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An Effective Earth's Surface Image Classification using HOG and ANN Algorithms

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ABSTRACT

The crucial motive of this present paper is to probe and classify the globe's top area picture as the image of the Satellite. On the globe's surface, it is immensely arduous to plainly classify the hydrosphere and atmosphere, because some on occasions, the two spheres are in the same form, so, it is exceedingly grueling to categorize both spheres. The rationale of classifying this is, the vapor in the atmosphere is cooled by the earth, which is quelled and then as rained. Space explorers therefore need to appraise the quantity of spheres before the precipitation and the number of spheres after the shower. Here some great ways suggested measuring them minutely. First, picture of the world's surface is taken by satellite; The HOG procedure is utilized to deblocking principal aspects of the image. Then, in the taxonomy algorithms, the most worthwhile ANN approach is utilized for this activity. The paper was therefore elaborated in the hope that the paper would utilize a superior mechanism and give researchers better gratification.

Keywords: *Earth's surface satellite images, Feature Extraction, Classification, Histogram of Oriented Gradients (HOG) and Artificial Neural Network (ANN).*

INTRODUCTION

There are four types of major spheres of this earth, where many species live. They are, respectively, Hydrosphere, Lithosphere, Atmosphere and Biosphere. Each of these spheres represents each type. That is, lithosphere means all the land on earth, Hydrosphere refers to all the water on earth, The Biosphere is all living things on earth, Atmosphere refers to the air found on the earth's surface. So, if researchers measure all this, it is possible to know the events and changes

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taking place on earth and forecasts of such natural disasters to come, be aware and take precautions from that.

As always, photograph the top area of the earth with satellite to measure the spheres, and then researchers will analyze that the image and measure it randomly. This can lead to many problems. Because, the scrutiny of the earth is extremely major to the mankind to live in the globe, this is because it is hugely predominant to examine when the earth will come, such as a hurricane, tsunami and tornado. As stated earlier, the measure of that sphere is very risky if it is miscalculated or approximated.

Focusing on this concept, this paper makes a decision; this means this system is much better and more efficient to calculate them accurately and clearly, how to calculate it accurately, the researcher must distinguish all four spheres accurately. So, although it is quite simple to distinguish these four spheres, it is very difficult to distinguish Atmosphere and Hydrosphere. This is because the two spheres are identical in the picture and the colors are a bit similar. That is why this paper is designed to address this issue.

RELATED WORK

In paper [1], they use the separation method to obtain information about the Earth's surface, they used the NFCC algorithm for that method, and the quality of that section is unclear. In paper [2], their task is to inspect the surface of the earth, the image taken by the sensitivity of the remote. The prober of this paper conveyed out this duty with the aim of preventing the coming natural disaster to earth. To that end, he has tried many methods to find out which method is best. Finally, the analyst has stated that the supervised classification would be best suited for this process. This paper [3] aims to analyze cloud assemblages on the Earth's surface, for that purpose the paper is using the clustering and segmentation method. But, although its accuracy is somewhat correct, electrical energy and its cost are high. The author of this paper [4] takes a picture of the transport situation by satellite and analyzes it. For that study, they have used methods such as feature extraction, classification, and preprocessing. They were not as hands-on as they thought.

In paper [5], the image taken by the satellite is usually much larger, so it takes up more space. So, they resorted to the LZMA method of preventing this, but it took more time. In paper [6], they have adopted a method for measuring and controlling space, for that, they have used a

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method of deep learning, the system they utilized took more time. In paper [7], they have invented a method to automatically segment satellite images, and they have used the Haralick's features method in classification system to improve that image. But that process is taking too much time to run. In paper [8], a study is carried out to ascertain the position of cloud gathering on the surface of the earth, the study shows that deep learning has used the categorical method, this has delayed publication.

