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Squid Species Matching using Fuzzy Edge Based Algorithm

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Abstract*: *In the area of Commercial species identification, Squids species identification is significant because Squids plays an important role in Marine food chain. The identification of Squid species requires information about their morphometric features. Body shape feature is one of the important morphometric features for Squids. Hence, we consider only shape feature of Squid. Edge detection is an important technique to extract the shape feature for Squid images. Squid images contains uncertainty because of the problems occurs in the data acquisition and its complex structure. Hence, to avoid above mentioned uncertainties occurs in the Squid images consider Fuzzy edge map. In this work Fuzzy Edge Based Retrieval Algorithm is proposed for the query based Squid image retrieval from Squid's database. In the process of Fuzzy Edge Based Retrieval Algorithm, first Fuzzy Edge map is constructed for Squid images later the Euclidian distance similarity measure performs between Query image and the candidate images in the Squids database. Based on the similarity metric the relevant Squid images are matched with query image are retrieved. The performance of proposed algorithm analysed with precision recall graphs.

Keywords* : *Squid species, Shape extraction, Fuzzy Edge Map, similarity matching, Performance evaluation.

I. INTRODUCTION

Squids are classified as marine Cephalopod mollusc and it has a diverse group of invertebrates. In the food chain Squids occupy third trophic level. One of the most valuable and highly priced crustacean in marine fauna is Squid[1][2]. Generally, different species of Squids appear is similarly. Hence to identify the species Taxonomist presence is necessary. This process is time consuming and error prone. To avoid these conflicts the Computer based Automatic Identification system should be developed. For Squid species identification, shape feature occupies important role and many researchers has proved the importance in the identification of species [3][4]. Different edge detection techniques are applied like Sobel, Canny, Prewitt and so on. Because of the uncertainty in the Squid shape edges are not formatted properly.

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The Squid images have uncertainty shape due to the capturing of the images and its complex structure may be the causes of uncertainty. To overcome this issue, Fuzzy Edge Based Retrieval Algorithm is proposed for Squid species identification in this study. Fuzzy Edge map technique is used to enhance the formation of edges because it helps to deal with imprecise and vague information [5]. Fuzzy edge map also helps to detect every edge of image which will be associated with it. Retrieval is an important aspect in image recognition system. The main objective of retrieval technique is to compare the similarity between the images and provide the efficient results. In this study Squids shape feature is extracted using Fuzzy Edge map technique. The query image with Fuzzy Edge is compared with the database images using similarity metric i.e., Euclidian distance. To accomplish this task display the resulted images with retrieving percentage.

II. PROPOSED METHODOLOGY

The flow of work done on Fuzzy Edge Based Retrieval Algorithm (FEBRA) is described in this section. The methodology of FEBRA is shown in figure 1.

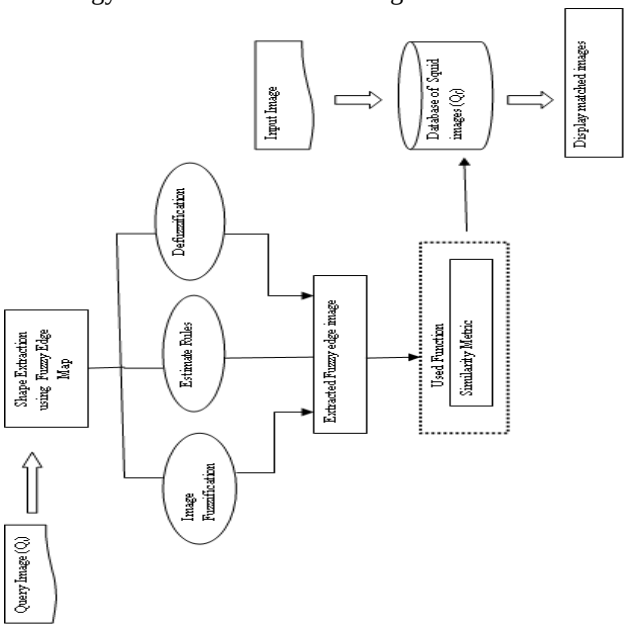

Fig. 1. FEBRA Methodology

In FEBRA first a query image (Qi) is given by the user and it is considered as input images. Shape feature of that image will be extracted using Fuzzy Edge map technique. To form the Fuzzy Edge map in the query image it will be converted into RGB to Gray image.

Later the query image with extracted Fuzzy Edge is compared with the images of Squids database (Qf) using the similarity metric. Finally, highly scored and smallest distance images are displayed as output with matched percentage.

III . FEATURE EXTRACTION

Feature Extraction is a initial process of image matching. It is used to extract the significant information from images such as species shape edge [6][7].

