



UNIVERSITY OF
WATERLOO

UC SANTA CRUZ

Designing Safer Touch Displays

Digitally Distributing Physical Touch on a Public Display

Lou Elah Süsslin, Vienna University of Technology

Ville Mäkelä, University of Waterloo

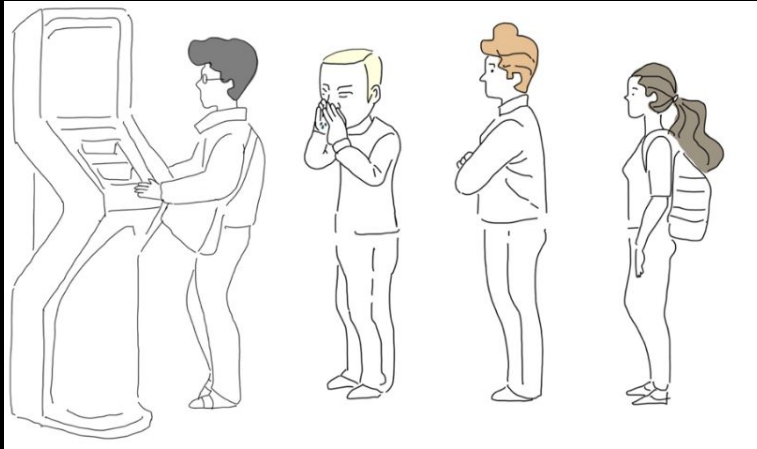
Florian Alt, LMU Munich

Linda Hirsch, UC Santa Cruz

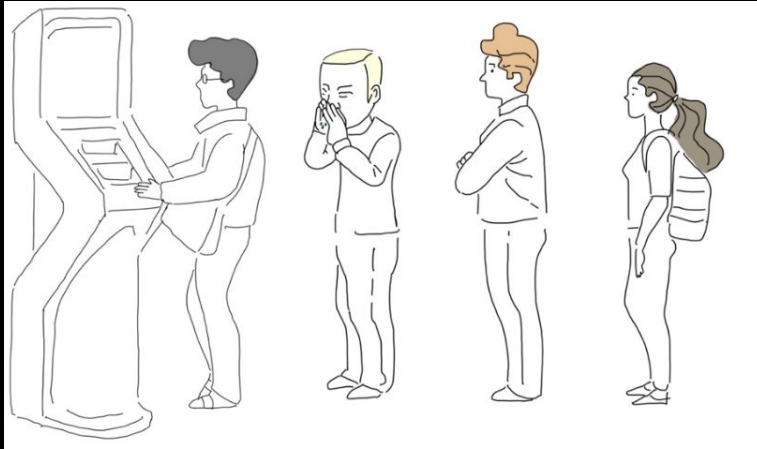
Mensch und Computer 2025, Chemnitz/Germany

Seem familiar?

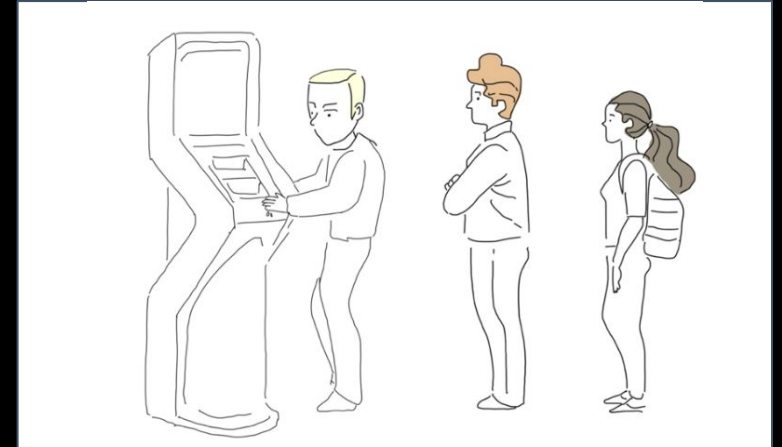
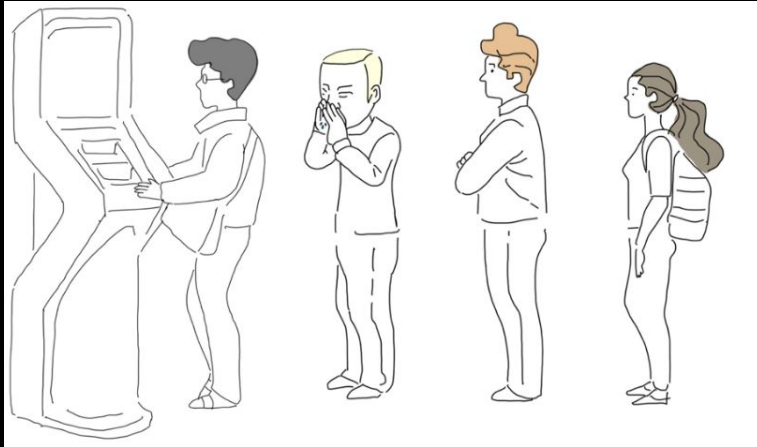
Seem familiar?



Seem familiar?



Seem familiar?



Can get even worse!

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News

Tests find traces of faeces on popular restaurant touchscreens

Tests conducted by Dr Paul Matewele, a microbiologist at London Metropolitan University, have found that touchscreens in McDonald's restaurants carry faeces.

Date: 4 December 2018

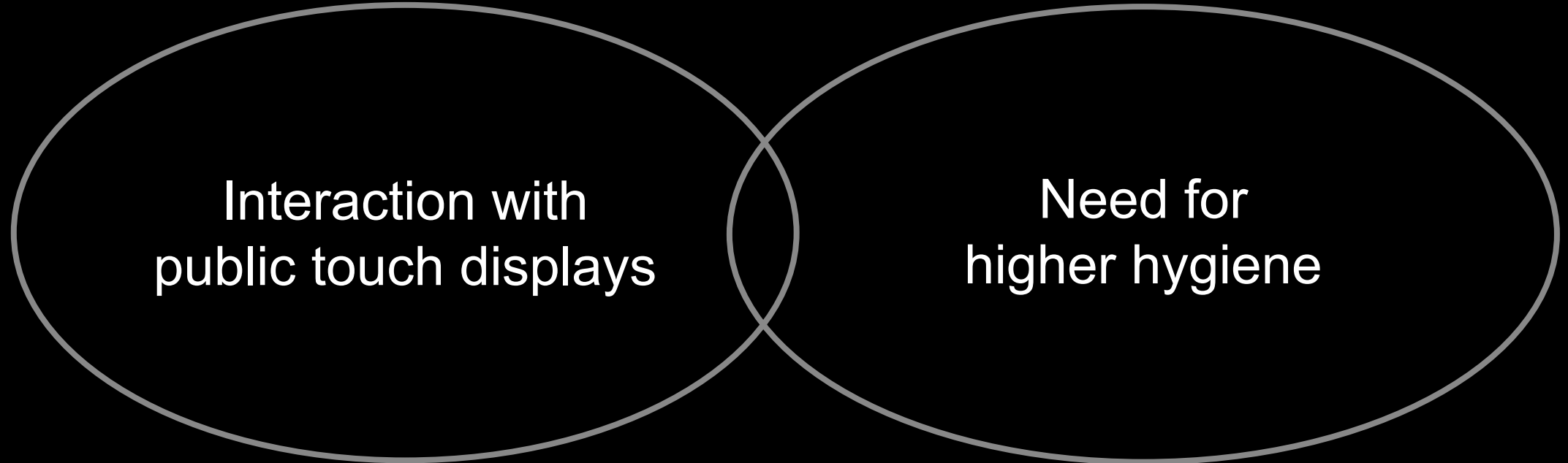
Large Scale Problem

Large Scale Problem

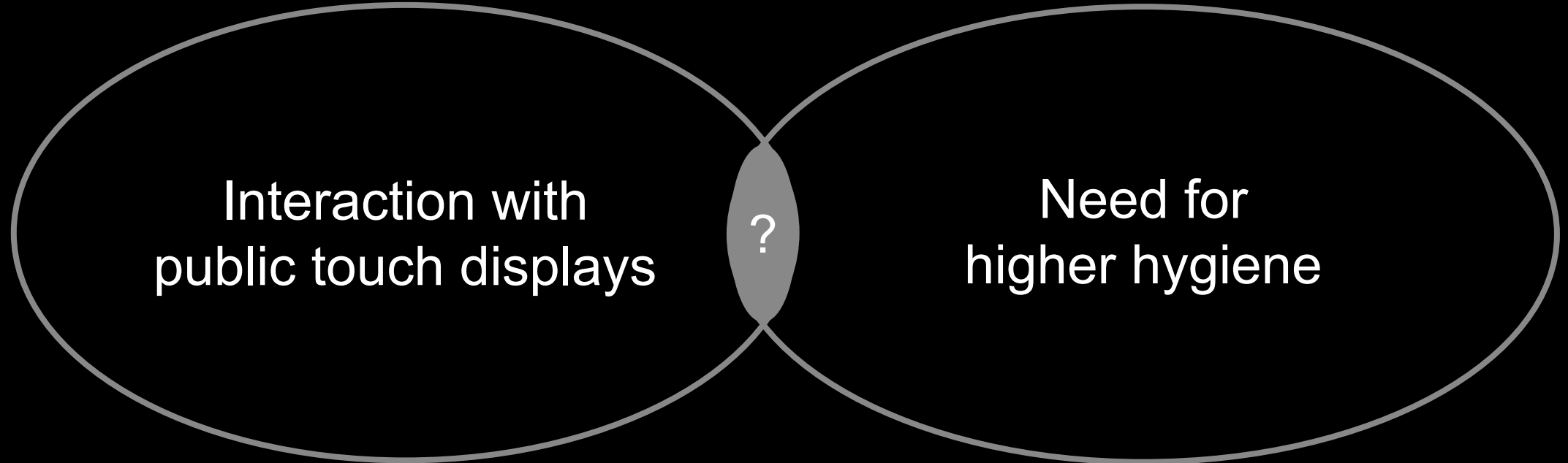


Interaction with
public touch displays

Large Scale Problem

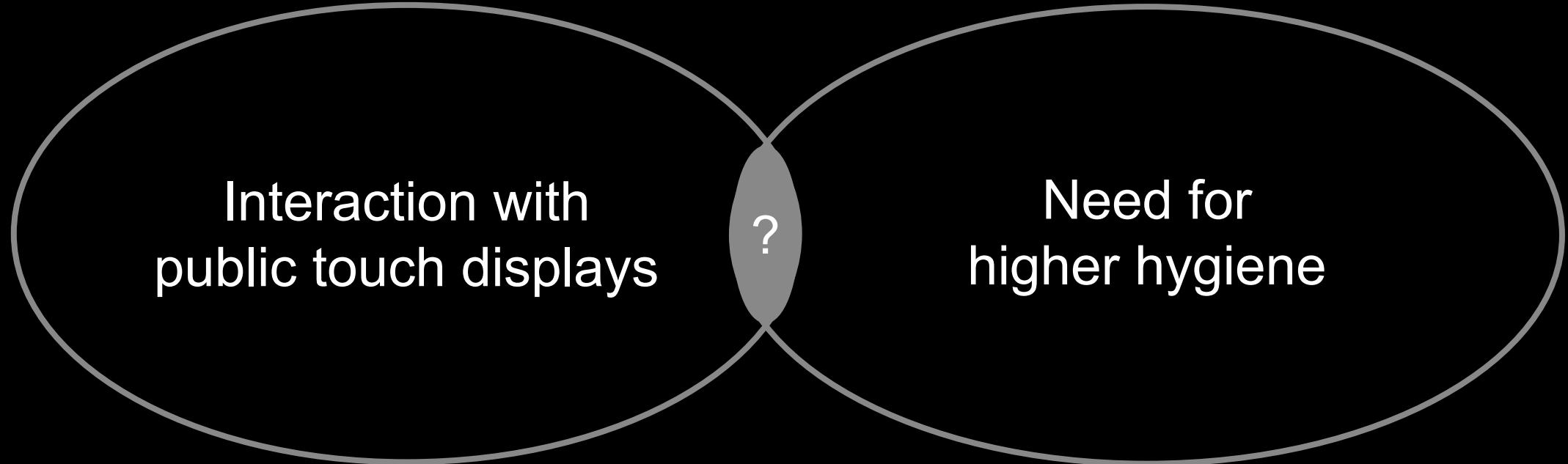


Large Scale Problem



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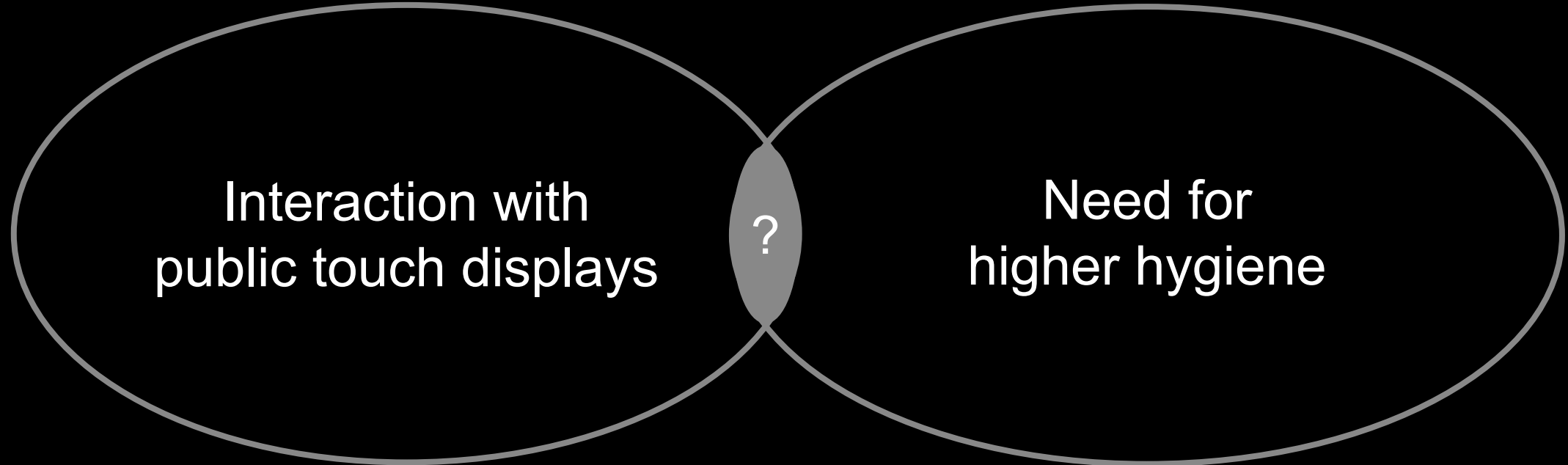
Hardware



