FISH RECOGNITION SYSTEM

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DECLARATION

I declare that this thesis entitled “FISH RECOGNITION SYSTEM is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this report entitled “FISH RECOGNITION SYSTEM” and in my opinion, this thesis it complies the partial fulfillment for awarding the award of the degree of Bachelor of Electrical Engineering with Honours

Signature : .....

Supervisor Name : .....

Date : .....

DEDICATIONS

To my beloved mother and father

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ABSTRACT

Recognition is defined as the ability to detect and identify object into their respective classes. Nowadays there are a lot of different recognition system methods that can be used to identify an object. An example of recognition system that can be implemented is a system that can be used to recognize fish. A development of fish recognition system is crucial to maintain the sustainability of fish ecosystem for future generations. This is because researcher will have to measure its population by recognizing each type of fish species. In order to recognize fish and classify them according to its species, there are several methods that have been proposed by previous researcher. Hence, for this research, several methods of fish recognition system was studied to find the most accurate and user friendly to be used as the main system. The chosen system then will be developed to classify several fish according to its species.

ABSTRAK

Pengiktirafan ditakrifkan sebagai keupayaan untuk mengesan dan mengenal pasti objek dalam kelas masing-masing. Pada masa kini terdapat banyak kaedah pengenalan sistem yang berbeza yang boleh digunakan untuk mengenal pasti objek. Satu contoh sistem pengiktirafan yang boleh dilaksanakan adalah sistem yang boleh digunakan untuk mengenali ikan. Pengembangan sistem pengiktirafan ikan adalah penting untuk mengekalkan kelestarian ekosistem ikan untuk generasi akan datang. Ini kerana penyelidik perlu mengukur populasi mereka dengan mengenali setiap jenis spesies ikan. Untuk mengenali ikan dan mengklasifikasikannya mengikut spesiesnya, terdapat beberapa kaedah yang telah dicadangkan oleh penyelidik terdahulu. Oleh itu, untuk kajian ini, beberapa kaedah sistem pengenalan ikan dikaji untuk mencari yang paling tepat dan mesra pengguna untuk digunakan sebagai sistem utama. Sistem yang dipilih kemudiannya akan dibangunkan untuk mengklasifikasikan beberapa ikan mengikut spesiesnya.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

The main field of this research is regarding recognition system, specifically on the recognition system of fish species. This chapter will discuss on the analysis of the background for recognition system by covering the research background, motivation, problem statement, objectives and the scope that will be used for the research.

1.2 Research Background

Recognition is defined as the ability to detect and identify objects into their respective classes[1]. Recognition system has been applied in various fields to help in the area of environment or ecological research where it can help scientist to identify and classify certain types of species or specimens. Whereas in manufacturing industries, where multiple goods can be produced using a single manufacturing line, recognition system can be used to classify objects such as food and beverages according to its specific requirement such as sizes, types, colors or shapes for packaging.

Previously, the researches done on the recognition system mostly are focused on the objects on the land. However, for the last 30 years the growth of research on the underwater-based technology has undergone a fast development. This is because it was prompted by the first United Nation Conference on Environment and Development or also known as The Earth Summit held in 1992 at Rio de Janeiro, Brazil that acknowledged the lack of information within the ocean[2]. This is proven due to the facts that most part of the oceans is still unexplored. Thus, greatly increase the demand for the system that can recognize underwater object.

1.3 Problem Statement and Motivation

Sustainability of fish ecosystem is very important especially for our future generation to ensure that our food supply does not run out. In order to decide the current status of fish population, researchers are required to manually go to the fish habitat to obtain data and manually do the recognition of the fishes. However, methods used by researchers to investigate fish sustainability is quite invasive. For example, casting nets into the sea will disrupt the balance of the ecosystem. Other example of method used by researcher involves the use of camera by recording an underwater video and then manually calculates the fish species. The researchers mean of obtaining data to ensure the sustainability of the fish is very time consuming and troublesome.

