DESIGNEERING INTERACTION

A Missing Link in the Evolution of Human-Computer Interaction

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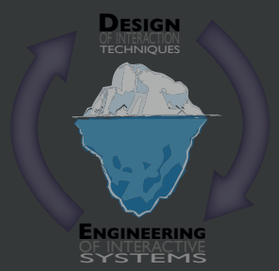
Université Paris-Sud
Laboratoire de Recherche en Informatique
Inria - in|situ| group

Habilitation à Diriger des Recherches
May 7th, 2013



research only real when shared

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Fanny Chevalier
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Guillaume Faure
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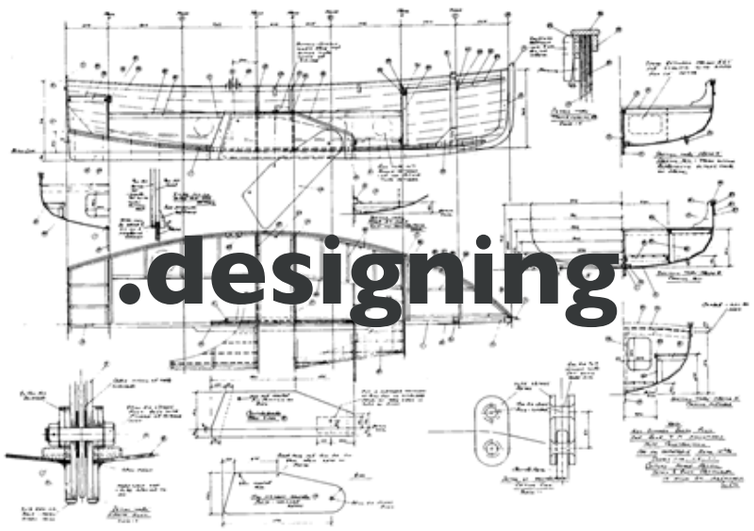
Emmanuel Pietriga
Clément Pillias
Romain Primet
Anne Roudaut
Quentin Roy
Jean-Marc Vézien
Julie Wagner

Alexandra Merlin



.designing

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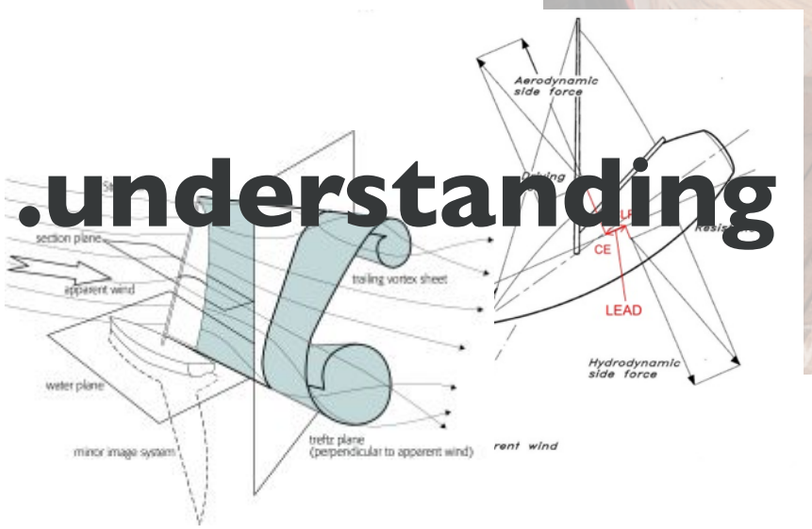
design
theories
technology
craftsmanship



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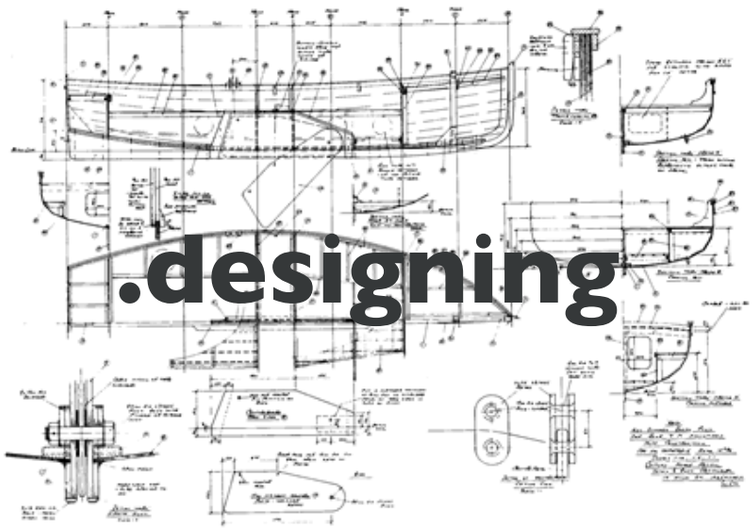

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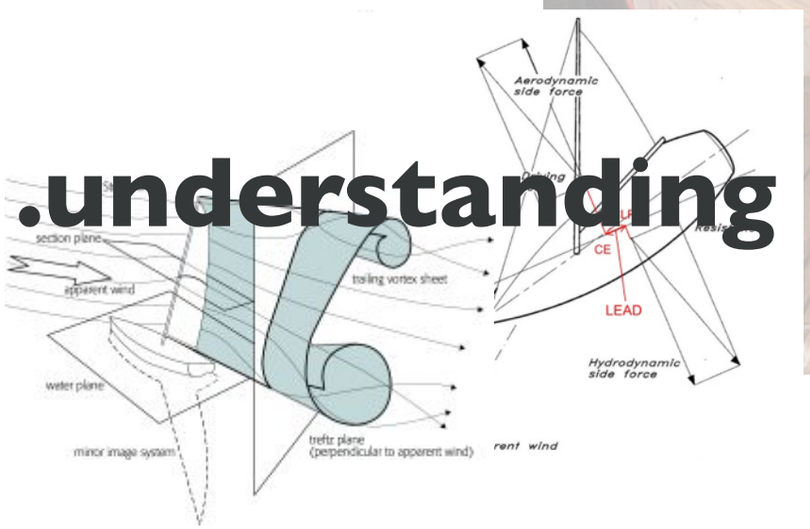


.understanding

the golden age of a young research field

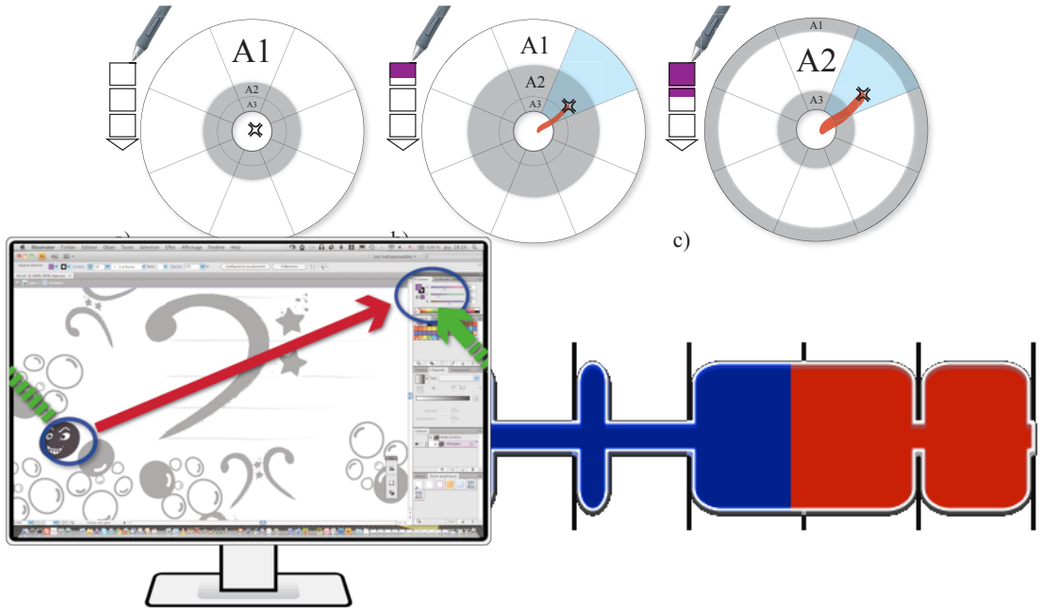
Stuart Card - keynote @ CHI '12

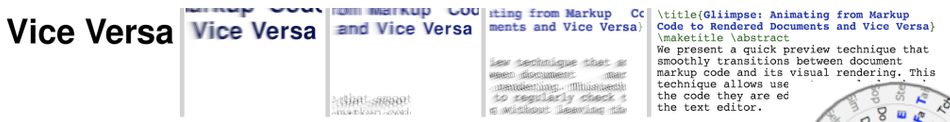
"*how to ground the field, accelerate its progress, and make it cumulative by fashioning theories and incorporating them into practice*"

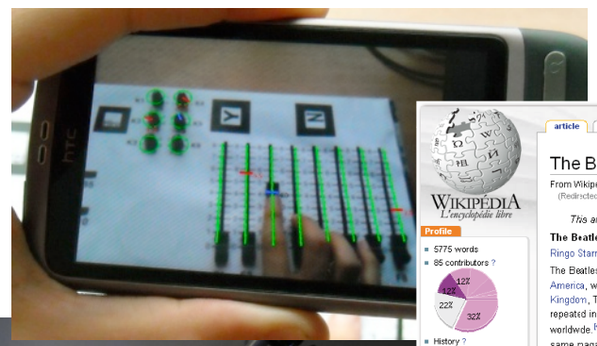
↳ Technology develops by combinatoric evolution and we need to understand how HCI works with technology, to focus on technological and theoretical progress all together in order to successfully take on the new "*golden age*" that HCI is entering now.

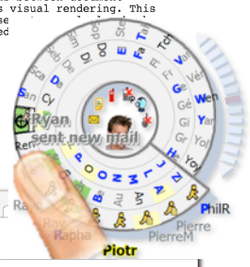
interaction design and software technology

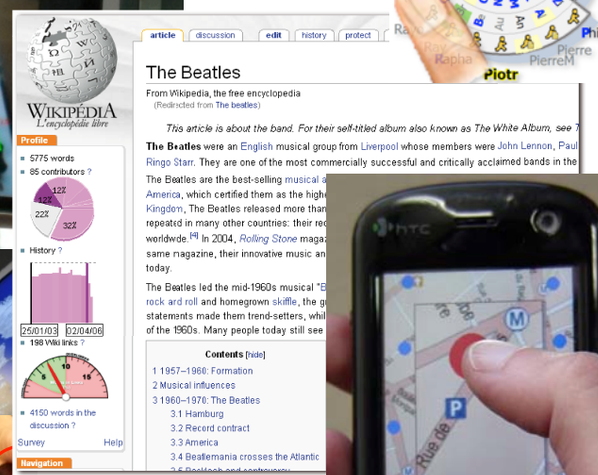
designing interaction techniques

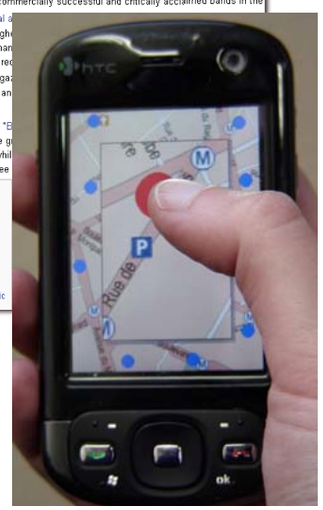




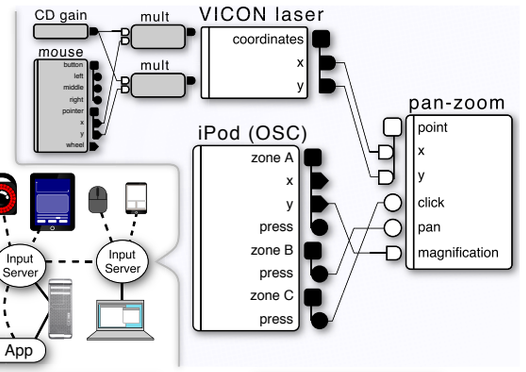


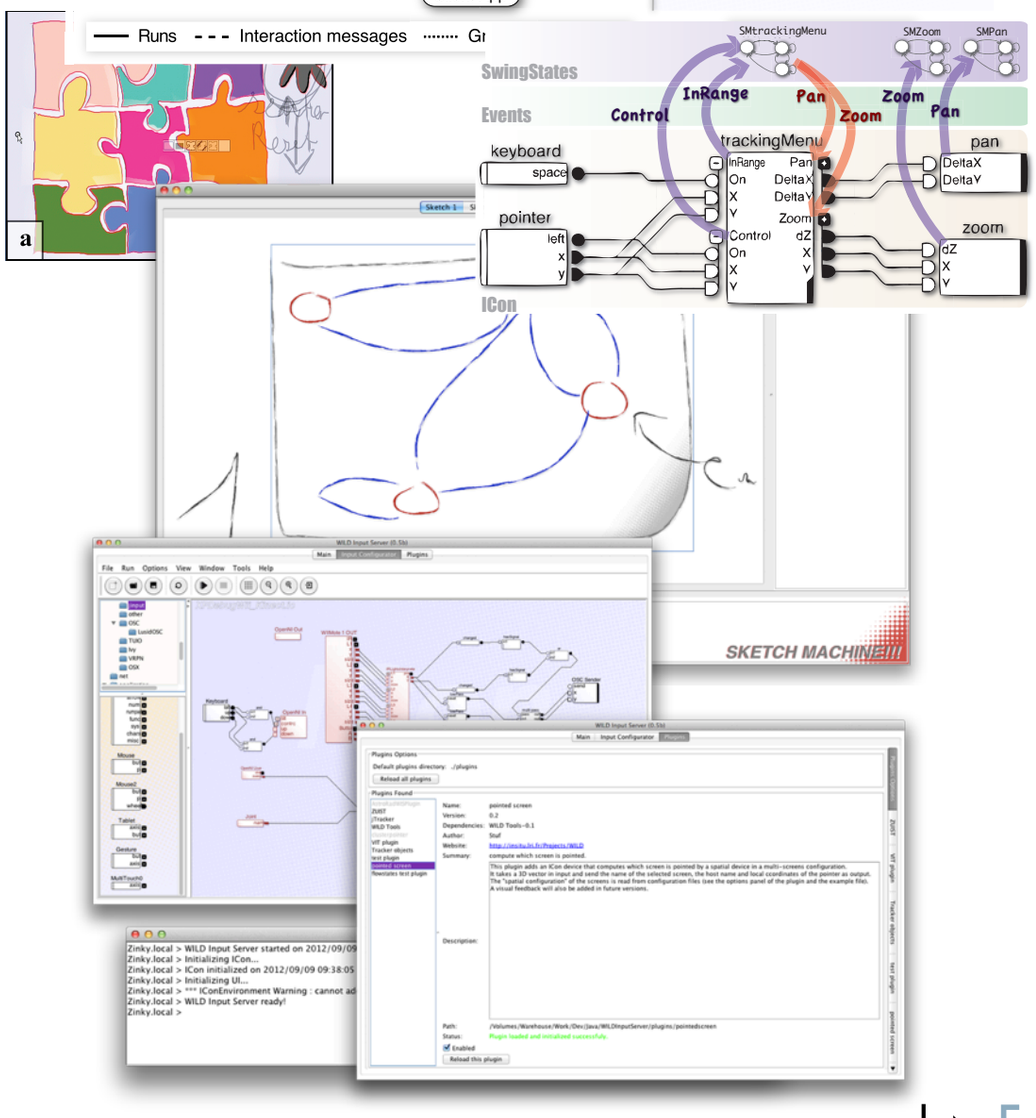


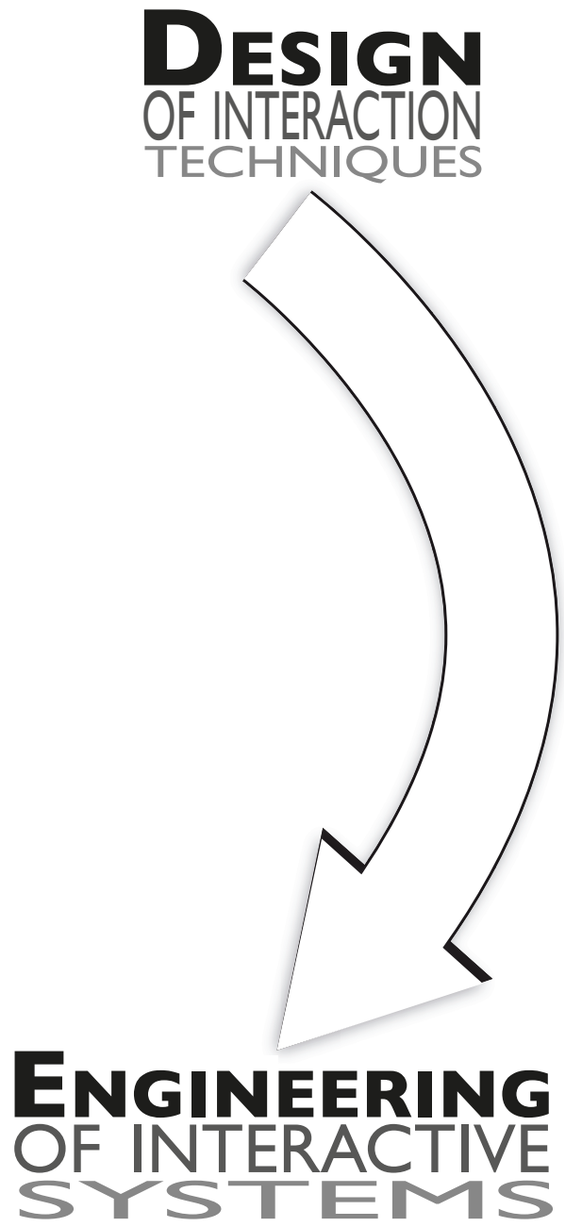




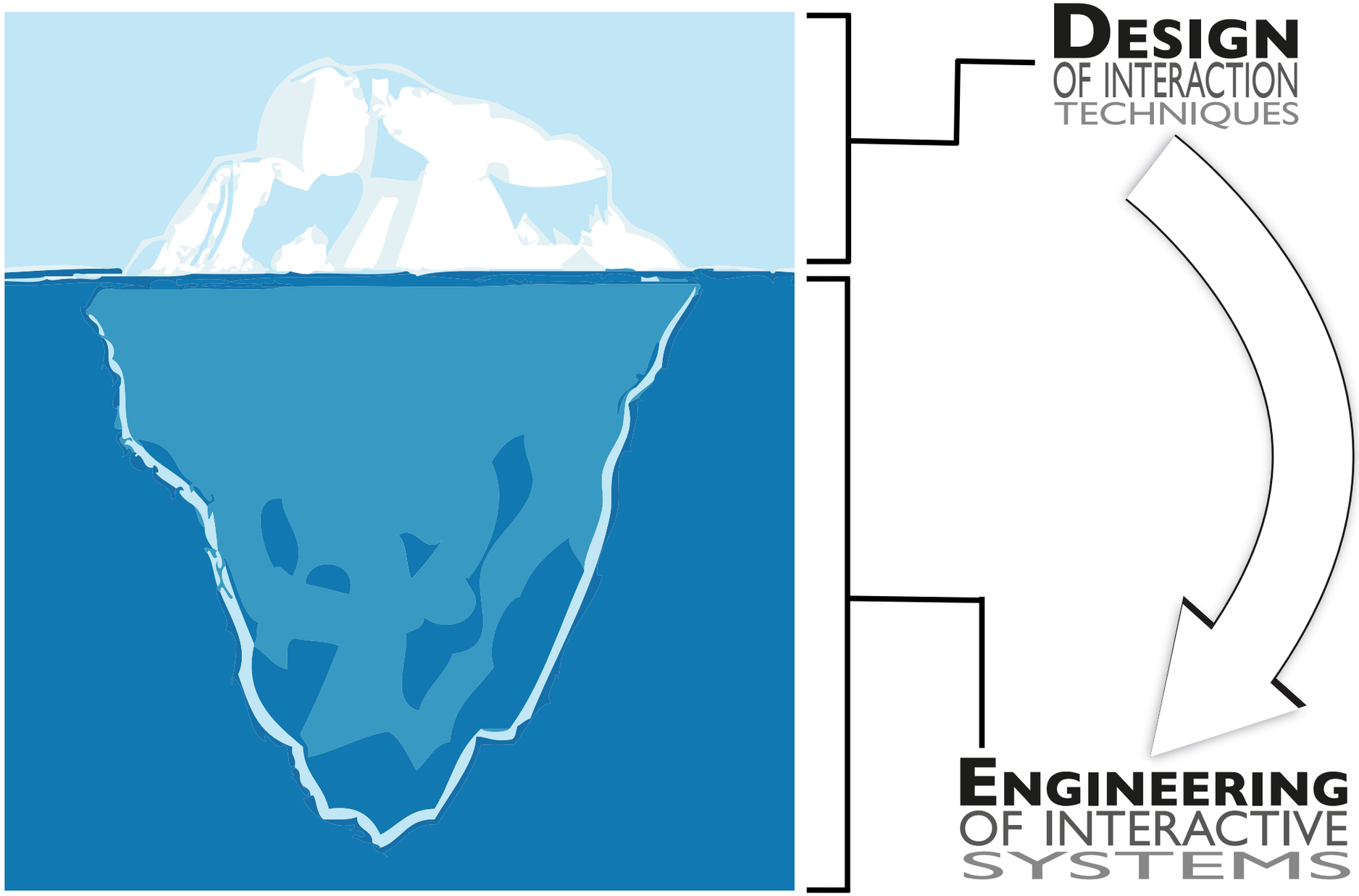
engineering interactive systems





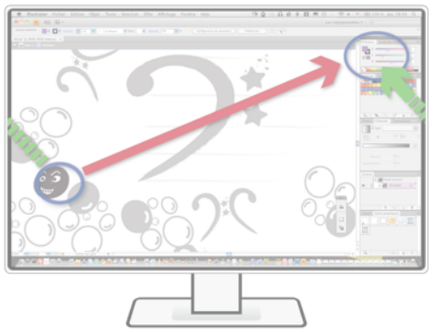

DESIGN
OF INTERACTION
TECHNIQUES
ENGINEERING
OF INTERACTIVE
SYSTEMS

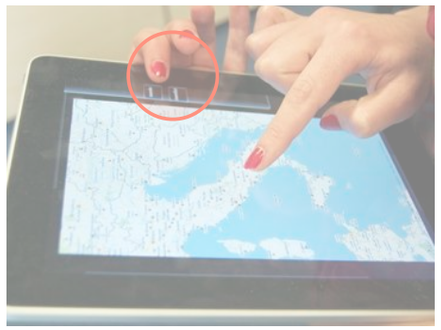
interaction design challenges technology



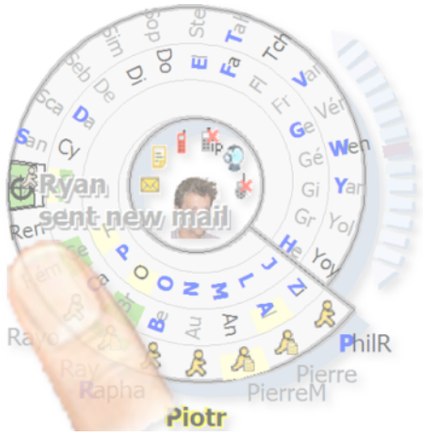
interaction design challenges technology

.when interaction design is driven by technology





.when interaction design is constrained by technology

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   <br><input type="submit" value="Submit"/>
</form>
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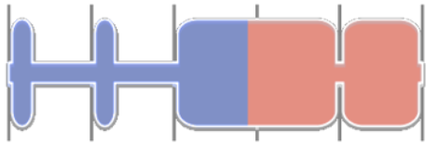
Registering form
Name:
E-mail: Send me mail.

Registering form
Name:
E-mail: Send me mail.
Submit

.when interaction design improves technology

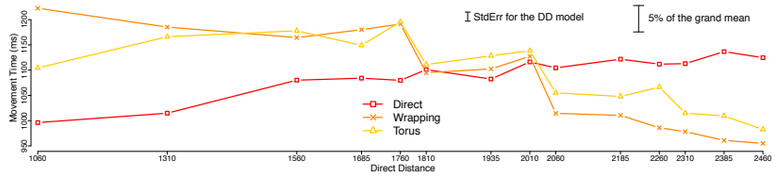


DESIGN OF INTERACTION TECHNIQUES

ENGINEERING OF INTERACTIVE SYSTEMS

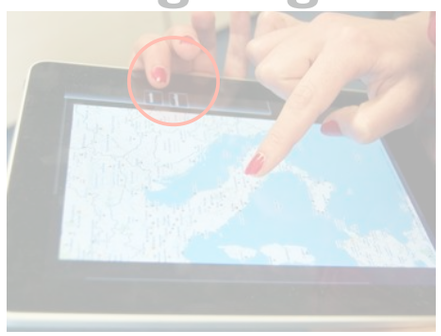
when interaction design is driven by technology

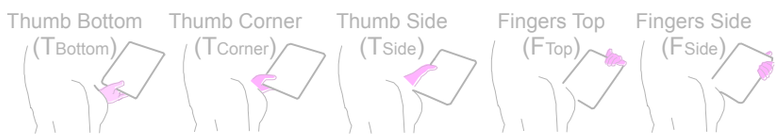
.designing with limitations



[TorusDesktop - CHI'11]

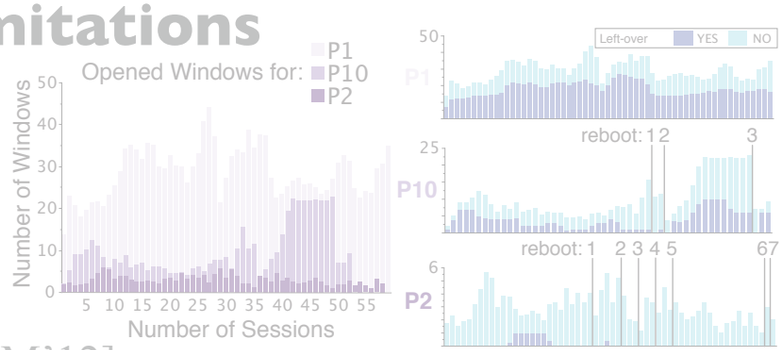
.designing for features





[BiPad - CHI'12]

.identifying limitations



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DESIGN OF INTERACTION TECHNIQUES

ENGINEERING OF INTERACTIVE SYSTEMS

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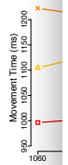

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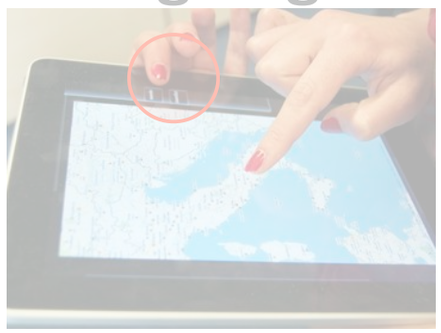

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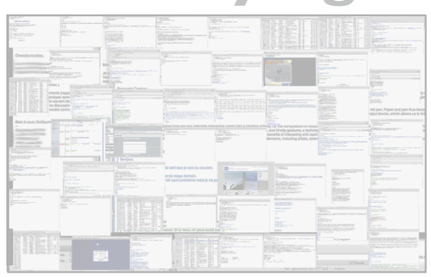

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TorusDesktop

with O. Chapuis & P. Dragicevic

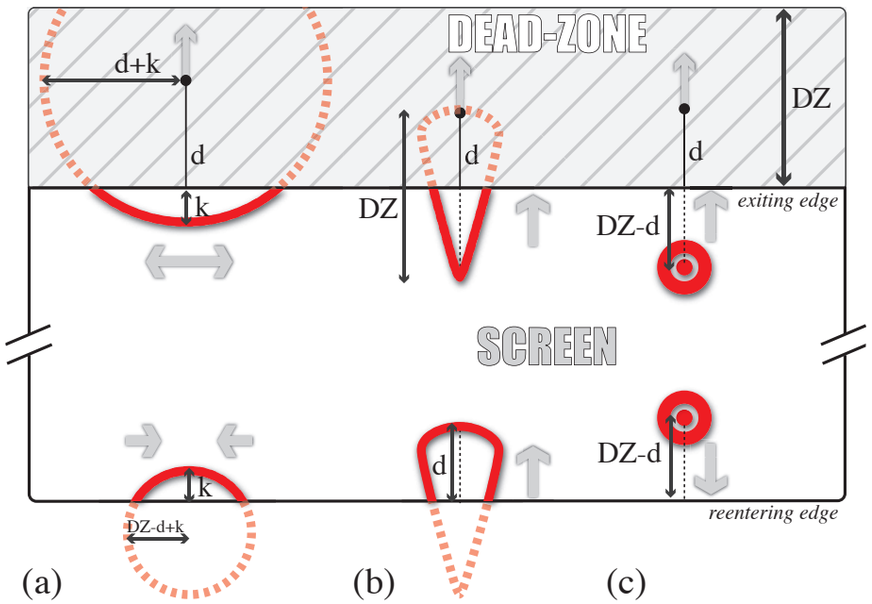
.designing with limitation

↳ accessing targets in real systems

detecting user's intentions

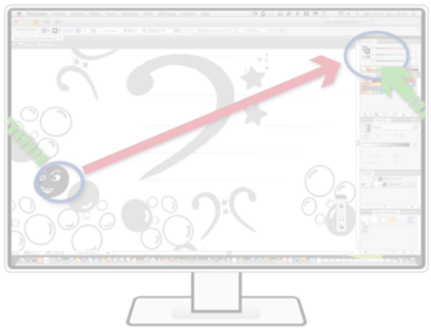
objective : target agnostic pointing technique

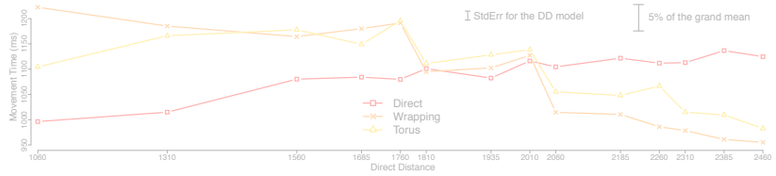
solution : revisit cursor wrapping



when interaction design is driven by technology

.designing with limitations





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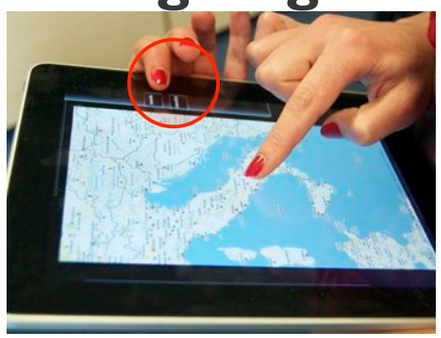
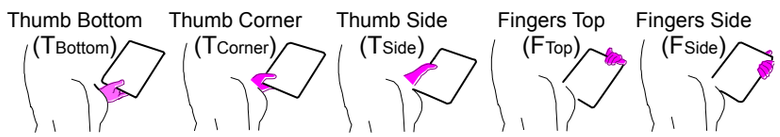
.designing for features





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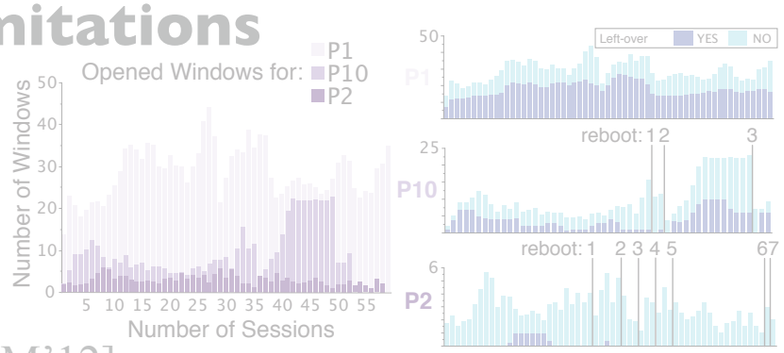

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DESIGN OF INTERACTION TECHNIQUES

ENGINEERING OF INTERACTIVE SYSTEMS

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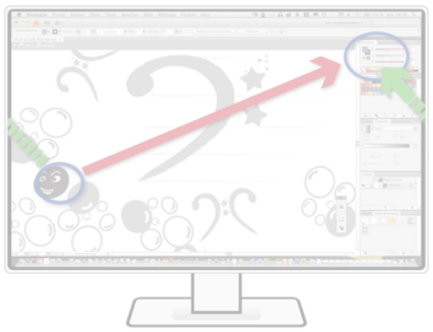

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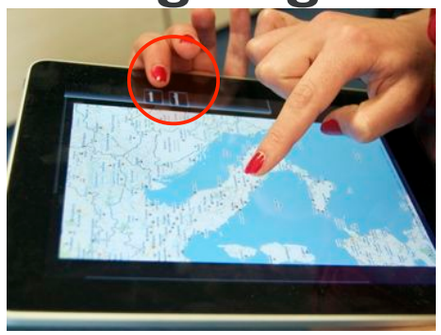

[BiPad - CHI'12]

.identifying limit

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BiPad

with J. Wagner & W. E. Mackay

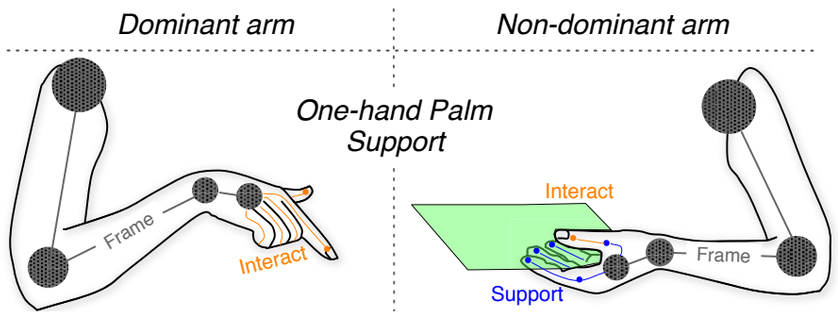
.designing for features

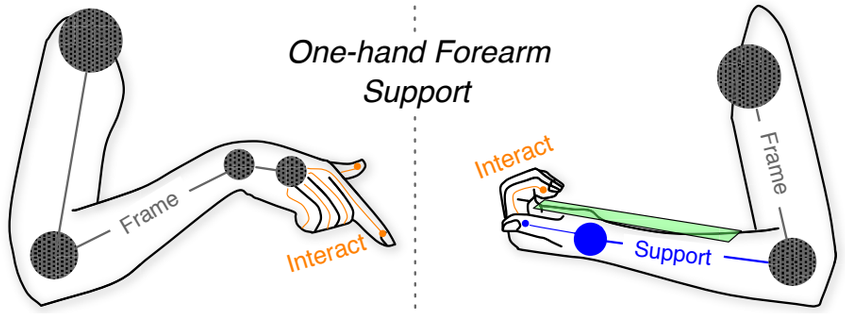
↳ handheld devices

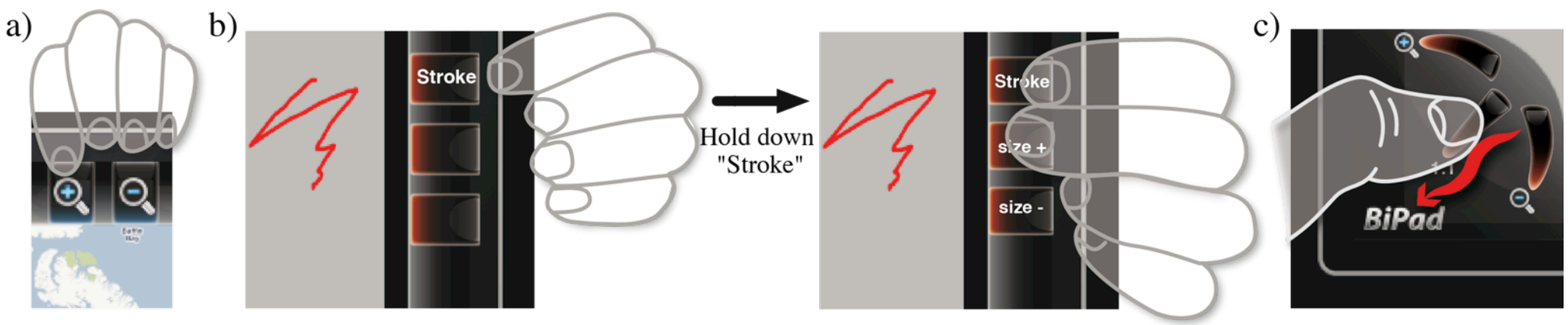
multitouch capabilities

objective : bimanual interaction in mobility

solution : design space and multiple designs

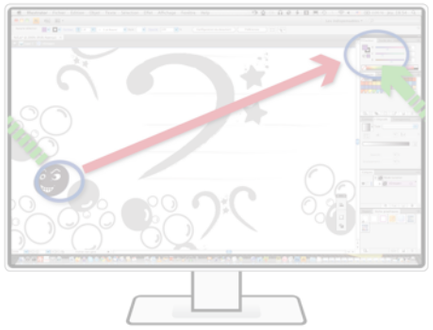


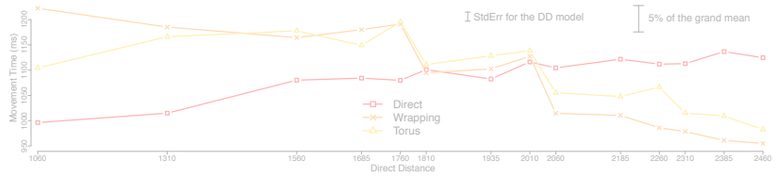




when interaction design is driven by technology

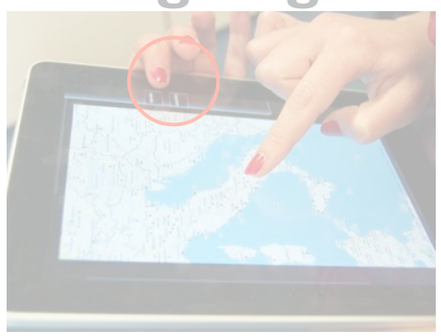
.designing with limitations

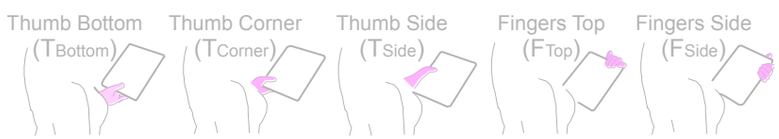




[TorusDesktop - CHI'11]

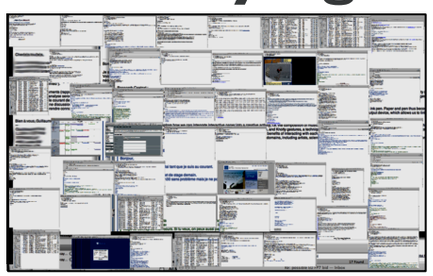
.designing for features

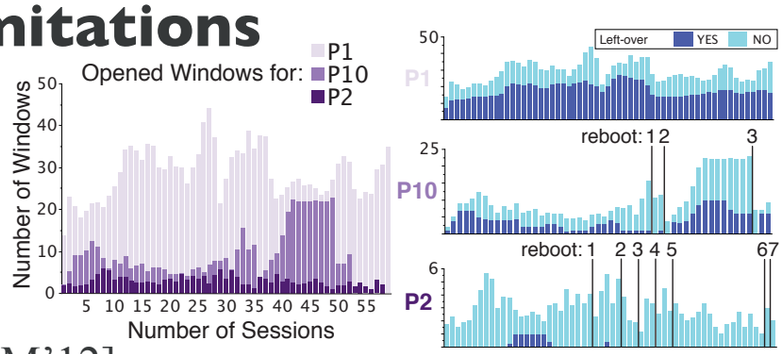




[BiPad - CHI'12]

.identifying limitations





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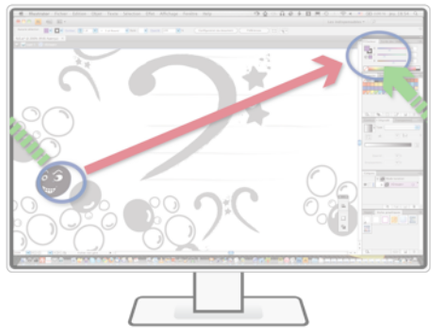
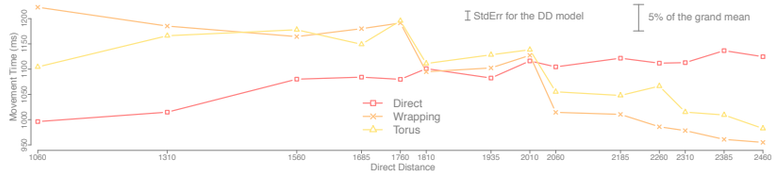
DESIGN OF INTERACTION TECHNIQUES

