FISH RECOGNITION BASED ON ROBUST FEATURES EXTRACTION FROM COLOR TEXTURE MEASUREMENTS USING BACK-PROPAGATION CLASSIFIER

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ABSTRACT

Problem statement: image recognition is a challenging problem researchers had been research into this area for so long especially in the recent years, due to distortion, noise, segmentation errors, overlap, and occlusion of objects in digital images. In our study, there are many fields concern with pattern recognition, for example, fingerprint verification, face recognition, iris discrimination, chromosome shape discrimination, optical character recognition, texture discrimination, and speech recognition, the subject of pattern recognition appears. A system for recognizing isolated pattern of interest may be as an approach for dealing with such application. Scientists and engineers with interests in image processing and pattern recognition have developed various approaches to deal with digital image recognition problems such as, neural network, contour matching and statistics.
Approach: in this work, our aim is to recognize an isolated pattern of interest in the image based on the combination between robust features extraction. Where depend on color texture measurements that are extracted by gray level co-occurrence matrix.
Result: We presented a system prototype for dealing with such problem. The system started by acquiring an image containing pattern of fish, then the image segmentation is performed relying on color texture measurements. Our system has been applied on 20 different fish families, each family has a different number of fish types, and our sample consists of distinct 610 of fish images. These images are divided into two datasets: 500 training images, and 110 testing images. An overall accuracy is obtained using back-propagation classifier was 84% on the test dataset used.
Conclusion: We developed a classifier for fish images recognition. We efficiently have chosen a image segmentation method to fit our demands. Our classifier successfully design and implement a decision which performed efficiently without any problems. Eventually, the classifier is able to categorize the given fish into its cluster and categorize the clustered fish into its poison or non-poison fish, and categorizes the poison and non-poison fish into its family.

Keywords*: Neural network, ANN, image segmentation, gray level co-occurrence matrix, color texture, digital image recognition, and feed forward back propagation classifier, poison and non-poison fish.*

1. INTRODUCTION

Recently, a lot of works was done by depending on the computer; In order to let the processing time to be reduced and to provide more results that are accurate, for example, depending on different types of data, such as digital image and characters and digits. In order to automate systems that deal with numbers such as Fingerprint verification, face recognition, iris discrimination, chromosome shape discrimination, optical character recognition, texture discrimination, and speech recognition. And an automatic fish image recognition system is proposed in this work. Digital image recognition has been extremely found and studied. Various approaches in image processing and pattern recognition have been developed by scientists and engineers to solve this problem [1] [2]. That is because it has an importance in several fields. In this study, system for recognized of fish image is built, which may benefit various fields, the system concerning on isolated pattern of interest, the input is considered to be an image of specific size and format, the image is processed and then recognized the given fish into its cluster and Categorize the clustered fish into poison or non-poison fish, and

categorizes the non-poison fish into its family. The proposed system recognizes isolated pattern of fish as the system acquire an image consisting pattern of fish, then, the image will be processed into several phases such as pre processing, and feature extraction before recognizing the pattern of fish .The back-propagation classifier (BPC) used for the recognition phase.

2. PROBLEM STATEMENT

The problem statement of this study extracted from the previous studies, several efforts have been devoted to the recognition of digital image but so far it is still an unresolved problem. Due to distortion, noise, segmentation errors, overlap, and occlusion of objects in color images [3] [4]. Recognition and classification as a technique gained a lot of attention in the last years wherever many scientists utilize these techniques in order to enhance the scientific fields. Fish recognition and classification still active area in the agriculture domain and considered as a potential research in utilizing the existing technology for encouraging and pushing the agriculture researches a head. Although advancements have been made in the areas of developing real time data collection and on improving range resolutions [5] [6], existing systems are still limited in their ability to detect or classify fish, despite the widespread development in the world of computers and software. There are many of people die every day because they do not have the ability to distinguish between poison fish and non- poison. Object classification problem lies at the core of the task of estimating the prevalence of each fish species. Solution to the automatic classification of the fish should address the following issues as appropriate:

