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Shape- Based Fish Recognition Using Neural Network

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Abstract-

Detection and recognizing an object is very difficult and takes a long times especially for the live object. In this work We propose to framework for image retrieval using neural network .During various image retrieval parameters available shape parameter is preferred because it is closest to human perception. Neural Network would be used for training the networks. Neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the network function is determined largely by the connections between elements. We can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements. we propose a general set of features extraction using robust feature selection, image segmentation and geometrical parameter and their correspondent weights that should be used as a priori information by the classifier. Dataset- Aquatic: we would be focusing on identifying the best and closest match of using shape parameter using neural network approach.

Keywords- Artificial Neural Network, Species Recognition, Fish Features, Image Processing, Back Propagation.

I. INTRODUCTION

Shape is an important visual feature and it is one of the basic features used to describe image content. Shape representation and description is a difficult task. This is because when a 3-D real world object is projected onto a 2-D image plane, one dimension of object information is lost. As a result, the shape extracted from the image only partially represents the projected object. To make the problem even, more complex, shape is often corrupted with noise, defects, arbitrary distortion and occlusion.

One of the fundamental challenging problems in computer vision is detecting object inside an image or video frames. With a system that can detect objects, it would help human to do their jobs that use their visual capability. For example a system that has a computer vision capability that can search objects as the target and process them. Like a robot system that can detect object in industry that later would be automatically processed without human involved.

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 (Patrick *et al*., 1991; Nery *et al*., 2005) [13], 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:

- Arbitrary fish size and orientation; fish size and orientation are unknown a priori and can be totally arbitrary
- Feature variability; some features may present large differences among different fish species
- Environmental changes; variations in illumination parameters, such as power and colour and water characteristics, such as turbidity, temperature, not uncommon. The environment can be either outdoor or indoor
- 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
- Segmentation failures; due to its inherent difficulty, segmentation may become unreliable or fail completely.

Feature extraction refers to a process by which fish attributes are computed and collected from size and shape measurements through the distance and geometrical tools. The goal of a feature extraction determines a largest set of features.

II. PROBLEM STATEMENT

Several efforts have been devoted to the recognition of digital image but so far it is still an unresolved problem. (Bai el al,.2008 Kim and Hong ,2009) [11], due to distortion, noise, segmentation errors, overlap, and occlusion of objects in colour images. 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 (Patrick et al,. 1992 and Nery et al. 2006) [13],existing systems are still limited in their ability to detect or classify fish. And 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.

Recognition ability from image can also be applied into computer system for automated recognition based on not just the text input but also the shape of images. The recognition of patterns (fishes) from scanned images of documents has been a problem that has received much attention in the fields of image processing, pattern recognition and artificial intelligence. Classical methods such as experiments on species pattern recognition (plants, rats, and many more) and particularly fishes do not suffice for the recognition of their shape due to some reasons. Firstly; considering that the image is to be run into a neural network system, the recognition of that image is subjected to the disturbance or spoilage of the system due to some characteristics such noise and climate. Secondly; related to the recognition of the fish shape is made difficult because there are no hard-and-fast rules of the ability of recognizing and defining the appearance of a given fish.
The Object classification problem lies at the core of the task of estimating the prevalence of each fish species. They mentioned
about that this issue still has a problem with classification and identification of fish species, and the authors understand that any
solution to the automatic classification of the fish should address the following issues as appropriate:
Arbitrary fish size and orientation; fish size and orientation are unknown a priori and can be totally arbitrary;
Feature variability; some features may present large differences among different fish species;
Environmental changes; variations in illumination parameters, such as power and colour and water characteristics, such as turbidity, temperature, not uncommon. The environment can be either outdoor or indoor;
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;

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 (Alsmadi ,et al 2009 ; Nery, et al, 2006 and Lee, et al,2004)[18].

