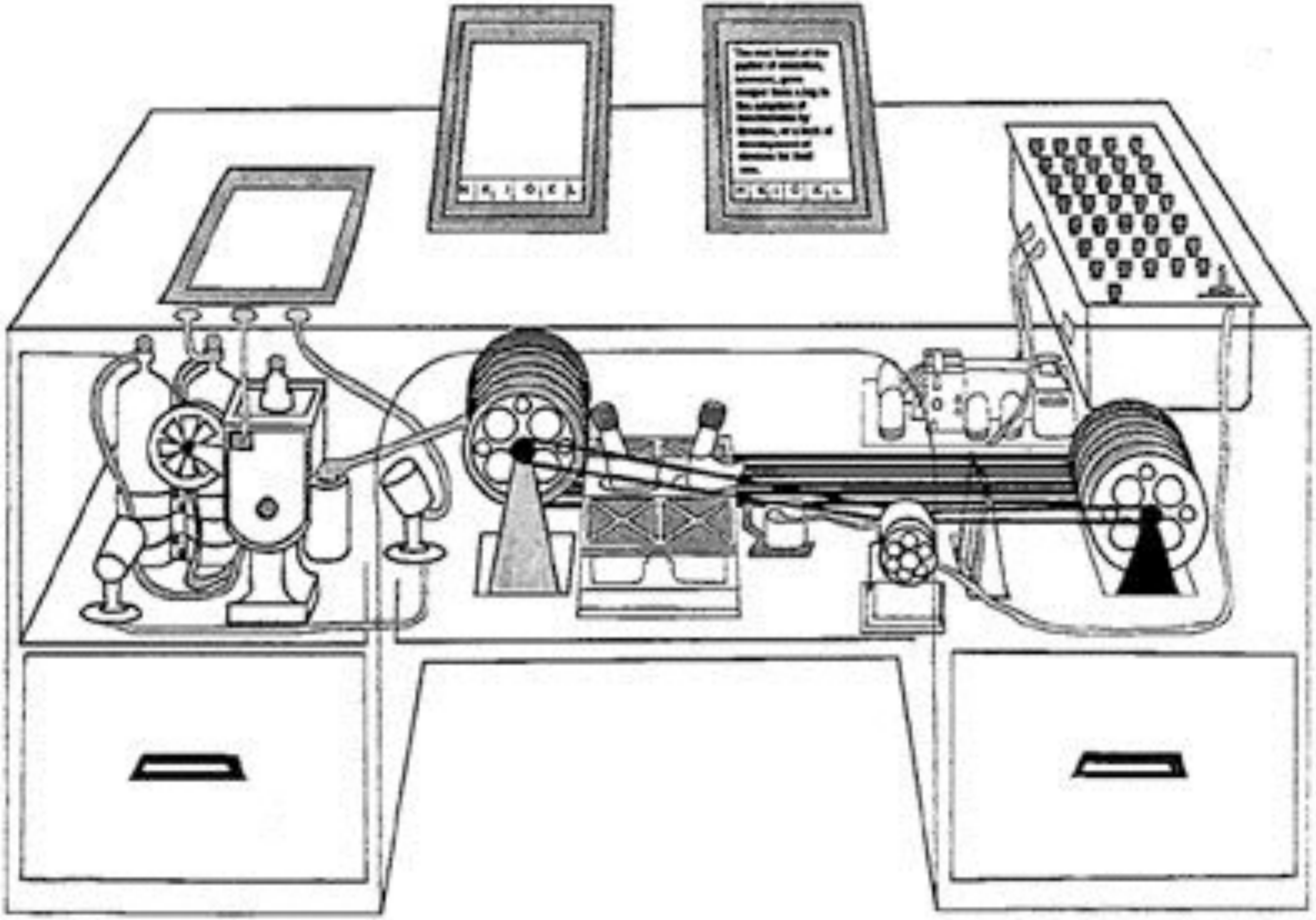
Human-Computer Interaction Research

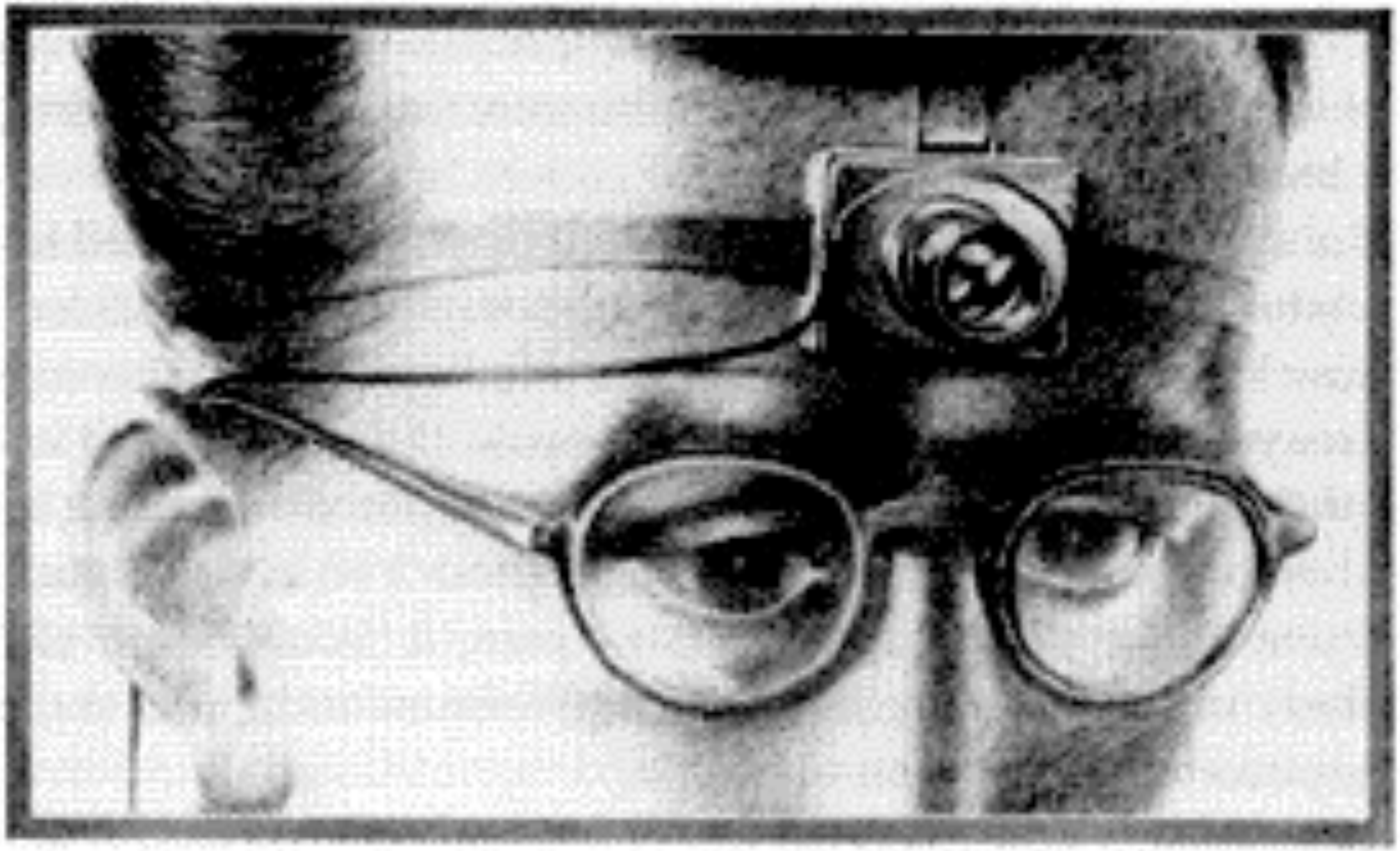
MICHAEL BERNSTEIN

FALL 2016

CS376.STANFORD.EDU

THANKS TO SCOTT KLEMMER





A scientist of the future records experiments with a tiny camera fitted with universal-focus lens. The small square in the eyeglass at the left sights the object (*LIFE 19*(11), p. 112).

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"There is a new profession of **trail blazers**, those who find delight in the task of establishing useful trails through the enormous mass of the common record. The **inheritance from the master becomes**, not only his additions to the world's record, but **for his disciples the entire scaffolding** by which they were erected."

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WIKIPEDIA
The Free Encyclopedia

HCI Research

Envisioning and understanding
the future of interaction
between people, society, and technology

Introductions

Michael Bernstein

- Assistant Professor, Computer Science
- Member of the HCI Group

TAs

- Rob Semmens
  - PhD in Learning Sciences and Technology Design

- Kesler Tanner
  - PhD in Computer Science

Course Goals

Parse and make novel contributions to HCI

Know the seminal and recent literature

Apply the multiplicity of HCI research methods


reading
doing

Expected background

- Most important: are you prepared to complete a mini-research project of your own choosing?
- Helpful:
  - Depth in at least one of {programming, social science methods, design, STS}
  - Experience in design (e.g., CS 147, CS 247)
- Required:
  - CS or SymSys HCI track: A- or better in CS 147 or CS 247
