International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-9 Issue-1, May 2020

Intelligent System for Matured Coconut Identification

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Abstract: ***Vision is the key component in Artificial Intelligence and automated robotics. Identification of Matured coconuts in the coconut tree crown is one of the main expected functionality to be executed in Real Time for Automated coconut Harvesting Machine. This functionality is executed by an Intelligent System attached with that machine.. This project deals with the design of that intelligent system using the concept of Artificial Intelligence. Thus the prediction of matured coconut in the present captured image of coconut tree crown with the previous knowledge is done by that designed Intelligent System. In order to identify the coconut in the present capture image, a computing board and Jetson Nano board is used, which compares the captured image with a dataset and identifies the various stages of the coconut. In this paper we used two high speed graphics processors and identified which one has more accuracy.***

Keywords: MobileNet, Small Visual Geometric Group, Jetson Nano, Next Unit Computing

I. INTRODUCTION

India has manufactured a lot of coconut trees and contributes to 27% of coconut production across the world. In this project to identify the various stages of coconut by using two Single Shot Multibox Detector techniques. In Image processing dataset creation is the main thing get good quality images with good resolutions. Then Image preprocessing is elimination of noises in the image by using binning method or clustering or kernel or regression or moving average or curve fitting methods. Then Image segmentation is identifying the object region. In feature extraction is to extract the main object region in matrix values based on the color or ridges. There are many extract methods like shape or texture or wavelet or Laplacian of Gaussian or first order intensity for statistical methods. In this paper SSD is used for image classification by applying machine learning algorithms. Lastly prediction of coconut in inference stage using learners is supervised and unsupervised learning. Nowadays various improvements in the field of agricultural robotics, an automated robot is developed and has to climb the coconut trees and harvest the coconuts, though execute this functionality on an intelligent system attached with that machine. In coconut harvesting machines, Camera plays a vital role. After climbing the tree, a connected camera captures the image compared with a trained dataset and identifies the coconut. In the stage of identification the dataset must be trained. Use a computing board and a Jetson nano board to train and deploy on those dataset. In the training stage Single Shot Multibox detector is used and it trains six frames in a single second.

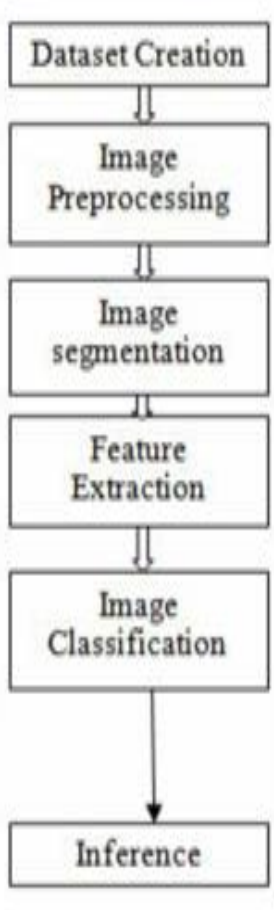

Fig 1.1 Basic architecture of image processing

Likewise, the various networks combine to predict from Identify the region of interest of the position of the camera. The SSD model is simple proportionate to methods that expect object proposals because it totally removes proposal Identify the region of interest of the position of the camera. The SSD model is simple proportionate to methods that expect object proposals because it totally removes proposal . generation and subsequent pixel and summarizes all computation in a single network. The main objective of this project is to identify the coconut. So we compare our dataset into methods are Small VggNet and MobileNet SSD.

Manuscript received on April 02, 2020.
Revised Manuscript received on April 15, 2020.
Manuscript published on May 30, 2020.
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II. RELATED WORKS

To Design the Intelligent system to provide required data and trained that machine has able to identify the coconut. This system has improved by a lot of literature that identifies many stages of coconuts. There are many literatures that use contour identification, canny edge detector, laplacian of Gaussian, PSO, technique to detect the shapes and colors of the coconuts. Contour based identification technique identifies the stem of the coconuts. Canny edge and laplacian of Gaussian technique has identified the edges of the coconut.

Particle Swarm Optimization is one of the methods to find the best position of the coconut based on the image captured input image. But its drawback is difficult to find the starting position of the co-ordinates. All this previous work has more validation loss in the images.

