Prototyping for Designers

Embedded Interface Design

with **Bruce Montgomery**

Learning Objectives

Students will be able to…

- Consider prototyping from other perspectives
- Recognize different goals for varying proto fidelity
- Consider mechanical prototyping options

Before we start

- So, Alan Kay?
- Did we learn anything?

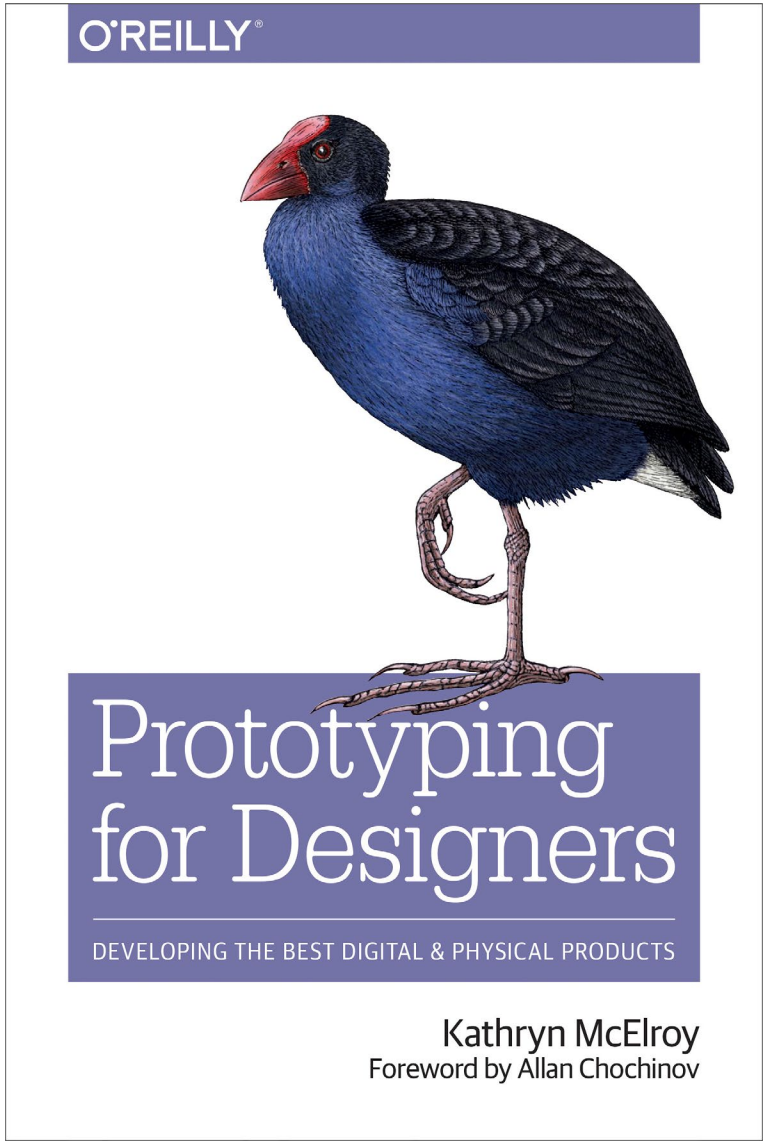
- If you attended the Alan Kay talk, and you'd like your 5 points of quiz extra credit, go to this link and sign in:
- https://docs.google.com/document/d/14m_hZVhcz4hnzjKso-p1gAiYTQmVmcmogO44dPR6q4M/edit?usp=sharing

Prototyping again? Haven't we covered this?

- We've talked about software tools and cloud-based tools for software and interface prototypes
- We've talked about user experience approaches to prototyping and using paper or higher-fidelity prototypes for user testing
- We've talked about UX processes for progressively elaborating design with user involvement
- This is a little different view of prototyping as a process for design – really elaborates on some points we've made
- We'll touch on mechanical prototypes here too
- Later we'll look at alternative microprocessor platforms to the RPi3 and other tools for embedded device prototypes

Prototyping for Designers

- McElroy, 2016, O'Reilly
- What and Why
- Fidelity
- Prototyping Process
- Digital and Physical Protos
- Testing with Users
- Embedded Device Platforms and Support
- Lots of Resources and Links
- Very on target for class, using first time as secondary textbook
- Reference [1]



What is a Prototype?

- The Oxford definition: “A first, typical or preliminary model of something, especially a machine, from which other forms are developed or copied.”
- The definition misses the usual intent to test and improve and detail over time, or to increase scope
- An audition (Etsy), an interview (IDEO)

- Reference [1]

Prototype – Interactive or Static?

