Identify A Flower Auto-Recognition System Based on Deep Learning

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled **"Solution Architecture Infrastructure Security Internship"**, submitted by Akib Istiak Rifat, ID No: **213-15-4619** to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on **13 January, 2025**.

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ABSTRACT

The identification of flowers is one of the most popular areas of research in the computer vision. This technology proves useful in many areas such as botany, agriculture, environmental science and also teaches in schools. This work is aimed at developing a robust flower recognition system using techniques of deep learning.

The images were shot in natural conditions under different lighting, weather, and angles to introduce variability and robustness to the dataset. We have employed transfer learning for state-of-the-art deep learning models such as CNN, InceptionV3, and MobileNetV2. Among these, the best performance was given by MobileNetV2, which showed high accuracy with great computational efficiency. There, the accuracy is 98.33%, and all the models have been trained with great accuracy. Results from the study have showcased the performance of deep learning in the automation of recognizing flowers. The optimum model and FlowerNet collection serve to highlight opportunities not only for improving plant identification, biodiversity conservation, and ecological study but also to form a useful basis for upcoming developments in the field. These results really show how powerful deep learning can be for flower recognition automation. The best model proposed further, with the FlowerNet collection, provides a useful basis for further development in the area by underlining opportunities for improvement regarding plant identification, biodiversity conservation, and ecological study.

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CHAPTER 1
Introduction

1.1 Introduction

Flowers are a symbol of beauty. There are various types of flowers found in different parts of the world. It is because of the beauty of flowers that our Earth is so beautiful. The beauty and fragrance of flowers can make anyone's mind beautiful, peaceful, and joyful. Flowers are not only a symbol of beauty, but they also possess various extraordinary qualities and characteristics in different places. Flowers from different parts of the world have their own unique beauty and features.

Identifying all types of flowers is not easy for the general public because there is a lot of similarity in the diversity and physical characteristics of different species of flowers. This makes it difficult for the average person to identify them easily. In this technological age, it has become possible for the general public to easily identify flowers through the use of technology.

The goal of this research is to use deep learning technology to develop an automated floral recognition system. Eight different kinds of flowers will be used in this study: Sunflower, White frangipani, Red rose, Chrysanthemum, Catharanthus, Euphorbia, Gardenia and Red hibiscus. The general public finds it difficult to distinguish these flowers because of their resemblance to other flowers in terms of shape, structure, and color. CNNs, or convolutional neural networks, will be used in the suggested system. Images of these blooms will be included, and the system's ability to correctly identify their species will be evaluated.

1.2 Motivation

This process of flower recognition will essentially establish a connection between nature and technology. Flowers are an important part of biodiversity. Flowers play an important role in maintaining environmental balance, preserving cultural heritage, and promoting mental health. In today's fast-paced urbanized world, people, especially in urban areas, are losing connection with nature. Many people are not experienced with flowers. Students, researchers, and nature enthusiasts often face difficulties in flower identification and classification, as expert assistance or proper information is not easily available. There are many methods for flower identification. The traditional methods are time-consuming and difficult for the general public to use due to a lack of expertise. The development of deep learning has revolutionized many fields. Deep learning has provided powerful solutions in the field of image recognition and classification. It is possible to create an automatic flower recognition system through deep learning, which will be effective and user-friendly. With it, it is possible to create a system that can be an educational tool for students and fans of nature, and a significant help to promote biodiversity and conservation. The goal of this thesis is to research on a super implementation flower recognition system using the deep learning technology We do hope that this system will provide a significant step in closing the gap between the general public and nature, bridging the gap, and evolving environmental education and conservation efforts.

1.3 Rationale of the Study

Identification of flowers, particularly auto flowering flowers is a topic of great interest in the fields of agriculture, horticulture, conservation, even therapeutic uses. Traditionally, human expertise, including the knowledge of botanists and field experts, is heavily applied in the classification and identification of flowers nested by manually measuring the phenotype of flowers. This process, nevertheless, is subjective, time consuming and error-prone, especially for specimens with a large number of different species or minute morphological differences. In recent years, advancements in artificial intelligence, particularly deep learning, have opened new avenues for automating complex tasks that require pattern recognition and decision-making. It has been demonstrated that deep learning models with convolutional neural networks (CNNs) are especially useful in dealing with visual data, therefore these models can be optimum for tasks such as flower identification. Such models have the ability to learn complex structures from various images of flowers and can accurately classify them within a short period of time. Studying auto-flowering plant species is particularly important because these plants have the ability to flower without being dependent on exogenous factors which in this case can refer to light cycles. This attribute further enhances their value in controlled agricultural settings or in specific crops such as ornamental and medicinal plants. Considerable efforts are necessary for the identification and taxonomy of such species for the enhancement of agricultural activities, monitoring of ecosystems, and the conservation of some of the threatened or rare breeds. The purpose of this study is to find the middle ground between the traditional time-consuming manual processes and the modern technological innovative approaches for the identification of flowers. The research aims to create a strong, extensible, and cost-effective system that uses deep learning for the identification of auto-flowering species with little human effort. This will not only optimize time and resources but will also improve the once low confidence and ease of classification of flowers in practice. In the end, it is expected that this research would advance the field of plant sciences by providing scientists, farmers, and environmentalists with a useful tool. Also, it will bring light on how deep learning might be applied further to agricultural innovation, biodiversity protection, and the development of sustainable practices.

1.4 Expected Output

The accuracy of identifying different flower species by our model should be high. Precisely, the model, after training, is expected to have an accuracy of 80-95%, which will ensure that the flowers are correctly classified and recognized. In this way, the identification of the specific species or category of flower images would also be correctly done. The model will be fast and efficient in recognizing and classifying the flower images. These will enable the users to identify flowers in a very short time, which would be of great use in fieldwork or any real-time application. The model will identify local species of Bangladesh flowers with great accuracy and thus help increase the awareness of local flowers among city people and the young generation. This system will increase the number of people knowledgeable in local flowers and raise interest in the environment through the system. This system will provide a great opportunity to easily identify local flower species for city dwellers who are not aware of them. This will bring awareness and curiosity in the case of local flowers among the younger generation, who usually have less knowledge about nature and flowers. It will also help in collecting information on local flowers that might be useful in environmental research. The model will work quickly and efficiently for flower image recognition and classification. This will allow users to learn about flowers' identities in a very short time, which will be particularly useful in fieldwork or real-time applications. The model will be able to accurately identify the local flower species of Bangladesh, increasing awareness about local flowers among city dwellers and the younger generation. Through this system, it will be possible to increase the number of people who are knowledgeable about local flowers and generate interest in the environment. For city dwellers who are not aware of local flowers, this system will provide a great opportunity to easily identify local flower species. Additionally, it will raise awareness and interest in local flowers among the younger generation, who generally have less knowledge about nature and flowers. This system will also assist in collecting information about local flowers, which can be used in environmental research.

