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IMAGE RECOGNITION ON FLOWER CLASSIFICATION USING NEURAL NETWORK

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ABSTRACT

The integration of computer technology in various fields including agriculture has facilitated modernization and automation. One of the significant applications of computer technology in agriculture is the classification of flowers. Proper identification and classification of flowers are essential as they play a crucial role in the ecosystem. Morphological features of flowers and leaves are the basis of their classification. This study aims to propose a flower image classification system using an artificial neural network for four different types of flowers, namely sunflower, rose, lily, and dandelion. The proposed system can have various applications in floriculture and the classification of other plants. An image of a flower serves as the input to the system, and it is used to segmented based on the dataset images of similar flowers with comparable features. The artificial neural network is then trained using 125 samples of the four different groups of flowers. Using an artificial neural network, the proposed system achieves an accuracy of around 82%. This high accuracy is attributed to the integration of both DWT and GLCM techniques in the proposed system allows the extraction of accurate textural features, which enable efficient flower classification. The use of an artificial neural network in the proposed system allows the system to learn and improve its classification accuracy. The system can also be updated with additional data to improve its accuracy further. The proposed flower image classification system using an ANN is a significant development in the field of floriculture and the classification of plants. The system's accuracy of approximately 82% showcases its potential for application in real-world scenarios. The system can be further enhanced by incorporating additional data to

improve its accuracy and potentially be utilized in other areas of plant classification.

***Keywords**: Classification, Image Recognition, Artificial Neural Network, Segmentation, feature extraction.*

INTRODUCTION

The pace of change in the world is accelerating and technological advancements are participating a significant role in modernizing and automating various fields, including agriculture. The classification of flowers is an essential application in agriculture, as it helps in identifying and grouping them accurately. Flowers and leaves are classified based on their morphological features. However, identifying a particular flower's species can be a daunting task for non-professionals due to the lack of botanical knowledge. Moreover, if the image is surrounded by leaves or soil, it becomes nearly impossible to recognize the flower.

In the past, identifying an unknown flower using digital plant books on mobile devices has been a time-consuming process. As a solution to this issue, a portable framework that can provide a better method of obtaining a wide variety of data has been proposed. The use of cell phones and computer image recognition could be seen as an approach to improving the quality of living circumstances that have been affected by the rapid growth of the human population. To preserve the natural environment in which ecosystems are getting destroyed, it is essential to have plant and environment education. Therefore, image recognition is one of the significant applications in the world of computer innovation that is directed towards the goal of environmental conservation. Recognizing flowers is a relatively new and challenging field in image communication technology. Most image recognition studies have focused on identifying objects such as faces, cars, or bikes. However, recognizing flowers requires a different approach, as flowers have complex structures and intricate patterns. To address this challenge, numerous techniques and algorithms have been proposed to identify a flower based on its features, identity, and composition. One of the techniques proposed is a flower image classifying system using artificial neural networks. This system can be useful in floriculture and classification of other plants. The suggested approach relies on extracting textural features by employing the DWT and GLCM. The image of the flower is taken as an input to the system, which

is then segmented based on the dataset images with similar appearing and featured flowers. The artificial neural network is trained using 125 samples of four different groups of flowers, namely, sunflower, rose, lily, and dandelion. This application gives an accuracy of approximately 82% with artificial neural networks. Flower image classifying system using artificial neural networks is a significant contribution to the field of image communication technology. It can help in identifying and recognizing flowers accurately and efficiently, which is essential in agriculture, floriculture, and environmental conservation. The system's accuracy and efficiency can be improved by using more advanced techniques and algorithms, and future research can explore the application of this technology in weed control with herbicide purposes.

