Automated quality assessment of crops

Problem statement

Automated quality assessment of crops is the problem of assessing the quality of the crops so that required necessary actions can be taken place timely to minimize the loss to crops. The main purpose of farmers is to increase the turnout of their fields. Crop quality assessment is a very essential task as it can provide the fundamental information for understanding the quality of the crops and its diseases. There is a need of an automated system which can provide some meaningful information by processing large number of images timely and yet accurate. Nowadays, Computer Vision and Deep Learning based solutions are becoming popular for the assessment of image and videos. In this research, a novel Convolutional Neural Network(CNN) based automated quality assessment method will be exploited for assessing the quality of the crops in the Indian context. One of the challenge in applying Convolutional Neural Network based quality assessment is, applying such models for the Indian context needs large amount of data to train the models. Another challenge is, applying such models on large number of images requires lot of processing power(GPU's) and time. Also factors like varying light conditions, problems caused by wind, changing plant background and dirt on leaves can affect the result. On successful completion of the project it will deliver the functionality that will enable to assess the quality of the crops in real-time.

Background

Despite the challenges, automated quality assessment remains an active research area in computer vision in recent years. Numerous approaches have been proposed over the years. The earlier methods of quality assessment were based on image processing and works in a similar way. During the binarization a black-and-white picture is created in which the crop is displayed white and the soil black. Therefore, undesirable plants are detected more easily due to a higher contrast. In the past Artificial Neural Network(ANN) and Support Vector Machine(SVM) based approaches also have been applied for the quality assessment of crops. In crop quality assessment main aim is to measure the plant position with high accuracy and to evaluate the plant quality depending on its growth. The plant segmentation is an importance process to locate the plant and its boundary in images to enable the further analysis. The leaves of crops can overlap with each other, it is one of the main challenge of the leaves segmentation. Previous work on "Quality assessment of row crop plants by using a machine vision system" is available in [1].

Methodology

Architecture of the automated crop quality assessment model is shown in fig 1.

Step 1: Data collection and dataset preparation
This will involve collection of crops leaf images from available sources. The more specific data of any crop may be requested form agriculture department of the state for quality assessment of local crops.

Step 2: Developing a CNN based quality assessment model
Popular pretrained CNN feature extraction models such AlexNet, GoogleNet and Inceptionv3 will be exploited for this task. The images will be inputted to developed CNN model as input. First the model will be trained with training data and then it will be evaluated on testing

data. The output of the model will give the result, based on which the quality of the crop can be classified. The typical architecture of CNN is shown in fig 2.

Step 3: Training and experimentation on datasets

The quality assessment model will be trained on populated dataset and based on local crops dataset in Indian context as part of this project. The whole dataset will be divided into training and testing part.
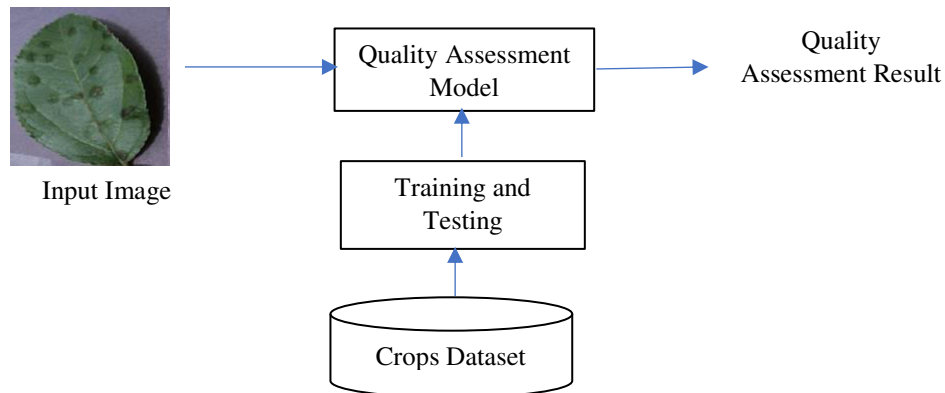
Fig 1. Architecture of CNN based Automated Crops Quality Assessment

Experimental Design

Dataset

PlantVillage dataset will be used to train and test the model. Plant Image dataset contains more than 50,000 images of classified plant diseases and healthy images. The images span 14 crop species. All the images in the PlantVillage database were taken at experimental research stations associated with Land Grant Universities in the USA. More information is available at [2].

Evaluation Measures

Measures such as accuracy, F_1 score, Mean Precision, Mean Recall and accuracy will be calculated and compared with existing methods.

Software and Hardware Requirements

For the development and experimentation of the project, Python based Computer Vision and Deep Learning libraries will be exploited. Specifically, libraries such as OpenCV, TensorFlow, Keras will be used. Training will be conducted on NVIDIA GPUs for training the end-to-end version of CNN based automated crop quality assessment model.

References:

1. Weyrich M, Wang Y, Scharf M. *"Quality assessment of row crop plants by using a machine vision system"*. In Industrial Electronics Society, IECON 2013-39th Annual Conference of the IEEE 2013 Nov 10 (pp. 2466-2471). IEEE.
2. https://arxiv.org/abs/1511.08060
3. Barbedo JG, Godoy CV. "*Automatic classification of soybean diseases based on digital images of leaf symptoms*". In Embrapa Soja-Artigo em anais de congresso (ALICE) 2015. In: CONGRESSO BRASILEIRO DE AGROINFORMÁTICA, 10., 2015, Ponta Grossa.

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