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# An Analytical Review on Plant Detection Methods based on Machine Learning

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## ABSTRACT

A highly significant subject in the earth's ecology is that of plant identification, which is essential for the preservation of an environmentally friendly climate. Certain of the plants have considerable therapeutic benefits. Nowadays of locating a plant is not easy by examining at its physical qualities. This article presents an intellectual database of publications throughout the span of 2015–2020. It has been discovered that the newest generation of fully convolutional neural networks (CNNs) in the spatial field of image identification has achieved exceptional performance. In this study, strategies are explored the ideas of Machine learning and several leaf recognition algorithms.

**Keywords:** Machine Learning, Artificial Intelligence, Leaf Detection, Deep Learning, Image Processing.

## I. INTRODUCTION

Artificial Intelligence (AI) is now the most significant aspect of our life, and it is utilised in a variety of fields like computer vision, robotics, digital marketing transformation, the medical profession, banking, and commercial sectors, among other things. A subset of Artificial Intelligence (AI) would be machine learning, which is a theoretical algorithm analysis and a mathematical model that performs a specific check without explicitly programming on the basis of assumptions and templates. Artificial Intelligence (AI) has primarily been designed to create machines that think and act like human beings, and machine learning would be a sub-part of AI. Supervised learning, unsupervised learning, and reinforcement learning are some of the most fundamental artificial learning methodologies available. Unlike supervised learning algorithms, which need a collection of outcomes, unsupervised learning algorithms just require identification of the data format and unlabeled inputs, which are not present in supervised learning algorithms.

Deep learning produces improved outcomes even when dealing with large amounts of data. Deep learning, which is utilised in picture recognition and computer vision, among other applications, makes use of artificial neurons that are identical to those found in humans. A variety of deep neural networks, including recurrent neural networks and deep belief networks, are utilised in a variety of applications such as speech recognition, language processing, translation software, audio recognition,

bioinformatics, and drug research. Despite the fact that plants are a vital part of every natural life [1], the official naming of these organisms will guarantee that every natural life is conserved and maintained for future generations to come. Plants are necessary for our medicinal requirements, as alternative sources of energy such as biofuels, and to meet our various domestic needs such as wood, clothing, food, and cosmetics. Plants also provide us with a variety of other products such as wood, clothing, food, and makeup. The current extinction trend is mostly the result of overt and indirect human activities, both direct and indirect. The creation of accurate identification information as well as plant geography propagation is critical to the long-term sustainability of ecosystems in the world.

[2] A large number of countries throughout the world are now developing plans to develop channel control systems for national agriculture. India will have a long history of employing plants as a healing source, and this will continue. This type of investigation is referred as as Ayurveda [3]. According to Ayurvedic principles, every plant on the planet has a certain therapeutic worth. This is regarded as a sort of alternative medicine to allopathic treatment across the world. One of the most significant advantages of this is that it has no negative side effects.

Taxonomists use a systematic classification system to categorise medicinal plants that are prone to miscarriage under specific settings. Attempts to streamline the plant inspection process are being made by using image recognition algorithms, which have just lately begun to surface. When it comes to plant identification research, methodologies that are based on colour features are frequently employed to develop a plant recognition method.

In such a picture, colour interpretation is most likely dependent on the colour distributions present; nevertheless, this is not a safe function since there are some scenarios in which the temporal precision of this characteristic is exploited. Lighting changes, leaf movement via waves, camera jitter, altering of focus, and rapid changes in camera parameter all lead to inaccurate plant category predictions. Given the various studies that have been conducted, the category of plants that are dependent on digital pictures is today considered to be a problematic issue. Those investigations were centred on the examination of certain plant leaves in order to aid in the identification and categorization of plants [4]. In the following years, they were used in a slew of research to construct a model for a plant leaf identification system, which was ultimately successful.

Gaber et al. employed MCA to obtain visual features from plants [5], as well as linear discriminant analysis to derive visual characteristics from plants. Researchers have also demonstrated that broad convolution neural networks (BCNs) outperform traditional object recognition or detection algorithms that are based on ordinary working light, texture, and shape properties, among other things. Typically, the CNN systems that are used in large-scale plant recognition operations comprise of a trait extractor that is followed by a classifier that is trained on the data. Despite the presence of occlusions, harvesting plant crops is not always an easy task. In fact, many plants are unable to have visible sections of their leaves at all. Additionally, various studies were carried out that were pertinent to the use of machine vision technologies to solve similar challenges on the other hand. Using machine learning techniques to recognise landscapes in aerial images, aerial image identification in agricultural computing is an example of computer recognition technologies in agricultural computing.

