Design Course

Tangible User Interface - II

Digital Data and Information

by
Prof. Keyur Sorathia
DoD, IIT Guwahati

Source:
https://www.dsource.in/course/tangible-user-interface-ii

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Introduction

This quote by Wellner, Mackay and Gold will provide an immediate glimpse of the course setting,

"We live in a complex world, filled with myriad objects, toys, and people. Our lives are spent in diverse interaction with this environment. yet, for the most part, our computing takes place sitting in front of, and staring at, a single flowing screen attached to an array of buttons and a mouse"

The field of Tangible User Interface (TUI) attempts to think beyond a single flowing screen attached to an array of buttons and a mouse, and seek researchers and designers attention to think of interfaces those are natural and balances our physical and digital world. I recommend reading the course of TUI-I before pursuing for advance course.

The course of TUI-I covered basic fundamentals of Tangible User Interfaces, where various TUI definitions, history and its evolution, models of TUIs, difference between TUIs and GUIs were explained. The TUI-II is relatively advance course, where TUI fundamentals are elaborated through representation of major characteristics, related research areas, its embodiment possibilities and TUI metaphors. It will also trigger a discussion of possible potential feedback and output modalities.

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Tangible Bits - Introduction

Before we attempt to understand design fundamentals and guidelines of TUIs, let us take a small break to understand the concept of tangible bits to demonstrate digital information through tangible objects. A concept presented by Hiroshi Ishii (MIT Media Lab, Tangible Bits group) and his students, tangible bits aimed to make digital information directly accessible and manipulable through real world objects as a display and a medium of manipulation. Hence, it aimed to provide a platform where the entire world would become an interface, an interface that encompasses "realness", being able to touch that included multi sensory perceptions.

The concept of tangible bits was further explained through 3 themes and its relevant prototypes. These themes created the initial base of tangible user interfaces. Following are the 3 concept prototypes.

- metaDESK
- ambientROOM
- transBOARD

metaDESK:
As a part of metaDESK concept, a prototype of Tangible Geospace was built. Tangible Geospace uses physical models of landmarks such as MIT's Great Dome and Media Lab buildings as phicons to allow the user to manipulate 2D and 3D graphical maps of the MIT campus. This example represents one category of TUI application, where concepts are prototyped on interactive surfaces. It also provided a new set of icons dedicated to tangible interfaces, that included lens, phicon, tray, phandle and instrument to represent graphical UI window, icon, menu, handle and widget respectively.

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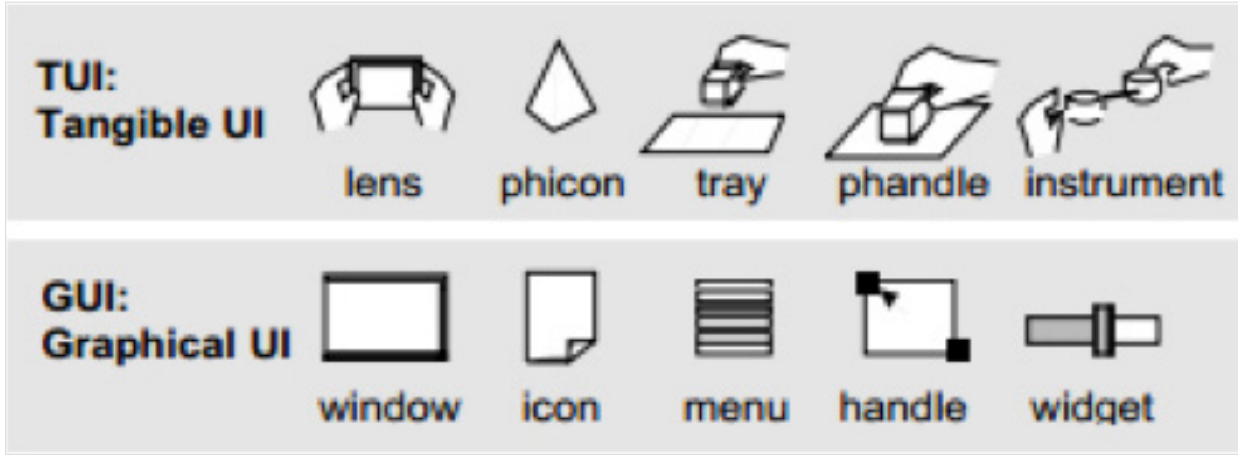

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ambientROOM:
The ambientROOM complements the graphically-intensive, cognitively-foreground interactions using ambient media – ambient light, shadow, sound, airflow, water flow – as a means for communicating information at the periphery of human perception. Communicate information, which is not the user's primary foreground task, providing seamless transition of user's interaction between background, and foreground information. This example represented an example concept of ambient environment enabled tangible interfaces.

