An Approach For Fish Disease Recognition

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JUNE 2021

APPROVAL

This Project/internship titled "**An Approach For Fish Disease Recognition**", submitted by Rafat Bin Mahmud, ID: 172-15-10155 and Md. Safein Sadad, ID: 172-15-10091 and Hafiz Al Asad, ID: 172-15-10175 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 2nd June, 2021.

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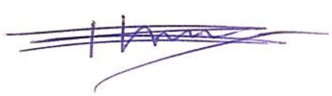

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We hereby declare that, this project has been done by us under the supervision of **Md. Jueal Mia, Sr. Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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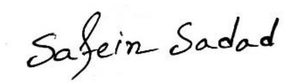

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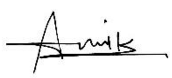

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ACKNOWLEDGEMENT

First we express our heartiest thanks and gratefulness to almighty God for His divine blessing makes us possible to complete the final year project/internship successfully.

We really grateful and wish our profound our indebtedness to **Md. Jueal Mia**,
Sr. Lecturer, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "*An Approach For Fish Disease Recognition*" to carry out this project. His endless patience ,scholarly guidance ,continual encouragement , constant and energetic supervision, constructive criticism , valuable advice ,reading many inferior draft and correcting them at all stage have made it possible to complete this project.

We would like to express our heartiest gratitude to Md. Jueal Mia, Dewan Mamun Raza, and Dr. Touhid Bhuiyan, Head**,** Department of CSE, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

Fisheries is a prominent sector in Bangladesh. It has giant contribution in our economy. There are many people involved in this sector for their livelihood in this country. There are lots of principle invested in fisheries. This sector has also some barriers. Infected diseases are the prime culprit for fish cultivation. These diseases are created havoc situation for fish cultivation. Infected diseases apparent many problems in fish cultivation, such as decrease of production, deficit of protein, wracked of cultivator's investment. So, cultivators need proper steps from heinous hands of these diseases. Traditional evaluation of these diseases are very difficult task for cultivators according to time and proper management. Through computer vision approach technological identification of these diseases is becoming more effective way day by day. So in our work we expose a sophisticated way to identify the diseases by which fish are infected. Epizootic Ulcerative Syndrome (EUS) and Tail and Fin Rot are most common infected diseases of fish cultivation in our country. This proposed method would be helped to the fisheries sector in Bangladesh to cultivate fish for effectively and probably increasing fish production by measuring proper way after technological identification of diseases. K-means clustering is being used for image segmentation after image preprocessing system is implemented. Ten particular traits are omitted in our thesis. Multiple classification techniques are used for classification. Random Forest algorithm gains almost 80.62% proficiency.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Bangladesh is one of the most significant inland fishing country. Fisheries sector plays a vital role in our national economy. According to Yearbook of Fisheries Statistics of Bangladesh 2018-2019 this sector contributes 3.5 percent to our national GDP [1]. There are many people involved in this sector for their livelihood. Almost 12 percent people of the total population of Bangladesh directly or indirectly engaged with this sector [1]. According to FAO (Food and Agriculture Organization), Bangladesh is one of the world's most important inland fishing country [2]. According to Yearbook of Fisheries Statistics of Bangladesh 2018-2019, the total production of fish is 43.84 lakh MT in fiscal year 2018-2019 that proves that Bangladesh is one of leading country in fish cultivation. The average of fisheries growth is 12 percent in last 12 years. Bangladesh's fish production has raised six times more than previous production in last three decades (7.54 Lakh MT in 1983-84 to 43.84 Lakh MT in 2018-19) [4]. Bangladesh obtains 8th position in fish production according to the report of Prothom Alo [3].

