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Multiclass classification of dry beans using computer vision and machine learning techniques

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Abstract

There is a wide range of genetic diversity of dry bean which is the most produced one among the edible legume crops in the world. Seed quality is definitely influential in crop production. Therefore, seed classification is essential for both marketing and production to provide the principles of sustainable agricultural systems. The primary objective of this study is to provide a method for obtaining uniform seed varieties from crop production, which is in the form of population, so the seeds are not certified as a sole variety. Thus, a computer vision system was developed to distinguish seven different registered varieties of dry beans with similar features in order to obtain uniform seed classification. For the classification model, images of 13,611 grains of 7 different registered dry beans were taken with a high-resolution camera. A user-friendly interface was designed using the MATLAB graphical user interface (GUI). Bean images obtained by computer vision system (CVS) were subjected to segmentation and feature extraction stages, and a total of 16 features; 12 dimension and 4 shape forms, were obtained from the grains. Multilayer perceptron (MLP), Support Vector Machine (SVM), k-Nearest Neighbors (kNN), Decision Tree (DT) classification models were created with 10-fold cross validation and performance metrics were compared. Overall correct classification rates have been determined as 91.73%, 93.13%, 87.92% and 92.52% for MLP, SVM, kNN and DT, respectively. The SVM classification model, which has the highest accuracy results, has classified the Barbunya, Bombay, Cali, Dermason, Horoz, Seker and Sira bean varieties with 92.36%, 100.00%, 95.03%, 94.36%, 94.92%, 94.67% and 86.84%, respectively. With these results, the demands of the producers and the customers are largely met about obtaining uniform bean varieties.

Keywords

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Keywords Plus: [ARTIFICIAL NEURAL-NETWORKS](#); [QUALITY](#); [ORIGIN](#)

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