CLASSIFICATION OF FISH IMAGES BASED ON SHAPE CHARACTERISTIC

By

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2DPCA	2D principle component analysis
ACR	Axis correction ration
AE	Absolute error
ALL	Acute lymphoblastic leukaemia
AML	Acute mylogenous leukaemia
ANN	Artificial neural network
BMC	Bone mineral content
BMD	Bone mineral density
BP	Back propagation
CV	Cross validation
DA	Descriptors average
DT	Decision templates
EMG	Electromyography
FAR	False acceptance ration
FD_R	Fourier Descriptor using Robert cross edge detection
FD_R(DA)	Fourier Descriptor using Sobel cross edge detection with Descriptor Avarage
FRR	False rejection ration
FD_S	Fourier Descriptor using Sobel cross edge detection
FD_S (DA)	Fourier Descriptor using Sobel cross edge detection with Descriptor Avarage
GA	Genetic algorithm
GAR	Genuine acceptance rate

GIS	Global information system
GMI	Geometric moment invariant
HDR	Handwriting digit recognition
HMM	Hidden markov model
ICA	Independent component analysis
IUR	Improve unit range
KNN	K-Nearest neighbor
LDA	Linear discriminate analysis
LM	Levenberg-marquardt
MHD	Minimum hamming distance
MI	Moment invariants
MLP	Multilayer perceptron
MLP_LM	Multilayer perceptron trained by Levenberg-marquardt
MMD	Minimum mean distance
NN	Neural network
ORL	Olivetti research laboratory
PAE	Percentage absolute error
PCA	Principle component analysis
PD	Partial discharge
PIN	Personel identification numbers
PMAE	Percentage min absolute error
PSO	Particle swam optimization
PZMI	Pseudo Zernike moment invariant
RBF	Radial basis function
RTS	Rotation, Translation and Scaling

SAR	Synthetic aperture radar
SD	Shafer Dempster
SFAM	Simplified fuzzy ARTMAP
SIFT	Scale-Invariant feature transform
SPSS	Statistical package for the social sciences
STFT	Short time fourier transform
SURF	Speeded up robust features
SOM	Self organizing Map
SVM	Support vector machine
TPMAE	Total percentage min absolute error
UMI	United moment invariant
WBC	White blood cells
WCM	Weight central moment
ZMI	Zernike moment invariant

Pengkelasan Gambar Ikan Berdasarkan Ciri-ciri Bentuk

ABSTRAK

Kerja penyelidikan ini telah dijalankan untuk menganalisis dan mengelaskan jenis-jenis imej ikan berdasarkan ciri-ciri bentuk. Ciri-ciri bentuk imej ikan diekstrak dengan menggunakan tiga jenis teknik momen tak bervariasi (MI) dan penghurai fourier (FD). Jenis-jenis Momen tak bervariasi adalah masa Geometrik momen (GMI), Bersatu momen (UMI), Zernike momen (ZMI). Dalam teknik FD, terdapat dua pengesanan pinggir telah digunakan untuk membentuk sempadan imej, iaitu pengesanan silang Robert dan pengesanan silang Sobel. Teknik-teknik pengekstrakan ciri telah digunakan untuk menganalisis imej kerana ciri-ciri yang tak berubah imej berdasarkan perubahan kedudukan, faktor skala dan putaran. Terdapat dua cara untuk memeriksa prestasi teknik pengekstrakan ciri, iaitu analisis antara kelas dan analisis klasifikasi. Bagi analisis antara kelas, satu set persamaan telah digunakan untuk mencari teknik yang terbaik di antara FD dan tiga jenis MI berdasarkan nilai rendah pada Ralat Jumlah peratusan Min Mutlak (TPMAE). Sementara itu, untuk analisis klasifikasi, Rangkaian Neural Buatan dikaji dan digunakan untuk mengkelaskan imej ikan. Vektor ciri yang dihasilkan oleh teknik pengekstrakan ciri yang mewakili imej akan digunakan sebagai input klasifikasi. Keputusan analisis intra-kelas menunjukkan bahawa UMI adalah teknik yang terbaik di antara teknik momen manakala FD yang menggunakan pengesanan pinggir Sobel menunjukkan TPMAE lebih rendah berbanding dengan pengesanan pinggir Robert. Untuk bahagian pengelasan, dua jenis rangkaian neural tiruan (ANN) iaitu Layer-pelbagai Perceptron (MLP) dan Ringkasan Fuzzy ARTMAP (SFAM) rangkaian neural telah digunakan untuk mengkelaskan imej berdasarkan kategori ikan. Algoritma Leverberg-Marquardt (LM) digunakan untuk melatih rangkaian MLP dan memeriksa kebolehgunaannya. Berdasarkan pengelasan yang telah dijalankan, keputusan menunjukkan bahawa semua rangkaian menghasilkan prestasi baik dalam pengelasan dengan ketepatan keseluruhan adalah sekitar 90%. Walau bagaimanapun, MLP dengan menggunakan Leverberg-Marquardt menunjukkan prestasi pengelasan yang tinggi dalam mengkelaskan imej ikan berbanding dengan rangkaian SFAM.

