Classification of Flower Images by usingTransfer Learning and Machine Learning Approach

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Abstract:

Classification of flower is treated as the complex problem, due to its less discrimination between many flowers type. It is fact that many flowers are share many common things between them like, color, shape and texture of the flower. In real world there are many types of flowers are existed and classifying them without having the core knowledge of flowers is very difficult task. In this situation, the need arises to develop a system to classify the flower types efficiently. Hence, this proposed method has done its work efficiently by extracting the CNN features by considering the 2074 flowers imagesbelongs to 6 types species. The features were extracted from Alexnet and Googlenet models by using transfer learning technique, obtained recognition accuracy from classification layer of each CNN models and in extension of the experiment from fullyconnected layer from each models the CNN features are extracted and fed to machine learning methods named as LDA,KNN and SVM. In the recognition accuracy the Googlenet model has exhibited the best performance by obtaining 97.84% recognition accuracy. The novelty of this paper is that it is free from pre-processing.

Keywords: CNN, Alexnet, Googlenet, LDA, KNN, SVM.

DOI Number: 10.14704/nq.2022.20.8.NQ44371 **NeuroQuantology 2022; 20(8): 3445-3454**

I. Introduction

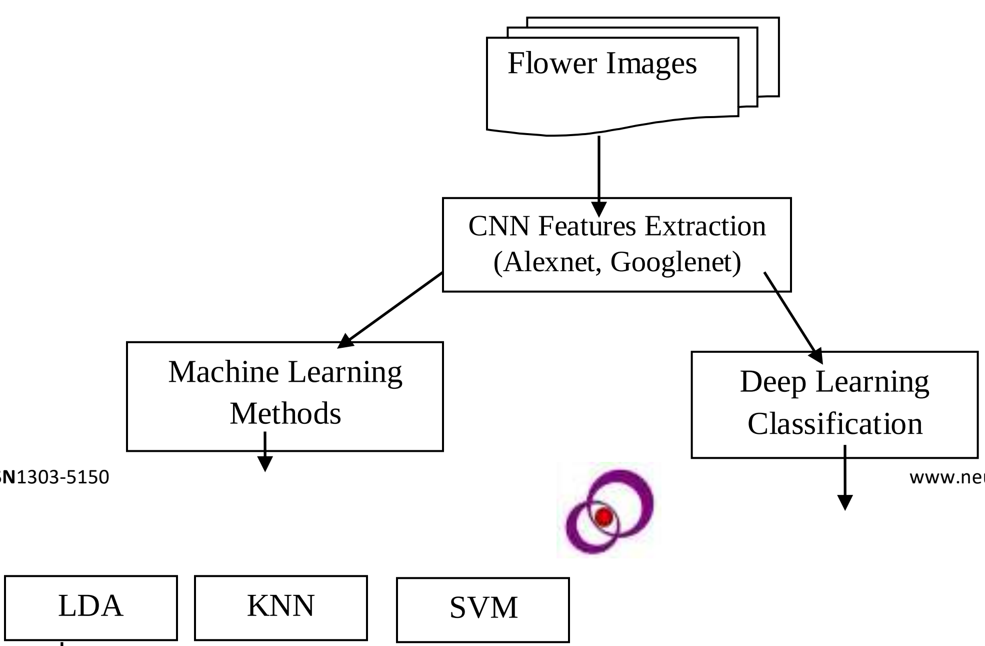
Flowers have a significant impact on human life and these are being used for decorate homes, gardens, perfume making, food for insects, devotional offerings, and also provides some medicinal benefits to thehuman beings. Flowers are grown on a variety of climatic conditions and terrains. On the earth, there are 369000 types of species of flowers [1]. It is more chances of having more similarities amongst the flowers. For ordinary people with bare eyes, it is tough to discriminate and recognize the individual flowers amongst several flowers. This scenario needs some specialist people known as botanists who studied the characteristics and properties of several flowers. The botanists were hard to find in all places where recognition is required. Hence, in this case, there is a need to have a system that can correct flowers for the further process. Considering some features like color, shape, and texture is not enough; it may also need some other features. It is a fact that many flowers are sharing the same features like color and shape. Hence, it is difficult to make differentiation between flowers. To avoid such problem, this proposed method is applied, and we are madethe best use of deep learning models viz., Alexnet and Googlenet. From the early past,deep learning models outperformed several kinds of image classification that may contain more classes and have images in millions.