Large Scale Problem

Hardware

Non-touch

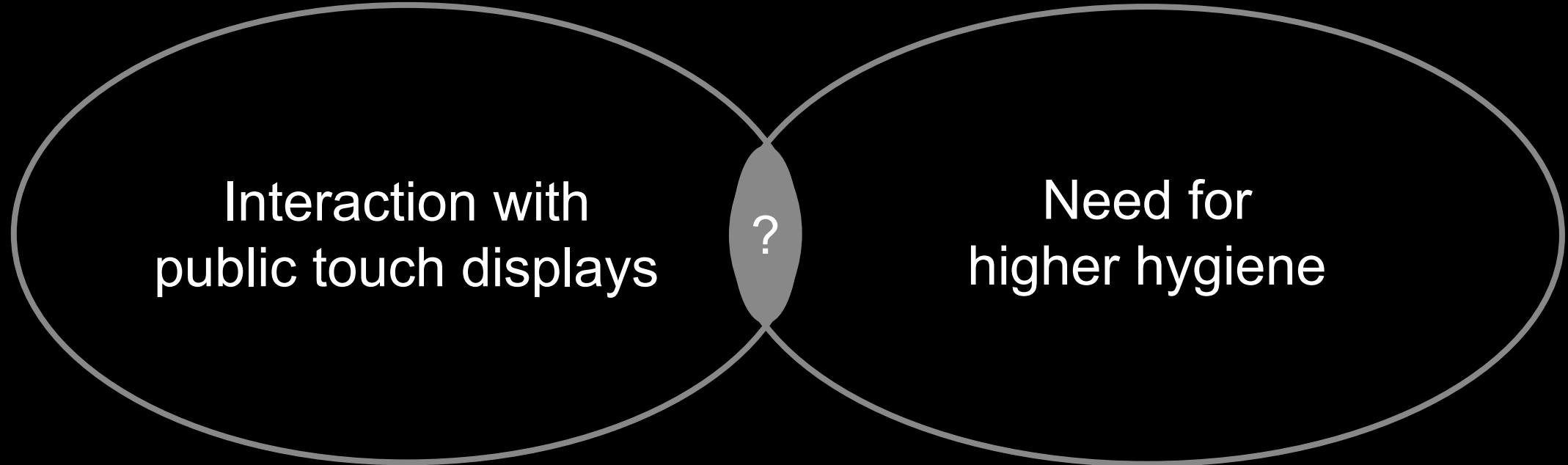


Large Scale Problem

Hardware

Non-touch

Software

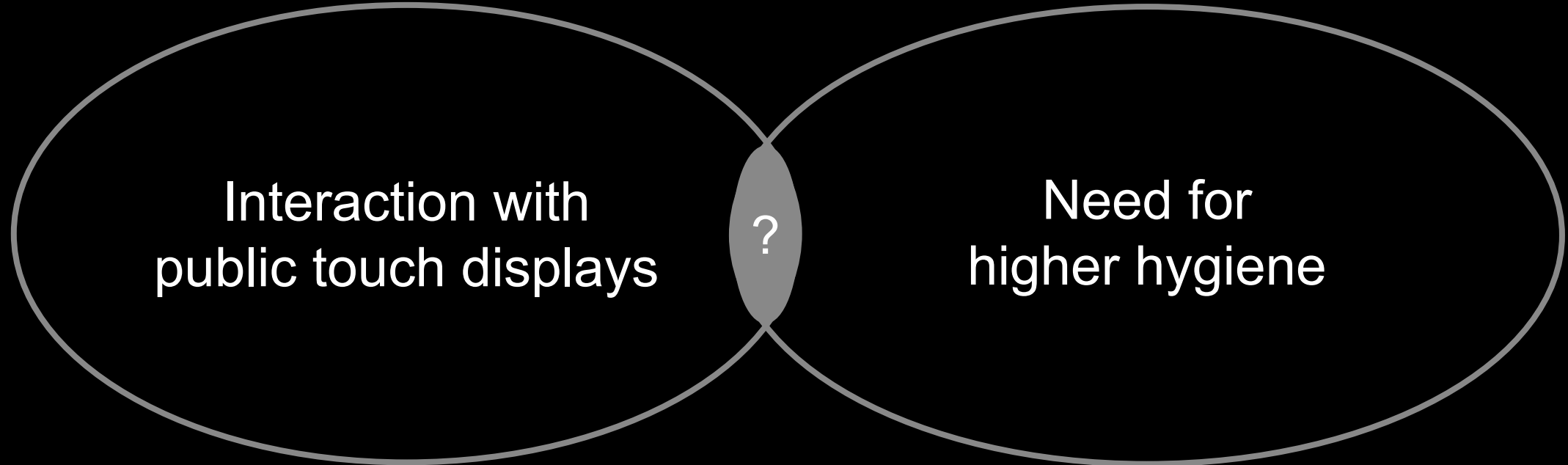


Large Scale Problem

Hardware

Non-touch

Software



Adaptive UI

Research Questions

Research Questions

RQ1

How can we reduce (the perceived) touch overlaps on shared displays through digital interface adaptations?

Research Questions

RQ1

How can we reduce (the perceived) touch overlaps on shared displays through digital interface adaptations?

RQ2

How do the interface adaptations impact the perceived usability?

Concept: *GUI Rearrangement*

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(UI, Prev' Users Touch)

Rearrangement



UI'

Concept: *GUI Rearrangement*

(UI, Prev' Users Touch)

Rearrangement



UI'

Concept: *GUI Rearrangement*

(UI, Prev' Users Touch)

Rearrangement



UI'

- Different users tap buttons in different places
- Reduces Touch Overlap
- Increased interaction hygiene?

Rearrangement Strategies

Raindrop

Waterfront Terminal

Station of Departure

Waterfront Terminal

Waterfront Terminal

Station of Arrival

move up

move left

move right

move down

Rule-based

Metro Inter View City

Language EN

Help

Station of Departure

Waterfront Terminal

Station of Arrival

West End Main Square

Popular Offers

4-Station-Ticket

24-Hour-Ticket

One-Way-Ticket

Multi-Journey-Ticket

Bicycle Ticket

Monthly Subscription

Priority-based

1	2	3	...							11
12	...									22
...										...
67	...									77

Metro Inter View City

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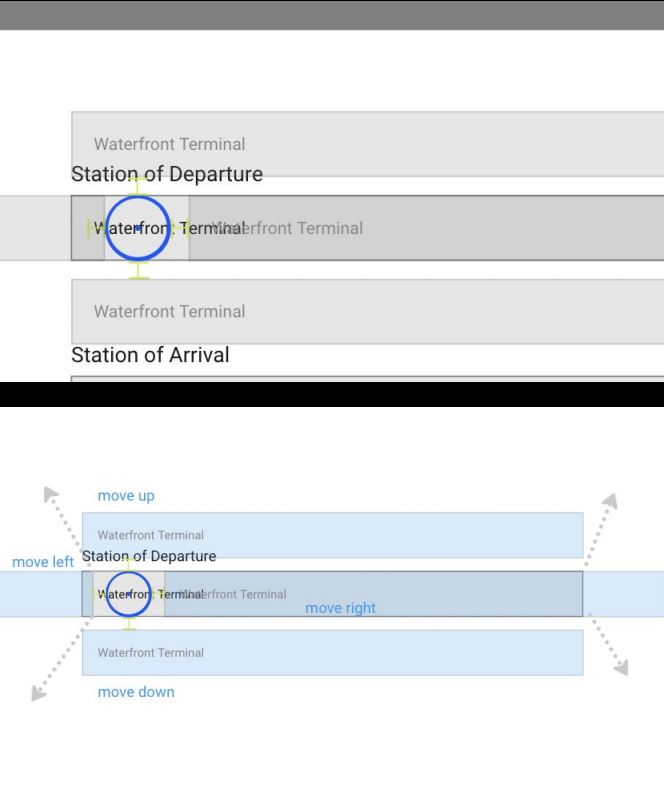
Multi-Journey-Ticket

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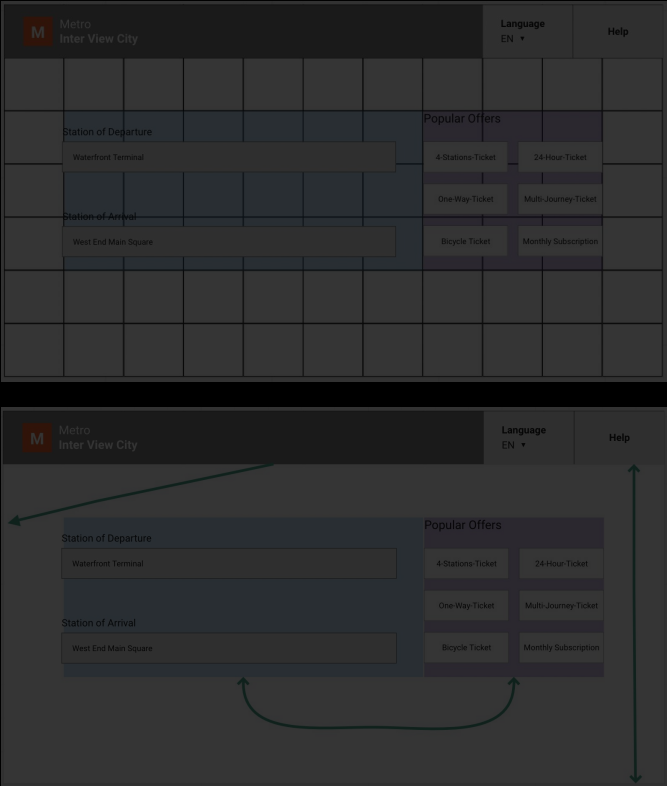
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Rearrangement Strategies

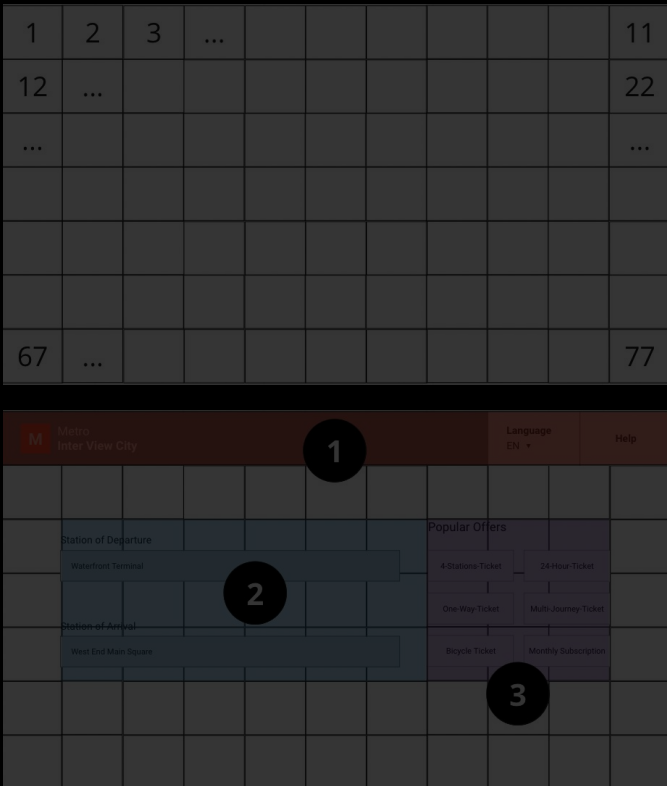
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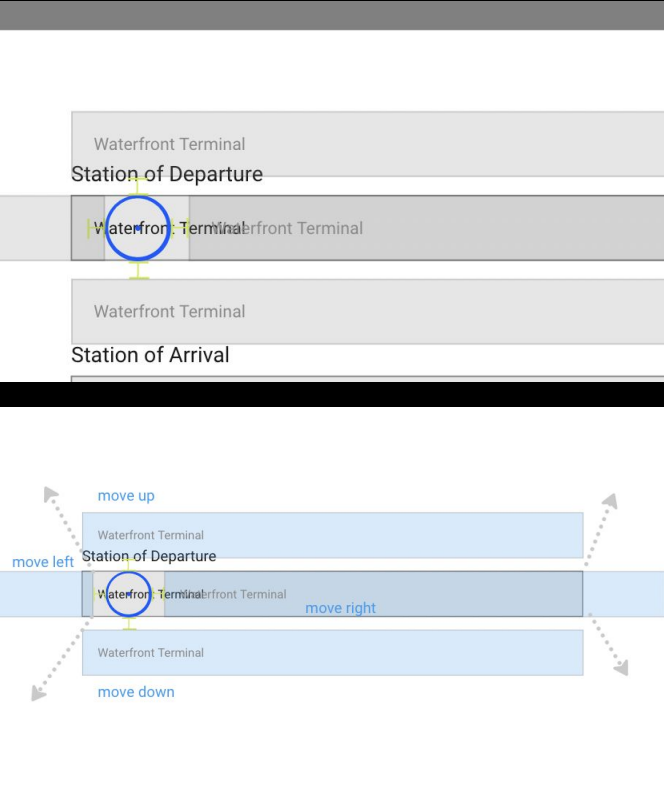