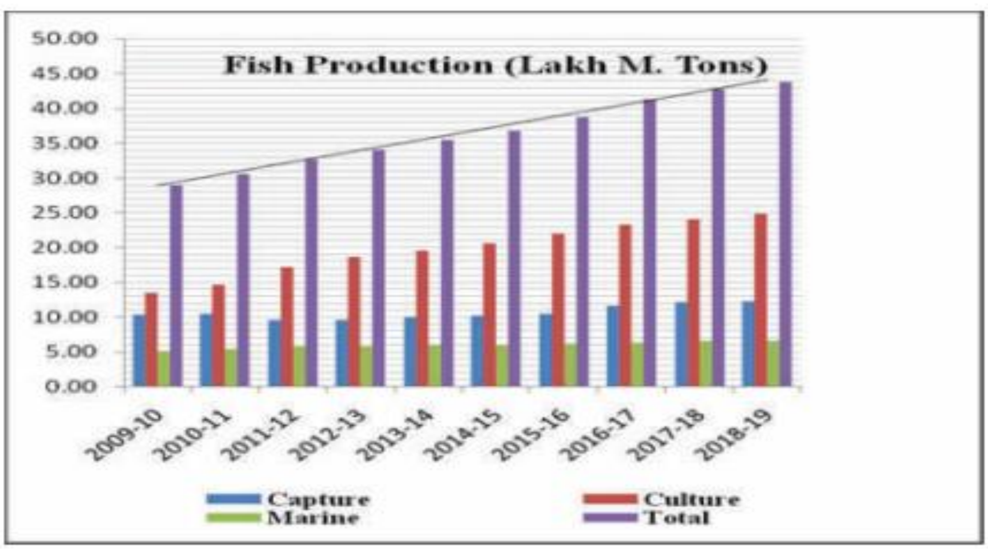

Fig 1.1.1: Last ten years fish production in Bangladesh

Bangladesh acquire a vast amount of foreign currency from exporting fish and fish related product. According to Yearbook Of Fisheries Statistics of Bangladesh 2018-2019, The country earns BDT 4,25031.00 lakh (as per EPB) by exporting almost 73.17 thousand MT of fish and fishery products [4]. Infected diseases damage production of fish as well as diminish it’s quality and quantity. Approximately 15% of production of fish are lessened per year for the reason of infected diseases when these fishes are ready in kitchen, cultivators are acutely realized their investment paralyzing in developing countries [4]. Without appropriate steps, these disease will show monastery figure. Famine, deficit of protein, production of many physical disease, breakdown of economy are the output of these diseases. Bacteria, virus and fungus are mainly responsible for fish diseases. There are many usual diseases of fish by fish are affected that’s are Epizootic Ulcerative Syndrome (EUS), Ulcer, Skin Eosin, Gill Damage, Tail and Fin Rot etc. In this paper we chiefly focus on Epizootic Ulcerative Syndrome (EUS) and Tail and Fin Rot.

Traditional assessment is very difficult and does not provide standard picture of result. It has many disadvantages. It kills time and money. So technological identification is timely steps for reducing the losses of money and time. Furthermore it increases the production of fish and ensured the protein in human body. Computer vision approach is one of the popular approach in modern times. It is widely used for the identification of diseases.

1.2 Motivation

Fishery has a profound contribution in the economy of Bangladesh. Almost 3.5 percent comes from fishery in our national GDP [4]. But infected diseases create unmeasurable loss of this sector. So identification of these types of infected diseases is inevitable to gear up of this sector. In our paper we are exposing a way where cultivators can easily identify these diseases.

There are some particular motives in our thesis.

- To increase the contribution of fishery in our GDP.
- To lessen the amount of work and time through identify disease.
- To develop the livelihood of cultivators.

1.3 Rationale of the Study

There are many researches proceed on technological identification diseases. To detect fish diseases through this process has some challenges also. Because fishes are mostly infected in winter season. So collecting data of these diseases are tough. Furthermore we applied our outmost endeavor in this paper.

1.4 Consequences

Our thesis aims that to technological identification of fish diseases (Epizootic Ulcerative Syndrome (EUS), Tail and Fin Rot).

Our system will analysis the fish's disease part and reveal the average proficiency of these diseases.

1.5 Report Layout

This chapter shows many parts, such as introduction of the fish disease recognition, motivation, rational of the study and the consequences of the thesis. Later followed by the report layout.

We will explain the background of our thesis topic in chapter 2.

We will explain the research methodologies utilized in our study in chapter 3.

We will explain classification and the model study in chapter 4.

We will explain the gained experimental results and discussion in chapter 5.

We will explain the conclusion and future work in chapter 6.

CHAPTER 2
BACKGROUND

2.1 Introduction

Internet is one of the sophisticated via where everything is available. So, computer vision in fish disease is probable solution to the cultivators. Traditionally all disease in agriculture is cured by manual treatment. This system is isolated and not applicable in the modern variant of diseases. For this reason, try to bring out a solution to cure these diseases. Computer vision is one of outputs of technology based research. Technological identification is rarely used in the sector of fishery. It has lots of advantage to the cultivators. Cultivators can easily identify fish disease through this system and remove their complexity around anonymous fish diseases. In a word, technological identification is a gigantic help line in fish cultivation.

2.2 Related Works

In modern era specially in the field of diseases, Computer Vision is booming word. It has reduced human limitation for the recognition of disease. This system is gained popularity for it's using perfection. In future people will mostly depend on this system. There are a lot of research occurred via computer vision for disease identification but less amount is done in fish diseases.

This system plays a significant role in the fisheries sector. It is methodically very helpful to the cultivator. Some noticeable diseases detection through computer vision are mentioned in this section:

Malik et al. [5] introduce a system in order for identification of fish disease using image processing technique. In this work, image segmentation was done by histogram equalization method, after applying this they applied Canny's edge detection technique. They applied two feature descriptor technique HOG and FAST for extracted features of images. By applying two Neural Network and K-NN (Nearest Neighbor) algorithm classification had been done in this work.

Chakravorty et al. [6] deployed a system for detection of fish disease from the images of fish with help of PCA method and where K-means clustering is used for segmentation on the basis of color feature. For achieving better accuracy in disease are identification also with its measurement is inevitable so that HSV images and Morphological operation are introduced in this work. Four fish images are used which are affected with Epizootic Ulcerative Syndrome (EUS) in this system. This way is provided a satisfactory result after applying for curing the disease. This proposed work reveals good satisfactory accuracy. PCA method is used after extracting the feature to form the feature vector and segmented then according to Euclidian distance.

Zhang et al. [7] have proposed a system in which leaf image based cucumber disease recognized. They work with seven major cucumber disease and they use 60 images from each of the disease leaves. So, their dataset consists of 420 images. By applying K-means clustering segmentation has been done in this work. In segmentation, the affected part of a cucumber image has been separated. Feature extraction performed based on color and shape. Sparse Representation (SR) is applied for classifying the diseases. Their system attained 85.70% accuracy beating the other four classifiers.

Wei et al. [8] have deployed skin disease recognition method based on image color and texture features. In this work they used support vector machine (SVM) for recognized the diseases. They work with three different type of skin disease. Feature set is created by feature extraction through color and texture feature. They obtain higher accuracy in their work which is 90% compare with other skin disease recognition work.