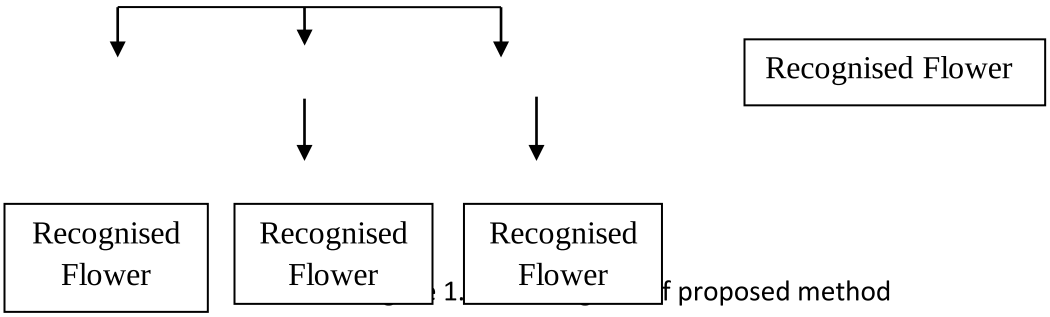
In the literature, many papers are found related to flower classification, and few papers are discussed here. The deep learning and machine learning-based flower classification is given in [2], they have considered standard Oxford-17 and Oxford-102 flower datasets, for the Oxford-17 dataset, they obtained the highest recognition accuracy of 99.8% from the MLP Classifier. In the work of [3], they have selected the deep features to recognize the flower species, they have adopted two pre-trained models known as Alexnet and VGG16, and they have concatenated both models feature, then they have applied the minimumRedundancy Maximum Relevance (mRMR) method to select the potential features and those features are submitted to SVM classifier obtained the 96.39% and 95.70% recognition accuracy by using the Flower17 and Flower102 standard datasets. The pretrained InceptionV3 based flower classification is reported in [4], they have used the transfer learning method to train the flowers and obtained the 95%, 94% on Oxford-17 and Oxford-102 datasets, respectively. The authors in [5] have presented the NAS- FPN and Faster RCNN based flower classification, in their experiments, they have used the 30 class flowers dataset and obtained 96.2% classification accuracy.

The remaining paper is organized in this way; section-ii has the details of the proposed methodology, experimental results, and discussion is given in section-III, at last section-IV followed by a conclusion.

II. Proposed Method

In this proposed method, we have made used the transfer learning technique to customize the pretrained CNN models. We have employed the two widely used pretrained CNN models;Alexnet and Googlenet,and extracted the CNN features from them. Next we haveconsidered the three popular machine learning methods known as LDA,KNN, and SVM. In the literature, few works are reported the usage of deep learning and machine learning, but they have not used the three machine learning methods as given in our proposed approach.





1. f proposed method

To carry out the experiment, we have taken the six types of flower images dataset from flowers-299[6] standard dataset.

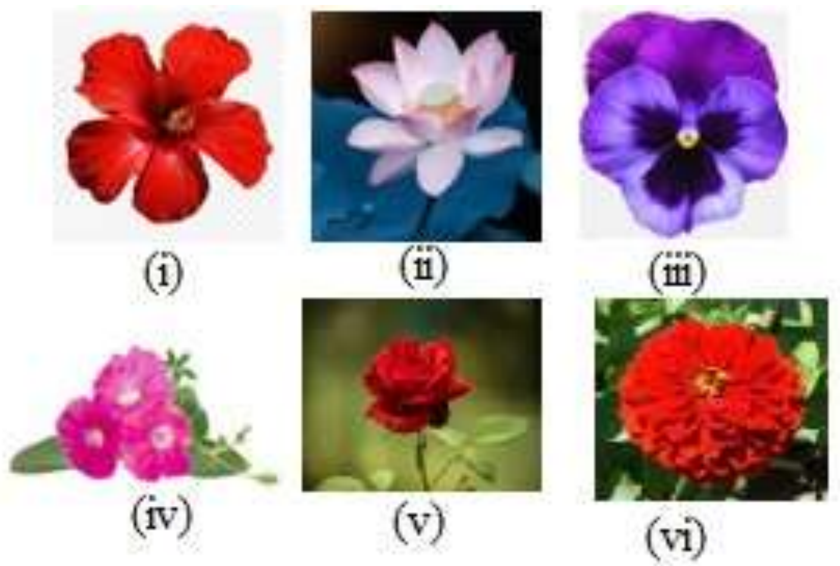


Figure2. Sample input flower images. (i) Hibiscus (ii) Lotus (iii) Pansy (iv) Petunia(v) Rose (vi) Zinnia

The Following Table 1. Shows the description of the dataset.