1.5 Report Layout

The distinctive features of our endeavors are as follows:

Chapter 1: In this chapter we are introduction our research materials.

Chapter 2: In this chapter we are completed background study.

Chapter 3: In this chapter we done research methodology.

Chapter 4: In this chapter we are discuss result analysis and discussion.

Chapter 5: In this chapter we are discuss how to impact our society and environment in our research paper**.**

Chapter 6: In accordance with 6.1, 6.2, and 6.3, an overview of the accomplished study, a conclusion, and potential future research are shown in this section.

CHAPTER 2

Background Study

2.1 Terminologies

This section will thus discuss some of the previous literature that has been conducted in this area of study. In our work, Convolutional Neural Networks (CNNs), a preferred platform for image categorization, primarily for flowers, have been employed. There are 187 images in each of the flower types making a total of 1500 images in our dataset. It's worth for us to have worked with 8 types of flowers. We have applied several machine learning algorithms to train our dataset. Below is a short description of the flowers used in our research; this will help us study and provide us with necessary information for our work:

Red Rose:

The deep and striking color of the red rose is famous around the world for its beauty, emotion, love, and affection. Its smell is the most lovely and attractive, drawing in anyone among all the other hues of the rose. The rose petals are soft and velvety, placed in several layers, gradually converging towards the center of the flower. The rose stem has thorns, which act as a defense mechanism. The intoxicating smell of the rose elevates the mood and has been used for centuries in perfumes, cosmetics, and scented oils. The red rose was once considered a symbol of the goddess Venus, being used in ancient Greek and Roman civilizations. About 5,000 years ago, roses were first cultivated in China. Beyond their beauty, rose petals have been found to contain a number of natural compounds that have been used medicinally and cosmetically for ages. Rose petals are rich in antioxidants, anti-inflammatory, and anti-bacterial properties, making them highly beneficial for skin care.

Red Hibiscus:

The red hibiscus is a vibrant, dark red, captivating flower found in various countries around the world. It predominantly grows in tropical and subtropical regions. The petals of the flower typically consist of five parts. Among these, there is a large structure where the ovary and nectar-like pollen are located. The petals of the hibiscus flower are rich in natural anti-bacterial and anti-inflammatory properties, which can be beneficial for various health issues. Hibiscus is very beneficial for skin and hair care, as well as for digestive issues.

White Frangipani:

The Frangipani is an extremely beautiful and fragrant flower that grows mainly in tropical regions. It usually has five petals, which are soft and smooth to touch. The yellow color at the center of the petals makes the flower even more beautiful. Besides beauty, the flower is also appreciated for its medicinal value. The extracts are used in skin care and also in treating minor inflammatory conditions. The Frangipani symbolizes purity, peace, and beauty in many cultures.

Sunflower:

Sunflower (Helianthus annuus) is a bright yellow flower known for turning its face towards the sun. This flower mainly consists of yellow petals with a dark brown or black center. The sunflower is particularly sensitive to sunlight and follows the sun's path throughout the day. It is used for oil production, food, and beauty purposes. The sunflower symbolizes hope, positivity, and strength.

Gardenia:

The scientific name of this beautiful and fragrant flower is Gardenia jasminoides. It is primarily found in tropical and subtropical regions. The petals of the white gardenia flower are smooth and waxy.In addition to its beauty and fragrance, it is also valued for its medicinal properties. In traditional medicine, gardenia is used to enhance digestion, reduce inflammation, and relieve stress.

Euphorbia:

Euphorbia is a common name for the particular kind of flower and it is of different shapes and sizes. This tree mainly occurs in the regions of low rainfall and high temperature, although its species areum in many places in the world. It has properties of a milky white flowing sap which may be somewhat an irritation to the skin. This plant is traditionally grown as an ornamental plant and several varieties of this plant are used for medicinal purposes.

In our study, photographs of Euphorbia flowers have been used for its recognition to define its features and to collect necessary data for classification.

Chrysanthemum:

Chrysanthemum is an important flower species, best known today for its showy and beautiful flowers. Known as “mum”, the flower is available in different shapes and sizes and colours including white, yellow, red, pink, purple. This is one of the common winter flowers and is commonly used to make gardens more beautiful.

Chrysanthemum flowers are widely used not only as ornamental plants but also as a medicine. They are used in tea and specially some countries cultivate them for medicinal purposes. In the present study photographic images of the Chrysanthemum flower has been used to describe the features of the flower and to generate data for classification.

Catharanthus:

Periwinkle or Catharanthus is a small, pretty flowering plant. It is usually seen in pink, white and purple colors and occurs in warm conditions. This plant garnishes gardens by improving their beauty and is also prized in healing processes. To extract features of Catharanthus flowers for further classification, images of the flowers have been used in our study.