1) Arbitrary fish size and orientation; fish size and orientation are unknown a priori and can be totally arbitrary;

2) Feature variability; some features may present large differences among different fish species;

3) Environmental changes; variations in illumination parameters, such as power and color and water characteristics, such as turbidity, temperature, not uncommon. The environment can be either outdoor or indoor;

4) Poor image quality; image acquisition process can be affected by noise from various sources as well as by distortions and aberrations in the optical system;

5) Segmentation failures; due to its inherent difficulty, segmentation may become unreliable or fail completely;

And the vast majority of research-based classification of fish points out that the basic problem in the classification of fish; they typically use small groups of features without previous thorough analysis of the individual impacts of each factor in the classification accuracy [7] – [9].

3. RELATED WORK

Selecting suitable variables is a critical step for a successful implementation of image classification. Many potential variables may be used in image classification such as shapes and texture, and it can be done by the feature extraction process. The purpose of feature extraction is to determine the most relevant and the least amount of data representation of the image characteristics in order to minimize the within-class pattern variability, whilst, enhancing the between-class pattern variability. There are two categories of features: statistic features and structural features. Feature extraction from an image is a major process in image analysis. An image feature is an attribute of an image. Image features can be classified into two types: natural and artificial ones. The natural features are defined by the visual appearance of an image such as luminance of a region [10], whilst artificial features are obtained from some manipulations of an image such as image amplitude histogram and filters [11]. Image analysis requires the use of image features that capture the characteristics of the objects depicted so that they are invariant to the way the objects are presented in the image. Historically, the process of extracting image features has been anthropocentric: the features calculated are defined in a way that captures the attributes the human vision system would recognize in the image. Thus, features like compactness, brightness etc are features which have some physical and perceptual meaning. It is not however necessary for the features to have a meaning to the human perception in order to characterize well an object. Indeed, features which broaden the human perception may prove to be more appropriate for the characterization of complex structures, like the objects often one wishes to identify in an image [12]. Sze et al. [13] have proposed a classifier based on color and shape features of fish to deal with the shape-based retrieval problem. They mentioned about the necessity of using shape and

color of fish to search the fish database of Taiwan. The developed technique is able to perform scale, and rotation invariant matching between two fishes. A target object selected by a bounding rectangle has to be processed by a foreground/background separation step. The target object (foreground part) is then converted into a Curvature Scale Space (CSS) map. In order for performing rotation invariant matching, The authors further converts the CSS map into a circular vector (CV)map and then find its representative vector based on the concept of force equilibrium. After rotating the representative vector into the canonical orientation, every unknown object can be compared with the model objects efficiently. An image-processing algorithm developed by Zion et al. [14] has been used for discrimination between images of three fish species for use on freshwater fish farms. Zernike velocity moments were developed by [15], to describe an object using not only its shape, but also its motion throughout an image as claimed by [16].Classification is the final stage of any image-processing system where each unknown pattern is assigned to a category. The degree of difficulty of the classification problem depends on the variability in feature values for objects in the same category, relative to the difference between feature values for objects in different categories. Mercimekm et al. [17] and Lee et al. have proposed shape analysis of images of fish to deal with the fish classification problem. A new shape analysis algorithm was developed for removing edge noise and redundant data point such as short straight line. A curvature function analysis was used to locate critical landmark points. The fish contour segments of interest patterns were then extracted based on landmark points for species classification, which were done by comparing individual contour segments to the curves in the database. Regarding the feature extraction process, the authors tackled in their research the following features: fish contour extraction; fish detection and tracking; shape measurement and descriptions (i.e. shape characters (features), anal and caudal fin, and size); data reduction; landmark points; landmark points statistics (i.e. curve segment of interest). In their study, they have chosen nine species of fishes that have similar shape characters and the total of features was nine features. Also, they recommended that the decision tree is considered as a suitable method to obtain high accurate results of fish images based on the common characters used, such as: caudal, anal, and adipose fin. Furthermore, the authors claimed that the number of shape characters needed to be used, and how to use them depending on the number of species and what kind of species are required by the system to be classified. Their experiments conducted 22 fish images that belong to 9 species, where the detection percentage of the classification process was 90%.

