

# Designing Tangible Interaction

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# Overview

- Introduction
- Tangible Interaction
- Hornecker and Buur's Tangible Interaction Framework
- Examples of design methods
- Some resources

# Remember! Design principles/frameworks are not the same as design methods!

Principles help you to make *principled* design decisions (ie making a decision based on some kind of *collective wisdom* about design rather than personal preference/dislike/nice colours/feeling-grumpy etc.)

They are not prescriptive and always need to be interpreted and appropriated within concrete design situations (ie they don't actually tell you much about what to specifically design).

But they can be used to guide the selection of methods and tools that you use in the design process and to analyse what is happening at various stages of the design process and evaluate prototypes and other aspects of the developing design

In 1981, Tom Moran, a researcher at Xerox PARC defined the user interface as:

those aspects of a system that a user comes into contact with

which at that time meant:

an input language for the user, an output language for the machine, and a protocol for the interaction

that is the user does something that is, in some way meaningful to the software running on the computer they are using, that software can interpret the users action and do something, and then provide some kind of appropriate response that is meaningful to the user.

# Tangible Interaction

Tangible Interaction is an *umbrella* term that encompasses user interfaces and interaction approaches that emphasise:

- tangibility and materiality of the interface
- physical embodiment of data
- whole-body interaction
- the embedding of the interface and the users' interaction in real spaces and contexts.

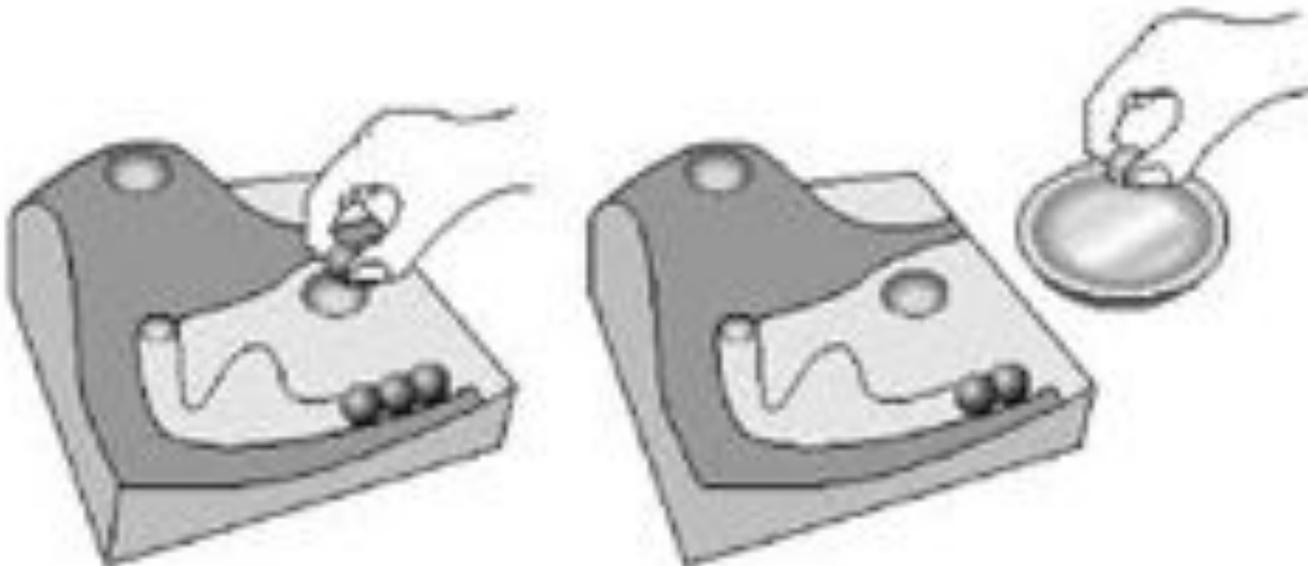
The focus is on interaction via interfaces that are in some way physically embodied – in physical objects and/or the physical environment

