FLOWER RECOGNITION BY IMAGE PROCESSING

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ABSTRACT:

Flowers all as plants are very important and essential if not necessary resources for human well-being as well as all life on Earth. In general, there are many different types of flowers in existence and new flower species are being discovered on regular basis even though they all share similarities in their color, shape, texture, petals and features. Individuals with limited botanical knowledge would not be able to differentiate among these flowers at a glance. Thus the need to recognize and classify these various species of flowers into their respective categories. However, in order to recognize a flower appropriately, it is crucial and vital to provide important information including the flower's name. Flower recognition is very important to botanist, individuals and most importantly to florist. In this work, we present flower recognition algorithms based on information from an input random colored flower images of different flower species. The algorithms presented are Support Vector Machine Learning (SVM) and AlexNet all developed using Mathlab. We found that the proposed algorithms were able to recognize the flower species with an average accuracy of 83.45 given a flower dataset of 3500 flowers of 5 different species.

Author Keywords

Machine learning; flower image recognition; SVM.

1 INTRODUCTION

Flowers all as plants are essential to the balance of nature and in people's live. They are the ultimate source of food and metabolic energy for nearly all inserts, which cannot manufacture their own food. Thus the study of flower is vital because they are a fundamental part of life on Earth, and generate the oxygen and food that allows humans and insects to exist. There are many different types of flowers and new species of flower are being discovered continuously. Sometimes we walk in a nearby park and encounter a new flower that we have never seen before. Given an image of a flower, an ordinary person with limited Botanical knowledge would not be able to tell which species that flower belongs to. We usually have to consult flower guide books or browse any relevant web pages on the Internet through keywords searching. Typically, such a keyword searching approach is not practical for most people. Since digital cameras have been widely used for most people, therefore it would be very useful to identify the blooming plant based on flower images taken by a digital camera. The fist problem in such a flower recognition algorithm is how to accurately extract the flower region from a natural complex background. Once this is achieved, effective color, shape, and texture features are extracted for further recognition purpose.

This paper describes our approach for the flower recognition using colored images that helps to recognize a flower image in order to determine their species. The approach employs image classification based on an existing dataset. The rest of this paper is organized as follows. Section 2 provides an overview of the ML algorithms considered for this work. Section 3 describes the proposed flower image recognition algorithm. Some experimental results will be given in section 3. In section 4, we present the experimental results. Section 5 is left for the conclusions and Section presents the difficulties encountered.

2 Overview of Machine Learning Algorithms Used

As mentioned earlier, the proposed flower image recognition are based on SVM and AlexNet machine learning techniques. As such, we are going to first present an overview of these techniques in the sequel.

Machine learning is considered as a subfield of Artificial Intelligence and it is concerned with the development of techniques and methods which enable the computer to learn. It is mainly divided into two categories, namely; Supervised learning and Un-Supervised learning. Supervised learning is further subdivided into Regression techniques and Classification techniques in which SVM belongs.

SVM was first heard in 1992 introduced by Boser, Guyon, and Vapnik in COLT-92. SVMs belong to a family of generalized linear classifiers. In another terms, SVM is a classification and regression prediction tool that uses that machine learning theory to maximize predictive accuracy while automatically avoiding over-fit to the data. SVMs become famous when, using pixel maps as inputs; it gives accuracy comparable to sophisticated neural networks. It is also being used in many applications, such as hand writing analysis, face analysis, image analysis and so forth, especially for pattern classification and regression based applications. SVMs were developed to solve classification problems, but recently they have been extended to solve regression problems. Even though it's considered that Neural Networks are easier to use than this, however, unsatisfactory results are obtained. A classification task usually involves with training and testing data which consist of some data instances. Each instances in the training set contains one target values and several attributes. The goal of SVM is to produce a model which predicts target value of data instances in the testing set which are given only the attributes.