ENGINEERING OF INTERACTIVE SYSTEMS

when interaction design is driven by technology

.designing with limitations





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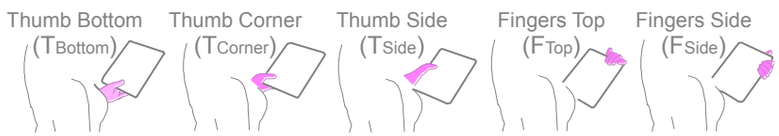
.designing for features



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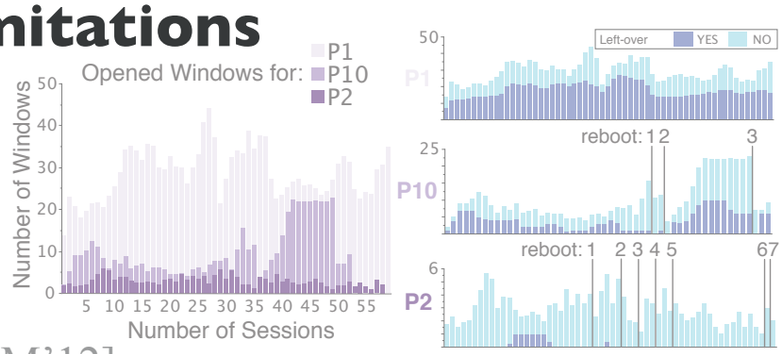
.identifying limitations



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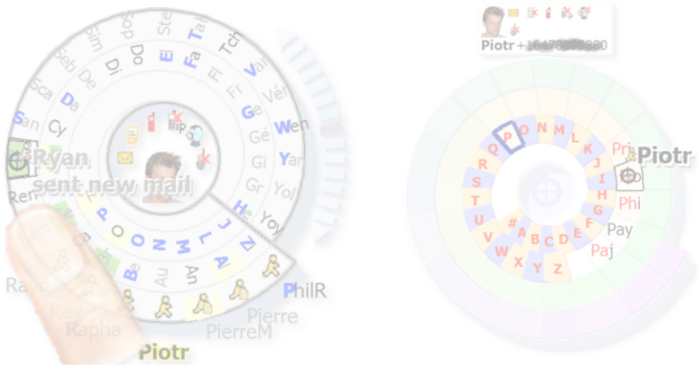
DESIGN OF INTERACTION TECHNIQUES

Evaluation

ENGINEERING OF INTERACTIVE SYSTEMS

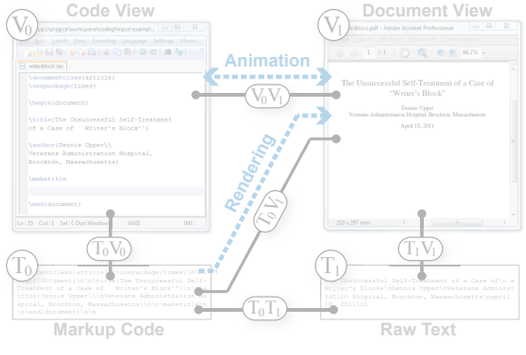
when interaction design is constrained by technology

.performance issues

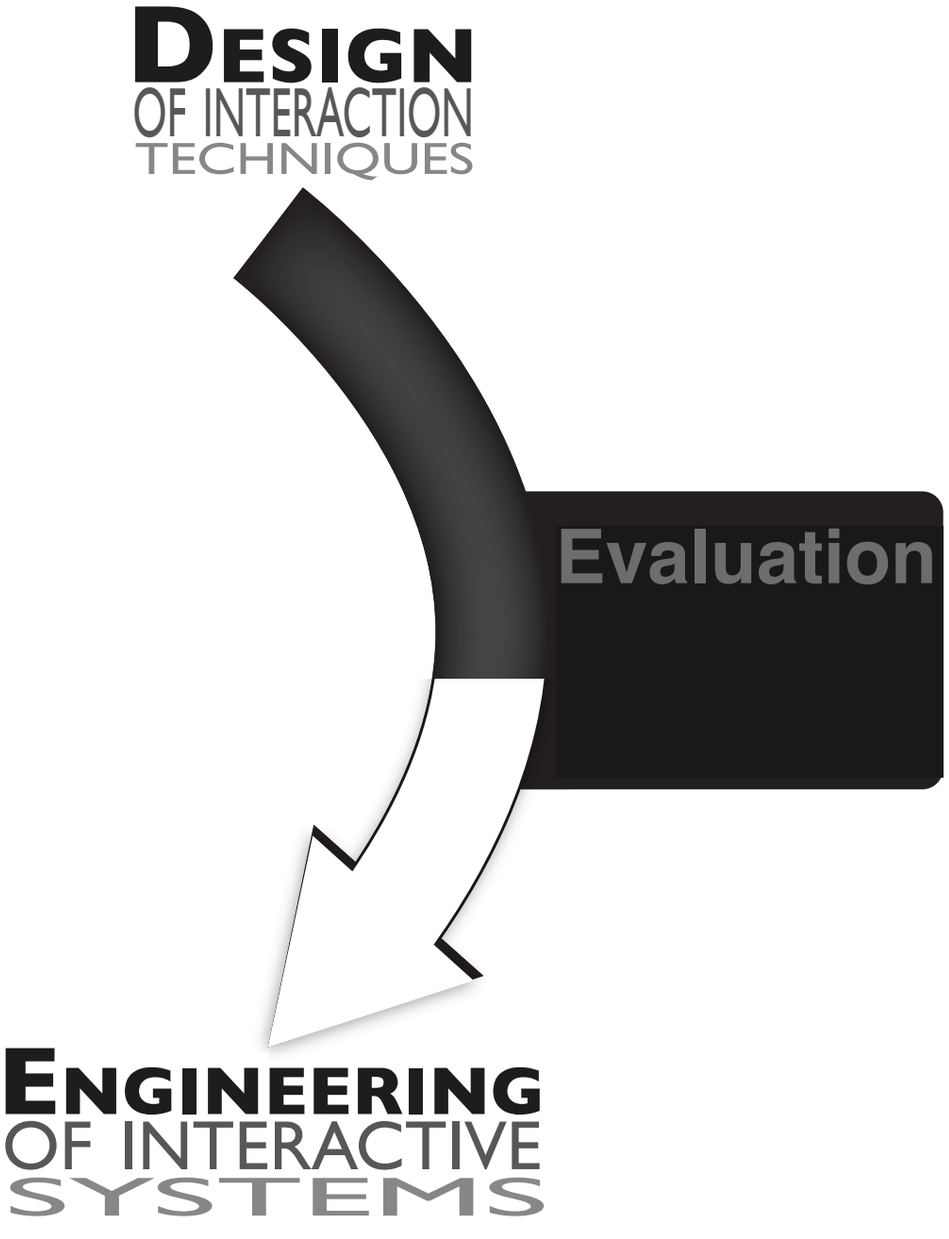


[SpiraList & SnailList - NordiCHI'06 & Interact'07]

.openness and interoperability issues

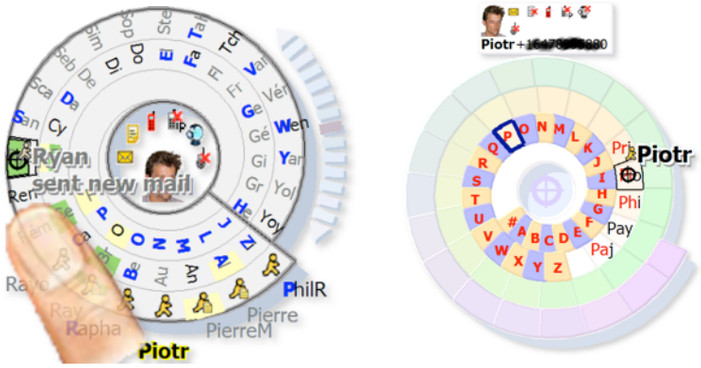


[Gliimpse - UIST'11]



when interaction design is constrained by technology

.performance issues



[SpiraList & SnailList - NordiCHI'06 & Interact'07]

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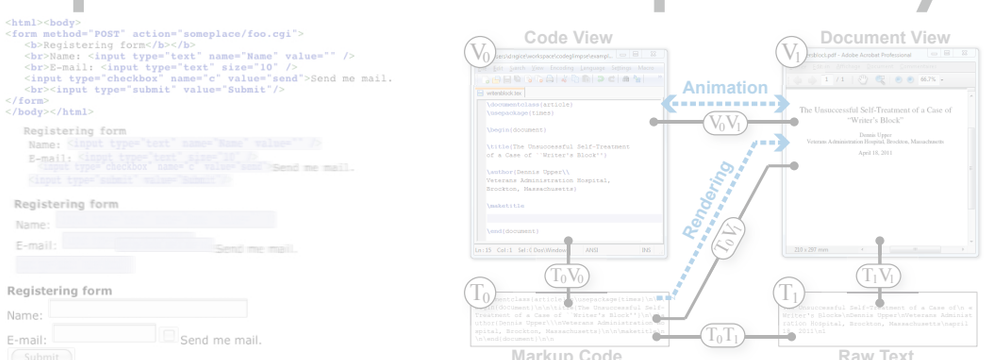
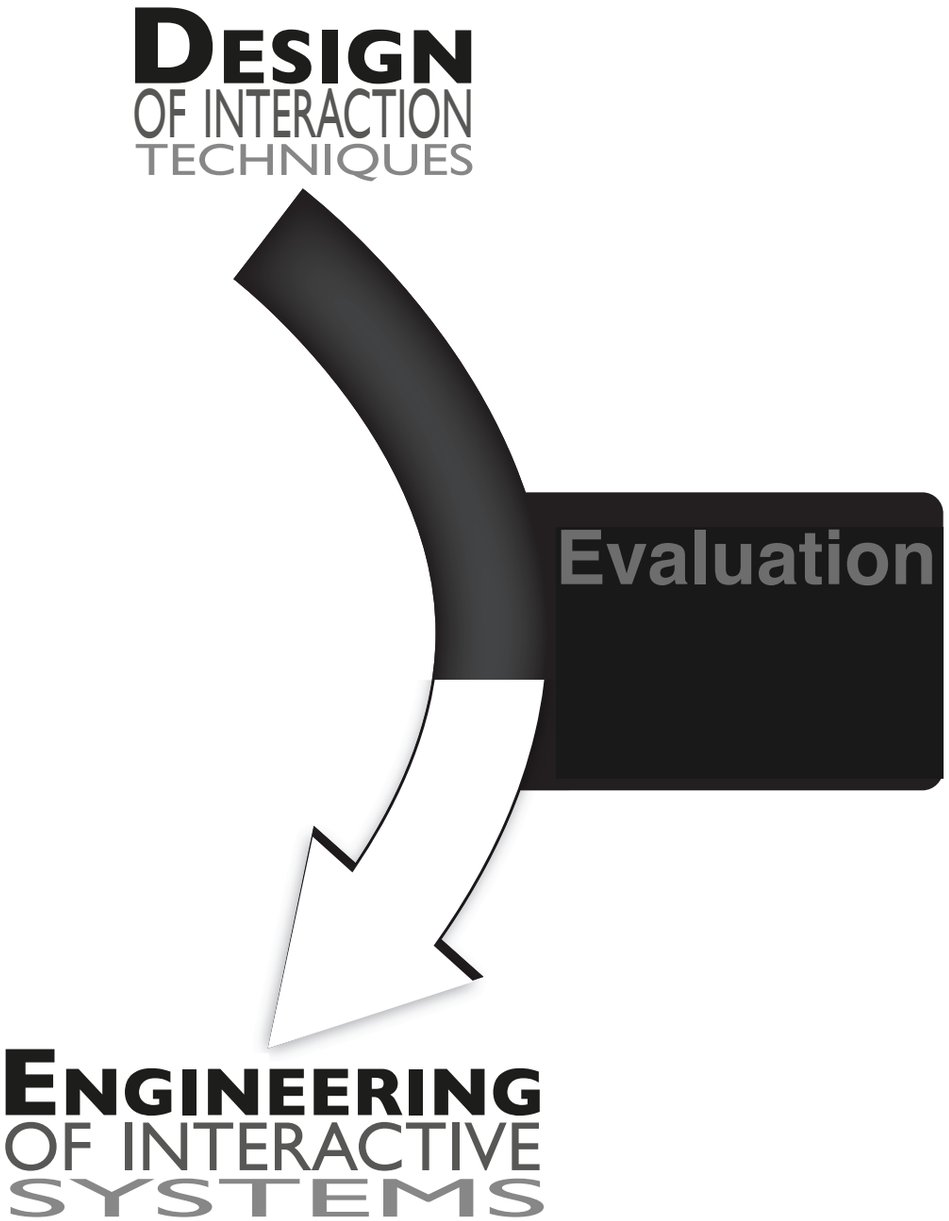


[Gliimpse - UIST'11]

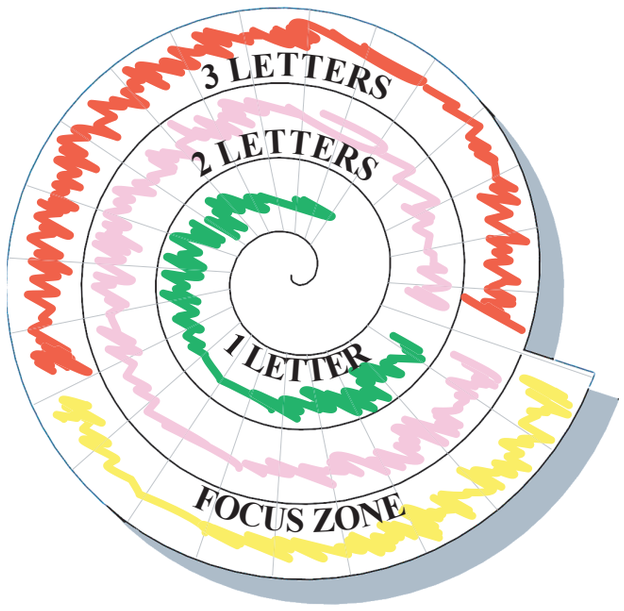


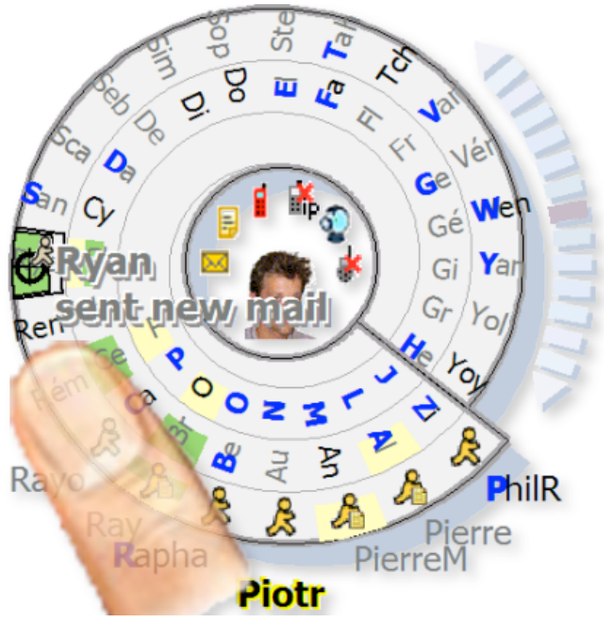
SpiraList & SnailList

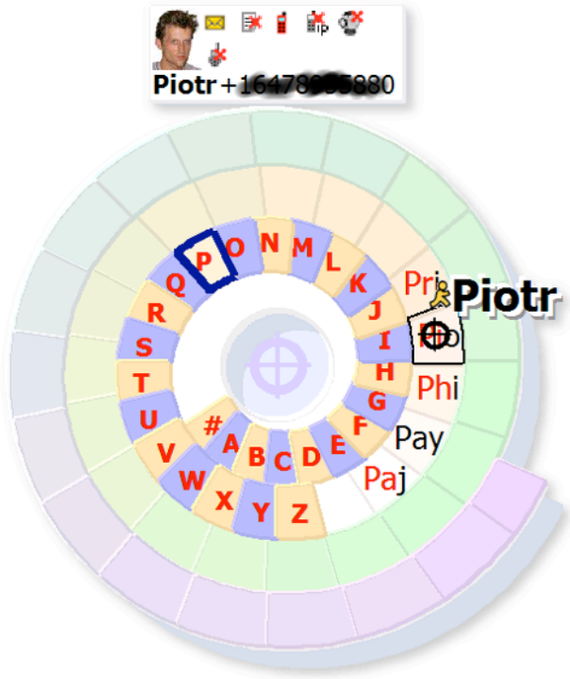
with E. Lecolinet

objective : manipulating large lists on mobile devices

solution : new layout and F+C data presentation







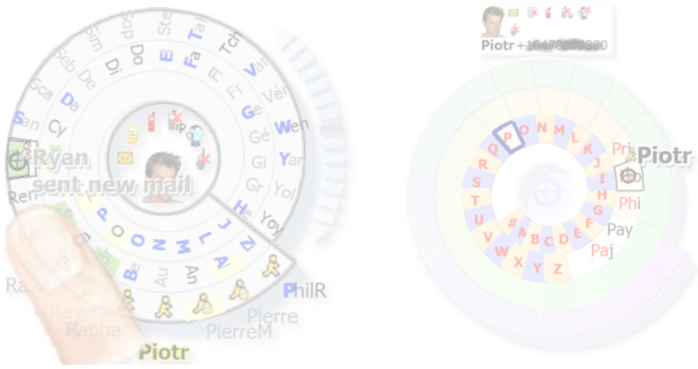
.performance issues

↳ input hardware

advanced graphics vs limited hardware/libraries

when interaction design is constrained by technology

.performance issues



[SpiraList & SnailList - NordiCHI'06 & Interact'07]

.openness and interoperability issues

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  <B>Registering form</b></b>
  <br>Name: <input type="text" name="Name" value="" />
  <br>E-mail: <input type="text" size="10" />
  <input type="checkbox" name="c" value="send">Send me mail.
  <br><input type="submit" value="Submit"/>
</form>
</body></html>
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Registering form

Name:

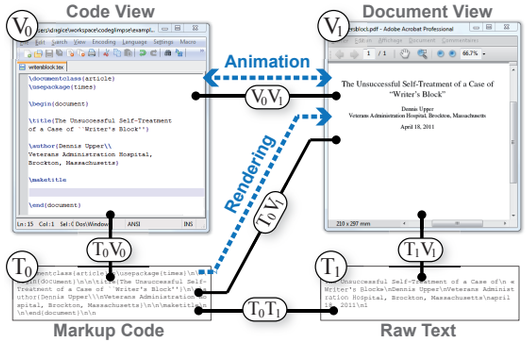
E-mail: Send me mail.

Registering form

Name:

E-mail: Send me mail.

Submit



[Gliimpse - UIST'11]

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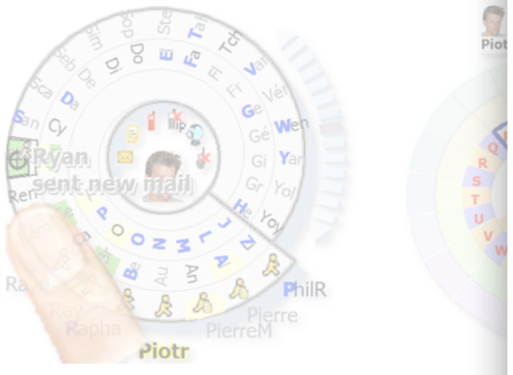


[SpiraList & SnailList - No

.openness and in

[Gliimpse - UIST'11]

Gliimpse

with P. Dragicevic & F. Chevalier

objective : improve markup langage editing

solution : in-place & on-demand animations

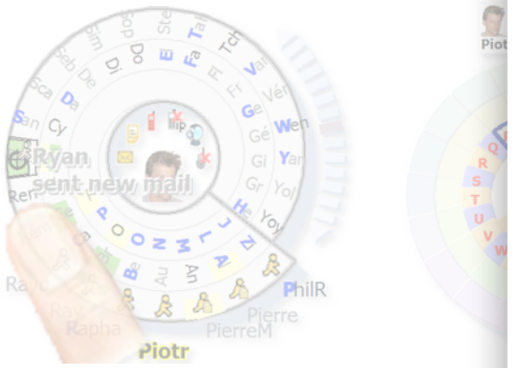
.openness and interoperability issues

↳ components inspection

linking components

when interaction design is constrained by technology

.performance iss



[SpiraList & SnailList - No

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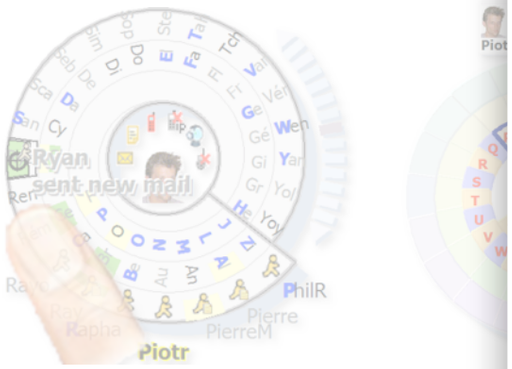

[SpiraList & SnailList - No

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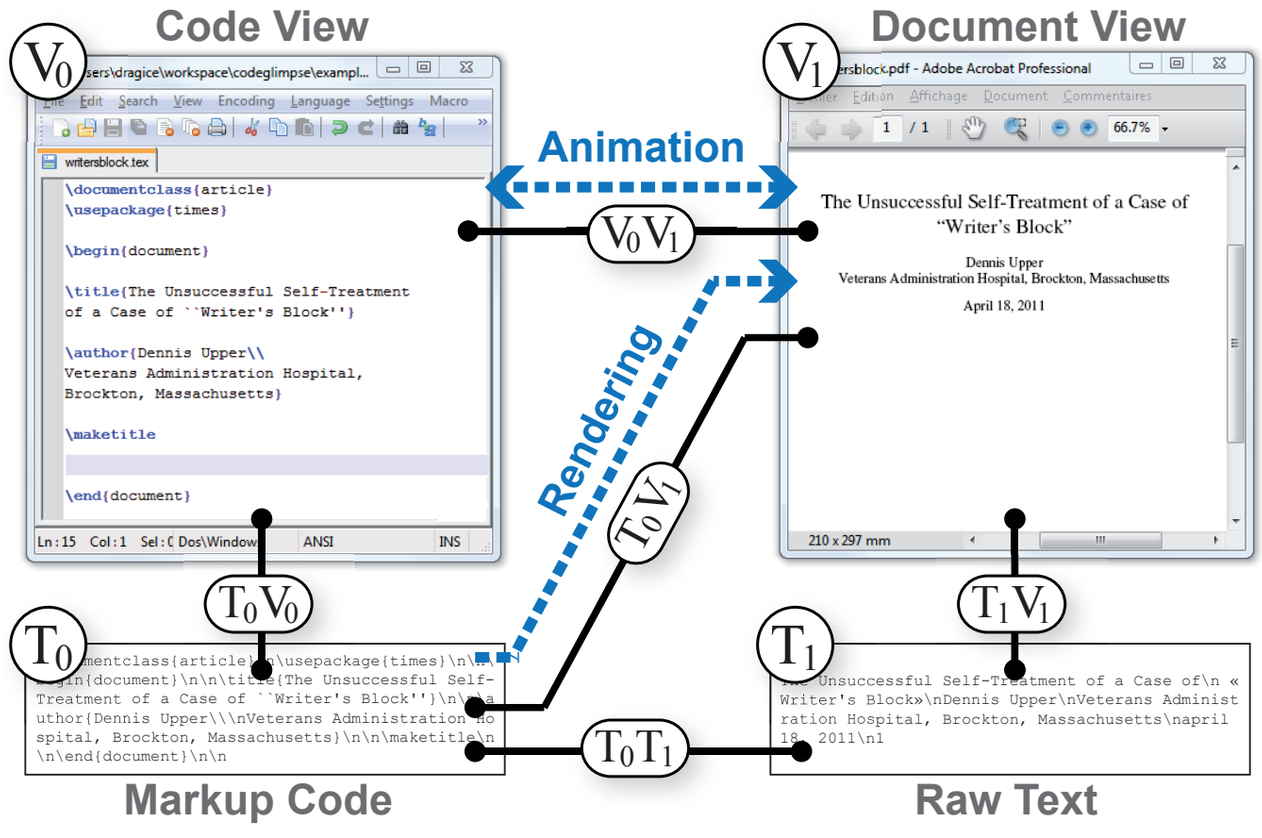

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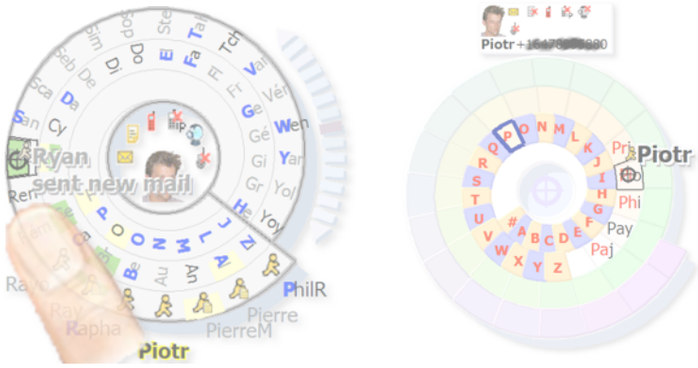
linking components

when interaction design is constrained by technology

.performance issues



[SpiraList & SnailList - NordiCHI'06 & Interact'07]

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</form>
</body></html>
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Name:
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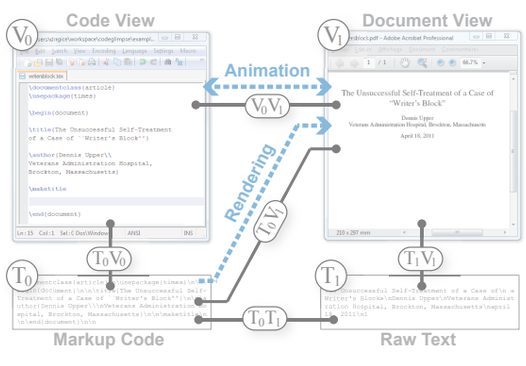
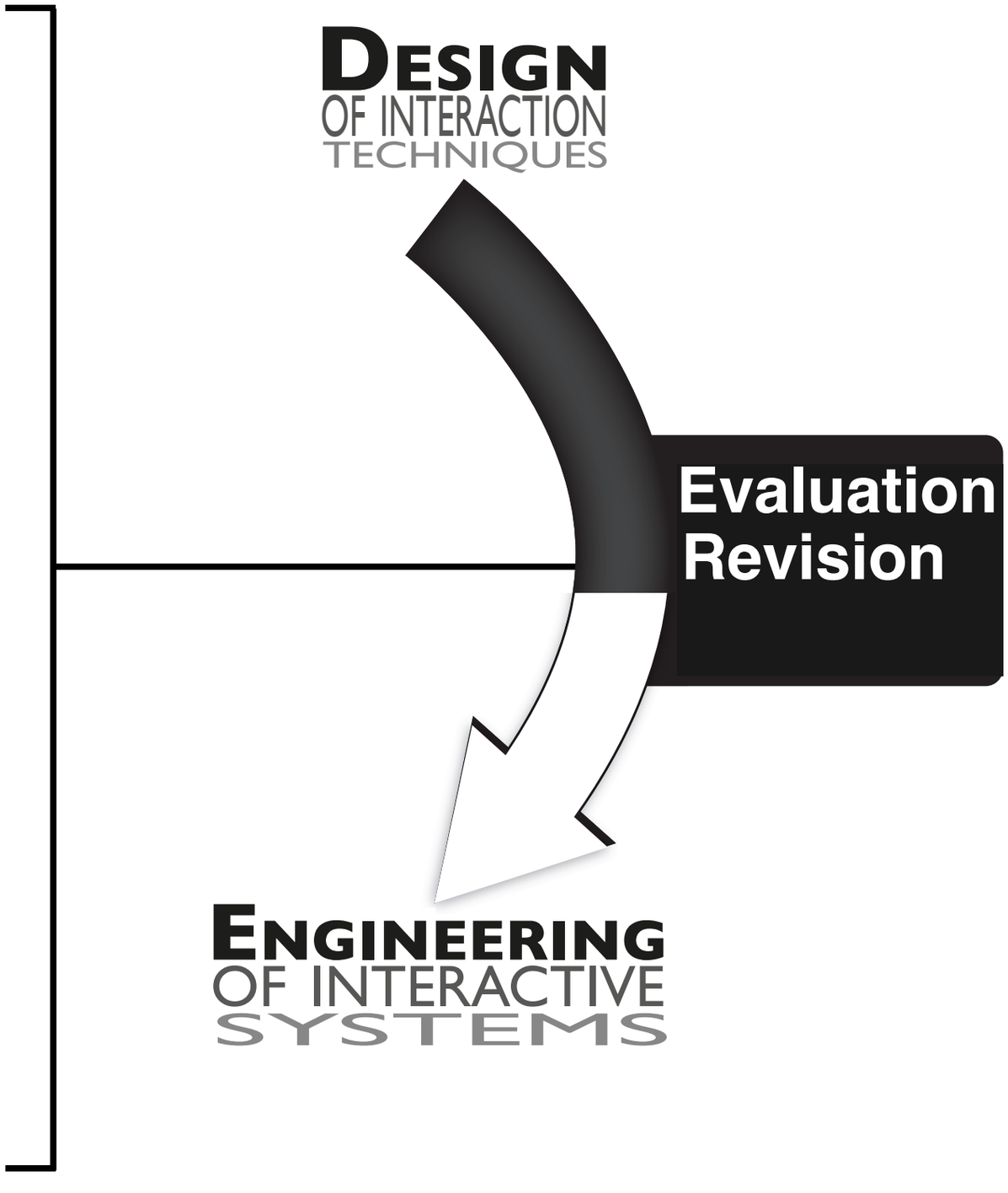
Send me mail.
Submit

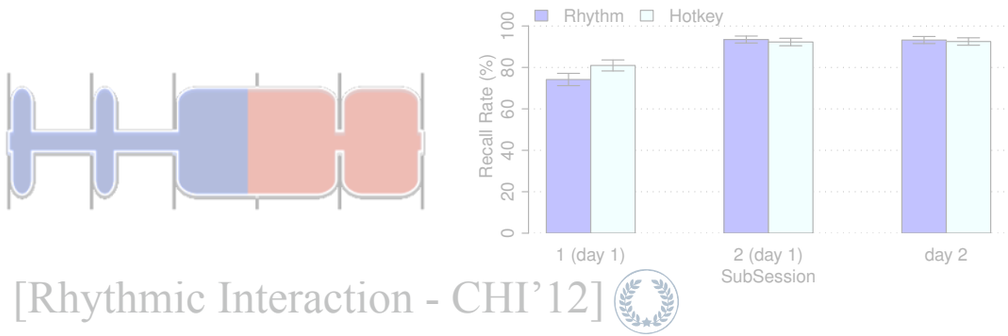


[Gliimpse - UIST'11]



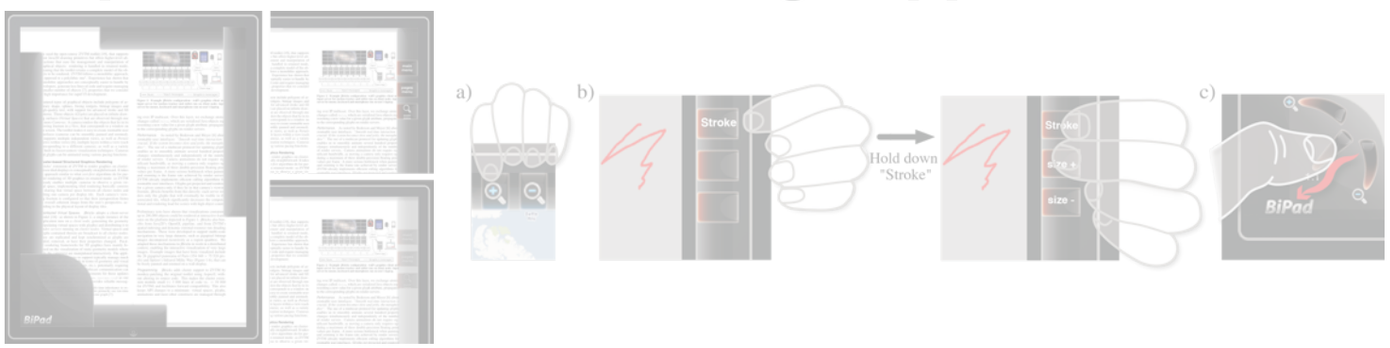
when interaction design improves technology

.integration of new designs

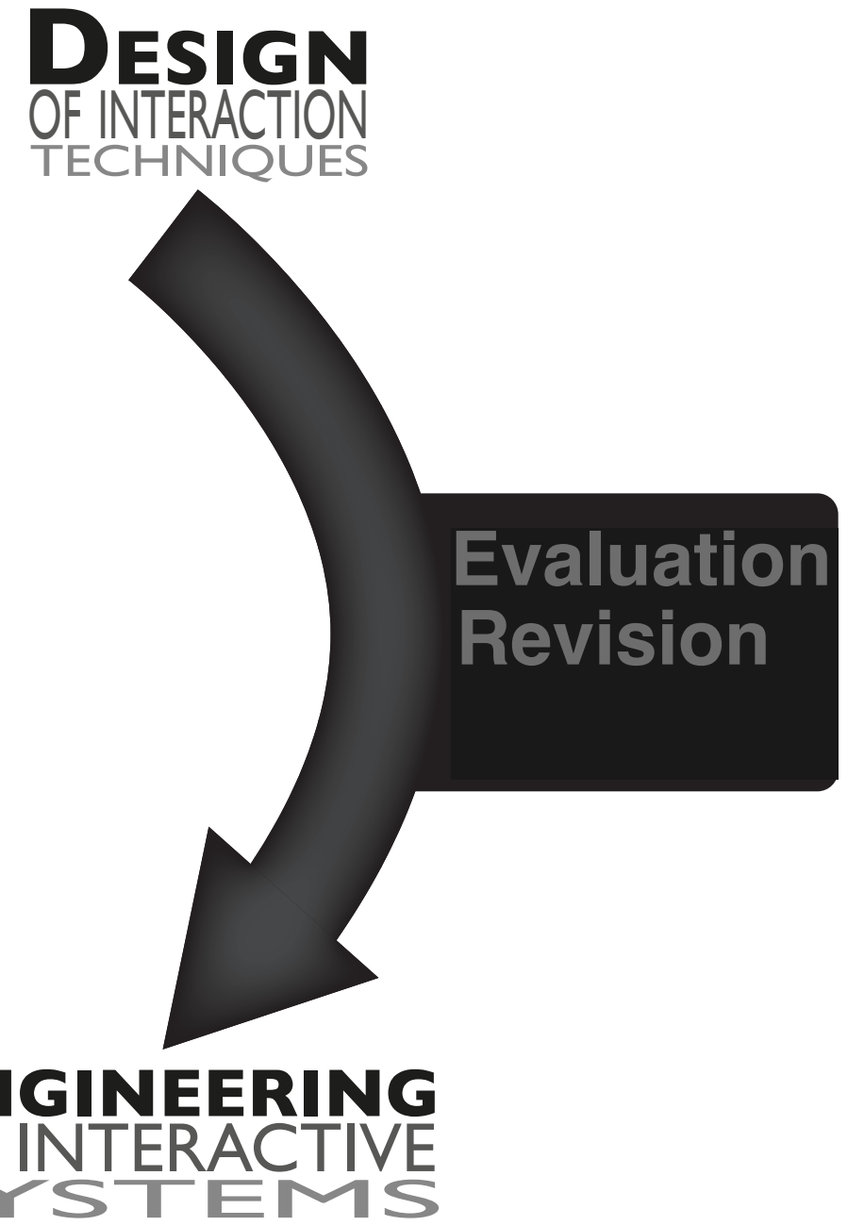


[Rhythmic Interaction - CHI'12]

.replication and new design opportunities

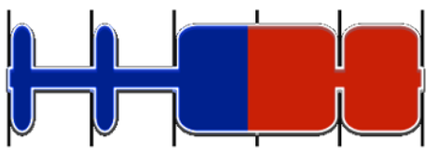


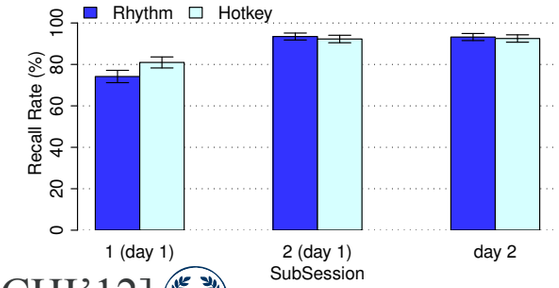
[BiPad - CHI'12]



when interaction design improves technology

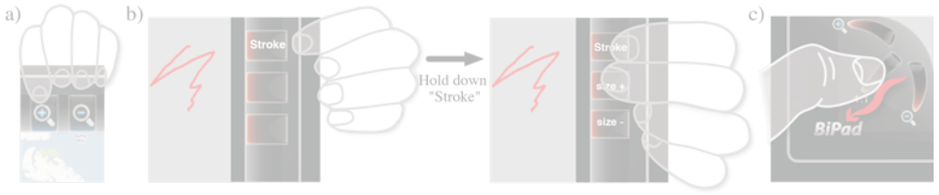
.integration of new designs



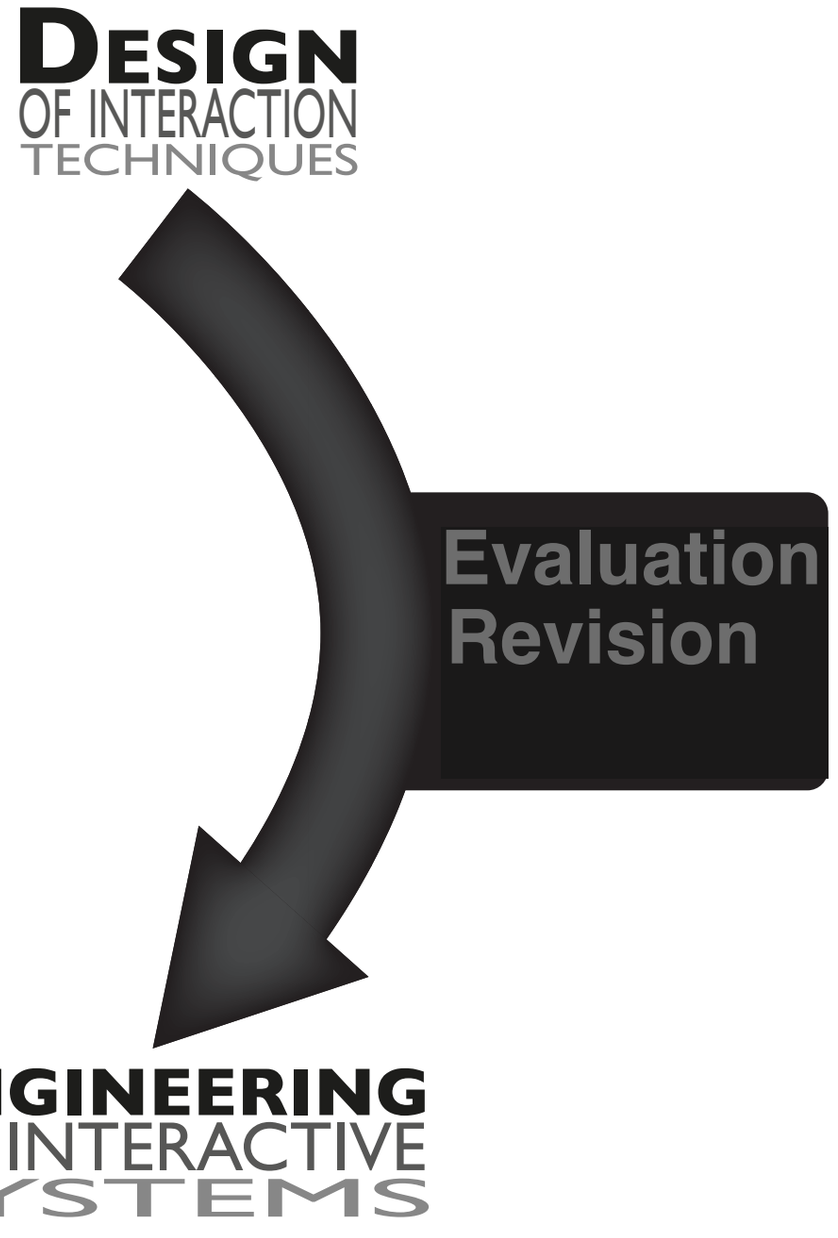


[Rhythmic Interaction - CHI'12]

