International Journal of Scientific Research & Engineering Trends
Volume 11, Issue 1, Jan-Feb-2025, ISSN (Online): 2395-566X

Review on Accuracy Enhancement of Flower Classification Using Machine Learning

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Abstract- The rapid evolution of Artificial Intelligence (AI) and Machine Learning (ML) technologies has led to the development of increasingly sophisticated algorithms and models. In particular, these advancements have been pivotal in the domain of flower classification and recognition, aiming to identify and categorize the vast array of species of flowers present on our planet. This review delves into the convergence of AI and ML within the realm of flower classification, a domain that greatly benefits from the advancements in computer vision. As a sub-field of AI, computer vision plays a crucial role in extracting intricate features from floral specimens and subsequently utilizing classification algorithms to accurately label and categorize them. This literature review offers a meticulous and comprehensive exploration of the existing body of knowledge, aiming to elucidate the various methodologies and approaches employed in the taxonomic categorization of floral specimens. It encompasses an extensive survey of scholarly works, research papers, and innovative techniques that contribute to the advancement of flower identification systems. The review addresses diverse strategies, including but not limited to deep learning architectures, neural networks, feature extraction methodologies, and optimization techniques used in the classification of flowers. By synthesizing and critically analyzing the existing literature, this review aims to provide insights into the state-of-the-art techniques and emerging trends in the field of flower classification and recognition using AI and ML. This paper holds several benefits to the society such as: agriculture, environment conservation, education and tourism.

Index Terms- Flower Recognition, Flower Classification, Textural Features, Image Segmentation, Floral Specimen Categorization.

I. INTRODUCTION

Now a day's it is very important to identify naturally occurring objects and recognise its type. It is useful to identify flower type in various fields such as Gardening, botany research, Ayurvadic treatment, Farming, floriculture etc. Our literature survey have to found that the different Image processing techniques used to extract features from flower and classify them using computational intelligence algorithms. Digital image processing deals with manipulation of digital images through a digital computer. It is focuses on developing a computer system that is able to perform processing on an image [1]. Digital image processing technologies such as Classification, Feature extraction, Pattern recognition etc are useful to classify the images.

II. CLASSIFICATION ALGORITHMS

Classification techniques are widely used to classify data among various classes. Classification techniques are being used in different system to easily identify the type and group to which it is belongs to. There are many algorithm used for classification. There is mainly two types of classification algorithms Supervised classification algorithms and Unsupervised classification algorithms. Supervised classification algorithms [2-3]:

- Artificial Neural Networks
- Learning vector Quantization
- Decision tree induction
- Nearest neighbour classifier
- Bayesian classifier
- Support vector machine
- Regression trees etc.

III. LITERATURE REVIEW

Base paper Michele Torresani et al. [1] The abundance and diversity of plants and insects are important indicators of biodiversity, overall ecosystem health and agricultural production. Bees in particular are interesting indicators as they provide a key ecosystem service in many agricultural crops. Worldwide, habitat loss and fragmentation, agricultural intensification and climate change are important drivers of plant and bee decline.

Rupinder Kaur et al. [2] In this research paper, our main focus is to design and develop a system for classification and recognition methodology for the acknowledgment and retrieval of a Sunflower flower in the natural environment centralized on the indigenous habitat dependent on a multi-layer method. Further, we design applications for their better classification.

Don Chathurika Amarathunga et al. [3] Accurate identification of insect pests is essential in crop management as they are one of the primary causes of yield losses. However, differences between insect species demand different pest control strategies. Hence, research on new technology for fine-grained classification of insect pests is potentially important.

Yongrong Zheng et al. [4] Flowers have great cultural value, economic value and ecological value in our life. Accurate classification of flowers facilitates various applications of flowers. However, existing datasets for the visual classification task mainly focus on common RGB images. It limits the application of powerful deep learning techniques on specific domains like the spectral analysis of flowers

Chenglong Zhang et al. [5] Chemical and mechanical thinning processes have long been used in stone and pome fruit production. During the thinning of apple flowers, growers use chemicals to regulate the tree load.

