A DEEP LEARNING-BASED REAL-TIME WEB APPLICATION FOR MEDICINAL PLANT IDENTIFICATION AND USAGE AWARENESS

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ABSTRACT

Medicinal plants have been a source of healing and wellness for centuries, yet many people today lack awareness of these valuable natural resources and their potential uses. Identifying medicinal plants can be a challenging and time-consuming task, often requiring expert knowledge. Our web application transcends mere identification; it serves as an inclusive platform, not only revealing the plants' identities but also shedding light on their historical, cultural, and contemporary applications. In this project, we introduce a novel approach to address this issue by developing a real-time web application powered by deep learning. real-time web application leverages the capabilities of deep learning to provide instantaneous and accurate results for various tasks, from image recognition to data analysis. Powered by advanced neural networks, it offers users a seamless and efficient experience, making complex tasks feel effortless. Our system is designed to identify medicinal plants and provide information about their uses in real-time. To tackle this challenge, we introduce a pioneering solution: specifically, Convolutional Neural Networks (CNN) in image recognition and data analysis. The purpose of this web application is to make valuable information about medicinal plants more accessible to the general public. Beyond mere identification, our web application goes a step further by offering insightful awareness of usage. For each recognized plant, users receive detailed information about its botanical classification, medicinal properties, historical uses, preparation methods, and potential side effects or precautions. This comprehensive knowledge empowers individuals to make informed decisions about the utilization of medicinal plants for various health and wellness purposes. This project aims to bridge the knowledge gap surrounding medicinal plants, making this valuable information more accessible to the general public.

Keyword: - *Medicinal plants, real-time web application, deep learning, CNN- Convolutional Neural Network, Image recognition, Botanical classification*

1. INTRODUCTION

In recent years, there has been a growing interest in harnessing the power of deep learning and machine learning techniques to revolutionize the identification, classification, and awareness of medicinal plants. Medicinal plants have been a source of healing and wellness for centuries, yet many people today lack awareness of these valuable natural resources and their potential uses. This comprehensive literature survey explores a diverse range of research endeavors dedicated to this common objective. From real-time web applications powered by Convolutional Neural Networks (CNNs) for medicinal plant recognition to the creation of standardized datasets for plant disease and leaf recognition, each study contributes significantly to the rapidly evolving field of plant sciences and healthcare. These innovative solutions offer not only instant identification but also insightful knowledge encompassing botanical classification, historical uses, preparation methods, and potential side effects, empowering individuals to make informed decisions about utilizing medicinal plants for health and wellness. This synthesis of research efforts forms a compelling narrative of technological innovation, bridging the knowledge gap surrounding medicinal plants and paving the way for a future where plant-based remedies are more efficiently and effectively integrated into healthcare practices and biodiversity preservation.

2. MILESTONES

On 2019 march, a paper "Analysis of transfer learning for deep neural network-based plant classification models"[1], Computers and Electronics in Agriculture, published by A.Kaya, A.S.Keceli, C.Catal, H.Y.Yalic, H.Temucin and B.Tekinerdogan. in this paper, Plant species classification plays a vital role in safeguarding biodiversity, yet the conventional method of manual classification is labor-intensive, costly, and reliant on skilled experts who are often in short supply. To address these challenges, several machine learning algorithms have been proposed to facilitate the automated classification of plant species. Deep Neural Networks (DNNs) have been widely applied to various datasets for this purpose. However, these DNNs have typically been used in isolation, with little effort to leverage and transfer knowledge gained from different DNN applications. In the realm of machine learning, transfer learning entails utilizing insights gained from multiple DNN applications. This article delves into the outcomes of four distinct transfer learning models applied to deep neural network-based plant classification, using four publicly available datasets. Our empirical investigation reveals that transfer learning can yield significant advantages for automated plant identification and can enhance the performance of underperforming plant classification models

In August 2018, "Factors influencing the use of deep learning for plant disease recognition"[2], Biosystems engineering vol. 172, pp. 84-91, 2018, published by J.G. Barbedo, in this paper, Deep learning is rapidly emerging as a crucial tool for image classification. This technology is now finding applications in the realm of plant disease classification and recognition. While promising outcomes have been observed with this approach, it often conceals certain unaddressed issues in related experiments. This article undertakes an investigation into the primary factors influencing the design and efficacy of deep neural networks when applied to plant pathology. Through a comprehensive analysis of this subject, we aim to shed light on both the advantages and limitations, ultimately leading to more realistic conclusions. The arguments presented in this text draw upon existing studies in the literature and experiments conducted using a meticulously constructed image database. This database, comprising nearly 50,000 images, is being made freely available for academic purposes and faithfully captures and replicates many real-world conditions anticipated in practice.