Elayaraja *et al.* (2022) a GA-based CNN classification algorithm was developed for segmenting the tumor section in cervical pictures, and it achieved 99.37 percent mean sensitivity, 98.9 percent mean specificity, and 95.21 percent mean accuracy [11]. Thiyaneswaran et al. (2020) utilized k-mean clutsering approach for the detection and segmentation of cancer portions in skin pictures and obtained 90.0% of mean accuracy [12]. Kumarganesh et.al. (2018) suggested an ANFIS classifier process for the classification of cancers from the foundation imageries and attained 96.0% of classification precision [13]. Kumarganesh et.al. (2016) advised an Adaptive Neuro Fuzzy Inference System (ANFIS) classifier system for the classification of cancers from the source imageries and attained 93.07% of sensitivity, 98.79% of specificity, and 97.63% of tumor segmentation accuracy [14]. Sentthilkumar et.al. (2022) recommended an Adaptive Neuro Fuzzy Inference System (ANFIS) classifier system for the classification of cancers from the source imageries and attained 93.07% of sensitivity, 98.79% of specificity, and 97.63% of tumor segmentation accuracy [15].

PROPOSED METHODOLOGY

The flow of this new system is, first, the extraction of features in earth's surface of satellite imagery, and then is to distinguish the atmosphere and the hydrosphere in the image. To do this they have used two new methods in this new system. This flow is shown in the figure 1 below:

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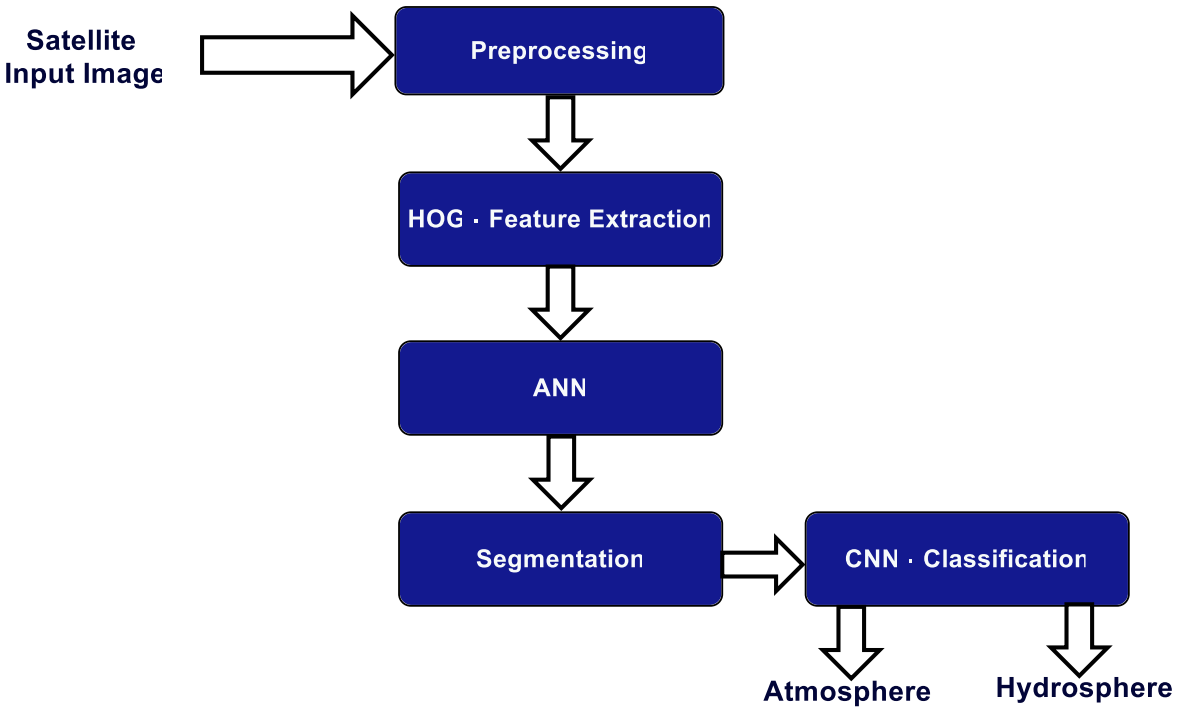

