

## Using Deep Learning Real-Time Object Detection Convolution Neural Networks for Fast Fruit Recognition in the Tree

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**Abstract :** Image/video processing for fruit in the tree using hard-coded feature extraction algorithms have shown high accuracy during recent years. While accurate, these approaches even with high-end hardware are computationally intensive and too slow for real-time systems. This paper details the use of deep convolution neural networks (CNNs), specifically an algorithm (YOLO - You Only Look Once) with 24+2 convolution layers. Using deep-learning techniques eliminated the need for hard-code specific features for specific fruit shapes, color and/or other attributes. This CNN is trained on more than 5000 images of apple and pear fruits on 960 cores GPU (Graphical Processing Unit). Testing set showed an accuracy of 90%. After this, trained data were transferred to an embedded device (Raspberry Pi gen.3) with camera for more portability. Based on correlation between number of visible fruits or detected fruits on one frame and the real number of fruits on one tree, a model was created to accommodate this error rate. Speed of processing and detection of the whole platform was higher than 40 frames per second. This speed is fast enough for any grasping/harvesting robotic arm or other real-time applications.

**Keywords :** artificial intelligence, computer vision, deep learning, fruit recognition, harvesting robot, precision agriculture

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