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A FRUIT QUALITY INSPECTION SYTEM USING FASTER REGION CONVOLUTIONAL NEURAL NETWORK

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Abstract - *Quality and safety are the key factors in modern food industries. Every day high quality fruits are exported to other countries and produce a good income. That is why the grading process of the fruit is important to improve the quality of fruits. However, fruit classifying by humans in agricultural industry is not adequate, requires large number of employments and causes human faults. To overcome this problem, this paper presents a reliable detection method by making use of tensor flow library, Faster R-CNN algorithm and soft max classifier used to detect and classify the quality of fruit. Faster R-CNN algorithm is a capable classification algorithm in which both region proposal generation and objection tasks are all done by the same convolutional networks.*

Key Words*: *Deep learning, Faster R-CNN, convolutional network, tensor flow, fruit quality inspection

1.INTRODUCTION

Deep learning is a method whose architecture is composed of an input layer, hidden layer and an output layer. These layers form multiple non-linear transformations which attempt to model high-level abstractions in data and form good learning algorithms, which can perform the intellectual learning like learning the features. The word deep means there are. The quality of fruit is detected and it is essential part of research in food industries. This can be done by implementing deep learning techniques like convolutional neural network on the fruit dataset. The Early detection can be performed visually by humans, however it may be nearly impossible to continuously monitor large amount of fruits without having some kind of automated system. In this context, image processing-based software capable of detecting the infestation using only the images provided by cameras. In this context, the system for automatic identification and detection of quality is proposed in the literature. This system is capable of identifying the quality of multiple fruits. Sometimes the image get loaded is taken in advance and sometimes it is taken at runtime. So quality of fruit detection is very big task in food industries and it plays major role in economic rate. So we introducing Faster Region CNN to classify defected and non defected fruit . There is some method that could deal with representation learning by automatically learning a Hierarchy of growing complex features directly from data that is known as Deep Learning .So need to concentrate highly on designing architecture instead of manually inspection which may require specialized knowledge and more inspection. Convolution Neural Networks have been used for several object recognition and biological image segmentation challenges. Still a CNN used to operates over patches using kernels. To increase the accuracy Faster R-CNN algorithm is used to detect the quality of fruit automatically.

2. LITERATURE SURVEY

Belsha. N, Hariprasad. N[1],In agricultural and horticulture, image processing is one of the widely used applications. In this paper, automated quality identification using some image processing techniques is there that can be done using some image features which help in quality detection of vegetables like Shape, colour and size. This research work presents identification of good and bad vegetable is focused on the image processing techniques like segmentation and classification. First extract certain features from the input vegetable image, later using different method like thresholding, segmentation using k-means clustering and classification using SVM (Support Vector Machine) and ANN (Artificial Neural Network). It gives results in terms of accuracy in percentage.

Rashmi Pandey, Nikunj Gamit, Sapan Naik[2], In India, demand for various fruits and vegetables are increasing as population grows. Automation in agriculture plays a vital role in increasing the productivity and economical growth of the Country, therefore there is a need for automated system for accurate, fast and quality fruits determination. Researchers have developed numerous algorithms for quality grading and sorting of fruit. Color is most striking feature for identifying disease and maturity of the fruit. In this paper; efficient algorithms for color feature extraction

are reviewed. Then after, various classification techniques are compared based on their merits and demerits. The objective of the paper is to provide introduction to machine learning and color based grading algorithms, its components and current work reported on an automatic fruit grading system.

Rashmi Pande, Nikunj Gamit, Sapan Naik [3], Mango grading is done by using the human expert. Human expert grade the mangoes using hands and eyes which cause lack of objectivity, efficiency and accuracy. Automation plays a significant role to eliminate human's interaction with the goal of achieving safety, accuracy and consistency. The aim of this paper is to achieve quality standard of mango using novel colour and size based grading algorithm. In this paper, Image database is prepared with different size and colour of mango which was collected from local vendors. CIELab colour model is used to classify mango in healthy and diseased category. Dominant density range based algorithm is applied to extract colour feature. After that Healthy mango is detected. Size feature is calculated using area and diameter in order to classify in different grade. At final stage, size feature is fed to fuzzy inference system for grading.

3. ALGORITHM

The approach is similar to the R-CNN algorithm. But, instead of feeding the region proposals to the CNN, we feed the input image to the CNN to generate a convolutional feature map. From the convolutional feature map, we identify the region of proposals and warp them into squares and by using a RoI pooling layer we reshape them into a fixed size so that it can be fed into a fully connected layer. From the RoI feature vector, we use a softmax layer to predict the class of the proposed region and also the offset values for the bounding box.

The reason "Fast R-CNN" is faster than R-CNN is because you don't have to feed 2000 region proposals to the convolutional neural network every time. Instead, the convolution operation is done only once per image and a feature map is generated from it.

Fast R-CNN is significantly faster in training and testing sessions over R-CNN. When you look at the performance of Fast R-CNN during testing time, including region proposals slows down the algorithm significantly when compared to not using region proposals. Therefore, region proposals become bottlenecks in Fast R-CNN algorithm affecting its performance.

Similar to Fast R-CNN, the image is provided as an input to a convolutional network which provides a convolutional feature map. A separate network is used to predict the region proposals, instead of using selective search algorithm on the feature map to identify the region proposals. The predicted region proposals are then reshaped using a RoI pooling layer which is then used to classify the image within the proposed region and predict the offset values for the bounding boxes.