Figure1: Block diagram of Proposed Methodology

Figure 2: Input Satellite Image

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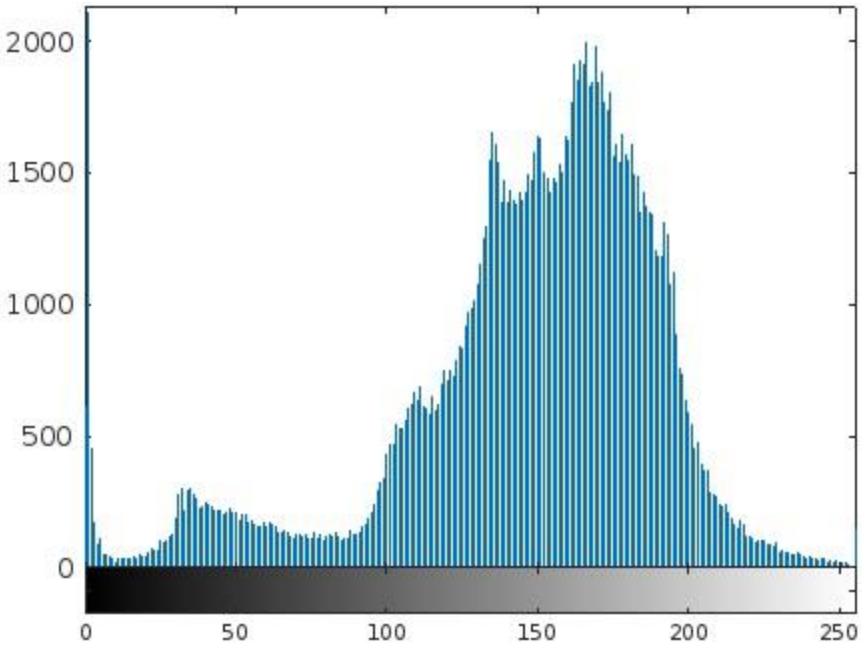

Figure 3: Histogram of the Input Satellite Image

Figure 4: Histogram Equalization of the Input Satellite Image

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$$x^t = T(x) = \sum_{i=0}^{x} n_i * \frac{max.intensity}{N} \quad (1)$$

Where $n_i = Number\ of\ pixel\ at\ the\ intensity\ i$

N = Total number pixel in the image

A. Feature Extraction

First, we need to know why we use the feature extraction method here. These lessen the dimensions of the given picture. Here, why we subside the dimensions of the photograph means the attributes of a photograph are usually very large, if it does not do so, the computation process for processing the image will be very difficult. Therefore, a best and accurate calculation mechanism is required to simplify the process that is to reduce the features. So, this paper uses the HOG method as that algorithm [16-18]. This is because this system reduces unnecessary dimensions and then selectively to give classifier only the important dimensions. In figure 5, the steps of the HOG algorithm are sorted.

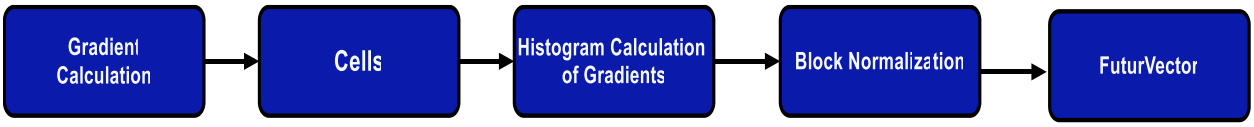

Figure.5: Flow of HOG

Feature extraction is the conversion of an image from a fixed size to a feature vector. By combining these feature vectors, important features can be created. For example, if the link of an image is computed by HOG for 64*128, this gives the 3780 vector of size. However, the true dimension of this is size, 64*128*3 = 24576. But that amount is reduced by this HOG to 3780 size vector. And this HOG states that the appearance of an existing thing in a picture can be described by the edge vectors. The steps below give you an opening to compute the information of an image.

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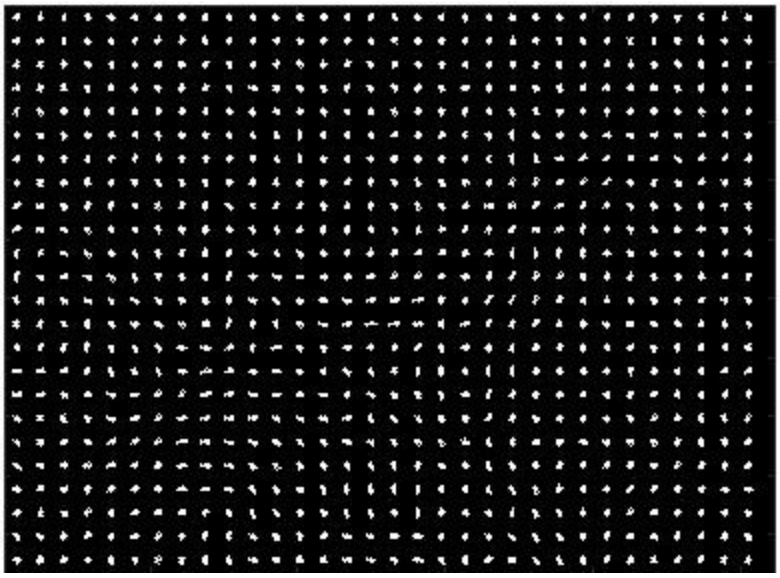

