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Reducing Fish Losses due to Epizootic Ulcerative Syndrome in aquaculture Industry through Image Processing for Sustainable Fish Farming

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Abstract: *The paper explains Enhanced Histogram of oriented gradients, a feature extractor which extract the relevant features and gives better performance in terms of Accuracy, Computation time, error rate when applied with Neural Network for classification. It has been observed through Analysis or experimentation that it gives better performance in detection of EUS(Epizootic ulcerative syndrome) disease.*

Keywords: *EUS (Epizootic ulcerative syndrome), EHOG(Enhanced Histogram of oriented Gradients),Neural Network(NN), PCA(Principle Component Analysis)*

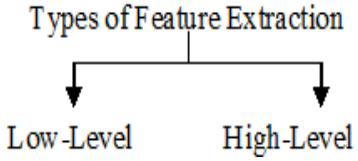
I. Introduction

Aquaculture is one of the most rapidly growing food production sectors in the world providing nutritional security for millions. India is the second largest fish producer in the world after china playing a vital role in the social-economic development. West Bengal is the second largest fish production state in India (after Andhra Pradesh)[1,2]. The system is being facing by serious threat due to severe intensification and unscientific management. One of the major deterrents in the aquaculture sector due to fish disease that is caused by virus[3], bacteria and fungus resulting loss of more than 1000 crores to the Indian agricultural export value. In India, the *EUS(Epizootic Ulcerative syndrome)* has been reported in Assam, West Bengal, Odisha, Andra Pradesh, Tamil Nadu, Uttar Pradesh, Karnataka, Bihar, Maharashtra and Punjab and EUS is serious fish disease problem[4]. In India, fresh and brackish water is the uniform transmission of meddlesome fungus which is link with Epizootic Ulcerative Syndrome (EUS). In monsoon and post monsoon season EUS infection was occurred. It may due do mixing of polluted water from domestic waste, fecal matter and Sewage through rain runoff. It is a disease definitive diagnosis. Huge loss of production in aquaculture is occurring because of many reasons. Among these causes, a disease is the most serious constraint that causes damage to the livelihood of farmers, loss of job, reduced incomes, and food insecurity. To overcome losses because of infectious diseases in aquaculture, it is necessary to act upon every health constraint based on scientifically proven and recommended as well as locally applicable ways [5]. As "prevention is better than treatment," it is advisable to focus on preventing the occurrence of disease rather than treating it [6]. Fish is also a livelihood of millions of people so that prevention of fishes is very necessary [7]. The disease is still misidentified by the people. Traditional method was very time consuming and it is done by the experience of fish farmers or fish veterinarians. There are number of methods or technique to automatic detection of disease in less time. In pattern recognition and image processing, initially the first step is image pre-processing where filtering, noise removal, and conversion of color to gray scale. It may have dramatic positive effect on the quality of feature extraction. The common step in many feature descriptor methods is the image pre-processing that is analogous to the mathematical normalization of data set. To improve the image analysis and feature extraction the pre-processing step in image processing plays an important step. Segmentation is also a part of image processing [8] and it is also of different kind of segmentation e.g. depth segmentation, super-pixel method binary method, gray and color. There are many applications for image pre-processing e.g. removal of illumination noise, binarization, thresholding, resizing and normalization etc. The main purpose of the normalization is to enhance the image. To the recognition system an image will be captured using a camera and fed as probe. The image is then pre-processed to enhance its quality. Enhanced Histogram oriented techniques has been applied in the paper. The features are extracted using suitable schemes. Classification algorithm are used to classify after extracting the features from the feature extractor, feature classified through classification algorithm [9]. Then transformed the data to minimize the number of features representation and if the data is large in number then it may be redundant of the data into minimum number of features.

II. Feature Extraction

Feature Extraction is the process of transforming the input data into a set of features. Information relative to color, shape, texture or context that belongs to the features, Many feature extractor algorithm has been used to extract the feature of the fish.

There are two types of feature extraction Low level feature extraction and High level feature extraction.



Finding the points, lines, edge in low level feature extraction etc while high level feature extraction provide more significant information for further processing of Image analysis and it also use the low level feature. There are different feature extraction technique that is based on transform, spatial, boundary, edge, color, shape and texture features. In finding shapes and objects in computer images high level feature extraction is responsible. According to chosen (or specified) conditions as the extraction generally seek invariance properties, whatever their position, their orientation, or their size that implies in finding objects the extraction result does not vary. The values of any parameter that can control the appearance of a shape through technique as it find shape reliably and robustly. To change the level in the illumination level: to find a shape whether it dark or light. Features extraction and classification learning is the fundamental for classification. Extracting the most relevant information from the data available is the first part.

