Lecture 16

Human-Centered Development

Three Approaches to UI Design

• Attitude of technology-centered development
  – Progress made by technological advances
  – The more bells & whistles the better

• Attitude of designer-centered development
  – Progress made by considering the intuitions of the designer
  – Imagining what the user will do and feel

• Attitude of human-centered development
  – Progress made by incorporating the users into the design process
  – Empirical studies integrated early into the design
Human-centered software development
(John Gould, IBM 1983)

- Definition
  - Early and Continuous Focus on Users
    - Direct contact through interviews, observations, surveys, participatory design in order to understand characteristics of users and their jobs
  - Integrated Design
    - All aspects of usability need to be parallel, all aspects of usability under one focus or period
  - Early and Continuous User Testing
    - Throughout development, intended users involved throughout the design and prototyping of their performance and functions are monitored qualitatively and quantitatively
  - Iterative Design
    - As the system matures, user interfaces, help systems, etc. are kept flexible and modified based upon results of user testing; testing cycle is repeated

Iterative Model of Development

- Steps in method

Steps in method (note: iterative!)

1. Planning
   - Scope of project, investigate user population (document analysis, interviews, surveys, observation) & related systems
2. Requirements Analysis
   - Task analysis of existing system, problem scenario development
   - Requirements for usefulness (functionality) and usability
3. Design (Presentation & Interaction Design)
   - Specifications (yes!) for human-computer interaction (UI)
4. Implementation (Prototyping)
   - Storyboards, mock-ups, software prototypes
5. Usability Evaluation
   - Evaluation without users: cognitive walkthrough, heuristic evaluation (guidelines), GOMS, Keystroke Level Model (KLM)
   - Evaluation with users (usability testing, interviews, questionnaires)
Step 1: Planning

- Scope of project
  - Time frame
  - Costs and other resources
  - Purpose
  - Context
- Gathering information about needed system
  - Prior and related systems
  - User studies
    - Who are the users?
    - What should the system do?
    - User needs
    - User constraints

User Studies

How do you get user information?

- Artifact analysis
- Interviews
- Observation
- Participation
- Survey/Questionnaire
Artifact Analysis

- Collect and examine the documents, objects and other resources that people use in their activities
- Try to understand the content of the information and the role it plays in activities

Interviews

- Advantages
  - Gathers opinion, Creates rapport
- Disadvantages
  - Must be well-planned
  - Bias: Information often filtered
- Types
  - Structured
    - Fixed set of questions with simple answers
  - Unstructured
    - More open questions

Observation

- Advantages
  - Not an opinion, but an objective record
  - Captures detail
- Disadvantages
  - Intrusive, Time consuming
- Types
  - Passive: “Hanging out”
    - Used in very early design when don’t have much information about user’s activities
  - Active
    - Provide users with problems to solve or tasks
Participation

- When the observer learns and participates in the work activities
- Overcomes the Hawthorne effect
  - Bias of being observed
- Obtain otherwise privileged information
- Creates first-hand domain knowledge

Survey/Questionnaire

- Purpose
  - Reaches lots of people
  - Perform statistical analysis on data
  - Avoids bias by anonymity
  - Consistent questions
- Design Issues
  - Must be carefully designed, do pilot
  - Must not be time-consuming & easy to reply
  - Must make sense
  - Must gather precise answers, not vague ones
  - Ask only questions which support the design
  - Sample vs. population

Survey: Good Example

![Survey Example Image]
Step 2: Requirements Analysis

- What is a requirement?
  - What the system will do, not how
  - Captures constraints as well
  - Types of requirements
    - User Functions: what the user can do
    - Usability: combines functions with usability measures
    - Other: hardware, software functions or constraints

Goals for requirements analysis

- **Ascertain the user’s needs**
  - Determine what tasks and subtasks must be carried out
  - Include tasks which are only performed occasionally. Common tasks are easy to identify.
  - Functionality must match need or else users will reject or underutilize the product

Getting User Requirements
Requirements

- Example: Rapid Transit Ticket Dispenser
  - Functional requirement: User must be able to purchase ticket
  - Usability requirement: User must be able to purchase simple ticket in under 2 minutes.
  - Functional requirement: Support for blind users.
  - Usability requirement: Blind user must be able to purchase simple ticket in under 4 minutes.
  - Functional requirement: User instructions should be in English and Spanish.
  - Usability requirement: User must be able to read instructions at 8th grade level.