Figure 6: HOG Transform image of the Input Satellite Image

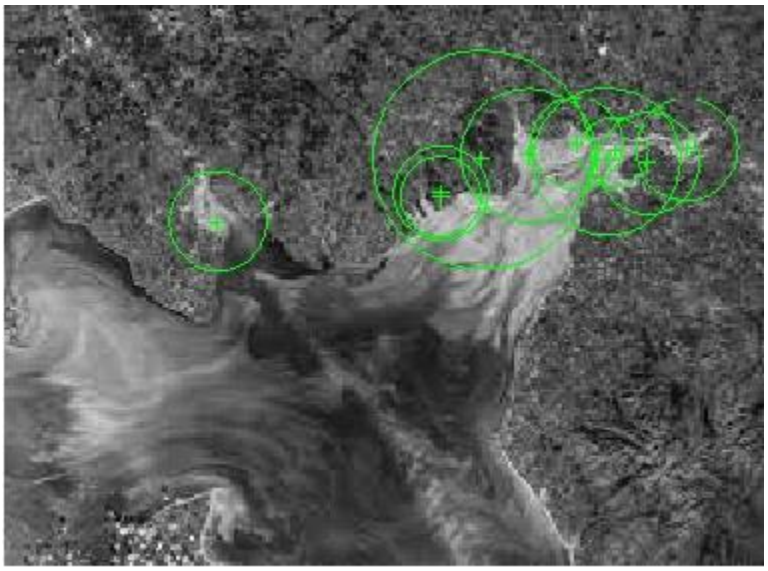

Figure 7: SURF Feature image of the Input Satellite Image

Gradient Calculation

First, we need to quantify the worth's of x and y from the gradient image, then from the original film, the size of the g_x and g_y should also be estimated. To figure 8 this out, we can filter the original image by the following kernel and then calculated [19]. The attitude and extent of the gradient can be computed utilizing the equations g_x and g_y of the gradient pictures.

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$$g = \sqrt{g_x^2 + g_y^2} \qquad (2)$$

$$\theta = \arctan \frac{g_y}{g_x} \qquad (3)$$

Calculated gradients are called unsigned. So, the range of theta is 0 to 180 degrees.

Cells

Separate the image by n*n.

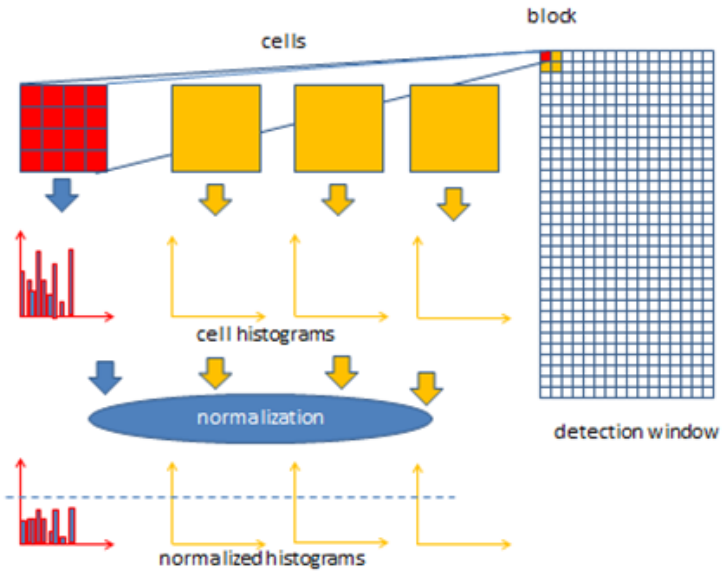

Figure.8: Structure of HOG

Compute histogram of gradients

We know very well the gradient in every pixel of the n*n cell, so there are m magnitudes and m directions. That means there are N numbers in total. The histogram of these gradients will provide brief and very useful features. Then N numbers have to convert to M bins. The histogram bins are parallel to the degrees of gradient, every pixel in the photograph assurance 1 or 2 bins in the histogram [20]. In a pixel, if the slope is correct in the degree, then the pixel gives equal viscosity.

