Method of Measure Length of Fish from Digital Image

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ABSTRACT

Fish length is very important to the fishery research to identify fish population. The fish length sample is a main parameter to identify fish reproduction, recruitment, growth and mortality. Currently in Malaysia, researchers have to measure the fish length one by one manually by using measurement tools. This method is high cost as the fish has to be bought first for measuring purpose. Moreover, the manual process of measuring fish length is very time consuming. Therefore, a method to measure the length of a fish automatically is greatly needed to solve these problems. In this paper, we propose a method for measuring fish length from the digital image. This method uses the image processing to process the image to get the length of fish in an image and implements the formula magnification optic to get ratio for obtain the actual length of fish.

Keywords

Fish length, image processing, digital image

1. INTRODUCTION

Obviously, fish is a main source of protein in Malaysia and the requirement increase from year to year. From the Annual Fisheries Statistics, the catch yield fisheries in Malaysia are unstable as can be seen in Figure 1.1. This problem occurs as the catch process is carried out without concerning the fish life cycle ecosystem. The fish life cycle related with graph fish stock assessment which catch yield will increase with the increase of fishing effort but after the level renewal of the resource (the reproduction and the body growth) yield will be reduction if the fishing increase continued (refer Figure 1.2).

Therefore fish reproduction can be considered as vital information to fisheries department. From fish stock assessment mathematical, we will know the time of fish reproduction is based on the fish length or age data. According to [10], the length value is better than fish age value for data collected. Thus, it is obvious that fish length is so important in order to obtain fish reproduction for catch yield fisheries increment from year to year.

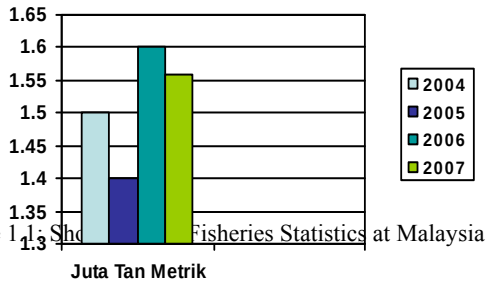

Figure 1.1: Sho Fisheries Statistics at Malaysia

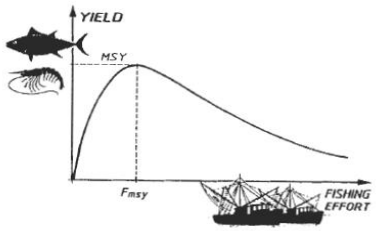

Figure 1.2: Fish Stock Assessment

In the current method, we need to buy the fish before the measuring process can be done, which means it can be costly and time consuming [10]. For this reason, the method with less-computation is highly demand.

In this paper, we proposed a method to measure a fish length from a digital image. This method implements image processing technique to process the image to obtain the fish length in an image. We also uses the formula magnification optic to get ratio for obtain the actual length of fish.

2. LITERATURE REVIEW

From the previous works, there are a lot of papers discussing methods to measure the various objects such as the size of fish [1,2,3,4], size of leaf [7], size of cow [6] and object [8,9] from a digital image. Naiberg et al. [1] has developed a size assessment system underwater using model-based recognition and stereoscopic vision. Model-based recognition is used to locate object and stereo vision system to determine distance and sizes given stereo video input. However, the stereo vision system is very expensive and the matching procedures

also still have error and poor image quality that can affect the accuracy of measurement.

Another method is automated Fish Recognition and Monitoring (FIRM) which proposed by Lee [3]. This method has five main processing steps: image acquisition, object detection algorithm detects the presence of an object (DMA), identifying the fish with object contour extraction used Canny Edge operator and identification, tracking of the fish object determines the location of the fish , triggering the recognition process when an image of the whole fish can be acquired. The measurement size and species of fish used shape-based recognition. Lee et. al [3] did not focus to obtain size of fish, their focus comparison technique to shape matching. This method is suitable for fish in an aquarium.

Beside that, some previous paper discussed measurement of species and fish length by implementing computer vision for sorting fish in industrial area [4]. Such method must have laboratory equipped with a conveyor belt and other hardware such as pc, lamp and sensor as in Figure 2.1.

