MAS 834: Tangible Interfaces
Media Arts and Sciences Graduate Seminar, Fall 2001
Prereq.: Permission of instructor
G (Fall)
3-3-6 H-LEVEL Grad Credit

When:  Friday, 2:00 PM - 5:00 PM
September 14 - December 7, 2001

Where:  E15-054

Instructor:  Hiroshi Ishii  ishii@media.mit.edu  One Cambridge Center 5F
Tel. 3-7514

TAs:  James Patten  <jpatten@media.mit.edu>
Angela Chang  <anjchang@media.mit.edu>

Guest speakers:  Rob Jacob  <rjacob@media.mit.edu>  Associate Prof, Tufts Univ.
Rich Fletcher  <fletcher@media.mit.edu>  MAS Ph. D. candidate
Brygg Ullmer  <ullmer@media.mit.edu>  MAS Ph. D. candidate

Secretary:  Lisa Lieberson  <lisasue@media.mit.edu>  One Cambridge Center 5F,
Tel. 3-9836

Course description

People have developed sophisticated skills for perceiving and manipulating their physical environments. However, most of these skills are not engaged by the traditional Graphical User Interface (GUI) that has become the central approach in Human-Computer Interaction (HCI) design. The GUI represents information mainly as abstract pixels on flat rectangle screens, allowing people to manipulate them only indirectly with a remote controller such as a mouse and keyboard.

The Tangible User Interface (TUI) is an attempt to give physical form to digital information, making bits directly manipulable and perceptible by people. The goal of TUI research and design is to build the next generation of interfaces that go beyond the current and dominant GUI paradigm.

This course will explore the design space of TUIs, a new form of HCI which focuses on the physical embodiment of computational media. Tangible Interfaces will make bits accessible through augmented physical surfaces (e.g. walls, desktops, ceilings, windows), graspable objects (e.g. building blocks, models, instruments) and ambient media (e.g. light, sound, airflow, water-flow, kinetic sculpture) within physical environments.

This is a project course with enrollment limited to keep a design studio atmosphere. We will explore different ways of broadening the bandwidth of interaction between people and digital information through Tangible Interfaces that help people learn, design, and communicate using
the full range of human senses and skills. We will pursue the interfaces that are not only practical, but also aesthetically pleasing and engaging.

For example, we explore the interfaces that allow users to “grasp & manipulate” information by coupling digital information and computation with physical objects on augmented surfaces, so that multiple users can have direct access to the shared information space that supports collaboration, and enable users to be aware of information at the periphery of human senses using ambient display media such as light, sound, airflow, water movement, and kinetic sculpture in an augmented space, so that users can take advantage of peripheral awareness while focusing on foreground task.

The goal of this course is to design new instances of Tangible Interfaces that take advantage of physical affordance of objects and spaces to achieve a legibility and seamlessness of interaction not achievable with traditional GUI.

The instructor will provides:
Background – HCI, GUI, Ubiquitous Computing, and Augmented Reality Framework and theory of TUIs,
Design examples and successful applications of TUIs, and
Enabling technologies for TUIs.

Students will design/develop experimental Tangible Interfaces, applications, underlying technologies, and/or theories using concept sketches, posters, physical mockups, and working prototypes. Studio discussion of ideas using tangible materials such as posters and physical mockups are encouraged to refine the design collaboratively. Over the course of the semester, each student is required to complete one warm-up exercise, two design projects, and one final presentation.

Grading is based on the following factors:
participation in class discussion: 30% (at least 80% of class attendance required.)
presentation of warm-up exercise: 10%
presentation of the completed first project: 20%
final presentation of the completed second project: 30%
final project report in CHI short paper format: 10%


Mailing list:
• ti01@media.mit.edu all the admitted students to MAS.834 Fall 2001
• ti01-staff@media.mit.edu instructors + TAs + secretary
URL: http://tangible.media.mit.edu:555/courses/ti01/ online syllabus
### Tentative Course Schedule

(9/7*)  No class  
9/14  Course Overview and TUI Introduction by Ishii, Assignment 0 (warming-up exercise)  
9/21*  Context of TUI (part 1 and 2) by Prof. Rob Jacob  
9/28  Poster presentation of assignment 0, Context of TUI (part 2) by Ishii, Assignment-1 (first project)  
10/5*  Framework of TUI (Ullmer)  
10/12  First project proposal due (assignment-1) – poster presentation  
10/19  Tangible Interfaces Design Cases (part 1) by Ishii, Psychology of TUI (Patten)  
10/26  Presentation of completed first project (assignment-1), Assignment-2 (second project)  
11/2  Tangible Interfaces Design Cases (part 2) by Ishii  
11/9*  Enabling Technologies (Fletcher and Patten)  
11/16  Second project proposal due (assignment-2) – poster presentation  
(11/23)  no class - Thanksgiving Vacation  
11/30  Tangible Interfaces Design Cases (part 3)  
Context of TUI (part 3: future) by Ishii  
12/7  Final presentation of completed second project (assignment-2)  
CHI 2001 Short Talks and Interactive Posters submission deadline