Block normalization

In the pre-existing step, the calculated histogram is not robust to lighting changes. To dictate the severity of the picture, multiply by a fixed factor, and then the histogram also measures its values. Histograms can be processed by default to prevent these effects. That is, take the

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histogram as the vector of the elements and divide each part by the quantity of this vector, thus increasing the element vectors.

$$f_{bi=[b1,b2,b3,\ldots\ldots,b36]} \quad (4)$$

$$f_{bi=\frac{f_{bi}}{\sqrt{||f_{bi}||^2+\epsilon}}} \quad (5)$$

Feature Vector

To calculate the ultimate feature vector for the whole picture in a given image, moves in the n-steps of the block of 2n*2n. Each of the features is then merged together to create the final features.

B. Classification utilizing ANN

In the feature extraction method, using the HOG algorithm, the critical feature vectors were identified [21]. So here we have to give those feature vectors as input to ANN algorithm.

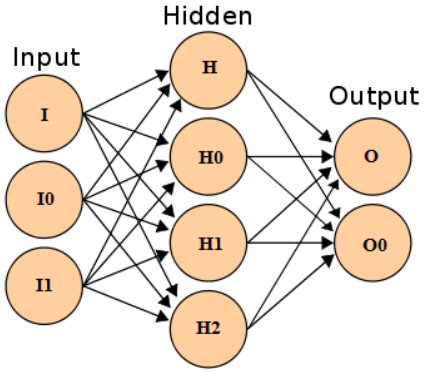

Figure 9. Structure of ANN

In this ANN system, the connections between the nodes are the most important ones. The following description shows how to find the weight of each link [22]. In the figure 4 at the top, only the worth of the input is known. So, we can take the inputs here as I, I0, and I1, the hidden layers should be taken as H, H0, H1, and H2, and outputs will take be O and O0.

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Steps to operate the algorithm

1. To begin the algorithm, first, assign random weight across all connections.
2. Inputs and connections must be utilized to discover the activation outlay for hidden nodes.
3. Then, to compute the activation rate of the output nodes, need to use the activation rate and the output link for the hidden nodes.
4. Then need to find the error in the output node, and then all connections between hidden nodes and output nodes need to be re-measured.
5. Using the errors and the weight found on the output node, the error in the hidden node should be detected.
6. Then re-measure the weight between the input node and the hidden node.
7. Then, repeat this process until the convergence criterion is fully met.
8. Estimates the activity rate of the output nodes using the weight of the final link.

The calculations of each link in the ANN method are the same [23]. Here we use a sigmoid relationship to find the activation rate of the variable in each layer. So, the following equation is used to find the H variable's activation rate.

$$\text{Logit (H)} = W(I*H)*I + W(I0*H)*I0 + W(I1*H)*I1 + \text{Constant} = f \quad (6)$$

W (I * H) means that the weight of the link between I and H denotes.

$$P(H) = \frac{1}{[1+e^{(-f)}]} \quad (7)$$

Equation to Re-calibration of weights:

$$\text{Error @ H} = W(H*O)*\text{Error @ O} + W(H*O0)*\text{Error @ O0} \quad (8)$$

Using this error, the weight between the hidden node and the input node can be measured in a similar way.

