Image Processing Technique To Detect Fish Disease

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Abstract

Disease is one of the major cause for fish mortality. The identification of diseased fishes are at early stage to prevent and spreading diseases. Manually detecting fish diseases are not error free. The image of the diseased fish recognise by using PCA method. In this work diseased area segmentation of fish image based on colour features with K-means clustering. HSV images and Morphological operation open for better accuracy to diseased area detection and measurement. Taken four Epizootic Ulcerative Syndrome (EUS) diseased fish images as a case study to evaluated the proposed approach. The experimental results clear indication of the effectiveness of proposed approach to improve the diseased identification with greater precision as well as correctly compute diseased area. The simulation results of this approach is encouraging.

Keywords: PCA, K-Means, HSV, Morphological Operation, Diseased Fish Images, Image Processing.

1. INTRODUCTION

Fish constitutes a major component of diet for the people of North- East India particularly in Assam. Fishes form an important element in the village economy. Fishing and fishery is one of the main source of employment and income for the people residing in the village. Large-scale mortality occurs among the fresh water fishes has been increased since 1988 due to dreadful disease Epizootic Ulcerative Syndrome (EUS), symptom tiny red spot on the body surface initially. This spot later develop ulcer. After few days losing its scales and muscles exposes body. Infected fish dies within a short period.[1] [2][3].

Fish disease is a serious problem due to its ability to spread rapidly through water to neighboring aqua-farms. Therefore, rapid and accurate diagnosis is required to control such diseases. Traditionally, fish diseases have been diagnosed by using the accumulated experience of fisher man or fishery departmental expert. However, the accuracy of such final diagnosis ultimately depends on individual skill and experience and the time spent studying each disease. In order to overcome this limitation, digital image processing technique to detect and classify fish diseases from digital images. [4][5] [6].

2. MATERIALS AND METHODS

Fish effected with Epizootic Ulcerative Syndrome (EUS) were collected from the different part of the Barak Valley, Assam and identified by human expert. Pictures(Fig1) of diseased fish were taken by the SLR camera. Images were 200 by 200 pixels so that an engineering compromise can be obtained between processing time of algorithms and clarity retention of input images.

(a) (b) (c) (d)

FIGURE 1: (a)*Clarias batrachus***,** (b)*Puntius chola***,** (c)*Labeo bata* and (d)*Labeo gonius* are infected with EUS disease.

2.1 Principal Component Analysis (PCA)

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation. The PCA approach is used to reduce the dimension of the data by means of data compression basics and reveals the most effective low dimensional structure of image patterns. This reduction in dimensions removes information that is not useful and precisely decomposes the fish structure which involves transformation of number of possible correlated variables into a smaller number of orthogonal (uncorrelated) components known as Principal Components. Each fish image may be represented as a weighted sum (feature vector) of the eigen fish, which are stored in a 1D array. The test image can be constructed using these weighted sums of eigen fish. When a test image is given, the weights are computed by projecting the image upon eigen fish vectors. The distance between the weighted vectors of the test image and that of the database images are then compared. Thus one can reconstruct original image with the help of eigen fish so that it matches the desired image. [7] [8] [9] [10].

2.2 K-Means Clustering

Cluster analysis, also called segmentation analysis or taxonomy analysis, creates groups, or clusters*,* of data. Clusters are formed in such a way that objects in the same cluster are very similar and objects in different clusters are very distinct. Measures of similarity depend on the application.

Clustering can be considered the most important unsupervised learning problem; so, as every other problem of this kind, it deals with finding a structure in a collection of unlabeled data. Clustering is defined as the process of organizing objects into groups whose members are similar in some way. A Cluster is therefore a collection of objects which are similar between them and are dissimilar to the objects belonging to other clusters.

K-Means Clustering is a partitioning method. The function k-means partitions data into k mutually exclusive clusters, and returns the index of the cluster to which it has assigned each observation. Unlike hierarchical clustering, k-means clustering operates on actual observations (rather than the larger set of dissimilarity measures), and creates a single level of clusters. The distinctions mean that *k*-means clustering is often more suitable than hierarchical clustering for large amounts of data. [11] [12] [13] [14] [15].

