# Exploring Design Directions for Wearable Privacy

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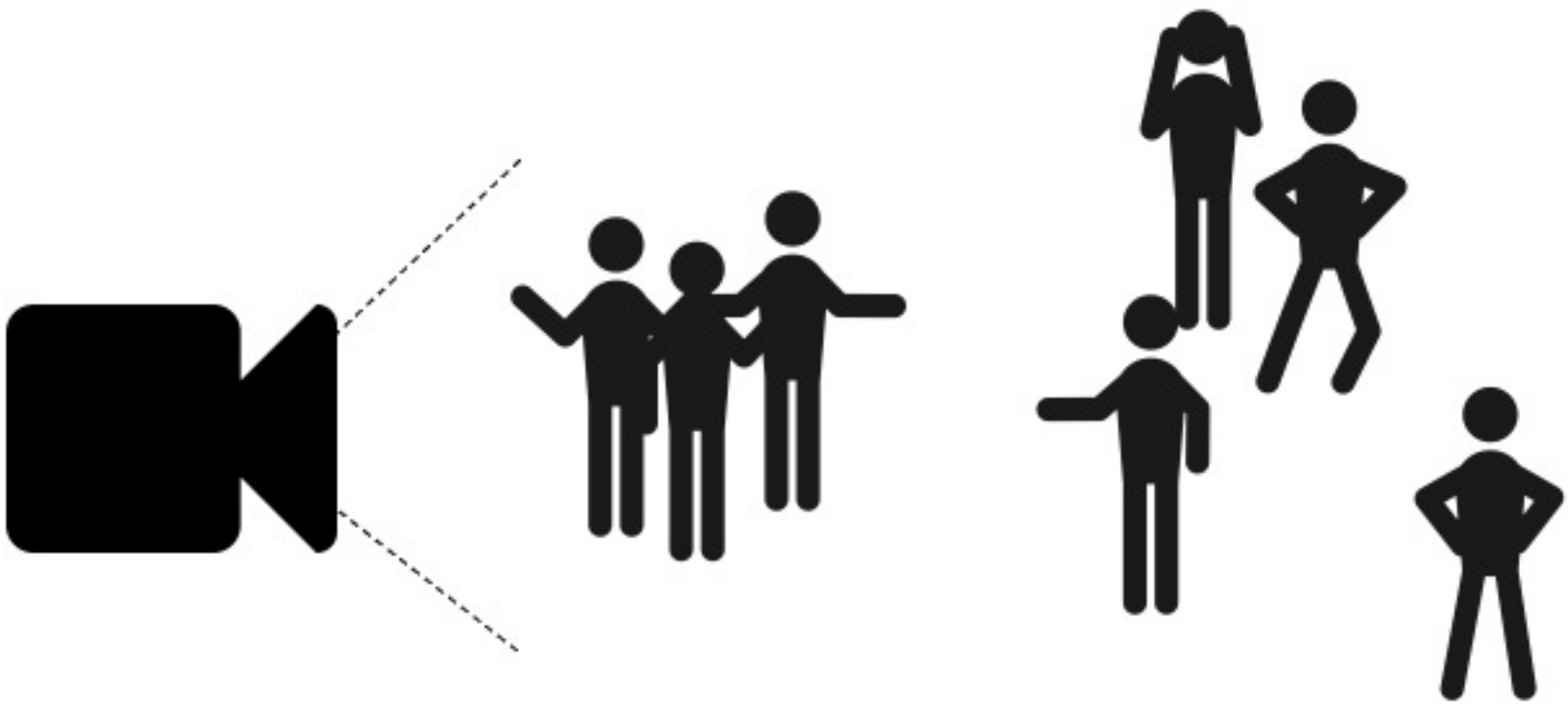
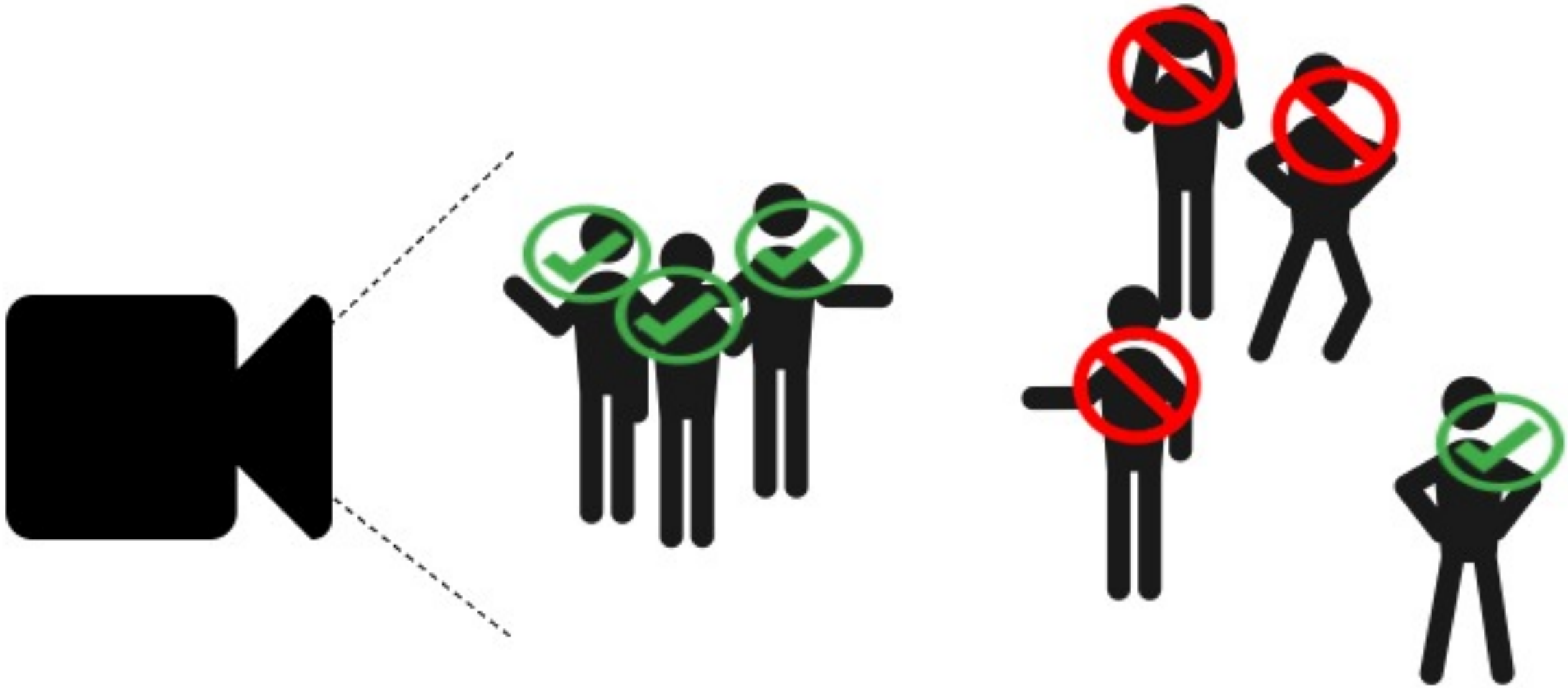