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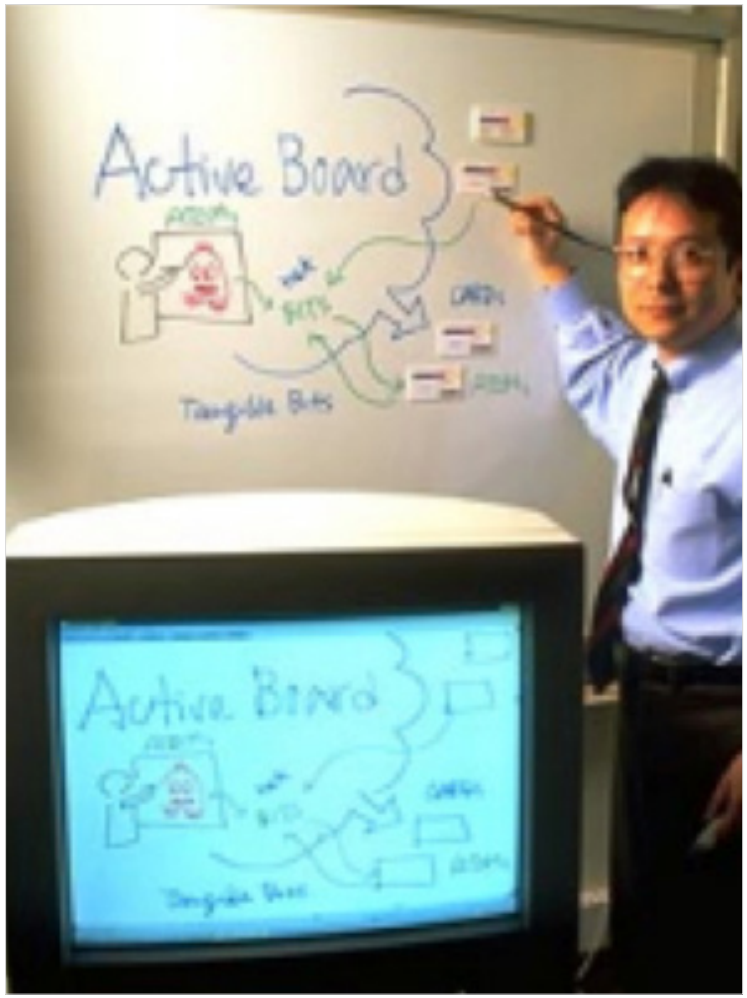
transBOARD:
The transBOARD is a networked digitally enhanced physical whiteboard designed to explore the concept of interactive surfaces that absorb information from the physical world, transforming this data into bits and distributing it into cyberspace. "HyperCARDs" are used as containers of digital strokes, used as phicons. Pen-strokes from the whiteboard are virtually "stored" within the card and "recorded" in virtual space. Hence user can keep the meeting contents with cards.



Above three examples provided a new beginning and novel approach to user interfaces, where it empowered the vision of Dr. Mark Weiser of making computers truly ubiquitous and invisible.

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Research Areas and Characteristics

Related Research Areas:

• Tabletop interfaces:

Tabletop interfaces combines interaction techniques and technologies of interactive multi-touch surfaces and tangible interfaces. A tracking mechanism typically embedded underneath the table detects the positioning, movements and correlated interactions across tangible objects. These inputs are detected, analyzed and further provided an appropriate feedback and eventually an output through a projection.

• Tangible Augmented Reality:

Tangible objects are combined with augmented reality displays, where objects as inputs help augment relevant information. Object manipulations such as rotation, vertical/horizontal movements, pressure etc. are various examples of input gestures on tangible augmented reality examples.