2.3 Comparative Study

Automatic disease recognition of fish is rarely performed and this proposed system is very satisfactory project on fish disease. We compare our work on fish disease recognition with other automatic disease recognition. We expose the comparison with a table in the below:

Reference	Disease	Dataset	Class	Segmentation Algorithm	Classifier	Average Accuracy
Our Work	Fish	485	3	K-means clustering	Random Forest	80.62%
Malik et al [5]	Fish	NA	2	Histogram Equalization	Neural Network and K-NN	NA
Chakravorty et al [6]	Fish	NA	2	K-means clustering	PCA	NA
Zhang et al [7]	Cucumber based on leaf	420	7	K-means clustering	SR	85.70%
Wei et al [8]	Skin	NA	3	GLCM	SVM	90.00%

Table 2.3.1: Argumentative comparison with another's work

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Data Collection:

In the field of research area the significance of data collection is fundamental. For gaining higher accuracy it is imperative to acquire authentic and adequate data. In our work we identify fish disease by image processing. So we collected real time data for our work. We collected images of fish which are infected with Epizootic Ulcerative Syndrome (EUS) and Tail and Fin Rot disease. We collect all of these image which are captured by our camera. We gathered these data from December 2020 to March 2021.

Fig 3.1.1: Fish Cultivation in Bangladesh

3.2. Description of Fish Disease:

Fish is a premier source of protein in Bangladesh. It provides maximum portion of protein to human body. It is an also mine of mineral, water, vitamin, carbohydrate. In a word it is an essential food source for human body. But some diseases disrupt the production and elementary quality of fish and these diseases also deprive of human body from these essential elements like protein, vitamin etc. Epizootic Ulcerative Syndrome (EUS) and Tail and Fin Rot are one of them. In this part, the two diseases are discussed in briefly:

1. Epizootic Ulcerative Syndrome (EUS):

The causative agent of this disease is *Aphanomyces invadans* (Fungus). And later affected by bacteria such as *Vibrio, Aeromonas, Micrococcus, Bacillus*. Symptom: Initial lesion may appear as red spot often with a brown, necrotic, fungus covered center with a raised whitish border. In some species lesion can lead to complete erosion of posterior body.

Fig 3.2.1: Epizootic Ulcerative Syndrome (EUS)

2. Tail and Fin Rot:

This disease generally caused by bacteria which is *Aeromonas* and *Myxobacteria*. Symptom: The colous of the fish turn to cloudy. Decrease the sliminess of skin. At the preliminary stage, red spots are seen on tail and fins. Fin layers become disintegrated / tattered and gradually rot.

Fig 3.2.2: Tail and Fin Rot disease

3. Healthy

In fish body there is no spot and also tail and fins are all okay. Full fish should be fresh

Fig 3.2.3: Healthy Fish

3.3 Fish Disease Recognition Process:

The basic step for disease recognize consist of following approaches:

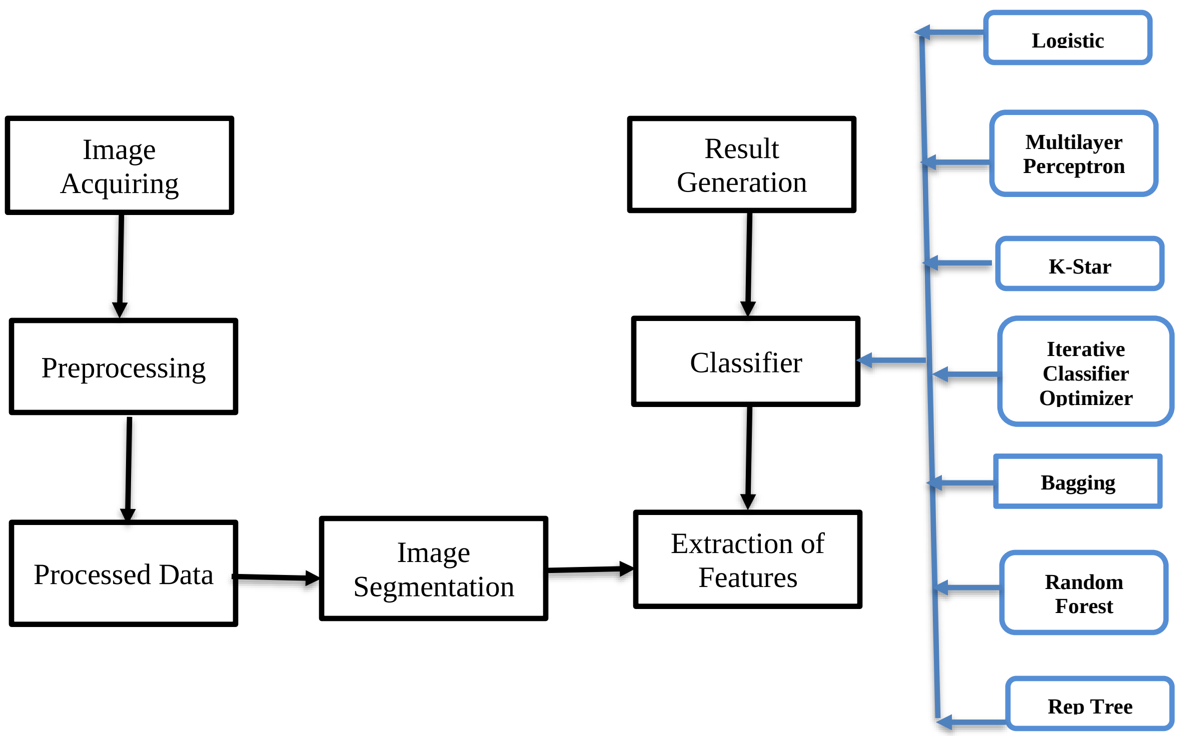

Fig. 3.3.1: Automated fish disease recognition working process.

