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Underwater Object Recognition Using KNN Classifier

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Abstract

In this paper, wavelet transform based method for underwater object recognition is presented. In this approach, input images are decomposed into sub-bands using multi resolutional analysis known as Discrete Wavelet Transform (DWT). Each sub-band in the decomposed image having valuable information about the image, the mean values of every sub-band are assumed as features. This system is tested on underwater object database. The database contains 200 pictures of 100 different objects. The database is considered for the classification based on K-Means Neural Network (KNN) classifier. The outcome shows that maximum recognition accuracy of 94.65% is obtained by this method.

Keywords: Underwater Object recognition, DWT, KNN Classifier.

1. Introduction

Edge maps and clustering based different multicolored regions are detected. A rotation invariant and illumination object recognition system is proposed in [1]. The color images from different regions covering multiple segments are taken for object representation in [2]. Tree structure based model that captures the background information from more than a hundred object categories is discussed in [3]. Context model based on tree is presented that increases the performance of object recognition and also gives a coherent analysis that enables consistent image querying system by various object categories. Object recognition based Group Sensitive Multiple Kernel Learning (GSMKL) method to contain intra-class diversity and inter-class correlation is explained in [4]. A video surveillance object recognition algorithm is described in [5], in which enhanced length-width ratio and invariant moments of object are extracted as shape

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feature. Given object is distinguished for bayesian approach of dynamically selecting camera parameters from a limited set of object classes is proposed in [6]. The Gaussian process regression is applied to learn the likelihood of image features given the object classes and camera parameters.

A method used for the category of object recognition by educating the admired methods from the following two aspects is presented in [7]. Models that are used for capturing the related information among the hundred object types using a tree structure are discussed in [8]. Objects are used that include numerous instances of diverse object categories.

2. Methodology

The system for underwater object recognition system is constructed based on DWT feature extraction as an initial step. These features are tested and classified by the classifier where the output is obtained as the second step. These two steps are done for both the training and the testing input images. The framework of our underwater Object recognition system is as shown fig 1.

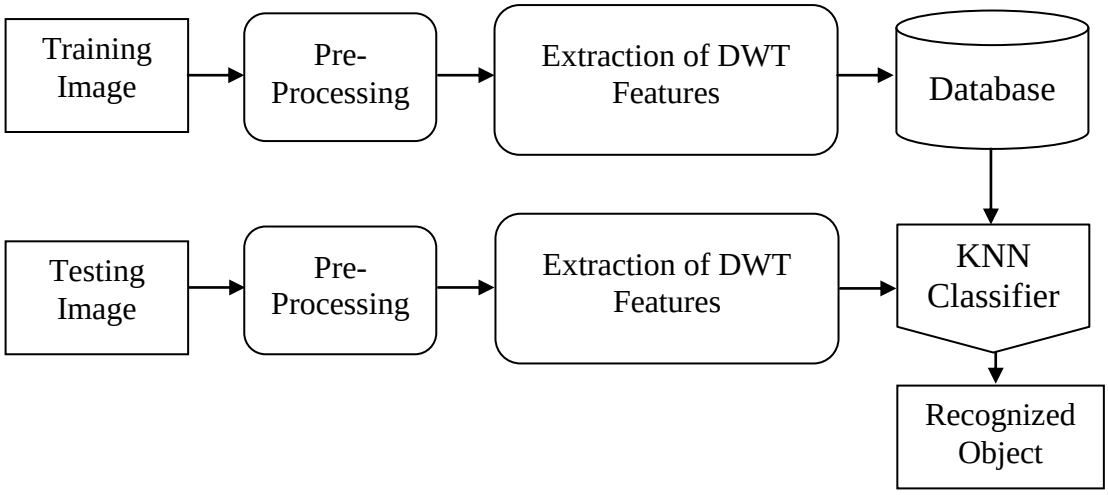

Figure 1 Block diagram of Underwater Object Recognition System

2.1 DWT

DWT technique is used in this method to denoise the given input image using decompositions. The DWT features will be having discrete level of wavelet transform features. This feature extraction is done for various levels of decomposition process. In mathematical and practical analysis, DWT is a wavelet transform for which the wavelets are discretely sampled. As

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with other wavelet transforms, a key advantage it has over Fourier transforms is temporal resolution.

2.2 Feature Extraction

An extraction of feature is the most important step in all machine learning systems. In our system the DWT features are extracted in each level of decomposition method. Before extracting the features, first the input images undergoes the pre-processing step where the colour conversion of RGB to Gray colour conversion is done. By using these pre-processed images only the DWT features are extracted. The DWT features will be having discrete level of wavelet transform features. This feature extraction is done for various levels of decomposition process. The features extracted are saved as trained database that are used later in classification process.

(a)

(b)

Figure 2 (a) & (b) Images used in the proposed system

2.3 Classification

The same step is done for both the training and testing sets. Extracted features are stored in the database according to their equivalent index class for the recognition. The features are extracted and are given as the inputs for the classifier as they need two types of inputs like trained database as one input and the tested image features as another input. Then the KNN classifier used here will start to compare both the features and separate the image class according to the species in the present.

3. Results

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DWT features based underwater object recognition system is tested on Underwater Object Database. The database contains 200 pictures of 100 different objects. The images are tested and classified by using the KNN classifier. The image size present in the database is of 128X128 in size. So as to calculate the performance of our proposed system, given database is separated into two sections namely training and testing set of database images. DWT features are extracted and are tested and classified by using the KNN classifier as explained above. Table 1 stats the accuracy of the recognition that are obtained in this system for the underwater object recognition system.

Table 1 Recognition accuracy of the underwater object recognition system

Level of Decomposition	**Recognition accuracy (%)**					
	10^0	20^0	30^0	45^0	60^0	90^0
2	88.25	80.57	75.18	68.42	62.04	54.51
3	88.38	79.80	74.02	68.84	59.03	52.71
4	90.91	82.72	78.15	71.45	65.17	59.63
5	96.52	90.31	84.30	76.03	69.76	62.51
6	99.13	95.57	90.85	84.63	77.95	70.57

The approach uses up to 6^{th} level of DWT decomposition. KNN classifier makes use of Euclidean distance as distance measure for classification. Among the 100 objects used 85 objects are accurately classified and only 15 objects are misclassified.

3.1 Conclusion

System for recognition of underwater object is done based on DWT features and KNN classifier is explained in this paper. The system uses the sub band energies of DWT as features that are used to represent the type of the object from the object database. The system is tested with six diverse training set that are divided from the database. Result stats that the system gives a good recognition accuracy of 98.63% for the features extracted at 6^{th} level of DWT decomposition and the overall recognition accuracy of 94.65% of db.

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