• Reality based interfaces:

Taking ahead the concept of TUIs, reality based interfaces proposes the emerging styles of interactions, where it aims to take advantages of user well-entrenched skills and experience of interacting with real non-digital world to a greater extent than before. It proposed four themes of naive physical, body awareness skills, environment and social awareness. Naive physics uses the common sense knowledge of people having about their own world. Body awareness and skills uses awareness of people of their own physical body and their skills of controlling and coordinating their bodies. Environment awareness uses the sense of surroundings, people's skills of manipulating and navigating in their environment, whereas social awareness propose the use of social skills; skills of interacting with each other verbally and nonverbally and their ability to work together to accomplish a common goal.

Key Characteristics of TUI:

Key characteristics of TUI demonstrate basic fundamentals and guidelines for designing tangible interfaces. It provides five major parameters that TUI systems tend to suffice.

• Physical digital coupling:

Physical representations are computationally coupled to underlying digital information The characteristic emphasizes on physical-digital coupling of interfaces. It proposes to use physical representation to provide digital information as core characteristic of TUI projects. A good example of physical-digital coupling is "Urp" where a range of couplings such as graphical geometries data (wind, shadow etc.) are coupled with building objects, clock hands etc.

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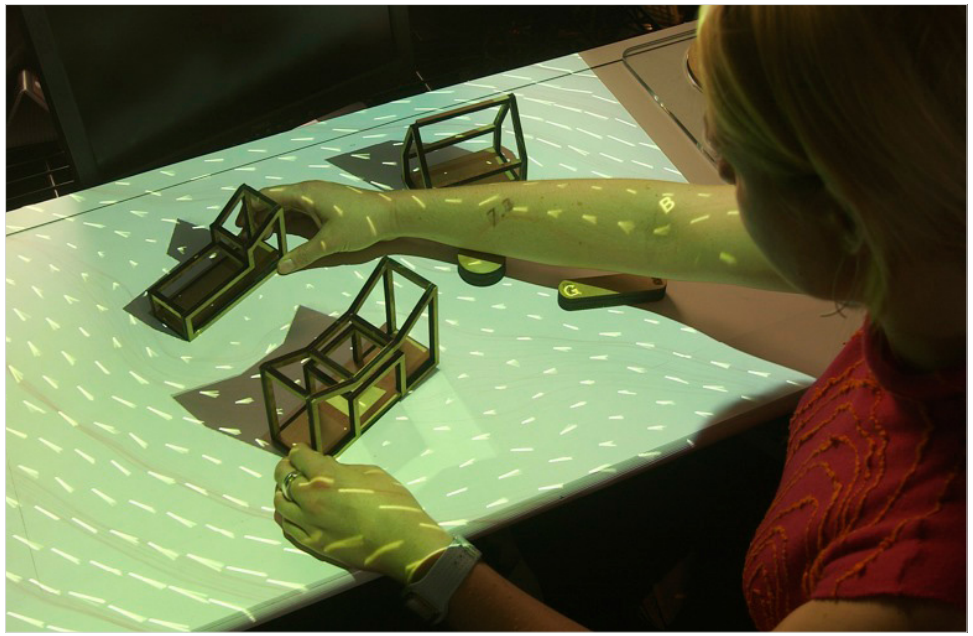
• **Embodiment of physical representations:**
Physical representations embody mechanisms for interactive control
Physical objects used in TUIs should act to control and manipulate digital information. Such interventions provide ease to users if designed with familiar physical objects and familiar interactions. For example, interactions of rotation of familiar artifacts (e.g. clock hands), their insertion or attachment to each other serves as tangible user interfaces' primary means of control.



