*i*Journals: International Journal of Software & Hardware Research in Engineering (IJSHRE)
ISSN-2347-4890
Volume 10 Issue 4 April 2022

Smart Application to Screen, Alert and Suggest Remedies for Cotton Disease

Khushal Shah[1]
Singapore International School, Mumbai
International Baccalaureate Diploma Program
Khushalshah101@gmail.com

Reetu Jain[2]
Chief Mentor
On My Own Technology Pvt Ltd, Mumbai, India
Reetu.jain@onmyowntechnology.com

Abstract-Cotton cultivation is very unpromising sometimes as the plants get diseased. The farmers with their naked eyes cannot differentiate between the cotton quality. When these diseased plants are sent for industrialization, the clothes made from these are hazardous for humans. India produces 26% of the cotton in the world, making it the lead producer. There are various factors that affect cotton, like high water consumption causing pollution, soil degradation, greenhouse gas emissions, use of harmful pesticides and fertilizers. Farmers in debt, when face with land clearing, soil erosion, loss of biodiversity resulting in low productivity, often commit suicide. To stop this sorrowful scenario from continuing, I along with my team came up with a deep learning project of reducing the amount of infected cotton being sent to be clothed.

Keywords – Convolutional Neural Networks, Smart Phone, Image processing, Machine Learning, Transfer Learning

I. INTRODUCTION

Introduction- Cotton is a soft downy substance like fine wool. It is cultivated almost all over the world, but mainly in the U.S.A., India, Egypt, and Brazil. In India, it is largely grown in the Deccan, Punjab, U.P Tripura, and Assam. Today the Indian cotton crop is the second-largest product in the world. Cotton is obtained from a plant of the same name. Some cotton plants grow very tall, and some remain very low. They require long warm weather with a fair amount of rain to grow well.

Cotton is grown in India on huge scales. In the financial year 2020, cotton production in India amounted to approximately 36.5 million bales. Favorable trade policies and increasing disposable income led to an increase in cotton production over the years. [1] This matched the growth in its demand in domestic consumption and exports. Cotton was an important indicator for the country's textile and apparel market. Cotton growth in India peaked in the year 2014 when 39.8 million bales were produced.

To some extent, cotton is a need in a human's life. Cotton has many daily life uses without which it is difficult and uncomfortable to live. The main uses of cotton are fabrics and clothing. Cotton can be woven or knitted into velvet, corduroy, denim, jersey, flannel, velour, and chambray. For many years, baby care and feminine products were made of man-made material exclusively.

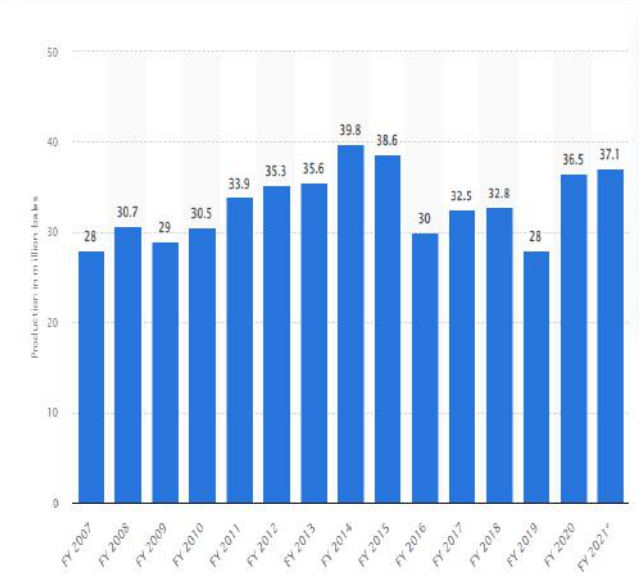

Figure 1: "Static of the Cotton Production"

As time passed, this material was replaced by cotton as a soft and perfect match for a baby's skin. Cotton is also a common ingredient in lotions, body washes, and shampoos for babies. In feminine care, cotton is often seen in pure, natural products. High-quality hygiene pads, panty liners, and tampons may be made from 100% cotton, both conventional and organic, or in some cases a blend of cotton with synthetic materials.

