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Pruszko, Laura; Chaffangeon Caillet, Adrien; Fan, Zhuzhi

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Shape-Change in Keyboard Interaction: Exploring the Future of Input Devices Through Prototyping

Laura Pruszko
Glasgow Caledonian University
Glasgow, Scotland
laura.pruszko@gcu.ac.uk

Adrien Chaffangeon Caillet
Univ. Grenoble Alpes, CNRS, Grenoble INP, LIG
Grenoble, France
adrien.chaffangeon@univ-grenoble-alpes.fr

Zhuzhi Fan
University of Bristol
Bristol, England
zhuzhi.fan@bristol.ac.uk

Abstract

This full-day studio explores the intersection of shape-changing technology and keyboard interaction. We invite HCI researchers, interaction designers, and accessibility specialists to prototype and reflect on the future of input devices. Participants will be introduced to key concepts in shape-changing interfaces and methodologies before engaging in hands-on, sustainable prototyping activities, using ideation tools and quick-build materials to explore how shape-changing interfaces can reshape the way we interact with keyboards. The studio will foster a collaborative environment where participants from diverse disciplines can experiment with non-expert prototyping methods and reflect on the role of keyboards in tangible interaction design.

Keywords

shape-change, keyboard, user-input, tangible interaction, prototyping

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1 Introduction and Background

Shape-changing user interfaces introduce exciting possibilities for dynamic physical interactions, where the physical form of the device itself can change either in response to user input/system events or to adapt to a task [22], a user [21], or an environment [19]. Such devices have already been proposed to enhance existing input devices, such as an inflatable mouse [10] or a knob that can change into a slider [8]. Despite the potential for shape-changing technology to transform keyboard interaction, this area remains underexplored in HCI research: although keyboards continue to dominate text entry and digital interaction, their core design has remained static so far. We believe that integrating shape-change into keyboards opens up new opportunities to enhance user experience, provide richer interaction, and adapt to diverse needs.

In the specific case of virtual keyboards, their layout can be adapted to improve user experience, thanks to the flexibility of graphical user interfaces (GUIs). For instance, increasing key size to aid users with motor challenges [11] or employing a zoomable layout for small screens like smartwatches [12] and a 1-line layout keyboard consuming smaller screen portions in tablets [13]. These examples demonstrate the value of adaptive interfaces, hinting at the potential for shape-changing physical keyboards to deliver similarly improved interaction experiences outside the virtual world. Recent advancements in shape-changing technology [9, 20, 21] now make it possible to introduce this flexibility to physical devices like mice [10] and knobs [8], suggesting that keyboards could also benefit from similar innovations.

Previous efforts of both researchers and industrial designers in keyboard design have focused on context-specific adaptations, such as compact keyboards with half number of keys and thus smaller size for one-handed use [15], keys arrangements adapted to users' hand posture to reduce muscle fatigue [17], circular keyboards for collaborative tasks [6], and curved keyboards to reduce typing strain [7, 18]. Some designs, like a rollable keyboard, aim to improve portability [4, 24]. Additionally, some previous work and products also focus on enriching users' interaction experience by keys' shape changes; for example, kirigami keys passively change shape when pressed to enhance tactile feedback [3], and keys involved in hotkey shortcuts can rise to be more accessible [2]. However, these designs have some "irregular" shapes for specific purposes, and many remain static, lacking the dynamic flexibility to adapt to different contexts. Furthermore, the current landscape of shape-changing keyboards presents only limited shape adaptations, such as split keyboards with changeable modularity [7], despite advances in the broader field of shape-changing interfaces [9, 20, 21].

We identified two significant research gaps. First, the few researches on shape-changing keyboards tend to focus on individual components, such as keys [2, 3], rather than exploring the potential of fully dynamic keyboards. Second, most commercial products and academic work only address a limited range of shape-changing taxonomies [9, 20, 21], overlooking opportunities for more flexible, responsive interaction designs. Bridging these gaps could redefine keyboard interaction by introducing greater adaptability and inclusivity into an everyday tool. Shape-changing keyboards, for instance, could dynamically adjust to accommodate users with motor impairments by altering key size, spacing, or resistance, creating custom layouts that reduce physical strain.

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Activity type	Duration	Description
Onboarding	**45 minutes**	**Welcome, presentations, icebreaker**
	10min	Welcome and introductions
	20min	Presentation of background and workshop goals
	15min	Icebreaker
Ideation & 2D Prototyping	**135 minutes**	**Affinity diagram and extended posters**
	45min	Affinity diagram session
	60min	Extended poster creation
	30min	Extended poster presentations
Lunch Break	*1 hour*	
Hands-on 3D Prototyping	**120 minutes**	**Presentation of 3D prototyping kit and hands-on prototyping**
	15min	Introduction to 3D prototyping kits
	15min	Tutorial with 3D prototyping kit
	90min	3D prototyping
Conclusion and Wrap-up	**60 minutes**	**Presentation of prototypes, demo, wrap-up and reflection**
	30min	Final presentation of prototype with interactive demos
	30min	Wrap-up and reflection

Table 1: Schedule of the Studio.