The question one may ask is: **Why SVM over Neural Network (NN).** Let's try to answer this with the aid of the following scenarios. Firstly, working with neural network for supervised and unsupervised entails the use of multilayer perceptron (MLP) which continuously uses forward and backward propagation which includes the approximation of continuous nonlinear functions (e.g., the sigmoidal function, ReLu function etc)

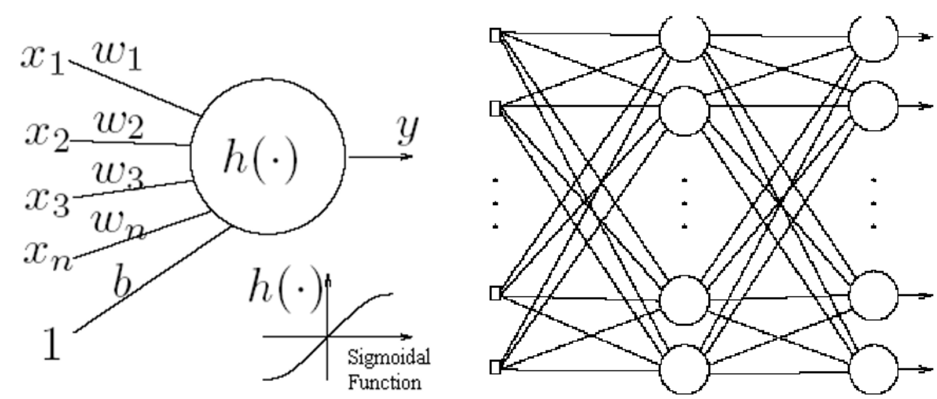

Figure 2: a] Simple Neural Network b]Multilayer Perceptron. [10][11]. These are simple visualizations just to have a overview as how neural network looks like.

Figure 1:

There can be some issues noticed. Some of them are having many local minima and also finding how many neurons might be needed by a task is another issue which determines whether optimality of that NN is reached. Another thing to note is that even if the neural network solution used tends to converge, this may not result in a unique solution. Now let's look at another example where we plot the data and try to classify it and we see that there are many hyper planes which can classify it. But which one is better?

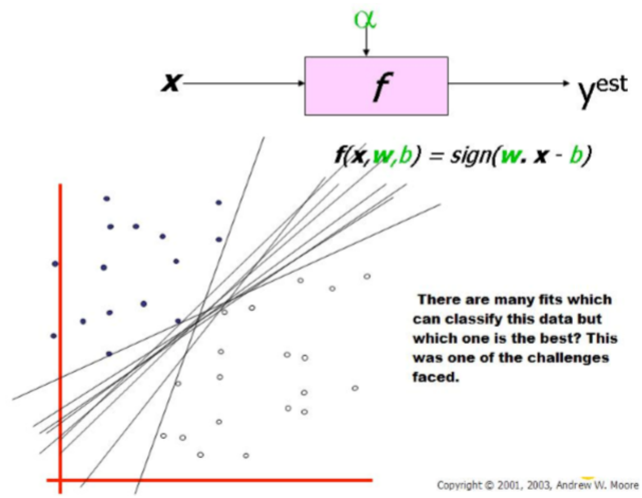

Figure 2:

In the above figure, we see that there are many hyper planes which can be fitting in to classify the data but which one is the best is the right or the correct solution. Thus the need for SVMs arises.

SVM has been found to be successful when used for pattern classification problems. One of the major challenges is that of choosing an appropriate kernel for the given application. There are standard choices such as the *Gaussian or Polynomial kernel* that are the default options, but if these prove inefficient or if the inputs are discrete structures more kernels will be needed.

The next machine learning technique considered in this work is Convolutional Neural Network (CNN) more especially Alexnet. CNN are very similar to ordinary NN: they are made up of neurons that have have learning weights and biases. Each neuron receives some inputs, runs its "activation function" and sends out the output to other nodes. The whole network still expresses a single differentiable score function: from the raw image pixels on one end to class scores at the other.

So what does change? CNNs architecture make the explicit assumption that the inputs are **images**, which allows us to encode certain properties into the architecture. These then makes the forward function more efficient to implement and vastly reduces the amount of parameters in the network. By knowing the input is an image, we can use convolutions (hence the name) on the image which are known to extract good properties from the image such as edges. CNNs became very popular in recent years, starting with AlexNet, developed by Alex Krizhevsky, Ilya Sutskever and Geoff Hinton. The AlexNet was submitted to the ImageNet ILSVRC challenge in 2012 and significantly outperformed the second round-up. The success of AlexNet spark an interest to CNNs which dominated the following years ImageNet challenge (almost all the competitors used CNNs), and inspired researchers and practitioner to apply Deep NN to various other tasks such as speech recognition, face recognition, and more. Below is a figure showing the activations for each layer of the CNN.

