

The Life of a Building

Machine Knitting a Year of Visitor Data and Online Community Participation During a Pandemic

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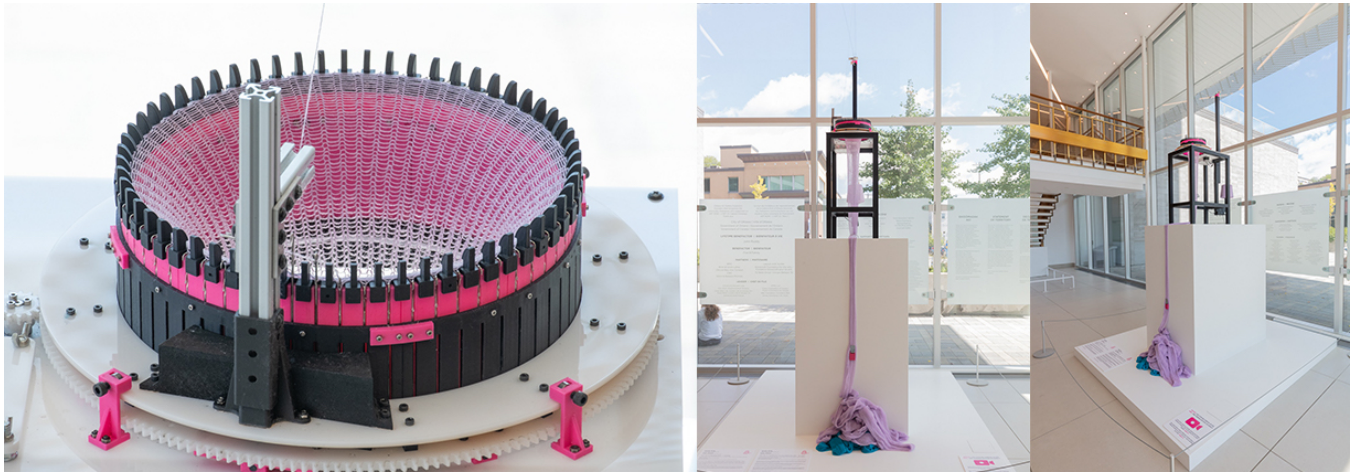


Figure 1: Installation view of *The Life of a Building*, a commission of the Ottawa Art Gallery (July 2021-July 2022) (Photo credit: Justin Wonnacott)

ABSTRACT

During the pandemic many individuals turned to handcrafts such as knitting to cope with the uncertainty and anxiety we were collectively feeling. In this artwork we wanted to bring knitting out of isolation and to use it as a method of community participation to document the “recovery” year at a local art gallery. In July 2021 we launched *The Life of a Building* at the Ottawa Art Gallery in Ottawa, Canada, which knits visitor data at the physical gallery as well as online interactions on the gallery website. Each month the colour of the yarn changes, creating a tangible, soft record of this unpredictable year. During TEI, the audience will be able to visit the gallery website, click a button to create their own row of stitches on the machine, and watch the knitting machine knit them into the installation through the livestream.

CCS CONCEPTS

• **Human-centered computing** → **Visualization systems and tools.**

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KEYWORDS

artwork, data visualization, aesthetic visualization, data sculpture, data physicalization, knitting, fabrication, participatory design

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1 INTRODUCTION

Due to the pandemic, many public spaces in Ottawa, Canada, were closed last year, and we waited in anticipation for when we could visit art galleries again. During this time, we collaborated on an artwork that would record the year beginning when galleries were allowed to re-open to visitors (July 2021-July 2022), but also to reflect the blended experience of the re-opening where some activities could be in-person, yet many activities remained online. During the pandemic, though the physical spaces of local art galleries were closed, they still held an important place in our community through virtual talks, gallery tours, and online workshops. It became clear that the gallery space was more than just a physical space, but a community that could keep us inspired even through difficult times.

The Life of a Building (2021-2022) by Greta Grip and Lee Jones visualizes the “recovery” year and the community experience at the Ottawa Art Gallery through a soft, tangible record of knitted stitches

(Figure 1). When individuals enter the building, their presence is sensed and a row of stitches added to the knitted record. Equally, individuals can also participate in the artwork by clicking a button online and then watching the machine knit their row through the livestream. This artwork highlights both the tangibility that we missed during our year and a half online, as well as the benefits of the online environment such as greater inclusion and expanding our community beyond our local city.

During TEI this community will grow to include individuals physically located at the conference at KAIST in Daejeon in the Republic of Korea, as well as individuals participating virtually from around the world. This artwork reflects the hybrid environment many of us are living in as well as the hybrid modality of the conference itself. In this paper we discuss our implementation and installation, and reflections on the process of creating this artwork.