.replication and new design opportunities



[BiPad - CHI'12]



Rhythmic Interaction

with E. Ghomi, G. Faure, O. Chapuis & M. Beaudouin-Lafon

objective : explore rhythmic patterns as an input method

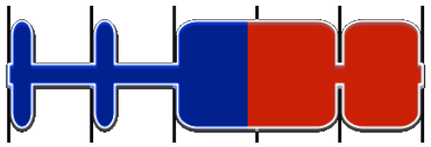
solution : design, feasibility & technology

.integration of new designs

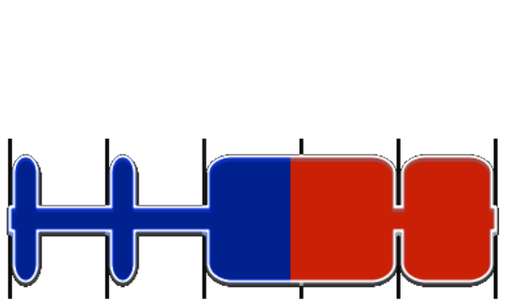
↳ standard input devices

universal recognizer

.integration of n



[Rhythmic Interaction - CH

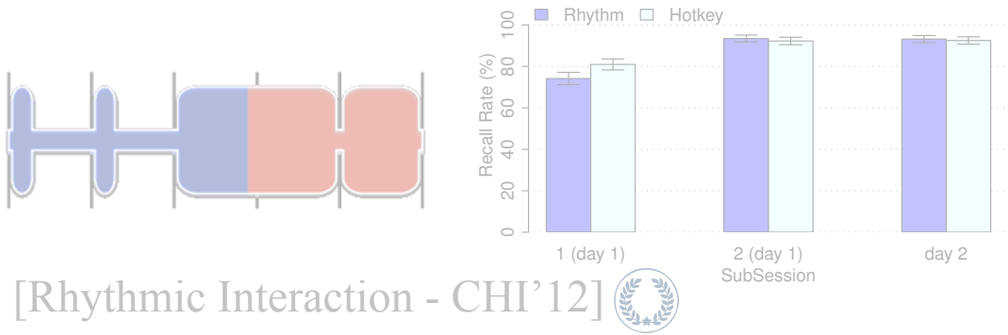


.replication and

[BiPad - CHI'12]

when interaction design improves technology

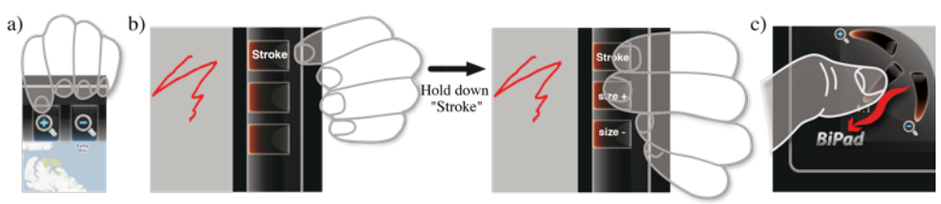
.integration of new designs



[Rhythmic Interaction - CHI'12]

.replication and new design opportunities

[BiPad - CHI'12]



DESIGN OF INTERACTION TECHNIQUES

Evaluation
Revision

ENGINEERING OF INTERACTIVE SYSTEMS

.integration of n

[Rhythmic Interaction - CH

.replication and

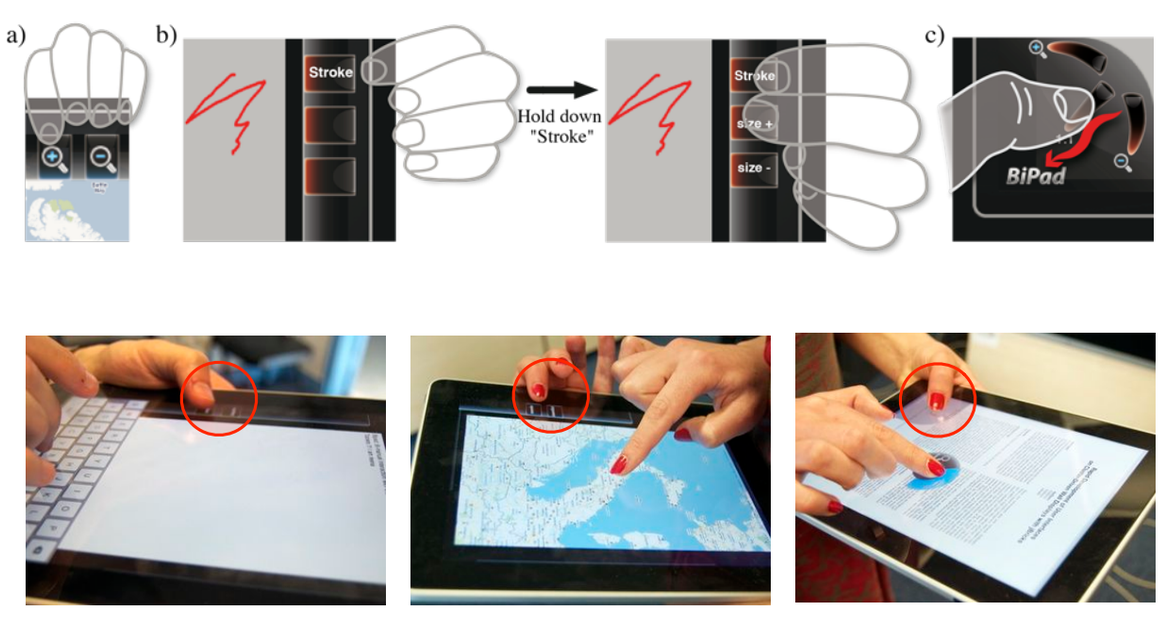
[BiPad - CHI'12]

BiPad *(again)*

with J.Wagner & W. E. Mackay

objective : bimanual interaction in mobility

solution : design space, design & **toolkit**



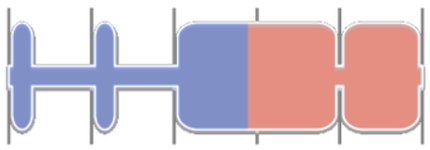
.replication and new design opportunities

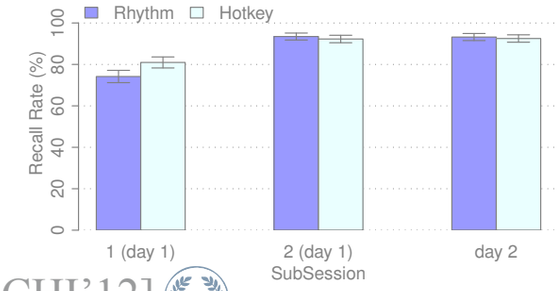
↳ "real-world" applications

toolkit

when interaction design improves technology

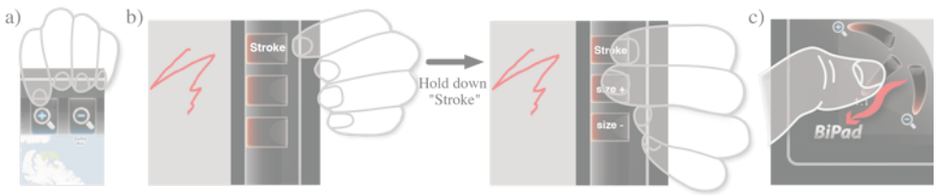
.integration of new designs





[Rhythmic Interaction - CHI'12]

.replication and new design opportunities



[BiPad - CHI'12]

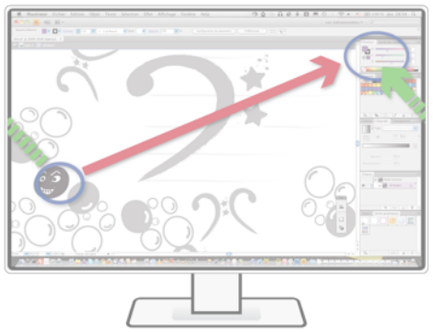
DESIGN
OF INTERACTION
TECHNIQUES

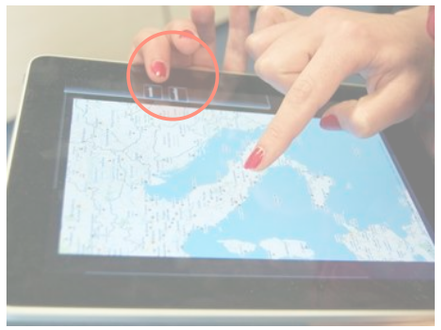
Evaluation
Revision
Extension

ENGINEERING
OF INTERACTIVE
SYSTEMS

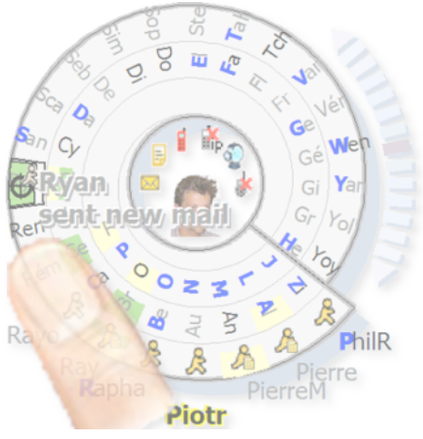
interaction design challenges technology

.when interaction design is driven by technology





.when interaction design is constrained by technology

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   <input type="checkbox" name="c" value="send">Send me mail.
   <br><input type="submit" value="Submit"/>
</form>
</body></html>
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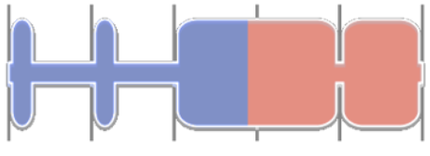
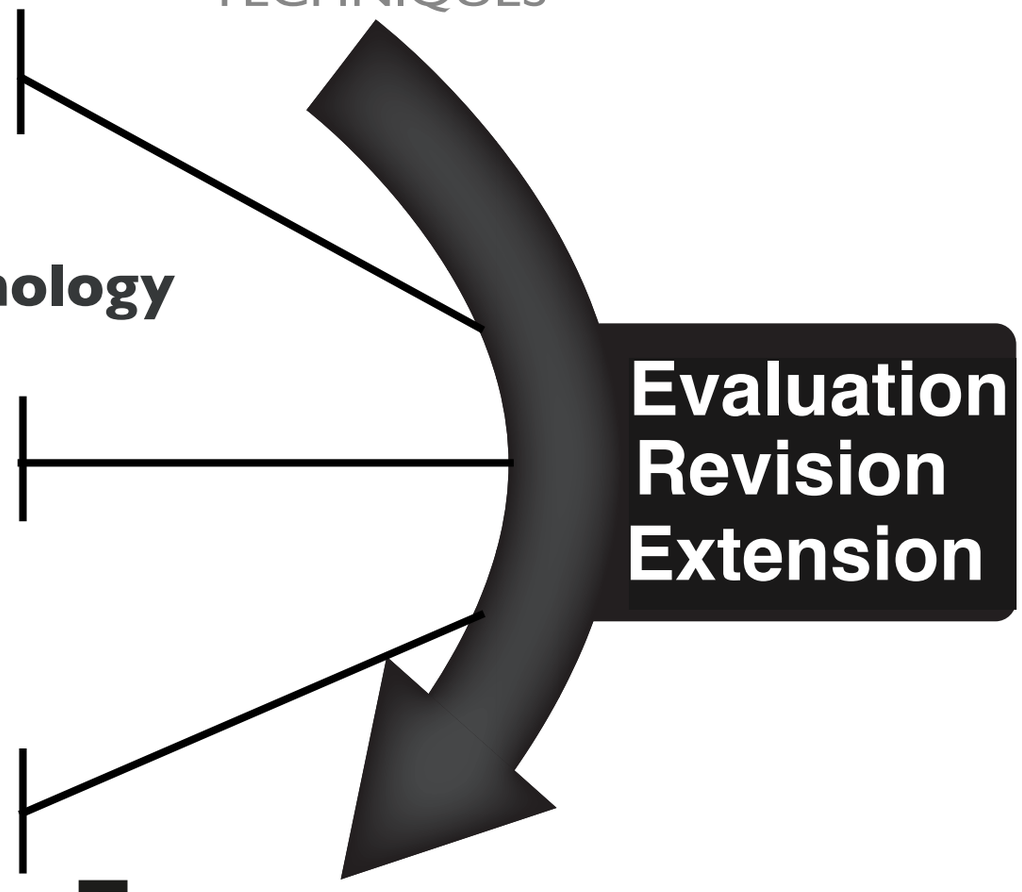
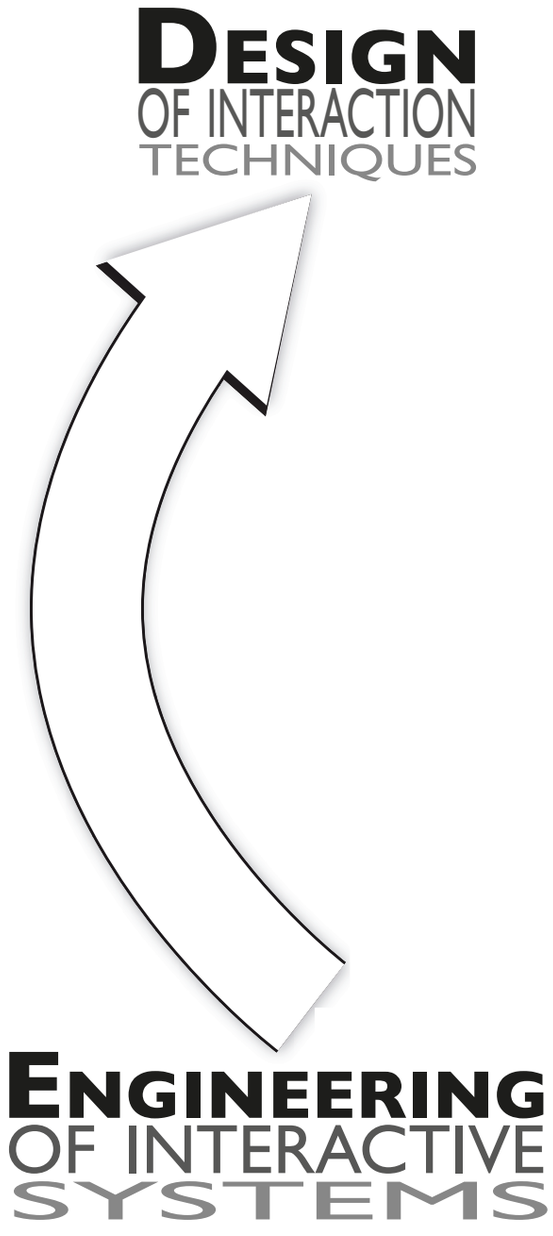
Registering form
Name:
E-mail: Send me mail.
Submit

.when interaction design improves technology



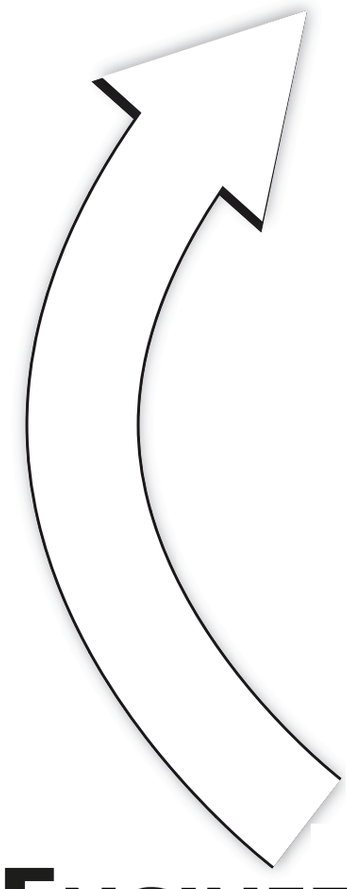


engineering unleashes interaction design



engineering unleashes interaction design

DESIGN
OF INTERACTION
TECHNIQUES



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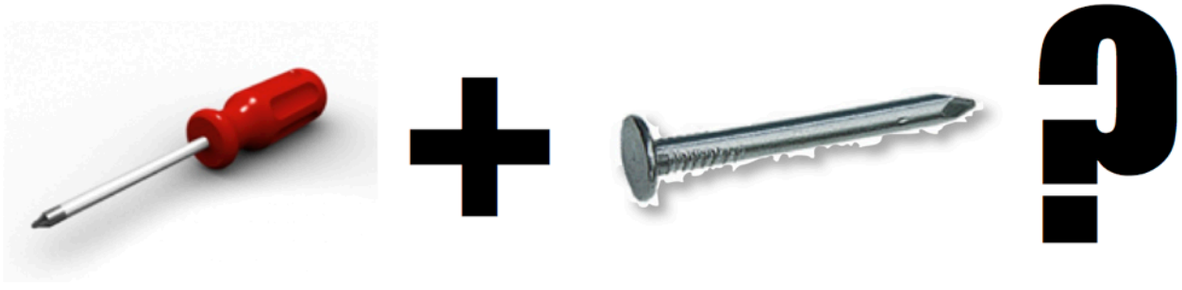

engineering unleashes interaction design

DESIGN
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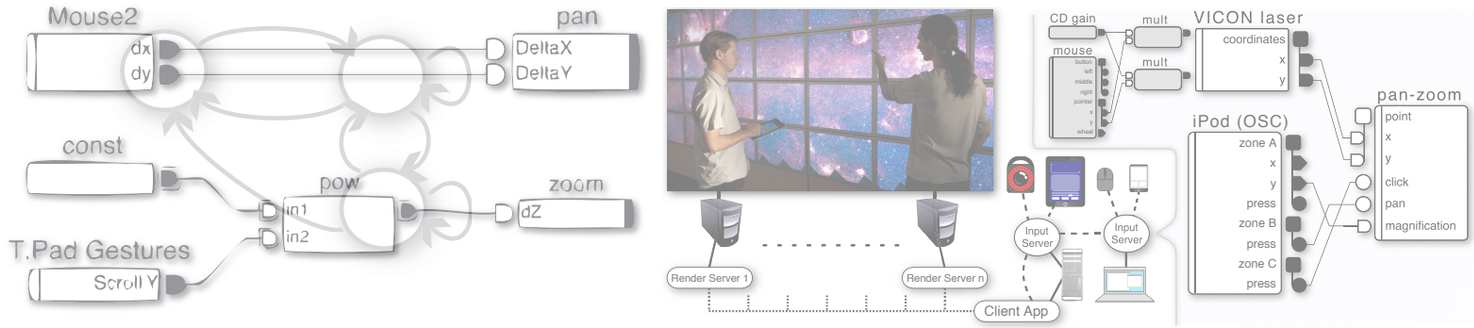
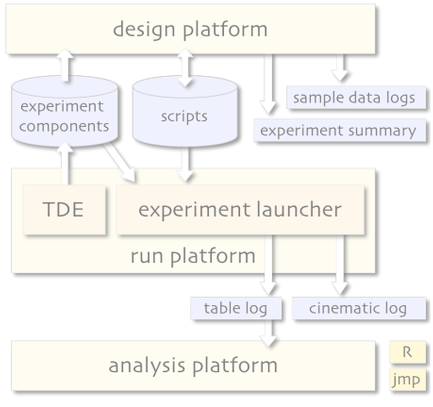
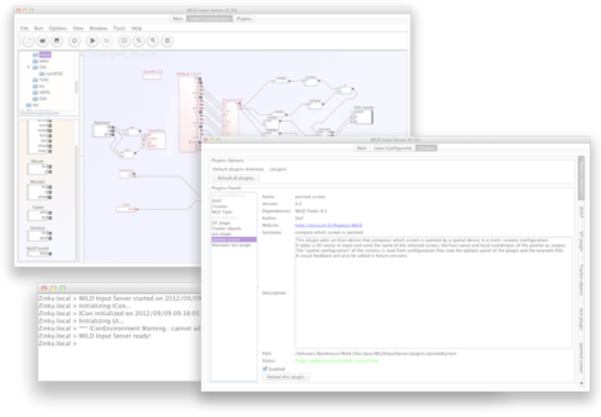
.when technology defines possible designs



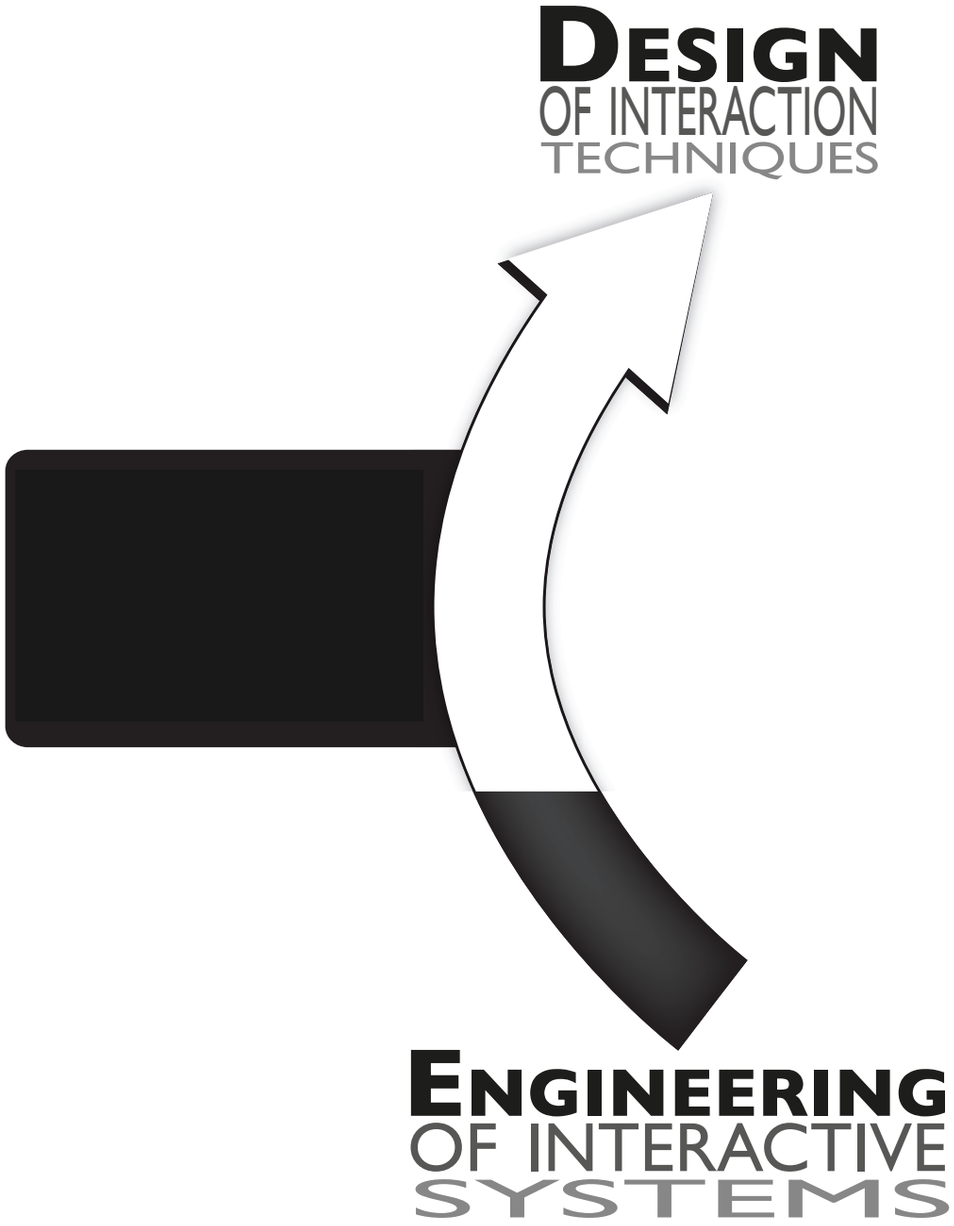
.when technology enables the evaluation of designs



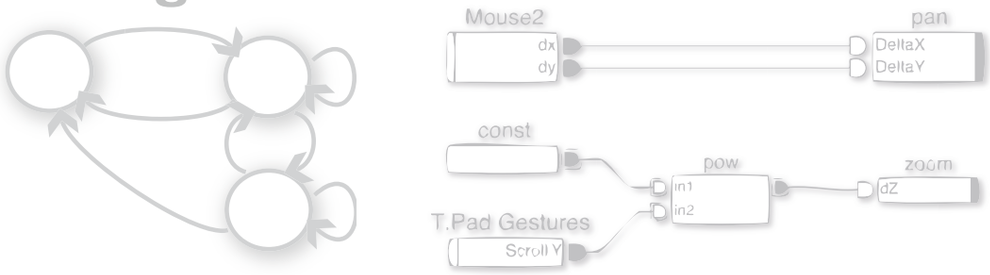


.when technology integrates designs

when technology defines possible designs

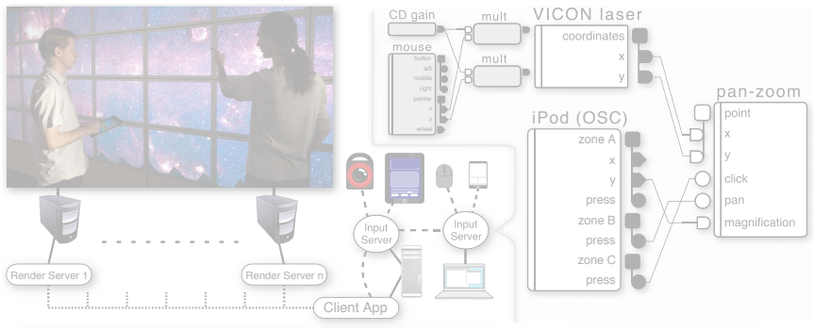


.building blocks and combination



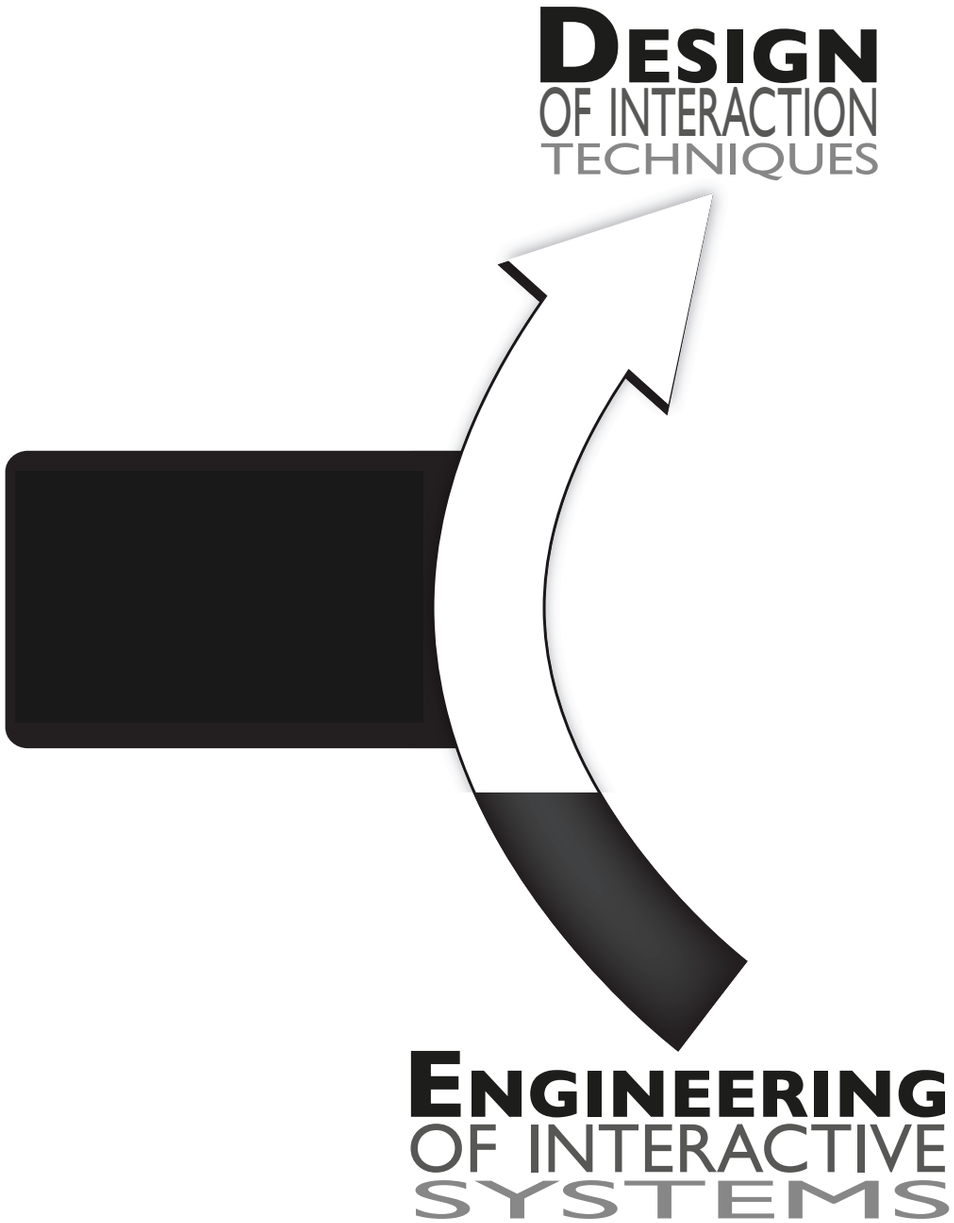
[FlowStates - IHM'09]

.interoperability and extension

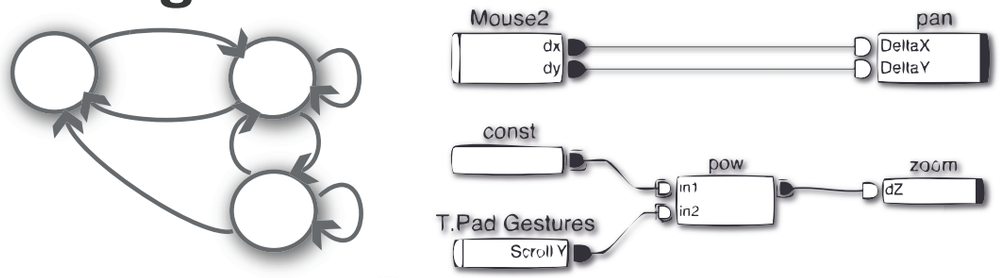


[jBricks - EICS'11]

when technology defines possible designs

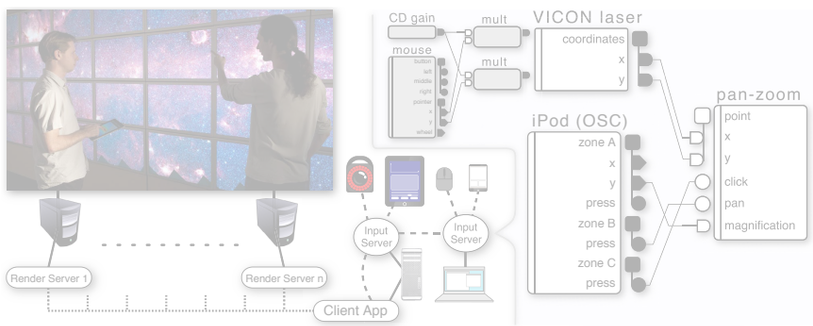


.building blocks and combination



[FlowStates - IHM'09]

.interoperability and extension



[jBricks - EICS'11]

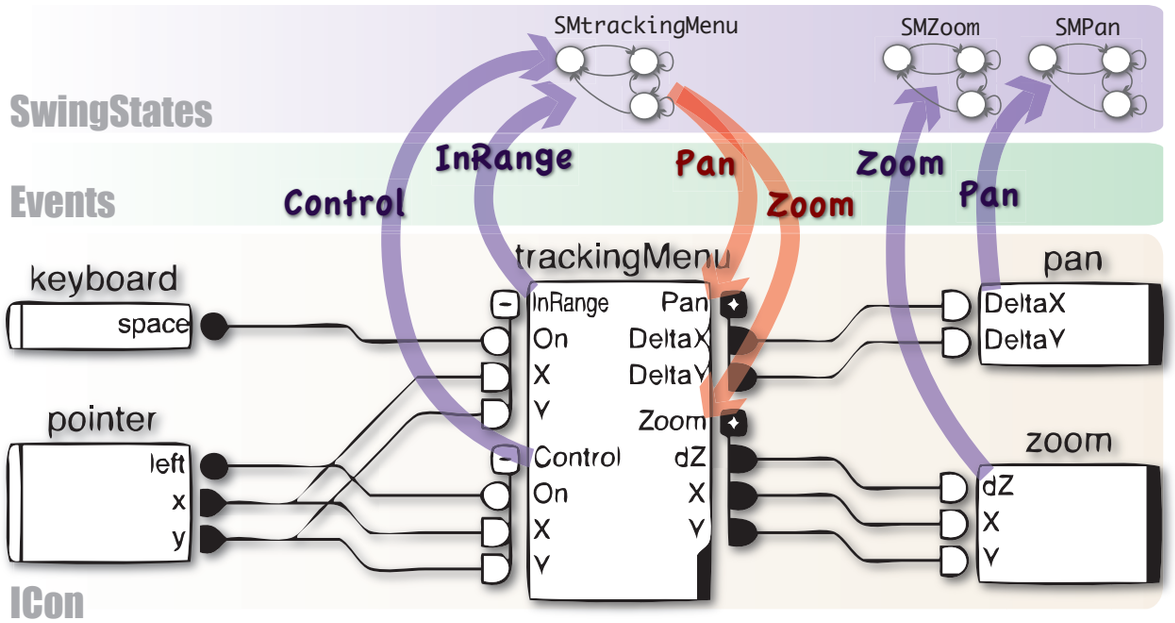
when technology defines possible designs

FlowStates

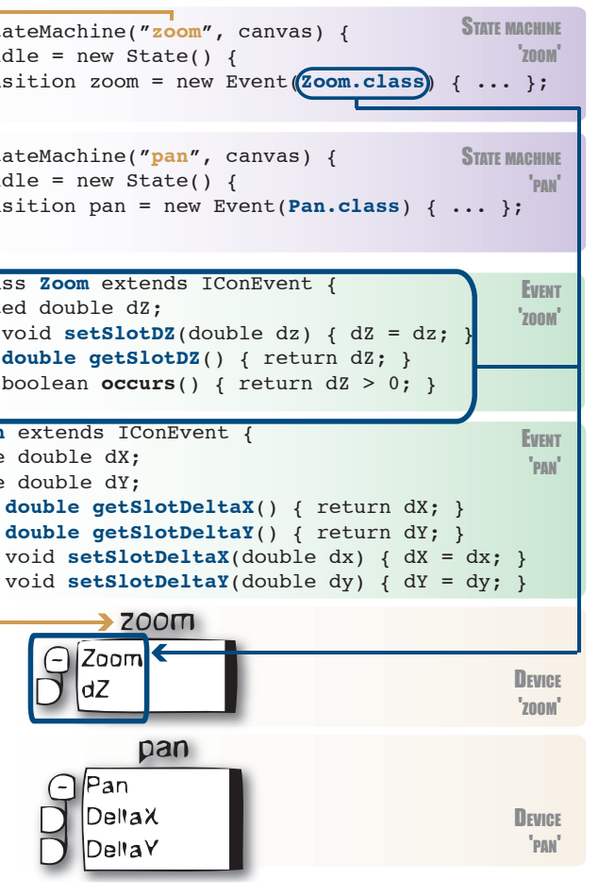
with C. Appert, P. Dragicevic & M. Beaudouin-Lafon

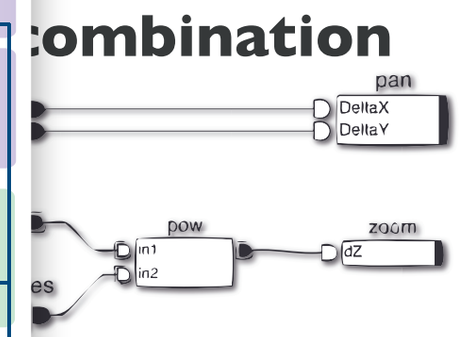
objective : prototyping advanced interaction

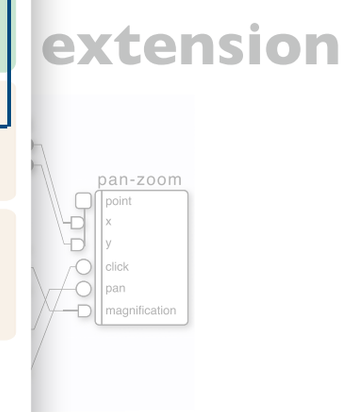
solution : state-transition (SwingStates) & data-flow (ICon)




```
new IConStateMachine("zoom", canvas) {
   State idle = new State() {
      Transition zoom = new Event(Zoom.class) { ... };
   };
}
new IConStateMachine("pan", canvas) {
   State idle = new State() {
      Transition pan = new Event(Pan.class) { ... };
   };
}
public class Zoom extends IConEvent {
   protected double dZ;
   public void setSlotDZ(double dz) { dZ = dz; }
   public double getSlotDZ() { return dZ; }
   public boolean occurs() { return dZ > 0; }
}
public Pan extends IConEvent {
   private double dX;
   private double dY;
   public double getSlotDeltaX() { return dX; }
   public double getSlotDeltaY() { return dY; }
   public void setSlotDeltaX(double dx) { dX = dx; }
   public void setSlotDeltaY(double dy) { dY = dy; }
}
```







.building blocks and combination

↳ describing = programming adaptability and dynamicity

when technology defines possible designs

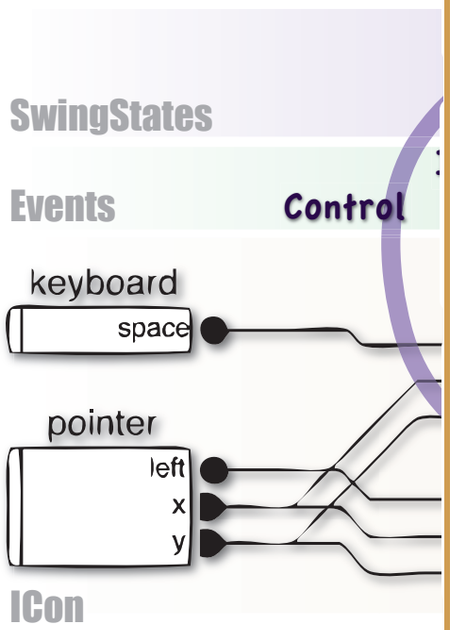
FlowStates

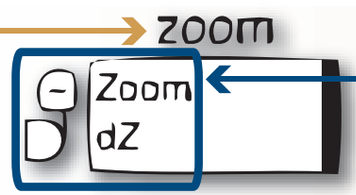
with C. Appert, P. Dragicevic & M. Beaudouin-Lafon

objective

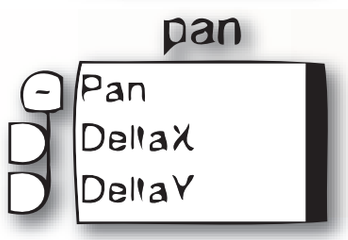
solution

```
new IConStateMachine("zoom", canvas) {                    STATE MACHINE 'ZOOM'
   State idle = new State() {
      Transition zoom = new Event(Zoom.class) { ... };
   };
}
new IConStateMachine("pan", canvas) {                     STATE MACHINE 'PAN'
   State idle = new State() {
      Transition pan = new Event(Pan.class) { ... };
   };
}
public class Zoom extends IConEvent {                     EVENT 'ZOOM'
   protected double dZ;
   public void setSlotDZ(double dz) { dZ = dz; }
   public double getSlotDZ() { return dZ; }
   public boolean occurs() { return dZ > 0; }
}
public Pan extends IConEvent {                            EVENT 'PAN'
   private double dX;
   private double dY;
   public double getSlotDeltaX() { return dX; }
   public double getSlotDeltaY() { return dY; }
   public void setSlotDeltaX(double dx) { dX = dx; }
   public void setSlotDeltaY(double dy) { dY = dy; }
}
```





DEVICE 'ZOOM'



