

# Deep Learning for Smart Agriculture

A. Kavitha

Head & Assistant Professor of Computer Science,  
Aditanar College of Arts and Science, Tiruchendur, Tamilnadu, India

**Abstract - In the modern era of industrial revolution 4.0 Artificial intelligence, Machine learning, Deep learning, IoT and Robotics have become more and more popular in research and also used in many applications such as natural Language processing, visual data processing, social network analysis, drug discovery, image classification, text mining and so forth. Nowadays deep learning has applied in many applications of smart agriculture such as water and soil management, crop cultivation, crop disease detection, weeds removal, crop distribution, robust fruits counting and yield prediction. This paper is focusing on how the deep learning is used for smart agriculture.**

**Keywords: Artificial intelligence, AI, Agriculture, Crop, Convolutional neural network, Deep learning, DL**

## I. INTRODUCTION

Agriculture ensures the food security for the country that's why it is the backbone of the country. It plays a vital role in external trade of most of the country. In most parts of the world approximately 75% of people rely on agriculture as a livelihood. Due to the boom of population there is a need to increase yield in the field of Agriculture so we have to improve the status of Agriculture in better way. Farmers are looking for efficient ways to increase the crop production in less expense and efficient utilization of available resources. This contributes new implementation of digital technologies in agriculture field to help the farmers to make better decisions and increase yields. Nowadays using deep learning methods we can overcome various problems and challenges in agriculture fields [1].

## II. LITERATURE REVIEW

Nowadays from home appliances to spacecraft, everything is digitalized and these are made possible only because of intelligent systems that use artificial intelligence and their associated applications. At present machine

learning makes our life better. Deep learning is part of Machine learning that aim is to build neural networks to simulate the human brain for analytical learning. It interprets the data such as text, images, video, and sound by mimicking the way the human brain work [2]. Recently it is used to solve complex problems like image recognition, natural language processing, image classification, image segmentation, object detection. Deep Learning requires huge amount of training dataset because classification precision of DL classifier totally depends on the size and quality of the dataset.

Learning may be Supervised, Unsupervised and Reinforcement learning. In agriculture, natural language processing, spam email filtering, malware filtering, online fraud detection, optical character recognition and face detection supervised techniques are used. In sentiment analysis, market segmentation and anomaly detection unsupervised techniques are used. Recently AI, ML, DL, IoT and robotics are very helpful in agriculture field to minimize the manpower, improve the quality of crops, water and soil management and detect crop disease in early stages. For the past 10 years most researches are going on deep learning in Agriculture field [3].

## III. DEEP LEARNING FOR SMART AGRICULTURE

At present deep learning, computer vision, image processing, robotics and IoT technologies are very supportive to farmers. AI based drone technology is very helpful for farming because it makes it easier to monitor, scan and analyze the crops by providing high quality images. This technology is useful to identify the progress of the crops. In addition, farmers can decide whether the crops are ready for harvest or not. There is no limit to describe the applications of deep learning in Agriculture even some of the applications of DL in agriculture are given below. The following diagram Fig 1 shows the applications of deep learning in Agriculture.

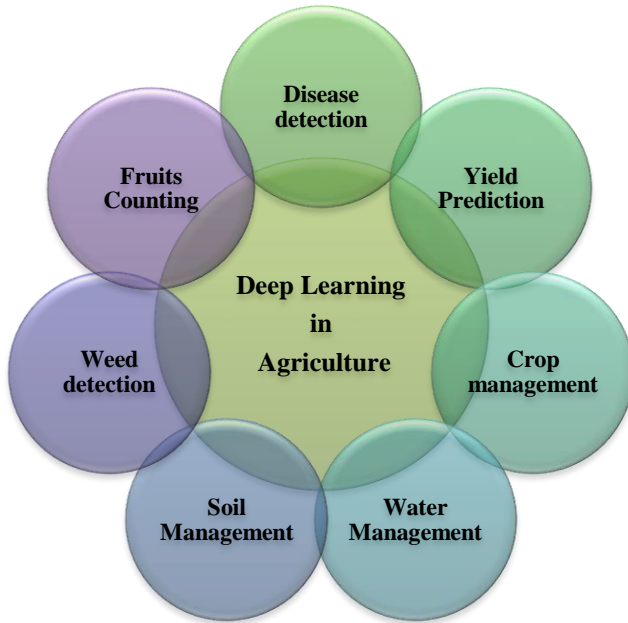


Fig 1 Applications of Deep Learning in Agriculture

#### Crop Management

Crop management is very important function to improve the quality of the crop. Nowadays drones are playing a vital role in crop management function of agriculture like crop monitoring, scanning of fields and so on.

