LoopScroll: Exploring Knitting-based Tangible Input for Mindful Screen Interaction

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Abstract

Infinite-scrolling interfaces on social media reduce effort in content discovery but also encourage doomscrolling, raising concerns about digital overconsumption and its negative effects on mental wellbeing. While prior work has explored software-based self-monitoring mechanisms, few studies have examined tangible design interventions at the input level during screen interaction. We present LoopScroll, a knitting-inspired system that translates hand movements into screen-scrolling actions. Drawing on the rhythmic qualities of knitting, LoopScroll maps users' movement tempo to scroll speed, introducing friction into scrolling to encourage more deliberate engagement with screen content. The knit-to-scroll interaction also produces a growing knitted piece that materializes screen time, fostering temporal awareness through a playful, tangible trace of use. Through design exploration, we discuss how knitting-based gestural input can serve as an embodied attentional intervention against doomscrolling, contributing a tangible interface as a design provocation for input-level resistance to mindless scrolling.

CCS Concepts

• **Human-centered computing → Interactive systems and tools**; **Gestural input**; **Ubiquitous and mobile computing**.

Keywords

Tangible User Interface, Screen Interaction, Knitting, Wellbeing, Embodied Cognition, Social Media

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1 Research Background

Social media featuring advanced personalization algorithms and infinite scrolling design reduces mental effort in content discovery but also encourages mindless scrolling [2, 17] and "doomscrolling" – a habitual, immersive tendency to continue scrolling even when it produces negative affect or a sense of lost time [30, 33, 35]. This pattern of use results in prolonged screen engagement [15, 16, 21], drawing users into cycles of unconscious habitual consumption that degrade cognitive capacity [20, 24, 35, 38]. Recent work has documented the effects on attention, memory, and mental fatigue [6, 7, 10, 19, 35, 40] and concerns about emotional and psychological wellbeing [11, 20, 27, 35]. Despite recognizing the overuse and its negative impacts, users consistently report difficulty regulating scrolling behavior [3, 18], suggesting a further need for behavioral interventions.

Much HCI research has addressed digital self-regulation through software-based interventions such as screen time trackers, content blockers, and goal-setting systems to increase users' self-monitoring awareness and prevent the activation of non-conscious habits [8, 18, 20, 25]. However, these tools primarily operate at the cognitive and motivational levels, leaving the embodied mechanics of screen interaction behaviors such as swiping and scrolling largely unaddressed [12, 18, 20]. As a result, they are limited in addressing mindless scrolling, which is sustained not only by attention and intention but also by repetitive bodily action. Tangible user interfaces (TUIs) offer an alternative by treating the body and physical environment as active parts of interaction rather than passive input channels [32, 39, 41]. Drawing on embodied cognition, this perspective frames bodily action as a cognitive resource that shapes how users perceive and engage with digital systems [9, 14]. Prior work shows that physical engagement can deepen cognitive involvement [23, 28] and support mindful microbreaks during screen use [1]. Yet these interventions have largely remained supplementary to screen interaction rather than embedded within it. Little work has examined how input-level tangible interventions might support mindful scrolling by turning scrolling from an automatic gesture into a deliberate, embodied act.

Inspired by "slow technology", which frames friction not simply as a barrier to efficiency, but as a design strategy for interrupting automatic behavior and opening space for more deliberate, reflective engagement [13], we reconsider screen interaction as more than a functional input technique: scrolling becomes an embodied experience shaped by rhythm, effort, and repetition. Creative practices such as craft and knitting in particular, offer a generative starting point for our design exploration. Sennett [31] describes how slow, repetitive manual work cultivates embodied knowledge through trained attentiveness and physical routine. Studies of psychological wellbeing and knitting practice also suggest that rhythmic manual activity can support attention during knowledge-intensive tasks and is associated with improved mood, relaxation, and focused engagement [5, 26, 29]. Together, these accounts position craft not only as a productive activity but also as a temporal and sensory

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practice through which attention is organized and sustained. Despite these qualities, knitting has rarely been explored as a mode of digital interaction. Specifically, the rhythmic, tactile, and attentional properties required for knitting practice remain underexamined as design resources for addressing habitual and mindless scrolling. To explore this possibility, we present *LoopScroll*, a knitting-based gestural interface that reconfigures scrolling as an embodied act. In doing so, we investigate how the repetitive tempo and material engagement of knitting might intervene in doomscrolling and explore the conditions under which more mindful screen interaction could be supported.