4. MATERIAL AND METHOD

This work had focused on two hundred images of fish which collected from global information system (GIS) on Fishes (fish-base) and department of fisheries Malaysia ministry of agricultural and Agro-based industry in putrajaya, Malaysia region currently, the database contains 610 of fish images. Data acquired on 22th August, 2008, are used.

5. IMAGE SEGMENTATION

Image segmentation is crucially significant for the successfulness recognition of the image, it is still a dream for the computer to outperform human natural ability for visual interpretation, and thus feature extraction still remains a challenging task in various realms of computer vision and image analysis. This section describes the image segmentation based on color texture measurements.

Texture is one of most popular features for image classification and retrieval. Forasmuch as grayscale textures provide enough information to solve many tasks, the color information was not utilized. But in the recent years, many researchers have begun to take color information into consideration [18].

Color Texture analysis plays an increasingly important role in computer vision. Since the color textural properties of images appear to carry useful information for discrimination purposes, it is important to develop significant features of color textures. We have chosen the Gray Level Co occurrence Matrix (GLCM) method for the extraction of feature values from color textures.

5.1. Grey Level Co-occurrence Matrix

The Grey Level Co-occurrence Matrix, GLCM (also called the Grey Tone Spatial Dependency Matrix) is a tabulation of how often different combinations of pixel brightness values (gray levels) occur in an image. The GLCM described here is used for a series of "second order" texture

calculations. First order texture measures do not consider pixel neighbor relationships, while Second order measures consider the relationship between groups of two (usually neighboring) pixels in the original image. Third and higher order textures measures (considering the relationships among three or more pixels) are theoretically possible but not commonly implemented due to calculation time and interpretation difficulty. In our work we employed the second order textures measures [18].

5.2. GLCM Calculations based on Color texture measurements.

In the color texture measurements, five distinct steps occur in processing. The first and most important step is the image acquisition. It is imperative that images to be of high quality color, which included in our data, and typically we are dealing with digital images. Since the shapes of fish are not similar, we used crop faction to determine the shape of fish manually to eliminate the errors .So the second step subtracted a crop out from the pattern of interest (fish shape),this approach enable to enhance the quality of fish recognition. The third step a flirtation of captured crop out of fish pixels using a 5×5 Gaussian Filter. The fourth step subtracts the values of the original crop of fish pixels from the values of the filtered one to obtain different values between them resulting a new image, the reason behind that, to reduce the range of colors and speed up the calculation of GLCM matrix [19].

The fifth step is commenced after having the new image, where we have divided the new image into 4×4 blocks. For each block we have calculated the image quality features depending on the Grey Level Co-occurrence Matrix (GLCM) of the new image. The final step is to store the obtained features. Then, we have calculated six different image quality features of the "new image". Which are average or mean value, standard deviation, contrast, dissimilarity, homogeneity and energy .Figure 1 illustrate the complete process of the extracted the color texture measurements model.

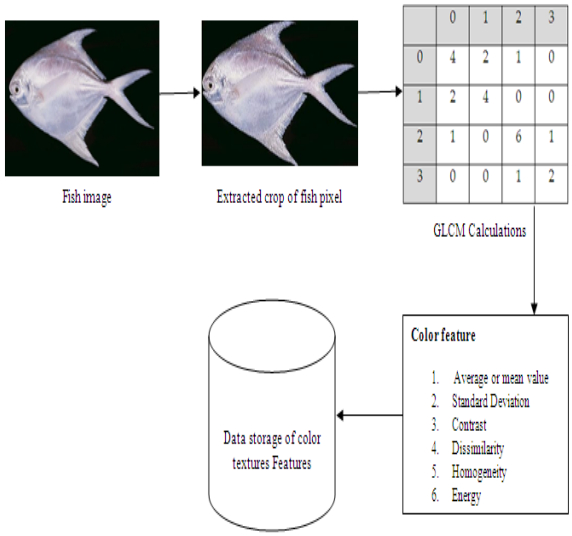

Figure 1: extracted the color signature and texture measurement model.