  - Other programs: none

To take CS 376, you must apply by 11:59pm Wednesday

http://hci.st/376apply

Project

Your main goal in CS 376

- The "doing" part of the course, in teams of three
- We will be scaffolding you through the process
  - Brainstorming
  - Proposal
  - Execution
- A project related to your ongoing research (or another course project) is great

FatBelt: Motivating Behavior Change Through Isomorphic Feedback

Trevor Pels, Christina Kao, Saguna Goel
Human Computer Interaction (Computer Science), Stanford University
{tpels, chris18, sgoel1}@stanford.edu

ABSTRACT

The ultimate problem of systems facilitating long-term health and fitness goals is the disconnect between an action and its eventual consequence. As the long-term effects of behavior change are not immediately apparent, it can be hard to motivate the desired behavior over a long period of time. As such, we introduce a system that uses physical feedback through a wearable device that inflates around the stomach as a response to calorie overconsumption, simulating the long-term weight-gain associated with over-eating. We tested a version of this system with 12 users over a period of 2 days, and found a significant decrease in consumption over a baseline period of the same length, suggesting that through physical response, FatBelt moved calorie intake drastically closer to participants goals. Interviews with participants indicate that isomorphism to the long-term consequences was a large factor in the system's efficacy. In addition, the wearable, physical feedback should allow a more vivid and emotionally resonant simulation of long-term negative consequences.