2.3.1 Feature Extraction In HSV

The HSV space component to reduce computation and improve efficiency. Unequal interval quantization according the diseased fish color perception has been applied on H, S, and V components. In accordance with the different colors and subjective color perception quantification, quantified hue (H), saturation (S) and intensity (V) are obtained. Hue ranges from 0 to 360 degrees, with variation beginning with red, going through yellow, green, cyan, blue and magenta and back to red [16] [17] [18].

2.3.2 Morphological Operations

Morphological image processing is a collection of nonlinear operations related to the shape or morphology of features in an image. The morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images [19].

3. EXPERIMENTAL FINDING

3.1 Algorithm for PCA

Let the training set of images be $\Gamma_1, \Gamma_2 \ldots\ldots \Gamma_M$ the average fish of the set is defined by

$$\Psi = 1/M\sum_{i=1}^{M} \Gamma i$$

Each fish differs from the average by vector

$$\Phi i = \Gamma i - \Psi$$

Where i=1….M

The co- variance matrix is formed by

$$C = A.\,A^T$$

Where the matrix A is given by

$$A = [\Phi_1,\Phi_2,\ldots\ldots \Phi_M]$$

This set of large vectors is then subject to principal component analysis, which seeks a set of M orthonormal vectors. To obtain a weight vector W of contributions of individual eigen-fishes to a fish image, the fish image is transformed into its eigen-fish components projected onto the fish space by a simple operation.

$$W_k=u^t_k\Phi$$

For k=1... M', where M' £ M is the number of eigen- fishes used for the recognition. The weights form vector W = [w1,w2,….wm] that describes the contribution of each Eigen- fish in representing the fish image, treating the eigen-fishes as a basis set for fish images. The simplest method for determining which fish provides the best description of an unknown input fish image is to find the image k that minimizes the Euclidean distance $€_k$.

$$€_k=||(\Omega-\Omega k)||^2$$

Where W_k is a weight vector describing the kth fish from the training set.

The MATLAB was used to implement the algorithm(Figure 2) &(Figure 3).