- Some say a prototype is anything testable and improvable
- Some say a prototype must be interactive
- Seeing everything as a prototype gives you an opportunity to always be testing your assumptions, regardless of the means
- Your benefit will be incremental improvement and product feedback

- Reference [1]

Prototyping Mindset

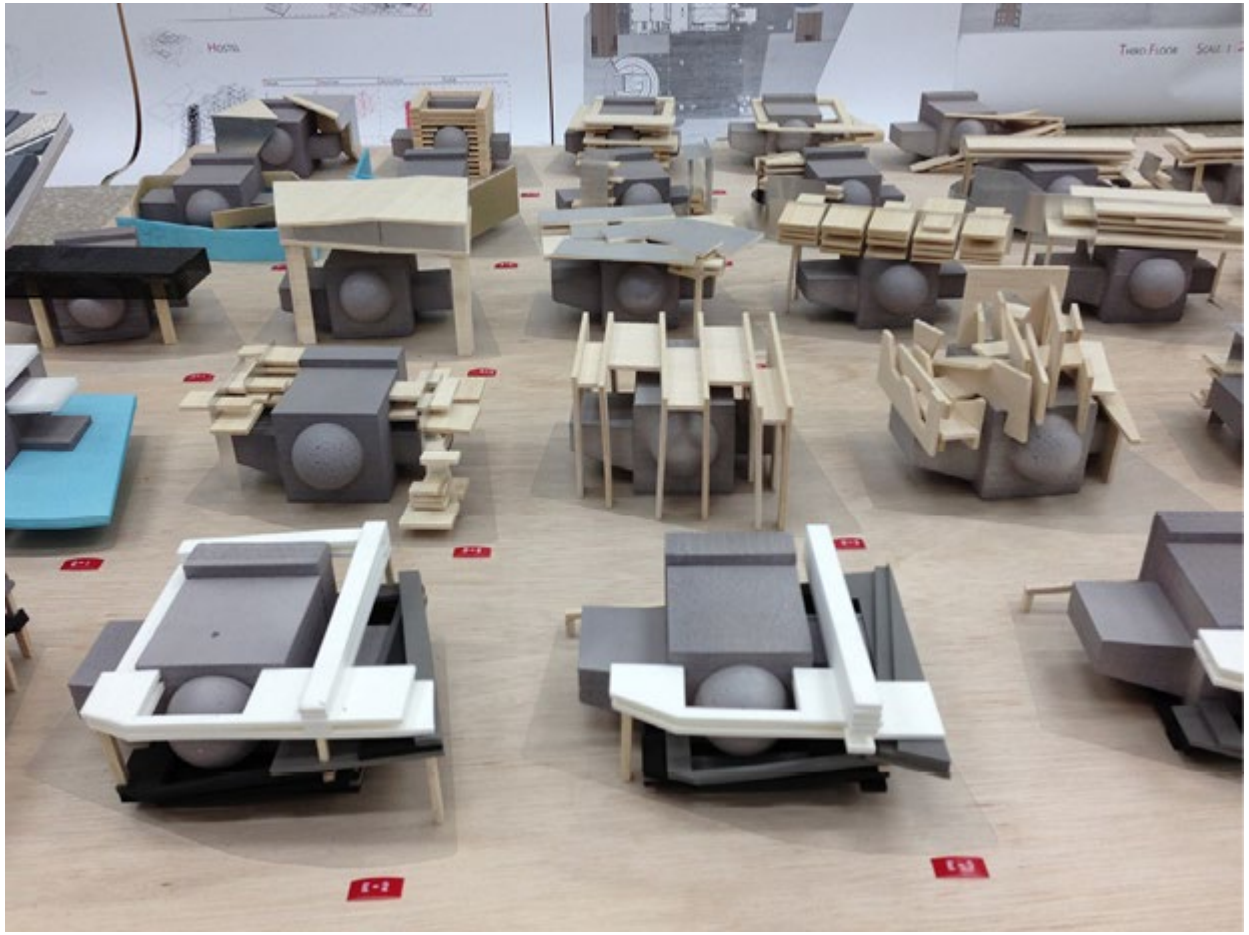
- It’s natural to have discomfort at showing unfinished work
- But you must be able to be open to feedback, as each interaction strengthens a design
- The more you can make prototyping a natural part of your entire design process, sharing early concepts with stakeholders, peers, and users, the more improvement you can make
- Developing skills to quickly prototype ideas will allow more test and improve cycles, and should lead to providing key features for products in desired design periods for delivery

- Reference [1]

Prototyping Examples

- Architecture
  - Common to create models and presentations at different design stages to communicate design intents for a building or a space

- Reference [1]