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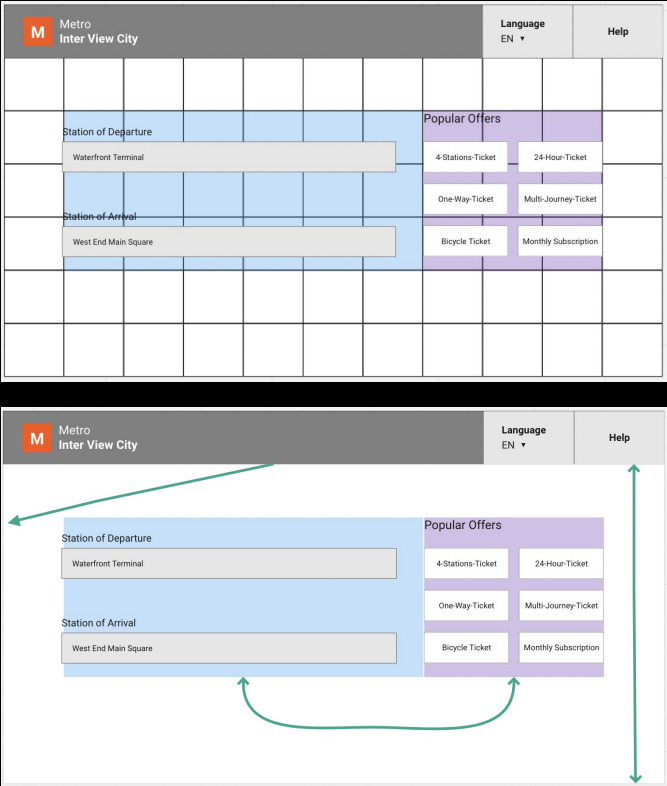


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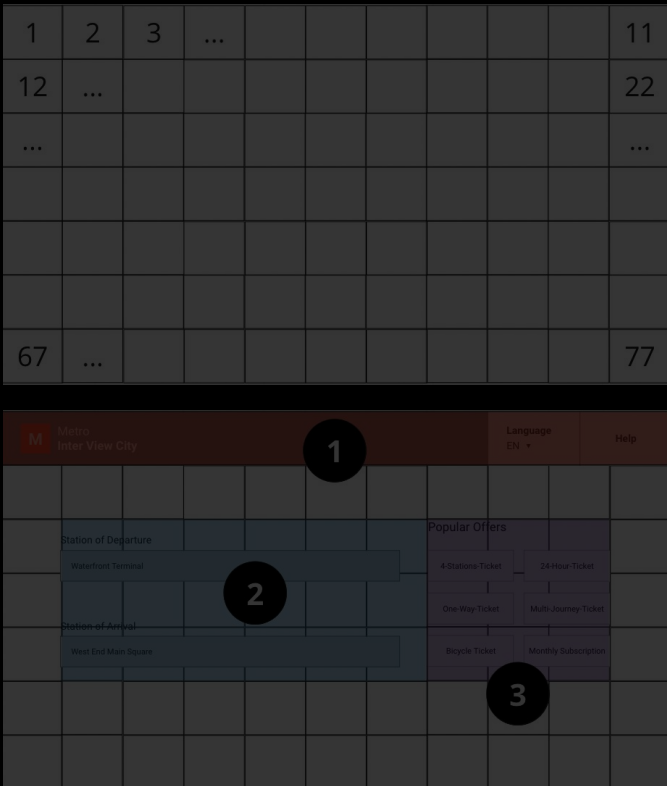
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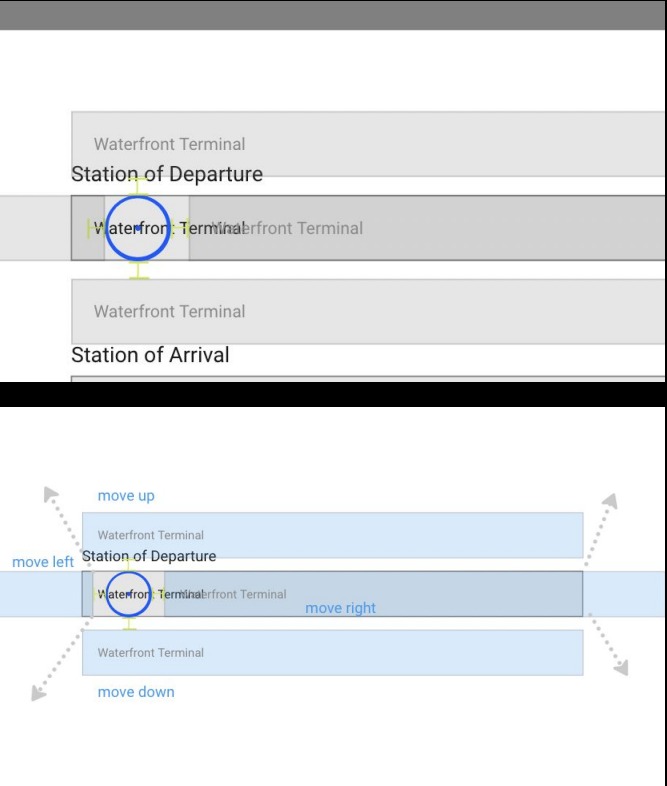


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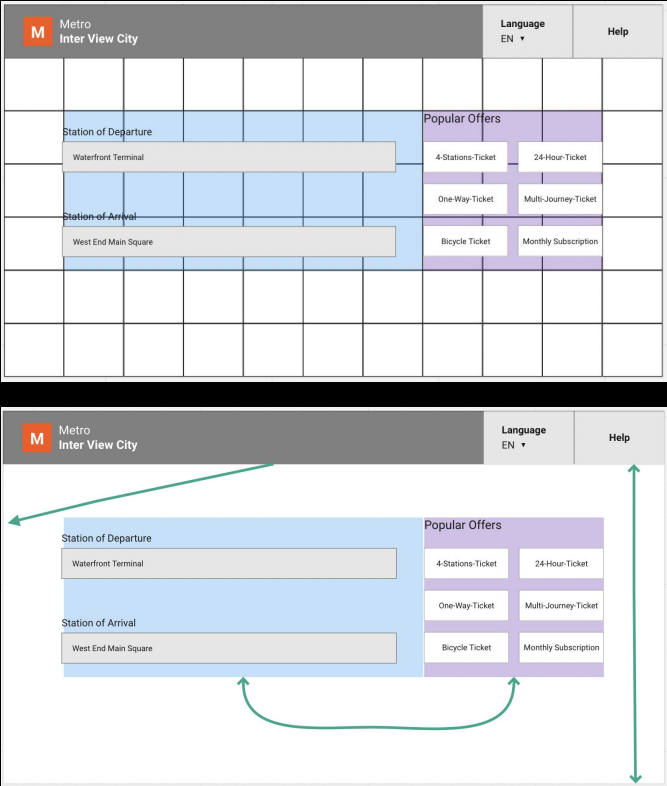


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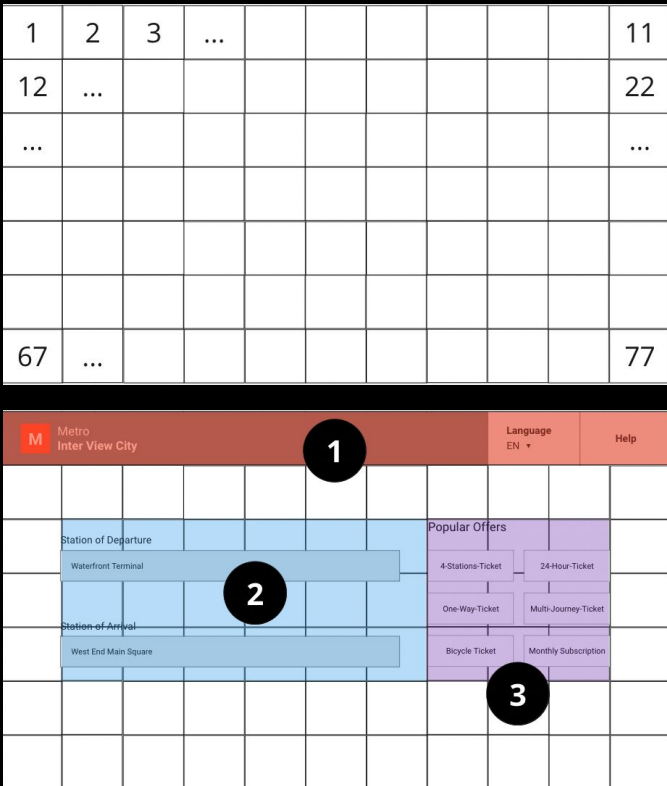
Raindrop



Rule-based



Priority-based



HCI Expert Interviews

Setup

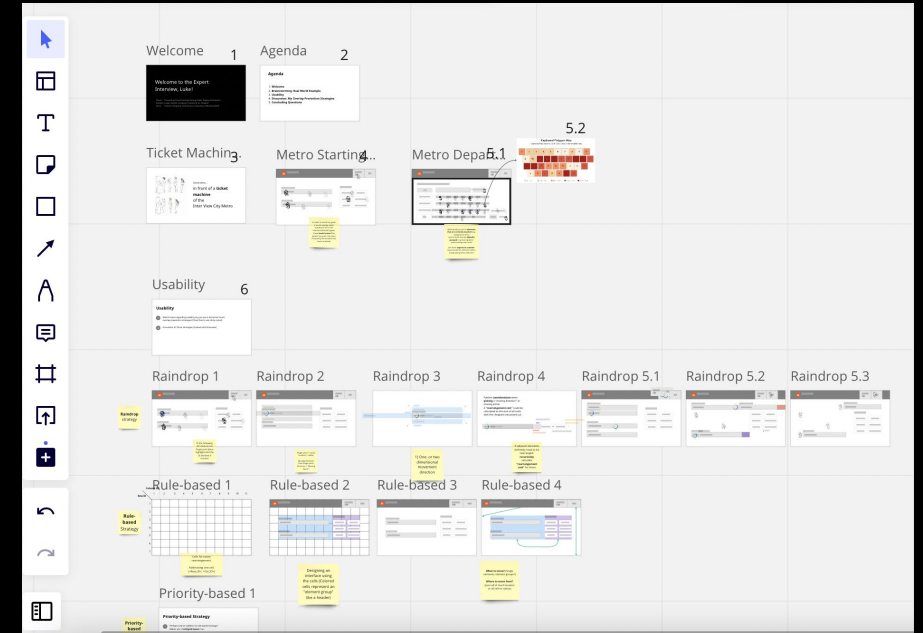
- 30–40 min 1:1 video interviews
- Remotely with collab whiteboard
- Public touch scenario, simplified UI

Goal

- Brainstorm further touch overlap reduction strategies
- Collect feedback on our three strategies
- Focus: Usability, limitations, alignment with common heuristics

Participants

- Four experts, all with a PhD
- Extensive HCI experience (8.5–20 years)
- Expertise in Public Displays or Adaptive UI



Collaborative whiteboard setup, Miro

HCI Expert Interviews

Preferred Rearrangement Strategy: Rule-based

HCI Expert Interviews

Preferred Rearrangement Strategy: Rule-based

Maintains element relationships

HCI Expert Interviews

Preferred Rearrangement Strategy: Rule-based

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No excessive whitespace

HCI Expert Interviews

Preferred Rearrangement Strategy: Rule-based

Maintains element relationships

Maintains recognizability

Easy to implement in existing UIs

Less effort than Priority-based

No excessive whitespace

Clear(-er) implementation

Study Design

Methodology

Study Design

Methodology



Lab Setup for Study

Study Design

Methodology

- Exploratory, within-subjects, mixed-methods lab study (N=26)



Lab Setup for Study

Study Design

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- Exploratory, within-subjects, mixed-methods lab study (N=26)
- Snack and Drink machine UI on an Acer T232HL touch display



Lab Setup for Study

Study Design

Methodology

- Exploratory, within-subjects, mixed-methods lab study (N=26)
- Snack and Drink machine UI on an Acer T232HL touch display
- Six experimental conditions



Lab Setup for Study

Study Design

Participants (N=26)

Study Design

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- 14 men, 10 women, 2 non-binary/genderqueer/diverse

Study Design

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- Ages: 19–32 years (median: 25)

