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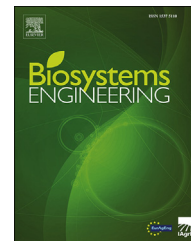
Research Paper

A novel image processing algorithm to separate linearly clustered kiwifruits

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This research work aims at developing a machine vision system capable of distinguishing kiwifruits on plants prior to harvest. The methodology was based on developing an algorithm able to detect each fruit, even when they are clustered in a line. It segments the fruits from the background, counts the number of fruits in each cluster, and identifies the edges of each fruit. After segmentation, the algorithm initially distinguishes between the fruit skin and calyx based on colour differences using selected hue and red channels. Next, a calyx line is drawn to connect all the calyxes in one cluster together. Then, the periphery of each cluster is scanned to find the contact points between the adjacent fruits. Finally, a separating line is drawn between the two closest contact points, provided that this line intersected almost vertically the calyx line. The separating lines determine the borders of each fruit and enable singling them out. The results showed that 93.7% of the fruit calyxes were correctly detected. In night-time with flash, 92.0% of the fruits were separated and counted correctly by the algorithm.

1. Introduction

China is the largest country producing kiwifruits worldwide, with a yield of 2.4 Mt in 2016 from a cultivated area of 197,048 ha (UN Food & Agriculture Organization, 2018). The Shaanxi Province has the largest production, accounting for approximately 70% and 33% of the local and global production, respectively (Hu et al., 2017). Harvesting kiwifruits in this area mainly depends on manual picking, which is labour-intensive (Fu, Sun, Li, & Wang, 2016). Therefore, introducing mechanical harvesting is highly desired.