Current Topics in
Media Computing and HCI

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Media Computing Group
RWTH Aachen University

Summer term 2016

http://hci.rwth-aachen.de/cthci
Goals

• Understand ways to do research in HCI

• Practice how to retrieve and evaluate information from the literature ⇒ Preparation for thesis and future research work

• Learn about up-to-date developments in Human–Computer Interaction and interactive multimedia from new books and recent conference/journal articles
Topics for 2016

- Research literacy (3.5 weeks)
  - Understanding HCI research approaches
  - Experimental research and user study protocol (case study: text entry techniques)
  - Statistics in HCI research (case study: midair input techniques)
  - Publication and peer-review process

- Research topics (7.5 weeks)
  - Interactive Textiles
  - Augmented reality in HCI
  - Personal fabrication and personal design
  - HCI design patterns
  - Interactive museum guide systems
  - Touch and tangibles on large interactive surfaces

Interleaving
Current Topics in Media Computing and HCI

• Audience
  • M.Sc. Computer Science
  • M.Sc. Media Informatics
  • M.Sc. Software Systems Engineering
  • B.Sc. Computer Science (extra credit / carry-over)
  • B.Sc. / M.Sc. Technical Communication (with focus on CS/HCI research)

• Prerequisite: DIS I
  • In our lectures, assignments, and exams we assume that you know DIS I
Literature Sources

• Recent conference papers
  • CHI, UIST, ISS, DIS, Ubicomp,…
• Recent journal articles
  • TOCHI,…
• Older seminal papers
Literature Sources

- Recent books
  - Research Methods in HCI (Lazar et al., 2010)
    - Highly recommended reading for more details about evaluation methods—especially if you are going to do your thesis at our chair!
  - Research Methods for the Behavioral Sciences (Gravetter and Forzano, 2015)
    - Further recommended reading for more details about experimental research methods
Administrative

• Format: 6 ECTS
• Lecture: Tuesday, 10:15–11:45
  • Presentation & discussion of research topics
  • Small group in-class exercises
  • Weekly reading assignments (individual)
• Lab: Wednesday, 14:15–15:45
  • Practice skills learned from the lecture and discuss reading and written assignments
  • 3 written assignments (in groups)
  • 1 mini HCI research project (in groups)

