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Automatic Fruit Detection and Counting System Using Neural Network

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ABSTRACT

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In the field of agriculture, Identification and counting the number of fruits from the image helps the farmers in crop estimation. At present manual counting of fruits present in many places. The current practice of yield estimation based on the manual counting of fruits has many drawbacks as it is time consuming and expensive process. while considering the progress of fruit detection, estimating proper and accurate fruit counts from images in real-world scenarios such as orchards is still a challenging problem. The focus of this paper is on the web application of fruit yield estimation. This web application helps the farmers to count the number of fruits easily. This system provides an automated and efficient fruit counting system using computer vision techniques. This paper provides the progress towards in-field fruit counting using neural network object detection methods. So this process is done by recognizing each fruit in the image and taking the count. In the neural network, we have used YOLO architecture for recognizing the fruits.

Keywords : Image processing, fruit classification, computer vision, neural network, yolo architecture.

I. INTRODUCTION

Precise detection of different kinds of fruit species, vegetables, or in general food, is an important topic nowadays. Estimating the accurate and reliable fruit or vegetable counts from images in the real-world has received significant attention. It is also a relevant topic in industrial applications. The main aim of the application is, it can be used in agricultural fields to estimate the fruit counts. Farmers can estimate the result using this application, fruit counts provide information for logistics planning. But the problem is that counting the fruits from the tree is difficult. So image processing plays a very important role in every field. In agricultural fields to detect and segment fruits, image processing is used. To identify the object in the natural environment, imaging is the major component used. There is an increasing number of robotic applications aimed at detecting fruits from images so that this application can help to count the number of fruits from the images so that farmers can estimate the fruit count before harvesting. This project provides a computerized method to count the number of fruits. In this paper, we are going to detect and count the food species such as Apple, Orange, Banana, Carrot, and Broccoli. We are using Yolo architecture in the Neural network for this project. A Neural network works like a human brain and complex one to understand. To recognize the fruits neural network plays an important role because it is very good at image processing. A Neural network doesn't work for 100's of data, So we are using a large amount of data so that a neural network works better. For counting the food species we have some limitations. Our system will not count other than these species because of their size and (x,y) coordinates.

II. LITERATURE SURVEY

Literature Survey is the review of the previously published paper on some topics. So we have referred to the below papers to gain knowledge.

[1] The paper "Automatic fruit recognition and counting from multiple images" demonstrates the measuring of observable features in living organisms, such as counting the number of fruits from the image. In this paper authors "Y. Songa, C.A. Glasbey a, G.W. Horganb, G. Polderc, J.A. Dielemand, G.W.A.M. van der Heijdenc" presented the method for identifying and counting fruits from images in cluttered greenhouses and described two methods to find and count pepper fruits: the first method to find fruits in a single image using a bag-of-words model, and the second method is to get accurate estimates from multiple images using a novel statistical approach to cluster repeated.

[2] The authors Nicolai-Haeni, Pravakar-Roy, and Volkan-Isler presented the paper named "Apple Counting using Convolutional Neural Networks" to Estimate the accurate and reliable fruit counts from images in real-world has received significant recent attention. Estimation of fruit counts before harvest provides information for logistics planning. When progress has been made towards fruit detection and estimating the actual counts remains challenging. In practical cases, fruits are often clustered together. So, methods that only detect apples fail to offer general solutions to estimate accurate fruit counts. In this work, the author formulated fruit counting from images as a multi-class classification problem and solve it by training a Convolutional Neural Network(CNN).

[3] The Paper "Image Segmentation for Fruit Detection and Yield Estimation in Apple Orchards" presents an image processing framework for fruit detection and counting using orchard image data. A general-purpose image segmentation approach is used, including two feature learning algorithms; multi-scale Multi-Layered Perceptrons (MLP) and Convolutional Neural Networks(CNN).