Prototyping Examples

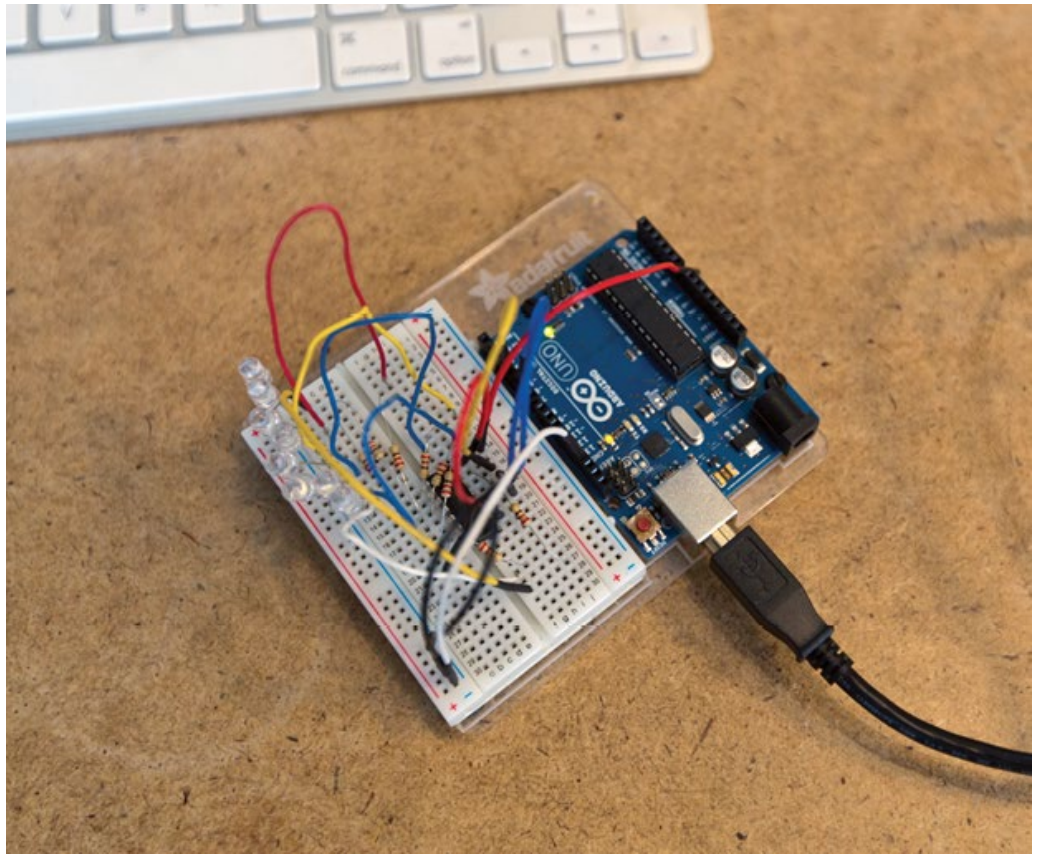
- Industrial Design
  - Common practice to create many prototypes, with ergonomics, ease of use, and manufacturability in mind
  - Sketches, foam models, material reviews, aesthetic models, scaled mockups, 3D physical models, and final models

- Reference [1]

Prototyping Examples

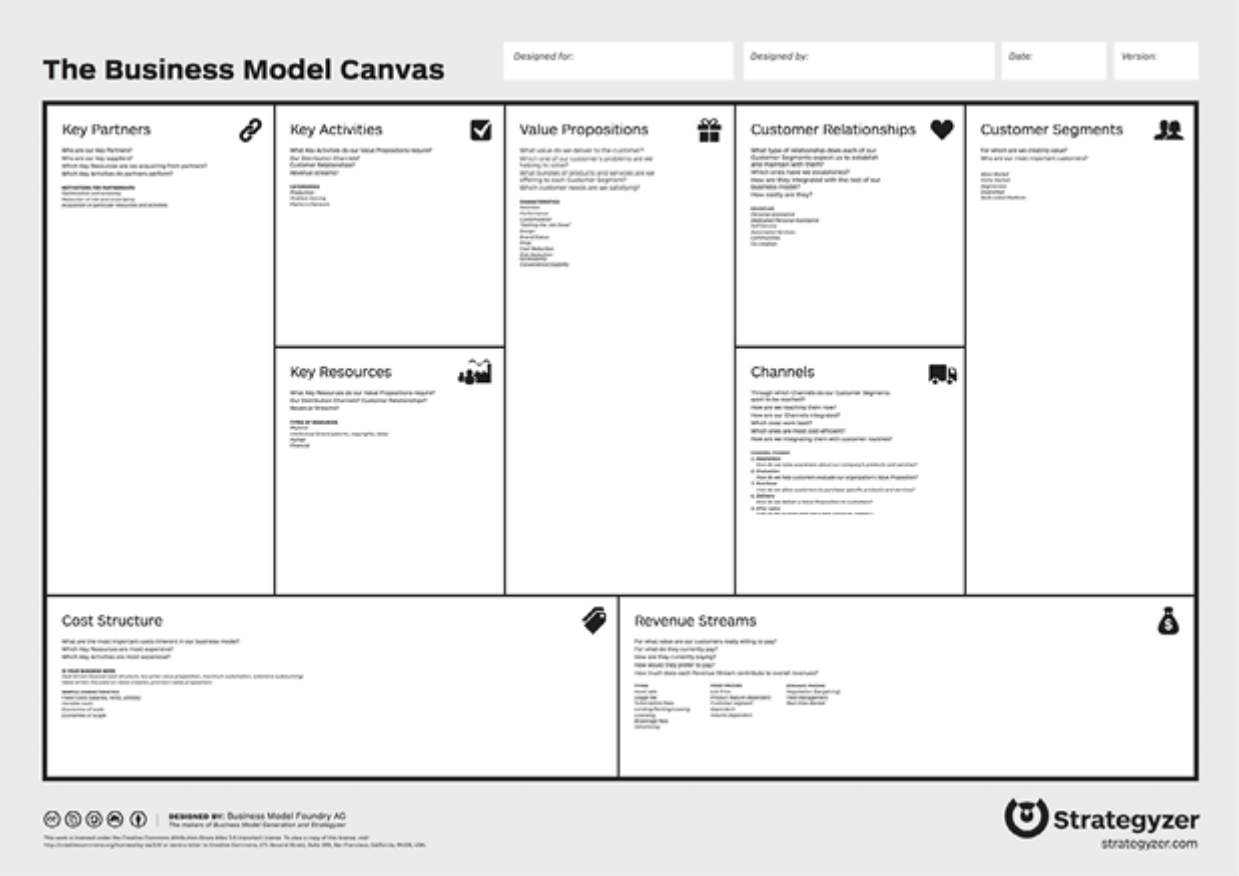
- Personal Electronics
  - From initial concepts on breadboards to full works-like models with custom boards
- Software and Apps
  - Sketches, Wireframes, Mockups, Prototypes with increasing functionality