By having a fish recognition system, recognition of a fish species can be done efficiently with less effort without any harmful side effect as it could be used to help researchers such as scientist or marine biologist to improve the process or procedure on obtaining the data on the sustainability of fish species.

1.4 Objectives

The main objective is as follows:

- To develop a fish recognition system that can classify adult reef-associated fish.

1.5 Scope

The scopes of the researches are as follows:

i) 4 types of adult reef-associated fish are used to obtain result from fish4knowledge dataset[3]:

- *Dascyllus Reticulatus*
- *Plectroglyphidodon Dickii*
- *Chromis Chrysura*
- *Amphiprion Clarkia*

ii) Horizontal orientation of fish images for recognition process

iii) Implementation technique by using MATLAB software

1.6 Conclusion

This chapter has presented on the importance of the fish recognition system to ensure the stability of the fish sustainability as food supply for the current and future generation. The next chapters will cover about the previous research that has been done regarding the method for recognition of fish and the most suitable method for fish recognition will be chosen.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter consists of researches regarding fish recognition system where different approach is used to identify fish and is follow by the theoretical section on the selected method for the project.

2.2 Support Vector Machine Approach.

The Support Vector Machine (SVM) is define as a type of classifier that can classify, regress, or other tasks in a highly dimensional space by building a hyper planes[4]. A hyper plane that has the biggest separation to the training-data point of any class shows a good difference because by having a bigger margin the percentage of making a mistake for the classifier is smaller[5]. according to research paper by Diego Mushfieldt, Mehrdad Ghaziasgar, and James Connan[4] that describe the basic for a flexible system that can be used to recognize different type of fish species and demonstrate the data instantly to the user, segmentation of the needed fish with a novel pre-processing procedure is used. A classification method using SVM is employed to identify 20 fish based on its shape and color. In 11 out of the 20 fish, the experimentation result proved the system was 100% in accuracy while 17 of the 20 fish score the accuracy of above 70%. The whole system consists of three main components which is segmentation, training and recognition using an SVM, and Figure 2.1 shows an example of the result.

Figure 2.1 Example of Result

The usage of SVM was also applied in the research paper by H. Qin, X. Li, J. Liang, Y. Peng, and C. Zhang[7], who have implemented the DeepFish-SVM-aug-scale method for classification. According to this research, live fish recognition framework based on a simple cascaded deep network that was fed to SVM classifier is comparable with a carefully designed and tuned deep Convolutional Neural Network architecture. Underwater fish dataset image that was shown in Figure 2.2 was acquired from truth dataset made by the Fish4Knowledge project[3].

A linear SVM layer was adopted instead of commonly used Softmax layer because it is the most effective and has the least falsely classified fish as shown in Figure 2.3 because out of 3908 test images, only 53 fish are falsely classified as a different result of test images. This system is considered effective as it can achieve the accuracy of 98.64%.