Table 1. Dataset Description

Sl. No.	Name of Flower	No. of Image
1	Hibiscus	379
2	Lotus	339
3	Pansy	308
4	Petunia	409
5	Rose	290
6	Zinnia	349
Total		2074

From the total images of 2074 the 80% (1670) of images are used for training and 20% (415) images for testing.

The above input images are fed to the two widely used pretrained CNN models named as Alexnet and Googlenet. We have adopted the transfer learning technique [7] to train our input images. In this technique we have replaced last three layers, viz., fully connected, softmax and classification layers. In fully connected layers we have mentioned the number of classes from our dataset.

Alexnet: The AlexNet is awidely used pretrainedconvolution neural network(CNN)[8][9][10][11] in many research areas such as image recognition, object detection and classification and further it is easy to understand. It is basically developed to classify the 1000 object image categories. This model accepts the image size of 227x227. In our experiment we have normalized our input images into 227x227 size.It contains the five convolutional layers, max-pooling ones, Rectified Linear Units (ReLUs) as non-linearity, three fully-connectedlayers, and dropout [12]. It takes less time to execute and giving the best recognition accuracy for any kind of input images. In this experiment we have given the 6 types of flower images to classify and it has given relatively good recognition accuracy. From the last layer of alexnet known as classification layer the recognition accuracy is obtained and it has given 95.19% recognition accuracy.

Googlenet: Basically, it is introduced in [13]. The complexity of this CNN design is highlighted by the fact that it is made up of 22 layers and a newly added building block called the inception module.This innovative method demonstrated that CNN layers could be stacked in a variety of ways other than in a traditional sequential order.A Network in Network (NiN) layer, a pooling technique, a large-sized convolution layer, and a small-sized convolution layer are among the modules.To reduce dimensionality, computed in parallel and followed by 1 1 convolution operations. From classification layer the given CNN features are trained and obtained the 97.84% recognition accuracy.From the above models we have extracted CNN features from Alexnet 1024 features and Googlenet had given 1024 features. By the fullyconnected layer we have extracted features, in these layers all the nodes were connected and it works based on the classes of input image. The features extracted from Alexnet and Googlenet are submitted to popular machine learning methods known as LDA, KNN and SVM classifiers.

III. Experimental Results and Discussion

To obtain the highest recognition accuracy it is necessary to have potential features, leads to agood result. In the process we have utilized the popular pretrained CNN models named as Alexnet and Googlenet. The features from Alexnet and Googlenet were given as input to machine learning methods viz., LDA, KNN and SVM.

In the results first we focus on pretrained CNN models results, then we proceed to machine learning models-based recognition accuracy.

The following figures are showing the recognition accuracy obtained from the alexnet by using classification layer.

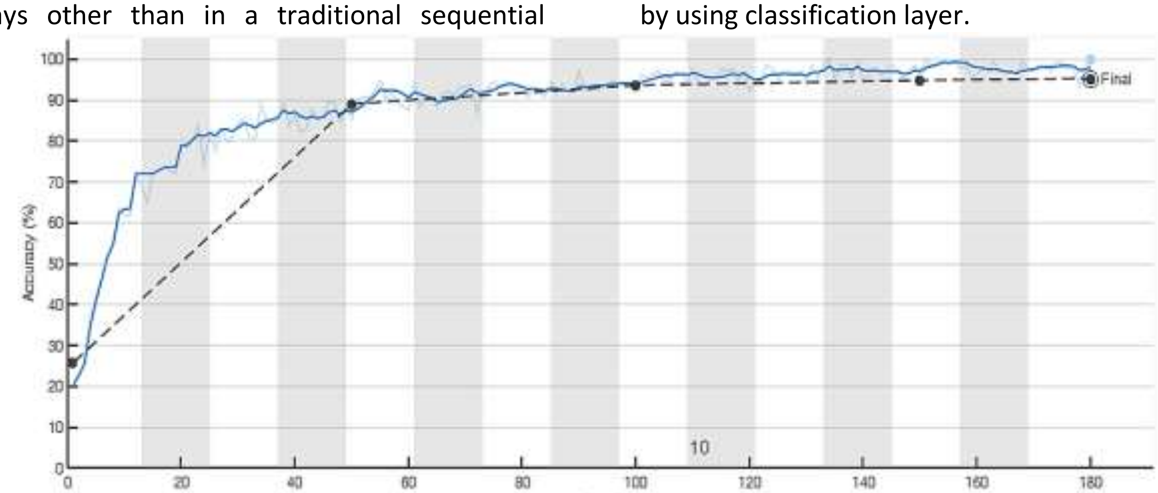


Figure 3. Alexnet training plot for training data.