III. IDENTIFICATION

NEURAL NEYWORK

Neural Networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the network function is determined largely by the connections between elements. We can train a neural network function is determined largely by the connections between elements. We can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements. Commonly neural networks are adjusted, or trained, so that a particular input leads to a specific target output. The network is adjusted , based on a comparison of the output and the target, until the network output matches the target.
An Artificial Neural Network (ANN) is an information-processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurones. This is true of ANNs as well. Artificial Neural Network is a system loosely modelled on the human brain. The field goes by many names, such as connectionism; parallel distributed processing, neurocomputing, natural intelligent systems, machine learning algorithms, and artificial neural networks. It is an attempt to simulate within specialized hardware or sophisticated software, the multiple layers of simple processing elements called neurons. Each neuron is linked to certain of its neighbours with varying coefficients of connectivity that represent the strengths of these connections. In this subsection, we show identification results obtained under the condition that one specified fish species was identified from among some fish species. The specified species was D. macrophthalmus in the identification. For learning, each teacher signal for the specified species was 1 whereas that for the other species was 0. The network had a three layer structure with 21 outputs. The number of learning, which was determined as a standard in pretests, was 10000.

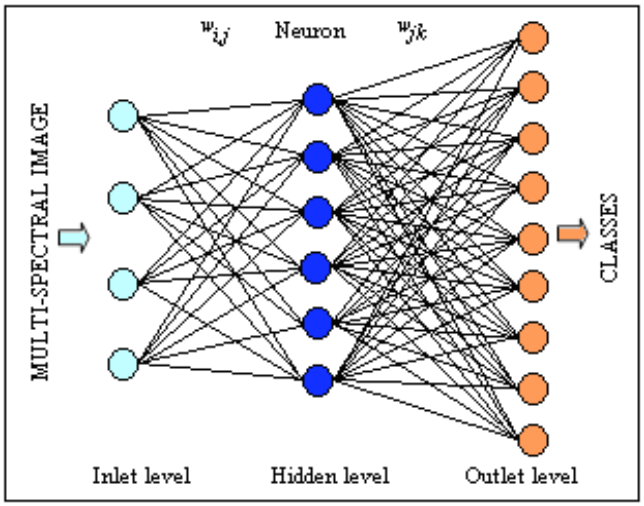

Figure 2. Artificial Neural Network structure

IV. TRAINING PROCESS: BACK-PROPAGATION

In training process neural network adjusts its free parameters (Yao, 1995; Carvajal ,et al ,2006). It starts with a set of initial weights associated to relationship between pairs of neurons (or synapses). These values change depending of error committed in
classification, following Generalized Delta Rule (Pao, 1989; Carvajal ,et al ,2006). This process is repeated iteratively until convergence is reached in two phases. Firstly a set (xp) of inlet data is introduced in neural network. This set is propagated forward network, delivering an outlet (yp), which is compared with desired outlet (dp), obtained from training sites. Error committed in classification at this moment in training process (ep) is calculated according to (1):

$$e_p = \frac{1}{2}\sum_{k=1}^{M}\left(d_{pk} - y_{pk}\right)^2 \qquad (1)$$

Where k is neurons outlet index in last level, and M is total number neurons in this level. Secondly, classification error is propagated backward, modifying weight factors wp using Rumerhart rule (2) (Atkinson and Tatnal, 1997; Carvajal ,et al ,2006).

$$\Delta w_{ji}(t+1) = \eta\frac{\partial e_p}{\partial w_{ji}} + \alpha\Delta w_{ji}(t) \qquad (2)$$

Where η is learning rate and α is momentum factor. The iterative process finishes when difference between classification error in two iterations t and t+1 in (2), falls under a threshold value. Parameters affect to velocity which convergence is reached. So, if learning rate is high, mathematical solution will be early encountered but it is possible that in next iteration, classification increases. Using a high momentum factor, these oscillations can be reduced.

V. THE FEATURE EXTRACTION APPROACH

As a first step we have set out to determine a largest set of features. For each fish species, we have computed 47 different features, which can be divided in four main groups, differentiated by the type of extracted information. Those groups and their corresponding numbers of features are:

A. Pre-processing:

In the pre processing step, an image filtration is required to remove noise from the image, through background unification process to ease the isolation of patterns of interest (fish) from the background of the image in the next step. Also, the image might need adjustment of its rotation. The input of a pattern recognition system is typically a digital image. The digital images were downloaded to a personal computer having a Pentium 200MMX microprocessor and 96 MB of RAM .

