



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 10, October 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.569



# Modern Age Agriculture – Deploying Deep Learning Techniques

Shravani H A<sup>1</sup>, Nirmala V<sup>2</sup>, Shruti B P<sup>3</sup>

Department of ISE, Sri Krishna Institute of Technology, Bangalore, India<sup>1,2</sup>

Faculty, Department of ISE, Sri Krishna Institute of Technology, Bangalore, India<sup>3</sup>

**ABSTRACT:** Agriculture is a backbone of our nation. It affords us with many basic necessities like food and raw material which are regarded as the basic blocks for rapidly increasing the country's economy. These materials are susceptible by different factors which include decline in pollination, many kinds diseases in crops, no proper irrigation technique, lack of water resources and many extra added to it. The Deep learning (DL) incorporates a modern approach for image classification and data analysis with high potential value. Deep learning is a current technique in most of the agricultural domain, which is being applied to various other neighborhoods. Deep learning concepts are applied to numerous other agricultural issues, such as disease detection or identification, fruit and plants classification and fruit counting are recognized under these. The conclusions indicate that DL gives higher accuracy rates, exceeding with rare conditions, and many other image processing techniques are validated based on their accuracy conditions specified. In this survey, a clear review of research customized to applications of DL for modern agriculture is reviewed with many real examples. Our research shows high potential of deploying DL techniques for modern age agriculture.

**KEYWORDS:** Image Processing, Artificial Neural Networks, Convolution Neural Networks, Deep Learning.

## I. INTRODUCTION

The study shows approximately 70% of the existing creatures are depended on the agricultural products. This part faces numerous difficulties to achieve the demands of increasing population which has almost doubled in last 5 decades. Raising population and climatic conditions are considered the harmful factors for agriculture to meet it's requirements. Precautions are taken to overcome the threats with the introduction of the modern techniques in agricultural land. With the help of computer vision along with the IOT, DL and ML, i.e., sub areas of AI, it has been possible to put forth a genuine solution for this problem area. Precision agriculture, a field that combines all above mechanisms and is regarded as a vital feature to handle with the agricultural domain challenges like environment problems, nourishment efficiency, feasibility, quality standards. Newly, recent mechanisms which are ordinary in today's production is being put in to farming, like IoT and robotics plan of action giving raise to the idea of 'smart farming'. The smart farming is vital to resolve difficulties of farming in many ways. ML with image processing is considered as one of the most popular techniques to analyze the images. Many algorithms of ML like Random Forest, SVM and K-means, are most popular compared to the remaining. Also, the recent technique used by numerous researchers today is DL. Machine learning and deep learning and are the sub-areas of Artificial Intelligence. It gives many benefits like increased performance and more learning abilities and precision over machine typical ML algorithms. This survey gives a particular review of research applications restricted to DL for latest agricultural aspects including with present applications and techniques.

## II. METHODOLOGY

The recorded analysis in this field of study mainly involves following points:

a) Explore latest similar works, not exceeding five years; to assess and scrutinize the gathered work. Here, keyword-based find from journal articles or conference papers was carried out from scientific databases like Science Direct and IEEE Xplore, and from Google . As the find keywords we used the below question:

["Deep Learning"] AND [Agriculture] OR "Farming"]

b) A detailed assessment and scrutiny of the task was performed .The assessment of the gathered data aims to provide solution to the below problems: i) problem identification ii) type of data used iii) deep learning architecture iv) deep

learning model v) overall accuracy vi) comparison to alternative ML techniques and also works which are alike to the existing systems in the literature vii) employed hardware and actual time application.

### III. DEEP LEARNING

Deep Learning is part of machine learning methods based on Artificial Neural Networks (ANN). DL has various utilizations from natural language to image processing. Different deep learning architectures such as Recurrent Neural Networks (RNN), Recursive Neural Networks, Deep Neural Networks (DNN), Convolutional Neural Networks (CNN), Deep Belief Networks (DBN) and Fully Convolutional Networks (FCN) have been successfully applied to diverse research areas including land management. DL increases the complications of ANN and represents data hierarchically through various layers of abstraction. For example, in image processing lower levels can recognize the edges whereas the higher levels will identify items like objects or faces. AlexNet, VGG, CaffeNet, GoogleNet and ResNet are some popular DL models which are publicly available for research with the advantage that most of them are already pre-trained with open data-sets, which means that the network is ready for successfully identifying the several features.