# Examples: The Marble Answering Machine

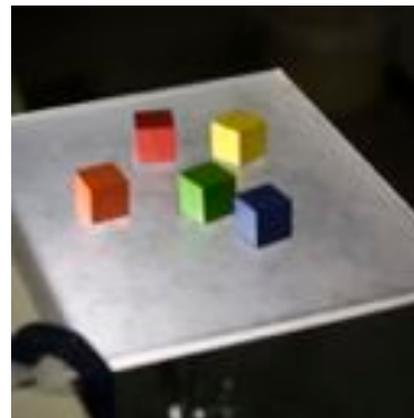
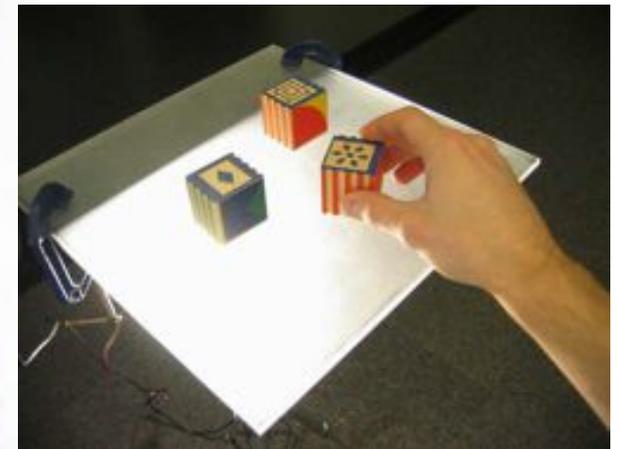
Durrel Bishop, 1995.

The marbles represent incoming calls. The user takes a marble and puts it into the hole at the top to play the message.

→ Data could be represented through physical objects and manipulated by physically handling the objects.



# Examples: Hiroshi Ishii's *Tangible Bits*.







# Tangible Interaction

As it becomes easier and cheaper to build working prototypes and functioning systems the field is diversifying rapidly

- some systems involve actuation (eg a mechanical device)
- some rely on complex sensor-based data-collection
- some are based on conductive fabrics etc.
- some focus on tinkering and making things (eg physical computing)

How can the *form* of a physical object and *digital behaviour* be more closely coupled so people can interact in richer ways with digital products and with other people through them?

# Tangible Interaction

Many installations employ *interactive spaces* which are sensorised to track users' behaviours and can also integrate tangible objects into the spaces.

- movements of the human body provide direct input into interactive technologies of various kinds
- both gestures and whole-body movement (eg dance) can be used to interact within these environments.
- these movements can be *pure and/or* related to physical objects

# Tangible Interaction

We can interact with small objects that we can grab and move around within arms reach

- more the focus of tangible user interfaces and product design

We can interact with large objects within a large space and therefore need to move around with our whole body

- more the focus of installations and digital architecture

# Tangible Interaction

The shift in *phrasing* from tangible interface to tangible interaction was intended to focus on the design of the interaction instead of the visible interface.

This puts the qualities of the interaction into the foreground of attention, and requires system designers to think about what people actually do with the system.

It further encourages thinking of the tangible system as part of a larger ecology and as located in a specific context.

Application areas include: learning and education, domestic appliances, games, interactive music installations or instruments, museum installations, tools to support planning and decision making and, increasingly, health and fitness etc