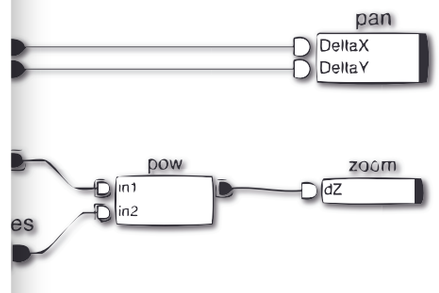
DEVICE 'PAN'

.building b

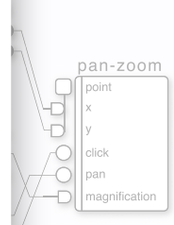
↳ describ

adaptat

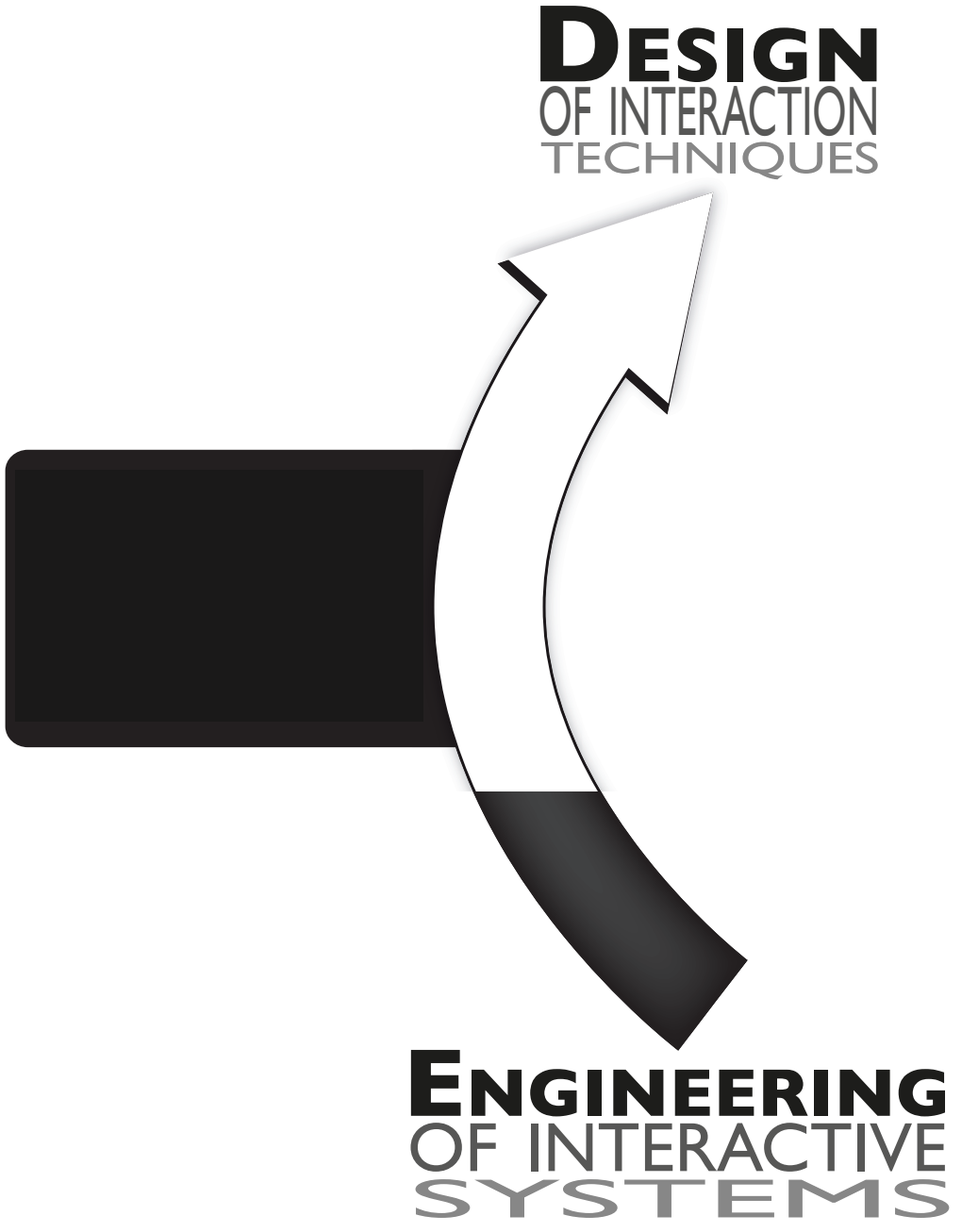
combination



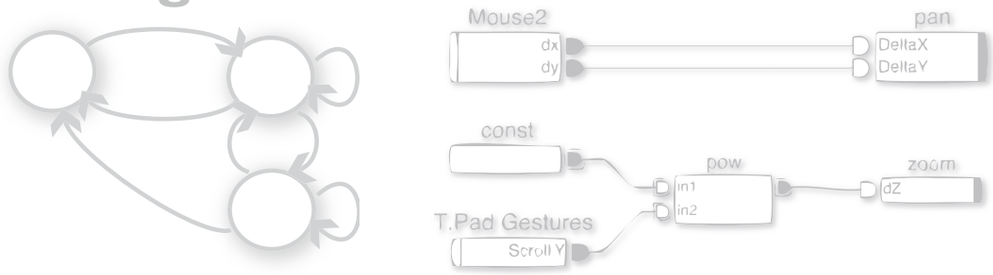
extension



when technology defines possible designs

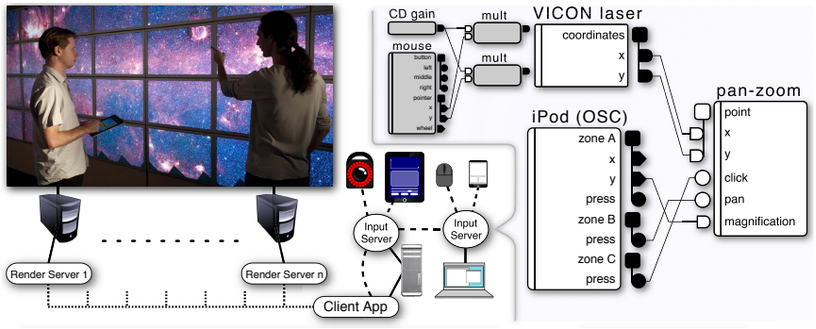


.building blocks and combination



[FlowStates - IHM'09]

.interoperability and extension



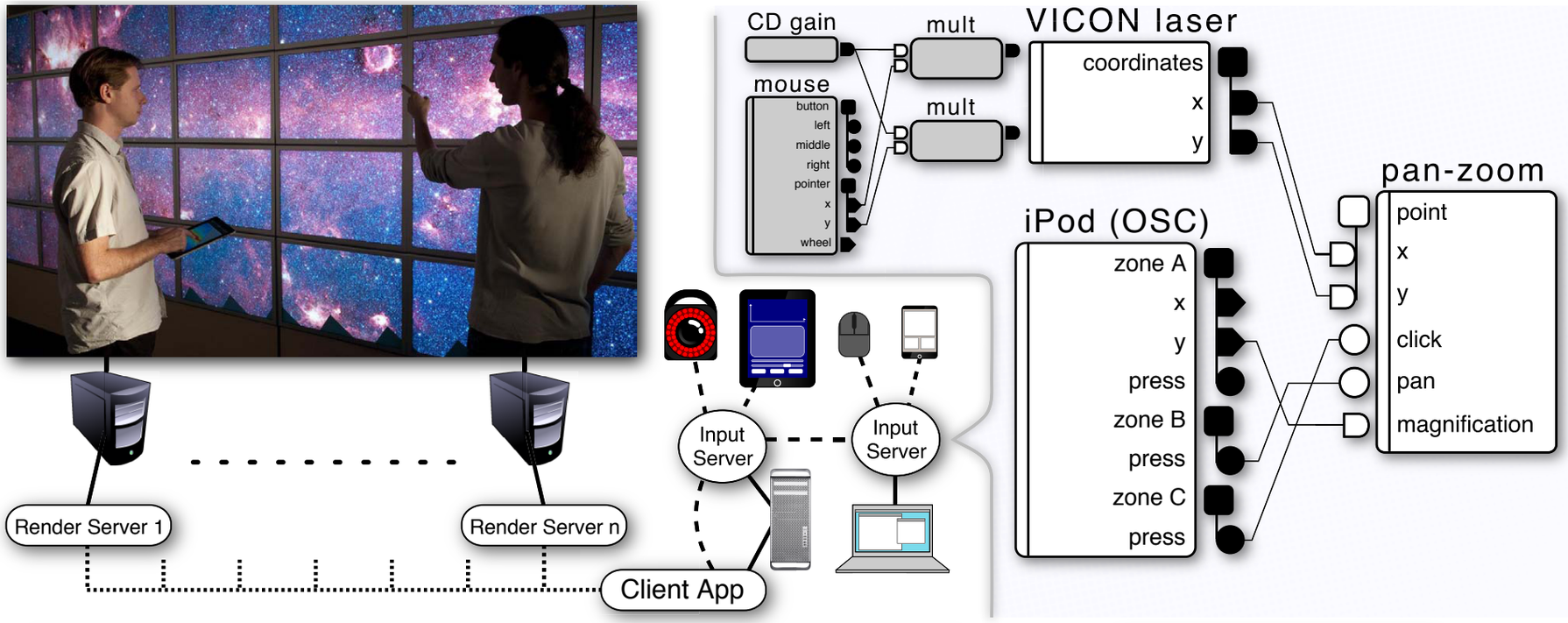
[jBricks - EICS'11]

jBricks

with E. Pietriga, R. Primet & M. Nancel

objective : rich graphics & advanced interaction in multi-surface environments

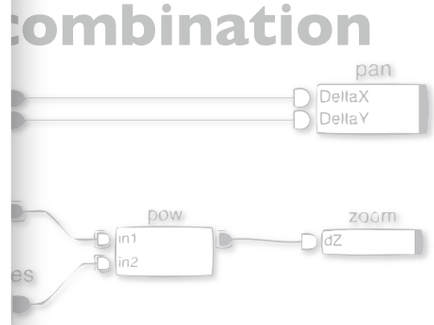
solution : separation of concerns



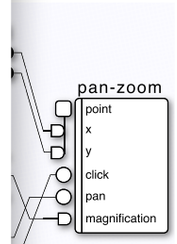
.interoperability and extension

↳ separate graphics and interaction

several levels of combination



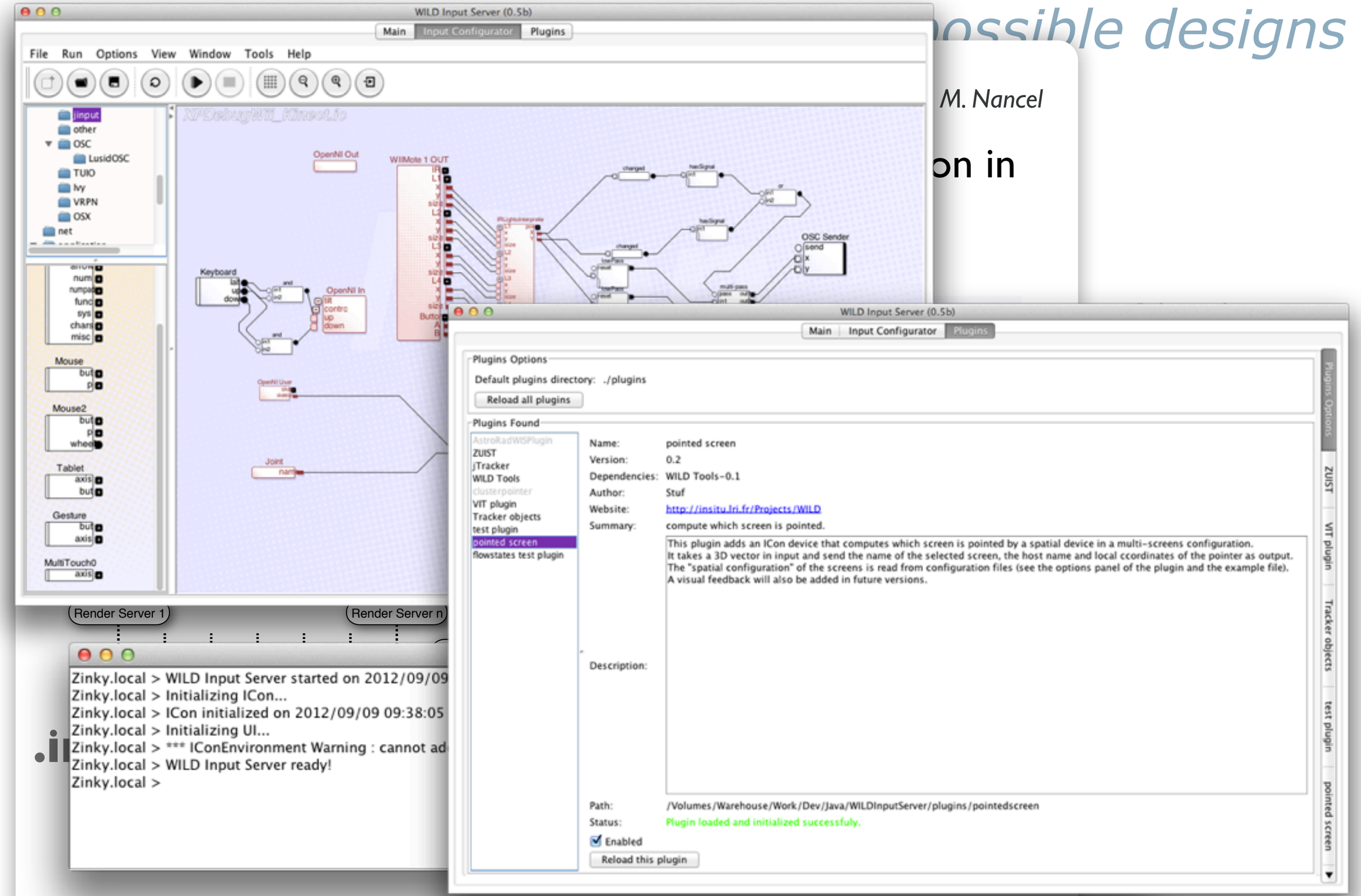
extension



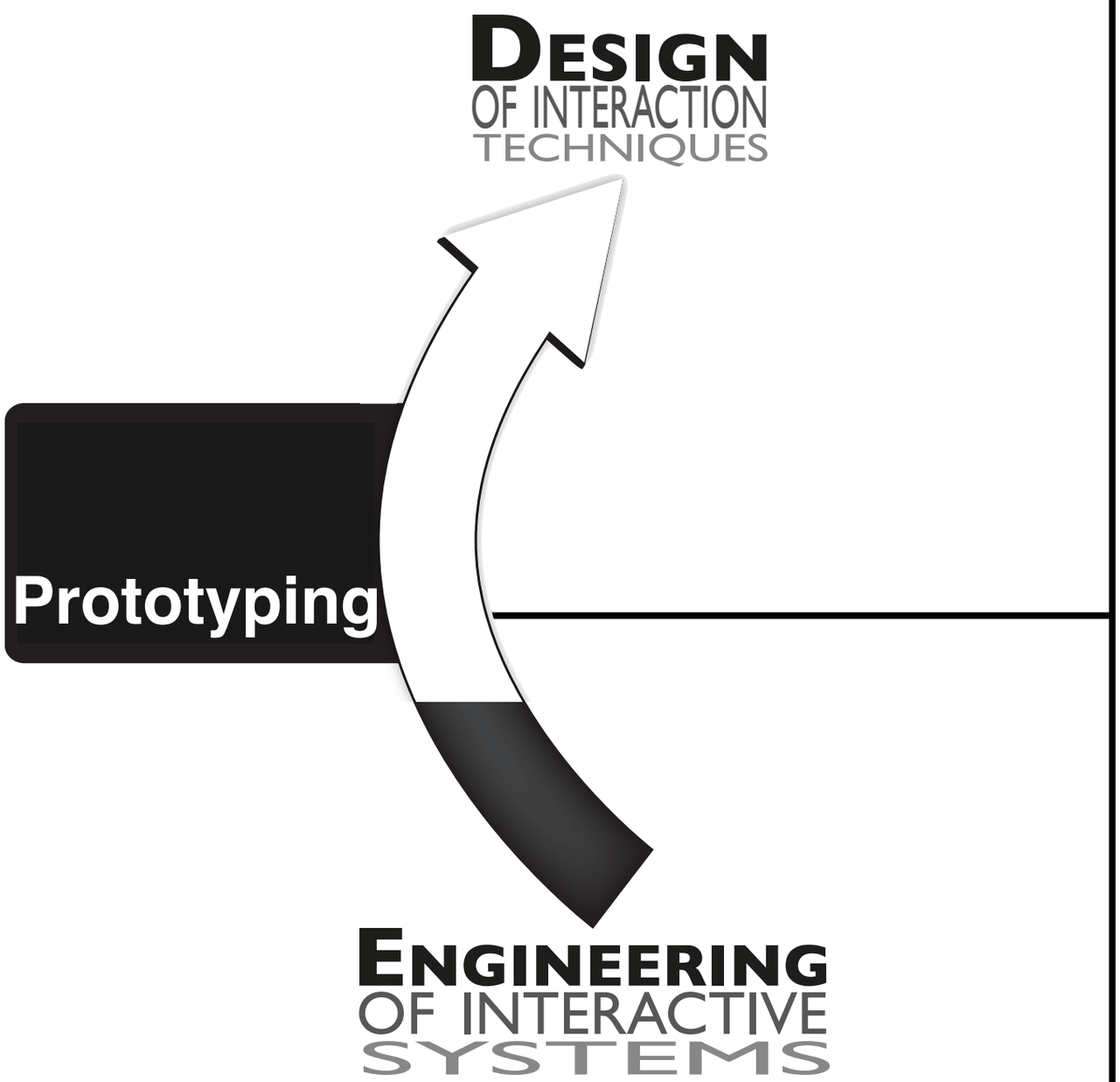
ossible designs

M. Nancel

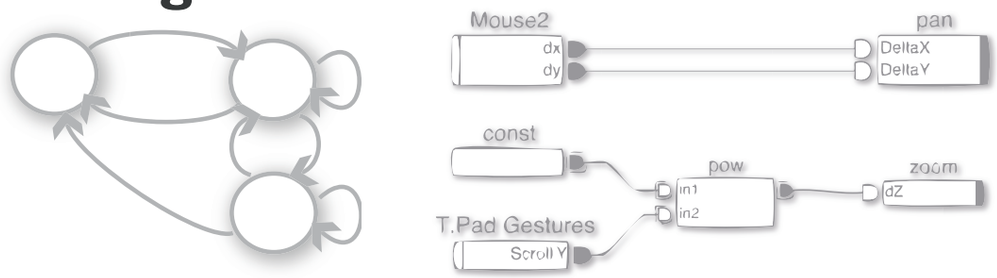
on in



when technology defines possible designs

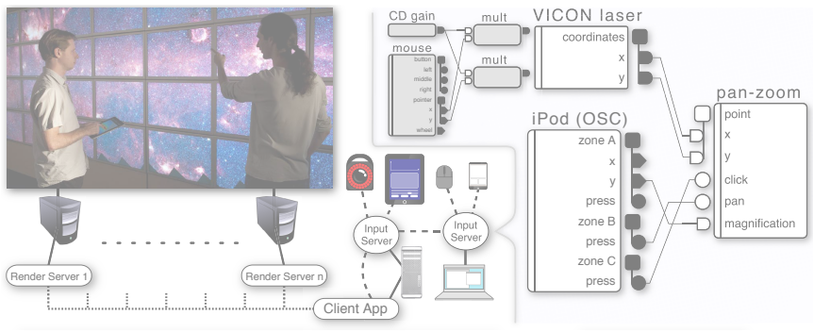


.building blocks and combination



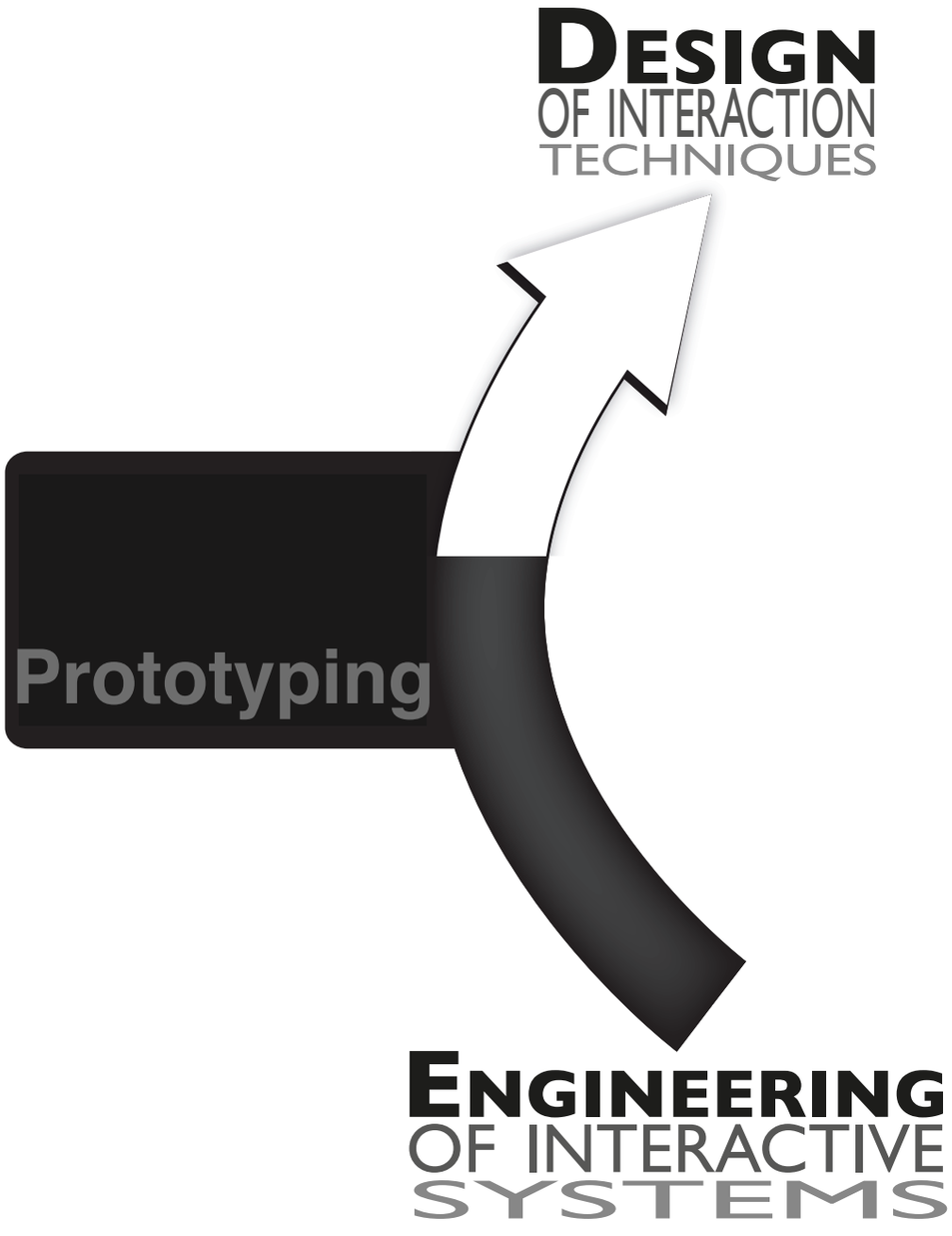
[FlowStates - IHM'09]

.interoperability and extension

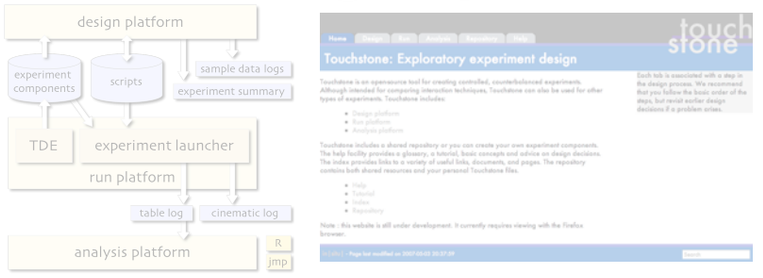


[jBricks - EICS'11]

when technology enables the evaluation of designs

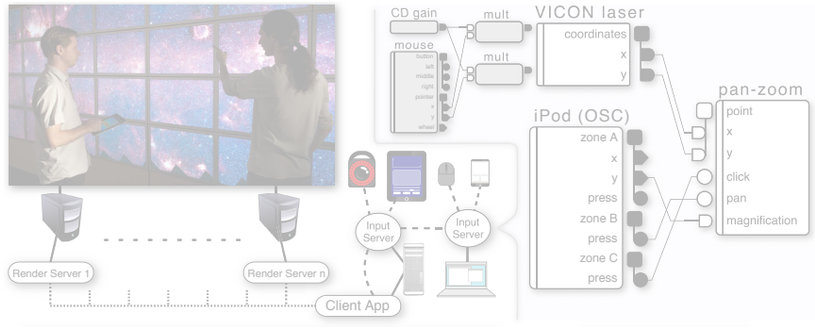


.conducting experiments



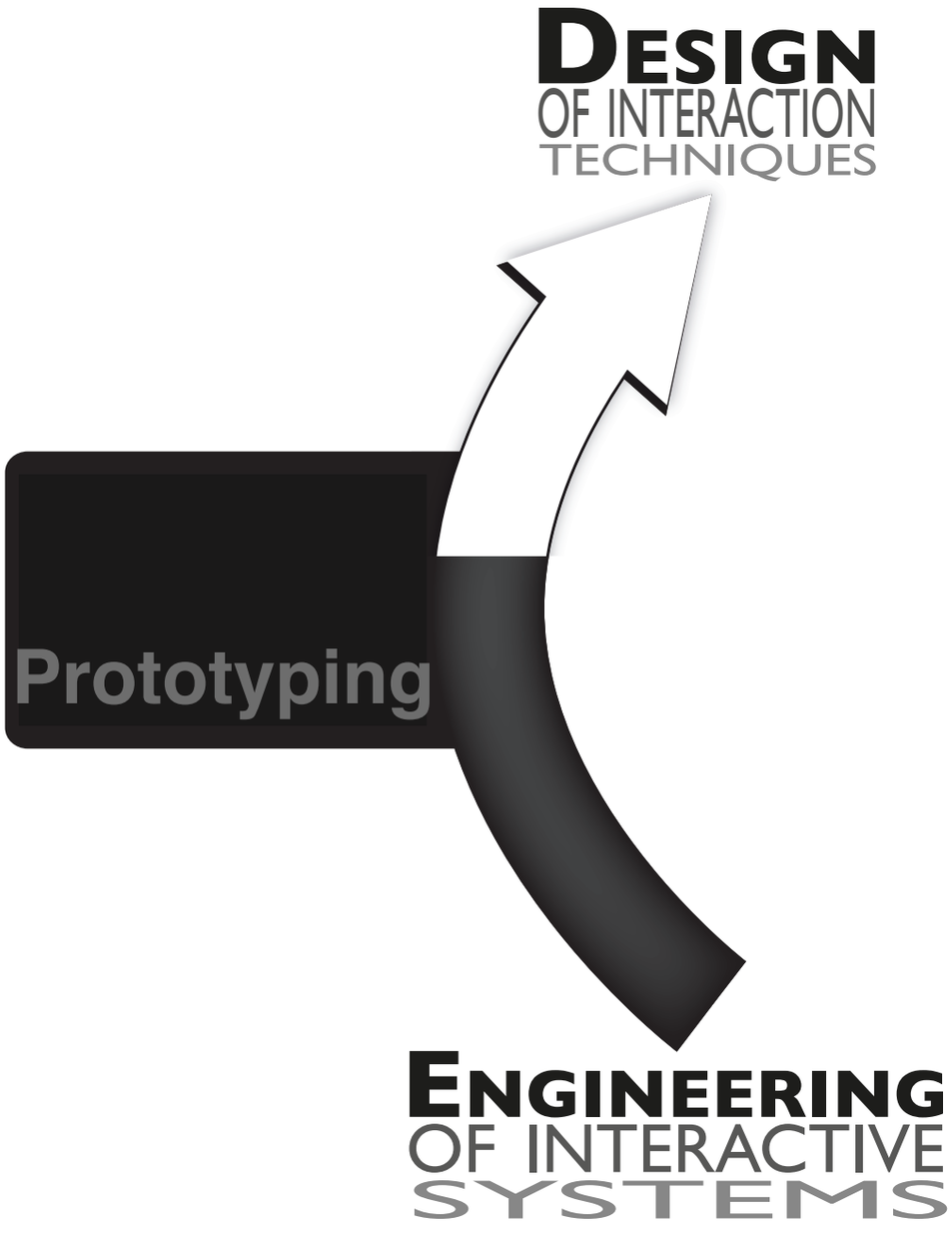
[Touchstone - Mackay et al., CHI'07]

.software quality



[jBricks - EICS'11]

when technology enables the evaluation of designs



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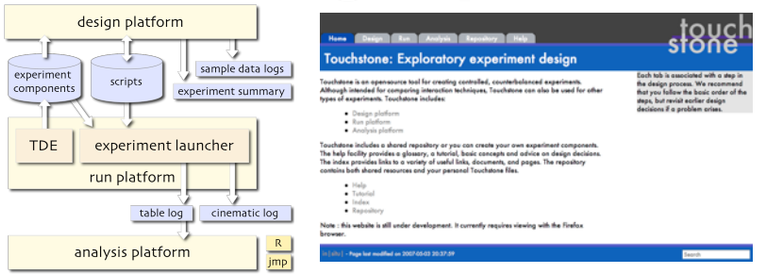

[Touchstone - Mackay et al., CHI'07]

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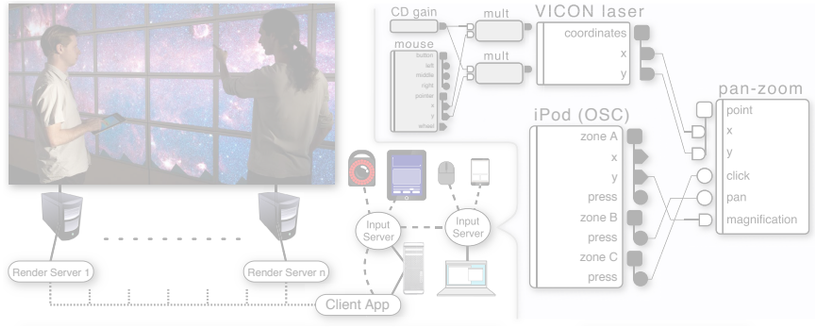
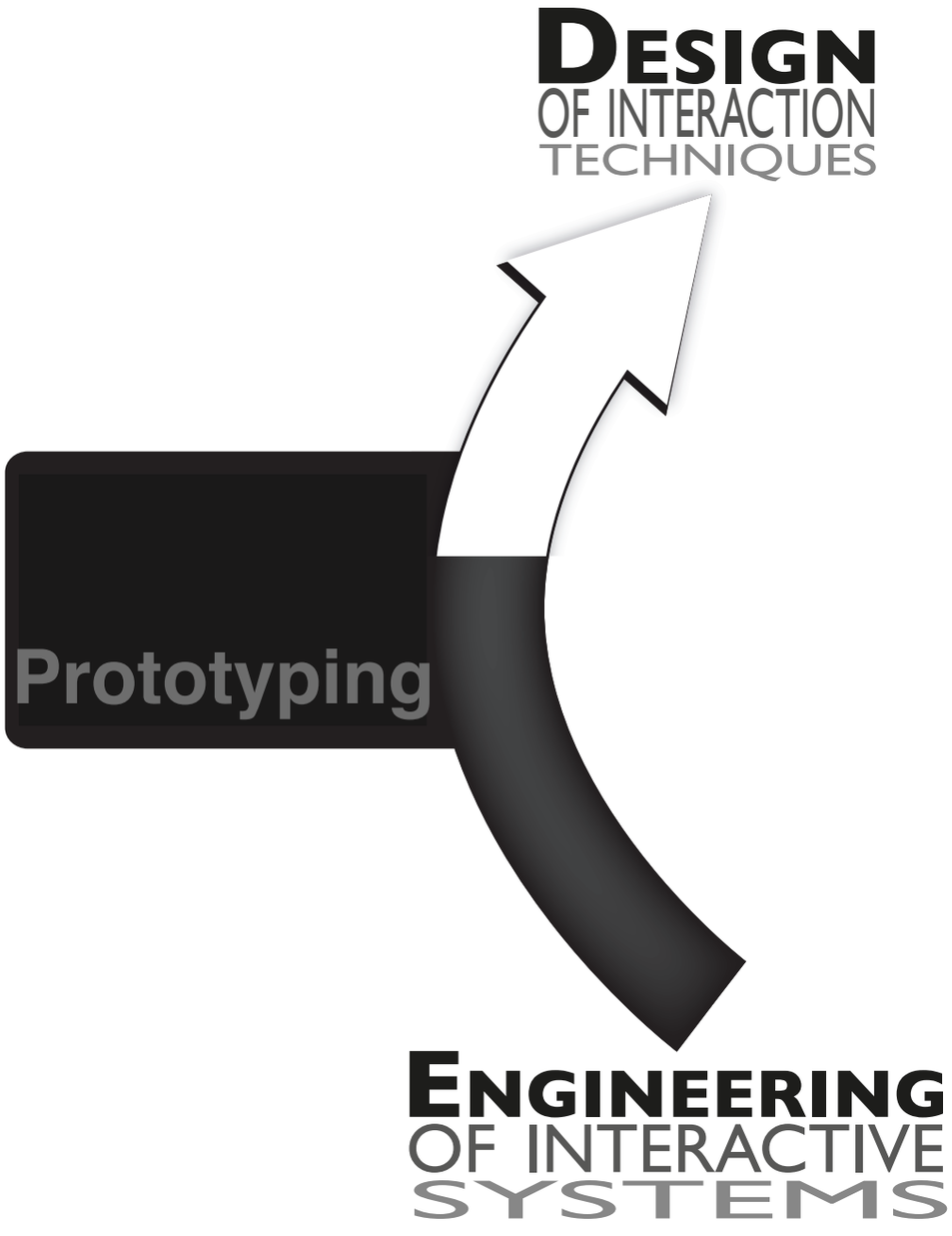


[jBricks - EICS'11]

when technology enables the evaluation of designs



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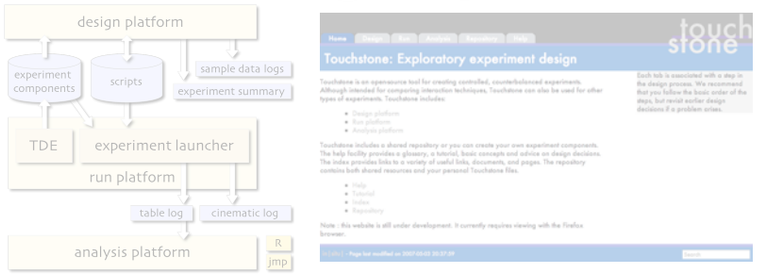

[Touchstone - Mackay et al., CHI'07]

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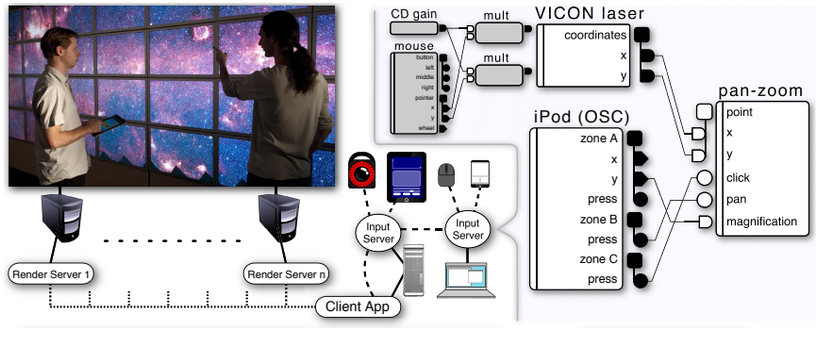
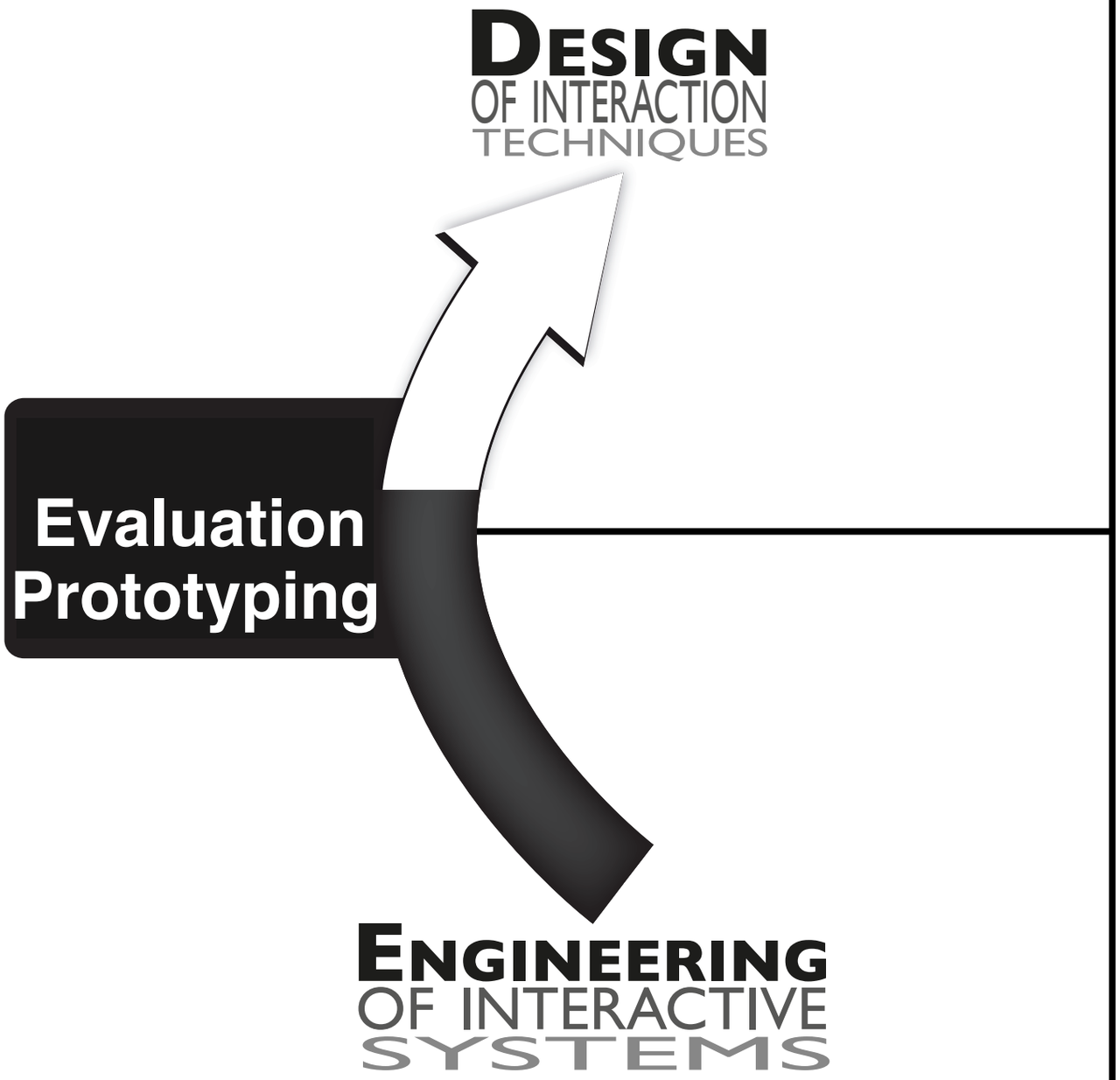
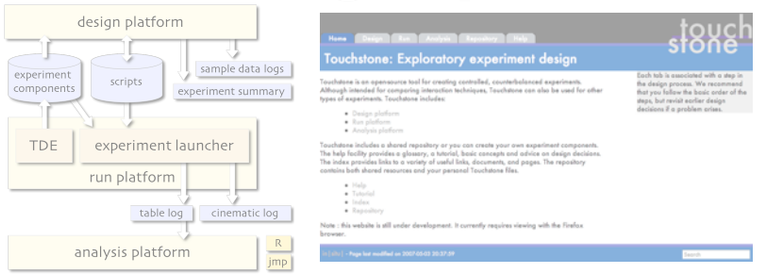