Taking these statistics and facts into consideration, we found our problem statement. India has a diverse climatic

condition which causes many crops to fail. Farmers are not usually financially stable, so this creates multiple problems for them. Due to the global pandemic, the functioning of the world went online which caused everyone to buy electronic gadgets which could be used for working or educational purposes. [1] Farmers who did not have the finance, and wanted to educate their children, could not do so as purchasing a mobile or a laptop and a stable internet connection is a liability that does not serve the needs of a family when their economical state is not healthy.

Farmers face difficulties on a regular basis which creates mental pressure and a burden on them. When it gets out of control, farmers that cannot handle it take a huge step and commit suicide. Monsoon failure, climate change, high debt burdens, government policies, mental health, personal issues, and family problems are some of the main reasons for farmers' suicides in India.

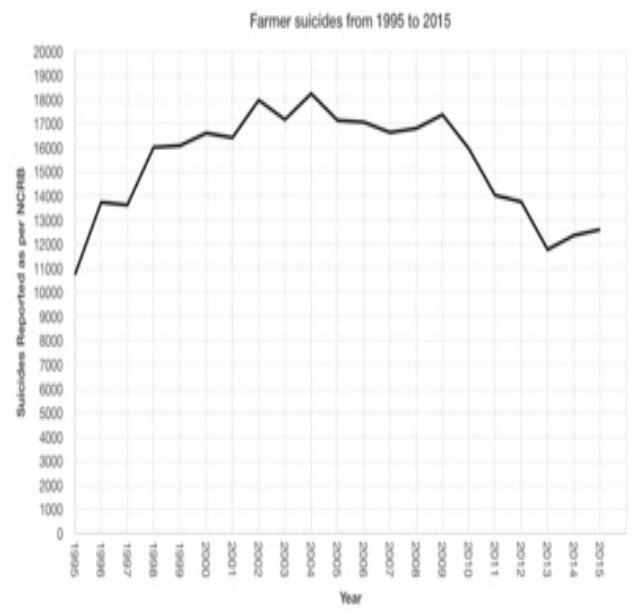

Figure 2: "Farmers Suicide rate"

The main problem statement we decided to solve was to avoid cotton failure. Cotton cultivation is not very easy as cotton plants often get diseased. Textile industry in India has revenue of 108.5 billion USD. [1] The largest producer of cotton in the world, 26% of world cotton production. 60 million people are directly indirectly involved in the production, processing, marketing & trade. India's yield per kg hectare is 487 vs the world average is 768 kg/ha. Cotton is highly affected due to its high-water consumption which causes pollution, soil degradation, greenhouse gas emissions, use of harmful pesticides and fertilizers. Farmers in debt, Commit Suicide, Land clearing, Soil erosion, contamination, and loss of soil biodiversity result in low productivity of the soil which creates mental health issues for the farmers which leads them to take a big step. Due to this sorrowful scenario, we decided to come up with a deep learning method of reducing the amount of infected cotton being sent to be for industrialization–and hence, reducing the spread of cotton diseases.

II. LITERATURE REVIEW

Existing solutions that the farmers use currently for the good growth of their crops are pesticides. Many farmers choose to use chemicals to keep weeds and pests from destroying their crops and to add more nutrients to the soil. There are three different kinds of pesticides: herbicides, insecticides, and fungicides. All three of these pesticides are used to kill different kinds of pests that can be found on a farm. It may kill pests but the negative effect of pesticides is that they may impact the crop physiology through various disruptions, such as perturbation in the development of the reproductive organs, growth reduction, and alteration of the carbon and/or nitrogen metabolism, leading to a lower nutrient availability for plant growth. Another method used by farmers is managing farms as ecosystems (agroecology) through efforts such as integrating livestock and crops to reduce transportation-related costs and pollution; integrating trees and shrubs to provide shade and protect crops, animals, and water resources; and managing uncultivated areas to control erosion. Along with nutrients, manure and compost applications tend to improve soil organic matter, biological activity, and potential disease suppression. The negative effect of this method is that livestock emit almost 64% of total ammonia emissions, contributing significantly to acid rain and to acidification of ecosystems. Livestock are also a highly significant source of methane emissions, contributing 35–40% of methane emissions worldwide. This is harmful for the environment on a global scale. [1]