[4] The Paper "Recognizing and counting Dendrocephalus brasiliensis (Crustacea: Anostraca) cysts using deep learning" discusses an automatized approach for the detection and counting of Dendrocephalus brasiliensis cysts from images captured by a digital microscope.DBrasiliensis dataset includes a repository with 246 images containing 5141 cysts of Dendrocephalus brasiliensis and trained two state-of-the-art object detection methods, YOLOv3 (You Only Look Once) and Faster R-CNN (Region-based Convolutional Neural Networks), on DBrasiliensis dataset to compare them under both cyst detection and counting tasks.

[5]The Paper "Disease Detection in Plants using Convolutional Neural Network" mainly based on a new technique of identifying the diseases in plants by Image processing is done by capturing the infected region of an image. The infected image is provided for enhancement followed by image segmentation. then, the segmented image is given as input for the classification using a convolutional neural network.

[6] Sachin D. Khirade, A. B. Patil proposed a method for the detection of disease in fruit plants using the leaf region of a plant. And it also discusses the segmentation techniques suitable for better identification of diseases and also other methods for the extraction of features are used for the detection of diseases in plants.

[7]Reeba Korah S. Maheswari proposed an image segmentation method in which the region of interest is extracted using RGB values.

III. PROPOSED SYSTEM

The main purpose of this work is to present a system to count the number of fruits from the image automatically. The below figure will give a brief idea of how fruits can be detected and counted using this system.

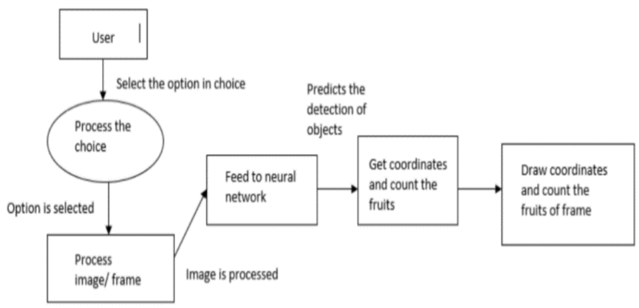

Figure 1 System Architecture

This system is used to count the number of fruits like apple, orange, carrot, broccoli, banana. In this application, users have two options either to upload an image or to capture from a webcam. Capturing an image can be done by using mobile through the application, downloading from the internet, and many more. While capturing the image user has to follow certain guidelines like the image should not contain any shadow or illumination effect clamor, and brightening effects, etc. An image should not be blurred and the image should have good clarity like Hd quality images will get a proper count. For apple,banana and broccoli certain space between each fruit is required. The user needs to give input images accordingly. Once when the user chooses the option and providing the input image it processes the respective image/frame through image processing. After image processing, the system detects the location and counts the number of fruits in the image. The system is implemented using colab, Opencv, Tensorflow, Neural Networks and is coded with Python. Below are the steps involved in this system.

Data Collection

The first step is data collection where data is collected to pass it to the neural network. In this step large amount of data is collected to increase the accuracy and to build a successful system. For that reason, we are collecting a maximum data as possible.Data Collection is very important as the performance of the system depends upon the number of data collected.

Data Labelling

There are different types of architecture available for object detection. In a neural network, there are different types of neural networks and even can design our neural network So choosing the right architecture is important while building a system. In this system, we have used Yolo Architecture which is the most accurate real-time detector. The reason we are using Yolo architecture in this system because it is simple and is very useful for object detection. YOLO (You Only Look Once) algorithm, that uses neural networks to provide real-time object detection. This algorithm is popular because of its speed and accuracy.

Training the System

The training system is a most complex process, once a network has been structured for a particular application, that network is ready to be trained. After selecting the right architecture, it is required to edit the configuration files of the YOLO architecture. In this step for training the system, we have used Google Colab cloud to get a high processing system or cloud. Since we don’t have highly efficient GPU systems we have used Google colab cloud. We have used Colab because it supports the most popular machine learning which can be easily loaded in our notebook and also it allows anybody to write and execute the python code easily through the browser.

By using this cloud we have trained the system and generated the weight file.