2.2 Related Work

Often, flowers share similarities in shape, size, and color. In such cases, correctly identifying the flowers can be difficult and time-consuming. An accurate method for flower classification is needed, one that can correctly analyze the differences in shape, size, and color. Being able to classify a flower without the assistance of a botanist would be extremely beneficial. As a result, a great deal of research has been conducted on this topic. Mengxiao Tian1 et al.[1] A modified Tiny Darknet model is proposed for the classification of flowers based on the 17-flower dataset from Oxford University. The proposed model, in conjunction with a Softmax classifier, achieved 92% accuracy, outperforming the traditional method. This model has a simple structure, fewer parameters, and gives effective recognition. This will be highly suitable for the automatic flower classification in agriculture and also in the plant information retrieval system. Hazem Hiary et. al [2] This paper is aimed at the development of a two-step deep learning classifier for flower classification, including segmenting the flower regions and then using a robust CNN for species identification. The paper introduces some innovative training methods and achieves more than 97% accuracy on three famous datasets. Possible extensions to diverse applications, enhancing segmentation, and generalizability are potential future works. Integration with platforms like Visipedia is also a very promising direction. It is a flower-classification-oriented approach that may be modified in view of more complicated tasks for other domains. Shantala G Giraddi et. al [3] proposed the fine-tuning of the pre-trained VGG16 model by classifying flowers into five categories using the Kaggle flower dataset, which reached a classification accuracy of 97.67% and 95.00%, respectively, for validation and test datasets without overfitting when applied on small datasets. The size of the flower dataset restricts the study and affects the generalization capability of the model, resulting in a higher testing error. Neda Alipour et. al [4] In this paper, we are trying to classify 102 flower species using a robust deep learning method. And also the transfer learning approach employs DenseNet121 architecture to categorize various species of oxford-102 flowers dataset and fine-tuning to achieve higher accuracy compared to existing method.Apart from that, the research work is pre-processing and optimizing the dataset for better performance, attaining higher accuracy of 98.6% over 50 epochs. The scope of this study is limited to the Oxford-102 flower dataset; this method may need optimization in case of more complex datasets or diverse applications. Burhan Duman et al. [5], in their paper, had tested several models in a way that one among the models was able to attain the best classification accuracy. These include MobileNet_V2, Resnet152v2, Inception_v3, InceptionResnet_v2, and DenseNet169. They had been training the classification model based on 5 and 17 classes datasets. Therefore, this topic was highly researched. The best model was Resnet152v2, with an accuracy of 92%. The training of this model was done using the Adam and Sajid optimizers with 5, 15, and 50 vertices, and 5 classes were used. They compared the results with the Oxford-17 dataset, and as a result, the accuracy of the Oxford-17 dataset was lower than their dataset. Therefore, they concluded that the accuracy rates of the models were not significantly affected by the number of classes, 5 and 17. This was done by Gandhinee Rajkomar et.al [6] with a dataset consisting of 11,660 images divided into 106 classes. Their dataset consisted of the following models: CNN, AlexNet, GoogleNet, MobileNet, ResNet, and VGG19. Each class consists of 110 images with three types of training, namely 70% being the training data, 20% is for validation, and the remaining 10% test the dataset. InceptionV3 and MobileNetV2 models achieved an accuracy score of 97.30% and 97.11%, respectively. For InceptionV3 with its layers set as non-trainable, accuracy is 94.22%, while their accuracy in the case of the Oxford-17 dataset is higher. In the research article, Lin Shi1 et al. [7] proposed a fast method: retraining a CNN network based on Inception-V3 using a small dataset. They chose 32 flower categories for their study using the Oxford-17 and Oxford-102 datasets. Compared to other methods, the accuracy in classification can reach around 95%. The proposed research by I. Gogul et al. [8] presented the Deep Learning-based method for the identification of species from flowers using CNNs. They gather images using a mobile inbuilt camera module. Herein, they perform feature extraction for flower images using the transfer learning approach; therefore, features will be complex and thus get extracted from a pre-trained network. It then uses a machine learning classifier like Logistic Regression or Random Forest to increase the accuracy. Herein, the proposed method, CNN and Transfer Learning, were implemented with OverFeat, Inception-v3, and Xception architectures with the performance of 73.05%, 93.41%, and 90.60% Rank-1 accuracy, respectively, on the FLOWERS102 dataset. M. V. D. Prasad et al. [9] in their research aimed to correctly classify flower images from the OUFD and KLUFD flower datasets. The proposed CNN model was applied to classify the flower database, which contains 132 flower categories captured in different modes.The dataset was split into four sets based on the conditions of light and capturing angle.The dataset was divided into four sets according to the capturing angle and light conditions. Images of solitary flowers can be found in Datasets 1 and 2, flowers with leaves in Dataset 3, and several similar flowers in Dataset 4. After then, all of these photos were resized to 128 by 128 pixels, which improved the CNN's speed. It outperformed all other models employed in the categorization, yielding an accuracy of 97.78%. Zi Yuan Ong et al. [10] conducted research on developing a flower recognition model. The authors modified some pre-trained models, such as ResNet50 and VGG19, besides introducing a new SqueezeNet-inspired model enabled to process and remember all the flower species data. For VGG19, an accuracy of 88% for 5 categories of flowers and 84% for 102 species of flowers was achieved. Although the research had achieved its objectives, there was some limitation with respect to computational complexity and hardware constraint. Other pre-trained models like AlexNet and VGG16 could be explored in further improvements. Thi Thanh Nhan Nguyen et al. [11], in their study, have demonstrated the prowess of deep convolutional neural networks for plant species identification based on flower images. Known CNNs such as AlexNet, Caffe Net, and GoogLeNet were compared in this study, with the highest performance observed for GoogLeNet. The model, on a dataset of 967 species of flowers of PlantCLEF 2015, achieved 67.45% accuracy at rank 1 and 90.82% at rank 10, surpassing the traditional Kernel Descriptor techniques. Huthaifa Almogdad et al. [12], conducted the work using feature analysis and classification of objects. Based on the Oxford 102 Flowers dataset, consisting of 8,189 images, they proposed a four-step methodology:Enhancing the quality of images,Applying the Chan-Vese algorithm for image segmentation,Feature extraction of color, texture and shape, Applying classifications using Back-Propagation BPNN.The performance of their method was accuracy of 81.19% was realized. According to Fadzilah Siraj et al. [13], image processing is essential in classification of flowers and therein, color and texture histograms are used to scrutinize flower images. The study showed that having enough images for each flower and replicating challenging images increases the correctness of temperamental neural networks. Saiful Islam et al.[14], This study discusses identification of local flower in Bangladesh employing machine learning approach to CNN (Convolutional Neural Network).