In this paper, we explore a system using wearable computing and physical feedback to create short-term consequences simulating long-term results. This system, "FatBelt", operates under the hypothesis that making the consequences of users' actions short-term, *while maintaining isomorphism to the long-term consequences*, will result in greater behavior change. It uses a small inflatable pack worn across the user's stomach, beneath the shirt that automatically inflates when the user consumes greater than his or her daily calorie goal, simulating the long-term physical effects of overeating.

We conducted an evaluation with 12 users using a lightweight, manual version of the belt for 2 days, after a 2 day baseline. We found that calorie intake decreased significantly with the belt. We also conducted interviews with all

Visimu: A Game for Music Color Label Collection

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ABSTRACT
Based on previous studies of the associations between color and music, we introduce a scalable way of using colors to label songs and a visualization of music archives that facilitates music exploration. We present Visimu, an online game that attracted users to generate 926 color labels for 102 songs, with over 75% of the songs having color labels reaching high consensus in the Lab color space. We implemented a music archive visualization using the color labels generated by Visimu, and conducted an experiment to show that labeling music by color is more effective than text tags when the user is looking for songs of a particular mood or use scenario. Our results showed that Visimu is effective to produce meaningful color labels for music mood classification, and such approach enables a wide range of applications for music visualization and discovery.

consistent correlation between emotional ratings for music and the emotional ratings for colors [7]. Bresin found that people choose different color to classify the same piece of music when the instruments in the music or the interpretations of the musician's emotion are different [8].

From these observations, we think using colors to represent mood in music can leverage the abstract nature of colors while we can study the concrete relationships between them and the mood of the music. We developed Visimu, a game that uses the theoretical foundations regarding the associations between color and music, and provides a scalable way to label songs with colors. We show that the visualization of music archive using color labels generated from Visimu is a better alternative than text-based music archive.

GAME DESIGN

Brainstorm, Define, Prototype: Timing Constraints to Balance Appropriate and Novel Design

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Elaine Zhou
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ABSTRACT

We present the results of a human creativity experiment that examined the effect of varying the timing of narrowed constraints. Participants were asked to create a static web ad for Stanford University guided under a timed design process and were introduced to a narrowed constraint either at the beginning, middle, or end of the prototyping process. The narrow constraint addressed goal and task constraints by specifying the target audience and ad size. We find that groups introduced to narrow constraints prior to the brainstorm yielded more appropriate results, while those introduced prior to the final production yielded more novel results. Our results suggest that effective timing of design constraints may further optimize ideation and design methodologies.

seeks a richer theoretical understanding of utilizing the time frame of narrowing constraints in order to help individuals yield more effective results.

Creativity as explored by current literature can be defined in two main aspects: novelty (the degree to which the product is unexpected and distinctive) and appropriateness (how useful, or good according to some reference group) and we define creativity similarly in his study [3], [5], [7]. Constraints can be classified under two categories; *input restrictions* and *input requirements*. [6]. We focus on Goal Constraint as an input requirement, outlined as the most crucial type of constraint, and the task constraint as an input restriction, which deals with design's concrete dimensions and quantitative aspects. [4]

What you will achieve

- The conception, execution, and communication of a new idea in the world of HCI
- A novel contribution to any area of HCI research
- An appropriate method for demonstrating that contribution: design, engineering, social science, theory, etc.

Best project gets a $1500 trip

- Michael will pay for one team member of the best project team to attend CHI and present their work in the poster track
  - CHI is the biggest, most famous research conference in HCI
  - Funding is continent on your poster submission getting accepted
  - Everyone is welcome to submit, but others have to find their own funding (undergrads: UAR student grants!)

week 1	Brainstorming round 1
week 2	Form teams, brainstorming round 2
week 3	Abstract draft
week 4	Abstract revision
week 5	
week 6	Project faire, round one
week 7	
week 8	
week 9	Project faire, round two
week 10	
finals	Final project paper and presentations

Brainstorm round 1 due Friday

Goal: distill what a contribution is to HCI research, and generate some sample contributions

Project Inspiration

STANFORD HCI GROUP COURSES PEOPLE RESEARCH CONNECT DIRECTIONS

PEOPLE

Maneesh Agrawala · Michael Bernstein · James Landay · Stu Card · Terry Winograd · Affiliated Faculty · Students · Visitors · Alumni

CO-CONSPIRATORS

d.school · Liberation Tech · Graphics · Visualization · Project Open Mobile Internet · MobiSocial · Lytics Lab

WHAT'S HAPPENING

- Ge Wang awarded Guggenheim Fellowship
- Empath wins best paper at CHI 2016; Augur wins honorable mention
- Maneesh Agrawala joins the CS HCI faculty
- Jeff Hancock joins the Communications faculty
- Soylent in the Communications of the ACM [video]

PAPERS

CSCW 2017

A Glimpse Far into the Future: Understanding Long-term Crowd Worker Accuracy Kenji Hata, Ranjay Krishna, Li Fei-Fei, Michael Bernstein
PROJECT

ECCV 2016

Visual Relationship Detection with Language Priors Cewu Lu*, Ranjay Krishna*, Michael Bernstein, Li Fei-Fei PROJECT *oral*

Syllabus

CS 376 in three acts

1. Introduction
2. Depth
3. Breadth

Ubiquitous Computing

Social Computing

Design and Creation

methods	stats	foundations
computational social science	programming	collaboration
critiques of HCI	visualization	creativity tools