[jBricks - EICS'11]

when technology enables the evaluation of designs

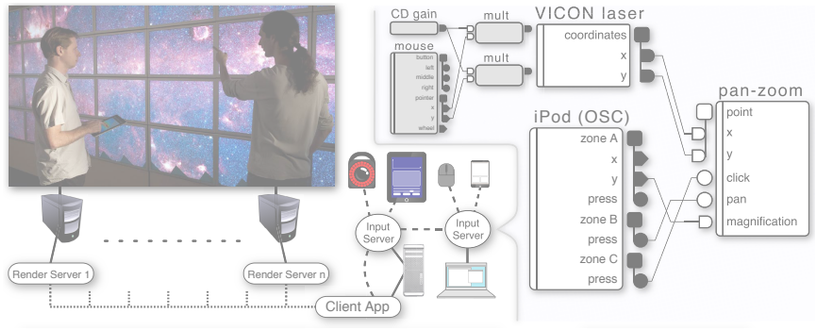


.conducting experiments



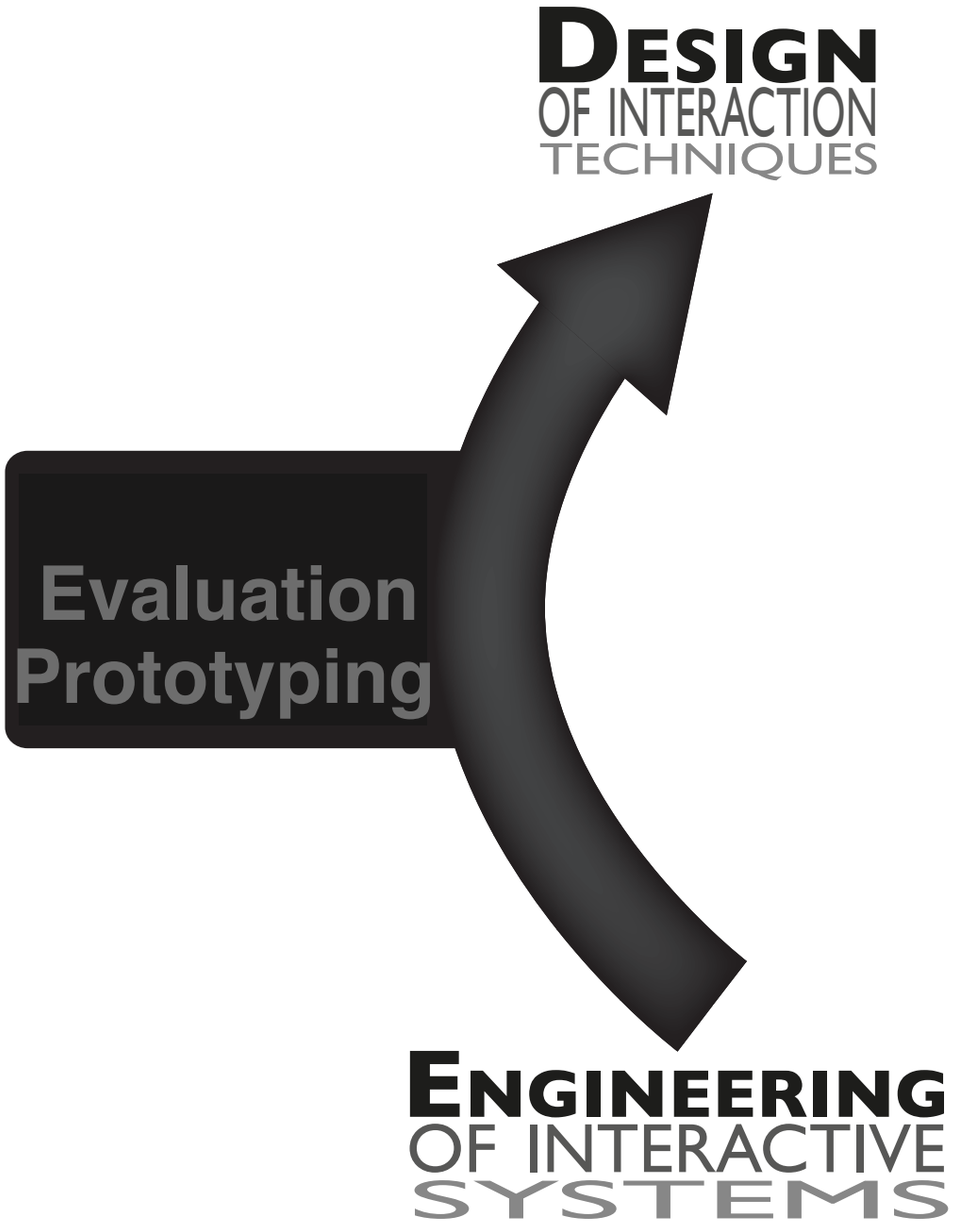
[Touchstone - Mackay et al., CHI'07]

.software quality

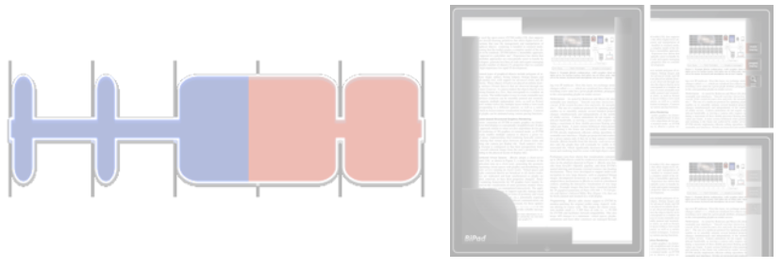


[jBricks - EICS'11]

when technology integrates designs

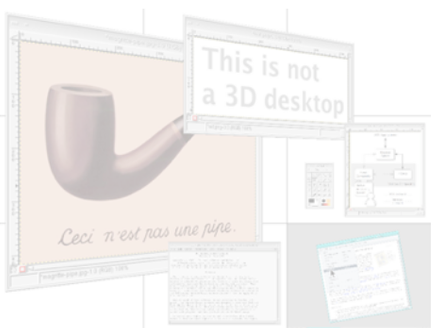


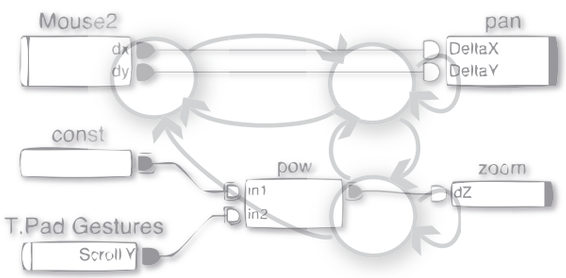
.toolkit or application level



[Rhythmic Interaction, BiPad - CHI'12]

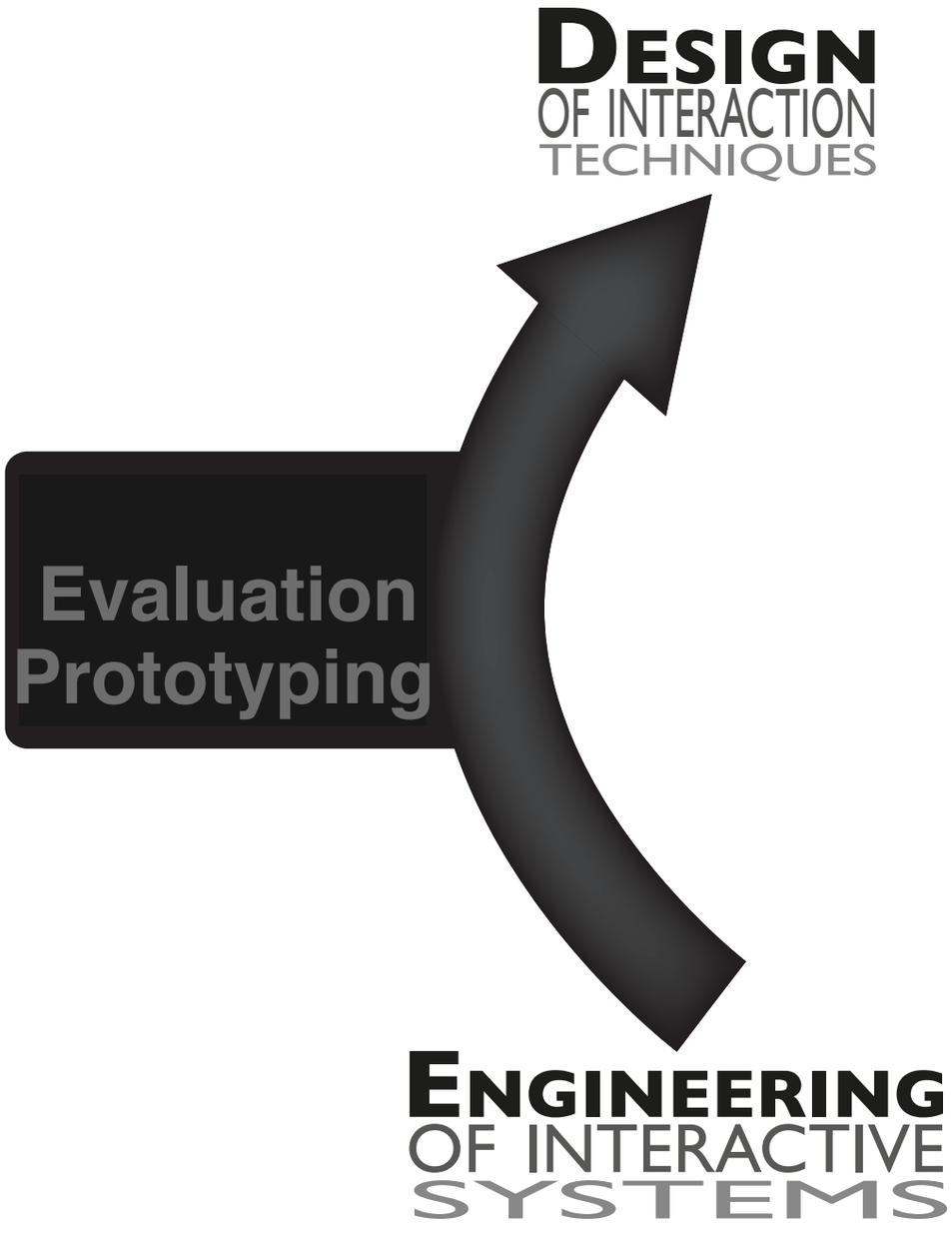
.opening closed systems



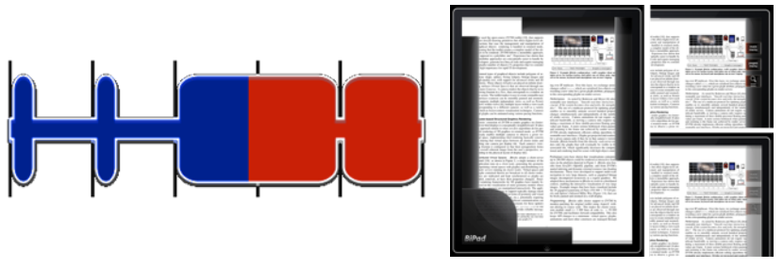


[Metisse - Chapuis and Roussel, UIST'05] [FlowStates - IHM'09]

when technology integrates designs

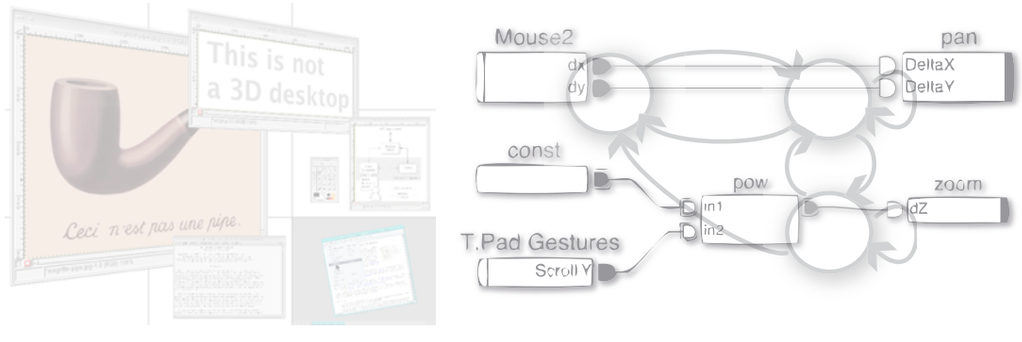


.toolkit or application level



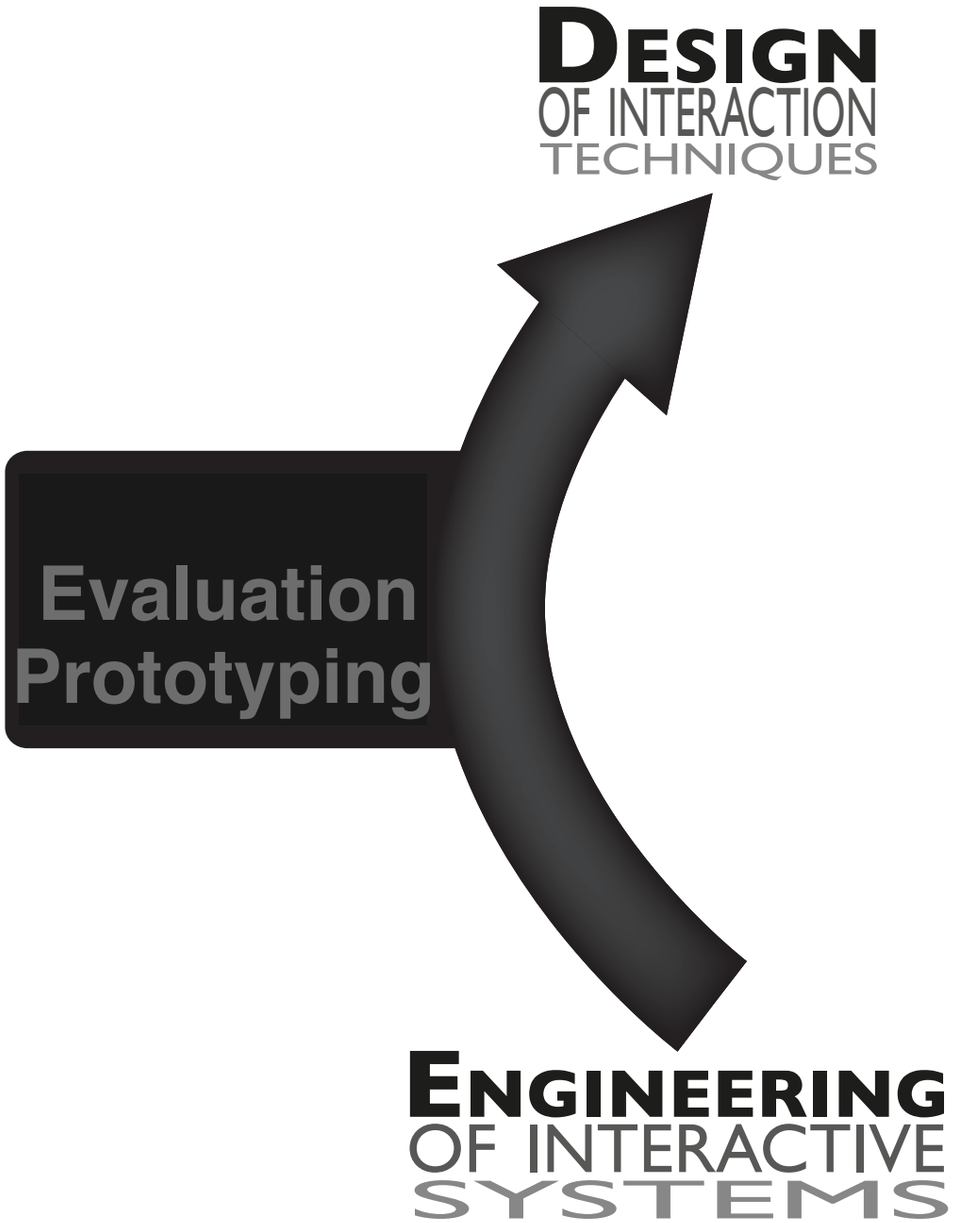
[Rhythmic Interaction, BiPad - CHI'12]

.opening closed systems

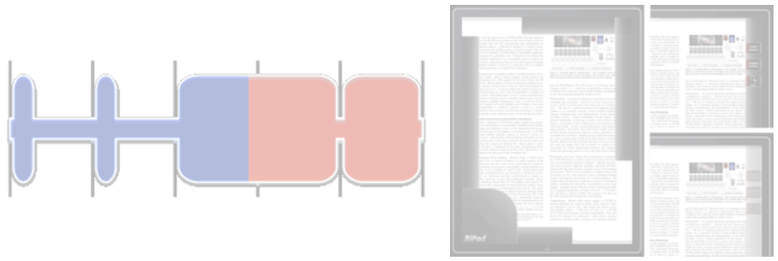


[Metisse - Chapuis and Roussel, UIST'05] [FlowStates - IHM'09]

when technology integrates designs

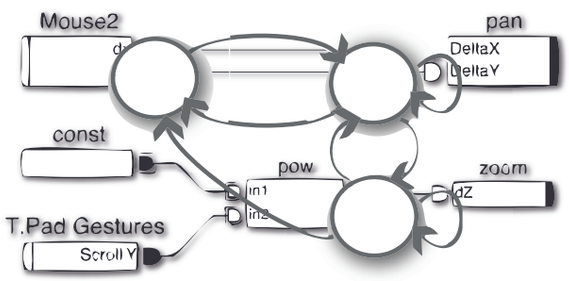


.toolkit or application level



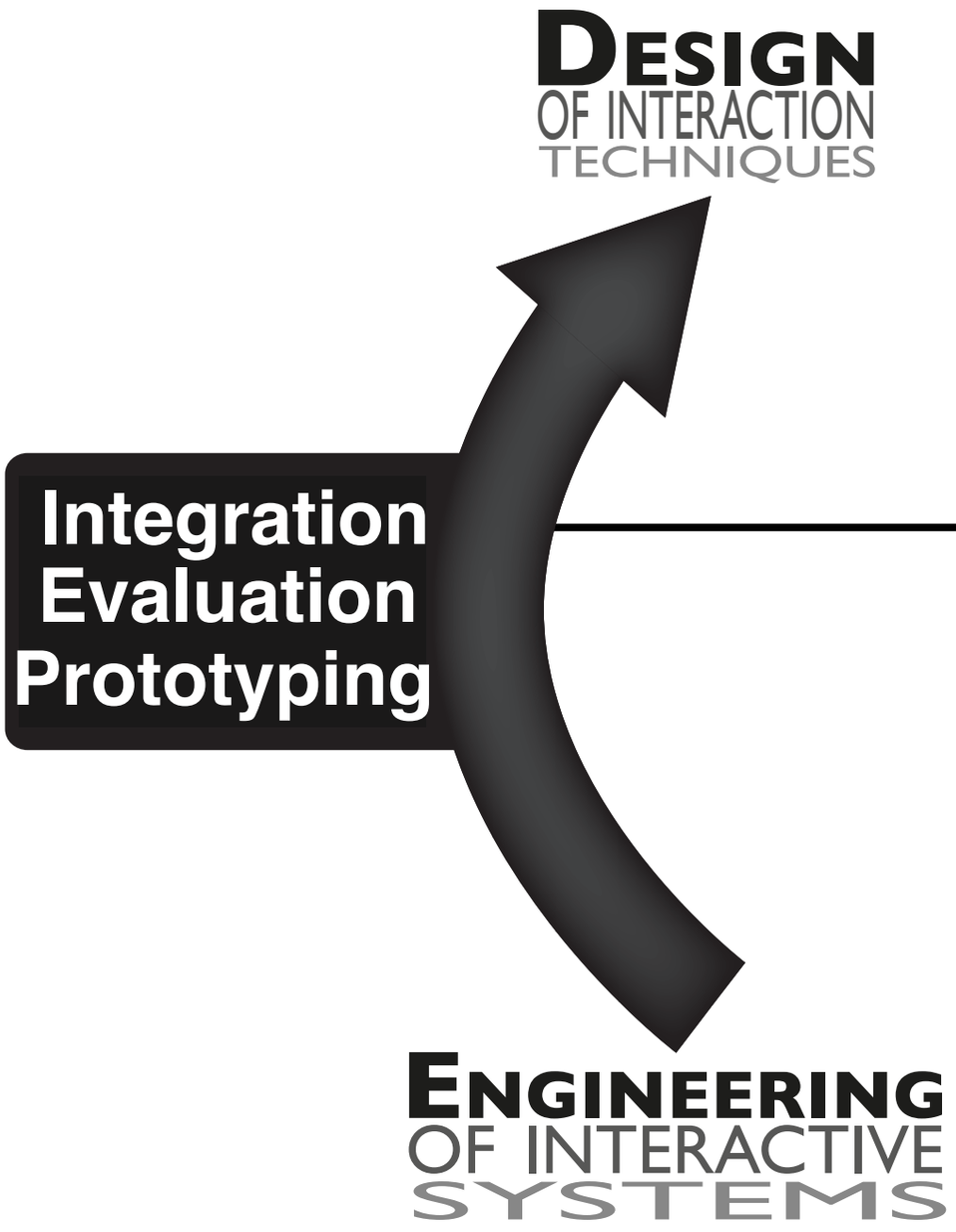
[Rhythmic Interaction, BiPad - CHI'12]

.opening closed systems

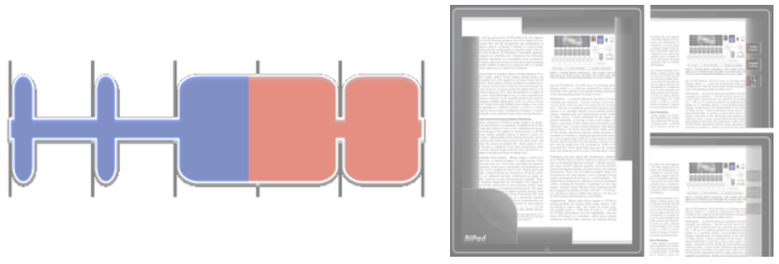


[Metisse - Chapuis and Roussel, UIST'05] [FlowStates - IHM'09]

when technology integrates designs

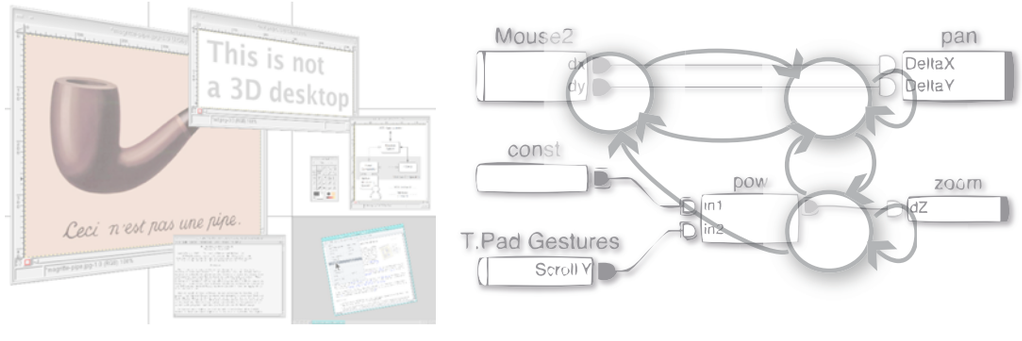


.toolkit or application level



[Rhythmic Interaction, BiPad - CHI'12]

.opening closed systems



[Metisse - Chapuis and Roussel, UIST'05] [FlowStates - IHM'09]

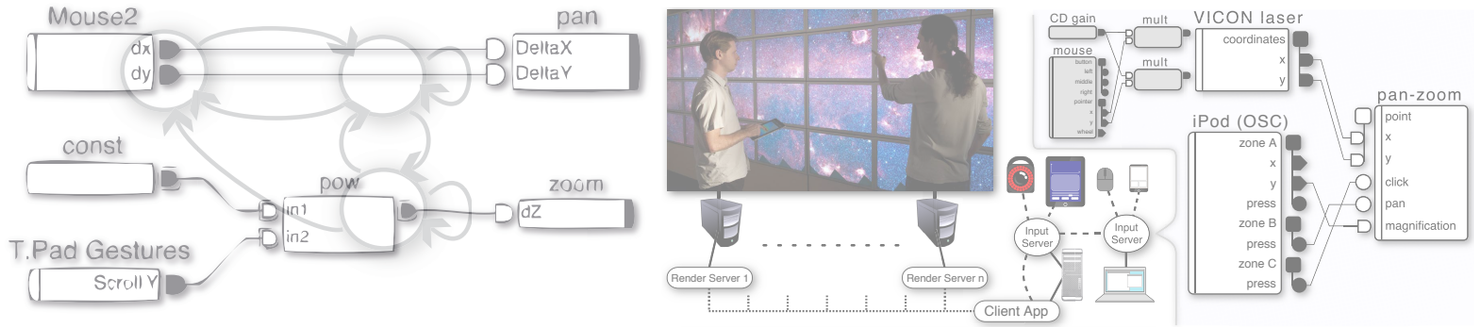
engineering unleashes interaction design

DESIGN
OF INTERACTION
TECHNIQUES

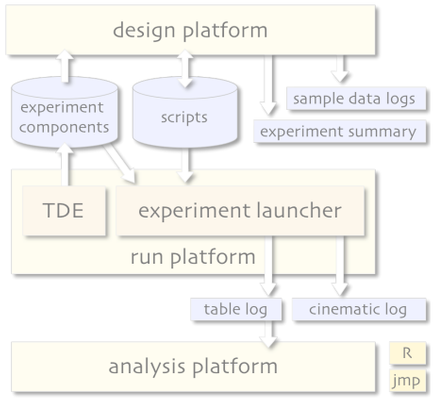
Integration
Evaluation
Prototyping

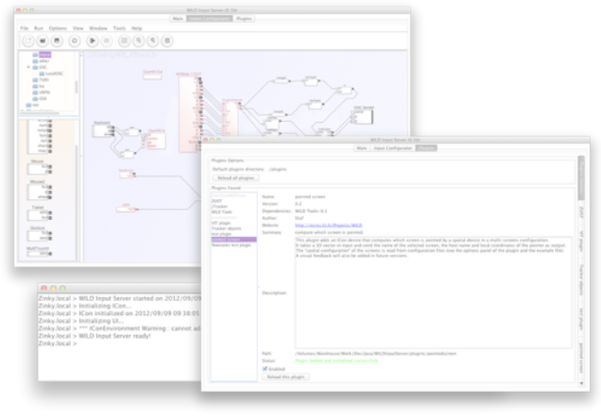
ENGINEERING
OF INTERACTIVE
SYSTEMS

.when technology defines possible designs

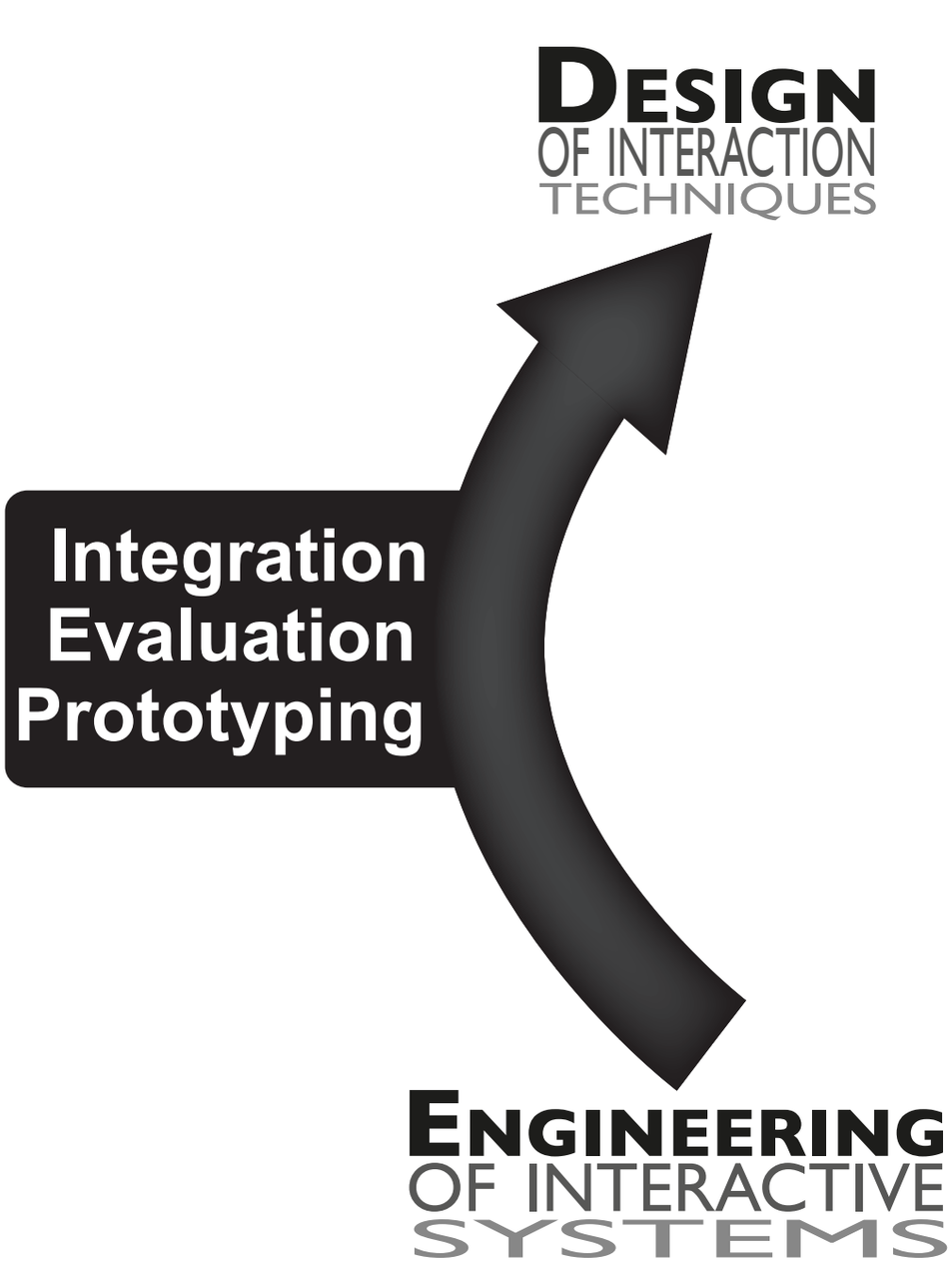


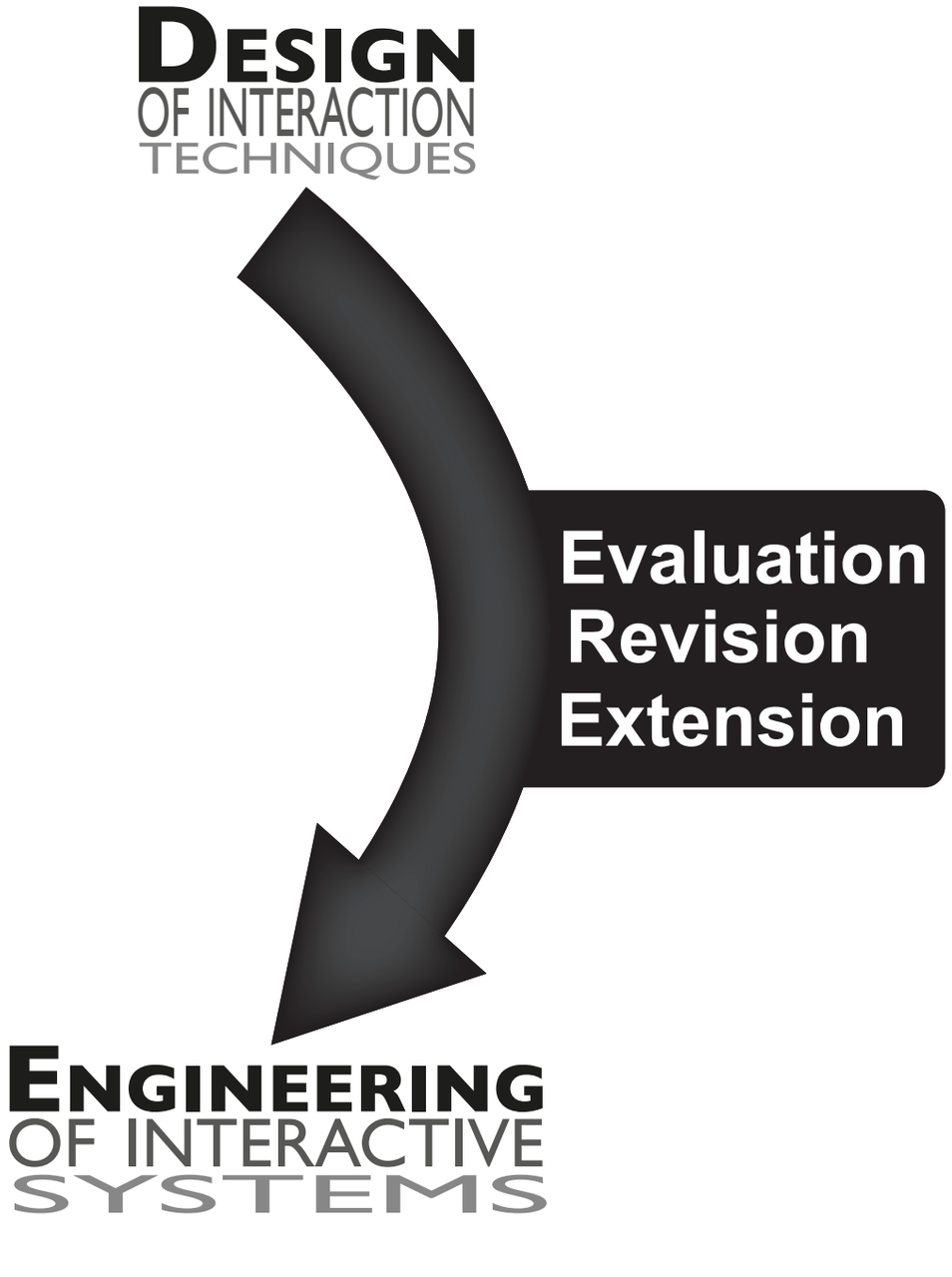
.when technology enables the evaluation of designs



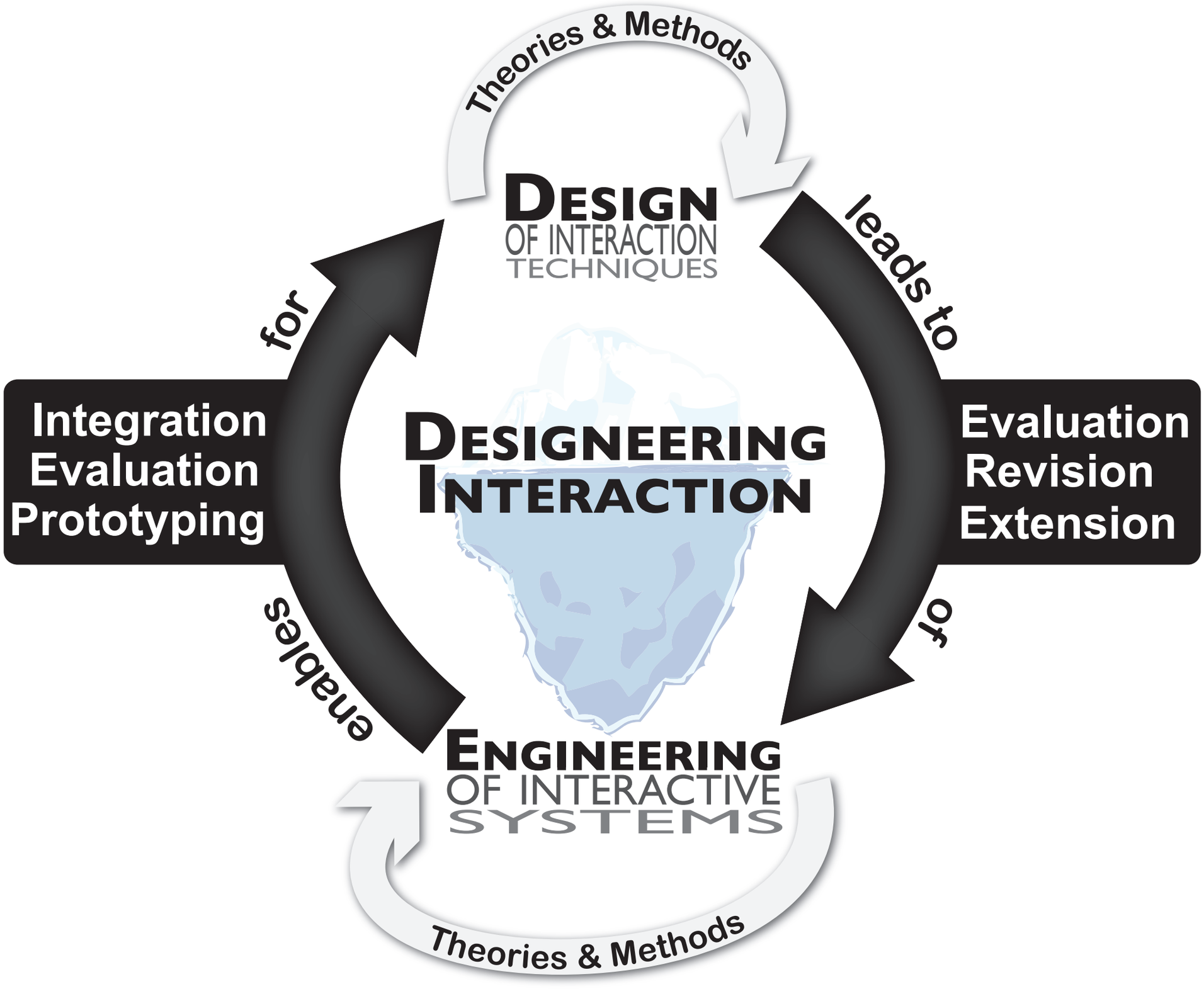


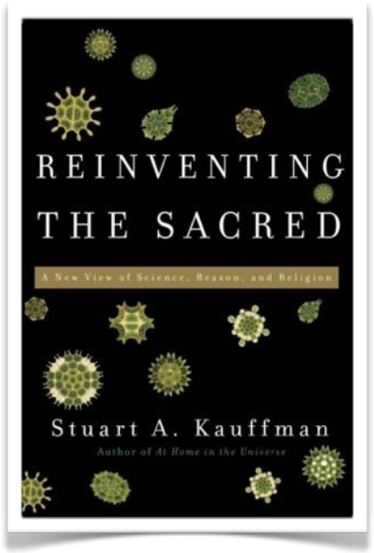
.when technology integrates designs


DESIGN
OF INTERACTION
TECHNIQUES
Integration
Evaluation
Prototyping
ENGINEERING
OF INTERACTIVE
SYSTEMS

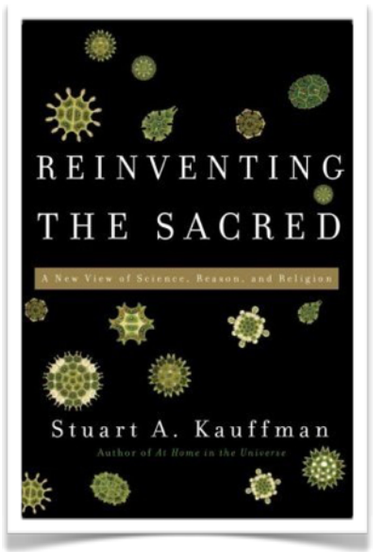

DESIGN
OF INTERACTION
TECHNIQUES
Evaluation
Revision
Extension
ENGINEERING
OF INTERACTIVE
SYSTEMS

the cycle of Designeering Interaction





"Consider a reaction graph with N molecular species, polymer sequences of A, and B monomers of diverse lengths. ***Call this initial N the actual****. Now ask the organic chemist to draw all the reactions that these N species might undergo [...]. It may well be that the products of some of these single-step reactions will not be among the initial N in the "actual" but will be new molecular species.* ***Call the set of new molecular species reachable in a single-reaction step from the actual, the adjacent possible****.* [...] *The initial plus its adjacent possible can be considered a new actual, which will then have a new adjacent possible."*