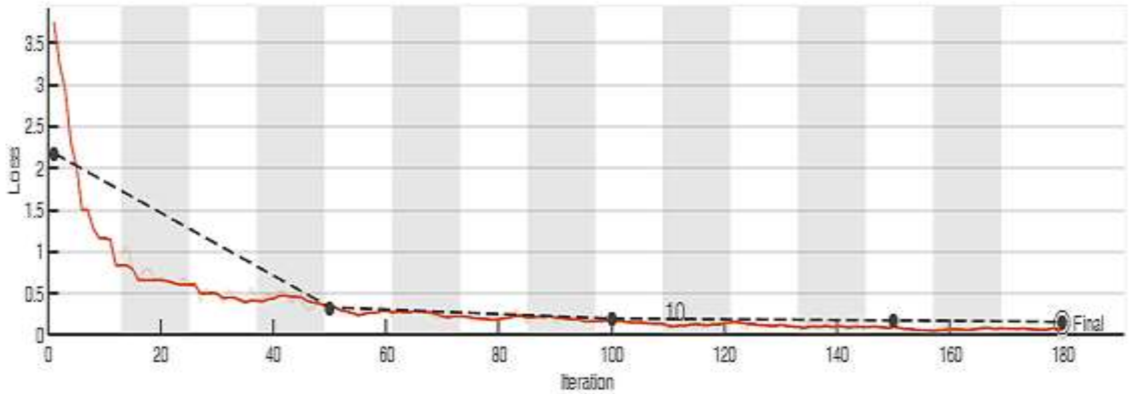


Figure 4. Validation loss of Alexnet.

The following figures are showing the recognition accuracy obtained from the Googlenet by using classification layer.

