Privacy User Interfaces for Intelligent Retail Stores

Frederic Raber   frederic.raber@dfki.de

DFKI, 66123 Saarbrücken

DFKI
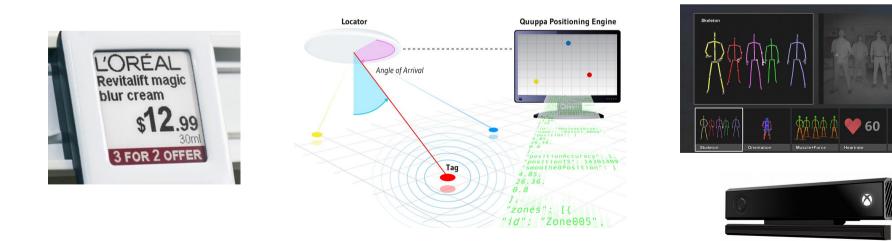German Research Center for Artificial Intelligence

Motivation

Privacy problems are all around us:

- Public video surveillance

- Smartphones

- Wearables

- Smart homes

- **Intelligent retail stores**

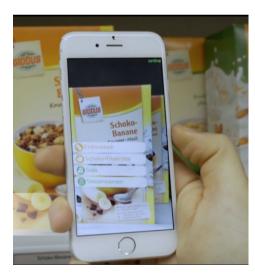# Intelligent retail stores

What is an intelligent retail store?

➔ Store equipped with
  ➔ Sensors (RFID tags, video/depth camera, tracking systems) and
  ➔ Actuatotors (displays, ESLs, illumination systems, customer smartphones)

➔ Recording information about shopping process, like picked-up products, shopping route, items in the shopping basket etc.
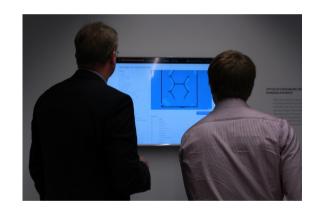
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Intelligent retail stores

What is an intelligent retail store?

→ Allows to offer customer services

Product lens

In-store analytics

„Invisible checkout"

Intelligent retail stores

Does it exist?

➜ Several pilot stores:

- ➜ Amazon go, about to be rolled out in UK and France
  http://t3n.de/news/supermarkt-amazon-go-paris-863506/

- ➜ Innovative Retail Lab
  http://www.innovative-retail.de/

- ➜ Edeka Future Store

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Intelligent retail stores

The big drawback:

Massive collection of personal data

No possibility to allow / deny collection of parts of the data

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Intelligent retail stores – Special issues

- Stakeholders interested in the data are highly diverse (retailer, friends, family, third parties like marketing agencies / social networks)

- Data items are very diverse, so is the perceived privacy desire for each of them
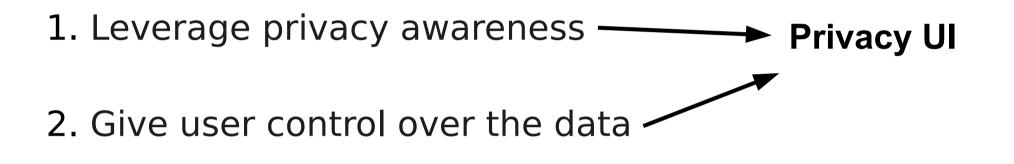
Overview

How to solve this problem?

1. Leverage privacy awareness

2. Give user control over the data

3. Assist user while doing
   privacy settings

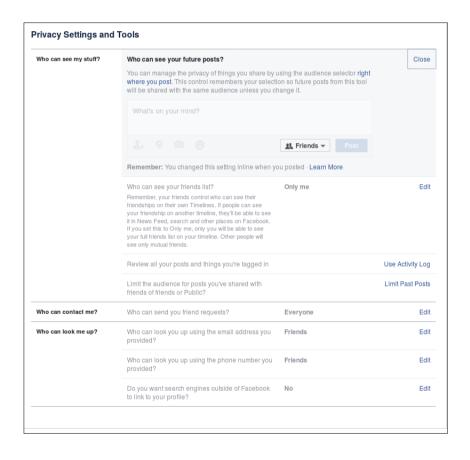Privacy User Interfaces for Intelligent Retail Stores

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Overview

How to solve this problem?