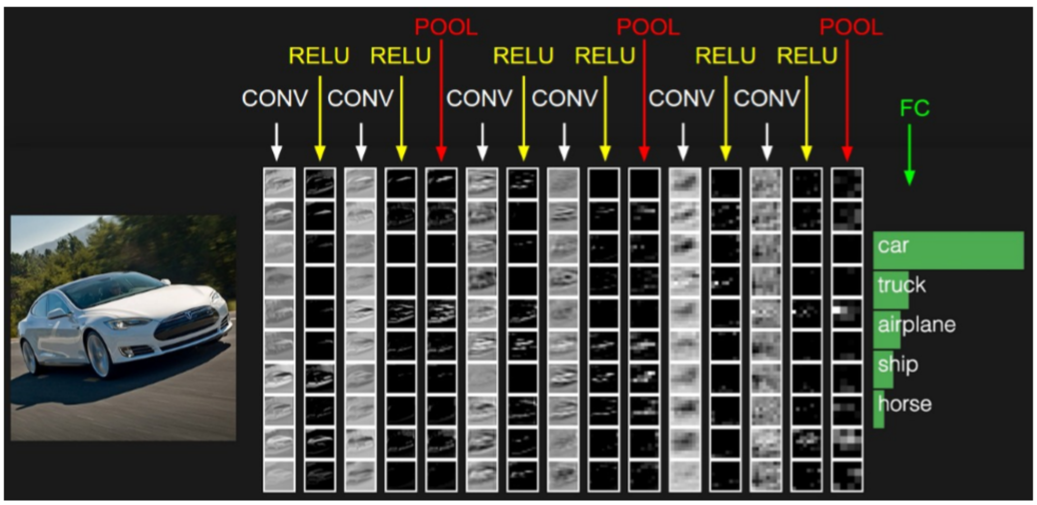

Figure 3: Example CNN activations for each layer

Figure 3:

3 The Proposed Flower Image Recognition Methodology

The proposed flower image recognition algorithms consist of five major phases. These phases are shown below in a typical image based plant (flower) recognition system and these phases are explained in the consecutive subsections.

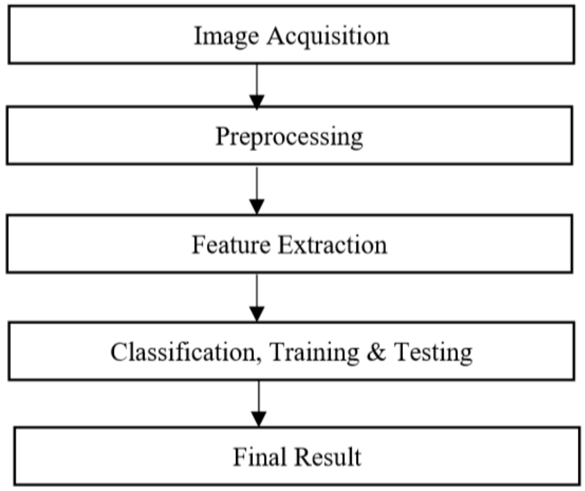

Figure 4: Flow diagram of proposed scheme.

3.1 Image acquisition

A flower image can be easily acquired using scanner or digital camera. The image can be of any size. The proposed algorithms are tested on the flower recognition data set obtained from **Kaggle** which contains 3500 RGB flower images of 5 different species; each species has 700 sample flower images.

