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Freshness Classification of Milkfish (Chanos chanos) using Wavelet Transformation in Image Extraction

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ABSTRACT

It is important to assess a fish if it is fresh or not fresh because a not fresh fish can harm the human's health. Milkfish (Chanos chanos) is the most familiar fish in a market today. In present generations many sensor technologies have been created or develop to answer the drawbacks of conventional methods for freshness classification of fish. Most of these methods are still in the stage of laboratory research and need further improvements and exploration researches for practical applications. There are several techniques used for conversion of image and one of them is the image processing. It is automatic, efficient, and non-destructive method for segmentation of tissues and monitoring the freshness of the fish. This study, generally aimed to classify milkfish (chanos chanos) freshness into fresh and not fresh based on Trained Cascade Model and Coiflet Wavelet Filter and Support Vector Machine. The eyes, gills, and body tissues of milkfish (chanos chanos) are segmented using clustering based method and its feature are strategically extracted in the wavelet transformation domain using Coiflet wavelet filter. Six scaling was used and wavelet function coefficients so improved in pixel averaging and differencing lead to a smoother wavelet and increased capability in several image-processing techniques. The study showed the accuracy results of 85.407% in Region of Interest Detection and 98% in Confusion Matrix for classification. The study is considered as significant to fish vendor, fish grower and fish consumers. Generally, study showed that the method used had improved results in freshness classifications.

Key words: Confusion Matrix, Coiflet Wavelet Transform, Fish Freshness, Region of Interest, Support Vector Machine

1.INTRODUCTION

Milkfish (Chanos chanos) most familiar fish found in many fish grower in the Philippines. It is locally called "bangus" here in the Philippines, which also named as the national fish of the country. Fish is a delicate entity; fish freshness and quality are vital indicators of its commercial success as goods [1]. Human sensory evaluation still remains the best and most precise way of assessing fish freshness. Non-human method of assessment exists but these can be challenging [2]. There is a number of methods have been used to identify the freshness of a fish. The Philippines' Bureau of Fisheries and Aquatic Resources refers to a quality table of fresh fish using sensory evaluation [3].

Image processing is the technique in which a picture is converted into digital form and to perform some processes on it, in order to acquire a superior image or to extract some essential data from it [4]. The wavelet transform [5] is commonly used in machine vision as an image processing method for object recognition and classification [6]. Wavelet have been applied in the previous studies to analyze images [7] and remote sensing was used in several applications for removing impair noise from images [8] using of surface analysis and applications with integration of high phantom resolution images with high spatial decree images, [9]. The main attribute of using image processing method is its non-damaging and flexible character to classify the parameters that involve in visual quality [10]

Throughout two decades, many extraction methods have been presented in numerous domains [11], particularly the time domain, the frequency domain and the time-frequency or time-scale domain. Among these method, features based on wavelet analysis are commonly used as an effective tool to extract valuable information from sEMG signal [12],[13]. A common approach of feature extraction from wavelet transformation is the computation of coefficient allocation over certain mother of wavelet [14]. The wavelets key advantage is their capability to spatially adapt to features of a function such as discontinuities and varying frequency performance. The compressed support means the localization of wavelets. That is, a region of the data can be processed without affecting the data outside the region [15]. Generally, the wavelet transform is an advanced technique of signal and image analysis [16].

Image analysis is a non-destructive, non-hazardous frequent tool for assessment of data based on images and analysis of its colour variations throughout imaging software can be an key method to classify the quality of fish [17], some in food production sectors using image processing [18], other used fuzzy logic based method for classifications of fish freshness [19].

The main goal of the study is the classification of milkfish (chanos chanos) into fresh and not fresh. This is achieved by using Wavelet Transformation in image extraction which is a non-destructive and non-hazardous method of classification. On the other hand, using image processing, only image of the fish is taken and using some segmentation method, the eyes, gills, and body tissue are segmented and analyzed.

The contribution of the study is efficient image processing based techniques for classifying of milkfish (chanos chanos) into fresh and not fresh. This is achieved by analyzing the wavelet transform domain features of the segmented tissues of the eyes, gills, and body from milkfish images. A complete statistical and image processing method has been obtained to discover these image features variations in segmented eyes, gills, and body outline to develop practical tool for classifying fish freshness.

The highlights of this study is to modify a set of features extraction based on Wavelet Transformation Coefficients (WTC) using confusion matrix and region of interest and Support Vector Machine (SVM) neural network to categorize the freshness of fish into fresh and not fresh. The some parts of the paper are presented as follows: Section 2 discusses the materials and methods; Section 3 provides the results and discussion. Finally, the conclusion presented in Section 4 of the paper.