Classification Of Fish Images Based On Shape Characteristic

ABSTRACT

This research work has been conducted to analyze and classify the types of fish image based on shape characteristic. The features of characteristic of fish image are extracted by using three Moment Invariants (MI) techniques and Fourier descriptors (FD). The types of Moment invariants are Geometric moment invariant (GMI), United moment invariant (UMI), Zernike moment invariant (ZMI). In the FD's technique, there are two edge detection have been used to create the boundary of the image, namely Robert cross detection and Sobel cross detection. These feature extraction techniques have been used to analyze the image due to its invariant features of an image based on translation, scaling factor and rotation. There are two ways to examine the performance of feature extraction techniques, namely intra-class analysis and classification analysis. For the intra-class analysis, a set of equations has been implemented to find the best technique among the three different types of moments and Fourier descriptors based on the low value of Total Percentage Min Absolute Error (TPMAE). Meanwhile, for the classification analysis, the Artificial Neural Network (ANN) is explored and adapted to classify the fish images. The feature vectors produce by feature extraction techniques that represent the image are used as the input of classification. The results of the intra-class analysis indicate that the UMI was the best technique among the moment techniques while Fourier descriptor by using the Sobel edge detection shows the lower TPMAE as compared to Robert edge detection. For the classification part, two types of ANN's which are Multilayer Perceptron (MLP) and Simplified Fuzzy ARTMAP (SFAM) neural networks have been used to classify the image based on fish category. The Leverberg-Marquardt (LM) algorithm is used to train the MLP network in order to check the applicability. Based on the classification that has been computed, the results show that all networks perform good classification performance with overall accuracy is around 90%. However, the MLP trained by Leverberg-Marquardt shows the highest classification performance in classifying the fish images as compared to the SFAM network.

CHAPTER 1

INTRODUCTION

1.1 Background

Shape analysis based on recognition and classification is an important system in our daily lives. It acts like a human vision system which it will capture the image by eyes and sending it to the brain to be classified. The process of shape analysis is to analyze the raw data and classify based on the classes of the shape. The major component in shape analysis is feature extraction which is it used to extract the features in an image either the structural approach or global approach. Yet, it is also a part of pattern recognition techniques which aims to extract the value from an object as differentiates it from the other objects. Usually, pattern recognition will be classifying the data according suitable classes based on its pattern features. A complete shape analysis have three stages. The first stage is the detection of the orientation and scaling of the image. The second stage is the extraction of the features from the image, while the third stage involves classification based on the extracted features vector. The feature extraction can be performed by using moment invariants and Fourier descriptors. Meanwhile, the classification can be performed using Artificial Neural Network (ANN).

Presently, the ability to identify and classify the types of fish being a great need for the department of fisheries in order to obtain the diversity of fish species. In this world, there are many types of fish with variety of colours and shapes. Due to this situation, process for classification and recognition has became a big challenge. However, the identification of fish is still in progress because the information obtained from the fish is not enough to compare to the other fish to make the possible difference. This is because it requires a detail in understanding the characteristics of fish as well. Therefore, there are several analyses performed about feature extraction and classification of fish images to determine the best technique so that it can be purposed and developed.

Consequently, in order to accomplish the initial step of this research, the Moment Invariants (MI) and Fourier Descriptors (FD) have been used as feature extraction techniques. These techniques have been chosen to perform feature extraction from the image characteristics that can be obtained through Rotation, Scale and Translation (RTS) invariant. Furthermore, these techniques also have been proven as an effective technique for extraction feature of binary or grey images in many applications. There are three types of moment invariants namely Geometric moment invariant (GMI), United moment invariant (UMI) and Zernike moment invariant (ZMI) which have been studied and analyzed. While, two edge detection namely Robert Cross and Sobel Cross have been compared for Fourier descriptors computation. These feature extraction techniques have been analyzed by using intra-class analysis and classification performance analysis.

