Sensor-Integrated Tracking System for Food Waste Management: A Cost-Effective Mitigation Strategy for the Sri Lankan Hospitality Sector

D.M.N. Jesika[1]*, G.M. Somaratne[1], N.S. Dharmaratne[2], D.W.N. Sandanika[3], T.P.G.K. Upathissa[1], M.A. Samarasekera[3]

[1]*Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya, 20400, Sri Lanka*
[2]*Department of Computer Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, 20400, Sri Lanka*
[3]*Cinnamon Hotels and Resorts, Colombo 02, 00200, Sri Lanka*
**fst19018@agri.pdn.ac.lk*

Food waste generation within the hospitality industry poses a critical threat to environmental sustainability, social equity, and economic stability. Precise waste measurement and monitoring are fundamental prerequisites for waste mitigation. Currently used manual waste measurement and reporting remains labor-intensive and low in accuracy. Although high-end AI waste-tracking solutions have been introduced, their adoption in developing countries like Sri Lanka is hindered by high implementation costs and a lack of customization for local food items. This study presents a low-cost, sensor-integrated tracking system engineered for large-scale hotel kitchens. The architecture of the system leverages Internet of Things (IoT) integration, utilizing load cells/weight sensors coupled with an HX711 amplifier and ESP32 microcontroller to facilitate accurate weight capture and seamless data acquisition. Weight data is synchronized via a Firebase cloud database to a dedicated Flutter-based mobile application, which serves as the primary user interface for hotel staff. The mobile application enables real-time selection of waste sources and categories while generating comprehensive waste reports, including edible vs. non-edible analysis across distinct operational areas and key waste indicators, such as edible food waste per cover and CO_2 emission from edible food waste to drive data-driven waste reduction strategies. System validation was conducted by testing in a real hotel kitchen environment. A paired t-test comparing the automated scale measurements against manual weight measurements yielded ($p > 0.05$), confirming the system's accuracy by indicating the mean difference between the two systems was statistically insignificant. Furthermore, a Wilcoxon Signed-Rank test was done for staff feedback evaluation ($p < 0.05$), demonstrating significant improvements of the system over the manual method in terms of usability, data clarity, organization, and operational relevance. While commercial tracking systems require an enterprise investment of 90 million LKR plus recurring annual fees, this localized hardware system costs around 25,000 LKR per unit, providing a highly financially viable alternative. This localized, low-cost digital solution offers a scalable framework for enhancing sustainability within the hospitality industry.

Keywords: food waste, weight sensors, hospitality industry, database, mobile application