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ARTIFICIAL INTELLIGENCE FOR AGRICULTURE: A TECHNIQUE OF VEGETABLES CROP ONION SORTING AND GRADING USING DEEP LEARNING

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Abstract: - A highly use of artificial intelligence (AI) in agriculture are most important in recent days. The technology use is a trending approach for development and innovation of agriculture. An India is the second largest onion produced country in the world. So in our proposed research works focused on identification and classification of healthy and defected onion. Use of deep learning technology which is types of artificial intelligence to solve the identified problem. The deep learning based Convolution Neural Network (CNN) architecture developed, train and tested on onion images datasets. The CNN model providing the performance metrics i.e. accuracy on training datasets is 97.59 % and 92.45% on testing. So, proposed model precisely identified the quality of onion and classified as healthy and defected onion. The onion model sorting and grading onions quality, which support of more production onions in the country. The onion farming ultimately gives more profit to the farmers, which motivates farmers for onion agriculture**.**

Keywords: - *Artificial Intelligence (AI), Deep Learning, Convolution Neural Network (CNN), Sorting and Grading (S & D, identification and Classification.*

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I INTRODUCTION

An agriculture growth is source of wealth and its development depends on huge productions. The India is the second largest onion production country in the world. The India's onion having its own identity with taste and famous in the entire corners of world. The onion production and harvesting in the country mainly from November to June and onion available through years. There are different category of onion like light red, dark red, white and rose red [1]. The demand of onion is huge in world due to its taste and also important for health's of human being. The onion is crops which are most important to earn from foreign exchange and economy support to the country. The Indian onions farms have acquired 695 thousand hectors land and production around 9248 tons and 1378 thousand exported in 2007. The onions exports are now increases up to 10 thousand millions tons in 2021.

The artificial intelligence (AI) increases these productions precisely by grading and sorting good quality of onions to sell into market or store, which improves the gross domestic product (GDP) country. There are onion farming challenges likes shortage of onions, price hikes and loss due natural disaster and many more. The world population continuously increasing and also demands of onions increased so, huge production needed and important in coming years.

1.1 Onion Nutrients

The onion includes a vitamin C, flavonoids, phytochemical and sulphuric which gives healthy compound to human body [2]. The sweet onions are very famous and available in the market which produced in the low level sulfur type soil in the specific regions [3].

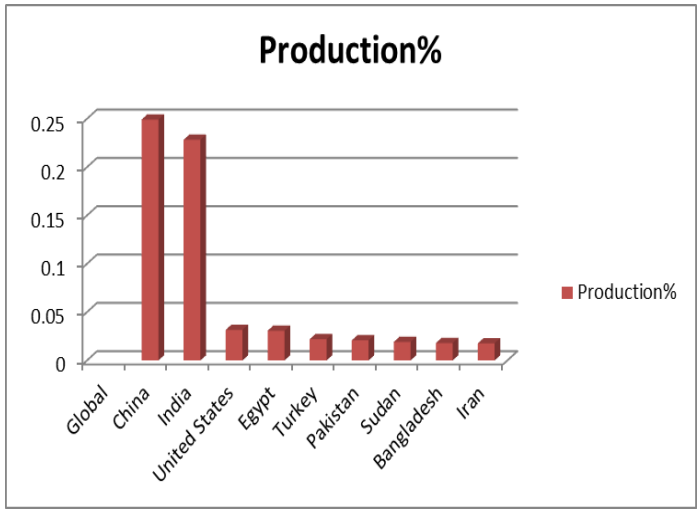


Figure -1: Onion production V' s Country

To find onion nutrient a spatially resolved transmittance spectroscopy system which detecting internal rots in onions. The near- infrared spectroscopy transmitter measured

the rot- affected onions. [4]

The figure 1 shows the onion production in the different country with relatively percentage of productions (%). From the complete productions total 65% of global onions produced by eight countries and India ranked second in the world. The onion is most important vegetable crops eaten in world followed by tomatoes and potatoes. In the global 8.4 million of tons onions are produced and eaten every year in the world.

1.2 Highest Onion Production Country

In the global eight countries produced the onion which includes China, India, United State, Egypt, Turkey, Pakistan, Sudan, Bangladesh and Iran. The total production in the world India is producing 22.83% onions productions.

