# FUZZY EDGE IMAGE MATCHING ALGORITHM FOR SQUID SPECIES IDENTIFICATION

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**ABSTRACT** Squid image features plays an important role in matching system. The effectiveness of these Squid species features depends on the global features. The identification of Squid species requires information of their morphology. Body shape is very useful to characterize the one species to another species. In Shape extraction, edge detection is an important aspect. Edge is an important visual feature and it represents visual information with a limited number of pixels. While considering the morphology of Squid, it can have uncertainty due to climatic conditions. Hence, in this study feature extraction is done by fuzzy edge map. In this paper we proposed Fuzzy Image Edge Image Matching Algorithm (FEIMA) for Squid species identification. Similarity metric is used for matching of query and the candidate images in the database and it finally displays the class of species. The proposed algorithm performance is calculated by using Average of precision and recall.

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

## 1. INTRODUCTION

Squids are classified as marine Cephalopod molluscs. Squids are a diverse group of invertebrates nearly there are estimated to be about 375 species of Squids in different seas and oceans and they occupy third trophic level in the food chain. One of the most valuable and highly priced crustacean in marine fauna is Squid (E. G. Silas 1985; Anusha J. R. et al., 2014). Generally, recognition of Squid species taxonomist presence is very needful and it is also time consuming process. To avoid this problem Fuzzy Edge Image Matching Algorithm (FEIMA) is proposed for Squid species identification, which is based on Fuzzy edge map and Manhattan similarity metric. Every Squid image has got its own and similar characteristics. These features are play very important role in subsequent identification and discrimination between images. While Shape is considered to identify the Squid species sometimes uncertainty will occur, hence to overcome the problem caused by uncertain shape of species we used Fuzzy edge map for shape extraction (Kenneth H. L. et al., 2006). An edge is a boundary between two uniform regions. Uniform regions do not seem to be sharply outlined, tiny intensity variations between two near pixels don't perpetually represent a position, these intensity variations square measure give shading effects. In these regions every edge is compared with the intensity of neighboring pixels. Here edge pixels are defined as fuzzy values that is call it as fuzzy edges. In Fuzzy method, membership function is used to define the pixel belongs to an edge or a uniform region (Pooja R. Bhat, 2017). Then the detected fuzzy image shape is matched with database images which is also having Squid images based on similarity metric and displays the species class. The experimental results shows which are high similarity scored images are matched that are displayed.

## 2. METHODOLOGY OF PROPOSED METHOD

The flow of work based on Fuzzy Edge Image Matching Algorithm (FEIMA) as shown in Figure 1.