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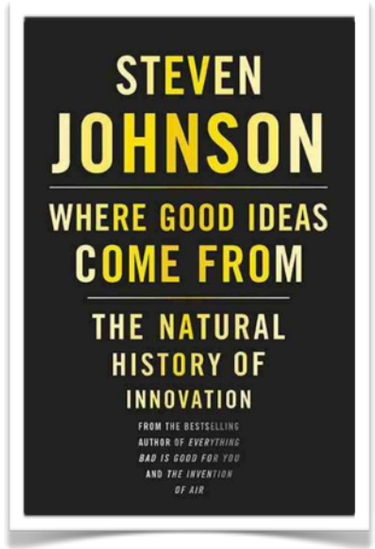
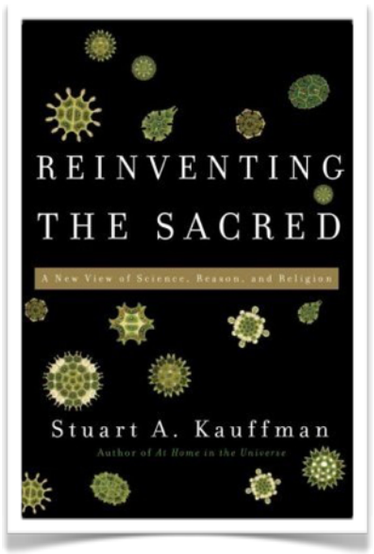


"[...] we like to think of breakthrough ideas as sudden accelerations on the timeline, where a genius jumps ahead fifty years and invents something that normal minds [...] couldn't possibly have come up with. But the truth is that ***technological (and scientific) advances rarely break out of the adjacent possible****; the history of cultural progress is, almost without exception, a story of one door leading to another door, exploring the palace one room at a time. But of course, human minds are not bound by the finite laws of molecule formation, and so* ***every now and then an idea occurs to someone that teleport us forward a few rooms****, skipping some exploratory steps in the adjacent possible. But* ***those ideas almost always end up being short-term failures****, precisely because they have skipped ahead."*



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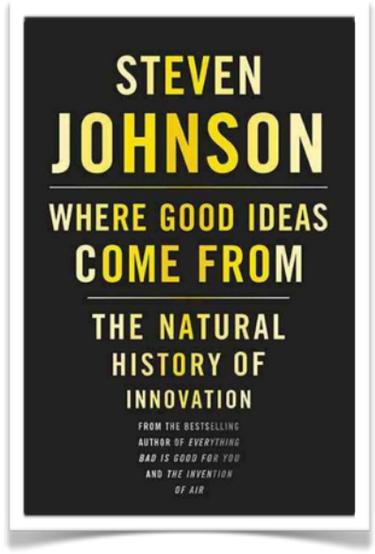

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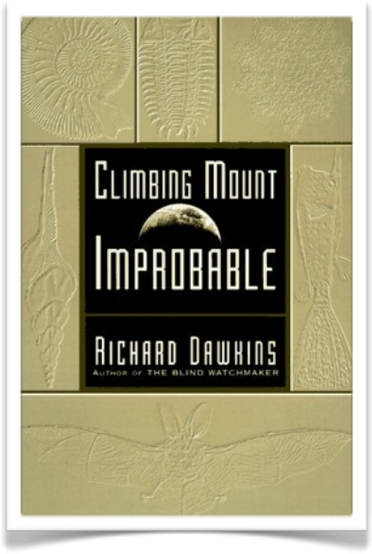
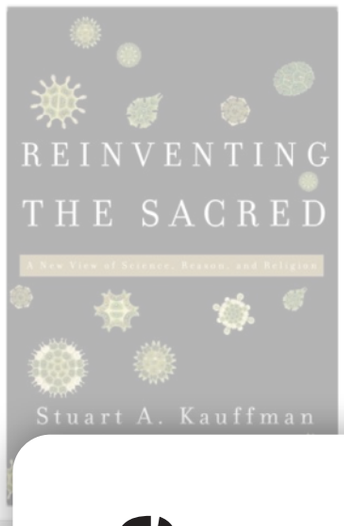
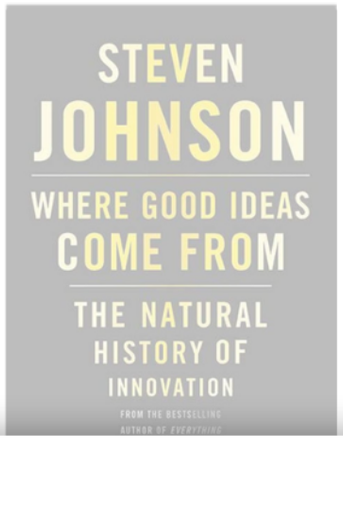
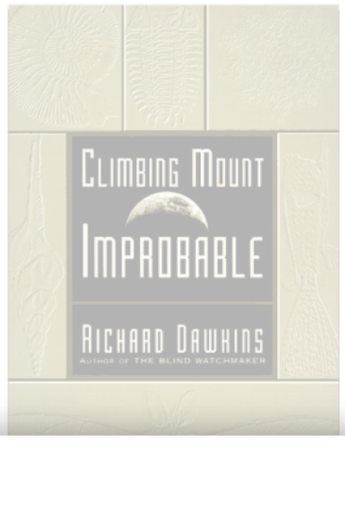


"There can be ***no sudden leaps upward*** *– no precipitous increases in ordered complexity. Second, there can be* ***no going downhill*** *– species can't get worse as a prelude to getting better. Third,* ***there may be more than one peak*** *– more than one way of solving the same problem, all flourishing in the world."*

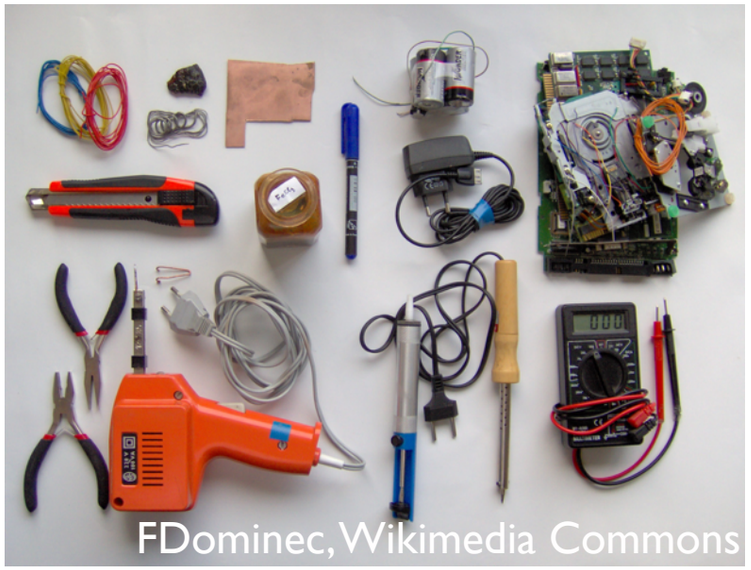

REINVENTING
THE SACRED
A New View of Science, Reason, and Religion
Stuart A. Kauffman


STEVEN
JOHNSON
WHERE GOOD IDEAS
COME FROM
THE NATURAL
HISTORY OF
INNOVATION


CLIMBING MOUNT
IMPROBABLE
RICHARD DAWKINS

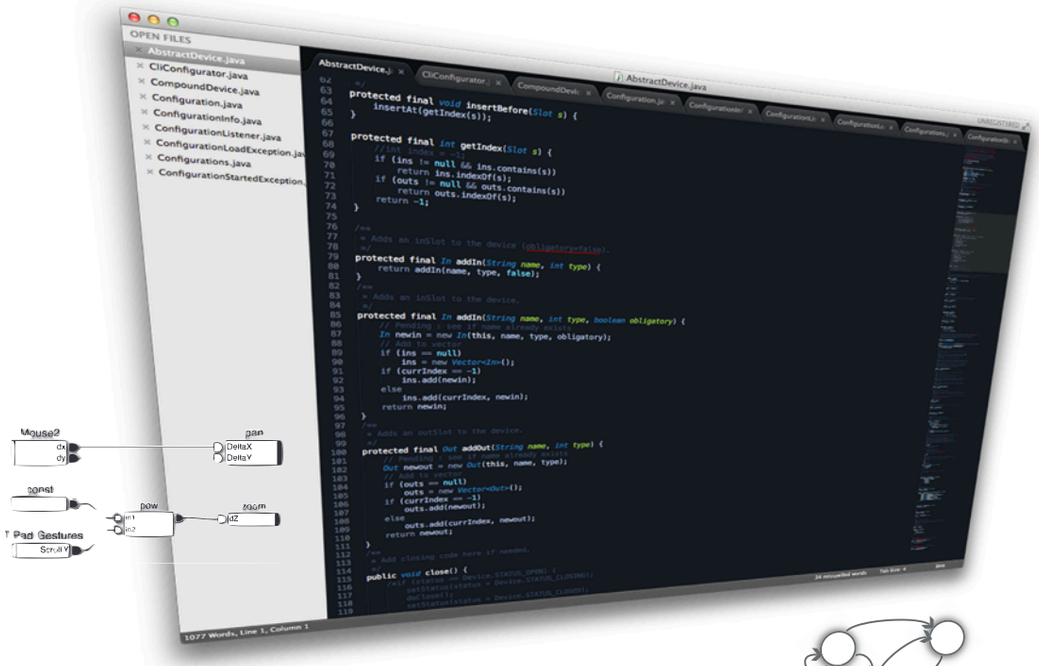
The Adjacent Possible
Mount Improbable

the actual of HCI

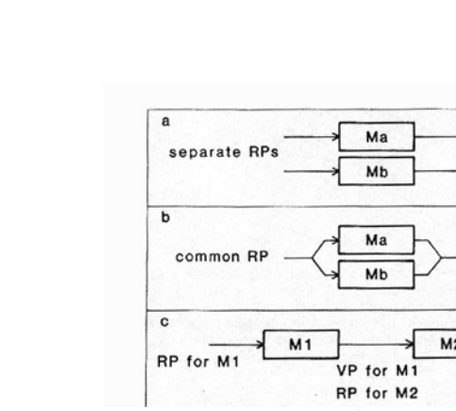


.electronics

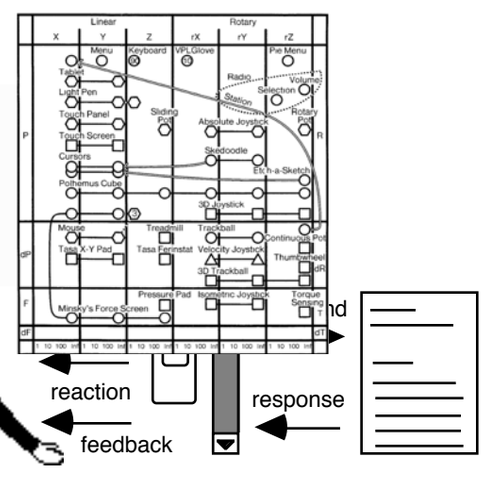
.input|output devices



.software models, languages & toolkits



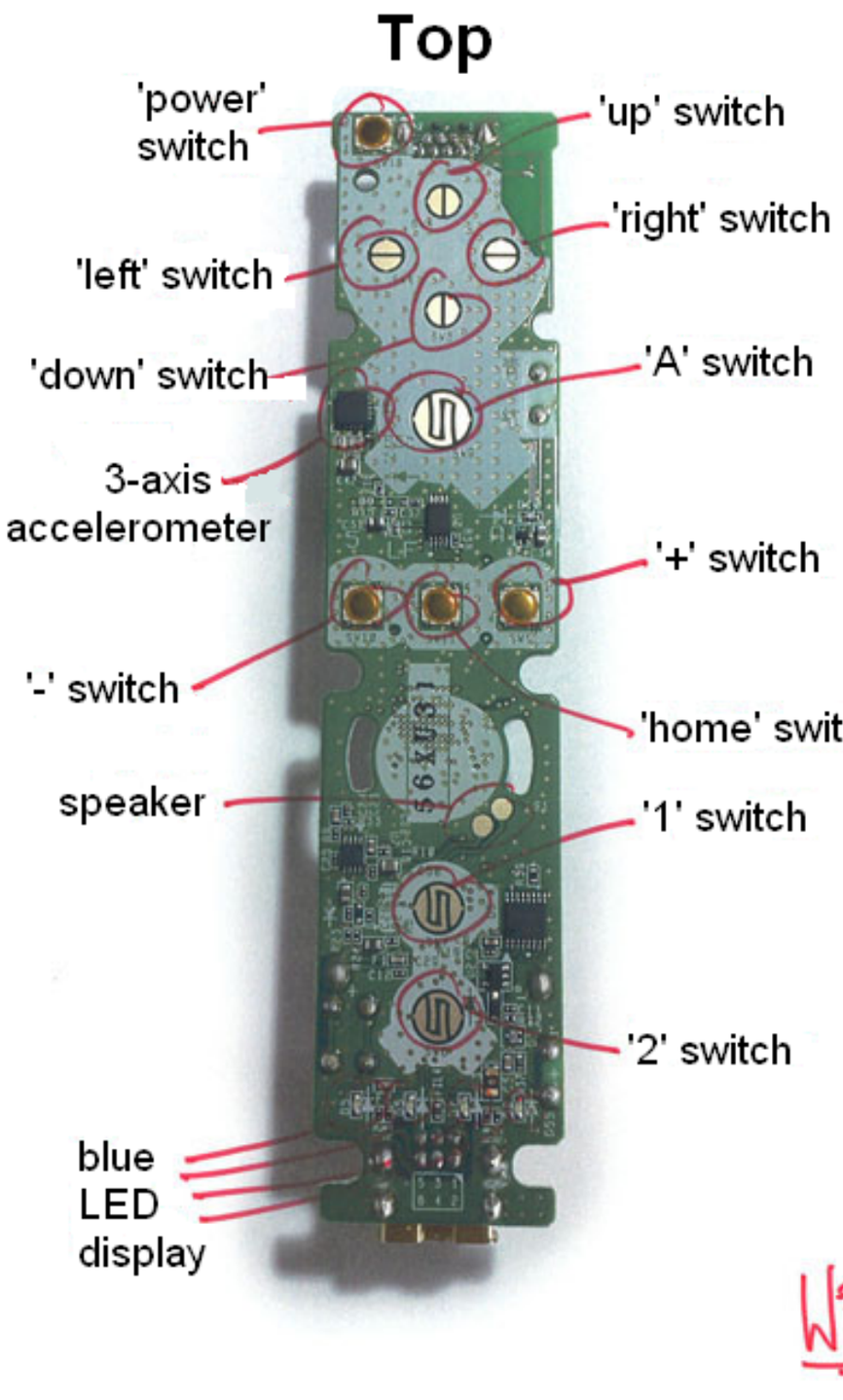
$$T = a + b \log_2 \left(1 + \frac{D}{W}\right)$$

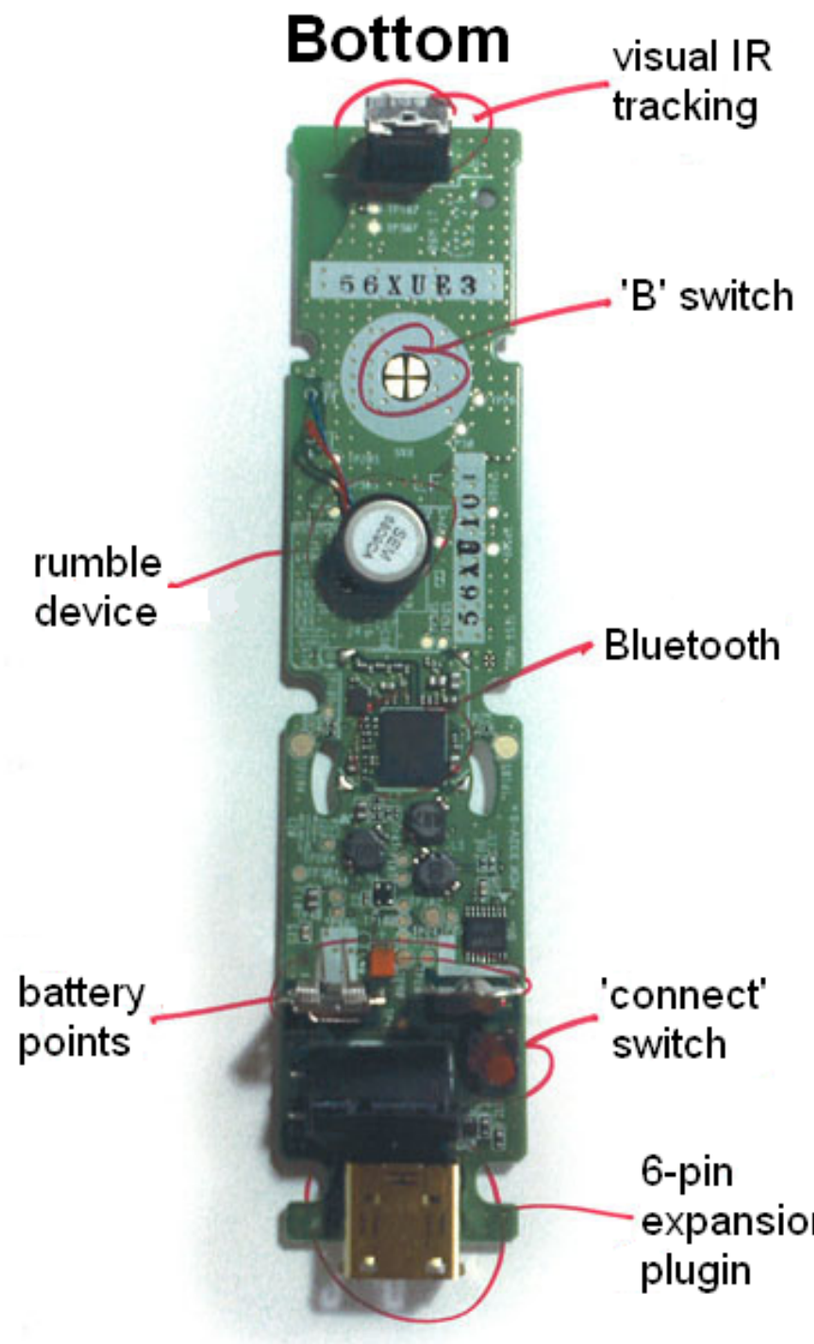


.theories & models

example of adjacent possible: the Wiimote

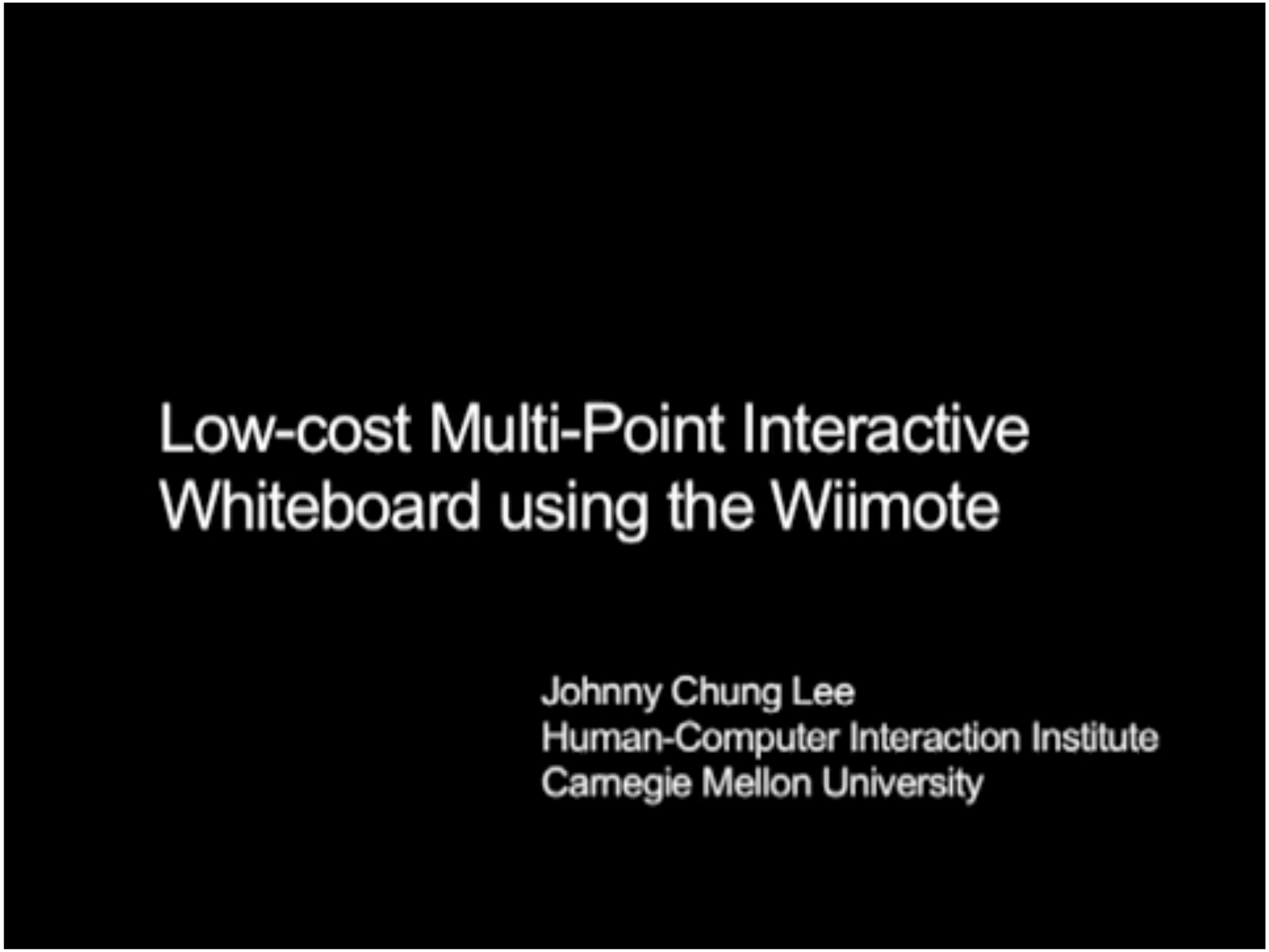
example of adjacent possible: the Wiimote





J. Brindza & J. Szweda, netscale.cse.nd.edu

example of adjacent possible: the Wiimote



.Engelbart, augmenting human intellect (60s)

monday afternoon

december 9

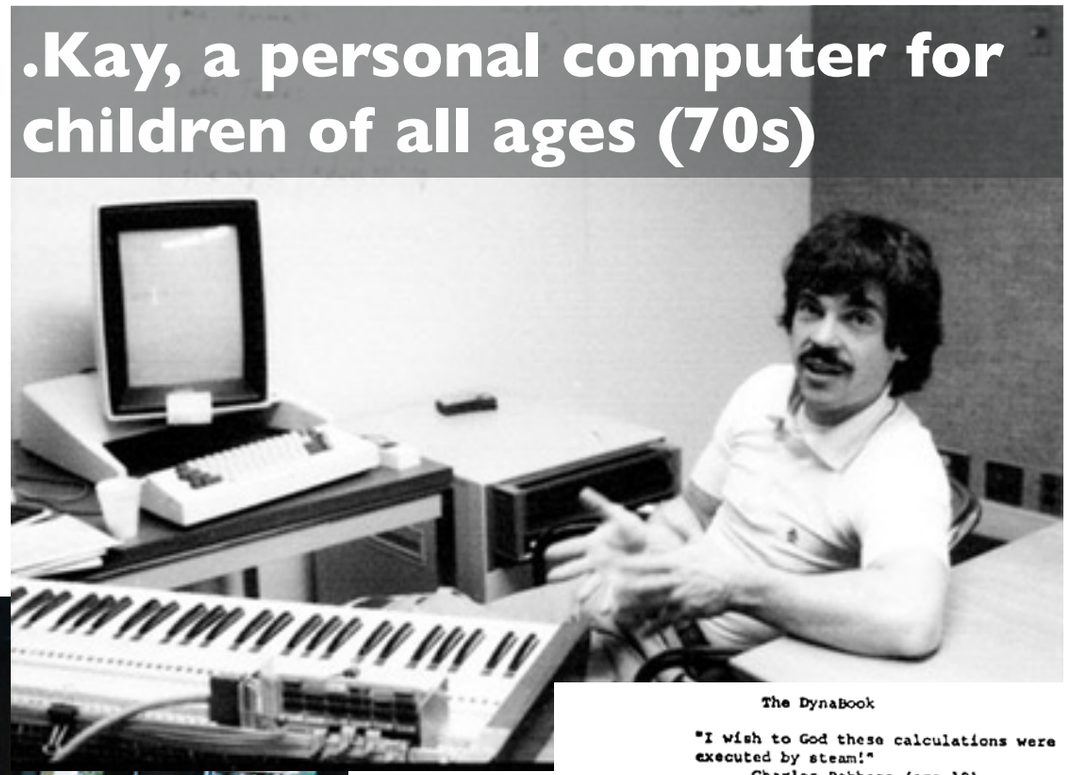
3:45 p.m. / arena

Chairman:
DR. D. C. ENGELBART
Stanford Research Institute
Menlo Park, California

a research center for augmenting human intellect

This session is entirely devoted to a presentation by Dr. Engelbart on a computer-based, interactive, multiconsole display system which is being developed at Stanford Research Institute under the sponsorship of ARPA, NASA and RADC. The system is being used as an experimental laboratory for investigating principles by which interactive computer aids can augment intellectual capability. The techniques which are being described will, themselves, be used to augment the presentation.
The session will use an on-line, closed circuit television hook-up to the SRI computing system in Menlo Park.
Following the presentation remote terminals to the system, in operation, may be viewed during the remainder of the conference in a special room set aside for that purpose.

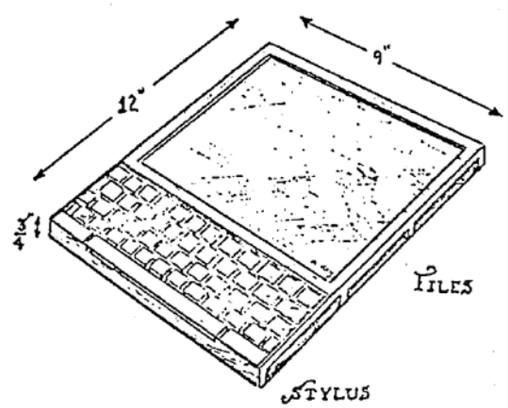
.Kay, a personal computer for children of all ages (70s)

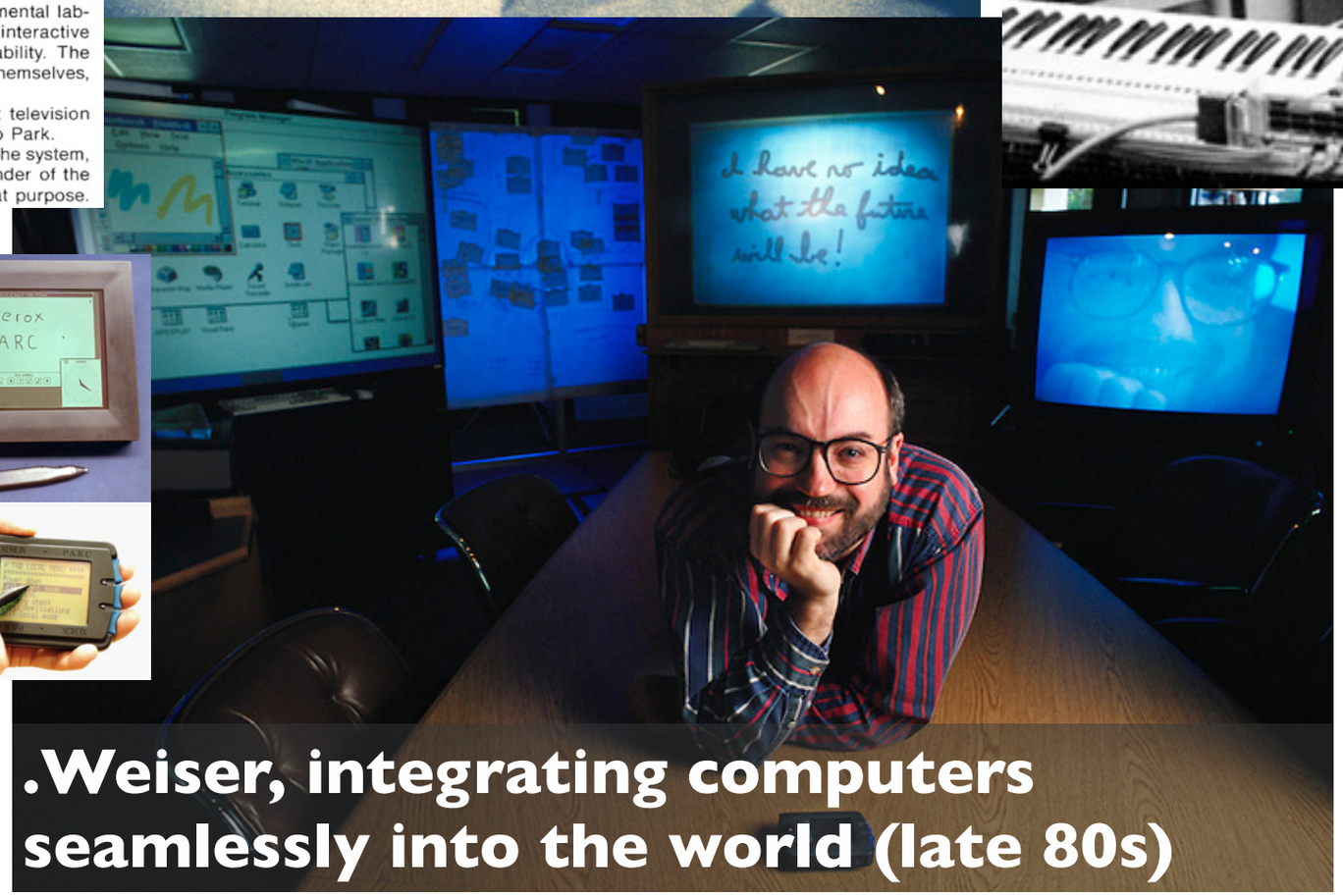


The DynaBook

"I wish to God these calculations were executed by steam!"
Charles Babbage (age 19)
ca. 1803

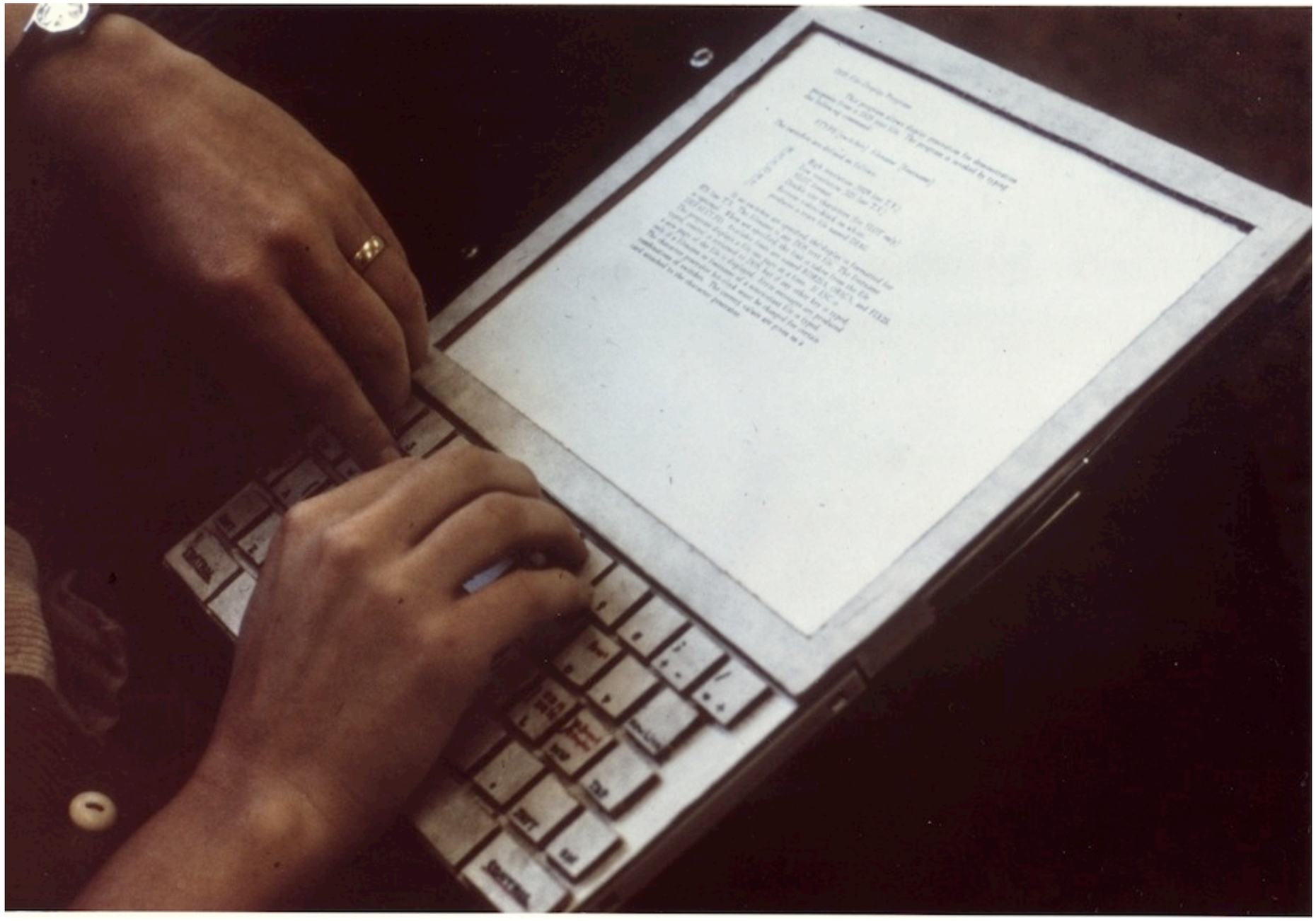
"The Analytical Engine weaves algebraic patterns, just as the Jacquard Loom weaves patterns in silk."
-Ada Augusta
Countess of Lovelace





.Weiser, integrating computers seamlessly into the world (late 80s)

ex: Dynabook [Kay, 70s]



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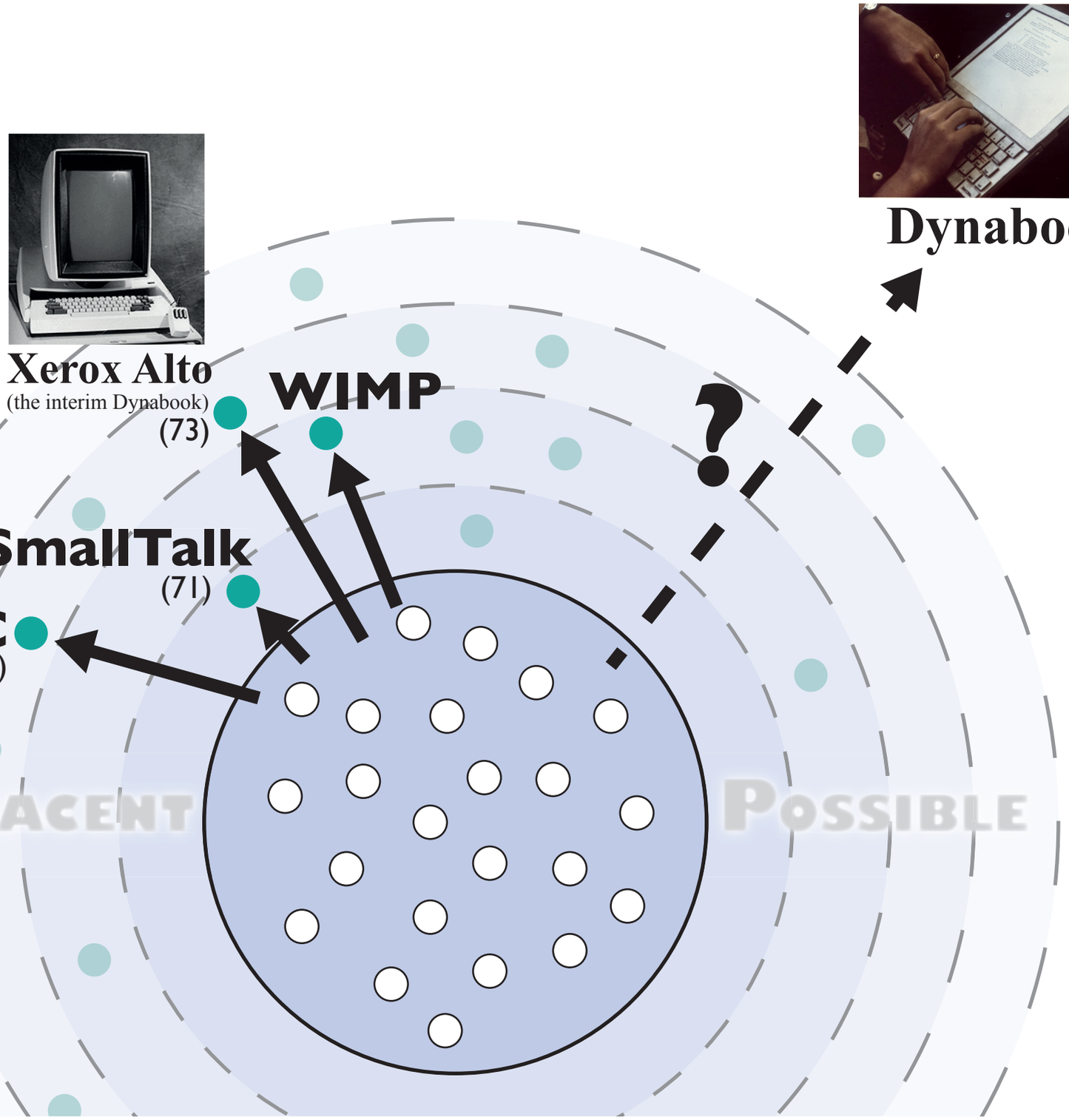
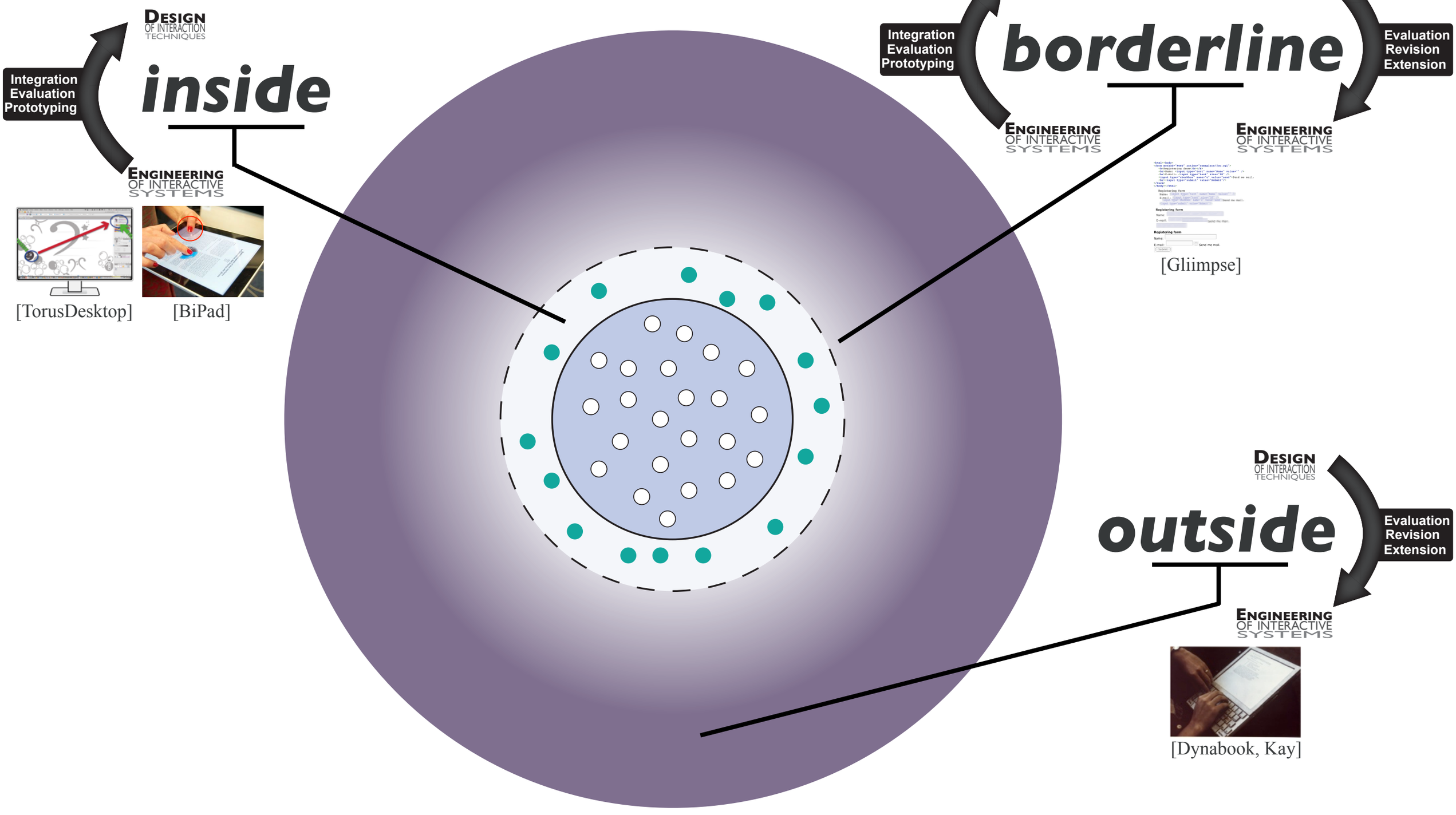


ideas and the adjacent possible



ideas and the adjacent possible

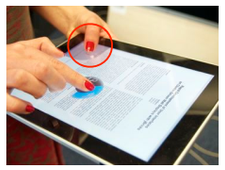
DESIGN OF INTERACTION TECHNIQUES

inside

Integration Evaluation Prototyping

ENGINEERING OF INTERACTIVE SYSTEMS

[TorusDesktop]



