Grading of Dry Coffee Beans for Specialty Coffee Using Image Processing Techniques

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Specialty coffee is the highest-quality coffee produced in the coffee industry. Grading coffee beans for the specialty grade is a crucial operation in the production process. All over the world, manual selection is being practiced for green coffee grading and it requires a lot of trained labor. As a solution, Image processing technology can be used effectively to grade coffee beans according to the bean characteristics of specialty grade. In this study, an algorithm was trained to identify specialty-grade beans in *Coffea arabica* using image processing technology. One thousand two hundred images of coffee beans were captured and trained with OpenCV library. Using the trained algorithm, a specialty coffee sorter machine was developed, based on feature identification of beans using a raspberry Pi4 computer and a Pi camera. The sorter machine was specially developed to grade a single bean at a time under artificial light conditions for better clarity and accuracy. The developed sorter can reject deformed beans, inert materials, blacked beans, broken beans, dried cherries, and undersized beans apart from specialty-grade beans. The developed sorter machine was able to separate accepted and rejected beans with an overall accuracy of 86.5% and a rate of 10 beans per minute. The false negative rate of the machine was 0.21. The true positive rate was 0.929, and the false positive rate was 0.06. As further improvements, sorter machine can be developed to grade coffee beans from *Coffea canephora* and *Coffea liberica* by training separate algorithms. Self-learning capabilities also can be included to the sorter machine to grade coffee beans in different stages in processing.

Keywords: Coffee grader machine, Coffee grading, Coffee sorter machine, Image processing, Specialty coffee

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