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An Approach to Determine the in Transit Vibration to Fresh Produce Using Long Range Radio (LORA) Wireless Transducers

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Abstract : Ever increasing demand for quality fresh produce by the consumers, had increased the gravity on the post-harvest supply chains in multi-fold in the recent years. Mechanical injury to fresh produce was a critical factor for produce wastage, especially with the expansion of supply chains, physically extending to thousands of miles. The impact of vibration damages in transit was identified as a specific area of focus which results in wastage of significant portion of the fresh produce, at times ranging from 10% to 40% in some countries. Several studies were concentrated on quantifying the impact of vibration to fresh produce, and it was a challenge to collect vibration impact data continuously due to the limitations in battery life or the memory capacity in the devices. Therefore, the study samples were limited to a stretch of the transit passage or a limited time of the journey. This may or may not give an accurate understanding of the vibration impacts encountered throughout the transit passage, which limits the accuracy of the results. Consequently, an approach which can extend the capacity and ability of determining vibration signals in the transit passage would contribute to accurately analyze the vibration damage along the post-harvest supply chain. A mechanism was developed to address this challenge, which is capable of measuring the in transit vibration continuously through the transit passage subject to a minimum acceleration threshold (0.1g). A system, consisting six tri-axel vibration transducers installed in different locations inside the cargo (produce) pallets in the truck, transmits vibration signals through LORA (Long Range Radio) technology to a central device installed inside the container. The central device processes and records the vibration signals transmitted by the portable transducers, along with the GPS location. This method enables to utilize power consumption for the portable transducers to maximize the capability of measuring the vibration impacts in the transit passage extending to days in the distribution process. The trial tests conducted using the approach reveals that it is a reliable method to measure and quantify the in transit vibrations along the supply chain. The GPS capability enables to identify the locations in the supply chain where the significant vibration impacts were encountered. This method contributes to determining the causes, susceptibility and intensity of vibration impact damages to fresh produce in the post-harvest supply chain. Extensively, the approach could be used to determine the vibration impacts not limiting to fresh produce, but for products in supply chains, which may extend from few hours to several days in transit.

Keywords : post-harvest, supply chain, wireless transducers, LORA, fresh produce
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