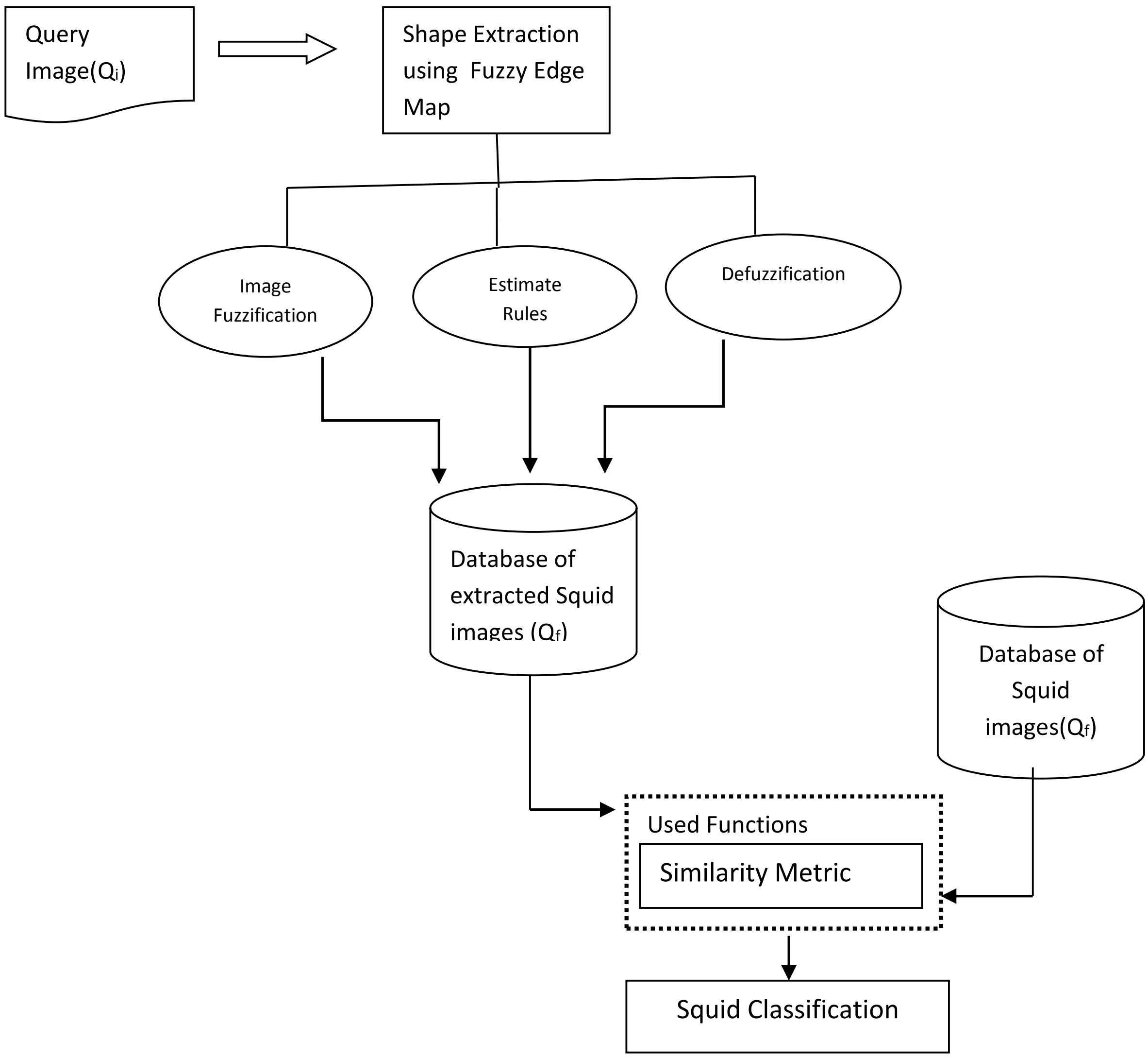



**Figure 1.** FEIMA work flow

In this process first the user can give a query image as $Q_i$ and then it can be converted into gray scale image after that species edge is extracted by using fuzzy edge map technique which contains fuzzy rules and membership functions. The extracted shape feature is stored in database $Q_f$. This query feature compared to the already stored database images. In matching process compute the similarity between query image and stored images using Manhattan distance metric and same feature extraction procedure is applied on query image also. If the distance is less than the limit value, then that species is considered to be matched species of a query image and are displayed as class of species.

## 3. FEATURE EXTRACTION

Feature Extraction is an initial process of image matching. It is used to extract the significant information from images such as species shape edge (Felicitas Perez Ornelas et al., 2015; Abdallah A. Alshennawy, 2009). 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 (Hamid R. Tizhoosh, 2002). In this work shape feature extraction is done using fuzzy edge map.

### *3.1 Fuzzy edge formation for Squid species Shape*

Edge detection has a significant role in higher level processing. Image edges have important information about image content (Xiaogbin Wang et al., 2013). Edge map has various applications in the field of pattern recognition, medical image analysis and military technology etc., (Shashank Mathur et al., 2008). 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. The real species images like Squids have uncertain shape hence we are using Fuzzy edge map technique to extract the shape, it can smoothen and sharpening edges and Fuzzy edge map based algorithm is more flexible in handling thickness of edges in the final image. 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 two 3 x 3 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 following equations (1) and (2). Higher membership value characterizes strong edge pixels, and lower membership values will characterize weak edge pixels (Wang Xiaoling et al., 2005).

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

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

The fuzzy rules are used for generating the edge map based on pixel values. Fuzzy rules are deal with eight neighbours, it checks pixel is in the edge or not. These neighbours depends on gray level pixel weights. If the middle pixel represent the edge, weights of the four sequential pixel degree is black and remaining pixels are white.Thus the fuzzy conditions and membership values helps to extract the edges with a very high efficiency. From the experience of the tested images in this study, it is found that the best result to be achieved at the range of black pixels is from zero to 80 gray values and white pixels from 80 to 255 weight (Hiremath P.S. et al., 2008) (Shaveta Malik et al., 2016). 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 2.