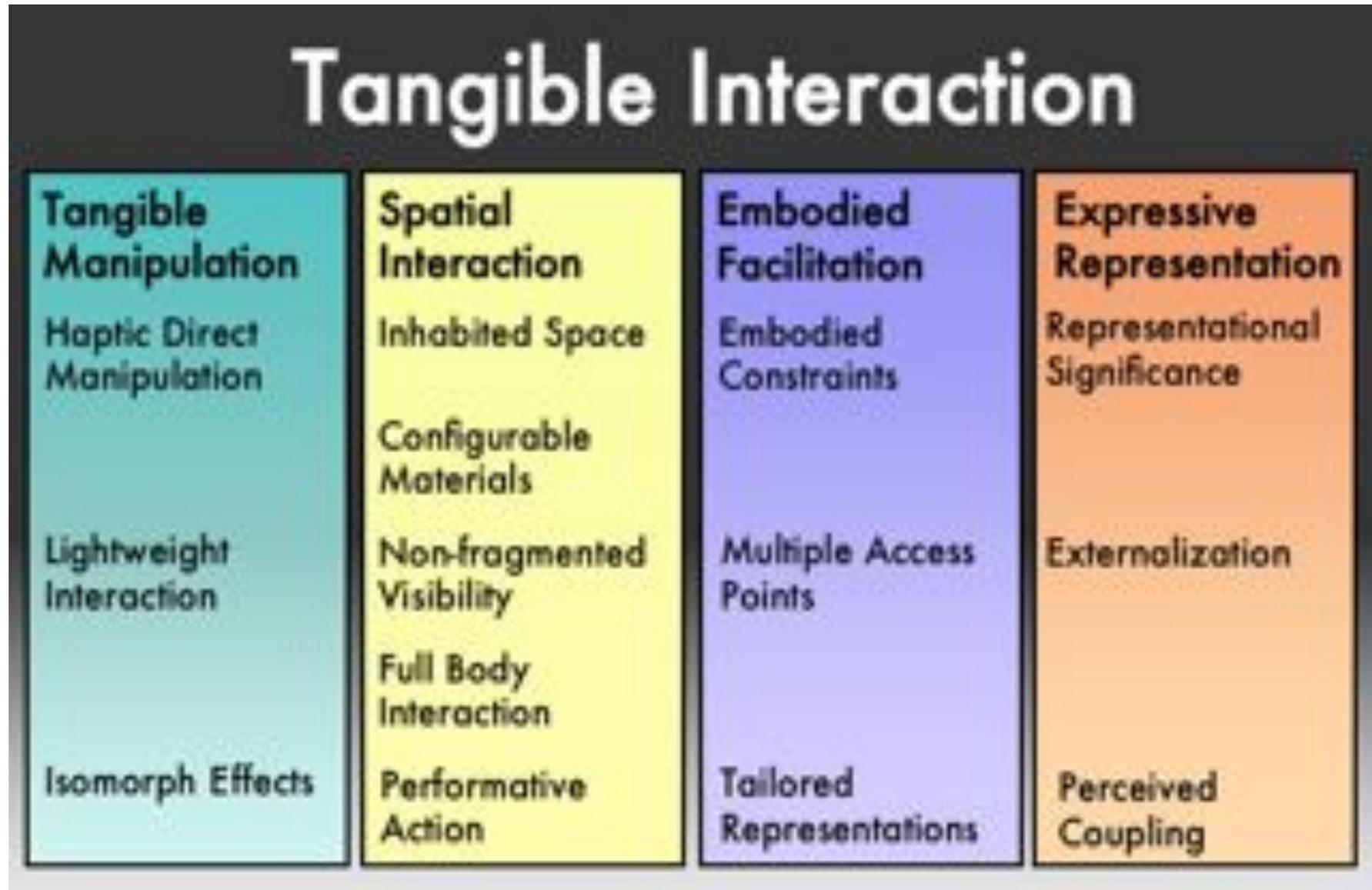
# Design principles for tangible interaction

Newer conceptualisations of tangible interaction (and interaction design generally) focus on human action, control, creativity and social action instead of the representation and transmission of information.

4 major design principles:

- tangibility and materiality
- physical embodiment of data
- bodily interaction
- embeddedness in real spaces and contexts

# Hornecker and Buur's Tangible Interaction Framework – this might be useful for your assignments!



Eva Hornecker and Jacob Buur, Getting a grip on tangible interaction: a framework on physical space and social interaction. CHI 2006.

# Hornecker and Buur's Tangible Interaction Framework –

**Tangible Manipulation** - material representations with distinct tactile qualities that are typically physically manipulated in tangible interaction

**Spatial Interaction** - tangible interaction is embedded in real space and therefore occurs by movement in space

**Embodied Facilitation** - the configuration of material objects and space affects and directs emerging group behavior

**Expressive Representation** - the material and digital representations employed by tangible interaction systems their expressiveness and legibility.

# The Tangible Interaction Card Brainstorming Game

Inspired by the growing use of design games to both inspire design and to evaluate prototypes and existing interactive technologies

- always part of Participatory Design approaches
- increasingly part of the toolkit for human-centred approaches to technology design (and increasingly design in general)
- this game uses the four themes of Hornecker's tangible interaction framework

You can download it and use it in your projects!

# Tangible Interaction

## Tangible Manipulation

Haptic Direct Manipulation

Lightweight Interaction

Isomorph Effects

## Spatial Interaction

Inhabited Space

Configurable Materials

Non-fragmented Visibility

Full Body Interaction

Performative Action

## Embodied Facilitation

Embodied Constraints

Multiple Access Points

Tailored Representations

## Expressive Representation

Representational Significance

Externalization

Perceived Coupling

Eva Hornecker and Jacob Buur, Getting a grip on tangible interaction: a framework on physical space and social interaction. CHI 2006.

