

Techniques for Eliciting IoT Requirements: Sensorina Map and Mind IoT

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Abstract. *The Internet of Things (IoT) comprises devices that communicate and process data over the Internet. Requirement elicitation in IoT systems is crucial but faces challenges such as heterogeneity, interoperability, scalability, and requirements volatility. This work introduces two new techniques to support this phase: the Sensorina Map, inspired by the Empathy Map, and Mind IoT, based on the Mind Map. We conducted two empirical studies in an academic setting to assess the viability of these techniques. The first study evaluated ease of use and effectiveness in helping engineers recall requirements, utilizing a Focus Group to gather perceptions. The second observational study assessed the techniques' utility and ease of use. Results indicated that these methods are viable and can significantly contribute to IoT systems research and practice, benefiting professionals and researchers.*

Resumo. *A Internet das Coisas (IoT) envolve dispositivos que comunicam e processam dados pela Internet. A elicitação de requisitos em sistemas IoT é crucial, mas enfrenta desafios como heterogeneidade, interoperabilidade, escalabilidade e volatilidade de requisitos. Este trabalho apresenta duas novas técnicas para apoiar essa fase: o Mapa Sensorina, inspirado no Mapa de Empatia, e o Mind IoT, baseado no Mapa Mental. Dois estudos empíricos foram realizados em um ambiente acadêmico para verificar a viabilidade dessas técnicas. O primeiro estudo avaliou a facilidade de uso e a eficácia em ajudar engenheiros a lembrar requisitos, utilizando um Focus Group para coletar percepções. O segundo estudo observacional avaliou a utilidade e a facilidade de uso das técnicas. Os resultados mostraram que os métodos são viáveis e podem contribuir significativamente para a pesquisa e prática em sistemas IoT, beneficiando tanto profissionais quanto pesquisadores da área.*

1. INTRODUCTION

The advancement of IoT has brought new challenges for requirements engineering (RE) due to the heterogeneous, interoperable, and volatile nature of IoT systems. In this context, conventional RE methods may not adequately capture and express the diverse needs and information necessary to develop IoT systems. In response, industry professionals

and researchers have sought to propose or adapt traditional methods to enhance IoT systems' design and ensure the final product's quality.

In this context, this work proposes two techniques: the Sensorina Map and Mind IoT. The Sensorina Map is an adaptation of the Empathy Map, aimed at mapping the interactions between the sensors within the IoT system, identifying the information collected and the possible actions derived from the data. Mind IoT aims to support software engineers in visualizing information, facilitating the identification of specific points that might go unnoticed or be overlooked. These techniques can be used in combination or separately, depending on the project's needs, and are designed to be adaptable and flexible to accommodate changes in requirements. The techniques involved two stages: an exploratory study and a theoretical foundation. The exploratory study Souza et al. 2022 analyzed the suitability of DT techniques in eliciting requirements for IoT systems and identifying their benefits. The theoretical foundation, based on Motta et al. 2023, considers the actors' diversity, the systems' dynamic nature, technological changes, and evolving user needs.

2. Methodology

Our work was based on Shull et al. 2001. They encompassed the proposed techniques' definition, evaluation, and refinement. These techniques were refined after each experimental study, incorporating feedback and improvement suggestions to enhance the robustness of the methods and ensure alignment with the research objectives.

3. Conclusion

In the present text, we abstract the article Souza et al. submitted in the Journal of Systems and Software. This work aimed to assist software engineers in gathering IoT system requirements by developing two techniques: the Sensorina Map and Mind IoT. Inspired by Design Thinking, these techniques were validated through feasibility and observational studies. Users found them useful and easy to use, though some refinement is needed. We expect the Sensorina Map and Mind IoT to aid in improving IoT system quality during early software development stages.

References

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