



Deep learning applications for oil palm tree detection and counting

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ABSTRACT

Oil palms are one of the essential crops in agricultural productivity for developing countries such as Malaysia and other tropical areas. For predicting the yield and production of palm oil, the counting process is often carried out. Manually counting oil palm trees is one of the solutions but it requires a massive labour force, and the result is often inaccurate. To overcome this problem, automated techniques for oil palm detection have been developed. However, the performance of existing automated techniques for oil palm detection deteriorates when the planting layout of the oil palm tree is not well organized. Deep learning applications for oil palm tree detection and counting offer a powerful solution to the challenges of precision agriculture, enabling plantations to increase productivity and sustainability while reducing costs and manual labour. Deep structured learning, more generally deep learning is one of the widely used computer vision technology, especially in agricultural engineering. Deep learning method is an essential tool when it comes to monitoring the plantation. Different deep learning networks are utilized for classification tasks towards oil palm trees. In order to promote the use of deep learning in the oil palm industry, this paper main contribution is to provide an understanding of the utilisation of deep learning and its application in oil palm tree counting. The gaps and opportunities for research in oil palm plantations based on deep learning techniques will also be discussed.

1. Introduction

Along with the increasingly rising demand for solving complicated problems with the support of learnable machines, deep learning has developed over the past few years as a field of interest to researchers. Machine learning assures to minimize the efforts through self-learning of past experiences [1] practising three ways of learning especially, learning without supervised, semi-supervised and under supervised [1]. As the prerequisite, feature extraction is needed for the conventional machine learning techniques, and this requires a domain expert [2]. One of the challenging tasks is the selection of relevant features with the specific problem. Nonetheless, the deep learning method overcomes feature selection problems by not having a pre-selected feature but automatically extracts important features from the raw input for a problem in hand [3]. The deep learning model is the combination of processing layers that have the ability to learn through multiple levels of abstraction and this grant the network to learn distinct features [4]. Deep learning has become a way to achieve promising results in different applications such as image recognition [5], voice recognition [6], topic classification, sentiment analysis [7], language translation [8],

natural language understanding, signal processing [9], face recognition [10], forgery detection [11], prediction of bioactivity of small molecules [12] and many others. Three common architectures are used to create deep learning which are Convolutional Neural Network (CNN), Deep Belief Network (DBN), and Recurrent Neural Network (RNN) [13]. DBN is widely used for general classification problems while RNN is used when data is more in the form of sequential. However, CNN is more popular when it comes to the classification of image, text, and sound [14].

Agricultural technology grew rapidly in the 20th century. The importance of technology to agriculture has been discovered and numerous amount of commercial technology has led to an incredible evolution of mechanical technology [15]. The introduction of the first successful gasoline tractor was in 1892. The invention of tractors not only changed the way the land was cultivated but also changed the crops of farmers [16]. With the support of technology, productivity is increased. Yet, the production still is not enough to support the world's demand for the future. Hence, the idea of "precision agriculture" has been adopted [17]. Precision agriculture mostly focused on observing, monitoring, reacting to the variability of crops either from inter or

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