Flat No More: From Personal Screens to Shared Tangible Devices

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Figure 1: Examples for the use of novel form-factor devices as collaborative tangibles. (A) a tangible display cube for a face-to-face meeting, (B) a spherical display to control speaking rights, (C) a passive tangible that visualizes speaking time. Images generated using the Create tool on You.com and subsequently edited by the authors.

Abstract

In this position paper, we propose a continuum of tangible interfaces, from tailored artifacts to everyday mobile devices. While mobile devices are tangible, their form factors reinforce individual use. Emerging multi-surface and non-planar devices (foldables, cubes, spheres) may change this, enabling shared use and supporting not only task collaboration but also relational micro-dynamics in co-located settings.

Keywords

Tangible user interface, Co-located interaction, Human-human dynamics, Non-Planar Interfaces, Multi-Surface Devices

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1 Introduction & Background

Tangible user interfaces (TUIs) have long promised to bridge physical and digital interaction by coupling computation with graspable artifacts [7]. Over the past decades, research has produced a wide range of tangible systems across domains like education [15, 25], information visualization [3, 21], and urban planning [4, 17, 22]. However, a large portion of these systems remains tightly bound to specific tasks or domains. They often succeed within controlled settings but rarely transition into everyday artifacts.

Meanwhile, mobile devices have become the main computing platform in everyday life. Although they are rarely discussed as TUIs, they are inherently tangible and facilitate embodied interaction. Their dominant form factors and interaction paradigms, however, reinforce individual use, even in co-located settings [1, 6].

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Technological advances now suggest increasingly complex mobile form factors that move beyond flat, rectangular screens. Foldable devices, round smartwatches, display cubes, and spheres demonstrate how consumer hardware is beginning to adopt multi-surface and non-planar geometries. These emerging forms introduce surfaces that can be accessed from different orientations, potentially enabling new collaborative affordances [2, 18].

In this position paper, we argue that tangible interfaces can be understood as existing on a continuum of specificity, ranging from highly specialized domain artifacts to everyday mobile devices. Based on this continuum, we explore how emerging multi-surface and non-planar consumer devices may shift the role of everyday tangibles from individual tools toward collaborative objects. We also propose that these devices provide opportunities to facilitate the everyday relational micro-dynamics of co-located interactions.

2 Degrees of Specificity in Tangible Interfaces

We argue that there is a continuum of tangible devices, ranging from artifacts designed for distinctive use cases to commercial mobile devices such as phones and smartwatches (see Figure 2). This is related to Koleva et al.'s [10] classification of TUIs along a coherence continuum.

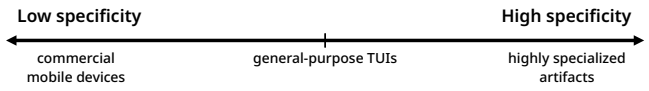

Figure 2: TUIs along the specificity continuum.

We see traditional mobile devices as a form of *everyday tangible* that people already use daily. While they offer inherent tactility, they are often not perceived as TUIs. We therefore position them as low-specificity tangible artifacts that support interaction through touch, motion, orientation, and physical controls. In addition to traditional mobile phones, tablets, and smartwatches, this also includes devices such as the Sifteo Cubes [13]. At the other end of

the continuum, there are highly specialized tangibles designed for a specific use case and application setting. Take, for example, ScaleDial by Klamka et al. [9], a tangible device for teaching musical scales and triads. Its design and interaction are tightly bound to that single context, making it a clear example of a domain-specific tangible interface at the specialized end of the continuum. Between these extremes lie general-purpose TUIs. These devices often utilize reusable physical primitives that applications can map to different functions. This allows them to be reused across tasks and domains. Examples include SLAP [23, 24] or spatially-aware displays [11, 19, 20]. We position general-purpose TUIs in the middle of the continuum because, unlike mobile devices, their physical form is often designed for a specific interaction. Thus, the way a tangible looks can reveal its purpose, meaning, and way it should be used by leveraging its physical characteristics. Take, for example, the knob in SLAP [23], which highlights its ability to be rotated due to its round shape. Similarly, light tangibles might be more obvious to pick up. These affordances may be lost with tangibles that serve a much broader range of purposes.

It is important to mention that specialized devices have been shown to perform better than general-purpose interfaces [3, 5]. Nevertheless, we believe everyday mobile devices hold a unique position as tangibles because of their ubiquity, versatility, and familiarity. While specialized TUIs may offer some physical affordances, they largely remain isolated prototypes or niche products. In contrast, mobile devices are already deeply integrated into users' daily lives, offering a "mass market" platform for tangible interaction that does not require new hardware.