Course Overview

week 1	Intro to Ubicomp; Intro to Social Computing
week 2	Intro to HCI Design Research; Social Computing
week 3	Social Computing; Human-Robot Interaction
week 4	[Michael @ UIST] Methods; Comp. Social Science
week 5	Ubiquitous Computing
week 6	Design
week 7	Stats; Foundations
week 8	Special topics: Programming; Collaboration
week 9	Special topics: Creativity
week 10	Special topics: Visualization; Critiques of HCI

Administrivia

Course Info

Mondays & Wednesdays 3:30-5:20pm, Littlefield 107

4 units, possible to register for 3 units, no CR/NC option

http://cs376.stanford.edu

cs376@cs.stanford.edu

My Info

Office Hours: Thursdays 4:30pm-6:00pm, Gates 384

http://hci.stanford.edu/msb

msb@cs.stanford.edu

Format

3:30-4:10	Instructor-led overview via lecture
4:10-4:15	Break and split into two rooms
4:15-5:00	Student-led reading discussion

Laptop policy

- Lecture: take notes if you want
  (but science says you'll remember more if you do it on paper)

- Discussion: no laptops

Grading

25%	Paper Critiques
5%	Participation
10%	Leading an in-class discussion
60%	Original research project

Readings

Reading: come prepared!

- Typically two readings per class meeting
- I strongly suggest hiding in the library, distraction-free

Critiques

- Submit your critiques at http://cs376.stanford.edu
- Due at 11:59pm, the night before class

Writing Critiques

- Future research directions that this paper inspires for you
- Why the paper does/doesn't seem important
- Observations of novel methodology or methodology that seems suspect
- Why the paper is/isn't effective at getting its message across
- How the paper has changed your opinion or outlook on a topic

~~“This paper has so many problems:”~~

“This inspired me to develop an idea:”

Example Length

- As We May Think
  Rating: 5/5

This paper was fascinating because it forces us to consider technologies that nowadays we take for granted. In some ways Bush was overly optimistic; for example walnut-sized wearable cameras are uncommon (even though they are possible), likely because optical and physical constraints favor handheld sizes. In other ways he underestimated, such as the explosion of data. For example, some modern cameras can store ten thousand photos rather than a hundred.

Underestimating the data explosion is also apparent in the disconnect between the initial problem description ("publication has been extended far beyond our present ability to make real use of the record") and the first two-thirds of the paper, which describe technologies that would (and did!) exacerbate the issue by further proliferating data. Yet, he recognizes this issue later in the paper, and then goes on to predict search engines

It is remarkable how many technologies are predicted in this paper: digital photography, speech recognition, search engines, centralized record-keeping for businesses, hypertext (even Wikipedia?). At the same time, many of the predicted implementations are distorted by technologies and practices common at the time, like "dry photography" or "a roomful of girls armed with simple keyboard punches". While these presumably served to make the hypotheses more accessible to readers of the time, is it even possible to hypothesize technology without such artifacts.

Aside from predictions, this paper is important for the way Bush frames science in the support of the human race, by augmenting the power of the human mind. It is likely that many of the scientists (and physicists in particular) that were his audience felt guilt and despair from the destruction wrought by advances in nuclear, and even conventional, weaponry in the war. In that social context, seeing science described as a powerful constructive tool for good must have been inspiring.

Discussants

Two rooms

- For discussions, we have also reserved Littlefield 103 around the corner
- We’ll split the class each day, rotating rooms and hosts

Leading a discussion

- You have 45 minutes during the second half of class
- Split your team into two, each leading discussion in one room

- Do not summarize readings, assume everyone has read them
- Identify points of interest, be prepared to spur and lead in-class discussion
- Incorporate critiques submitted by the class
- Full description on the class web site

CS 547: HCI Seminar

Fridays 12:50-2:05pm, Gates B01
http://hci.st/seminar/

This quarter's guests include leading luminaries in wearable computing, music interfaces, digital art, human-robot interaction, and more.

Questions?

Ubiquitous Computing

MICHAEL BERNSTEIN
CS 376

Ubiquitous?

Flickr: GARNET

Ubiquitous?

Flickr: GARNET

Ubicomp Vision

- ‘A new way of thinking about computers in the world, one that takes into account the natural human environment’ where computers will ‘vanish into the background’, weaving ‘themselves into the fabric of everyday life until they are indistinguishable from it.’

Mark Weiser (late 80s/early 90s), quotes compiled by Daniel Fallman

Beyond Weiser

- Ubiquitous computing is a set of visions for distributing computation into the environment.
- These visions require interactive systems to become reactive, context-aware, ambient, and embedded in everyday activities.

