International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-11, September 2019

Image Processing of Vegetables and Predicting Disease

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Abstract*: Diseases present in vegetables as well as fruits are producing huge number of sufferings in the economic losses with addition to the losses of our agricultural industry worldwide. The main concern of this project is to understand various issues faced by the farmers in addition to consumer community also and hence to deliver a solution in regard to this major issue for farmers in detecting and classifying the category of the disease present in the vegetables and fruits. According to various studies we concluded that the diseases could occur through various aspects like viruses, fungus, bacteria etc. Hence as a result there is a great need to terminate such precious losses to the vegetables along with the farmers and in addition with the whole agricultural environment. Sometimes not only such aspects can cause damage to the vegetables but also there are many more reasons which are improper transportation of these vegetables from one origin to another, diverse climatic conditions could also be a reason of such causes. We have used python as a programming language with OpenCV library and HSV model of object detection to derive the optimal results. This library is used to perform several image manipulation operations. The dataset including numerous amount having traces of bacteria, fungi, etc. on vegetables are created. Then we implied HSV model which helps us to detect the spots or we can say traces of bacteria, fungi on the vegetables and hence the mask of that region is separated from the RGB image. GUI is created in python only which makes the program interactive with the user. Hence as a result we are able to see different types of spots for different type of disease.

***Index Terms*: HSV model, Image manipulation, OpenCV, RGB image**

I. INTRODUCTION

Agriculture is considered to be the crucial part for huge bulk of people which are dependent on agricultural practices to earn their living. This field is especially opted by many people in our country India due to various reasons and studies concluded that almost about two-third population which we are having are engaged upon agriculture for having wealthy life for them as well as their family. Not only has this but the results also mentioned that almost every citizen is directly or indirectly dependent on such practices.

Manuscript published on 30 September 2019.
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Not only this, but they are also have great amount of contribution towards the GDP of our nation which is almost around 36.2 percent which was recorded by the last survey conducted.

No. Of Workers (in million)			Worker Participation Rate (%)		
Total	Rural	Urban	Total	Rural	Urban
482	349	133	40	42	35

Farm Workers	Total (in million)			% of Total Workers		
	Total	Rural	Urban	Total	Rural	Urban
Cultivators	119	115	4	25	3	3
Agricultural Labourers	144	137	7	30	39	6
Total farm workers	263	252	11	54	72	8

Fig1: Participation of people in Agricultural activities [1]

As we know that India is referred as an agricultural nation worldwide. Therefore, farmers produces huge range of vegetable crops in appropriate or we can say suitable areas where different vegetable crops can sustain their availability for example vegetable crops such as brinjal, Lady Finger, etc. are grown during the summer period. As we have huge variety of climatic conditions, need to take good care of the vegetable crops so as they can sustain for a longer duration of time. Also major issue which is terminating the important vegetable plantations is continuous increase in the degrees of the temperature on earth that can be referred as global warming. Due to this issue the water level on earth is decreasing and due to such adverse effects vegetable crops are declining at constant rate and due to this reason water supply to them may be inadequate. Survey was conducted for determining the sufferings of these crops and results shows that it's not the farmer's fault but adequate water supply is not provided in several rural areas due to which risk of availability of several diseases increases at a constant rate. So the optimal solution for this issue is effective irrigation methods such as drip irrigation. According to various studies we concluded that the diseases could also occur through various aspects like viruses, fungus, bacteria etc. Hence as a result there is a great need to terminate such precious losses to the vegetables along with the farmers and in addition with the whole agricultural environment. This disease caused by fungus, viruses or bacteria can spread by various means such as through air, high quantities of fertilizers or even excessive use of pest control spray. Sometimes, flying insects may transport such bacteria in vegetable crops.

It is very challenging task for the farmers to identify the presence of such disease causing particles at a very starting age. Even if they are successful in observing the disease then in this worst
scenario they are unable to predict the disease type and hence fails to kill the substance which are effecting vegetable crops or unable to find the optimal solution to overcome the disease.