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Study Design

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- 14 men, 10 women, 2 non-binary/genderqueer/diverse
- Ages: 19–32 years (median: 25)
- Mostly university students (21/26)
- All familiar with public displays & touch interaction
- Most used public displays at least weekly (14/26)

Study Design

Variables

Study Design

Variables

Independent variables

Study Design

Variables

Independent variables

- Layout condition
 - Rearranged Vertically (RV)
 - Rearranged Horizontally (RH)
 - Baseline

Study Design

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Independent variables

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- Traces Condition
 - Without Traces
 - With Traces

Study Design

Variables

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Dependent variables

Study Design

Variables

Independent variables

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Dependent variables

- Average Task Completion Time

Study Design

Variables

Independent variables

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 - Baseline
- Traces Condition
 - Without Traces
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Dependent variables

- Average Task Completion Time
- Perceived Usability Score
 - Hedonic TAM, 7-point Likert scale

Study Design

Procedure

Study Design

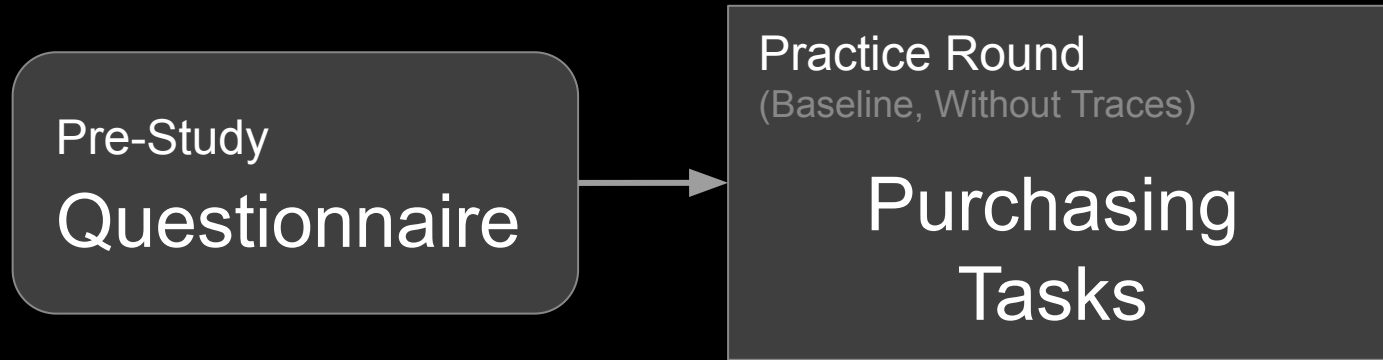
Procedure

Pre-Study

Questionnaire

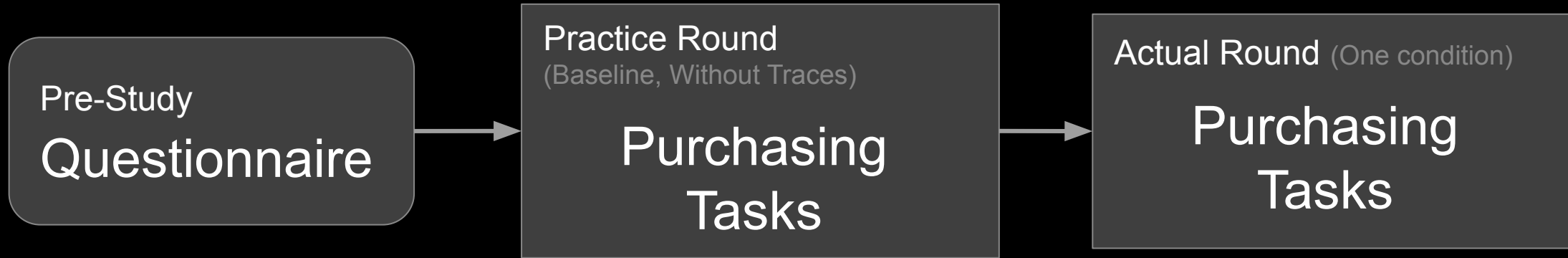
Study Design

Procedure



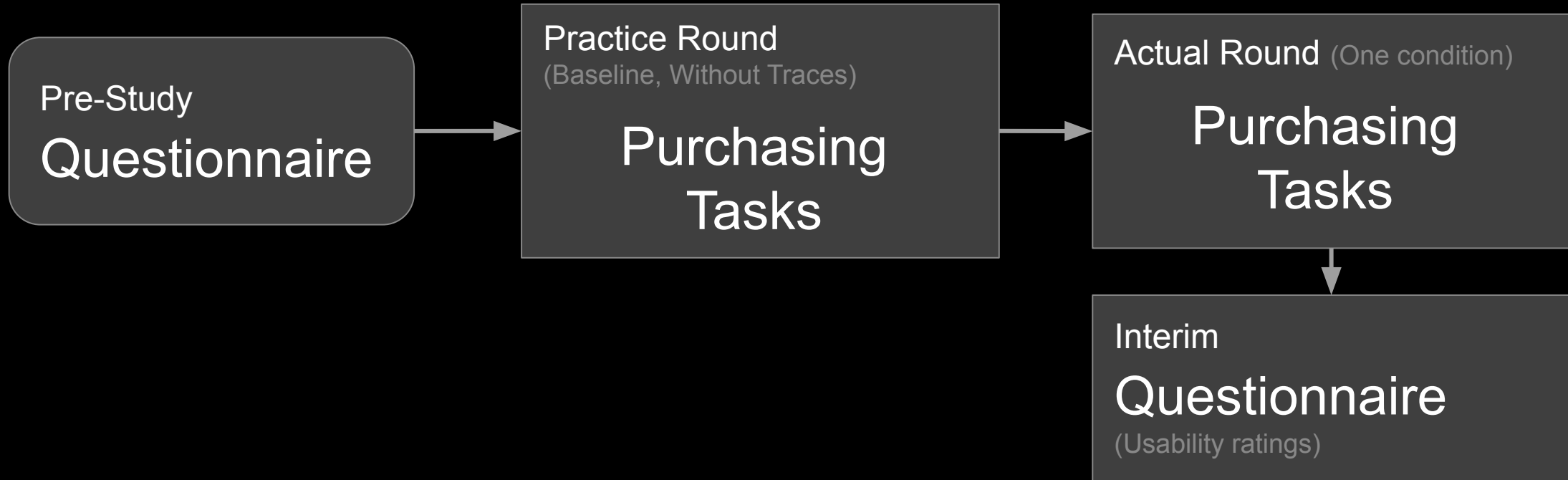
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Procedure



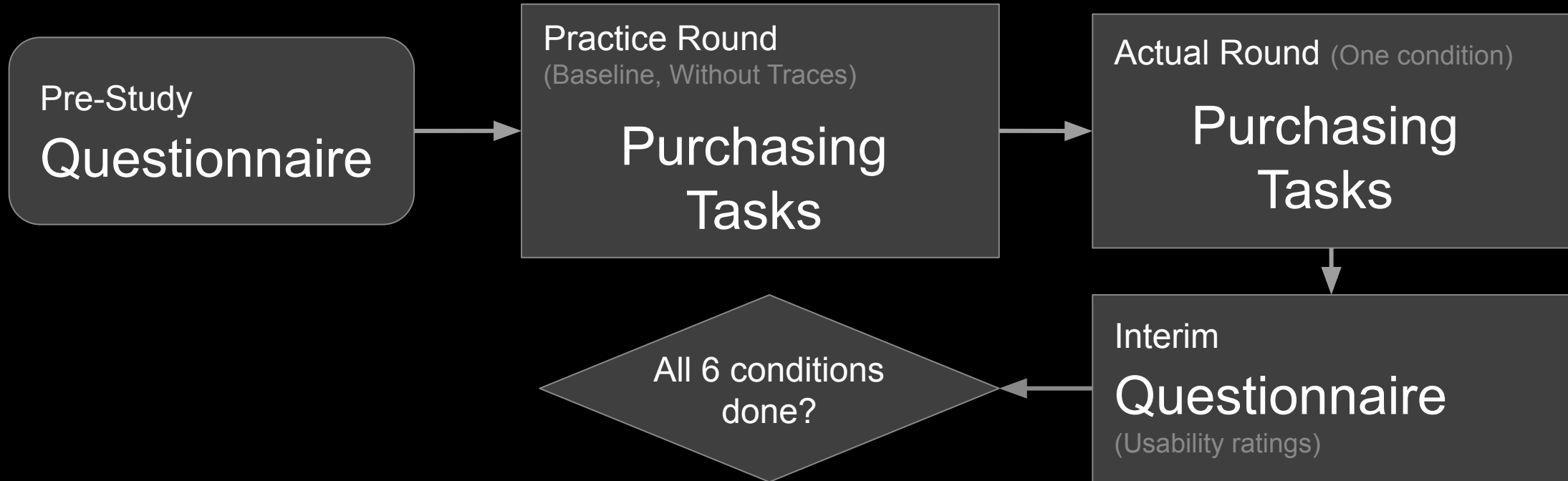
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Procedure



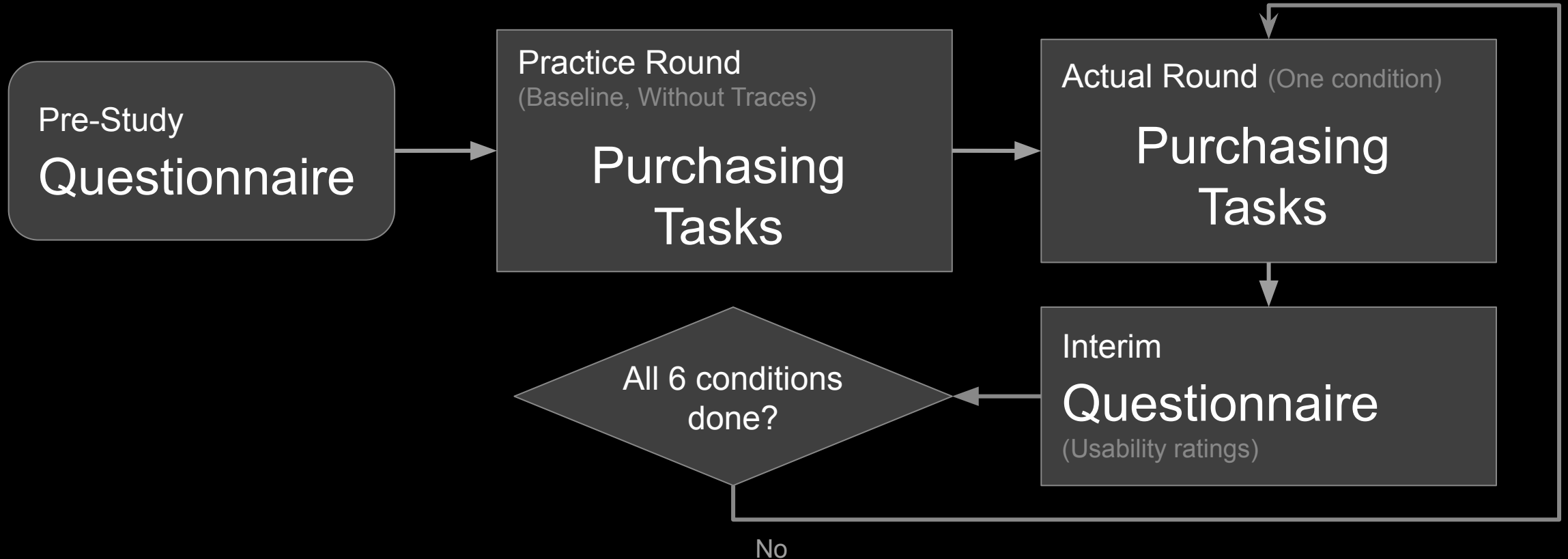
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Procedure