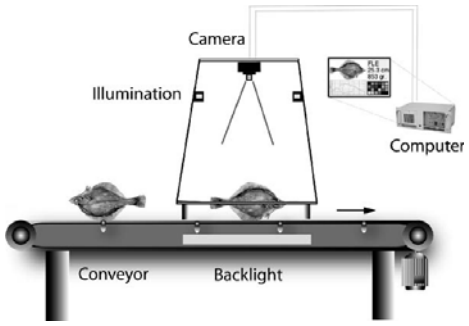

Fig. 2.1: Modern Hardware which used by [White,2006]

This method must have a laboratory that is equipped with a conveyor belt which needs a lot of money. In the real world, the fish should be measured. This research need measure fish length rapidly without going to laboratory because the fisherman sales the fish as soon as possible. It also needs the method measure length of fish with short time, accuracy and inexpensive method.

In recent year, there has been papers developed method measure size of object without laboratory and fix distance from object to camera [8,9]. Pickle et. al [9] developed software namely AnalyzingDigitalImages. The method Pickle at. al [9]used reference object which help obtain ratio one pixel. After get that ratio, actual size object value will achieved. The advantage used method's Pickle is no need fix distance and illumination but disadvantage is all object in image must have object reference (refer fig. 2.2).

Object Reference

Fig. 2.2: Example Object Reference

Hsiu et al. [8] solve the problem Pickle's method which measure size object from digital without object reference. The method's Hsiu obtain size object directly from digital image.
Hsiu et al. [8] using equation magnification and software image viewing program. The equation magnification used to obtain ratio for get actual object value and software image viewing program to detected edge automatically. Fig. 2.3 show the flow chart of Hsiu.'s method.

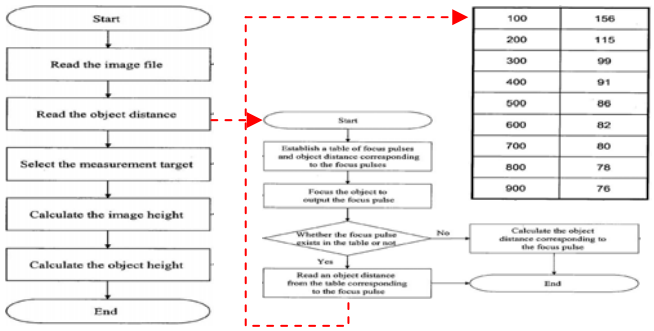

Fig. 2.3: The Flow Chart of the Method's Hsiu

The example of object that hsiu et al [8] used was coat. The object is very simple feature. In this research is use fish as study material. A lot of problem to process image of fish especially in detect fish in image because head and tail of fish have curve and corner must detect accurate to get accuracy calculated size fish. Serkan et al [11] is potential to detect of detection like fish using maximizing bending ratio and curvature to detect corner. From the Hsiu's and Serkan's method, this motivates us to develop a new method for measure fish length from digital image by combining both of the method.

3. PROPOSED METHOD

From the previous work, this research used Hsiu's method to obtain the actual length of fish and Serkan's method used in process the image. Figure 3.1 show flowchart our proposed method to measure length of fish from digital image.

3.1 Data

Image of fish is obtained from researcher which takes revenue from the fisherman catch. Number of fish image is one. The position of fish in image is horizontal or vertical. The image must have information such as distance object, focus length and pixel size. Hsiu et al .[8] created a method for calculating distance object, wherein a table of focus pulse and corresponding object distance is established in an image capture device; the image capture device utilizes the tables to calculate the object distance. The distance image and the pixel size also should be built-in parameter value of the image capture device used to calculate actual fish length and image of fish length.

