What we expect

1. A set of requirements
   contract style • ≤4 pages

2. A set of use cases
   Pressman style • ~10–20 pages

3. A GUI design
   covering all “must-have” and most “may-have” use cases

4. Architectural models and data models
   covering all “must-have” and most “may-have” use cases

5. An executable prototype
   covering all “must-have” use cases
When an application has been designed to market or sell products or ideas, aesthetics may have as much to do with success as technical design.

What is good design?

Don't go to the right?

Check the link for examples of bad designs.
What do these symbols mean?

Real example from a (expensive) car (as in the picture, no idea which model)—the icons on the buttons placed on the car’s dashboard are unclear. I have highlighted the vague ones in red.

How much is the gas?

It is not obvious which label belongs to which field.

Interface

Examples of “cool” interfaces.
Interface

Definition

interface
n. Computer Science

- The point of interaction or communication between a computer and any other entity, such as a printer or human operator.
- The layout of an application's graphic or textual controls in conjunction with the way the application responds to user activity: an interface whose icons were hard to remember.

What is Design?
What is Design?

Design is not just what it looks like and feels like. Design is how it works.

Super cool chopstick - the front end doesn't touch the table.

Apple isn't perfect. Some examples of problems with Apple products – faulty CDs, discolored handrests, smoking connectors, and exploding batteries.
What is Design?

2007
Balenciaga Collection

User is centric to design. Every decision should be made keeping the user in mind.

User-Centric Design

- Cost saving!
- Competitive market - user expectations.
- Political demands
- Is Help always helpful?
Human Capabilities

- Memory
- Attention
- Visual Perception
- Learning
- Color
- Language + Communication
- Ergonomics

Memory

- Associations are built by repetition.
- Scaffold model (more likely to remember items that have many associations).
- Recognition is easier than recall.
- Working memory has small capacity.
- Long-term memory has large capacity.

Attention

- Attention is a resource – gets divided amongst tasks.
- Automatic well-learnt processes not need much attention.
- Important to get (for you as a designer).
Visual Perception

• We excel at pattern recognition.
• We automatically try to organize visual displays and look for cues.
• Motion, grouping, contrast, color can make different parts of a display more or less salient.

Learning

• Learning is improved by organization.
• Consistency and mnemonics improve learning.
• Targeted feedback facilitates learning.
• Learning occurs across people and organizations.

Learning

• Incrementally presented information accelerates learning.
• Some users like to explore systems to learn; others will not.
• Workers focus on accomplishing tasks, not learning software.
Color

- Red-green color blindness (protanopia & deuteranopia)
  - 8% of males
  - 0.4% of females
- Blue-yellow color blindness (tritanopia)
  - Far more rare
- Guideline: don’t depend solely on color distinctions
  - use redundant signals: brightness, location, shape

Protanopia = absence of red receptors
Deuteranopia = absence of green receptors
Tritanopia = absence of blue receptors

Traffic lights are readable even for color-blind people (due to location of lights). Also notice the blueish tint in the “green” light.

Example of an Ishihara color test plate.
[Note 1] The numeral "74" should be clearly visible to viewers with normal color vision. Viewers with dichromacy or anomalous trichromacy may read it as "21", and viewers with achromatopsia may not see numbers. [Wikipedia]
Language + Communication

syntax, semantics, pragmatics; conversational interaction, specialized languages

Ergonomics

arrangement of displays and controls; cognitive and sensory limits; effects of display technology; fatigue and health; furniture and lighting; design for stressful and hazardous environments; design for the disabled...

Where does user-centered design fit into the development process?
Traditional Waterfall Model

Requirements → Design → Code → Integration → Acceptance → Release

Waterfall Model Poor for UI Design

- UI design is risky.
  - So we are likely to get it wrong.
- Users are not involved in validation until acceptance testing.
  - So we won’t find out until the end.
- UI flaws often cause changes in requirements and design.
  - So we have to throw away carefully written and tested code.
Iterative Design

- Design
- Implement
- Evaluate

Why NOT Iterative Design?

- Every iteration corresponds to a release
  - Evaluation (complaints) feeds back into next version’s design
- Using your paying customers to evaluate your usability
  - They won’t like it
  - They won’t buy version 2

Spiral Model

Iterative design is the current best-practice process for developing user interfaces. It’s a specialization of the spiral model described by Boehm for general software engineering.

each iteration has a cost or fidelity or accuracy
Spiral Model Iterations

- Early iterations use cheap prototypes (paper prototyping).
- Later iterations have richer implementations.
- More iterations generally means better UI.
- Only mature iterations are seen by the world.

