Navel Orange Blemish Identification for Quality Grading System

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Abstract

Each year, the world's top orange producers output millions of oranges for human consumption. This production is projected to grow by as much as 64 million in 2010 and so the demand for fast, low-cost and precise automated orange fruit grading systems is only deemed to become more increasingly important.

There is however an underlying limit to most orange blemish detection algorithms. Most existing statistical-based, structural-based, model-based and transform-based orange blemish detection algorithms are plagued by the following problem: any pixels in an image of an orange having about the same magnitudes for the red, green and blue channels will almost always be classified as belonging to the same category (either a blemish or not). This however presents a big problem as the RGB components of the pixels corresponding to blemishes are very similar to pixels near the boundary of an orange. In light of this problem, this research utilizes a priori knowledge of the local intensity variations observed on rounded convex objects to classify the ambiguous pixels correctly. The algorithm has the effect of peeling-off layers of the orange skin according to gradations of the intensity. Therefore, any abrupt discontinuities detected along successive layers would significantly help identifying skin blemishes more accurately. A commercial-grade fruit inspection and distribution system was used to collect 170 navel orange images. Of these images, 100 were manually classified as good oranges by human inspection and the rest are blemished ones. We demonstrate the efficacy of the algorithm using these images as the benchmarking test set. Our results show that the system garnered 96% correctly classified good oranges and 97% correctly classified blemished oranges. The proposed system is easily customizable as it does not require any training. The fruit quality bands can be adjusted to meet the requirements set by the market standards by specifying an agreeable percentage of blemishes for each band.

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