Deep Learning can solve more complex problems particularly well and fast because of more complex models used which allow massive parallelization. These complex models which are employed in DL can increase classification accuracy or decrease bugs in regression problems, provided there are acceptably large datasets available describing the ostacle. Although, DL has met popularity in numerous applications it can be applied to any form of data such as audio, speech, natural language or more generally to continuous or point data such as weather data, soil chemistry and population demographics.

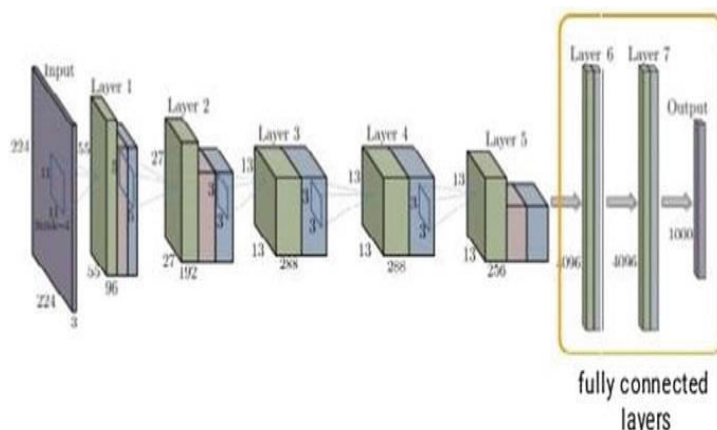
A huge advantage of Data Learning is feature learning i.e., the automated feature extraction from raw data with features from higher levels of the hierarchy which are being formed by the composition of lower level features. Gates, convolutions, fully connected layers, pooling layers, activation functions, memory cells etc. are the different elements of the DL and usage of them depends upon the network architecture used i.e., Convolutional Neural Networks, Recursive Neural Networks, Recurrent Neural Networks.

### IV. IMPLEMENTATION

The following sub-sections present a brief introduction to CNN, FCN, and RNN.

#### A. Convolutional Neural Network

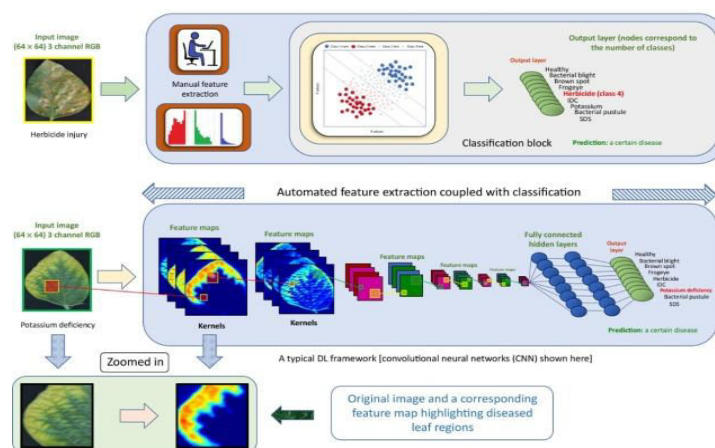
Convolutional Neural Network (CNN) is regarded as most commonly used proposal of the Deep Learning which is considered as deep feed-forward Artificial Neural Network. In disparity to ANN, CNN is capable of studying and analyzing compound problems comparatively quick because of the complex models and weight sharing, which allow parallel computing. Figure 1 illustrates a working of CaffeNet, an architecture of CNN, where the different convolutions are carried out at few layers of the network creating various representations of the text file.



**Figure 1 :** CaffeNet: an Example of CNN Architecture

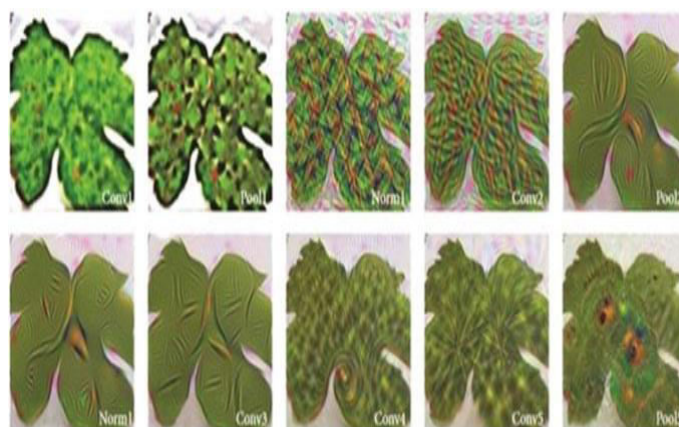


CNN's increase the probability of correct classifications, provided that an adequate large dataset is available. A common technique used to increase the dataset and improve CNN accuracy is the data augmentation. As CNN's are uniform to translation, size, the dataset can be enlarged by adding a sequence of arbitrary transformations to the original images, such as rotation.