FLOW CHAT FOR EXPERIMENTATION PCA

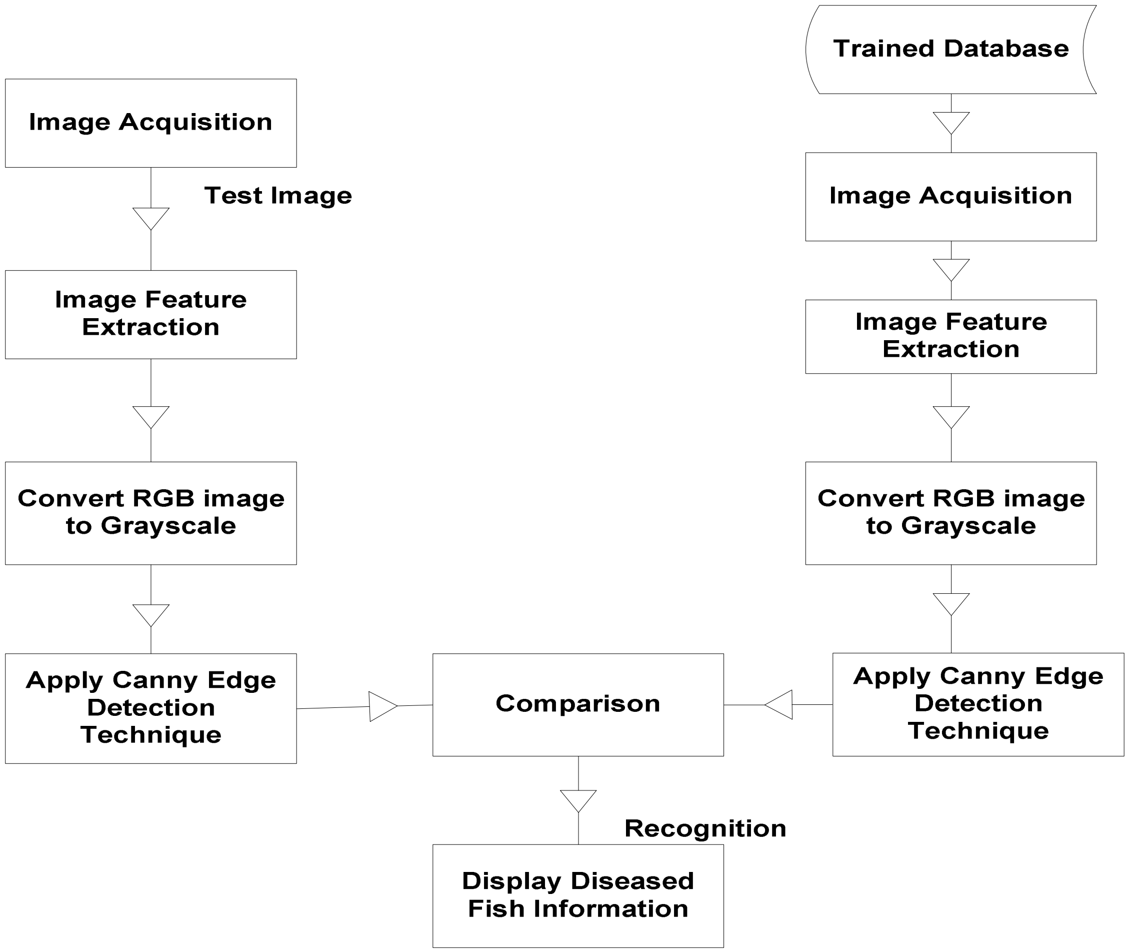


FIGURE 2: Complete Process of PCA.

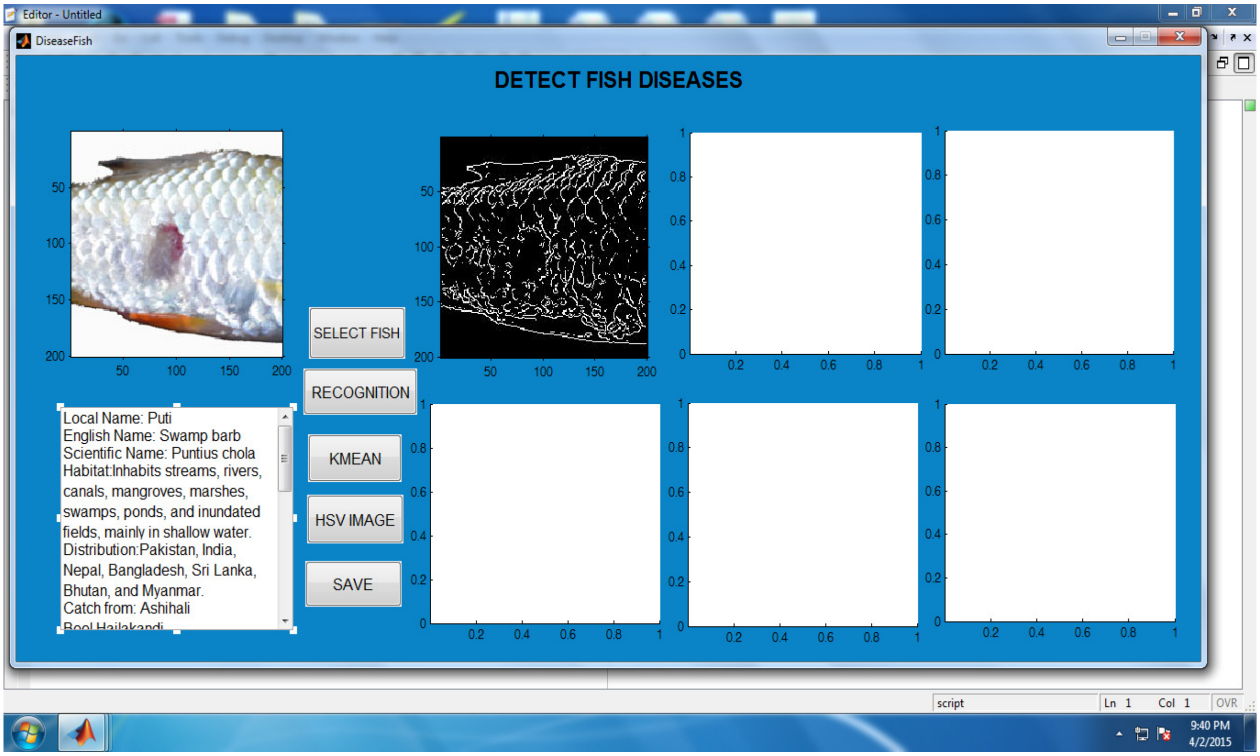


FIGURE 3: Fish Recognition using PCA.