In the approach, the emphasis is made on identifying eight kinds of local flowers where locally based dataset of images is generated containing 5120 training and 1280 testing images. The model attains 85% classification accuracy given by the machine learning algorithm; for future work, we plan for a larger dataset, including more species, and the flower count for the beauty sake and for business. Mastura Hanafiah et al.[15],In this paper, the performance of flower recognition is assessed by using deep CNN with transfer learning on Kaggle data set, more specifically addressing the two most well known architectures, namely AlexNet and VGG16. While using VGG16 we were able to better accuracy as compared to AlexNet and that was 95.02% while AlexNet was 85.69%. Although the method was effective, the researchers observed some limitations concerning variations within classes and similarities between classes. Future work proposes the creation of a recognition engine for wildflowers in National Park based on more sophisticated algorithms. Rohit Sangale et al.[16],they have used CNN to build a deep learning network to classify the following 102 categories of flowers: Oxford 102 Flower Dataset (8189 images). The model received high training and testing accuracy rates and far exceeded the rate of random classification, 0.98%. This method is suitable for real-time applications and will be useful to botanist as well as camping lovers. Flower recognition that can be performed with reasonably acceptable accuracy is the primary objective of Adrian Iftene et al.[17]. The dataset was generated by web crawling with 299 flower species and 387 images on the average for every label. An average of 111/2 images per label were also excluded based on their size, content and repetition. The dataset was uploaded to Kaggle. The use of GPUs in training is much faster than that of CPUs. Potential enhancements to the dataset were addsizes which involves adjusting the size images at times increasing the image number and changing the method of search. Sometimes one may need to experiment with layers and this involves optimization which is a slow process and very resource consuming. Burak Erdil

Bic¸er et al.[18],This paper identifies the ability of Convolutional Neural Networks (CNNs) to be used for flower recognition and which could be used in precision marketing and agriculture. CONVs implemented with MobileNetV2 delivered impressive performance in identifying flowers hence helping the farmers in crop surveillance and marketing techniques. Concerns entail data gathering, images fluctuation and a call for efficient models. For these, more extensive future work in transfer learning, larger data sets, and better hardware are needed more generally. CNNs provide, in general, great opportunities for a sustainability and profitability improvement of agriculture and marketing.

2.3 Comparative Analysis and Summary

TABLE 2.3: COMPARATIVE ANALYSIS TABLE

Authors	Tropic	Proposed Method	Dataset(Number of images)	Accuracy	Year
Mengxiao Tian et al	Flower identification	CNN	680	92%	2019
Hiary, H. et al	Flower classification	CNN	Not Specify	99%	2018
Alipour et al	Flower Image Classification	DenseNet121	8228	98.6%	Not Specify
Giraddi et al	Flower Classification using Deep Learning models	VGG-19	3520	97%	2023
Duman et al	Classification of Flower Images	Mobile NetV2, ResNet1	3673	95.59%, 88.96% 91.55%	2022

		52v2, InceptionV3			
Rajkomar et al	Identification of Flowers	InceptionV3, MobileNetV2	11660	99.74%, 95.90%	2023
Lin Shi1 et al	A Flower Auto-Recognition	CNN	Not Specify	95%	2018
Gogul et al	Flower Species Recognition System	CNN, Inception-v3, Xception	Not Specify	73.05%, 93.41%, 90.60%	2017
M. V. D. Prasad et al.	An efficient classification of flower images	CNN	1250	97.78%	2018
Zi Yuan Ong et al	FLOWER RECOGNITION MODEL	VGG-19	Not Specify	88%	2022
Thi Thanh Nhan Nguyen et al	Flower species identification	CNN	37269	90.82%	2016
Huthaifa Almogdad et al.	Flower Recognition System	CVAC	8189	81.19%	2018

Fadzilah Siraj et al.	Image Classification	NN	234	79.9%	2016
Saiful Islam et al	Classify Local Flower	CNN	6400	85%	2020
Mastura Hanafiah et al	Flower Recognition	VGG16 AlexNet	2648	85.69%, 95.02%	2021
Rohit Sangale et al	Flower Recognition	CNN	8189	98%	2020
Adrian Iftene et al	Flower Recognition	NN	387	Not Specify	2022
Burak Erdil Bic¸er et al.	Flower Recognition	CNN	4242	Not Specify	Not Specify

2.4 Scope of the Problem

While embarking on a new task, one may encounter many challenges. If the planning about where to start and how to finish the task is not properly done, complications may arise. Finding the correct data is always a challenge, and incomplete or incorrect data is not fit for analysis.The adaptation of new technologies or methods may be difficult because of unfamiliarity. If the algorithm is not working correctly, then the results may become unpredictable.

Lack of required time and resources regarding the new task make its successful execution more difficult. In a new environment, many unknown factors may emerge. Furthermore, a shortage in previous practice can delay solving problems.

2.5 Challenges

collected by us, which required a lot of time and effort. Many flowers look similar, but their species may be different, which creates problems in accurate identification. Some flowers have multiple colors (such as red, pink, and white roses), which made it difficult to Collecting flower images was a major challenge. Most of the images were identify them accurately. Some species had a few representatives in the dataset, and hence were hard to detect correctly. Ensuring the model was working fine across different conditions was also tough. Many images of flowers are taken on complex backgrounds; hence, it is tough for the model to clearly distinguish between the flower and unwanted objects.

CHAPTER 3

Research Methodology

3.1 Introduction

In this chapter, we will explain how we initiated our research work. We applied Convolutional Neural Network (CNN) for flower image classification because it is the most powerful and popular method.This section discusses the techniques and methodologies adopted for our research. In this context, the steps and ways of reaching the research objectives are elaborated in detail. Starting with data collection, the pre-processing was needed for the data to be in good quality to be used.

Each of these steps is discussed step by step in this chapter, giving a clear view into our research methodology and the way it has been used.

3.2 Data Collection Procedure

We collected most of the images using our mobile phones. We collected images of eight types of flowers. The flowers are: Joba (red Hibiscus), Gardenia, red Rose, Sunflower,White Frangipani, Chrysanthemum, Catharanthus and Euphorbia. A total of 1500 images were collected.