To overcome this vital issue researchers have proposed such advance computing mechanism system which are able to predict the type of disease through infected images of various vegetable crops. The image is snapped through the high resolution cameras of phone and the operations on images are performed using python programming language in addition with the opencv, numpy libraries and as a result we are able to identify the spots or traces on vegetable samples and hence disease can be predicted by observing the nature of the spots. HSV object detection model is implemented for accurate perception of the spots present on the maintained dataset.

The most challenging task during the phase of task was maintaining the productivity of images with maximum details present in spots. It is very dominant task to produce the image including all details which can fit in optimal memory space. These images are snapped through AI cameras and hence are very large in terms of size. Another typical task we have gone through was to overcome illumination situation from beginning till end. Illumination differs lot even though when the time was fixed while snapping. Therefore, the solution for numerous user explain thresholding with producing necessary needs.

We observed that for the background colour removal color space manipulation from RGB to HSV is ideally useful. We concluded that thresholding methodology provides ideal result as compared to background removal methodology. We evaluated color segmentation through masking of green pixels in background and then implementing thresholding on derived masked image to obtain binary image. This could be useful to derive accurate disease features.

II. LITERATURE REVIEW

The application of texture statistics in evaluating the vegetable disease was discussed primarily through colour transformation where RGB is converted to HSV model space due to the factor that HSV is good approach to describe the color. Masking in addition to termination of green pixels along with the help of threshold value.

For evaluation of vegetable crop diseases the optimal way for preventing the sufferings in the yield in addition to the quantity of the agricultural product. It requires very high scale of work, with expertized in vegetable crop diseases, also require very much processing time. Therefore, image processing or manipulation is implemented for the evaluation of vegetable diseases. Disease detection involves numerous number of methods such as image acquisition, image segmentation, image annotation, pre-processing of images, extraction of the features and classification. This project shows several methods implemented for the evaluation of vegetable diseases. This paper had come up with various ways to segment the disease part of the vegetable. This paper also described about few ways for extraction of features with classification methodology so we could extract the features of suffered parts as well as the classification vegetable disease. The optimal detection in addition to classification of vegetable diseases is essential part for the successful cultivation of various vegetables and that could be achieved using image manipulation. This paper also mentioned about numerous methods to segment the disease spot of the vegetable. Some Feature extraction along with classification methodology were also discussed which could be implemented so as to extract the features of defective parts of vegetable and the classification of diseases. The usage for ANN methodology so as to classify the disease inside vegetables like self- organizing feature map, SVMs etc. could ideally be used. From the help of such methods, we can ideally identify and classify several diseases by the implementation of image processing methods.

III. METHODS

A. Methodology

We have used Python programming language because it is universally useful with various potential favorable circumstances for image processing and it is open source language so its utilization acquires no expense or authorizing. It runs in most of the operating systems such as MAC OS X, linux, and Microsoft windows. It is also very easy to learn and understand python because the syntax is designed as English-like syntax, it is object oriented (like JavaScript), dynamically typed language. Most importantly for the project to image processing of vegetables there are many modules and packages both incorporated into the Python and accessible as additional items (add-ons) which plays a major role in object detection under image processing. So that's what makes python to be the most suitable language for the project.

Some python libraries/modules used in the project are:- Numpy- to store and manipulate image data.

Opencv- to do all the operations identified with Images

[3]. Tkinter- to handle all the GUI operations.

For IDE we have used PyCharm, PyCharm is one of the mostly utilized IDEs for Python programming language. In fact, PyCharm is used by many of the big ventures like Twitter, HP, and Symantec. It is compatible with microsoft windows, linux and Mac. In the meantime, the highlights given by PyCharm help developers to compose an assortment of programming applications in Python. The developers can even play with PyCharm UI as indicated by their particular needs and inclinations. Additionally, they can broaden the IDE by browsing more than 50 modules to meet complex project necessities.