# How can privacy preferences be communicated towards (wearable) cameras?

… in situations where people are **constrained in what they can carry or wear?**

5

# Existing approaches

- No mass-market solution available
- Approaches from related literature
  - not applicable in such a scenario
  - intrusive
  - do not meet the context-dependent nature

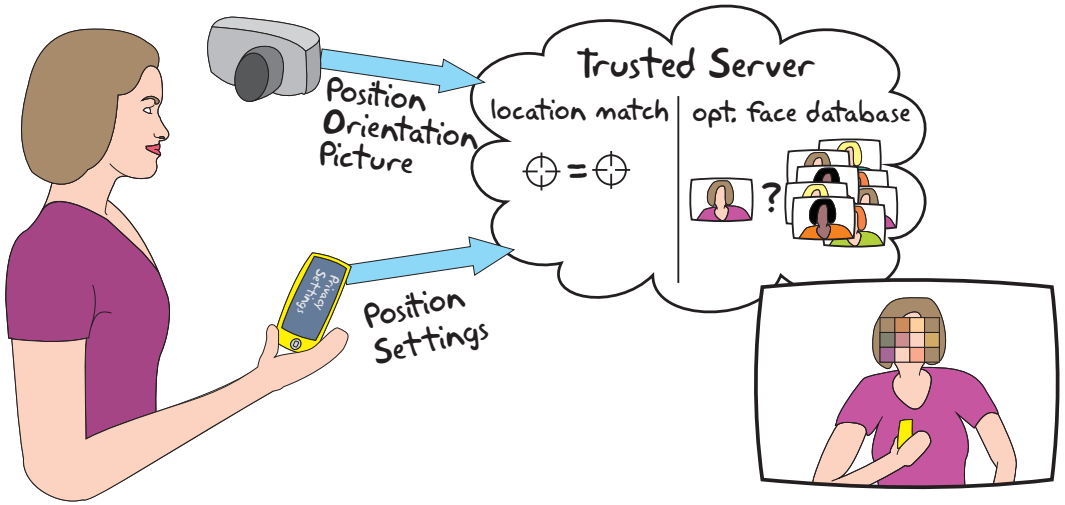
# Methodology

- Define 3 conceptual (“meta-”) PETs from related work
- Conduct qualitative interviews in the public places
  - Beach
  - Café
- Google Glass served as example technology to provoke participant reactions

