

## **Introduction to Prototyping**



# **Learning Goals**

- Being able to put different prototyping techniques into perspective
- Know when to use which technique
- Have an overview of prototyping approaches



## Introduction to Prototyping

Prototype, a definition:

 "A concrete representation of part or all of an interactive system" (based on [1])

[1] Beaudouin-Lafon, M., & Mackay, W. E. (2009). Prototyping tools and techniques. In Human-Computer Interaction (pp. 137-160). CRC Press.



Introduction to Prototyping

Photo by Anna Shvets from https://www.pexels.com/photo/women-standing-on-wooden-planks-3727647 (PD)



## Introduction to Prototyping











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# **Systemizing Prototypes**



# **Learning Goals**

- Understand why prototypes are useful
- Know different ways to systemize prototypes



ISO 9241-210:2019 (EN) Human-centered design for interactive systems

#### Systemizing Prototypes

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Systemizing Prototypes



ISO 9241-210:2019 (EN) Human-centered design for interactive systems

Systemizing Prototypes

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- Minimize the time for early design Iterations
- Make errors quickly!
- Enables to explore more design options

"A concrete representation of part or all of an interactive system"

Beaudouin-Lafon, M., & Mackay, W. E. (2009). Prototyping tools and techniques. In Human-Computer Interaction (pp. 137-160). CRC Press.

Prototyping models your final product and allows you to test attributes of the final product even if it's not ready yet."

Horn, J. (1998). The usability methods toolbox handbook. San Jose State University: Industrial and Systems Engineering Department, San Jose, CA.

- Dynamic visual model providing a communication tool for customer and developer that is far more effective than narrative prose or static visual models for portraying functionality. It has been described as:
  - functional after a minimal amount of effort
  - a means for providing users of a proposed application with a physical representation of key parts of the system before system implementation
  - flexible, modifications require minimal effort
  - not necessarily representative of a complete system.

Connell, J. L., & Shafer, L. (1989). Structured rapid prototyping: an evolutionary approach to software development. Yourdon Press.

- Work flow, task design
- Screen layouts and information displays
- Difficult, controversial, critical areas
- Everything else considered important...



Systemizing Prototypes

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# **Taxonomy of Prototypes**

- Horizontal vs. Vertical Prototypes
- Low-Fidelity vs. High-Fidelity Prototypes
- Non-Functional vs. Functional Prototypes
- Evolutionary prototypes vs. throw away prototypes



# **Horizontal Prototyping**

- Demonstrates the feature spectrum without implementing them
- Helps to evaluate/test
  - Navigation (e.g. finding a specific function or feature)
  - Overall user interface concept
  - Feature placement
  - Accessibility
  - User preferences
- Applicable in low-fidelity prototyping and high-fidelity prototyping
- Used in early design stages
  - To determine the set of features to include
  - To decide on the user interface concept



Systemizing Prototypes

# **Vertical Prototyping**

- Demonstrate a specific feature
- The details of the function/feature are shown/implemented
- Helps to evaluate/test
  - The optimal design for a particular function
  - Optimize the usability of this function
  - User performance for this particular function
- Often used in high-fi prototyping but is also applicable to low-fi prototyping

## Horizontal Prototype



## Vertical Prototype



not prototyped



## Low-Fidelity PDA Prototype

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Photo by Mark Richards from https://www.computerhistory.org/revol ution/mobile-computing/18/321/1648

## High-Fidelity Prototype



# Low-Fi prototypes

- Check ideas and interaction flow
- Fast, cheap and easy to change
- Advantages
  - Cheap, easy and quick to implement
  - Users are keen to criticise
- Disadvantages
  - No real functionality, difficult to identify errors
  - Reuse and extending difficult to impossible
  - Not all ideas can be realized

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Photo by Mark Richards from https://www.computerhistory.org/revol ution/mobile-computing/18/321/1648

# **High-fidelity Prototype**

- Looks & feels like the final product
  - Colors, screen layout, fonts, ... text used
  - Response time and interactive behavior
- Restricted functionality
  - Only certain functions work
  - Functionality is targeted towards the tasks
  - Invisible issues (e.g. security)
- Standard technologies for prototyping
  - HTML, JavaScript
  - Axure, Director, Presentation programs
  - GUI Builder (e.g. Visual Basic, Delphi, NetBeans)