Tangible Computing

- Directly-manipulable physical interfaces to data and computation
- ‘Pure’ form of ubicomp in that there is no computer to be seen

Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms

Hiroshi Ishii and Brygg Ullmer
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Tangible Media Group
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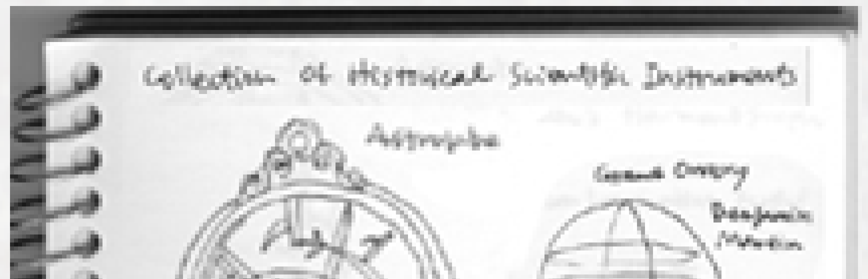
ABSTRACT
This paper presents our vision of Human Computer Interaction (HCI): "Tangible Bits." Tangible Bits allows

BITS & ATOMS
We live between two realms: our physical environment and



Urp: a luminous-tangible workbench for urban planning and design.
Underkoffler, Ishii. CHI '99.

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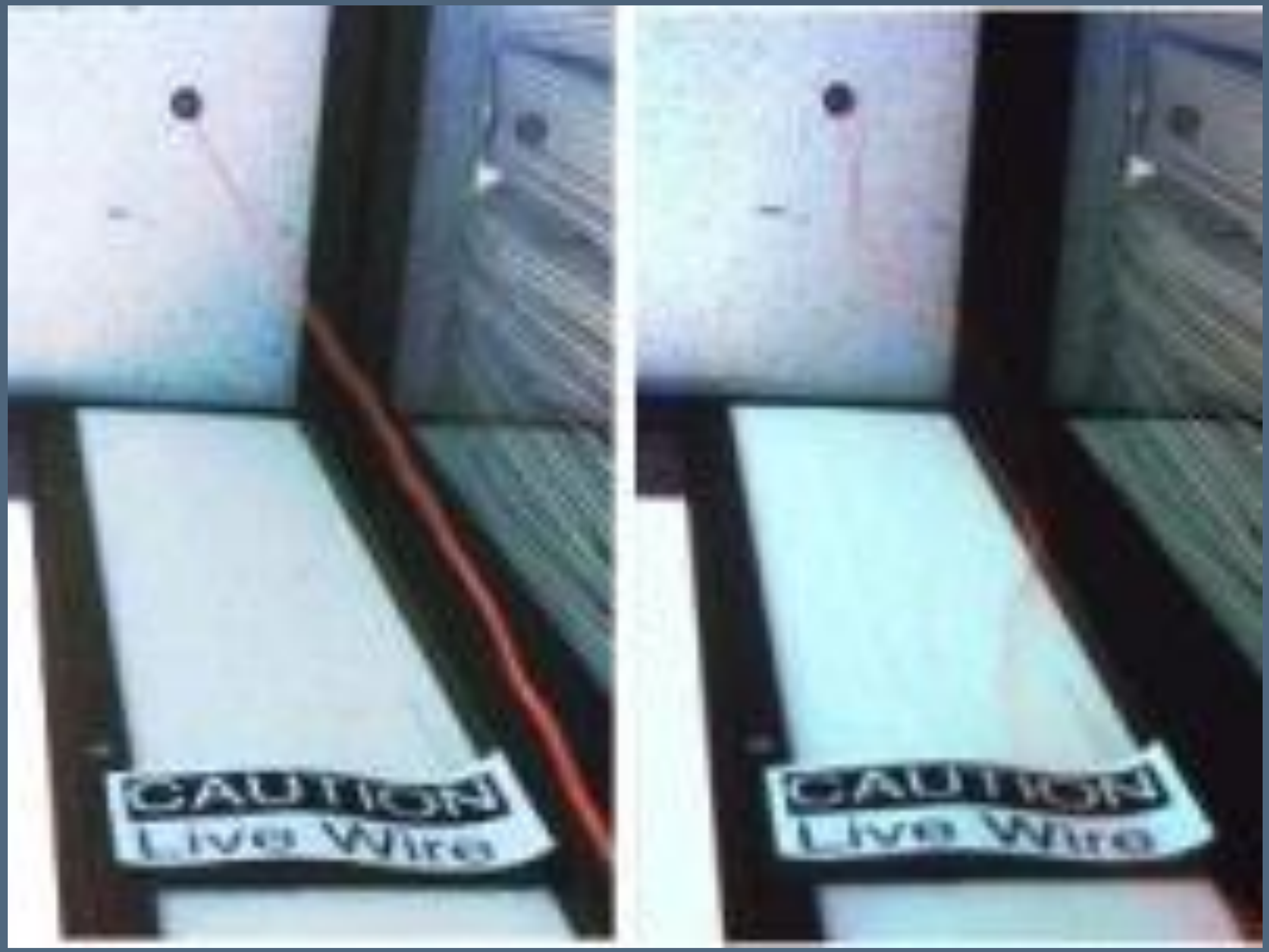
Underkoffler, Ishii. CHI '99.

Ishii, Mazalek, Lee. Bottles as a minimal interface to access digital information. CHI EA '01.

Ryokai, Marti, Ishii. I/O Brush: Drawing with Everyday Objects as Ink. CHI ’04.

Transforming data into physical form

- What Weiser calls one of the first calm technologies: Live Wire, a wire on a stepper motor, monitoring ethernet traffic
  [Jeremijenko '95]



Themes of ubicomp research

- Activity sensing and monitoring
- Context-aware computing
- Input techniques

Activity recognition

- Sense the user's physical state by using minimally invasive sensors
- For example, wearing five 2d accelerometers and predicting tasks like walking, watching TV, reading, eating...