[BiPad]

DESIGN OF INTERACTION TECHNIQUES

borderline

Integration Evaluation Prototyping

Evaluation Revision Extension

ENGINEERING OF INTERACTIVE SYSTEMS

[Gliimpse]

DESIGN OF INTERACTION TECHNIQUES

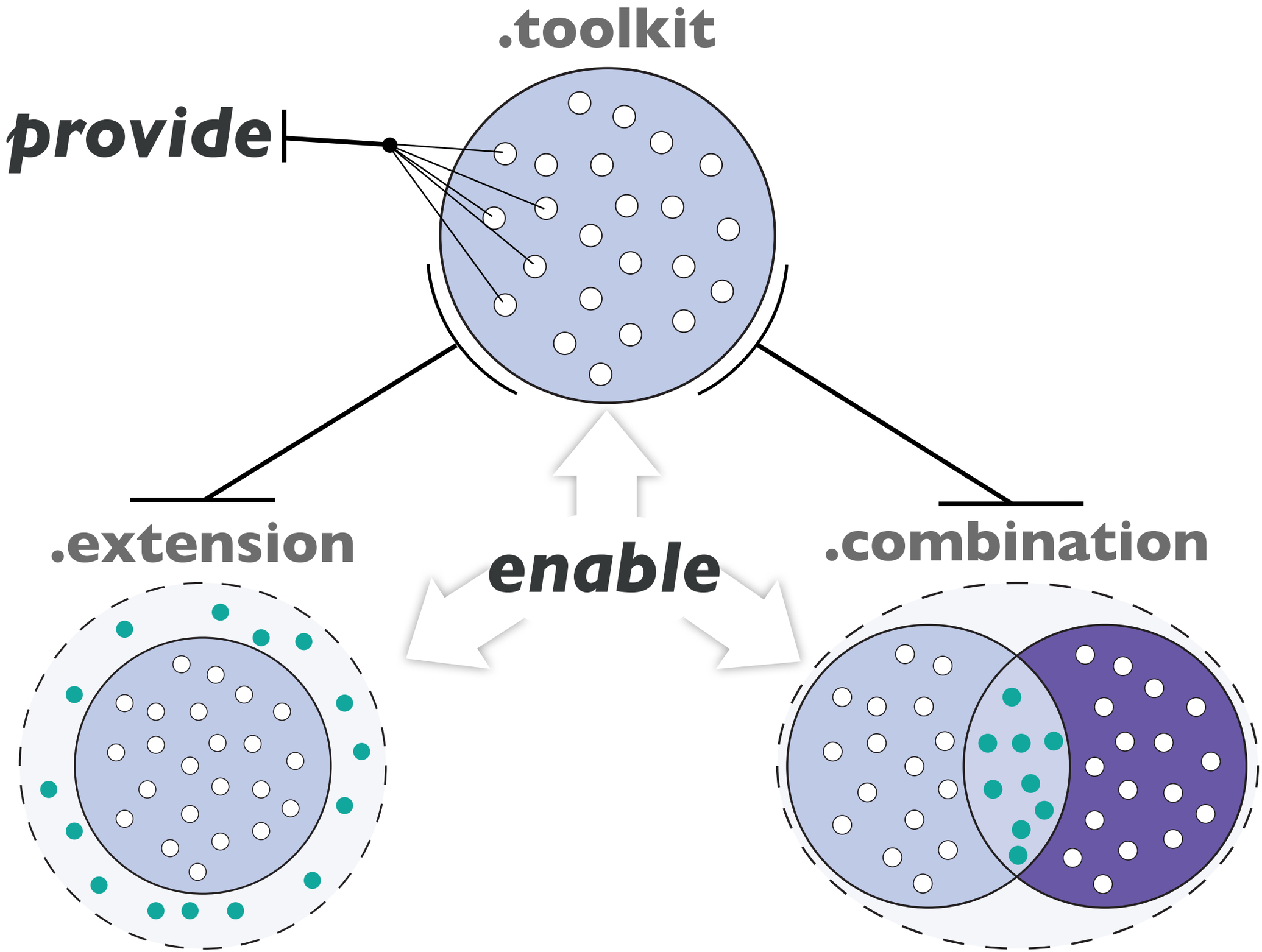
outside

Evaluation Revision Extension

ENGINEERING OF INTERACTIVE SYSTEMS

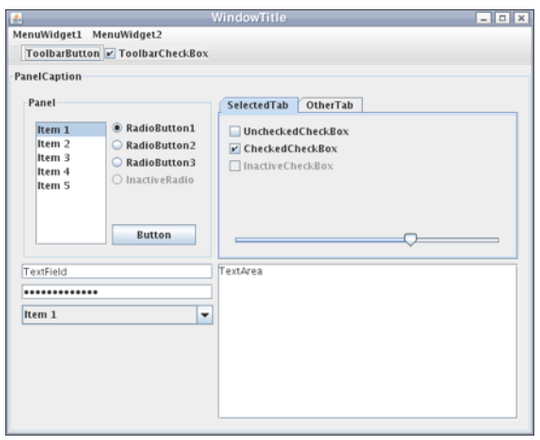
[Dynabook, Kay]

the adjacent possible of a toolkit



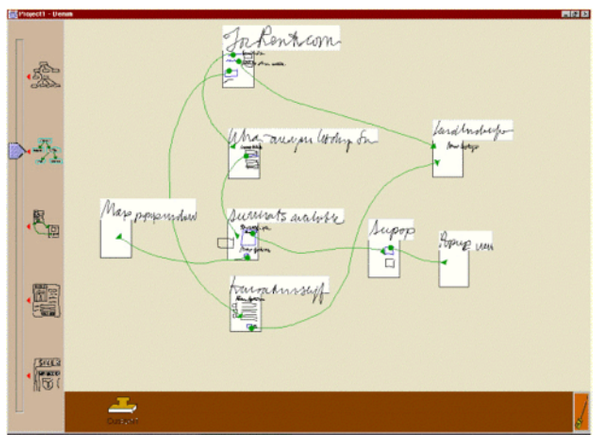
provide = *atomic parts*

WIMP



.widgets

SATIN
[Hong & Landay - UIST'00]



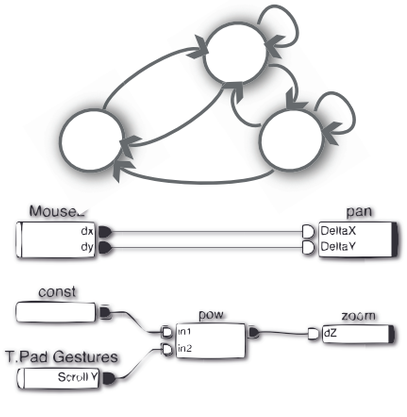
.strokes interpreters

.gestures recognizers

.strokes

.gestures

FlowStates



.state machines

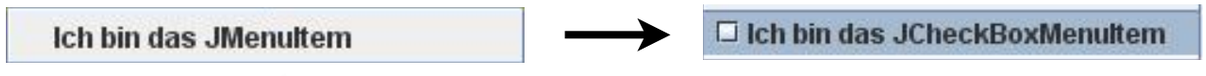
.data-flow devices

.abstract events

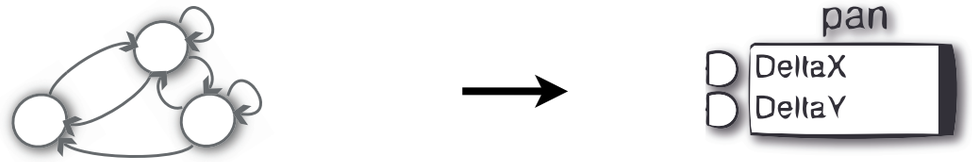
enable = *extension, combination, reuse and interoperability*

extension

- **.inheritance**

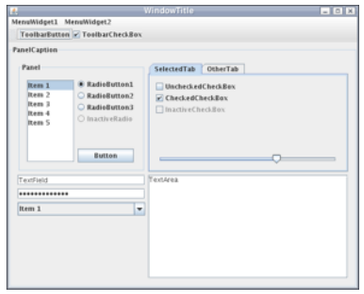


- **.creation**

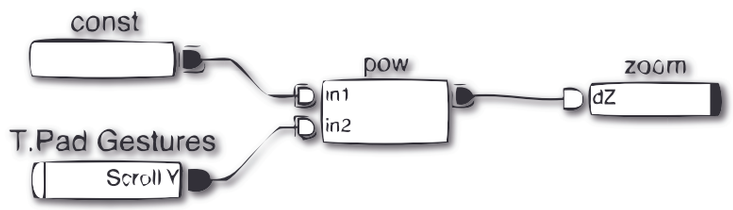


combination

- **.structural**



- **.logical**



reuse

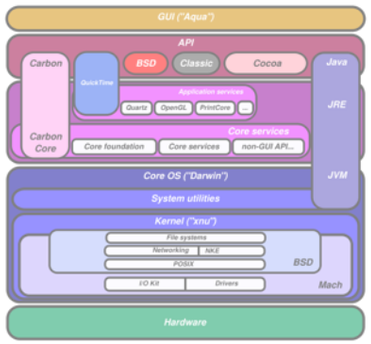
- **.extensions**
- **.combinations**

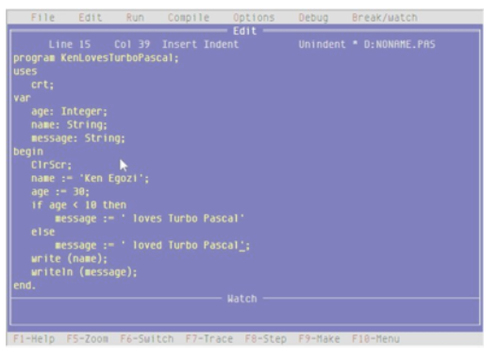
interoperability

- **.internal**
- **.external**

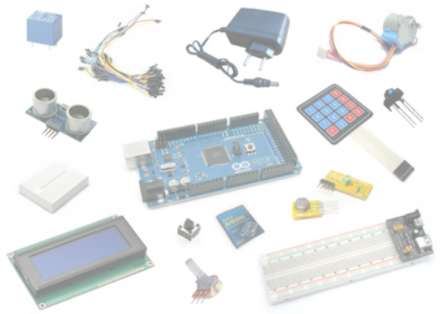
perspectives: tools for designeering interaction

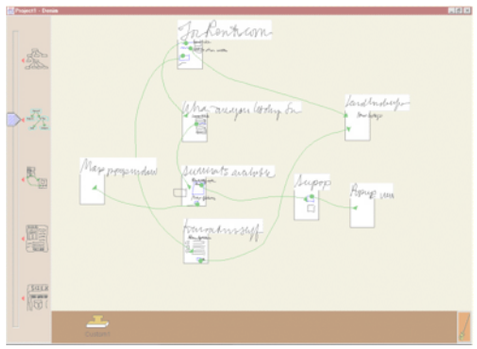
.system and programming languages



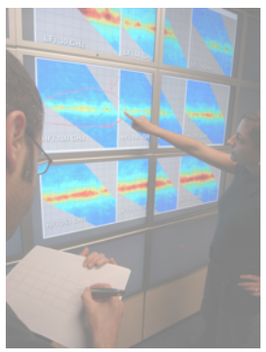


.creative prototyping: sketching interaction, not interfaces



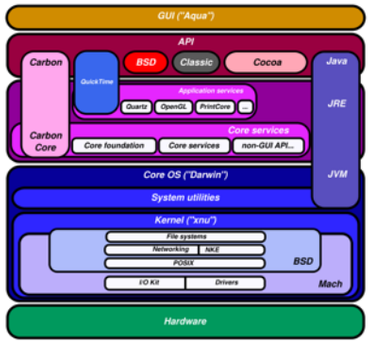


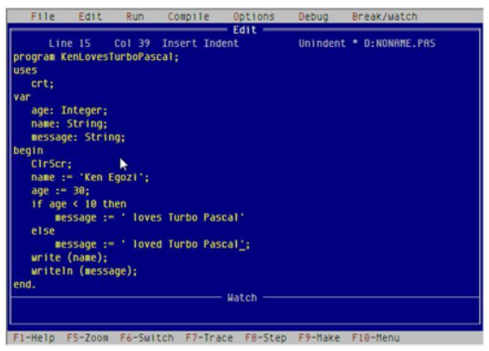
.adaptability for end-users



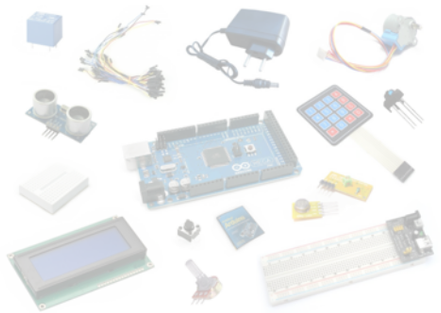
perspectives: tools for designeering interaction

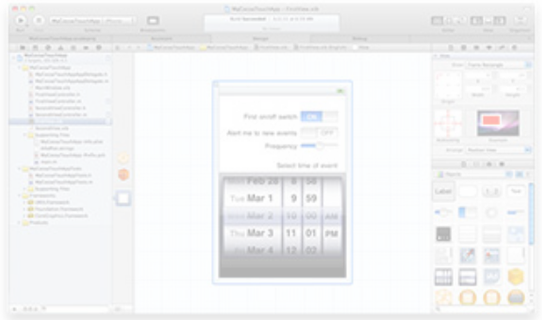
.system and programming languages

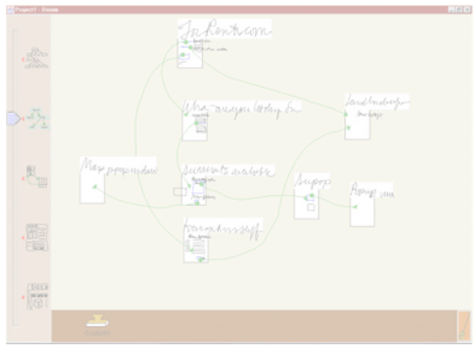




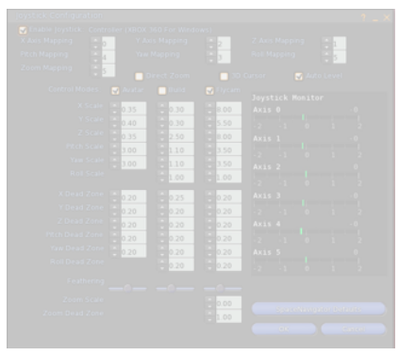
.creative prototyping: sketching interaction, not interfaces

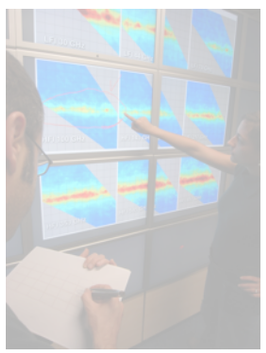






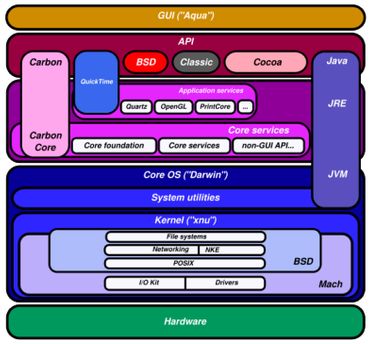
.adaptability for end-users



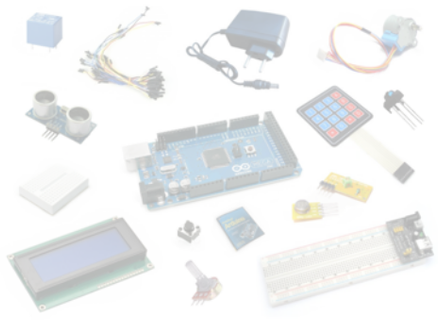


system & programming languages

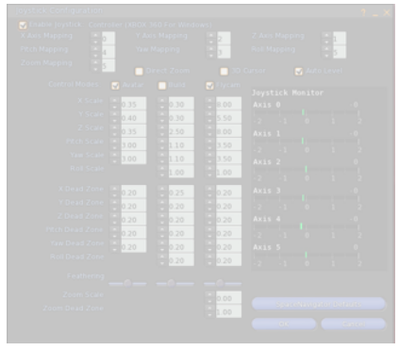
.system and prog

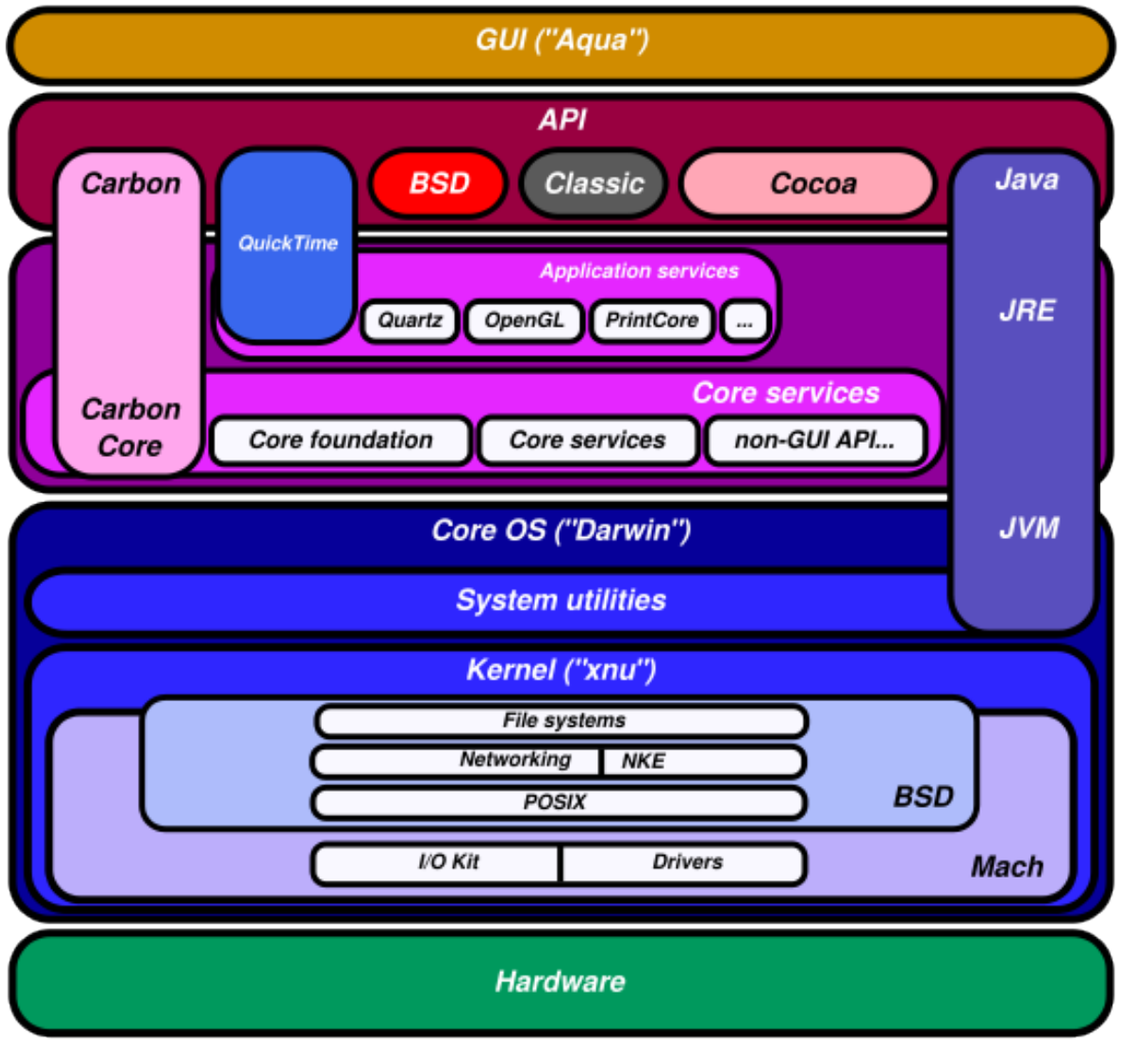


.creative prototy



.adaptability for





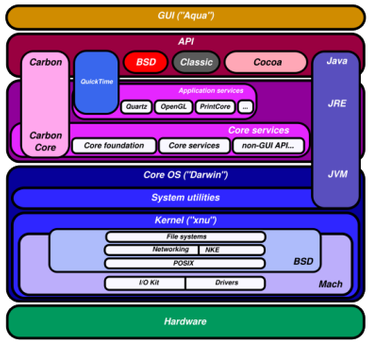
.low-level language/libraries

↳ combination and interoperability

unifying the levels

system & programming languages

.system and prog



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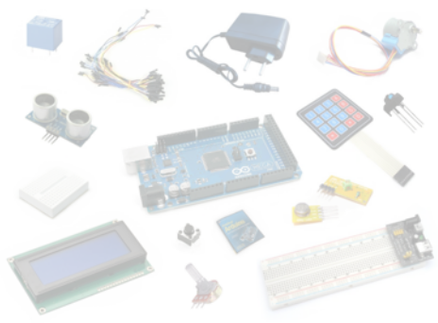
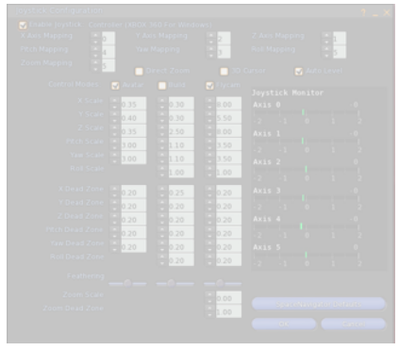
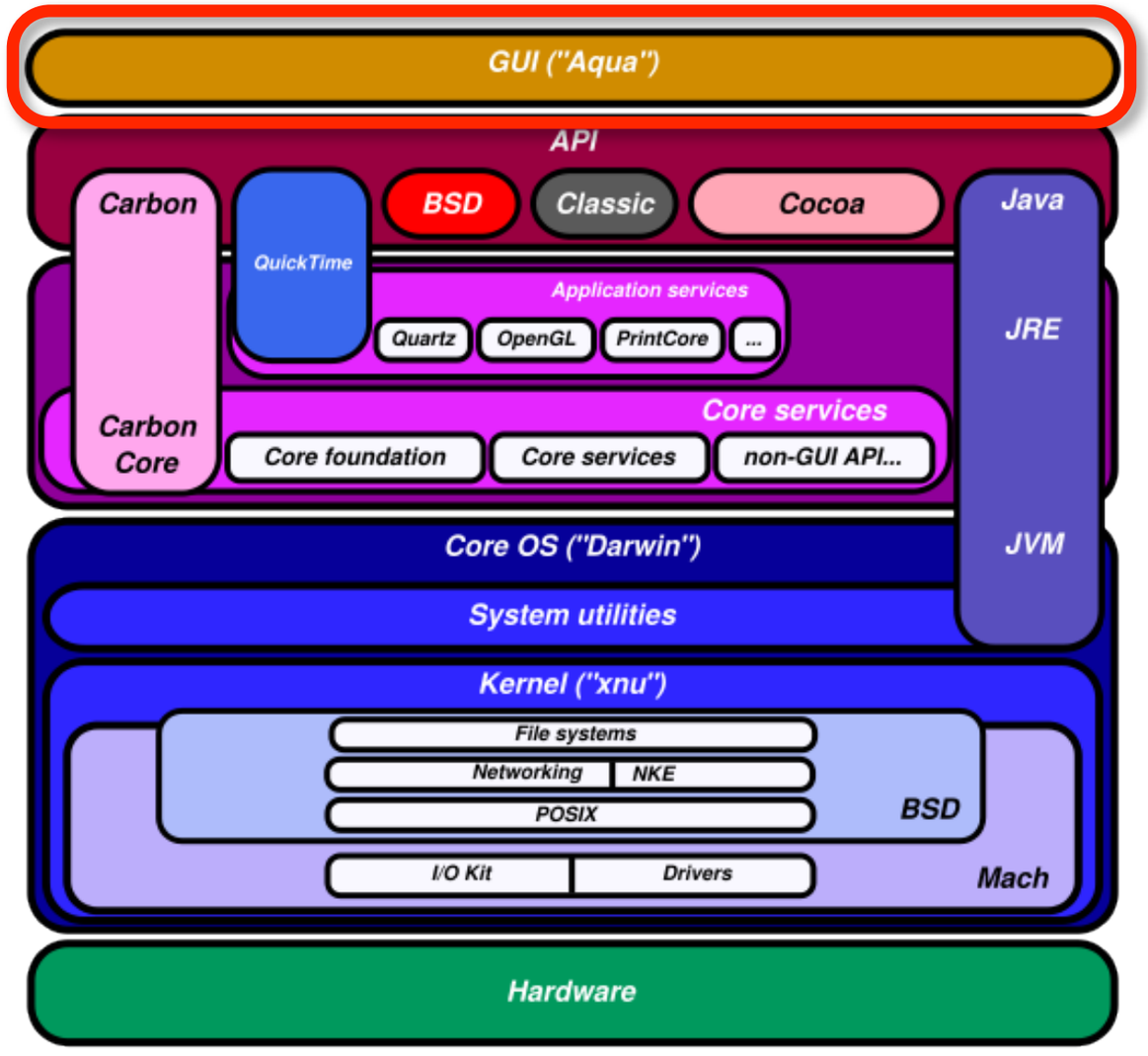


.adaptability for





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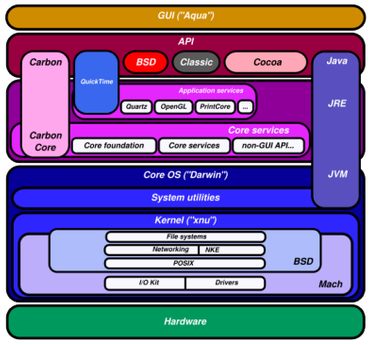

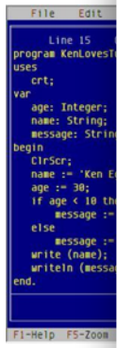

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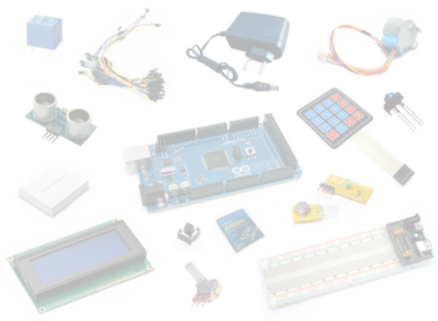
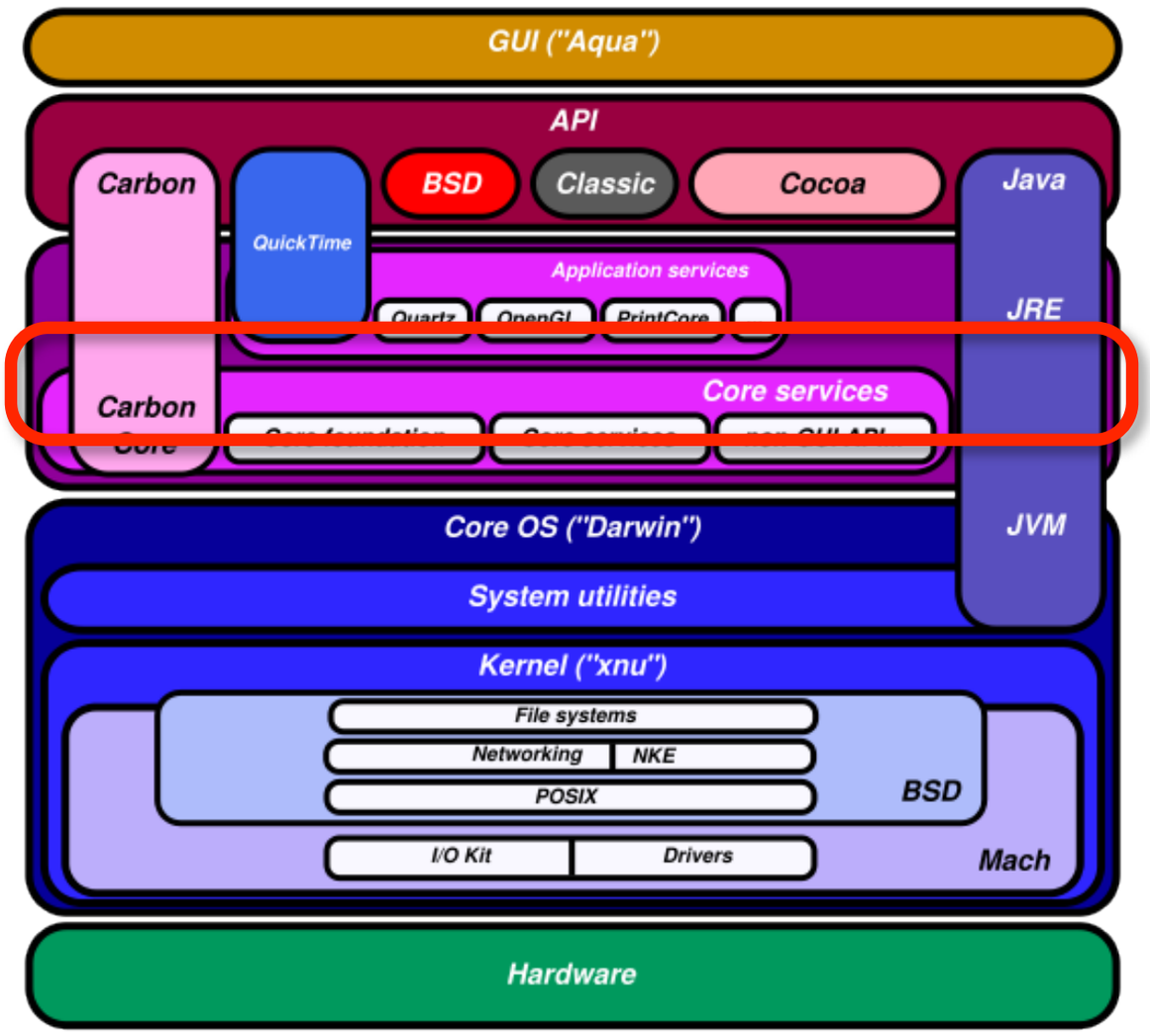


.adaptability for



[Metisse - Chapuis & Roussel, UIST'05]

.low-level language/libraries

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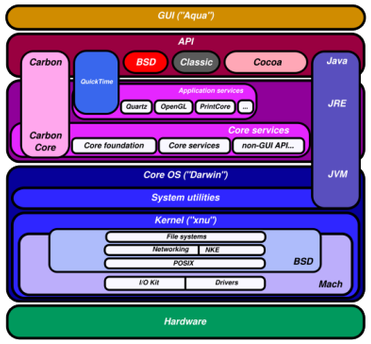

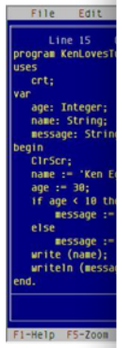

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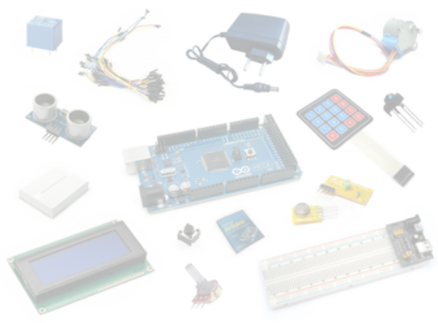
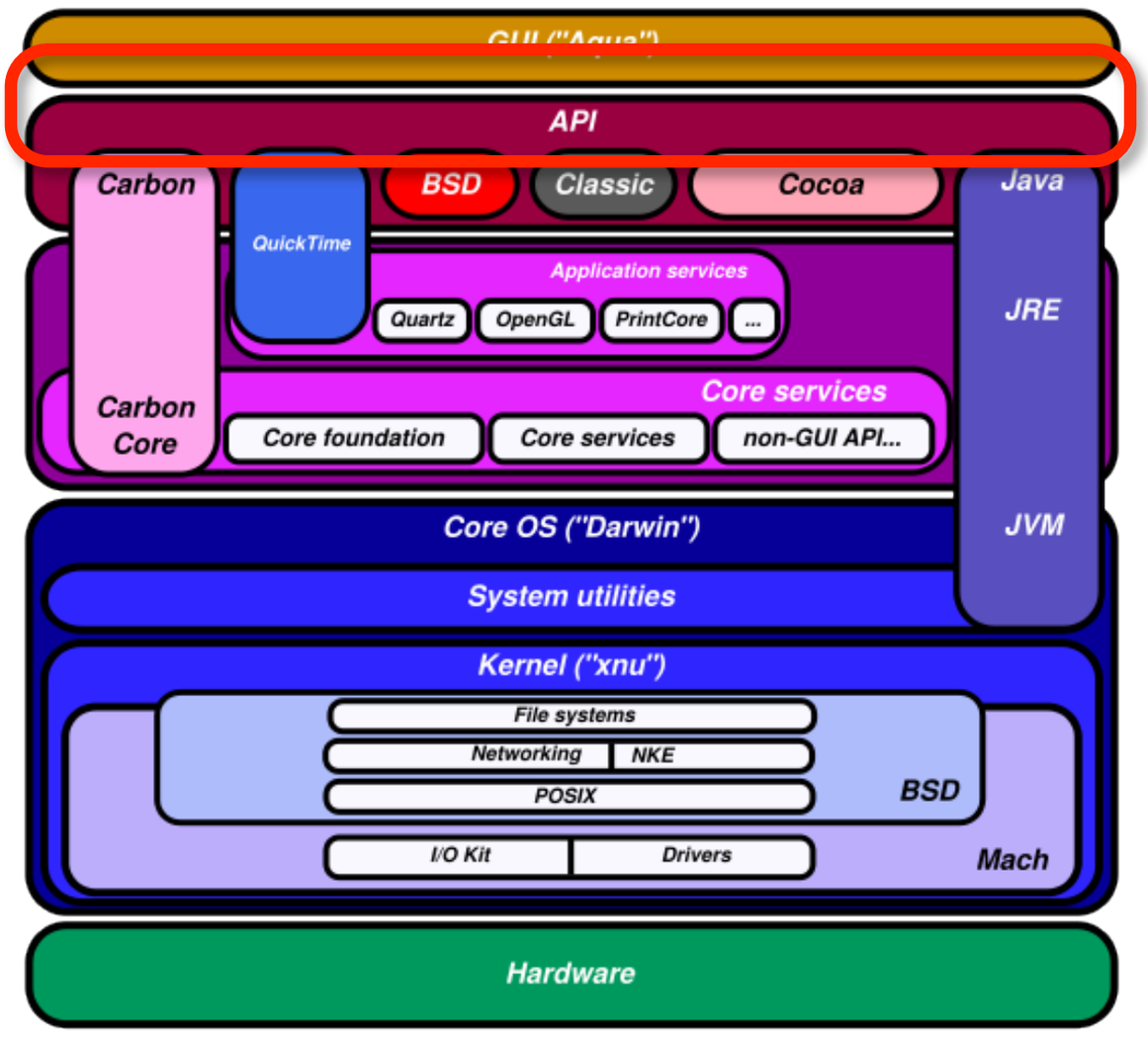
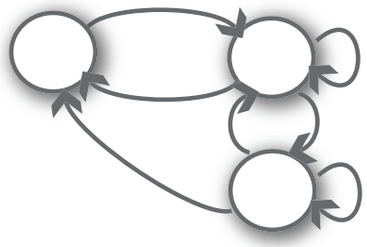


.adaptability for





[SwingStates]