The approach to recognition

The field of computer vision has grown rapidly in recent years, and the use of image recognition in various fields, including agriculture, has become increasingly important. One such application is the classification of flowers, which is essential for the floriculture industry, botanical research, and environmental conservation. Accurate identification and grouping of flowers based on their morphological features can aid in their proper care and management. However, this can be a challenging task for non-experts, especially when the flowers are surrounded by foliage or other background elements. The proposed approach is aimed at resolving this problem of ANN and image processing techniques are used. Specifically, the system utilizes the discrete wavelet transform (DWT) and the gray level co-occurrence matrix (GLCM) to extract textural features from the flower images. The extracted features are then used to train a Multilayer Perceptron Neural Network, which can accurately classify the flowers into four different groups, including sunflower, rose, lily, and dandelion. The approach consists of two phases: preparation and grouping. During the preparation phase, the surface highlights are extracted from a set of prepared/training images, and these highlights are used to train the neural network. In the grouping phase, the flower images are segmented to remove unwanted background elements using a threshold algorithm. The segmented images are then processed by the neural network to determine the class of the flower. The proposed approach offers several advantages over traditional methods of flower classification, such as digital plant books. It provides a fast and accurate way to identify

and group flowers based on their features, even in the presence of complex backgrounds. This can be particularly useful for non-experts who do not have extensive botanic knowledge. Moreover, the proposed approach can have broader applications beyond flower classification, such as in the field of weed control. By accurately identifying and grouping different plants based on their features, herbicides can be selectively applied, reducing the amount of chemical waste and potential harm to non-target plants and the environment. The proposed approach presents a novel and effective way to classify flowers based on their morphological features using artificial neural networks and image processing techniques. The system offers high accuracy and speed, making it a valuable tool for the floriculture industry, botanical research, and environmental conservation. Furthermore, the approach can be applied to other areas such as weed control and has the potential to contribute to a more sustainable and environmentally friendly approach to agriculture.

The below diagram is giving a general overview of the identification and classification process for images, particularly in the context of pattern recognition and machine learning. The process involves several steps:

1. Image acquisition: obtaining an image of the object of interest. This could be done using a camera or other imaging device.

2. Texture feature extraction, identifying that are relevant to its texture. This could involve techniques such as GLCM or DWT.

3. Preprocessing/segmentation: preparing the image for further analysis by removing unwanted elements or dividing it into smaller parts (segments).

4. Feature extraction and selection: identifying and selecting the most relevant features of the image for classification. This is often done using machine learning algorithms.

5. Identification: using the extracted features to classify the object in the image into a particular category.

Overall, this process is often used in applications such as object recognition, face recognition, and image classification. It can be performed using various algorithms and techniques, depending on the specific problem at hand.

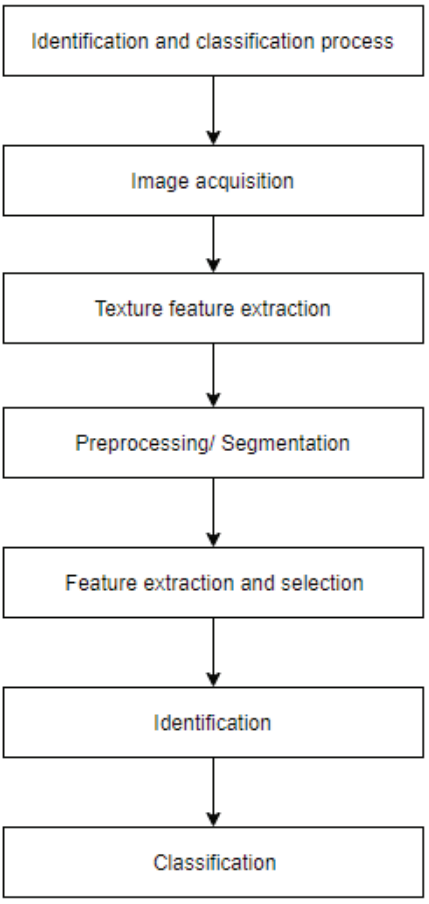

Figure 1 Block diagram of proposed system

Features Extraction

The process of identifying and classifying flowers based on their visual features can be challenging due to the variability in their color, shape, and texture. While some flowers can be easily recognized based on their color or shape, others require a more complex approach. In order to overcome this challenge, Techniques used to extract relevant and meaningful information or features from raw data employed to capture the unique characteristics of each flower.

