CSE 440: Introduction to HCI
User Interface Design, Prototyping, and Evaluation

Lecture 15: Interface Implementation

James Fogarty
Alex Fiannaca
Lauren Milne
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Kelsey Munsell

Tuesday/Thursday
12:00 to 1:20
Today

Exam Q&A Time and Place
Comments on Mockups
A Story About Art
Comments on Presentations

Understanding Tools and Interfaces
Fogarty Adventures in Bad Visuals

Needed to Present for UW Innovation Award

Needed a storyboard, but am visually inept

First experience with oDesk/Upwork
Initially, the specification was unclear on what to do. Jane talks to her sister about potentially changing to a brother if it's easier to get a distinct character here.

They had similar issues, for them it turned out to be a need to control stress and get more exercise.

People are talking about what's causing Jane's issue is a recurring thing, look ahead to see that.

Stressed person icon is recurring, look ahead to see that.
Guidance on Desired Style

Desired Style

What can I buy that is healthy and easy to prepare?

But not this black on white color, see color and presentation slide
Version 1

Unsure What To Do
Unsure What To Do
Version 3

Unsure What To Do
Final Version

Unsure What to Do

- Consults Brother
- Had Similar Symptoms
- Shares his Triggers
- Stress & Exercise
Two Storyboards

Before Our Advances
After Our Advances

Three Iterations
Less Than Three Hours Time
Approximately $300
Before

Meet Jane

Severe Symptoms
Missing Work
Needs Help
Before

Unsure What to Do

- Consults Brother
- Had Similar Symptoms
- Shares his Triggers
- Stress & Exercise
Before

Tracking Mood and Physical Activity

- Buys a Fitness Band
- Tracks Mood
- Tracks Physical Activity
Before

Making Sense of the Data

Lots of Data
Mood Over Time
Activity Over Time
But No Understanding
Before

Maybe Her Doctor Can Help

- Did not Track Symptoms
- Did not Track Food
- Elimination Diet
- Difficult to Follow
- Lengthy Process
- Possibly Inconclusive
After

Revisiting Jane

Most Common Triggers
Food
Stress
Suitable Sensors / Apps
After

Appropriate Capture

Tracks for a Baseline
Automated Reminders
Low-Burden Tracking
Timely Symptom Input
After

Jane’s Personal Hypotheses

Possible Triggers
- Lactose
- Caffeine
- Stress

Confounding Effect
After

Self-Experimentation

Self-Experimentation
Lactose
Caffeine
Jane Has Her Answer
Engaging Clinician with Data

Data is Actionable

Personalized Interventions
Fogarty Adventures in Bad Visuals

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Presentation matters

In the real world, you can spend money on this
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Understanding Tools and Interfaces
Overall Message

Happy with talks, especially on Friday

    Prep, Calibration, Environment

Want everybody to keep improving

Room to improve in relating elements of your work, referring to reasons for design decisions
Timing

“An 8 minute time limit will be strictly enforced”

7:40          10:00
8:30          10ish
8:45          10:15
9:00          11:00
9:00          11:45
9:45          13:00
Tasks

**Categorize Time Spent**
What qualifies as work or play?

**Set Goals For Each Category**
How much time should you spend on each activity?

**Share Schedule and Free Time**
Who should be notified? Who is free right now?

**Decide What To Do While Waiting**
What can get accomplished within that time?

**Adapt Correctly To Schedule Changes**
What can be pushed back and what has a solid deadline?

**Get Reminders for Flexible Tasks**
When is the best time for lunch?
Storyboards

Star People!
Hard to Follow
Selected Design

- Simplest overall design of the three
- Most aesthetically pleasing due to effective organization and spacing
- Easy way to set goals without any outside pressure on what you choose
- Firmly addresses the most important user need of tracking overall usage
Storyboard 2:

1. David likes the new song released recently, so he shares it on the SR app.

2. When he posts it, he adds tags and defines the group of people he wants it to be seen.

3. Daniel then gets a message showing that David likes the music.

4. Daniel then messages David about his idea of the song.
Focus on the Right Thing

Contextual Inquiries

One person still uses food journaling consistently and has a positive experience. One person stopped food journaling because she reached her goal and had a nutritionist. The third person loves taking pictures of her food and just seeing what she’s been eating. Had them take us through their process during mealtime, motivations, difficult, benefits.
Initial Paper Prototype
Initial Paper Prototype
Task 1: Finding a SmartMatch

Criteria
- Level
- Avg Dist
- Avg Time
- Route Pref

Criteria
- Level
- Avg Dist
- Avg Time
- Route Pref

Frank
About: Happy guy who runs casually
Level: Novice
Rating: ★★★★

Jenn
No more matches found!!
Rating: ★★★

Match!
Finding Match
Match!
Add + Find Another
Add + Find Another
Testing - Results

- **Heuristic Evaluation**
  - High Severity Issues
  - Example: “Go Shopping” mode was useless

- **User Testing**
  - High and Medium Severity Issues
  - Example: Takes too long to get to “Add Item”

- **Design Mockup Critique**
  - Low Severity and Aesthetic Issues
  - Example: Home screen too cluttered
Final Paper Prototype

IEP-Connect Classroom

Many Screens on One Slide
Final Paper Prototype

Task 2 - Record Water Intake

Many Screens on One Slide
Fewer Screens, Show Connections
Fewer Screens, Show Connections
IMPROVED DESIGN

Sunday, November 2nd, 2014

Overall

Sessions

Distracted      Productive

Session 1

Session 2

60% 40%

Session 1 (9 am - 1:20 pm) - 4h 20 m

2h 10 m
facebook

20 m
conversations

1h 50 m
MatLab

Click on activity for more actions.
IMPROVED DESIGN

Sunday, November 2nd, 2014

- **Distracted**
  - Session 1: 30% (40 minutes)
  - Session 2: 20%

- **Productive**
  - Session 1 (9 am - 1:20 pm): 4 hours 20 minutes
  - 2 hours 10 minutes: Facebook
  - 20 minutes: Conversations
  - 1 hour 50 minutes: MatLab

Click on activity for more actions.
IMPROVED DESIGN

Sunday, November 2nd, 2014

Overall

Session 1
- Distracted
- Productive
- 2h 10m
- Facebook

Session 2
- 20m
- Conversations

1h 50m
- MatLab

Click on activity for more actions.
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Session 1 (9 am - 1:20 pm) - 4 h 20 m

- 2 h 10 m Facebook
- 20 m Conversations
- 1 h 50 m MatLab

Click on activity for more actions.
IMPROVED DESIGN

Sunday, November 2nd, 2014

Overall Sessions

Distracted  Productive

Session 1 (9 am - 1:20 pm) = 4 h 20 m

Session 1  40%  60%

2h 10m  facebook

20m  conversations

1 h 50 m  MatLab

Click on activity for more actions.
IMPROVED DESIGN

Sunday, November 2nd, 2014

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Sessions

Distracted  Productive

Session 1

Session 2

60%  40%

4 h 20 m

Session 1 (9 am - 1:20 pm)

2h 10m

facebook

20m

conversations

1h 50m

Mat Lab

Click on activity for more actions.
Initial Paper Prototype

Task 1: Is Netflix worth it?

1. View the Koala homepage
2. Navigate to Netflix Detailed View
3. View your Usage Score for Netflix
4. Go to Settings
5. Click “Unsubscribe”
6. Return to homepage
Initial Paper Prototype

Task 1: Is Netflix worth it?

