Preliminary Design of a Recognition System for Infected Fish Species Using Computer Vision

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Abstract. For the purpose of classification of fish species, a recognition system was preliminary designed using computer vision. In the first place, pictures were pre-processed by developed programs, dividing into rectangle pieces. Secondly, color and texture features are extracted for those selected texture rectangle fish skin images. Finally, all the images were classified by multi-class classifier named SVMs. The experiment showed that color and texture are the appropriate features for fish species classification. The multi-class classifier based on SVM will be developed for further work.

Keywords: Recognition system, Infected fish, Fish species, Computer vision.

1 Introduction

The dramatic and widely spread of fish disease is the driving force in the development of machine vision system to identify these diseases. Our ultimate aim is to develop an image-processing system for identification of common carp in China. Users take a photograph of diseased fish by phone cameras or other move terminal with the ability of taking a picture and sent the photograph to our system, this system identify the disease by image analyzing and send the results to users by wireless network. For an intelligent system of fish diseases recognition based on image processing, the first step must be the recognition of fish species obviously.

So far many different methods of processing images or hydro acoustic techniques for fish recognition, classification and monitoring have been proposed. F Martinez de Dios et al. (2003) [1] used an underwater stereo vision system for estimating the weight of adult fish in sea cages from their length, and an over-the-water stereo system for estimating fish weight in a nursery. D.J.White et al.(2006) [2] described trails of computer vision machine(The Catch Meter) for identifying and measuring different species of fish. The fish are transported along a conveyor underneath a digital camera. Boaz Zion et al.(2007) [3].develop a real-time underwater computer vision system for Common carp (Cyprinus carpio), St. Peter's fish (Oreochromis sp.) and grey mullet

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D. Li and Y. Chen (Eds.): CCTA 2011, Part I, IFIP AICT 368, pp. 530–534, 2012.

(Mugil cephalus) in pool in which fish swim through a narrow transparent unidirectional channel. S.Duarte et al.(2009) [4] obtain a quantitative index form measuring flatfish activity using image analysis for studying fish behavior and welfare. Hugo Robotham et al.(2010) [5] classified schools of anchovy, common sardine, and jackmackerel using support vector machines (SVMs) and two types of supervised artificial neural networks (multilayer perceptron, MLP; and probabilistic neural networks, PNNs) during acoustic surveys in south-central Chile by hydro acoustic techniques.

Image analysis is the key techniques before classification for a computer vision. The aim of image analysis is to extract the features of the objects. Texture and color are usually be used as common features for image analysis. Textures are encountered almost in all digital picture from conventional photography to seismic and microscopy images [6-9]. Color is one of the most significant low-level features that can be used to extract homogeneous regions that are most of the time related to objects or part of objects [10].According to extracted features, classification is a procedure for sorting each element of a data set into one of the finite sets of classes utilizing a decision criterion[11].

In this paper, a new system was preliminary designed for recognition of infected fish species, this system refers to color and texture feature extraction and multi-class classifier. In the first step, pictures be pre-processed by developed programs, dividing into some rectangle pieces. Then color and texture features are extracted for those selected texture rectangle fish skin images. Finally, all the images are classified by multi-class classifier named SVMs.

2 Materials and Methods

2.1 Image Acquisition

Live images are received by a GPRS modem when farms send their infected fish pictures to our system. The computer vision system mainly consists of GPRS modem, image receiver module, image pre-processed module, image analysis module and image recognition module.

Through the GPRS modem, the infected fish images are received, then the image are processed by the pre-processed module to obtain the texture fish skin images as inputs to analysis module. According to the analysis results, the recognition module classified the images by training and studying. Images of six common fish were obtained: grass carp, black fish, chub, wuchang fish, bighead carp, red bellied pacu.

2.2 Image Pre-processing

A large number of color images were acquired by GRPS to this computer vision system. All the images were pre-processed. We have the automatic cutting program to cut the infected fish image with 32×32,64×64,128×128,256×256,512×512 window sizes. All the images were manually selected to remove the unqualified ones which are not full of fish body skin.Fig.1 shows one of the original images and one of the processed qualified texture images. . After the selection, images were enhanced by 3×3 media filter which may smooth the noise of the image.

(a)Original image (b)Processed image

Fig. 1. Original and processed images

2.3 Feature Extraction

The texture fish skin images usually have different colors and textures. Therefore, it is difficult to classify them accurately by only one type of feature. Color, shape and texture are commonly used features types in classification problems.

As lighting conditions and environments are easy to be fully controlled, it will be appropriate to use texture and color features as vectors inputs for classification. Fish vary in size and shape, but sometimes for getting a clearly vision for small disease spot, fish photos collected by system users may not be a whole fish, those photos of fish shape cannot be decide. So shape features are desirable to avoid, on the contrary, texture and color features are chosen as the preferable image features.