# Conceptual PETs

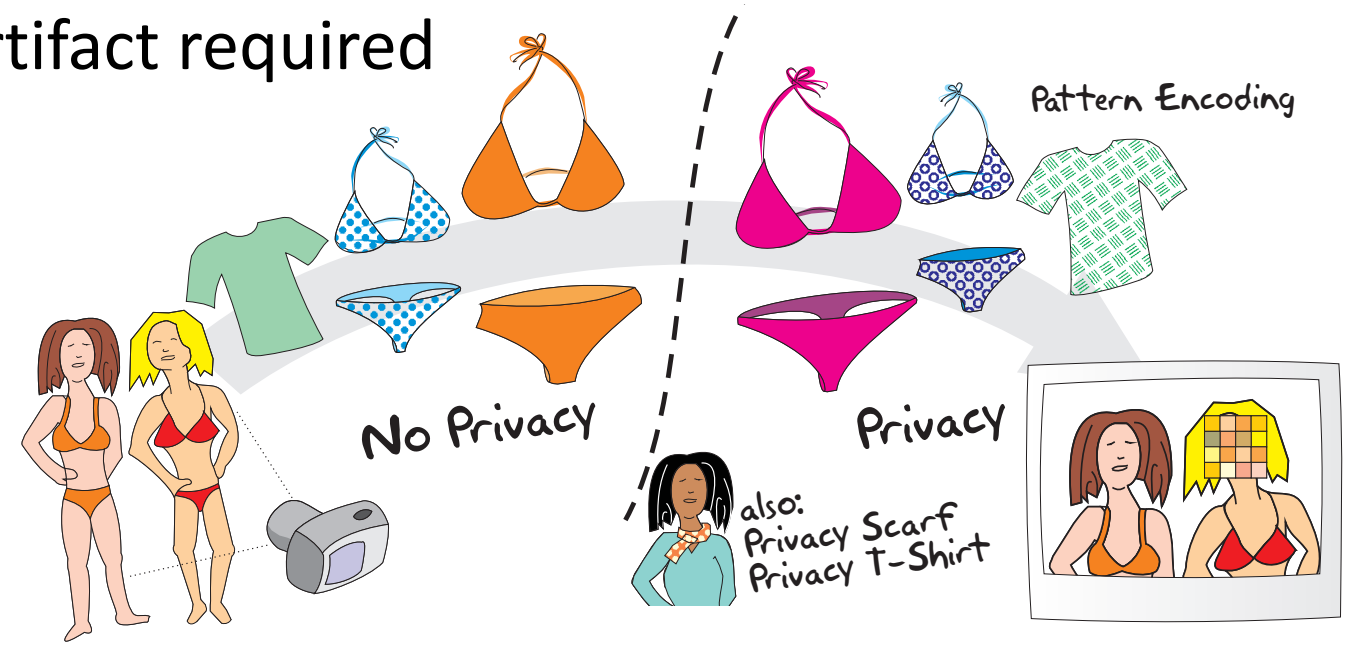
# Privacy App

- based on SnapMe [1], and Faceblock [2]
- Uploads pictures to a centralized service
- Individuals on pictures are identified via co-location and (optional) face recognition



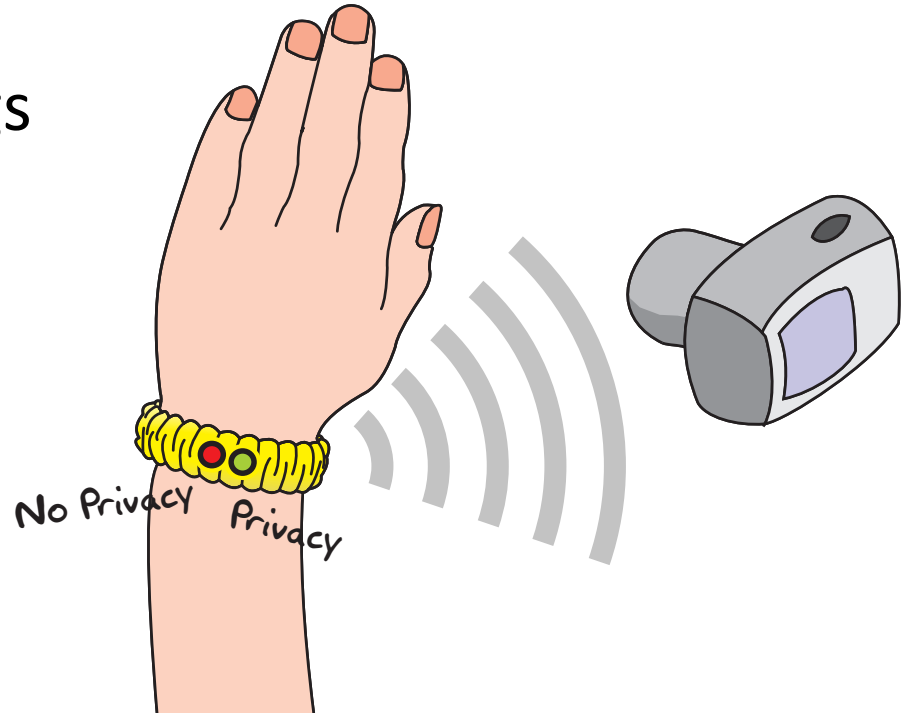
# Privacy Fabric

- based on *Respectful Cameras* [3] and P3F [4]
- Fabric patterns to encode privacy policies
- Pattern recognition
- No digital artifact required



# Privacy Bracelet

- half-way point between app and fabric
- served as middle ground during interviews to contrast between the other two
- bracelet with a button
- emits signal to cameras in the surroundings



# User Study

# User Study

- Field sessions (beach/café)
- Qualitative semi-structured interviews
- 20 participants
  - 9 male, 11 female
  - age: 19-42, median: 25
  - no participant was working in an IT-related field!