Active attendance in both lecture and lab expected!
Final Grade

• 30% midterm (June 14)
• 15% 3 written assignments
• 10% mini HCI research project
• 45% final (August 2nd or earlier)
• **40 seats** available (but already >50 registrations)
• Register in CAMPUS or email Phil for registration **today**
• Priority will be given based on:
  • Semester
  • Prior involvement with classes at this chair
  • Handing in the declaration of compliance tomorrow in the lab
• You will know if you’re in by tomorrow after the lab
• First assignment in the first lab (tomorrow)
<table>
<thead>
<tr>
<th>Lecture date</th>
<th>Lecture topic</th>
<th>Lecture presenter</th>
<th>Lab date</th>
<th>Lab topic</th>
<th>Lab moderator</th>
<th>Written assignment</th>
<th>Assignment logistics</th>
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<tr>
<td>12/04/16</td>
<td>(no lecture: Orientation)</td>
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<td>13/04/16</td>
<td>(no lab: Orientation)</td>
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<tr>
<td>19/04/16</td>
<td>R1: Three approaches to HCI research</td>
<td>Jan</td>
<td>20/04/16</td>
<td>Paper reading and identifying contribution types</td>
<td>Phil</td>
<td>A01: Categorizing research contributions and writing contribution statements</td>
<td>20/04/16</td>
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<tr>
<td>26/04/16</td>
<td>R2: Mechanics of experimental research and how to write a user study protocol (Case study: Text-entry techniques)</td>
<td>Jan</td>
<td>27/04/16</td>
<td>Literature searching and contributions &amp; benefit statement</td>
<td>Phil</td>
<td>(A01 peer feedback)</td>
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<tr>
<td>03/05/16</td>
<td>(No Lecture: Student Representative Council Meetings)</td>
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<td>04/05/16</td>
<td>Designing experimental user studies</td>
<td>Phil</td>
<td>A02: Reverse-engineering user study protocol</td>
<td>04/05/16 02/05/16 04/05/16</td>
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<tr>
<td>10/05/16</td>
<td>R3: Understanding statistics in HCI research</td>
<td>Krishna</td>
<td>11/05/16</td>
<td>(No Lab: CHI)</td>
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<td>(A02 peer feedback)</td>
<td>11/05/16 10/05/16</td>
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<td>(No Lecture: Excursion Week)</td>
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<td>(No Lab: Excursion Week)</td>
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<tr>
<td>24/05/16</td>
<td>T1: Interactive Textiles</td>
<td>Nur</td>
<td>25/05/16</td>
<td>• A01 discussion • Writing a review for research papers</td>
<td>Phil</td>
<td>A03: Writing reviews for scientific articles</td>
<td>25/05/16 24/05/16</td>
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<td>31/05/16</td>
<td>T2: HCI Research in Augmented Reality</td>
<td>Phi</td>
<td>01/06/16</td>
<td>• A02 discussion</td>
<td>Phil</td>
<td>(A03 peer feedback)</td>
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<tr>
<td>07/06/16</td>
<td>T3: Personal Fabrication</td>
<td>Jan</td>
<td>08/06/16</td>
<td>• Midterm exam preparation lab</td>
<td>Phil</td>
<td>(Midterm exam preparation)</td>
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<td>14/06/16</td>
<td>Midterm: R1–3, T1–3 (30%)</td>
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<td>15/06/16</td>
<td>• Midterm exam discussion (not review)</td>
<td>Phil</td>
<td>A04: Mini HCI research project: ?</td>
<td>15/06/16 14/06/16</td>
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<tr>
<td>21/06/16</td>
<td>R4: Peer-review process in HCI T4-1: Pattern language</td>
<td>Jan</td>
<td>22/06/16</td>
<td>• A03 discussion • Mini project group appointments</td>
<td>Phil</td>
<td>A04 Part 1: Research question</td>
<td>22/06/16 22/06/16</td>
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<td>28/06/16</td>
<td>T4-2: Pattern language • Course evaluation</td>
<td>Jan</td>
<td>29/06/16</td>
<td>(No Lab: RWTH Sports Day)</td>
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<td>A04 Part 2: Experimental protocol</td>
<td>29/06/16</td>
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<td>05/07/16</td>
<td>T5: Interactive Museum Guide Systems</td>
<td>Phi</td>
<td>06/07/16</td>
<td>Mini project group appointments</td>
<td>Phil</td>
<td>(A04 continued)</td>
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<tr>
<td>12/07/16</td>
<td>T6-1: Touch and Tangibles on Large Interactive Surfaces</td>
<td>Simon</td>
<td>13/07/16</td>
<td>Final exam preparation lab</td>
<td>Phil</td>
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<tr>
<td>19/07/16</td>
<td>T6-2: Touch and Tangibles on Large Interactive Surfaces</td>
<td>Christian Ch.</td>
<td>20/07/16</td>
<td>Mini project final presentation</td>
<td>Phil</td>
<td>A04 Report</td>
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Learning Resources

- Public website with all general info: http://hci.rwth-aachen.de/cthci including links to:
  - L²P course room (slides, literature, assignments)
  - Lecture recordings on iTunes U
  - Research papers in the ACM Digital Library
    - Free access from inside RWTH network
CTHCI Team

- Prof. Dr. Jan Borchers
- Philipp Wacker, M.Sc.
  - wacker@cs.rwth-aachen.de (start subject with “[CTHCI]”)
- Additional topic presenters
Plagiarism

The law of similarity captures the idea that elements will be grouped perceptually if they are similar to each other. For instance in the following dialog we tend to divide the given files into two groups:

```
Law of Similarity
The law of similarity states that objects will be grouped perceptually if they are similar to each other. In other words the repetition in the forms persuades the human mind to group it.
```


Cite and quote instead of plagiarizing!
Consequences of Plagiarism in this Class

• Plagiarism will result in an immediate 5.0 for this class.
• Repeated plagiarism will also lead to banning from all other i10 classes.
• Sign the declaration of compliance and hand it in after the lab.
Three Approaches to HCI Research