3.2 K-means Clustering Algorithm

The basic aim of the proposed approach is to segment colors automatically using the K-means clustering technique and L*a*b* color space. The introduced framework of defect segmentation operates in six steps as follows (Figure 4).

Step 1. Read the input image of diseased fish.

Step 2. Transform Image from RGB to L*a*b* Color Space. It consists of a luminosity layer in 'L*' channel and two chromaticity layer in 'a*' and 'b*' channels. Using L*a*b* color space is computationally efficient because all of the color information is present in the 'a*' and 'b*' layers only.

Step 3. Classify Colors using K-Means Clustering in 'a*b*' Space. To measure the difference between two colors, Euclidean distance metric is used.

Step 4. Label Each Pixel in the Image from the Results of K-Means. For every pixel in our input, Kmeans computes an index corresponding to a cluster. Every pixel of the image will be labeled with its cluster index.

Step 5. Generate Images that Segment the Input Image by Color. To separate the pixels in image by color using pixel labels, which will result different images based on the number of clusters.

Programmatically determine the index of each cluster containing the diseased part of the fish because K-means does not return the same cluster index value every time. But can do this using the center value of clusters, which contains the mean value of 'a*' and 'b*' for each cluster (Figure 5).

Gray-scale image of *Clarias batrachus* , *Puntius chola* , *Labeo bata* ,*Labeo gonius* (Figure 6).