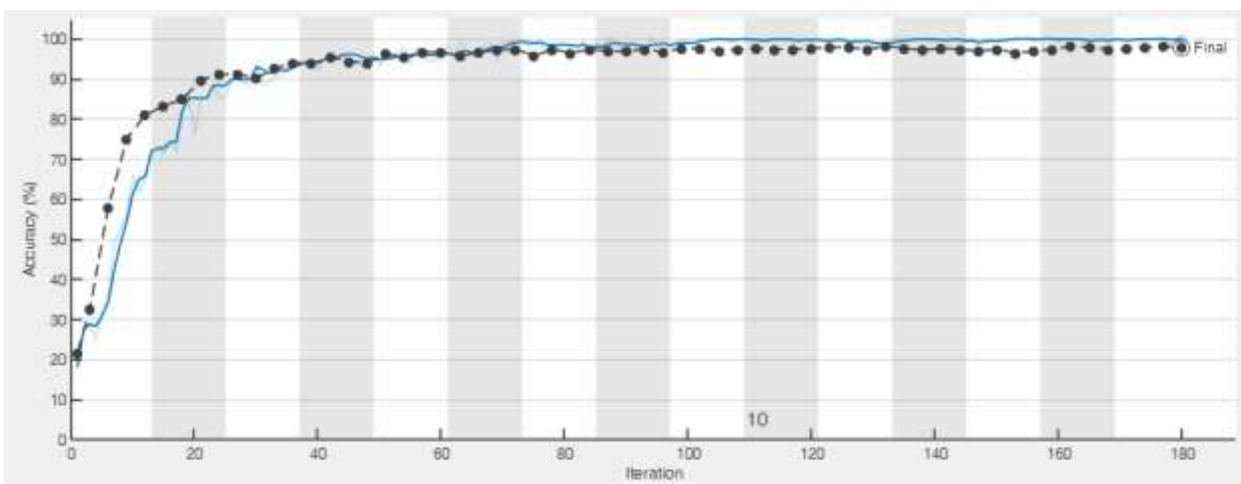


Figure 5. Googlenetnetwork based training plot

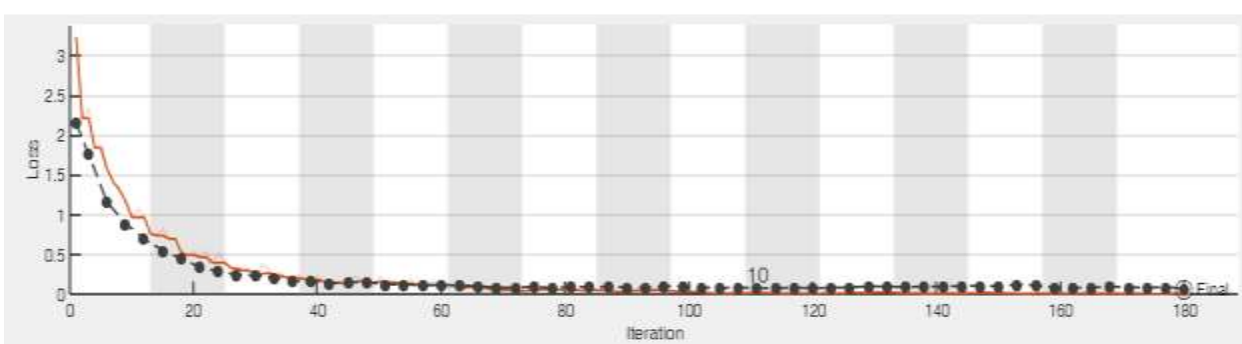


Figure 6. Googlenetnetwork based validation loss plot.

After obtaining the recognition results from Alexnet and Googlenet, we proceed to make use of machine learning models known as LDA, KNN and SVM. Following figures contains the confusion matrix after obtaining the results based on Alexnet and Googlenet CNN features.

Figure 6. Confusion matrix for LDA of validation data of Alexnet

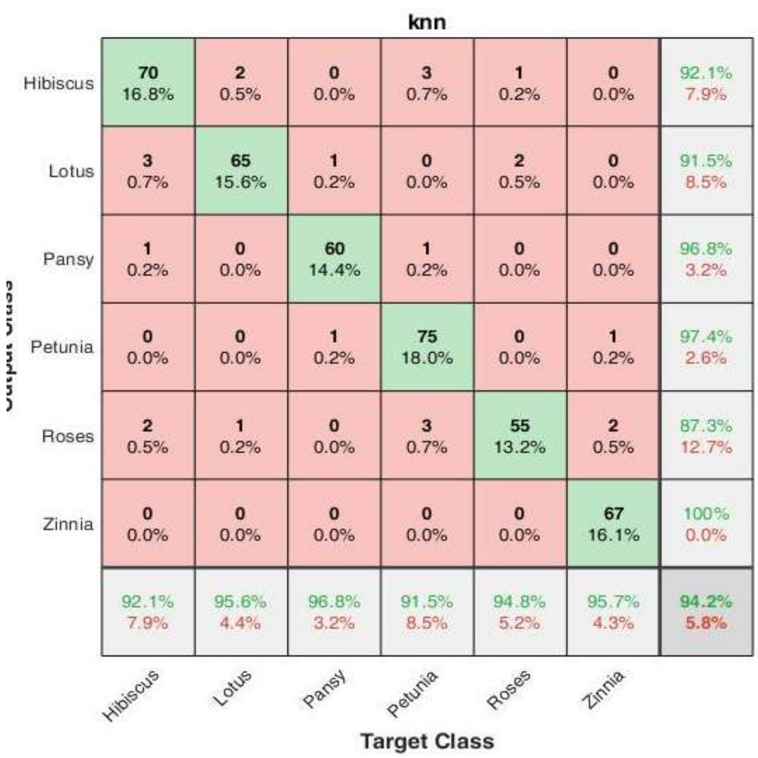


Figure 7. Confusion matrix for KNN of validation data of Alexnet.