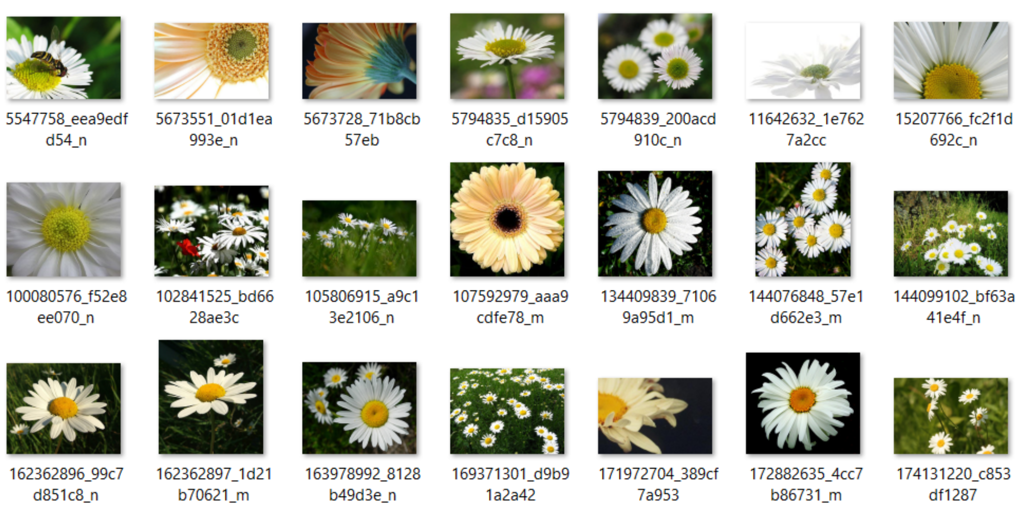

Figure 5: Flow diagram of proposed scheme.

Each image in the dataset is of 1600$times$1200 resolution having. File names of all images are certain string of characters followed by a ".jpg" suffix.

3.2 Preprocessing

In order to extract any specific information, image preprocessing steps are carried out before the actual analysis of the image data. Preprocessing refers to the initial processing of the input flower images to eliminate or correct the distorted or degraded images. The figure below illustrates techniques like RGB conversion, binarization, smoothing, filtering, edge detection etc used for the enhancement of the flower image.

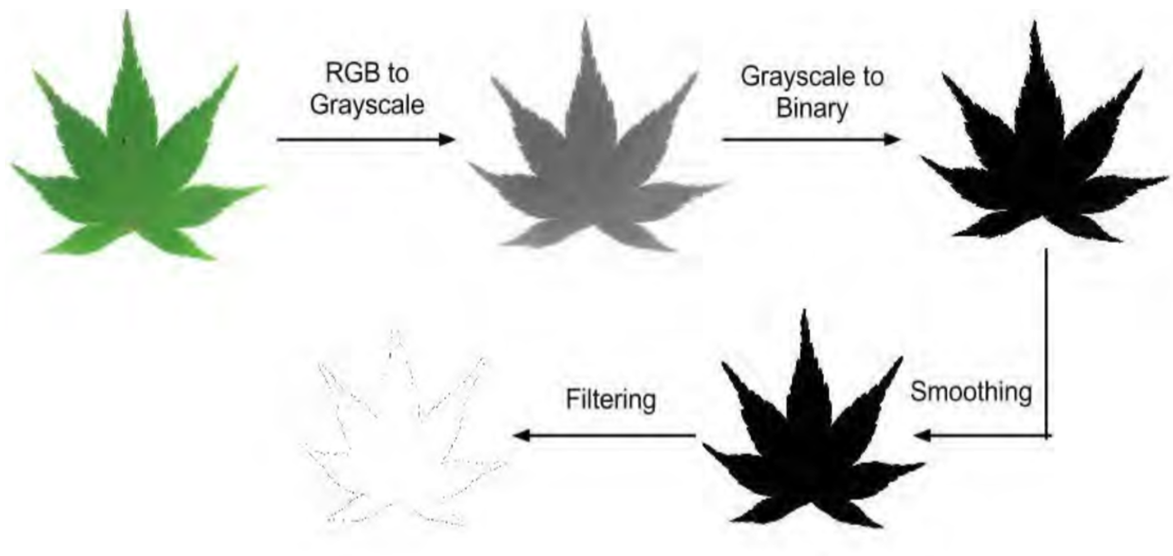

Figure 6: Preprocessing steps.