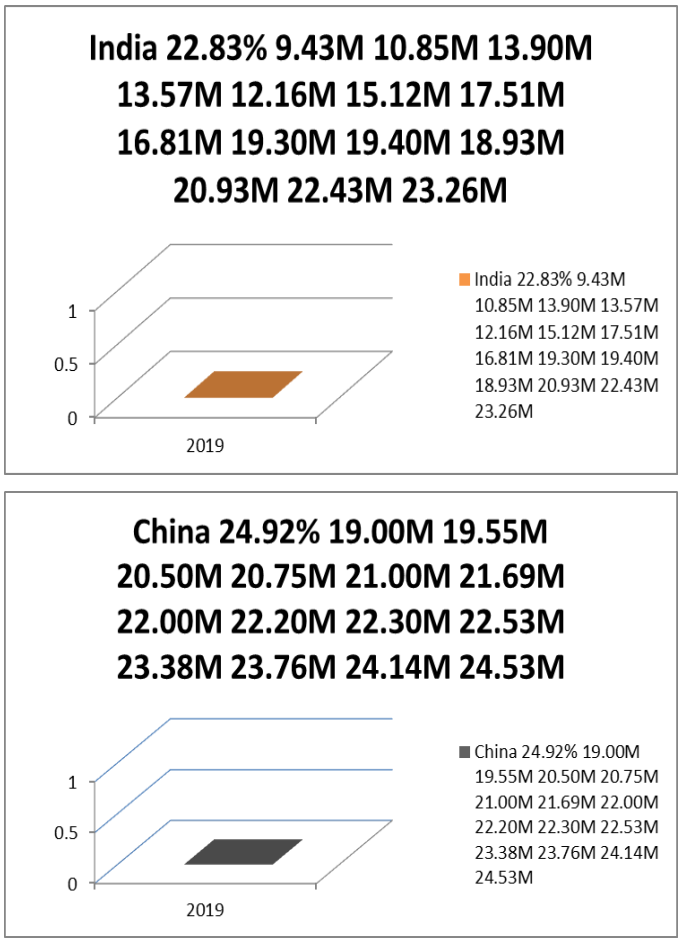


Figure -2: Onion Production in India and China 2019

An onion prices are always volatile which always impact on farmers, consumers, traders and even governments. The things important to manage about onion farming are the investments decision; resources allocations are difficult. The consumers are always opposing and force to reduce onion prices in the country when it is suddenly hike. The volatile prices managing or balance is very difficult task for government which is always hard to balance between farmer and consumers [5].

The onion crops include various factors which affected the onion prices, variations in the rate, low productivity, and constraints with the storage, market demand and supply, market efficiency, marketing and export policy of government all are the important consideration while needed and support to onions farming. The shortage of onions in the market due to loss In the storage methods, which need to improve so we can support to balance the required of onions not only in our country but also for whole world [6].

II MATERIAL AND METHODS

2.1 Grading and Sorting Onion Techniques

The sorting and grading of onion carried on the basis of size, quality and shapes. The better quality of onions also helps for strong economy gain for farmers. The sorting of onions with size as small, medium, large and extra-large and weights also co-related respectively with 115gm,170gm, 285gm and 454gm. The diameter of onions which are between 1 inch to 4 inches. The following table 1 show grading and sorting and crucial parameter size weight and diameter mentioned.

TABLE 1 ONION GRADING PARAMETER

Onion Parameter			
Onion	**Average**	**Weight**	**Diameter**
Size	**Weight**	**Range**	**(in inches)**
Small	115g	144g or less	1 to 2.25
Medium	170g	144g to 230g	2.25 to 3.25
Large	285g	230g to 345g	3.35 to 4
Extra-Large	454g	345g or more	4 to more

The prices of onions depend on size and consider while sell into the open markets. The demands of medium onion are high as compare small and large or extra-large onions. But many of farmers sell the onion without grading and sorting the onions, so famer getting lower value of onions which they have produced. The manual grading doing the seller and retailers and they are earning more or almost double profits than the farmer. The farmers always facing major issues with manpower and cost to grading the onions. So, in our proposed research help lot for problem and issues of farmers facing in onion farming [7].

2.2 Sample Image and Datasets Preparations

With the different tools and technology are preferred same tested for onion sorting and grading techniques. A Lab view is the software developed which identify colour of images,

spectral images, and depth on onions. The measure and count the weight also possible with collected multimodal onion datasets. The model finds maximum diameter, volume and density to identify the defected and healthy onions. The onion result tested on sweet onion to measure the weight, volume and density and classify as healthy and defective onions with accuracy is 88.9 %. The model also helpful to inspection of similar feature of crops [8].

The sample dataset preparation and data collection are the important steps for proposed research. So the two categories of onions images i. e defected onions and healthy (good quality) types of sample collected. The collected sample has divided into training and testing datasets.