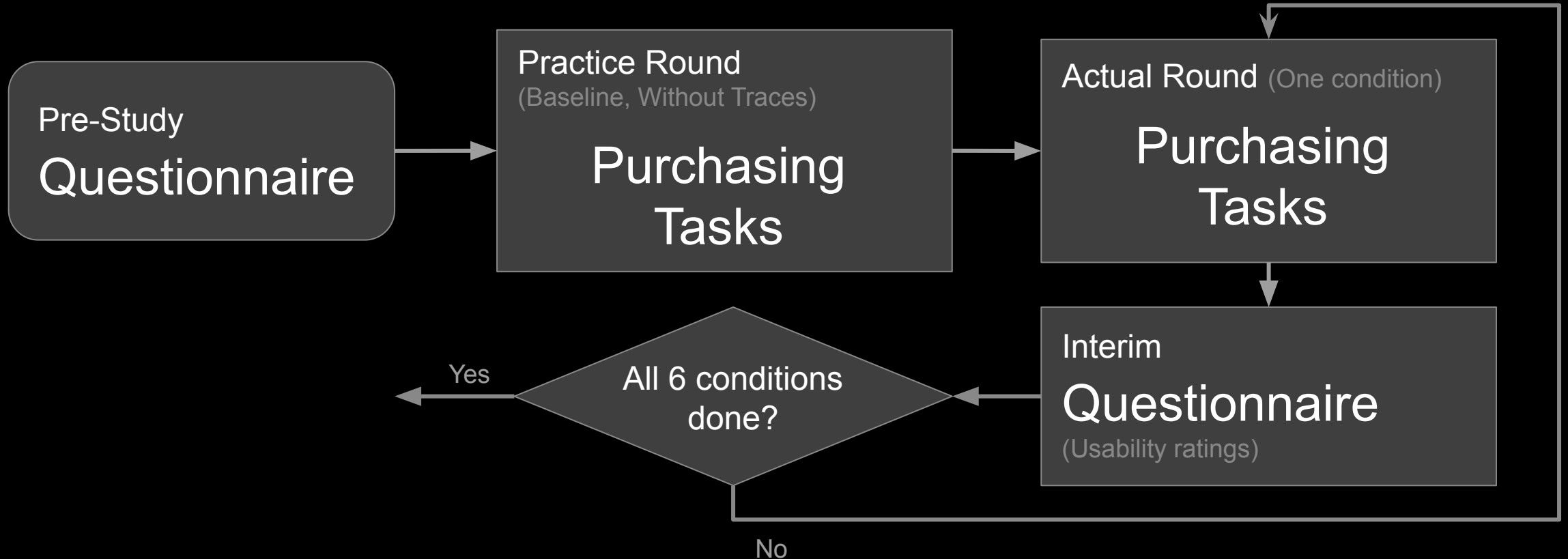
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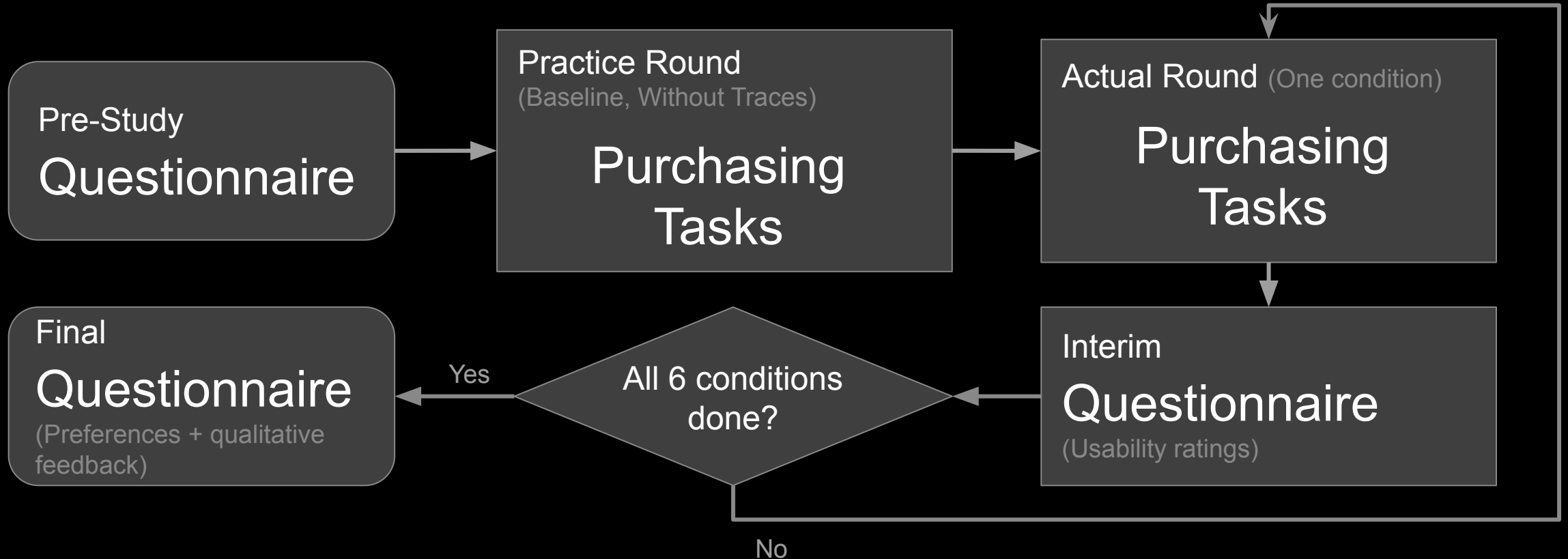
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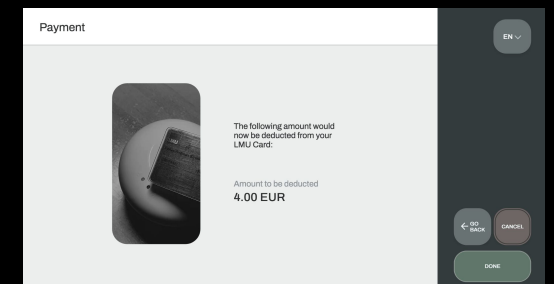
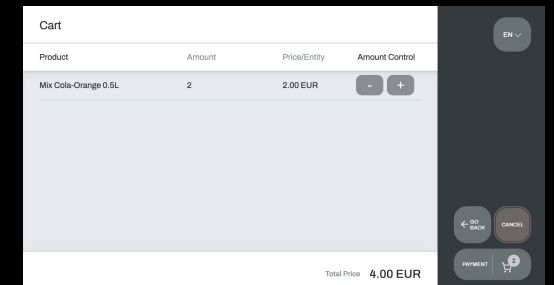
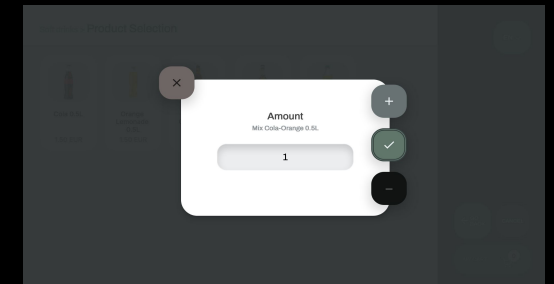
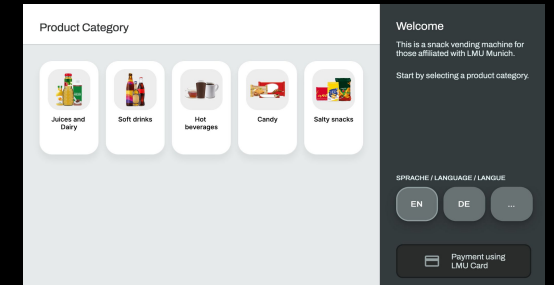
Study Design

Procedure



Study Prototype

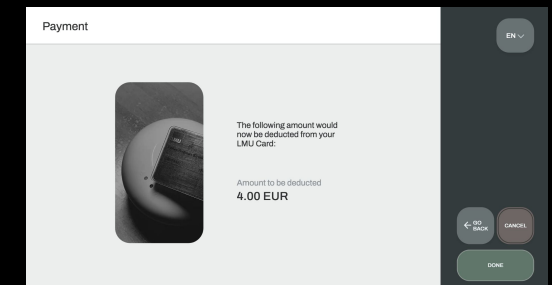
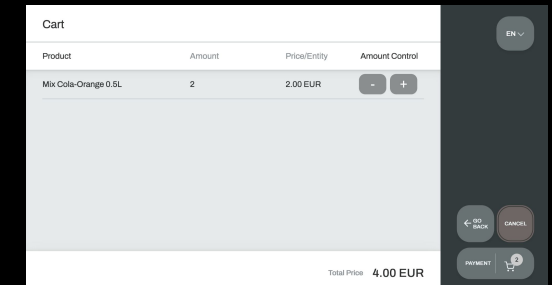
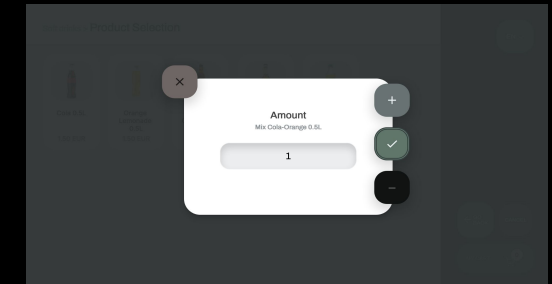
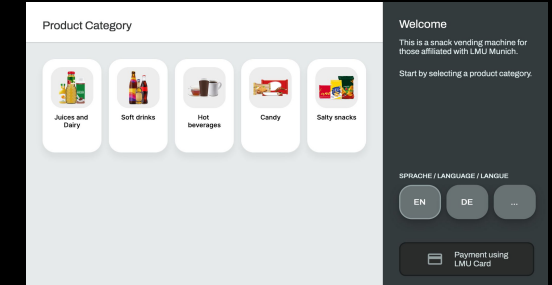
Baseline Layout of UI (Control)



Study Prototype

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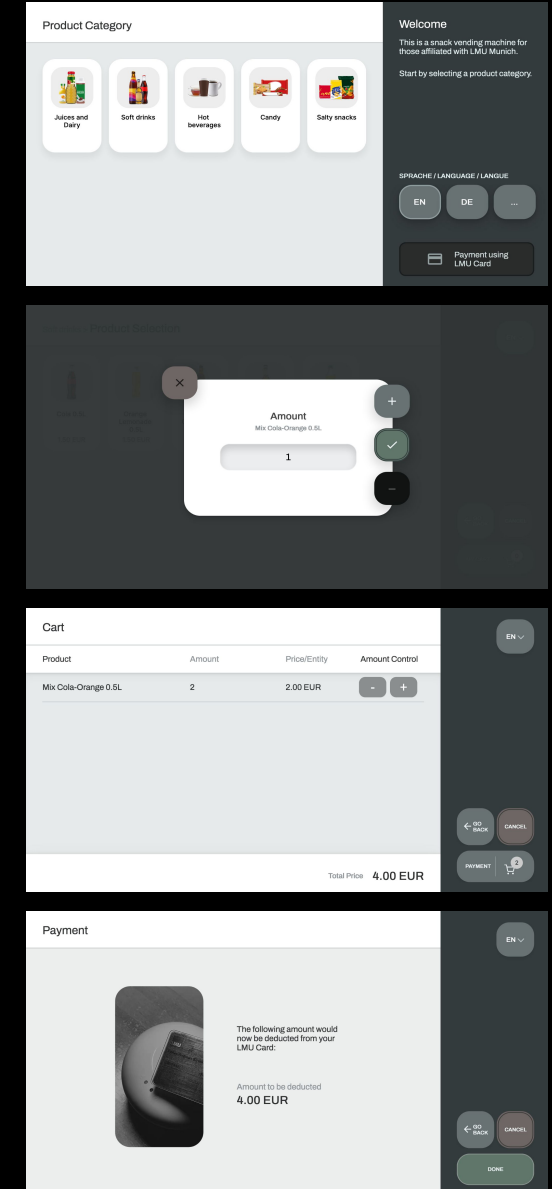
- Core UI of a Snack & Drink Machine



Study Prototype

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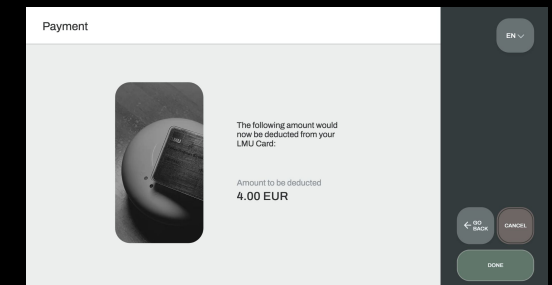
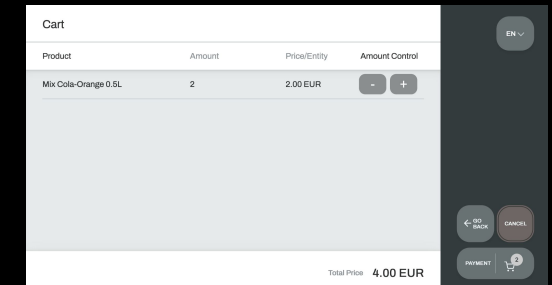
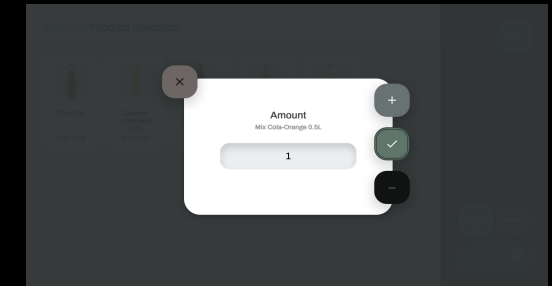
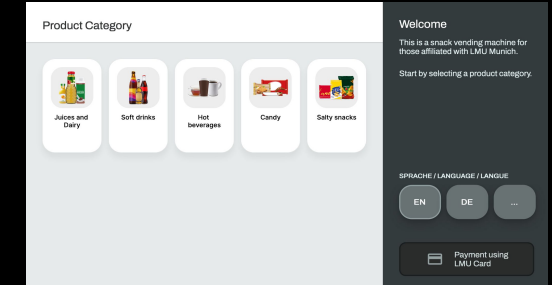
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 - Screens: Welcome, Product Category, Order Review, Payment