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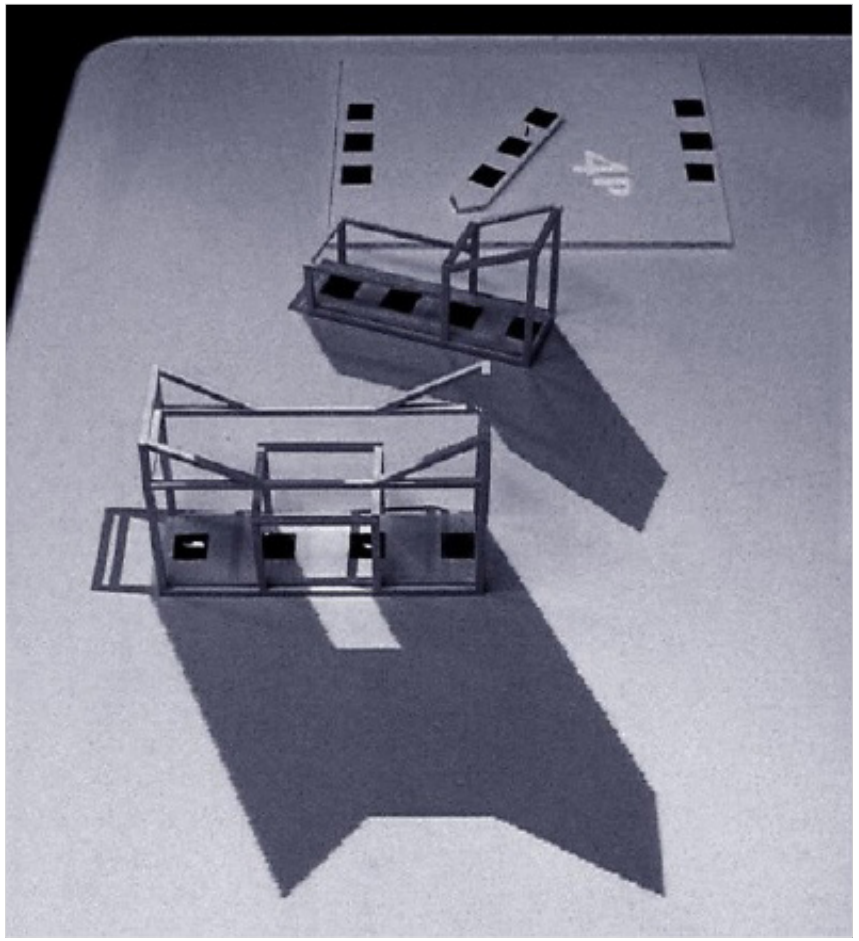

• **Balancing physical-digital representations:**
Physical representations are perceptually coupled to actively mediated digital presentation TUI relies upon appropriate balance between physical and digital representations. Researchers and designers must be able to answer; How to map physical objects and their manipulation to digital computation and feedback in meaningful and comprehensive manner?
In case of URP, rotation of clock hand represents change in time. It is very important to communicate a familiar interaction, where change in time represents change in sunlight and eventually the shadows of building blocks.

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• **Physical input and its relationship with others:**
Relationship between the sequence, adjacencies or other logical relationship between systems of physical objects are mapped and interpreted by computational system. It is very important to consider physical objects' position, sequence and orientation to each other. The position, sequence and orientation of physical object play an important role to interpret the output mechanism from computational system. Cookie scale computers used in siftable interprets each other's function, position and orientation to provide solutions to simple math problems.

• Mechanism of interactive control:
Embodiment of mechanism for interactive control with tangible representation:
Metaphors, affordances and semiotics are integral part of TUI systems. Objects, its relevant information and possible associated interactions must be natural and intimidating real world interactions. Actions supported by the objects should be based on well-understood actions related to the object.
E.g. if bottle is chosen, then opening a bottle with a cork is well understood action.

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TUI Embodiment and Metaphors

TUI Embodiment:
This section showcases four different kind of information embodiment in TUI systems. Variety of projects, based on their context, contents and users choose their embodiment in TUI systems. They are:

• **Full embodiment:**
In full embodiment, output device itself is an input device. The object that is used to control and manipulate interactions and information itself is a output device where digital information is present. Siftable is a full-embodied TUI system, where users manipulate the blocks to demonstrate output on same blocks.

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• **Nearby embodiment:**
Unlike full embodiment, output in nearby embodiment is near to the input object, but not exactly the input object. Most tabletop interfaces/interactive surfaces are good example of nearby embodiment.

• **Distant embodiment:**
In distant embodiment, output of TUI system is either at a distance or in other room to the input object. Bowl, where physical blocks of animated characters are kept in the bowl to play related animated movie on TV represents distant embodiment. Here, user places physical object in a bowl kept at a distance where output is showcased on television screen.

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• **Environment embodiment:**
As indicated in the name, the output is presented in the surrounding environment. In most cases, the surrounding environment of the same room is considered under environment embodiment.

TUI Metaphors:
TUI systems use various objects to control and manipulate digital information. Such metaphors are sometimes abstract and sometimes clearly represent its association with digital information.

• **Metaphor of noun:**
When objects look like a real thing or represent object used in everyday life, these objects are called metaphor of noun. However, actions of these objects are most weakly related to real world actions.
E.g. navigational blocks, tagged objects.