Texture is the reflection of brightness change of an image in the space. Two different types of statistical texture features are extracted. One is grayscale histograms (GH) based texture and the other is gray level co-occurrence matrices (GLCM) based texture. GH based texture features, including mean intensity, mean contrast, roughness, third-order moment, consistency, and entropy. GLCM based texture features, including second-order moment (energy), entropy, contrast and correlation.

Color is an important feature as well for fish species classification. Eight color features are extracted, i.e., the mean of the R channel of a color image, the mean of the G channel of a color image, the mean of B channel of a color image, the mean of RGB of a image, the mean of H channel of a color image, the mean of S channel of a color image, the mean of I channel of a color image and the mean of HIS of a image.

2.4 Classification

As a binary classifier, SVM has the advantage of the generalization ability when limit samples were available. In this research, SVM will be chosen.

The classification of fish species into six categories can be considered as constructing several binary classifiers and combining them into one multi-class classifier. In this study, a MSVM will be constructed to serve for the classification of fish species based on computer vision. A number of methods can be used to construct the MSVM, we used the one-against-one [12] algorithm.

The one-against-one is such a method that constructs k(k-1)/s classifiers where each one is trained on data from two classes. For training data from the jth classes, a binary classification will be solved.

3 Experiment and Analysis

All the algorithms used in the research for fish image processing and recognition were programmed in Matlab2010.The test environment was a personal computer with Pentium(R) Dual-Core 2.70 GHZ CPU and 3.24GB SDRAM.

After image pre-processing, totally 540 fish texture images were obtained, including each 90 object s of six fish species. Features were extracted from each image, forming a 22-dimensional feature vector each.

Previous experiment showed that the rotation can hardly affects texture features, thus it is no matter that how the users chose a shooting angle. It will be stable that the image processing system to extract features before classification. Inertia moment and correlation textures remain stable while energy and entropy decreased as window size increased. The next step, we will do some experiment of classification with the obtained feature vectors.

For the theories and some experiment above, the recognition system was preliminary designed as follow (Fig.2).

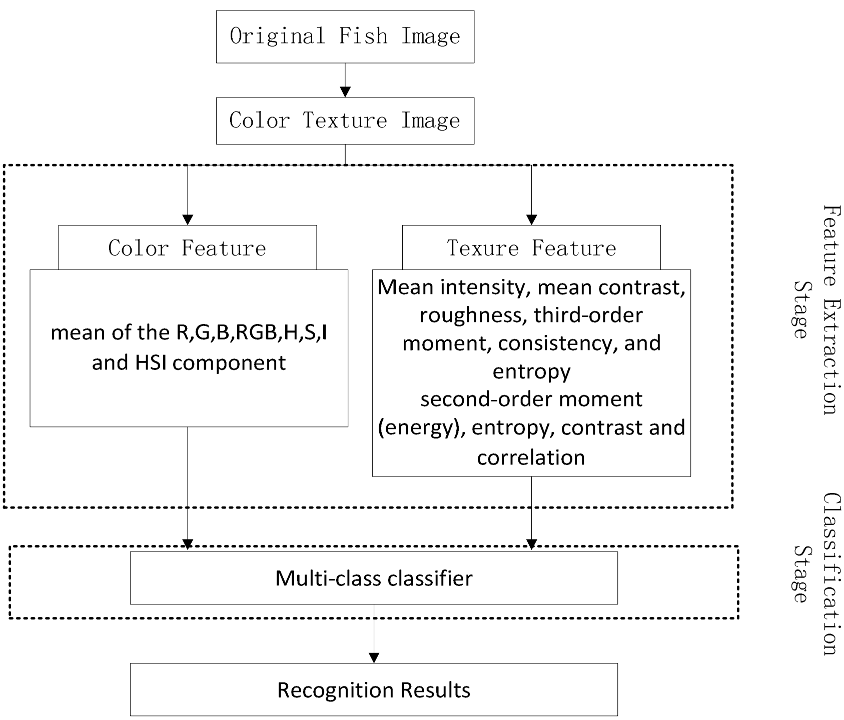

Fig. 2. Design of the recognition system

4 Conclusion

In this paper, we designed a recognition system for infected fish species. Color and texture features are more effective than any single type of feature to classify species of fish. With the future work of MSVM developing, infected fish species will be classified accurately and quickly.

Acknowledgments. This work is support by Beijing Natural Science Fund of "Research on Digital Culture of Intensive Aquatic Product" (4092024); The national science and technology supporting plan of "Integration and Demonstration of Key Technology for overall sense of agricultural field" (2011BAD21B01-1); Special Grand National Science-technology Project "TD-SCDMA based Development and Demonstration of Rural Informationization Application" (2009ZX03001-019-01); "Remote Diagnosis and Prevention and Control Application of Animal Epidemics " (2009P106) funded by the Translation of Scientific and Technological Achievements in Agriculture into Productive, Tianjin, China.

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