6. NEURAL NETWORK MODEL

The multilayer feed forward neural network model with back-propagation classifier (BPC) for training is employed for classification task as shows in Figure 2,which illustrates our implemented neural network contains three layers which are the input layer, the hidden layer and the output layer. The number of neurons is varied from layer to another (except The output layer consist of 20 neurons since we need to classify 20 fish families [1, 2,…, 20], each of which correspond to one of the possible family's that might be considered) in order to determine the suitable number of neurons for both input and hidden layers, therefore, obtaining high accurate results.

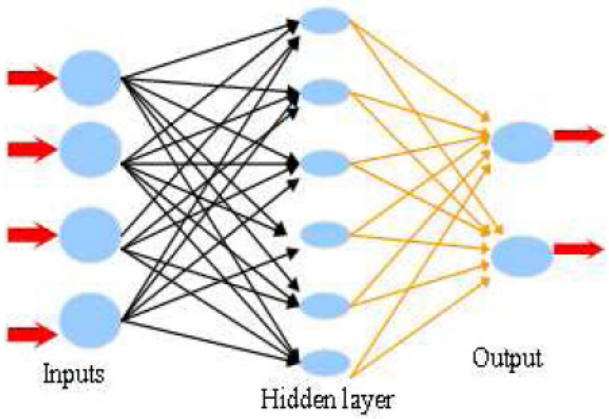

Figure 2: Multilayer feed forward neural network model

The developed Back-propagation classifier (BPC) is trained with termination error (TE) 0.01 in 411 epochs the value of learning constant (learning rate LR) used is 0.1. In our experiment we built the neural network with number of input features, three layers and different numbers of neurons in order to achieve our goal. The following Table 1 shows the number of input features and number of neurons for each layer that determined experimentally.

TABLE 1
NUMBER INPUT FEATURES AND NEURONS FOR EACH LAYER

Training Classifier	Number of input features	NO. Neurons in Layers		
Back - propagation classifier	18	Layer #1	Layer #2	Layer #3
		22	30	20

7. EXPERIMENTAL RESULT

As we shows in figure 3, the accuracy of recognition test results for each fish family (20 families) based on the color textures features, which are vary from a family to another. From the figure 3 below, the obtained results by the BPC indicate a high accuracy of each fish family's recognition percentage, which lie between 81% as minimum percentage of accuracy and 90% as a maximum percentage of accuracy. Some of the results that are close to the minimum percentage (e.g. Sillaginidae) are due to the relationship between neighboring pixels (e.g. Megalopidae) and share the same shape characters. For both methods, this causes a noise identification interruption to the BPC to classify properly. However, in the other hand, some families share the same shape characters with each other, but each one has its own species-specific traits. This enables the BPC to recognize the respected family easier, for example, some of the poison fishes have the same shape characters with other non-poison fishes, but with some dissimilarity such as the interdorsal-adipose space, which is an empty space between dorsal fin and adipose fin.

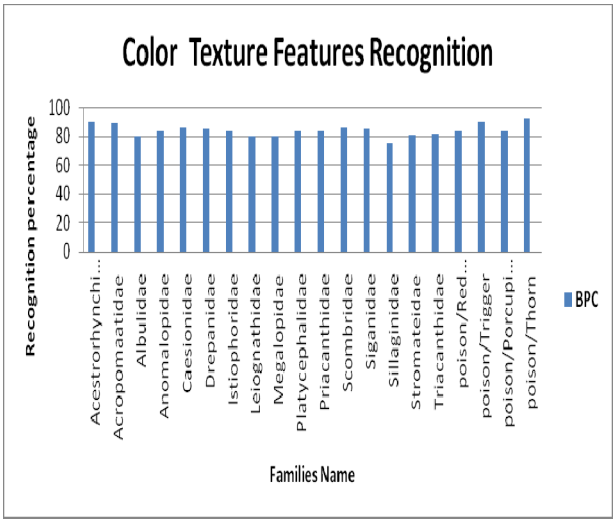

Figure 3: illustrates the accuracy of recognition test results for each fish family based on the color texture measurements.