- Reference [1]



Why prototype?

- To understand users, problems, and solution correctness
  - Problem discovery
- To find alternative solutions
  - Avoid being stuck on one design
- To understand strategy
  - The problem being solved, value propositions, channels, resources, etc.
  - Plan a roadmap for development
  - Image: The Business Model Canvas
- Reference [1]



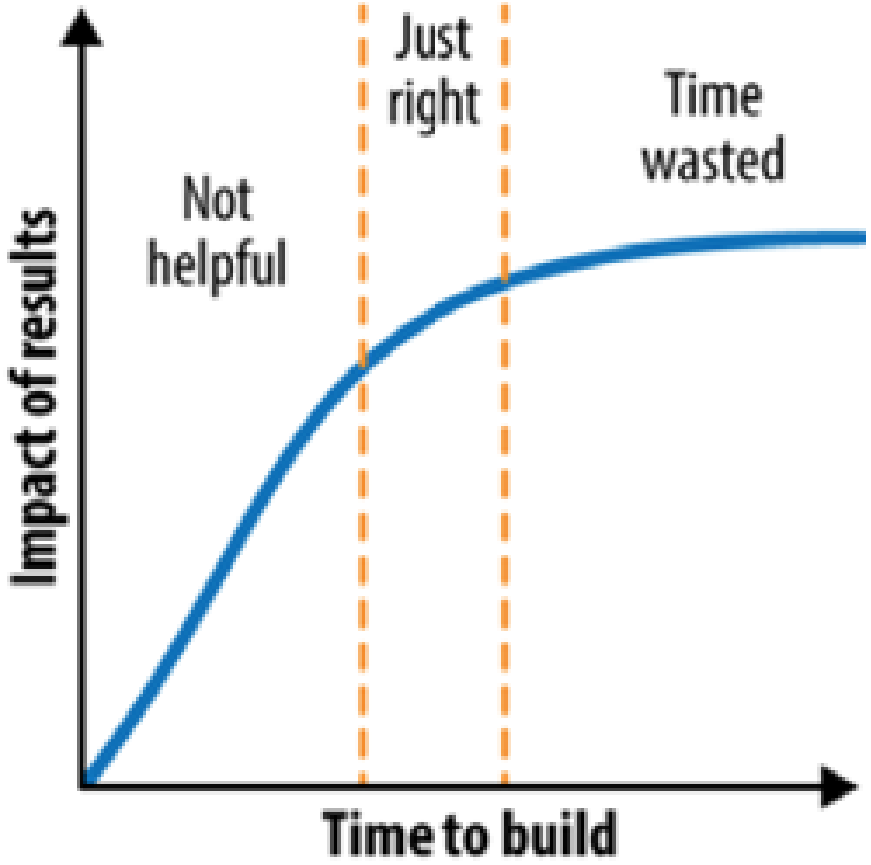
Why prototype?

- Understand user flows
- Support user-centered design
  - Our UX design processes
- Communications
  - Help focus meetings
- Develop a culture of prototyping
  - Weekly feedback sessions
- Testing and product improvement
- Advocating for designs, user needs, product directions

Reference [1]

How much effort for prototypes?

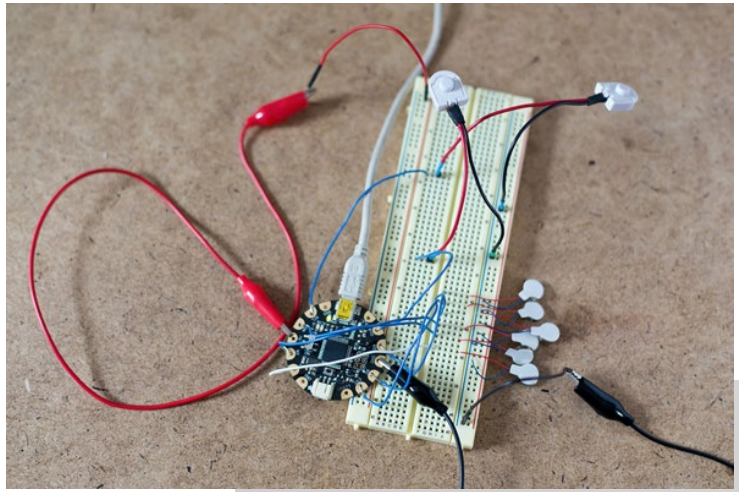
- You have to decide on the time and effort for a prototype based on its impact or value
- Start with low fidelity and increase fidelity levels until assumptions are tested and proven or fixed
- Generally more simple prototypes at frontend, less as ideas are refined
- Danger in fidelity being too high, as users will subconsciously see the design as finished