Requirements as Tasks

- Example: Rapid Transit Ticket Dispenser
  - Function: Purchase ticket
    - Subfunction: Determine fare
      - Give the destination
      - Specify journey type, either one-way or round trip
      - Receive quoted fare
    - Subfunction: Obtain ticket
      - Pay the money
      - Receive the ticket and any change due
  - NOTE: Hierarchical levels of abstraction

Step 3: Design

- Why do we document the proposed design as a specification?
  - Formalizes Design
    - Specification proposes the exact user interaction and presentation; leaves nothing to ad hoc decisions
  - Guides Implementation
    - Used to define the programming implementation
  - Creates Communication
    - Represents the evolving design to the client and all members of the team
  - Evaluates design
    - Completeness, correctness, consistency and performance times
Design Specification Types
- Presentation specification
  - Initially low fidelity sketches progressing to screen shots
- Interaction specification
  - Describes the Tasks beginning with the core
  - Types
    - Narrative
    - Storyboard
    - Network

A Picture Is Worth 1000 Words!

ATM User Interface Layout
Sketch: Virtual Science Fair Exhibit Window

Screen shot: Virtual Science Fair Exhibit Window

Interaction as Narrative

- Definition
  - Sentences describing the tasks: how the user accomplishes each functional requirement
- Reference within the text to a view of the presentation (screen)
- Can also represent tasks and actions as indented text
- Can include the context for the task and fictional users: scenario
- Can be used in user documentation for completed system
Interaction as Narrative

- Example: Graphics editor
  - To draw a Bezier curve, the user selects “Bezier” from the Draw menu (see Figure 1), and then chooses either “Point-to-point” or “Curve fit”. In point-to-point mode the user then clicks on positions in the drawing window. The system draws a Bezier curve fit to each point. (See Figure 2 for an example.)

Interaction as Storyboard

- Definition
  - a method developed by animators many years ago to design cartoons
- Storyboard shows the major “moments” in an animation as a sequence of pictures
- Storyboard can be used to show user interaction as a sequence of pictures of the screen
- May be annotated with comments

Storyboard Example: ATM Machine

- Type: Sequence of Screens
- Task: Fast Cash Money Withdrawal
ATM Screen 1a

The Exchange
Please insert your card
-face up-

ATM Screen 1b

The Exchange
Please insert your card
-face up-

Hello
Sarah Ann Douglas
Please enter your PIN
Press when done------>
Press Cancel if error made

ATM Screen 4

Select your transaction
Press cancel if error made

Fast Cash $40------>
Withdrawal------->
Balance----------->
Next Selection------>
ATM Screen 8
Transaction being processed
Please wait

ATM Screen 5
Please remove your cash from tray

ATM Screen 6
Do you want another transaction?
Yes
No
ATM Screen 3

Please take card

Thank you!

ATM Screen 1

The Exchange

Please insert your card

-face up-

Virtual Science Fair Storyboard
Virtual Science Fair Exhibit
Initial Window Sketch

Virtual Science Fair Exhibit
Initial Window Mockup

Beyond Storyboards to Interaction Networks

• Definition: Interaction network
  – Abstract representation of the interaction between the user input and the display
  – Augmented Transition Network (ATN)
    • Nodes
      – System response
    • Arcs
      – User action
      – Finite State machine
ATM Example

ATM Example

ATM Screen 2
Do you want more time?

Yes---------------------->

No----------------------->
ATM Example

ATM Screen 7
Select Account for Balance inquiry
Press cancel if error made
Checking --> Savings --> Credit Card -->

ATM Example
Example: Heartbeat

Heartbeat Set Preferences

Step 4: Implementation (Prototyping)
- Physical Storyboards
- Mock-ups
- Software prototypes
Step 5: Usability Evaluation

- Another whole lecture!