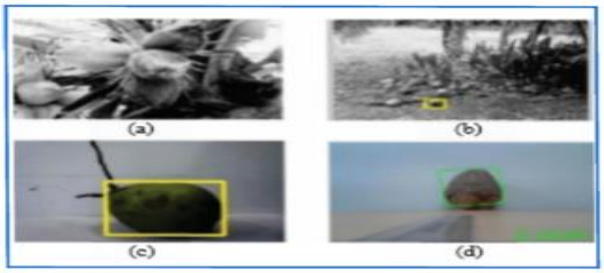


Fig 2.1 Various Methodologies Identification of coconut

III. METHODOLOGY

In this work, Single Shot Multibox Detector is to extract the coconut area and identify the coconut and give the details to the user to take further action like chopper or distance measurements. Connect the Camera in the climbing robot to capture the image in various angles. After Capturing respective input image and it will analyze with a trained dataset and identify the type of the coconut.

A. Small Visual Geometry Group

Small Visual Geometry Group is used to train the dataset it will extract the coconut area in the image and it train several times. In VGG convolution layer is the first layer to extract the coconut details from an input image. It filters the unwanted noise in the image and erodes the data and annotates the main data and connected all squares in fully connected layers. SSD is designed for object detection in real-time images.

ReLU- Non-linearity Rectified Linearity Unit (ReLU)
After getting the matrix values in convolution layer it has analyze the values. It will clear the negative values and converted into zero.

Padding

It actually improves performance by keeping info at the borders

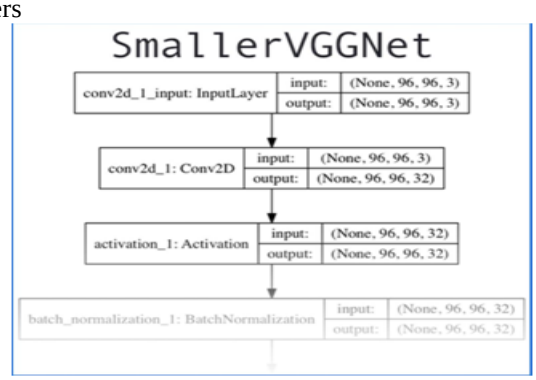


Fig 1.2 Small VGG Architecture

Pooling layers

It collects all the layers outputs and rejects the unwanted data in the images. There are three types pooling layers are
Sum Pooling is summing all the layers in the extracted features (Collected values in ReLu).
Maximum Polling is picks greatest element from the extracted features (Collected values in ReLu).
Average Polling is collect all convolution outputs and average the all layers.

Fully Connected Layer

Fully Connected Layers have each neuron received from every element of the previous layer. It collects all input parameters and it classifies the object.

Softmax

It is a squashing function and this function is used to limit the output of the function into the range 0 to1. It is used to determine the probability of the object in the image.

A.MobileNet

MobileNet SSD is the simple method to classify the images. In MobileNet, convolution layer is classified in to two divisions: first one is a depth wise, this convolution has eroded the unwanted regions and gives extracted data to point wise convolution layer and this layer gets the value and extract the features. The MobileNet architecture also uses standard convolution, once start the learning process very first layer and all other layers do depth wise separable convolution instead. This two convolution layers combines trained the datasets and get a better results.

- **Depth wise convolution**
- **Point wise convolution**

Depthwise Separable convolution block is enhancement technique that defines the contrast and sharpening of the image. In this technique it trains the data and generate (.PB) file. Protobuff file ha defines the size of the network
MobileNet has best in region based segmentation it separate the object from the background by the use of annotation tools.

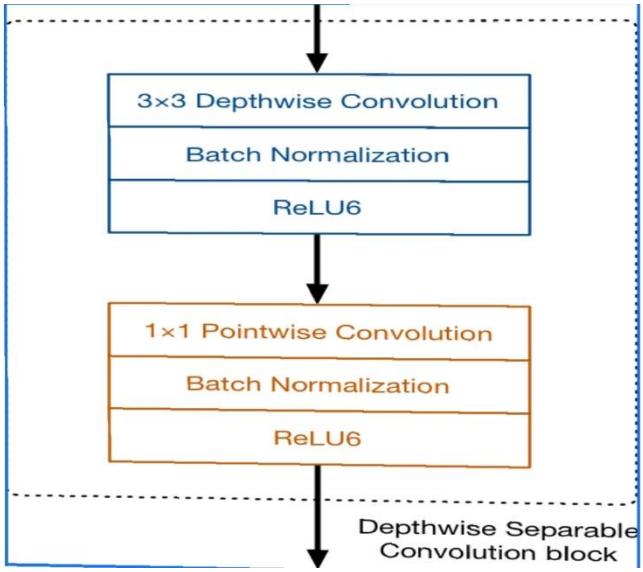
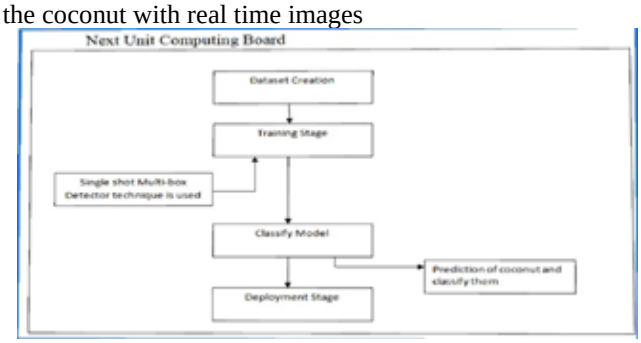