Study Prototype

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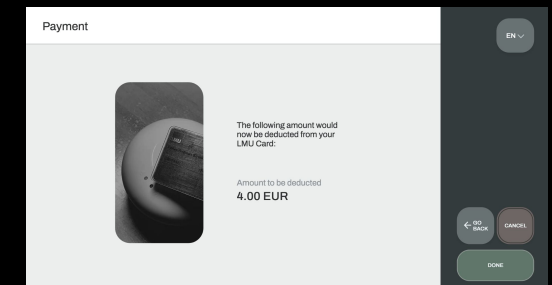
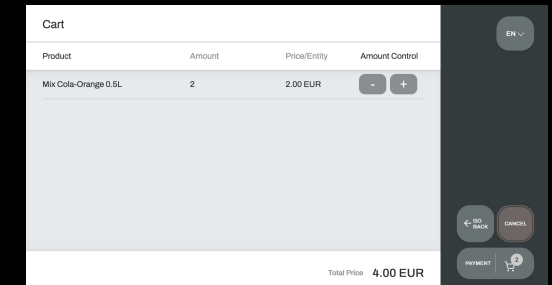
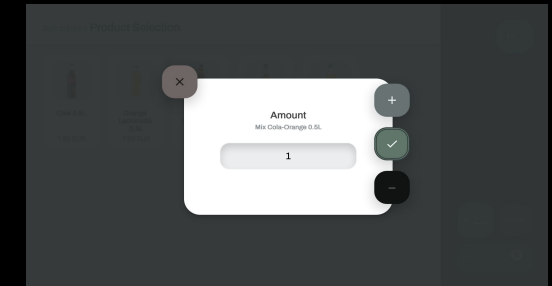
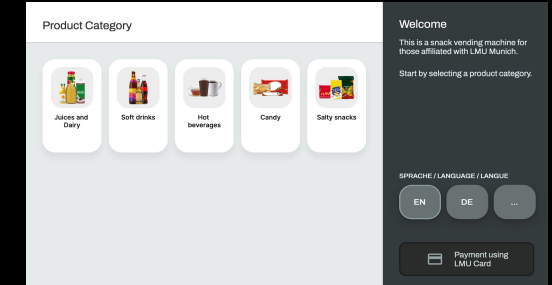
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Study Prototype

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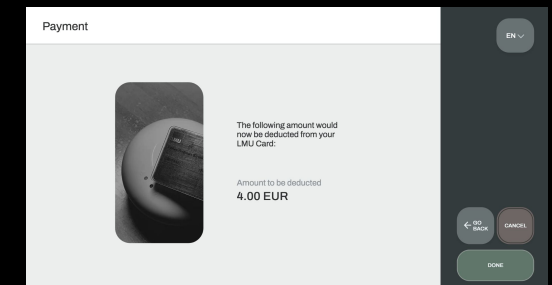
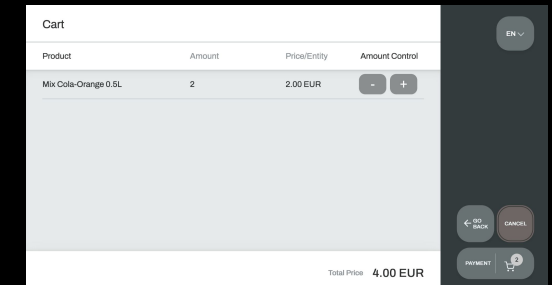
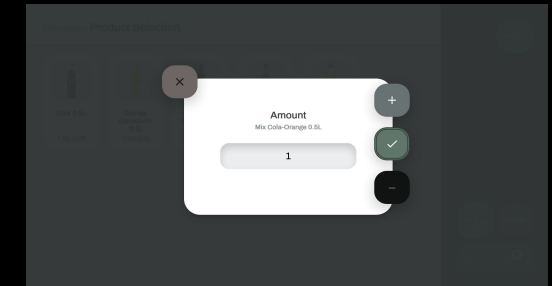
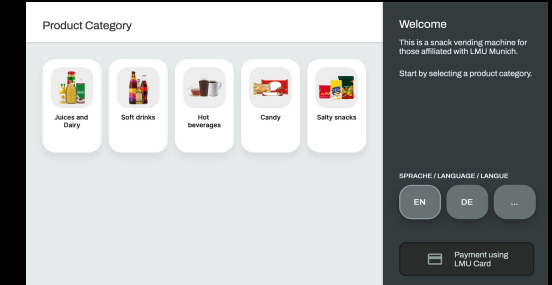
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 - Elements differentiated by shape/size



Study Prototype

Baseline Layout of UI (Control)

- Core UI of a Snack & Drink Machine
- Inspired by McDonald's kiosks
 - Screens: Welcome, Product Category, Order Review, Payment
- Common usability heuristics
 - Minimalist, high contrast, clear buttons
- Focus on Accessibility
 - Elements differentiated by shape/size
- Implemented via ReactJS (MVC-Architecture)



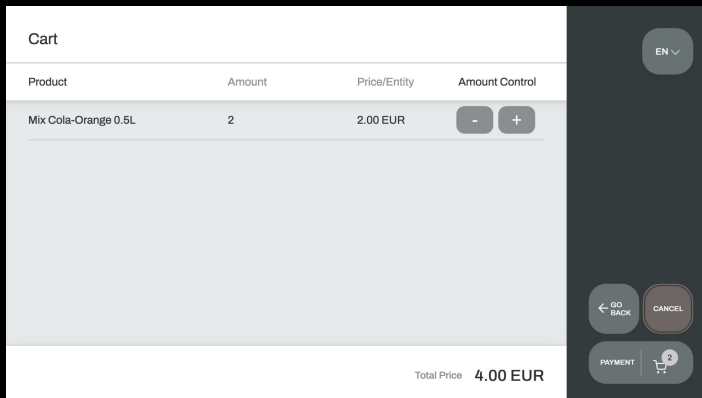
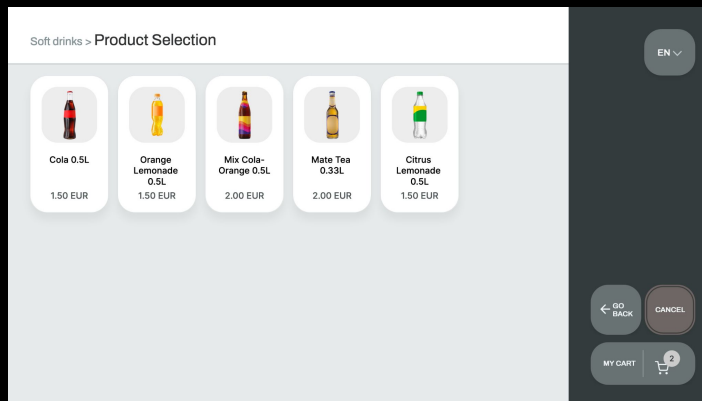
Study Prototype

How Rule-based Rearrangement Works

Study Prototype

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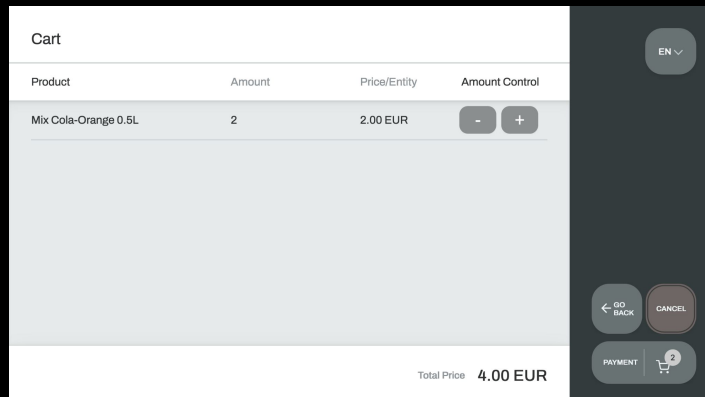
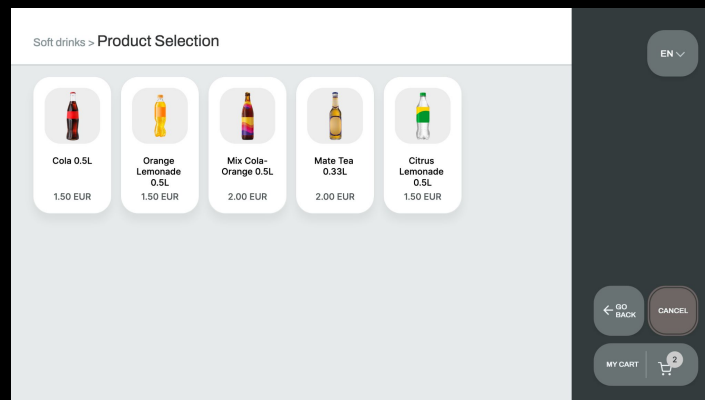
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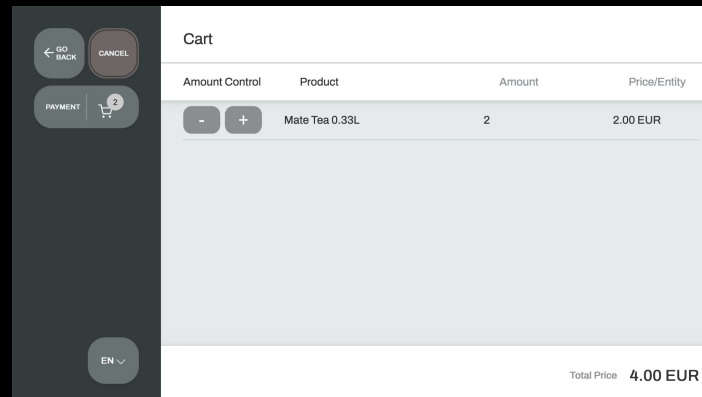
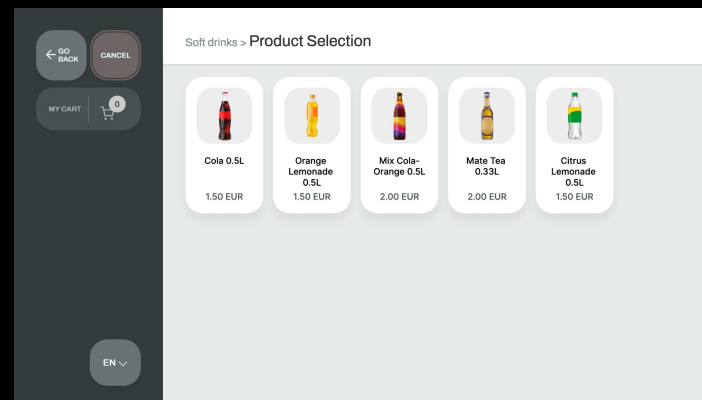
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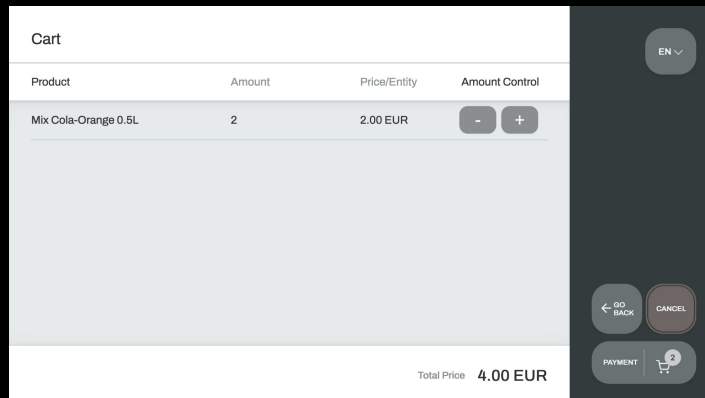
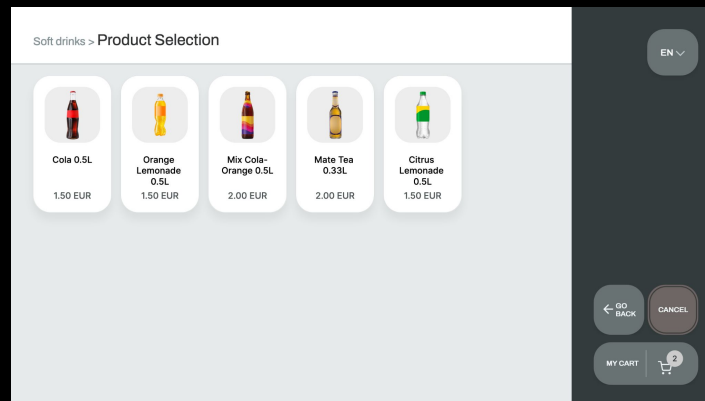
Rearranged Horizontally