"Deep learning models for plant disease detection and diagnosis"[3], Computers and Electronics in Agriculture, published by K.P. Ferentinos, in 2018, In this research paper, they developed convolutional neural network models to carry out the detection and diagnosis of plant diseases using simple leaf images of both healthy and diseased plants, leveraging deep learning techniques. Our models were trained using a comprehensive open database containing a total of 87,848 images, encompassing 25 different plant species across 58 distinct classes of [plant, disease] combinations, which also included images of healthy plants. We conducted training across various model architectures, with the best-performing model achieving an impressive success rate of 99.53% in accurately identifying the corresponding [plant, disease] combination or healthy plant. This remarkable level of accuracy positions the model as a valuable advisory tool or early warning system for plant disease detection. Furthermore, this approach holds promise for potential expansion into a fully integrated plant disease identification system designed to operate effectively under real-world cultivation conditions.

"An AI Based Approach for Medicinal Plant Identification Using Deep CNN Based on Global Average Pooling" [4] published by Rahim Azadnia, mohammed maitham Al-Amidi, hamed Mohammadi, Mehmet Akif cifci, Avat Daryab and Eugenio Cavallo in 2022. In this research paper, Medicinal plants have been a subject of great importance in maintaining human health for a significant period. However, identifying these medicinal plants is a time-consuming and labor-intensive task that often requires the expertise of specialists. Therefore, there is a growing need for a vision-based system that can assist both researchers and the general public in quickly and accurately recognizing medicinal herb plants. This study presents an intelligent vision-based system designed to identify herb plants by creating an automated Convolutional Neural Network (CNN). The proposed Deep Learning (DL) model comprises a CNN block for feature extraction and a classifier block for categorizing the extracted features. The classifier block incorporates various elements, including a Global Average Pooling (GAP) layer, a dense layer, a dropout layer, and a softmax layer. The effectiveness of this solution was evaluated using images at three different levels of definition (64 × 64, 128 × 128, and 256 × 256 pixels) for leaf recognition of five distinct medicinal plants. The results consistently demonstrate that this vision-based system achieved an accuracy rate exceeding 99.3% across all image definitions. Consequently, the proposed method provides an efficient real-time solution for identifying medicinal plants, with the potential to replace traditional identification methods.

The paper published by Vaibhav Tiwari, Rakesh Chandra Joshi, Malay Kishore Dutta" [5] Deep neural network for multi-class classification of medicinal plant leaves" this article describe the Plant diseases pose a significant challenge to the agriculture industry, demanding early detection to effectively manage and mitigate their impact. A major portion of disease symptoms manifests in plant leaves. However, manual leaf analysis by specialized experts in laboratories is costly and time-intensive. Therefore, there is a pressing need for automated and highly accurate techniques for detecting plant diseases, enabling early diagnosis, and reducing economic losses. This research presents a deep learning-based approach for the detection and classification of plant diseases using leaf images. The study utilized a diverse image dataset comprising leaf samples from 12 different crops categorized into 22 distinct classes. The dataset's inclusion of various intra-class and inter-class variations adds complexity, making the training of deep learning models more challenging. Extensive experimentation was conducted, evaluating multiple deep neural networks with various combinations of optimizers, and learning rates. Additionally, a comprehensive analysis involved five-fold cross-validation and testing on separate, unseen images, assessing the model's performance across various statistical parameters. The proposed approach yielded promising results, achieving an average cross-validation accuracy of 98.68% and an average test accuracy of 97.69%. These outcomes were obtained even when dealing with images featuring both intra-class and inter-class variations, highlighting the effectiveness of the developed model in plant disease detection and classification.

Amrutha M Raghukumar and Gayathri Narayanan published a report "Comparison Of Machine Learning Algorithms For Detection Of Medicinal Plants" [6] in 2020 march 13 based on ayurvedic medicinal plants hold immense significance as a primary source of medicine, offering remedies for a wide array of ailments, including cardiac disorders, respiratory diseases, fertility issues, and more. The accurate identification of these medicinal plants plays a pivotal role in ensuring effective treatments. However, manual identification methods can be prone to inaccuracies and are often time-consuming. To address these challenges, there is a growing preference for automated medicinal plant recognition systems. This automated recognition process involves the extraction of key features from images of plant leaves, encompassing shape, texture, and color attributes. Subsequently, machine learning classification techniques, such as K-Nearest Neighbors (KNN) and Support Vector Machines (SVM), are employed for the classification task. To assess and compare their performance, extensive simulations and experiments are conducted using MATLAB R2019a as the primary platform.