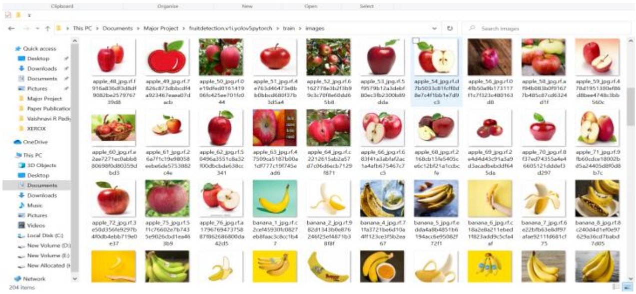

Figure 2 Training dataset

Script Prediction

In this step, we are making a script for prediction after the weight file is generated. First, we have loaded the weight file and then passed an input image through it to get the script for prediction. We can calculate the prediction only after the image is passed with the help of weight files. In this we have used Opencv is an open-source computer vision and machine learning software library because to give an image as the input and it will help us to pass through the weight file and results from the output. The result will be in the form of coordinate values and values are added in the image.

Creating GUI Using flask

Creating Graphical User Interface using a flask is the final step to build this system. There are many libraries available in python. We have used flask because it is simple to create GUI and also neural network can be deployed in Flask library. We have also created HTML and CSS pages and deployed the neural network-scripts into this flask while creating the GUI in the flask. So after deploying the neural network we can pass the data through the browser and this gets connected with the backend through the neural network and provides output to the user. The output is displayed to the user with the help of Flask.

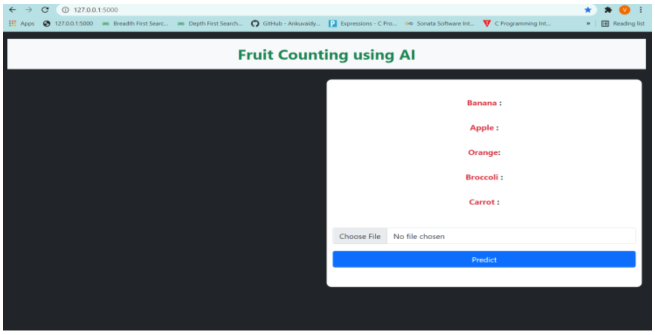

Figure 3 Front End design

IV. RESULT ANALYSIS

The system is developed with a user friendly GUI. The results after counting the number of fruits and comparison between manual and system count are given.

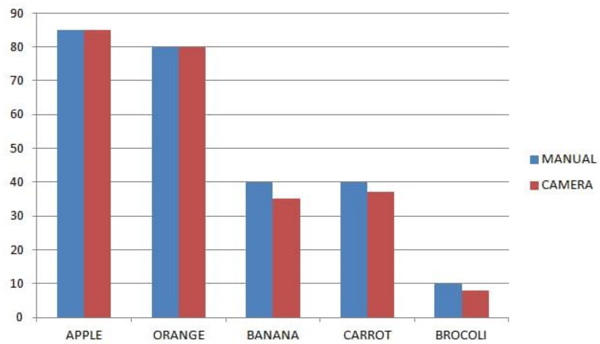

Figure 4 Comparison Between the manual and Camera count.

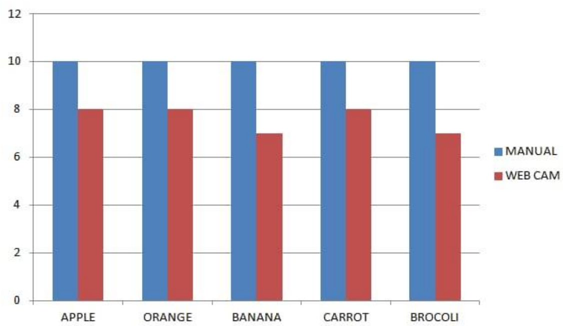

Figure 5 Comparison Between the manual and web camera count.

