

Bachelor's Thesis

Evaluating Freshness Measurement Technologies in Retail: A Systematic Review

Background

Freshness management is a critical challenge in the retail environment, where the deterioration of perishable products like fruits, vegetables and meat leads to significant food waste and economic loss (Zhai et al., 2025). Traditionally, retailers have relied on personal inspection or static expiration dates, which are often subjective and imprecise indicators of real product quality. However, the emergence of advanced technologies offers new possibilities for real-time and accurate monitoring. Innovations such as non-destructive testing, near-infrared spectroscopy, electronic noses or intelligent packaging sensors allow for the precise detection of changes and spoilage indicators without damaging the product (Prempeh et al., 2025). Despite the availability of these diverse technologies, there is a need to systematically aggregate existing research to understand which methods are most suitable for implementation in a retail environment.

Objective

The primary objective of this thesis is to conduct a systematic literature review to identify and classify the current technologies available for measuring the freshness of fresh products within the retail sector. Subsequently, the study aims to technically evaluate these methods by analysing key performance metrics such as detection accuracy, sensitivity, cost-effectiveness, and the feasibility of implementation. Finally, the research intends to compare the operational readiness of these technologies to determine which offer the most robust solutions for reducing food waste and ensuring safety in modern retail supply chains.

References:

Zhai, X., Xue, Y., Sun, Y., Ma, X., Ban, W., Marappan, G., Tahir, H. E., Huang, X., Wu, K., Chen, Z., Zou, W., Liu, B., Zhang, L., Yang, Z., & Katona, J. (2025). Colorimetric Food Freshness Indicators for Intelligent Packaging: Progress, Shortcomings, and Promising Solutions. *Foods*, *14*(16), 2813. <https://doi.org/10.3390/foods14162813>

Prempeh, N. Y. A., Nunekpeku, X., Kutsanedzie, F. Y. H., Murugesan, A., & Li, H. (2025). A Comprehensive Review of Non-Destructive Monitoring of Food Freshness and Safety Using NIR Spectroscopy and Biosensors: Challenges and Opportunities. *Chemosensors*, *13*(11), 393. <https://doi.org/10.3390/chemosensors13110393>

Language:

English

Requirements:

Fundamental experience in forecasting and machine learning techniques

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