Image Acquisition:

In this task, image acquisition is the initial step where pieces of image are restored for training and testing. Digital and mobile camera are used for capturing these images. This way is widely used for image acquisition. We are not only collected affected fish images but also images of healthy fish. These images are very transparent to notify any kind of affected area. The picture are in RGB form. A couple image Epizootic Ulcerative Syndrome (EUS) affected fish are exposed in fig 3.3.2

Fig. 3.3.2: Diseased fish’s original image

Image preprocessing:

Raw images are acquired from many sources that can not use in further process. To improving the quality of images, the sample images are processed and converted into expected form. For reducing the noise of images, some steps are taken such image resizing, filtering the images, enhancement of contrast, conversion of color. These are discussed briefly in this segment.

- **Image resizing:** Firstly, we resize the input images which are essential for classification and required for next processes.
- **Image Filtering:** Removing noise, smoothing filter are prime task of image filtering. And these tasks are applied in our work.
- **Contrast Enhancement:** There are existed many techniques to perform contrast enhancement. Histogram equalization is one of the techniques that is applied in this work.
- **Color conversion:** We convert the color of the images from RGB to L*a*b* to highlight the difference between health part diseased part of the images. L*a*b* color space basically executed from the CIE XYZ dimensional values. The L*a*b* space compose of a luminosity "L*" or brightness layer, chromaticity layer "a*" signifying where color cascade along the green-red axis and also chromaticity layer "b*" expressing where the color cascade along the yellow-blue axis.

Original Image **Contrast Enhanced**

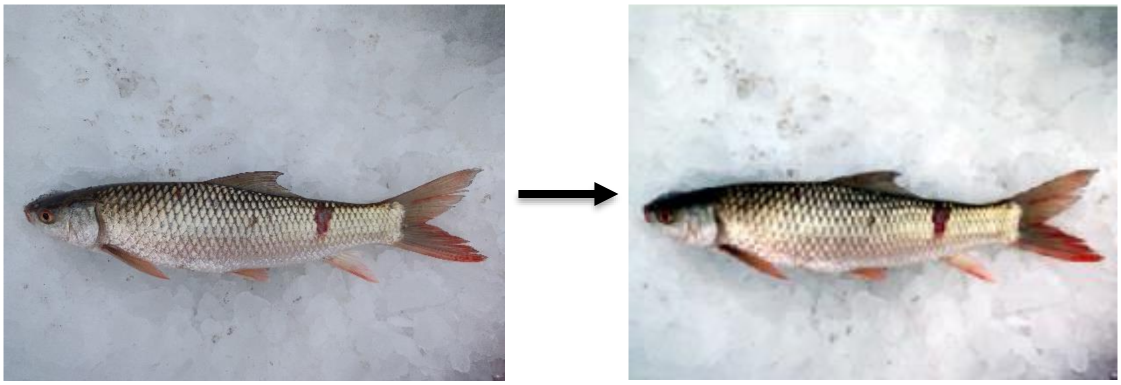

Fig 3.3.3: Enhancement of contrast

Image Segmentation:

After accomplishing of image preprocessing, we have to perform segmentation of the first image for going to the next or upcoming step.

K-means clustering segmentation is applied here. A dialog box that is the entrance of the number of cluster resemblance basis exposes in segmentation part. After that it forwarded to our proposed system.

The algorithm for K-means segmentation:

- Grasp center of K cluster, indiscriminately otherwise focused on some heuristic.
- For minimizing the distance between the pixel and the cluster center, every pixel of the image is engaged to the cluster.
- Averaging all of the pixel in the cluster shows the real cluster center. Until Convergence is obtained, ways 2 and 3 will be repeated.

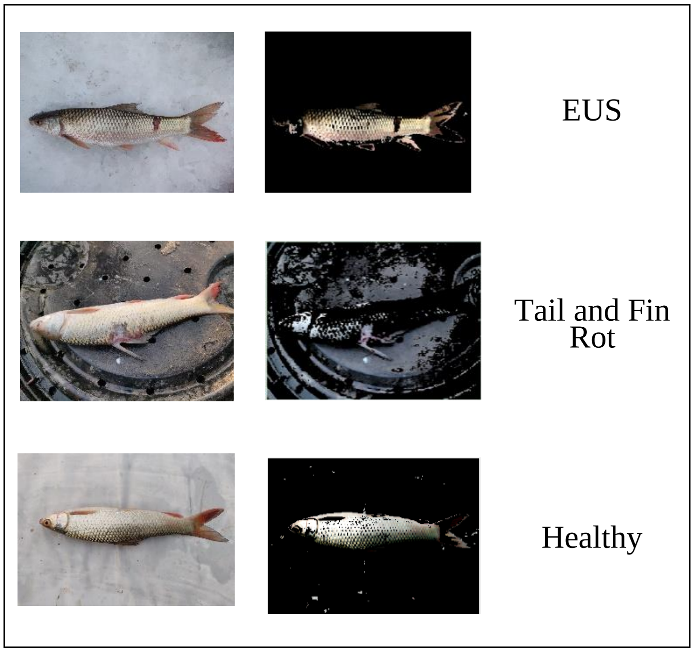

Fig 3.3.4: Segmentation of Images

Feature Extraction:

Every disease shows different traits based on color, shape and texture for this reason feature extraction is essential for acquiring information from an image. By the help of feature extraction, we can analyze the characteristics of the diseases. We are basically used statical and GLCM features. We have illustrated our feature set by borrowing features from statistical and GLCM. We have used five statistical features in our work which are mean (μ), standard deviation (σ), variance (σ^2), kurtosis (κ), skewness (γ). In our work we have also extracted five GLCM features which are contrast (C), correlation (ρ), energy (E), homogeneity (H), entropy (S). Mathematical formula of this work is expose in below:

1. Contrast (C): $C = \sum_{i=0}^{l_g-1} \sum_{j=0}^{l_g-1} (i-j)^2 P(i,j)$

2. Correlation (ρ): $\rho = \frac{\sum_{i=0}^{l_g-1} ijP(i,j) - \mu_x \mu_y}{\sigma_x \sigma_y}$

3. Energy (E): $E = \sum_{i=0}^{l_g-1} \sum_{j=0}^{l_g-1} (i,j)^2$

4. Homogeneity (H): $H = \sum_{i=0}^{l_g-1} \sum_{j=0}^{l_g-1} \frac{P(i,j)}{1+(i-j)^2}$

5. Mean (μ): $\mu = \frac{1}{n} \sum_{i-1}^{n} I_i$

6. Standard deviation (σ): $\sigma = \sqrt{\frac{\sum_{i-1}^{n} (I_i - \bar{I})^2}{n}}$

7. Entropy (S): $S = -\sum_{i=0}^{l_g-1} \sum_{j=0}^{l_g-1} P(i,j) \log P(i,j)$

8. Variance (σ^2): $\sigma^2 = \frac{1}{n} \sum_{i-1}^{n} (I_i - \bar{I})^2$

9. Kurtosis (κ): $K = \frac{\frac{1}{n}\sum_{i-1}^{n} (I_i - \bar{I})^4}{(\frac{1}{n}\sum_{i-1}^{n} (I_i - \bar{I})^2)^2} - 3$

10. Skewness (γ): $\gamma = \frac{\bar{I} - I_M}{I_\sigma}$

i). Actual Class	ii). Acquired Image	iii). K-means clustering segmented image	iv). Extracted Features (C), (ρ), (E), (H), (μ), (σ), (S), (σ^2), (κ), (γ)	v). Recognized Class
Tail and Fin Rot			(1.039, 0.87 0.31, 0.83, 49.22, 70.39, 4.43, 4631.44, 1.00, 3.52, 1.28)	Tail and Fin Rot
Tail and Fin Rot			(1.50, 0.70, 0.35, 0.87, 40.73, 58.20, 3.67, 3120.18 1.00, 3.13, 1.1)	Epizootic Ulcerative Syndrome (EUS)
Epizootic Ulcerative Syndrome (EUS)			(1.18, 0.74, 0.67, 0.92, 20.95, 52.81, 1.66, 2735.49, 7.19, 2.35)	Epizootic Ulcerative Syndrome (EUS)
Epizootic Ulcerative Syndrome (EUS)			0.55, 0.92, 0.62, 0.92, 30.30, 67.39, 2.34, 4160.07, 5.97, 2.09)	Tail and Fin Rot
Healthy			(0.48, 0.95, 0.39, 0.94, 198.02, 76.49, 5.92, 5093.41, 5.07, -1.89)	Healthy
Healthy			2.24, 0.67, 0.25, 0.84, 51.87, 66.18, 4.45, 10.71, 4112.88, 3.22, 1.04)	Epizootic Ulcerative Syndrome (EUS)

Fig 3.3.5: Representation of extracted features which get from a pair of three different class's images where each image of the pairs is correctly recognized and other image of the pair is incorrectly recognized.

Classification:

After feature extraction, we classified these images into 3 classes by using image classification technique. These are EUS, Tail and Fin Rot and Healthy. Multiclass classification method are used in this system. Multilayer Perceptron, Logistic, K-Star, Multiclass Classifier, Random Forest etc classifiers are used in our proposed system. But through Random Forest algorithm we attain higher accuracy 80.62% to recognize the disease.

CHAPTER 4
CLASSIFICATION AND MODEL STUDY

4.1 Classification

We used seven classifier models for recognizing the fish disease to compare the average accuracy rate.

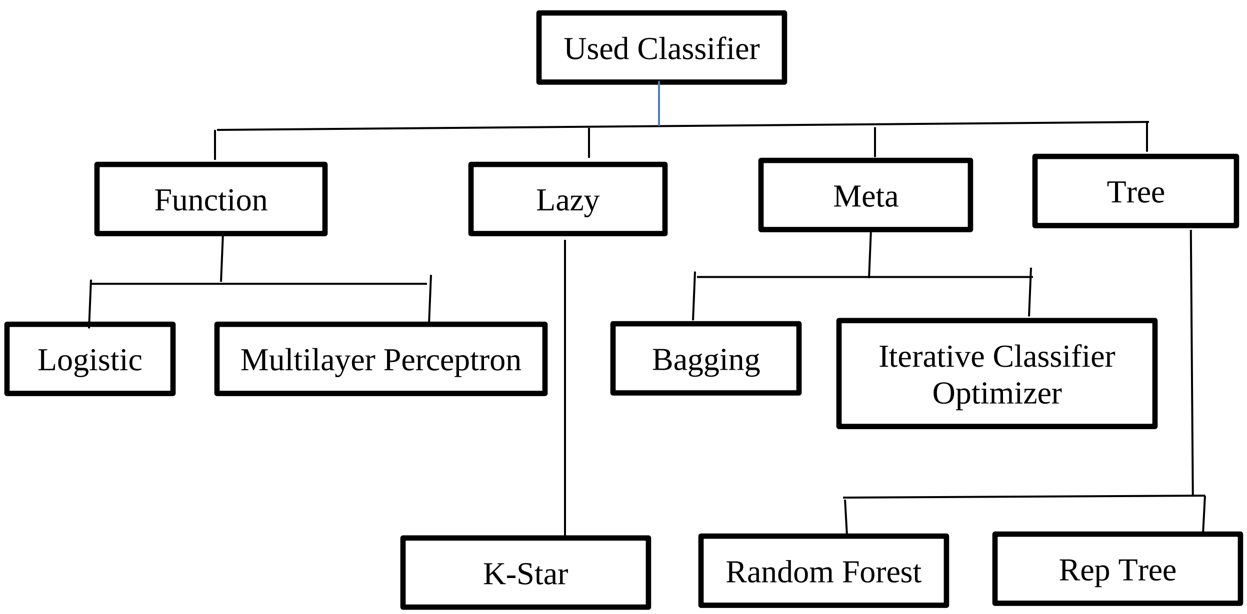

Fig. 4.1.1: Selected classifiers to recognize fish disease.

