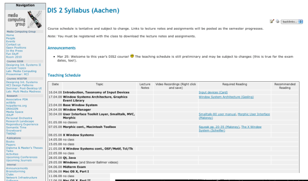
Designing Interactive Systems II

Computer Science Graduate Programme SS 2010

Prof. Dr. Jan Borchers
RWTH Aachen University

http://hci.rwth-aachen.de

Today



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- Current Topics
- Lab: Media Computing
- Proseminar: HCI

Courses WS07/08
- Designing Int. Systems
- HCI Design Patterns
- Seminar: Post-Desktop UI
- Lab: Multi Media Madness

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- hcipatterns.org
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DIS 2 Syllabus (Aachen)

backlinks...

Course schedule is tentative and subject to change. Links to lecture notes and assignments will be posted as the semester progresses.

Note: You must be registered with the class to download the lecture notes and assignments.

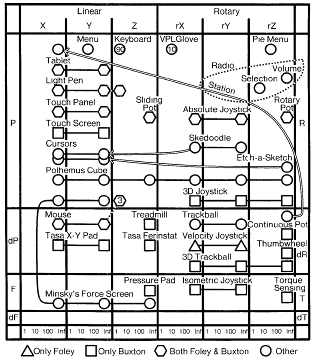
Announcements

- Mar 25: Welcome to this year's DIS2 course! 😎 The teaching schedule is still preliminary and may be subject to changes (this is true for the exam dates, too!).

Teaching Schedule

Date	Topic	Lecture Notes	Video Recordings (Right click and save)	Required Reading	Recommended Reading
16.04.08	**Introduction, Taxonomy of Input Devices**			Input devices (Card)	
17.04.08	**Window Systems Architecture, Graphics Event Library**			Window System Architecture (Gosling)	
23.04.08	**Base Window System**				
24.04.08	**Window Manager**				
30.04.08	**User Interface Toolkit Layer, Smalltalk, MVC, Morphic**			Smalltalk-80 user manual, Morphic User Interface (Maloney)	
01.05.08	no classes				
07.05.08	**Morphic cont., Macintosh Toolbox**			Squeak pp. 20-35 (Maloney), The X Window System (Scheifler)	
08.05.08	**X Window Systems**				
14.05.08	no class				
15.05.08	no class				
21.05.08	**X Window Systems cont., OSF/Motif, Tcl/Tk**				
22.05.08	no class				
28.05.08	**Qt, Java**				
29.05.08	**Windows** (and Stever Ballmer videos)				
04.06.08	**Midterm Exam**				
05.06.08	**Mac OS X, Part I**				
11.06.08	no class				
12.06.08	**Mac OS X, Part II**				
18.06.08	**Web 2.0**				
19.06.08	**subArctic, ARToolkit**				
25.06.08	**MAX/MSP**				
26.06.08	**Interactive Multimedia: Audic**				
02.07.08	**Interactive Multimedia: Audic Input**				
03.07.08	**Interactive Multimedia: Displ and Output**				
09.07.08	**Symbian, Haptics**				
10.07.08	**Looking Forward** & Course Eva				
16.07.08	**Final Project Presentations**				
17.07.08	**Final Exam**				

- Class syllabus
- About our group
- Device technology



Administrivia

- New format: V3/Ü2
- Lecture: Wednesday, 9:00–12:00
- Lab: Monday, 15:30–17:00
- 6 credit points (8 with additional work if needed)
- Final grade:
  - 20% weekly assignments   25% midterm exam
  - 20% final project   35% final exam
- Requires MPO 2010
- Lecture recordings on iTunes U

RWTH Aachen University is one of Europe's leading technology institutions renowned for its high standards in education and research. Its high-level academic approach to teaching focuses on acquiring expert knowledge in the basic sciences, complemented by application-oriented education and training.

Students, in particular in Engineering, benefit from engagement in research, applying and developing their knowledge in existing projects undertaken by research groups, thus gaining excellent professional competence.