2 Artifact Development

2.1 Design Goals and System Overview

We engage with the notion of "slow technology" [13] to design temporal resistance into interaction that encourages more reflective engagement with digital technology. Following this design ideology, we introduce tangible, physical friction into screen interactions to heighten users' embodied awareness of their attention and support more deliberate scrolling behavior. In summary, *LoopScroll* comprises a knitting needle-shaped input device and a Chrome browser extension that together translate users' knitting movements into screen-scrolling commands (see Figure 1). At the input stage, two modified knitting needles with differentiated conductive zones generate discrete contact signals during stitch formation. These signals are read by an Arduino Uno R3 and transmitted to the browser as structured serial data over USB. At the output stage, the browser extension parses the incoming data and issues scroll commands to the active webpage, with scroll distance mapped proportionally to knitting tempo, thereby coupling the pace of content consumption to the felt rhythm of the user's hands. As users knit to scroll, they also produce a growing knitted piece that materializes screen time, offering a tangible, embodied trace of browsing that makes the otherwise invisible passage of time both felt and visible.

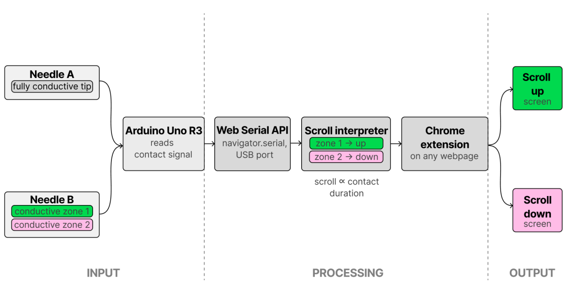

Figure 1: LoopScroll: System Overview

2.2 Design Details and User Interaction

2.2.1 Hardware Design and Signal Processing. We 3D-printed two custom knitting needles based on standard 10 mm knitting needles [4]. This gauge was selected for its chunky loops, which provide strong tactile feedback and support muscle memory, helping preserve the feel of familiar knitting practice while lowering the learning threshold for use. Each needle consists of a PLA body and an aluminum tip joined through a diameter interference fit, with the slight elasticity of the PLA securing the connection without adhesive. The needles are further differentiated by their conductive zones. Needle A has a fully conductive tip, while Needle B includes two segmented conductive zones (see Figure 2): Zone 1 is contacted only during the deliberate pause when a loop is released, and Zone 2 is engaged consistently during stitch formation (see Figure 3). Contact between Needle A and Zone 2 triggers scroll-down, corresponding to the most common contact area in a standard knit stitch, while contact with Zone 1 triggers scroll-up. In this way, the sensing logic is embedded within familiar knitting movements rather than layered on top of them as an external control scheme.

Each conductive zone is wired to a unique digital input pin on the Arduino Uno R3, producing a binary signal in which contact is registered as `LOW` and separation as `HIGH`. We arrived at the final conductive layout through iterative prototyping. Eight candidate configurations of conductive tape were applied to standard bamboo needles (Figure 4), each connected to the Arduino board and tested by repeatedly performing a basic knit stitch while the Serial Monitor displayed the resulting binary output in real time. The resulting `0`/`1` waveform served as the primary evaluation signal: successful configurations produced stable, rhythmic patterns, whereas poorly positioned zones generated irregular, noisy, or flat output. Configurations were assessed against three criteria: (1) alignment with natural hand positions during knitting, to minimize interference with established grip and movement habits; (2) waveform consistency sufficient to support reliable scroll triggering; and (3) robustness across common stitch variations, including purling, which reverses needle entry direction and alters the contact geometry between needles. In the final design, the microcontroller continuously reads the contact state of each conductive zone via pins `2`, `3`, and `4`, and transmits the results as structured serial messages over USB at `9600` baud. Each message encodes the three input states as `b0, b1, b2`, where `0` indicates contact and `1` indicates no contact, ensuring a clear signal for each stitch event. Scroll distance is determined by contact duration: each stitch that maintains contact with a conductive zone contributes a fixed increment of 50 px to the screen's scroll position. We determined this value through early-stage co-design with three knitting practitioners across various knitting speeds and scroll values. The selected increment produced smooth scrolling aligned with typical reading speeds, without noticeable jumping or lag. This coupling keeps scroll speed responsive to knitting rhythm: faster knitting produces faster scrolling, while pauses in movement pause scrolling.