8. RESULTS

The methods have been implemented in MATLAB programming language on a CPU Core 2 Duo 2.33 GHZ. We have considered different fish images families, obtained from Global Information System (GIS) on Fishes (fish-base) and department of fisheries. For experimentation purpose 610 hundred fish images families are considered, 500 fish images for training and the rest 110 for testing. The following table describes the overall training and testing accuracy obtained based on robust features extracted from color texture measurements using BPC.

Table 2: Description of the overall accuracy of training and testing

Description	Results
Overall training accuracy	85%
Overall testing accuracy	84%

In addition, the problem in fish recognition is to find meaningful features based on the image segmentation using color texture measurements. An efficient classifier that produce better fish images recognition accuracy rate is also required. As we show in Table 2 the overall training accuracy equals to 85% and the overall testing accuracy equals to 84%.

9. DISCUSSION

In previous studies such as (Nery et al.; 2006) performed fish recognition based on color texture features, extracted only from the ventral part of the fish. This limited area (determined by the classifier) reduces the accuracy of fish recognition due to the values and relationships between the neighboring pixels of the fish textures are converged to each other, where this make it hard for the classifier to recognize smoothly and accurately the processed image.

Hence, in our work we intend to recover this drawback by extracting the texture measurements from the image as a whole. Specifically, the pattern of interest (fish) will be determined in the classifier by the crop completely as described in the previous section. Shape characters of fish are playing a major role in fish recognition based on color texture measurements. Where, in some cases, some fishes have dorsal fin and adipose fin with a gap (inter dorsal-adipose space) between both of them; while in some similar fishes have both fins close together without any gap, as shown in the figure below. The same situation is considered for the fish tail including forked and rounded tails (see the figure 4 below). The nature of the tail shape is involved in our study however a tail that has a double emarginate shape, lunate shape or forked shape, the spaces between the shape's characters are significantly influenced the values of the relations between color texture features (Fisheries research institute, Malaysia; 2004).

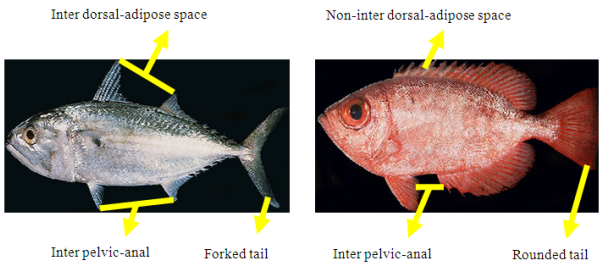

Figure 4: Different shape characters

10. CONCLUSION

In this paper, generally discussed image segmentation based on color texture measurements. 6 color texture features have been extracted using GLCM method. In the color texture, we extracted the GLCM's features from the whole pattern of interest (fish), which is in our case differs from previous studies that considered only small parts of the pattern of interest. This way, we utilize the characters of the shape, and the Shape characters of fish play a major role in fish recognition based on color texture measurements, since the differences between shape characters of fish give different features values that help us to distinguish between each family. Our experimental results suggest that our feature selection methodology can be successfully used to significantly improve the performance of fish classification systems. Unlike previous approaches which propose descriptors and do not analyze their impact in the classification task as a whole. We propose a general set of 6 features and their corresponding weights which may be used as a priori information by the classifier. Moreover, our work presents a novel set of features extracted from color texture measurements. The overall accuracy for PBC was 84%.

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