2. METHODOLOGY OF THE STUDY

2.1 Concept of the Study

Figure 1.0 shows the conceptual framework of the study. The proposed method of freshness classification in milkfish samples images using image processing. Segmentation and feature extractions are the two processes that involved in classification of freshness. Image acquisition limits on the eyes, gills, and body. The images of milkfish (body, eyes, and gills) was cropped using Matlab to ascertain the region of interest. The cropped images undergo transformation from the RGB colour masking into greyscale. The results of RGB images transformation was used for image segmentation. Image segmentation used a Coiflet Watershed transformation. The segmented images were used for feature extraction. The main focus of the study is feature extraction using the Coiflet Wavelet Filter transformation. The decomposition was be done up to 10 levels once the decomposition is done respective approximation coefficients of the features are extracted. The Support Vector Machine Neural Network used for training as neural network. The output of this study determined the freshness of the milkfish (chanos chanos) if it is fresh or not fresh.

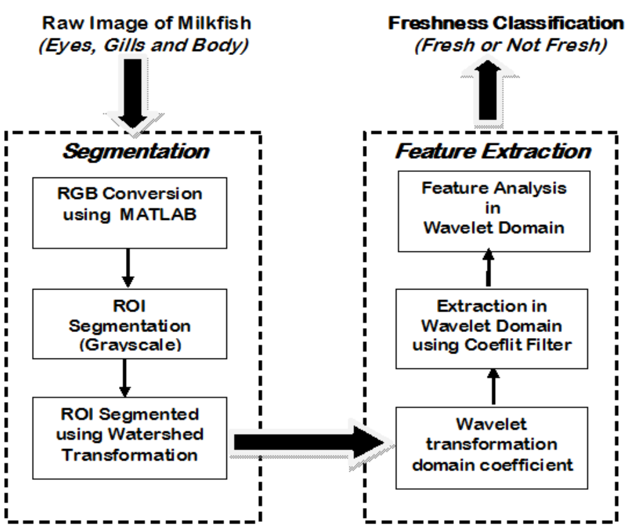


Figure 1: Conceptual Framework of the Study

2.2 Region of Interest Segmentation

In above discussion, changes in eyes, gills and body images features is one of the major characteristics that is easily perceptible and has discriminatory variation used for investigation in the proposal work. The segmented area of eyes, gills, and body of milkfish is consider as region of interest (ROI) for feature extraction as it contains the maximum discriminatory information required for freshness classification.

To segment the area of eyes, gills, and body of milkfish (ROI), the RGB image is converted using MATLAB. The RGB to MATLAB transformation of the images helps in classification of images in different regions, on the basis of individual colours which are mixture of red, green, blue and yellow colour. This transformation aids in colour based segmentation which is significant to the problem for segmenting the eyes, gills, and body from the whole image.

The region of interest (ROI) set as a classifier to identify the freshness of the milkfish. So it’s important to set an accurate system before it feeds to the SVM network for milkfish freshness classification.

The accuracy of ROI detection rate is,

$$\text{ROI Detection Rate} = \frac{\sum \text{Extracted images of ROI classifiers}}{\sum \text{datasets used for ROI validation}}$$

2.3 Development of the Study

Figure 2.0 two-dimensional DWT shows a decomposition of approximation coefficients at level j in four components: 1.) the original masked greyscale image, 2.) the down sampling of columns to keep the even indexed columns for both the lower diagonal and upper diagonal rows of the greyscale image, 3.) the down sampling of rows to keep the even indexed columns for both the lower diagonal and upper diagonal columns of the greyscale image, and 4.) the details in three orientations (horizontal, vertical, and diagonal).

The said extracted features were inserted to the Support Vector Machine (SVM) model using fitcecoc MATLAB command. The same mentioned process will be done to the images to be tested and validated. The results compiled in the confusion matrix which will show the false acceptance ratio, false rejection ratio and the accuracy of the system.