2.2.2 Browser Extension and Use Scenarios. We also developed a Chrome browser extension (currently supported on PC only) to support flexible integration with web-based social media platforms that use infinite scroll, where scrolling functions as the primary navigation mechanism in the absence of pagination [17, 34]. Our interaction design maps directly onto this structure: each knit stitch advances the page, and the feed continues to progress as long as the user keeps knitting. The extension is built on the Chrome Web Serial API, which applies the function `navigator.serial` to read data directly from a USB-connected Arduino without requiring a native application or driver installation. A persistent read loop

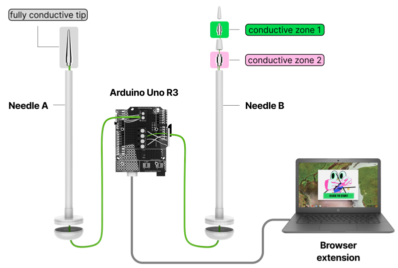

Figure 2: Hardware diagram: Needle A (fully conductive tip) and Needle B (two segmented conductive zones) wired to the Arduino Uno R3 via dedicated digital input pins, connected to the browser extension over USB.

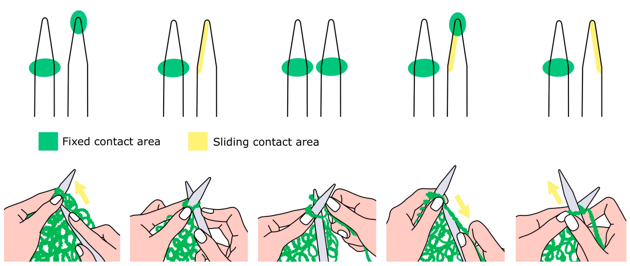

Figure 3: Contact geometry between Needle A and Needle B during a standard knit stitch [4]. Zone 2 (lower tip) is engaged consistently during stitch formation, triggering scroll-down; Zone 1 (upper tip) is contacted during the deliberate pause when a loop is released, triggering scroll-up.

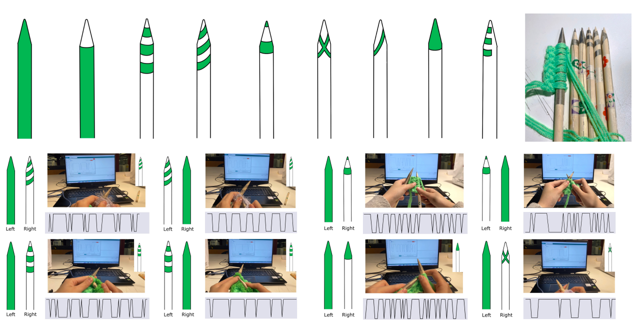

Figure 4: Iterative conductive tape configurations tested on standard bamboo knitting needles (top), and the corresponding binary output waveforms captured via Arduino Serial Monitor during continuous knit stitch performance (bottom). Consistent, rhythmic waveforms indicate well-placed conductive zones; irregular or flat outputs indicate poor contact geometry.

parses incoming serial messages, and issues scroll commands via `window.scrollBy()`, with smooth scrolling enabled to produce fluid page movement synchronized with knitting tempo. As the extension operates at the browser level rather than injecting site-specific logic, it requires no per-site configuration and is compatible with any webpage rendered in Chrome, including platforms we tested such as Pinterest, BBC News, and X (formerly Twitter). Figure 5 illustrates a use scenario and interaction features: users open any social media page in a Chrome browser on a laptop or desktop and launch the LoopScroll App v1.0 extension (Step 1). A start button then appears as an overlay on the page. When clicked, it opens the Chrome serial port selector dialog, allowing the user to connect to the Arduino device (Steps 2–3). Once connected, knitting movements scroll the page in real time, while time spent browsing is also materialized as a growing knitted piece made by hand (Step 4).

