ABSCISSION POINT EXTRACTION FOR RIPE TOMATO HARVESTING ROBOTS

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ABSTRACT—Due to the randomness of the natural growth of tomatoes in greenhouses and different storage days for market needs, it is difficult to find appropriate methodologies for certain ripe-tomato-harvesting robot systems. This paper proposes a novel approach for recognizing ripe tomatoes from the natural background in greenhouses and extracting abscission points after color segmentation for autonomous robot systems. The ripe tomatoes are recognized and segmented using $L^*a^*b^*$ color space method from complex tomato plants containing clutter and occlusion in tomato greenhouses. The bi-level partition fuzzy logic entropy, which could discriminate the object and the background in grayscale images, is improved to segment the ripe tomatoes. The improved exhausted search method based on the maximum value of the histogram is proposed to increase the precision of segmentation threshold and the efficiency of searching. The mathematical morphology operations are used to eliminate binary image noises after segmentation. Finally the abscission point of cluster of tomatoes is obtained for the robot to pick up tomatoes precisely. The proposed approach is validated on tomato images taken in natural greenhouses. Experimental results show that the proposed method is capable of obtaining the abscission point of ripe tomatoes effectively and precisely.