The figure 3 shows the sample images of two categories are identifies and classify as below.

Figure -3: A: Defected (Unhealthy), B: Healthy (Good Quality)

The total numbers of sample collected for healthy or good quality are 104 and for unhealthy or defected onions are 96. The sample includes different size color and single and group of onions.

2.3. Data Augmentations

The data augmentation is a technique used to automatically expand the size of a training dataset. The images created and modify in the dataset. The number of sample images is more which ultimately gives more the accuracy for classification between healthy and defected onions and also improved lot.

To train the deep learning neural network models on more data which result in more accurate models. The augmentation techniques create variations in the images that improve the ability to fit models to generalize what model learned to new applied images. The deep learning neural network keras library provides the capability to fit models using image data augmentation via the Image Data Generator class. The process of augmentation where all the images rotate, cropping, flipping, shearing, zoom in and zoom out the samples of images.

III EXPERNIMENT & RESULT

3.1. Convolution Neural Network

The deep learning (DL) based techniques detect and extract the features of onion images. The deep learning with Convolution Neural Network (CNN) architecture used take the input images apply the filter or kernel, pooling layer, flatten layer followed by activation functions. The convolution neural network based model finding information from the images and classifies accordingly for better performance and achieved high accuracy. The convolution neural network training model required high volume of images as train and test datasets. The image datasets convert into the train and test and process with high configuration computing system.

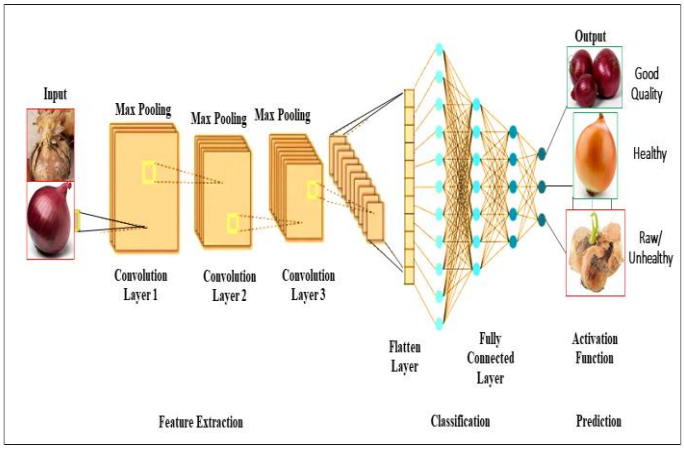


Figure -4: Convolution Neural Network (CNN) Onion Classification Model

The cloud based tools also available for this solution. The cloud based solutions is always successful, beneficial and effective, which easily deploy at any platform. The figure 4 shows the structure for onion classification model which identify the good quality or healthy and defected onion or unhealthy onions from given image dataset. The CNN model having different hidden layers which filter the features images and applied to next layer and finally to activation function. The choice of activation functions in the hidden layer. The activation function added into an artificial neural network to help network learn complex patterns from the image datasets.

3.1. Hyper-Parameters Tuning

In the hyper parameters tuning number of epochs, hidden layers, hidden nodes, activation functions, drop outs, learning rates, batch size are used. The hyper parameter tuning affects the performance of model. The hyper parameter tuning means repeated adjustments of hidden layers, epochs, activation function or learning rate. The fine tuning of the model optimized best accuracy and minimizes the average loss of model. The learning rate is parameter it should not small or large, in the small learning rate over fitting occurs and large learning rate support to regularization the training datasets. The diverge is happen with very high learning rate. The variation with learning rate is best for training model. Setting the increase LR and slowly observation at always achieved best result if model.

TABLE 4 HYPERPARAMETER SETTING PARAMETER

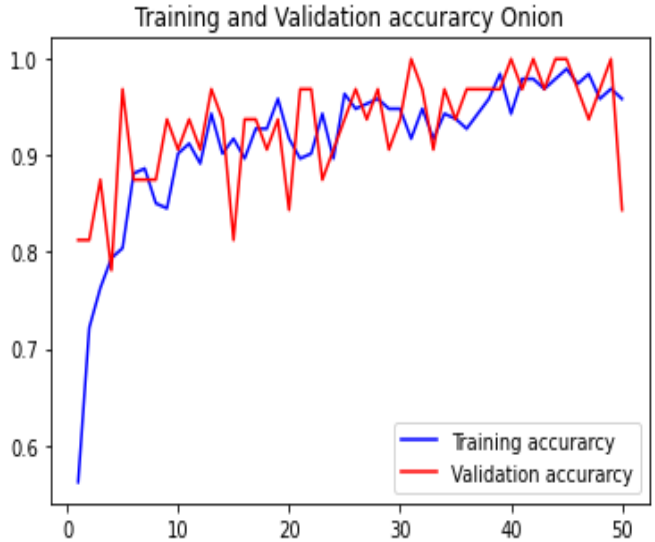
Hyperparameter	Values
Input Image Shape	(224,244,3)
Kernel Size	(3,3)
Pool Size	(2,2)
Drop Out Rate	0.25
Activation Function	Rectified Linear (ReLu)
Batch Normalization	256

