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Chipless RFID Multisensory Tags - Trends, Strengths, Challenges, and Prospects: A Review

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Abstract

The concept of chipless radio frequency identification (CRFID) multiparameter tag sensors is fairly new and nowadays has gained importance among researchers for their ability to identify objects and sense multiple parameters at once without requiring integrated chips (ICs), onboard power sources, and active components. This article presents a comprehensive review of such tag sensors, emphasizing its current stage of development, performance comparisons, and existing research gaps. This study provides a detailed classification of resonator structures, identification (ID) and sensing mechanisms, sensing functions and factors, and smart/sensitive materials (SMs), establishing a new unified taxonomy. Furthermore, it provides details on the sensing mechanism and physics behind it, maps resonator types to their design principles with their sensing functions, alongside their corresponding smart/sensitive materials (SMs), and reveals their multiparameter

decoupling and selectivity techniques. It also comments on the substrates used and the adopted printing process. A critical quantitative evaluation follows based on key ID [coding capacity (CC), spectral density (SD), and spatial density (SPD)] and sensing metrics [sensitivity, dynamic range (DR), and read range (RR)]. Finally, this article discusses current challenges such as limited CC, short RR, absence of dedicated readers and standards, and issues with selectivity and suggests future directions, including artificial intelligence (AI) integration and scalable deployment for the Internet of Things (IoT), smart logistics, environmental monitoring, and industrial automation. © 1963-2012 IEEE.

Author keywords

Chipless radio frequency identification (CRFID); multiparameter tag sensors; resonator designs; sensing capability; smart/sensitive sensing materials; standardization protocols

Indexed keywords

Engineering controlled terms

Automation; Distributed computer systems; Integrated circuits; Intelligent control; Parameter estimation

Engineering uncontrolled terms

'current; Chipless radio frequency identification; Multi-parameter tag-sensor; Multiparameters; Radio-frequency-identification; Resonator design; Sensing capability; Sensing material; Smart/sensitive sensing material; Standardization protocol

Engineering main heading

Resonators

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