III. Classification

Classification of the data after the feature extraction is a hefty work of machine learning area. There are many applications of machine learning e.g. "financial forecasting", "organization" and "retrieval of multimedia" and "bioinformatics". In the machine learning, training data is manually partitioned and is subsequently used as reference for classification of new data and hence known as supervised classification method. It is widely divided into three categories: Neural Network, texture classification, and data mining techniques. By means of texture properties of an image "texture classification" an image processing technique helps to identify different regions of image. To do the different kinds of traditional classification neural network are promising alternative. To detect hidden pattern "data mining" is one of the domains which uses "machine learning", "statistical", "visualization", other extraction techniques [7]. In the paper classification algorithms have been used to classify the "EUS" and "Non-EUS" fish dataset through NN (Neural Network). Neural Network has high computational power and gives good accuracy as compared to other algorithms. To enhance the performance and efficiency, modified feature extractor (EHOG) has been used which extracts more information and helps in improving the classification accuracy.

IV. Methodology

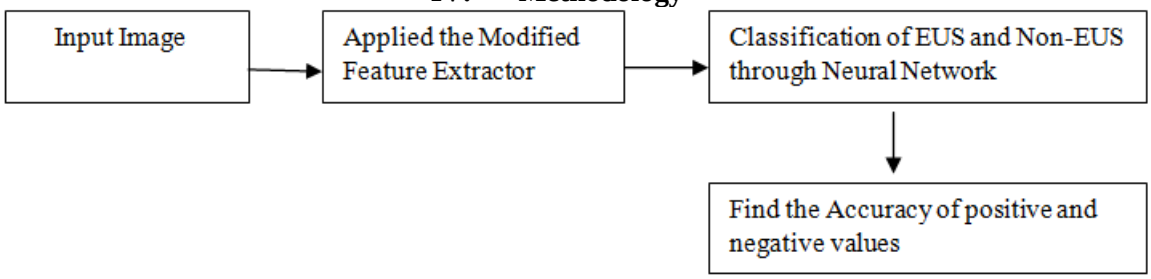


Figure 1: Flow chart of EHOG Feature Extractor Method

The above figure 1 shows that the method of Enhanced feature extractor (EHOG), first collects the images of EUS and Non-EUS fish. After that extract the different features and then applied the classification algorithm which divides the dataset into training and testing dataset for classification through Neural Network. After classification find the accuracy for positive and negative values in terms of performance measures.

- **Sample of training Dataset**

Figure 2: Sample of Training Dataset (EUS Infected Fish)

In Figure 2 shows the Sample of EUS (Epizootic Ulcerative Syndrome) infected fish which is used in experimentation and these images are collected from "(NBFGR, Lucknow) and ICAR-Central Inland Fisheries Research Institute (CIFRI), Kolkata

- **EHOG (Enhanced Feature Extractor)**

The Enhanced Feature Extractor is the Modified feature extractor of Histogram of Oriented Gradients.
The Steps to Explain the EHOG: -

- Extract the image and then divide the image into cells (4*4) and combine it into the blocks (2*2).
- After that compute the gradient and Magnitude in terms of intensity and gradient magnitude is affected by illumination changes, but its direction is not.
- The magnitude of the image gradient changes when one increases or decreases the intensity. The orientation of the image gradient does not change", direction of the "gradient arrows are fixed whereas the size changes.
- After that calculate directions and orientations of bins, "increase the number of bins, increases the size of the feature vector" which require" more time to process, selection of orientation values" specified as a "logical scalar". so that adjust the nearest angle 0,45,90,135 degree.
- When set this "property to true", "orientation values are evenly true in bins between -180 & 180 degree "and when set this "property to false"; they are evenly spaced from "0 through 180".
- "The value of theta that are less than" 0 are placed into a theta +180 value bin using signed orientation can help differentiate light to dark" and "dark to light" transition within image region.
- To set the value of threshold T low =0.075, if the value higher than the given value then it will take more time and skip more blocks, then compute the edges with the connected blocks.