The onion model train and tested for different hyper-parameter values setting across and best fit model with the data setting number of times. The table 4 values show where model is best fit model.

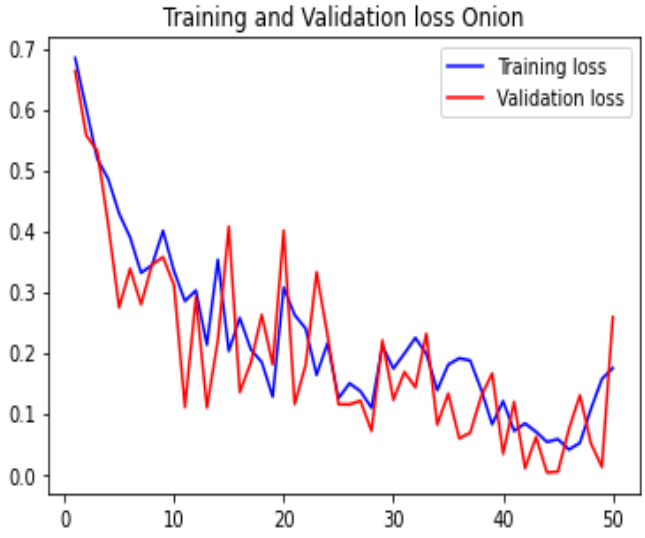
TABLE 5 MODEL TRAINING & TESTING ACCURACY

No. of Epochs	Training Accuracy	Testing Accuracy
Onions (50)	97.57	92.45
Onions (60)	**98.45**	**94.84**

The model training and validation accuracy and loss show in the chart 1. The model train and test with datasets and best accuracy noted with training parameter show in table 7. The table 5 show training and testing accuracy, the training accuracy taken over images available in dataset and testing accuracy calculated over the field images, which is 92.45 % and 94.84% for 50 and 60 epochs respectively



(a)



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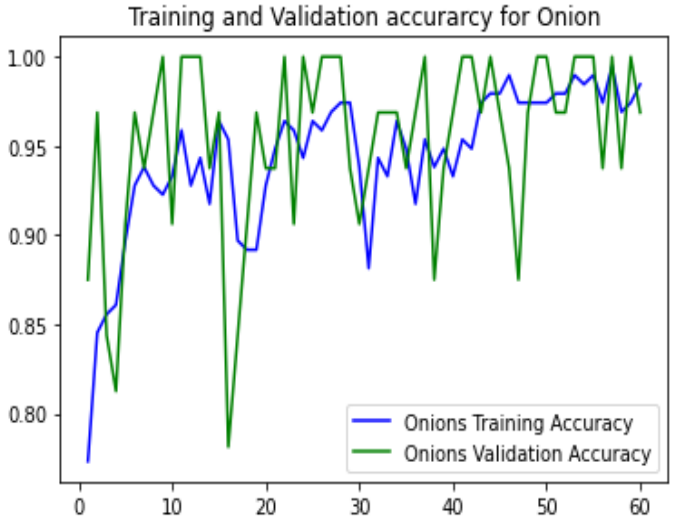
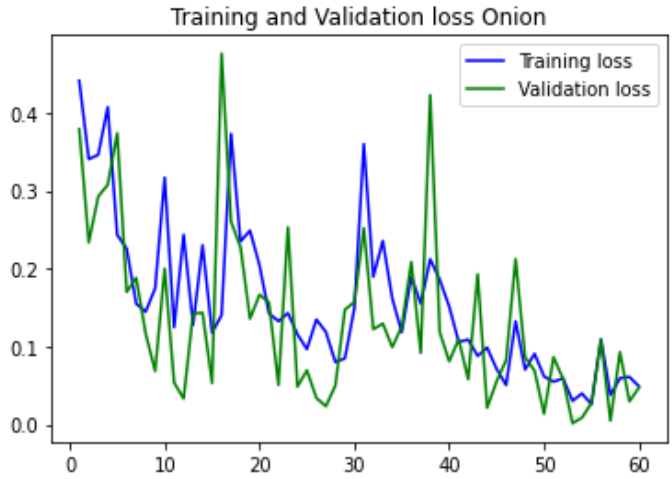


