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Master's Dissertation

Privacy in the Internet of Things: Fostering User Empowerment through Digital Literacy

Nelson Vieira
Orientation Mary Barreto

University of Madeira
Faculty of Exact Sciences and Engineering

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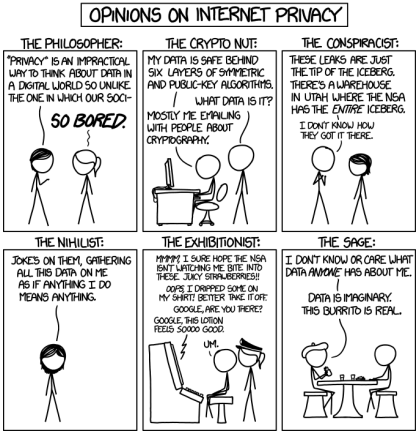
What is privacy?

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↑        @@ -42,1 +42,1 @@
42  - Privacy
42  + Security
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Introduction

Internet of Things (IoT) devices are everywhere. These devices create new ways of collecting and process personal data from users and non-users. Most end users are not even aware or have little control over the information that is being collected by these systems.
This work takes an holistic approach to this problem by doing:

- Systematic literature review;
- A survey;
- A mobile application.

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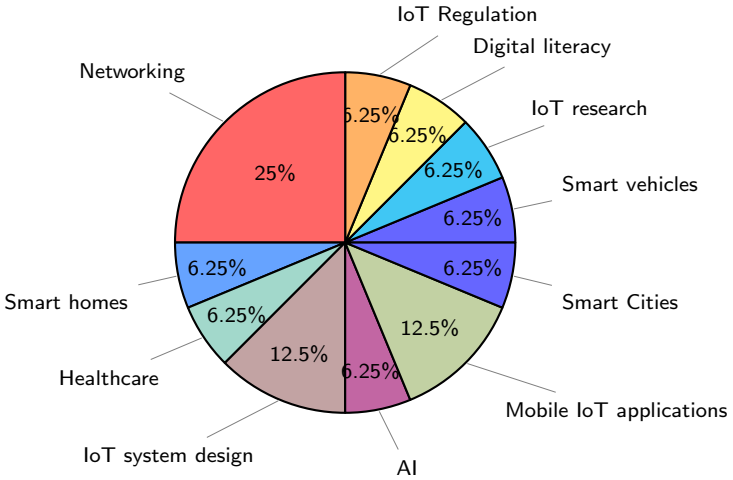

Figure 1: Distribution of literature per IoT domain. (Chapter 6.1, p.67)

State of the Art

There are two main ways to provide privacy in IoT systems:

- Through security [1, 2, 3, 4];
- Privacy notices [5, 6];

Legislation or a framework/architecture mainly fall into one these two categories.

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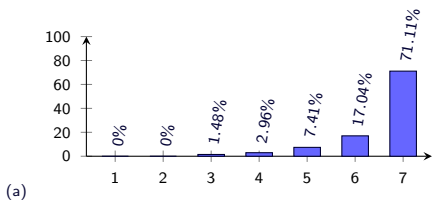
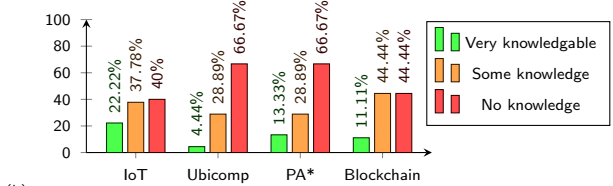
Survey

86 Questions

- General knowledge and attitudes towards privacy
- Disposition for sharing personal information
- Privacy concerns
- Current online habits and practices
- Profile identification
- Knowledge and habits regarding the Internet of Things
- Demographic data



(a)