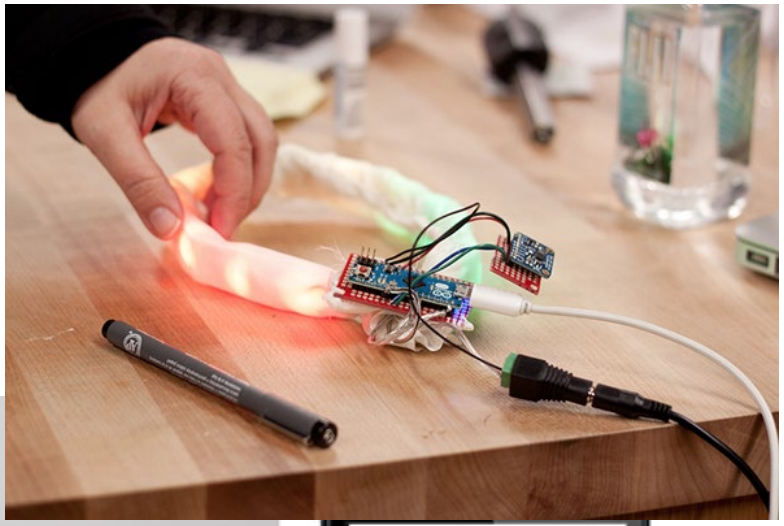


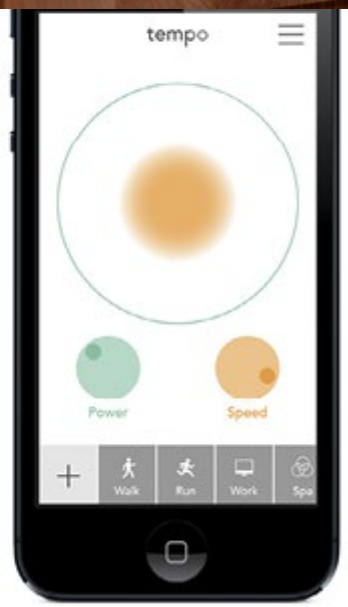
Reference [1]

Prototype Fidelity

- Low, Mid, and High Fidelity Levels
- Pros, Cons, and Uses
- Reference [1]