(c)



(d)

Chart -1: Training Validation Accuracy (a,c) & Loss (b,d) Onion

The training the Convolution Neural Network (CNN) model by setting the parameter mentioned in table 7. The model sets for different value of batch size, epochs, learning rate and image size. The batch size and epoch are support getting best accuracy and best fit model with below parameter.

TABLE 6 TRAINING PARAMETER SETTING

Parameter	Setting
Batch Size	42
Epochs	50,60
Learning Rate	0.002
Image Size	256 x 256 x 3

TABLE 7 MODEL EPOCH WITH TRAINING AND VALIDATION ACCURAYC AND LOSS

Pre-trained Model 50 epochs (%)			
Training accuracy	*Validation accuracy*	*Traning Loss*	*Validation Loss*
0.9759	**0.9688**	**0.0572**	**0.0055**
Pre-trained Model 60 epochs (%)			
Training accuracy	*Validation accuracy*	*Traning Loss*	*Validation Loss*
0.9845	**0.9688**	**0.0491**	**0.0473**

TABLE 8 PRE-TRAINED MODEL 50 EPOCH WITH TRAINING/ VALIDATION ACCURAYC AND LOSS

IV CONCLUSIONS

In our proposed research work, there are two types onions healthy (good quality) and unhealthy (defected onion) collected and prepared the dataset. In the next steps with data augmentation, image pre-processing, model architecture images are applied and processed. The input images are applied to the convolution neural network (CNN) model. So in our research work deep learning CNN model achieved accuracy for training images is 97.59 % and for testing images accuracy is 92.45%. The main focused of the research to provide the advancement in the onions agriculture and increase onions production. In the future, same model implement and process on the NVidia Jet son Nano hardware. The ultimate target of research is to increase the profits of onion farmers and export more onions in the global market and same helps for strong economic support in the agriculture onions. Hence, this research study attempted to design, development and performance optimization low cost machine for size, quality grading and sorting of onions.

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REFERENCES

[1] A. Nile, E. Gansukh, G. S. Park, D. H. Kim, and S. Hariram Nile, "Novel insights on the multi-functional properties of flavonol glucosides from red onion (Allium cepa L) solid waste – In vitro and in silico approach," *Food Chem.*, vol. 335, no. July 2020, p. 127650, 2021, doi: 10.1016/j.foodchem.2020.127650.

[2] M. S. S. Alijla, "Deep Learning for Classifying Types of Onion using Google Colab," vol. 5, no. 1, pp. 51–56, 2021.

[3] K. S. Yoo, L. M. Pike, B. S. Patil, and E. J. Lee, "Developing sweet onions by recurrent selection in a short-day onion breeding program," *Sci. Hortic. (Amsterdam).*, vol. 266, no. October 2019, p. 109269, 2020, doi: 10.1016/j.scienta.2020.109269.

[4] J. Sun, R. Künnemeyer, A. McGlone, N. Tomer, and K. Sharrock, "A spatially resolved transmittance spectroscopy system for detecting internal rots in onions," *Postharvest Biol. Technol.*, vol. 163, no. January, p. 111141, 2020, doi: 10.1016/j.postharvbio.2020.111141.

[5] P. Birthal, A. Negi, and P. K. Joshi, "Understanding causes of volatility in onion prices in India," *J. Agribus. Dev. Emerg. Econ.*, vol. 9, no. 3, pp. 255–275, 2019, doi: 10.1108/JADEE-06-2018-0068.

[6] W. F. Buelher, "Review of literature chapter 2 review of literature," *Status I*, no. 1990, pp. 11–54, 1988.

[7] D. M. C. C. Gunathilake, W. M. C. B. Wasala, and K. B. Palipane, "Design, Development and Evaluation of a Size Grading Machine for Onion," *Procedia Food Sci.*, vol. 6, no. Icsusl 2015, pp. 103–107, 2016, doi: 10.1016/j.profoo.2016.02.022.

[8] W. Wang and C. Li, "A multimodal machine vision system for quality inspection of onions," *J. Food Eng.*, vol. 166, pp. 291–301, 2015, doi: 10.1016/j.jfoodeng.2015.06.027.

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