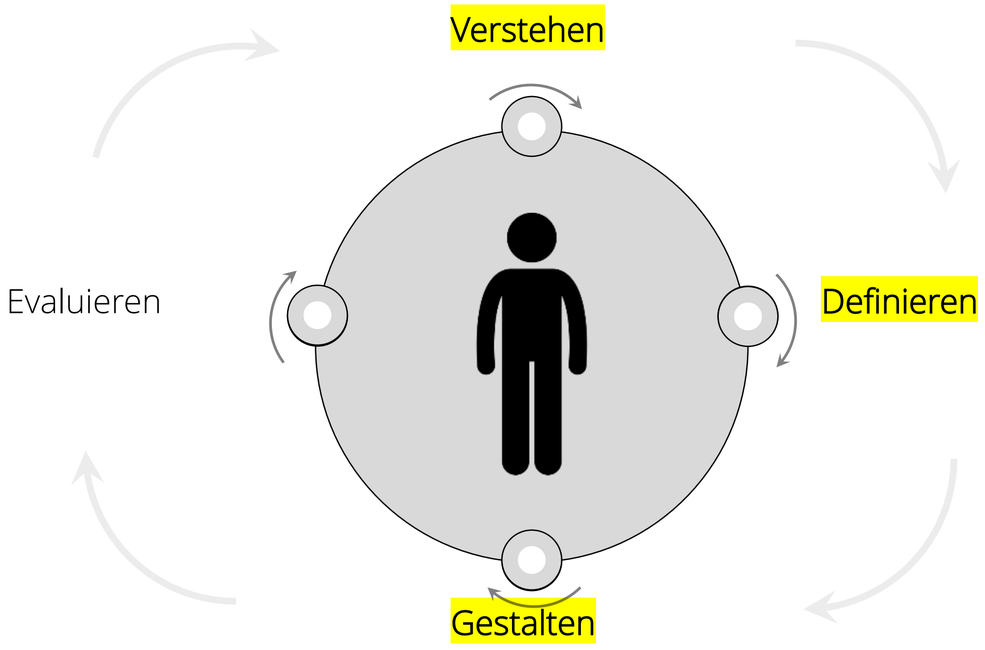

Human-Computer Interaction SoSe 25

Design Process – Part 1

Jan Gugenheimer

TECHNISCHE UNIVERSITÄT DARMSTADT

Lecture

1. What is Human-Computer Interaction
    1. Basics of HCI
    2. History of HCI
2. Cognitive Basics
    1. Cognition and Perception
    2. Metaphors and Mental Models
    3. *In-class Exercise*
3. Usability Engineering
    1. (Human) Design Processes
    2. Prototyping
    3. *In-class Exercise*
4. Evaluation Methods
    1. Study Design
    2. Methodology
    3. *In-class Exercise*
5. Post-WIMP + Input Devices
6. Mixed-Reality
7. Wrap-Up and Q&A

Lecture

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7. Wrap-Up and Q&A

Learn

Human-Computer Interaction :

Design Processes

Prototyping and Evaluation

Learn

Processes

Be able to understand the Human-Centered Design Process and its steps and name different types of development processes in HCI

Prototyping and Evaluation

Be able to understand and apply the different types of prototypes and know how to design and conduct a valid experiment

"Bill Buxton brings design leadership and creativity to Microsoft. Through his thought-provoking personal examples he is inspiring others to better understand the role of design in their own companies."
Bill Gates—Chairman, Microsoft Corp.

Sketching User Experiences

getting the design right and the right design

Bill Buxton

MORGAN KAUFMANN

Design Process

Human-centered design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques

Task:

Imagine I ask you to implement and design a cloud-based service to allow students and teachers to have an online learning platform enabling teaching and learning in an efficient, safe, and enjoyable way.

Question:

How would you approach this ? What would you start with ?

Goal:

This week we want to look at processes and tools that should help you when faced such a challenge

Preece, Jennifer, Helen Sharp, and Yvonne Rogers. Interaction design: beyond human-computer interaction. John Wiley & Sons, 2015.

User-Centered Design

User-centered design (UCD) is an **iterative design process** in which designers **focus on the users** and their needs in each phase of the design process. In UCD, design teams involve users throughout the design process via a variety of research and design techniques, to create **highly usable** and accessible products for them. [1]

Human-Centered Design

Human-centered design is an **approach to interactive systems** development that aims to make systems **usable** and useful by **focusing on the users**, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques.

- ISO 9241

Usability

The extent to which a product can be used by specified users to achieve specified goals, with effectiveness, efficiency and satisfaction in a specified context of use

- ISO 9241

[1] https://www.interaction-design.org/literature/topics/user-centered-design

User-Centered Design

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Human-Centered Design

Human-centered design is an **approach to interactive systems** development that aims to make systems **usable** and

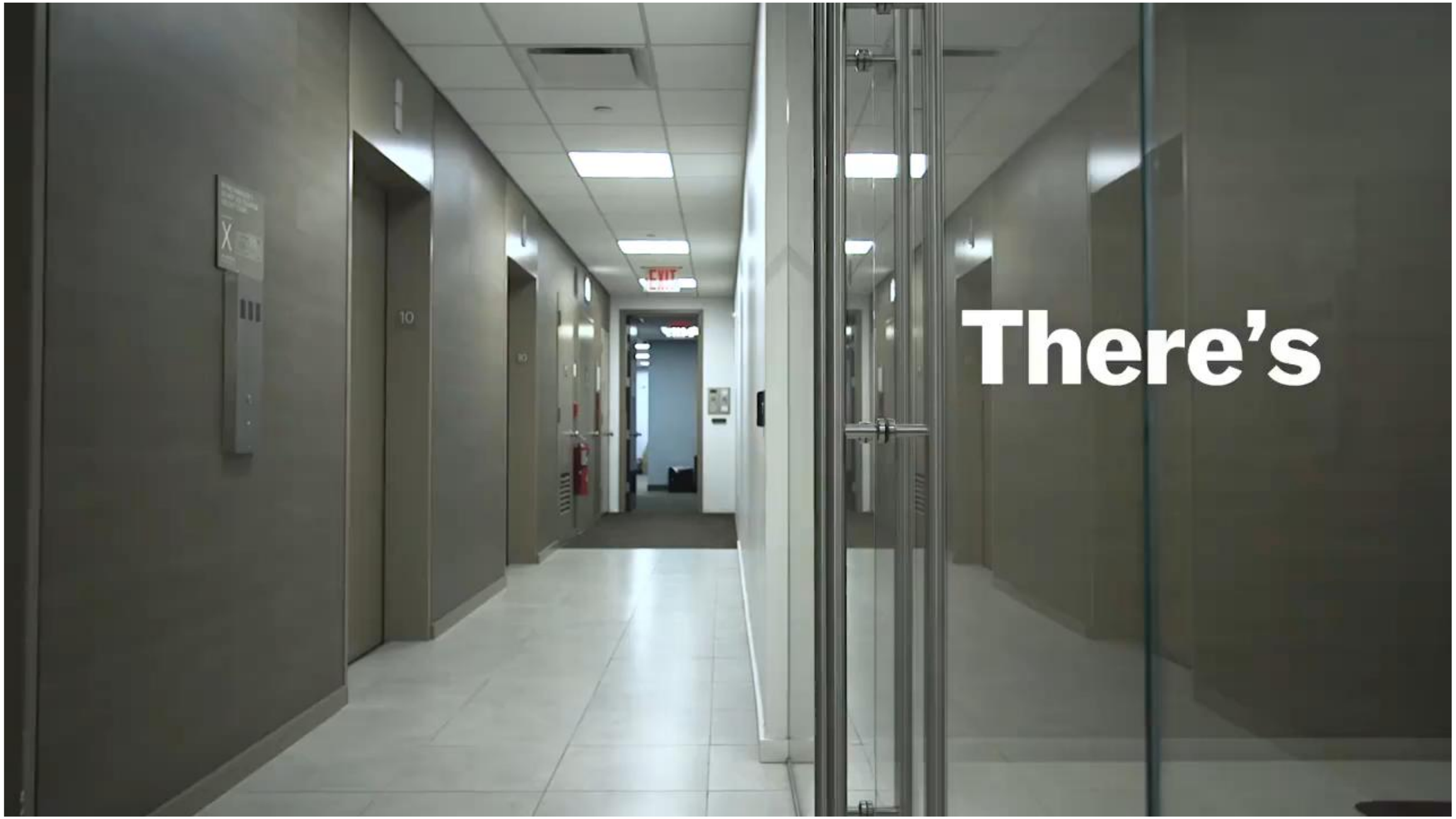
What is the difference between Human-Centered Design and User-Centered Design

Usability

The extent to which a product can be used by specified users to achieve specified goals, with effectiveness, efficiency and satisfaction in a specified context of use

- ISO 9241

[1] https://www.interaction-design.org/literature/topics/user-centered-design



https://www.youtube.com/watch?v=q7CpRH2WbME

User-Centered Design

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Human-Centred Design

Human-centered design is an **approach to interactive systems** development that aims to make systems **usable** and useful by **focusing on the users**, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques.

- ISO 9241

The term “User” is removing the emotional side from the Human and hides the human nature

and

The process should not only think about the “end user” but actually every human involved in the process (maintenance, selling,..)

Human-Centred Design Process

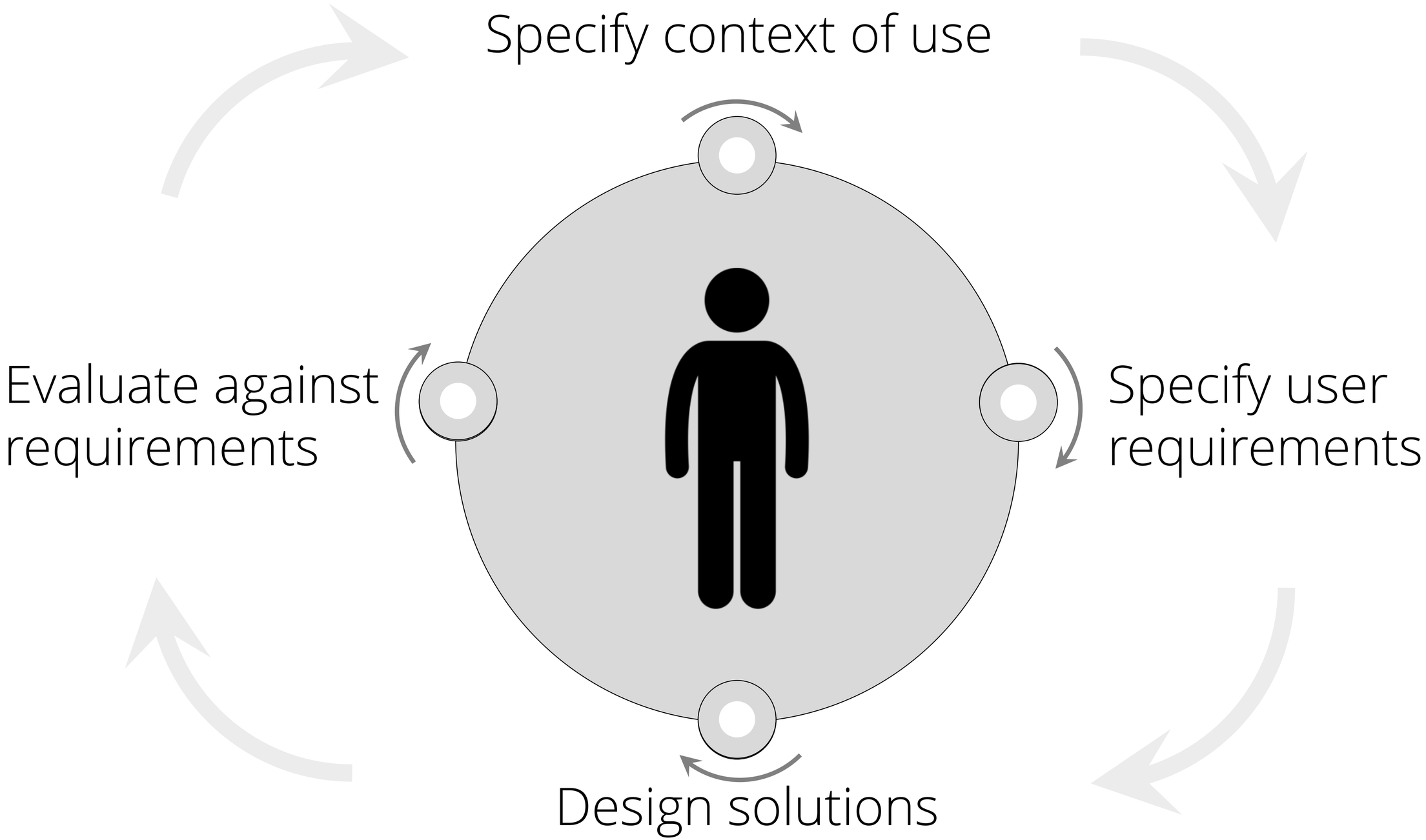
ISO 9241-210:2019 Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems

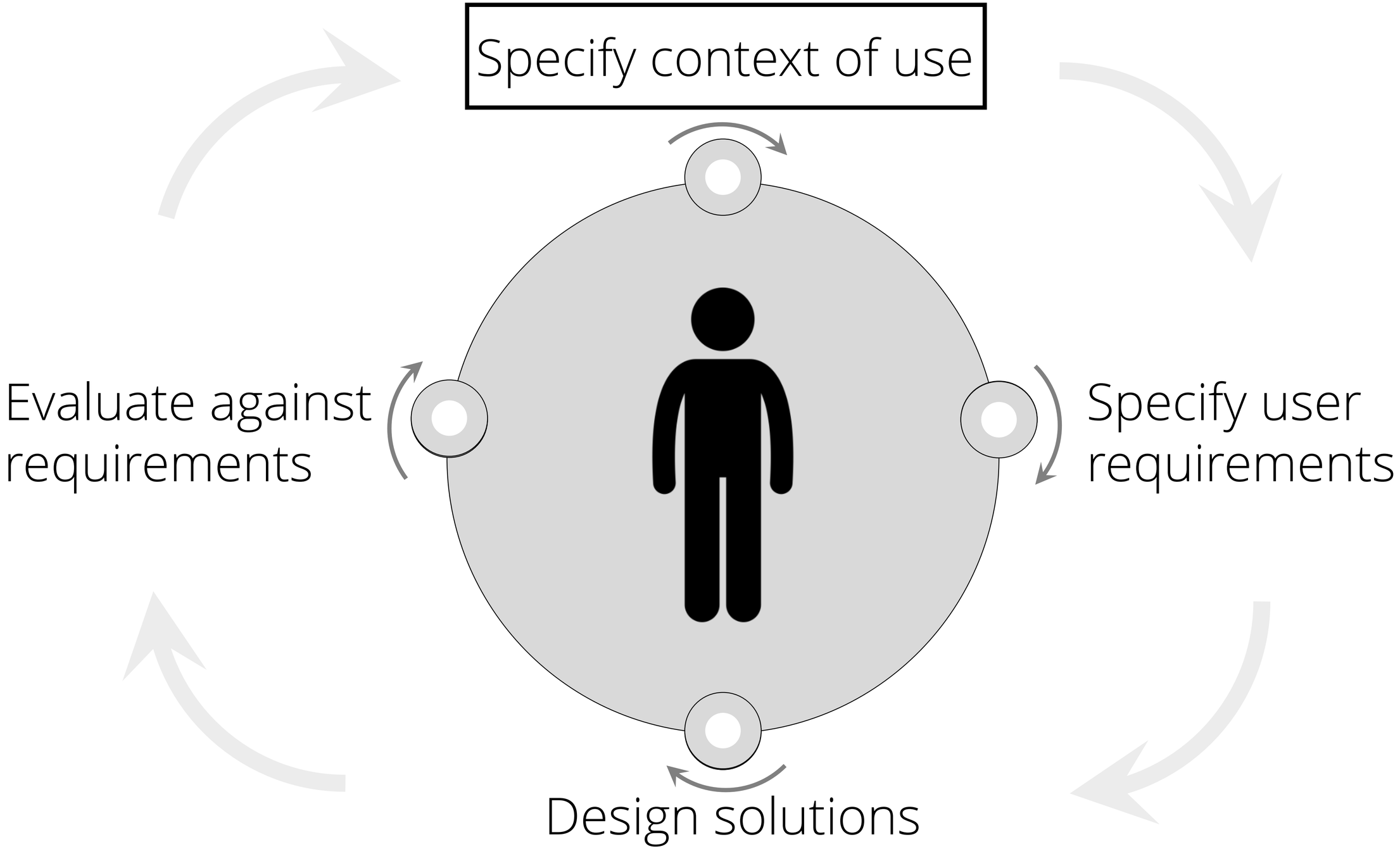
Goal:

"Human-centered design is an approach to interactive systems development that aims to ***make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques****. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance." -* ISO 9241-210:2019(E)

Properties:

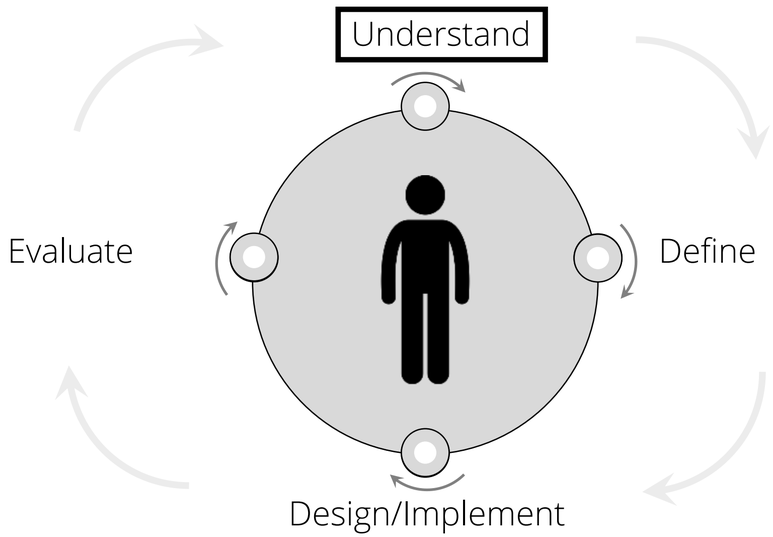
- Iterative process with the human in the centre
- Focus on empathy and understanding the user within the context
- Human involvement in every step of the process (only conducting a user study is not HCD)
- Highly interdisciplinary teams (computer science, psychology, social science, design ...)


Specify context of use
Specify user requirements
Design solutions
Evaluate against requirements


Specify context of use
Specify user requirements
Design solutions
Evaluate against requirements

Specify context of use

"Identify who the primary users of the product, why they will use the product, what are their requirements and under what environment they will use it" [1]



Goal:

Deep understanding of the user and the context of usage

Methods:

- Observations/ Ethnography
- Interviews (structured, semi-structured, unstructured)
- Focus groups

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Qualitative vs Quantitative Methods

"Identify who the primary users of the product, why they will use the product, what are their requirements and under what environment they will use it" [1]

Qualitative:

- Inductive
- Holistic analysis of a phenomenon (→ maybe develop a theory)
- Non-standardized measures (interpretation of the selected data)
- Often small sample sizes (saturation)

Quantitative:

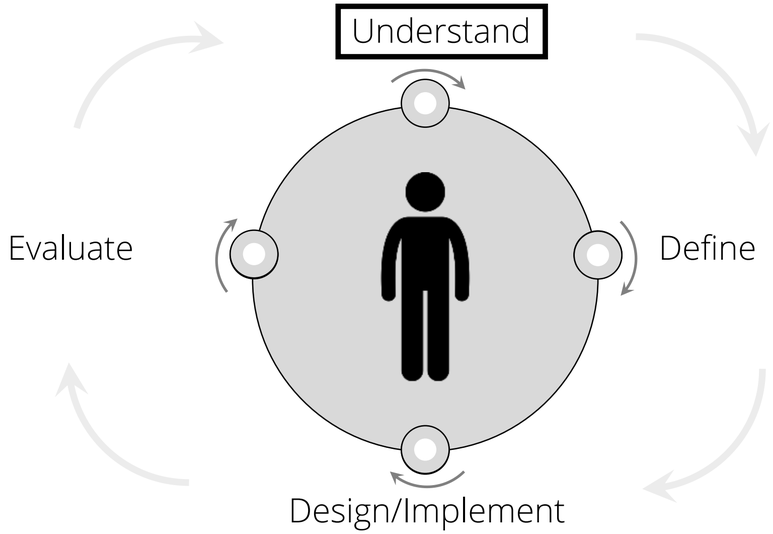
- Deductive
- Precise measure for one controlled outcome (→ maybe test a theory)
- Standardized measure (statistical analysis)
- Ideally large sample sizes

Mixed Method

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Specify context of use (Ethnography)

"Identify who the primary users of the product, why they will use the product, what are their requirements and under what environment they will use it" [1]



Properties:

- Qualitative Method
- Researcher observes and/or interacts with subjects in their real-life environment
- Example: I want to design a better online streaming solution for students and teachers. I observe the current behavior and try to immerse in each role for a while

Tools:

- Participant Observations (documented via image, video or even written diary)
- Participant Interviews/Surveys

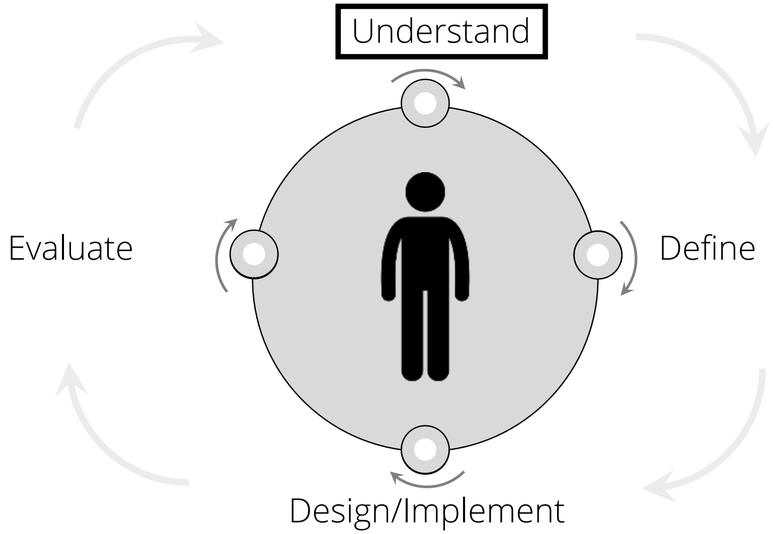
When to use ?:

- Early in the design process
- Work well with very complex and/or critical problems

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Specify context of use (Ethnography)

"Identify who the primary users of the product, why they will use the product, what are their requirements and under what environment they will use it" [1]



Pro:

- Help to identify unexpected issues
- Get a detailed and faithful representation of user behavior

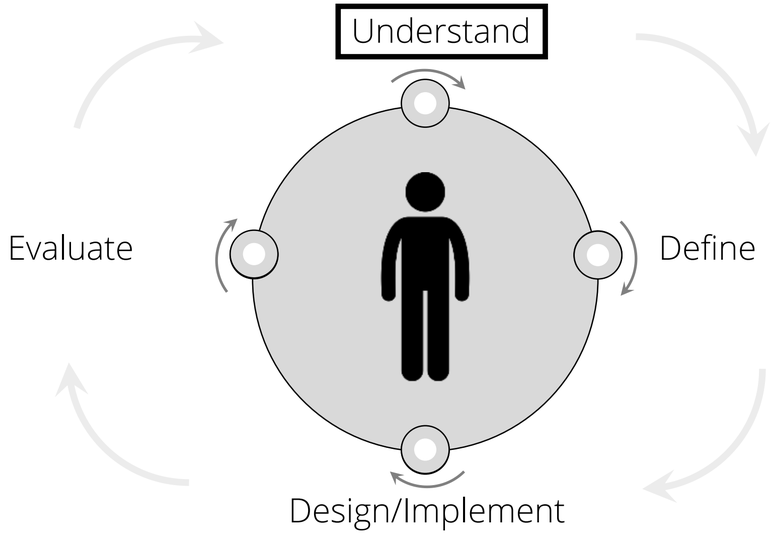
Con:

- Participants may not behave natural if someone is around
- Researcher may even impact some of the behaviour through his/her actions

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Specify context of use (Interviews)

"Identify who the primary users of the product, why they will use the product, what are their requirements and under what environment they will use it" [1]



Structured:

- All questions are created in advance
- Every participant gets the same order of questions
- Closed Questions (e.g., 'yes' or 'no,' 'male' or 'female', Likert)

Semi-Structured:

- Only parts of the interviews are created in advance
- A combination of structured and unstructured
- Participants may bring up interesting topics that the interviewer focuses

→ This results often in a rework of the initial set of questions

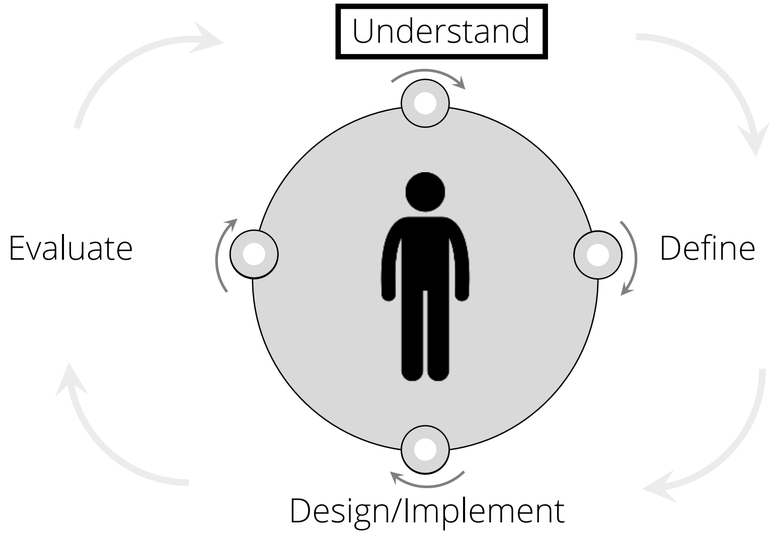
Unstructured:

- Goal of a free flowing conversation to uncover aspects you could have not thought of before
- Open Questions (e.g., can you tell me how happy you feel right now?)

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Specify context of use (Interviews)

"Identify who the primary users of the product, why they will use the product, what are their requirements and under what environment they will use it" [1]



Structured:

- Pro:
  - Large amount of data can be collected for a low cost
  - Quantitative data that can be further used in statistical analysis
- Con:
  - Lack of detail or unexpected response.

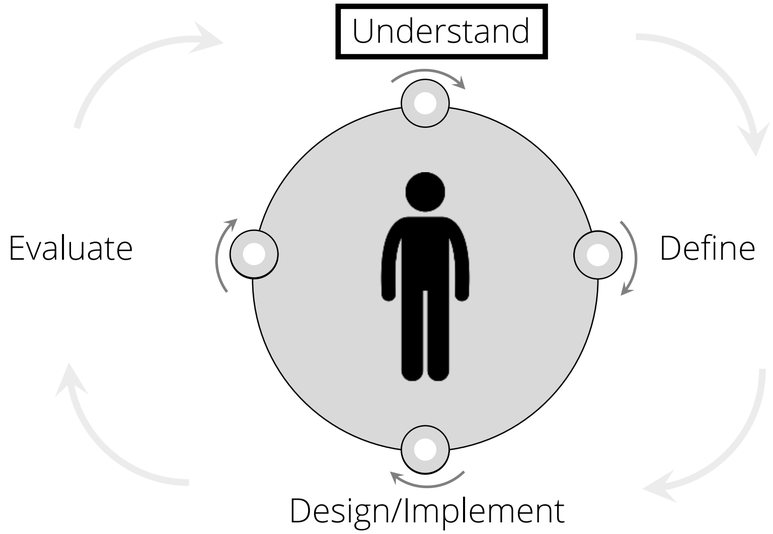
Unstructured:

- Pro:
  - More flexible and can include concepts that are just discovered inside an interview
  - Interviewer has the ability to ask and deeper understand (e.g., why, why not, how do you approach ...)
- Con:
  - Time-consuming and difficult to analyse qualitative data (e.g. grounded theory, thematic analysis)

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Specify context of use (Focus Groups)

"Identify who the primary users of the product, why they will use the product, what are their requirements and under what environment they will use it" [1]



Properties:

- Qualitative Method
- A group of participants is interviewed together
- Often times not a representative sample but a purposely selected group
- The interviewer's goal is to keep the group on topic

Tools:

- Participant Observations (documented via image or video)
- Participant Interviews/Surveys

When to use ?:

- Early in the design process
- Group dynamics could help to further explore a complex topic

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Specify context of use (Focus Groups)

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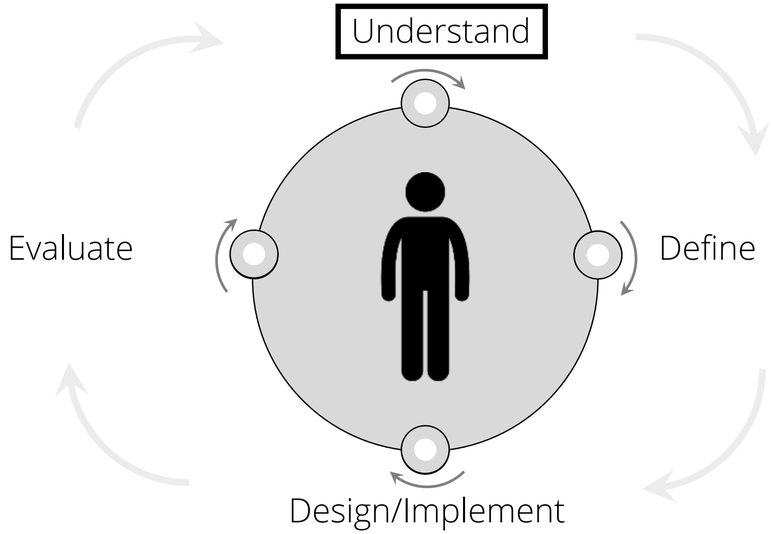


Pro:

- Depth through open ended questions
- More validity since participants may feel more comfortable to discuss certain topics inside a group which is more natural behavior
- Less time intense then conducting multiple individual interviews

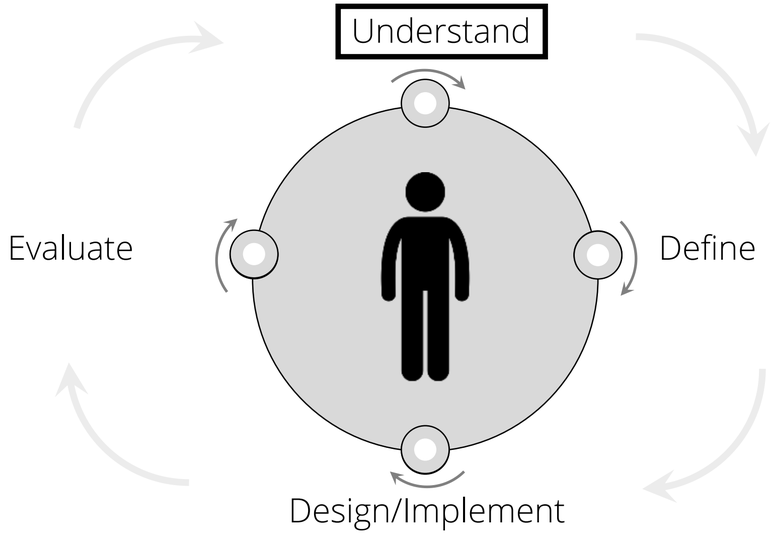
Con:

- Sometimes difficult to keep participants on topic
- Social dynamics could negatively impact the results (e.g., shy people may not speak up, people could have false statements to impress other participants...)