3.1 Convolutional layer

Here a dot product is computed at each sub region of the input data with its kernel and the results are obtained from the output of this convolution layer. This layer is to parameterized by the size and number of kernels, width and height dimensions of the layer and non-linearity is applied to activate a functions.

3.2 Max–pooling layer

In order to reduce the feature size it performs down sampling operation. It considers small blocks of data and generates a singular output for each block. This layer follows a convolution layer and performs a down sampling operation in order to reduce the feature size. It considers only small rectangular blocks of the data and generates only a singular output for each and every block. This can be done in various ways, but one thing is that it takes maximum in the block. Hence if the block size is 2 × 2, then the number of features will be reduced by 4 times.

3.3 Softmax layer

It turns out that the SVM is one of two commonly seen classifiers. The other popular choice is the **Softmax classifier**, which has a different loss function. If you've heard of the binary Logistic Regression classifier before, the Softmax classifier is its generalization to multiple classes. Unlike the SVM which treats the outputs as (uncalibrated and possibly difficult to interpret) scores for each class, the Softmax classifier gives a slightly more intuitive output (normalized class probabilities) and also has a probabilistic interpretation that we will describe shortly. In the Softmax classifier, the function mapping stays unchanged, but we now interpret these scores as the unnormalized log probabilities for each class and replace the *hinge loss* with a **cross-entropy loss** that has the form.

3.4 Deep learning classification

At last, after several convolution and maxpooling layers, the features obtained are transformed into a distinct one- dimensional vector that is also used for the

classification. Layers are fully connected in classification and use only one output unit per class label.The gradient based learning and Deep Learning algorithm are useful for getting the accurate percentage level of tumor cells. It is highly important that to initialize all weights to small random values in Deep neural network. To train deep networks iterative gradient based optimization.

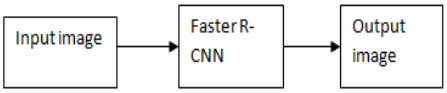

Figure -1: Flow diagram

4. EXPERIMENTAL SETUP

We installed libraries like pandas, matplotlib, tensorflow, keras ,numpy,opencv-python,sklearn,h5py, then took image of two thousand fruit picture which combination of both defected and non defected and converted the image data into .xml file and then to .csv file. CSV file contains the name, class and bounding box coordinates for each image. There can be multiple rows for one image as a single image can have more than one object be seen.

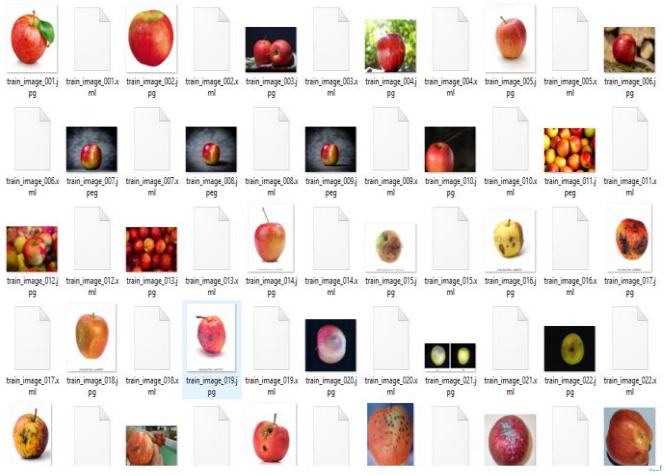

Figure -2: Both defected and Non defected dataset

After which a tensor flow record is generated. There are 6 columns in the train file.image_names will contains the name of the image, fruit type which denotes the type of the fruit. xmin is x-coordinate of the bottom left part of the image, xmax is x-coordinate of the top right part of the image ymin is y- coordinate of the bottom left part of the image, ymaxis y- coordinate of the top right part of the image. Training is done on those images.

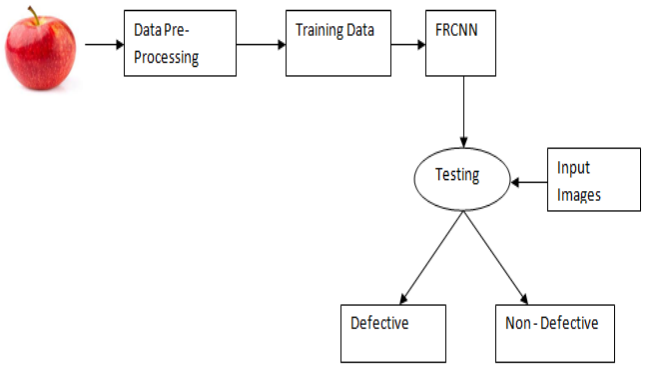

Figure -3: Processes performed while running the algorithm

We will be using the keras_frcnn library to train our model as well as to get predictions on the test images. It will take a while to train the model due to the size of the data

Figure -4: Output

After training phase inference graph is generated and then with new fruit images testing is done in which the region and the accuracy of the type of fruit is depicted as the output.

5. CONCLUSION

The proposed system is able to categorize the fruit depending on quality. For this we considered machine learning methodology. In this work, we have detected the region and accuracy of the quality of fruit more than 95% which is more than deep mind algorithm and CNN. To improve the detection of fruit by working simultaneously with report.

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