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RESULTS AND DISCUSSION

In this paper, two mechanisms are utilized, in this portion; therefore, the behavior of the procedure utilized in this paper is compared with the operation of another algorithm. In Fig. 12, the HOG algorithm is compared to the SURF. In this comparative test, the HOG algorithm is more accurate than the SURF in the performance of feature extraction. That is, the HOG algorithm gives the accuracy of 95.1% and the SURF method is 74%.

a) Hydrosphere Image b) Atmosphere Image c) Composition of both

Figure.10: Segmentation output

Figure.11: Classification of Segmented Image

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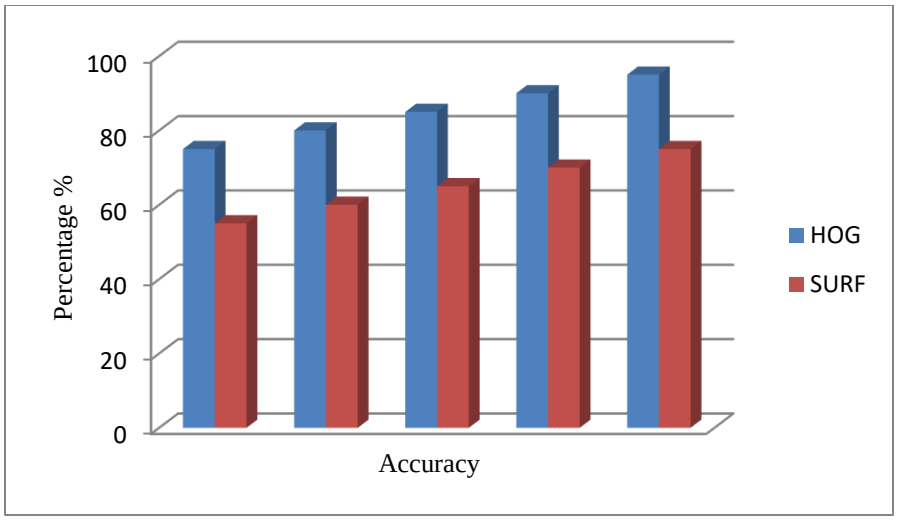

Figure.12: Accuracy Level of HOG & SURF

Similarly, for classification in figure 13, the ANN method is used and then compared with the SVM method. Of these, the ANN method gives the accuracy of 98% and the SVM method 83%. So, in this test, it is shown that the ANN method is better than the SVM system.

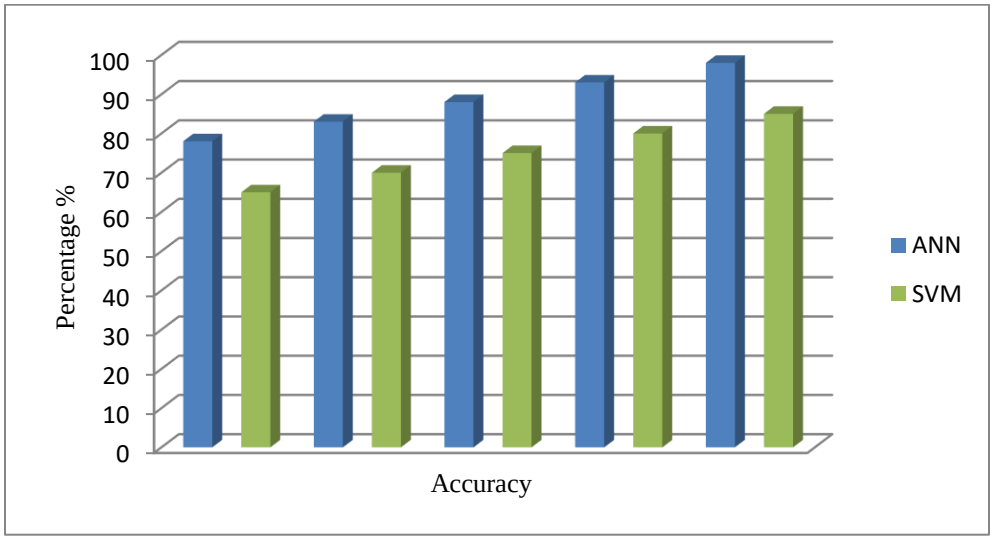

Figure.13: Accuracy Leve of ANN & SVM

CONCLUSION

In this section, the description of the final stage of this paper is stated, that is, HOG mechanism is first used to identify the vectors of main features of the photograph of Earth's surface area. Then the input to the ANN procedure is utilized to classify the outputs of the HOG algorithm.

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These inputs are processed in ANN mechanism and then classified as atmosphere and hydrosphere. In doing so, the functions of those two algorithms were compared with other methods. In this paper in that comparative experiment, the two methods used have performed very accurately. Therefore, this paper is believed to be very useful for space researchers.

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