1. Leverage privacy awareness   ⟶   **Privacy UI**

2. Give user control over the data ⟶ **Privacy UI**

3. Assist user while doing
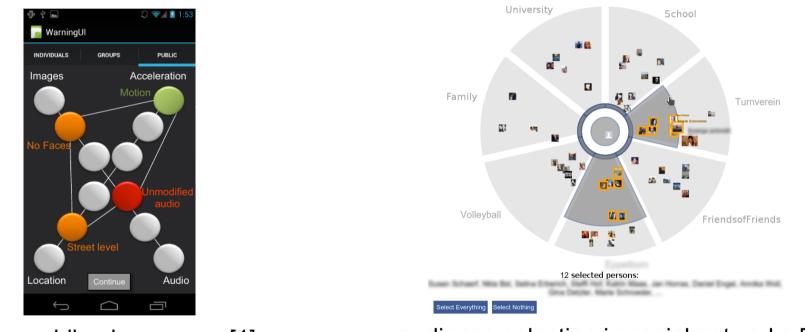   privacy settings   ⟶   **Privacy management system**

Privacy UI - Concept

Current standard: List-based UI

Privacy UI - Concept

Better: Radar metaphore

.. for mobile phone apps [1]

.. audience selection in social networks [2]

[1] D Christin et al.: Raising User Awareness about Privacy Threats in Participatory Sensing Applications through Graphical Warnings
[2] F Raber et al.: Privacy Wedges: Area-Based Auditory Selection for Social Network Posts

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Privacy UI - Questions

Can we design a privacy UI based on a radar metaphore for intelligent retail data?

➜ Which data is recorded in an intelligent retail store?

➜ How can this data be clustered?

➜ Can the clusters be ordered?

How can we cope with the special difficulties that arise in the domain of intelligent retail data?

Does a radar-based UI perform better than a conventional list-based UI?

Privacy UI - Questions

Can we design a privacy UI based on a radar metaphore for intelligent retail data?

➔ Which data is recorded in an intelligent retail store?

➔ How can this data be clustered?

Background study

➔ Can the clusters be ordered?

How can we address the special difficulties that arise within privacy of intelligent retail data?

Does a radar-based UI perform better than a conventional list-based UI?

Evaluation study

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Privacy UI – Background study

Which data is recorded in an intelligent retail store?

→ Expert interview with a member of the Innovative Retail Laboratory

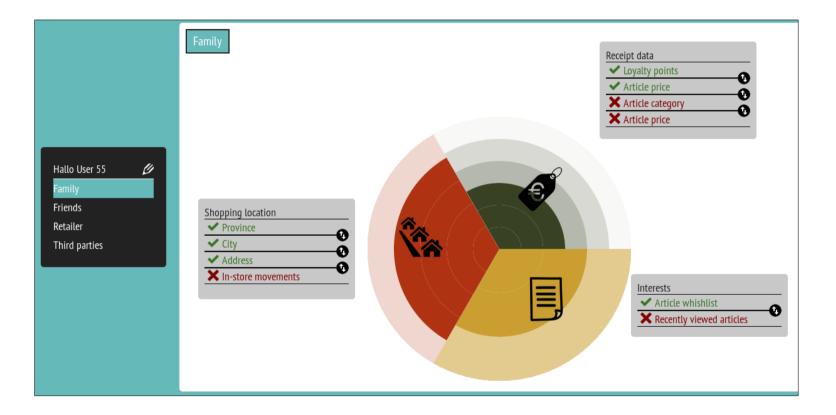| Service	Data	Used by		Stakeholders
		IRL	Amazon	
"Invisible" Checkout	- Address - Birthday - Name - Recent visits - Recently viewed - Bought products: - Category - Amount - Price - Loyalty	X	X	Retailer, Friends, Family
Digital shopping list	- Wishlist	X		Retailer, Friends, Family
Customer heatmap/flow	- Location	X	?	Retailer
Allergy advisor	- Allergies	X		Retailer, Third Parties (Insurance)
Product recommender	- Nutrition - Income	X	?	Retailer, Third Parties (Targeted Ads)

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How can we cluster the data? Can they be ordered?

→ Small-scale user study (5 participants)

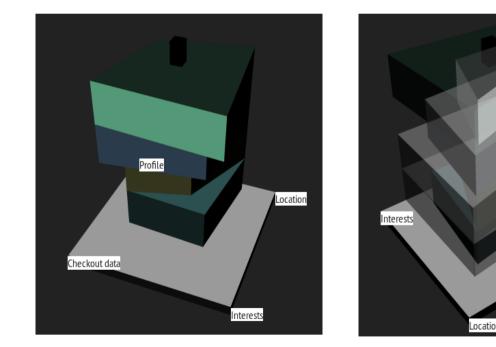|		P1	P2	P3	P4	P5	Rank
Personal Data	Address	3	4	3	4	4	
	Birthday	3	1	2	3	2	
	Name	3	2	2	4	4	
	Income	5	3	3	4	3	
	Gender	3	1	2	3	2	
	Education	3	3	3	4	4	
Location data	Recent visits						
	- Province	1	1	2	3	3	1
	- City	2	2	2	3	3	2
	- Address	3	2	3	4	3	3
	Movement	4	1	2	3	3	4
Shopping Receipt	Loyalty points	1	2	3	3	2	1
	Items bought						
	- Amount	4	3	3	2	3	2
	- Category	3	3	3	3	2	3
	- Price	3	2	3	3	2	4
Interests	Wishlist	1	3	3	3	2	1
	Recently viewed	2	3	3	3	2	2