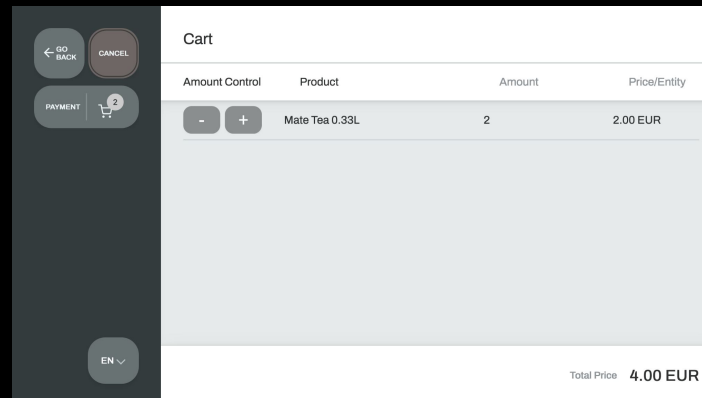
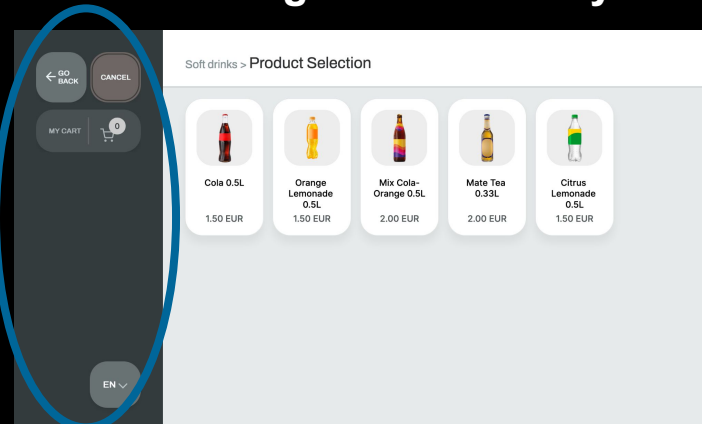
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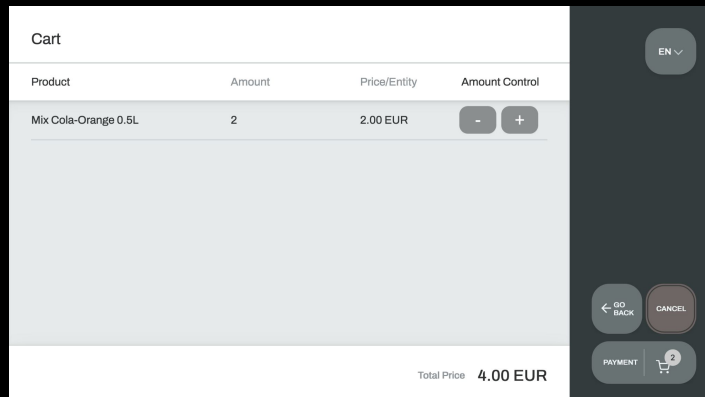
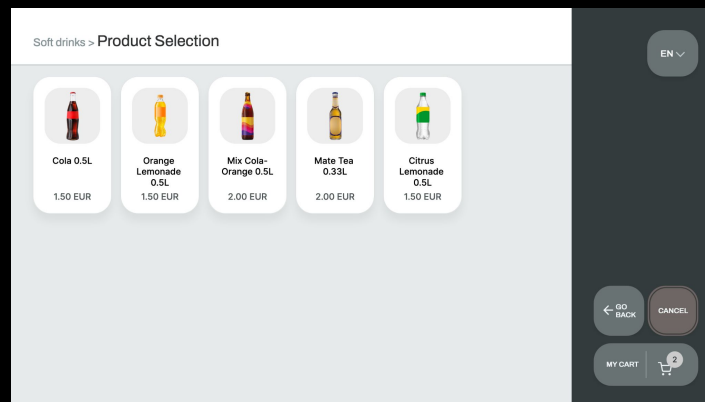
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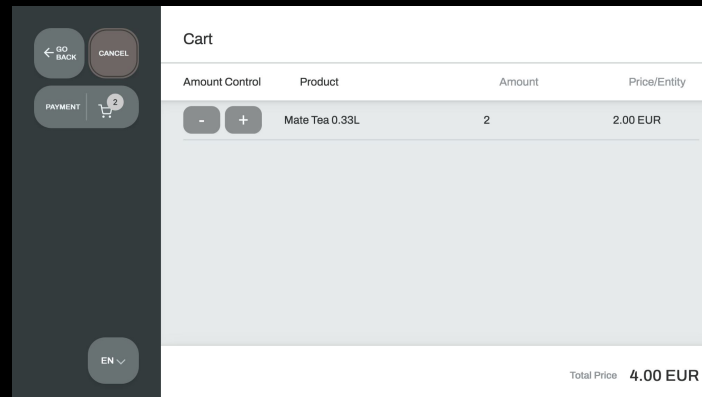
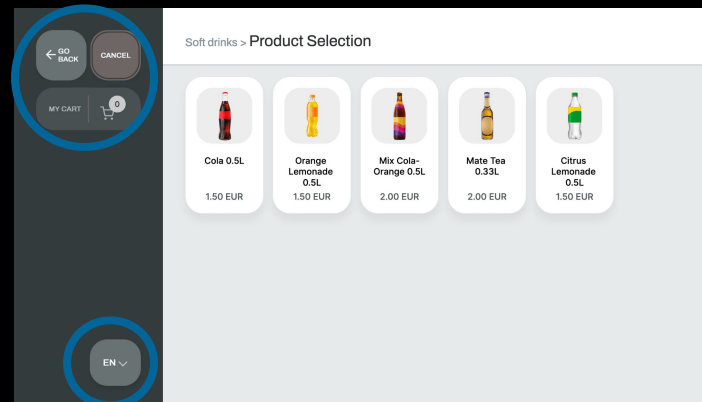
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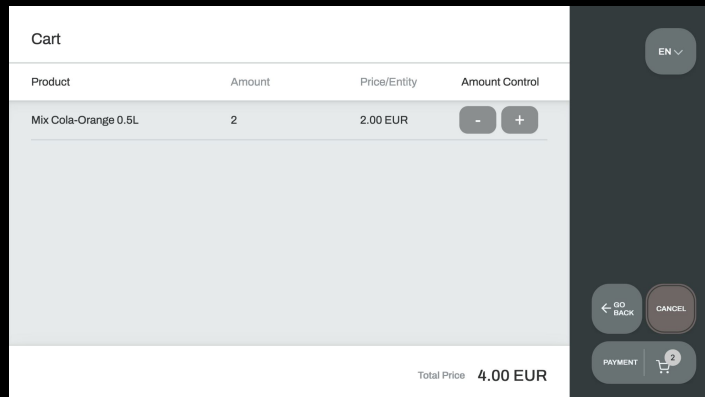
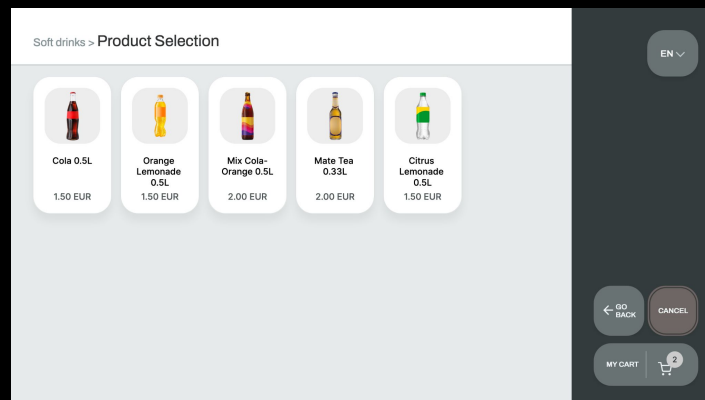
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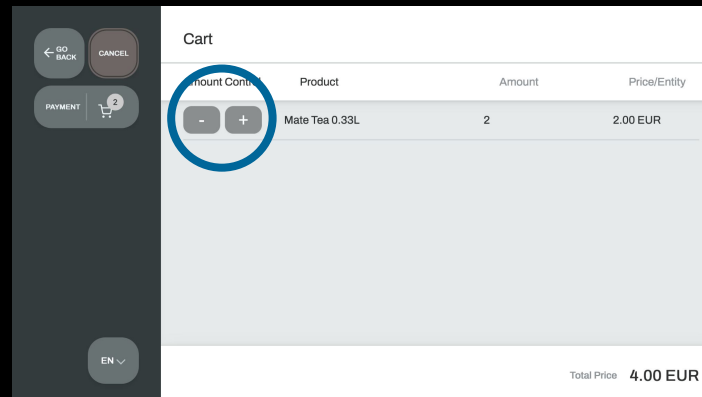
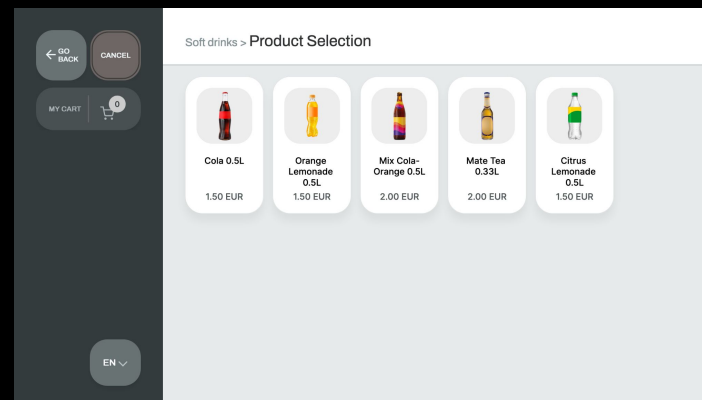
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Baseline



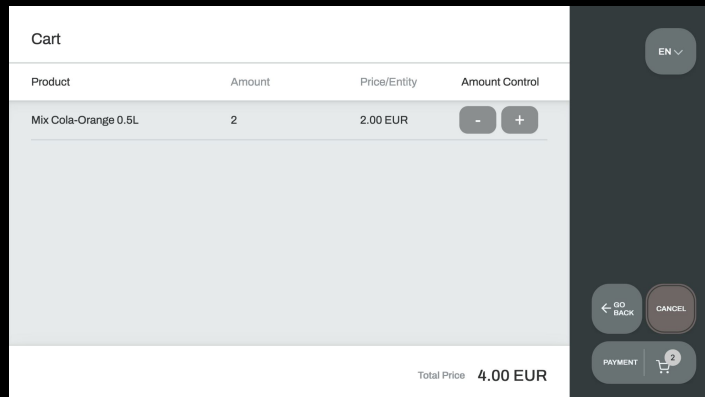
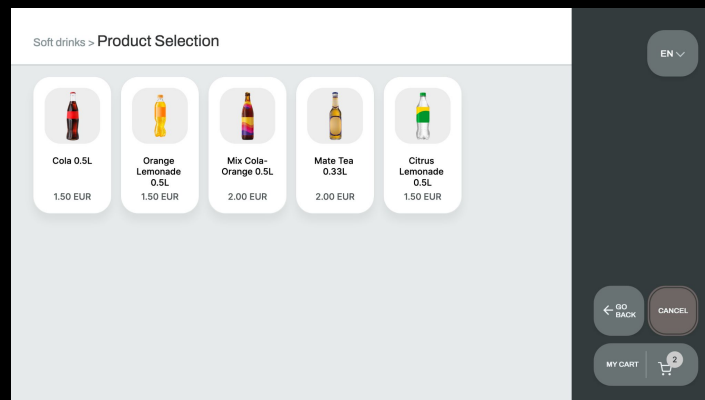
Rearranged Horizontally



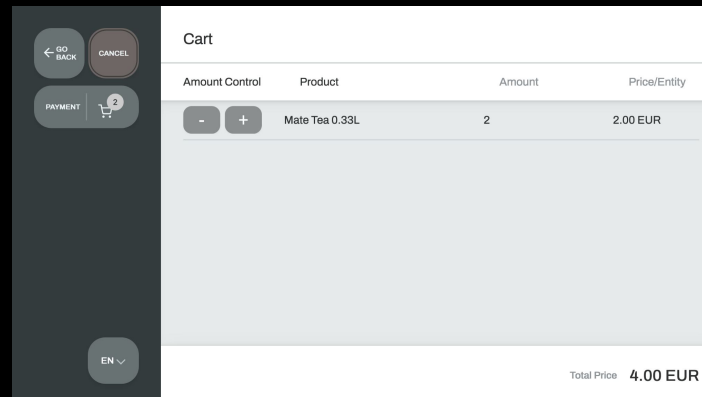
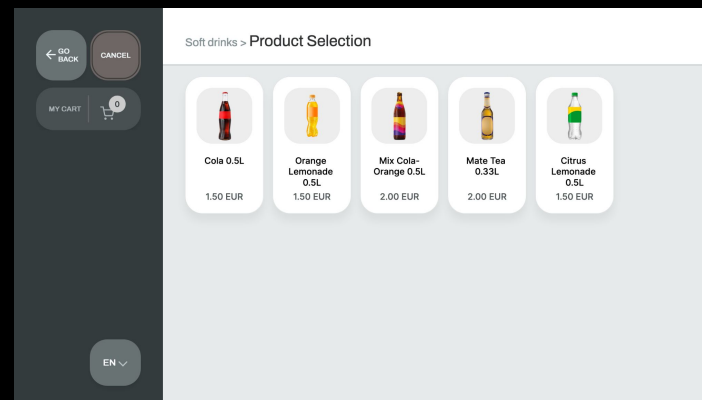
Study Prototype