Fig 1.3 MobileNet SSD Architecture

3.1 Execution

A. Computing Board Execution

Computing (NUC) Board under Ubuntu linux os is used to execute the SSD method. A Logitech 720p camera has connected with NUC Board capture the image and identifies the coconut. The NUC Board process, the captured image has preprocessed by using morphological operation. By using SSD technique, the collected images has trained well, after the training a (.h5) file has generated. This file has predicted the coconut with real time images



. **Fig 3.1 Proposed Methodologies**

Database Creation

To capture the coconut bunch images in various poses and orientations. A Total of 3000 images are captured and divided into five categories. For each category it contains 600 images. Green coconut, Matured coconut, Green coconut in tree, Matured coconut in tree, No coconut these are the five categories of coconut.

Required Tools

- Keras
- Python3

Training Stage

In this paper SSD technique is used to detect the coconut position, in the various categories of the images Detect the coconut in the various kernel sizes. This is used to improve the accuracy of prediction of the coconut. Total 3000 images are classified by 10 Epochs. Each epoch has trained 300 images and gives the accuracy of the total images. Default loss is the identical metric as train loss and this is used to find the average value of ten epochs. Training accuracy usually keeps increasing throughout training and validation accuracy used to find the average value of those 10 epochs.

Deployment Stage

After the trained stage we get the trained model, by using a USB camera to capture the input image and compare the trained model and identify the coconut.

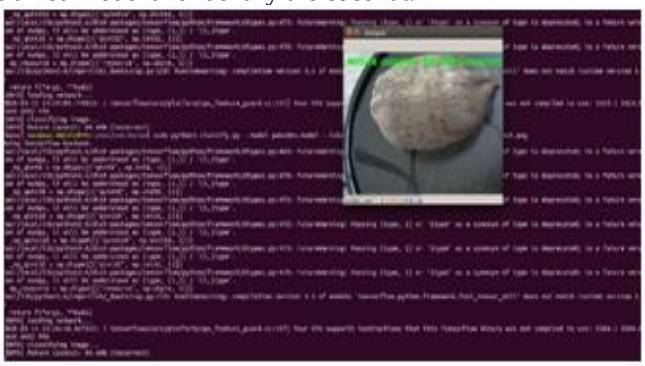


Fig 3.3 Detection of matured coconut

Fig 3.3 Detection of green coconut

B. Jetson Nano Board Execution

It executes in three stages are

- First Stage: Dataset creation
- Second Stage: Preprocessing and Analyzing
- Third Stage: Comparison with trained model

I captured various stages of coconut images and classified five different types and each type contains 600 images.

Required Tools

- TensorFlow-GPU v1.4
- CUDA v9.0
- cuDNN v7.0
- Anaconda with Python 3.6
- LabelImg

Preprocessing and Analyzing

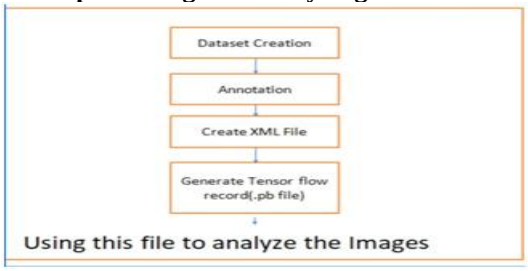


Fig 3.4 Proposed Methodologies

Gathering and Labelling pictures

- LabelImg is a great tool for labelling the images.
- LabelImg stores each image data in (.xml) files
- These image data (.xml) files will be used to generate TensorFlow Records, which are one of the inputs to the TensorFlow trainer.
- Once you have labeled and saved each image, there will be one .xml file for each image in the\test\train directories.
- Then convert the (.Xml) File to CSV format for both test and train files.