Md. Ariful Hassan, Md. Sydul Islam, Md. Mehedi Hasan, Sumaita Binte Shorif, Md. Tarek Habib & Mohammad Shorif Uddin published an article "Medicinal Plant Recognition from Leaf Images Using Deep Learning" [7] in 14 march 2022, which recognizing medicinal plants is vital for advancing plant cultivation, increasing medical industry production, and preserving plant species from potential extinction. Leaf analysis plays a crucial role in plant recognition. However, the availability of standardized datasets for medicinal plant leaves remains limited. This chapter addresses the creation of a standardized dataset and the utilization of deep learning models for plant recognition, as they have demonstrated superior accuracy. To achieve this goal, the chapter investigates the effectiveness of three widely-used deep convolutional neural networks (CNNs): InceptionV3, MobileNet, and Xception. A comprehensive series of experiments is conducted using the newly developed dataset, aiming to

identify 11 distinct medicinal plants based on their leaf images. Among these deep CNN architectures, MobileNet proves to be the most effective, as validated by four essential evaluation metrics derived from the confusion matrix.

The paper, titled "Herbal Plants Leaf Image Classification Using Deep Learning Models Based on Augmentation Approach"[8] and authored by Gaurav Kumar and Vipin Kumar, published on July 31, 2022, delves into the shifting landscape of our world, marked by a growing transition towards renewable energy sources and natural remedies in healthcare. Herbal plants, celebrated for their medicinal attributes, are emerging as valuable substitutes for synthetic pharmaceuticals, catering to the healthcare needs of both humans and animals. The crux of unlocking the potential of these herbs lies in their precise identification. This paper takes on the formidable task of herbal plant identification, leveraging the prowess of Deep Learning (DL) models. The authors have achieved commendable success in categorizing 25 distinct types of herbal plant leaf images, employing an array of deep learning models. Their endeavors have yielded impressive results, culminating in the highest test accuracy of 97.68% when using the original dataset and an even more impressive 98.08% with augmented data. Crucially, it's worth noting that this research builds upon the foundation laid by the authors' previous work, titled "Herbal Plants Leaf Image Classification using a Machine Learning Approach." In their earlier study, they applied six classical Machine Learning (ML) algorithms to the original dataset, achieving the highest classification accuracies of 82.51% through the Multi-layer Perceptron (MLP) classifier.

The paper titled "A Study on Medicinal Plant Leaf Recognition Using Artificial Intelligence" [9] authored by Vina Ayumi, Ermatita Abdiansah, Handrie Noprisson, Mariana Purba, and Marissa Utami, and published on October 28-29, 2021, delves into the realm of medicinal plant recognition, a process traditionally characterized by its time and resource-intensive nature. To mitigate these challenges, researchers have increasingly turned to the integration of artificial intelligence technology. This paper seeks to undertake a comprehensive systematic literature review of medicinal plant leaf recognition studies published in the last two years (2019–2020), drawing from reputable sources such as IEEE, Springer, and Science Direct. This review has identified and analyzed 15 studies dedicated to medicinal plant leaf recognition utilizing artificial intelligence methodologies. The datasets predominantly employed for this purpose are privately sourced, although notable public datasets such as Leaf, Flavia, and the Swedish dataset have also been utilized. Among the diverse range of techniques explored, the study highlights the effectiveness of the Multichannel Modified Local Gradient Pattern (MCMLGP) and Gray Level Co-Occurrence Matrix (GLCM) as feature extraction methods. Furthermore, various classifiers have been deployed with promising results, including Convolutional Neural Network (CNN), Multi-Layer Perceptron trained with the Backpropagation algorithm (MLP-BP), Support Vector Machine (SVM), and Transfer Learning (VGG19).

The paper titled "Detecting Medicinal Plants Using YOLOv5: A Mobile Vision Approach" [10] authored by Daryl B. Valdez, Chris Jordan G. Aliac, and Larmie S. Feliscuzo, and published on April 26-28, 2023, explores the historical use of medicinal plants for healing purposes has persisted through the ages. Considering technological advancements, the field of automated plant species identification has made significant strides. Although numerous studies have concentrated on classifying plant species based on their leaves, the automated identification of plant organs beyond leaves has remained largely uncharted. This research delves into the precise and automated detection of flowers from medicinal plants within their natural surroundings. To achieve this objective, a novel medicinal plant object detection dataset, featuring four common medicinal plant species in the Philippines, is introduced. A YOLOv5-based model is then trained to detect medicinal plant flowers with an impressive mean average precision of 83%. Furthermore, an integrated mobile application is developed, showcasing the feasibility and acceptance of real-time automated detection and identification of medicinal plant species. These findings bear substantial significance for the future of traditional medicine and the preservation of invaluable medicinal plant species.