FLOW CHAT FOR EXPERIMENTATION K-MEAN

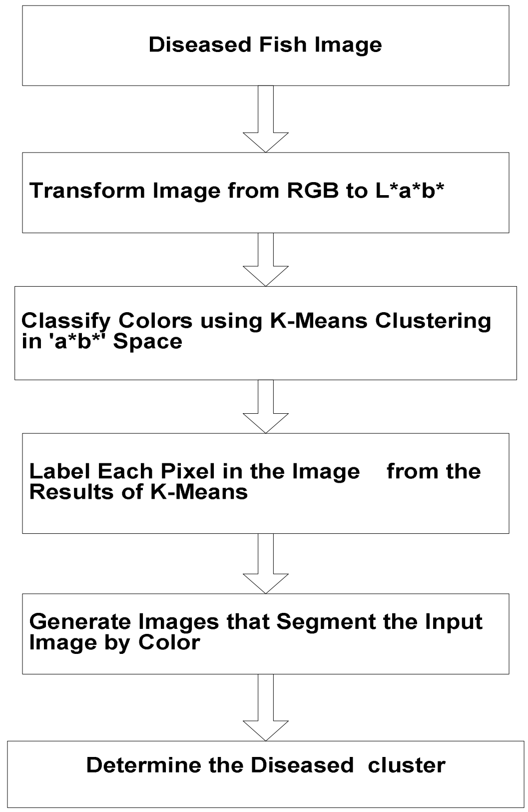
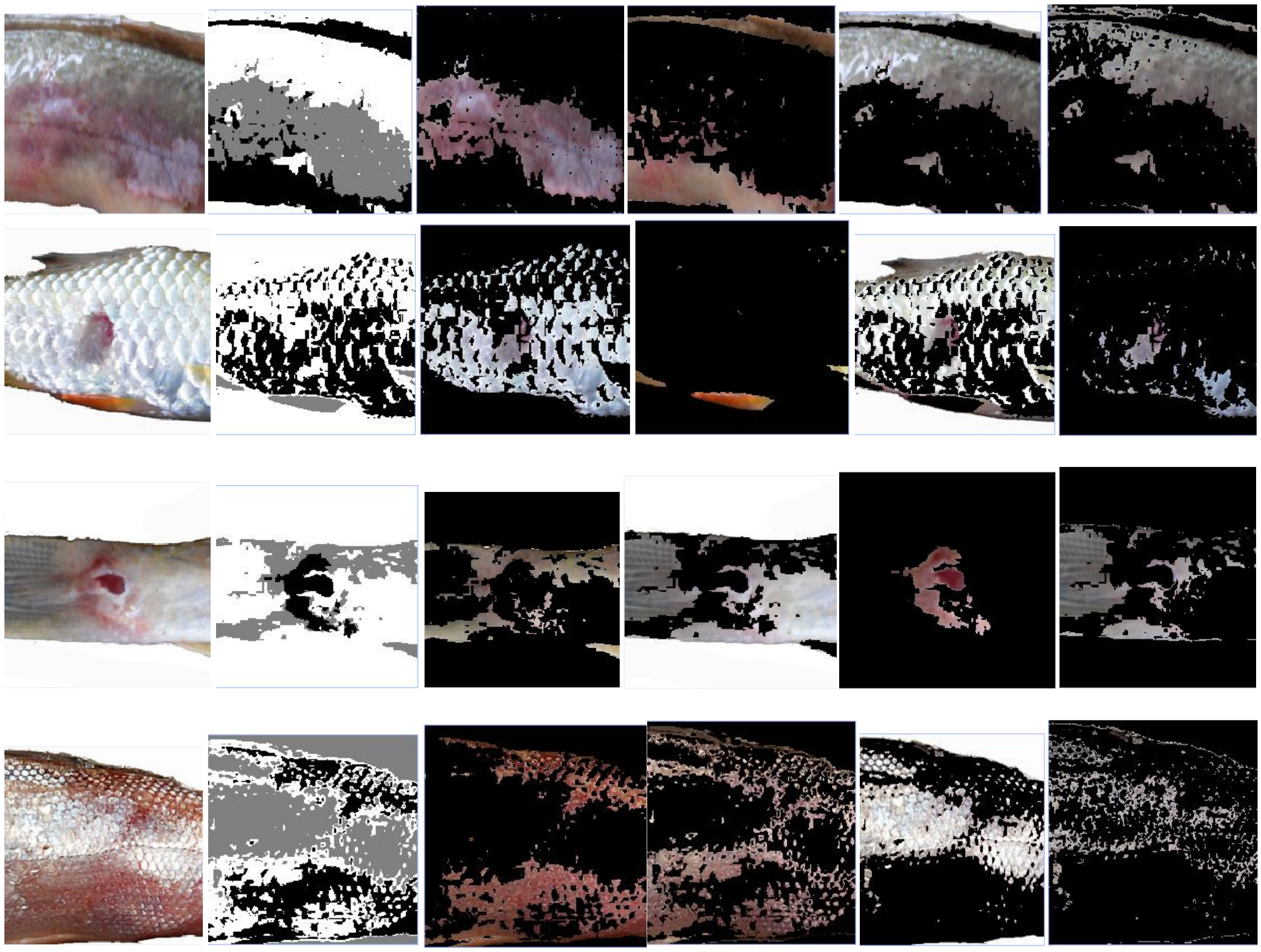


FIGURE 4: Complete Process of K-means Clustering.



(a) (b) (c) (d) (e) (f)

FIGURE 5: K-Means clustering (a) Image of *Clarias batrachus , Puntius chola , Labeo bata ,Labeo gonius* are infected with EUS disease with five clusters(b) Index Cluster (c) Cluster1, (d)Cluster2, (e) Cluster3, (f) Blue nuclie.

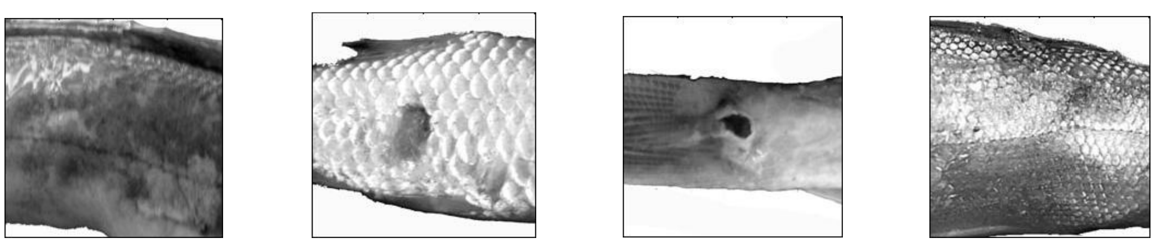


FIGURE 6: Gray-scale image of *Clarias batrachus , Puntius chola , Labeo bata ,Labeo gonius.*

3.3 HSV and Morphological Open

Morphological operations open can also be applied to improved Hue images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest. Morphological techniques probe an image with a small shape or template called a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighbourhood of pixels(Fig: 7) &(Fig: 8).

