



Digital Image Processing Techniques for Detection and Diagnosis of Fish Diseases

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Abstract— *Image processing is used in many fields of knowledge because it allows the automate processes to get more information about the object being examined. One of directions of use of image processing technology is the study of fauna and flora, and in particular, the detection and diagnose of diseases of some representatives of fauna. In this article, we looked at the possibility of studying fish diseases by applying the methodology of color image segmentation. The surfaces of fish body considered the main information source to detect infections. We successfully have detect infected areas on fish body and identified a total area of lesions. The proposed method makes it possible to automate the process and reduce the time of diagnosis of Infectious dangerous fish diseases.*

Keywords: *fish diseases, image processing, color segmentation, segmentation marker, spatio-temporal analysis*

I. INTRODUCTION

Fish play an important role in human life and considered as one of most important links in the overall food chain, it is a source of phosphorus, calcium and good fats, in addition, it able to purify and destroy harmful plants in water. But the fish as other living beings can also suffer from different diseases, since almost all the fish carry pathogens and parasites. Water temperature, which varies from season to season, and pollution of water resources can be considered as one of the main factors in the spread of fish diseases [1, 2].

To detect and then prevent certain diseases of fish, we need an effective, accurate, simple and quick method; because of rapid spread of disease among fish. Late detection of fish diseases and late measures for non-proliferation of such diseases will inevitably lead to significant economic costs in the field of fisheries and can also affect human health [3, 4]. Thus, the study of fish diseases using new approaches will enhance the control of fish populations and breeding.

II. METHODS OF STUDYING FISH DISEASES

Classical methods of studying fish diseases.

In general, Diagnosis and detection of fish diseases is time consuming and difficult task due to the need to analyze the relevant microorganisms, which are carriers of the disease. Among the classical methods for determining fish diseases, Biochemical tests [5], microbiological studies [6, 7] and Histological studies [8, 9] can be highlighted. At the same time one of the methods for studying fish diseases is the spatio-temporal analysis [10, 11] which is focus on studying the dynamics of fish disease based on foci of disease. The development of spatio-temporal analysis can be considered the use of image processing methodologies for the study of fish diseases.

Image processing as a tool for analyzing and detecting fish diseases.

In fact, image processing methodology is a representation of separate pictures of an individual perception of the reality to extract additional information about objects under study. Standards of perception can be formed in systems similar to human sight, such as the video shooting, a photo or could be transformed in images of visual perception of the human by means of some technical device. These circumstances impose certain features and restrictions, both on the nature of considered standards of perception, and possibilities of their analysis.

In article A. Navarro *et. all* considered the possibility of using automated software for image analysis (named IMAFISH_ML) for the study of fish [12]. The authors showed that IMAFISH_ML software provides fish farmers and researchers with an efficient, fast and automatic tool to objectively asses morphological and growth traits [12]. However, IMAFISH_ML is only a tool to evaluate products for industrial purposes. D. Zhu *et. all* with the help of image processing methodologies examine the structure and mechanics of fish scales (on the example of striped bass - *Morone saxatilis*) [13]. This makes it possible carry out diagnostics fish diseases. J. Hu *et. all* consider using computer vision to diagnose fish diseases [14]. Diagnosis of diseases of fish is based on classifying species of fish based on color and texture features. Color and texture subimages of fish skin were obtained from original images. Color features, statistical texture features are obtained by a wavelet analysis. H. Yao *et. all* for fish disease studies consider contour extraction from images [15]. In order to improve the accuracy and stability of fish image segmentation, they proposed a new fish images segmentation method which is a combination of K-means clustering segmentation algorithm and mathematical morphology. H. Chakravorty, *et. all* consider various image processing methods to study fish diseases [16]. Nevertheless, despite the

ability of using various methods of processing and analyzing of image, one should consider the specifics of how these images are displayed. The consideration of possibility of application of separate methods of analysis and image processing allows: to choose the most comprehensible methods of analysis and image processing, to optimize structure study of fish diseases and to increase a productivity and an overall performance of system of intellectual analysis of data. At the same time, the methods of analysis and diagnostics of fish diseases (image processing) show the feasibility of using the data clustering method. This conclusion is based on the fact that many fish diseases can be observed visually where fish diseases affect the surface of the fish body which make it possible to see and analyze.

III. METHODOLOGY AND DATA

The main stages of image processing in the study of fish diseases

The main objective of the application of imaging methodology in the study of fish diseases should be called clustering of objects in the image, which allows realizing various image segmentation procedures with more subsequent analysis which will lead to take appropriate decisions. Based on the ratio of different clusters we can talk about a degree of manifestation of fish diseases. In parallel we need to apply the methodology of the human-machine in image processing (Fig. 1).

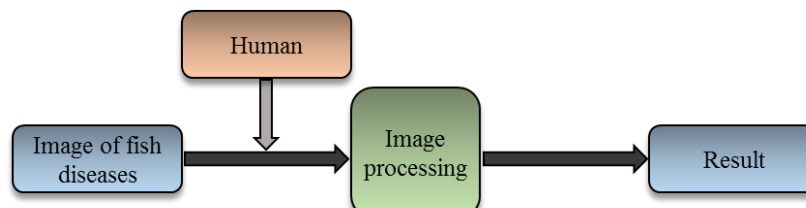


Fig. 1 Human-machine methodology in image processing for the study of fish diseases

To achieve our goal we will follow the following steps [17]:

- Choosing markers for individual objects.
- Detecting objects in the image.
- Calculating the proportion of an object in the image.