Md. Musa, Md. Shohel Arman, Md. Ekram Hossain, Ashraful Hossen Thusar, Nahid Kawsar Nisat & Arni Islam published an article based on “Classification of Immunity Booster Medicinal Plants Using CNN: A Deep Learning Approach” [11] in 23 October 2021, the paper addresses the environment has bestowed upon us a diverse array of plants, some of which hold the key to medicinal treasures. In Bangladesh, these medicinal plants are known as Ayurveda, Homeopathy, and Unani, and they are increasingly recognized for their potential in combating contemporary health challenges such as the Covid-19 pandemic. The immune system's vitality plays a pivotal role in safeguarding one's health against viruses, bacteria, and pathogens. A robust immune system serves as a formidable defense, while a weakened one renders an individual susceptible to infections and illnesses. Within the realm of

medicinal plants, certain varieties are renowned for their immune-boosting properties, making their classification of paramount importance. To tackle this classification task, we assembled a collection of leaf images representing six distinct classes, known locally as Darchini, Tulshi, Tejpata, Sojne, Neem, and Pathorkuchi. This article introduces the application of the Convolutional Neural Network (CNN) algorithm for plant classification. Leveraging CNN, we achieved an impressive accuracy rate of 95.58% in identifying these plants from their leaf images. Looking ahead, as the threat of infectious viruses persists, our research serves as a valuable resource, empowering individuals with knowledge about the immune system and the medicinal plants that fortify it, enabling them to combat diseases and viruses effectively

"Medicinal Plant Classification using Convolutional Neural Network and Transfer Learning" [12] Authored by Daryl B. Valdez, Chris Jordan G. Aliac, and Larmie S. Feliscuzo, and published on September 15, 2022, this research delves into the multifaceted realm of medicinal plants. These plants not only represent a crucial source of therapeutic compounds but also offer an alternative avenue for medications, serving a substantial portion of the global populace. With recent advancements in computer vision, the field of plant identification via image analysis has witnessed remarkable progress, promising enhanced accuracy, precision, and practical applications. This paper embarks on a mission to achieve precise and automated identification of medicinal plants. To facilitate this endeavor, we have meticulously assembled a pioneering dataset, featuring images spanning ten distinct classes of medicinal plant species. Additionally, a supplementary class encompasses a mix of weeds, vines, and non-medicinal plants. Our innovative solution, grounded in the MobileNetV3 architecture, presents an economically feasible, dependable, and efficient framework for classifying medicinal plants. Harnessing the power of Transfer Learning, our results proudly reveal an impressive accuracy rate of 97.43% when confronted with this formidable task. Collectively, these findings underscore the immense potential of our efficient and reliable medicinal plant classifier, primed for real-world applications.

The paper titled "Identification of Medicinal Plant Using Machine Learning Approach,"[13] authored by Nayana G. Gavhale and Dr. A.P. Thakare, and published on July 7, 2020, delves into the ancient practice of utilizing plants as medicinal sources in Ayurveda. Traditionally, the preparation of Ayurvedic medicine involves the crucial step of manually identifying the correct plant. However, with the demand for mass production, automating the identification process becomes essential. This study introduces a technique for the automated identification of medicinal plants using the Random Forest algorithm, an ensemble supervised machine learning method that leverages color, texture, and geometrical features.

The paper titled "Identification of Ayurvedic Leaves using Deep Learning,"[14] authored by Roshan Umate, N. R. Wankahde, P.G. Jaiswal, Swati G. Kale, Shoaib Ansari, Tawfeek Khan, Mansi Chitriv, Harshit Sathone, Hariyali Mansata, and published on May 28, 2023, explores the realm of Ayurveda, often referred to as the "science of life" due to its seamless integration into daily living. Ayurveda relies on the use of leaves, roots, and fruits of medicinal plants for treating various ailments, garnering significant attention for its minimal side effects compared to conventional medicines. Consequently, Ayurveda has emerged as a prominent research field in the healthcare domain. Presently, the identification of medicinal plants relies on human expertise and knowledge passed down through generations, which is susceptible to errors. Hence, there is a growing demand for an automated system utilizing advanced technologies like computer vision and machine learning to accurately identify plant species based on their leaves in the Ayurvedic healthcare domain. This research is conducted using a self-created dataset comprising 4,390 images representing 35 different species of medicinal leaves. The system, an Android-based application, employs Convolutional Neural Networks (CNN) for leaf classification. The dataset is divided into 80% for training and 20% for testing, and various metrics are employed to evaluate system performance, resulting in an impressive reported accuracy of 94.10%.