We divided our dataset into two parts: 1200 images were kept as the Training Dataset, and 300 images were kept as the Validation Dataset. The following figure shows a sample dataset of red rose flowers.

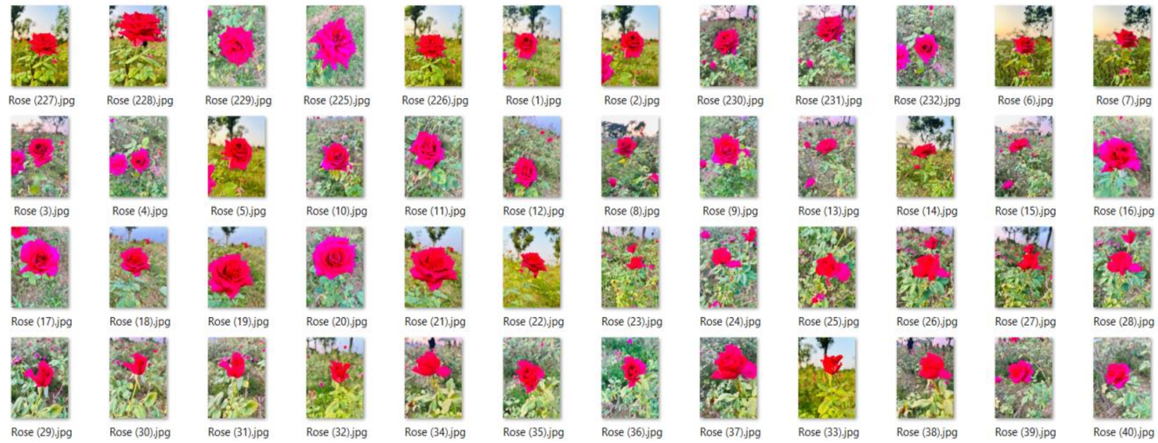

Figure 3.2: Sample Dataset

TABLE 3.2.1: THE TRAINING DATASET TABLE

Flower Name	Quantity
Sunflower	360
Red Rose	185
White Frangipani	88
Red hibiscus	72
Gardenia	115
Euphorbia	130
Catharanthus	122
Chrysanthemum	127

TABLE 3.2.2: THE VALIDATION DATASET TABLE

Flower name	Quantity
Sunflower	90
Red Rose	47
White Frangipani	23
Red hibiscus	18
Gardenia	28
Euphorbia	33
Catharanthus	31
Chrysanthemum	32

3.3 Dataset Cleaning

We have examined all the photos we captured to ensure that there are no blurry or damaged images. Additionally, we took all the photos with full zoom to ensure that they are of high quality and can be easily identified. We deleted all the images that were blurry or of poor quality, so that our accuracy could improve. The photos we collected have been uploaded to Google Drive so that they can be used in our program. The final dataset table is provided below:

TABLE 3.3: THE FINAL DATASET TABLE

Flower name	Quantity
Sunflower	452
Red Rose	232
White Frangipani	111
Red hibiscus	90
Gardenia	143
Euphorbia	163
Catharanthus	153
Chrysanthemum	159

3.4 Dataset Preprocessing

We initially trained the dataset using the images we captured, but our accuracy was low. As a result, we performed data preprocessing. Data preprocessing is an important task. After we preprocessed the data, our accuracy improved significantly.

3.5 Proposed Methodology

Transfer learning, which is used in deep learning, is a method of tackling new problems or challenges by utilizing previously designed models. It is not a deep learning algorithm but rather a strategy for leveraging existing models. The current or specific task is usually related in some way to the previous task. It could involve classifying items into specific categories that are represented in a particular file format.

The old model learns to adapt to new, unseen inputs, which is essential for making predictions. Transfer learning can be categorized into three types and typically uses deep neural network algorithms. This process in deep learning is capable of providing high-quality output even with fewer.

3.5.1 InceptionV3

Inception V3 is a neural network capable of learning multiple features. To capture features at various resolutions, it integrates 1x1, 3x3, and 5x5 convolutions along with pooling workflows. Inception V3 consists of a total of 48 layers, including convolution, pooling, and other carefully integrated layers.

The Inception model is a pre-trained model that utilizes the ImageNet dataset, which contains thousands of images from various categories. Inception V3 is purposefully designed to deliver high-quality results and improve computational efficiency. Compared to previous models, it simplifies convolutions, making it highly beneficial for programmers.

3.5.2 MobileNetV1,V2,V3

MobileNet is a low-code learning model. Designed for mobile and embedded applications. This model is known for its memory and mathematical calculations, which can be used in very small spaces. MobileNet is designed for depthwise separable convolution, which reduces parameters and mathematical convolution. This model is capable of doing heavy work.

It has some versions, MobileNetV1, V2, V3. One step is better than the other. Prior to performing the main depth-wise separable convergence, the linear restriction layer within the inversion residual performs a convolution in the form of 1x1 with a low-dimensional bottleneck. Using mobileNet, complex tasks can be simplified. For which many programmers use MobileNet to do good work. And this program is known as a good model for mathematical work.

3.5.3 CNN

CNN model is designed to use image and video data. It is designed to learn different types of patterns. This model contains convolutional layer, activation function, pooling layer, fully connected layer, softmax/sigmoid activation. The filter size typically ranges from 3x3, 5x5, or 7x7, depending on the complexity of the features being detected. This model allows image classification, object detection, semantic segmentation, which is very easy in image detection. Basically Convolutional Neural Network (CNN) is a deep learning model which is mainly used to analyze image or spatial data. The main parts of CNN are convolutional layer, where features are detected from the image using filters, pooling layer, which reduces the size of the image, and fully connected layer, which makes decisions. CNN model is widely used for image classification, object detection, semantic segmentation, etc.

3.6 Model Training

There are various types of models, including CNN, MobileNet, InceptionV3. We used these 3 models. Some of their architectures are shown below.