As a result, RWTH Aachen University is ranked consistently as one of Germany's top institutions, and our graduates are highly sought after in industry and academia. International surveys underline the reputation of our graduates to be able to tackle highly complex challenges, work successfully in problem-solving teams, and display leadership qualities.

LINKS
- RWTH Aachen University
- RWTH Aachen University - Faculties
- International Researchers
- Prospective Students

ABOUT RWTH

RWTH transparent
Zuletzt geändert: 12. Jan 2009
Tracks insgesamt: 8

Events
Zuletzt geändert: 11. Jan 2009
Tracks insgesamt: 9

FACULTIES & COURSES

Architecture
Zuletzt geändert: 11. Jan 2009
Tracks insgesamt: 17

Civil Engineering
Zuletzt geändert: 12. Jan 2009
Tracks insgesamt: 8

Computer Science
Zuletzt geändert: 12. Jan 2009
Tracks insgesamt: 80

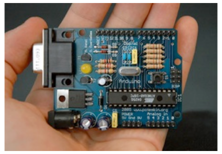
Medicine
Zuletzt geändert: 12. Jan 2009
Tracks insgesamt: 88

DIS II Topics: The 1-Page Overview

- Central question:
  How do interactive systems work?
- Device technology
- Window systems
  - Own, existing
- Mobile and Physical Computing
- Interactive Web & Multimedia Systems
- Lab: From X to Mac OS X, Prototyping Environments

The Syllabus In Detail

- What makes a UI tick?
- Technical concepts, software paradigms and technologies behind HCI and user interface development
- Part I: Key concepts of UI systems
  - Window System Architecture Model
- Part II: Comparing seminal window systems
  - Mac, X11, AWT/Swing, Windows, NeXT/OS X, iPhoneOS,…
  - Paradigms & problems, designing future UI systems
  - Overview of UI prototyping tools



The Syllabus In Detail

- Part III: UIs Beyond The Desktop
  - Think beyond today's GUI desktop metaphor
  - UIs for Mobile, Haptics, Physical Computing, Ubicomp, Multimedia
- The Lab
  - Part I: Implementing Simple Reference Window System
  - Part II: Development using several existing GUI toolkits (such as Java/Swing, Interface Builder)
  - Part III: Working with iPhone, Quartz Composer, Arduino, etc.

Lab

- Register for the class in CAMPUS
- Join the L2P class room
- Register as iPhone Developer
  - developer.apple.com/iPhone
- lab sessions on Mondays

DIS 2 Team @ media computing group

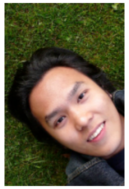
- Prof. Dr. Jan Borchers
  - B.Sc. & M.Sc. CS, U Karlsruhe & U London
  - Ph.D. CS, U Linz, U Ulm & TU Darmstadt
  - Assist. Prof. at Stanford & ETH Zurich
  - Full Prof. of CS, RWTH Aachen Univ.
  - Research area:
    Interaction Design for New Media

DIS 2 Team @ media computing group

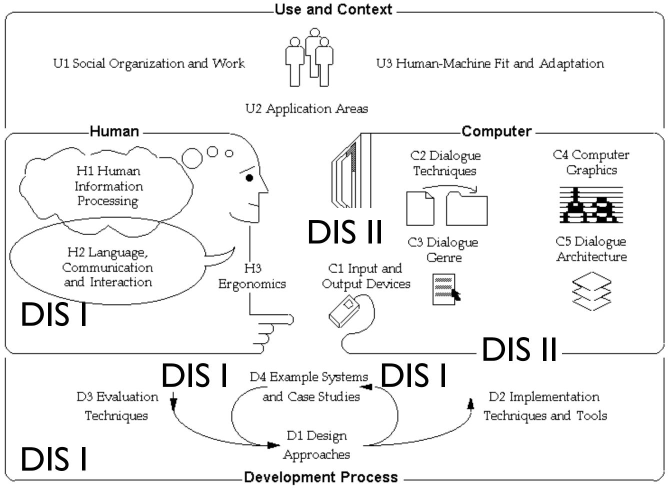
- Dipl.-Inform. Moritz Wittenhagen
  - Diplom, RWTH Aachen
  - Video Navigation
  - wittenhagen@cs.rwth-aachen.de

