

A deep Learning framework for Black Tea Grade Identification in Low Country, Sri Lanka

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Abstract

Sri Lanka is renowned worldwide for its tea production, with Low Country black tea grade playing a pivotal role in driving the nation's economy. Identifying black tea grades is essential for quality assurance, pricing, and standardization, enhancing the market demand and preserving tea production quality. Traditional black tea grading methods in tea factories rely on manual labor and subjective evaluation, leading to inconsistencies and inefficiencies that can impact quality and pricing. This study introduces a deep learning and Image Classification approach to automate black tea grading, focusing on four main black tea grades: OPA (Orange Pekoe A), BOP (Broken Orange Pekoe), OP1 (Orange Pekoe One), and P (Pekoe). For this research, images were collected from multiple tea factories in different low-country regions, focusing on factors identifying features such as dry tea leaves color, shape, and size. To ensure accuracy, an 80/20 training and testing split was applied to a dataset of approximately 1,000 images, maintaining a 1:1 ratio, allowing for the clear identification of the components of a single dry tea leaf. After preprocessing the dataset to an image resize of 80x80 pixels and labeling, four CNN models that are Alex Net, VGG16, VGG19, and a custom CNN model were trained and tested. Each model performed well, among which the VGG16 model achieved the highest accuracy of 99.69%, confirming a high ranking among the four black tea grade samples, which is a great approach to automating the identification process. This automated grading framework reduces human error and labor while providing a scalable and objective solution for the tea industry, leading to more consistent grading standards. This CNN-based automated grading framework enhances quality assurance and production efficiency while reducing human error and labor. It provides a scalable and objective solution for the tea industry, paving the way for consistent grading standards and supporting Sri Lanka's tea sector in maintaining competitive, high-quality production.

Key Words: *Black Tea Grades Identification, Deep Learning, Image Classification, Low Country Sri Lanka, Convolutional Neural Networks (CNN) Models*