Perspective

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Multispectral and Hyperspectral Approaches Work on the Visible and Near Infrared Spectral Bands

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Description

With the continued population growth, the food industry needs to keep increasing production and improving the quality of products. Directly or indirectly related to the increase in food production are the cereals, which are at the base of the pyramid of the food industry, both for human and animal consumption. According to the Food and Agriculture Organization's last report the world cereal production in 2020 has been 2765 million tonnes, 2% higher than 2019. The report shows that the increase in production has kept the same ratio during the last decade and it is expected to keep the same ratio in the near future. Therefore, since it is difficult to increase the arable land, improvements are required in other processes in the production chain to increase productivity. One of these improvements is related to the automation of the classification of food grains, where a great effort has been devoted in recent years by proposing new approaches to perform the classification in an automatic way. It should be noticed that the food grain classification problem requires specific features according to the type of variety or problem. Some classes (seeds) have a large inter-class variability making easier the solution while others show a very tiny inter-class variability (e.g classify between good grain and infected one).

Multispectral and Hyperspectral Based Approaches

Actually, some of these challenging problems small inter-class variability requires the usage of multispectral or hyperspectral technology. The contributions of this survey are as follows. Firstly, it presents a general pipeline that is used to analyze the different stages generally involved in the classification process, providing discussions for each one of them. Due to the lack of common benchmarks for validation and the complexity of reproducing different approaches, quantitative comparisons become difficult. Therefore, the survey presents an analysis of the most important proposals for each stage and provides quantitative evaluations when possible. Finally, general conclusions are given pointing out the current limitations and future trends from a more general viewpoint. Although most of the approaches proposed in the literature for the seed grains classification problem work on the visible spectrum there is an increasing number of approaches that rely on information from other spectral bands or other types of images (e.g., multispectral, hyperspectral), mainly due to the reduction in the prices of these technologies during the last decades. According to the reviewed papers, multispectral and hyperspectral based approaches are good solutions not only to classify grains according to their features, such as healthy or fermented but also to classify the grain varieties, which sometimes are quite similar from a visual point of view.

Quality of the Final Results Is Directly Related To the Quality of the Input Data

For instance, some multispectral approaches can classify transgenic and non-transgenic varieties. Another detail to highlight from this review is that most multispectral and hyperspectral approaches work on the visible and near infrared spectral bands, just a few approaches go further NIR spectral band reaching the short-wavelength infrared or even mid-wavelength infrared. Regarding the ultraviolet spectral band, just a couple of works exploit this band. It could be mentioned as a general conclusion that multispectral and hyperspectral technologies offer many possibilities that still need to be explored. The main drawback that can be observed is the lack of well-documented and available datasets for reference. In most of the approaches presented in the literature, researchers acquire their dataset and make their contributions, which make it difficult to compare the different techniques. Hopefully, common benchmarks will be shortly available to be used as references by the community. As in most computer vision applications, the quality of the final results is directly related to the quality of the input data; noisy data, low contrast, poor lighting, overlapping objects all of these factors would represent a challenging problem. Hence, there is a clear trade-off between the time and effort spent in the preprocessing stage and the quality of the final results. A common characteristic among the reviewed works is that all the image acquisition conditions are kept under control. This reduces the processing operations and helps to obtain good results.