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Combine Technique for Classification of IRS P6 LISS-III Satellite Images

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Abstract : Land use and land cover classification is one of the important research areas to monitor the land cover of earth surface. It required research and findings in different parts of classification *i.e*. global classifiers, efficient classification algorithm, feature selection techniques and improvement in classification accuracy. So, by considering all these parameter here the combined approach of classifiers is proposed to improve the accuracy of the classification. The proposed technique is implemented with artificial neural network and K-nearest neighbour. The proposed work is trained and tested with the IRS P6 LISS-III satellite images of different regions of Mumbai area and the results are calculated using the confusion matrix results in terms of accuracy. The calculated result shows the improvements of accuracy at the maximum places where the accuracy of the individual classifier is less whereas in the case of combined it is showing the improved results. The proposed algorithms are implemented using the MATLAB2012 mathematical simulation toolbox.

Keywords : K-Nearest Neighbors (KNN), Artificial Neural Networks (ANN), IRS (Indian Remote Sensing), LISS-III (Linear Imaging and Self Scanning Sensor)

1. INTRODUCTION

Remote sensing is one of the important technologies to monitor the different resources which are available on the earth surface. Today due to lots of human involvements in the natural resources such as water, forest, wetland, mountain, rain forest and ocean, there is tremendous change in the behaviour of the nature. These changes in behaviour of nature, there are different disasters are faced by the human as well as the other organisms which are available on the earth surface. So, to overcome all these issues and problem, to monitor the earth surface in terms of its changes in land use and land cover, soil, weather, ocean temperature, moisture in the soil and some time to monitor certain organism those are at the position of extinct from the nature. The satellite technology plays very vital role in such cases of monitoring. The one of the very important application of remote sensing is to provide the image of earth surface for monitoring of the area covered by different resources during span of the time. Such satellite images are used to monitor the land use and land cover area of earth surface as well as to find out changes which are occurred on the earth surface due to some disaster cause by nature or dur involvement of the human activity. This will helps to define different laws and policies for protection of different resources and promoting us for sustainable development.

The satellite provides images as like normal information in terms of multispectral or hyper spectral band form so here need some techniques to analyse and interpret the satellite images. So, to interpret and analyse the raw satellite images, there are different techniques and methodologies are available.

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Classification is one of the very popular and well accepted techniques available for analysis and interpretation of satellite image. But the classification of satellite image requires lots of research in terms of the efficiency of algorithm, global classification algorithms, feature extraction techniques, speed of classifiers and different techniques to evaluate the performance of the classifiers. So, in this paper the combined technique of classifiers is proposed in which the KNN classifier is combined with the artificial neural network. KNN classified results are supplied as input to the artificial neural network, here KNN classifier give the properly correlated features from the training set of data and with help of correlated data, uncorrelated data are removed from training set, that training set is supplied artificial neural network for training purpose. So, due to correlated and précised value the artificial neural network is well trained and it provides improved classification accuracy. It is also tried to evaluate its accuracy and suggestion that what can be further implemented to improve the performance.

The paper is organized as where it starts with introduction followed by study area and its characteristics, introduction to KNN and ANN, methodology, result, conclusion, future enhancement and acknowledgement.

2. STUDY AREA AND CHARACTERISTICS

Here the LISS-III satellite images of Mumbai, Navi-Mumbai and thane regions are used for training and testing purpose. LISS-III is the multispectral satellite image provide by the IRS P6 Indian satellite. The LISS-III satellite image is available in the form of multispectral images in the form of four different bands which are band 2, band 3, band 4 and band 5. The band 2 is green, band 3 is red, band 4 is near infrared and band 5 is available in middle infrared region. The LISS-III images are widely used for vegetation and land use land cover area mapping. LISS-III satellite image is provided by NRSA, Hyderabad, Hyderabad, Telangana 500042, and India.