• **Metaphor of verb:**
Objects are not likely to look like real thing or objects used in everyday life. The shape of the object is often irrelevant in metaphor of verb. However, the action associated with the objects acts like a real thing.

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Information and Interactions

Three types of information is represented in information systems.

- Functional information
- Augmented information
- Inherent information results

Functional information:
A direct result of the product's function (e.g. over door swings open on the pulling the handle down)

Augmented information:
Informs the user about internal state of the product (e.g. LED lights up the indicate the oven warms up)

Inherent information results:
Information results directly from the user's actions. (e.g. the feeling of a button pressed down and hearing it clicking)

This information is presented through various output media. Multiple possibilities such as images, 3D models, live video and dynamic graphics are presented through screen. Other possibilities such as color (through LEDs), light and change in material properties can also be used to provide intermediate and final digital information.

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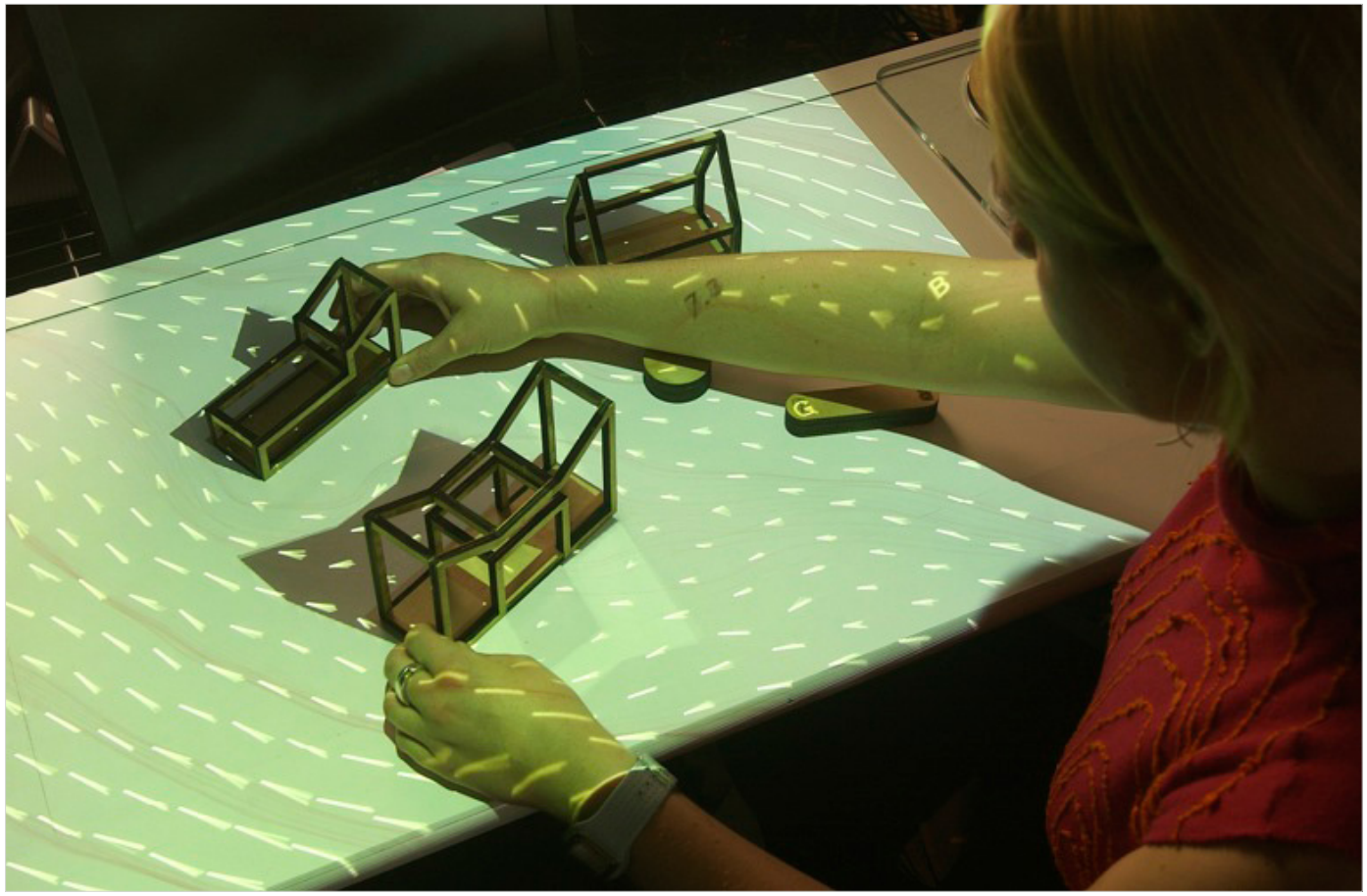