Meanwhile, Artificial Neural Network (ANN) has been utilized in order to classify the extracted data based on the fish images. In other name, ANN also known as a classification technique and it has been used for many applications in image

processing fields such as pattern classification, recognition, prediction and approximation. This is due to its ability to classify the complex and imprecise data. Furthermore, two types of ANN have been chosen namely Multilayer perceptron and Simplified fuzzy ARTMAP. These neural networks have been utilized to compare the performance of classification between moment invariants and Fourier descriptors.

1.2 Problem Statement

Based on the description of background, several images are utilized containing the different scaling and orientation factors as compared to its original image. The feature vectors produced from these images are different because there have their own values to represent each image. Besides, these feature vectors are used for classifying the images based on the categories in the classification process. This research is focusing on classification of fish images because fish classification and identification are high importance for both scientist and fisher. The new advances in technologies or motivate to be combined with optimum classifier and identifier technique to optimize scientist benefits as well as maintain sea creature safe. This research is motivated by :

1. The best feature extraction technique of fish image is highly important for accurate classification purposes.

2. Optimizing classification technique so that recognition rate is optimum.

1.3 Objectives

i) To analyze and evaluate the best techniques that can be used to extract the shape features of fish images in term of intra-class analysis.

ii) To develop a technique in order to optimize the feature vectors of Fourier descriptors.

iii) To analyse the classification performance of Multilayer perceptron and Simplified fuzzy ARTMAP neural networks for fish images.

1.4 Research Scope

The scope of this research is limited to pattern recognition using feature extraction and artificial neural network technique. Besides, the data used for analysis is limited to binary image only. Two main stages will be examined which are the extraction of the raw images and the classification of images based on categories. For the extraction stage, the moment invariants and Fourier descriptors have been used as feature extraction techniques. Meanwhile, for the classification purpose, the multilayer perceptron and simplified fuzzy artmap neural networks have been utilized. As a result, the best technique between group of feature extraction is obtained and the best classification between both neural networks is determined.

1.5 Thesis Outline

This thesis is organized into five chapters.

- Chapter 1 provides an introduction to the background of the research, problem statement, objective, scope of research, and an outline of the thesis.
- Chapter 2 is presents about the research and information which are related to this work. It consists of a literature review of previous research related to feature extraction techniques and artificial neural network.
- Chapter 3 explains the methodology of the research. This chapter will cover the techniques of feature extraction and classification processes that have been involved.
- Chapter 4 focuses on result and discussion. In this chapter, all implementations from previous chapter have been discussed.
- Chapter 5 presents the summary and conclusion of whole works. The recommendation for future works also has been discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This work involves the analysis of shape image that can be utilized to recognize and classify. The purpose of image recognition is to ease the computer to learn and process the image without human intervention. The fundamental step of image analysis is feature extraction before it goes for classification. Therefore, the main objective of this chapter is to elaborate the history of feature extraction techniques and artificial neural networks. There are several approaches found in the literature review to solve the problem of extraction and classification related to fish images.

This chapter is organized as follows. The next section presents a detailed description of review on feature extraction which is including the moment invariants and Fourier descriptors techniques. It is followed by a review of classification that involving the Multilayer perceptron and simplified fuzzy ARTMAP. The classification is based on the feature vectors that have been produced from the feature extraction techniques. Along with it, performance comparison between these feature extraction techniques are implemented. In addition to this chapter, the application that related to this work also will be discussed. Application areas that will be emphasized on are the image analysis, robotic and electrical system.

2.2 Feature Extraction

Feature extraction is part of pattern recognition techniques which aims to retrieve or extract the unique values from an object that differentiates it from other objects. For example, the feature extraction method is needed to retrieve the values that represent the characteristics of the object and to perform face recognition of an object in a digital photo image. The feature extraction for an object can be done by using various methods such as the Moment invariants and Fourier Descripors techniques. Work is performed using the binary image properties as the characteristic of fish images. Yu. X, et al. (2002) had performed the classification of the insect image using the same image properties as illustrated in Figure 2.1 (a). For the classification part, they used the Linear Discriminate Analysis (LDA) technique to classify the parameter of the images. Meanwhile, Yaakob, S.N. et al. (2006) had developed a system for the classification binary insect image using the same image properties as shown Figure 2.1 (b). They are using the Gaussian ARTMAP neural network to classify the binary insect images.

(a) (b)

Figure 2.1 Example of binary images characteristic