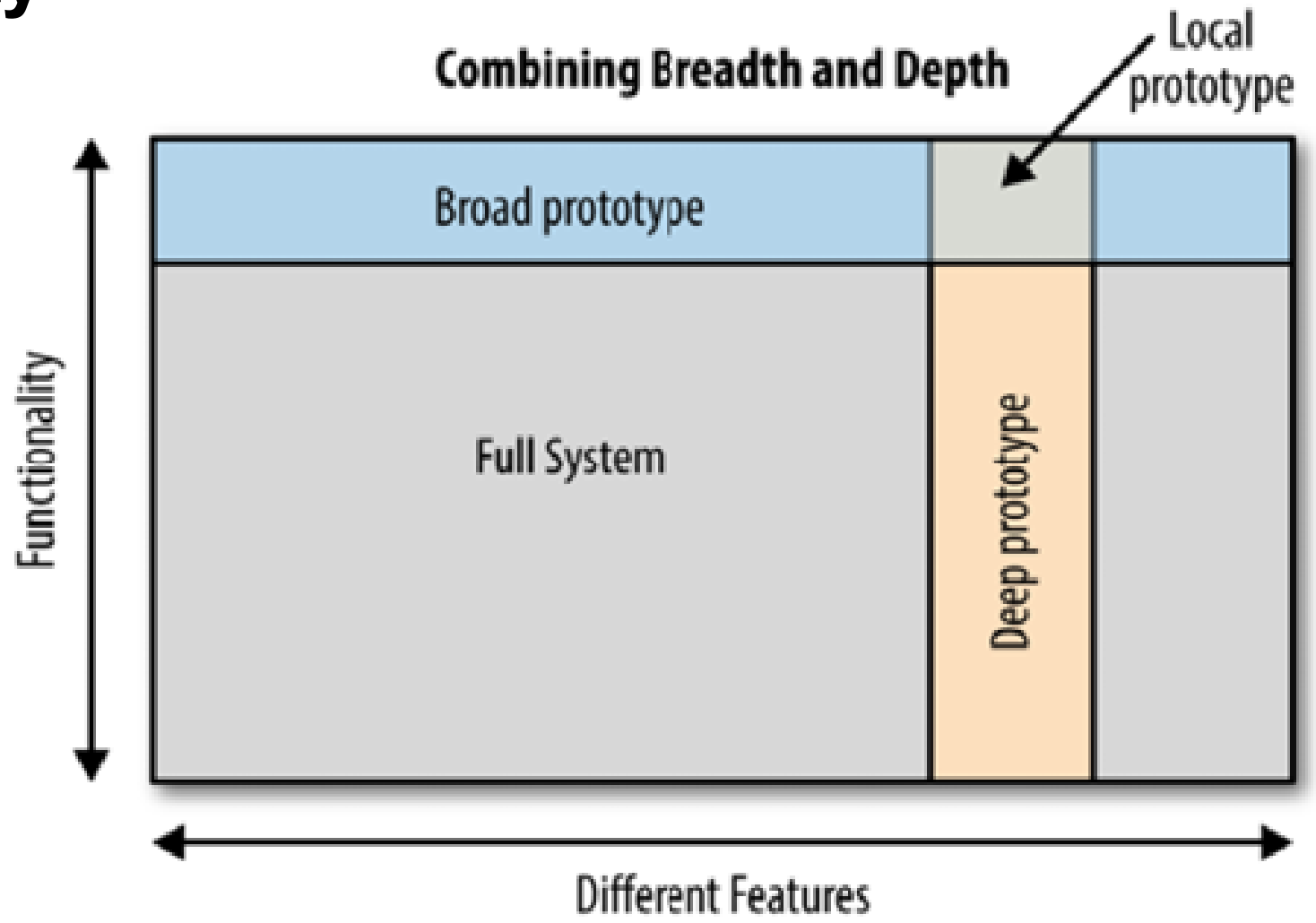
Prototype Fidelity

- Low, Mid, and High Fidelity Levels
- Pros, Cons, and Uses
- Reference [1]

	LOW FIDELITY	MID-FIDELITY	HIGH FIDELITY
Pros	Fast, low-skill, cheap, made with materials available around you	More interactive, easier to test, good balance of time and quality	Complete design, including visuals, content, and interactions; can test very detailed interactions
Cons	Limited interactions, harder to test details and full flows, little context for users	More time-intensive, but not fully functional	Very time-intensive, requires skills with software or coding, hard to test large concepts
Use	Exploring and testing high-level concepts like user flows and information architecture; best for making lots of different versions and testing them against each other	User testing specific interactions and guided flows; also better for stakeholder presentations, as these prototypes have more context	User testing very specific interactions and details, final testing of user flows, and presenting final design work to stakeholders

Dimensions of Fidelity

- Visual Refinement
- Breadth of functionality
- Depth of functionality
- Interactivity
- Data Model
- Reference [1]



Prototyping Process based on Prototype Focus

- Minimum Viable Prototype
  - Who are users, what is problem
  - User flow that solves problem
  - Make prototype to address flow
  - Test and repeat
- Exploration-Centric Prototypes
  - Generate lots of ways to solve problem
  - Use affinity to group similar ideas
  - Select a priority to move forward

- Reference [1]

- Audience-Centric Prototypes
  - Determine audience, goal, fidelity level
  - What needs to be shown to reach goal?
  - Special care with business stakeholders
  - Present to audience

Prototyping Process based on Prototype Focus

- Assumption-Centric Prototypes
  - Determine user, problem, and assumptions under test
  - Pick appropriate fidelity →
  - Consider type of test to run
  - Build and test appropriate prototype