In smart agriculture, deep learning algorithms are used to monitor the temperature and water level of the crops. In addition to farmers can observe their fields from anywhere in the world. This AI based smart agriculture is really efficient [4].

#### Water Management

Water is requiring for proper growth of crop. Scrutiny the water level at regular interval is very important for the growth of the crops. Based on the crop and soil category we can efficiently manage the water level using machine learning algorithm.

Kirtan Jha et al, proposed Artificial Neural Network (ANN) for smart irrigation system. It provides better water management in Agriculture [5].

#### Soil Management

Using machine learning techniques we can easily recognize the suitable crops and best type of fertilizer for the soil is an easy task. Gaussian kernel-based SVM (Support Vector Machines), Bayesian Networks and ANN are mostly used for better soil management. The quality of soil depends on its pH level, EC, primary, micro and macro nutrients on the selected crop so the classification of the pH and relevant soil nutrient indices helps to examine the health of the soil.

M.S.Suchithra et al, proposed ELM (Extreme Learning Machine) with hyperbolic tangent function achieves a good result for pH classification in soil

management. Here the best accuracy value obtained for pH classification is about 89% [6].

#### Weed detection

Detecting and removal of weeds are the main problem in Agriculture field. In earlier days the removal of weed has been done by manually. It is a time consuming and expensive but recently robots are used to control the weeds in many developed countries.

R. Dhayabarani et al, proposed convolutional neural network of deep learning algorithm for identifying weeds in the crop [7].

#### Disease detection

Crop disease is a major threat in agriculture field. Disease detection at earlier stage in crops is a time-consuming and tedious process when it is done by manually but with the development of AI and deep learning it is a less time consuming and easiest process [8].

Nikhil Patil et al, proposed crop Disease Detection using CNN (Convolutional Neural Network) system based on Deep Learning. This system gives the information about the crop disease immediately. While compared with traditional crop disease detection system, this system gives the accuracy rate of 89% [9]

S.P.Mohanty et al, proposed plant disease detection using convolutional neural network approach. CNN is the deep learning algorithm that resolves more complex problems with a larger model and producing acceptable results. The model achieved an accuracy of 99.35% [10].

#### Yield Prediction

Each and every crop we need to concentrate on yield prediction. Machine learning and deep learning algorithms have been applied in crop yield prediction. It helps the farmers to decide on what to cultivate and when to cultivate [11].

Manjula et al., proposed Random Forest Algorithm for Millet crop yield that gives 99.74% of accuracy. Random forest gives the better yield prediction as compared to other algorithms such as Polynomial Regression and Decision Tree algorithms. It helps the farmers to identify the crop losses and prevent it in future [12].

#### Fruits counting

Recently there is significant advancement in computer vision that is mostly used to identify the object. At present, in most places the yield estimation is done by manually so it is a time consuming and expensive process therefore it is not convenient for very large fields.

Maryam Rahnemoonfar et al, proposed novel deep learning architecture for counting fruits based on convolutional neural networks and a modified version of Inception-ResNet. This system gives 91% average test accuracy on real images and 93% on synthetic images. It is used to count tomatoes and other fruits. It can able to count ripe and half-ripe fruits. [13].

#### IV. CONCLUSION

In the world, due to the population growth there is a great demand for agriculture products. That's why it is necessary to increase the production in agriculture. Nowadays the latest technologies such as machine learning, deep learning, IoT and robotics are used to increase the agriculture production, reduce the production costs and increase the income. Rain, Cyclone, flood, climatic changes, Weed, pest and lack of manpower are some of the factors that affect the growth of the crops in Agriculture field so deep learning technologies are mostly used by farmers to improve the crop management and various applications of agriculture. In future deep learning will achieve a remarkable success in agriculture field.

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