MACHINE LEARNING BASED AGE PREDICTION OF COCONUT - Synopsis

Submitted by

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Introduction

Smart farming approaches driven by machine learning are revolutionizing all phases of agriculture like crop yield prediction, disease detection, soil parameter prediction, and harvesting, to name a few. These smart techniques can help address challenges like fulfilling the high food demands of the increasing population.[1]

Computer vision is a sub-field of machine learning that brings visual capabilities to a system. Image classification and object detection are two usual tasks in computer vision and transfer learning based classification and detection methods are suitable for fruit identification, localization, maturity detection, and classification. Deep learning based computer vision techniques have enabled intelligent harvesting systems based on information from images.[2]

Coconut is Kerala's most important cultivated crop, accounting for 39 percent of the state's net sown area, according to 2013-14 statistics. The lack of skilled labor and high wage rate pose challenges to coconut farming in the state. Better technology integration can aid laborers and farmers in enhancing the productivity of coconut cultivation. [3] Despite the high demand for coconut, farmers face the prospect of severe financial losses due to the challenges involved in coconut harvesting, like low labour supply and high labour cost due to crop height and its complex trunk structure.[4]

Motivation

Coconuts at different stages of development are suitable for different purposes. At seven to nine months of age, coconuts are considered tender and are harvested for drinking purposes. Those with a maturity greater than twelve months are harvested for commercial nut production [4]. In addition to this, coconut at different ages are used in varied value added products.Coconut is considered a healthy food and hence there is a high demand for shifting the market towards value-added products such as coconut milk, coconut ice cream, coconut

cream, coconut vinegar, coconut water concentrate, packaged tender coconut water, nata-de-coco, coconut cream, coconut flour, desiccated coconut, coconut protein powder, and the like [5]. All these different products need coconuts belonging to different weeks or months of age. High expertise is required to correctly predict the age of coconut in such an intricate manner.Ascertaining the correct age of coconuts will help farmers in the timely harvesting of coconuts and to supply them to manufacturers of value-added products. This can open up better commercial possibilities for coconut cultivation. Automatic age prediction can also be a stepping stone for fully automated coconut harvesting by drones.Thus there is a need to classify coconuts based on their age. Specific expertise is required to ascertain the age of coconuts. A machine learning powered software application that can predict the age of coconut correctly can be of great use for palm climbers, coconut farmers and for automating coconut harvesting in the future.

Aim, Scope and Approach

Traditional methods for determining the age of coconuts are time-consuming and cumbersome in nature. This project aims to classify coconuts according to their age into tender or mature using machine learning techniques and image data. Transfer learning based solutions are[6] explored in the project. Further, a suitably trained machine learning model can be incorporated into an Android app for ease of use, decreasing the dependency on highly skilled palm climbers and farmers to find the age of coconuts.A sample Android application was built as part of this project.

The initial approach was to consider the problem as a classification task based on only the image data that was made available. Application of pre-trained models based on VGG16, ResNet50, and EfficientNet-Lite architectures were analyzed to classify coconut as tender or mature.

A simple classifier may not be sufficient to perform the prediction correctly in more natural settings. The presence of leaflets, leaf stalks, and the background can contribute to the

scene [4]. Hence an object detection based approach is considered next. Detecting coconut from its background is needed before classifying it. The similarity between coconut and its background makes the detection of coconuts in their natural environment very challenging. Object detection based on EfficientDet and Faster-RCNN were studied in this regard.

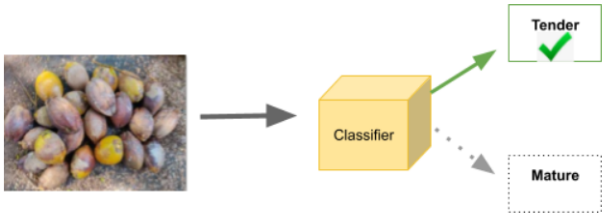

Figure 1: Coconut age prediction as a classification problem

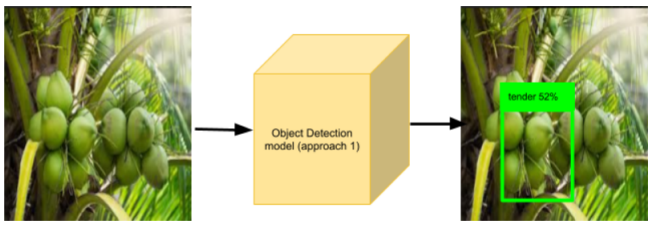

Figure 2: Coconut age prediction with object detection - approach 1

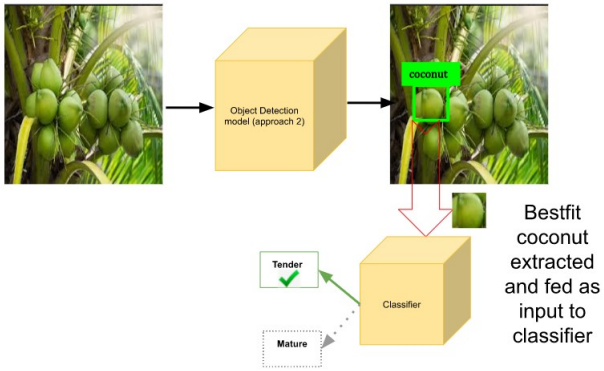

Figure 3: Coconut age prediction with object detection - extracting best fit coconut and feeding to classifier - approach 2

References

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