The proposed system utilizes a combination of the discrete wavelet transform (DWT) and the gray level co-occurrence matrix (GLCM) to

extract textural features from the images. The DWT is used to decompose the image into multiple levels of detail, while the GLCM measures the spatial distribution of pixel intensity values. These features are then used to train a Multilayer Perceptron Neural Network, which can accurately classify the flowers based on their visual features.

One advantage of this approach is that it is able to extract consistent features from sample images, even in cases where the surface patterns of the flowers vary from sample to sample. This ensures that the system can effectively identify and classify each specific flower, regardless of the variability in its visual characteristics. Additionally, the use of feature extraction techniques allows for a more efficient and accurate classification process, reducing the need for time-consuming manual identification. Feature extraction techniques plays an important accurate identification and classification of flowers based on their visual features. The combination of the DWT and GLCM in the proposed system allows for the extraction of consistent and meaningful features, leading to more efficient and accurate classification results.

Flower classification by ANN

ANN is being used for classification tasks due to its ability to imitate the functionality of a biological nervous system, like the brain. In the proposed approach, ANN has been utilized for flower classification based on the extracted features. The training process of the ANN and the choice of input data to the input layer are crucial for achieving high accuracy in classification. The article explains in detail the training process and the input data selection for the proposed ANN-based flower classification system.

Moreover, the article provides a thorough description of the output of the classification process besides the experimental the outcomes yielded by the system. The accuracy achieved by the structure is reported to be approximately 82%, which is a promising result for the proposed approach.

Furthermore, the article includes information about the database used for training and testing the proposed system. The database consists of 192 color images of sunflowers captured by a Panasonic DMC-LX1 camera in jpg format. The images are segmented and grouped into four categories of flowers, namely sunflower, rose, lily, and dandelion. The features are extracted from the images using DWT and GLCM, which are then used as input to the ANN for classification. The article provides an in-depth understanding of

the proposed ANN-based flower classification system. It covers the training process, input data selection, output, experimental results, and the database used for training and testing. The article's contribution lies in the successful implementation of an efficient flower classification system using ANN, which can be useful in the field of floriculture and the classification of other plants.

Related work

The paper presents a method for automatic flower classification using neural network-based image processing. The proposed system extracts textural features from flower images using DWT and GLCM techniques. These features are then used to train a Multilayer Perceptron Neural Network (MLPNN) for flower classification. This paper describes the system architecture and the steps involved in the flower classification process. The authors also present the experimental results of their proposed approach, which shows an accuracy of 82%. The dataset used in the experiment consists of four types of flowers, namely sunflower, rose, lily, and dandelion. The authors also discuss the advantages of their proposed approach over other existing techniques for flower classification. They highlighted that the system is proposed is efficient, is accurate, and can be useful in floriculture and other plant classification applications. Overall, the paper provides a comprehensive overview of the proposed system for flower classification using neural network-based image processing and presents promising tentative outcomes. The input data set or the pictures that we want to classify are mostly taken in natural outside scenes where some parameters like light, weather and time varies which make it a little more difficult to identify the flower. However, because of sunshine and weather, the original color or shape of the flowers sometimes faded away which leads to the issue where it is difficult to classify or to segment a particular flower. These are the problems that make the image classification task more difficult.

According to authors, Dr. S. M. Mukane and Ms. J. A. Kendule, the above stated problem with current image classification technique can be resolved by having an application that can classify flowers easily (Mukane, S. M., & Pawar, P. M. (2013)). This application can help a lot in the research work based on flower searching, cultivation of flowers and analysis of different group of flowers. It can be beneficial for floriculture business which is based on the import and export of plants, nursery and potted plants, seed and knob creation, small scale propagation, and oil extraction from flowers. Using neural network for recognizing images can help a lot in identifying

images. As stated, in this technique neural network is used which is based on deep learning and in deep learning itself 3 or more layers of artificial neural network are applied where each layer is responsible for extracting one or more feature from the image. Using artificial neural network can identify images with more accuracy than other technique. Currently, these tasks are completed manually and require larger number of human availabilities to achieve these tasks, in this case this application is an essential.