# Results

# Technology Familiarity

- Everyone had a rough idea of Google Glass
- 17 participants immediately associated a camera with the device

# Privacy Considerations

- Discomfort and irritation(12)
- Am I being recorded? (11)
- Vexation, concerned about mass surveillance (6)

*"If someone wore it [Google Glass] in front of me, I'd definitely ask him to take it off."* (P13)

# Privacy Considerations

- neutral feeling, have gotten used to cameras, but context is important (8)

*"In general, I don't really care about privacy. But I would not want to be filmed drinking during a party."* (P17)

*"[…]. Maybe Glass performs face recognition in the background and transmits the information about the recorded people to the NSA. This would make every Glass-wearer an unintended little helper of the NSA."* (P19)

# PETs Preferences

| Privacy App | Privacy Fabric | Privacy Bracelet |
|---|---|---|
| 4 | 2 | 13 |
| 2€ | Common clothing price | 10-200€ |

→ No trend differences (beach/cafe)!

# PETs Preferences (and Concerns)

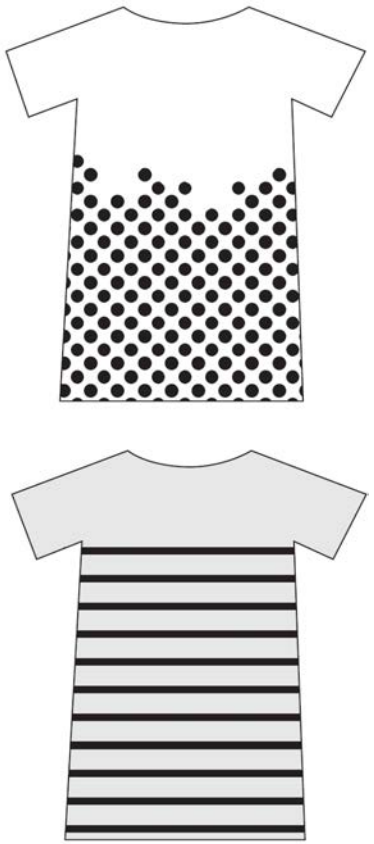
- Bracelet
  - Ease of use, convenience, visibility
  - Does not require smartphone, OSN
- App

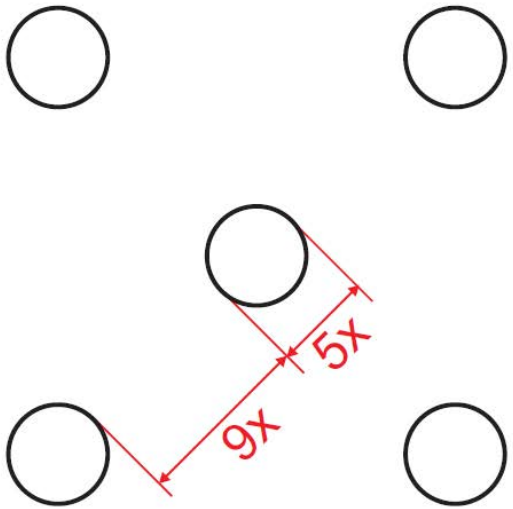
> *"The server behind the app bothers me just as much […]."* (P15)

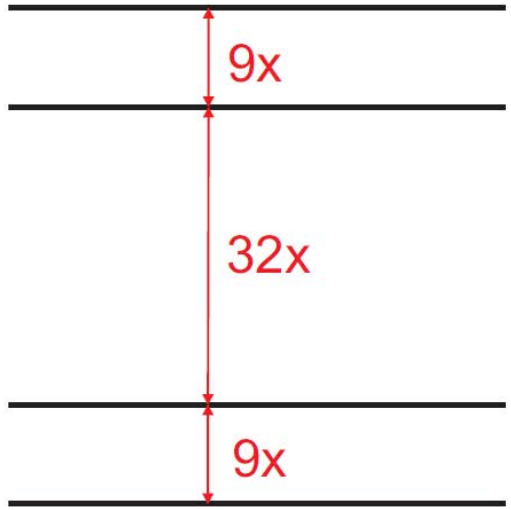
- Fabric
  - Personal styling preferences
  - Difficult to adjust to the context
  - Little understanding of how this could work