No order :(

Privacy UI – Initial design

Privacy UI – Special difficulties

Highly diversive nature of stakeholders

→ Hard to have overview over multiple radars!
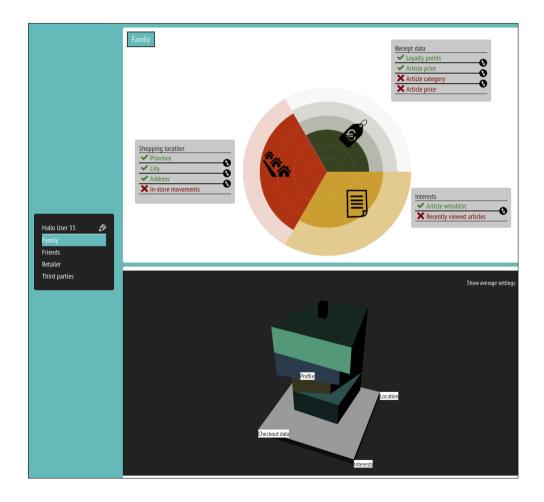How to spot errorneous/unusual privacy settings?

- „Privacy Pyramid"

- 3D radar UI

- Easy to spot differences to an average privacy profile

Privacy UI – Final design

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Privacy UI – Final design

URetail: Privacy User interfaces for Intelligent Retail Stores

Privacy UI – Evaluation

Is the radar-based UI better than a list-based UI?

→ Do users understand how to use the UI and the pyramid?
→ Are the clusters and orders correct?
→ Is the UI perceived to be more efficient?
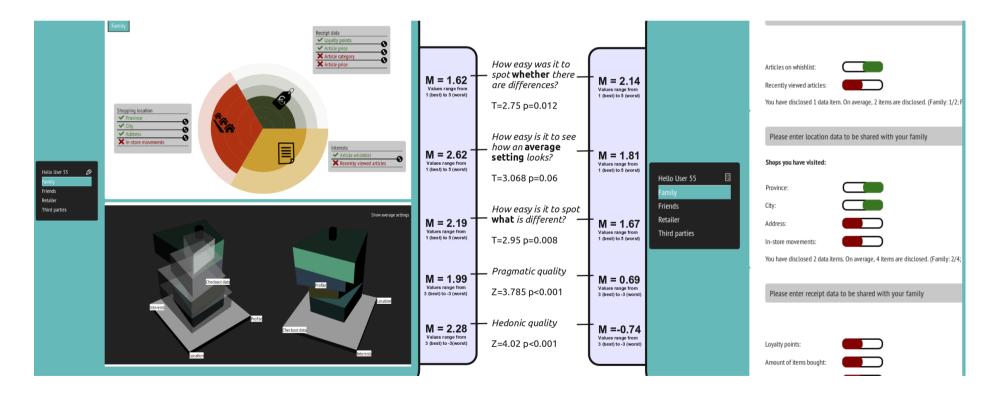→ Is the user experience better compared to a list-based UI?

→ User study (21 participants), aged 17 – 52 (avg. 31.19)

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Privacy UI – Study design

- Within-Subject design

- Subjects set their retail privacy settings using radar or list-based UI

- Attrakdiff questionnaire and additional questions after each condition:

  - It was easier for me to spot...
    - whether there are unusual settings
    - how many are unusual
    - which settings are unusual
    - what an average value is
    - how much the difference is

  - I found the visualization to be..
    - clear
    - visually appealing
    - fun to use

Privacy UI – Study results

- Only 11 out of 20 subjects clicked single items, on average 2 times
- 3 participants rearranged the items, on average 2 times
→ clusters and orders seem to be correct

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Privacy UI – Discussion & Future work

- Both pragmatic and especially hedonic score clearly higher for the radar interface

- Interaction time similar for both Uis
    - → Training phase needed for radar interface

- Radar interface better for most tasks, but not for all of them
    - → Use combination of radar- and list-based interface in future version?

- Some of the subjects disclosed more items to the retailer, as it is an impersonal subject for them

- Some mentioned that the level of disclosement depends on the product bought

Conclusion

- Intelligent retail stores collect a large amount of sensitive private data

- Stakeholders as well as perceived sensibility of data is very diverse

- URetail uses an advanced „three-dimensional" radar metaphore

- Evaluation results indicate a better usability and user experience

- Best results might be achieved with a combined interface

- Subjects suggested new ideas for inferring privacy settings, based on how the item bought is perceived by others

Thank you :)

Contact:

Frederic Raber
DFKI, Saarland Informatics Campus, Building D3.2
66123 Saarbrücken
Frederic.raber@dfki.de