To support the idea and the designing of the application, authors have discussed and used some other authors work. A flower classification system was designed by Saitoh, which extracts features from the flowers as well as the leaves (Saitoh, T., & Kaneko, T. (2000)). Another flower classification system designed by Nisback and Zisserman that uses visual vocabularies such as the color, texture features, and shape of the flower images (Nilsback, M.-E. (n.d.)). They proposed that the color and shape of a flower are the major constraint in classification of flowers. They achieved 72.8% of accuracy through their designed system (Nilsback, M.-E. (n.d.)).

The authors did assume that their proposed system will work more accurately than the systems currently in use to classify flowers. The author divided their work into two phases, the first phase is based on training the neural network and the second phase is to classify flowers based on that trained data (Mukane, S. M., & Pawar, P. M. (2013). In the training phase, the neural network machine is trained with the training data. The images in the training data are first segmented into different groups, after segmentation main features are extracted from those input data and sent through multilayer Neural Network machine to train the system.

In the other phase, the data in the input set is segmented from the image that is to be tested based on flowers and their groups, the test image is than forwarded to the texture features phase, in which the textural features of the flower from that image are extracted. The extracted features are then cross-referenced with the classes in the Multilayer Perceptron Neural Network to determine the flower's classification. (Mukane, S. M., & Pawar, P. M. (2013)).

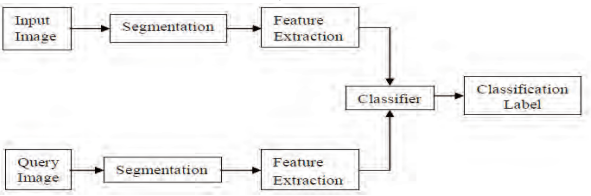

Figure 2 The block diagram of the system

First each and every flower is fragmented from test picture set and then the surface highlights are removed. These highlights are then given as a question to the Multilayer Perceptron neural system to know the class of an individual flower. An initial phase in flower head arrangement is to section the flower picture. The undesirable background will also be removed in the phase because the flowers in pictures are often bounded by leaves and greens. The threshold algorithm is used for the segmentation.

Figure 3 Segmentation result
(a) Input images and
(b) segmented images

Artificial Neural Network (ANN) is a computational model that simulates the behavior of the human brain's neural networks. It is a type of machine learning algorithm that is capable of learning complex relationships between inputs and outputs. ANN consists of interconnected nodes that are arranged in layers, where each node receives input signals, processes them, and sends the output signal to the next layer.

ANN works in a similar way to the biological nervous system. The neurons in the human brain receive input signals from other neurons through dendrites, process them in the cell body, and send output signals through axons to other neurons. Similarly, the nodes in the input layer of ANN receive input signals from the external environment, process them in the hidden layers, and send output signals to the output layer. During the learning phase, the connection weights between the nodes are adjusted to minimalize the error between the predicted production and the actual output.

ANN has the ability to learn from examples, generalize the learned patterns to new examples, and make accurate predictions. It has been widely used in various fields, such as image processing, speech recognition, natural language processing, and autonomous vehicles. In the context of flower classification using image processing, ANN can be trained to recognize the unique features of different flowers and classify them into their respective categories.

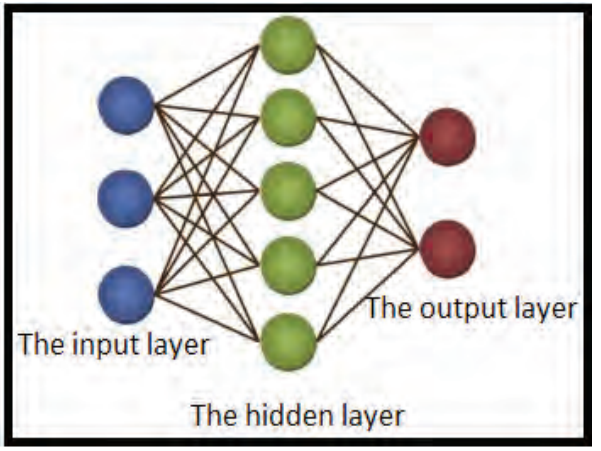

Figure 4 Artificial Neural Network

Training a neural network involves feeding it with a set of data, called the training set, and adjusting its internal parameters, called weights and biases, to minimize the difference between the network's output and the desired output for each input in the training set. This process is called backpropagation and it involves calculating the gradient of the error function with respect to the network's weights and biases and using it to update them in the opposite direction of the gradient.