Here, we discussed about 7 classification models.

4.2 Model Study

Logistic:

Logistic is a function which is form a model based on binary dependent variable. It can be form different classes of events including visual image such fish, cat, dog, lions etc. Each stuff will be detected with numerical digit's probability between 0 and 1.

Class	Accuracy	Error Rate	Sensitivity	Specificity	Precision	FPR	FNR
Tail and Fin Rot	79.38%	20.62%	10.10%	97.15%	47.62%	02.85%	89.90%
EUS	72.58%	27.42%	83.89%	63.87%	64.13%	36.13%	16.11%
Healthy	89.07%	10.93%	88.57%	89.35%	82.45%	10.65%	11.43%

Table 4.2.1: Execution of Logistic.

Multilayer Perceptron:

Multiplayer Perceptron (MLP) is an artificial neural network which is function algorithm approach. MLP is applied superficially to any feedforward artificial neural network (ANN). For training MLP applies backpropagation technique basically which is a supervised learning technique. For its satisfactory performance it used widely in research work. Numerical value has excellent performance with MLP.

Class	Accuracy	Error Rate	Sensitivity	Specificity	Precision	FPR	FNR
Tail and Fin Rot	78.97%	21.03%	34.34%	90.41%	47.89%	09.59%	65.66%
EUS	72.37%	27.60%	70.61%	73.72%	67.40%	26.28%	29.38%
Healthy	88.45%	11.55%	89.14%	88.06%	80.82%	11.94%	10.86%

Table 4.2.2: Execution of Multilayer Perceptron.

K-Star:

K-Star is an example-based classifier actually which is a lazy algorithm approach. It shows differentiate between many example-based learners. It applies an entropy-based distance function. It provides standard accuracy but less than the accuracy of Random Forest

Class	Accuracy	Error Rate	Sensitivity	Specificity	Precision	FPR	FNR
Tail and Fin Rot	77.11%	22.89%	38.38%	87.05%	43.18%	12.95%	61.62%
EUS	72.78%	27.22%	69.19%	75.55%	68.54%	24.45%	30.81%
Healthy	87.84%	12.16%	85.71%	89.03%	81.52%	10.97%	14.29%

Table 4.2.3: Execution of K-Star.

Iterative Classifier Optimizer:

This is basically meta algorithm approach. Iterative classifier is use cross-validation and optimizer number of iterations in the classifier. This classifier is very much capable stirring missing class. And also, this classifier capable to handling nominal and binary class. It also can handling attributes as like as nominal, binary, numeric, empty nominal.

Class	Accuracy	Error Rate	Sensitivity	Specificity	Precision	FPR	FNR
Tail and Fin Rot	78.76%	21.24%	25.25%	92.49%	46.30%	7.51%	74.75%
EUS	71.96%	28.04%	72.04%	71.90%	66.38%	28.10%	27.96%
Healthy	87.42%	12.58%	90.29%	85.81%	78.22%	14.19%	9.71%

Table 4.2.4: Execution of Iterative Classifier Optimizer.

Bagging:

Bagging is the machine learning ensemble meta-estimator that is fitted base classifier per on indiscriminate subsets of the real dataset and then sum of their individual predictions to build a ultimate prediction. Evaluation of stability, downcast variation enhancement of accuracy and assists in prohibiting the over fitting of machine learning are the benefitted implementation of bagging.

Class	Accuracy	Error Rate	Sensitivity	Specificity	Precision	FPR	FNR
Tail and Fin Rot	78.35%	21.65%	21.21%	93.01%	43.75%	06.99%	78.79%
EUS	72.37%	27.63%	75.83%	69.71%	65.84%	30.29%	24.17%
Healthy	87.01%	12.99%	87.43%	86.77%	78.87%	13.23%	12.57%

Table 4.2.6: Execution of Bagging.

Random Forest:

Random Forest is ensemble learning method for classification. It operates with help of multitude decision tree and outputting the class which is mean or average of the individual trees. It helps many decision tree classifiers which are applied on various sub samples of the dataset and Predictive accuracy, control overfitting is the result of using various decision trees. This classifier has made great impact on our work. We obtain 80.62% accuracy by using this classifier. This result is best comparison to other classifiers.

Class	Accuracy	Error Rate	Sensitivity	Specificity	Precision	FPR	FNR
Tail and Fin Rot	78.76%	21.24%	27.27%	91.97%	46.55%	08.03%	72.73%
EUS	73.40%	26.60%	76.30%	71.17%	67.08%	28.83%	23.70%
Healthy	89.69%	10.31%	89.14%	90%	83.42%	10.00%	10.86%

Table 4.2.9: Execution of Random Forest.

Rep Tree:

Reducing Error Pruning (REP) is based on the principle of calculating the information obtain with entropy and also minimizing the error produce from variant REP Tree applies. It produces best one from all spawned tress. At the outset of the model preparation, it shorts the evaluation of numeric traits.

