Title : **Photometric Apiculture in Beekeeping using Modern Digital Techniques**

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ABSTRACT

Honey production is essential for agriculture and environmental sustainability, yet traditional monitoring methods are time-consuming and error-prone. This study develops an AI-driven image analysis model to detect and quantify honeycomb composition, including **honey-filledcells, and pollen cells**, using 4K hive images captured in a **controlled light-box setup**. The model is trained using **Roboflow**, with manual annotations for comparison. The dataset includes hundreds of images showcasing different colors and textures of honey and pollen cells, enabling predictions of honey accumulation, total cell count, and estimated honey weight.

The AI's precision is validated against manual counting and weight measurements from major honey farms in Chiang Mai, Thailand. Results indicate high accuracy and reduced processing time, demonstrating potential for scalable, non-invasive hive monitoring. This research advances precision apiculture and contributes to environmental monitoring, supporting data-driven decision-making for beekeepers. Future work will refine predictive accuracy and expand real-time monitoring applications.

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