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View Progress

Animation

Interface
<table>
<thead>
<tr>
<th>Category</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUNCH</td>
<td>$5.49</td>
</tr>
<tr>
<td>COFFEE</td>
<td>-$3.49</td>
</tr>
<tr>
<td>MOVIES</td>
<td>-$11.20</td>
</tr>
<tr>
<td>ICE CREAM</td>
<td>-$4.42</td>
</tr>
<tr>
<td>DINNER</td>
<td>-$7.79</td>
</tr>
<tr>
<td>COFFEE</td>
<td>-$4.89</td>
</tr>
<tr>
<td>BOWLING</td>
<td>-$10.20</td>
</tr>
<tr>
<td>KIT KAT</td>
<td>-$0.99</td>
</tr>
<tr>
<td>BRUNCH</td>
<td>-$11.42</td>
</tr>
<tr>
<td>BEER</td>
<td>-$4.00</td>
</tr>
</tbody>
</table>
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Understanding Tools and Interfaces
Tools and Interfaces

Why Interface Tools?
Case Study of Model-View-Controller
Case Study of Animation
Sapir-Whorf Hypothesis
Thoughtfulness in Tools
Sequential Programs

Program takes control, prompts for input

Person waits on the program

Program says when it is ready for more input, which the person then provides
Sequential Programs

while true {
    print "Prompt for Input"
    input = read_line_of_text()
    output = do_work()
    print output
}

Person is literally modeled as a file
Event-Driven Programming

A program waits for a person to provide input

All communication done via events

“mouse down”, “item drag”, “key up”

All events go to a queue

Ensures events handled in order
Hides specifics from applications
Basic Interactive Software Loop

```
do {
    e = read_event();
    dispatch_event(e);
    if (damage_exists())
        update_display();
} while (e.type != WM_QUIT);
```

Nearly all interactive software has this somewhere
Basic Interactive Software Loop

Have you ever written this loop?
Basic Interactive Software Loop

Have you ever written this loop?

Contrast with:

“One of the most complex aspects of Xlib programming is designing the event loop, which must take into account all of the possible events that can occur in a window.”

Understanding Tools

We use tools because they

- Identify common or important practices
- Package those practices in a framework
- Make it easy to follow those practices
- Make it easier to focus on our application

What are the benefits of this?
Understanding Tools

We use tools because they

- Identify common or important practices
- Package those practices in a framework
- Make it easy to follow those practices
- Make it easier to focus on our application

What are the benefits of this?

- Being faster allows more iterative design
- Implementation is generally better in the tool
- Consistency across applications using same tool
Understanding Tools

Why is designing tools difficult?

Need to understand the core practices and problems
Those are often evolving with technology and design

Example: Responsiveness in event-driven interface

Event-driven interaction is asynchronous

How to maintain responsiveness in the interface while executing some large computation?
Understanding Tools

Why is designing tools difficult?

- Need to understand the core practices and problems
- Those are often evolving with technology and design

Example: Responsiveness in event-driven interface

Cursor:
- WaitCursor vs. CWaitCursor vs. In Framework

Progress Bar:
- Data Races vs. Idle vs. Loop vs. Worker Objects
Fundamental Tools Terminology

Threshold vs. Ceiling

Threshold: How hard to get started
Ceiling: How much can be achieved
These depend on what is being implemented

Path of Least Resistance

Tools influence what interfaces are created

Moving Targets

Changing needs make tools incomplete or obsolete

Myers et al, 2000

http://dx.doi.org/10.1145/344949.344959
Tools and Interfaces

Why Interface Tools?
Case Study of Model-View-Controller
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Sapir-Whorf Hypothesis
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Model-View-Controller

How to organize the code of an interface?

This is a surprisingly complicated question, with many unstated assumptions requiring significant background to understand and resolve.
Seeheim Model

Results from 1985 workshop on user interface management systems, driven by goals of portability and modifiability, based in separating the interface from application functionality

Huh?
Seeheim Model

Lexical - Presentation
- External presentation of interface
- Generates the display, receive input
  e.g., “add” vs. “append” vs. “^a” vs. e.g., how to make a “menu” or “button”

Syntactic - Dialog Control
- Parsing of tokens into syntax
- Maintain state
  e.g., interface modes

Semantic - Application Interface Model
- Defines interaction between interface and rest of software
  e.g., drag-and-drop target highlighting
Seeheim Model
Seeheim Model