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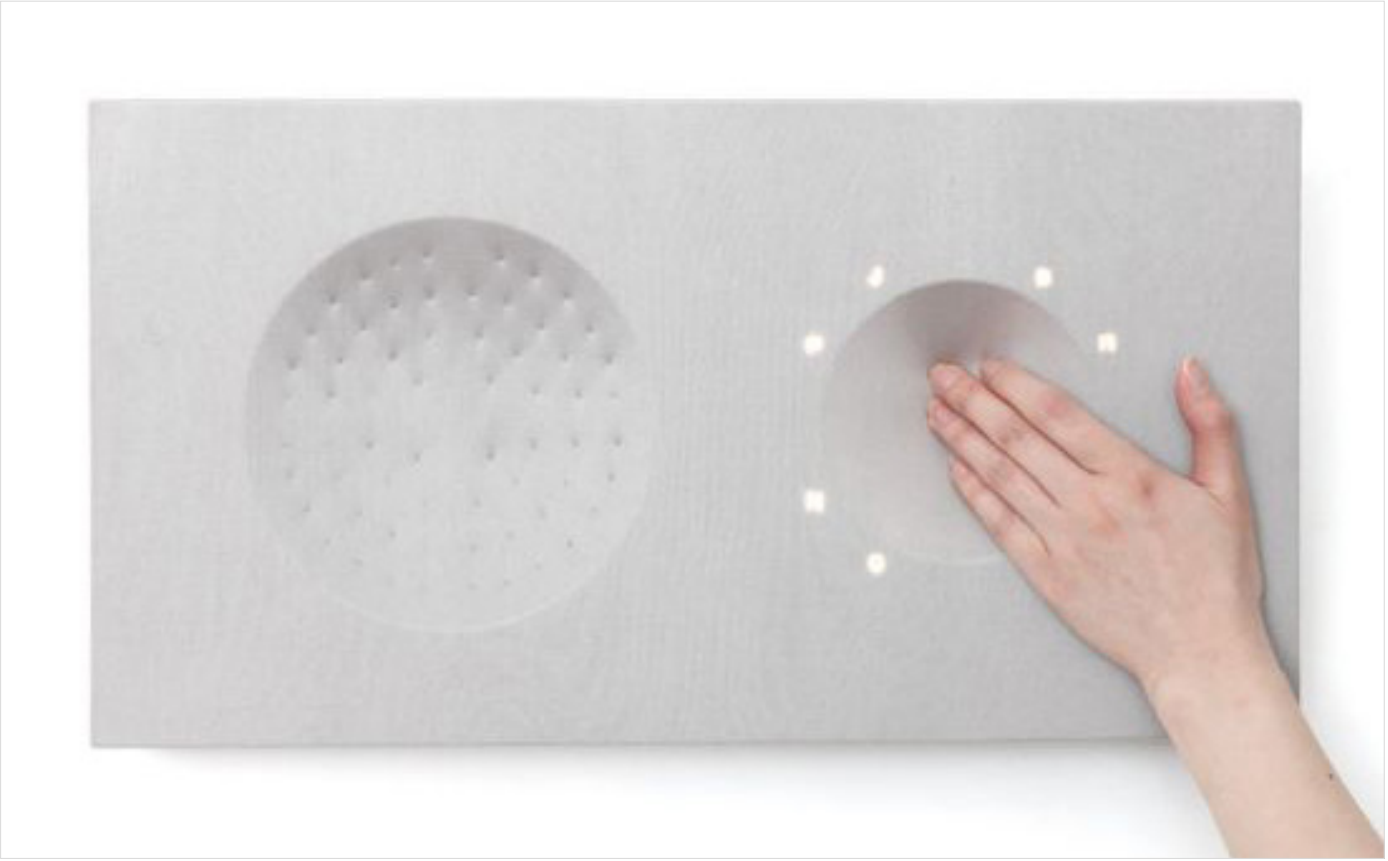

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For more details, please click on the following link:
www.embeddedinteractions.com

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