. My parents lived, for a short time, at the bottom of the hill, down by the sea.
Best wishes
[Redacted]



EXPLORING FAIR ISLE COLOURWAYS

Following the feedback from the Shetland based knitter and the knitter in Glasgow, who both mentioned the difficulties of choosing colour, I aimed to explore ways of designing a tool which could enable quick experimentation of motif and colour.



EMBROIDERED FAIR ISLE SWATCHES

This resulted in a laser cut template that could be embroidered with wool. The number of rows corresponded with the size of the matrix in the Kniterator. I chose to explore the embroidering as a faster alternative for beginning knitters to encourage experimentation with Fair Isle colourways.



USING FAIR ISLE SWATCHES AS INTERACTIONS

Personal experimentation with the embroidering template showed, that the method was quick but not as effective as imagined. However, as I was interested in bringing materiality to the interaction with the Kniterator, I imagined the embroidered swatches as possible interaction points to explore the motifs digitally. In the following page, I will describe how this stepping stone resulted in the interactive Fair Isle swatches.

These patterns would have been used when planning to knit a Shetland allover pattern jumper. This would give the knitter an idea of colours and how to 'set' the patterns by counting the stitches. These swatches were knitted by the late Vera Hawick of Urafirth – she was a very skilled knitter of Fair Isle patterns.



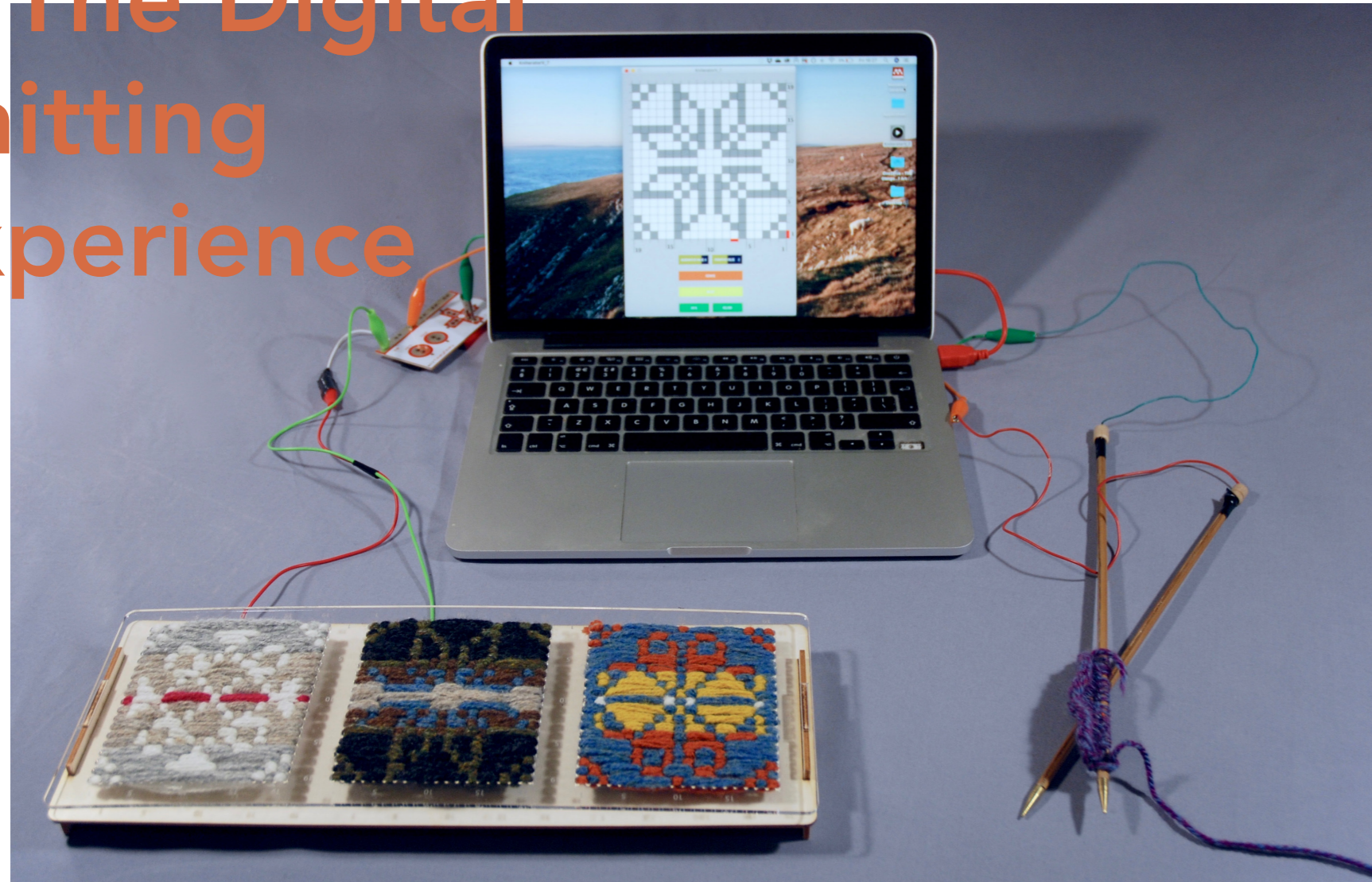
// [...] If somebody had a new pattern, you would knit it and then had it to look back at it. They were like templates in knit. You would also get so much more information from it because you could see the texture, the colour blending and the gauge. Some people would cut the repeat pattern out of an old jumper and just keep that as a reference. (Local knitter Ida)