3.6.1 CNN Model :

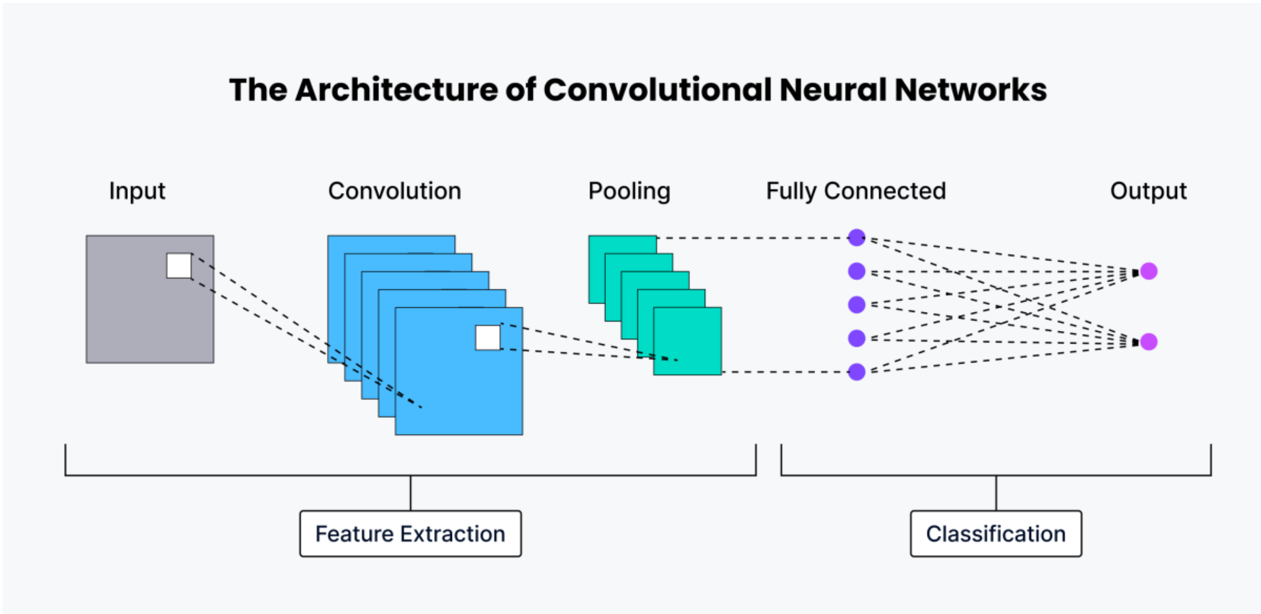

Figure 3.6.1: CNN Model Architecture

3.6.2 InceptionV3:

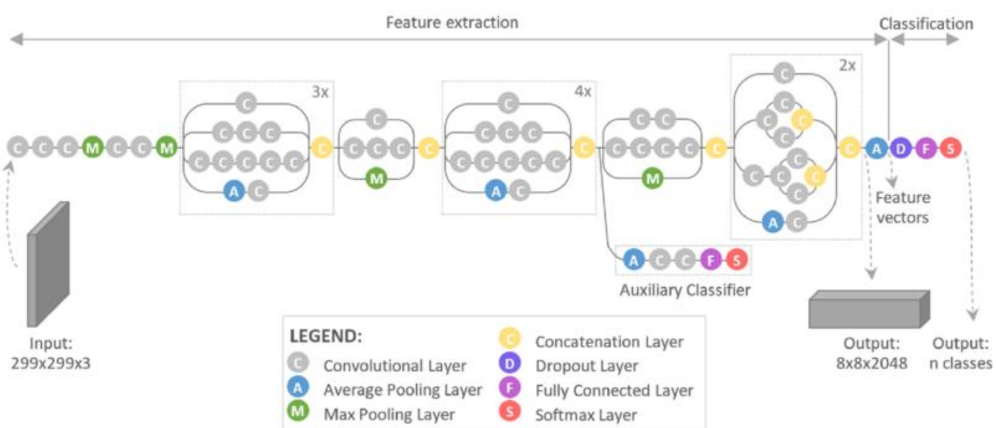

Figure 3.6.2: InceptionV3 Model Architecture

3.6.3 MobileNetV2:

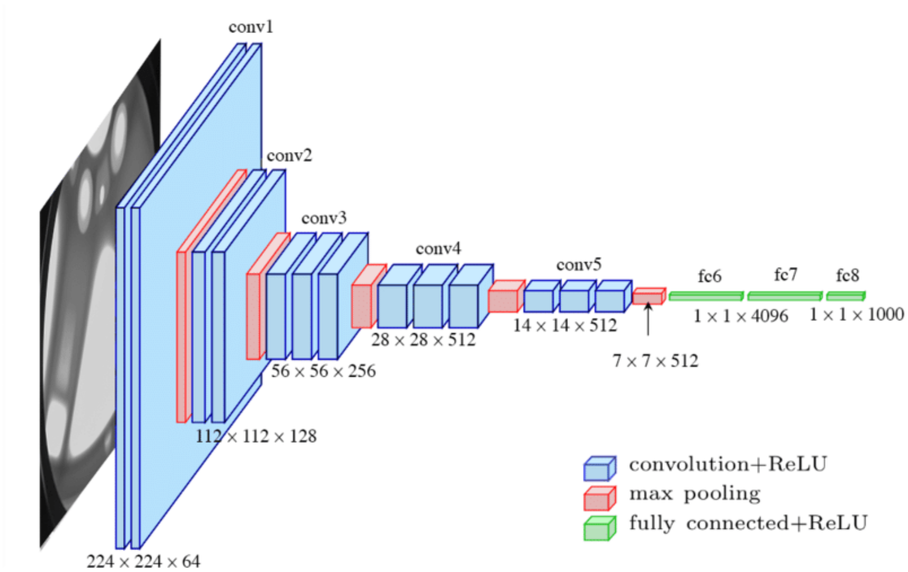

Figure 3.6.3: MobileNetV2 Model Architecture

3.7 Implementation Requirements

- Different Deep Learning Frameworks and Libraries
- Windows 11
- Google Colab with runtime TPU
- Google Drive
- Iphone & Realme Phone

CHAPTER 4

Result Analysis and Discussion

4.1 Introduction

We deployed three distinct deep-learning models to achieve the highest level of precision on our custom-made dataset. Our model is CNN, InceptinV3, MobileNetV2 then our dataset is proper ready then we start training model.

