Privacy-Patterns for IoT Application Developers

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1 Motivation

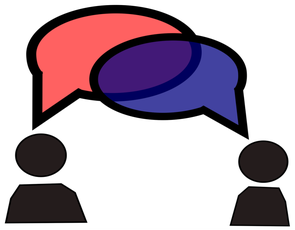
- IoT apps typically collect and analyse personal data categorised as sensitive which may be subject to a higher degree of protection under data privacy laws.
- Privacy concerns for app design or implementation are rarely discussed by developers.
- There are limited tools to assist developers' privacy learning.
- **PARROT**, an interactive IoT application design tool, is supplemented with different techniques to help increase developers' privacy awareness.

2 Methodology

Qualitative user research:

1. 12 semi-structured interviews.

2. 6 IoT application design tasks.
3. Discussion session with participants to explore how they integrate privacy and how PARROT could help.



3 Design tasks

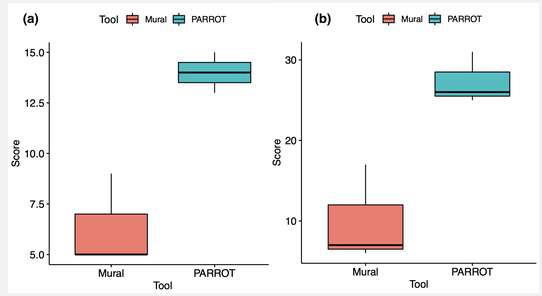
- Between-subjects study.

Privacy measures:

- **6** privacy by design principles.
- **20** privacy patterns.

1. Use of dummies	11. Data breach notification
2. Location granularity.	12. Privacy dashboard
3. Minimal information asymmetry	13. Added-noise obfuscation
4. Asynchronous notice	14. Increasing aggregation awareness
5. Privacy policy display	15. Privacy awareness panel
6. Outsourcing [with consent]	16. Obtaining explicit consent
7. Onion routing	17. Informed implicit consent
8. Anonymity set	18. Who's listening
9. Pseudonymous identity	19. Sticky policies
10. Privacy icons	20. Lawful consent

4 Results

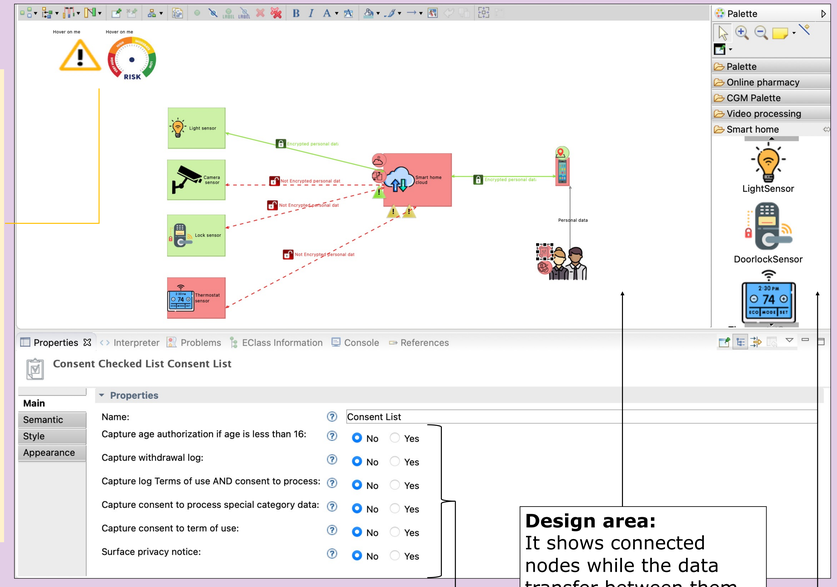


(a) Mean rates of privacy principles scores in Mural and PARROT. (b) Mean rates of privacy patterns scores in Mural and PARROT.

5 What do you expect from PARROT?

"I definitely struggle to understand and apply privacy and privacy patterns because there are many different documents, laws and IoT devices... PARROT will tell you already what privacy needs to be fulfilled for that node which is super useful, in my opinion...you don't have to start researching about it" (Pair 4).

PARROT design:



Circular shape reflects privacy-by-design requirement

Triangular shape represents best practices that not part of privacy by design.

Design area: It shows connected nodes while the data transfer between them.

Privacy configuration area: The questions are a combination of direct and indirect ones to make sure developers read and understand their choices.

Palette area: It enables developers to drag, drop and connect nodes.

6 What is the legal perspective?

PARROT is able to include privacy-specific design components into the IoT application "from the beginning rather than retrospectively" (lawyer).

7 What does PARROT offer to you?

- "The questions help me to think more about the data subject perspective, not the problem owner only" (Pair 5).
- "The generated colours are helpful to flag any privacy issue immediately... I think it helps to rethink the question again" (Pair 2).

8 Conclusion

The participants demonstrated how an assistant tool helps to embed privacy principles and increases their awareness of privacy patterns.

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