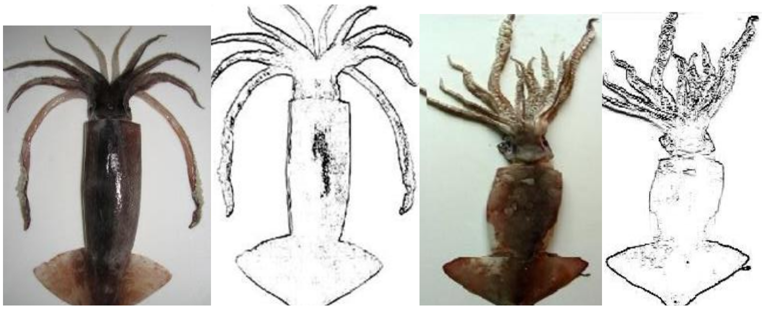


**Figure 2.** Squid species Edges formation using Fuzzy edge map

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 may given a query image then the system changes the image into its own internal representation of feature vectors and present edge detected image. After then compute the similarities between the feature vectors of the query image and the feature vectors of the database images using similarity metric. The algorithm of the proposed method FEIMA is given below:

*Algorithm: Fuzzy Edge Image Matching Algorithm (FEIMA)*
*Purpose: To Match the similar images based on Query Image.*
*Input: Gray scale Squid image.*
*Output: N similar images with smallest distance withQuery Image.*
*Steps to follow*
*{*
*Step1:- Input the query image* $Q_i$.
*Step2:- Extract the Shape Features of Q using Fuzzy Edge Map.*
*Step3:- Save these shape on the feature vector* $Q_f$.
*Step4:- Calculate the similarity measure between QueryImage and already stored Images in the database. For thepurpose of similarity metric using Manhattan Distance.*
*Step5:- Based on the Manhattan Distance display the matched image.*
*}*

## 3.2 Similarity Metric

Manhattan distance calculates sum of difference in every dimension of vector space. It is sum of absolute differences of corresponding components (Diksha Kurchaniya et al., 2017). Manhattan distance is also known as 'City Block Distance' or 'L1 distance'. Manhattan distance is based on absolute value distance, as opposed to squared error distance. Absolute value distance should give more robust results, whereas Euclidean would be influenced by unusual values. The Manhattan distance between two points, $x_j$ and $y_j$, with *k* dimensions is calculated as:

$$D = \sum_{j=1}^{k} \left| x_j - y_j \right| \quad \text{for } j=1, 2...k \qquad (3)$$

Feature vector value of query image is represented by $x_j$ and feature vector value of database image is represented by $y_j$.

## 4. EXPERIMENTAL RESULTS

This section includes Squid image database as shown in figure 3 and to check the effectiveness of the proposed matching system. The proposed system is implemented using MATLAB. Squids image database containing 200 images spread over fifteen classes like *DorytheuthisSiblogae*, *UroteuthisDuvaceli*, *TodarodesPacificus* etc., is used as the database. This section also deals with evaluation metrics.

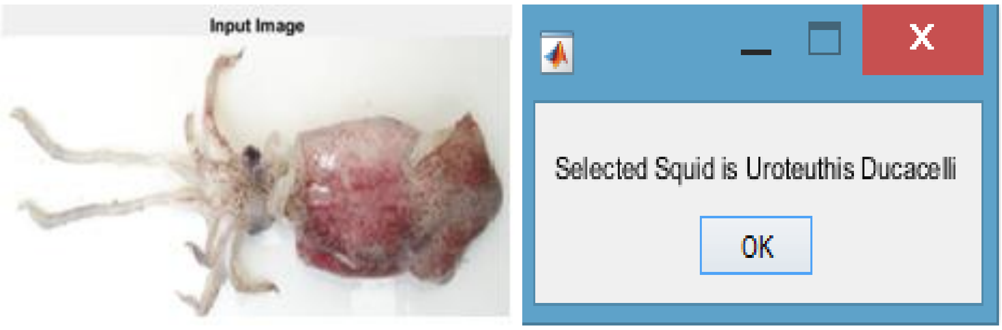
Image Database:

**Figure 3.** Squid Species Image Database

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.