**Figure 2 :** The Image Representation at Each Layer to the Problem of Plant Disease Identification in the CaffeNet CNN

The Figure 2 shows the image representation at each layer to the problem of plant disease identification in the CaffeNet CNN, to create different representation of the given dataset, beginning from more common ones at primary layers, fetching more precise at the deeper layers, various different convolutions are performed at required coatings of network. The convolutional layers are worn to take out the features from the input image and then dimensionality of the image is reduced using pooling layers. Convolutional layer take out and cipher the low-level features into more particular features for the given problem domain. These are regarded as the filters which transform the input image to another image to understand the specified design. In various scenarios fully connected layers are placed at the output of the model to put in the task of classification using more particular high-level characteristics procured from the network to categorize the given image with predefined classes or used for regression tasks to produce numerical prophecy. Input vector given as the input to each layer which in turn returns the output vector. Figure 3 represents the output layer visualization after processing respective layer of the CNN: CaffeNet for plant disease identification.



**Figure 3 :** Output Layer Visualization After Processing Respective Layer of the CNN: CaffeNet for Plant Disease Identification

### B. Fully Convolutional Networks

FCN is a CNN based architecture that uses down-sampling (convolution) followed by up-sampling (deconvolution) to produce semantic mask as the resulting sequel. Typically, the input image is downsized to pass through several convolution layers, and the output is one predicted label for the input image. FCN networks do not downsize the image, thus the output is not a single label, which allows to up-sample the output and pixelwise prediction of the class. Figure 4 shows an example of a semantic segmentation with FCN.

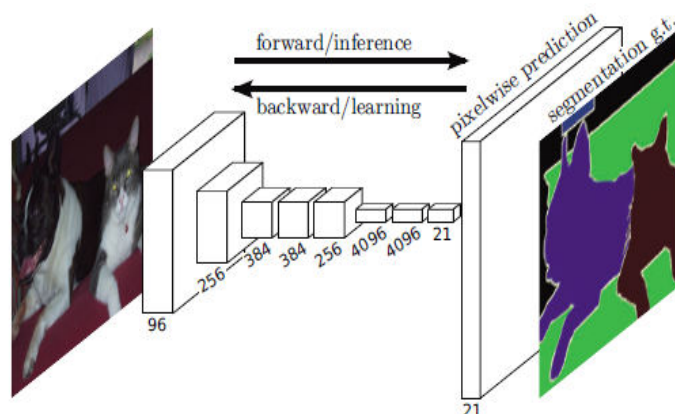


Figure 4 : FCN Semantic Segmentation

### C. Recurrent Neural Networks

RNN is a multi-temporal network model which represents connections between nodes with directed graphs along a temporal sequence. This permits ephemeral dynamic behavior. Unlike mono-temporal models (CNN's), RNN has access to information in its own internal memory, which means that it can consult the earlier read for the classification of the current read. This makes it suitable for temporal sequence task like speech recognition. Figure 5 shows the Diagrammatic representation of RNN.

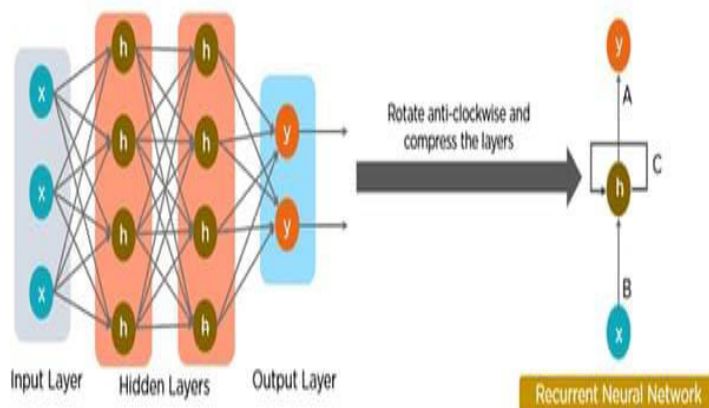


Figure 5 : Diagrammatic Representation of RNN

## V. DEEP LEARNING APPLICATIONS IN AGRICULTURE

Deep Learning can be applied to many fields of the agriculture like crop management, livestock management, crop management and management of field hap. CNN is the most popular architecture used for such application as mentioned in many papers. Nevertheless, some scientists have used RNN and FCN. Deep Learning may be appropriate to whole growing and harvesting cycle. It starts with the seed plantation (soil preparation, seeds breeding and water feed measurement) till the robot picks the harvest after confirming the ripeness using computer vision and machine learning techniques.