A tab named as health predictor is inculcated in the GUI through which if the image which user wants to check for the disease, then he/she can check through it. If in case the image selected is not present in the database then it will automatically suggests the name for the healthy vegetables that you should refer. The path to the image can be selected through the browse tab which is also available in the GUI.

B. HSV Model

HSV model is a recognized cylindrical-shaped arrangement ofdifferen points in a RGB model. HSV is an acronym for hue, saturation, and value. So HSV is a shading model that depicts hues (tone or tint) as far as their saturation (immersion or measure of dark) and their value (luminance or brightness) [4]. The principle of this model is cylindrical shaped geometries with shade, their precise measurement, beginning at the red essential at 0°, going through the green essential at 120° and the blue essential at 240°, and afterward wrapping back to red at 360°.The two portrayals rework the geometry of RGB in an endeavor to be progressively instinctive and perceptually important dependent on the shading. Saturation
(s) of the shading varies from 0 to 100 %. Likewise once in a while it is also referred as the "purity". Lower is the saturation of shading, more is the "grayness" available and the more blurred the shading will show up. Value (v) of the shading varies from 0 to 100%.

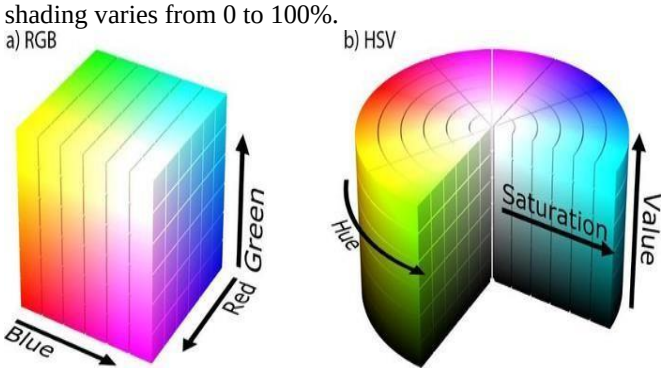

Fig2: RGB vs. HSV model [2]

The advantage of using the HSV model is that the HSV color space is very like the manner by which people see color [5]. Different models, aside from HSL, characterize color in connection to the essential colors. The colors utilized in HSV can be plainly characterized by human recognition, which isn't generally the situation with CMYK or RGB.

C. Alternate Ways For Object Detection

TENSORFLOW: TensorFlow is an open source library that is utilized to execute artificial intelligence and the frameworks. These two names contain a progression of incredible calculations that offer a typical test—to enable a PC to figure out how to naturally spot complex examples or potentially to settle on most ideal choices. It uses different enhancement methods to make the figuring of scientific articulations simpler and more effective. Some interesting features about TensorFlow are proficiently works with scientific articulations including multi-dimensional arrays, great help of neural systems and artificial intelligence ideas, high adaptability of calculation crosswise over machines and tremendous informational indexes [6]. Together, these highlights make TensorFlow the ideal structure for machine learning at a generation scale.

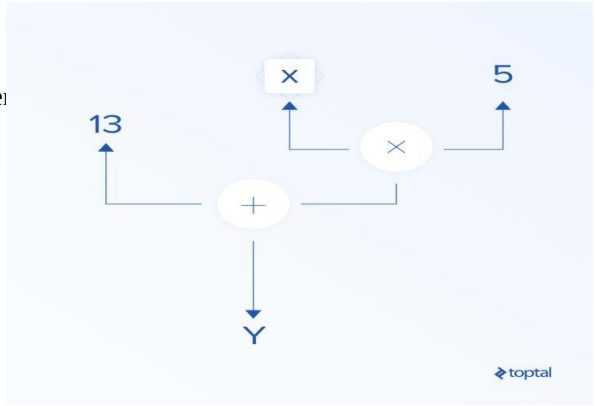

Fig3: Data flow graphs [7]

In TensorFlow, calculation is portrayed utilizing information stream charts (flow graphs). Every hub of the chart speaks to a case of an arithmetic activity (like +, -, or *) and every edge is a multi-dimensional informational collection called as tensor at which the tasks are accomplished.