Test
Empirical science

Look
Ethnography

Make
Engineering and design
Empirical Approach

- Research question
- Observation
- Hypothesis
Initial Observation

- Begin with casual or informal observation
- Usually comes from personal experience that catches your attention or raises questions in your mind
- Example: “Cloth has an affordance of pinching. Could this be useful for interaction design?”
Identify variables and hypothesis that are associated with your observation

**Variables**: characteristics or conditions that change or have different values for different individuals

**Research question**: a statement that describes or explains a relationship between or among variables

- A proposal to be tested

- Example: “For pinching cloth, different areas of the body would differ in preference and the way people pinch”
• **Concrete and testable** statements derived from the research question

• **Operational definition**: a specific set of operations for measuring external, observable behavior

• In-class exercise: try giving an operational definition for the variables highlighted below

  • “There would be a difference in user’s preference for pinching cloth among different areas on the body.”
Research Example: Pinstripe

• Karrer et al., CHI ’11
• Recall the prediction:
  • “There would be a difference in user’s preference for pinching cloth among different areas on the body.”
• Method:
  • Identify 16 different body areas
  • Ask the participants to perform the pinching gesture in these areas
  • Collect convenience rating in 5-point Likert scale
Planned Observation

• Collect data to support, refute, or refine the original hypothesis

• Three strategies
  • **Descriptive research:** X happens
    • Focus on the current state of each *individual* variable
  • **Relational research:** X and Y happen together
    • Measure **two or more variables** that *exist naturally* from each participant
  • **Experimental research:** X causes Y
    • **Manipulate** one or more variables and observe their **effects** to other variables
Descriptive Research

• Describe a naturally-occurring phenomenon
• Measure and report individual variables without claiming relationships
• Natural phenomena can occur when using a new technology as well
• Methods: observation, survey, case study
Research Example:
Natural Troubles of Driving with GPS

• Brown (Sweden) and Laurier (Edinburgh), Best paper CHI ’12

• Goal: To understand users’ interaction with GPS navigation system in non-controlled setting

• 14 drivers, 2 video cameras, field notes
  • 9 hours of video → 75 clips → 37 detailed transcriptions
  • Analyzed the data to find common patterns/themes and construct theories that explain them
Figure 1: Following GPS instructions

While the driver 'follows' what the GPS recommends the driver still needs skill to read what the GPS says and even to ignore GPS instructions.
Natural Troubles of Driving with GPS

• Contribution & benefits:
  • “Presents a video analysis study of driving using GPS navigation systems in natural settings. The paper argues for [understanding] driving with [a] GPS as an active process and not as ‘docile driving’.”

• Conclusion
  • Designer should take “driver intelligence” into account
    • E.g., less persistent instructions when the user decided to deviate from them
  • Normal natural trouble: “GPS is used in the way that was not foreseen. The driver must take instructions and the map and fit them with the situation.”
Relational Research

- Measure a set of variables for each participant
- Examine to identify patterns of relationship
  - Changes in one variable are consistently and predictably accompanied by changes in another variable
- Measure the strength of the relationship
Research Example: Social Network Activity and Social Well-Being

- Burke (CMU), Marlow, and Lento (Facebook), Best paper CHI ’10 🏆
  - “An empirical analysis of the relationship between direct and passive communication on Facebook and social well-being, including loneliness, bridging, and bonding social capital.”

- Survey in Likert scale (N=1193)

- Analyze the past two months of users’ Facebook activity data, e.g.,
  - Friend count (actual)
  - Directed communication: comments, likes
  - Passive consumption of broadcast items such as status updates
Patterns in the Relationship between Variables

General relationship

Positive relationship

Negative relationship

Simulated data for instructional purpose, based on the result from [Burke et al., CHI '10]
Strength of the Relationship between Variables

Simulated data for instructional purpose
Limitations of Relational Research

• Correlation does not imply causation
  • E.g., loneliness ⇒ less direct communication?
    or less direct communication ⇒ loneliness?
    or third variable ⇒ direct communication and loneliness?