B. Image Processing:

Image processing involved in isolation of patterns of interest (fish) from the background of the image; and colour extraction of a
fish image via space RGB and dividing the neighbouring pixel in term of colour similarity into a number of groups, and finds the correlation between similar groups. The digital images converted from the native Kodak digital camera format (KDC) to the 8 bit colour bitmap format (BMP). The size of the images was 856x804 pixels. After the BMP images were

obtained, they were pre-processed with the Image Processing Toolbox v2.0 for MATLAB v8.0. The BMP images were converted to indexed images based on a red-green-blue (RGB) colour system. Each pixel of an image was classified into one of 256 categories, represented by an integer in the range from 0 (black) to 255 (white).

C. Segmentation:

Segmentation is one of the deepest problems in pattern recognition. The method involves analysis of each picture to find the contours of the pattern. Dividing the fish into a certain number of segments, measurements and characteristics (size, shape, colour, geometrical parameter), and analyze the colour in each segment. The purpose of segmentation is identifying the objects to be recognized into the raw data and storing them into database.

D. Feature Extraction:

The goal of a feature extraction determines a largest set of features. In which characterizing the objects to be recognized by measurements whose values are likely very similar for those in the same class, and very different for those in different ones. This leads to the idea of seeking for distinguishing features that are invariant to irrelevant transformations of the input. For example, the absolute position of an object identified in the acquired scene is irrelevant to the category of that object and thus the representation to be used should be insensitive to its absolute position. The main categories of feature extraction approach can be listed below:

- *Size measurements*
- *Shape and Texture measurements*
- *Colour signatures*
- *Geometrical Parameters*

The following two figures are illustrate the fish feature extraction based on the four categories of feature extraction mentioned above:

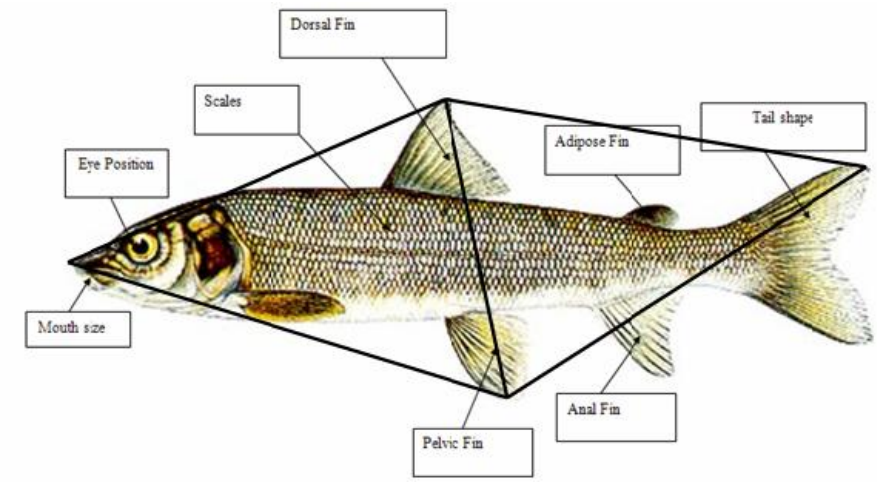

Figure 5a: Fish External Anatomy (Fish Features)