# **High-fidelity Prototype**

- Advantages
  - Show how the finished product will look and feel
  - Behaves like the final product for selected tasks
  - Allows predicting efficiency
- Disadvantages
  - Can be very time-consuming to implement
  - Users can only "use" the implemented functions
  - Feedback centered around look & feel
  - Managers may expect that "the product" is nearly ready



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## **Low-Functional Prototypes**



# **Learning Goals**

- Know techniques to develop prototypes with low functionality
- Be able to select an appropriate prototyping technique

# The many purposes of Prototypes

- Within the design team
- Communication with others
- Test with potential users



Low-Functional Prototypes





Video by Judith Amores from https://vimeo.com/76766231 (CC-BY-SA)

- Exploring design ideas
- Communicating interface designs
- Early user tests



### Low-Functional Prototypes

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Low-Functional Prototypes



Niels Henze

#### Low-Functional Prototypes



Low-Functional Prototypes

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# **Advantages and Disadvantages**

- Low-functional prototypes
  - Provide little to no (automated) functions
  - Paper, standard software or dedicated tools to build them quickly
- Advantages
  - Requires little effort
  - Speeds up the design iterations
  - Explore many design solutions
- Disadvantages
  - Not everything can be realized
  - Efficiency is hardly measurable
  - Reusability is limited

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#### Video by Carlota Caldeira da Silva from https://www.pexels.com/video/curtains-of-a-door-being-blown-by-wind-3881701/ (PD)



## Wizard of Oz Prototypes



# **Learning Goals**

- Understand what Wizard of Oz prototypes are
- Know how and when to use Wizard of Oz prototypes



Wizard of Oz Prototypes



Habler, F., Schwind, V., & Henze, N. (2019). Effects of Smart Virtual Assistants' Gender and Language. In MuC.

- Compare different voices and personalities
- Participants got a set of tasks
- Experimenter played pre-recorded sound files
- Participants did not even notice that no speech recognition or reasoning was involved

# Development is hard – not testing is harder

- Often unclear if a system is worth the development effort
- Especially true for systems requiring novel hardware or algorithms
- Learning if the system is useful and the functions users want requires the system

# Wizard of Oz

- An invisible 'wizard' controlling parts of the functionality
- We only implement the easy parts but leave the hard part to the human operator
- Provides the user with the experience without extensive implementation effort for the prototype
- Typical areas
  - Speech recognition
  - Speech synthesis
  - Annotation
  - Reasoning
  - Computer vision

- "Wizard of Oz is a rapid-prototyping method for systems costly to build or requiring new technology. A human "Wizard" simulates the system's intelligence and interacts with the user through a real or mock computer interface."
- "Pay no attention to that man behind the curtain ...," takes on a new meaning when the curtain is replaced by a computer terminal

Maulsby, D., Greenberg, S., & Mander, R. (1993). Prototyping an intelligent agent through Wizard of Oz. In Proceedings of the INTERACT'93 and CHI'93 conference on Human factors in computing systems.



#### Wizard of Oz Prototypes



Engraving from the book: Freiherr Joseph Friedrich zu Racknitz, Ueber den Schachspieler des Herrn von Kempelen, Leipzig und Dresden 1789. Herrn von Kempelen, Leipzig und

## Wizard of Oz Prototypes









SIMILAR PRODUCTS





Meatball



A meatball is ground meat rolled into a small ball, sometimes along with other ingredients, such as brea.. Wikipedia G More results

Wizard of Oz Prototypes

Henze, N., Schinke, T., & Boll, S. (2009). What is that? object recognition from natural features on a mobile phone. In MIRW.

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Le, H. V., Mayer, S., Weiß, M., Vogelsang, J., Weingärtner, H., & Henze, N. (2020). Shortcut Gestures for Mobile Text Editing on Fully Touch Sensitive Smartphones. In ToCHI.

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# **A Wizard for Gesture Recognition**

- Assess shortcut gestures with the 'perfect' gesture recognizer
- Participants performed the gestures as they would do with the real system
- Operator monitored participants and activated the respective functions on a second device

# **Advantages and Disadvantages**

- Wizard of Oz
  - Implemented only the "soft" part
  - Using human operators for the hard parts
- Advantages
  - Receive early feedback
  - Compare with alternatives
- Disadvantages
  - Even implementing the soft parts requires effort
  - Unclear if operator's performance can ever be reached
  - Performance depends on the operator

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