• Third variable problem: unidentified variable controls the correlated variables
Limitations of Relational Research

- **Shallow** data from large number of people instead of **deep** data
- Can be improved by follow-up interviews, follow-up surveys
- Participant sampling method limits the conclusion
- Method: advertisement on Facebook
- Participants: only English-speaking users, but compensated by many countries of origin
Experimental Research

• Purpose: To infer cause-and-effect relationship
• Controlling independent variable
• Observe the change in the dependent variables
• In-class exercise: recall the following experimental designs
  • Between-group vs. within-group
  • Benefits and drawbacks
• More details in next lecture
Research Example: Mid-air Pan-and-Zoom on Wall-sized Displays

- Nancel et al. (Paris), Best paper CHI ’11

- Contributions & Benefits:
  - “Design and evaluation of multiscale navigation techniques for very large displays based on three key factors: number of hands involved, type of movement, type of feedback.”
Figure 2. Matrix of the 12 techniques organized according to key characteristics: uni- vs. bimanual, degree of guidance, linear vs. circular gestures.

1D path involves guiding gestures along a particular path in space; in 2D surface gestures are made on a touch-sensitive surface; while in 3D free gestures are totally free.

Despite the less natural mapping from input to commands, such continuous, clutch-free gestures have been successfully applied to vertical scrolling in documents [25, 33], and to pan and zoom on large, touch-sensitive surfaces in CycloStar [21]. Circular gestures potentially benefit from an automatic Vernier effect [13]: as zooming is mapped to angular movements, the larger the circular gesture's radius, the greater the distance that has to be covered to make a full circle, and consequently the more precise the input.

Guidance through Passive Haptic Feedback

Two main categories of techniques have been studied for mid-air interaction on wall-sized displays: freehand techniques based on motion tracking [32, 36]; and techniques that require the user to hold an input device [5, 10, 19, 23]. Input devices provide some guidance to the user in terms of what gesture to execute, as all of them provide some sort of passive haptic feedback: A finger operating a knob or a mouse wheel follows a specific path; gestures on touch-enabled devices are made on planar surfaces. Freehand techniques, on the contrary, provide essentially no feedback to the user who can only rely on proprioception [24] to execute the gesture. We call this dimension the degree of guidance.

Gestures can be guided to follow a particular path in space (1D path); they can be guided on a touch-sensitive surface (2D surface); or they can be totally free (3D free). These three values correspond to decreasing amounts of passive haptic feedback for the performance of input gestures.

DESIGN CHOICES

Panning. For all techniques, controlling the cursor's position is achieved naturally by ray-casting from the dominant hand to the wall display (dashed arrows in Figure 2). As mentioned earlier, first order of control was discarded for both pan and zoom operations. Panning is achieved by dragging, as in applications such as Adobe Illustrator™ or Google Maps™ with their typical hand-shaped cursor.

Zooming. As in desktop applications such as Google Maps™ or NASA's WorldWind, linear techniques zoom in by moving forward towards the display and zoom out by moving backwards; circular techniques zoom in by turning clockwise and zoom out by turning counter-clockwise (solid arrows in Figure 2). Pointing plays an important role when zooming, as it specifies the focus of expansion (zoom in)/contraction (zoom out). Letting users specify this focus point is very important on displays of that physical size, as they will typically not be standing right in the center. A focus of expansion implicitly located at the center of the screen would make zooming operations tedious and hard to control as every zoom operation would require multiple panning actions to compensate drifts induced by the offset focus.

Bi-manual interaction. All bimanual techniques (Figure 2, bottom row) are grounded in Guiard's study of asymmetric division of labor in bimanual actions that led to the Kinematic chain model [14]. Following the observation that motion of the dominant hand typically finds its spatial reference in the results of motion of the non-dominant-hand, we assign...
Unimanual - Linear - 2D Surface
Three Approaches to HCI Research

- **Test**: Empirical science
- **Look**: Ethnography
- **Make**: Engineering and design
What You Need To Do Now

• Sign up for this class in CAMPUS by tomorrow!
• Read this paper today (definitely before the lab!):
  • Seven Research Contribution Types in Human-Computer Interaction
    — Jacob Wobbrock, 2014
• Come to the lab this Wed, April 20th!
  • Literature searching and reading techniques
  • Help with CAMPUS/L2P problems
• Read this paper before the next lecture:
  • How to Read an Engineering Research Paper — William G. Griswold

Links to articles:
hci.rwth-aachen.de/cthci
Literature