The final aesthetic and functionality of the interactive Fair Isle swatches were directly drawn from the Fair Isle swatches found in the folder in the Tangwick Ha museum in Shetland. As part of the digital knitting experience, they served as a "tangible Fair Isle motif library". By touching one of the swatches the black and white motif appeared in the matrix of the Kniterator where it could be modified. It was important to me to embody this insight about templates in knit, as it metaphorically translated the traditional design process into a digital one and the interaction concretely showed the difference between colourway and motif in Fair Isle. Something knitters apparently had difficulties with.

Shetland Wool Conductive Thread Laser Cut Acrylic



5. The Digital Knitting Experience

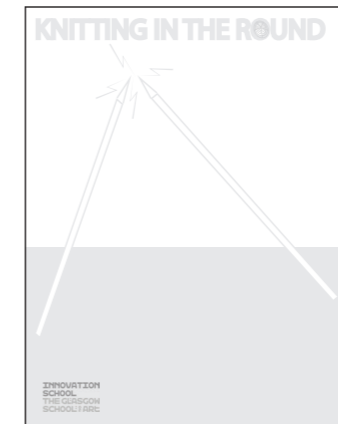


THE DIGITAL KNITTING EXPERIENCE

The schematic shows an initial concept of how I planned to disseminate the prototypes at the conference in Shetland. My concern was that the prototypes would be interpreted as propositions for deployable products, whereas I was interested in foregrounding the methodological aspect of experiencing them as stepping tones towards future design approaches.

INTERACTIVE FAIR ISLE SWATCHES

By touching one of the three swatches the black and white motif appears in the matrix of the Kniterator.

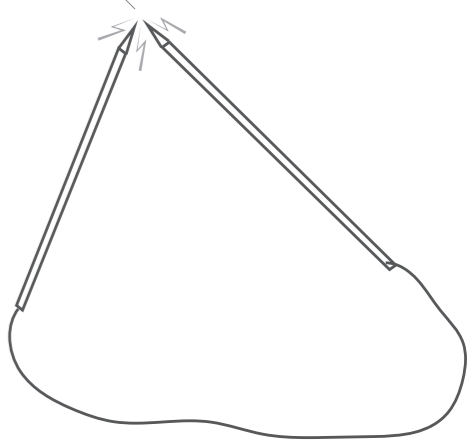


THE KNITERATOR

In the Kniterator knitters can explore to modify the traditional motif either by using algorithmic design methods or manually. It also allows to design entirely new ones from scratch.

DIGITAL KNITTING NEEDLES

The digital knitting were linked to stitch and row counting interface in the Kniterator. They allowed to demonstrate the principle of the interactive pattern and how digital tools could complement traditional making techniques.