YOLO: By using “You only look once (YOLO)”, as the name suggests object detection can be done in real time. YOLO has its own slick design dependent on CNN and rectangular boxes and is demonstrated to be an in-a-hurry object detection strategy for broadly utilized issues [8]. YOLO breaks the picture into a network S×S parts, each of these parts is in charge of foreseeing 5 jumping boxes. A jumping box portrays the box shape that encases a particular material. YOLO also shows a score that how much accurate is the result of every object detected.

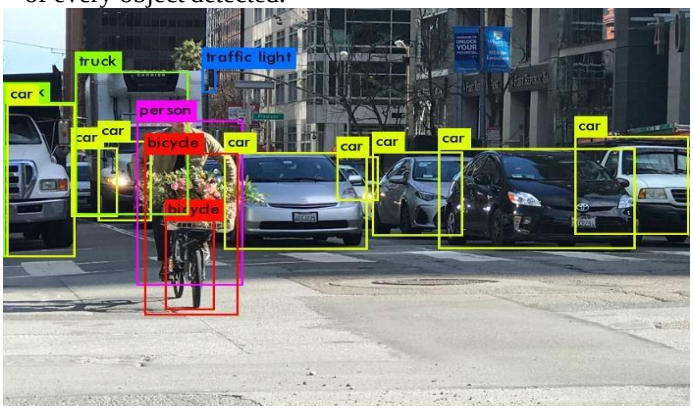

Fig4: Objects detected by YOLO [10]

Earlier location frameworks repurpose classifiers or localizers to perform recognition. They apply the model to a picture at various areas and scales [9]. High scoring districts of the picture are viewed as identifications. YOLO utilizes a very surprising methodology.

It applies only one neural system to the full picture. This system separates the picture into districts and predicts bouncing boxes and probabilities for every area. These bouncing boxes are weighted by the anticipated probabilities [14].

CNN: As the scenario come towards machine learning, artificial neural networks which is known to be the specified kind of convolutional neural networks provides very optimal performance [11]. Such neural networks were used for wide variety of classification purposes such as image, audio, etc. Numerous type of neural networks are implemented to evaluate different tasks like to predict the sequence of words it is more likely to use recurrent neural networks and in contrast to this convolution neural networks are used in image classifications [12]. In neural network mainly there are three different type of layers which are discussed below:

Input Layers: It is the layer through which the input is delivered to model. The quantity of neurons at this layer is almost equal to the total features available in data.

Hidden Layer: After this step data is delivered into hidden layer. We can have several hidden layers depending on the quantity of the data. Each hidden layers could have numerous number of neurons that are greater than number of features. The output at each layer is obtained through matrix multiplication of output at previous layer in addition to learnable weights of layer and then through addition of learnable biases accompanied through the activation function that converts the network nonlinear.

Output Layer: Output at hidden layer is delivered to logistic function such as sigmoid or softmax that converts output at each class to probability score for each class.

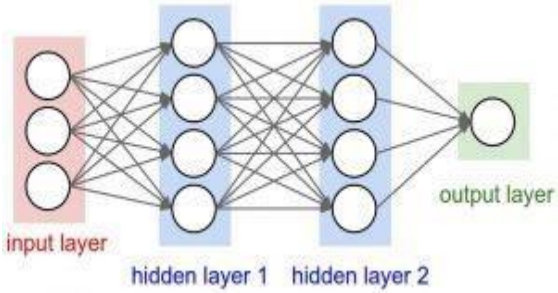

Fig 5: Layers of CNN [13]

IV. RESULT

In this project we have collected few images of vegetable crops which are affected with diseases. Also a healthy data set is maintained keeping in mind that if the user couldn't find out the disease through available dataset then the user could be able to look for the same in health predictor and the response will be automatically provided by it through which the user would able to know the condition of the vegetable selected by the user. GUI is built through which interaction with the user is quite friendly.

