Deep Features Based Coral Reef Classifications Using Machine Learning

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ABSTRACT:

The Sea water is the source for a number of creatures. Among the creatures coral reefs are the one with 800 classes of species. It is a stimulating task to classify coral.Based upon its characteristics and features scientist grouped the coral reefs in to several classes. There are a number of machine learning algorithms implemented to inspect and group the coral species.The main aim of this work is to effectively use handcrafted features and deep features for classifying the coral classes. Here the feature descriptors such as Local Binary Pattern, Local Arc Pattern are proposed to excerpt the features of coral.The features retrieved by above methods are classified using KNN and Random Forest. EILAT dataset is used for above experiments.The outcomes which attained gives the effectiveness of the above methods.

Keywords: *LBP, KNN, Random Forest, Local Arc Pattern.*

1. INTRODUCTION

The Coral reefs are the invertebrate animals fabricated by calcium carbonate. Coral reefs are the valuable ecosystem for marine tropical and helter Coral reef play an essential role in coastal zone which it acts as a natural breakwater to curtail wave impacts from storms. Human influence on coral reefs is extensive. Bereavement of coral reefs is caused by the environmental changes, pollution and rise of water temperature [1],[2]. Plastic Pollution and Water pollution is one of the factor which sets worlds coral reef at risk. The exploration of underwater images is a stimulating and major computer vision problem. Examination of coral images which was conducted manually was both time consuming and inclined to error. There are complications in using classification methods for analysing the coral reef due to water turbidity which impose ambient light and image color. There are various classification methods used. This chapter deliberates latest research in classifying coral reef using VGG 16 and handcrafted features such as Local Arc Pattern, Local Binary Pattern.

The Contribution of this work are the following:

- Analysing and classifying the underwater coral reef images using handcrafted features and Deep features
- Discussing the layers of VGG and its structure.
- Exploring the results based on the implementation of Local Binary Pattern,
  Local Arc Pattern.
- Comparing the results of VGG-16 ,LBP and LAP.

2. RELATED WORK

Image classification is an obligatory step in detection and study of coral reefs. A lot of image classification systems have been predicted till date. Numerous classification technologies are implemented to attain better accuracy in classifying the species of coral. In this study several classification methods are observed by its results and accuracy which was implemented by various authors. Marcos [3] applied a feed forward back propagation neural network to depict Coral reef in to three benthic classifications living coral, dead coral and sand. Regression and classification problems are solved using Decision-tree algorithms. The features of corals are depicted using Local Binary Patterns (LBP). Paul Anton Letnes [4] used multi or hyper spectral imagery from satellite and aeroplanes to analyse coral. Machine learning method which is used here is used to classify the large scale image classification of coral species.SVM classification algorithm and Scikit-learn software packages for PLS are used.Mehta[5] implemented Support Vector Machine (SVM) for analysing the texture of coral reef for better performance. Radial Basis kernel function is also used. Pizarro [6] presents a preliminary investigation in using a state-of-art bag of features for object recognition system to classify coral based on labeled examples. M.D.Stokes and G.B.deane[7] used normalized color space and discrete cosine transform in a statistical distance based classification for classifying the coral images which was collected by ecologist.[8] classify coral species using Local Binary pattern(LBP) and CLBP method.Shihavuddin[9] implemented K nearest neighbour (KNN),probability density weighted mean distance(PDWMD),support vector machine (SVM),neural network(NN). Nurhalis[10] objective was to implement Support Vector Machine(SVM),Random Tree, Decision Tree (DT), Bayesian and k-nearest neighbour(KNN) to achieve accuracy of coral reef benthic habitat mapping classifications..

3. METHODOLOGY

The methodology implemented the state of art deep learning method to classify the coral reef classes. Figure 1 used VGG model and handcrafted features for classification. A recent major development in image classification has been the use of deep layered networks of VGG 16 with 16 layers for excellent results. The Test images of coral which are classified using the classifiers such as KNN and Random Forest. The classified results shows the various classes of coral.