Uddhav Bhattarai et al. [6] Flower and fruit count is a critical metric in developing crop-load management and harvesting strategies during flower/fruit development and harvest seasons. Growers currently rely on their prior experience and/or manual count in sample areas/trees to estimate the number of flowers/fruits in orchards.

Guo Li et al. [7] Asynchrony of kiwifruit flowering time results in different flower phenological stages in canopy at the same time. Pollination quality of flowers is influenced by their phenological stages, while their distributions determine fruit distributions and influence kiwifruit quality and yield. Thus, it's necessary to find suitable flowers to be pollinated based on flower phenology and its distribution.

Ganbayar Batchuluun et al. [8] Studies regarding image classification based on plant and crop disease images that were acquired using a visible light camera have been conducted in the past, whereas those based on thermal images are limited. This is because the thermal images are blurry due to the nature of the thermal camera, which makes it extremely difficult to classify objects.

Seid Mohammad Alavi-Siney et al. [9] A two-year field experiment (2014–2016; Zanjan, Iran) was conducted to monitor potential diversity pattern and adaptability power among 18 Iranian saffron ecotypes under Zanjan climatological conditions using seven flower-related and three qualitative traits (crocin, picrocrocin, and safranal, determined by UV–visible spectra), and analyzed by supervised and unsupervised approaches.

Sathira Dilshan Bataduwaarachchi et al. [10] A fundamental step towards an autonomous cross-pollination process for tomato plants involves classifying tomato flowers in line with their maturity. This paper is concerned with the development of a novel, portable, and deep learning enabled multi-classification system for classifying maturity levels of tomato flowers.

Jennifer P. Albarico et al. [11] There is a demand for flowers globally all year round, more particularly roses, necessitating increased production for flowers. Demand for roses has increased due to their year-long availability as well as its uses in cosmetic, perfume, medicinal products, food raw materials and decoration industry.

Munjur Alom et al. [12] Deep learning (DL) has gradually taken the lead as the most effective approach in the agricultural fields due to the early identification and classification of plant species and diseases for improving the quality of crop production because of recent technological breakthroughs, which have had a significant impact on agriculture.

Lucas Gabriel Souza Santos et al. [13] The maintenance of the variability of plant genetic resources is important both for conservation purposes and for the expansion of the genetic bases of the species. Machine learning is an additional tool with great potential that has been used in the search for solving various agricultural challenges.

Salik Ram Khanal et al. [14] Early-stage identification of fruit flowers that are in both opened and unopened condition in an orchard environment is significant information to perform crop load management operations such as flower thinning and pollination using automated and robotic platforms.

Yuying Shang et al. [15] Flower thinning at the most appropriate stage could achieve high and stable yield of apple. Achieving the accurate and real-time detection of apple flowers can provide necessary technical support for the vision system of thinning robots. An apple flower detection method based on lightweight YOLOv5s algorithm was proposed.

Xinyang Mu et al. [16] Identification of individual king flowers within flower clusters is a critical step for developing a robotic apple pollination system. Typically, each cluster has five to six individual flowers, and the king flower can be occluded by the lateral flowers because of their central position in a flower cluster.

Gurpreet Singh et al. [17] Flower classification plays a vital role in various domains, including agriculture, botany, and ecology by facilitating the identification and categorization of different floral species. In recent years, the advancement of deep learning techniques has revolutionized image classification tasks, offering powerful tools for automated flower recognition. In this study, we proposed a ResNet50 model for the classification of different types of flowers. The ResNet50 model is known for its depth and effectiveness in capturing intricate features from raw image data, making it well-suited for complex classification tasks. To achieve accurate flower classification, we leverage the pre-trained ResNet50 model, which has been trained on a large-scale dataset called ImageNet, to extract high-level features from flower images. Transfer learning is employed to fine-tune the model on a specific flower dataset, thereby adapting it to the nuances and characteristics of floral imagery.