Choosing markers and detection of objects are based on the identification of the object by color, which is a standard procedure in the image processing that allows to select an area of a predetermined set of colors.

For calculating the proportion of an object in the image the following formula will be used [18]:

$$V = \frac{S_i}{S} 100\% \quad (1)$$

Where

V_i – Proportion of i objects in the image;

s_i – Area of the i objects in the image;

S – Image area.

Data for analysis

To accomplish the task we will use a variety of images which are available for public internet access of fish diseases such in Fig. 2 (White Spot (*Ichthyophthirius multifiliis*)), Fig. 3 (Damaged skin and quilted disease) and Fig. 4 (Damaged skin).



Fig. 2 White Spot (*Ichthyophthirius multifiliis*).



Fig. 3 Damaged skin and quilted disease.



Fig. 4 Damaged skin.

Fig. 2, Fig. 3 and Fig. 4 show that the fish body does not occupy the entire area of the image, therefore we have to take this fact into consideration when measuring the scope of infection. To do this, we will find the fish area, and then find the infected area to the fish area. The whole image processing methodology can be summarized in the following steps [18]:

- Step 1:** selection of markers for individual objects
- Step 2:** detection of objects in the image
- Step 3:** calculating the proportion of an object in the image
- Step 4:** calculation the proportion of infected area to the fish area.

IV. RESULTS AND DISCUSSION

In this part we will apply the previously described methodology on a specific images. Let us choose image in Fig. 2 and apply marker of white spots on it, after processing we get the infected area on fish body (Fig. 5a - blue color) and the healthy area of fish body (Fig. 5b - red color).

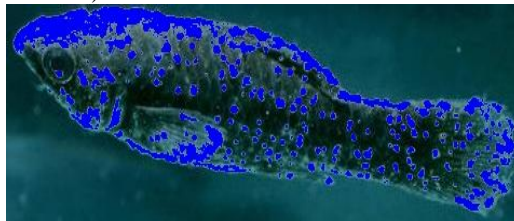


Fig. 5a Disease area on fish body

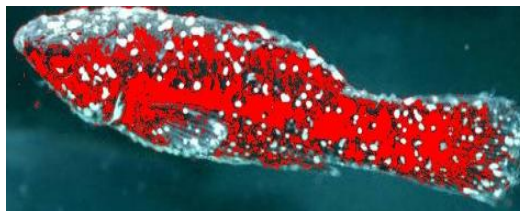


Fig. 5b Healthy area of fish body

Calculations show that the infected area of the entire image is about 11%, while the healthy area is about 27%, so the proportion of disease area to the body of fish is equal to 28.93%. It can be said that much of the fish's body struck by disease.

Fig. 3 shows two kinds of fish diseases. Therefore, we will use two markers to detect the diseased areas. Fig. 6a shows quilted disease area on fish body (blue color), Fig. 6b shows damaged skin area (red color). The area of quilted disease for the entire image is about 2%, while the area of damaged skin is about 8%. The area of the healthy part of the body of fish to the entire image is about 46% and the area of all disease to the body of fish is about 17.85% (3.57% - quilted disease, 14.28% - damaged skin).

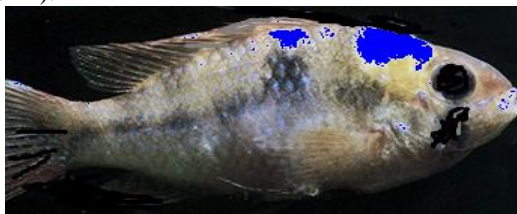


Fig. 6a. Area of quilted disease

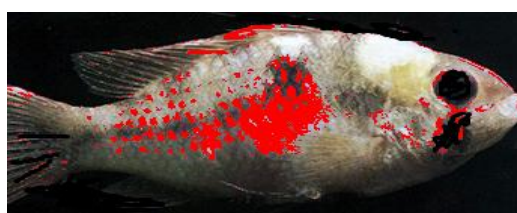


Fig. 6b Area of damaged skin

Fig. 7 (for Fig. 4) shows the damaged skin area (blue color). The area of damaged skin to the entire image is about 5% and the area of damaged skin to fish body is about 9.6%.

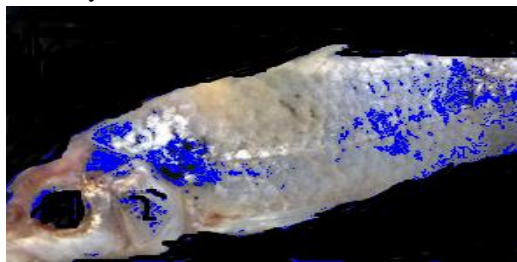


Fig. 7 Area damage the skin

The main disadvantage of this methodology is the appearing of false point marked as infected areas due to the automatic allocation of the selected color which may affect the calculation. On the contrary, this methodology has many advantages such as: the ability to change the size of the marker when selecting the colors in the image segmentation to avoid any appearance of false points, the ability to analyze fish skin areas that are difficult to identify visually and the ability to isolate areas of the skin with varying levels of destruction.

V. CONCLUSIONS

In this work we consider the possibility of using digital image processing methodology to detect and diagnose fish diseases by determining the infected areas on fish body. To do this, we have used color image segmentation ideology and colored markers to detect healthy and infected areas of fish body. The results have shown the feasibility of using digital image processing methodologies to study fish diseases.

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