Fig 6: GUI

We have used HSV model to detect the affected parts in the vegetables and this model can also be used to detect different colored spots which may not be identified through human eyes. We have only detect spots of few diseases such as powdery mildew, club root, anthracnose. From the study we conclude that the detection in vegetables through image processing is still in progress as its very complicated task to detect disease at very early stage. Also from the survey we have concluded that only 14% of diseases we are able to predict for only particular type of plants or vegetables. For using the HSV model to detect the affected parts in plants the user must have the knowledge of color values to be used so as to trace the spot efficiently. Now here is the bigger challenge for all as being the programmer we have knowledge about only for the few colored spots values, so consider the scenario where we have given the product to the consumer than how does he know what are the values they have to implement so as to get the accurate value or we can say if they have lack of knowledge or no knowledge regarding this than it is completely waste product for them. Hence keeping this scenario in mind we have also built a tool referred as track bar through which the consumer can easily use this product and obtain desired results effectively and as a results solution for preventing the vegetable crops from getting damage can be prevented.

The results which we obtain are discussed below and the outputs are also given so as to identify the nature of the spots present on the surface of the vegetable crops.

A. Powdery Mildew: It is the general type of fungal disease which could easily be identified in vegetables. Low moisture contents in combination with humidity (high) on surface of vegetables makes the condition favorable for them to occur. Although the symptoms are recognizable later during the growing phase. Clearly visible white to grey powdery growth is observable on the infected parts.

Treatment:

a) In the sunny areas resistant cultivators are to be used whenever possible.

b) Too much implementation of nitrogen should be avoided and organic fertilizers should used in very low amount.

c) Milk sprays with combination of 60% water as well as 40% milk are the optimal home- made recipe to prevent vegetables from getting affected.
d) Deploy all debris of plants instead of composting it.
e) If the symptoms are recognizable than use of fungicides can be implemented for the prevention of vegetables.

Samples

Fig 7: Original Image (Green Leafy Vegetables)

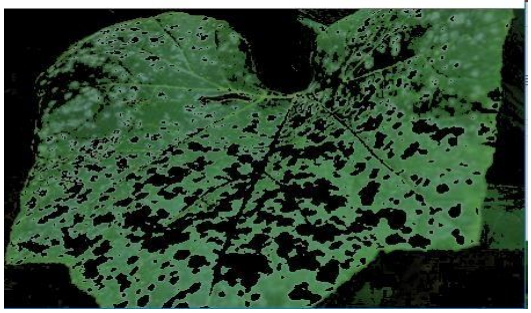

Fig 8: Spot Detection using HSV

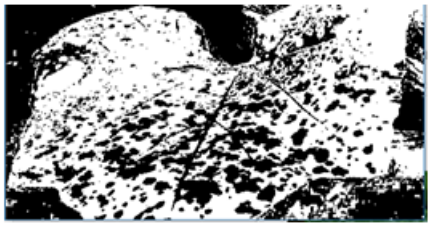

Fig 9: Mask Image

B. Anthracnose: This type of disease is also occur due the presence of fungus in genus colletrotrichum. The infected vegetables have water soak lesions which are dark in texture. The center region of such lesions may develop pink, gelatinous masses during moist in addition to hot climatic conditions. Wet climate in addition to cool atmosphere is responsible for promoting their development.

Treatment

a) Implementation of resistant variety of plants and western style grown seeds which does not have exposure to any sort of disease.
b) Fungicides such as neem-oil spray which have organic properties are to be sprayed to kill the eggs.
c) Vegetables must be treated with SERENADE Garden with proper precautions.
d) Liquid form of sulfur powders along with copper sprays are subjected to the crops on weekly basis.
e) The tools implemented during the harvesting period must be treated with disinfectants after harvesting is done every time.