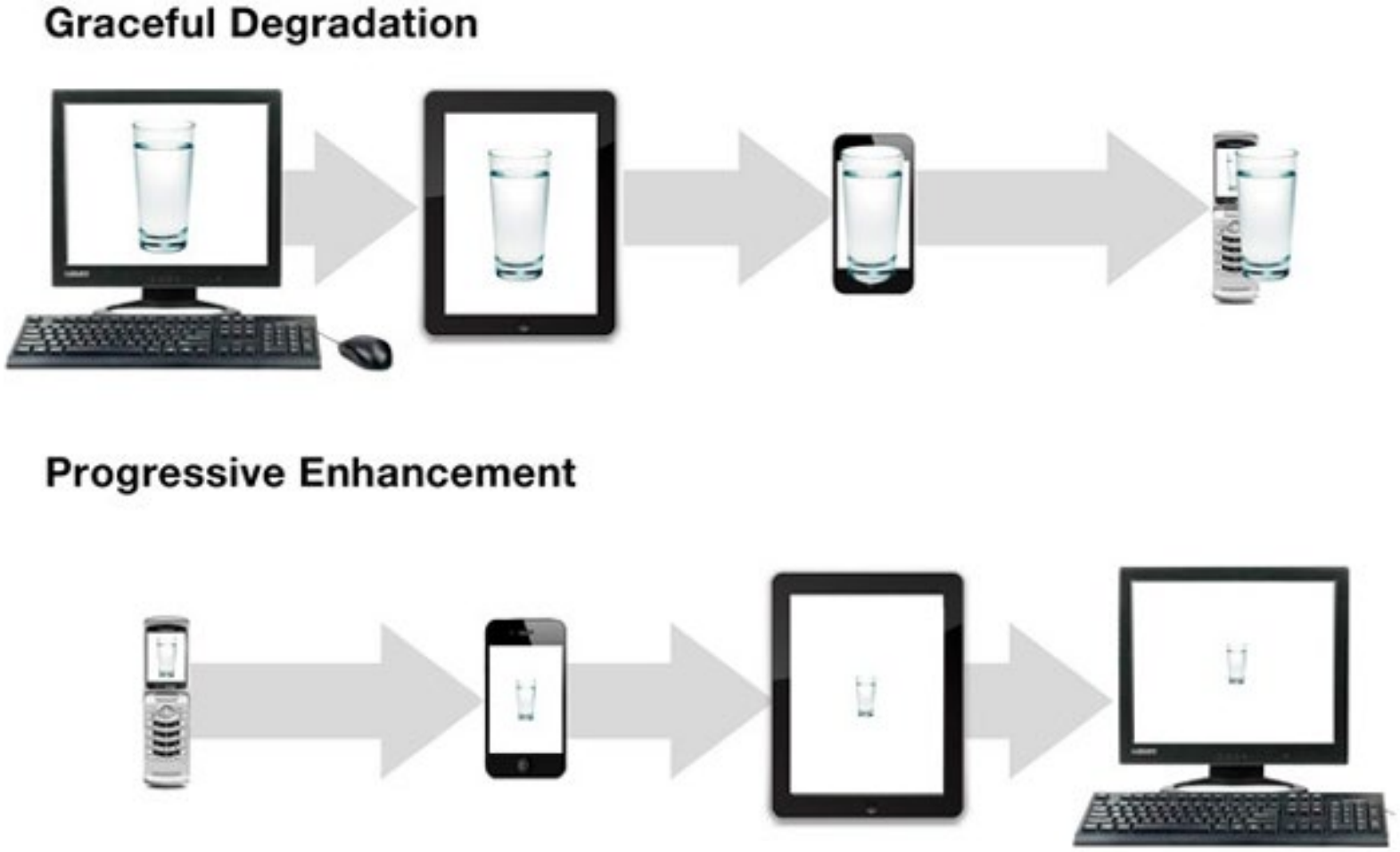
- Reference [1]

FIDELITY LEVEL	LOW	HIGH
Assumptions about...	• High-level concepts • Navigation • Terminology • User flows • General functionality • Who your user is	• Completing tasks • User understanding • High-fidelity navigation • Visual design details like iconography and typography • Written content

Prototyping Considerations for Digital Products

- Scoping challenge for software
- Screen variations
- Layering for Depth
- Style guides – Google Material Design
- Responsive Design →
- Different interaction approaches
- Accessibility and limited user abilities

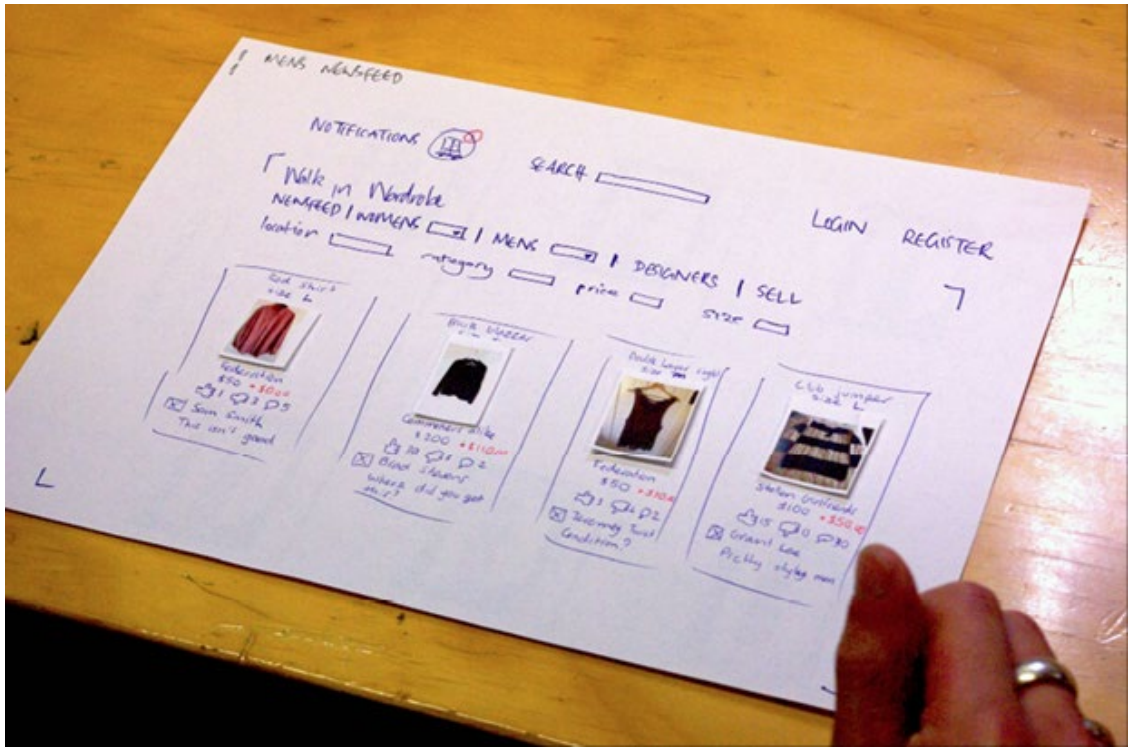
Reference [1]