USER ➔ Presentation ➔ Dialogue Control ➔ Application Interface Model ➔ APPLICATION

Lexical

Syntactic

Semantic

Huh?
Seeheim Model

Rapid Semantic Feedback

In practice, all of the code goes in here
Model-View-Controller

Introduced by Smalltalk developers at PARC
Partitions application to be scalable, maintainable
View / Controller Relationship

In theory:

Pattern of behavior in response to input events (i.e., concerns of the controller) are independent of visual geometry (i.e., concerns of the view)

Controller contacts view to interpret what input events mean in context of a view (e.g., selection)
View / Controller Relationship

In practice:

View and controller often tightly intertwined, almost always occur in matched pairs

Many architectures combine into a single class
Model-View-Controller

MVC separates concerns and scales better than global variables or putting everything together

Separation eases maintenance

- Can add new fields to model, new views can leverage, old views will still work
- Can replace model without changing views

Separation of “business logic” can require care

- May help to think of model as the client model
Model-View-Collection on the Web

Core ideas manifest differently according to needs

For example, backbone.js implements client views of models, with REST API calls to web server

Web tools often implement views as templates
Model View View-Model

Design to support data-binding by minimizing functionality in view

Also allows greater separation of expertise
Tools and Interfaces

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Luxor Jr.
Luxor Jr.
Animation Case Study

Principles of Traditional Animation Applied to 3D Computer Animation

Lasseter, 1987

http://dx.doi.org/10.1145/37402.37407
Squash and Stretch
Squash and Stretch
Squash and Stretch

FIGURE 4a. In slow action, an object's position overlaps from frame to frame which gives the action a smooth appearance to the eye.

FIGURE 4b. Strobing occurs in a faster action when the object's positions do not overlap and the eye perceives separate images.

FIGURE 4c. Stretching the object so that its positions overlap again will relieve the strobing effect.
Timing

Just two drawings of a head, the first showing it leaning toward the right shoulder and the second with it over on the left and its chin slightly raised, can be made to communicate a multitude of ideas, depending entirely on the Timing used. Each inbetween drawing added between these two "extremes" gives a new meaning to the action.

NO inbetweens.......... The Character has been hit by a tremendous force. His head is nearly snapped off.

ONE inbetweens......... The Character has been hit by a brick, rolling pin, frying pan.

TWO inbetweens......... The Character has a nervous tic, a muscle spasm, an uncontrollable twitch.

THREE inbetweens..... The Character is dodging a brick, rolling pin, frying pan.
FOUR inbetweens......... The Character is giving a crisp order, "Get going!" "Move it!"

FIVE inbetweens......... The Character is more friendly, "Over here." "Come on-hurry!"

SIX inbetweens......... The Character sees a good looking girl, or the sports car he has always wanted.

SEVEN inbetweens......... The Character tries to get a better look at something.
Timing

EIGHT inbetweens.......... The Character searches for the peanut butter on the kitchen shelf.

NINE inbetweens........... The Character appraises, considering thoughtfully.

TEN inbetweens........... The Character stretches a sore muscle.
Anticipation
FIGURE 6. Andre's scratch was staged to the side (in "silhouette") for clarity and because that is where his itch was.
Staging

FIGURES 7-8. In Luxo Jr., all action was staged to the side for clarity.
Follow Through, Overlap, Secondary
Objects with mass must accelerate and decelerate. Interesting frames are typically at ends, tweaks perception to emphasize these poses.
Arcs
Luxor Jr.
Luxor Jr.
Animation: From Cartoons to the User Interface

Chang and Ungar, 1993
http://dx.doi.org/10.1145/168642.168647
Frames Three Principles

Solidity

Desktop objects should appear to be solid objects

Exaggeration

Exaggerate physical actions to enhance perception

Reinforcement

Use effects to drive home feeling of reality
Solidity: Motion Blur
Solidity: Arrival and Departure
Exaggeration: Anticipation

Figure 7. Objects anticipate major actions with a quick contrary motion that draws the user eye to the object in preparation for the main motion to come.
Reinforcement: Slow In Slow Out

