Universidade de Pernambuco (UPE)
Escola Politécnica de Pernambuco (POLI)
Instituto de Ciências Biológicas (ICB)

Coordenação de Pós-Graduação em Engenharia de Sistemas

Proposta de Dissertação de Mestrado

Área:	Cibernética
Linha de Pesquisa:	Modelagem e simulação de sistemas inteligentes e embarcados
Título Provisório:	Improving Indoor Localization of Industrial Workers Using Bluetooth Low Energy and Machine Learning-Based Signal Filtering
Orientador:	Gilberto Dênis de Souza Leite Filho (POLI-UPE)
Co-orientador:	Emmanuel Andrade de Barros Santos (POLI-UPE)

Descrição:

The accurate localization of workers in industrial environments is a critical enabler for safety management, productivity monitoring, and real-time decision support. Real-Time Location Systems (RTLS) based on Bluetooth Low Energy (BLE) beacons are an attractive solution due to their low power consumption, low cost, and compatibility with existing mobile devices [4][3]. However, BLE signals are highly susceptible to attenuation and multipath effects caused by walls, columns, machinery, and moving artifacts in factories, which leads to significant uncertainty in position estimates [1][2].

This research project aims to design and evaluate an RTLS framework for industrial worker localization using BLE, addressing these challenges by integrating signal filtering and machine learning (ML) methods. The project will explore approaches such as Kalman filters and adaptive filtering to mitigate random fluctuations in Received Signal Strength Indicator (RSSI) values [5]. In addition, trilateration techniques combined with machine learning models will be applied to improve accuracy by learning patterns of signal distortion under different spatial and environmental conditions [6].

The novelty of the project lies in combining signal processing techniques with data-driven learning strategies to enhance robustness and precision in complex industrial settings. A testbed will be implemented in a representative industrial environment, where BLE beacons will be deployed, and worker mobility data will be collected for training and evaluation. Performance will be assessed in terms of positioning accuracy, robustness to obstacles, and computational efficiency, providing guidelines for scalable deployment.

The expected contribution of this research is a practical and cost-effective RTLS solution that increases the resolution and reliability of worker localization in industrial environments. This work will help overcome key barriers for BLE adoption in factories, enabling safer and more efficient human–machine collaboration.

Do Candidato: Engenharia de Controle e Automação, Engenharia de Computação, Engenharia Eletrônica, Engenharia Mecânica, Engenharia de Materiais, Bacharelado em Física, Engenharia Física, e áreas afins.

Referências Bibliográficas:

[1] Marchi, B. (2023). *Indoor Positioning with Bluetooth Low Energy Beacons*. PhD Thesis, Università degli Studi di Trento.

[2] Novais, R. (2022). *Indoor Positioning Systems Using Bluetooth and IoT*. MSc Dissertation, Instituto Superior Técnico, Universidade de Lisboa.

[3] Reck, C. (2017). *Bluetooth Low Energy Beacons: Design and Performance Analysis*. MSc Dissertation, Hochschule Offenburg.

[4] Siekkinen, M. et al. (2012). "Performance and Energy Consumption of Bluetooth Low Energy." *IEEE Sensors*.

[5] Cinefra, M. (2012). "An Adaptive Indoor Positioning System Using BLE RSSI Filtering." *Proc. of International Conference on Indoor Positioning and Indoor Navigation (IPIN)*.

[6] Mouhammad, H. (2019). "Improving BLE Indoor Localization with Trilateration and RSSI Filtering." *Proc. of IEEE International Conference on Wireless and Mobile Computing*.