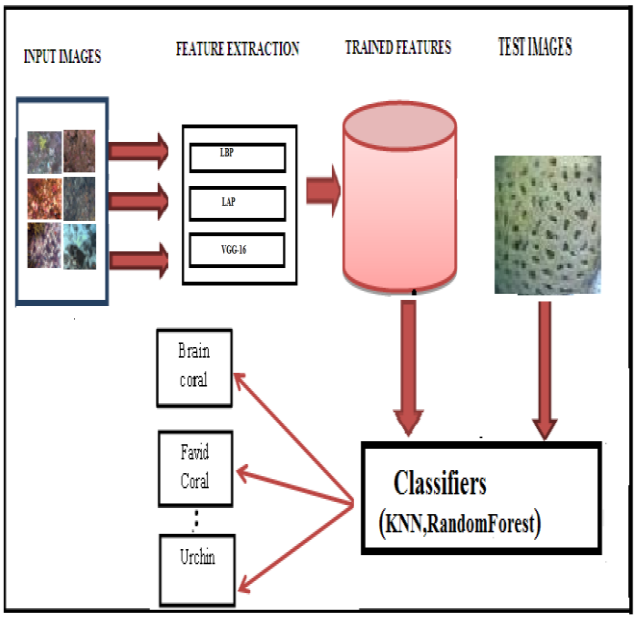
The methodology which are implemented in the proposed are:

- VGG -16 Architecture
- The Handcrafted Features such as

  a)Local Binary Pattern(LBP)

  b) Local Arc Pattern (LAP)

Figure 1: Block Diagram of Proposed Methodology



3.1: VGG – 16 Architecture:

VGG 16 is a convolutional neural network architecture with 16 layers.The layers which are present in VGG 16 are Convolutional layers, Maxpooling layers, Activation Layers, and Fully Connected Layers. This architecture is the composition of 13 Convolutional layers , 5 max pooling layers and 3 Dense layers which sums to form 21 layers but only have 16 weight layers. In Conv1 use 64 filters and conv2 use 128 filters, Conv4 and con Conv4 and Conv5 use 512 filters. The VGG implements deeper networks which gives better extracting features in coral reef images.

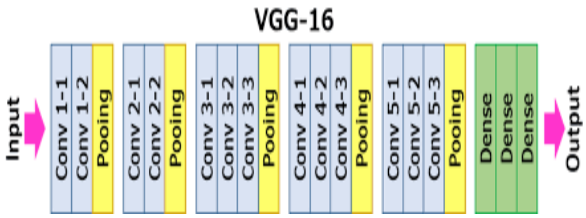


Figure 2: VGG Architecture

3.2 Local Binary Pattern (LBP):

Local Binary Pattern is a prevailing feature used in the proposed method for texture classification. The 3×3 pixel of coral reef image is used for classification.

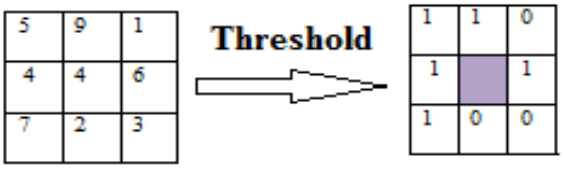


Figure:3 An Example for basic LBP operator

Binary:11010011

Decimal:211

The LBP operator substitutes the value of the pixels of an image with decimal numbers,which are called LBP.Each central pixel is equated with its eight neighbourhood pixel.If the center pixel value is larger or equal to its neighbourhood pixel then the value of the bit is 1 and if the center pixel is lesser than its neighbourhood pixel then the value of the bit is 0.All these binary bits are linked in a clockwise manner.The resulting decimal value of the generated binary number displace the central pixel value.The histogram of LBP anticipated over the image or region of the proposed system can used as texture descriptor to coral images.