3.3 Feature extraction

Our algorithms take into account the color and shape feature of the flower. Flowers of different species are invariably similar in color and so a single feature alone may not produce expected results. Therefore, the need to consider other flower features such as **shape features, geometric features and morphology features**. Under the geometric features we have diameter, length, width, area and perimeter features whereas under the morphology features we Narrow Factor, Perimeter Ratio of Diameter etc.

3.4 Classification, Training and Testing

Recall that a NN consists of neurons (units), arranged in layers which converts an input vector into some output. Each unit takes an input, applies a (often non linear) function to it and then passes the output to the next layer. The application of this nonlinear function sets the basis of the classification phases based on the properties this function. Weightings are applied

to the signals passing from one unit to another, and it is this weightings which are turned in the training phase leading to the learning of the algorithm.
Flower recognition data set contains a total of more that 3500 images of five different species of flowers. We actually used 3500 of these images of which 70% (2450) images where used as the trained set and the remaining 30% (1050) were used to test the efficiency of these algorithms in terms of accuracy.

4 Experimental results

The results obtained with these algorithm are shown below in terms of their accuracies. Figure 7 below show the classification out made by SVM with an accuracy of 0.8531 figure 8 is the accuracy graph obtained from AlexNet.

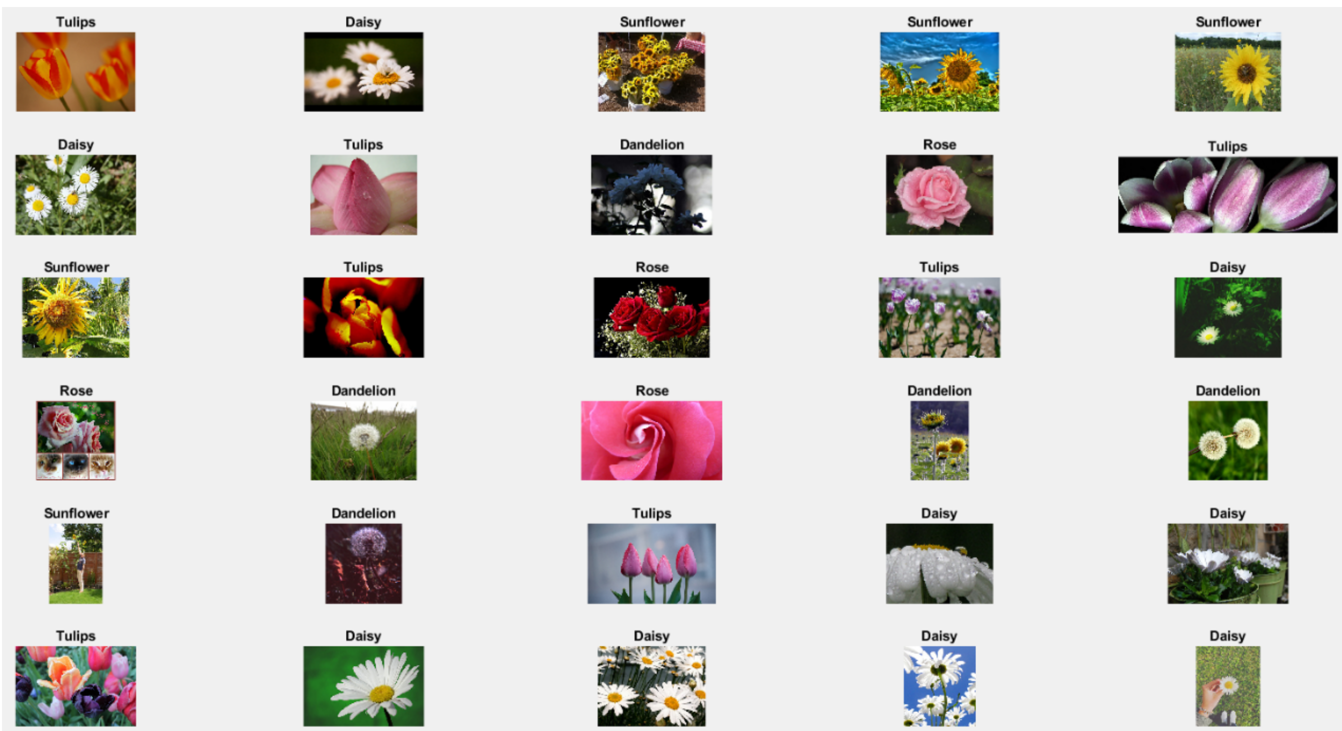

Figure 7: Classification output.