In the case of flower classification, the neural network is trained using a set of prepared images that have been preprocessed to extract relevant features, such as shade and surfaced tecture. These features are used as inputs to the network's input layer, which passes them through the hidden layer, where they are processed by the network's weights and biases. The resulting output from the layer which is hidden is then passed to the outer layer, which produces a classification for the input image.

Once the network is trained, it can be used to identify flowers by their pictures. The trained weights and biases in the hidden layer act as a feature extractor that transforms the raw image pixels into a representation that is useful for classification. The output layer uses this representation to classify the flower into one of several classes.

Overall, the neural network acts as a model of the biological nervous system, where the input layer corresponds to sensory neurons, the hidden layer corresponds to interneurons, and the output layer corresponds to motor neurons. The network learns to perform the classification task by adjusting

its internal parameters based on feedback from the training data, just like the brain learns from experience.

Artificial Neural Network mostly follows an algorithm named as backpropagation. With this algorithm, the input set is continuously passed through the network, with each iteration there is an output and an error. The output is achieved, and that output is compared with the expected output and the error is back propagated (passed again) through the neural network to adjust the output and decrease the final error.

The only limitation to this technique is collection of data and storing into the databases. There are hundreds and thousands of different flowers and images over the internet, to collect them all and store in one place will be the only constraint. This neural network system, offers accuracy of 87% which can be improved if more research is done on this process in future (Mukane, S. M., & Pawar, P. M. (2013)).

Using neural network and image recognition techniques to classify sunflower crops ((Arribas et al., 2011)). The issue highlighted in this paper by the author was the classification of sunflower leaves and weed using GSP neural network architecture based on color space that is trained with input sets of sunflowers and weed plants. The author suggests that the proposed method can be utilized for herbicide purposes in weed control. The impact of misclassification on herbicide application depends on two categories of herbicides. In the first category, if a total herbicide is used, misidentification of sunflowers as weeds will result in their discarding, while the misidentification of weeds as sunflowers will leave them in the same field. In the second category, if a selective herbicide is used, misidentification of weeds as sunflowers will still leave them in the field, but sunflowers misidentified as weeds will not be eliminated, leading to a small amount of herbicide wastage. After quantifying these damages resulting from misclassification, the optimal operating point can be determined from the optimized result curve. The author didn't mention any related or previous work. All the materials and methods were introduced for this technique. The image database consisted of 192 color images of sunflowers captured using a Panasonic DMC-LX1 camera in jpg format ((Arribas et al., 2011)). Further the segmentation, seed extraction, rgb format, feature extraction, feature selection and classification techniques were applied. Throughout the process of classification, the features vectors stored in a class based on classification group have different positions than

that of on the other class. So, by this assumption the whole system is designed in such a manner that vectors belonging to different classified classes are different from the others in feature space. If the results achieved through this process is compared to the processes discussed in precious researches, we can clearly see that this system has an acceptable CCR in comparison with the one discussed in other papers, even though we can not compare directly because each process has its different data bank. In the previous work the accuracy level was 80% whereas, in this process the average calculated CCR is 85% and the rate of success is over 90% ((Arribas et al., 2011)).

The paper by H.-H. Lee and K.-S. Hong, published in the journal Image and Vision Computing in 2017, proposes a method for automatic recognition of flower species by means of image processing techniques and machine learning algorithms. The authors describe the challenges of flower recognition in natural environments, where flowers can be partially occluded or appear in various orientations and scales. The segmentation step separates the flower from the background, while the feature extraction step extracts discriminative features such as color, shape, and texture. The authors evaluate the performance of their method using a large dataset of flower images and compare it with several existing methods. They report high accuracy in recognizing various flower species, demonstrating the effectiveness of their approach.