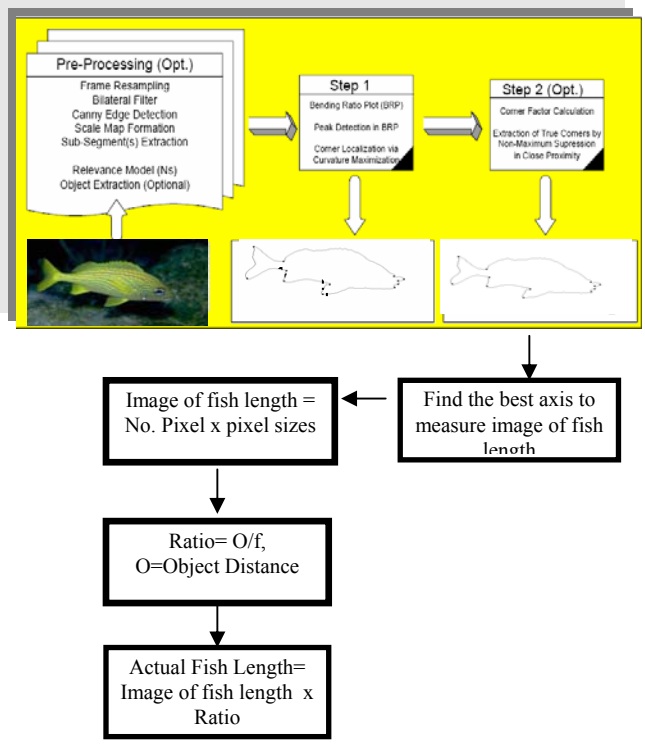

Fig. 3.1: Flow chart of proposed method

3.2 Find Region of Interest

In this research, we use Serkan's method to detect corner detection in image especially head and tail of fish. The pre-processing phase is initially performed, which mainly consists of four major parts (see [11] for details): Frame resampling (size transformation), iterative Bilateral filtering and Canny edge detection to form the *scale-map*, *sub segment* formation and analysis and finally the selection of the relevant *sub-segments* using a relevance model. After pre processing phase, the bending ratio is calculated. The formula a bending ratio can be expressed as follows:

$$BR(p_1) = \frac{L_S}{d_\infty(p_1, p_2)}$$

Where Ls is number of pixel from P_1 to P_2 and d_∞ represents the distance in L_∞ norm. Figure 3.1 show BR calculation. The example show in figure 3.2.

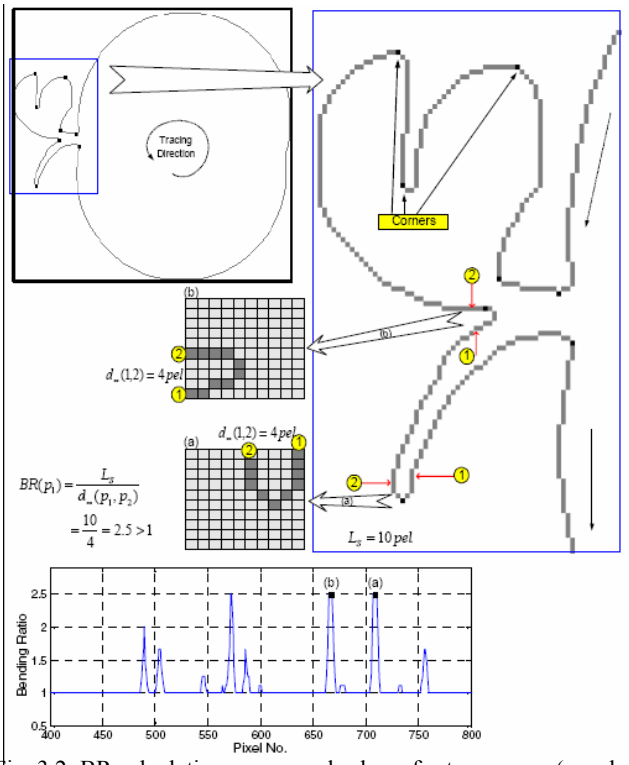

Fig. 3.2: BR calculation on a sample shape for two corner (a and b) detected [11].