Paper Prototyping

Figure 1.1 A hand-drawn paper prototype of a screen from an application used to design filters for scientific data.

Credits: Nielsen Norman Group
Paper Prototyping

- Fast way to mock up an interface - no coding required.
- Finds a variety of problems with the interface.
- Allows an interface to be refined based on user feedback before implementation begins.
- A multidisciplinary team can participate.
- Encourages creativity from the product team and users alike.

One may also compose parts of these on a computer, of course (at various levels of detail, up to a full-fledged mockup).
Disadvantage

- Doesn’t produce any code.
- Does not find all classes of problems with an interface.
- Can affect the way users interact with the interface.
- Users might think it is unprofessional.
- Has stronger benefits in some situations than in others.

UI Analysis & Design

- Iterative Design using a Spiral Model.
- Early focus on users and tasks.
  - User analysis: who the users are.
  - Task analysis: what they need to do?
  - Involve users as evaluators, consultants and sometimes designers.
- Constant Evaluation

Know Your User

- Novice
- Knowledgeable, intermittent user
- Knowledgeable, frequent user
- Age, gender, ethnicity
- Physical abilities
- Domain experience
- Application experience
- Work environment
- Communication patterns

For 2nd pt., imagine you need to test how to draw a curved line on Adobe Photoshop or how to operate an ego shooter. Paper prototyping is not the best way!
Know Your User

- Techniques
  - Questionnaires
  - Interviews
  - Observations
- Obstacles
  - Artificial barriers between developers and users.
  - Some users are expensive to talk to.

Example: Self-Service Grocery Checkout

- Who are the users?
  - Grocery shoppers
  - Wide age range
  - Possibly no computer experience
  - No training
  - Knowledge of products, but not management
  - Shoppers help each other.
  - Mostly women with small children.
  - Store assistants to help users.

Let’s look at an example. Suppose we’ve been charged with designing a system that will allow grocery shopper to ring up and pay for their purchases themselves.

Task Analysis

- Identify the individual tasks to be solved.
- Each task is a goal.
- Start with the big goal and then, decompose hierarchically.
  - Overall goal: Shoppers want to purchase groceries.
  - Tasks:
    - Register groceries into the system.
    - Pay

The next step is figuring out what tasks are involved in the problem. A task should be expressed as a goal: what needs to be done, not how.
Essential Parts of Task Analysis

1. What must be done?
   - Goal

2. What must be done before to make it possible?
   - Preconditions
     - Tasks on which this task depends
     - Information that must be known to the user

3. What steps are involved in doing the task?
   - Subtasks (may be decomposed recursively)

Example: Self-Service Grocery Checkout

- Goal
  - Enter groceries into register
- Preconditions
  - All groceries that you want are in the cart
- Subtasks
  - Enter pre-packaged items
  - Bag loose items, weigh and register them.

Dangers of Task Analysis

- Duplicating a bad existing procedure in software.
- Example: Flipping through a book
- Failing to capture good aspects of existing procedure
- Ask users why they do what they do, not just what they do

Suppose we did a task analysis by observing users interacting with paper manuals. We'd see a lot of page flipping: “Find page N" might be an important subtask. We might naively conclude from this that an online manual should provide really good mechanisms for paging & scrolling, and that we should pour development effort into making those mechanisms as fast as possible. But page flipping is an artifact of physical books! It would pay off much more to have fast and effective searching and hyperlinking in an online manual. That’s why it’s important to focus on why users do what they do, not just what they do.
Improve Task Analysis

- Questions to ask
  - Why do you do this? (goal)
  - How do you do it? (subtasks)
- Look for weaknesses in current situation
  - Goal failures, wasted time, user irritation
- Contextual inquiry
- Participatory design

User Design Principles

Observe users doing real work,
Challenge assumptions and probe surprises

Usability Principles

Nielsen’s 10 Principles Of UI Design
Nielsen’s Principles

1. Match the real world
2. Consistency and Standards
3. Help and Documentation
4. User Control and Freedom
5. Visibility of System Status
6. Flexibility and Efficiency
7. Error Prevention
8. Recognition, not Recall
9. Error Reporting, Diagnosis, Recovery
10. Aesthetic and Minimalist Design

Match the Real World

THE PROBLEM IS YOUR MODEM CAN’T INTERFACE WITH YOUR ISP BECAUSE YOUR RJ11 CABLE NEEDS UPGRADING

WILL IT COST MUCH?