[1] https://www.usability.gov/what-and-why/user-centered-design.html

The Interviewer Effect

"Identify who the primary users of the product, why they will use the product, what are their requirements and under what environment they will use it" [1]



Effect:

- Since the interviewer is also a human being in an interaction, his or her appearance may influence the perception of the participant
- Additionally, if exposed what the intention or the goal of the study is, participants may behave accordingly to please the interviewer

Example: In a user study exploring sexual harassment between males, a female interview could bias the sample since some participants may feel uncomfortable or even lie about their experiences

How to deal with it:

- Choose the interviewer as neutral as possible
- Train the interviewer to be as objective and unbiased as possible
- Do not always disclose the proposed solution (if a comparison is done)

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design Process

Human-centered design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques

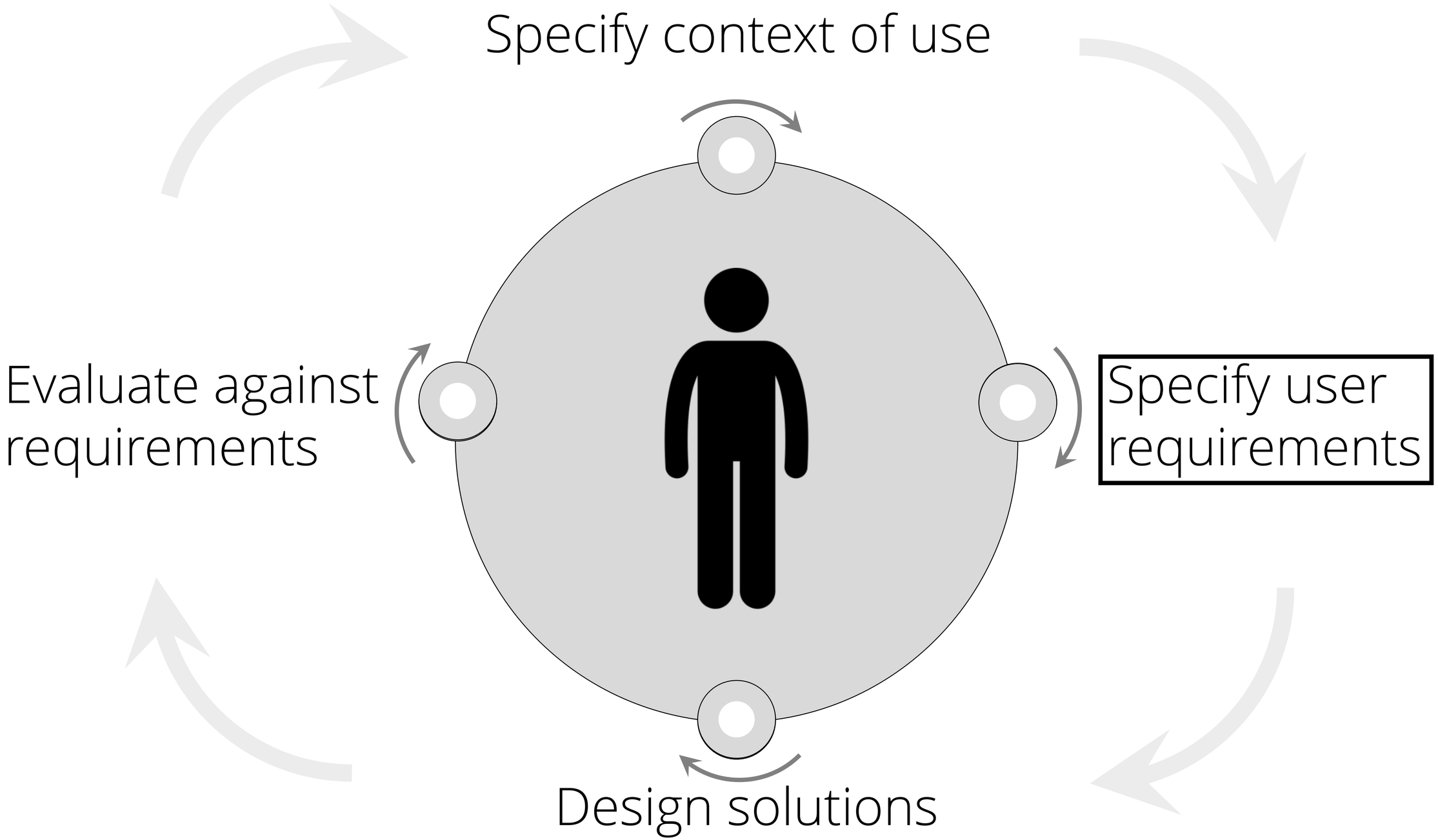
Task:

Imagine I ask you to implement and design a cloud-based service to allow students and teachers to have an online learning platform enabling teaching and learning in an efficient, safe, and enjoyable way.

Step 1:

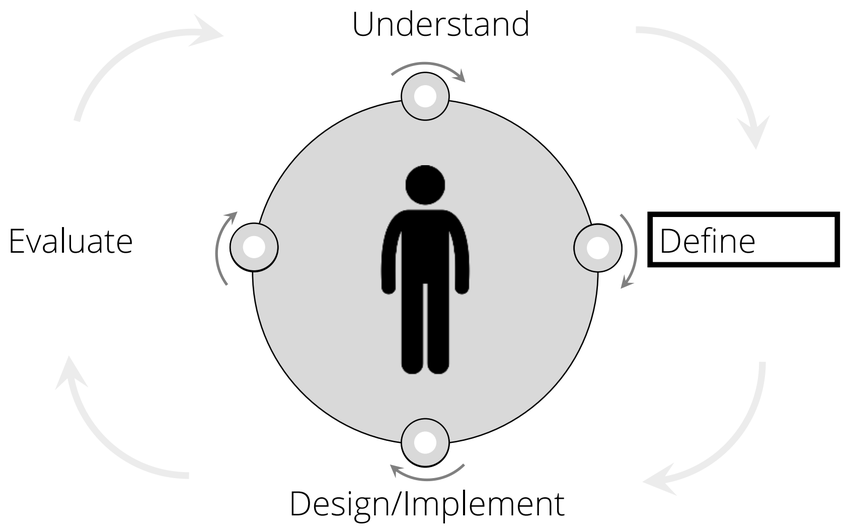
Immerse yourself in the context of use and the users. Become a teacher, a student and someone from the administration to understand what their needs are and how they use such a tool right now. Deploy techniques such as Ethnographies, Focus Groups and Interviews.

Preece, Jennifer, Helen Sharp, and Yvonne Rogers. Interaction design: beyond human-computer interaction. John Wiley & Sons, 2015.


Specify context of use
Specify user requirements
Design solutions
Evaluate against requirements

Specify User Requirements

"Once the context is specified, it is the time to identify the granular requirements of the product. This is an important process which can further facilitate the designers to create storyboards, and set important goals to make the product successful." [1]



Goal:

Specify user requirements and functionalities that are important for the product. Emphasize the actual needs we found in phase 1 (Understand)

Methods:

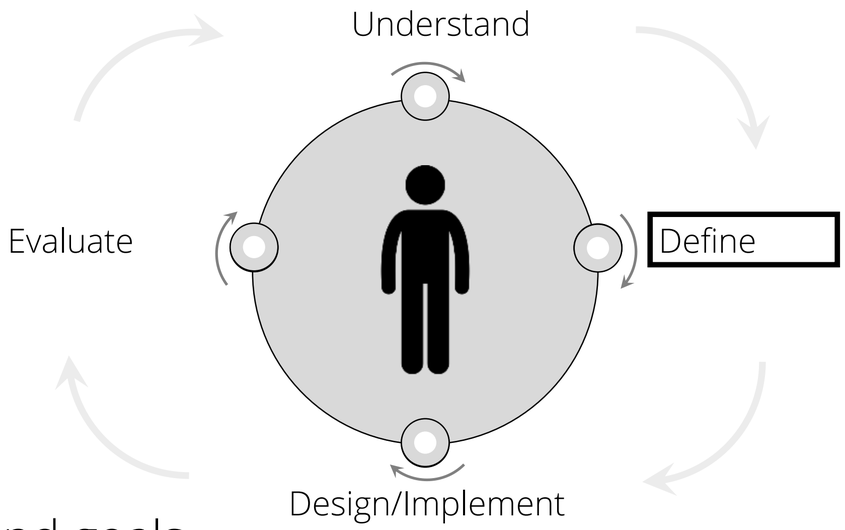
- Requirements specification (less used in research more in industry)
- Persona
- Scenario

Example:
We found through our initial observations and interviews that it is important to connect fast to our streaming solution (functionality) and timing is important (measure)

[1] https://www.usability.gov/what-and-why/user-centered-design.html

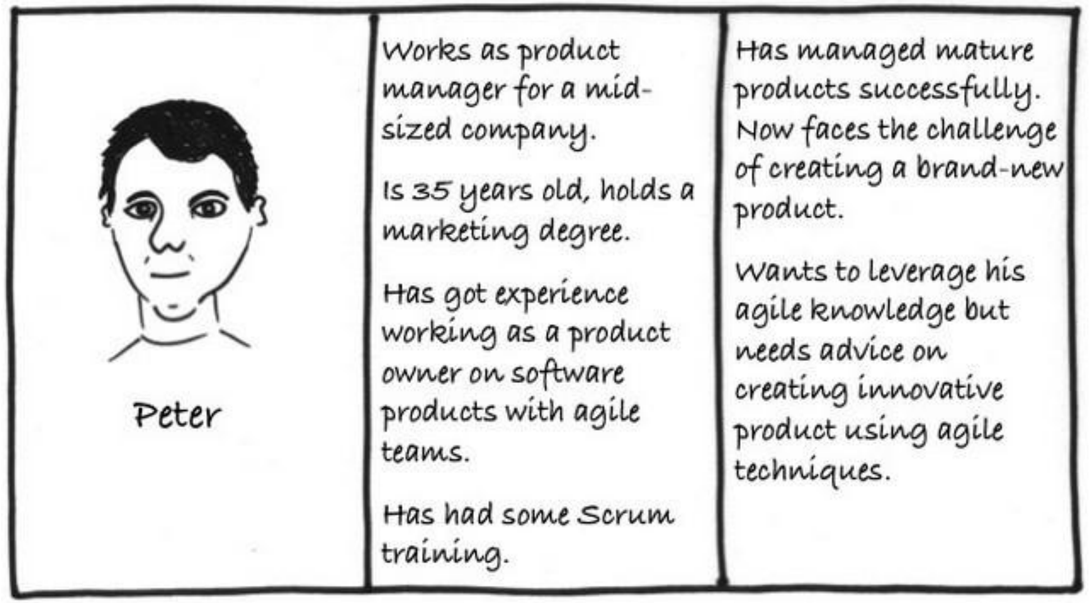
Specify User Requirements (Persona)

Personas are fictional characters, which you create based upon your research in order to represent the different user types that might use your service, product, site, or brand in a similar way [1]



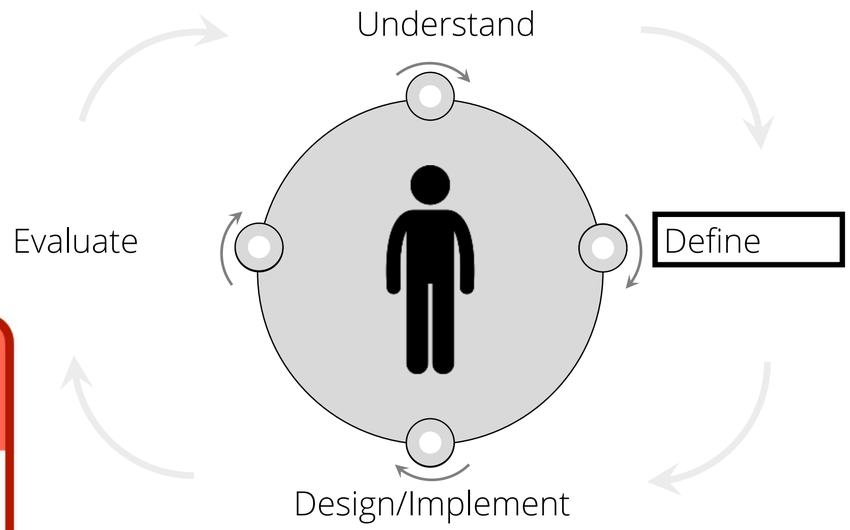
- Helps to understand the users' needs, experience, behaviours and goals
- Helps to "step out of yourself" (You are NOT the typical user !!, CS background, high education...)
- Different types of Persona (Goal-directed Persona, Role-based Persona, Engaging Persona, Fictional Persona)

Example for Engaging Persona:



[1] https://www.interaction-design.org/literature/article/personas-why-and-how-you-should-use-them

Specify User Requirements (Antipersona)



Lloyd Harwood

Anti-persona

Hotel Burglar

Age: 43

Job: Goods reseller

Lives: > 20 mi from targets

Tech proficiency: Medium

Goals

1. Steal goods from hotel safes
2. Resell goods and materials online without authorization
3. Not get caught

Motivations

1. Make money
2. Keep stolen valuables in good condition

Actions

1. Assesses hotel entrances, exits, and security
2. Visits hotels during high-traffic times to avoid attention
3. Disables tracking on devices; resets devices

Tools & Technology

1. Hardware tools for picking locks
2. Car

Needs

1. Hotels that lack high security
2. Hotels with multiple entrances and exists
3. Hotels with outdated locks or windows

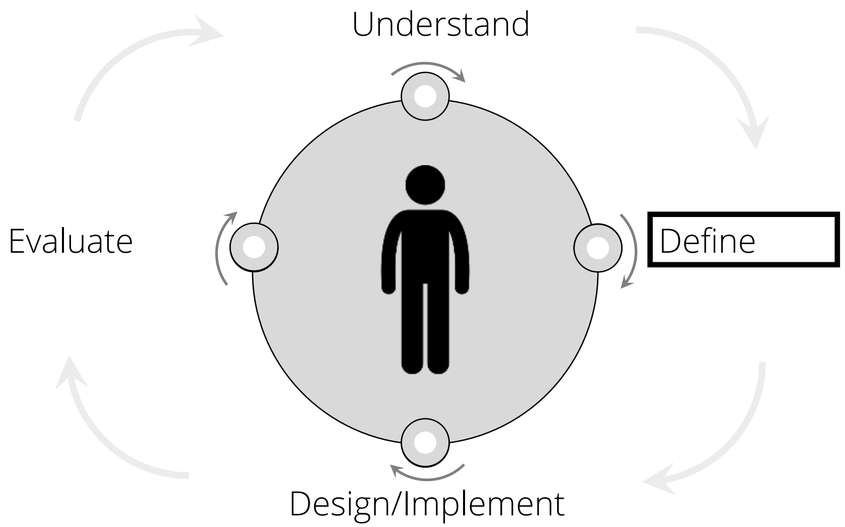
Consequences

HIGH

1. Safe business loses sales to current hotels
2. Costs to replace safes that were tampered with
3. Hotels lose business from customers

Specify User Requirements (Scenario)

User scenarios are stories which designers create to show how users might act to achieve a goal in a system or environment. [1]



- A Persona is often positioned inside of an actual user scenario
- Often focus on the most common use cases

- Structure:
  - Background – who are your users (including their knowledge base and skillset/s)?
  - Motivations – what goals do they want to achieve?
  - Tasks – what must they do to reach those goals?
  - Context of use – how will they encounter your design?
  - Environment – where will they try to use it?
  - Challenges – when they try to use it, what can get in their way (e.g., signal loss)?

[1] https://www.interaction-design.org/literature/article/personas-why-and-how-you-should-use-them

Specify User Requirements (Scenario)

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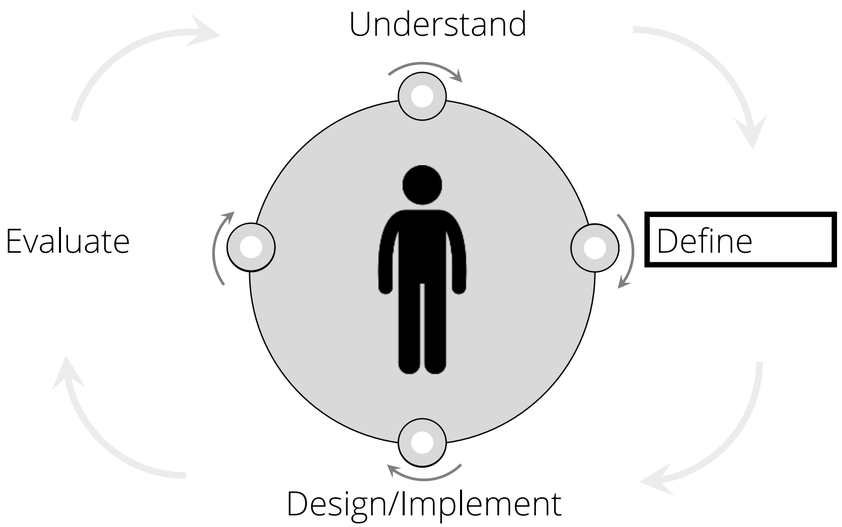

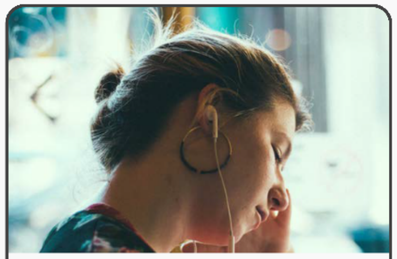

Rebecca

Casual audiophile

Age	26
Gender	Female
Occupation	Frontend developer
Marital status	Single
Location	Mountain View
Online locations	Work and mobile
Computer(s)	iPhone and MacBook Pro
Internet usage	8-9 hours

TECHNOPHOBE — TECH WIZ

CDs — MUSIC STREAMING

CASUAL LISTENER — HARDCORE GEEK

Music is essential to Rebecca's life. She is listening to tunes almost every second of her life, particularly while working.

Obstacles Rebecca faces:

- Too busy to explore new music artists she might like
- Streaming music consumes a lot of data

How will Rebecca interact with Spotify?

Questions Rebecca will ask:

- How do I keep updated on new releases by artists I follow?
- How do I learn of new artists I haven't heard of?
- Can I listen to music in a data-efficient manner?
- How can I listen on both my MacBook and my iPhone?

Who influences Rebecca?

Ads, Music charts, Her own tastes, Friends, Co-workers

Rebecca's situation

Goals, motivations:

- Listen to great music to keep her productive at work
- Relax and unwind at the end of the day
- Superior music quality for full enjoyment of tracks
- Expand the circle of music artists she listens to

Key words

music, jazz, r&b, pop, artists, new releases, top charts, background music

Rebecca's story

Music is a big part of my life; I like to think that I always have a "background music" running in each scene of my life. I love working while listening to music; somehow, it gives me a lot of focus on my task.

I regularly talk to my co-workers about music and singers — that's what we like to talk about over lunch. We're constantly looking for new artists to inspire us and to expand our music library, but lately it seems a little tough to do that. Everything seems to have a "filter bubble" effect, and we keep listening to the same genres and artists.

I really enjoy finding new artists that match my subjective taste, and most of the times I get those from my close friends. I wish there were a way to find more music and artists without having to rely on the serendipity of life!

Example of a persona that shows the six main elements you should include. Name, age, gender, tag line, experience and skills are placed on the left-hand side. The middle column focuses on the context to indicate how they would interact with a product or service. Finally, on the right-hand side some goals and concerns are shared, as well as a short scenario to indicate the persona's attitude.

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[1] https://www.interaction-design.org/literature/article/personas-why-and-how-you-should-use-them

Design Process

Human-centered design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques

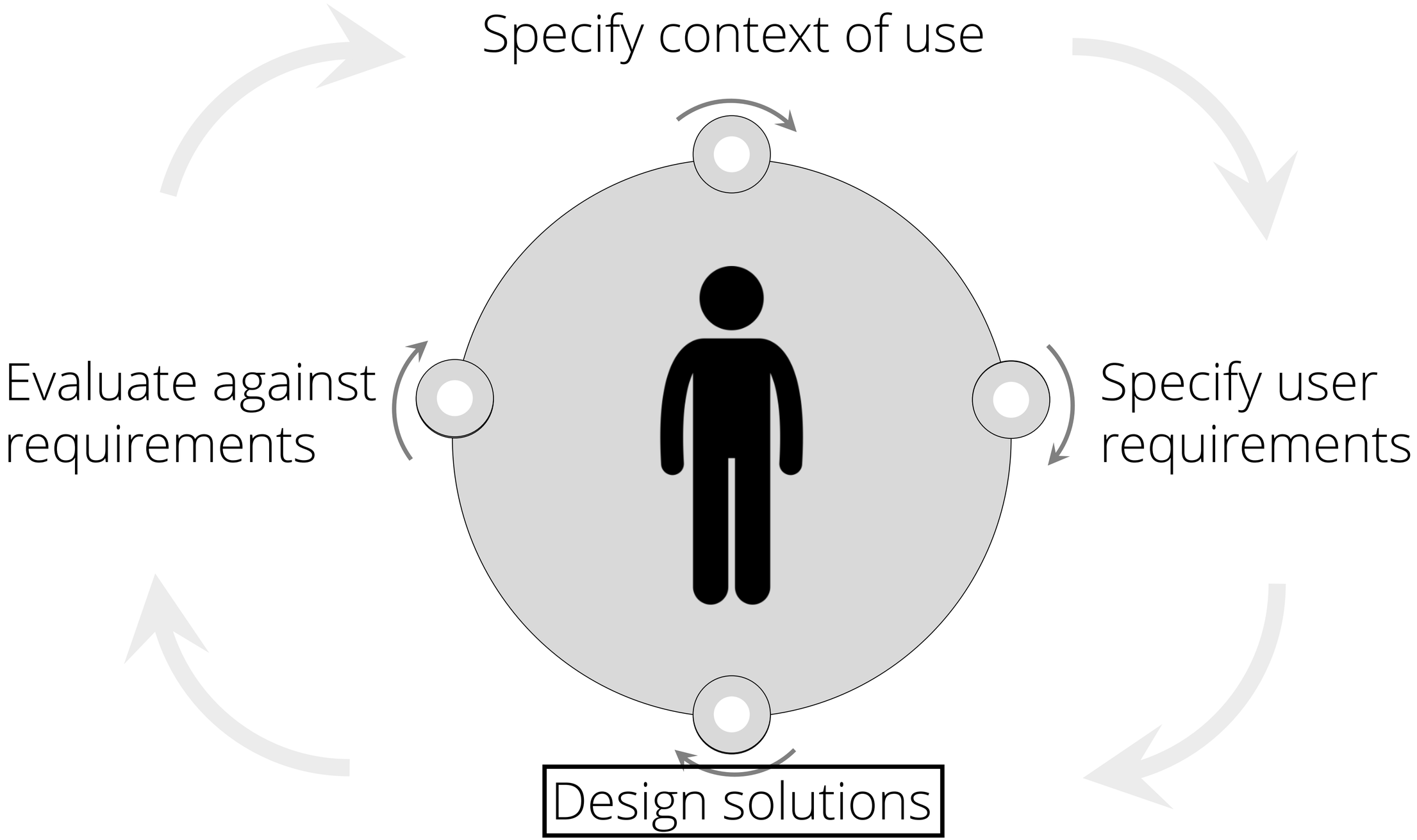
Task:

Imagine I ask you to implement and design a cloud-based service to allow students and teachers to have an online learning platform enabling teaching and learning in an efficient, safe, and enjoyable way.

Step 2:

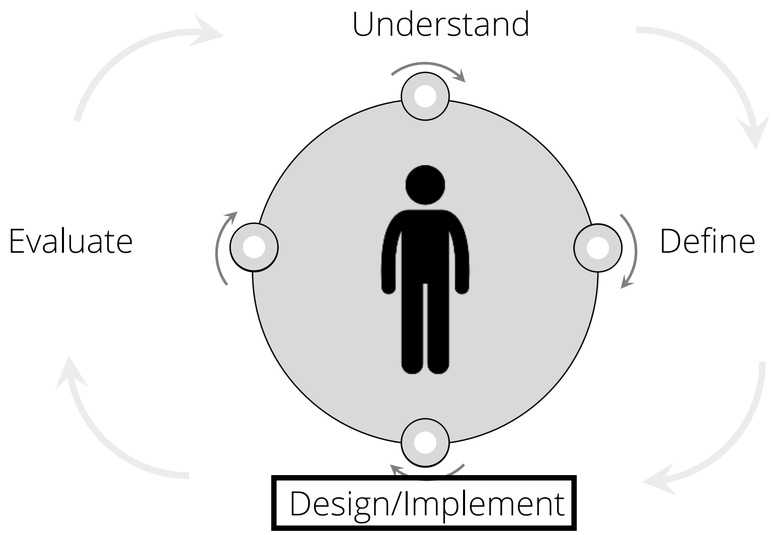
Use the data you collected in Step 1 to create Personas and Scenarios and write down the metrics that are important for the interaction (e.g. efficiency to setup the service, discoverability of features, easy to maintain for the administration...). These metrics will be used in Step 4 in the evaluation.

Preece, Jennifer, Helen Sharp, and Yvonne Rogers. Interaction design: beyond human-computer interaction. John Wiley & Sons, 2015.


Specify context of use
Specify user requirements
Design solutions
Evaluate against requirements

Design

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Goal:

Create and iterate multiple prototypes which will be later used in the evaluation phase. One important mindset is: **Move Fast ! Break Things ! Fail Fast!**

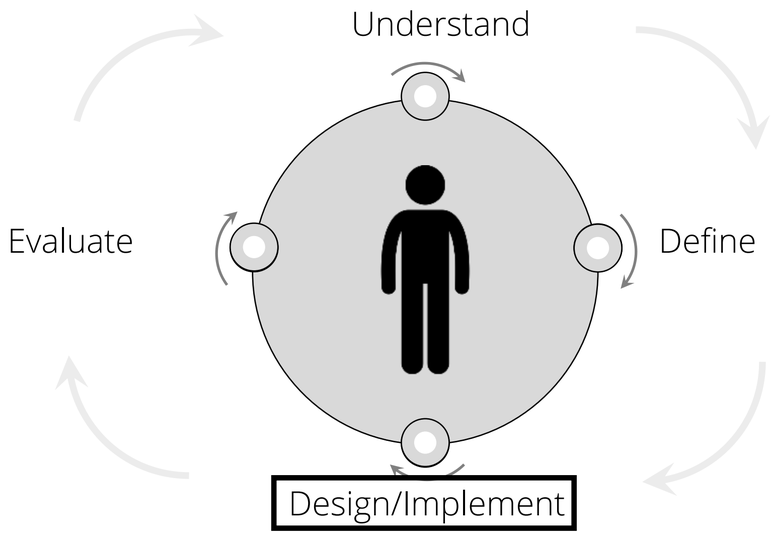
Methods:

- Low Fidelity Prototyping:
  - Storyboards
  - Sketching
  - Paper Prototypes
  - Roleplay
  - Wizard of Oz
- High Fidelity Prototyping
  - Software (e.g., Unity3D)
  - Interactive Wireframe (e.g.,. Figma, Adobe XD)
  - Hardware (e.g., Arduino)
  - Digital Fabrication (e.g., 3D Printing, Laser-cutting)

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design (Prototyping)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Definition:

"A first or preliminary version of a device or vehicle from which other forms are developed" - Oxford Dictionary

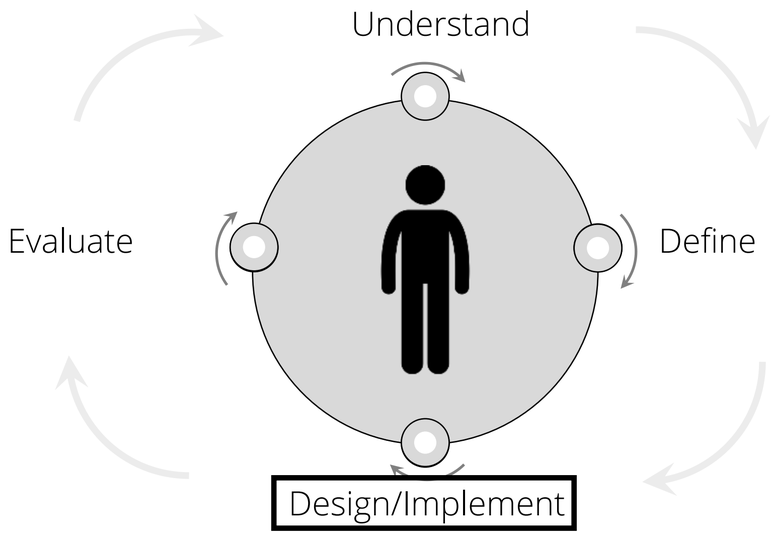
Goal:

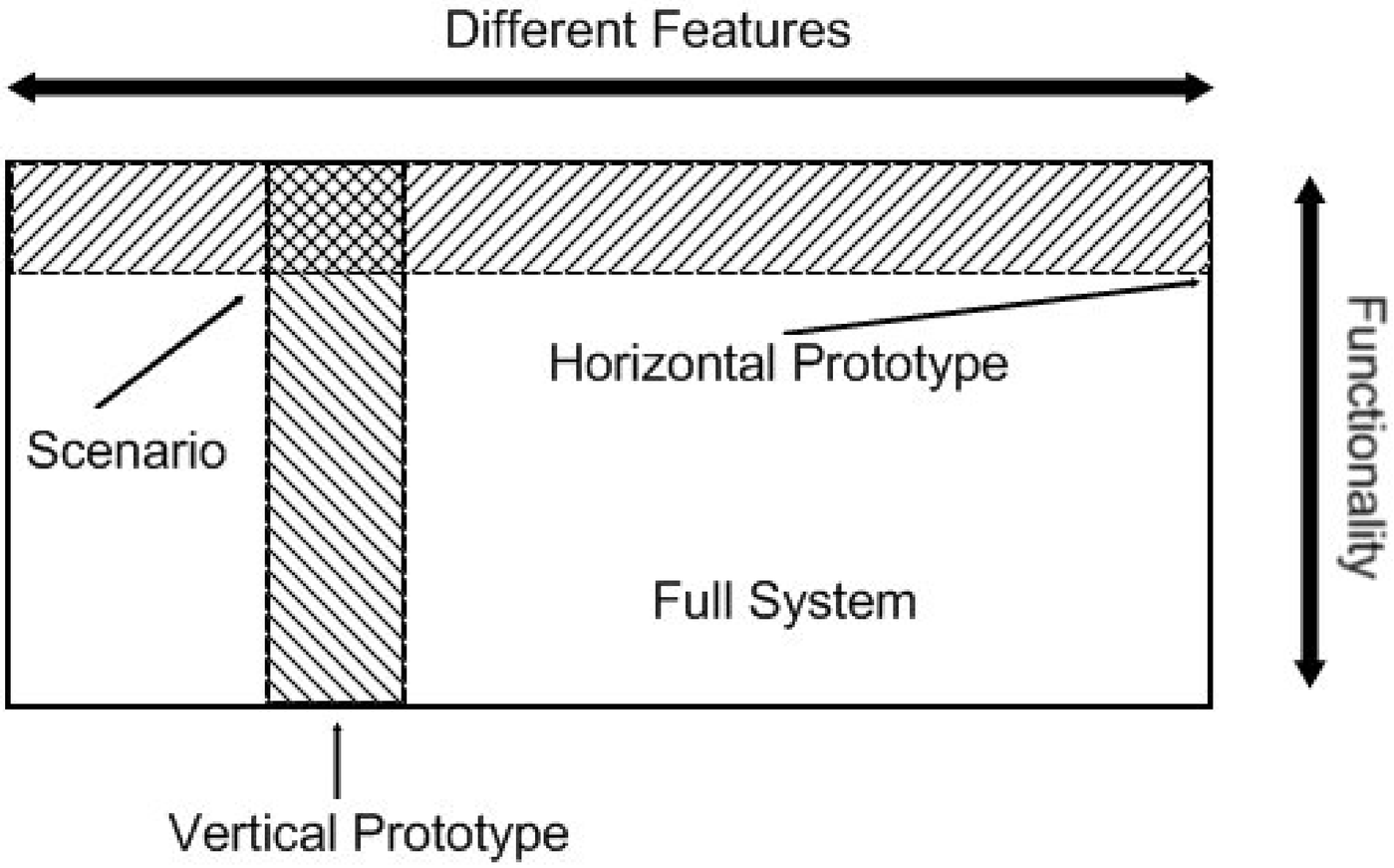
- Learning
- Searching
- Communicating

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Horizontal and Vertical Prototypes