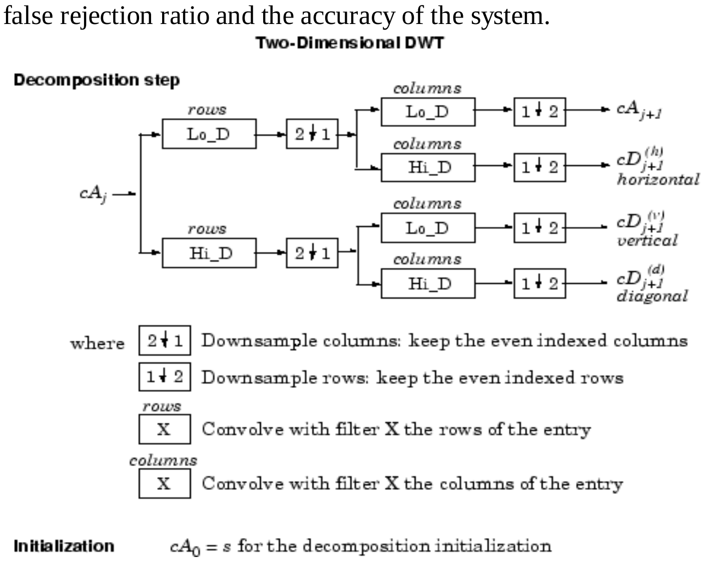


Figure 2: 2D Discrete-time Wavelet Transform Algorithm

3. DATA RESULTS AND DISCUSSION

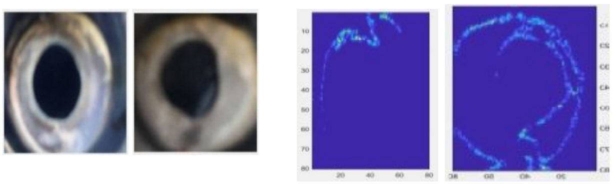
3.1 Region of Interest Detection

The proposed study is an image processing system that determine the freshness of a milkfish (chanos chanos) based on their eyes, gills, and body images.

There are 72 cropped images used as validation dataset for the body, 39 of those are validated as fresh milkfish’ gills. For not fresh milkfish body, 193 out of 215 are validated as not fresh. Refer to equation (1), it gives a 54.167% accuracy for fresh gills validation and 76.892% for not fresh eyes. Several milkfish fresh body pattern are detected in the raw images which causes a small accuracy in milkfish body detection.

After testing the detection of the correct ROI image of the milkfish body, the training dataset will be selected based on the correctly detected images.

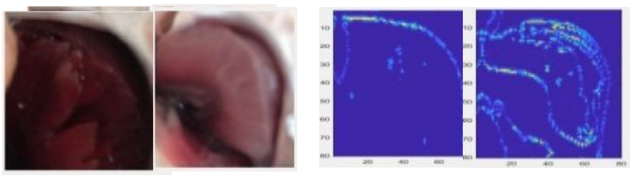
As to the results, out of 884 images, 755 is garnered an accurate data. These results shows an overall Region of Interest (ROI) detection rate of 85.40%.



Fresh Not fresh Fresh Not fresh

Region of Interest Cropped Images **Wavelet Pattern using coif2**

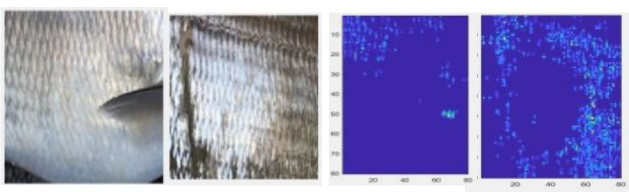
Figure 3: Eyes of the Milkfish (Fresh and Not Fresh)



Fresh Not fresh Fresh Not fresh

Region of Interest Cropped Images **Wavelet Patter Using coif2**

Figure 4: Gills of the Milkfish (Fresh and Not Fresh)



Fresh Not fresh Fresh Not fresh

Region of Interest Cropped Images **Wavelet Pattern using coif2**

Figure 5: Body of Milkfish (Fresh and Not Fresh

3.2 Classification of Milkfish Freshness Using Confusion Matrix

The Figure 6.0 shows the confusion matrix for the detection of freshness accuracy for the milkfish eye. The accuracy for the fresh eyes and not fresh eyes get 97 out of 110 and 196 out of 216 respectively. The overall accuracy of eye freshness is 89.9%.

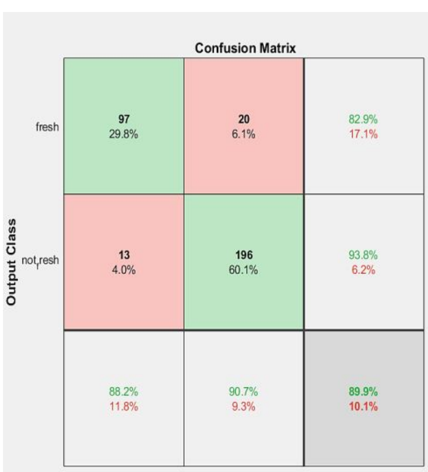


Figure 6: Confusion Matrix of Milkfish Eye Freshness

The Figure 7.0 shows the confusion matrix for the detection of freshness accuracy for the milkfish gill. The accuracy for the fresh gills and not fresh gills get 35 out of 41 and 144 out of 156 respectively. The overall accuracy for the gill freshness is 90.9%.