The applications includes :

1. Soil Moisture Prediction
2. Fruit Counting
3. Disease Spotting
4. Leaf Classification
5. Animal Welfare
6. Yield Gauging
7. Plant Remembrance
8. Weed Identification

## VI. FUTURE USAGE OF DEEP LEARNING TECHNOLOGY FOR THE ADVANCEMENT IN AGRICULTURAL DOMAIN

In this paper, we have highlighted many existing applications of computer vision where deep learning is already been applied in agriculture. The numerous implementations which are mentioned here are like weed identification, crop type classification, fruit grading and counting and many more. However, there are many areas of agriculture where deep learning could be applied for better results in the domain, such as pest detection, water stress detection in the plant, deficiency in the food, monitoring of greenhouse, water erosion monitoring. Also, other possible areas where deep learning could be applicable is image capturing via drones, i.e., aerial imagery to monitor the seeding process effectiveness, to increase the quality of wine production by harvesting grapes at the right moment to achieve best maturity levels, to monitor animals and their movements and to consider their overall welfare and identify possible diseases, and many other scenarios where computer vision helps. Moreover, applications which can predict plant growth, yield prediction, water needs assessment to avoid the diseases, and these models could find applicability in environmental informatics for understanding climate change prediction, weather condition and phenomenon prediction.

Finally, some of the solutions discussed in the surveyed papers could have a commercial applicability in the near future. The approaches incorporating Faster Region-based CNN and Detect Net CNN would be extremely useful for automated robots that gather crops, pull out weeds or for evaluating the expected harvests of various other reaps. A future application of this technique could also be used in microbiology for human or animal cell counting.

The DRNN model controlling the daily feed intake of pigs or chicken, predicting the accuracy of the required feed intake for whole of its growing period, would be useful to farmers when deciding on a growth curve suitable for various scenarios.

## VII. CONCLUSION

In this paper, we have performed a survey on the effort applied in the field of agriculture by deep learning. We have examined the models used, available data sources, performance measures, classes or regression values obtained from the various research papers. Our findings indicate that deep learning offers better performance and outperforms other popular techniques like image processing and traditional machine learning. For upcoming work, we aim to apply the regular concepts and best practices of deep learning, as described in this paper, to other areas of agriculture where this modern technique has not yet been adequately put in. Our main aim is to motivate more researchers to experiment with deep learning, applying it for solving various agriculture related difficulties involving classification or prediction, related to computer vision and image analysis, or more generally to evaluate the data. The overall profits of deep learning are motivating for its additional usage towards smarter, more sustainable farming and more secure food production.

## REFERENCES

- [1] S W Chen, S S Shivakumar, S Dcunha, J Das, E Okon, C J Taylor, V Kumar, "Counting Apples and Oranges with Deep Learning Using a Data Driven Approach", IEEE Transactions on Pattern Analysis and Machine Intelligences, Volume 30, pp. 1–1, June 2017.
- [2] K Jha, A Doshi, P Patel, M Shah, "A Comprehensive Review on Automation in Agriculture Using Artificial Intelligence", IEEE Geoscience and Remote Sensing, Volume 40, pp. 1–13, March 2020.
- [3] A Kamilaris, F X Prenafeta Boldu, "Deep Learning in Agriculture: A Survey", International Journal of Computer Vision, Volume 147, pp. 70–90, September 2018.



- [4] M Rahnemounfar, C Sheppard, "Deep Count: Fruit Counting Based on Deep Simulated Learning", Journal of Machine Learning, Volume 17, pp. 905, January 2017.
- [5] Kussul N, Lavreniuk M, Novikov A, "Deep Learning Crop Classification Approach Based on Coding Input Satellite Data Into the Unified Hyperspace", IEEE Transactions on Fuzzy Systems, Volume 73, pp. 239-244, April 2018.
- [6] Zhong L, Zhou H, "Deep learning based multi-temporal crop classification using Remote sensing of environment", International Journal of Robotics Research, Volume 213, pp. 430-443, November 2019.
- [7] Y Sun, Y Liu, G Wang, H Zhang, "Deep learning for plant identification in natural environment", IEEE Technology of Engineering Management Conference, Volume 99, pp. 1-18, December 2016.
- [8] Azevedo F, Shinde P, Santos L, Mendes J, Santos F N, Mendonca H, "Parallelization of a vine trunk detection algorithm for a real time robot localization system", The Journal of Agricultural Science, Volume 27, pp. 1-17, June 2018.





**Impact Factor:  
7.569**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details