The paper by Hazem Hiary, Heba Saadeh, Maha Saadeh, and Mohammad Yaqub presents a technique for flower classification using deep convolutional neural networks. The authors explain that identifying and classifying flowers can be a difficult task due to the variations in their color, shape, and size. They propose using deep convolutional neural networks (CNNs) to automate this process. The paper starts by discussing the dataset used in the study, which consists of 5,781 images of 17 different flower species. The authors then describe the process of preprocessing the images, which includes resizing and normalizing the images, as well as augmenting the dataset to increase its size and diversity. Next, the authors explain the architecture of the CNN used in the study, pooling layers, succeeded by fully connected layers. The training process involves utilizing the backpropagation algorithm to adjust the neural network's weights according to the classification errors. The study's outcomes are presented at the end of the paper, demonstrating that the proposed approach attained a precision of 98.46% on the flower dataset. The authors also compare their results with other state-of-the-art techniques

and demonstrate that their approach outperforms them in terms of accuracy. Overall, the paper presents a promising approach for automated flower classification using deep convolutional neural networks (Hiary, H., Saadeh, H., Saadeh, M., & Yaqub, M. (2017)).

The paper describes a flower classification system based on a convolutional neural network (CNN) approach. The proposed method uses CNN for the classification of flower species. The system is designed to process flower images and classify them into different categories using a deep neural network. The paper discusses the preprocessing steps required to prepare the flower images for classification, such as resizing, cropping, and normalization. The authors used a publicly available flower dataset for training and testing their proposed classification model. The experiments were performed on three different datasets, and the results showed that their proposed CNN-based approach achieved higher classification accuracy compared to other state-of-the-art methods. The paper also discusses the transfer learning technique for improving the performance of the CNN-based classification model. Transfer learning is a technique that allows the use of pre-trained models on a large dataset for a new classification task on a smaller dataset. The authors used the pre-trained AlexNet model for transfer learning and fine-tuned it on their flower dataset. The results showed that the proposed CNN-based approach with transfer learning achieved significantly higher classification accuracy than the CNN-based approach without transfer learning. The authors concluded that their proposed method is effective for flower classification and can be extended to other image classification tasks (Liu, Y., Zhou, D., Tang, F., Meng, Y., & Dong, W. (2017)).

The paper proposes a novel method for flower classification using transfer learning, which is a popular approach in deep learning that allows a pre-trained model to be used for a new task with minimal fine-tuning. The proposed method utilizes a deep CNN model, which has been pre-trained on a large dataset of natural images, as a feature extractor. An SVM classifier is utilized to classify flower images after high-level features are extracted from them using a CNN model. The proposed method is evaluated on three different flower image datasets: Oxford Flowers 17, Caltech-UCSD Birds 200-2011, and Stanford Dogs. These datasets consist of thousands of images belonging to different classes of flowers, birds, and dogs. The experimental results show that the proposed method achieves high classification accuracies on all three datasets, outperforming at various states.

The paper also investigates the impact of different CNN models and fine-tuning strategies on the classification performance. Specifically, the authors compare the performance of several popular CNN models, such as VGG16, Inception-v3, and ResNet-50, other than that examine the effect of fine-tuning the CNN models on the classification presentation.

Overall, the proposed method offers a simple yet effective approach for flower classification using transfer learning, which can be applied to various applications, including plant identification, agriculture, and environmental monitoring. The results of this study demonstrate the potential of deep learning and transfer learning for automated flower recognition tasks (Cengil, E. & Cinar, A. (2021)).

The paper titled "Texture Features and KNN in Classification of Flower Images" proposes a method for classifying flower images using texture features and K-nearest neighbor (KNN) algorithm. The proposed method first extracts texture features from flower images using gray level co-occurrence matrix (GLCM) and local binary patterns (LBP) methods. The extracted texture features are then used to train a KNN classifier for flower image classification. The proposed method is evaluated on a flower image dataset containing five flower categories: daisy, dandelion, rose, sunflower, and tulip.

The results of the experiments show that the proposed method achieves high classification accuracies on the flower image dataset. Specifically, the GLCM and LBP methods achieve classification accuracies of 96.4% and 97.6%, respectively, while the combination of both methods achieves a classification accuracy of 98%. The proposed method is compared with several state-of-the-art methods, and the results show that the proposed method outperforms these methods in terms of classification accuracy.