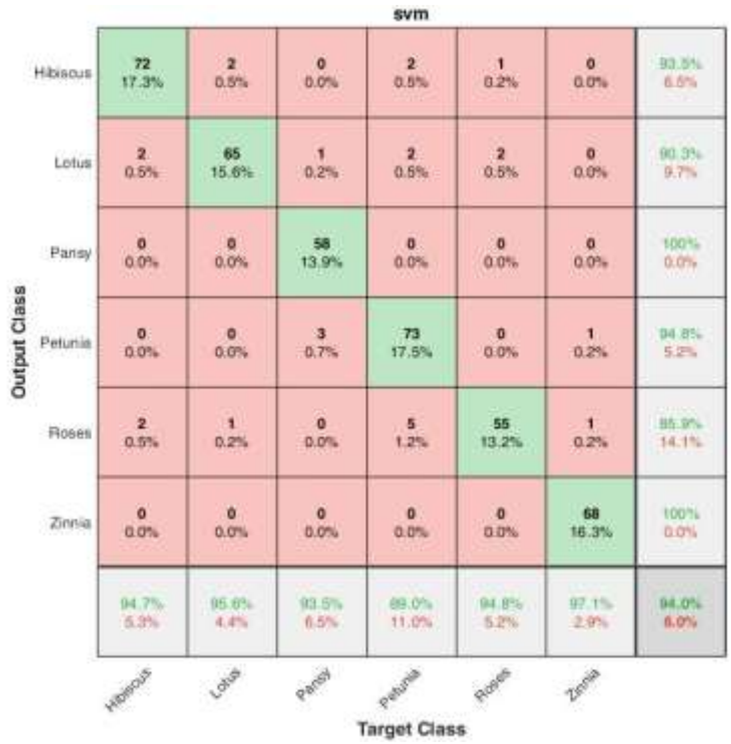


Figure 8. Confusion matrix for SVM of validation data of Alexnet

Figure 9. Confusion matrix for LDA of validation data of Googlenet

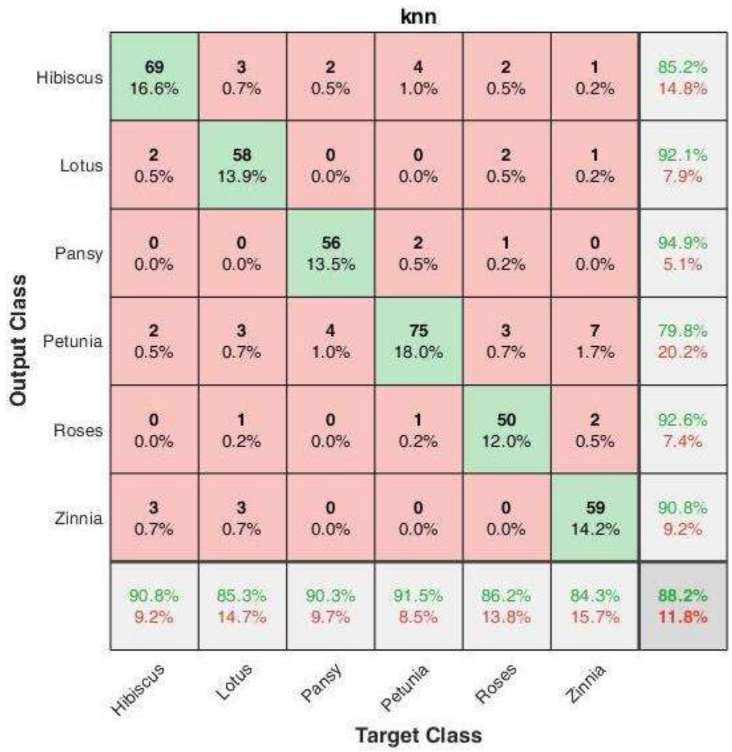


Figure 10. Confusion matrix for KNN of validation data of Googlenet

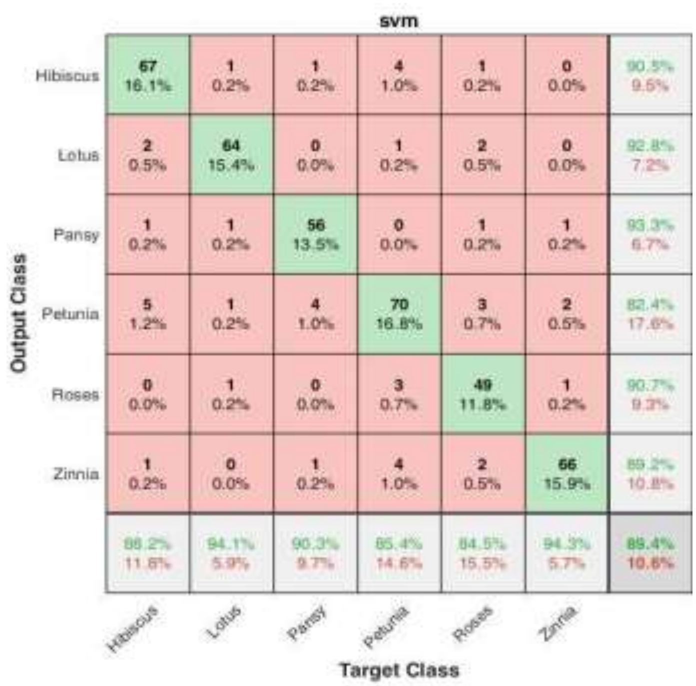


Figure 11. Confusion matrix for SVMof validation data of Googlenet

Following Table gives the results obtained from CNN pretrained models and machine learning models

Table 2. Average recognition accuracy obtained from CNN models and machine learning models

Sl. No.	**Methods**	**Average Recognition Accuracy**

1	Alexnet	95.19%
2	Googlenet	**97.84%**
3	CNN+LDA (Alexnet)	94.20%
4	CNN+KNN (Alexnet)	94.20%
5	CNN+SVM (Alexnet)	94.00%
6	CNN+LDA (Googlenet)	93.30%
7	CNN+KNN (Googlenet)	88.20%
8	CNN+SVM (Googlenet)	89.40%