Shape represents physical structure of object. For shape extraction edge has important role, edges characterizes gray level discontinuities of an image. The discontinuities between the regions are generally of strong value of edges. These discontinued regions provide sudden changes in pixel intensity which are indicators of boundaries of objects in the image [8]. In this work shape extraction is done using fuzzy edge map.

A. Fuzzy edge formation for Squid species

Edge detection has a significant role in higher level processing. Image edges has important information about image content [9]. Edge map has various applications in the field of pattern recognition, medical image analysis and military technology etc., [10]. There are many different methods for edge detection like Sobel, Canny, Prewitt etc., Some common problems of these methods are large volume of computation, sensitivity to noise, anisotropy and thick lines and it cannot properly handle uncertainty images. However, Fuzzy edge map handles the uncertainty of images. Hence we are using Fuzzy edge map technique to extract the Squid's shape and it can smoothen and sharpening the edges. Fuzzy edge map process initiate with fuzzification. In Fuzzification step, input values are represented as white and black pixels. For each pixel in input image edges measured using three by three linear filters. The two fuzzy sets are characterized by triangular membership functions, in this for each input associated to linguistic variables i.e., high and low. Black and white pixel ranges are defined in the following equations (1) and (2). Higher membership value characterizes strong edge pixels, and lower membership values will characterize weak edge pixels[11].

$$\mu_b(i) = \begin{cases} 0 & x < 0 \\ \frac{255-i}{255} & 0 \le i \le 255 \end{cases}$$

$$\mu_b(i) = \begin{cases} 0 & x < 0 \\ \frac{255-i}{255} & 0 \le i \le 255 \end{cases} \quad (1)$$

$$\mu_w(i) = \begin{cases} 0 & x < 0 \\ \frac{i}{255} & 0 \le x \le 255 \end{cases} \quad (2)$$

The fuzzy rules are used for generating the edge map based on pixel values. Fuzzy rules are deal with eight neighbours, it checks the pixel is in the edge or not. Neighbouring pixels depends on gray level pixel weights. If the middle pixel represents the edge, weights of the four sequential pixel degree represent as black and remaining pixels are white. Thus the fuzzy conditions and membership values helps to extract the edges with a very high efficiency. In this study, experiment with Squid images it is found that the best result to be achieved at the range of black pixels is from zero to 88 gray values and white pixels from 88 to 255 weight[12][13]. The two rules are generated for pixel generation for forming the edges, that is white pixel belongs to a uniform region and remaining pixels considered as black pixel. The result of Squid species edge map is shown in figure

Fig. 2. Squid specie Edge formation using Fuzzy edge map

After extracting the edges, matching is performed in a series of images depicting the same features but indifferent resolutions. In the process of matching, first the user giving a query image then the system changes the image into its own internal representation and present edge detected image. After then compute the similarities between the query image and the database images using similarity metric. The algorithm of the proposed method FEBRA is given below

Algorithm: Fuzzy Edge Based Retrieval Algorithm (FEBRA)

Purpose: To Match the similar images based on Query Image.

Input: Gray scale Squid image.

Output: N similar images with smallest distance with Query Image.

Steps to follow

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Step1:- Input the query image Qi.

Step2:- Extract the Shape Features of Q using Fuzzy Edge Map.

Step3:- Save these shape on the feature vector Qf.

Step4:- Calculate the similarity measure between Query Image and already stored Images in the database. For the purpose of similarity measure between query and database images using Euclidian Distance.

Step5:- Based on the Euclidean distance retrieve the N similar images with smallest distance are displayed.

}

B. Similarity Metric

In this task we are using Euclidian distance to find the similarity between two feature vectors[14]. If X = [x1....xi] and Y = [y1....yi] are two feature vectors then the Euclidean distance metric between X and Y is expressed following equation (3).

$$Euclidian\ Distance = d = \sqrt{\sum_{i=1}^{N}(X_i - Y_i)^2}$$

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IV . EXPERIMENTAL RESULTS

The proposed system is implemented using MATLAB. Squid image database shown in figure 3, it contains 200 images spread over fifteen classes. This section also deals with evaluation metrics and the result of our method and performance comparison with existing methods. The Squid images are acquired from different harbors, aqua centers and sea shores. The proposed method experimental results shows in following figures 4,5& 6.

V . PERFORMANCE EVALUATION OF FEBRA

For evaluating the FEBRA matching efficiency, we have considered two parameters such as recall and precision[15][16]. In our experiment, the precision and recall are calculated based on equations (4)&(5). Where 'a' is Number of Matched Squid images retrieved assigned, 'b' represented as total number of Squid images retrieved and total number of relevant Squid images in the database as 'c'.