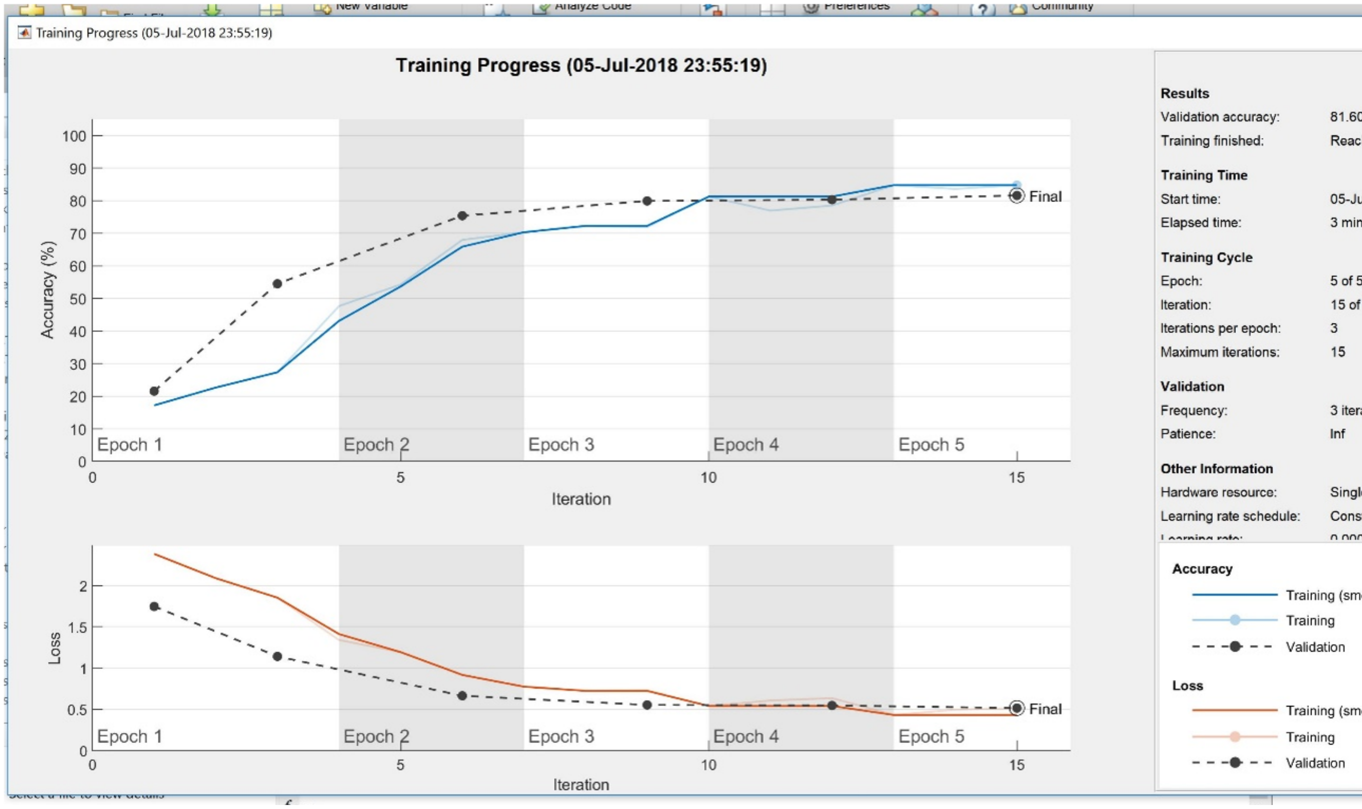

Figure 8: Classification accuracy.

5 Conclusion

In this work, we computationally compare the proposed algorithms that takes into account the color features and some additional features as explained in the work. The algorithms were tested on the flower recognition data set and the results were admissible as can be seen in experimental results.