FLOW CHAT FOR EXPERIMENTATION HSV AND PIXELS VALUE

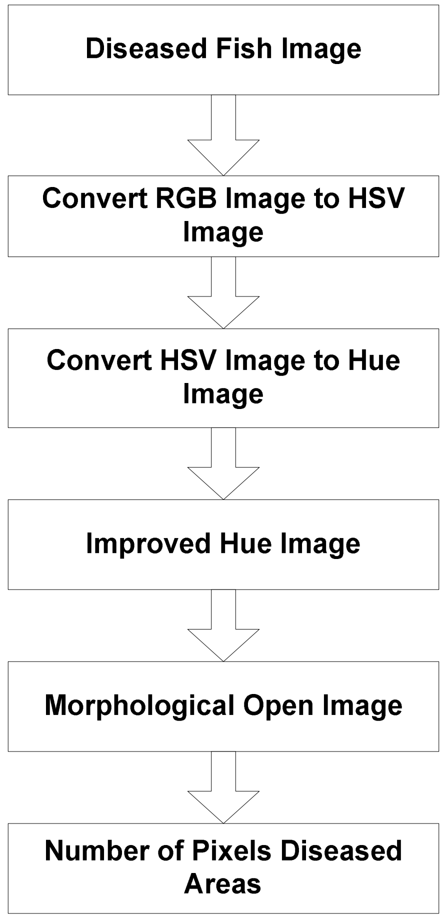
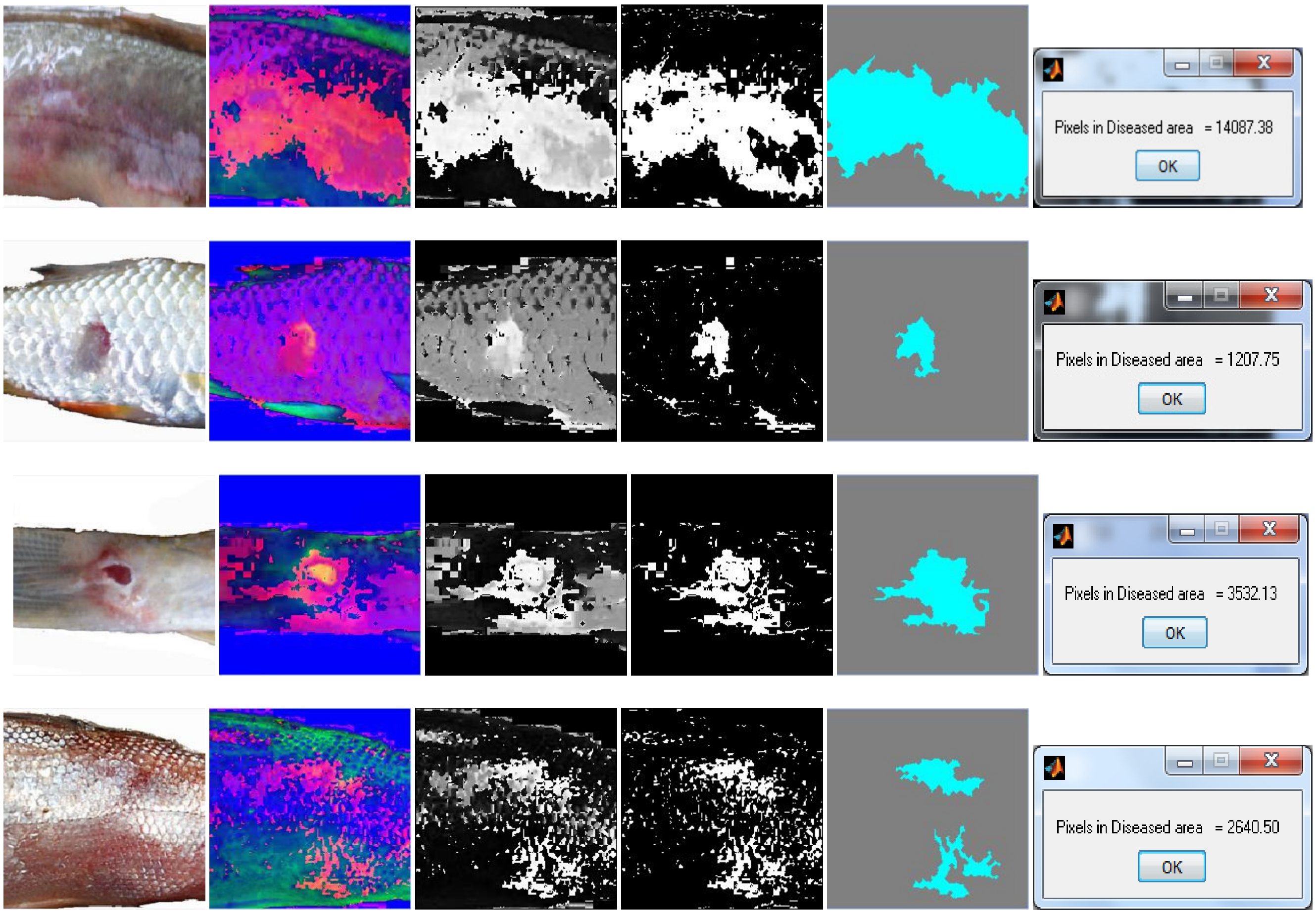