Class	Accuracy	Error Rate	Sensitivity	Specificity	Precision	FPR	FNR
Tail and Fin Rot	79.79%	20.21%	29.29%	92.75%	50.88%	07.25%	70.70%
EUS	72.78%	27.22%	76.30%	70.07%	66.26%	29.93%	23.70%
Healthy	87.22%	12.78%	85.14%	88.39%	80.54%	11.61%	14.86%

Table 4.2.10: Execution of Rep Tree.

CHAPTER 5
EXPERIMENTAL RESULTS AND DISCUSSION

5.1 Results

We have used 485 images of different fish both affected and healthy in our work. These samples are collected from different places of Bangladesh. EUS, Tail and Fin Rot and Healthy are the classes exposed in the database of the images. There are 200 images of EUS, 99 of Tail and Fin Rot and 186 of Healthy class. Via resizing the image, filtering the image, enhancement of contrast and reduction of noise collected images are pre-processed. K-means clustering is used for segmentation of images. After image segmentation we have extracted 13 features from images and keep 10 samples for further assessment. Rest the features are evicted for their redundant task. The diseases are identified by using these features and classify them by various type of classifier.

5.2 Descriptive Analysis

Random Forest algorithm provides maximum accuracy approximately 80.62% in this project. With the help of confusion matrix of Random Forest algorithm, we calculate accuracy, error rate, sensitivity, specificity, precision, FPR, FNR. And the confusion matrix is shown in Table 5.2.1. Performance of Random Forest is shown in Table 5.2.2. An average accuracy of the classifier is shown by using 10 folds cross validation and also applied it. The comparison of all classification algorithms is shown in fig. 5.2.2.

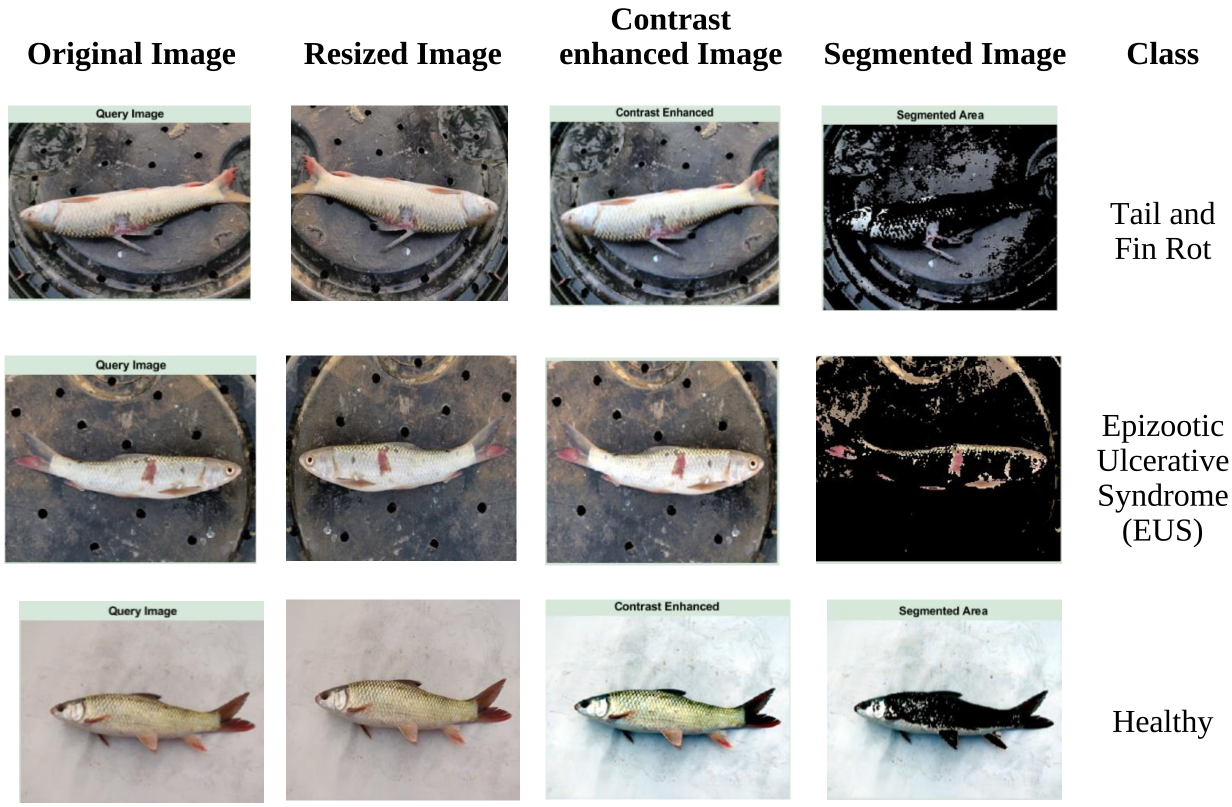

Fig. 5.2.1: Gradual process of fish disease recognition.

Confusion matrix is highlighted way to depict the feedback of a classifier. It consists of many rows and columns scenario shows as actual class and predicted class. Every row reveals actual class and where every column reveals the predicted class.

In Table 5.2.1 multi class confusion matrix of Random Forest is exposed.

	Predicted				
Actual		Tail and Fin Rot	EUS	Healthy	Total
	Tail and Fin Rot	27	63	9	99
	EUS	28	161	22	211
	Healthy	3	16	156	175
	Total	58	240	187	= 485

Table 5.2.1: Confusion Matrix of Random Forest Algorithm.