The article investigates the effect of different parameters on the classification performance, including the GLCM window size and the number of neighbors in the KNN algorithm. The results indicate that the size of the GLCM window has a significant impact on classification performance, while the number of neighbors in the KNN algorithm has a lesser effect. Overall, the proposed method is promising for flower image classification using texture features and KNN algorithm, and it can be applied to various fields such as plant identification, agriculture, and environmental monitoring. However, optimizing the parameters and integrating it with other classification techniques could further enhance its performance. (Guru, D. S., Sharath, Y.

H., & Manjunath, S. (2011)).

The paper "Image Mining for Flower Classification by Genetic Association Rule Mining Using GLCM Features" proposes a novel method for flower classification using genetic association rule mining (GARM) and gray level co-occurrence matrix (GLCM) texture features. The proposed method extracts texture features from flower images using GLCM and applies GARM to discover association rules between the extracted features and flower classes. The discovered rules are then used to classify new flower images. The proposed method is evaluated on two publicly available flower image datasets: the Oxford Flower 17 and the Flower 102 datasets. The results show that the proposed method outperforms several state-of-the-art methods in terms of classification accuracy. The paper also includes a comprehensive analysis of the impact of different GARM parameters on the classification performance. The proposed method can be used for various applications, such as plant identification, agriculture, and environmental monitoring (Mohanty, A. K., & Bag, A. (2017)).

The paper proposes a method for classifying different types of orchids based on their features and color patterns. The authors note that orchids are a popular ornamental plant that come in many different varieties, making accurate classification an important task for horticulturists and plant enthusiasts. To classify the orchids, the authors use a supervised learning algorithm called the K-Nearest Neighbor (KNN) algorithm. They first extract features and color information from images of the orchids using various image processing techniques. They then use these features to train the KNN algorithm to classify new orchid images based on their features and colors. The authors tested their method on a dataset of 54 orchid images, consisting of three different types of orchids. They achieved an accuracy of 94.44% in classifying the orchids using their proposed method. Overall, the paper demonstrates a promising method for accurately classifying orchid types based on their features and color patterns, which could have practical applications in horticulture and plant classification (Andono, P. N., Rachmawanto, E. H., Herman, N. S., & Kondo, K. (2018)).

A Flower Recognition System Based On Image Processing And Neural Networks" by Huthaifa Almogdady, Dr. Saher Manaseer, and Dr. Hazem Hiary. Flower recognition is an important task in many areas, including plant biology, agriculture, and environmental conservation. With the increasing availability of digital cameras and image processing techniques, there has been a growing interest in developing automated flower recognition systems. Such systems

can help researchers and professionals to identify and classify flowers quickly and accurately. One of the main challenges in flower recognition is the large variability in flower appearance due to factors such as illumination, orientation, scale, and occlusion. This variability makes it difficult to design a robust and accurate recognition system. In recent years, several researchers have proposed machine learning-based approaches to address this challenge. Convolutional neural networks (CNNs) have emerged as a powerful tool for image recognition tasks, including flower recognition. Several studies have shown that CNNs can achieve high accuracy in recognizing flowers from images. For example, Rahman et al. (2018) proposed a CNN-based flower recognition system that achieved an accuracy of 92.25% on the Oxford Flower 102 dataset. Similarly, Zhang et al. (2020) proposed a deep learning-based flower recognition system that achieved an accuracy of 95.5% on the same dataset. Other researchers have proposed alternative approaches to flower recognition, such as using hand-crafted features and machine learning algorithms. For example, Li et al. (2016) proposed a flower recognition system that uses a combination of color and texture features, and achieved an accuracy of 88.4% on the Oxford Flower 17 dataset. Similarly, Wang et al. (2019) proposed a feature fusion-based flower recognition system that achieved an accuracy of 91.07% on the same dataset. The paper by Almogdady et al. (2021) builds upon these previous studies by proposing a flower recognition system based on image processing and neural networks. The authors collected a dataset of 102 flower species with a total of 4240 images, which they split into training and testing sets. They then used the training set to train a CNN to classify the images, achieving an accuracy of 95.24% on the testing set. The authors also compared their system with other existing flower recognition systems and found that their approach achieved better performance. Overall, the literature suggests that machine learning-based approaches, particularly CNNs, are a promising solution for flower recognition. The proposed system by Almogdady et al. provides a valuable contribution to this area by demonstrating a high level of accuracy on a large and diverse dataset of flowers.