*Can users grab, feel and move  
"the important stuff"?*



Tangible Manipulation > Haptic Direct Manipulation

*Is there rapid feedback  
during interaction?*



Tangible Manipulation > Lightweight Interaction

*Can users proceed with small,  
experimental steps?*



Tangible Manipulation > Lightweight Interaction

*Can users experience the  
interaction straight away,  
from the start?*



Tangible Manipulation > Lightweight Interaction

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*Do people and objects meet  
and invite into interaction?*



Spatial Interaction > Inhabited Space

*How can the human body  
relate with the space?*



Spatial Interaction > Inhabited Space

*Can you create a meaningful  
place with atmosphere?*



Spatial Interaction > Inhabited Space

*Does shifting stuff (or your own  
body) around have meaning?*



Spatial Interaction > Configurable Materials

*Can everybody see and follow what's happening?*

*Can you use your whole body?*

*Bodily interaction is enlivening, expressive, observable, performative.*



*Spatial Interaction > Visual Access*

*Spatial Interaction > Full-Body Interaction*

*Can users take ownership of space by physically moving there?*

*Can users be proud of skilled body movement?  
Can they develop skill over time?*



*Spatial Interaction > Full-Body Interaction*

*Spatial Interaction > Full-Body/Performative*

*Can you communicate through your body movements while doing what you do?*



Spatial Interaction > Performative Actions

*Are actions publicly available?*



Spatial Interaction > Performative Actions

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*Does the physical set-up lead users to collaborate by subtly constraining their behavior?*



Embodied Facilitation > Embodied Constraints

*Is there a physical focus that draws the group together?*



Embodied Facilitation > Embodied Constraints

*Can all users get their hands on the central objects of interest?*

*Can you hand over control anytime, and fluidly share an activity?*



Embodied Facilitation > (Multiple) Access Points

Embodied Facilitation > (Multiple) Access Points

*Does the representation build on users' experience and connect with their skills?*

*What is the entry threshold for interaction?*

*(Can you provide a simple syntax of interaction regardless of the semantics?)*



Embodied Facilitation > Tailored Representations

Embodied Facilitation > Tailored Representations

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*Are representations legible,  
meaningful, and expressive?  
Are they of lasting relevance?*



Expressive Representation > Representational Significance

*Are physical and digital  
representations of similar  
strength? Can they augment and complement each other?*



Expressive Representation > Representational Significance

*Can users think or talk with/  
through objects, using them as  
props to act with?*



Expressive Representation > Externalization

*Does the representation give  
discussions a focus and provide  
a record (trace)?*



Expressive Representation > Externalization

*How easy is it to understand the relations between action and effects? Can you give "fake" causal feedback?*

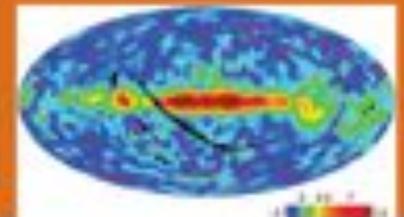
*Are there powerful representations that transform the problem?*



Expressive Representation > Perceived Coupling and Power



Expressive Representation > Perceived Coupling and Power



You can download these cards plus instructions of how to use them from: <http://www.ehornecker.de/CardGame.html>