And provide best model to recommend to other and apply the model to analyze the proper model which model are perfect for dataset. As a result in below to provide which model is better and best for classification, we can develop models using our particular dataset while preserving the weight that have been previously trained for each model.

4.2 Experiment Results and Analysis

The process of using a range of evaluation criteria to gauge a deep learning algorithm's performance is known as experiment result analysis. A model's efficacy has to be assessed early in the research process, and model evaluation also helps with model supervision. The accuracy of our model can only be assessed during the training and validation stages. In order to verify our model, we must analyze a wide variety of reports. To test our model, we need to create a confusion matrix and classification report. The next parts will deal with the brief introduction paragraph. We can rapidly ascertain which strategy is working with the strongest results by examining the comparison table between the simulators.

TABLE 4.2: THE EXPERIMENT RESULT OF THE EVALUATED MODEL TABLE

Model	Test Accuracy	Test Loss
InceptionV3	94.08%	0.35
MobileNetV2	98.33%	0.05
CNN	94.24%	0.13

4.3 Generating Confusion Matrix

A classification model's accuracy is analyzed using a table called the matrix of disorientation. It affords a clear account of all the forecasts generated by the framework against the actual values for the physical world which was predicted by the model. The performance of the categorization system can be explained by a table called the matrix of confusion. An example of a categorization system is an inconsistency matrix which shows and summarizes the results obtained. The use of the matrix makes it possible to give a general evaluation of the performance of the machine learning model across severally groups or divisions. An illustration of what an ambiguous matrix looks like is a matrix of the same dimensions as the number of types found in the dataset in terms of rows and columns. We may end up developing a variety of assessment metrics in an effort to understand how the model holds up for each category; the F1 score, accuracy, recollection (or sensitivity), various types of precision, and reliability. As a confusion matrix is used to compare the predicted and actual values, a matrix of squares of a collection of data points is often referred to. It has cells or regions of Truly Positive, Truly Negative, Those incorrectly said to be positive but are not, and Those said to be negative but are positive. When MobileNetV3 was applied on our particular dataset, it was observed that at the chronological order, 14, 48, 8, 213, 15 and 5 accurately classified the flower. The confusion matrix of the model is illustrated in Figure 4.3.

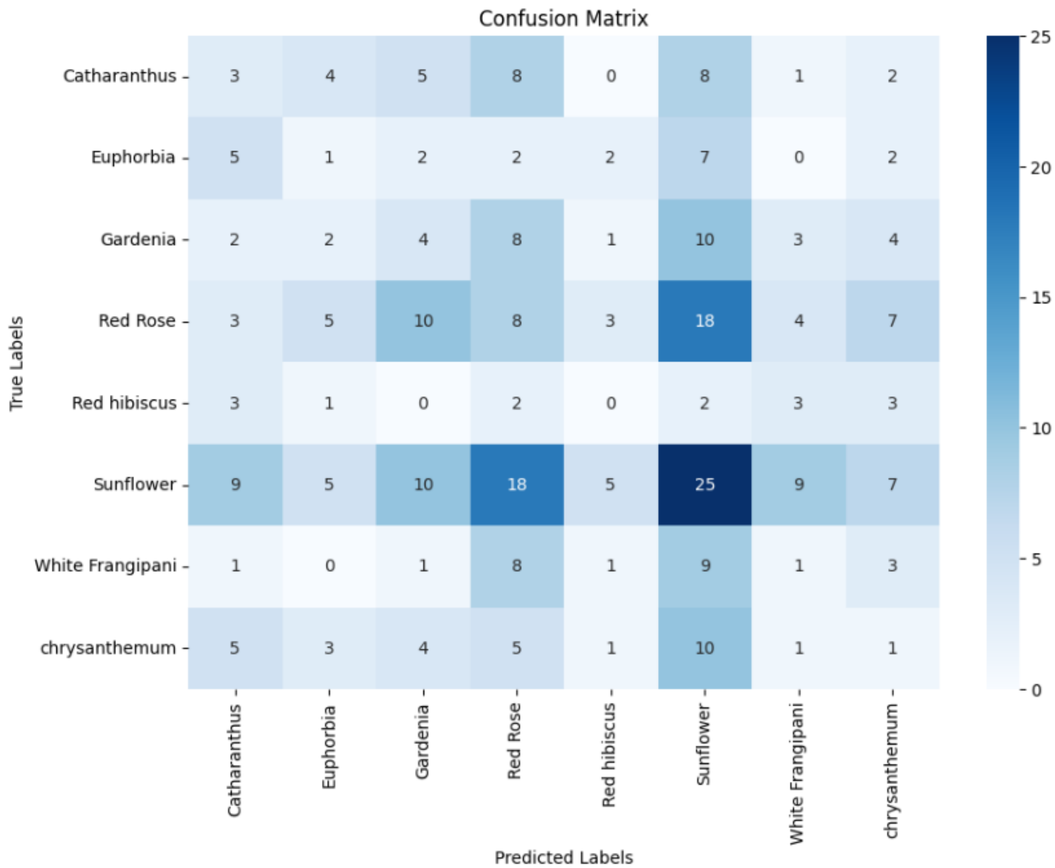

Figure 4.3: Confusion Matrix

4.4 Generating Classification Report

A verbal briefing that offers a thorough analysis of the categorizing method's performance across several classes or kinds is called a classification report. For every class, it shows important information including precision, recall, F1 score, and overall support percentage. The sample mean and general median are among the averages that are displayed. The categorization report offers insight into how the model does for a particular population and aids in assessing the model's overall performance. When working with datasets that are uneven or when numerous classes have differing levels of importance, this is extremely beneficial.

4.5 Training and Validation Accuracy and Loss Curve

We first ran 10 epochs of MobileNetV3 using the Keras Callback function with verbose set to 1, shuffle set to True, and validation steps set to none. Figure 4.5 shows the training and evaluation curves after 10 training epochs. The best epoch, with nearly flawless training and validation preciseness.