5.1 Shoormal Conference Display



DIGITAL FAIR ISLE
EXPLORING THE ROLE OF DIGITAL TECHNOLOGIES IN FAIR ISLE HAND-KNITTING

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In what ways could digital approaches innovate knitting?
What are the opportunities for digital tools in Shetland?
In what ways could digital technologies enhance youth engagement with crafts?

This research project explores possible roles for digital technologies in traditional crafts with a focus on Fair Isle hand-knitting. This is done across three elements of the craft practice; the material, pattern design, and tools and techniques. These three elements can be found in the interactions on display. They respond to findings of a first engagement on Shetland with members of the knitting community. Together, the interactions form a digital knitting experience which serves as a research tool to encourage conversations around future design approaches in Fair Isle knitting. It consists of three stages; a tactile transition from analog to digital, an algorithmic pattern design, and a hybrid way of knitting.

MATERIAL PATTERN DESIGN TOOLS/TECHNIQUES

INNOVATION SCHOOL
THE GLASGOW SCHOOL ARE

INTERACTIVE SWATCHES
What if traditional materials are used to interface with the digital world?

The digital Fair Isle swatches are a material library of traditional patterns. Through touch the black and white charts of the patterns are loaded into the matrix of the Fair Isle knitting program.

Research Insights:
Swatches are used in the planning of knitwear. As patterns are often not written down on Shetland they serve as 'templates in knit' to test gauge and colorways:
"There is a lot more going on if you've got your patterns in knit. And especially if you've got colour, this is the one thing about charting Fair Isle on paper or even on a screen. It is pretty flat. But if you've got it knitted there are things going on with textures and even the quality of the yarn, which is nowadays quite woolen, fuzzy, and three dimensional."

GENERATIVE PATTERNS
What if digital technologies could be used to co-design Fair Isle knitwear?

The Fair Isle knitting software algorithmically transforms existing patterns or helps to design new ones. It connects to the interactive swatches and the digital knitting needles.

Research Insights:
The Fair Isle design process has been described as almost hidden. Patterns are passed on in families and Shetland as a place has been named as a source of inspiration:
"There are on Shetland many knitters who knit only for a hobby like any other modern knitter. But their practice, their craft is based on traditional methods which they learned and absorbed locally from their friends and family."
"One of the things people are very aware and talk about is the idea of things not being written down and the kind of fluency which is almost improvisational."

For the setup at the Shoormal Conference on Shetland, I designed a display to present the provotypes alongside research insights and guiding questions for conversations. In the presentation of the additional information, I attempted to show a relevant narrative but did not make the insights as explicit as here in the portfolio in order not to impose my own interpretations. I hoped the balance between written insights and tangible interactions would encourage engagement, contextualise the tools and allow delegates at the conference to gain immediate access to the exploratory nature of this study. Further, the wooden materiality of the set-up was supposed to imitate a workshop character to counteract impressions of "finishedness" of the provotypes.

DIGITAL KNITTING NEEDLES
What if digital technologies can complement the intimacy and dexterity in hand-making?

The digital knitting needles hybridise the process of knitting. By being connected to the knitting program the knitter is assisted in navigating a new pattern.

Research Insights:
The Fair Isle knitting technique allows to quickly knit in the round with two yarns. Traditionally three double sided needles and a knitting belt are used. Nowadays, circular needles are an alternative. Experienced knitters often know patterns by heart:
"They had it in their heads, if somebody learned a pattern they knitted a bit. If somebody would come and say I had a new pattern, you would knit it and then you had to look back at it."
"The difficult part was the design, once it was chartered out it was kind of easy to make. But the problem, well it was a problem, they didn't charter it out. They figured it out along the way. It's nearly as if they designed on the go."

6. Digital Provotype Portfolio



THE DIGITAL PORTFOLIO

The digital knitting experience is seeking to provide a playful way of exploring future design approaches for digital tools in Fair Isle knitting. It questions how these approaches would look like if they were conceived in Shetland. On the USB stick is a copy of the Kniterator program provided. Please refer to the manual on page 18 for instructions. Additionally, if it is not desired to install the software, a short video demonstration is provided that shows core elements of the digital knitting experience. After exploring the fundamentals of the provotypes, please continue reading the thesis in the fieldwork chapter.