- Dipl.-Inform. Florian Heller
  - Diplom, RWTH Aachen
  - Virtual Audio Spaces
  - flo@cs.rwth-aachen.de

- Chatchavan Wacharamanotham, M.Sc.
  - M.Sc., RWTH Aachen
  - Collaboration in meeting, HCI for seniors
  - chat@cs.rwth-aachen.de



How DIS I and DIS II Cover HCI



ACM SIGCHI 1992

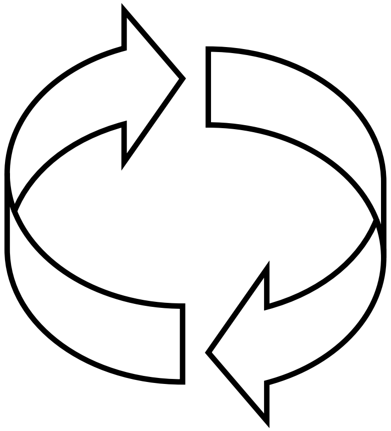
Some Core Aspects of DIS I Reviewed

- The question developers should be asking (but often forget):
  Not HOW, but WHAT to Design
- Technical viewpoint:
  "How do I build this?"
  - Easy to focus on for us CS folks
  - Important, but do not overlook…:
- User's viewpoint:
  "What does it do for me?"
  - An excellent system that nobody needs is useless!

Approach: Iterative Design—the DIA Cycle

Design

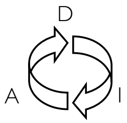
Forget the
waterfall
model !



Analyze/
Test/
Evaluate

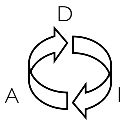
Prototype/
Implement

Prototyping & Testing



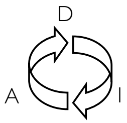
- D: Brainstorm/develop initial project idea
- I: Sketch scenario/storyboard of idea at work
- A: Ask real people (≠ students) about it
  - interviews, questionnaire
- D: Rework your feature set & user experience
- I: Paper prototype (crude for a reason)
  - Scenario, Storyboard, Post-It Prototype, …
- A: Have users use it to accomplish something

Prototyping & Testing



- D: Refine your feature set and user experience
  - Improve information and interaction design
- I: Interactive prototype
  - Director, Java, Visual Basic, ...
  - to throw away or keep
  - Limiting features: Vertical, horizontal, storyboard
- A: Have users "use" it to accomplish a goal
  - Intro, atmosphere, tasks, observation, interview, note-taking,...

Prototyping & Testing

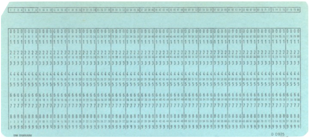


- Look for Style Guides for your development environment
  - Macintosh HI Guidelines, CUA, Motif Style Guide,…
- Check your system against "Golden Rules of Interface Design"
  - E.g., Ben Shneiderman: Designing the User Interface
  - Simple, Consistent, Language, Feedback, Errors, Exits, Memory, Help, Shortcuts,...

A Brief History of User Interfaces

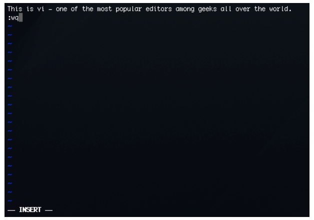
(Done in DIS I to understand the new interaction metaphors, reviewed here to understand the new programming paradigms)

- Batch-processing
  - No interactive capabilities
  - All user input specified in advance (punch cards, ...)
  - All system output collected at end of program run (printouts, ...)
  - → Applications have no user interface component distinguishable from File I/O
  - Job Control Languages (example: IBM3090–JCL, anyone?): specify job and parameters