3. CONCLUSIONS

In this comprehensive literature survey, a diverse range of research endeavors has been explored, all converging on the common objective of harnessing advanced technologies, particularly deep learning, and machine learning techniques, to revolutionize the identification, classification, and awareness of medicinal plants. From the development of real-time web applications utilizing Convolutional Neural Networks (CNNs) and for medicinal plant recognition to the creation of standardized datasets for plant disease and leaf recognition, each study contributes significantly to the rapidly evolving field of plant sciences and healthcare. These endeavors collectively underscore the potential of artificial intelligence in making valuable information about medicinal plants more accessible to the general public. By offering instant identification and insightful knowledge encompassing botanical classification,

historical uses, preparation methods, and potential side effects, these innovative solutions empower individuals to make informed decisions about utilizing medicinal plants for health and wellness. The synthesis of these research efforts forms a compelling narrative of technological innovation, bridging the knowledge gap surrounding medicinal plants and paving the way for a future where plant-based remedies are more efficiently and effectively integrated into healthcare practices and biodiversity preservation.

4. REFERENCES

[1]. C. Amuthalingeswaran, M. Sivakumar, P. Renuga, S. Alexpandi, J. Elamathi, S. Santhana Hari "Identification of Medicinal Plant's and Their Usage by Using Deep Learning" 2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI)

[2]. S.H. Lee, C.S. Chan, S.J. Mayo and P. Remagnino, "How deep learning extracts and learns leaf features for plant classification", Pattern Recognition, vol. 71, pp. 1-13, 2017.

[3]. J.G.A. Barbedo, "Impact of dataset size and variety on the effectiveness of deep learning and transfer learning for plant disease classification", Computers and Electronics in Agriculture, vol. 153, pp. 46-53, 2018.

[4]. G.L. Grinblat, L.C. Uzal, M.G. Larese and P.M. Granitto, "Deep learning for plant identification using vein morphological patterns", Computers and Electronics in Agriculture, vol. 127, pp. 418-424, 2016.

[5]. M.M. Ghazi, B. Yanikoglu and E. Aptoula, "Plant identification using deep neural networks via optimization of transfer learning parameters", Neurocomputing, vol. 235, pp. 228-235, 2017.

[6]. Rohit Sunil Meshram & Nagamma Patil "Classification of Medicinal Plants Using Machine Learning" Smart Innovation, Systems and Technologies book series, vol. 289, pp 255–267 2022

[7]. A Johannes, A Picon, A Alvarez-Gila, J Echazarra, S Rodriguez - Vaamonde, A.D Navaias, et al., "Automatic plant disease diagnosis using mobile capture devices applied on a wheat use case", Computers and Electronics in Agriculture, vol. 138, pp. 200-209, 2017.

[8]. S. Zhang, W. Huang and C. Zhang, "Three-channel convolutional neural networks for vegetable leaf disease recognition", Cognitive Systems Research, vol. 53, pp. 31-41, 2019.

[9]. A. Garcia-Garcia, S. Orts-Escolano, S. Oprea, V. Villena-Martinez, P. Martinez-Gonzalez and J. Garcia-Rodriguez, "A survey on deep learning techniques for image and video semantic segmentation", Applied Soft Computing, vol. 70, pp. 41-65, 2018.

[10]. G Chandan, Ayush Jain, Harsh Jain, Mohana" Real Time Object Detection and Tracking Using Deep Learning and OpenCV" 2018 International Conference on Inventive Research in Computing Applications (ICIRCA), 11-12 July 2018

[11]. A.K. Singh, B. Ganapathysubramanian, S. Sarkar and A. Singh, "Deep learning for plant stress phenotyping: trends and future perspectives", Trends in plant science, 2018, [online] Available: https://doi.org/10.1016/j.tplants.2018.07.004.

[12]. K. Golhani, S.K. Balasundram, G. Vadamalai and B. Pradhan, "A review of neural networks in plant disease detection using hyperspectral data", Information Processing in Agriculture, 2018, [online] Available: https://doi.org/10.1016/j.inpa.2018.05.002.

[13]. X. Zhu, M. Zhu and H. Ren, "Method of plant leaf recognition based on improved deep convolutional neural network", Cognitive Systems Research, vol. 52, pp. 223-233, 2018.