Activity Recognition from User-Annotated Acceleration Data

Ling Bao and Stephen S. Intille

Massachusetts Institute of Technology
1 Cambridge Center, 4FL

Activity recognition

- Detecting the user's state is powerful, but often involves invasive sensors.
- So, monitor the environment rather than the user: energy use, water use, activities of an aging population

Patel et al. At the Flick of a Switch: Detecting and Classifying Unique Electrical Events on the Residential Power Line. Ubicomp '07.

Environmental Sensors

- Monitor secondary signals in the environment: biosensors!

Nurturing Natural Sensors

Stacey Kuznetsov, William Odom, James Pierce, Eric Paulos
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ABSTRACT
Sensing has played a significant role in the evolution of ubiquitous computing systems, enabling many of today's compelling interactive and ubiquitous experiences. In this paper, we argue for expanding the current landscape of sensing to include living organisms such as plants and animals, along with traditional tools and digital devices. We present a field study of ten individuals who routinely work with living organisms such as plants, fish, reptiles and bees, and rely on these organisms as well as analog instruments and digital sensors to infer environmental conditions and inform future actions. Our findings offer a new perspective

individuals who use *everyday biomarkers*- common biological organisms that express information about an ecosystem or its many parts. We present a field study of 10 participants who routinely work with living organisms such as plants, fish, reptiles or bees. While many people make inferences about the environment (*e.g.,* a cloudy sky suggests the possibility of rain), we expect our sample of participants to be more attuned to environmental processes as their work explicitly engages with living systems. Specifically, we focus on participants' use of digital devices, traditional tools and living organisms to infer environmental conditions and inform actions related to

Hodges, et al. SenseCam: A retrospective memory aid. Ubicomp '06.

Context-aware computing

- Collect information about the user's environment, and use it to customize their computing experience
- Some types of context: location, social surroundings, activity level
- But beware overuse of the term 'context'!

Towards a Better Understanding of Context and Context-Awareness

Anind K. Dey and Gregory D. Abowd

Context-aware computing

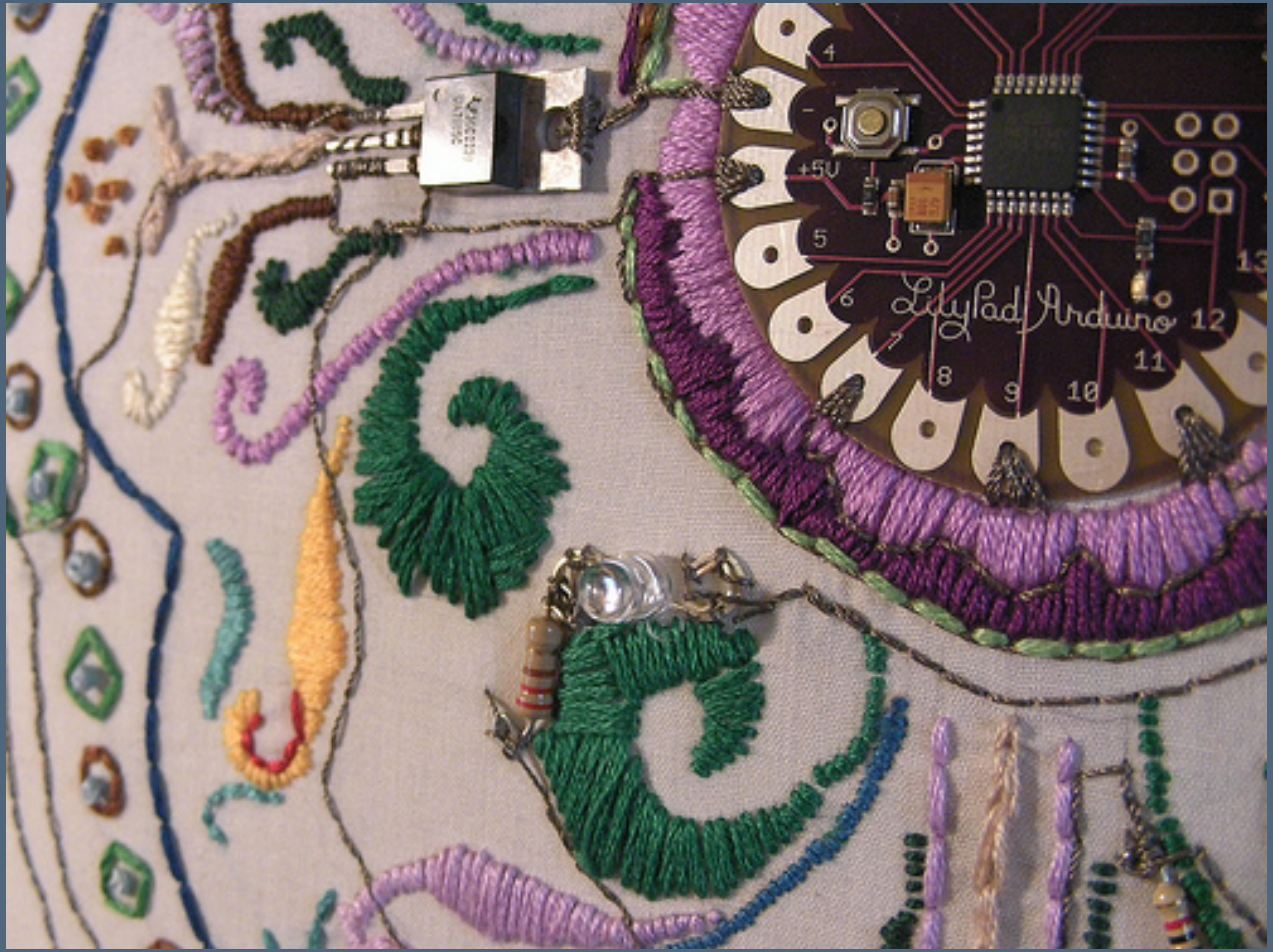
- Detection of context is typically the hardest problem
- Some successes:
  - Localization using wifi access points
    [LaMarca et al., Pervasive '05]
  - Social networks using mobile phones
    [Eagle and Pentland, Pers. Ubiq. Comp. '06]
  - Google Now