A Brief History of User Interfaces

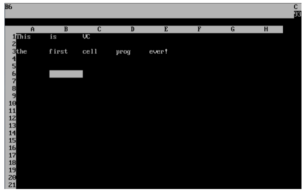
- Command-Line Systems
  - Command-line based interaction with simple terminal
  - Shorter turnaround (per-line), but similar program structure
  - → Applications read arguments from the command line, return results
  - Example: still visible in Unix commands
- Full-screen textual interfaces
  - Shorter turnaround (per-character)
  - Interaction starts to feel "real-time" (e.g. vi)
  - → Applications receive UI input and react immediately in main "loop" (threading becomes important)



```
This is vi - one of the most popular editors among geeks all over the world.
:wq
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
-- INSERT --
```

A Brief History of User Interfaces

- Menu-based systems
  - Discover "Read & Select" over "Memorize & Type" advantage
  - Still text-based!
  - Example: VisiCalc
  - → Applications have explicit UI component
  - But: choices are limited to a particular menu item at a time (hierarchical selection)
  - → Application still "in control"

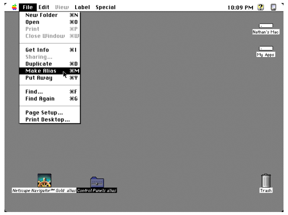


```
B6                                                              C
                                                               93

      A       B       C       D       E       F       G       H
 1This    is      VC
 2
 3the     first   cell    prog    ever!
 4
 5
 6
 7
 8
 9
10
11
12
13
14
15
16
17
18
19
20
21
```

A Brief History of User Interfaces

- Graphical User Interface Systems
  - From character generator to bitmap display (Alto/Star/Lisa..)
  - Pointing devices in addition to keyboard
  - → Event-based program structure
    - Most dramatic paradigm shift for application development
    - User is "in control"
    - Application only reacts to user (or system) events
    - Callback paradigm
  - Event handling
    - Initially application-explicit
    - Later system-implicit



Design Space of Input Devices

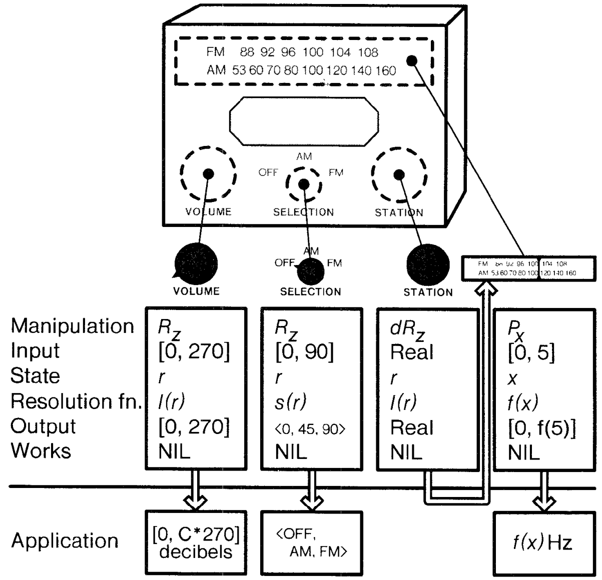
- Card, Mackinlay, Robertson 1991
- Goal: Understand input device design space
  - Insight in space, grouping, performance reasoning, new design ideas
- Idea: Characterize input devices according to physical/ mechanical/spatial properties
- Morphological approach
  - device designs = points in parameterized design space
  - combine primitive moves and composition operators

Primitive Movements

- Input device maps physical world to application logic
- Input device ≔ <M, In, S, R, Out, W>
  - Manipulation operator
  - Input domain
  - Device State
  - Resolution function In->Out
  - Output domain
  - Additional work properties