In Section 2, we conducted a study of numerous research publications relevant to plant recognition using deep learning and presented a table (Table 1.) including the results of the prior pattern detection approach. In Section 3, we spoke about the process for identifying people. During Section 4, we went into great detail regarding the design of the CNN network. In Section 5, we spent a great deal of time discussing

the process of leaf identification. Finally, in Section 6, we presented our paper's conclusion and addressed our plans for the future.

## II. LITERATURE REVIEW

The body of research on deep learning is quite extensive. In this part, we will discuss the work that has been done by a number of different researchers in the subject of plant identification using deep learning. For the purpose of categorization, Sapna Sharma. (2015) utilised principal component analysis (PCA), Hu's moment invariant approach, and morphological data. They employed sixteen distinct classes of the leaf.

This Matlab determines the circumference by counting the number of linked pixels around the edge of the region and calculating the distance between each one [1]. T. Gaber (2015) proposed a plant recommender approach that makes use of two-dimensional visual pictures of plants. Both the approach of attribute fusion and the procedure of multilabel classification were incorporated into this software. The results of the experiments showed that the accuracy of the function fusion approach was significantly greater than that of other separate applications. The testing demonstrated the robustness of the guidelines in giving correct information [2].

T. J. Jassmann (2015) conceived of a brand new CNN design. They experimented with the newly implemented Exponential Linear Unit (ELU) as CNN's non-linearity approach rather than the Rectified Linear Unit (ReLU). [3]

An architecture of the CNN was proposed by Hulya Yalcin (2016) in order to determine the morphology of plants based on photo sequences acquired from smart agrostations. In order to get rid of the picture qualities, the design is employed as a first processing step. Because of the influence they have on the capabilities of the neural network architecture, configuration of the CNN design and breadth are essential issues that should be noted. They employed 16 different types of plants and compared them to other ways; early data reveal that the CNN-centered strategy performs better than other approaches in terms of classification performance. [4]

According to Amala Sabu (2017), the problem of universal leaf identification presents significant challenges for computer vision. A process that is both effective in recovering the leaves of ayurvedic plants and valuable for other sectors of society, such as medical research and studies in botany. Recognize the images of the leaf in the photos. The investigation of the many strategies and categorizations that may be used to identify leaf types [5].

Lee, S.H., (2017) collected one of the photographs of plant leaves, which has also been discussed based upon the leaf attributes usage as an input, and a convolution neural network is now being utilised to discover patterns for each plant's depth information. CNN was applied here primarily for improving the depiction of the traits, while DN (Deconvolutional Network) was utilised for conducting successful research of Leaf organisms. It makes it easier to recognise the leaves of plants and the populations they belong to [6].

Ghazi, M.M., (2017) implemented three different models of transfer learning in order to explain the diverse plants and their identities. The LIFECLEF 2015 assessment was used to evaluate the Network. In order to come up with their recommendation, these three models made use of GoogleNet, VG-GNet, and AlexNet [7].

Barbedo, J.G. (2018) discussed the analysis of the key factors influencing the architecture and efficacy of deep neural networks applied to plant pathology. The in-depth study of the topic, which illustrates the benefits and disadvantages, will contribute to more concrete findings on plant pathology [8]. Barbedo, J.G. (2018) discussed the analysis of the key factors influencing the architecture and efficacy of deep neural networks applied to plant pathology.

Barbedo, J.G.A., (2018) investigated the application of problems encountered in transfer learning as well as the utilisation of deep learning. They discovered that CNN is an approach that may be utilised to categorise challenges related to plant biotechnology [9]. Zhu, X., (2018) makes use of CNN (Complex Background) in order to identify the plant leaves as little objects. The approach that was devised included the use of sample-normalization founding V2, which improved the accuracy of Region CNN. When the processing is complete, the sub-samples of high-quality photographs are divided into one hundred pieces, and the remaining images are sent back to be used in final production. The method gave the impression that it may be considerably quicker than the traditional area convolutional neural network work [10].