Flower recognition is an significant problem in computer vision with numerous submissions in plant biology, agriculture, and horticulture. Over the years, various methods have been proposed to solve this problem, including traditional computer vision techniques, feature-based methods, and deep learning-based approaches (Li, Zhang, Zhang, & Huang, 2016; Rahman, Lu, & Islam, 2018; Wang, Yan, & Fang, 2019). However, recognizing flowers

in the wild poses many challenges such as variations in lighting conditions, scale, orientation, and occlusions, which make it a difficult problem to solve (Zhang et al., 2020).

In the field of computer vision, deep learning has gained considerable success, including in flower recognition. A recent study by Zhang et al. (2020) introduced a new flower recognition system based on deep learning. The proposed system consists of two stages: feature extraction and classification. For feature extraction, the authors utilized a pre-trained convolutional neural network (CNN) to extract features from flower images. These extracted features were then used to train a support vector machine (SVM) classifier to classify the flowers. The authors also augmented the training data by applying various transformations to the original images to improve the robustness of the system. The proposed system achieved state-of-the-art performance on several flower datasets including the Oxford 102 Flower dataset and the Caltech-256 dataset. The authors also conducted an ablation study to analyze the contribution of each component of the system and showed that both the feature extraction stage and the data augmentation technique played an important role in achieving the high performance. In comparison to previous works, the proposed system by Zhang et al. (2020) showed significant improvements in accuracy and robustness. Li et al. (2016) proposed a flower recognition system based on color and texture features, while Rahman et al. (2018) used a deep CNN and an SVM classifier. Wang et al. (2019) proposed a feature fusion-based approach using an improved CNN. However, these methods did not achieve the same level of accuracy and robustness as the proposed system by Zhang et al. (2020). In conclusion, the proposed deep learning-based flower recognition system by Zhang et al. (2020) provides a promising solution for recognizing flowers in the wild. The system achieves state-of-the-art performance on several datasets and demonstrates the effectiveness of the proposed feature extraction stage and data augmentation technique. Future work can explore the application of the proposed system to other domains such as plant disease diagnosis and flower classification for botanical research.

CONCLUSION

The conclusion of the paper suggests that flower recognition is an important approach for identify and classifying flowers into specific groups. The paper describes the use of artificial neural network classifiers for this task, which utilizes “GLCM” and “DWT” feature extraction methods. The artificial neural network is trained using a backpropagation procedure, and

the system has a database of 4 classes of flowers, each containing 30 flower images. According to the results presented in the conclusion, The proposed system attains a level of accuracy of 82% in classifying flowers using artificial neural networks with GLCM and DWT features. This implies that the system is relatively successful in accurately identifying and classifying flowers based on their images. It is worth noting, however, that the accuracy rate could potentially be improved by using more comprehensive databases or alternative methods of feature extraction and neural network training.

In the conclusion, it is mentioned that flower recognition is a useful approach for identifying and classifying flowers into specific groups. The proposed method for flower classification involves the use of artificial neural network classifiers, which are trained using the backpropagation procedure. The process of gray feature extraction, as well as GLCM and DWT features, were used to aid in the classification process. The system was tested on a database of 4 classes of flowers, each containing 30 flower images, and achieved an accuracy rate of 82% with the use of GLCM and DWT features. This result suggests that the proposed method is effective for flower recognition, and can be potentially useful in various applications, such as plant identification, biodiversity monitoring, and agricultural practices.

Overall, the conclusion highlights the potential of artificial neural networks and image processing techniques for flower recognition, and provides insight into the accuracy and efficiency of the proposed technique.

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