### Menu

1) **Course Preview:** Course schedule and sampler of the past projects  
2) **Course Overview** (Ishii)  
   Overview of the course, projects, presentations, and possible submission to CHI/DIS conferences.  
   Perspective of Tangible Interfaces  
   Self introductions of students  
3) **Context of Tangible Interfaces**  
   3-A) **History of HCI** (Jacob),  
      Interaction styles: From Command Languages to Virtual Environments  
      Basic HCI concepts and terminology, Interaction Tasks, Techniques, and Devices; direct and indirect interaction, User interface software concepts  
   3-B) **Emerging new paradigms**  
      Augmented Reality, Mixed Reality, Ubiquitous Computing, Tangible Bits  
   3-C) **Future of Tangible Interface**  
      Integration with Industrial Design, Architectural Design, and Media Arts  
4) **Framework for Tangible Interface Design** (Ullmer)  
5) **Enabling Technologies for Tangible Interfaces** (Fletcher, Patten)  
6) **Tangible Interfaces Design Cases**  
   6-A) **Classic:** LiveWire (Natalie Jeremijenko),  
      Marble Answering Machine (Durrel Bishop), Anthony Dunne/ Fiona Raby (Fields and Thresholds), Bricks - Graspable UI (Fitzmaurice)  
   6-B) **TMG:** I/O Bulb and Urp, sensetable - platform for spatial TUI,  
      Triangles, bottles, InTouch, curlybot, PingPongPlus, and HandSCAPE (Jay Lee)
6-C) Others: Xerox PARC, U. of Colorado, Interval, CMU, etc.
6-D) Media Arts - Toshio Iwai, Naimark, Gansec, Meiwadenki, etc.

Assignments

0) Warming Up Exercise
Assignment-0: 1 page poster with sketches and text
- Analyze your interactions with everyday physical objects,
- Analyze the meaning of the objects and physicality, and
- Imagine: if these objects are connected to digital world, how it could help you to access to and manipulate the information or to communicate / collaborate with other people?
- Make a poster with design sketches (and text), and present in a class (5 minutes).

1) Project 1 (Assignment-1)
1-1) Assignment-1: first project proposal of “Tangible Interfaces” which utilizes graspable objects and your hands to manipulate digital information.
- Make a plan of your project to explore a form of Tangible Interfaces using graspable physical objects,
- Write a project proposal with sketches, and start mockup making.
- Make a poster with design sketches and text, and make a physical mockup for class presentation and discussion.
- Find a partner (2 students / group minimum) if possible and necessary.

1-2) First project proposal due
Presentations of first project proposals and design critique (all students)
- Bring a poster which summarizes your first project ideas with sketches. Poster does not need to be pretty but has to communicate your ideas well. We will put all the posters on the wall of a class room so that everyone can easily access to the ideas and review. Bring a physical mockup of your ideas to put on a table.
- Each group of students will give 5-10 minute presentation and discussion using this poster and physical mockup
- Find a partner (2 students / group minimum) to realize the idea you choose.

1-3) Discussion of the first project in progress
- Bring revised posters and/or mockups.
- We continue informal design discussion.

1-4) Presentations of completed first projects and design critique (all students)
- Bring a poster summarizing the results of your project.
- Bring working prototypes / mockups.
- Each group will give 5 – 10 minute presentation using the poster / prototypes / mockups.
- All the students and instructors join design critiques.
2) Project 2 (Assignment-2)

2-1) Assignment-2: second project proposal (extended Tangible Interfaces) based on the reflection of your first project, explore one of the following three directions.

- Extension to architectural space: extend the scale of interface to a large room/building/public space and design the physical interface which utilizes objects, space, and peripheral sensory information (ambient media).
- Extension to the human body: extend the physical interface closer to the skin to take advantage of tactility of physical interface. Design your wearable/tangible interfaces.
- Extension of your first project toward practical applications with clear focus on tasks.
- Continue to work on the first project to come up with new design to solve the problems identified in the design review.
- Develop theoretical framework or principles which guides design of tangible interfaces.
- Develop underlying sensing/actuation technologies for tangible interfaces.
- Find a partner (2 students / group maximum), and
- Write a project proposal, draw sketches, and start mockup / prototype making. Make a poster for class discussion.

2-2) Second project proposal due.

Presentations of second project proposals and design critique (all students)

- Bring a poster which summarizes your project ideas. We will put all the posters on the wall for collaborative design critique.
- Bring a physical mockup or prototypes,
- Each group of students will give 5 – 10 minute presentation using this poster and physical mockup / prototype.
- Discuss on the possible submission of your final project report to CHI Short Talks and Interactive Posters or DIS 2002 (both deadlines: December 7, 2000).

2-3) Discussion of 2nd project in progress

- Bring revised posters and/or mockups.
- We will have informal design discussion

2-4) Presentations of completed 2nd projects and design critique (all students)

- Formal 10 minute CHI style talk including live demo (or video),
- 2 – 3 pages paper summarizing project due (in CHI paper format)

CHI, DIS and SIGGRAPH Calendar

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<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Deadline</th>
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<tr>
<td>12/7/00</td>
<td>CHI 2002 Short Talks and Interactive Posters submission deadline</td>
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<tr>
<td>12/7/01</td>
<td>DIS 2002 submission deadline</td>
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1/9/02 SIGGRAPH 2002 Full Papers submission deadline

1/30/02 SIGGRAPH 2001 Emerging Technologies submission deadline

3/13/02 SIGGRAPH 2001 Sketches and Applications submission deadline

4/20-25/02 CHI 2002, Minneapolis, USA
http://www.acm.org/sigchi/chi2001/

http://www.acm.org/sigchi/dis2002/

7/21-16/02 SIGGRAPH 2002, San Antonio, USA

Suggested Reading List


Weiser, Mark, Does Ubiquitous Computing Need Interface Agents?


**TMG papers**

Patten, J., and Ishii, H., A Comparison of Spatial Organization Strategies in Graphical and Tangible User Interfaces, in Proceedings of Designing Augmented Reality Environments (DARE ’00), (Elsinore, Denmark, April 12-14, 2000), pp. 41-50


Wisneski, C., Ishii, H., Dahley, A., Gorbet, M., Brave, S., Ullmer, B. and Yarin, P., Ambient Displays: Turning Architectural Space into an Interface between People and Digital Information,