The name Garcia-Garcia (2018) One of the authors of this work focused their attention on high occupancy classification by using deep learning approaches. They gave brief presentations on the many themes related to in-depth study. This provides the necessary knowledge that is important for the objective at hand concerning deep learning [11].

Kaya, A., and Keceli. (2019) proposed the idea of using Deep Learning for Transfer Learning with the purpose of classifying plants. In this article, the influence of four distinct transference-training models on plant classification deals relying on DNN is examined for four different datasets. In conclusion, the findings of their theoretical research indicate that Transfer Learning provides a foundation for the self-estimating and analysing of plant classification. They utilise many formats that are widespread, such as End-to-End, Fine modulation, Fine modulation Cross Dataset, Deep Integrated Fine-tuning, and Classification by RNN-CNN. [12].

TABLE I

COMPARATIVE ANALYSIS

| Paper | Technique | Accuracy |
|---|---|---|
| T. Gaber (2015) [2] | Bagging classifier,2D based technique | 95% |
| T. J. Jassmann (2015) [3] | CNN, Rectified Linear Unit (ReLU) | 60% |
| Hulya Yalcin (2016) [4] | CNN | 97.47% |
| Lee, S.H (2017) [6] | CNN | 96.36% |
| Ghazi, M.M (2017) [7] | Transfer Learning on VGNN | 80.18% |
| Barbedo, J.G (2018) [8] | Deep Learning | 81% |
| Barbedo, J.G.A (2018) [9] | CNN | 84% |

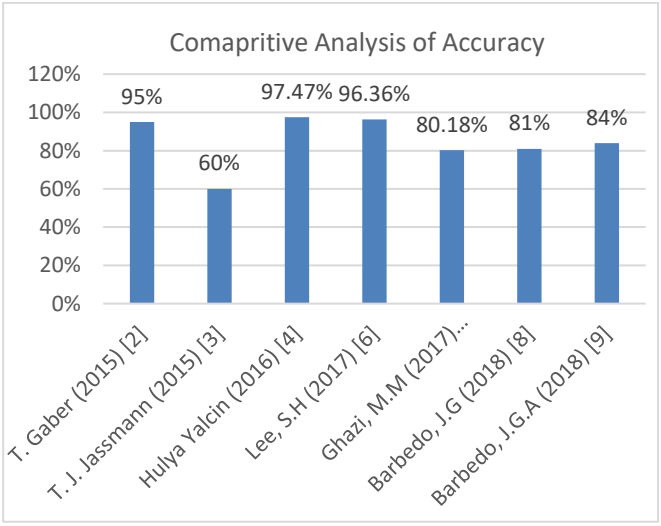


Figure 1. Graphical Analysis of Accuracy Comparison of Different Models

## III.CONCLUSION

Because the convolutional layers make use of the image's inherent features, CNN performs far better on images and videos than typical neural networks do. This is because CNN is able to better understand the content of the image. Neural feedforward networks with a simple architecture detect very little structure

in the data they receive. When all of the images are merged in the same manner, the neural network will achieve the same level of success as when it is trained on photographs that have not been mixed together. On the other hand, it works to optimise the coherence of the local spatial representation. As a result of this, it is guaranteed that they will considerably reduce the amount of operations required to analyse a picture by employing convolution on neighbouring pixel patches. This is because adjacent pixel patches have significance when taken together. We also refer to it as the core connector. The result of the conversion of a tiny pixel patch is then imported into the map, and a window is used to drag the result over the full image. In the process of detecting and classifying plants using automated or computer vision, there are various ways available; yet, there is still a dearth of study in this particular sector. In addition, there are no consumer solutions available at the moment on the market, not even those that deal with the identification of plant organisms based on images of the leaves. It has been determined that a distinct method including deep learning approaches is utilised in order to automatically identify and distinguish plants based on pictures of their leaves. The created model had the capability to detect the presence of a leaf and differentiate between unhealthy and healthy leaves.

In the next phase of study, the goal would be to increase the size of the dataset by expanding the number of samples and include a wider variety of plant leaf types. After doing a literature analysis on a variety of publications, we have come to the conclusion that CNN is the most effective method for accurately recognising plants and leaves. This conclusion was reached after conducting the literature research.

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