"Based on product goals and requirements, start an iterative process of product design and development." [1]

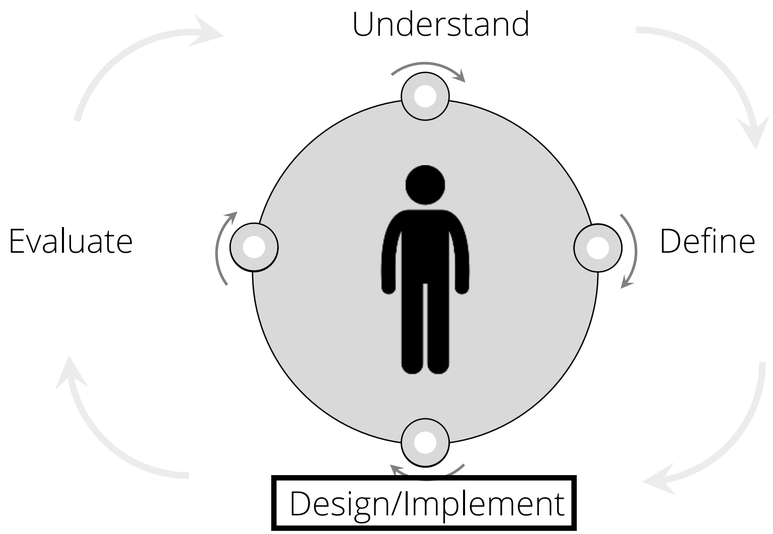


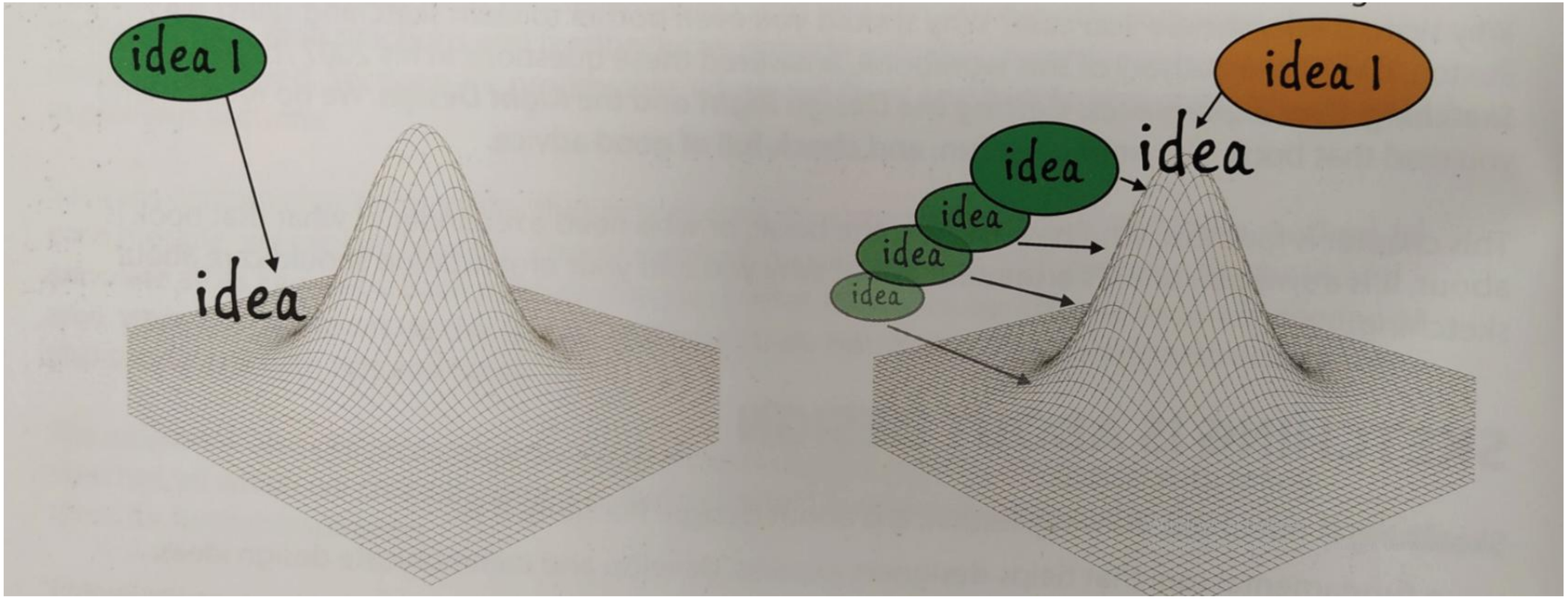


[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design: Getting the Design Right vs Getting the right Design

"Based on product goals and requirements, start an iterative process of product design and development." [1]





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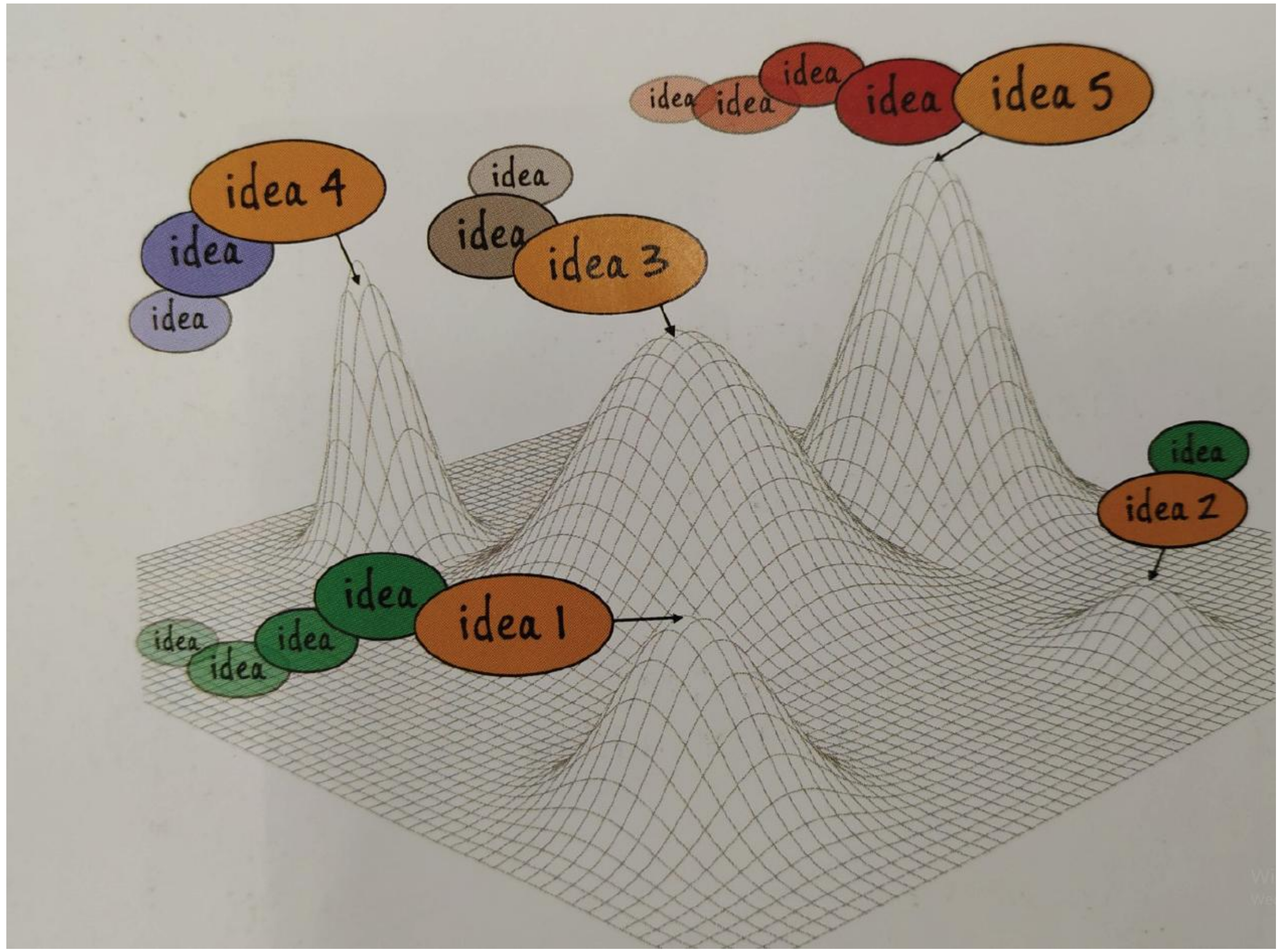

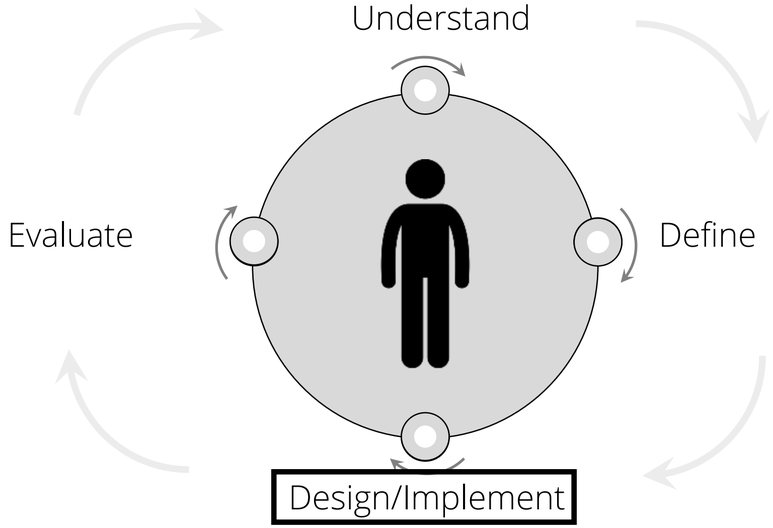

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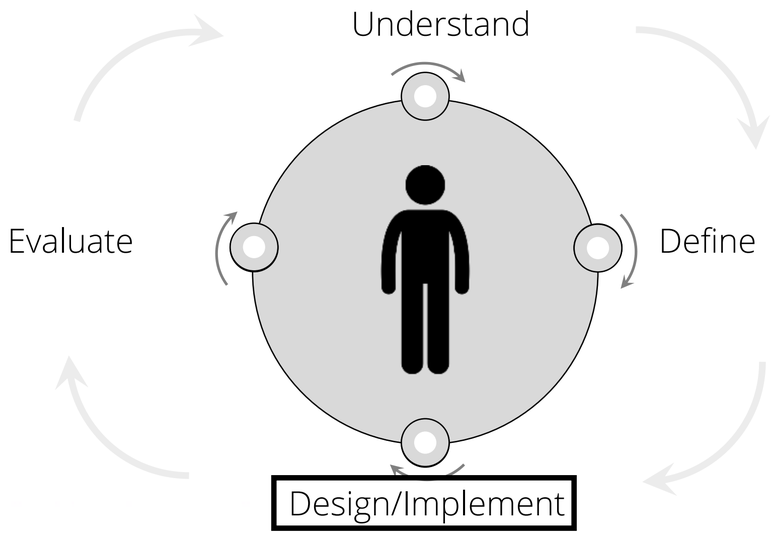
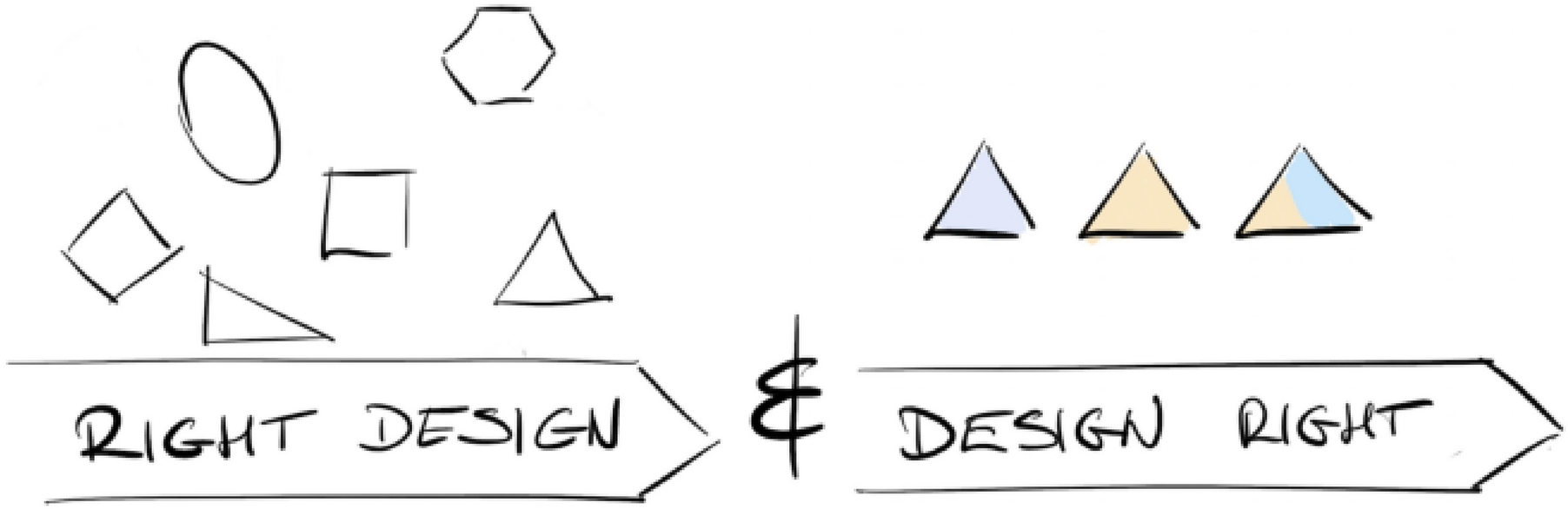
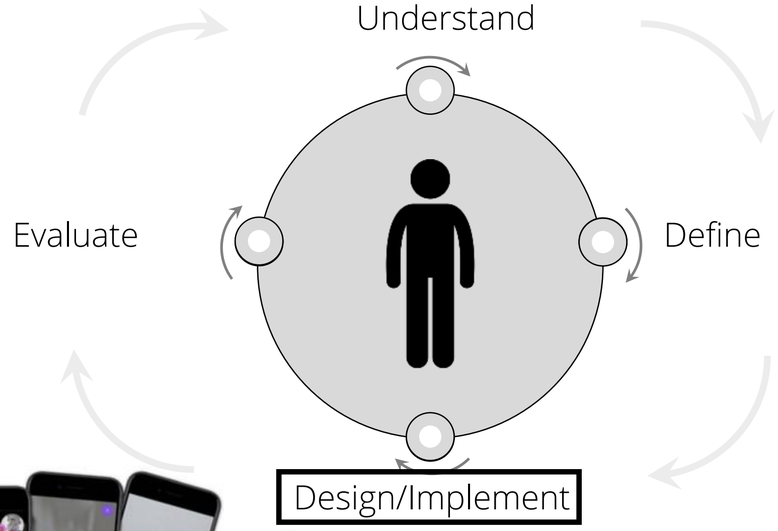


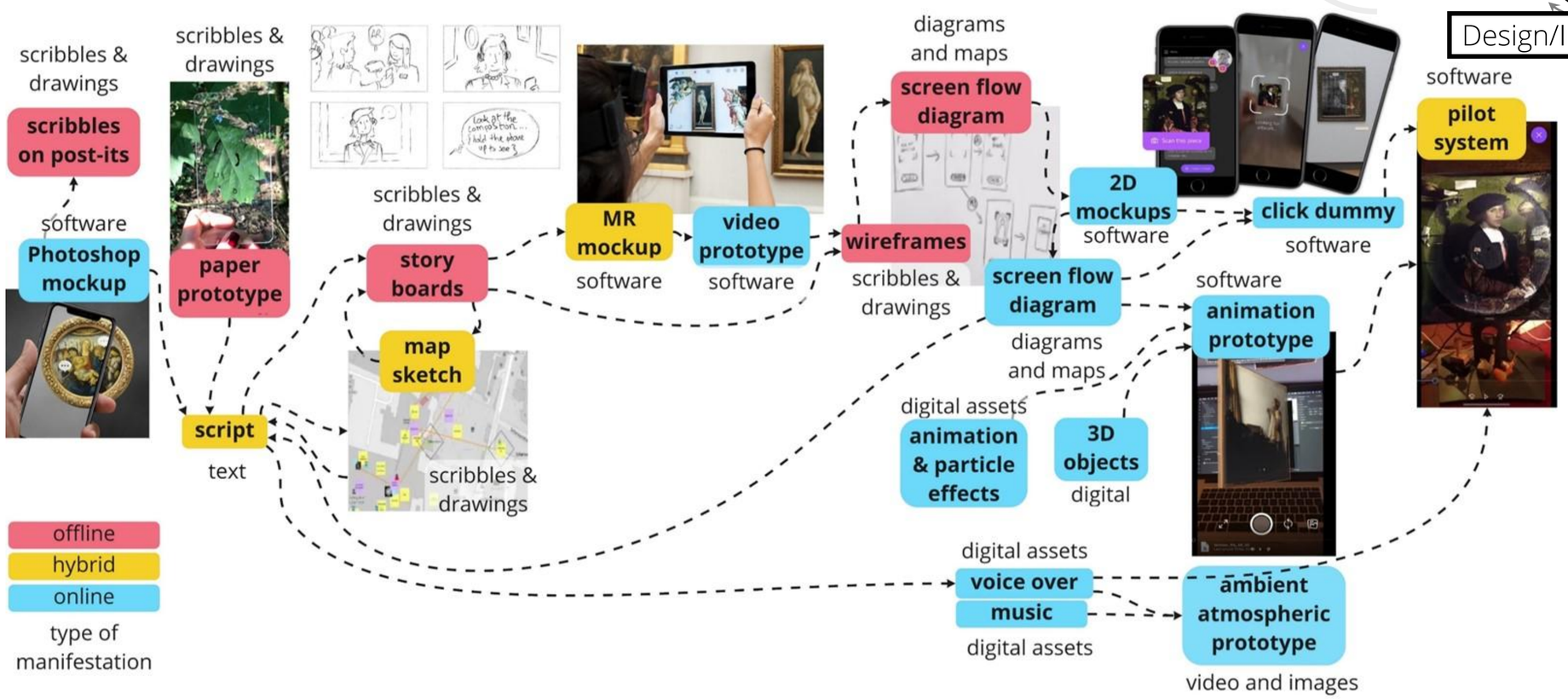


[1] https://www.usability.gov/what-and-why/user-centered-design.html

Prototyping in a Project’s context

There are many different types of prototypes. Usually, a combination of multiple types of prototypes is used throughout a single project to combine different strengths of prototyping methods (regarding their manifestation) and perspectives on application features.

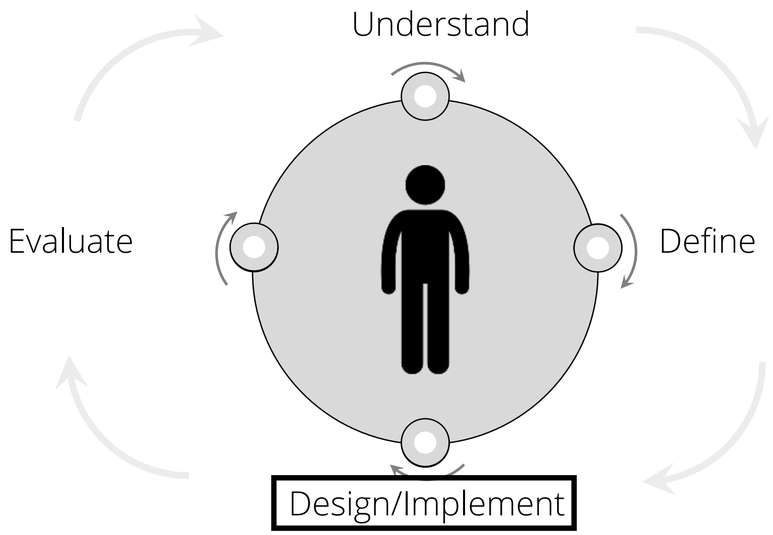


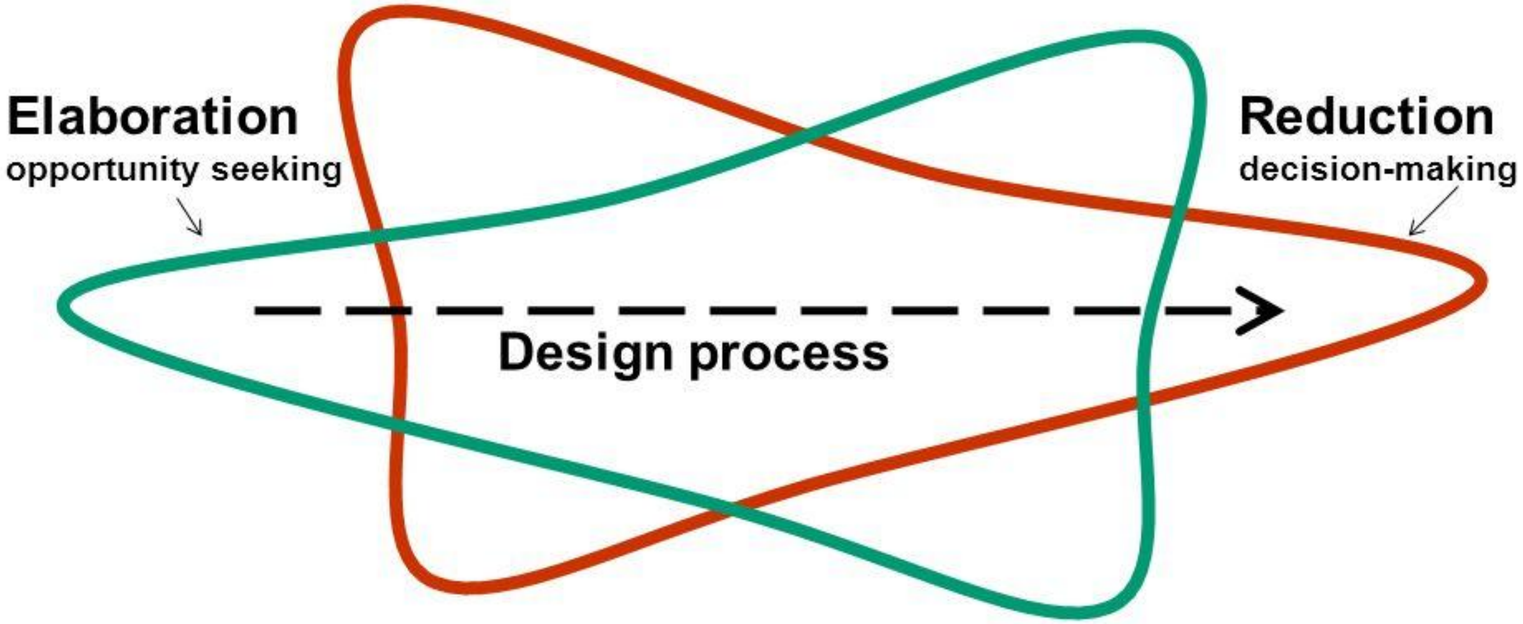


Veronika Krauß, et al.. 2022. Elements of XR Prototyping: Characterizing the Role and Use of Prototypes in Augmented and Virtual Reality Design. In Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22). Association for Computing Machinery, New York, NY, USA, Article 310, 1–18. https://doi.org/10.1145/3491102.3517714

Design (Prototyping)

"Based on product goals and requirements, start an iterative process of product design and development." [1]

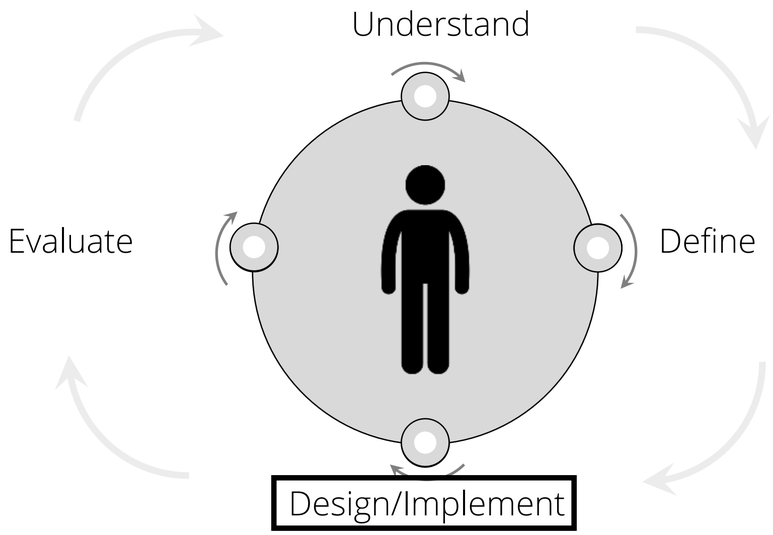




Slide idea by Bill Buxton. Source: Laseau,P. (1980) Graphic Thinking for Architects & Designers. John Wiley and Sons

Design (Low Fidelity)

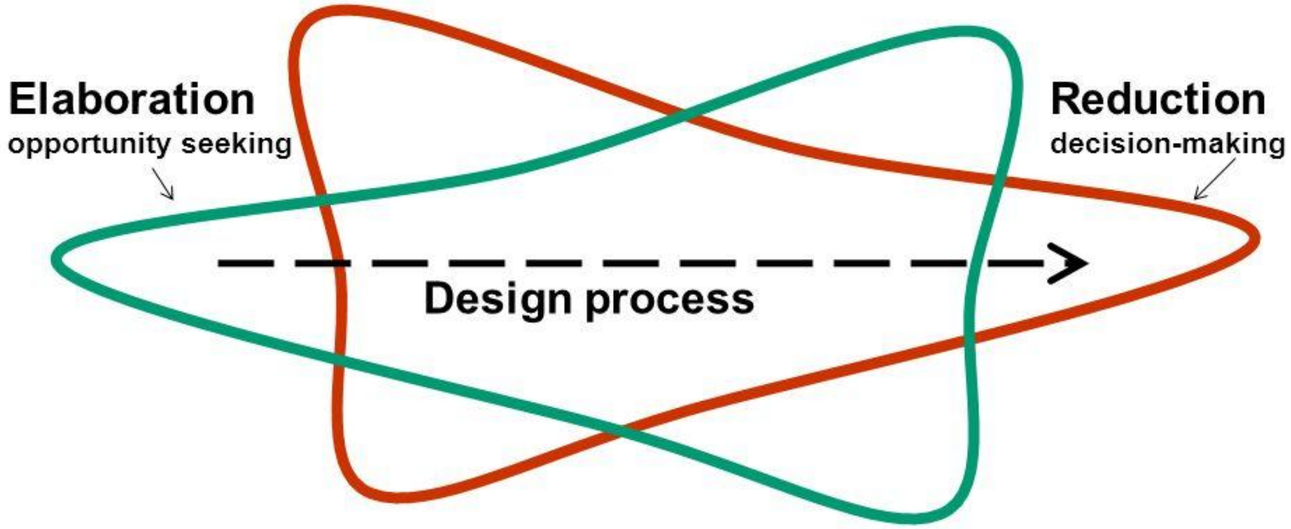
"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- Quick visual design
- Capture key interactions
- Focus on user experience
- Communicate design ideas
- "Learn by doing/experiencing"

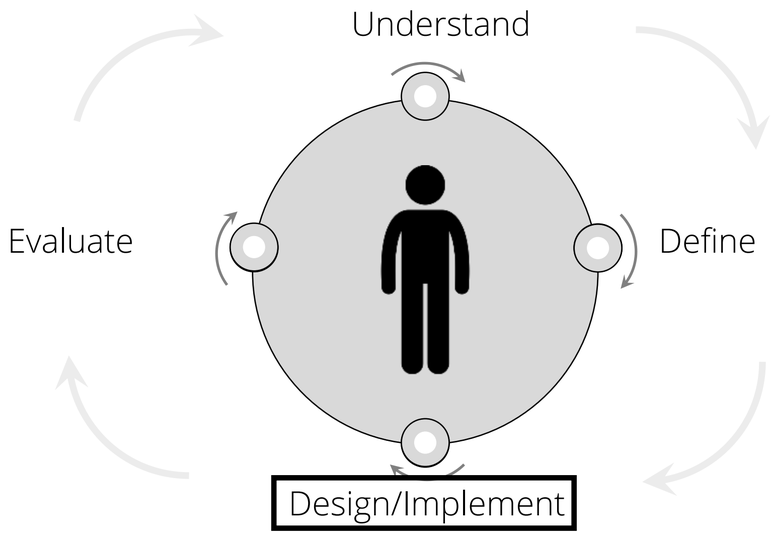
→ (often) focus on Elaboration



Slide idea by Bill Buxton. Source: Laseau,P. (1980) Graphic Thinking for Architects & Designers. John Wiley and Sons

Design (Sketches)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- Sketching is NOT about drawing its about design
- Sketching is a tool to help you: express, develop and communicate ideas
- Sketching is part of a process: idea generation, design elaboration, design choice and engineering

Helps to communicate a common ground of understanding (Visual Thinker vs Verbal Thinker) (https://www.youtube.com/watch?v=UBVV8pch1dM)

Tools:

- Pen and Paper or even software such as Illustrator

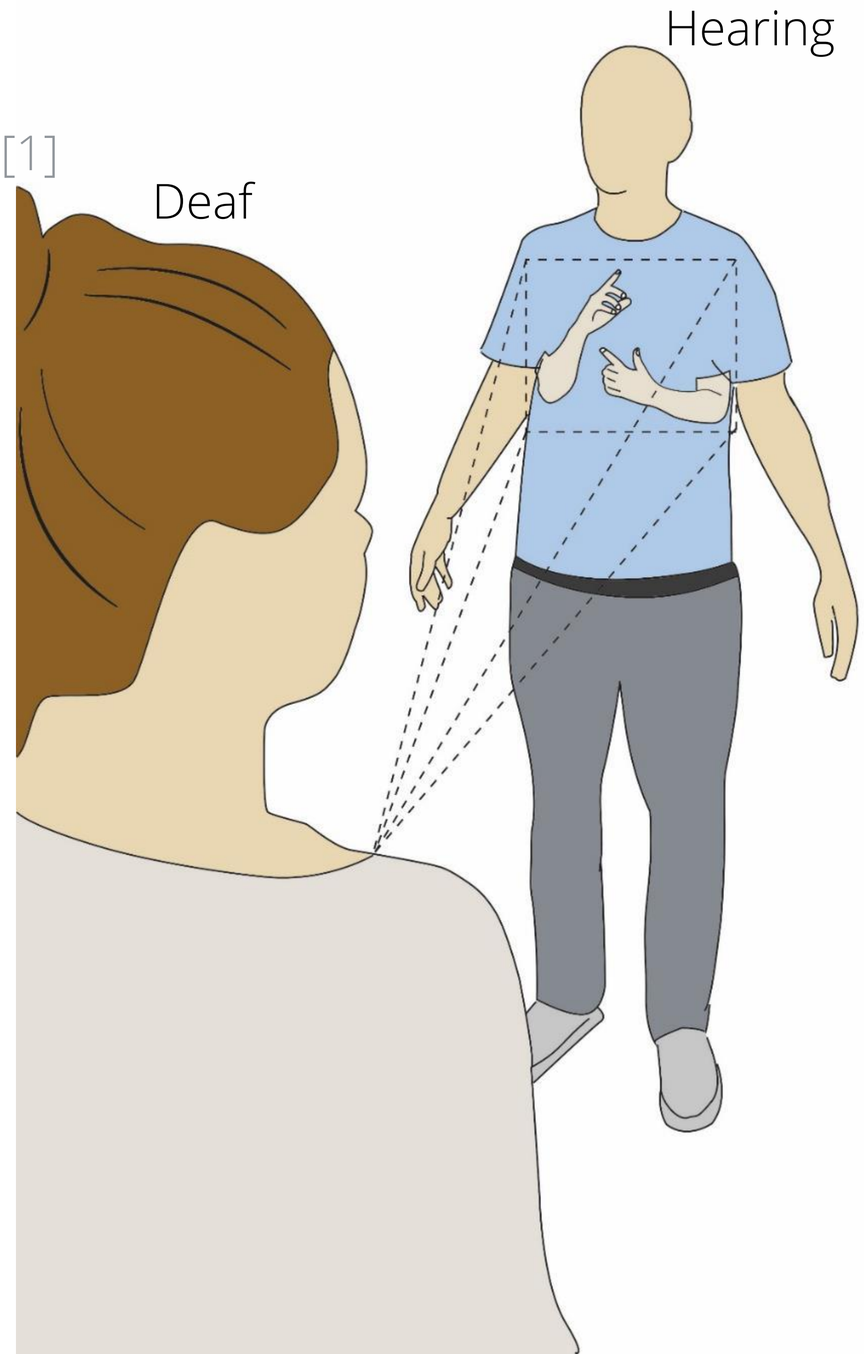
When to use ?:

- Early in the design process

Design (Sketches)

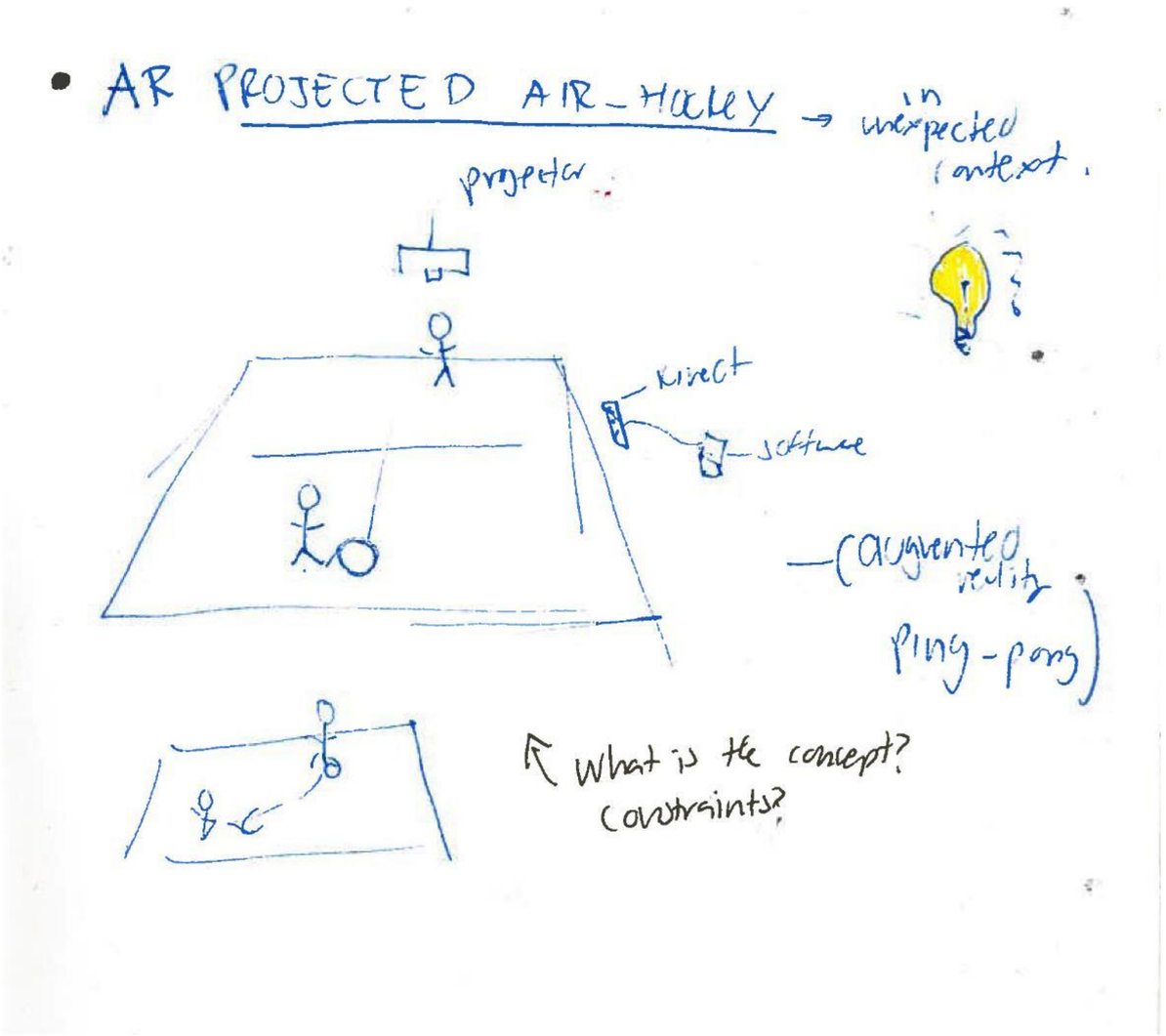
"Based on product goals and requirements, start an iterative process of product design and development." [1]

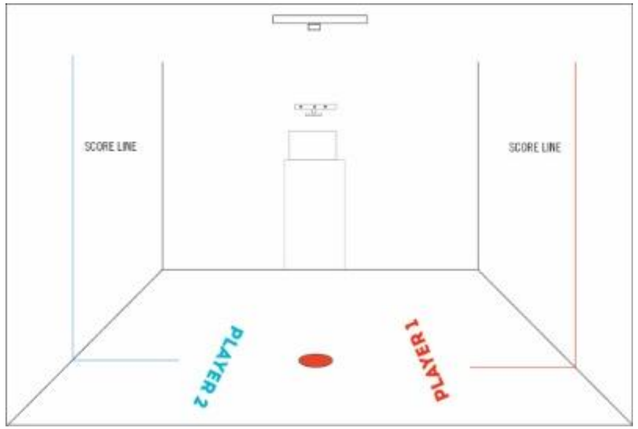
The image I used to explain people the concept that I showed you before about BodySign



Design (Sketches)

Augmented Reality Room-Scale Hockey

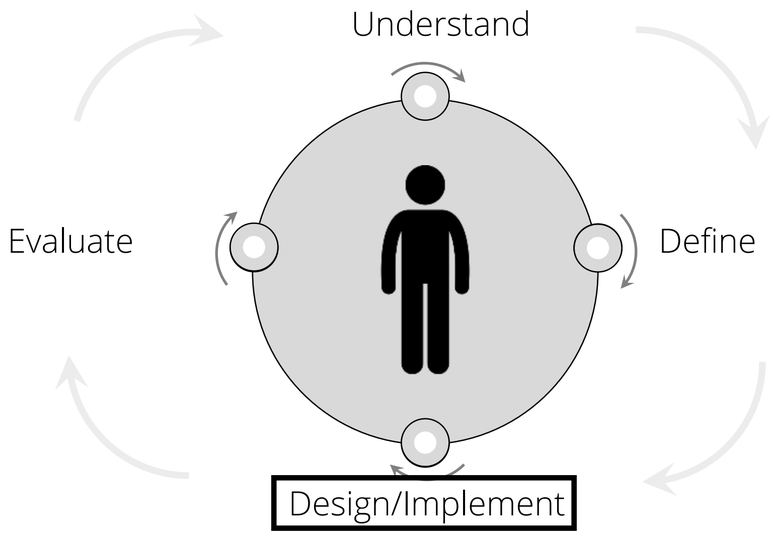




https://stereoscopica.wordpress.com/2013/05/29/augmented-reality-hockey-concept/

Design (Storyboards)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- Based on Sketching techniques
- Heavily grounded in Personas and Scenarios
- A great storyboard does not only include states but also transitions

→ How do I get from state one to state two ?

Tools:

- Pen and Paper or Software tools
- Storyboard templates

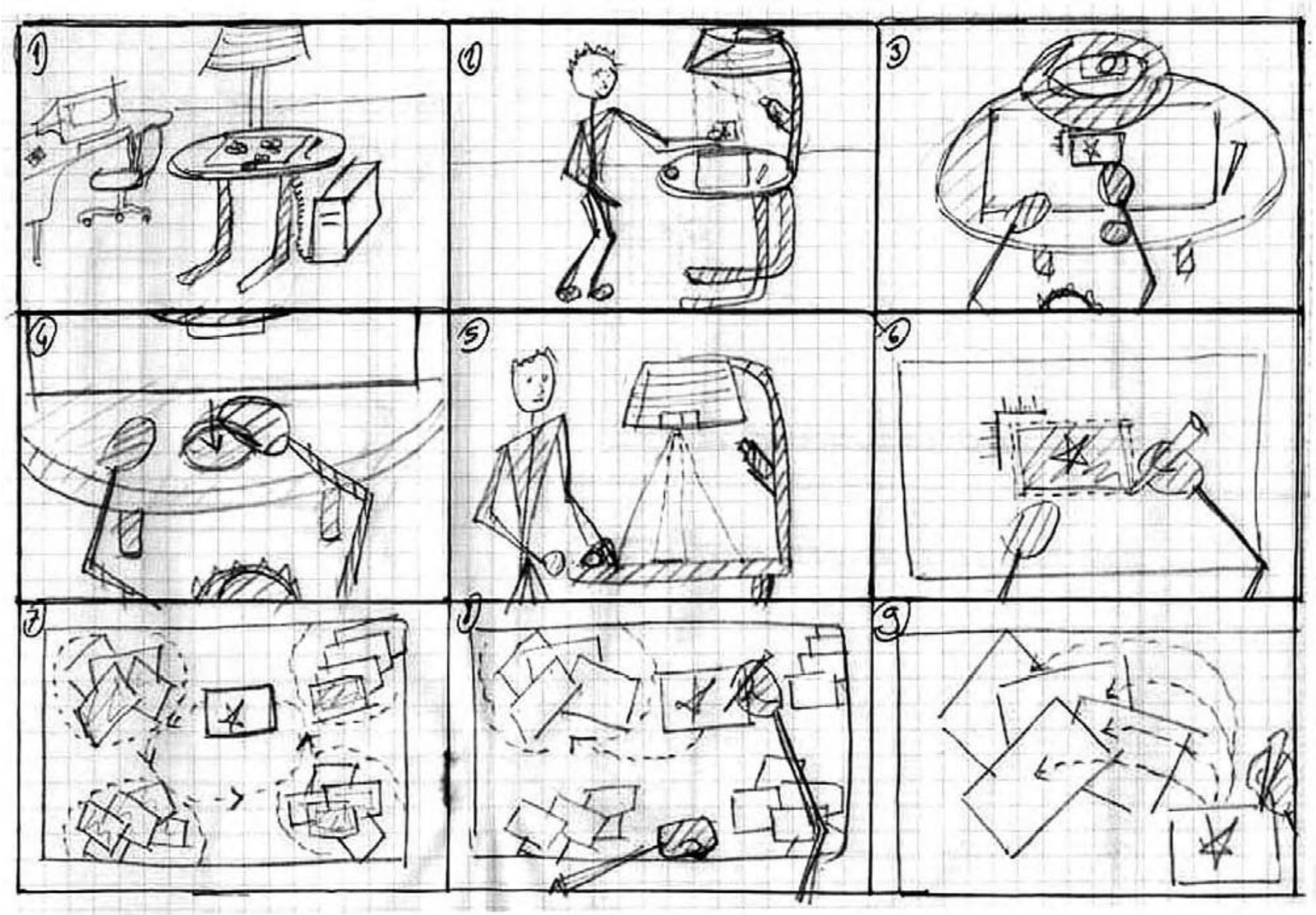
When to use ?:

- Early in the design process
- To explore transitions and not only static interfaces

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design (Storyboards)

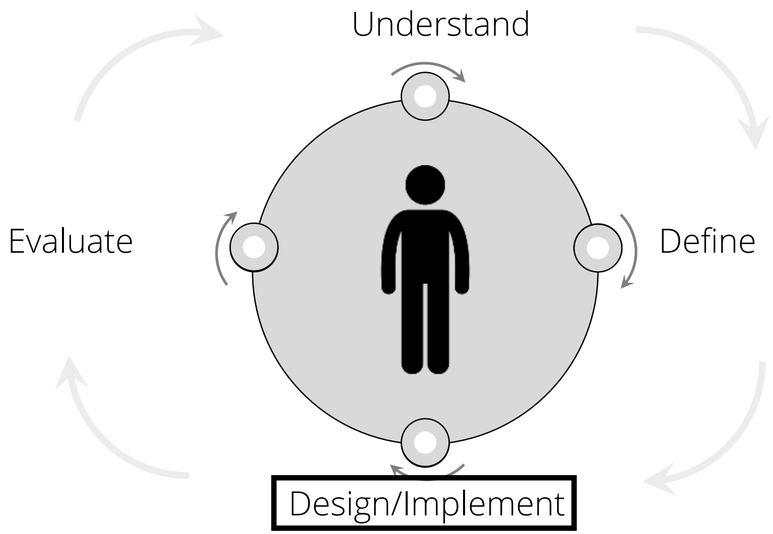
"Based on product goals and requirements, start an iterative process of product design and development." [1]



Design (Storyboards)

Design (Paper Prototypes)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- A physical mockup of the interface, mostly made of paper.
- Usually hand-sketched on multiple pieces, with different pieces showing different menus, dialog boxes, or window elements
- Difference to a simple "sketch" is a form of interactivity either through dynamic paper prototypes or the narrative of the designer
- Can be used in first user exposures

Tools:

- Pen, Paper, Whiteboards, Post-It-Notes, Glue, ...

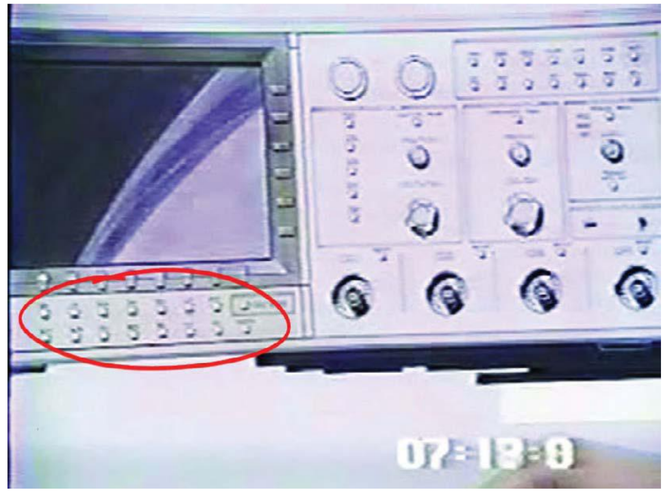
When to use ?:

- Early in the design process
- Work well with very complex and/or critical problems

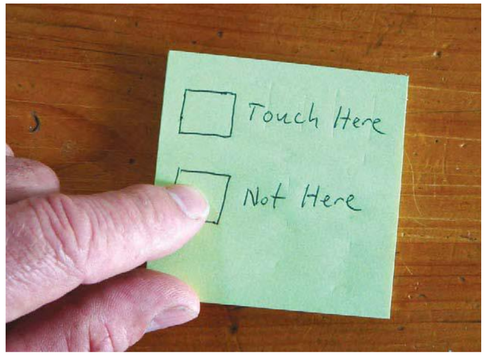
[1] https://www.usability.gov/what-and-why/user-centered-design.html

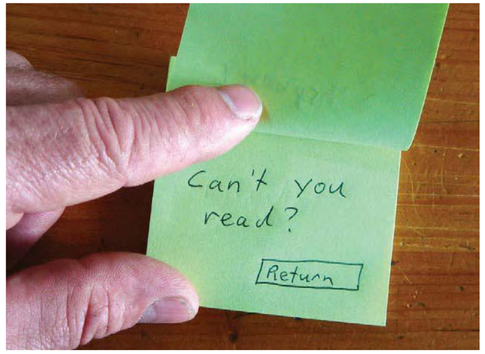
Design (Paper Prototypes)

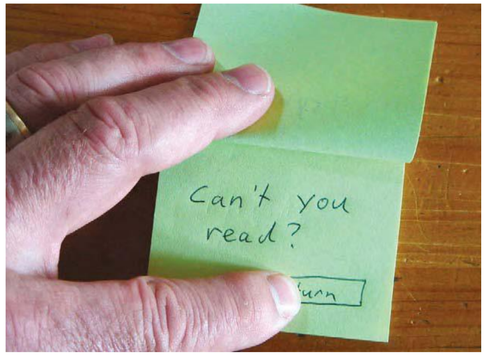
Static



Dynamic

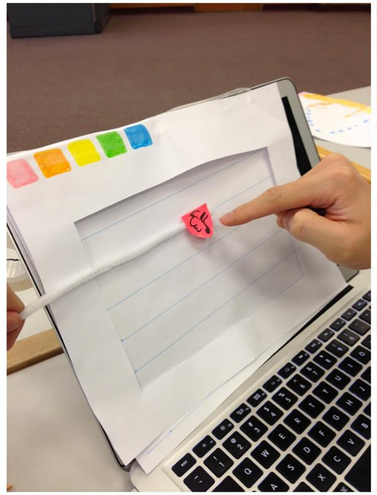


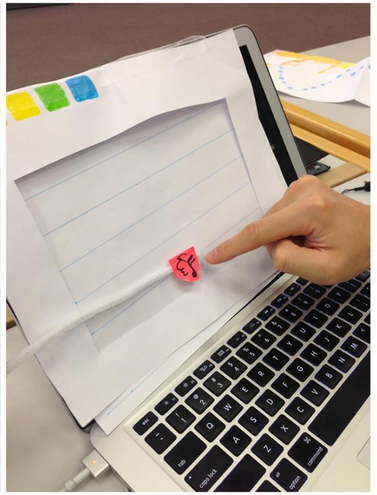


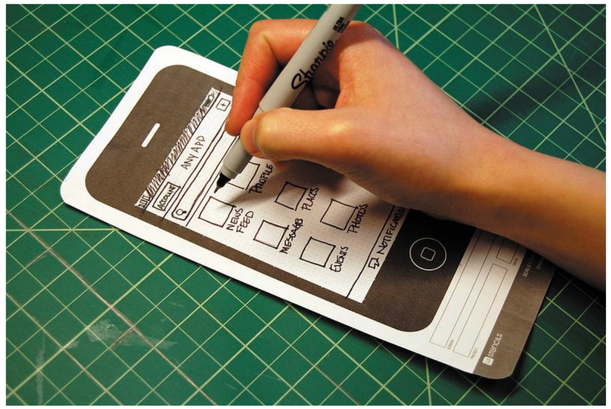


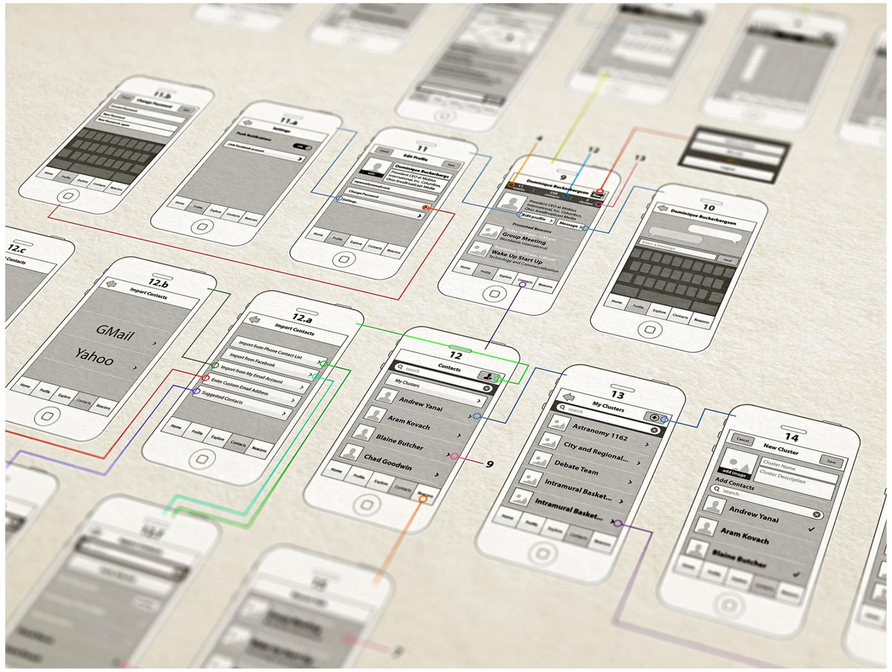
Design (Paper Prototypes)

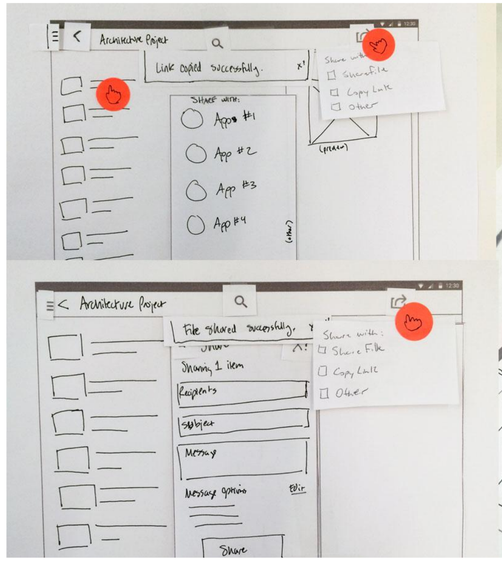
A lot of templates exist to allow for quick iterations and multiple designs

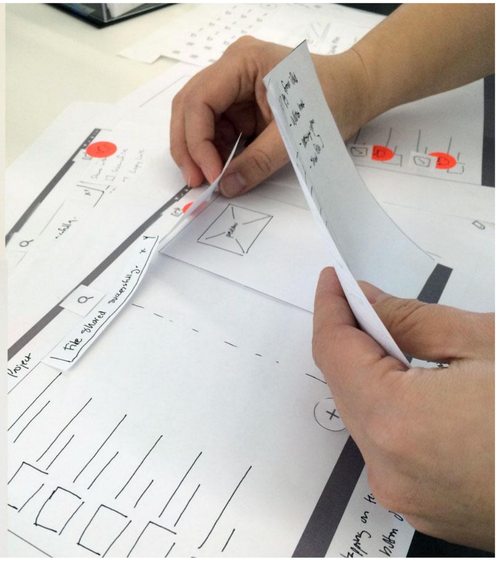








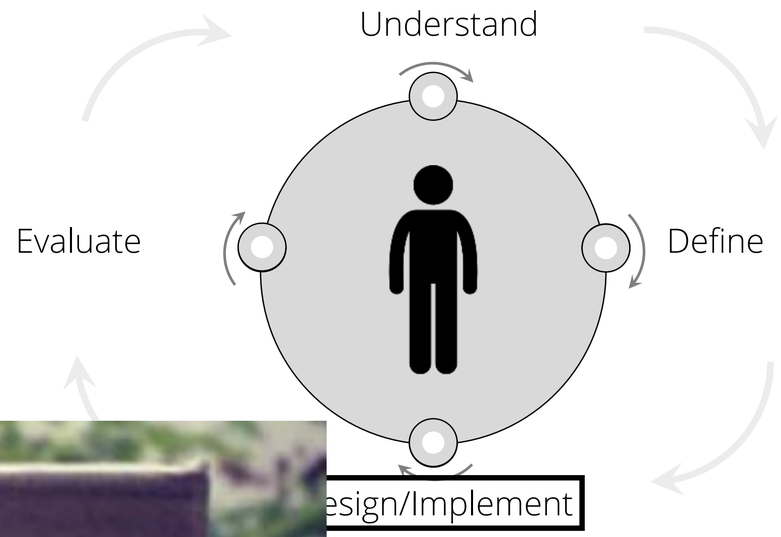




https://www.youtube.com/watch?v=9wQkLthhHKA

Design (Paper Prototypes)

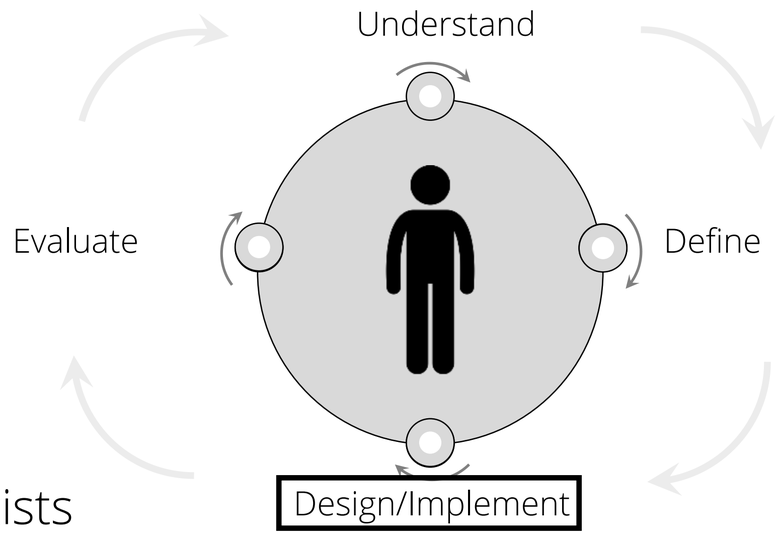
"Based on product goals and requirements, start an iterative process of product design and development." [1]



https://thenextweb.com/google/2017/03/02/feast-eyes-first-google-cardboard-prototype/

Design (Wizard-of-Oz)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- Create a "façade" to give the user the illusion as if the system exists
- "Fake" all the underlying functionality through a clever combination of existing technology

Tools:

- A combination of functional technology to keep up the illusion, combined with acting and a wizard control panel

When to use?:

- If you are interested in a certain concept/idea that arises from being exposed to the artefact that you try to WoZ and implementing it would take too much time.

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design (Wizard-of-Oz)

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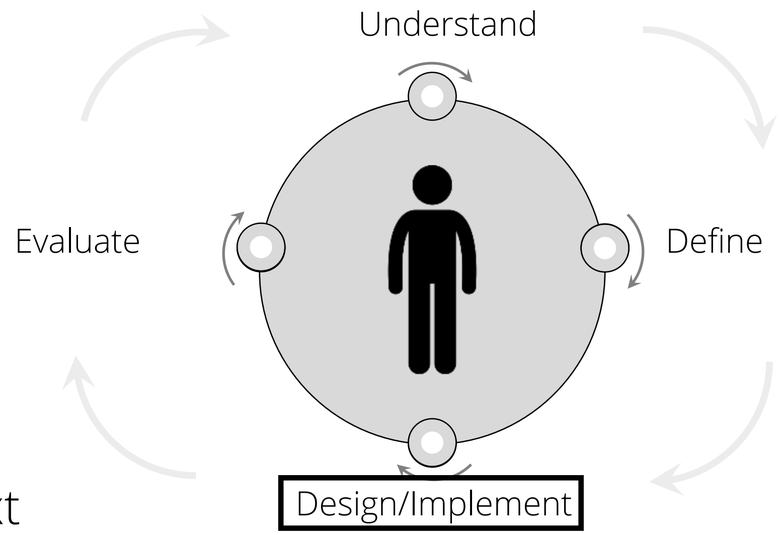

Example:

A prototype that evaluates how people interact with a Voice-To-Text Interface, in a time where NLP was not possible yet.