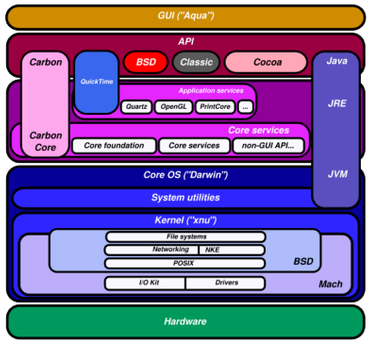
.low-level language/libraries

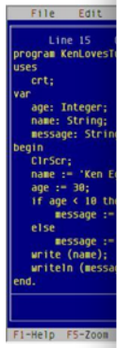
↳ combination and interoperability

unifying the levels

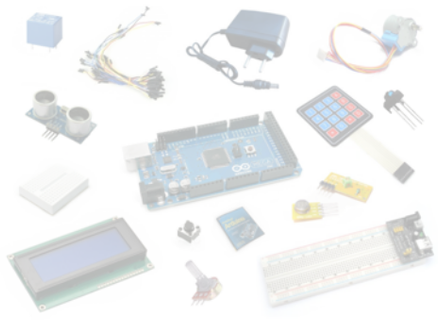
system & programming languages

.system and prog

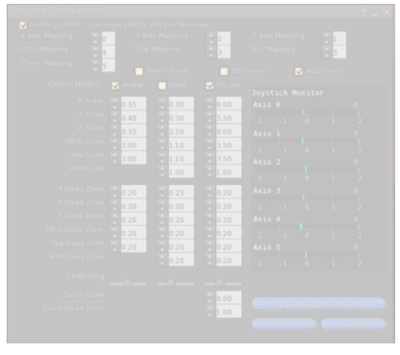


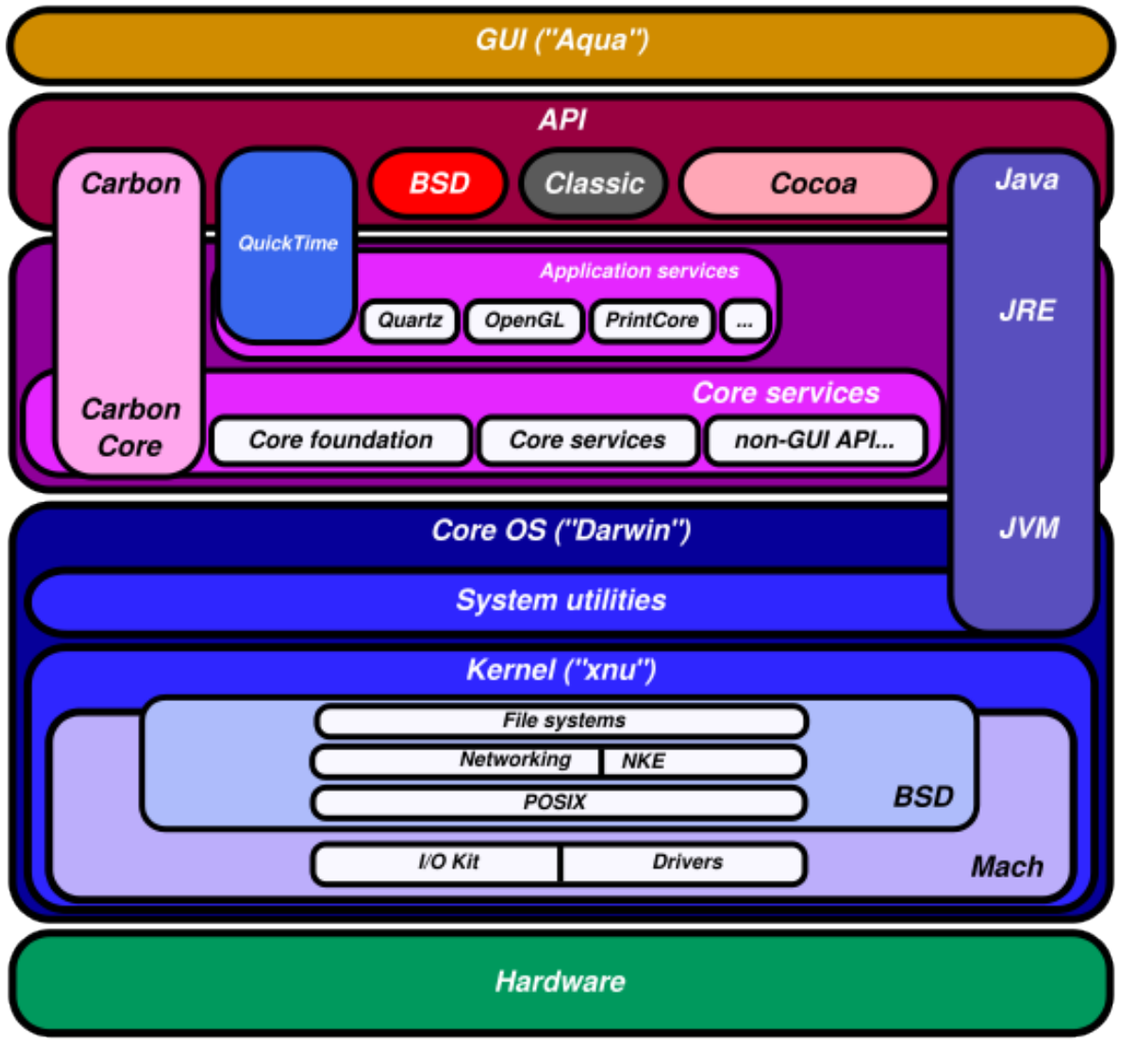


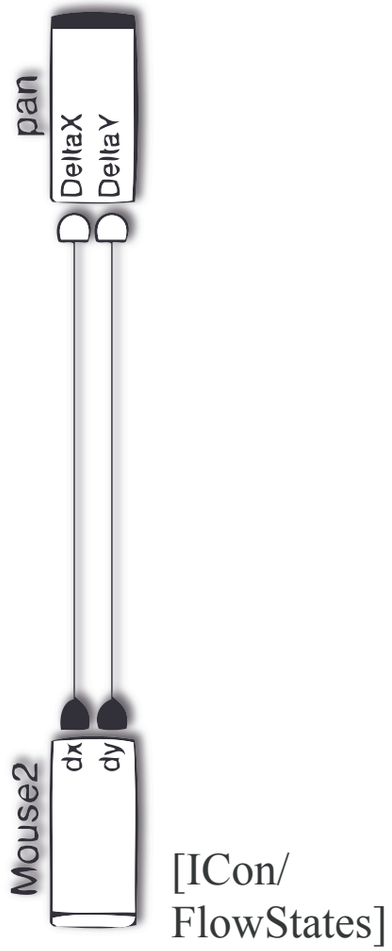
.creative prototy



.adaptability for







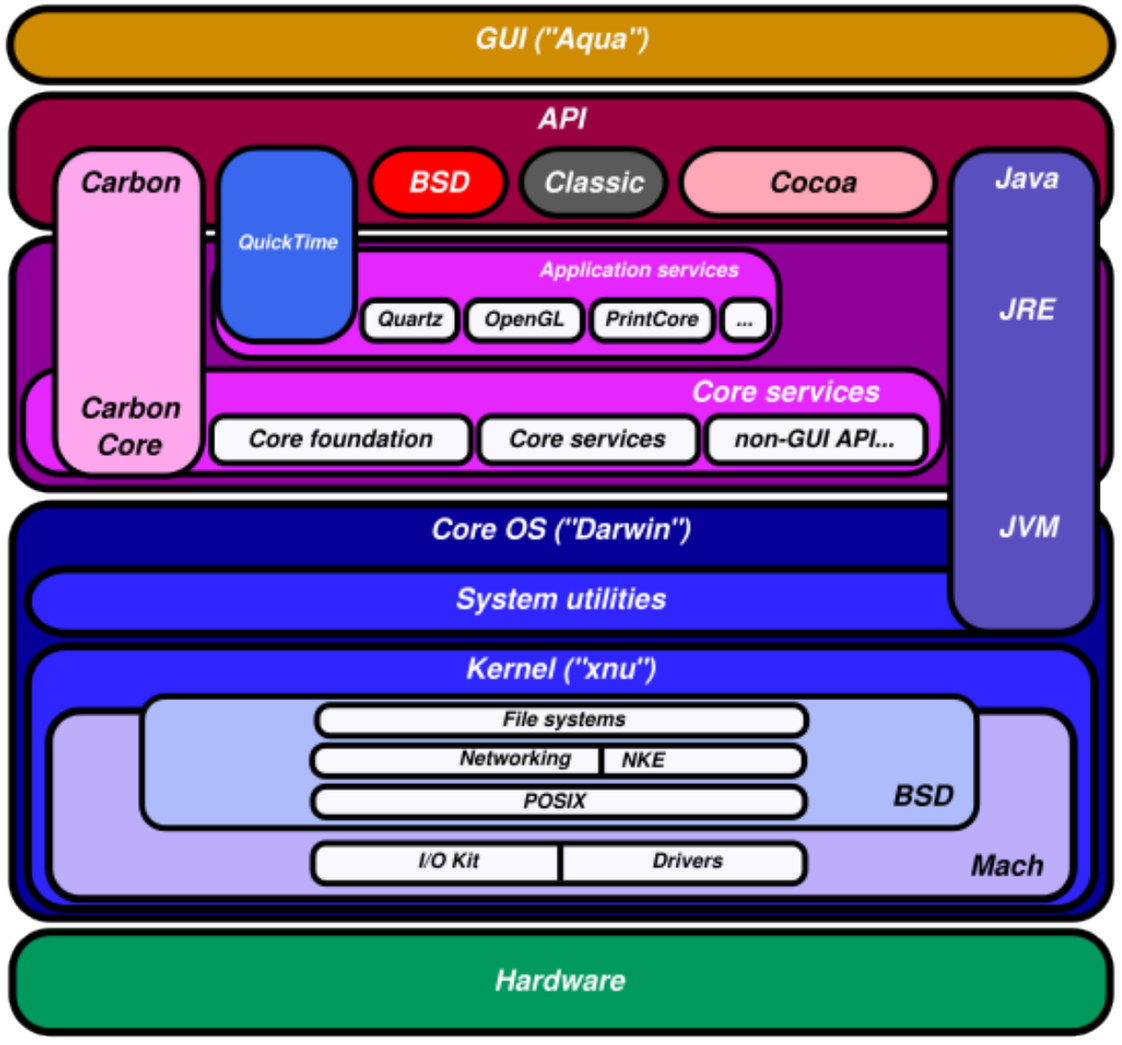
[ICon/ FlowStates]

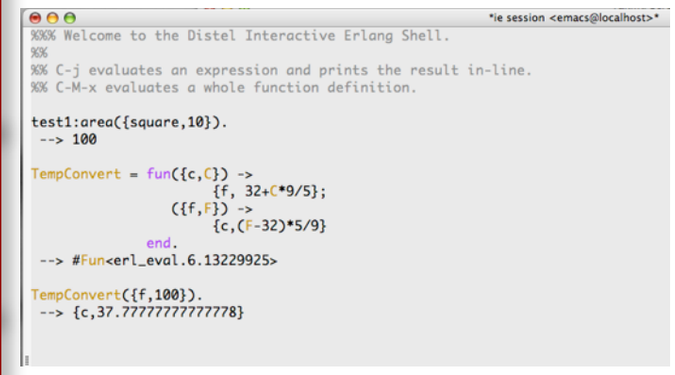
.low-level language/libraries

↳ combination and interoperability

unifying the levels

system & programming languages





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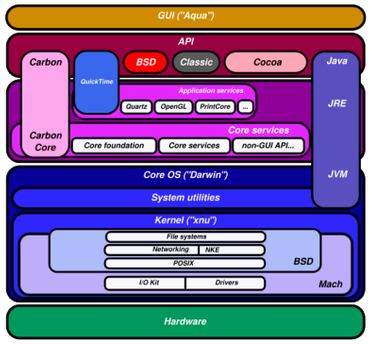

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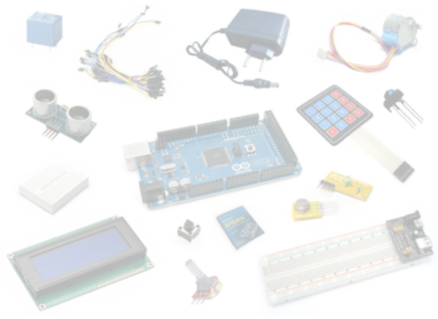

.adaptability for

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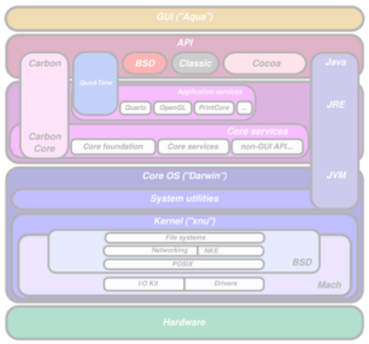
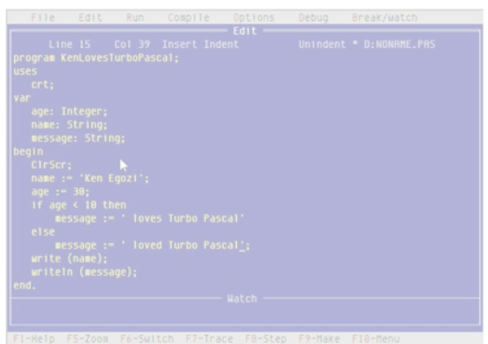
perspectives: tools for designeering interaction

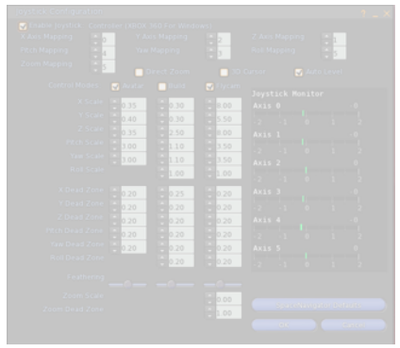
.system and programming languages

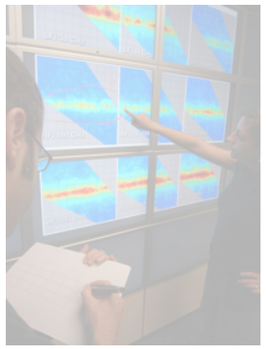




.creative prototyping: sketching interaction, not interfaces

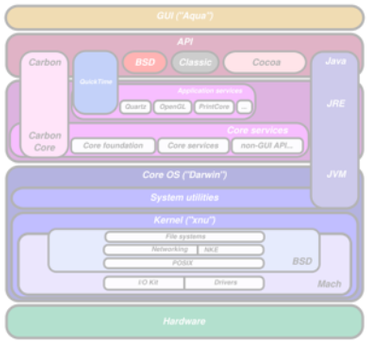
.adaptability for end-users

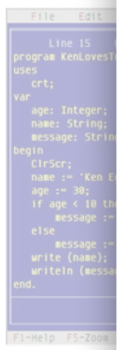




sketching interaction, not interfaces

.system and prog





.creative prototy

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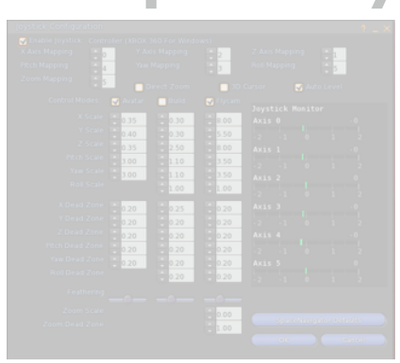
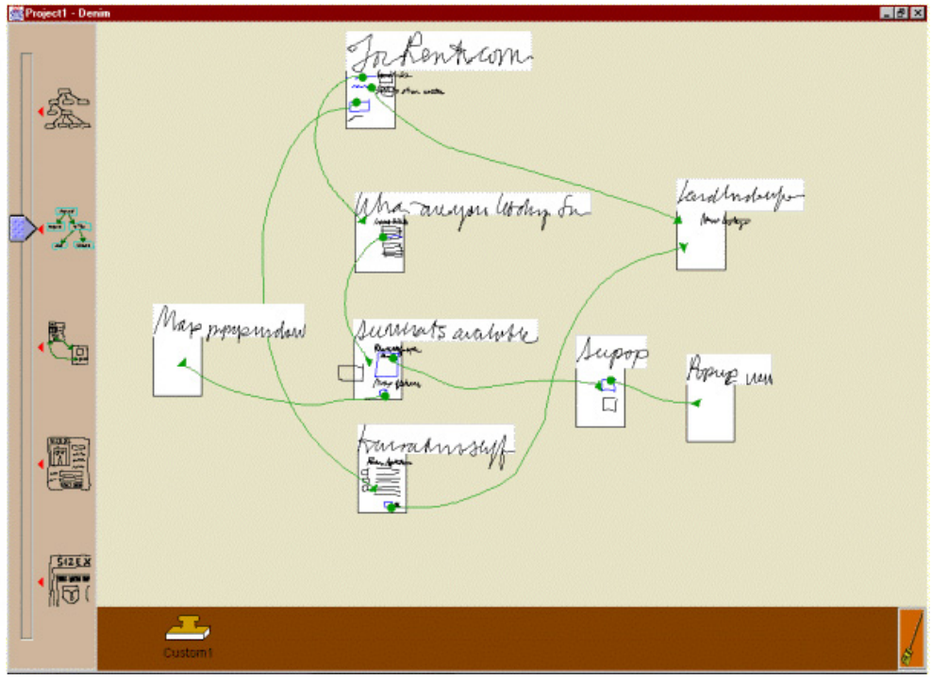


[Apple XCode]



[Denim - Lin et al, CHI'00]

.rapid and iterative design

↳ structural **and logical** combinations unifying the levels of prototyping

sketching interaction, not interfaces

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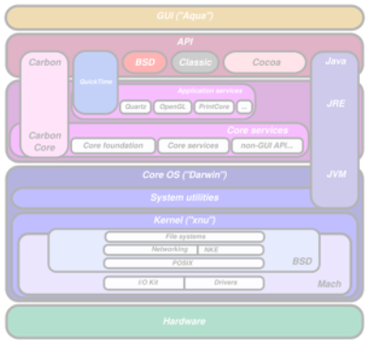
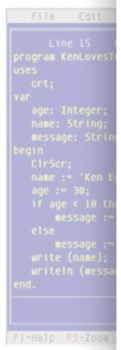
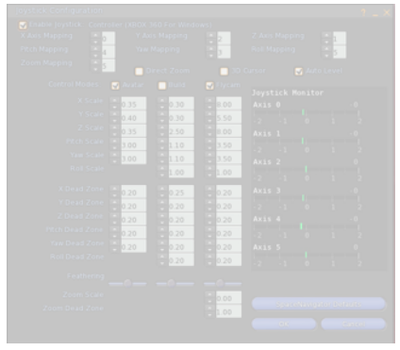
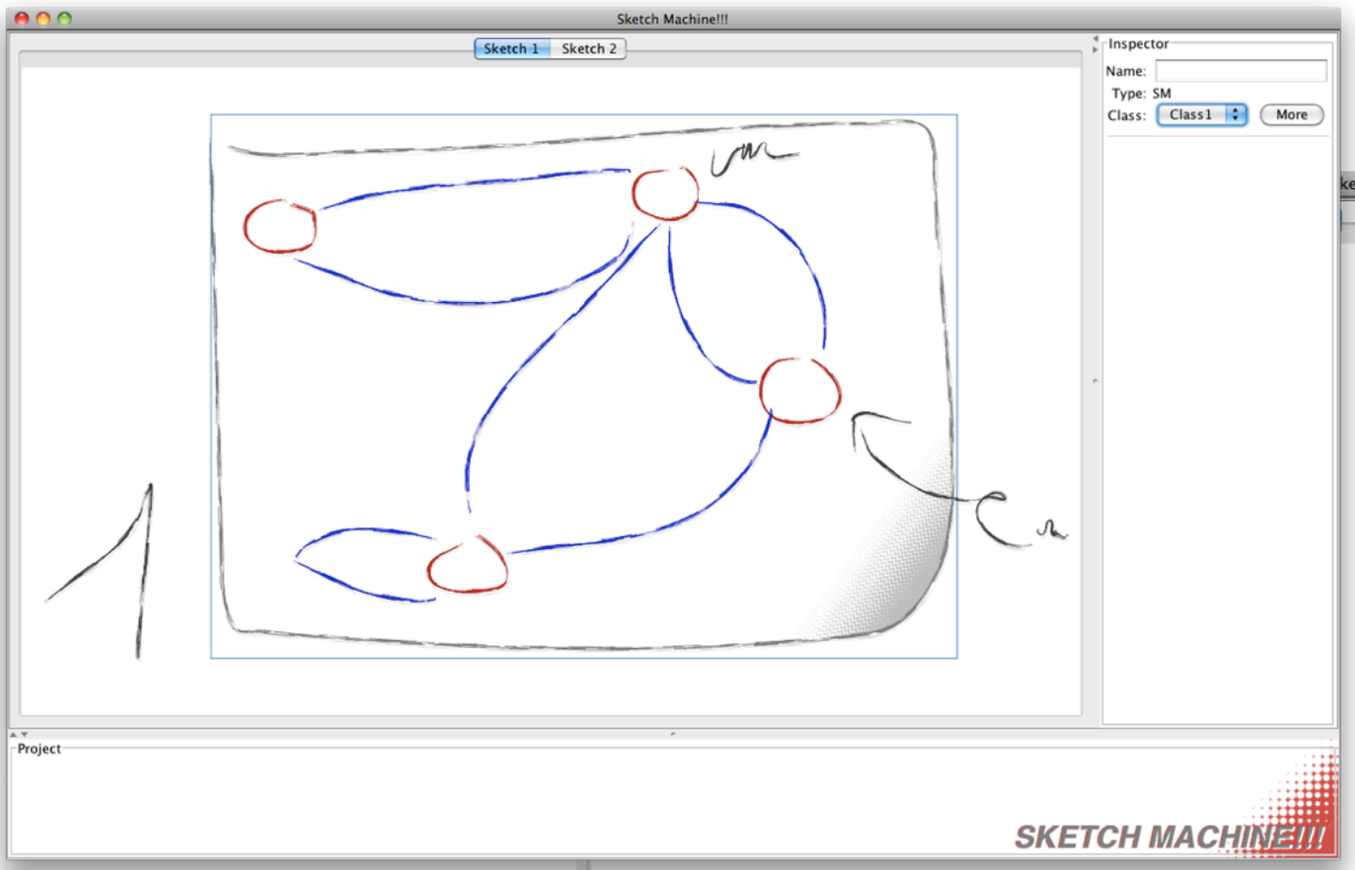


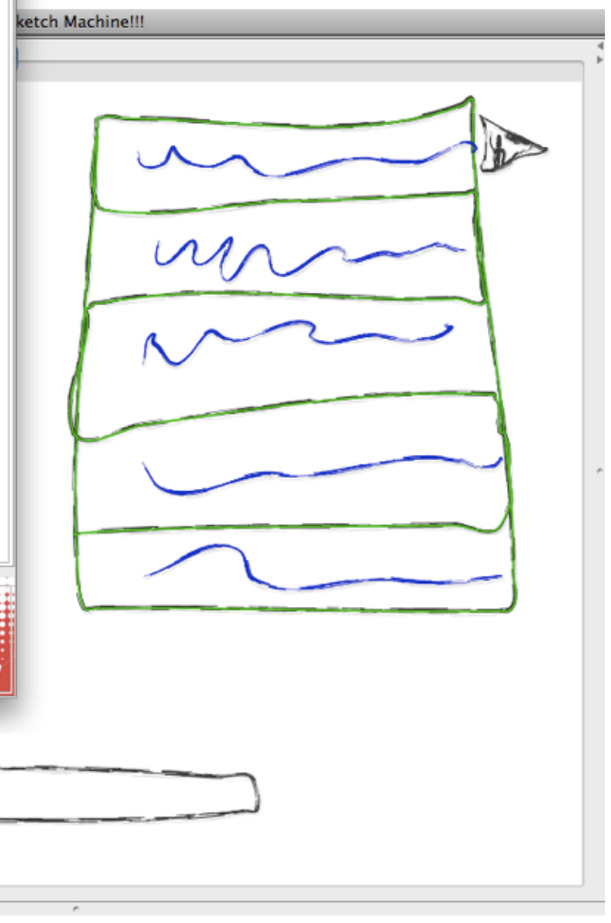


.creative prototy

.adaptability for







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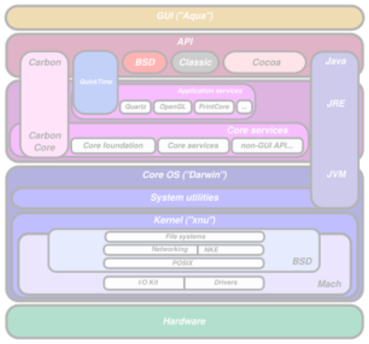

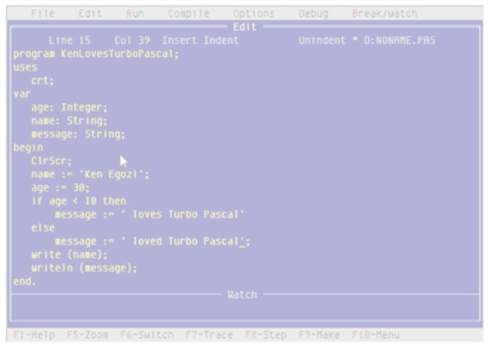

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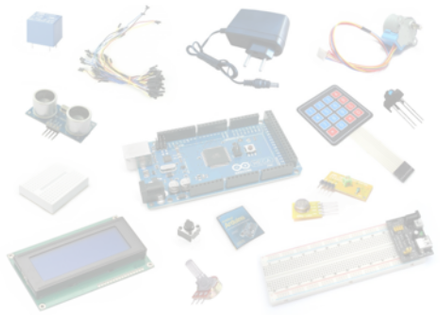
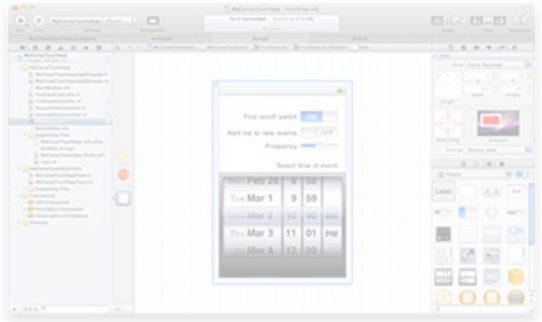
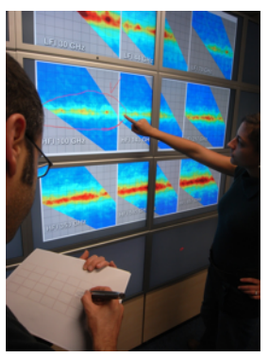


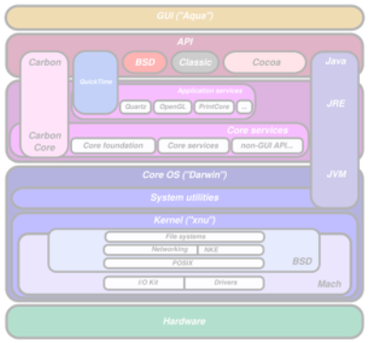


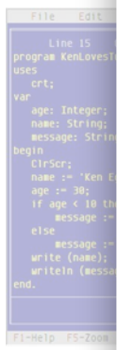
.adaptability for end-users



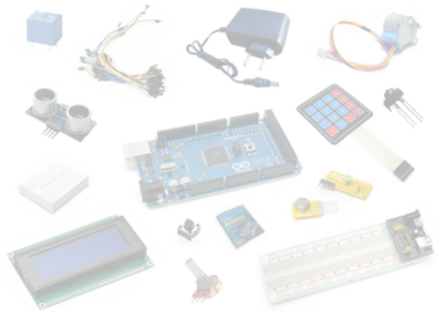
adaptability for end-users

.system and prog





.creative prototy



.adaptability for

.interaction as a first-class object

- ↳ interaction manipulation
- interaction transformation

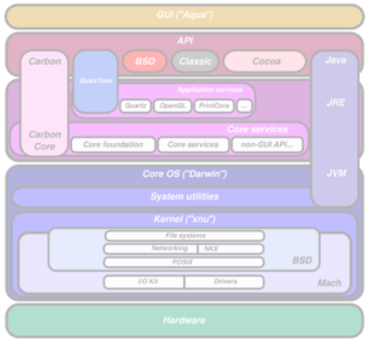
adaptability for end-users

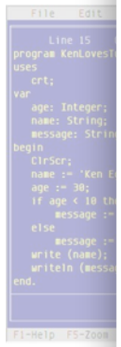
.interaction as a first-class object

↳ interaction manipulation

interaction transformation

.system and prog





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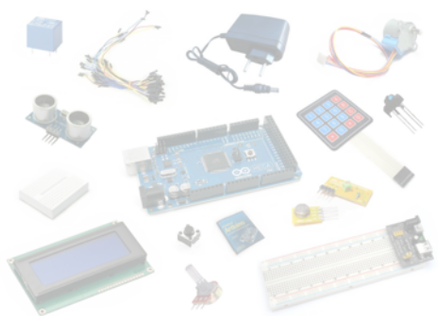

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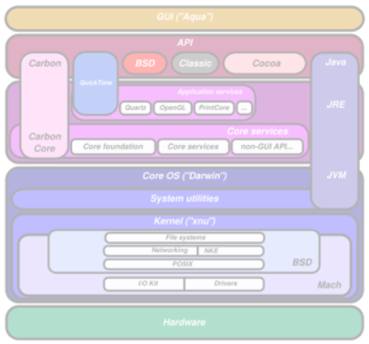
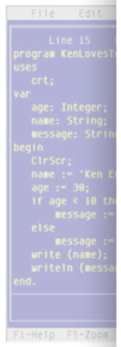
adaptability for end-users





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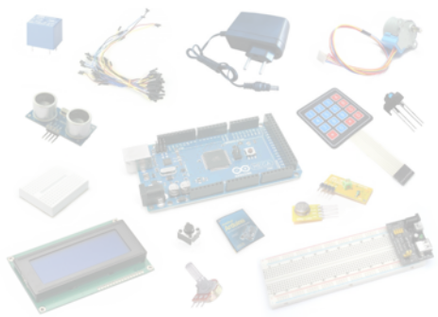

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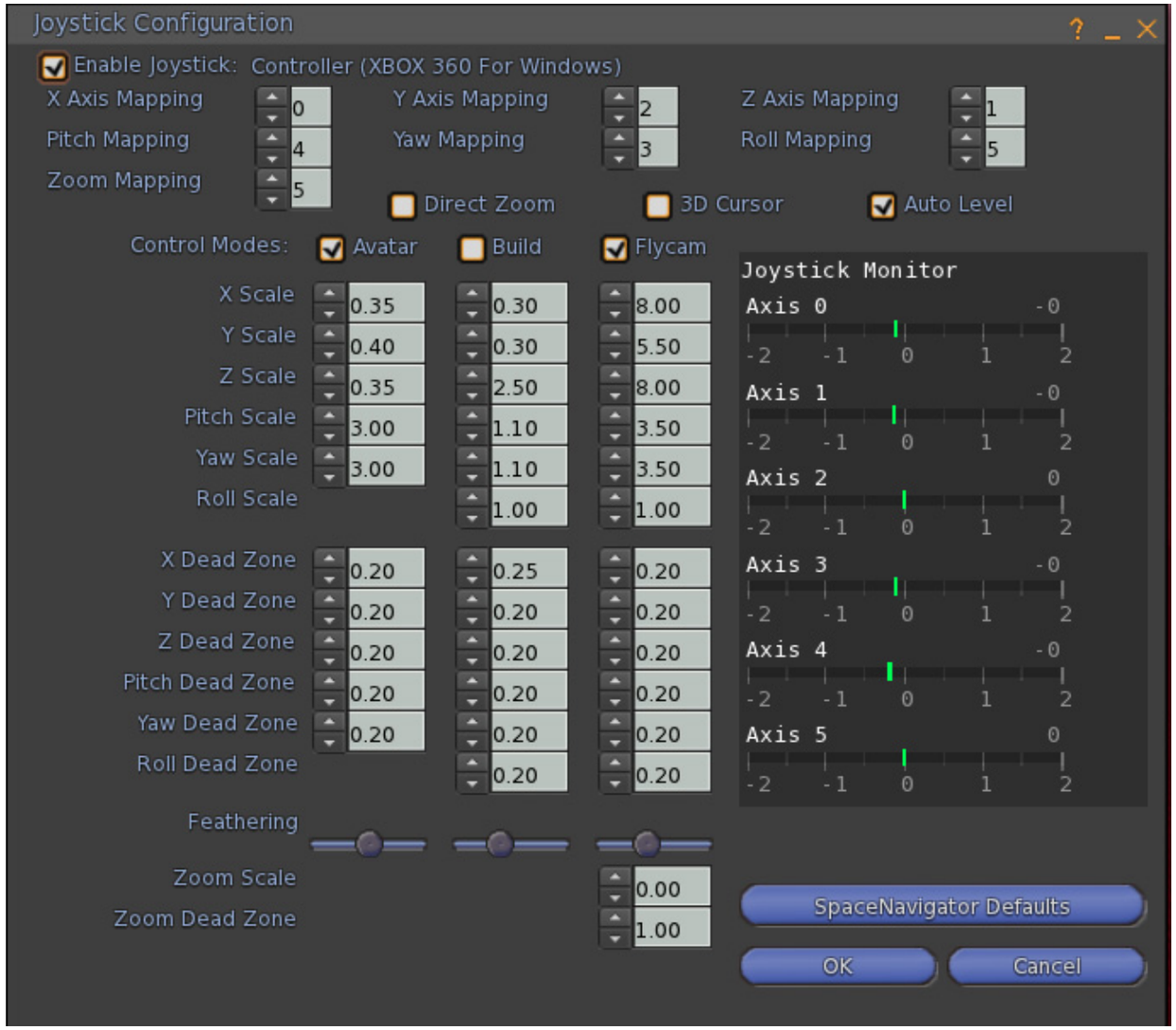

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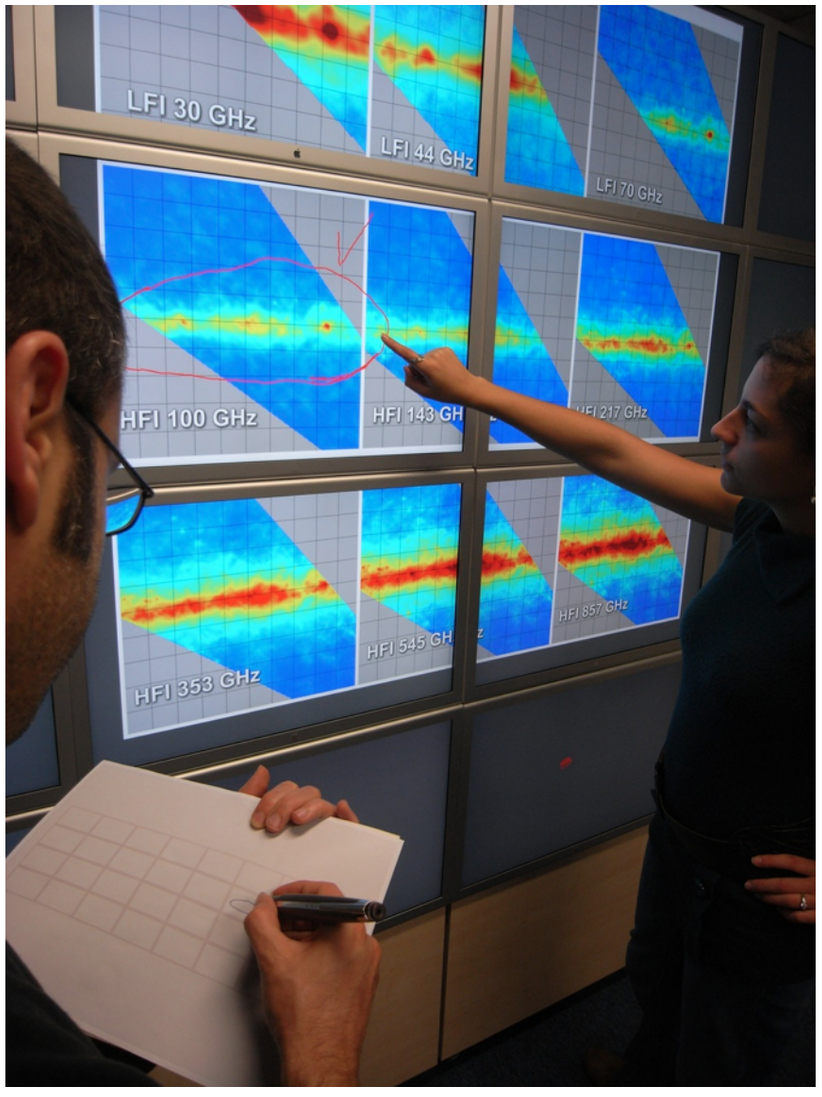

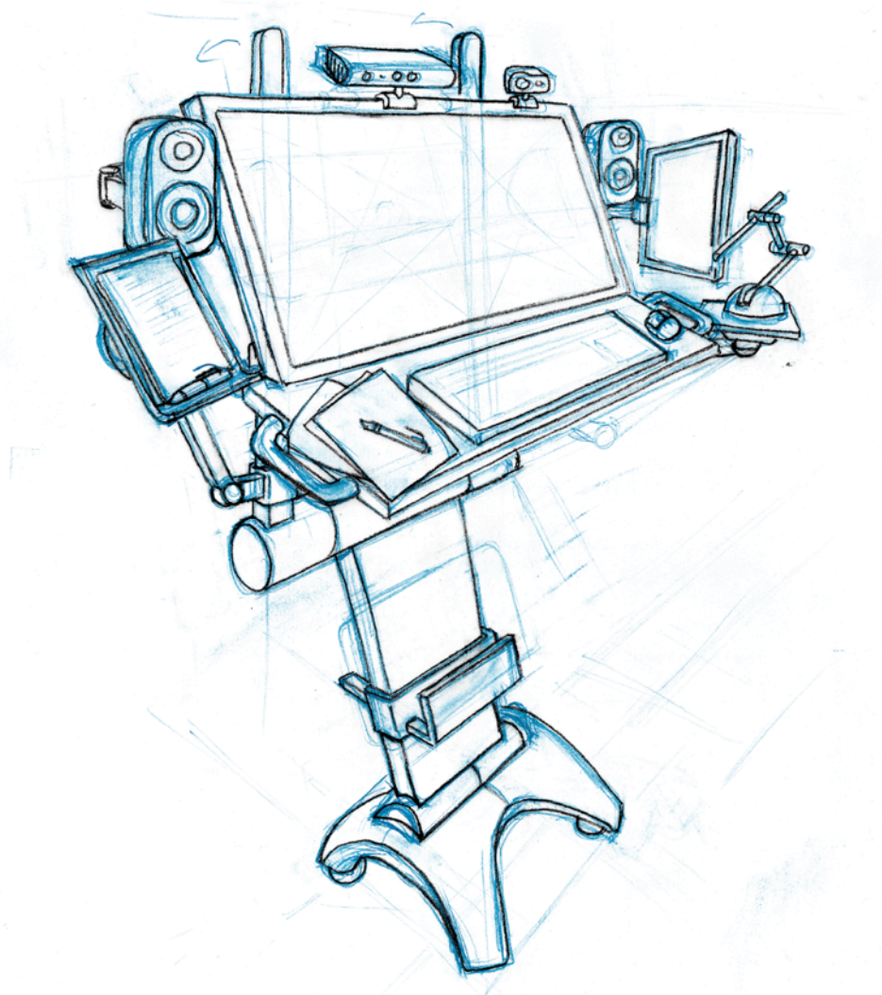

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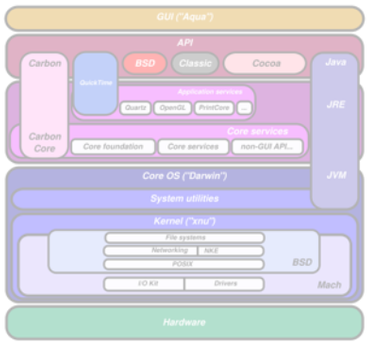

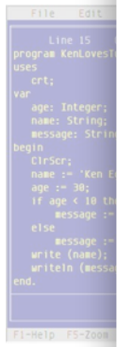

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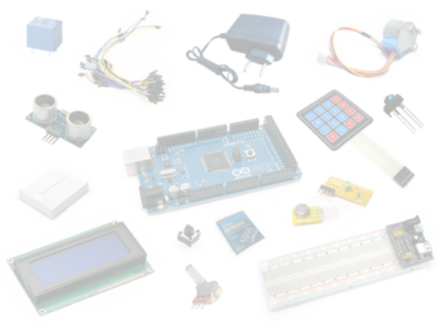

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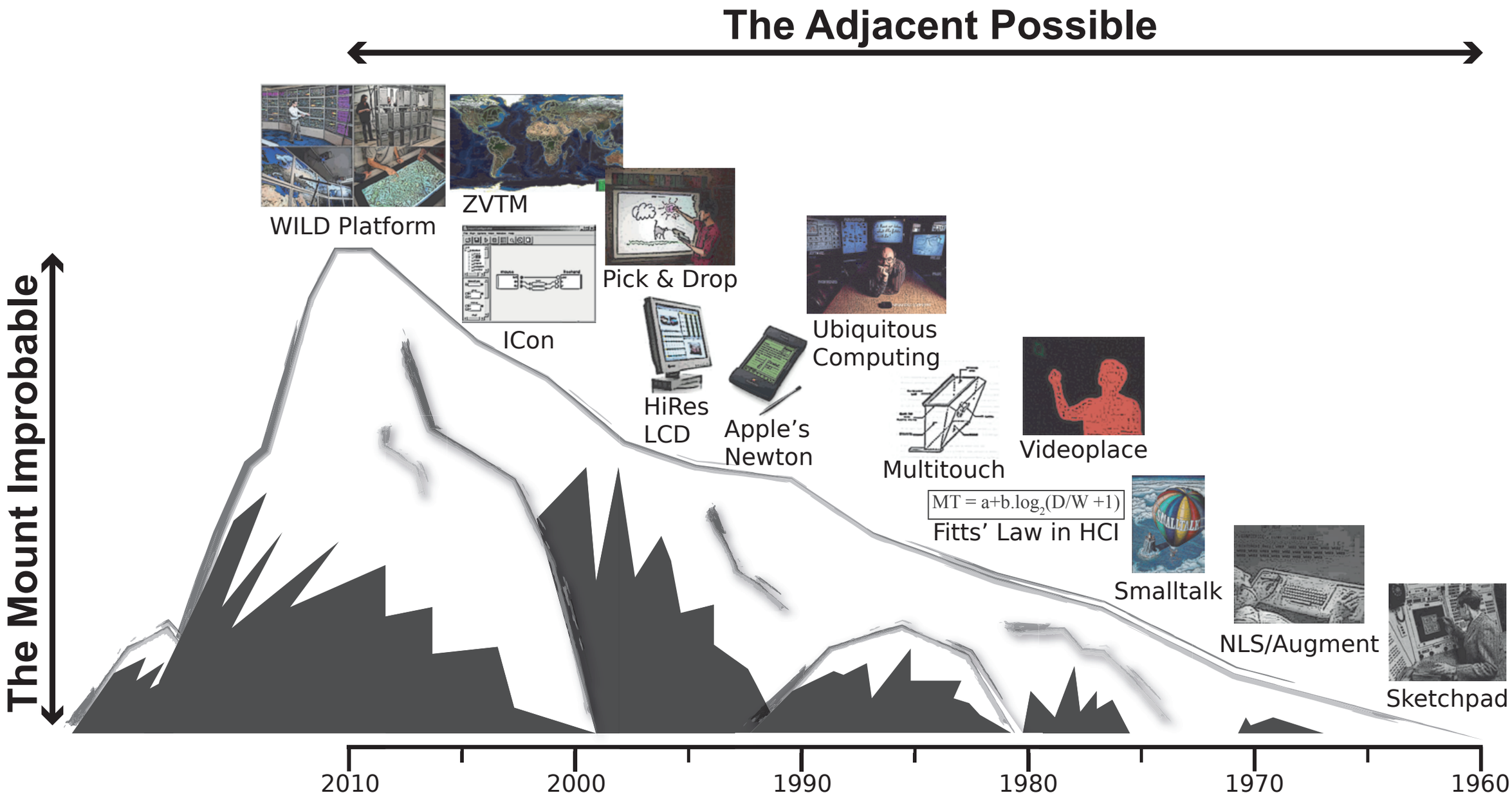
to be continued...



to be continued...

Double-click to edit