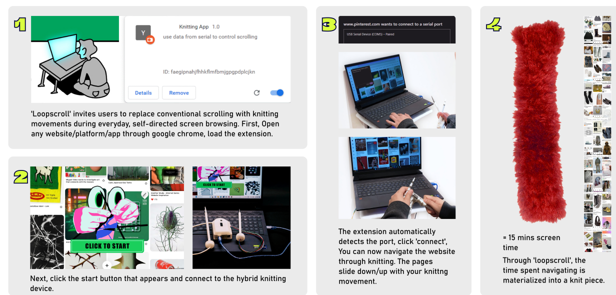

Figure 5: LoopScroll User Journey

3 Discussion and Conclusion

In this paper, we explore tangible design interventions at the physical input level to address mindless social media scrolling. We present *LoopScroll*, a hybrid system that couples digital navigation to continuous, rhythmic hand movement inspired by knitting. In conventional touchscreen interaction, scrolling is intentionally fast and low-friction: a thumb flick requires little effort, leaves little sensory trace, and incurs minimal temporal cost [17, 22]. Infinite-scroll interfaces intensify this dynamic by minimizing stopping cues and encouraging continuous consumption [17, 34]. *LoopScroll* intervenes in this by introducing friction through embodied action — repeated bodily movement, proprioceptive feedback, and rhythmic pacing of screen interaction. Rather than simply slowing screen interaction, this physical rhythm reshapes the temporal and sensory conditions of browsing. The body becomes an active mediator of attention, and pacing arises from the material demands of the craft rather than externally imposed limits. In this way, *LoopScroll* aligns with slow technology's emphasis on temporal resistance as a means of fostering more reflective engagement with digital systems [13]. Our system thus reframes scrolling as a paced and effortful activity rather than an almost effortless one, making the transition between exploration and scrolling more perceptible in the body. *LoopScroll* positions gestural input as an attentional intervention, encouraging more deliberate engagement through tempo, effort, and repetition rather than through restriction.

Further, this new screen interaction produces a growing knitted piece that materializes screen time as a physical trace of use. Rather than representing duration numerically through dashboards or summaries, *LoopScroll* externalizes time through the accumulation of stitches, allowing screen use to be experienced as a visible and tactile process. Overall, these qualities position *LoopScroll* as a tangible alternative to software-based self-monitoring approaches for mindless scrolling. Our design exploration suggests that knitting-based gestural input can serve as an embodied attentional intervention by introducing friction into scrolling and by materializing use over time. Studies on knitting and related crafts further suggest that rhythmic manual activity may support attention, positive mood, and focused engagement [5, 26, 29], pointing to the conditions under which more mindful screen interaction might emerge.

That said, in exploring the design, we also uncovered a tension within the system's core logic. For knitting to function as a pacing mechanism, the craft must be sufficiently familiar that it does not itself compete for attention. For less experienced knitters, knitting may demand sustained focus on needles and yarn, increasing cognitive load rather than redistributing it. Research suggests that the proficiency required for muscle-memory-level automaticity can be developed within one to two weeks of short daily practice sessions [36, 37], meaning the skill threshold is modest once engagement is established. The more pressing design question is how to motivate initial adoption among non-knitters. A direction for future development would be to replace the needle-based input of *LoopScroll* with a semi-automated craft tool: an adjusted hand-cranked knitting machine, for instance, would allow the same rhythmic and sensory hand movement to scroll input, while also producing tangible pieces — without requiring users to manage individual stitches. This would preserve the frictional, intentional quality of the interaction while substantially lowering the skill barrier to entry. Future work will examine *LoopScroll* through a longer-term, in-the-wild deployment combining system logging and interviews to explore opportunities and challenges of knitting-based rhythmic interaction for attentional awareness and self-regulation of mindless scrolling. We also aim for mobile compatibility: since accessibility frameworks on both Android and iOS support external input devices as substitutes for touch, registering *LoopScroll* as a ubiquitous device could extend the knit-to-scroll interaction to mobile social media platforms, broadening the system's applicability to the contexts where mindless scrolling most commonly occurs.

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