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design (Wizard-of-Oz)

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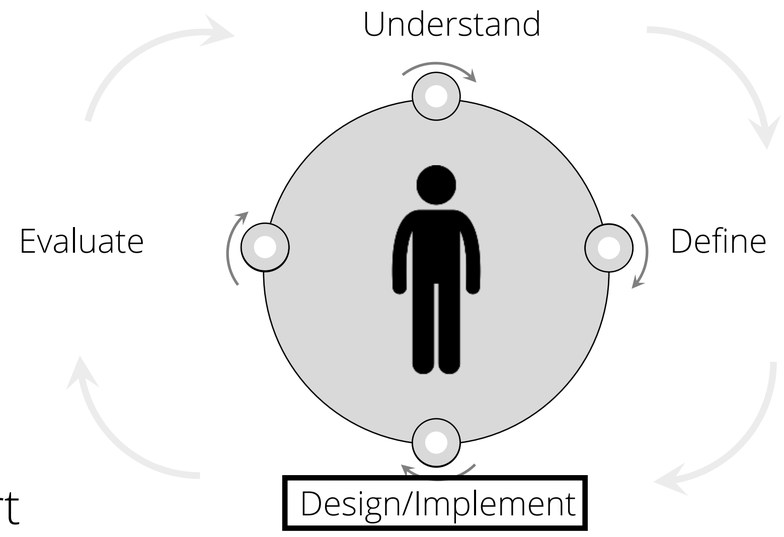
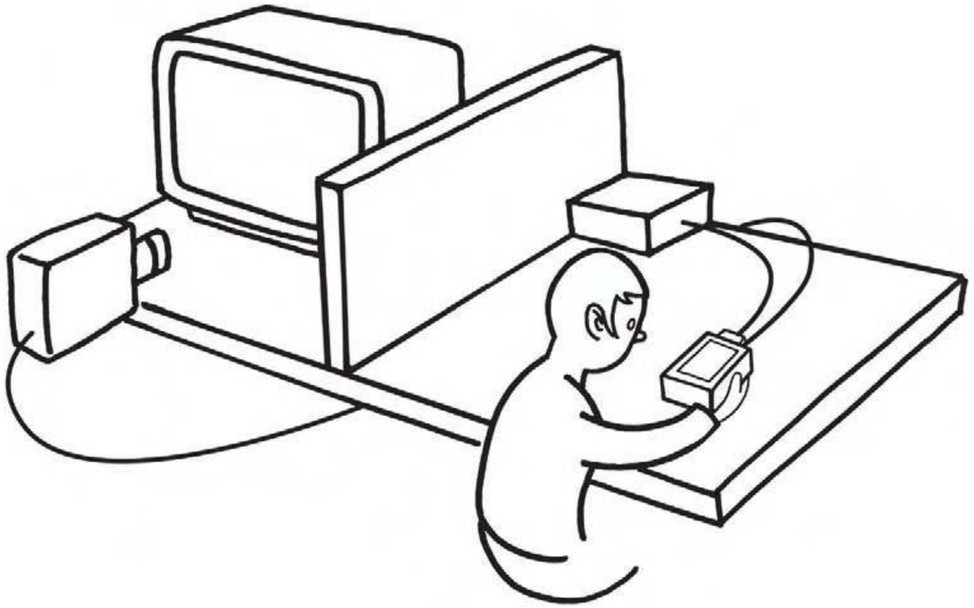


Example:

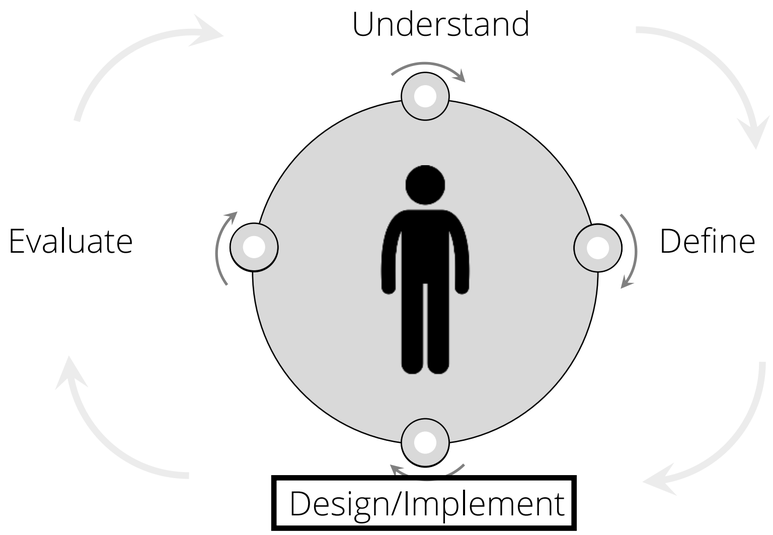
A prototype to evaluate how people can interact with a small smart device that has the capacity of a stationary rendering machine



[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design (High Fidelity)

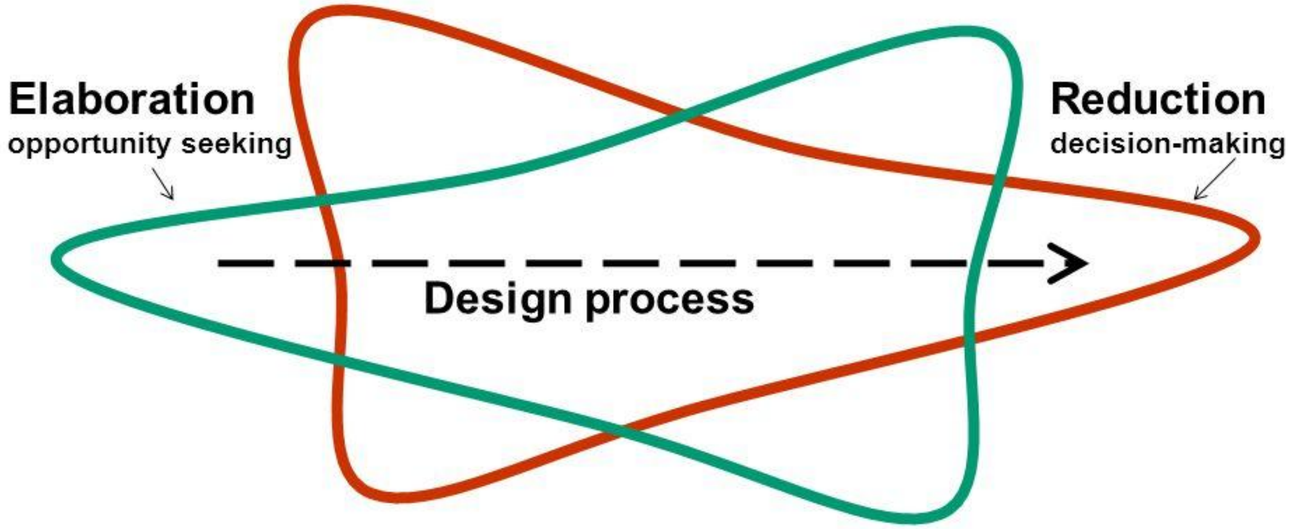
"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- Starting to think how you would implement something
- Want to have a clearer understanding of the desired product and in particular the functionalities
- Often important when prototyping interactions or interactive aspects
- Often used to communicate with decision makers

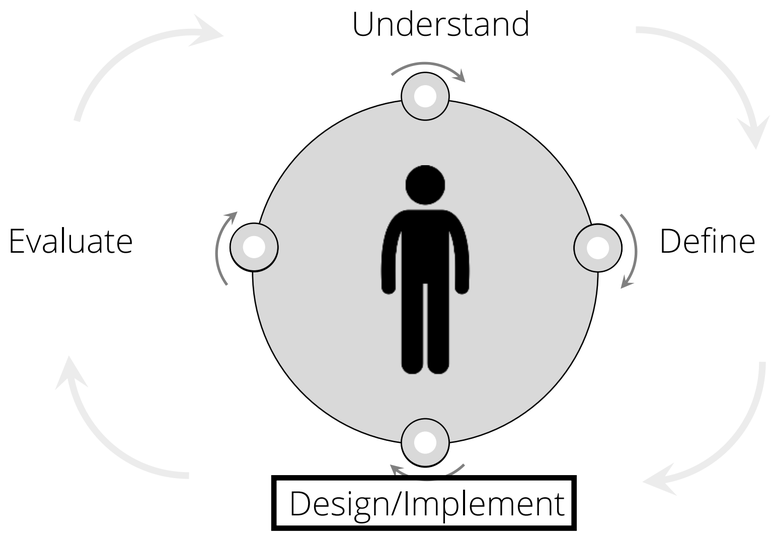
→ Focus on Reduction (not always!)



Slide idea by Bill Buxton. Source: Laseau,P. (1980) Graphic Thinking for Architects & Designers. John Wiley and Sons

Design (Interactive Wireframe)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- Unlike storyboards, form builders use actual working widgets, not just static pictures
- Using appropriate tools you can quickly have a visually horizontal prototype and even add some verticality using simple "scripting" techniques
- Only works for the software side of the prototype !

Tools:

- One of the hundreds of tools offered specifically for that (Adobe XD, Balsamiq, Figma,...)
- PowerPoint

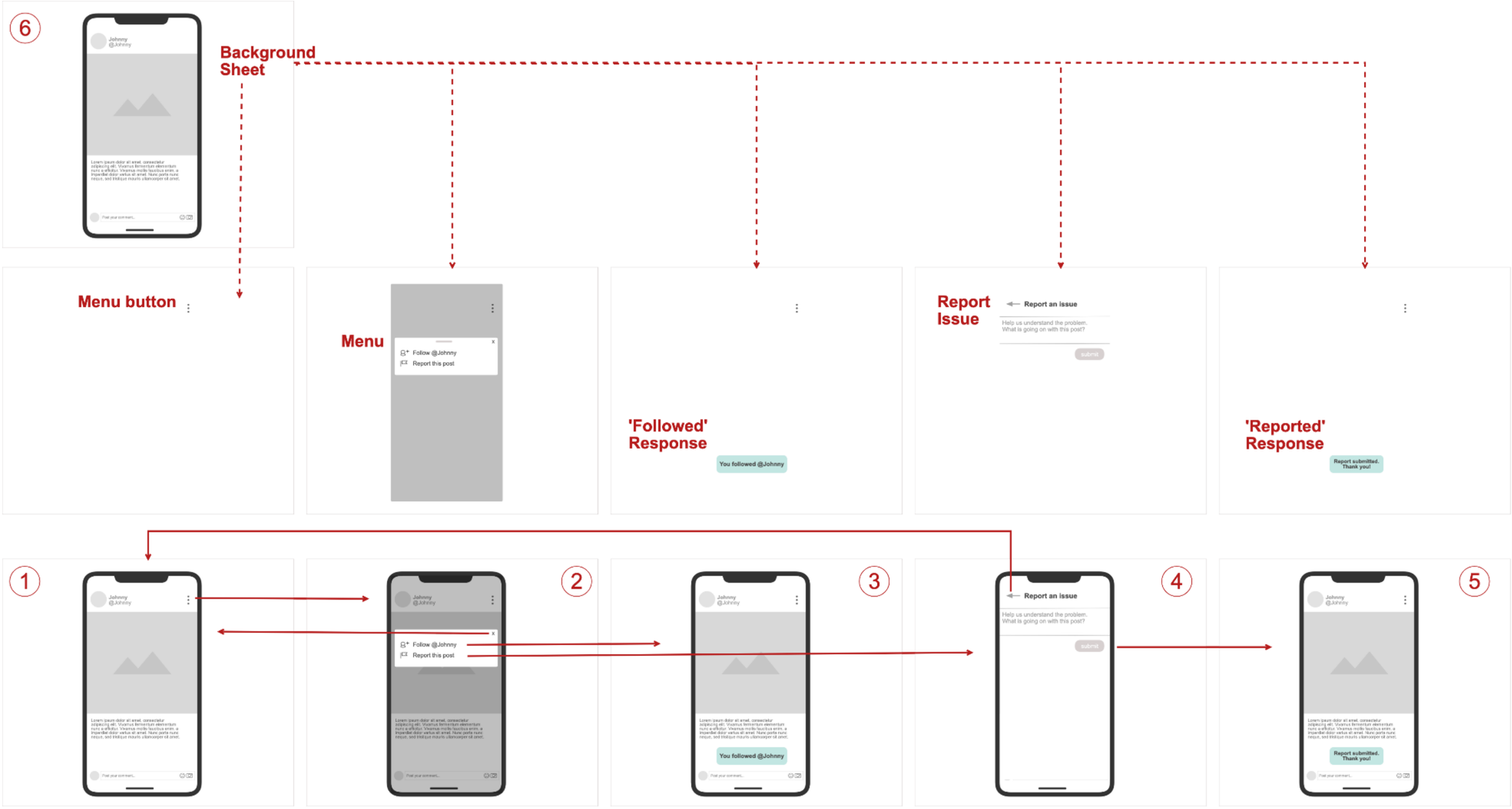
When to use ?:

- When you want to explore the visual design and the workflow of interactions

[1] https://www.usability.gov/what-and-why/user-centered-design.html

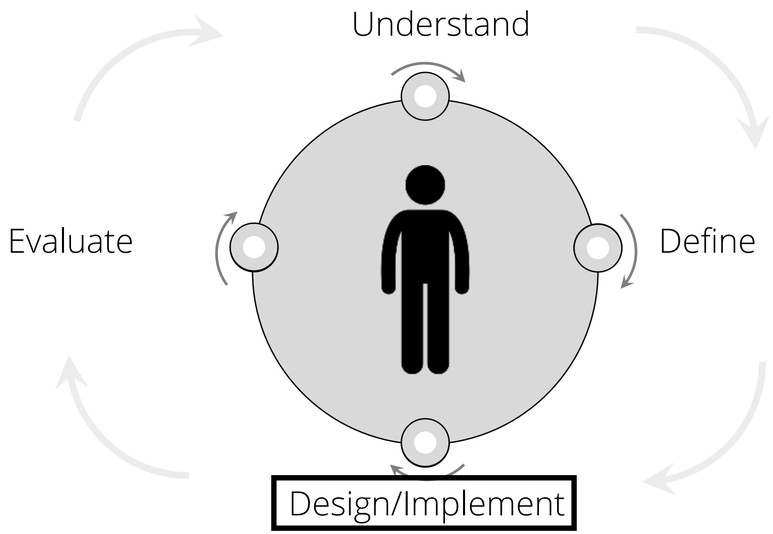
Design (Interactive Wireframe)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Design (Software)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- A functional prototype that can be later used in a study
- Shows often what aspects of the implementation you underestimated beforehand
- Focus is here NOT on nice code guidelines but on fast results !
- Often times I "reused" a different project that I found and build upon it

→ You do not have to start from scratch !

Tools:

- Frameworks and programming languages that you are familiar with
- Unity3D, Android Studio, Visual Studio (WPF), ...
- Example projects!

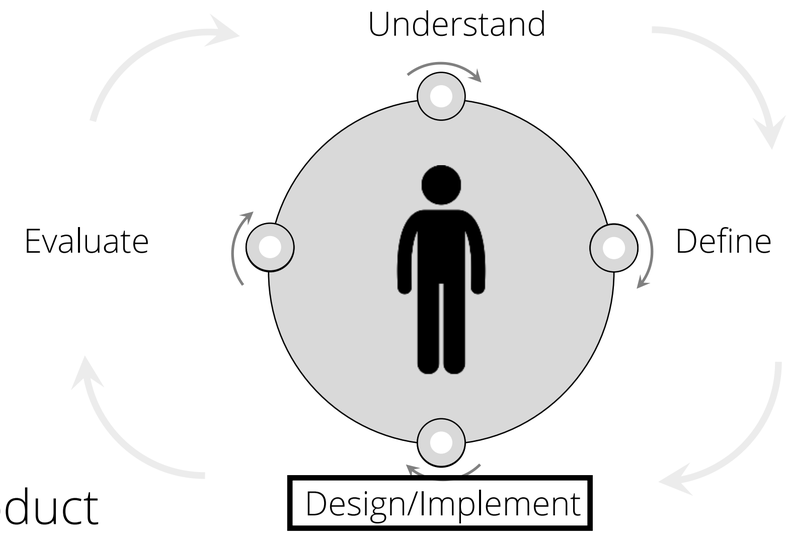
When to use ?:

- When you found the right design but did not get the design right (yet)

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design (Hardware)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- Similar to the software prototype, the goal is NOT to have a product but a first impression of how the artifact will behave/feel
- Focus on fast results and break things (literally !)
- Often it is more efficient to combine already existing systems and only "glue" them together using microcontrollers and duct tape

Tools:

- Microcontrollers (Arduino, Raspberry Pi,...)
- Breadboard, sensors, actuators and duct tape !
- Hacking ! If something that you want already exists, steal it and hack it !

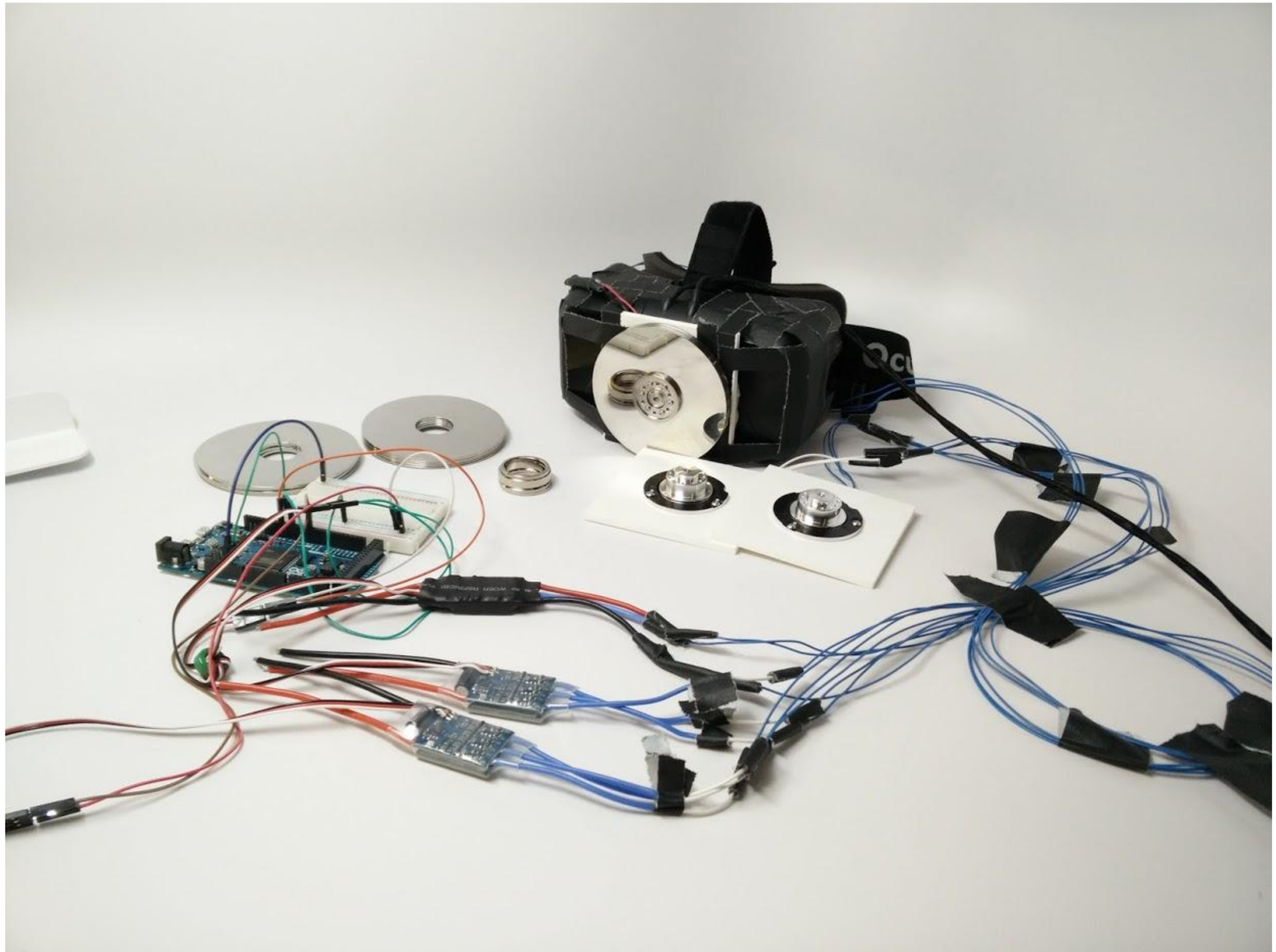
When to use ?:

- If you want to experience a certain physical behaviour

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design (Hardware)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Design (Hardware)

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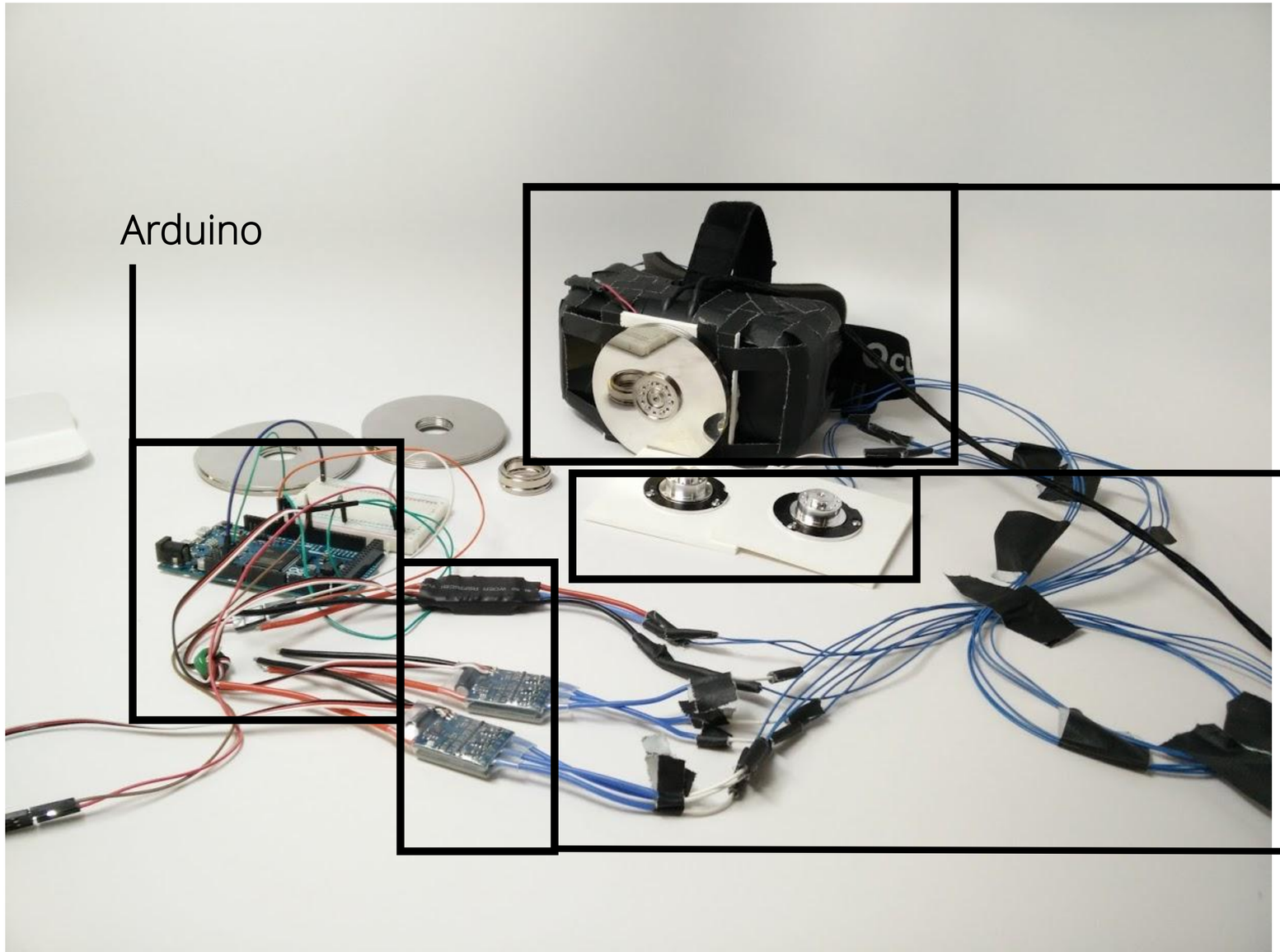
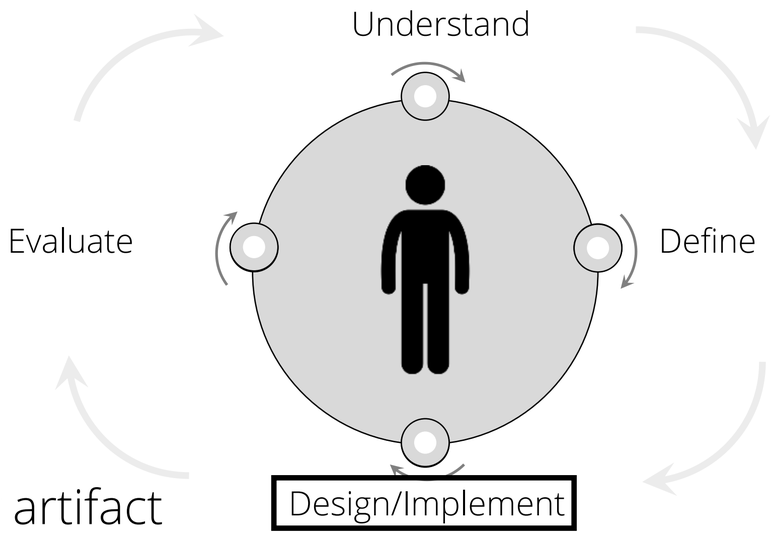


Design (Fabrication)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Properties:

- Fabricate cases, connectors or actuators that you need for your artifact
- Often used if you need to combine two pieces of hardware or you need a certain mechanical behavior that does not exist yet
- There are different fabrication technologies (additive vs subtractive)
- Pipeline: Modelling Tool → Slicer Software → Fabrication Device

Additive

- Stereolithography (SLA)
- Selective laser sintering (SLS)
- Fused deposition modeling (FDM)

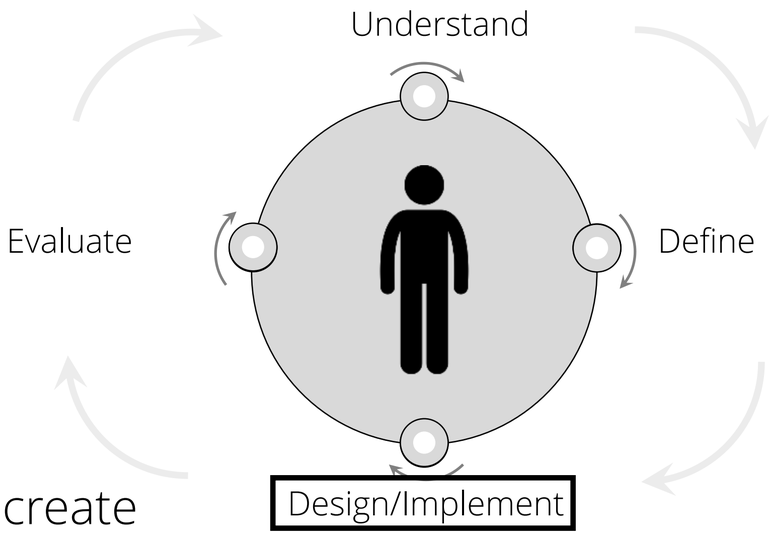
Subtractive

- Laser cutter
- CNC Mill

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Design (Rapid Prototype)

"Based on product goals and requirements, start an iterative process of product design and development." [1]



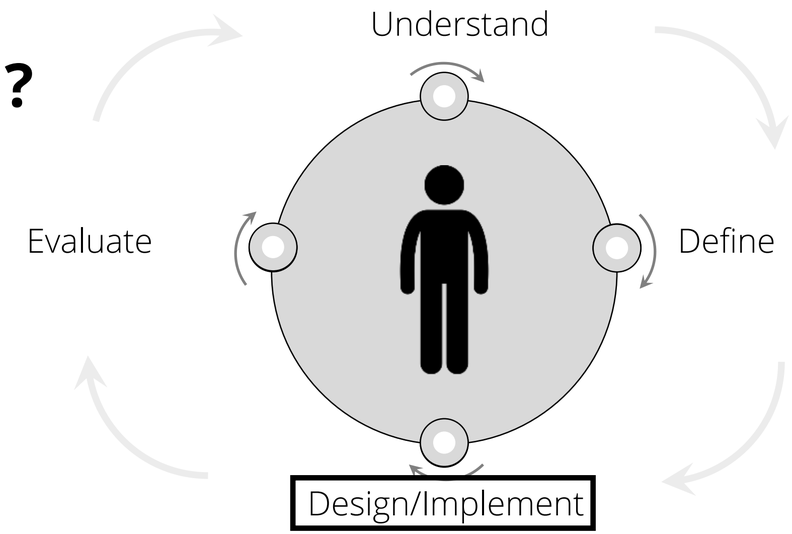
Goal:

Even for high fidelity prototypes, the goals is NOT a product but to create the illusion of having this product NOW and explore the experience

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Prototyping for Augmented and Virtual Reality ?

"Based on product goals and requirements, start
an iterative process of product design and development." [1]



Low Fidelity:

- Currently a HOT topic for researchers since there is a lack of understanding how to rapidly prototype in Mixed Reality and there is a lack of tools

- Physical Prototyping with real life objects (role play)
- Current tools for paper prototyping (e.g., Sketchbox)
- Research tools for paper prototyping (360Proto, XR-Director, ProtoAR)

→ Checkout Michael Nebeling at Michigan University (http://michael-nebeling.de/)

High Fidelity:

- Currently the most dominant platform is Unity3D and Unreal Engine

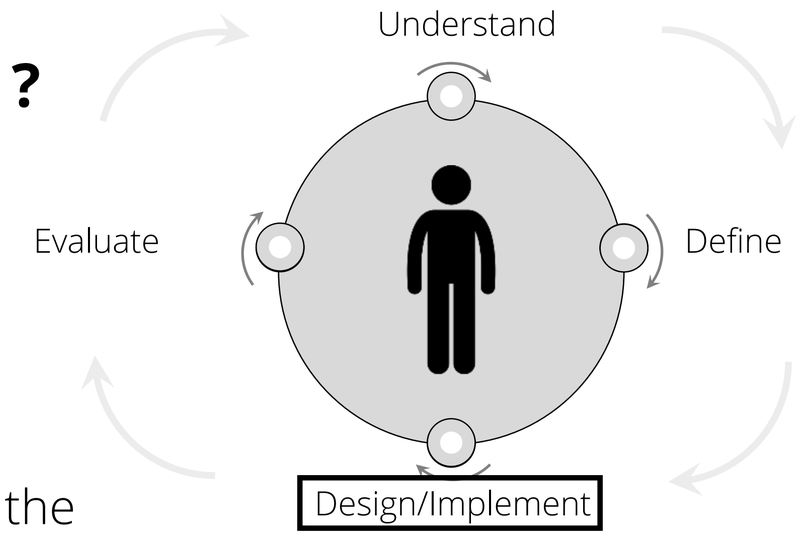
→ Allows to have access to most lower level hardware functionalities (e.g. sensor data, video streams)

- A faster alternative could be A-Frame (web based AR/VR)

[1] https://www.usability.gov/what-and-why/user-centered-design.html

Prototyping for Augmented and Virtual Reality ?

"Based on product goals and requirements, start an iterative process of product design and development." [1]



Physical Prototyping (No-Fi Tools)

- Use anything that you have to enable a brief understanding of the experience you are trying to achieve
- Instead of modelling anything in 3D use props that you have in your environment
- Instead of animating anything act it out

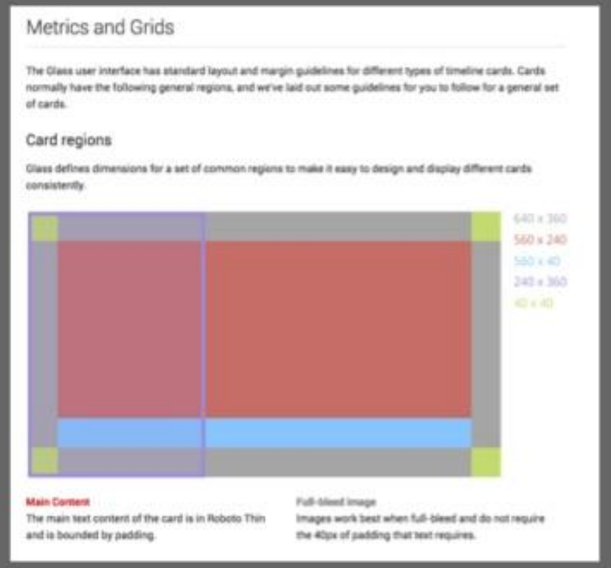
[1] https://www.usability.gov/what-and-why/user-centered-design.html

Let’s play a game. I show you a research prototype and you have to tell me how you would have created a first low-fidelity prototype without programming !

https://www.youtube.com/
watch?v=d5_h1VuwD6g

45°
40°
ALL-DAY
DEDICATED CONTROLLER
3 lbs
PHONE
OR NEW
AR, VIDEO, 3D, CAMERA
LOCAL PROX.
FULL-COLOR

Google I/O 2014 - Designing for wearables



Metrics and Grids

The Glass user interface has standard layout and margin guidelines for different types of timeline cards. Cards normally have the following general regions, and we've laid out some guidelines for you to follow for a general set of cards.

Card regions

Glass defines dimensions for a set of common regions to make it easy to design and display different cards consistently.

640 x 360
560 x 240
560 x 40
240 x 360
40 x 40

Main Content
The main text content of the card is in Roboto Thin and is bounded by padding.

Full-bleed image
Images work best when full-bleed and do not require the 40px of padding that text requires.

Typography

Glass displays all system text in either Roboto Thin (primary) or Roboto Light (secondary) depending on font size. If you're creating live cards or immersions, feel free to use different typography to convey your own branding.