V. Neural Network Classifier

- Neural Network (Pattern Recognition)

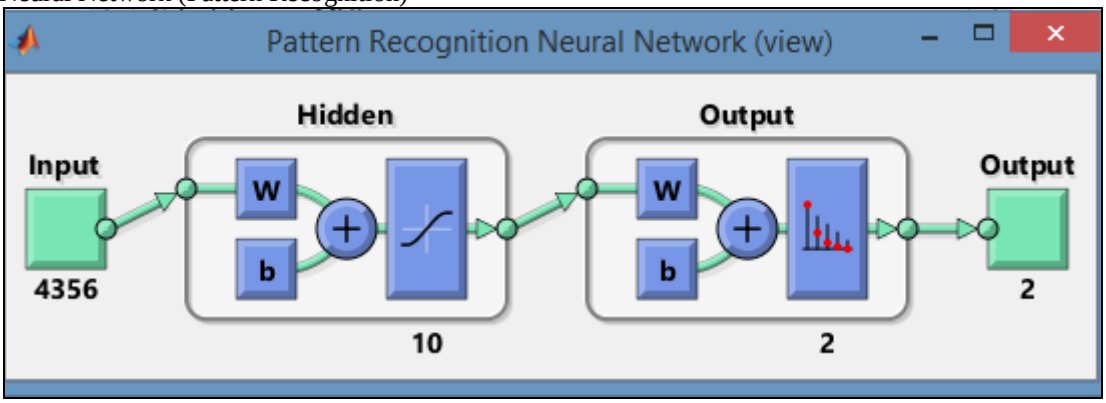


Figure 3: Pattern Recognition

It extracts the 4356 features in order to get a neural network to successfully learn task, it must be trained first. The training database is divided into training and testing set. The training set is used to train the neural network. To get the better results, train the neural network many times and get the average of classification accuracy. In which 10 cross validation have been used. The input or feature extracted by the feature extractor is 4356 and has taken 10 hidden layers which give the output. Testing set is used to test the neural network. To find the hidden neurons, in an architecture the dataset is divided into training set which is Ttraining and testing set which is Ttesting. The test set is used to test the ability of the network which is Network pattern recognition. [10].

The classification of EUS and Non-EUS fish is done by Neural Network and the features are extracted by the EHOG feature Extractor, which gives better accuracy, error rate and computation time as compared to the other Feature extractor.

- **EHOG-PCA-NN:**

EHOG (Enhanced Histogram of oriented Gradients) is combined with the PCA (principle of component Analysis) and then classify by Neural Network. PCA is used to reduce the dimensions as correlations between features in data can be found using a statistical method and linear technique for dimensionality reduction.

Reduction in dimensionality of data by done by eliminating irrelevant data from the dataset & is frequently used in both machine learning technique & image processing. Neural Network divides the dataset into training and testing set to train the network as it gives average classification based on 10 cross validation .

- **Analysis of Performance Measure of EHOG-PCA-NN**

Table 1: Performance Measure of EHOG-PCA-NN

Technique	Accuracy	Error Rate	Computation Time
EHOG-PCA-NN	98.7%	1.25	0.00719

The Table 1 shows the Analysis of performance Measure of EHOG-PCA-NN in Accuracy, Error Rate and Computation Time.

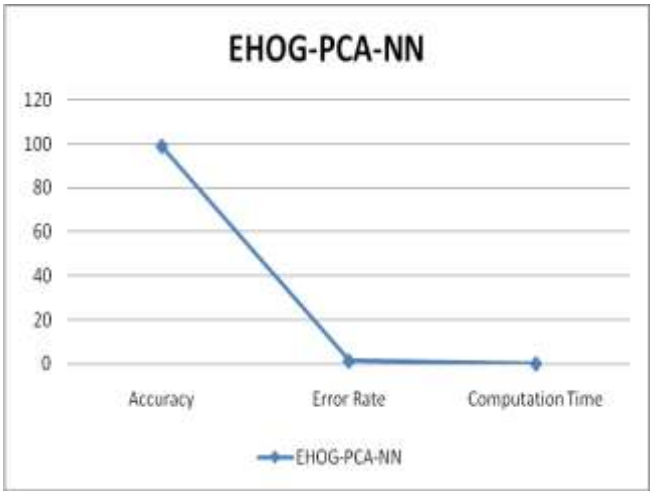


Figure 4: Performance Measure of EHOG-PCA-NN

In the above figure 4 shows that the Analysis of performance measure of EHOG-PCA-NN ,it shows the Accuracy of EHOG-PCA-NN = 98.7% ,Error Rate = 1.25, Computation Time = 0.00719.

VI. Conclusion

The EHOG (Enhanced Histogram of oriented Gradients) gives better result in detection of EUS disease. As EUS is misidentified by the people and it is necessary to prevent the mortality of fish because fish is the livelihood of millions of people. The EHOG-PCA-NN gives better results in terms of Accuracy it gives 98.6%, in computation time it gives 0.00719 and in error rate it gives 1.25.The best feature extractor will help in better classification.

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