Class	Accuracy	Average Accuracy
Tail and Fin Rot	78.76%	80.62%
EUS	73.40%	
Healthy	89.69%	

Table 5.2.2: Feedback of Random Forest Algorithm.

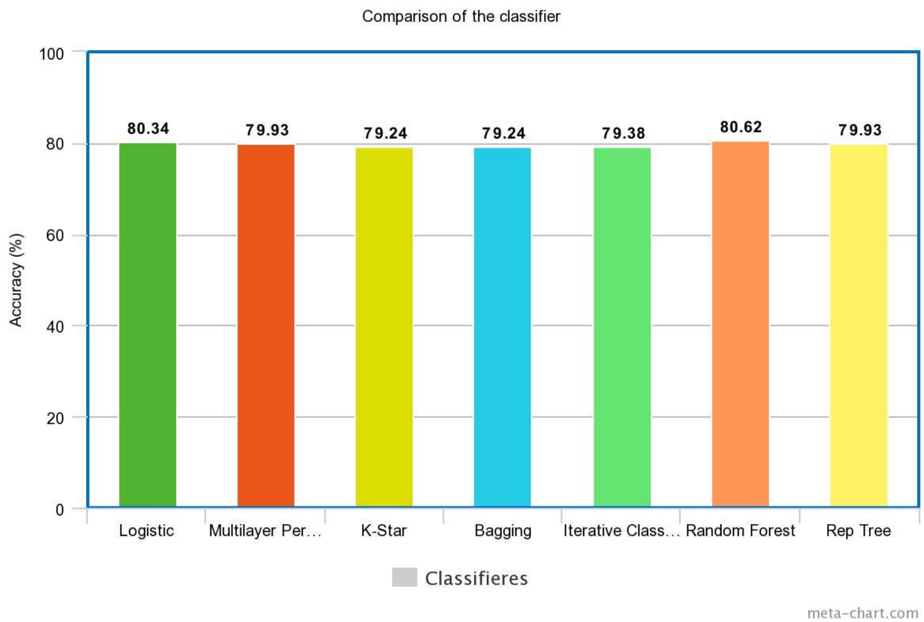

Fig. 5.2.2: Compare the performance of the other classifier algorithms

CHAPTER 6
CONCLUSION AND FUTURE WORK

6.1 Conclusion

This project is focused on automated fish disease recognition. This is the first and foremost entrepreneur in Bangladesh. It creates revolution in the fisheries sector. We applied this projected system on two disease which are very destructive for fish cultivation. . Epizootic Ulcerative Syndrome (EUS) and Tail and Fin Rot are the diseases which are used in our proposed project. To innovate this project, we follow many ways. Such as collecting image, then image resizing, filtering, after then contrast enhancement. K-means clustering is used for segmentation which is an important way of this project. Then feature extraction is used for data classification. After accomplishing all ways, we obtain the average accuracy 80.62% in this project. This will be very fruitful solution for fish cultivators.

6.2 Future plan

We work on two fish diseases where we unveil many unknown characteristics of those two particular fish diseases. In this research we achieve 80.62% accuracy that will very productive for detection of these particular diseases. Our posterior plan will to develop a mobile application where fish cultivator can easily detect particular fish diseases by following some steps and will get probable solution of those particular diseases. We will try to develop our accuracy by collecting data of others adding with the current data of fish diseases which are also recognized through images. We can apply this process on others organism which are visible with naked eye.

REFERENCES

[1] Yearbook of Fisheries Statistics of Bangladesh 2018-2019. Available online: http://fisheries.portal.gov.bd/ [Last accessed on April 30, 2021]

[2] Fishery and aquaculture country profiles. Available online: http://www.fao.org/fishery/facp/BGD/en [Last accessed on April 30, 2021]

[3] Bangladesh ranks in fish production. Available online: https://en.prothomalo.com/ [Last accessed on April 30, 2021]

[4] Fish disease and strategies taken by the farmers. Available online: https://www.researchgate.net/publication/ [Last accessed on April 30, 2021]

[5] Malik, Shaveta, Tapas Kumar, and A. K. Sahoo. "Image processing techniques for identification of fish disease." In *2017 IEEE 2nd International Conference on Signal and Image Processing (ICSIP)*, pp. 55-59. IEEE, 2017.

[6] Chakravorty, Hitesh, Rituraj Paul, and Prodipto Das. "Image processing technique to detect fish disease." *International Journal of Computer Science and Security (IJCSS)* 9, no. 2 (2015): 121-131.

[7] Zhang, Shanwen, Xiaowei Wu, Zhuhong You, and Liqing Zhang. "Leaf image based cucumber disease recognition using sparse representation classification." *Computers and electronics in agriculture* 134 (2017): 135-141.

[8] Wei, Li-sheng, Quan Gan, and Tao Ji. "Skin disease recognition method based on image color and texture features." *Computational and mathematical methods in medicine* 2018 (2018).

[9] Agarwal, Abhay, Adrija Sarkar, and Ashwani Kumar Dubey. "Computer vision-based fruit disease detection and classification." In *Smart Innovations in Communication and Computational Sciences*, pp. 105-115. Springer, Singapore, 2019.

[10] Ahmed, Md Shoaib, Tanjim Taharat Aurpa, Md Azad, and Abul Kalam. "Fish Disease Detection Using Image Based Machine Learning Technique in Aquaculture." *arXiv preprint arXiv:2105.03934* (2021).

[11] Ghyar, Bhagyashri S., and Gajanan K. Birajdar. "Computer vision based approach to detect rice leaf diseases using texture and color descriptors." In *2017 International Conference on Inventive Computing and Informatics (ICICI)*, pp. 1074-1078. IEEE, 2017.

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