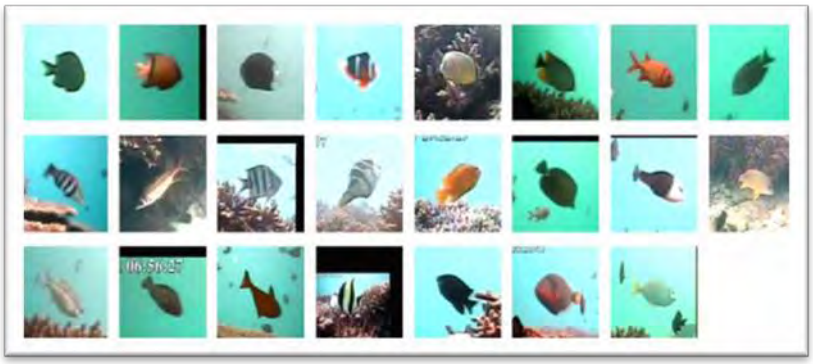

Figure 2.2 Dataset Used

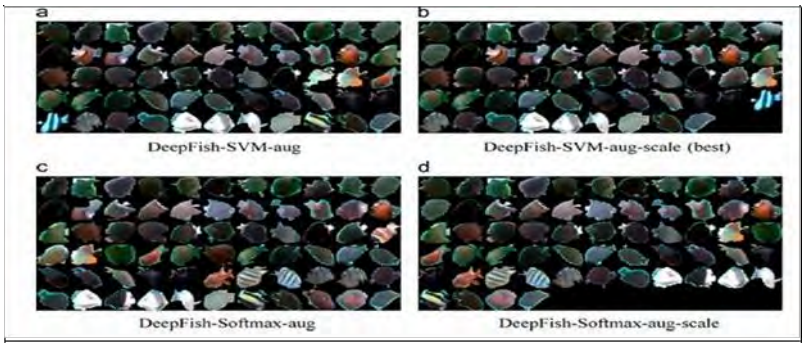

Figure 2.3 Falsely Classified Image

2.3 Template Matching Based Approach

Template matching is a technique that is able to do computerized processing for finding small parts of an image that can coordinate with a template image[6]. Template matching based approach is one of a method that can be used for classification of image by comparing two images thoroughly. The images used will show extracted part of edge point and the distance transform in the model image with another query image.

According to the research paper by Rova Andrew, Mori Greg, and Dill Lawrence M. that classify two fish species which is the Striped Trumpeter and Western Butterfish that is shown in Figure 2.4, this method can be part of a system that classified fish species automatically[7]. The method applied in this technique uses deformable template matching to align template images and query images. A deformable template matching was used so that it can align template images and query images to improve classifier that is based on texture that are precise to pixel alignment. However, the final classification to decide the output uses SVM as classifier. Each query image is warped to the striped trumpeter template and western butterfish template. Experimental results based on the table 2.1 shows the superiority of using deformable template matching over raw SVM texture based classification[7].

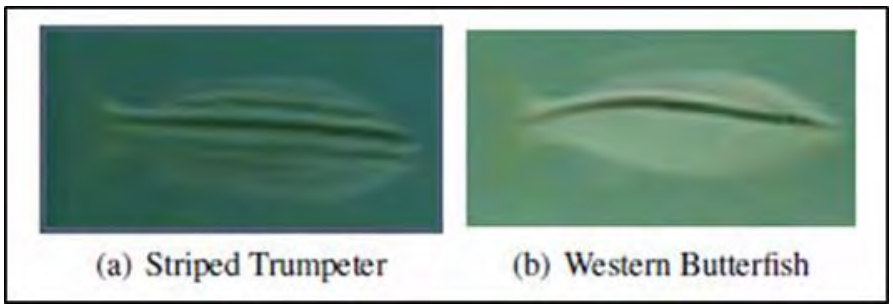

Figure 2.4 Type of Fish Used

Table 2.1 Result of Classification

SVM Kernel	Unwarped	Warped
Linear	84%	90%
Polynomial	81%	86%

2.4 Artificial Neural Network

An Artificial Neural Network is an interconnected processing information that make a decision from a specific problem given[8]. The processing information of an ANN is based on the way that a human nervous system work such as brain to create the resemblance of a brain neuron because just like human, it is a system that learned something from an example given[9].

2.4.1 Multilayer Perceptron Network (MLP)

MLP network is a class of feed forward artificial neural network that is made up of more than a single perceptron that is connected to one another as pictured in Figure 2.5. It is made up of three levels which is inlet level for signal receiving, hidden level for computational engine, and outlet level for decision making. Even with a single layer of hidden level, the systems are able to approximate any continuous function[10].