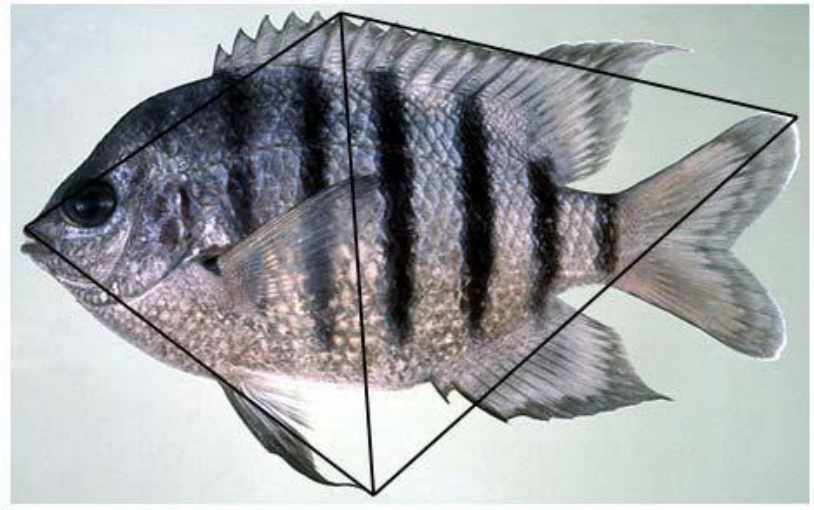

Figure 5b: Fish External Anatomy (Fish Features)

Figures 5a and 5b shows the fish external anatomy that is chosen to be used in fish classification. As follows, the explanation of each category illustrated in both figures:

 Size Measurements:

This group of measurements consists of planar measurements on the fish's area, and fish's length and width. These features are not invariant under translation, scales and rotation; they are fundamentally role in computing other relevant features.

Shape and Texture Measurements:

Using shape measurements, the external contour and edge detection of the pattern for each fish and to determine the significant similarity part, such as the tail shape. The geometrical parameters obtained by shape measurements as well. Using texture measurements determine the dorsal, anal, pelvic and adipose fins.

Colour Signature:

Kim and Hong, (2009) [9] Colour and texture are essential features for image segmentation and recognition since these features are commonly observed in most images, especially in colour textured images of natural scenes, where natural objects, such as the flowers or the wild animals, have their own colour and texture. Keenleyside (1979); the dorsum and ventral colorations constitute very important features that might be used to discriminate different fish species. Based on this fact, the usage of this information by assigning to each fish species a colour signature can be beneficial, which is composed of the average colour of the dorsum and the ventral region of the fish.

Geometrical Parameters

Through the usage of geometrical parameters, the eye position and size of mouth can be determined. Besides dividing the fish into two triangles, which can be a significant step in obtaining a high accuracy of fish classification. According to figures 5a and

5b, a different triangles are drawn based on the maximum and minimum points on the x-axes as well as y-axes, finalizing the triangle drawing process by connecting lines between the maximum and the minimum points on x-axes with the maximum and minimum points on y-axes. This will lead to the classification process through measuring the position of fish's eyes, size of mouth, and the similarity of the triangles, and coordinates of the triangles peaks.

VI. EXPERIMENT DESIGN

Table 1

Scientific name of fish family	Number of fish type	Training set	Test set
Istiophoridae	**10**	**10**	**10**
Ieiognathidae	**15**	**15**	**10**
Acropomaatidae	**10**	**10**	**10**
Scombridae	**15**	**15**	**10**
Stromateidae	**10**	**10**	**10**
Triacanthidae	**15**	**15**	**10**
Poison fish	**25**	**25**	**25**

Our Prototype system has been applied over 7 different fish families, each family has a different number of fish types, Our sample consists of distinct 100 of fish images , 100 images used for trained neural network and 75 used for tested , which are illustrated in table 1. The implementation of our prototype system including the training and testing processes of all fish families resulted that the classification accuracy of a fish type has a high quality and accurate classification result achieving 97.4%. Regarding this percentage of the obtained result, the significance of the combination of the image segmentation, feature extraction and the geometrical parameters is very high and dependent in order to obtain a high accuracy of a classification result.

VII. CONCLUSION

This work presents one of the object detection techniques for detecting fish objects. This work is aimed to study the implementation of neural network-based technique in detecting the fish object in a digital image. The result shows that the system is affected by the training data and the fish image that obscured and has a lot of noise. The FIRS fulfilled the research objective by extracting eight main fish features and recognizing some fish species by using image processing technique. Based on the experimental results, the FIRS employed the ANN technique to recognize the fish image with precision rates of 99.00 The ANN gave better precision rates than the EDM but the EDM used less processing time than the ANN. We developed an identification method of fish species with layered neural network learning based on truss protocol. As a future work, we will develop a quantification method of dynamic characteristics in a fish dynamic image and an identification method of fish species using the quantified characteristics.

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