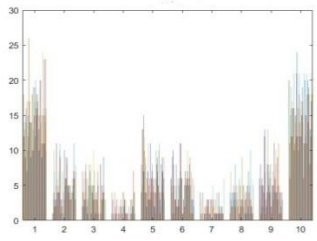
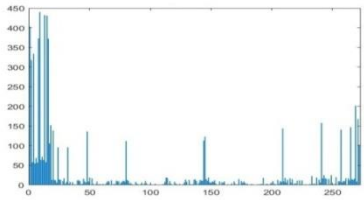


Figure 4: Histogram of LBP over coral image

3.3 Local Arc Pattern (LAP):

Local Arc Pattern is a Local feature descriptor for coral reef. Local Arc Pattern of center pixel is premeditated using 5×5 pixels.LAP consist of Pattern-1(P1) using 4 bit binary pattern and Pattern-2(P2) using 8 bit binary pattern.The pattern p1 require 16 bit combination and pattern p2 require 256 bit combination.A bin is made for each combination to count the number of occurences of the combination within a given block.P1 will spawn sixteen bins and p2 will create 256 bins. P1 and p2 are combined to build LAP histogram for a block. The feature vector length per block will be 272 by totalling 16 and 256.The final feature vector can be designed by concatenating the histograms of all blocks of an image.The coral image which are given in this proposed are operated with LAP and the histogram also obtained hich are listed in Figure 8.

Figure 5: Histogram of LAP operated coral image



3.5 Classifiers:

The Process of grouping test samples of texture in to classes refers to texture classification. Each classes are interrelated to some similarity criteria.The classification goal is to select appropriate category for an unidentified object,given a set of recognised categories.Since flawless classification is repeatedly unbearable, the classification may also be accomplished by determining the probability for each of known categories.

Two of the classifiers are used in the proposed system are:

1) K Nearest Neighbors,

2) Random Forest.

4. Experimental Results and Analysis

4.1 Dataset:

The Dataset which are used in the proposed system are EILAT. It contains 1123 image patches of size 64× 64 taken from coral reef near Eilat in the Red sea. Classes of Eilat are listed below. Patches have been classified in to eight classes

4.2 CLASSIFICATION RESULTS :

The Experimental results are listed in table1 which shows the classification summary.The three rows of table 1 represents the results of coral classification using the handcrafted features such as Local Binary Pattern (LBP), Local Arc Pattern (LAP) and VGG These features are classified using the classifiers KNN and Random forest. By comparing the accuracy value of handcrafted features VGG has high accuracy value with 97.54%.Similarly the Sensitivity, Precision, Sensitivity and Specificity is also high compared to LAP and LBP.Among the classification summary results of these handcrafted features using KNN and Random Forest as classifiers KNN score better performance than Random Forest.The Experimental results of handcrafted features and deep features are listed in three rows of table

TABLE 1: Classified results of different feature representations

Methods	Accuracy		Specificity		Sensitivity		Precision	
classifier	KNN	RF	KNN	RF	KNN	RF	KNN	RF
LBP	93.2 .	93.3	95.9	95.9	77.3	64.2	76.0	82.2
LAP	91.1	92.8	94.5	95.3	69.8	60.0	64.8	75.9
VGG-16	97.54	97.48	97.87	97.03	92.95	91.55	97.42	97.12

GRAPH 1: Comparision of F1 score results

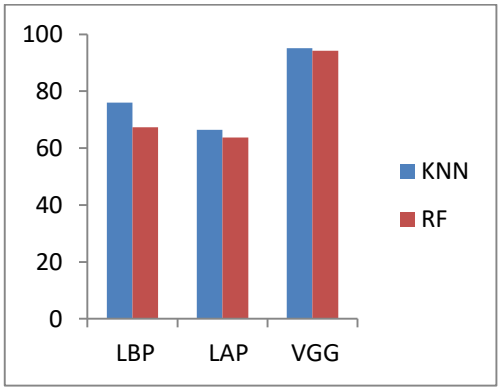


TABLE 2 : F1 Score result of KNN and RF

METHOD	KNN	RF
LBP	7597	0.6736
LAP	0.6643	0.6377
VGG-16	95.13	94.25

5.Conclusion

This paper use significant methods for extracting and classifying the features of coral reef images. Two traditional methods of Local Descriptors are reviewed and implemented. Later Experiments are conducted with the VGG 16 for classification.KNN and Random Forest are used as classifiers. By Comparing all the results shows that VGG gives better accuracy value than other

methods.VGG is an effective, discriminative and method which extract the feature of coral very accurately than other handcrafted features. These traditional methods embedded with VGG are used for further research.

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