Figure 4.5: Training-Validation Curve with 10 Epochs

4.6 Discussion

In the current work, three deep-learning topologies have been recommended for the flower classification system. These structures are employed to distinguish between fresh clean and image to produce best accuracy how fresh it is. We demonstrate the step-by-step process of our endeavor as well as the precision of its outcomes in the study's findings and analysis results. InceptionV3, MobileNetV2, and CNN models each obtained accuracy scores of 94.08%, 98.33% and 94.24% once our experiment was completed. The MobileNetV2 model outperformed the other suggested simulations, according to the results of the trial. The model offered decent detection precision when compared to other appliances.

CHAPTER 5
Impact on Society, Environment, and Sustainability

5.1 Impact on Society

Our project will help and have a big impact on society. Flowers are the most liked and popular subject around the world. From the production of flowers, many people can arrange their incomes. It is a profitable agriculture sector that helps so many people to continue their livelihood. If flower producers can identify the flowers correctly, then they can perform their work with more accuracy and properly. This will conserve flower quality, avoid being sick, and raise production level. The demand for this already exists around the world, hence they can bring in substantial commercial business from flower manufacturers or companies. But above all, it is first important that they must get hold of precise information over flowers. Proper identification lets them enhance production and enable a quality distribution of flowers within the market. Consequently, they will uplift their profit levels. Ordinary people will also be able to quickly and correctly identify their favorite flowers.

5.2 Impact on Environment

Our project, which will be based on Convolutional Neural Networks, will also have a very minimal environmental impact. CNN operates with a pre-defined model which is executed on a cloud server. It does not directly cause excessive carbon emission or any other harm to the environment. Our concept uses very little energy because it operates on a digital platform, thus it doesn't negatively impact the environment. This technology is safe and environmentally benign, and it will make the process of detecting and classifying information about flowers easier. I can thus state with confidence that there won't be any negative environmental repercussions from our CNN-based initiative.

5.3 Ethical Aspects

We deal only with flower-related data, so there are no concerns about personal information. The aim of our project is to help in the correct identification and preservation of flowers for proper care and conservation processes. Our approach is clear and straightforward; users understand how the technology works and can trust it. We guarantee the use of technology to create positive results without any harm to the environment or species of flowers. Our project will help improve flower cultivation and agriculture, ensuring sustainable economic growth among farmers and businesses.The CNN-based flower classification project will be designed by keeping in view ethical considerations: ensuring environmental sustainability, privacy, and social well-being.

5.4 Sustainability Plan

The flower auto-classification system focuses on long-term usability, scalability, and adaptability. Regular updates featuring new datasets and advanced algorithms will be carried out to ensure the accuracy of the system. In addition, the sustainability of the flower auto-identification system will be ensured through regular updates, ease of use, and stability of technologies. The efficiency of the system is further enhanced with the collaboration of experts and integration of new datasets. Financial sustainability shall be provided through subscription models and partnerships, while training and awareness programs ensure wide adoption of the system

CHAPTER 6

Overview of the Study, Conclusion, and Future Work

6.1 Overview of the Study

This paper presents the development of a deep learning-based automated flower recognition system using CNNs. Such a system will be able to recognize a wide variety of species from images with high accuracy and speed, thus enabling quicker, easier, and more reliable plant identification.It is a deep learning model used by the system in analyzing these visual essentials of flowers, such as shape, color, and structure, and texture. For this reason, the paper obtains the advantage of training its model by using the great dataset of flower images in such a way that allows discriminating with high accuracy various kinds of species of flowers. Applications of several deep learning models and techniques are made in the paper aimed at optimization in classification. It could have wide applications for agriculture, horticulture, botanical research, and environmental studies, where the correct identification of a flower and timely recognition might be quite indispensable. Such applications would relate to plant monitoring, disease detection, and conservation planning via real-time automatic identification. In fact, the application can be brought onto a mobile application platform very easily for instant identifications, where other applications involving plant health monitoring and multilanguage capability can also be pursued. In summary, this work will add to the field of computer vision and deep learning by applying these technologies to an important and practical domain: flower recognition.

6.2 Conclusions

Here, in this research work, an automatic flower recognition system using the Convolutional Neural Network technique was proposed that can identify flower species. In this paper, we would like to present the local flower species for identification, making the urban people and the young generation aware of the local flowers. The results derived from experiments conducted give proof that this model can provide an accuracy ranging from about 80% to 95%. The system will provide users with information on the right species of flowers within a very short time, thus developing interest in nature and the environment. This opportunity is especially going to serve those living in cities and who have little idea about the local flowers. It will identify the local species of flowers and help in environmental research, too, where data regarding the local species of flowers can be collected. This technology will open new horizons toward the conservation of local flowers and environmental research in the future.

6.3 Limitations

In contrast to the advanced technology of flower auto-recognition systems, there are some limitations that affect their performance in some ways. The big challenge lies in the collection of datasets, sufficient and diverse enough, since image collecting is not available for many of these flowers. Besides, most of them look very similar and thus do not allow the model to accurately identify whose is whose. Another huge problem is color variation, because flowers from the same species may have different colors. If the background of the image is complex, then the model is not able to find many differences between the flower and the background. Variations in lighting, angle, and quality of the image are other obstacles for recognition. Because a real-time recognition system depends on it, this seriously bounds those low-powered devices or, worse, mobile platforms.

Sometimes the model performs very well on the training data but, after some time, it fails to recognize new images that it has not learned about because of over-fitting. Moreover, it is dependent on features concerning only the shape, color, and texture of flowers, without inclusion of other characteristics such as fragrance or growth patterns. Furthermore, addition of any new species takes time and requires further training.In general, it requires more advanced datasets, newer algorithms, and optimization in real time.

6.4 Future Work

The future of the auto-classification system for flowers is bright. Future improvement in the following potential aspects may be: Application such that it will definitely facilitate identification of flowers through live mobile camera capturing. In addition, other important aspects include fragrance, growth, patterns, and environmental conditions. All these will be input in enhancing the accuracy in classifying the flowers. More flower species will be added to the system's database for more accurate identification. Multilingual support will be added to the system to ensure it can be used without language barriers for global users. These advancements will make the system more reliable, comprehensive, and user-friendly, making it highly effective in agriculture, floriculture, and research.

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