# Discussion

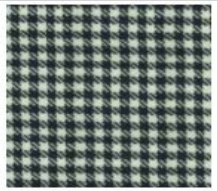
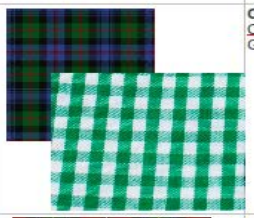
# P3F.at

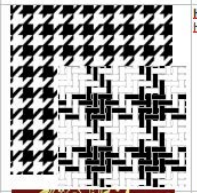
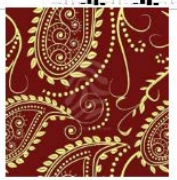
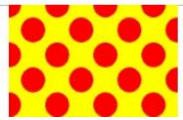




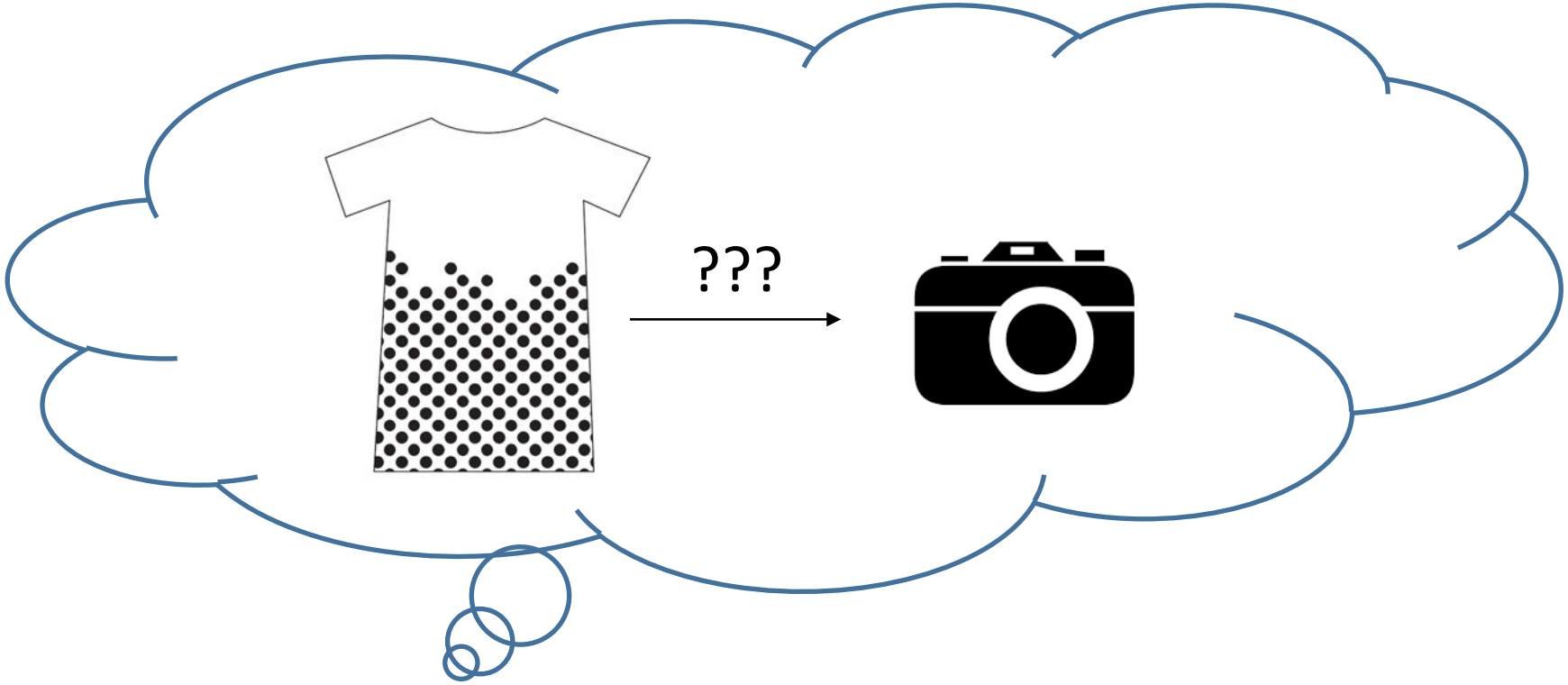
# P3F.at

| Beispiel | Name | Produktionsart | Muster-Encoding | Watermarking |
|---|---|---|---|---|
| | **Argyle**<br>Burlington-Karo | gewebt | Farben: zerstört geometrie<br><br>Streifendicke: stört Geometrie erheblich | |
|  | **Border Tartan**<br>(Shepherds' Plaid, Border check, Border Drab, and Northumbrian tartan) | gewebt | Farben: oft nur zweifärbig<br><br>Dicke: zerstört Geometrie | |
|  | **Check,**<br>Chequer, Vichy, Gingham | gewebt | Farben: oft nur zweifärbig<br><br>Dicke: zerstört Geometrie | |
| | **Plaid ('Plad'), Tartan** | gewebt | Farben: viele Mischfarben entstehen – passende Farbtupel sind schwer automatische zu generieren.<br><br>Dicke: zerstört in vielen fällen die Geometrie | |
| | **Camouflage** | print | Wesen des Musters ist es, Gleichmäßigkeiten zu zerstören. Damit ist die Kodierung (Delta zwischen Gleichmäßig und Ungleichmäßig) besonders schwierig | Watermarking schwierig |

| | | | | |
|---|---|---|---|---|
| | **herringbone**<br>Fischgrät, Chevron | gewebt | Supergleichmäßig – lebt davon | |
| | **Chevron** (manchmal ebenfalls Fischgrät, Herringbone) | gedruckt | Fabkodierung evt möglich, Strichdicke: evt möglich<br><br>Kodierungstechnisch eine Untermenge der Streifenmuster, da aus dem Grätmuster selbst keine Kodierung zu bauen ist. | |