2 IMPLEMENTATION AND INSTALLATION

Data physicalization “is a physical artifact whose geometry or material properties encode data” [7], and offers an alternative to how data is visualized on paper and screens by leveraging our spatial skills and making data more accessible and engaging [7].

The Life of a Building tangibly visualizes each visitor (in-person or online) with a row of knitted stitches. Even when visitors cannot see other visitors (due to physical distancing regulations), they can still see the evidence of that community through the knitted rows. We change the colour of the yarn on the first of each month so that we will be able to see changes and fluctuations throughout the year. In previous work researchers have used crafted data stories to initiate discussion on the invisible data sources in our lives such as everyday sounds [1], autobiographical experiences [5], as well as helping us create memoirs of difficult experiences [2, 3]. Hand crafts in themselves can help create markers of time, and previous research in hand knitting has highlighted how these crafted results can become a record of the process [8, 9]. At the end of the year (July 2022), we hope to be able to reflect on what this year was like as well as events that happened along the way through this knitted record.

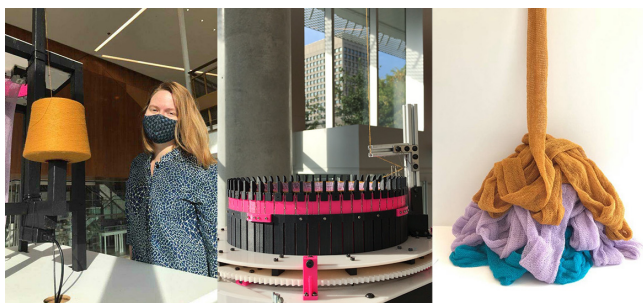


Figure 2: (left) Changing the yarn to yellow on September 1st, (middle) the yellow yarn entering the machine, (right) the accumulation of stitches half-way through September (Photo credit: Lee Jones and Greta Grip)

2.1 Hacking the Circular Knitic

The COVID-19 pandemic interrupted traditional manufacturing pipelines, and local makerspaces and rapid prototyping quickly became alternative manufacturing resources. For this project we adapted the Circular Knitic (2014)¹, an open-hardware circular knitting machine developed by the artist duo Varvara and Mar (Varvara Guljajeva and Mar Canet). The parts were recreated and assembled by a local prototyping lab (Bayview Yards) from files the artists provided on github² and tutorials on instructables³ with digital fabrication tools. Once we received the machine from the prototyping lab, we started hacking it so that it would visualize data combined from two sources: individuals who entered the Ottawa Art Gallery and those who interacted with the machine through the gallery’s website.

2.2 Knitting Visitor Data

One source of data was the visitors entering the gallery. We placed an ultrasonic sensor at the gallery entrance that measured when people walked through the entrance (Figure 3). This sensor sent messages to the knitting machine, both having wifi-connected microcontrollers so that they could send messages when online. Once a visitor was picked up on the sensor, the knitting machine was sent instructions to knit a row of stitches.

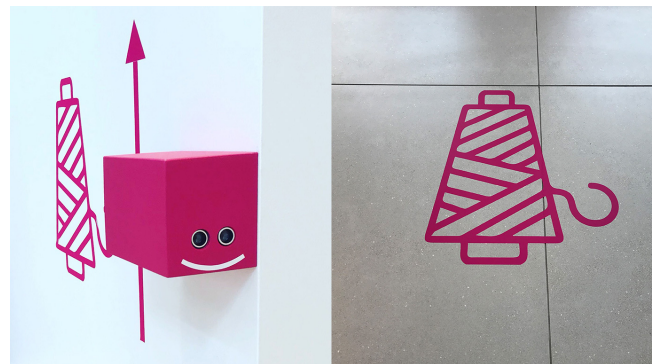


Figure 3: (Left) When visitors enter the gallery an ultrasonic sensor senses them and knits a row into the knitting machine. (Right) The gallery placed wayfinding marks to guide viewers through the gallery to the machine (Photo credit: Lee Jones and Greta Grip)

2.3 Hybrid Participation

The second source of data was button clicks. To reflect the blended experience of this time, we developed a micro-site on the Ottawa Art Gallery website where visitors could click a button during gallery opening hours (Figure 5) and then watch the stitches being knit on a YouTube livestream (Figure 4). Both the in-person and online interactions were counted equally as community participation, each getting a row of stitches. During TEI, participants will be able to

¹var-mar.info/circular-knitic/

²github.com/var-mar/

³[instructables.com/Circular-Knitic/](https://www.instructables.com/Circular-Knitic/)