6 Difficulties

Some of the difficulties encountered through out this work are as follows; First of all, it was very challenging to be able to get the right ML algorithm that will best do the required classification. Bellow is the accuracy graph obtained when NN was used.

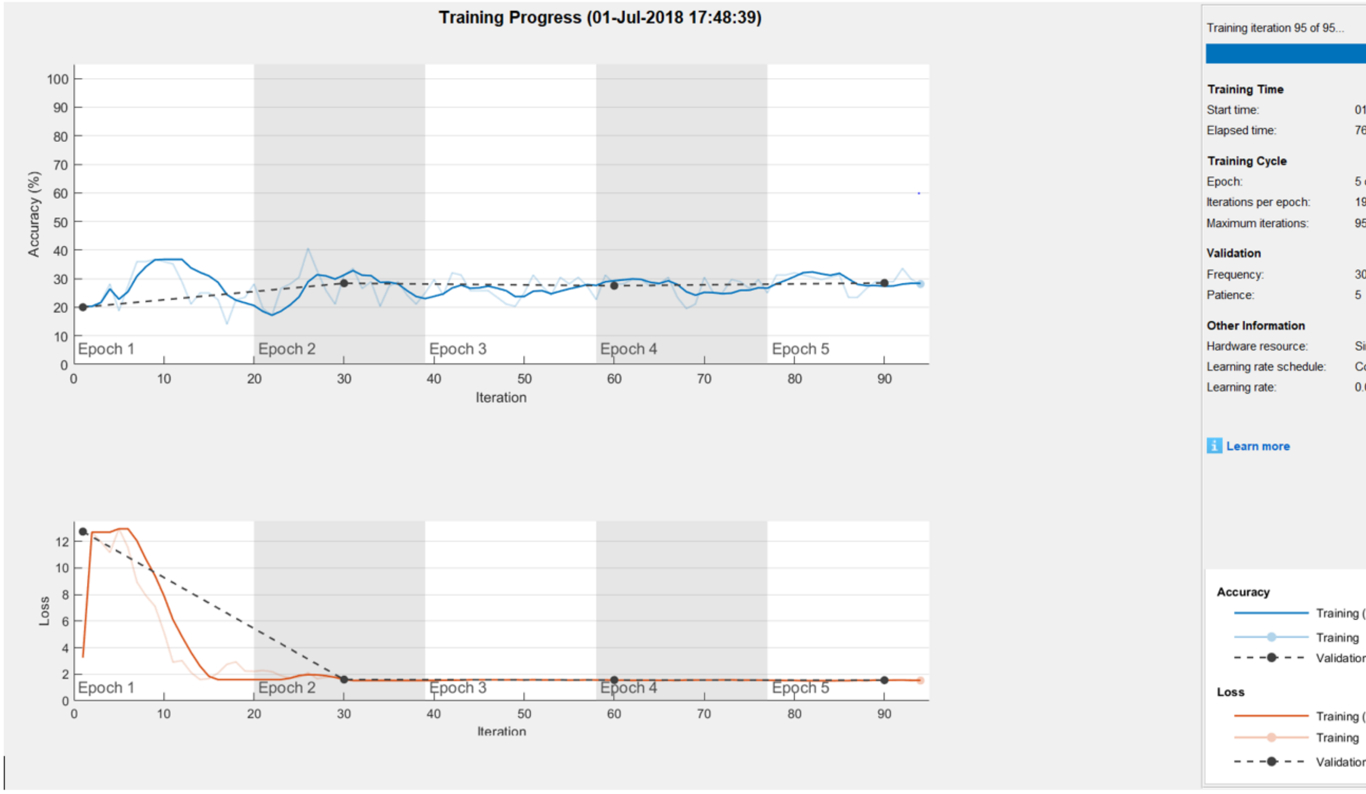

Figure 9: Classification accuracy.

We can see from the graph above that NN didn't do well in classifying these data. Secondly, we did encounter machine performance issues. That is at some point in time my computer wasn't able to run this algorithms and so we had to use another computer with higher performance.

Future perspectives

This work can be further extended to an entire system capable of identifying any species of flower.

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