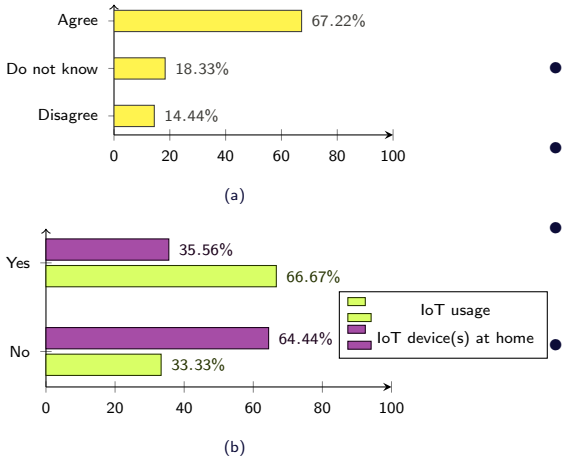


(b)

- High regard for privacy, with some caveats;
- Some difficulty understating digital privacy;
- Low literacy of technical jargon;

*PA - Privacy Assistant

Figure 2: Participant responses regarding: (a) participants' privacy importance perception and (b) general IT knowledge. (Chapter 5.1, p.49/51)



- Dismissal of privacy notices due to various factors;
- Some individuals use fake private data online;
- Some interaction with Internet of Things devices but low knowledge generally;
- Low grasp of IoT privacy;

Figure 3: Participant responses regarding: (a) unwillingness to read privacy notices and (b) IoT usage. (Chapter 5.1, p.55/58)

Application

What can the application do?

- Show the geolocation of the IoT devices;
- Information about the devices, like category, collection purpose, stored time, owner, etc.;
- Information about IoT privacy;
- Addition and editing of device's information.

Demonstration

Future Work

- Privacy literacy in IoT systems;
- Application of privacy in the design/development of IoT systems;
- Interoperability standards;
- User-centric approaches to IoT privacy.

Conclusion

- Standalone IoT privacy literature review;
- Tests from majority viewpoint of portuguese users;
- User testing reveals there is a large privacy knowledge gap;
- Application that aims to increase IoT privacy literacy.

Article submissions

- Submission to EURASIP Journal on Information Security, under special issue: Multimedia Security and Privacy Protection in the Internet of Things (IoT) - *Currently under review*
- Submission to e-Society 22nd International Conference 2024 - *Currently under review*

Thank you for your attention.

References I

Y. Zhao, J. Zhao, M. Yang, T. Wang, N. Wang, L. Lyu, D. Niyato, and K.-Y. Lam, "Local differential privacy-based federated learning for internet of things," *IEEE Internet of Things Journal*, vol. 8, no. 11, pp. 8836–8853, 2020.

Q. Zhang, L. T. Yang, Z. Chen, P. Li, and M. J. Deen, "Privacy-preserving double-projection deep computation model with crowdsourcing on cloud for big data feature learning," *IEEE Internet of Things Journal*, vol. 5, no. 4, pp. 2896–2903, 2017.

M. S. Ali, K. Dolui, and F. Antonelli, "IoT data privacy via blockchains and ipfs," in *Proceedings of the Seventh International Conference on the Internet of Things*, ser. IoT '17. New York, NY, USA: Association for Computing Machinery, 2017. [Online]. Available: https://doi.org/10.1145/3131542.3131563

References II

Q. Sun, K. Lin, C. Si, Y. Xu, S. Li, and P. Gope, "A secure and anonymous communicate scheme over the internet of things," *ACM Trans. Sen. Netw.*, vol. 18, no. 3, apr 2022. [Online]. Available: https://doi.org/10.1145/3508392

Y. Feng, Y. Yao, and N. Sadeh, "A design space for privacy choices: Towards meaningful privacy control in the internet of things," in *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, ser. CHI '21. New York, NY, USA: Association for Computing Machinery, 2021. [Online]. Available: https://doi.org/10.1145/3411764.3445148

A. Das, M. Degeling, D. Smullen, and N. Sadeh, "Personalized privacy assistants for the internet of things: Providing users with notice and choice," *IEEE Pervasive Computing*, vol. 17, pp. 35–46, 07 2018.