Improving Participatory Sensing Using Fog Computing Co-Design

Farzam Fanitabasi*
Chair of Computational Social Science, D-GESS, ETH Zurich

**This poster reflects on the research done while author with the ICT section, ESS Department, TPM Faculty, TU Delft*
Supervisory Team: Prof. Dr. Y. Tan, Prof. Dr. D. Helbing, Dr. A. Teixeira (until April 2017)
1 April 2016 - 15 March 2018

1 Context

The inherent openness of the participatory sensing platforms does come with its own disadvantages. Due to the fact that data comes from the devices participants and almost everyone can join the networks. This, coupled with the regular incentives (maybe monetary) that are considered for the participants, lead to inaccurate, or sometimes falsified, data entering the network.

2 Research Problem

In general, the problem of providing "good" data to users and applications is an inherently difficult problem which often depends on the application and data semantics as well as on the current context and situation. In many cases, it is crucial to provide users and applications not only with the needed but with also an evaluation indicating how much the data can be trusted. Therefore a critical requirement is the ability to assess the trustworthiness of data so to be able to discard untrustworthy data, execute recovery operations to correct data, and strengthen defense measures.

In this research, we attempt to research the trust, reputation, and the associated risk aspect of such systems when it comes to data collection, selection of trustworthy data sources, and analysis. For this, due to it's well-founded transaction structure, cyclic feedback loop, and simplicity of implementation, we use graph theory, and in particular, integrity models as our main way of mapping, calculating, and tracking the ever-changing dynamics of reputation and trust in participatory systems.

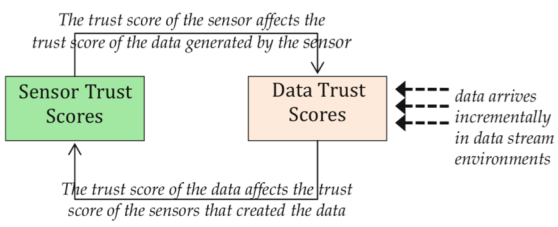

Figure 1: Interdependency between the data and sensor trust scores[2]

3 Developed Model

In the case of reputation systems for participatory sensing, the research, knowledge gap analysis, and finding concluded the need and benefits of a multi-attributed reputation system. This is due to the fact the on social systems, which participatory systems can be categorized in, the trust is not just a one-dimensional number. This notion of trust is case-dependent, activity related, and in addition to the past behavior of a given node, depends on current links and the risk-taking preference of the trusting node. For this purpose, a conceptual framework for multi-attributed, time-dependent, and activity correlated reputation system was developed, based on the social and trust theories.

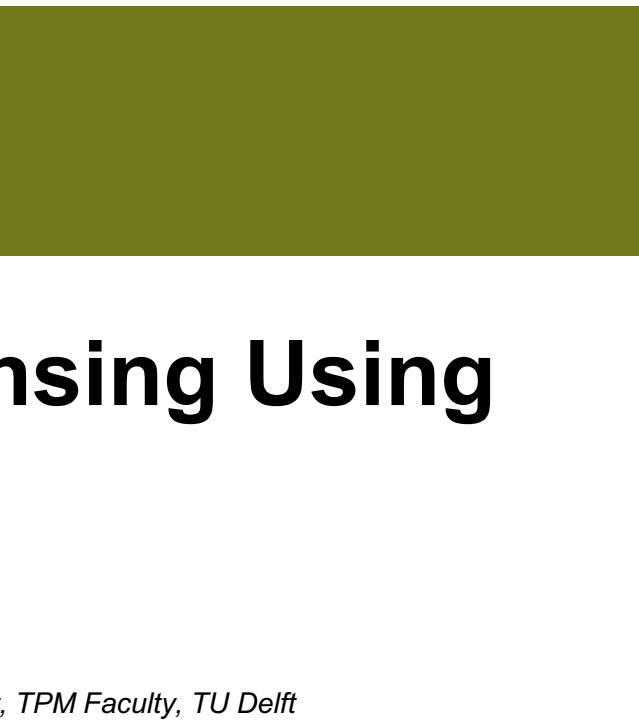

Fig. 2. Developed framework for multi-attribute reputation in PS

Theoretical Framework

1. A unified definition of PS which incorporates the innate ambiguity in data collection and certification processes.
2. Characteristics of a PS node in regard to its functions and relations to other nodes, both in data collection and trust management. This would be used for developing a multi-attribute trust profile for the node.
3. Mapping the relevant attack and threats of classic RS in PS and also designating the new attack models and their impact that arise with the adoption of RS systems in PS.
4. Study and summarizing the requirements, desired functionalities, and systems design of RS in PS.

5 Design and implementation

1. Design a conceptual multi-attribute reputation framework for PS. This framework should be able to define, weight, and select the appropriate reputation attributes (dimensions) based on the context and application.
2. System design and implementation of a P2P reputation system for PS, while considering the previously found theoretical backgrounds.

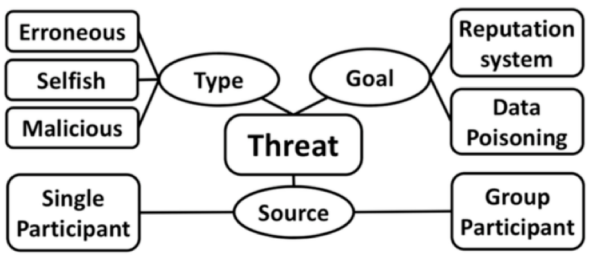

Figure 3: Threat model, reputation systems in participatory sensing

6 References

[1] NervousNet Vision, url = http://futurict.blogspot.nl/2016/01/nervousnet-towards-open-and.html, note = accessed: 2017-03-19.

[2] Elisa Bertino. Data trustworthiness—approaches and research challenges. In *Data privacy management, autonomous spontaneous security, and security assurance*, pages 17–25. Springer, 2015.

[3] Elisa Bertino and Hyo-Sang Lim. Assuring data trustworthiness-concepts and research challenges. In *Workshop on Secure Data Management*, pages 1–12. Springer, 2010.

[4] Jeffrey A Burke, Deborah Estrin, Mark Hansen, Andrew Parker, Nithya Ramanathan, Sasank Reddy, and Mani B Srivastava. Participatory sensing. *Center for Embedded Network Sensing*, 2006.

[5] Andrew T Campbell, Shane B Eisenman, Nicholas D Lane, Emiliano Miluzzo, and Ronald A Peterson. People-centric urban sensing. In *Proceedings of the 2nd annual international workshop on Wireless internet*, page 18. ACM, 2006.