Primary - Roboto Thin

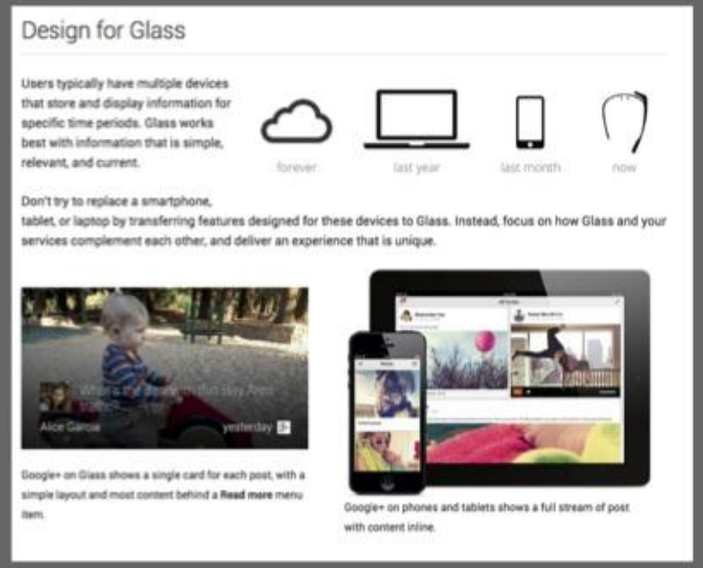
Glass displays most text in this font.

ABCDEFGHIJKLMN
OPQRSTUVWXYZa
bcdefghijklmnopq
rstuvwxyz123456
7890!?/+-=()[]#@$
%^&*<>:;"

Secondary - Roboto Light

Glass displays 26 px text in this font.

ABCDEFGHIJKLMNOPQRST
UVWXYZabcdefghijklmnopq
rstuvwxyz123456789 0!?/+-=()
[]#@$%^& *<>:;"



Design for Glass

Users typically have multiple devices that store and display information for specific time periods. Glass works best with information that is simple, relevant, and current.

forever | last year | last month | now

Don't try to replace a smartphone, tablet, or laptop by transferring features designed for these devices to Glass. Instead, focus on how Glass and your services complement each other, and deliver an experience that is unique.

Alice Garoe
yesterday

Google+ on Glass shows a single card for each post, with a simple layout and most content behind a **Read more** menu item.

Google+ on phones and tablets shows a full stream of post with content inline.

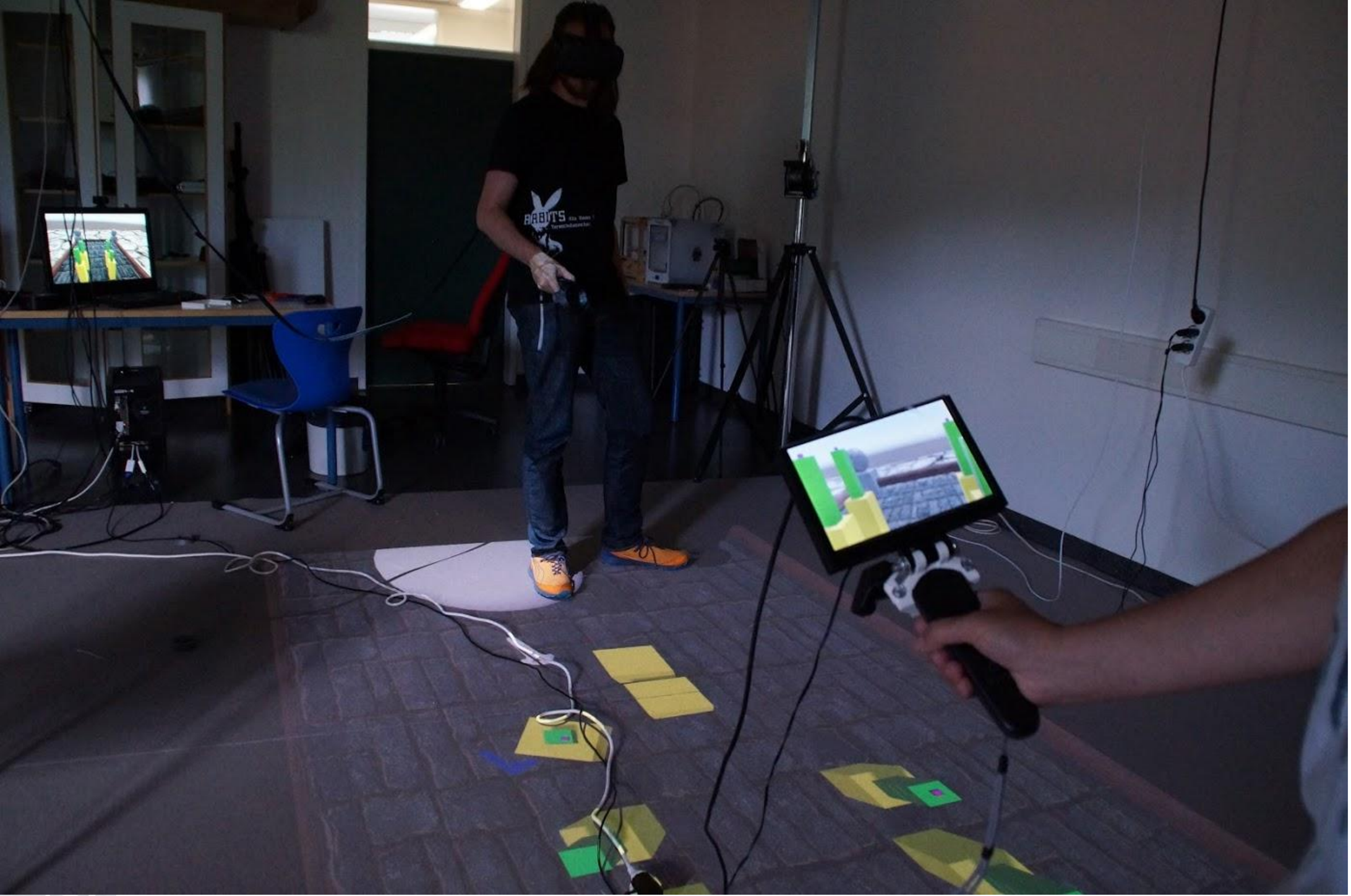
ShareVR: Enabling Co-Located Experiences for Virtual Reality between HMD and Non-HMD Users

Jan Gugenheimer, Evgeny Stemasov,
Julian Frommel and Enrico Rukzio

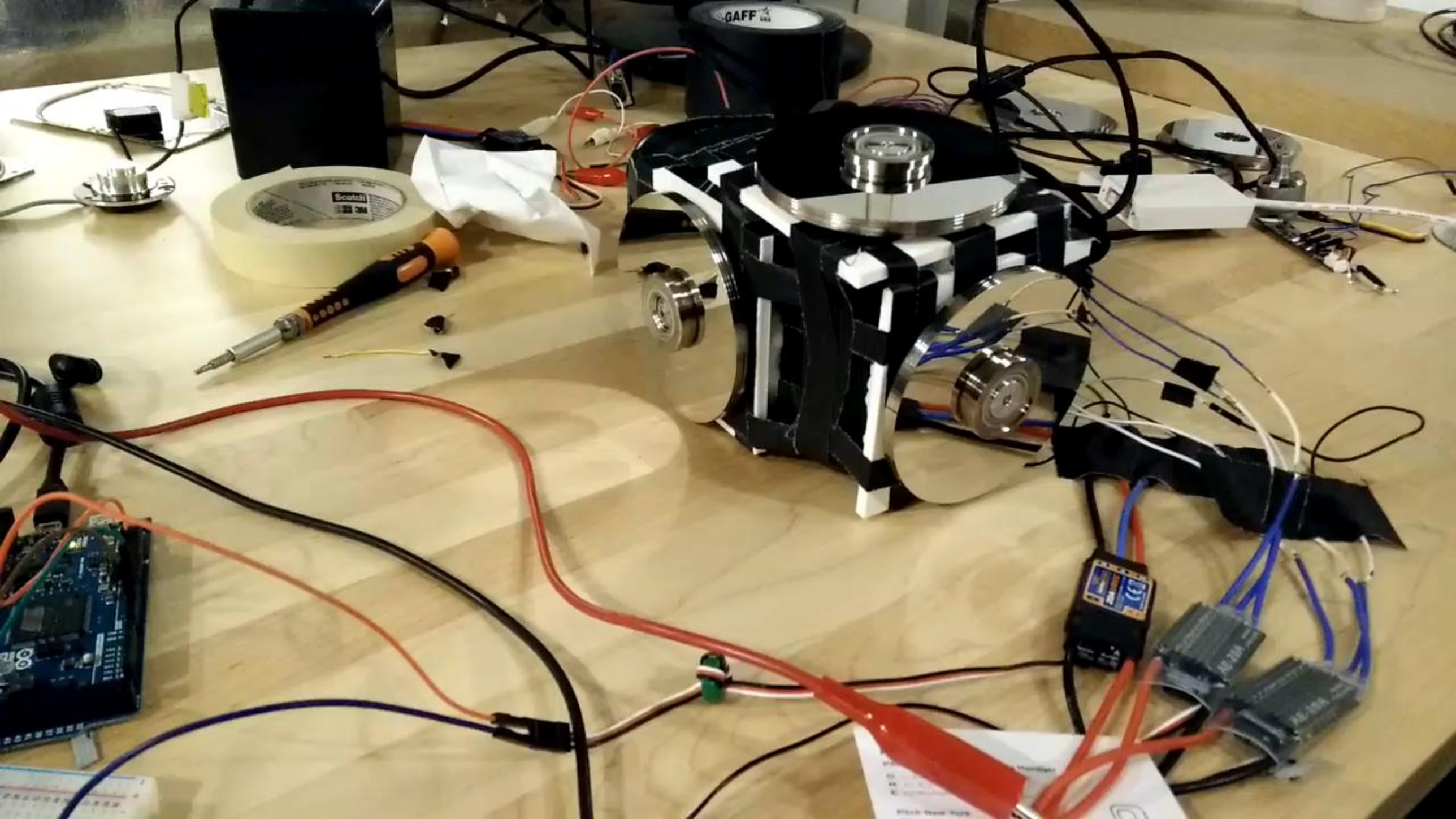
Ulm University

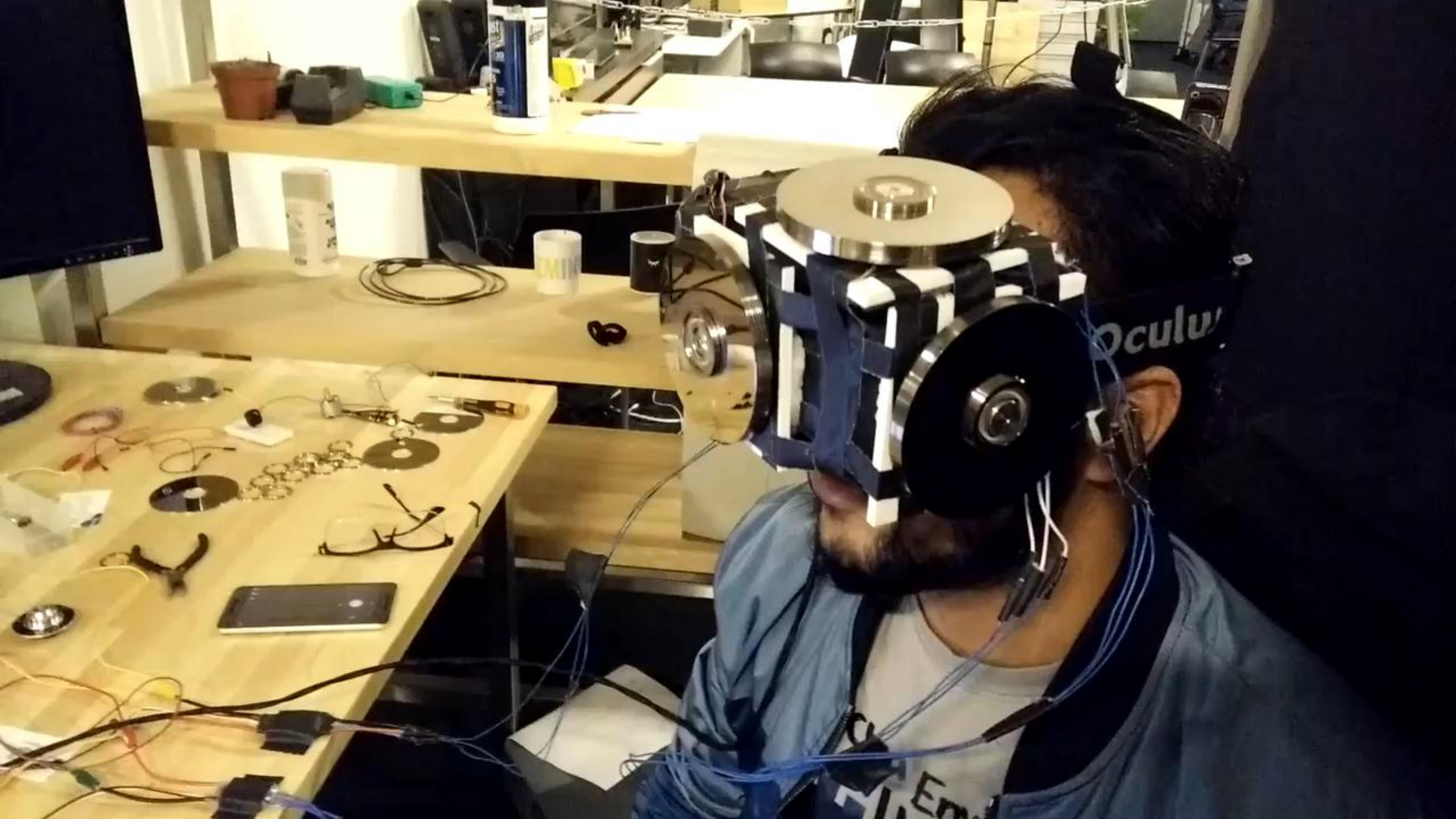
ulm university universität uulm

institute of media informatics



Oculus


GAFF
Scotch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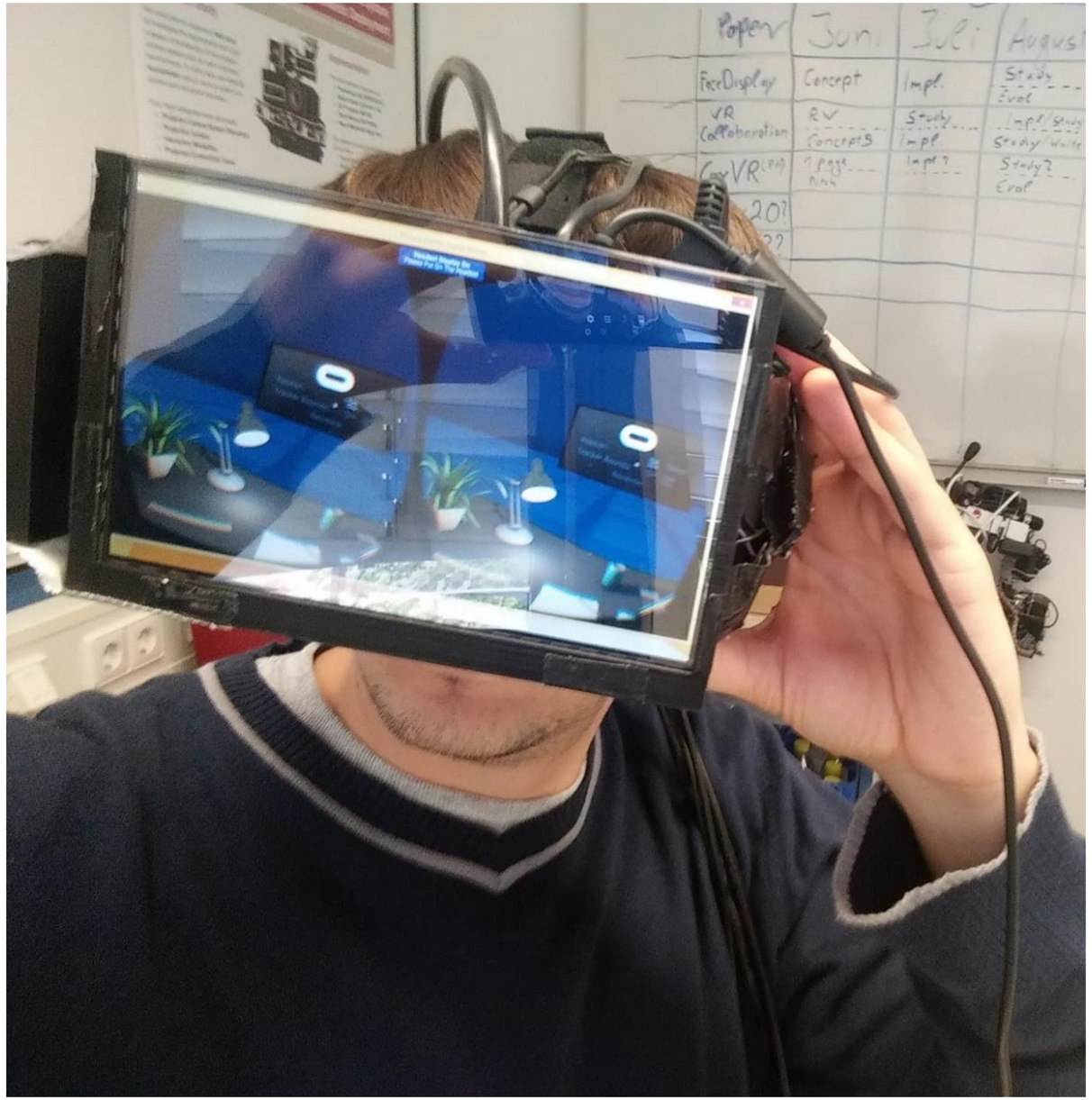
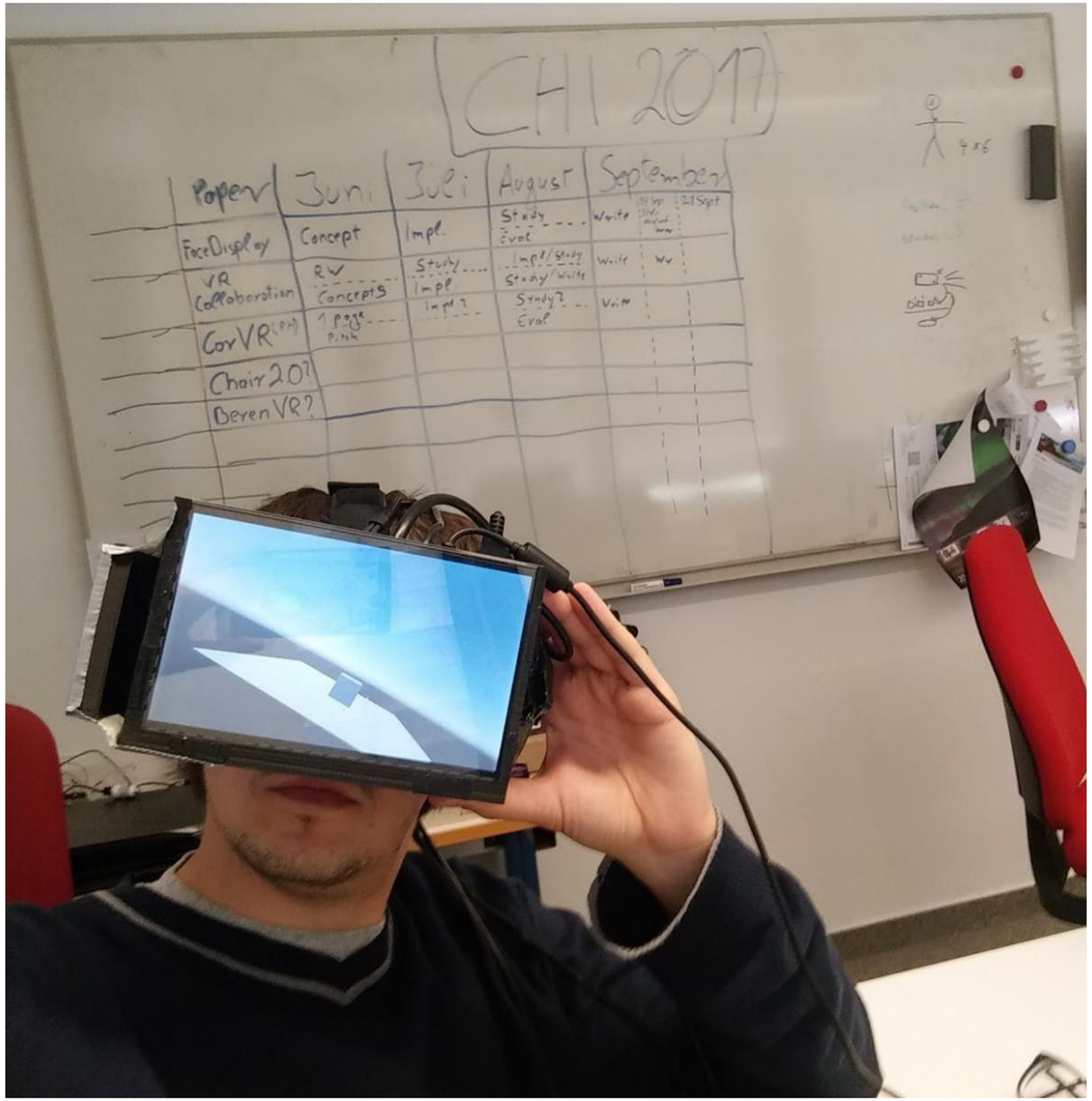
Augustiner
Augustiner

Augustiner
Augustiner

FruitSlicer


Paper
Juni
Juli
Augus
FaceDisplay
Concept
Impl.
Study
Eval
VR Collaboration
RW
Concepts
Study
Impl.
Impl/Study
Study/Write
CorVR
Impl?
Study?
Eval
Chair 2.0?
Beren VR?


CHI 2017
Paper
Juni
Juli
August
September
FaceDisplay
Concept
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Study
Eval
Write
VR Collaboration
RW
Concepts
Study
Impl.
Impl/Study
Study/Write
Write
CorVR
Impl?
Study?
Eval
Write
Chair 2.0?
Beren VR?

NEWS | CONSUMER ELECTRONICS

FaceDisplay and Other Bizarre Virtual Reality Projects from CHI 2017 › All the most bizarre virtual reality projects from CHI 2017

BY EVAN ACKERMAN | 10 MAY 2017 | 5 MIN READ

IEEE Spectrum | FaceDisplay and Other Bizarre Virtual Reality Projects from C...

Type to search

@AntTurner 6 years ago

Literally one of the most ridiculous non-purposeful inventions I have ever seen. Destroy it and get back to drawing boards.

26 Reply

reality projects from CHI 2017

BY EVAN ACKERMAN | 10 MAY 2017 | 5 MIN READ

@DiegottlosenCharmeure 6 years ago

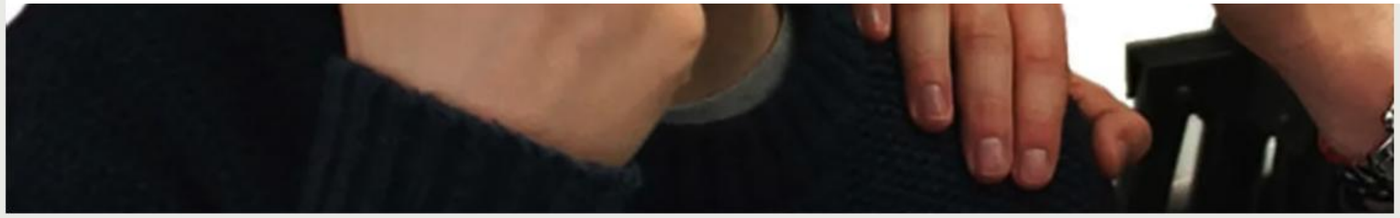
Hey boy! Do you and a friend want to look like total idiots?
Well it is possible now! Order your FaceDisplay today and act like complete fools.

6 Reply

@Stairwayto711 6 years ago

This is beyond a bad idea

1 Reply



@inceptional 6 years ago

What kind of gimmicky rubbish is this?

1 Reply

@vooyas.mp4 6 years ago

Is it stupid or is it stupid. I dont know...

Reply

@TinyBabyOwl 6 years ago

This is the worst thing I've ever seen.

1 Reply

@kilmor3151 6 years ago

Schämt man sich Deutscher zu sein

Reply

NEWS | CONSUMER ELECTRONICS

FaceDisplay and Other Bizarre Virtual Reality Projects from CHI 2017 › All the most bizarre virtual reality projects from CHI 2017

BY EVAN ACKERMAN | 10 MAY 2017 | 5 MIN READ

VR4EVER

10 days ago

Love it! The acoustic feedback is great. Typical Apple stuff with attention to detail. It just works.

Hmmm, why do I feel downvotes incoming...🙄😂

1 0 Reply • Share ›

Bryan

9 days ago

It could also show others something of what you are seeing, if you wanted to share.

On a plane it could display instructions to the flight attendant so they don't have to interrupt you to ask what you want to drink.

It could be used to augment some wicked Halloween costumes.

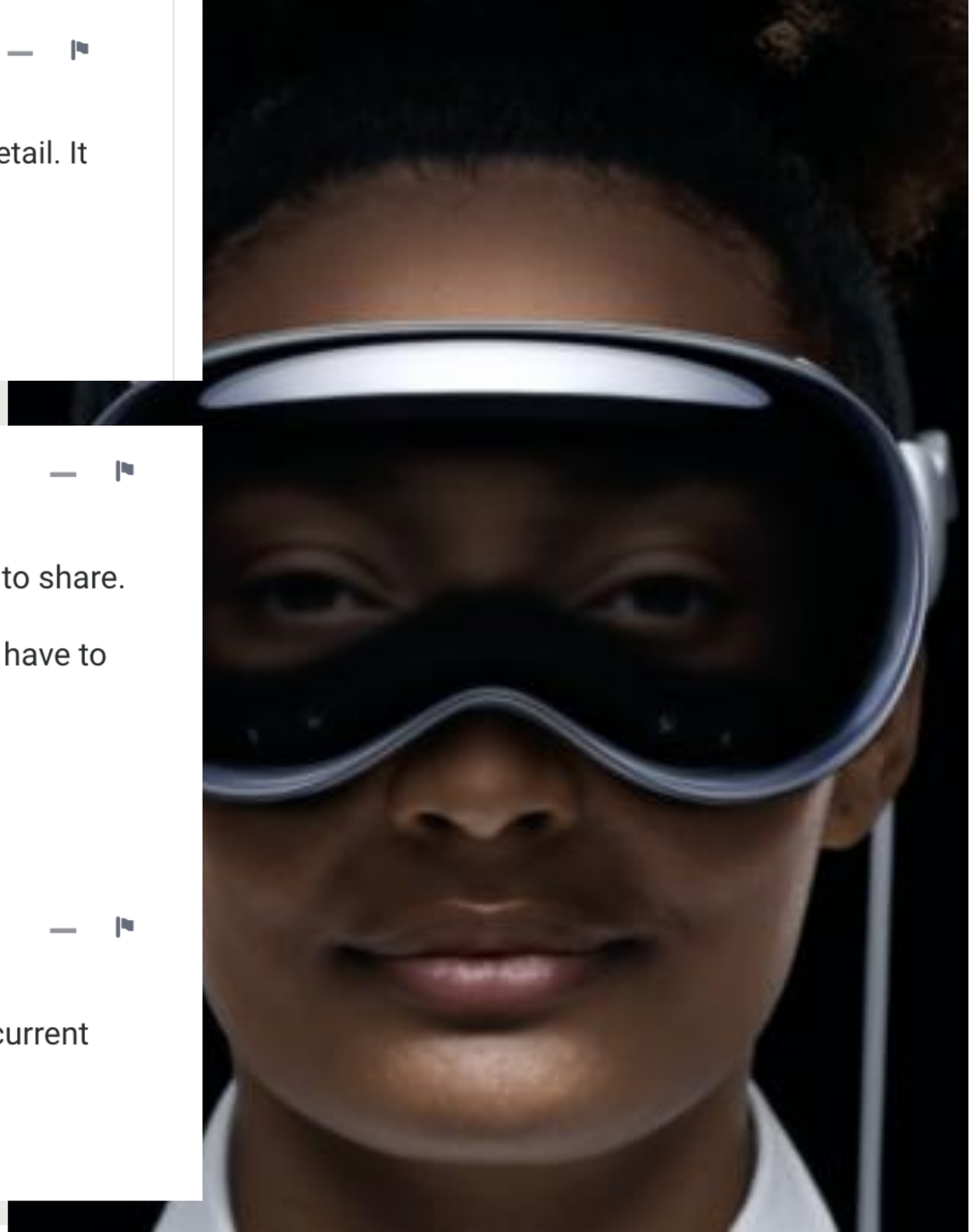
0 0 Reply • Share ›

Bryan

9 days ago

It could display a language translation for you to aid in travel outside your current language's

0 0 Reply • Share ›



Prototyping for Augmented and Virtual Reality ?

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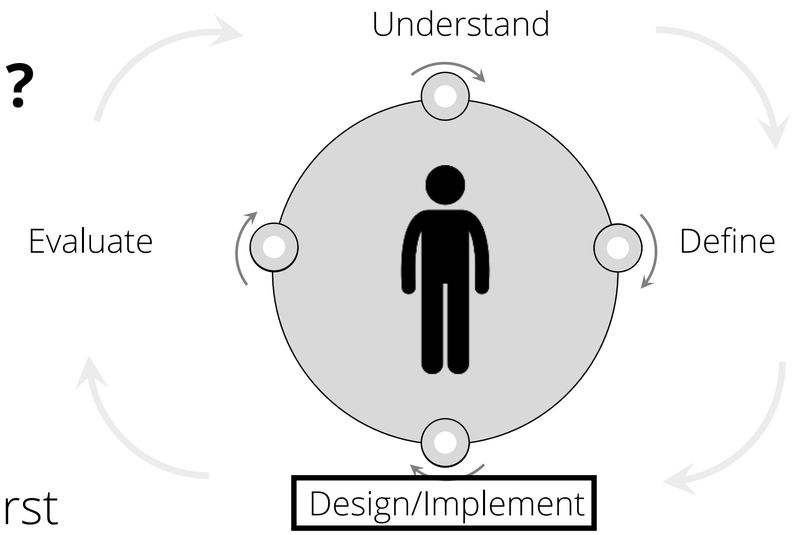


Low-Fi Tools

- A good alternative to using Unity3D but still be able to have a first impression how something looks like in AR or VR
- Little to no programming necessary
- Still grounded inside of rapid prototyping tools that are build not for AR or VR
- Currently heavily researched by the community:

„How can we enable everyone without having programming skills to be able to develop Virtual and Augmented Reality applications?"