|  | **Houndstooth**<br>Hahnantritt | gewebt, gestrickt | Geometrisch kaum veränderbares Muster | |
|  | **Paisley**<br>Persian pickles, Welsh pears, mango seeds, cypress tree | gewebt, print, gestickt | sehr kleinteilig, geringe Gleichförmigkeit | Mögliches Ziel für Watermarking |
| | **Toile de Juoy**<br>Toile | print | Kaum Wiederholungen oder Gleichmäßigkeiten, Synchronisationsproblem | Mögliches Ziel für Watermarking |
|  | **Polka Dots**<br>Mizu Tama, Polka<br><br>Sehr viele Varianten! | Print, (gewebt) | Variantenreichtum (Punktegröße, Farben) erleichtert das Kodieren, wobei Punkteabstände nur auf Flachen gegenständen funktionieren und eigentlich das Wesen des Musters zerstören. | |

# P3F.at

- Technically feasible (we implemented a matlab prototype)
- BUT: users do not understand how the communication between the camera and the fabric works and therefore have little trust.



# Photographer vs. Bystander

- Participants were allowed to try the device
- … and they liked it.
- Privacy concerns vanished!

# Feasibility Considerations

- “Recht am eigenen Bild” → Right of persons to their own image representation
- Legal foundation
- Robots.txt

# Beyond visual recording

- Smart environments, smart home, industry 4.0
- Sensors are everywhere!!

# Take-Home Message

- PETs should work regardless of a specific location (beach is a challenging environment!)
- Sense of control: a simple button to push
- Technical feasibility vs. user acceptance

# Questions?

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