Cotton is prone to multiple diseases like Alternaria leaf blight, root cot, fusarium wilt etc. A farmer cannot keep track of all diseases on his own. We used AI to create a dataset about cotton diseases. In this dataset, we provided images that belong to 4 classes: diseased leaf, diseased plant, fresh leaf, and fresh plant. Each image is filtered with 4 different effects to test the leaf and plant. Working with images is memory-consuming, especially if they are read and pre-processed at the same time. We created the dataset to identify if the leaf of the plant was affected or the plant, and then narrowed it down to the disease and if the plant was good enough to be industrialized or not. The main objective of the study was to create a CNN model to help us predict whether the images of the plants and leaves belong to the diseased or healthy category.

Use of smartphone agriculture identification is the new age study which will help to reduce the loss of the detection of disease and help improve the yield.

III. MATERIALS AND METHODS

Data was collected from various online sources including Kaggle, and Data World. The data consist of 2,347 images containing information showing healthy and lesioned leaves, as well as background material, such as soil and straw. The images are stored in the RGB color space, with a resolution of 102 × 102 pixels, and with no control of lighting, angle, or focal distance. The randomness of these characteristics makes it crucial that the algorithms analyzed are robust and provide invariable results. The data were divided into training, test, and validation sets. We are using a kerns model which gives us accurate optimization of image detection using modules like image data generators. It differentiates between a cotton plant and its leaves. The main algorithms for image processing for the detection of objects, plants, disease, or pattern recognition can be resumed in the pipeline, starting with the acquisition of images and progressing with pre-processing, attribute extraction, and classification.

Figure 3: "Classification of fresh leaf and Bactria leaf"

IV. METHODOLOGY

CNNs represent the continuing development of traditional artificial neural networks; they have a greater capacity for learning due to the representation of the data in hierarchical form in various levels of abstraction. Basically, a CNN

functions by performing various convolutions in different layers of the network. This creates different representations of the set of learning data, starting with the most general in the first layers and becoming more specific in the deeper layers. The convolutional layers act as a kind of extractor of characteristics since the reduction of the dimensionality of the entrance data groups them in layers.

The convolutional layers codify various basic resources into more discriminative ones, creating a series of intermediate layers separated by rectified linear units (ReLU) and layers of enveloping (pooling). In a more generic explanation, the convolutional layers act as filters, which transform one entrance image into another, highlighting specific patterns. In the next to last layer of the network, the final characteristics of the image are emphasized, thus, the final stage (layer) of the network acts as a linear classifier.

With standard image processing algorithms, the impact on the result occurs as a function of image quality, type and resolution; it also depends on the type of descriptor of the characteristics and the classifier selected. In the case of a CNN, it is the structure, which has the greatest influence on performance in the extraction and classification of the resources/aspects of the images.

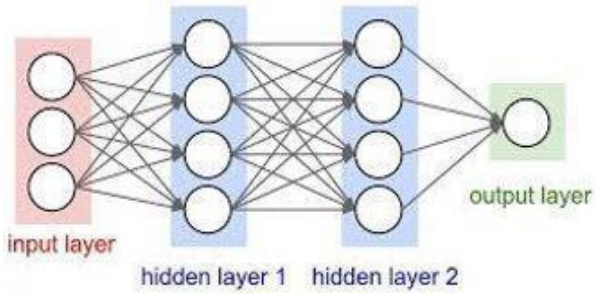

Figure 4: "Convolution Neural Networks"

Shallow networks limit the learning capacity because of the limited number of layers. For the recognition of lesions on cotton leaves based on image processing, the basic architecture for a CNN is found with Google Net and ResNet50. The processing structure of images for deep learning considers a stage for the weighting of the data and another for the artificial increase of data. Once the data is separated into training and testing sets, the number of images in the class with the smallest number of images is defined as the maximum value for the counting of images in each class for each of the two sets of data (training or test).