[1] https://www.usability.gov/what-and-why/user-centered-design.html

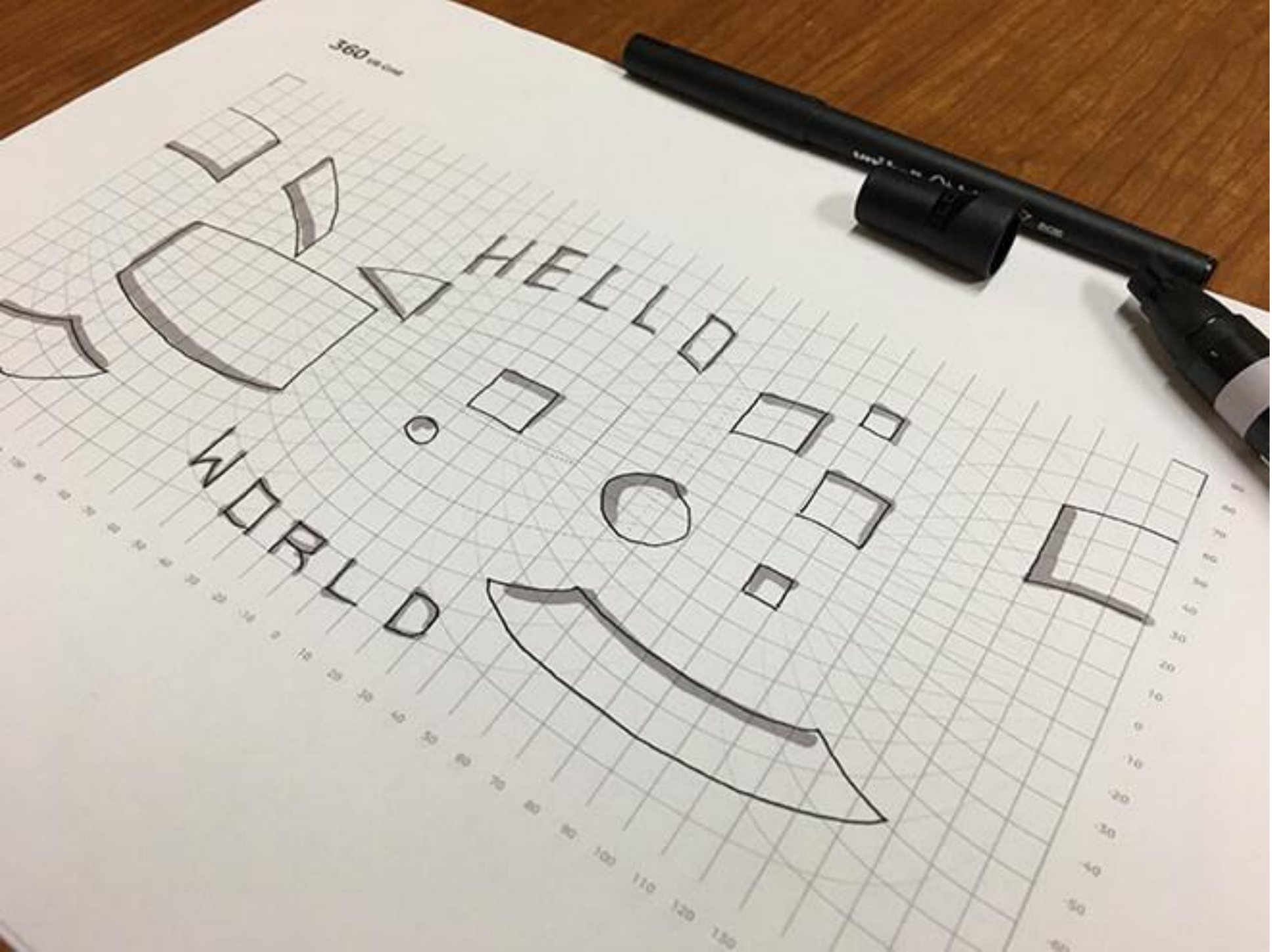
ProtoAR:
Rapid Physical-Digital Prototyping of Mobile Augmented Reality Apps

Information Interaction Lab

UMSI

http://protoar.com

http://mi2lab.in/360paper/tests/startrek/


360
HELLO
WORLD

https://www.youtube.com/watch?v=CdsJz3qelkE

Design Process

Human-centered design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques

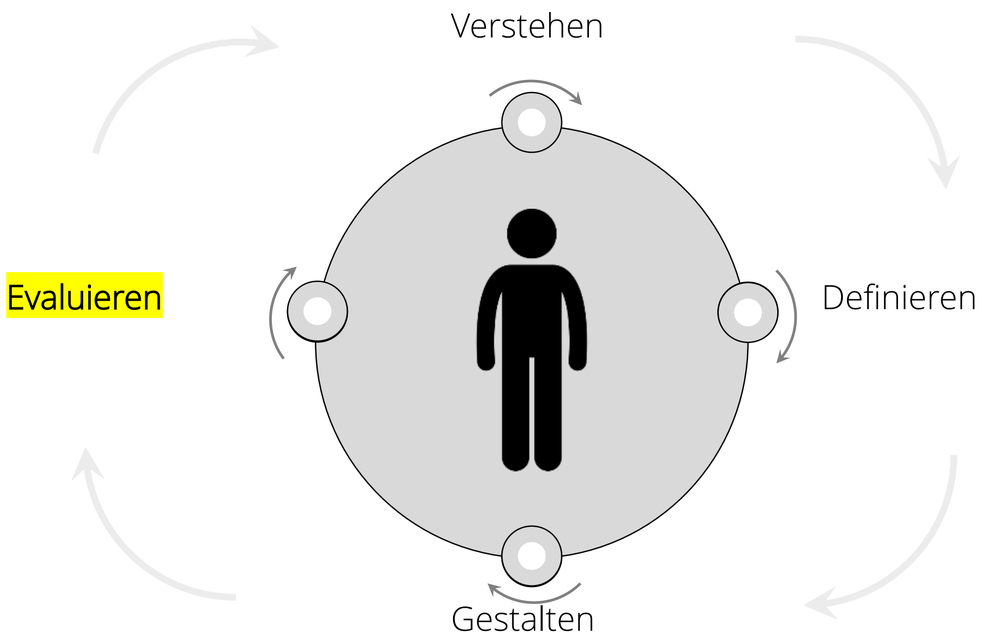
Task:

Imagine I ask you to implement and design a cloud-based service to allow students and teachers to have an online learning platform enabling teaching and learning in an efficient, safe, and enjoyable way.

Step 3:

Create a large amount of different designs using sketching, paper prototypes and later first interactive wireframes and finally a first iteration of a potential tool using your computer science skillset. Iterate all of these prototypes that you created within the design team AND include stakeholders in very step.

Preece, Jennifer, Helen Sharp, and Yvonne Rogers. Interaction design: beyond human-computer interaction. John Wiley & Sons, 2015.



Human-Computer Interaction SoSe 25

Design Process – Part 2

Jan Gugenheimer

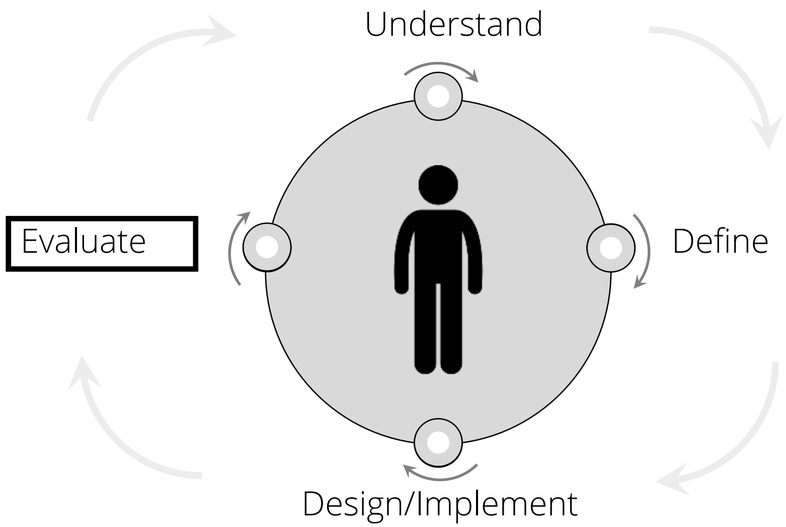
TECHNISCHE UNIVERSITÄT DARMSTADT

Lecture

1. What is Human-Computer Interaction
    1. Basics of HCI
    2. History of HCI
2. Cognitive Basics
    1. Cognition and Perception
    2. Metaphors and Mental Models
    3. *In-class Exercise*
3. Usability Engineering
    1. (Human) Design Processes
    2. Prototyping
    3. *In-class Exercise*
4. Evaluation Methods
    1. Study Design
    2. Methodology
    3. *In-class Exercise*
5. Post-WIMP + Input Devices
6. Mixed-Reality
7. Wrap-Up and Q&A

Evaluate

" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]



Goal:

Collect data on how a real user is interacting with the system. Metrics for evaluation are often derived from the requirements collected in the "Define" phase

Methods:

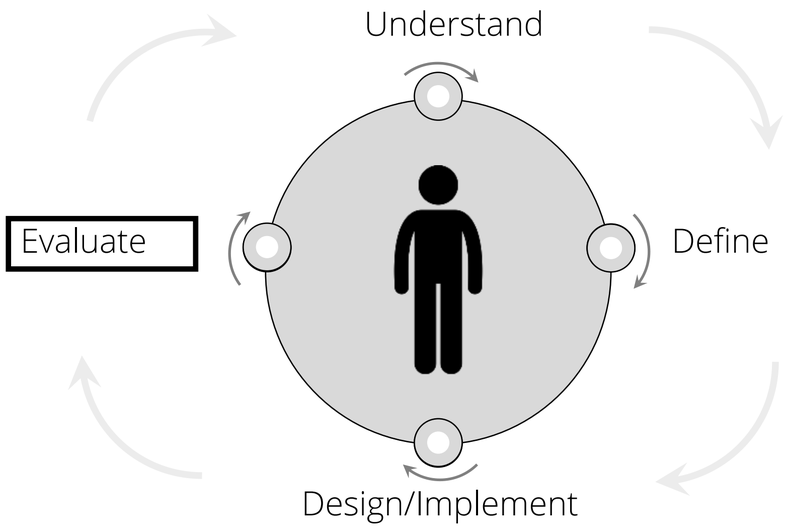
- Quantitative
  - Lab study
  - Field study
  - Survey

- Qualitative
  - Grounded Theory/ Thematic Analysis

http://web.mit.edu/6.813/www/sp16/classes/11-experiment-design/

Evaluate (Quantitative)

" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]



Lab study/experiment:

A lab experiment is an artificial situation, created by and highly controlled by the experimenter, that typically compares alternative user interfaces or measures how usability varies with some design parameter.

Field study:

A field study is a real situation, happening in the actual environment where people use the interface under consideration, and using real tasks (rather than tasks concocted by the experimenter).

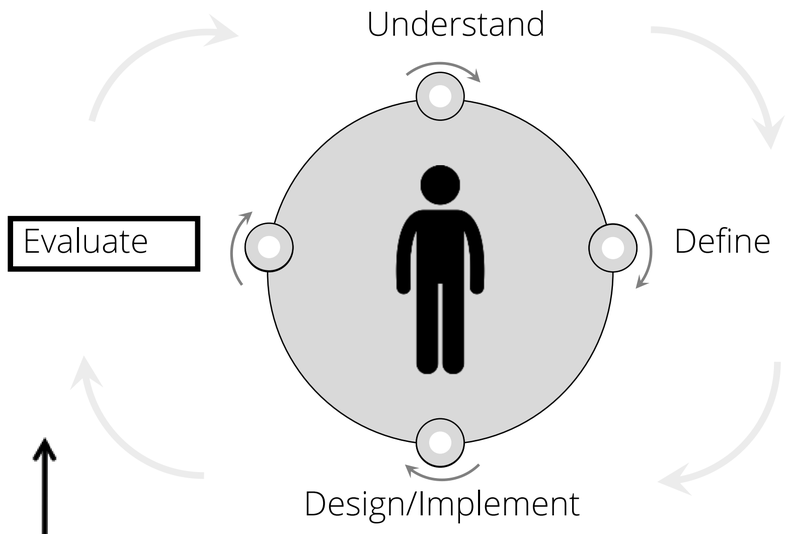
Survey:

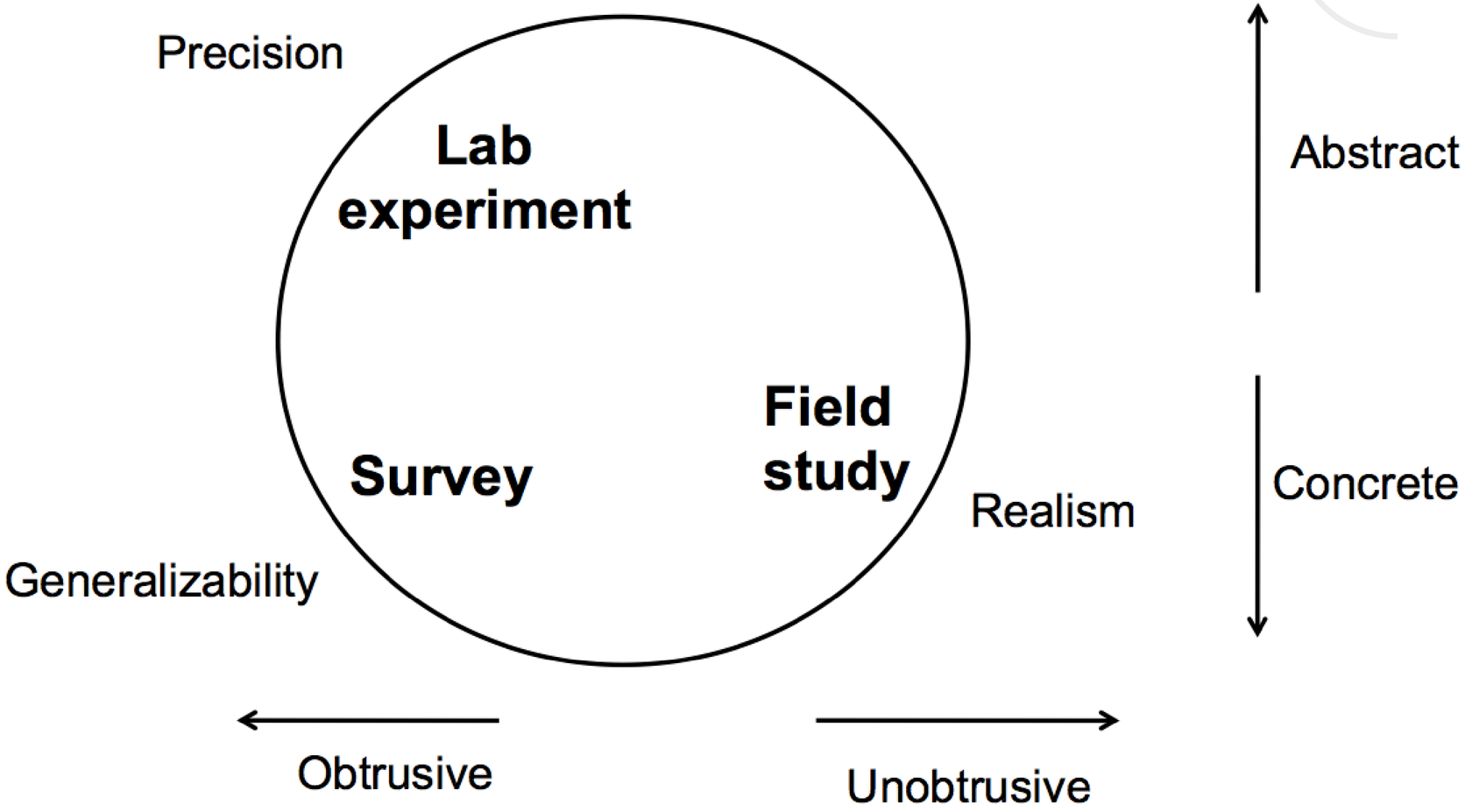
A survey is a questionnaire, conducted by paper, phone, web, or in person

http://web.mit.edu/6.813/www/sp16/classes/11-experiment-design/

Evaluate (Quantitative)

" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]

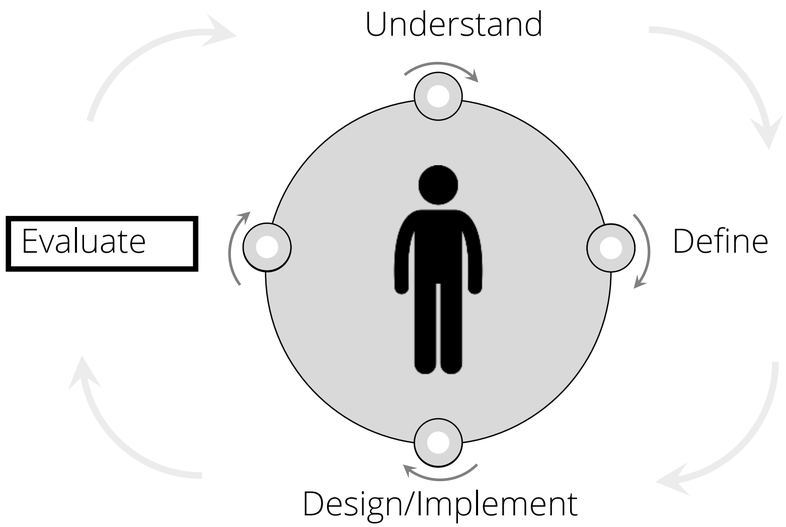




http://web.mit.edu/6.813/www/sp16/classes/11-experiment-design/

How to Design a Lab Experiment

“ Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development.” [1]



Task:

Imagine I ask you to implement and design a cloud-based service to allow students and teachers to have an online learning platform enabling teaching and learning in an efficient, safe, and enjoyable way.

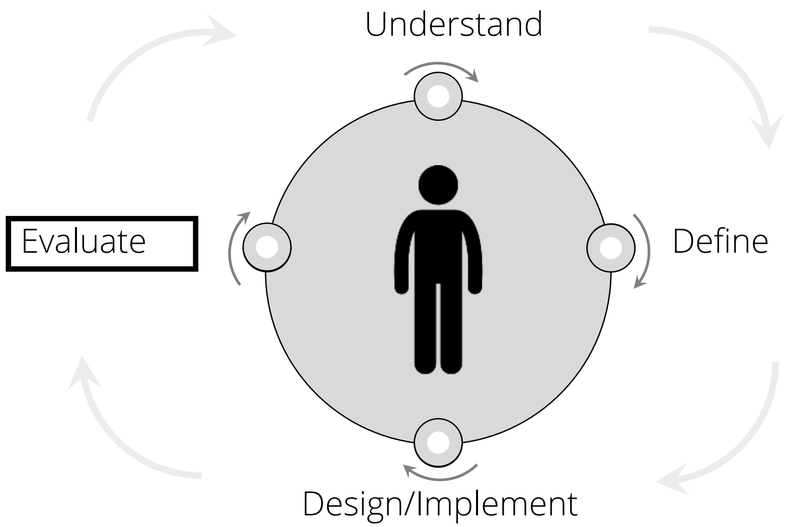
What we have:

Imagine we iterated through the hole UCD/HCD process and finally got a prototype that we want to evaluate in a user study. How are we going to do measure its efficiency, safety and how enjoyable the system is ? We want to design a lab experiment. How do we do it?

[1] https://www.usability.gov/what-and-why/user-centered-design.html

How to Design a Lab Experiment

" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]



Hypothesis:

- Quantifiable, measurable and falsifiable
- Example: " Our new system is faster to start for the teacher compared to the currently used system (Zoom + Local Streaming)"

Independent Variable (IV):

- the variables you're going to manipulate in order to test the hypothesis
- Example: Our IV is "System" with two levels (old and new)

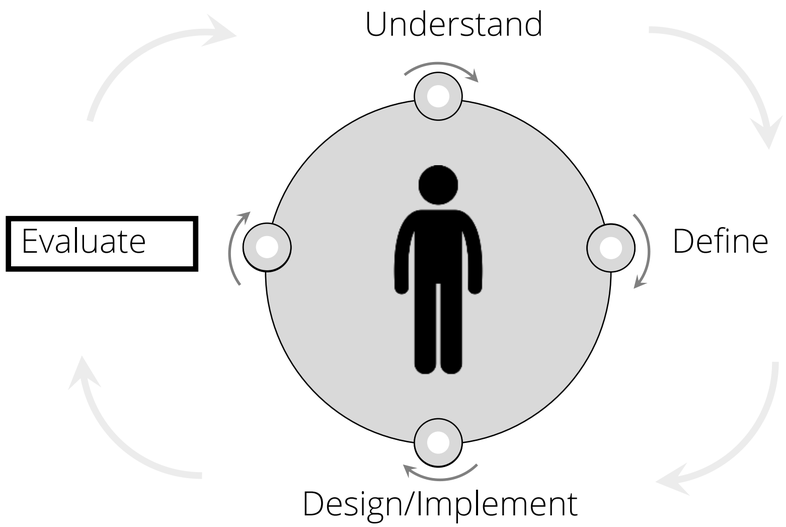
Dependent Variable (DV):

- the variables you'll actually measure in the experiment to test the hypothesis
- Example: Our DV is time measured in seconds from the first click until we have a stable connection locally and remotely

http://web.mit.edu/6.813/www/sp16/classes/11-experiment-design/

How to Design a Lab Experiment

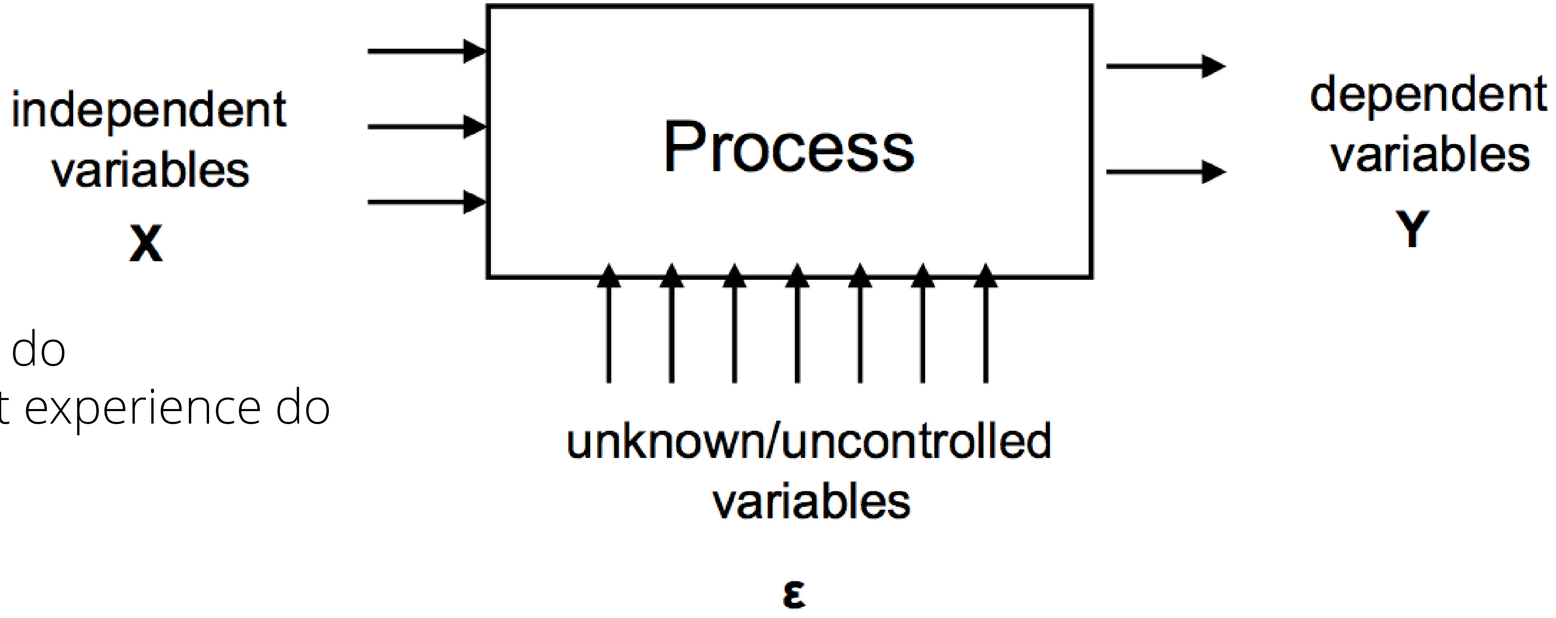
" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]



Controlled Experiment:

Manipulate the independent variables to understand the impact and relationship to the dependent variables. Watch out for unknown variables !

$$Y = f(X) + \varepsilon$$



Unknown Variables:

Example: What input device do participants use ? What past experience do participants have ? ...

http://web.mit.edu/6.813/www/sp16/classes/11-experiment-design/

How to Design a Lab Experiment

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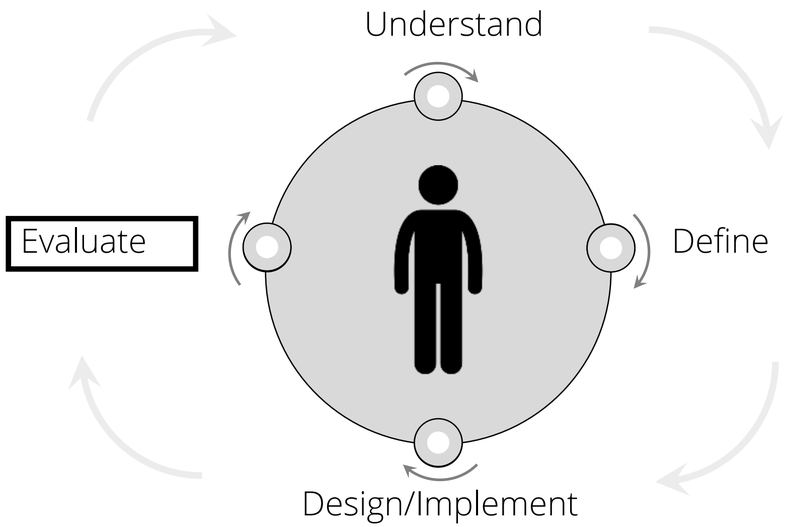


Users:

- Who do we recruit and how do we recruit ?

→ Most studies in (HCI) research are done with a student population sample

Ordering:

- In what order are we presenting the two levels of the IVs to avoid learning effects or fatigue ?

→ Either use a randomized order or a counter-balanced order (e.g. Latin Square)

Hardware:

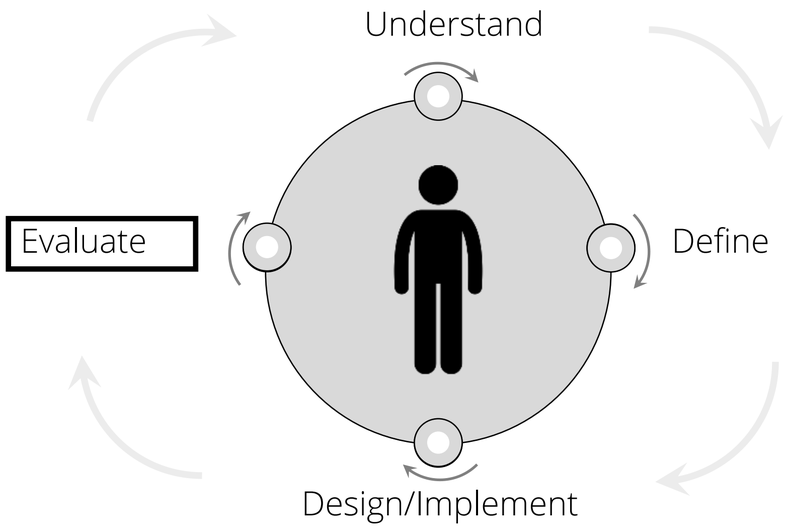
- Control as much of the environment as you can

→ Everyone conducts the study in the same room with the same lighting/noise and with the same hardware

http://web.mit.edu/6.813/www/sp16/classes/11-experiment-design/

Validity and Reliability

" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]



Internal Validity:

Internal validity refers to whether the effect we see on the experiment outputs was actually caused by the changes we made to the inputs, or caused by some unknown variable that we didn't control or measure

External Validity:

External validity refers to whether the effect we see can be generalized to the world outside the lab, i.e. when those variables are not controlled

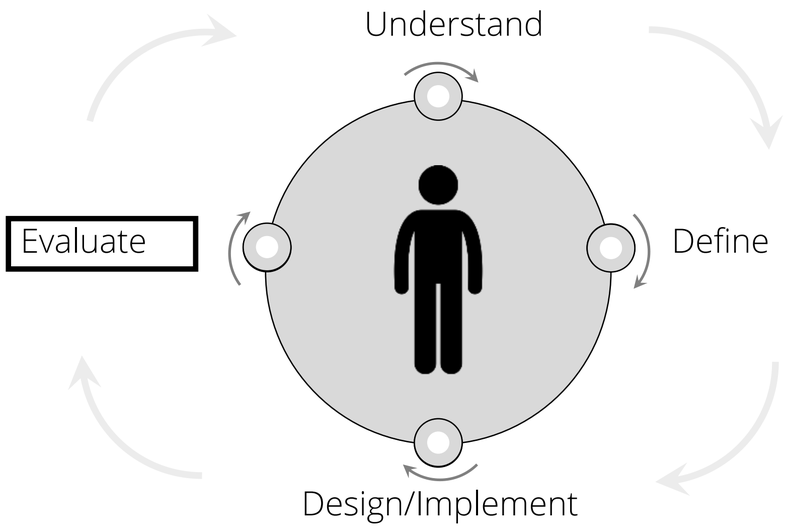
Reliability:

Reliability refers to whether the effect we see (the relationship between independent and dependent variables) is repeatable. If we ran the experiment again, would we see the same effect?

http://web.mit.edu/6.813/www/sp16/classes/11-experiment-design/

Between Subjects vs. Within Subjects

" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]



Between Subjects:

- We split our sample size in two groups and every participant only experiences ONE level of our IV
- One group uses only interface X, and the other group uses only interface Y.
- The performance of the X group is then compared with the performance of the Y group.

+ Avoid ordering effects and biases
- We need a large amount of participants

Within Subjects:

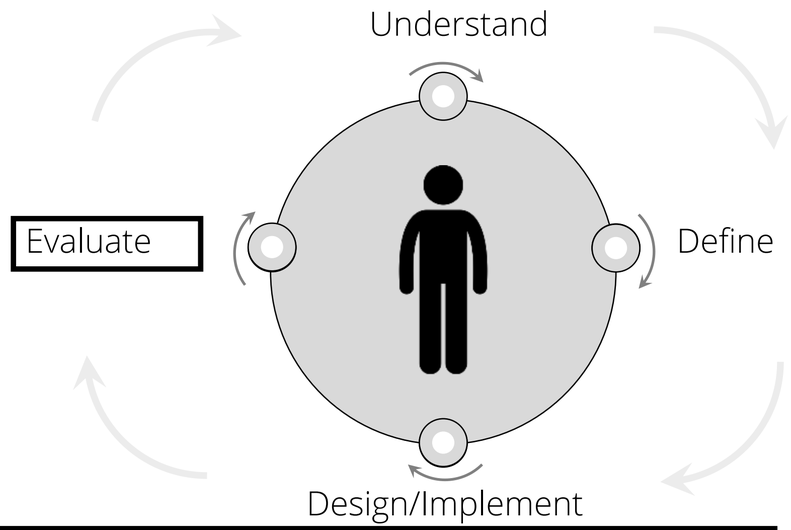
- Each user sees both interfaces, and the differential performance (performance on X - performance on Y) of all users is averaged and compared with 0

+ Less participants needed
- Ordering effects and biases (can be mitigated using counter balancing)

http://web.mit.edu/6.813/www/sp16/classes/11-experiment-design/

Between Subjects vs. Within Subjects

" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]



Between Subjects:

Which design should we use for our experiment ?