P, dP	R, dR
F, dF	T, dT

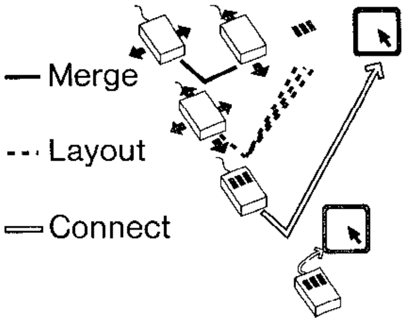
Radio Example



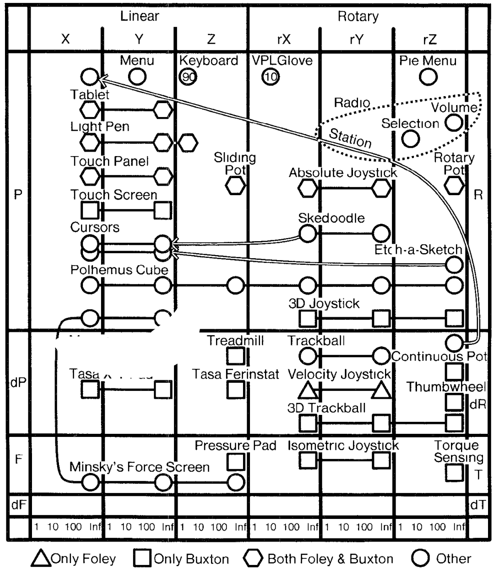
Manipulation	R_z	R_z	dR_z	P_x
Input	[0, 270]	[0, 90]	Real	[0, 5]
State	*r*	*r*	*r*	*x*
Resolution fn.	*I(r)*	*s(r)*	*I(r)*	*f(x)*
Output	[0, 270]	<0, 45, 90>	Real	[0, f(5)]
Works	NIL	NIL	NIL	NIL
Application	[0, C*270] decibels	<OFF, AM, FM>		*f(x)* Hz

Composition

- Merge
  - Result = Cartesian product
  - E.g., mouse coordinates: X⊕Y = {(x, y)}
- Layout
  - Spatial collocation
  - E.g., mouse (x, y) & buttons
  - How different from merge?
- Connect
  - Chaining
  - E.g., mouse output & cursor
  - Virtual devices



Design Space (excerpt)



Complete space ≔ {all possible combinations of primitives and composition operators}

Mouse = one point!

In-Class Group Exercise: SpaceBall

- Place the SpaceBall into the design space
  - Ball mounted on a plate with 12 buttons
  - Detects precise amount of pushing and twisting in all directions without moving
  - Auto-zeroes physically

Is This Space Complete?

- No – it focuses on mechanical movement
  - Voice
  - Other senses (touch, smell, ...)
- But: Already proposes new devices
  - Put circles into the diagram and connect them

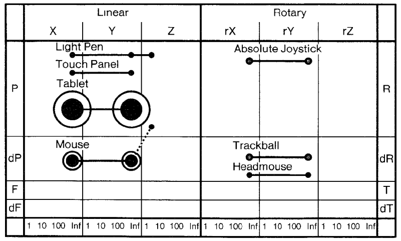
Testing Points

- Evaluate mappings according to
  - Expressiveness (conveys meaning exactly)
  - Effectiveness (felicity)
- Visual displays easily express unintended meanings
- For input devices, expressiveness suffers if $|In| \neq |Out|$
  - $|In| < |Out|$: Cannot specify all legal values
  - $|In| > |Out|$: Can specify illegal values

Effectiveness

- How well can the intention be communicated?
- Various figures of merit possible
  - Performance-related
    - Device bandwidth (influences time to select target, ergonomics and cognitive load)
    - Precision
    - Error (% missed, final distance, statistical derivatives)
    - Learning time
    - Mounting / grasping time
  - Pragmatic
    - Device footprint, subjective preferences, cost,...

Example: Device Footprint



- Circle size ≔ device footprint
  - Black: with 12" monitor
  - White: with 19" monitor
- What do we see?
  - Tablet, mouse expensive
  - Worse with larger displays
- But:
  - Mouse Acceleration alleviates this (model of C:D ratio?)
  - Higher resolution mice

Assignments

- Register in CAMPUS by Monday 12:00
- For next class, read:
  - Read Stuart K. Card, Jock D. Mackinlay and George G. Robertson: "A morphological analysis of the design space of input devices", ACM Transactions on Information Systems, **9** (2), 99-122, 1991
  - Read Window System Architecture chapter from Gosling's NeWS book (James Gosling, David S. H. Rosenthal, and Michelle J. Arden, "The NeWS Book", Springer-Verlag, 1989, Chapter 3)
- See the L2P course room for all materials