Reyad Hassan et al. [18] This study proposes a novel approach for identi-fying plant leaves using a combination of handcrafted visual leaf image features(shape, color, texture, and preliminary vein properties), their extraction strategies (based on image processing and statistical measures), and classification methods. To do so, a 5-step approach is presented comprising image acquisition, image pre-processing, feature extraction, classification steps, comparison, and evaluation. The presented approach is tested on publicly available standard leaf image datasets such as Flavia, Swedish, and our self-collected BDLeaf20 dataset comprising 20 Bangladeshi local plant species which include fruit, flower, and medicinal plants bearing a total of 107 leaf images.

Miguel Q. Deveraturda et al. [19] Convolutional Neural Networks (CNNs) have been extensively studied for plant classification. Previous research primarily focused on herbs, plant diseases, and flowers. However, a limited amount of research specifically addresses the classification of ornamental plants based on their species. This study developed a classification system using a Residual Network with 50 layers (ResNet-50) implemented on a Raspberry Pi 3B. The system utilized a Raspberry Pi camera module for image capture and employed transfer learning with a pre-trained model from Keras. The model was trained in 6 classes, including Aglaonema commutatum, Dieffenbachia compacta, Spathiphyllum wallisii, Dracaena bacularis, Dracaena trifasciata, and unknown, using a dataset of over 200 images per class.

Suvarna Vani K et al. [20] In the field of Ayurveda, the accurate identification of medicinal flowers is a critical aspect of ensuring the efficiency and safety of traditional remedies. Traditionally, medical professionals have relied on their visual acumen and olfactory senses to identify these therapeutic plants. However, the potential for human error in this process necessitates a more precise and reliable method. This approach employs a deep learning technique namely Convolutional Neural Networks (CNN), to enhance the accuracy of medicinal flower identification. The project aims to develop a robust model capable of classifying medicinal flowers with a high degree of precision, reducing the risks associated with mis-identification. The methodology involves the use of a diverse and comprehensive dataset comprising photographs of specific therapeutic flowers. Dandelion, daisy, and orchid are exemplified as notable candidates due to their frequent application in the treatment of respiratory ailments, digestive issues, skin problems, and various other health concerns in Ayurveda.

Epie F. Custodio et al. [21] Identification of medicinal plants is a difficult undertaking. It needs an expert's presence to recognize them. The goal of this study is to enhance existing classification and recognition accuracies of medicinal plant leaf. Additionally, actual image count was increased to add variance to the data and augment training accuracy. According to the study's findings, categorizing and identifying medicinal plants using model averaging ensemble is a viable attempt in boosting overall recognition accuracy rate.

Grace Maickel et al. [22] Flower identification is a technique that is used to distinguish different varieties of Rose flower. It is difficult for common people to identify the species of rose based on their color. Traditional sorting techniques are more time-consuming and prone to human error as the whole process is done by manual labor and visual inspection. The device uses a Convolutional Neural Network (CNN) to accurately determine each rose's color by taking pictures of the flowers through a camera that is placed in a top basket. After that, using a rotation mechanism driven by stepper motors, the categorized flowers are systematically deposited into matching color-coded baskets below. The goal of this project is to improve flower handling procedures by carrying eliminating manual sorting and providing precise and efficient rose segregation.

Nishanthini Mani et al. [23] This research study investigates the classification of Iris flowers based on their morphological structures, addressing the challenges posed by variations in attributes like size, shape, and color. This study explores various classification techniques and their practical implementations by conducting a comparative analysis using the IRIS dataset. With 21 attributes and three species (Setosa, Versicolor, and Virginica), each comprising 40 samples, this research aims to leverage machine learning algorithms to achieve precise classification. Key steps include data preprocessing, model selection, and hyperparameter tuning, with evaluation metrics to enhance the model performance.

B J Bipin Nair et al. [24] Image-based classification of medicinal flowers is a crucial and game-changing work that can help in developing the traditional medical practices and

healthcare techniques that have been followed in countries including India and China for centuries. Accurate work can help enhance traditional practices, making them faster and more efficient. Further studies on this topic can help in drug discovery. On doing a thorough review of the previous works we have found a lack of works regarding the classification of Indian Medicinal flowers and to overcome this, our work presents a robust methodology for classifying Indian medicinal flowers using the MobileNetV2 light-weight network.