Generating TensorFlow Records

- After creating a train_labels.csv and test_labels.csv file in the respective directories.
- Open the text editor to create a label map, where each type of coconut is assigned an ID number.
- This same number assignment will be used when configuring the labelmap.pbtxt file.

- To read data efficiently it can be helpful to serialize your data and store it in a set of files that can each be read linearly.
- Using (Csv) Number fields record it generates the tensor flow record (.PB file). Protocol buffer is used to identify the weight of the record.
- After getting a prototype buffer file and this file can be compared with real time capture image.

Import that (.pb) file and run the test images and verify the board can identify the coconut correctly. Then connect the Logitech USB camera and run the process. It runs in real time images and identify which type of coconut it is.

Test Images Output

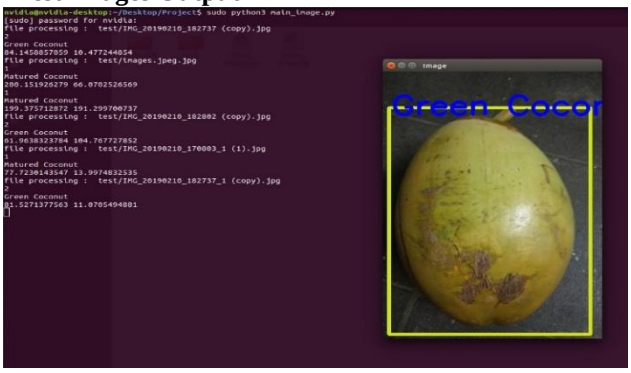


Fig3.5 Green Coconut Identification

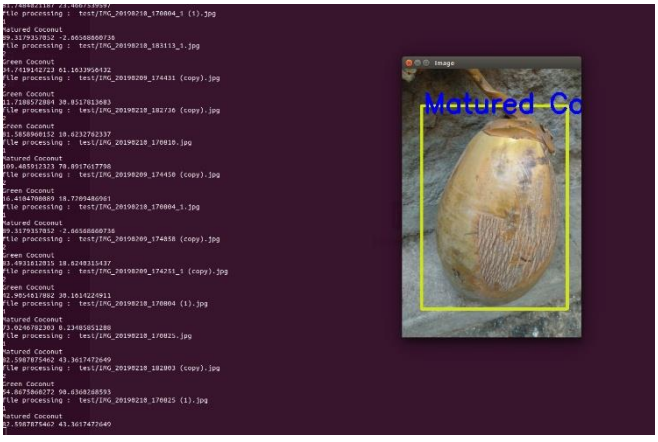


Fig3.6 Matured Coconut Identification

Real Time Identification

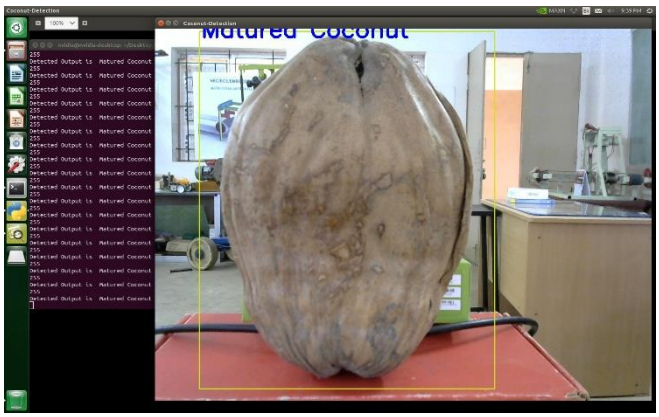


Fig3.7 (a) Real Time Matured Coconut Detection

Fig3.7 (b) Real Time Matured Coconut Detection

IV. CONCLUSION

For implementing 'Intelligent System for Matured Coconut Identification' the Small VGG net and Mobilenet technique used for classification is simple and effective. The accuracy of this technique is dependent on the clarity of images and all collected images in the same resolution. This identification method has executed in climbing robot that the machine has able to identify the coconut in real time images. It has also been implemented at the NUC board and Jetson Nano board which is able to detect the coconuts. Using Small VGG net and mobilenet SSD is intelligence to position the coconut accurately and input image has preprocesses for better accuracy. This will make easy to classify the images.

Future Scope

At present the intelligence (ability to identify matured coconut) is verified using intel NUC and Jetson Nano board. As future work, with the increased training set, the intelligence will be verified using google's cloud facility and trained in nvidia on board detection. This will get more accuracy and reduce loss in images (Jetson Nano).

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