3. CLASSIFICATION ALGORITHMS

Classification is technique of grouping different object into similar classes which consist of similar features. There are basically two types of classification techniques are available which are called as supervised and unsupervised classification. In supervised classification at the initial stage the trainer knows about the classes *i.e.* what are the features which are belongs to different classes whereas the things are opposite in the case of unsupervised classification where the features are classified into different classes based on its feature similarity. So, classes in unsupervised classification are called as cluster. Here two types of supervised classification techniques are adopted and combined to improve accuracy of the classifier which is as follows:

A. Artificial neural network

An ANN is stands for artificial neural network which is nothing but the modelling and simulation of the working of biological neurons available in the human brain. The artificial neural network consist of input, hidden and output layers which consist of different nodes, these nodes are called as the neurons which are actual processing unit of the artificial neural network. The neurons apply the summation and activation function on the coming input data from the other node and forward the output to the other node. Based on this there is very popular type of neural network is used which is called as the feed forward back propagation of neural network. The ultimate output is compare with the target and based on that error is calculated and back propagated to the previous node to adjust their weight in such a way that it can classify data in the appropriate class. This feature is called as "learning" in artificial neural network.

B. K-Nearest Neighbor Classification

The KNN is one of the very basic and easy classification technique is available for the classification. It is supervised classification technique which is not complex like other classification techniques *i.e.* ANN, SVM, Random forest etc. This algorithm simply creates and uses the different instances created from the training data dataset and these instances are used to classify the testing datasets into different classes. The KNN classification techniques never creates the internal model like other classifiers such as ANN and SVM etc. there for it is very simply to implement and provides the fast processing of the data.

4. PROPOSED METHODOLOGY

The methodology is the important part of any research which shows the actual implementation and working of the system. Through proposed methodology only the work of the research scholar is recognized and appreciated. Here, in this research paper the suggested combined model is implemented using MATLAB simulation tool box. So the detail step wise methodology is as follows:

A. Acquired LISS-III images

The LISS-III satellite image is freely available by the NRSA and downloaded from the Bhuvan website. Bhuvan provides the different types of satellite images from different sensors. Once the satellite image downloaded then it is the zip file consists of the four bands of LISS-III image with its description files.

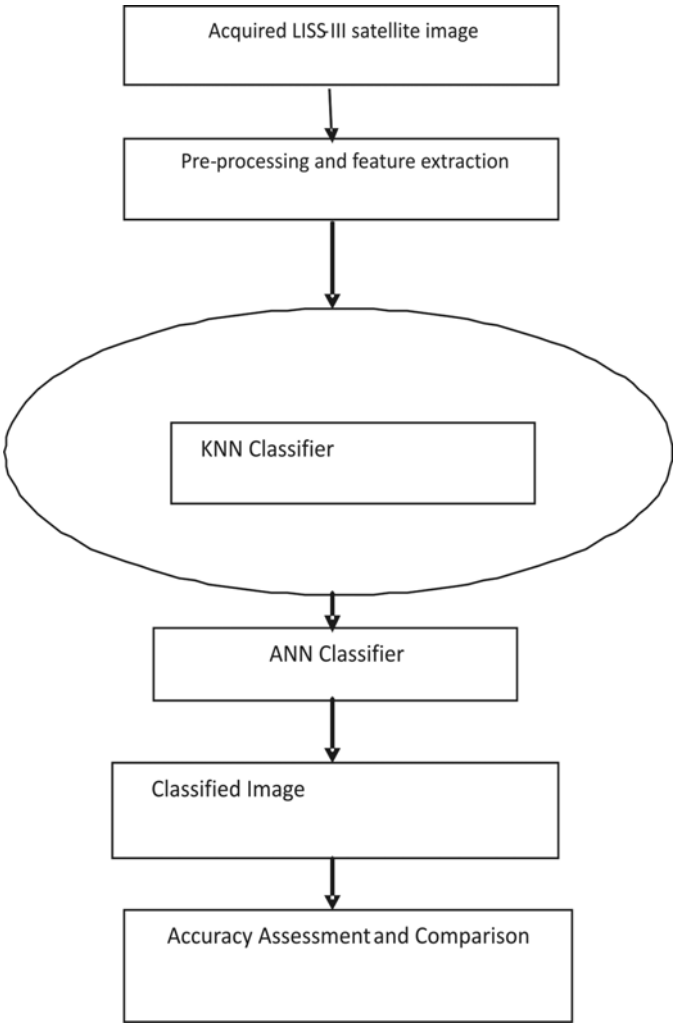

Fig. 1. Flow Chart of working of Algorithm.

B. Pre-processing and Feature Extraction

The very fundamental steps of satellite image classification is its pre-processing where the different features of the satellite image are enhanced by applying different low and high pass filters. Once the filters are applied and individual image of LISS-III satellite images are enhanced. Then from all the band of LISS-III images, the three different band of red, green and blue band are stack together and one RGB image is generated with three different grey level images. So, based on the area survey and different area maps the R, G and B features of different area (theme) *i.e.* water, forest, mangroves and development area are collected and based on that the training dataset is prepared.