Data Augmentation is used in our experiments to increase the dataset size by a magnitude of 2048. This is done by randomly cropping 224×224 patches from the original images, flipping them horizontally, and changing the intensity of the RGB channels using PCA color augmentation. This Data Augmentation helped reduce overfitting when training a deep neural network. The augmentations reduced the error rate of the model by over 1%. [1]

The images are first cropped into 224x224 for uniform accuracy of the detection of the disease after the images are used to remove the noise present in the image the low pass filter is used. As the edge which corresponds to high frequency is to be retained the Gaussian filter is used. It does not have sharp cutoff instead it has elegant and natural stop band response which allows adequate higher frequency components and thus exhibits small time-bandwidth product.

The image is converted from RGB to HSV color space and all connected components in the image having a number of pixels less than 100 are removed. [1]

After these the images are classified into 4 different types and then fed to a machine learning algorithm to detect the fresh leaf and infected leaves.

V. RESULTS

Transfer learning (TL) is a research problem in machine learning (ML) that focuses on storing knowledge gained while solving one problem and applying it to a different but related problem. For example, knowledge gained while learning to recognize cars could apply when trying to recognize trucks. [1]

The use of transfer learning helped us to recognize different disease on leaf and plant along with differentiating the fresh plant.

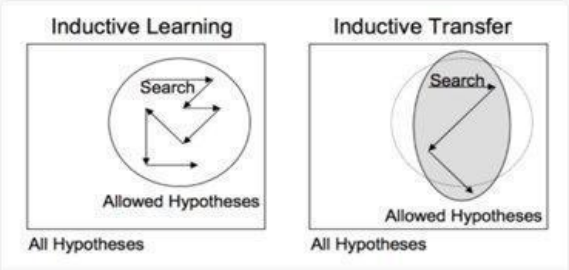

Figure 5: "Transfer Learning"

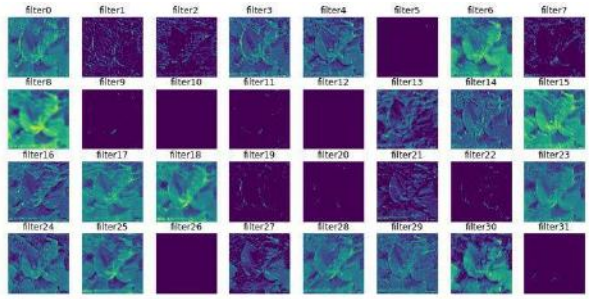

Figure 6: "Layers in CNN"

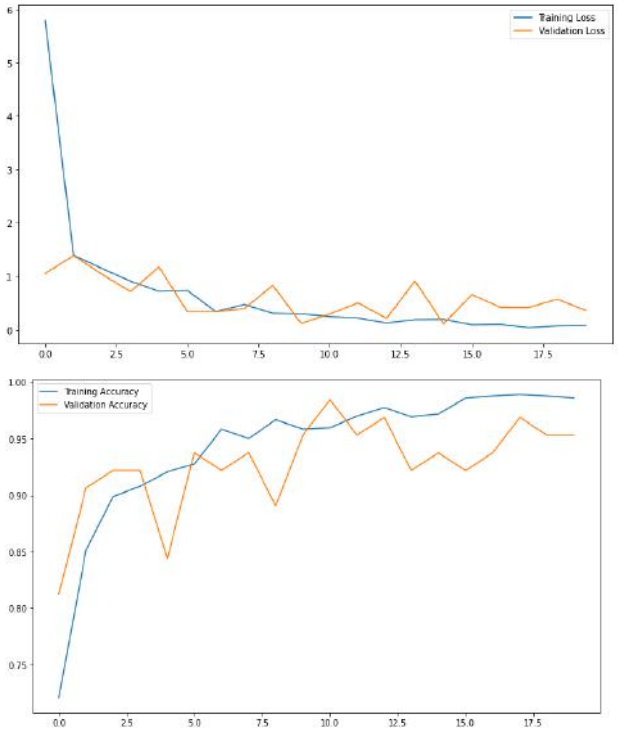

Figure 7:"Training Accuracy vs Validation Accuracy"