Samples

Fig 10: Original Image (Capsicum)

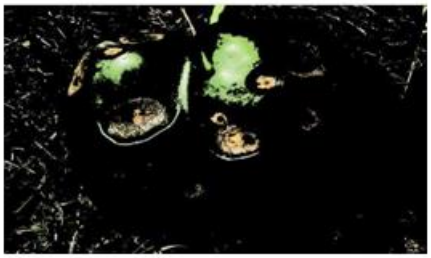

Fig 11: Spot Detection using HSV

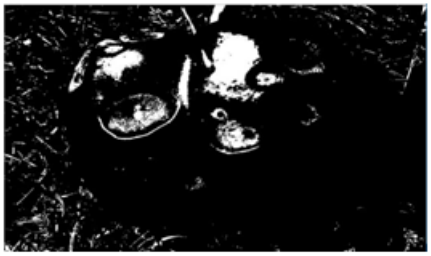

Fig 12: Mask Image

C. Club Root: It is a type of disease which generally affects brassica crops such as broccoli, cabbage, etc. The main reason of occurrence of this disease is due to the presence of soil-borne fungus namely Plasmodiophorabrassicae, generally deploy susceptible plants by passing through root hairs. Infected roots get swollen in addition they get deformed also. Due to this issue the crops are unable to absorb water.

Treatment

a) Proper cleaning of the plantation area to avoid the presence of disease.
b) Garden tools must be sterilized after being used.
c) Oyster shell should be mix in soil to make the pH more alkaline 7.2.
d) Infected plants should be removed.

Samples

Fig 13: Original Image (Roots of Cabbage)

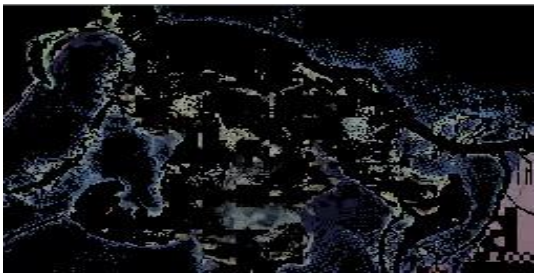

Fig 14: Spots Detection using HSV

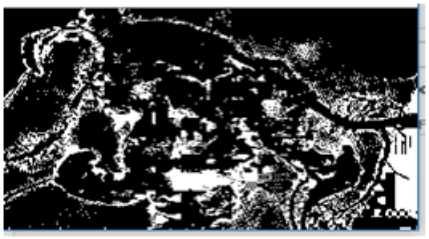

Fig 15: Mask Image

V. CONCLUSION

Image processing of vegetables and predicting disease in them is very challenging task. It can be done by many different image processing methodslike HSV, Tensorflow, YOLO, CNN but the technology which is most effective to obtain optimal results in detection of disease spots in vegetable crops is HSV. It helps in image processing by manipulating the value, saturation and hue of an image and showing the result in three different frames i.e. original image frame, mask frame, and spot detection frame. By using HSV we can detect the disease spots in the vegetables clearly and efficiently. To build the speed and precision of image processing and objectdetection of vegetables we are utilizing opencv module and for user interaction we used a GUI making module of python language which is Tkniter. After completion of the project we can say that the user could detect the disease spots in vegetables easily with the help of HSV model used in the project and will also able to detect whether the vegetable is healthy or not by using the health predictor function.

VI. FUTURE SCOPE

The examination in the field of image processing should proceed as an ideal and clear counter for image processing isn't accomplished at this point. Also many modifications are there which can be made in this project to make it more convenient to use, such as real time image processing of vegetables using a camera or it can also be shifted to cloud platform. As we have discussed above that currently we are only able to find some particular types of diseases in only few species of crops hence, we are looking further to detect more varieties of diseases. From studies we have concluded that with the help of infrared we will be able to exactly identify the nature of disease so as to achieve this we have to set infrared light at certain wavelength. In addition to making this evaluation in real time scenario we are looking further to make an API of this as well using flutter technology which is demand now as using this frame work we don't have to perform separate coding for android and ios. To achieve this we also have to learn dart language which is used to develop the API. Another addition to this is that we can also display the result after detection to the website which is direct touch with research departments so as the optimal solution could be provided. As you can see from the result section that at present we are able to identify the spots only when they are visible in such scenarios it is not have good worth so the system could also be developed through which we can identify the disease at very beginning stage.

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