Gautam Yadav et al. [25] Floweret recognition, a crucial aspect of plant identification and ecological research, plays a significant role in understanding biodiversity and ecosystem dynamics. This paper proposes a novel approach for floweret recognition leveraging advanced deep learning techniques. The proposed system utilizes convolutional neural networks (CNNs) to automatically extract hierarchical features from high-resolution images of flowerets, enabling accurate and efficient classification. The methodology involves a multi-stage process, starting with data preprocessing to enhance image quality and remove noise.

Mustafa Yurdakul et al. [26] Almond is a nut rich in essential nutrients. In addition to being a food, it is also used in cosmetics and the pharmaceutical industry. The market value of almonds is determined according to the quality of the almonds. Manually determining the quality of almonds by humans is a prone to error, time-consuming, and tiring process. In this study, For this reasons, well-known twelve pre-trained CNNs were used to classify almonds as normal and damaged. Then, the most successful model was used as a feature extractor, and the features were classified with various machine learning algorithms. In addition to all these, features were selected by using the FPA algorithm, and the classification process was carried out.

Abinash Tripathy et al. [27] With the availability of many social media sites, the reviews and comments by the customers are freely available for analysis. As reviews are in text, the amount of words needs to be processed for any analysis work is very large in amount. So, approaches need to be adopted for minimizing count of words without affecting the result. Thus, Flower Pollination Algorithm is used in present paper to select the fit reviews by using a fitness function. These fit reviews are than given input to Artificial Neural Network (ANN) for further classification. The classification result is evaluated with the help of confusion matrix and various other performance evaluation parameters obtained from the confusion matrix.

Rasendram Muralitharan et al. [28] Plants could be classified using plant flower information. Lot of existing flower-based plant classification systems are available. Some classification system uses DSP techniques to classify the plants. Some classification systems use machine learning techniques to classify the plants. Some classification system uses hybrid techniques to classify the plants. Some classification system uses other methods to classify the plants. Although we have lot of flower-based plant classification systems, the accuracy of the existing flower-based plant classification systems is low. We use machine learning techniques to classify the plants. Our system uses length, width, and mean RGB values of the flowers as the features of the machine learning models.
Shilpa Sethi et al. [29] Flowers are the foremost part of our biodiversity and a major source of food and medicines. Flower species identification is popular in the anthology field, due to the numerous health benefits. The identification of flowers by conventional methods is a tedious task. The availability and ubiquity of digital technologies and advancements in pattern recognition techniques, let the idea of automated flower species identification a reality. Current works had many limitations such as high inference time, high dimensionality, low accuracy and increased memory consumption. This paper provides an optimized feature selection technique to accurately identify flower species using machine learning techniques in less time.

Abhilasha Varshney et al. [30] This paper analyzes deep learning techniques for categorizing flowers, covering new advances, issues, and advancements in this emerging field. As the significance of automated flower identification continues to grow across many domains, deep learning algorithms have emerged as powerful tools for attaining accurate and effective categorization. By combining a variety of papers, methods, and datasets, this study offers a structured overview of the state-of-the-art in deep learning-based flower categorization. The main concepts, architectures, pre-processing techniques, transfer learning methodology, and performance evaluations employed in diverse research are covered in the article.

IV. CONCLUSION

Flower recognition is useful to identify the flower signature. The methods are used to extract flower features are based on color, shape, petal count and texture etc. In colour based model accuracy is high only if the flower colours are distinct. In shape based model there is problem if the view point of the image is different. Same as in petal count if the some of petals are missing then it may mislead to classify the image. Classifiers plays important role to test the data and check the accuracy of classification algorithm. Supervised classification gives higher accuracy as compared to unsupervised classification algorithms. MLP gives better result as compare to logistic regression, kNN, pNN and SVM. To identify different flower images based on its surface parameter is challenging and most expensive task. Flower image surface parameters are grain, color and texture. The combined feature extracted from each of its parameter is used to identify flower type and gives better result as compare to using single

parameter. Since flower grain analysis plays an important role in flower recognition it is used to identify the flower type. Whereas MLP feed forward method using back propagation algorithm gives higher accuracy to classify the flower images.

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