Precision = a/b (4)

Recall = a/c (5)

Image Database

Fig.3. Squid Species Image Database

Fig. 4(a). Query image (b)(c)(d)(e)(f) retrieved images with distances

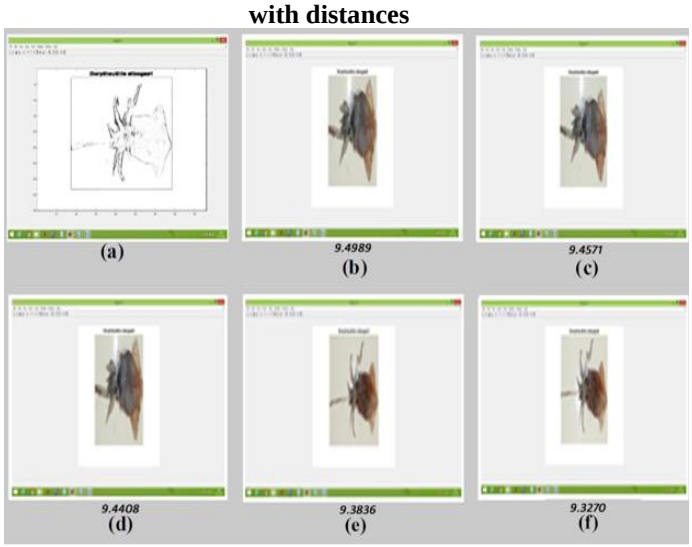

Fig. 5(a) Query image (b)(c)(d)(e)(f) retrieved images with distances

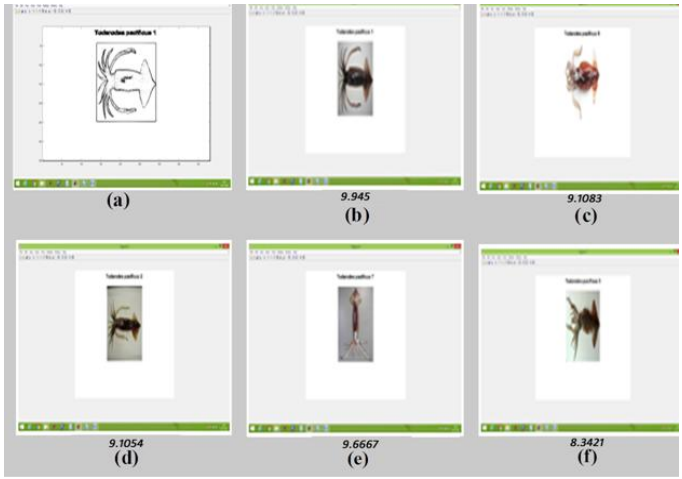

Fig. 6(a) Query image (b)(c)(d)(e)(f) retrieved images with distances

Average of precision and recall performance and its related graph is shown in Table 1 and figure 7 respectively.

Table- I: Average of Precision Recall Performance evaluation %

S.No.	Species Name	Average of Precision Recall Performance
1	Todarodespacificus	1
2	Illexillecebrosus	0.7
3	loligoDuvauceli	1
4	Todarodessagittatus	0.8
5	Collosal	0.8
6	Dosidicusgigus	0.8
7	Gonatopsismakko	0.7
8	Loligoopalescens	0.8
9	Gonatusantarcticus	0.8
10	Illexargentinus	0.6
11	Dorytheuthissibogae	1
12	Illexsteenstrup	0.9
13	Loligoforbessi	0.9
14	loligoopalescens	0.9
15	Neon flying	0.8

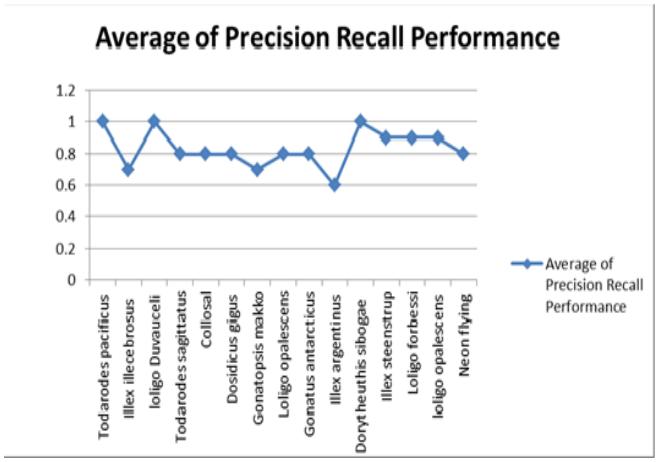

Fig.7. Average of Precision Recall plot

VI. CONCLUSION

In this paper successfully implemented Fuzzy Edge Image Matching Algorithm for Squid species identification. Squid species identification is more useful to Aqua farmers. They can easily recognize the Squid species class using FEIMA system. FEIMA system is more efficiently working and it provides accurate result than our existing system such as Feature based Fuzzy Inference System(FFIS). In future, some more different Squid species will be used to evaluate the effectiveness and efficiency of our proposed method.

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