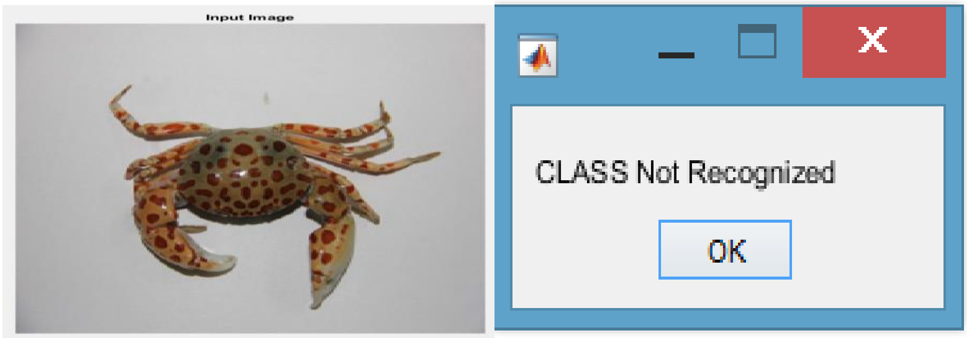

*(a)* *(b)*

**Figure 4.** (a) Query image; (b) Output (class of species)




*(a)* *(b)*

**Figure 5.** (a) Query image; (b) Output (class of species)




(a) (b)

**Figure 6.** (a) Input Image; (b) Output (class of species)

## 5. PERFORMANCE EVALUATION OF FEIMA

For evaluating the FEIMA matching efficiency, we have considered two parameters such as recall and precision (Jun Zhang et al., 2009). 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'.

$$Precision = \frac{a}{b} \quad (4)$$

$$recall = \frac{a}{c} \quad (5)$$

**Table 1.** Precision and Recall Analysis

| S.No. | Image | Precision (%) | Recall (%) |
|---|---|---|---|
| 1 | Figure 4. (a) | 85 | 82 |
| 2 | Figure 5. (a) | 86 | 84 |
| 3 | Figure 6. (a) | 20 | 85 |

Table 1 represents the matched and unmatched Squid images in the database, here first we have loaded the query image and then query image start to matching with database images, that matching efficiency can be calculated by precision and recall metrics. Average of precision and recall performance and its related graph is shown in Table 2 and figure 7 respectively. The features are computed by using fuzzy edge map and we fix the threshold value at 0.6. Although we have also selected with different threshold levels, but it cannot change the image result drastically.

**Table 2**. Average of Precision Recall Performance evaluation %

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

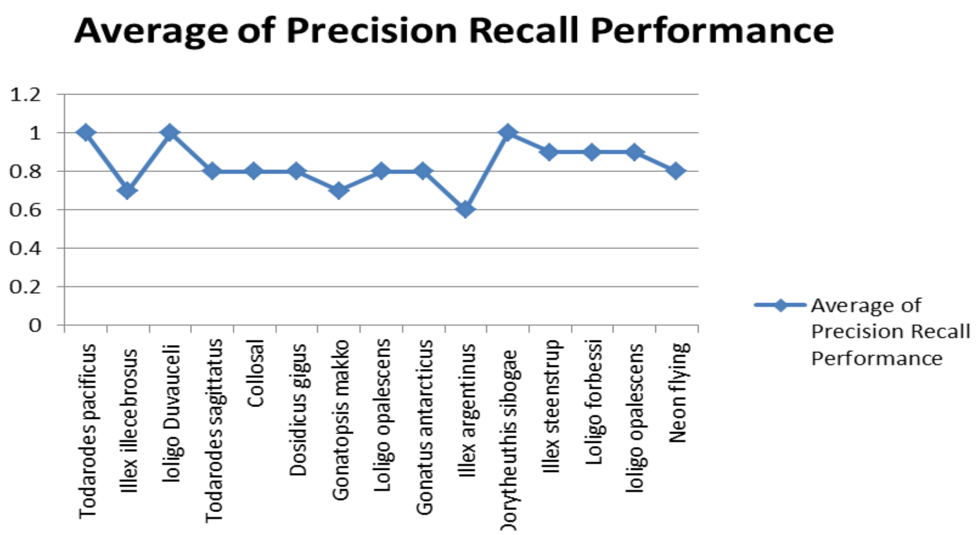



**Figure 7**. Average of Precision Recall plot

## 6. CONCLUSIONS AND FUTURE WORK

This paper presents a robust technique for extracting the shape of species i.e., Fuzzy edge map of an image. Other existing techniques it does not require any pre segmentation method for getting the features. The common problem with Squid species Image Matching is extracting the edge feature. This edge is a strong and important feature for characterizing an image. The edge region characterizes the transition between two uniform Plateaus. The fuzzy edge map pixels are classified into different types such as weak, Medium and Strong based on their membership values. Based on membership values we have 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.

## 7. ACKNOWLEDGEMENT

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