THAT DEPENDS ON WHETHER YOU KNOW I JUST SAID “YOU NEED A LONGER PHONE CORD”

Match the Real World

- Examples
  - Desktop
  - Trashcan
- Dangers of metaphors
  - Often hard for designers to find
  - Deceptive
  - Constraining
  - Breaking the metaphor
- Use of a metaphor doesn’t excuse other bad design decisions
Direct Manipulation

- User interacts with visual representation of data objects
  - Continuous visual representation
  - Physical actions or labeled button presses
  - Rapid, incremental, reversible, immediately visible effects
- Examples
  - Files and folders on a desktop
  - Scrollbar
  - Dragging to resize a rectangle
  - Selecting text
- Visual representation and physical interaction are important

Affordances
of direct manipulation

- Perceived and actual properties of a thing that determine how the thing could be used
  - Chair is for sitting
  - Knob is for turning
  - Button is for pushing
  - Listbox is for selection
  - Scrollbar is for continuous scrolling or panning
- Perceived vs. actual

Natural Mapping

- Physical arrangement of controls should match arrangement of function
- Best mapping is direct, but natural mappings don’t have to be direct
  - Light switches
  - Stove burners
  - Turn signals
  - Audio mixer
Feedback / Responsiveness

- Actions should have immediate, visible effects
  - Push buttons
  - Scrollbars
  - Drag & drop
- Kinds of feedback
  - Visual
  - Audio
  - Haptic (conveyed by sense of touch)

Consistency and Standards

Guidelines for Mac, Windows, Gnome, KDE, Android, iOS...

UI and writing!

Help and Documentation

Help should be (a) searchable, (b) context-sensitive, (c) task sensitive, (d) concrete, (e) short, (f) not needed
User Control and Freedom

- Provide Undo
- Long operations should be allowed to be paused/suspended
- All dialogs should have a cancel button

Visibility of System Status

- Change cursor to indicate action
- Use highlights to show selected objects
- Use status bar to show progress

Flexibility and Efficiency

- Recently-used history is one very useful kind of shortcut, like this recently-used files menu
Error Prevention

One way to prevent errors is to allow users to select rather than type. Misspellings then become impossible.

Recognition, not Recall

Use menus, not command languages
Use combo boxes, not textboxes
Use generic commands
All needed information must be visible

Error Reporting, Diagnosis, Recovery

A good error message should (1) be precise; (2) speak the user’s language, avoiding technical terms and details unless explicitly requested; (3) give constructive help; and (4) be polite
Aesthetic and Minimalist Design

Microsoft designs the iPod package
User Interface Testing

• How do you know you did everything well?
• Only way: Have real users test it!

Email "A Tale of Two Cities"

This task was performed using Suse 9.3 in a Portable Lab on the GNOME desktop. The test was administered in English. The following is a description of the task:

Your friend Arthur loves "A Tale of Two Cities". Please email the electronic book to him. His email address is arthur@ximian.com.
Issues Encountered

- Mail Client is referred to as “Evolution” (not “Mail” or similar)
- “Send/Receive” Button does not compose mail (but syncs with server)
- Attachment list hidden by default
- 20% of users failed to send mail
- Average successful time was 4:23 minutes


Reaction

- Typically, when project managers observe their design undergoing a usability test, their initial reaction is:

  Where did you find such stupid users?

Eye tracking

The following heatmap from one of our eyetracking studies shows how users looked at this homepage. Their task was to find the current population of the United States.
This and the following are poor examples of GUI design. In this slide, there is basically so many options, full of text, non-descriptive icons.

Tabs

Too many tabs???

Rewind

This seems to be a print dialog. Only the designers know what does the "rewind" button mean.
In Microsoft Assistant Killed in Denver, it was reported that Microsoft program managers demonstrated a technique to kill the assistant to a crowd attending a development conference.

On MS-word, there are so many possible effects on the same text. Note that options such as Strikethrough and Doublestrikethrough can be opted together for the same text. Similarly, subscript and superscript.
503 Polite People

The User at the centre of any design activity

“503 polite people say hello first”

Type “Mismatch”

The poor secretary, confronted with this message, simply typed “mismatch” – without success :-(

Interface

Summary

Nielsen’s Principles

1. Match the real world
2. Consistency and standards
3. Help and documentation
4. User control and Freedom
5. Avoidance of system traps
6. Memory and efficiency
7. Error prevention
8. Recognition not recall
9. Error reporting
10. Aesthetic and minimal design