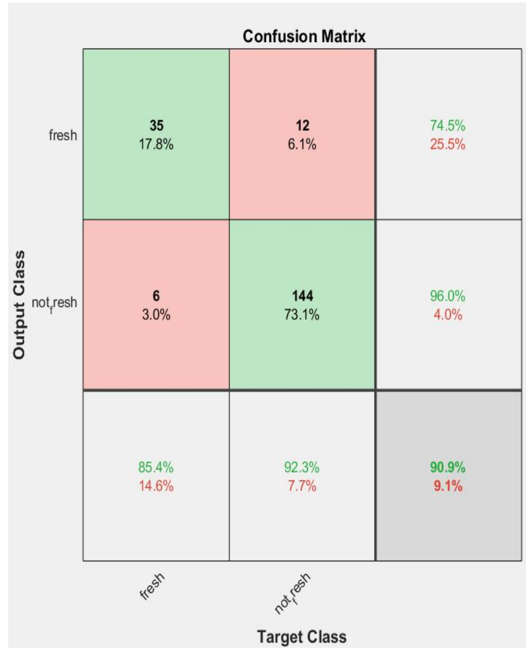


Figure 7: Confusion Matrix of Miklfish Gill Freshness

Figure 8.0 shows the confusion matrix for the detection of freshness accuracy for the milkfish body. The accuracy for the fresh body and not fresh body get 15 out of 39 and 191 out of 193 respectively. The overall accuracy of the body freshness is 88.8%.

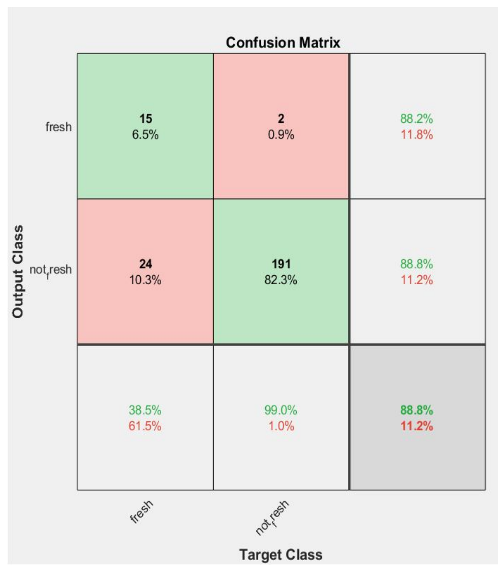


Figure 8: Confusion Matrix of Milkfish Body Freshness

As to overall accuracy results of confusion matrix based on multi class classification system for training, validation and testing dataset, the total classification rate is 98 percent and 2 percent for misclassification respectively.

3.3 Accuracy of Milkfish Freshness Classification

NOT fresh milkfish eyes;

Accuracy = Correct Sampled/total number of samples x 100%

Accuracy = 196/216 x 100 = 90.7%

The confusion matrix verifies that the not fresh milkfish based on its eyes, with 90.7% accuracy. The accuracy obtained can be checked with the total error of the system which is the total value outside the diagonal of the confusion matrix. The total misclassified test samples obtained were 20, and dividing it by the total number of test samples will give the total error of 9.3% which is equal to the percentage loss in accuracy.

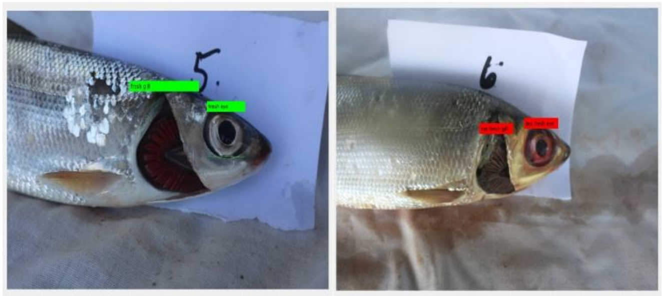


Figure 9: Sample Output Milkfish (Fresh and Not Fresh)

4. CONCLUSION

This study was used a non-destructive image processing for classification of milkfish (chanos chanos). The perceptible changes in segmented eyes, gills, and body tissues have been used in coiflet wavelet filter domain as discriminatory features. The study showed that the accuracy results of 85.407% in Region of Interest Detection and 98% in Confusion Matrix for classification. The study is considered as significant to fish vendor, fish grower and fish consumers. Generally, study showed that the method used had a good performance in terms of freshness classifications. This study is not limited only in application of milkfish but can be further studied or applied to other types fish. In addition, this study can be innovated through mobile applications for ease used.

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