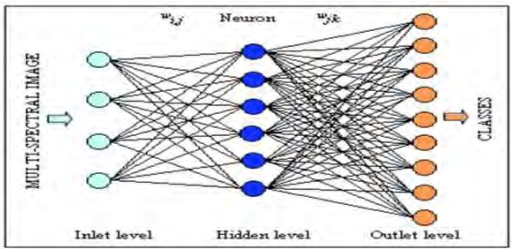

Figure 2.5 MLP Network structure

According to the research paper done by Eiji Morimoto, Yuichiro Taira, and Makoto Nakamura, a fish recognition system can be developed by employing neural networks that could learn to differentiate and classify fish species using references point[11]. References point was extracted from images of the body texture of the fish by using truss protocol as shown in Figure 2.6. In order to assemble the dataset used for network inputs, the truss lengths between reference points according to the total body length are used. The specified fish species that was used for the identification was D. Macrophthalmus. For the learning process, each signal for the specified species was labeled as 1 while the other species was 0. Figure 2.7 shows the learning results

of the method that proved its effectiveness because almost all of the specified D. Macrophthalmus species is 1 and the other species is 0.

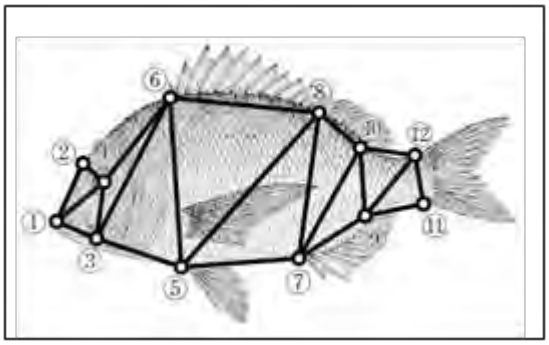

Figure 2.6 Landmark and Trusses[11]

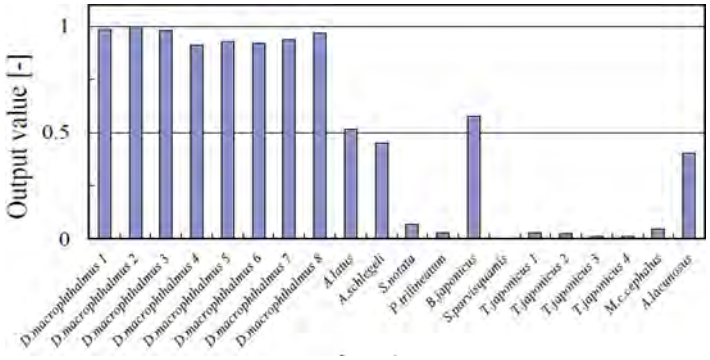

Figure 2.7 Learning Result[11]

Moreover, methods of fish recognition by using multilayer perceptron neural network are also done by Purti Singh and Deepti Pandey[12]. In their research, shape of the fish is an essential visual characteristic and is the key features used to illustrate the content of the image. The fish features that was approach are the size, shape, color, and its geometrical parameters. Based on the results, the recognition system that also include the training and testing processes of all fish shows accurate classification result that achieve 97.4%.

2.4.2 Convolutional Neural Network (CNN)

A CNN is also a class of feed forward artificial neural network that is commonly used for the analysis of image visualization. Compared to the neural networks that its neuron is fully connected with each layer, CNN will only consider the closest neurons in a given range[13]. This is possible because pixel information from an image will be extracted in a specific block size

Lecun et.al was the first person to propose the convolutional neural network algorithm to be used to recognize documents and created solutions to classify single digits, strings of digits and zip codes respectively[14]. The architecture of CNN was pictured in Figure 2.8.