C. Design of combined classifier of KNN and ANN

In the proposed methodology the first the KNN classifier is implemented and trained with the training dataset which consist of the red, green and blue features of different land cover area. Once the KNN is implemented and trained then with best response of the KNN once again the new training dataset is generated for the artificial neural network classifiers and then with the new training dataset it is trained and tested with the testing dataset for its accuracy assessment and efficiency evaluation.

V. RESULTS

The result evaluation of the classifier is based on its classification accuracy because the main intension of this research paper is to increases the accuracy of the classifier by their combined working. Classification accuracy is calculated for different observation with help of the confusion matrix and there complete summarized results are presented in terms of tabular data and graphical format.

Table 1. Accuracy of Single layer ANN with KNN

No. of Neurons	*Accuracy of ANN*	*Accuracy of combined KNN+ANN*
5	93.0556	96.1739
10	95.3125	94.9565
15	95.8333	95.6522
20	95.4861	96.1739
25	94.4444	94.4348

In table.1 and fig.2 describes about the result of classifier where the artificial neural network consist of one set hidden layers where there neurons are changing. The best accuracy of 95.8333% is noted when artificial neural network consist of 15 neurons in hidden layer. When the artificial neural network is combined with KNN, it shows the accuracy of 96.4348.

Table 2. Accuracy of double layer ANN with KNN

Neurons No.1	*Neurons No.2*	*Accuracy of ANN*	*Accuracy of combined KNN + ANN*
10	5	95.3125	96.1739
10	10	95.3125	94.9565
10	15	95.3125	95.6522
10	20	95.3125	96.1739
10	25	95.3125	94.4348

In table.2 in order to increase the accuracy of classifier first set of neurons are kept whereas the second set of neurons are changing. In that circumstances the accuracy of the classifiers are calculated with the alone artificial neural network and combined neural network with KNN. The above table.2 and fig.3 describes that when the artificial neural network is working alone with first set of constant neurons and second set of changing neurons then it has low and constant accuracy which is not changing. But when the above neural network with same set of configuration is combined with the KNN, it shows the improved classification accuracy. Classification accuracy of the combined classifier is more in number of observation except few observations where accuracy is less.

Table 3. Accuracy of double layer ANN with KNN

Neuron Layer 1	*Neuron Layer 2*	*Accuracy of ANN*	*Accuracy of combined KNN + ANN*
5	10	93.0556	96.9565
10	10	95.3125	96.9565
15	10	95.8333	96.9565
20	10	95.4861	96.9565
25	10	94.4444	96.9565

In table.3 and fig.4 describes the results where the second set of neurons kept constant and the first set of neurons are changing. When such artificial neural network is implemented it shows the accuracy of maximum 95.8333% whereas when it is combined with KNN it shows the accuracy of 96.9565%.

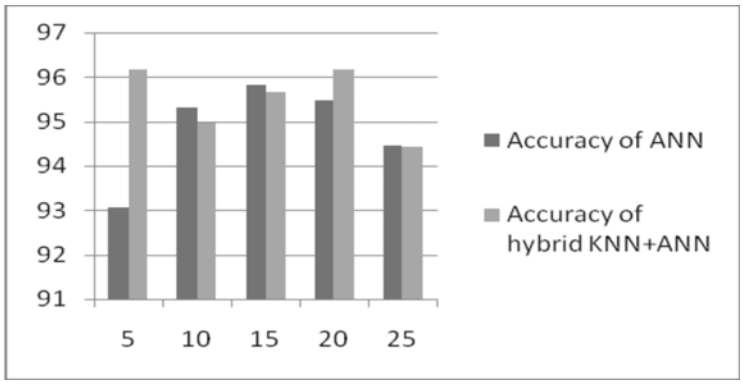

Fig. 2. Accuracy of single layer ANN with KNN.