Wearable Computing

Steve Mann, MIT Media Lab

Wearable Computing

- Lilypad Arduino
  [Buechley et al., CHI ’08]
- Google Glass, Apple Watch, FitBit…



Input and interaction

- Effective control of ubiquitous computing systems without the traditional input channels
- Gesture, on-body, on-wall, on-floor: on any surface available

Harrison, Morris, Tan. Skinput: Appropriating the Body as an Input Surface. CHI '10.

Harrison, Benko, Wilson. Omnitouch: Wearable Multitouch Interaction Everywhere. UIST '11.

Yao et al.. PneUI: pneumatically actuated soft composite materials for shape changing interfaces. UIST '13.

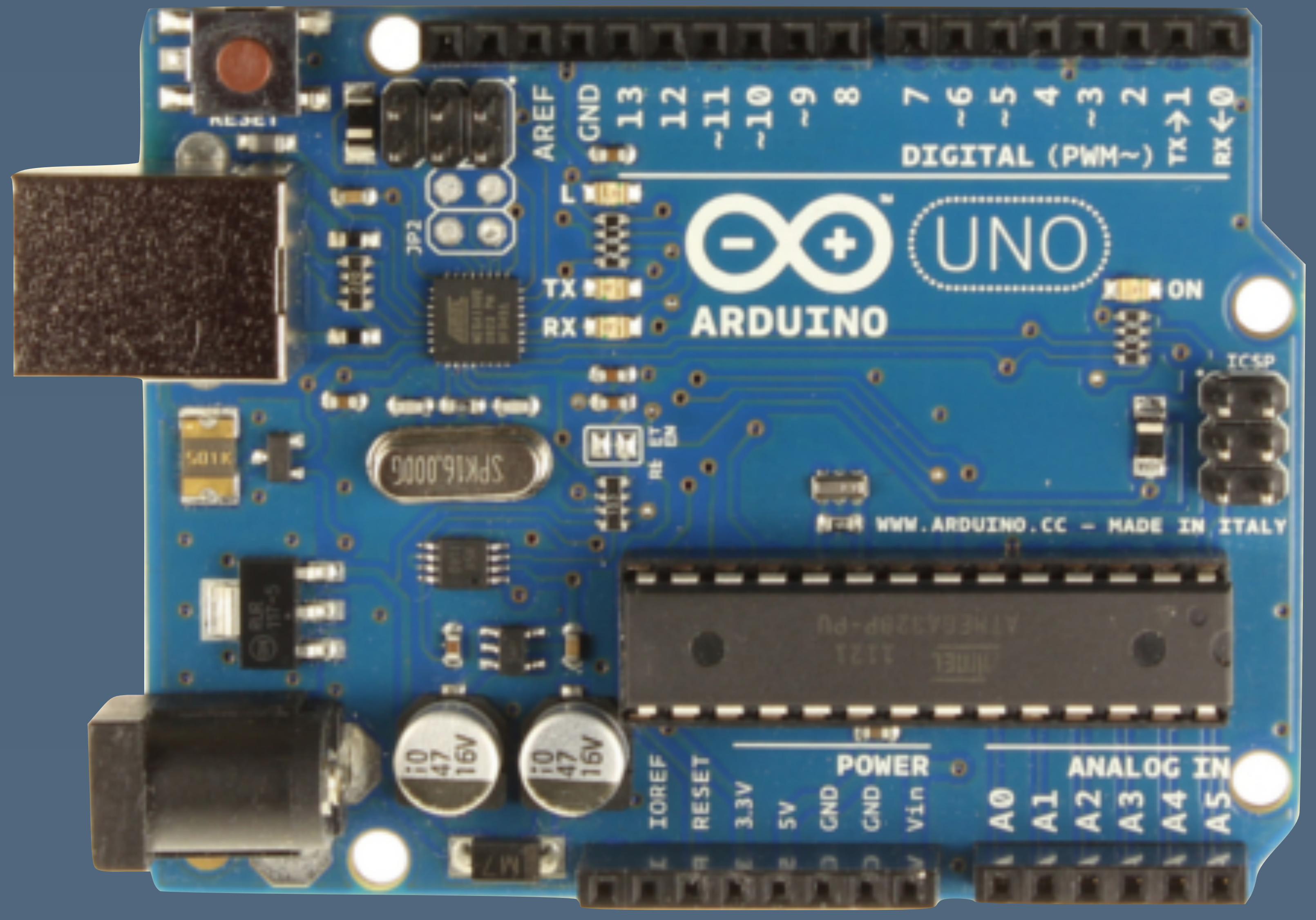
Follmer, Leithinger, Olwal, Hogge, Ishii. inFORM: Dynamic Physical Affordances and Constraints through Shape and Object Actuation. UIST '13.