Model	Size	Top-1 Accuracy	Top-5 Accuracy	Parameters	Depth
Xception	88 MB	0.790	0.945	22,910,480	126
VGG16	528 MB	0.713	0.901	138,357,544	23
VGG19	549 MB	0.713	0.900	143,667,240	26
ResNet50	98 MB	0.749	0.921	25,636,712	-
ResNet101	171 MB	0.764	0.928	44,707,176	-
ResNet152	232 MB	0.766	0.931	60,419,944	-
ResNet50V2	98 MB	0.760	0.930	25,613,800	-
ResNet101V2	171 MB	0.772	0.938	44,675,560	-
ResNet152V2	232 MB	0.780	0.942	60,380,648	-
InceptionV3	92 MB	0.779	0.937	23,851,784	159
InceptionResNetV2	215 MB	0.803	0.953	55,873,736	572
MobileNet	16 MB	0.704	0.895	4,253,864	88
MobileNetV2	14 MB	0.713	0.901	3,538,984	88
DenseNet121	33 MB	0.750	0.923	8,062,504	121
DenseNet169	57 MB	0.762	0.932	14,307,880	169

Figure 8:"Accuracy Comparison"

VI. CONCLUSION

In this paper, the diseased cotton leaf images are classified using CNN we have trained with various models, but these two models showed the best results 1) InceptionV3 - 97% accuracy 2) ResNet152V2 - 96% accuracy.
Convolution neural network where the training is performed by extracting four different diseases. Also, able to detect the amount of pesticide needed with the area of the land. Having this in a smartphone will be very helpful and will be able to detect and help the performance of the yield.

VII. AUTHOR PROFILE

Khushal Shah
Singapore International School, Mumbai
International Baccalaureate Diploma Program
Khushalshah101@gmail.com

Reetu Jain
reetu.jain@onmyowntechnology.com
Chief Mentor & Founder
On My Own Technology Pvt Ltd

VIII. ACKNOWLEDGEMENT

We would like to express my heartfelt gratitude to all the tutors and mentors of On My Own Technology Pvt. ltd. for extending their help in carrying out the particular project. It is because of their help that we are able to conduct the research. We shall remain ever grateful for their help and generosity. The authors would like to declare that no funding in any form is received for carrying out this research work.

IX. REFERENCES

1. "Why is cotton a problematic crop? – Dawn," [Online]. Available: https://www.dawn.com/news/252184/why-cotton-is-a-problematic-crop
2. "Textile Industry and Market Growth in India – IBEF," [Online]. Available: https://www.ibef.org/industry/textiles.aspx .
3. "Survey and Status of Different Diseases of Cotton under South Gujarat Region, India," [Online]. Available: - https://www.ijcmas.com/6-9-2017/Prashant%20B.%20Sandipan2,%20et%20al.pdf
4. "Indian Plant Protection Market Overview Report – ICFA," [Online]. Available: https://www.icfa.org.in/assets/doc/reports/sou_pp.pdf .

5. "A survey on Image Data Augmentation for Deep Learning – Journal of Big Data," [Online]. Available: https://journalofbigdata.springeropen.com/articles/10.1186/s40537-019-0197-0 .
6. "A Gentle Introduction to Transfer Learning for Deep Learning – Machine Learning Master," [Online]. Available: https://machinelearningmastery.com/transfer-learning-for-deep-learning/ .
7. "Transfer Learning in Deep Learning using keras – Medium (Giriteja Reddy)," [Online]. Available: https://medium.com/analytics-vidhya/transfer-learning-in-deep-learning-using-keras-b12e0ca6c459 .