FIGURE 7: Complete Process of HSV and Pixels Value.



(a) (b) (c) (d) (e) (f)

FIGURE 8: (a) Image of *Clarias batrachus* , *Puntius chola* , *Labeo bata* ,*Labeo gonius* are infected with EUS disease (b) HSV image, (c) Hue image, (d)Improved Hue image, (e) Morphological Open image and (f) Measured Pixels.

4. RESULTS AND DISCUSSION

Despite the importance of the subject of identifying fish diseases using image processing, the advances achieved seem to be a little. There is no ideal method would be able to identify any disease in any kind of fish. The present approach step forward to achieving fish disease identification and prevention.

The images of Epizootic Ulcerative Syndrome (EUS) diseased fish such as *Clarias batrachus, Puntius chola, Labeo bata ,Labeo gonius* features are extracted and processed by PCA to form the feature vector after that classify them according to the Euclidian distance. Experimental result indicates that the algorithm is workable with an accuracy greater than 90 percent.PCA used successfully in fish pathogen detection and face recognition.

Figure 5 shows the defect segmentation result of an diseased fish of *Clarias batrachus* , *Puntius chola* , *Labeo bata* ,*Labeo gonius* using K-means clustering technique. The segmented input image into five clusters in Figure 5 and it is clear that Cluster1,2 and 3 correctly segment the diseased portion. In this experiment input images are partitioned into Cluster 1,2 and 3 yields good segmentation as per requirement. K-Mean clustering algorithms technique used successfully in shrimp having white Spot Syndrome Virus, infected fruit part detection, detection of the plant diseases, skin colour detection and classification of leaf diseases.

Figure 8 HSV diseased fish images show the diseased area clearly. Hue indicates the dominant color of fish diseased area. The morphological operation open on a improved Hue image creates a new image in which the pixel has a non-zero value and successfully indicate the diseased area as well pixels value. The experimental results suggest that the introduced method for diseased segmentation accurately segment the diseased portion and measured pixels value of *Clarias batrachus , Puntius chola , Labeo bata ,Labeo gonius.* HSV used successfully in skin colour detection and texture feature extraction. The morphological operation used successfully in fish pathogen detection and brain tumors extraction from MRI images.

5. CONCLUSION

The proposed approach to investigate diseased fish through simulation to achieving the information to identified diseased fish of the fishery in the village area. It also showing automatic image of diseased fish from the fish database, helps to take curative and preventive measured to the spread of disease between fish farms rather than general diagnosis and rely on the performance of a human expert, leads improve management strategies in the village fish farming industry.

The image processing technique to detect fish disease is a complex problem demand more sophisticated approaches. For further study need to improve the performance, robustness and accuracy using techniques like pattern recognition of diseased area of the infected fish using neural networks, genetic algorithms, support vector machines and fuzzy logic.

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