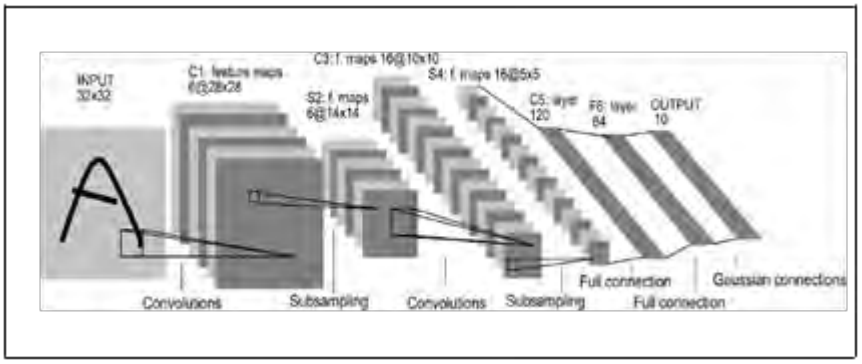

Figure 2.8 CNN Architecture

The usage of convolutional neural network is applied by M. Alsmadi et. Al [15] for fish recognition of four type of different species. The input test data was trained into the CNN model to get the recognition results. The training samples are regularized and adjusted to a uniform size and use batch approach in the training process to randomly select the training samples, preventing the adverse effects of poor data in the training process. By using the back-propagation algorithm for each small batch, the weight was updated. The training process was stopped when it reaches a certain number of iterations or the error reaches the threshold.

Convolutional neural network was also used by Minsung Sung, Son Cheol Yu, and Girdhar Yogesh[16]. The based technique of this method adopts the concept of You Only Look Once (YOLO) network algorithm for the recognition of fish in real time. Since object detection that is based on CNN algorithm have been improved in the recent years, main objectives for researchers nowadays are to improve accuracy and processing speed. Hence, YOLO was introduced by Redmon Joseph, et al. [17].

The usual classical method of fish recognition detects identical characteristic such as its features of shape or a pattern of color. To improve the precision of the system, seabed images are trained to be classified as a non-fish object because most fish has its skin texture identical to the seabed for defense mechanism. It is then labeled as „negative" to prevent the system from recognizing seabed as a fish. The same method was used to other underwater non-fish objects and labeled as „negative". The network was trained efficiently by using grid search to optimized the hyper-parameters that is made up of value of momentum, number of epoch, mini batch size, and learning rate. Figure 2.9 shows an example of fish recognition by implementation of YOLO and CNN algorithm.

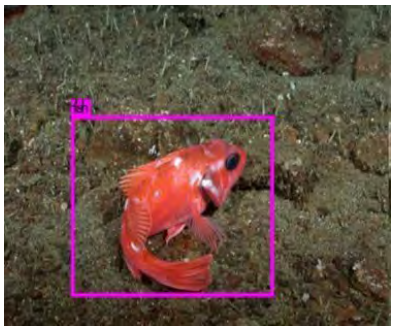

Figure 2.9 Detected Fish in Seabed

CNN algorithm was also implemented by Alex Krizhevsky et. Al with their publication paper entitled "ImageNet Classification with Deep Convolutional Neural Networks" [18]. The architecture for AlexNet is shown at figured 2.10 and was named after its first author, Alex Krizhevsky. AlexNet was abundantly greater than the earlier CNNs used for computer vision tasks such as Yann LeCun's LeNet paper in 1998[14].

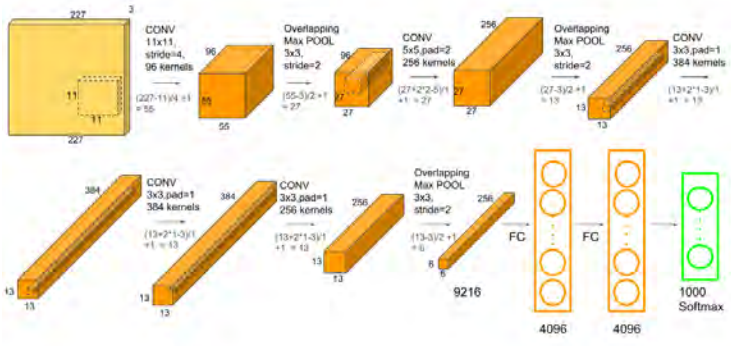

Figure 2.10 AlexNet Architecture [19]