Within Subjects:

- Each user sees both interfaces, and the differential performance (performance on X - performance on Y) of all users is averaged and compared with 0

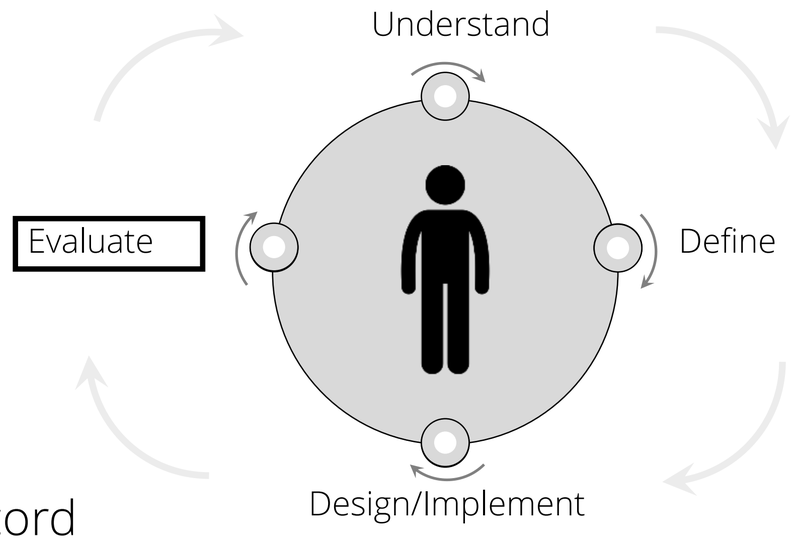
+ Less participants needed

- Ordering effects and biases (can be mitigated using counter balancing)

http://web.mit.edu/6.813/www/sp16/classes/11-experiment-design/

Evaluate (Qualitative)

" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]



Properties:

- Instead of having measurements of pre-defined metrics we record observations (video + audio) and interviews with participants resulting in a large amount of unstructured data
- We use different methodologies to structure, understand, interpret and make sense of the collected data

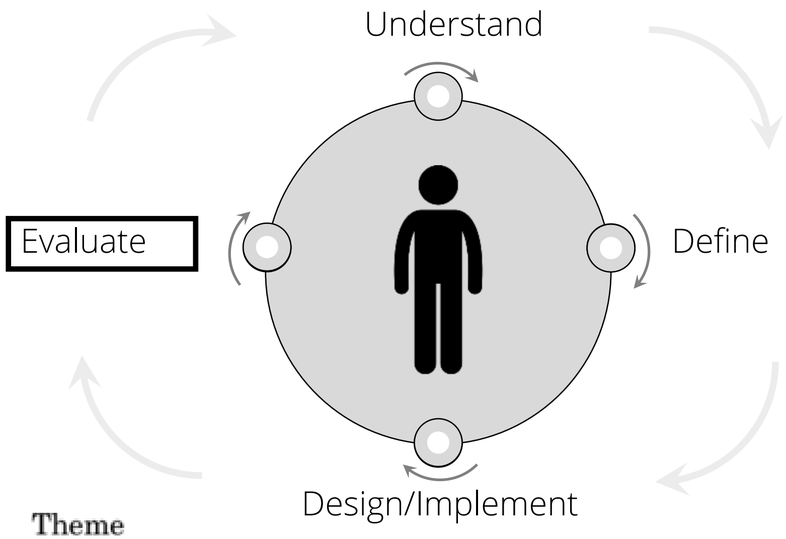
Thematic Analysis:

1. Familiarize yourself with your data (Transcript)
2. Assign preliminary codes to your data in order to describe the content
3. Search for patterns or themes in your codes across the different interviews
4. Review themes
5. Define and name themes
6. Produce your report

https://www.interaction-design.org/literature/article/how-to-do-a-thematic-analysis-of-user-interviews

Evaluate (Qualitative)

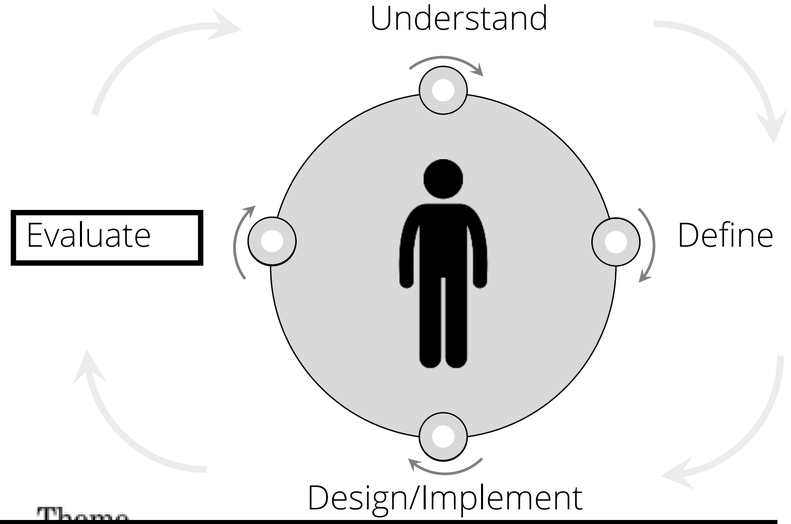
" Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development." [1]



Meaning unit	Code	Sub-theme	Theme
To be honest, I wonder if I live until next summer. I think I'm getting worse and worse and everything gets more and more difficult. This body cannot keep on panting and breathing in this way, like I do for hours sometimes. No 28	Will I live another year? My body can't go on anymore	Awareness of dying	Death anxiety
I can feel numb all over. The seizures make me so tired and I think that now I must help from someone. I'm just sitting at home, fighting until the ambulance arrives and they can help me. And I actually think that I'll die because I can't get any air. *I: How does it feel?* A lot of anxiety. Yes, there's a lot of anxiety. Well, I don't know how to put it; I'm afraid of dying. It's no fun fighting on your deathbed and not being able to breathe. That would be terrible. Many times I think; just as long as I don't die of COPD. No 25	Becomes paralyzed by COPD attacks Believes that you may die as a result of COPD attacks Experiences anxiety at attack Fear of dying of COPD	Fear of suffocation	Death anxiety

Evaluate (Qualitative)

“ Evaluation - ideally through usability testing with actual users - is as integral as quality testing is to good software development.” [1]



Meaning unit	Code	Sub theme	Theme
home, fighting until the ambulance arrives and they can help me. And I actually think that I'll die because I can't get any air. *I: How does it feel?* A lot of anxiety. Yes, there's a lot of anxiety. Well, I don't know how to put it; I'm afraid of dying. It's no fun fighting on your deathbed and not being able to breathe. That would be terrible. Many times I think; just as long as I don't die of COPD. No 25	COPD attacks Experiences anxiety at attack Fear of dying of COPD		

How can we control the level of subjectivity of this approach ?

Design Process

Human-centered design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques

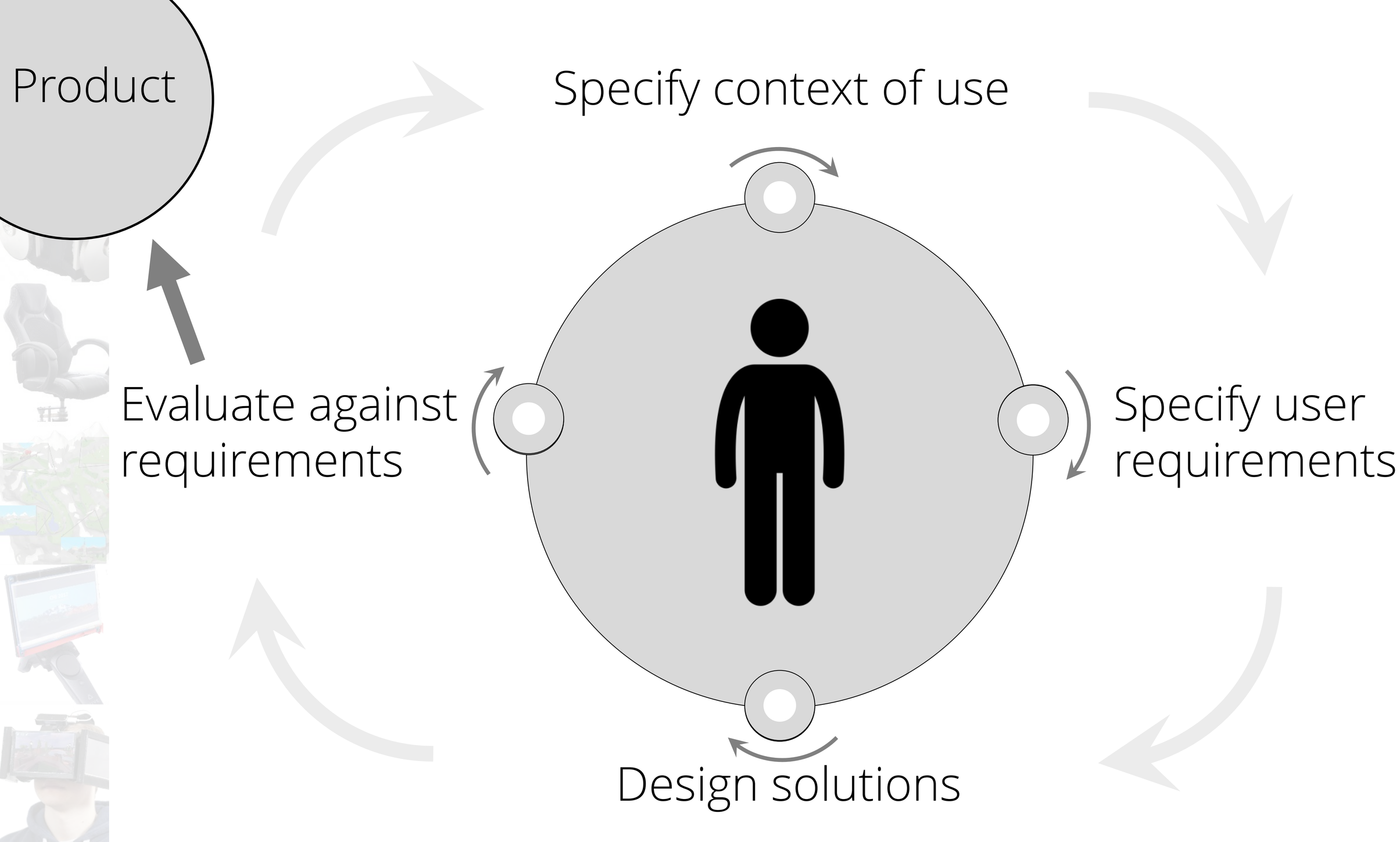
Task:

Imagine I ask you to implement and design a cloud-based service to allow students and teachers to have an online learning platform enabling teaching and learning in an efficient, safe, and enjoyable way.

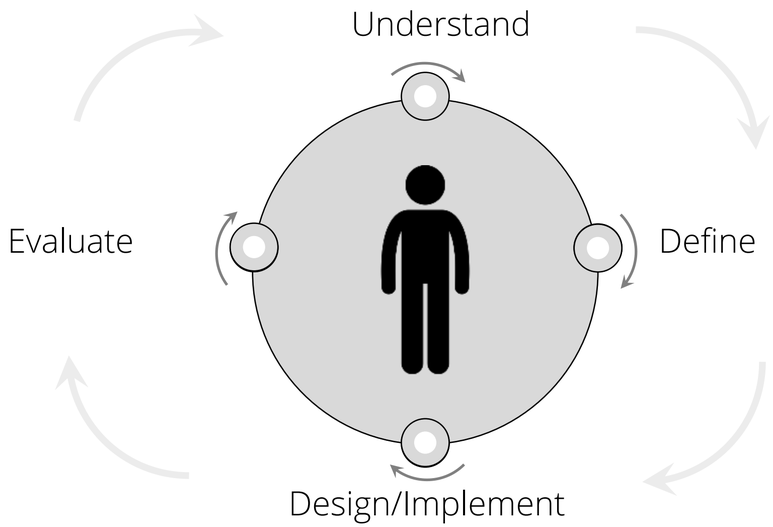
Step 4:

Conduct multiple experiments with all the different stakeholders (e.g. students, teachers, administration) and evaluate if your new system is able to outperform the current state of the art in terms of metrics you found in step 2. Use quantitative and qualitative methods to not only find that there is a difference (quantitative) between the systems but also try to understand why (qualitative).

Preece, Jennifer, Helen Sharp, and Yvonne Rogers. Interaction design: beyond human-computer interaction. John Wiley & Sons, 2015.


Product
Specify context of use
Evaluate against requirements
Specify user requirements
Design solutions

Criticism of Human-Centred Design



"Most items in the world have been designed without the benefit of user studies and the methods of human-centered design."

- Don Norman

Lack of Innovation

"Show me an instance of a major technology that was developed according to principles of human-centered design, or rapid prototype and test, or user modeling, or the technology adapting to the user. Note the word "major." I have no doubt that many projects were improved, perhaps even dramatically, by the use of these techniques. But name one fundamental, major enhancement to our technologies that came about this way"

- Don Norman

Norman, D. A. (2005). Human-centered design considered harmful. *interactions*, *12*(4), 14-19.

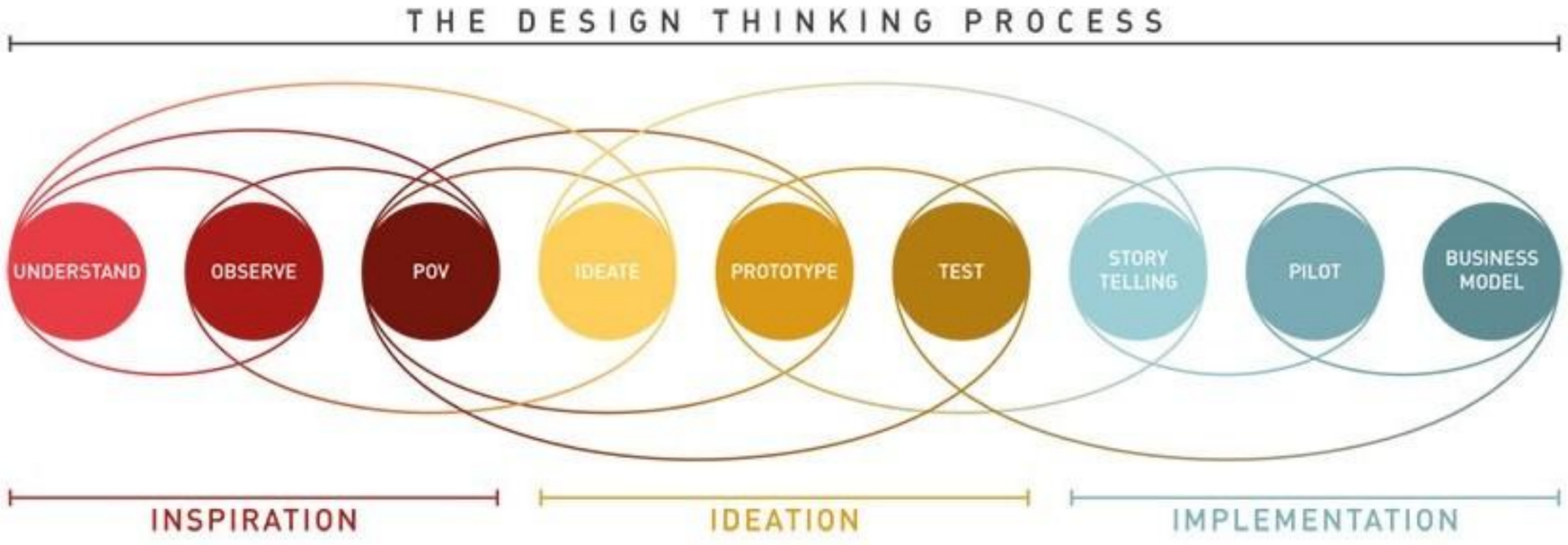
Design Thinking

A Wicked Problem is a "class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing"

- Horst Rittel

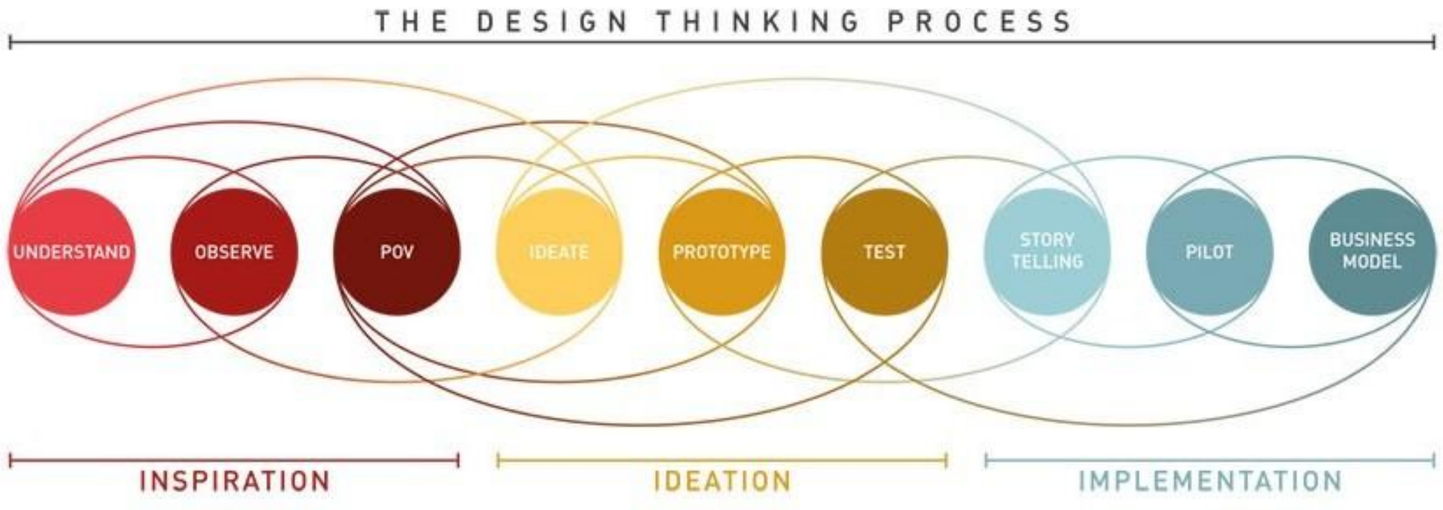
Design Thinking

Design thinking is a non-linear, **iterative process** that teams use to understand users, challenge assumptions, redefine problems and create **innovative solutions** to prototype and test. It is most useful to tackle **problems that are ill-defined or unknown**. [2]



https://hpi-academy.de/design-thinking/was-ist-design-thinking.html [2] https://www.interaction-design.org/literature/topics/design-thinking

Design Thinking



Properties:

- Start with **empathy** (a deep human focus, in order to gain insights)
- Involves **reframing** the perceived problem or challenge at hand, and gaining perspectives, which allow a more holistic look
- There are a wide variety of process breakdowns and visualisations ranging typically between 3 and 7 steps.
- Original steps (*define, research, ideate, prototype, choose, implement*, and *learn)*

Usage:

A process that is tailored more towards “wicked” or “ill defined” problems. Focusing more on radical innovation rather than incremental improvement (vs HCD/UCD)

https://www.interaction-design.org/literature/article/design-thinking-a-quick-overview

Ideation Methods

Ideation is the process where you generate ideas and solutions through sessions such as Sketching, Prototyping, Brainstorming, Brainwriting, Worst Possible Idea, and a wealth of other ideation techniques.

Goal:

The aim is to generate a large quantity of ideas that the team can then filter and cut down into the best, most practical or most innovative ones.

Techniques:

1. Sketching
2. Prototyping
3. Brainstorming
4. Brainwriting
5. Worst Possible Idea
6. ...

https://www.interaction-design.org/literature/article/what-is-ideation-and-how-to-prepare-for-ideation-sessions

Ideation Methods (Brainstorming)

Ideation is the process where you generate ideas and solutions through sessions such as Sketching, Prototyping, Brainstorming, Brainwriting, Worst Possible Idea, and a wealth of other ideation techniques.

Goal:

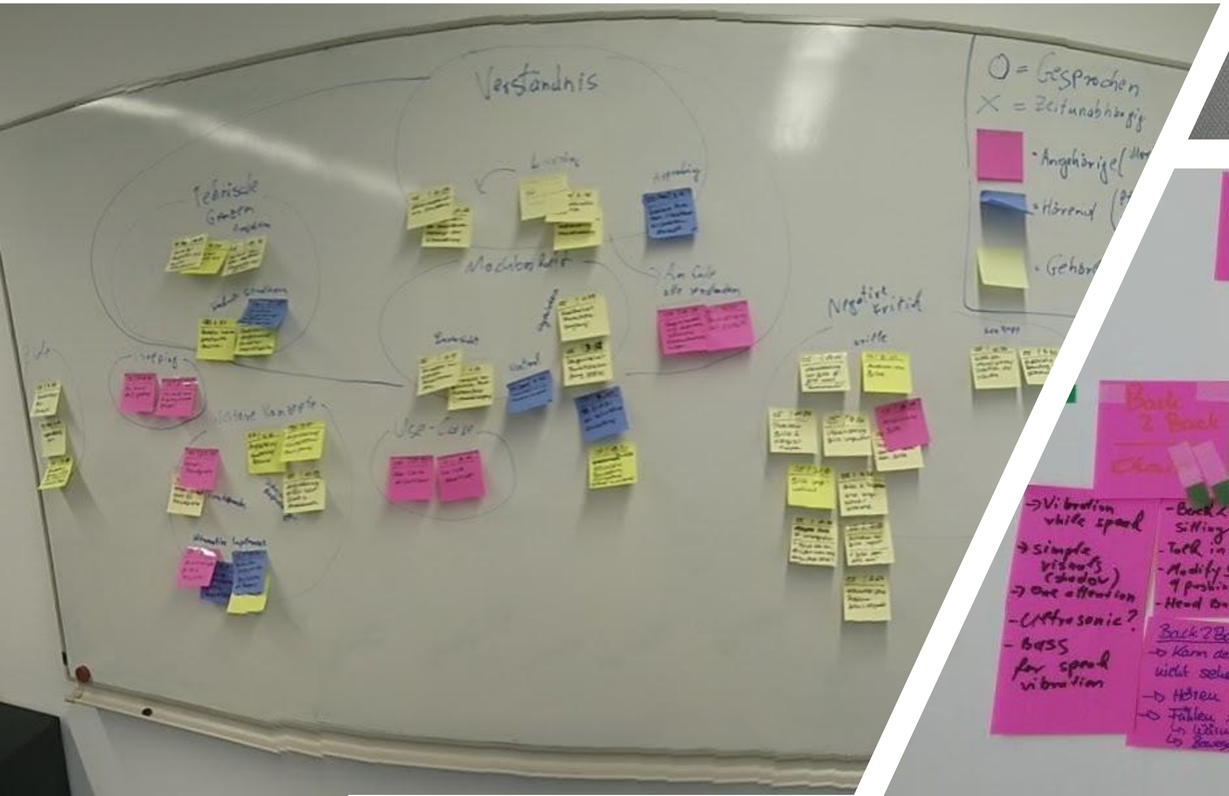
At its most basic level, a Brainstorm session involves sprouting related points from a central idea. Brainstorming is one of the primary methods employed during the Ideation stage of a typical Design Thinking process.

Steps:

1. Gather a group of 3-4 people
2. Define a topic
3. Everyone individually writes down ideas (e.g. Crazy 8)
4. Afterwards, everyone has to present each idea and others are encouraged to add similar ideas (NO BAD IDEAS)
5. Group the ideas by themes
6. Vote on ideas

https://www.interaction-design.org/literature/article/stage-3-in-the-design-thinking-process-ideate

Problems
Coping
Security/Privacy
Safety
Out OR Body
Education
Augmented Human
Exploit
Adoptive Devices
Fairness/Cheat


Verständnis
O = Gesprochen
X = Zeitunabhängig
Use-Cases

Sitting
Back 2 Back
Sitting
Back 2 Back
Face
Notification
Attention Pulse
Interaction
Change Bypass
VR Booth
Liegen?
Kino
Scenario

Ideation Methods (Worst Possible Idea)

Ideation is the process where you generate ideas and solutions through sessions such as Sketching, Prototyping, Brainstorming, Brainwriting, Worst Possible Idea, and a wealth of other ideation techniques.

Goal:

- An ideation method where team members purposefully seek the worst solutions in ideation sessions.
- The “inverted” search process relaxes them, boosts their confidence and stokes their creativity so they can examine these ideas
- Try to think about what made this specific idea bad in the first place, and can we revert it ?

Steps:

Individually or inside a group

1. Come up with as many bad ideas as we can.
2. List all the properties of those terrible ideas.
3. List what makes the worst of these so very bad.
4. Search for the opposite of the worst attribute.
5. Consider substituting something else in for the worst attribute.
6. Mix and match various awful ideas to see what happens.

https://www.interaction-design.org/literature/topics/worst-possible-idea

Ideation Methods (Ideation Hexagon)

Given the idea X what comes next ?

- (X^d) Generalize to another dimension
→ Flickr to Youtube

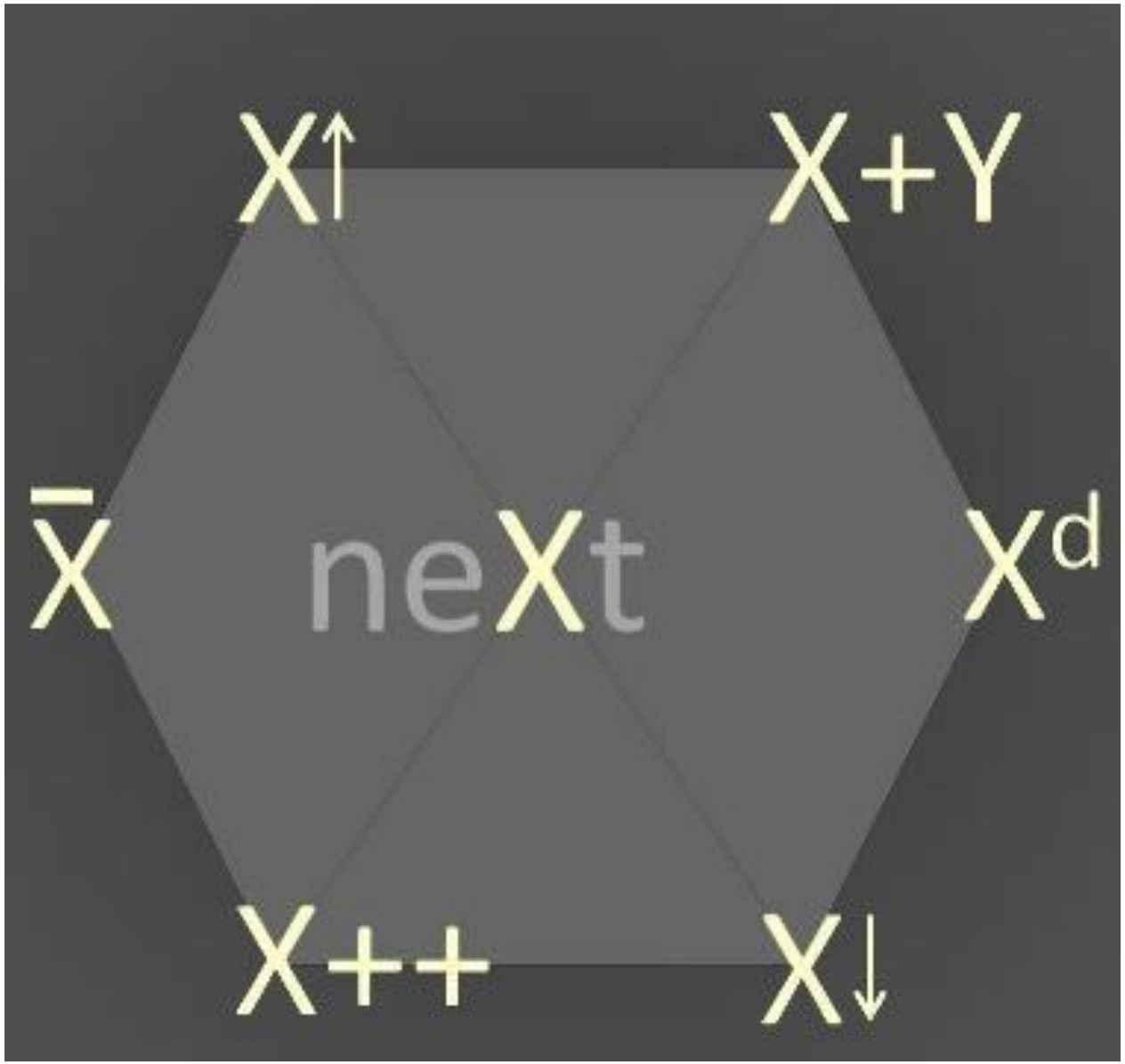
- (X+Y) Combine two ideas
→ Uber + Hairdresser

- (X up) Given a hammer find all the nails
→ App store for everything

- (X inverse)
→ Do the opposite with X

- (X++)
→ X + Adjective (e.g., faster, sustainable)

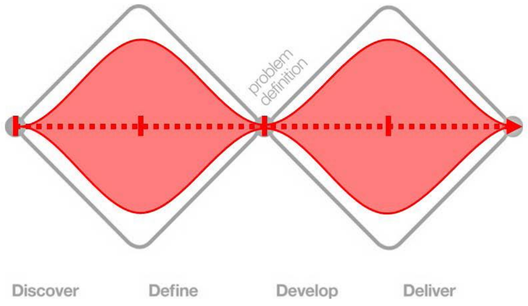
- (x down) Given a nail find all the Hammers
→ Alternative ways to solve the problem



https://tedxbeaconstreet.com/blog/ramesh-raskar/

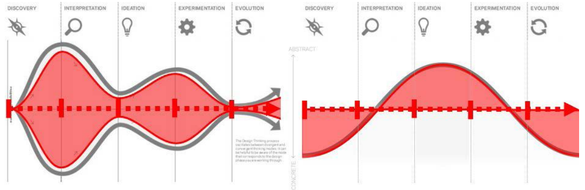
Design Process Methodology Comparison

Overview:

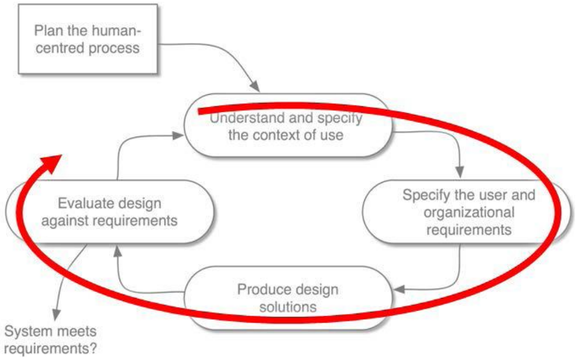


- In practice there are multiple types of design process (Human-Centered Design, Design Thinking, Double Diamond, IDEO,...)

- However, they all show substantial similarities



- When “bent” to a linear structure and sorted into more general stages (derived deductively from the models), most process models easily fit the order of:
  - analyse
  - define
  - design
  - finalise



- they all use different terms for similar content and also their purpose varies from researching design itself to being an instruction on how to proceed in the design process (descriptive and prescriptive models)

Bobbe, T., Krzywinski, J., & Woelfel, C. (2016). A comparison of design process models from academic theory and professional practice. In *DS 84: Proceedings of the DESIGN 2016 14th International Design Conference* (pp. 1205-1214).