Moreover, we envision the co-design potential of shape-changing keyboards, e.g., for communities using digitally disadvantaged languages. Tools like Keyman [1] have contributed to this area by allowing users to create virtual keyboard layouts for over 2,000 languages, many of which are marginalised in mainstream technology. Shape-change and modularity could extend this work by offering a flexible and sustainable platform for co-designing physical keyboards, allowing users to experiment with and refine different layouts tailored to non-Latin scripts and complex writing systems. Rather than a one-size-fits-all solution, this approach could facilitate an iterative, user-centered process to discover culturally and linguistically relevant layouts that go beyond the constraints of our traditional Latin alphabet. There is also the potential for intersectionality, e.g. a differently-abled user in a digitally disadvantaged language.

This one-day studio seeks to explore these possibilities through hands-on prototyping activities focused on shape-changing keyboards. Participants will experiment with sustainable, quick-prototyping methods to reflect on the future of keyboard interaction, accessibility, and inclusivity.

2 Learning Goals and Materials

Building on the challenges and gaps identified in the introduction, this studio will focus on three key learning goals to help participants exchange critically and creatively on the future of keyboard interaction.

First, participants will reflect on current trends and challenges in keyboard interaction, with a particular focus on how industry advancements and HCI research intersect, as well as the emerging possibilities offered by shape-change. Our studio will provide space to discuss how these trends influence current keyboard design and where new opportunities lie, particularly in bridging the gap between static designs and more responsive, adaptive interfaces.

Second, participants will actively explore how shape-changing technology can redefine keyboard interaction, particularly in accessibility and inclusivity. While systems should ideally adapt to users' needs, the inflexibility of physical interfaces often prevents this. As a result, users with varying accessibility requirements must create their own strategies to navigate these rigid systems, which can detract from the overall user experience, as illustrated in [25, Fig-3]. While the introduction highlights the potential of adaptive designs for accessibility and inclusivity, the studio will allow participants to take these ideas further by experimenting with different configurations and building new solutions.

Finally, the studio is structured to emphasise hands-on experimentation using our quick and sustainable prototyping kit. This includes Makey Makey invention kits [23], cardboard, paper, playdough, and graphite pencils, which are used and reused across various workshops and classes for rapid prototyping. The participants will also engage with our ideation kit featuring shape-change taxonomy cards and brainstorming cards to guide their creative process. These materials will support participants in prototyping ideas quickly and iterating on designs that push the boundaries of traditional keyboard layouts.

By the end of the session, participants will gain new insights into how shape change can be applied to create more adaptable, inclusive keyboard designs, and develop practical skills in sustainable prototyping. We hope they will leave the studio with ideas and methods for exploring the future of keyboard interaction in their own work.

3 Studio Plan and Schedule

3.1 Pre-Studio Activity

Before attending the studio, participants will be asked to take photos of various keyboard interactions they encounter in their daily lives, research, or media. These photos can represent personal or professional use cases and will support the affinity diagram session. Moreover, in preparation of the studio, we will send registered participants a short brief to introduce affinity diagrams and our prototyping kit.

3.2 Studio Activities

The studio's structure is organised into four key steps: (1) onboarding, (2) ideation and 2D prototyping, (3) 3D prototyping, and (4) conclusion and wrap-up (see Table 1). The activities span six hours, with the morning dedicated to 2D paper-based prototyping and the afternoon focused on 3D prototyping.

In the morning session, we will open the studio with a 45-minute presentation and icebreaker, followed by an ideation session. Participants will discuss the images they gathered during the pre-studio activity. Using the Affinity Diagram method [5, 14] and the Un-Deux-Tous (translated as "One-Two-All") technique [1] [16], they will map out existing keyboard use cases and identify the potential for integrating shape-change to enhance interaction design, accessibility, and inclusivity.

Once the affinity diagram is complete (and will remain visible throughout the session to encourage ongoing reflection), participants will start 2D paper-based prototyping with "extended posters." These posters can take various forms, from traditional 2D wall displays to more flexible setups, such as timeline-based layouts or deconstructed posters on a table. They can even include 2.5D paper models to explore preliminary shape-change concepts.

Following the lunch break, participants will be introduced to our 3D quick-prototyping kit. This session begins with a 15-minute introduction and 15-minute tutorial, followed by a 90-minute hands-on session where participants will prototype and iterate on their envisioned concepts for future shape-changing keyboard interactions.

Finally, a 30-minute demo session will allow participants to present their prototypes to the group, engage with each other's designs through hands-on demonstrations, and conclude with a 30-minute wrap-up for reflection and discussion on potential future collaborations.

[1]Each participant start by thinking and working alone, then discuss in pairs with their neighbor, and finally share their outcomes with the whole group.

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