3 Novel Form-Factor Devices as Collaborative Tangibles

As just established, we see contemporary mobile devices as tangible objects. They are graspable, directly manipulated, and tightly couple input and output. Yet in everyday use, they are treated socially as individual devices. Their interaction paradigms reinforce personal ownership, private orientation, and one-user-at-a-time engagement. In co-located settings, this hinders collaboration and may even weaken relational engagement between collaborators [1, 6]. The flat, rectangular form factor of conventional mobile devices reinforces this limitation. A single screen surface enforces a single orientation and a single primary user. When placed on a table, the display faces either up (visible but awkward to interact with) or down (inaccessible). These constraints make it difficult to establish a shared workspace or invite others into joint interaction.

Multi-surface and non-planar devices (foldables, display cubes, spherical interfaces) may offer a different dynamic. Multiple viewing surfaces, accessible from different orientations, make the device a shared object around which collaborators can gather. The physical structure of the device then shapes how bodies are arranged in space, how attention is distributed, and how people orient toward one another. The tangible manipulation of these devices (rotating a cube, folding a display, passing a sphere) could function as embodied communication.

For example, consider a display cube at the center of a table. Each collaborator views a different face, and rotating the cube toward someone directs their attention and invites a response (see Figure 1A). Similarly, a handheld spherical display could be used to control speaking rights in conversational storytelling, similar to a talking object (see Figure 1B). The shape of artifacts can also make a difference, as some shapes, like spheres, may be more pleasant to interact with. Furthermore, handheld devices can help users who face psychological problems, as speaking with a device that emits positive vibes may provide support (cf. [8]).

4 Tangibles Beyond Task Work

Many tangible user interfaces have been designed to support explicit collaboration tasks. Their value might be measured through task completion, performance, or engagement. Everyday co-located settings, however, involve relational micro-dynamics that have little to do with tasks. People sit together, chat, wait, negotiate attention, or navigate moments of tension and awkwardness. Such dynamics are central to how relationships are enacted.

Apart from serving as tangible objects solely for task completion, novel multi-surface and non-planar devices can also mediate everyday relational micro-dynamics. In this framing, the device functions as a passive tangible. For example, a shared object placed between two or more people could reflect patterns of conversational balance (see Figure 1C). A device might visualize accumulated speaking time across its surfaces, making dominance or withdrawal perceptible. Participants might adjust their behavior when the information becomes tangible and shared, creating opportunities for reflection.

5 Discussion and Conclusion

Another aspect we have not discussed is that collaboration in co-located settings does not necessarily require a single shared tangible interface. Given the ubiquity of mobile devices, collaborators often already bring their own tangible artifacts. In these cases, the output capabilities of mobile devices may additionally be used to signal mood or agreement to others. This notion of using mobile devices as tangibles beyond task work points to a continuum of how tangible artifacts participate in human-human interaction and how active or passive they are. We acknowledge that the more passive these artifacts become, the more likely they are to fall out of traditional definitions of tangible user interfaces. Nonetheless, especially in collaborative settings, we believe they can help improve co-located dynamics by conveying conversational and relational cues.

Furthermore, the fact that mobile devices combine input and output highlights another continuum of tangibles' output potential. This is related to the interaction dynamics of shape-changing interfaces discussed by Rasmussen et al. [16]. Output may be realized through light or display technologies (as in LEDs or displays, e.g., traditional mobile devices, Sifteo Cubes [13]) or through physical movement (cf. actuated tangibles, e.g., Topobo [15], Tangible Bots [14], Zooids [12]). At the same time, tangibles without embedded output can be coupled with interactive surfaces such as tabletops, projector setups, or display walls [21].

Put succinctly, we believe TUIs span a continuum from specialized artifacts to everyday mobile devices. Emerging multi-surface and non-planar form factors expand this space and create opportunities to position devices as collaborative tangibles that support relational dynamics beyond task work.

About the Authors

Julian Baader. I am a researcher at the Dresden University of Technology and a PhD candidate at the Interactive Media Lab Dresden, Germany. My research focuses on non-rectangular, non-planar displays and their potential applications in data visualization. I am investigating how interaction techniques, input modalities, and spatial manipulation must adapt when displays move beyond flat, rectangular screens. In particular, I explore what data visualization and embodied interaction might look like in a future where displays take on diverse forms and are embedded throughout the environment.

As I work with these novel form factors, I often find myself thinking less about the screen itself and more about what happens around it. When displays are no longer flat and front-facing, people gather differently, turn objects toward one another, and negotiate space and attention in new ways. These observations sparked ideas about how such devices might shape co-located interaction and relationships. I see a strong connection to tangible user interfaces and to questions of how physical artifacts mediate shared attention, participation, and conversational balance. I hope to join the workshop to exchange perspectives, refine these ideas, and explore how emerging devices can support human-human dynamics in everyday settings.

Susmita Khadse. I am an HCI researcher and PhD candidate at the Interactive Media Lab, Dresden University of Technology, Germany. My research focuses on scientific visualization, data storytelling, and the exploration of its emotional and contextual aspects across different media, including tangible interfaces. I believe that participation in this workshop can strengthen my knowledge of how to foster stronger relationships between users to communicate "data" through tangibles, which are storytelling devices themselves.

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