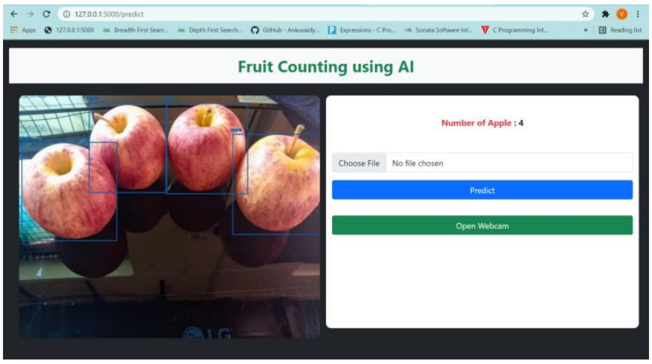

Figure 6 Counting number of apple fruit.

Figure 2 shows the number of apples. The proposed system will recognize the fruit in the image and also counts the number of fruits correctly. In this GUI, to count the number of fruits in the image, the square is fitted in the desired apple. Similarly, this system will work for orange, carrot, banana, and broccoli.

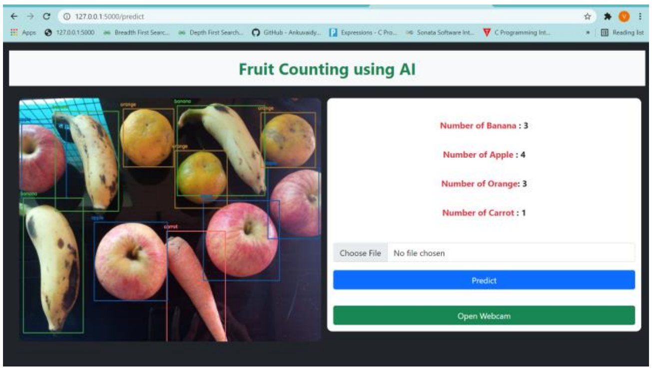

Figure 7 Counting Number of Mixed Fruit.

Figure 7 shows that the framework works fine when the image consists of a bunch of mixed fruits. The square is fitted for the fruits like apple, orange, banana, carrot, and broccoli. Recognizing and counting of mentioned fruits are exact. The proposed system achieved excellent accuracy

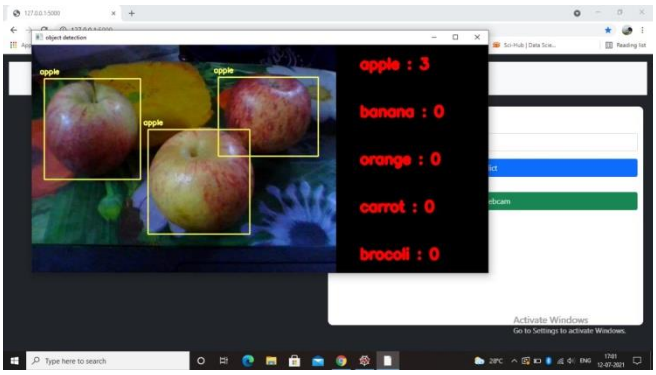

Figure 8 Counting Number of real time fruits using web camera option.

Figure 8 shows the framework that works fine with web camera option for real time fruits. User can place the fruits in front of camera and the system will count the number of placed fruits.

V. CONCLUSION

The proposed system deals with recognizing and counting the fruits from the images. Modern technologies are used to build this system. A lot of labor and different types of tools make manual counting expensive. The system has limited the count and obtained great success in recognizing and counting the fruits by either image uploaded by the user or captured. The neural network is developed to identify the fruits such as apple, orange, banana, carrot, and broccoli. A Yolo architecture for fruit detection was proposed in this paper. Datasets were used to evaluate the proposed framework. It achieved an excellent accuracy of 85% on the dataset.

In the future, we can decrease the limitations of counting so that the system can be used in large industries. This project is done by keeping one user in mind, but in the future, this system can be used for small and large industries. We can also try to collect more datasets and alter the system to count for other fruits and vegetables too.

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