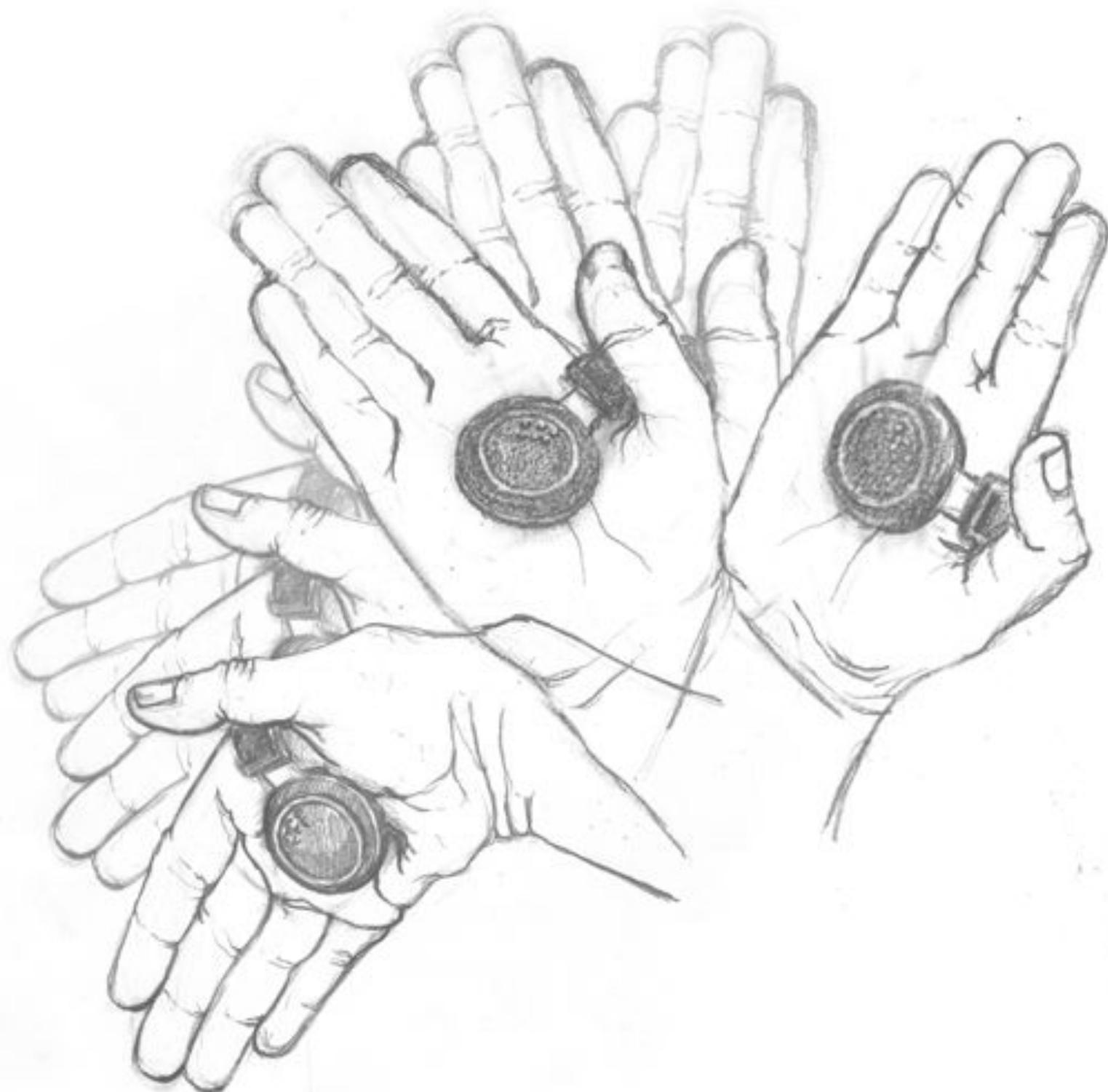
# Design methods for tangible interaction

Select methods that support major design principles, These can be from Hornecker and Buur's framework or more general ones:

- tangibility and materiality
- physical embodiment of data
- bodily interaction
- embeddedness in real spaces and contexts

Can include the basic methods of human-centred design that support user engagement and participation including (but not limited to):

- ethnographic user research, design workshops, iterative design, prototyping and frequent evaluation etc
- focus on enactment and immersion



# Some tangible interaction resources

Hornecker, Eva and Buur, Jacob (2006): Getting a grip on tangible interaction: a framework on physical space and social interaction. Proceedings of *ACM CHI 2006*. pp. 437-446 (available online).

Hornecker, Eva (2009) *Tangible Interaction*. [http://www.interaction-design.org/printerfriendly/encyclopedia/tangible\\_interaction.html](http://www.interaction-design.org/printerfriendly/encyclopedia/tangible_interaction.html)

Tangible Media Group at MIT <http://tangible.media.mit.edu/>

Larssen, Astrid (2011) How it feels, not just how it looks: Towards an understanding of kinaesthetic and proprioceptive experiences of interaction with technology, PhS thesis, UTS

Loke, Lian (2009) *Moving and Making Strange: A Design Methodology for Movement-based Interactive Technologies*, PhD thesis, UTS.

The Tangible Interaction Card Brainstorming Game <http://www.ehornecker.de/CardGame.html>