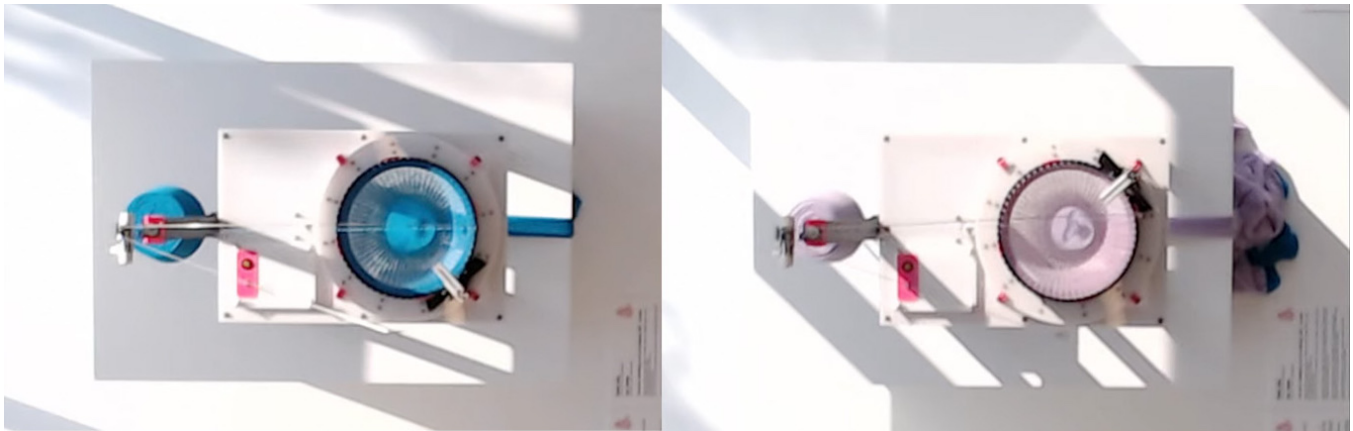


Figure 4: Overhead view of *The Life of a Building* in July (left), and August (right), through the livestream on the Ottawa Art Gallery website (Photo credit: Lee Jones and Greta Grip)

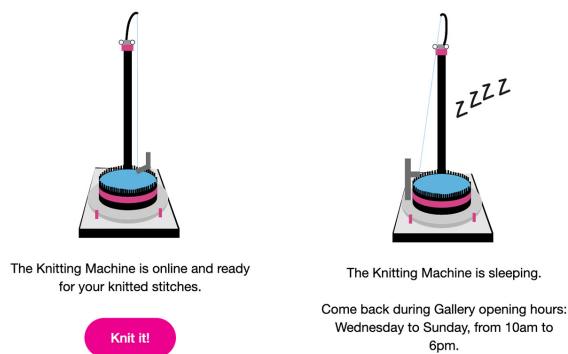


Figure 5: The website interface for interacting with the machine. During gallery hours a button appears that says "Knit it!" (left), and when the gallery is closed The Knitting Machine goes to sleep (right).

visit the website and watch their stitches knitted by the machine in Ottawa through the livestream.

3 REFLECTIONS

The artwork was installed during July 2021, and here we provide our reflections on the work several months into the year-long installation.

3.1 Interdisciplinary Collaboration During a Pandemic

Creating a textile fabrication machine required interdisciplinary teams including rapid prototyping (Bayview Yards), textile knitting (Greta), and ubiquitous computing (Lee and Boris), and collaborating virtually during this time only increased the silos. When working with tangible objects on interdisciplinary teams, some problems can only be solved in person. Because the machine was made locally, certain adjustments and replacements needed to be made to the machine, such as the specific rod tension spring used

to guide the yarn into the machine. The rapid prototyping team developed the machine made to specifications, but the material used for the rod as a replacement part was too stiff and impeded the yarn from getting the appropriate tension needed to knit a row of stitches. Another issue was that the machine motor mechanisms worked, but the needles did not raise high enough to catch the yarn to create a knit. As a result, Greta had to teach the prototyping team how knit structures are created through zoom in order to solve the issue. These were issues that could be tested and solved in moments if we were co-located, but without the tangibility of feeling an items' stiffness (which is difficult to both discover as a problem, and to convey through zoom), or being able to physically demonstrate, ended up needing several iterations due to local physical-distancing requirements. These mismatch moments highlight the tangibility of building where characteristics like stiffness and tension are difficult to convey virtually or to capture without specific measurement tools.