How Rule-based Rearrangement Works

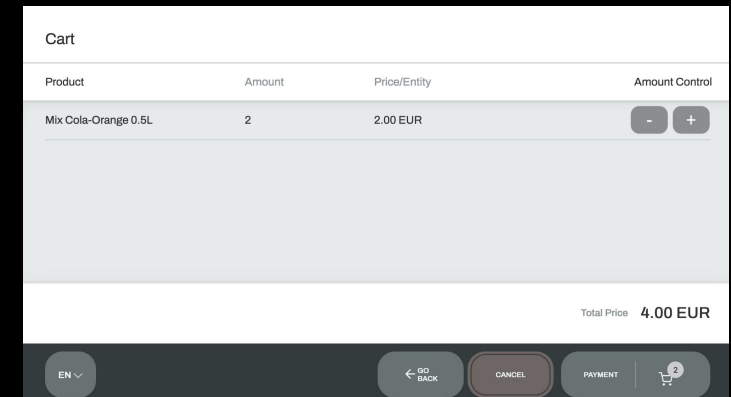
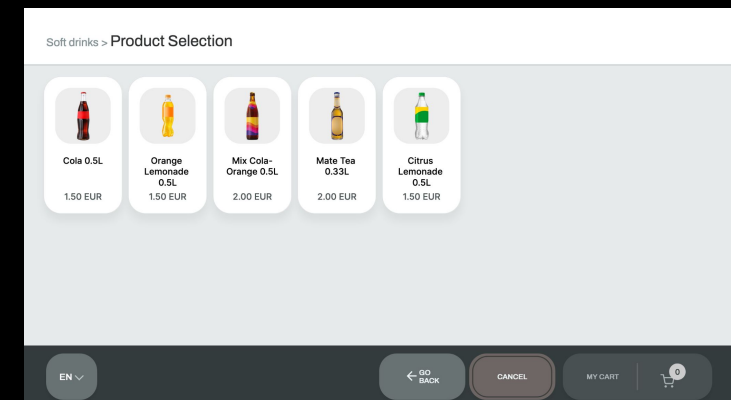
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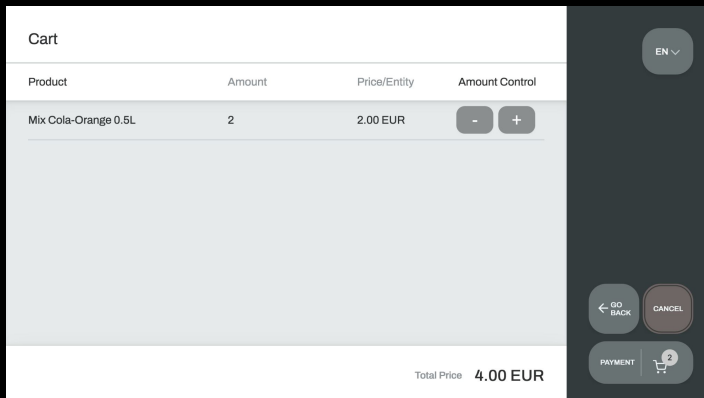
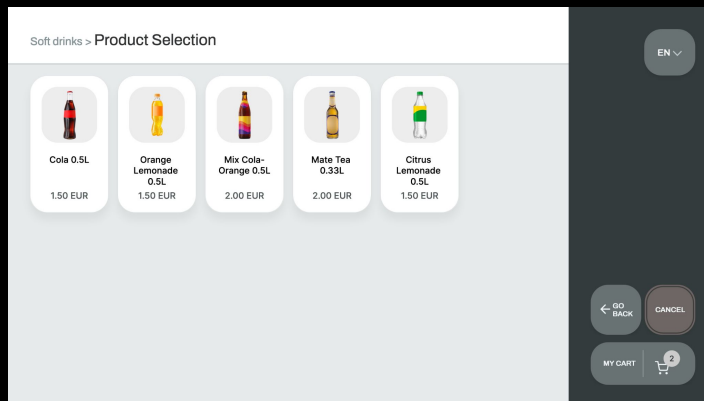
Rearranged Vertically



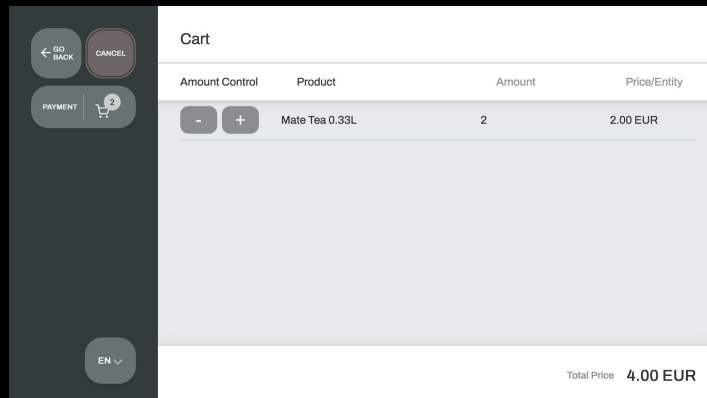
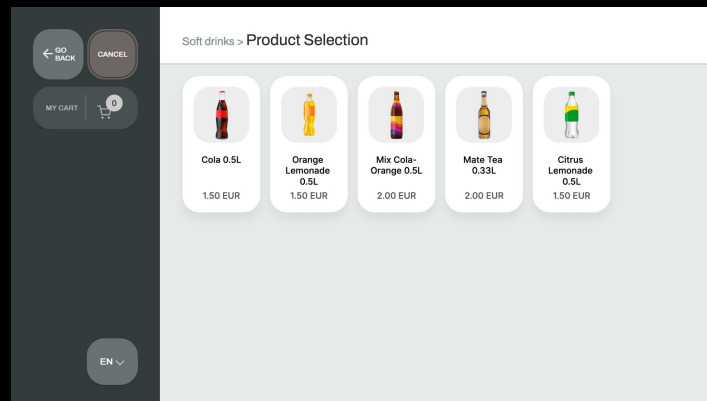
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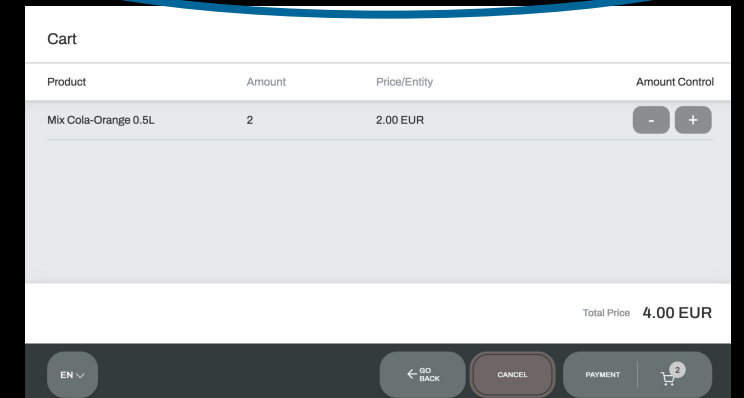
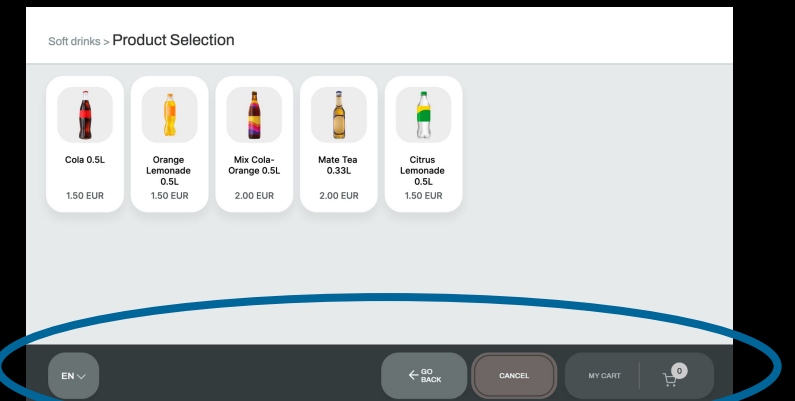
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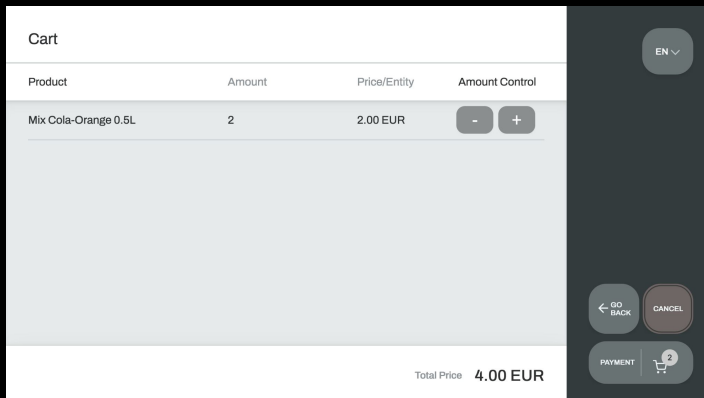
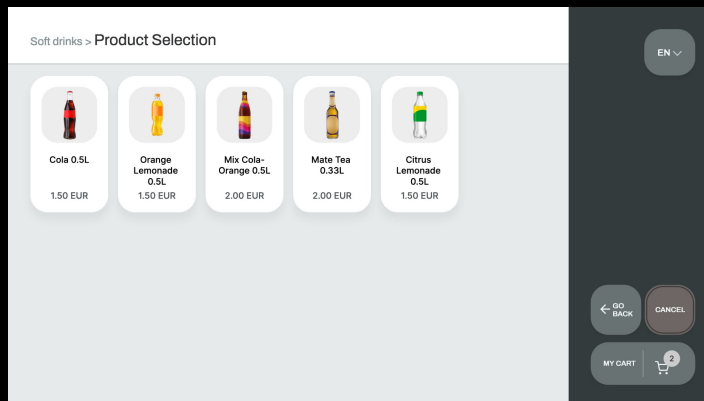
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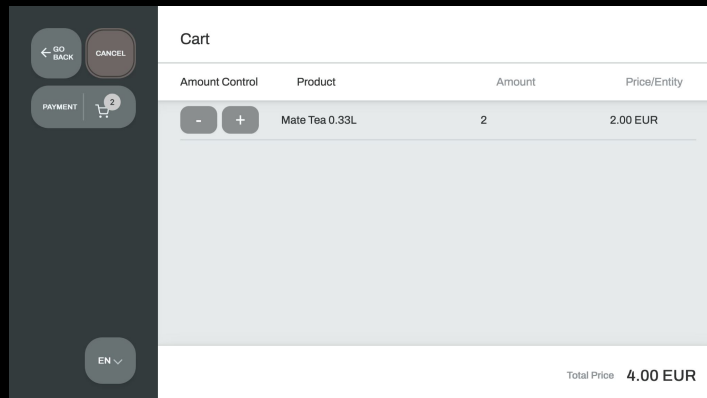
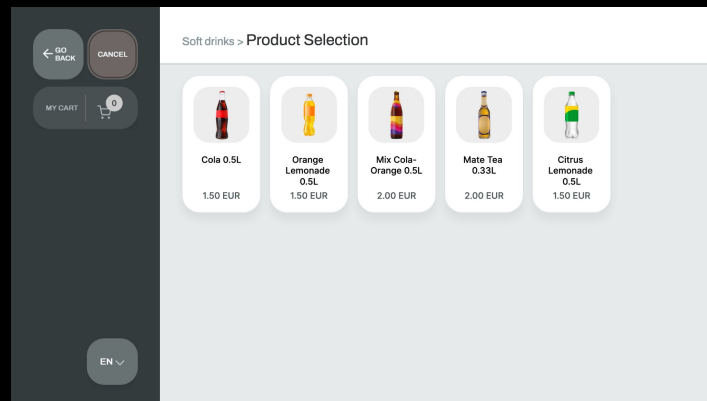
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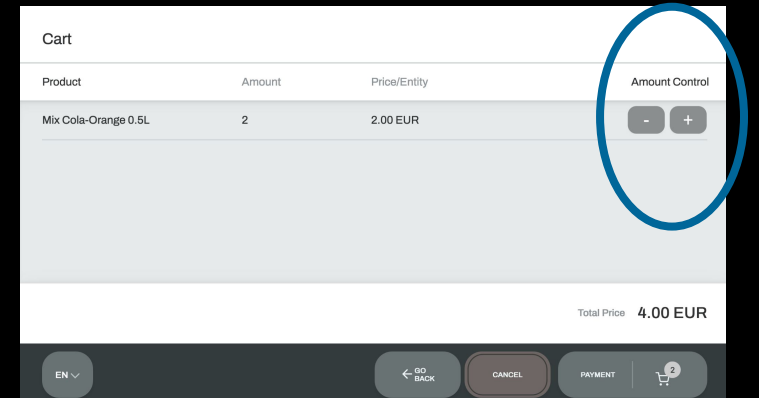
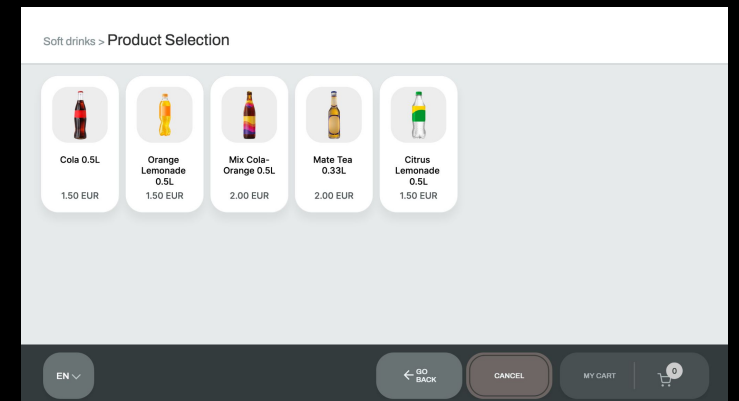
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Key Findings RQ1

Reducing Touch Overlaps

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Layout rearrangement
→ distributes touch

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Optional / user-controlled traces
→ hygiene perception & comfort

Key Findings RQ2

Impact on Perceived Usability

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Baseline faster to use

RH (-2.33 s, $p = 0.023$), RV (-2.14s, $p = 0.042$)

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Right-handed adaptation

→ arm repositioning

Other Findings

Hygiene & Privacy

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Rearrangement & hygiene
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Implications

Practical

Academic

Touch
Traces

Rearr-
angement

Implications

	Practical	Academic
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Implications

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	Respect learning curve	Usability trade-offs
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Rearrangement + Touch Traces

→ alter touch patterns → perceived hygiene benefit (RQ1)

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- Context-specific interface optimization for PDs

Let's explore **hygiene** as a
UI optimization objective!

Thank you!

Lou Elah Süsslin
suesslin@pm.me