Serkan et al. [11] checked for true corner during the tracing process , if $BR(p) > T_{BR}$, where $T_{BR} \geq 1$ is an empirical threshold, which can be set higher to detect only sharper (with smaller angle) corners in particular. A discrete curvature approximation is used within the moving window to find exact corner location. The curvature function $\kappa(u)$ is the derivative of the orientation function $\emptyset(u)$ [2], expressed as in (2) [11].

$$\phi(u) = \tan^{-1}\left(\frac{\dot{y}(u)}{\dot{x}(u)}\right) \Rightarrow \kappa(u) = \frac{\dot{x}(u)\ddot{y}(u) - \ddot{x}(u)\dot{y}(u)}{(\dot{x}^2(u) + \dot{y}^2(u))^{3/2}} \quad (2)$$

The curvature at a given contour pixel from the positions of neighboring pixels (p-1), p, and (p+1) can be approximated as in (3)[11]:

$$\kappa(p) = \frac{(x_{p+1} - x_{p-1})(y_{p-1} - 2y_p + y_{p+1}) - (y_{p+1} - y_{p-1})(x_{p-1} - 2x_p + x_{p+1})}{((x_{p+1} - x_{p-1})^2 + (y_{p+1} - y_{p-1})^2)^{3/2}} \quad (3)$$

Basically in step 1, all the (potential) corners yielding a peak in BRP are detected. In step 2 used corner factor to obtain the really corner. Let $CF(p_C^i)$ be the *corner factor* of the i^{th} potential corner, p_C^i and can be expressed as follows:

$$CF(p_C^i) = BR(p_C^i) \times \kappa(p_C^i)$$

3.3 Measuring Image of Fish Length

After the image process to obtain corner detection at part head and tail, the image will be process to obtain number of pixel from corner head to corner tail. The image of fish length will be obtain when number of pixel multiply with pixel size which get from image.

3.4 Measuring Actual of Fish Length

SThe actual of fish length is calculated with equation of "object distance/object height=image distance/image height". Wherein actual of fish length=object height, image height= image of fish length and image distance = focus length.

4. CONCLUSION

This research is expected to contribute an automated method of measuring the length of a fish using equation magnification and image processing which has high potential to be commercialized given its high reliability, durability and accuracy factors; as well as minimizing cost and time needed for such task. This means that it has to be able to measure length of the fish without having a person holding the fish. The idea is to capture the image of the fish using a camera that uploads the picture to the software to evaluate the length of the fish. The impact of the contribution from this research ensures the stability and security of the country's main source of protein

5. ACKNOWLEDGMENTS

Our thanks to MOSTI.

6. REFERENCES

[1] A.Naiberg&J.J.Little, 1994. A Unifed Recognition and Stereo Vision System. IEEE

[2] C.costa,A.Loy, S.Cataudella,D.Davis, M.Scardi, 2006. Extracting Fish Size Using Dual Underwater Cameras. Aquacultural Engineering. 218-227.

[3] D. J. Lee,R. Schoenberger, D. Shiozawa, X. Xu & P. Zhan, 2004. Contour Matching for a Fish Recognition and Migration Monitoring System. SPIE Optics East, Two and Three-Dimensional Vision System for Inspection, Control, and Metrology, vol. 5606-05, Philadelphia, PA, USA.

[4] D.J. White, C. Svellingen, N.J.C. Strachan, 2006. Automated Measurement of Spesies and Length of fish by Computer Vision. Fisheries Research 80. 203-210.

[5] M. Yousef Ibrahim & S.Sultana, 2006. Study on Fresh Fish Sorting Techniques. IEEE. 462-467

[6] Sakir Tasdemir, Murat Yakar Abdullah, Ürkmez Seref _nal, 2008. Determination of Body Measurements of a cow by Image Analysis. International Conference on Computer Systems and Technologies - *CompSysTech'08*

[7] MATTHEW E. O'NEAL,1 DOUGLAS A. LANDIS, AND RUFUS ISAACS,2002. An Inexpensive, Accurate Method for Measuring Leaf Area and Defoliation Through Digital Image Analysis

[8] Hsu H. O. Method for Calculating Distance and Actual Size of Shot Object. United States Patent, 2008

[9] Pickle J. Measuring Length And Area Of Objects in Digital Images Using Analyzing Digital Images Software. Concord Academy, 2008

[10] Mustapa Bin Man. Development of Web based Fish Stock Assessment Tools using Length Based Method. 2008

[11] Serkan Kiranyaz, Hantao Liu, Miguel Ferreira and Moncef Gabbouj, 2007. An Efficient Approach for Boundary Based Corner Detection by Maximizing Bending Ratio and Curvature.IEEE