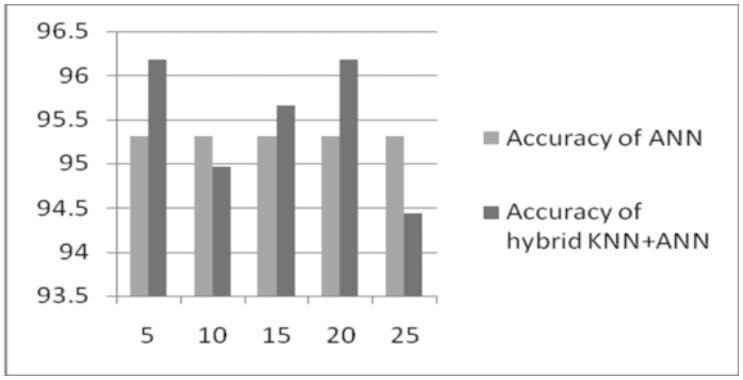

Fig. 3. Accuracy of double layer ANN with KNN (layer 1 neurons kept constant and Layer 2 neurons are increasing).

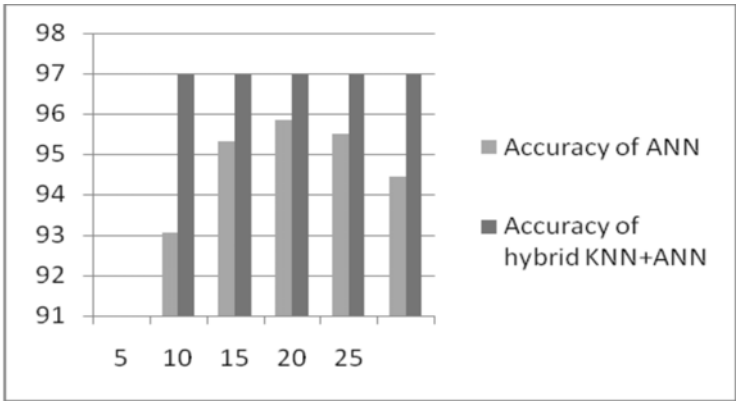

Fig. 4. Accuracy of double layer ANN with KNN (layer 2 neurons kept constant and Layer 1 neurons are increasing).

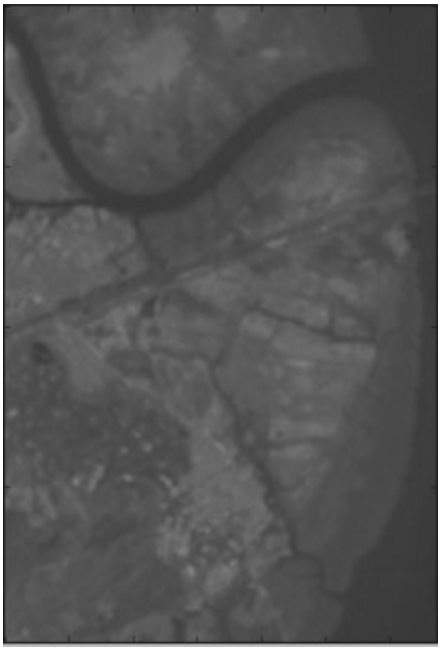

Fig. 5. LISS-III satellite image before classification.

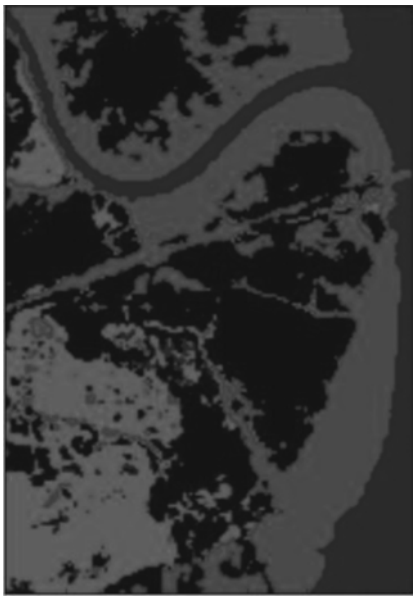

Fig. 6. LISS-III satellite image before classification.

Fig. 7. Index.

6. CONCLUSION

The proposed research work carried out by considering the fact of improving the classification accuracy by combined of two classifiers. The finding shows the improvement in the result of the classification accuracy. The tabular and graphical data shows that the classification accuracy was less but when it combined with the other classifier the accuracy is increased. The same concept can be implemented for the different theme of classification. As we are selecting the different band for specific classification theme the same way the different classifiers are combined to classify the different theme with the different classifier for generating one classification maps.

7. ACKNOWLEDGEMENTS

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