After the machine could knit, one benefit of this artwork ended up being the internet-connected components, because though we could not be co-located, we could test the interaction at a distance. For example, Lee could activate the sensor at her home, and it would turn on the knitting machine at Greta's home, and we could iteratively make changes while physically distanced. Building with IoT microcontrollers has the potential to enable new collaborations among distanced collaborators, but we recommend this only after the material stage.

3.2 Obstacles to Textile Digital Fabrication

The "magic" of digital fabrication machines is being able to reproduce an item anywhere in the world with digital files and local materials [6]. During the pandemic this enabled us to reproduce the Circular Knitic locally in Ottawa, Canada, but also highlighted the obstacles. The hardest items to procure were the textile-specific components, such as the knitting needles, yarn cones, and yarn winders, which ended up having to be shipped from Europe to Canada (especially when conventions such as cone size differed). This highlights the gaps in local manufacturing, especially for the



Figure 6: Installing the work during the pandemic (Courtesy of the artists and Rebecca Basciano)

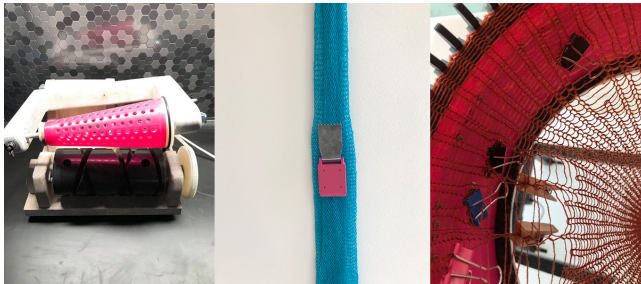


Figure 7: (left) custom yarn winder and yarn cone, (middle) the claw weight on the knitted tube, (right) “data accidents” [1] of dropped stitches in the knitted data record.

Canadian textile industries which have shifted over the past several decades to manufacturing abroad, and leaves us with barriers to re-creating these systems on a smaller scale. Whereas items like screws might be accessible in most place around the world, the availability of certain field-specific components (like machine knitting needles) will depend on whether they are already available within local industries.

Textile digital fabrication highlights these gaps and can create more transparency and discussion around textile manufacturing and how our things are made. Our hope is that small scale digital manufacturing (or micro factories) might help to revive the local textile industry. In future work we plan on exploring more textile digital fabrication machines within our local context to further explore these barriers and how to overcome them.

3.3 Maintenance

Though the knitting machine runs automatically, there two areas that need manual intervention. The first is the changing of the yarn colour on the first of each month. The second is that as the knitted rows add up the claw weights need to be manually moved up by the gallery attendants to ensure that the stitches are knotted properly for each row (and don’t jam or knit on themselves). This

limited us to only allowing interactions and resulting stitches when the gallery is open to ensure that it does not jam, but also limits participation to local opening hours, which is when the other half of the world is asleep. To make it truly inclusive and automated, in future work we could add a roll that would wind up the yarn tube below, acting as a weight to pull the knitted tube down.

We experienced one of these jams early in the project (in July) and decided that we would embrace these imperfections (or “data accidents” [1]) in the knitted tube. So currently, there is a small run (like the run in a stocking) in the month of July, and there will likely be other small imperfections that occur throughout the year. Other researchers have also discovered the co-authoring element of working with our physical materials when making data physicalizations [5]. Data physicalizations and materials have unique constraints, such as gravity, that data visualizations on paper or screen do not have to contend with [10].

3.4 Recommendations for Distanced Artistic Collaborations

Based on our experience creating this tangible artwork we provide the following recommendations:

- **R1:** Teach and share. Gaps in the process occurred because members did not understand collaborating fields. These were fixed by, for example, teaching members how to make a knit structure or how to work with a microcontroller. This need to understand collaborating fields has been highlighted in previous work [4], but is even more so required during virtual collaborations.
- **R2:** Explore materials first. In multidisciplinary teams there are often language and terminology barriers. How does one describe or measure stiffness, or tension? Our project emphasizes the importance of tangibly exploring materials as a first step, either with small samples, or explaining how a component works within the whole. We discovered gaps in terms of what materials were available locally and which ones needed to be alternatively sourced. Vavara + Mar were

also responsive to emails about these sourcing obstacles, which is another element to consider with open-hardware projects with unique materials.

4 CONCLUSION

In this paper we introduce *The Life of a Building*, a data artwork to measure visitors and online community participation at the Ottawa Art Gallery from July 2021-July 2022. The artwork visualizes this data as soft, tangible, knitted rows that will create a narrative of this year. Herein we discuss the context of the artwork, the implementation, and reflections on the project a few months into the year-long installation. During TEI we will present the artwork as a livestream that can be viewed online as well as in person, and viewers can watch their stitches happen in real-time.

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