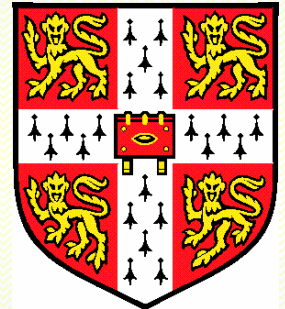


Meaning, Mapping & Correspondence in Tangible User Interfaces



*CHI '07 Workshop on
Tangible User Interfaces
in Context & Theory*



Darren Edge
Rainbow Group
Computer Laboratory
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A Solid Diagram Metaphor for Tangible Interaction

Alan Blackwell, Cecily Morrison & Darren Edge: *University of Cambridge*

- Technical paradigms of UbiComp are founded on *implicit metaphors* of interaction design:

<i>UbiComp Paradigm</i>	<i>Demonstrates Technology</i>	<i>Founded on Metaphor</i>
Conversational	NLP	Conduit
Inference	Sensing & Machine Learning	Sentience & Context
Solid Diagram	Sensing	Notation

- *Solid Diagrams* provide a human-centric approach to the specification of *abstract data structures* in the physical world



Tangible Interaction in a Mobile Context

Alan Blackwell, Gareth Bailey, Ignas Budvytis, Vincent Chen, Luke Church, Lorisa Dubuc, Darren Edge, Mattias Linnap, Vilius Naudziunas & Hugh Warrington: *University of Cambridge*

- Many multimedia computing devices are portable
 - Mobile phones, Music players, Video players
- Opportunity to support tangible interaction “on the spot”
- Design experiments:
 - Linking mobile devices to tangible surfaces
 - Bimanual interaction with mobile devices
 - Interaction with small articulated tangibles



Putting TUIs in Context: A Unifying Framework for Next Generation HCI

Michael Horn, Orit Shaer, Audrey Girouard, Leanne Hirshfield, Erin Treacy Solovey, Jamie Zigelbaum*, Robert Jacob: *Tufts University, *MIT Media Lab*

- *Reality-Based Interaction* (RBI) takes advantage of
 - Interfaces *like* the real world
 - Interaction *in* the real world
- Design should consider the *Power—Reality* tradeoff
 - Favour realistic features over unrealistic
 - Use unrealistic to increase “power”
 - Use analogies for unrealistic



Generative Design Methods for the Tangible Social Interfaces (TSI)

Pamela Jennings: *Carnegie Mellon University*

- *Constructed Narratives* is a TSI for collaborative design
- Tangible blocks generated from *Shape Grammars*
- Interaction:
 - Users log in profile of self-id, origins, environment & values
 - Users construct a physical 3D block model
 - Links sensed and fed into semantic engine
 - Visual semiotics seed WordNet searches
 - Results printed on a digital 3D model



Meaning, Mapping & Correspondence

- Meaning
 - User interpretation of the world
- Mapping
 - Relationship between the physical and the digital
 - “Physical : Digital”
- Correspondence
 - Deriving meaning from perceptions of the world
 - “Shown : Meant”



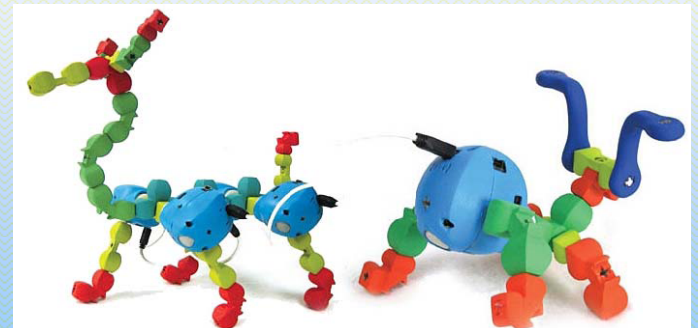
Spatial Mapping

- **Physical Arrangement → Digital Interpretation**
- *Style of Mapping* (Ullmer & Ishii: Emerging Frameworks)
- *TAC Paradigm* (Ullmer; Shaer, Leland, Calvillo & Jacob)
- *Spatial Syntactic Relations* (Engelhardt: Language of Graphics)
 - Solid Diagrams
 - “Examples of structural diagrammatic relations in the world include registering which objects are touching which other object, and which objects are contained within particular spatial regions”
 - Personalization
 - “Many TUI projects demonstrate spatial layout as a means to intentional physical personalization”



Temporal Mapping

- **Physical Specification → Digital Behaviour**
- *Abstraction & Notation* (Blackwell)
 - Solid Diagrams
 - “Most [implicit metaphors of interaction] focus on the immediate effect of communication to provoke system action or change of state. A further alternative is for the user to specify the structure of the required behaviour, rather than directly specifying the required actions”



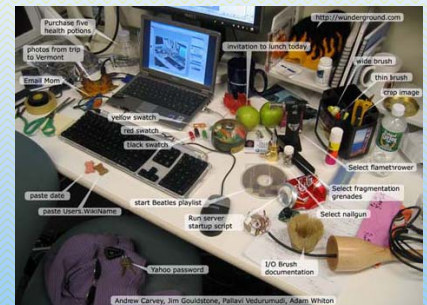
Representation Correspondence

- **Physical Representations → Conceptual Roles**
- *Iconic vs Symbolic* (Dourish: Where the Action Is)
 - Five Properties
 - “Semantic mapping between physical and digital representations may be literal, analogical, or metaphorical”
 - Augmented Toys
 - “Semantic mapping between the (virtual) role or function of an object and its appearance”
 - “Semantic distinction... can also [be] established by metonymic association”
 - Reality-Based
 - Interaction *like the real world*




Relation Correspondence

- **Object Relations → Conceptual Relations**
- *Preconceptual Image Schemata* (Lakoff: Spatialization of Form)
- *Indexical*
 - Everyday Manipulation
 - “Things that matter are close. Things that are close matter”
 - “Human everyday strategy to arrange objects in the real world into places”
 - Reality-Based
 - Information organization *in the real world*



MAC Analysis

	<i>Mapping</i>	<i>Correspondence</i>
More Physical  More Digital	Spatial	Tactile
	Attribute	Visual
	Action	Relation
	Temporal	Representation

Mapping and Correspondence (MAC) Analysis in TUI design is analogous to Cognitive Walkthrough in GUI design



Discussion Points

- Utility
 - Conceptual level
 - Completeness
- Usability
 - Terminology selection
 - Examples
- Integration
 - Experience, Expectations and Learning
 - Needs, Activities and Context