Figure 8. Objects ease out of their beginning poses and ease into their final poses. Although these motions are slower than that during the main portion of the movement, they are still quite fast.
Reinforcement: Arcs

Figure 9. When objects travel under their own power (non-interactively), they move in arcs rather than straight lines.
Reinforcement: Follow Through

Figure 10. When objects come to a stop after moving on their own, they exhibit follow through in the form of wiggling back and forth quickly. This is just suggested by the “wiggle lines” in the figure—in actuality, the object moves back and forth, with motion blur.
Animation Support in a User Interface Toolkit: Flexible, Robust, and Reusable Abstractions

Hudson and Stasko, 1993

http://dx.doi.org/10.1145/168642.168648
Events and Animation

Figure 5. Animation Event Translation and Dispatch
Not Just an Implementation

Provides tool abstractions for implementing previously presented styles of animation

Overcomes a fundamental clash of approaches

- Event loop receives input, processes, repaints

- Animations expect careful control of frames, but the event loop has variable timing
Events and Animation

Figure 5. Animation Event Translation and Dispatch
Transition Object

Figure 3. Parts of a Transition Object
Pacing Function

Figure 4. Two Example Pacing Functions
Computing a Frame

Figure 8. Translation from Time to Space
Animation Case Study

Based on increased understanding of how animation should be done in the interface, increasingly mature tools develop

Now built into major commercial toolkits (e.g., Microsoft’s WPF, JavaFX, jQuery)

Once mature, begins to be used as a building block in even more complex behaviors
Animation Case Study

The Kinetic Typography Engine: An Extensible System for Animating Expressive Text

Lee et al, 2002

http://dx.doi.org/10.1145/571985.571997
Kinetic Typography Engine

Kinetic Typography

Johnny Lee, Jodi Forlizzi, Scott Hudson
Carnegie Mellon University
Human-Computer Interaction Institute
2002
Kinetic Typography Engine

Kinetic Typography

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Kinetic Typography Engine

Goals of Kinetic Type
- Emotional content
- Creation of characters
- Direction of attention

Based on existing work

Animation Composition

Figure 6. Waveform addition by chaining

Figure 7. Waveform scaling by functional composition with amplitude
Animation Case Study

Prefuse:
A Toolkit for Interactive Information Visualization
Heer et al, 2005
http://dx.doi.org/10.1145/1054972.1055031

D3:
Data-Driven Documents
Bostock et al, 2011
http://dx.doi.org/10.1109/TVCG.2011.185
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Sapir-Whorf Hypothesis

Language is not simply a way of voicing ideas, but is the very thing which shapes those ideas.

Tools not only make it easy to build certain types of software, they push you to think in terms of the types of software they can support.

You must be aware of this when choosing tools, designing applications, and creating new tools.
Phosphor: Explaining Transitions in the User Interface Using Afterglow Effects

Baudisch et al, 2006

http://dx.doi.org/10.1145/1166253.1166280
Phosphor

Animation can help people follow interface transitions

But the right speed is crucial

Too fast increases error rate
Too slow increases task time

The right speed depends on familiarity, distraction, etc.

It cannot be determined
Phosphor shows the outcome immediately, then explains the change in retrospect using a diagrammatic depiction.
Phosphor

phosphor
Phosphor

phosphor
Challenging Assumptions of Tools

Phosphor breaks from the assumptions that have evolved into current transition tools
Tools and Interfaces

Tools embody expertise and assumptions

Tools evolve based on emerging understanding of how to address categories of problems

Be conscious of your tool decisions

Try to think about designs before tying to a tool
Choose good and appropriate tools
Understand what you are getting in a tool
Push yourself to think outside the tool
Prefab
Prefab
Prefab

Prefab uses pixel-level analysis to modify existing applications from the outside, using only pixels

Prefab is informed by how toolkits work, but not linked to any particular toolkit implementation

Allows trying and fielding new ideas that are not supported by existing applications or toolkits
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