Common Gestural Interaction

- Touch
- Double touch, pinch open, and pinch closed
- Drag, swipe, or fling
- Two-finger tap
- Two-finger press and rotate
- Hard touch (3D touch on iOS)
- Long press and swipe
- Pull down at top
- Two-, three-, or four-finger swipe
- Edge Swipes

Reference [1]



Prototyping Considerations for Digital Products

- Animation/motion studies
  - Use of paper storyboards for initial concepts →
- User flow
- Sketches
- Low, Medium, High Fidelity Digital Protos
- Information Architecture
  - Software structure
- Wireframes
- Paper Prototypes and Tests
- Low, Medium, High Clickable Protos

Reference [1]

Digital Prototyping Tools

Reference [1]

Name of program	Fidelity	User testing	Pros	Cons
Axure	Medium-high	Average	Create complex interactions, works with any digital format, expansive library of widgets to build out screens	High learning curve, difficult to use existing mocks
Balsamiq	Low	Low	Quick, low-fidelity prototypes	Limited functionality and motion options
Framer	High	Average	High-fidelity animation and interactions, can import Sketch or Illustrator files	Code-based, steep learning curve
HotGloo	Low	Low	Good library of UI elements	No import options, no animation support
Indigo Studio	Medium	Average	Gesture-based interactions, can prototype any digital format	Doesn't import mock-ups, just images, moderate learning curve
InVision	Medium-high	Good	Easy to learn, great feedback and sharing system, easy to import from Sketch or Illustrator	No features for creating elements, must have file from other program, hotspots only
Justinmind	Medium	Good	Good animation and gesture tools, stimulates final device for testing	Moderate learning curve

Digital Prototyping Tools

Reference [1]

Name of program	Fidelity	User testing	Pros	Cons
Keynote	Medium	Medium	Low-skill animation prototyping	Limited functionality, not built specifically for prototyping
Marvel	Medium	Good	Easy to learn, fast to build with existing mocks, basic animations	No features for creating elements, limited interactions, hotspots only
PoP	Low	Medium	Very fast, easy to use, includes some gestures and animations	Limited functionality, must have own mocks or sketches, hotspots only
Principle	High	Good	Timeline-based motion design, good for creating complex interactions and motion quickly	Not optimized for web design, only mobile, cannot view prototypes in a webview, and no Android app
Proto.io	Medium	Average	Can add animations to individual elements, good simulation of complex interactions	Learning curve, difficult to use existing mocks
Solidify	Good	High	Good for click-through prototypes, great for user testing, collects qualitative and quantitative data, some animation options	No animation for individual elements, no features for creating elements in tool
UXPin	Medium	Good	Large library of UI elements, can add animation to individual elements, some import options	Learning curve, limited interactions, no animated transitions or gesture-based interaction

Prototyping Considerations for Physical Products

- Smart devices, wearable, IoT
- Littlebits, Adafruit, SparkFun
- Electronics, Circuit Diagrams
- Microcontrollers and SBCs
- Coding and Troubleshooting
- Materials and Tactility →
- Components
- Alternatives for Controllers (tbd)
- Low, Medium, and High Fidelity Protos
- Component Prototypes
- Custom Circuit Boards

Reference [1]

Rapid Prototyping: Mechanical

- Additive: 3D Printing
  - Fast, Cheap (careful)
  - Consider manufacturability and complexity
  - May create hollow/incomplete versions
- Subtractive: Turning, Milling, Drilling
  - Precise
  - Surface finishes
  - Expensive, Skilled
  - Complex parts are difficult
- Casting: Creating a mold to fill with resin or plastic
  - Not fast
  - More expensive (depends on life of mold)
  - Best for batches of parts

Reference [2], Image [3]

Next Steps

- Quiz Extra Credit - Article Review assignment is posted…
- Sign up in Google Docs for Alan Kay lecture Quiz Extra Credit
- Project 5 active (due 11/20 for demos), Project 6 (will be due 12/11)
- New Quiz is up – another next weekend
- Class staff available to help
  - Shubham - Tues 12-2 PM, Fri 3-5 PM in ECEE 1B24
  - Sharanjeet - Tues 2-3 PM, Thur 2-3 PM in ECEE 1B24
  - Bruce - Tue 9:30-10:30 AM, Thur 1-2 PM in ECOT 242
- Final Exam is set
  - Tuesday Dec 17 7:30 PM - 10 PM ECCR 1B51
  - Final will be open notes and Canvas based, you'll need a PC

References

[1] Prototyping for Designers, McElroy, 2016, O'Reilly
[2] https://www.sculpteo.com/blog/2017/12/11/how-to-choose-between-rapid-prototyping-techniques/
[3] https://www.industryweek.com/intellectual-property/3d-printing-raises-new-legal-questions
[4] https://www.invisionapp.com/inside-design/6-ways-to-save-time-in-rapid-prototyping/