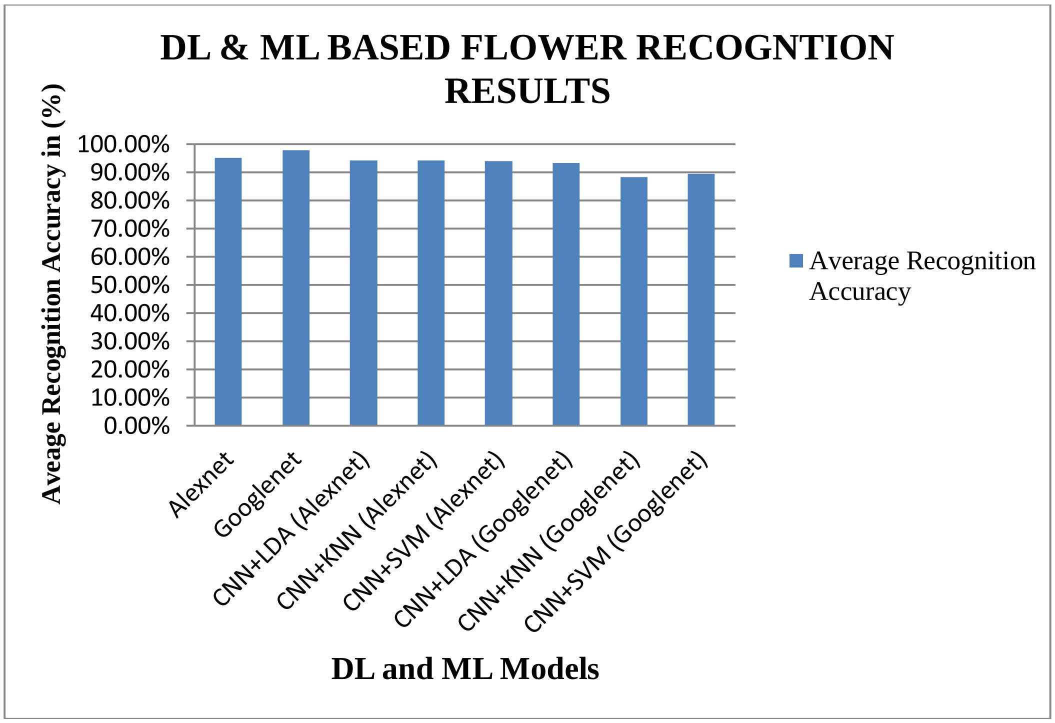


Figure 12. Deep Learning and Machine Learningmodels-based flower recognition accuracy.

From the above Table 2 and Figure 12, it is observed that the Googlenet has given the highest recognition accuracy of 97.84%, however the least recognition accuracy is obtained from the Googlenet features using CNN+KNN (Googlenet) it has able to reach 88.20%.

IV. Conclusion

The proposed work is efficiently used the two types of methods, such as Deep learning and Machine Learning for the detection of flowers. The CNN features are extracted by using the Alexnet and Googlenet pretrained models, and extracted features are submitted machine leaning methods known as LDA, KNN and SVM. From the results, it is clear that the Googlenet have obtained the highest 97.84% of recognition accuracy.

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