What's difficult about ubiquitous computing research?

- Noisy inputs
- Sensor fusion
- Context is only a proxy for human intent [Dey, in Krumm 2009]
- Lack of standardization in interface patterns
- Privacy

What are open opportunities in ubiquitous computing research?

- The hardware is increasingly easy to find and to program



Arduino Uno

What are open opportunities in ubiquitous computing research?

- New I/O opportunities are coming out every year — from industry and from HCI researchers

Next ubicomp topics

- Pervasive
  - Infrastructure-mediated sensing and behavior change
- Interaction
  - Tangible Bits and inFORM

In-class reading

The Computer for the 21st Century

Mark Weiser, 1999

Link on http://cs376.stanford.edu syllabus

25 minutes to read

10 minutes

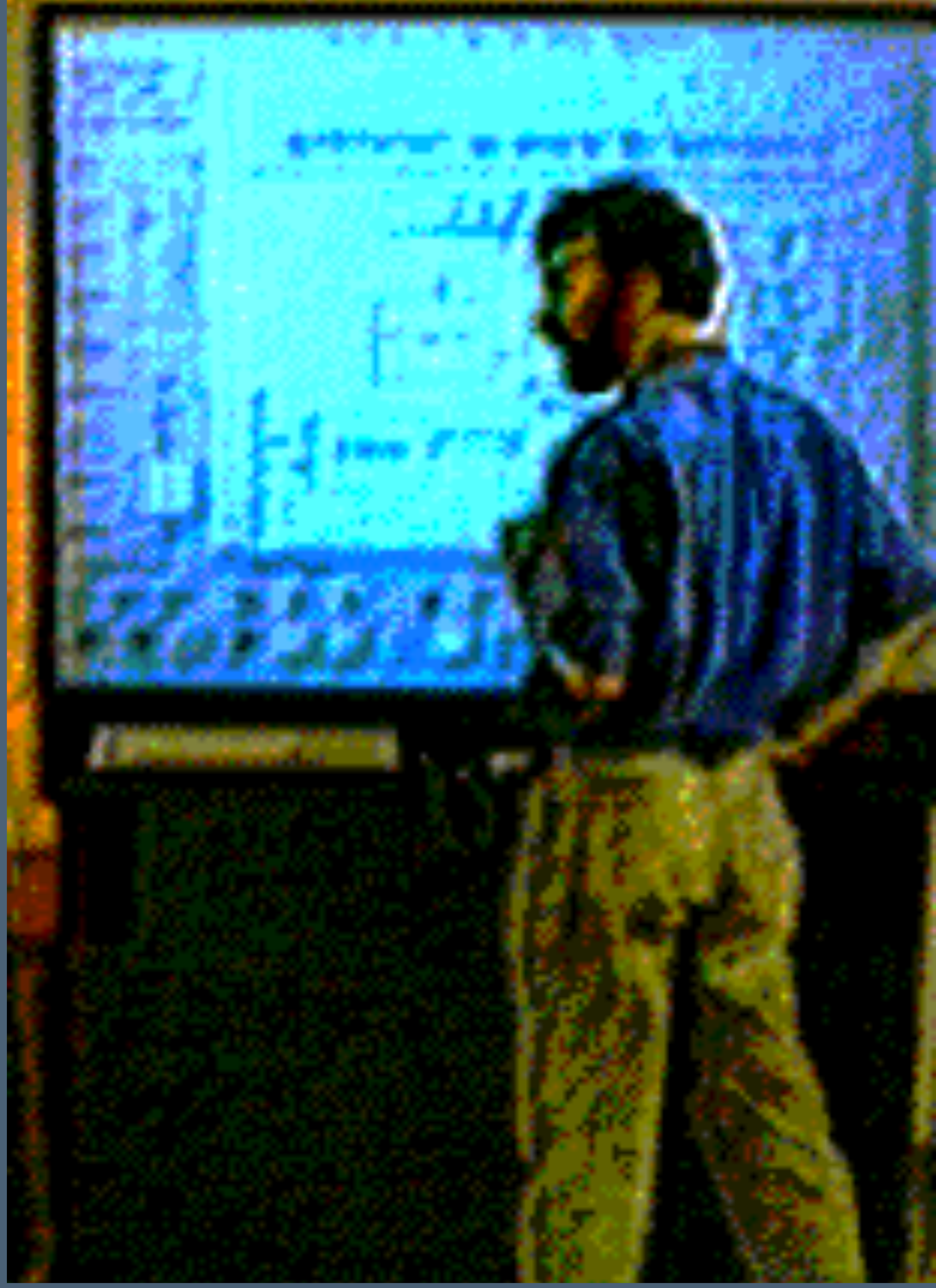
5 minutes

1 minute


SOFTWARE
PRESS
MUSIC
BACKGROUND
UBIQUITOUS COMPUTING

Tabs

Pads



Boards

What was most prescient?
What is still coming?
What might not come?

Wednesday: Introduction to Social Computing