Fish Length Measurement: The Results from Different Types of Digital Camera

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***Abstract*—Fish reproduction, recruitment, growth and mortality normally measured using fish length method for identifying the fish species population. Normally researchers in Malaysia buy the fish and measured length of fish one by one using simple fish measuring board made out of hardwood or acrylic plastic. This current method took longest time and very costly. In this paper, the researcher used different types of digital camera as digital images input data for identifying length of fish and using Hsiu's Method for analysis. Result of this experiment will be proposed to user in selecting the best camera as input device for measuring length of fish.**

***Index Terms*—fish length, digital camera, image processing, hsiu's method**

I. Introduction

Fishery performance indicators require continuous information for their determination as the fishery, its parameters, as well as management objectives vary over time. This information is derived from data that need to be collected and analyzed. Firstly, they provide a structured approach through a sequential pathway from the understanding of why data are needed, through what data need to be collected, to how data should be collected [1].

Fisheries policy and management objectives need to be based upon analyses of *reliable data*. Policy and management issues can be broadly divided into food security, socioeconomic and environmental concerns, each of which needs certain types of information for decision-making. While the precautionary approach could be used when information is insufficient, management in general should be based on the "*best scientific information available"* and this has important implications in terms of *type*, *quantity* and *quality of data to be collected* [2].

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II. Fish Length Measurement

Position Fish measurement refers to the measuring of the length of individual fish and of various parts of their anatomy. These length data are used in many areas of ichthyology, taxonomy and fisheries biology. The most common method to measure the fish is using a simple fish measuring board made out of hardwood or acrylic plastic. On the board there is a scale of various units such as millimeter or inches. The head of fish is place on the headboard and the tail on the ruler for measurement. The head should be on the left side and the caudal fin on the right side of the measuring board with the mouth closed. The individual fish were measure by using the board with the eyes of the observers should be at the perpendicular to the tip of the measurement. The lengths were recorded on a length data sheet [3].

In Malaysia, the fishery researchers used this method to measure the fish length. In our observation, this method is too time-consuming as it measures the fish individually one by one. The inconsistencies and inaccuracies of the length measurement do occur as a result of human bias factor such as the expertise, eyes and direction of the observers [3]. Since, it took a long time to measure the fish length it would be quite impossible to obtain large number of specimens to represent the population of fish under study. This normally happen when sampling the commercial fisheries at port as the fishermen have to sell the fish to wholesalers as soon as possible. In order to obtain a good population sample, the sample has to be taken from various vessels at the same day. As a result, the fishery researchers have to purchase the fish to get the data of length samples of the fish. Consequently, these would create a problem for those with limited budget. Therefore, a method to measure the length of a fish automatically is greatly needed to solve these problems [3], [4].

From the previous works, there are a lot of papers discussing on the methods to measure various objects such as the size of fish [5]-[7], size of leaf [8] and object [9], [10] from a digital image. Naiberg *et al*. [5] has

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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 expensive, the matching procedure still have an error and poor image quality that these could affect the accuracy of measurement. In this method, Lee et. al [6] focus on the comparison technique which is suitable for fish live in an aquarium.

Besides that, some previous papers discussed measurement of species and fish length by implementing computer vision for sorting fish in industrial area [7]. Such method must have laboratory equipped with a conveyor belt and other hardware such as pc, lamp and sensor as in Fig. 1.

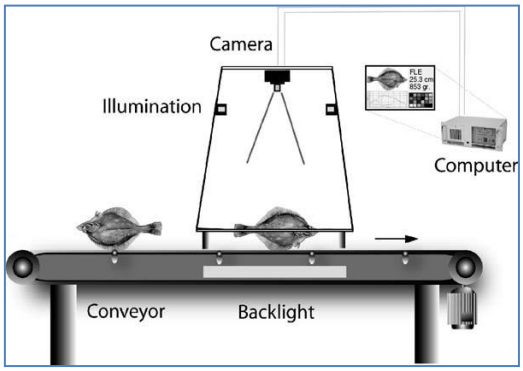

Figure 1. Modern hardware which used by [7]

This method must have a laboratory that is equipped with a conveyor belt which needs to spend a lot of money. In this research, measurement of fish length process can be completed by without going to laboratory. The development of less computation time, high accuracy and an inexpensive method to measure the fish length is highly demanding.

In recent years there has been several papers introduced method to measure size of object without laboratory and fix distance from object to camera [8]. Pickle *et al.* [9] developed software namely Analyzing Digital Images. This method used reference object which help to obtain ratio one pixel. After get that ratio, actual size object value will be achieved. The advantage used Pickle's method is not require a fix distance and illumination but its disadvantage is all object in image must have object reference (refer Fig. 2).

Figure 2. Example object reference

Hsiu *et al.* [10] solve the problem arise from Pickle's method regard to measure size object from digital without object reference. The Hsiu's method obtain size object directly from digital image. This method is suitable with our case study but we do not know how accurate this method [4]. Because of that, the objectives this paper to analysis the accuracy Hsiu's method in measuring object size like fish and introduce improvement of Hsiu's method.

III. HSIU'S METHOD

Hsiu et al. [10] using equation magnification and software image viewing program. The equation magnification is used to obtain ratio for get an actual object value and software image viewing program to detect edge automatically. The equation magnification is "object distance/object height = image distance/ image height". Fig. 3 shows flow chart of Hsiu's method.

A. Calculating Object Distance

The object distance is an important variable to obtain the size object. In Hsiu's method, it created a method for calculating distance object, wherein a table of focus pulse and corresponding object distance are established in an image capture device. After that, the image capture device utilizes the tables to calculate the object distance. Fig. 4 shows flow chart to calculating object distance.

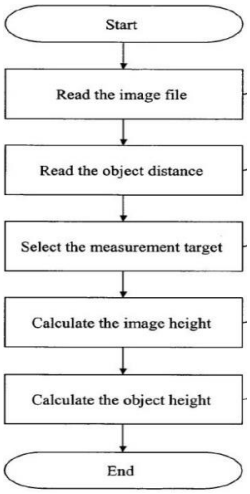

Figure 3. Hsiu's method

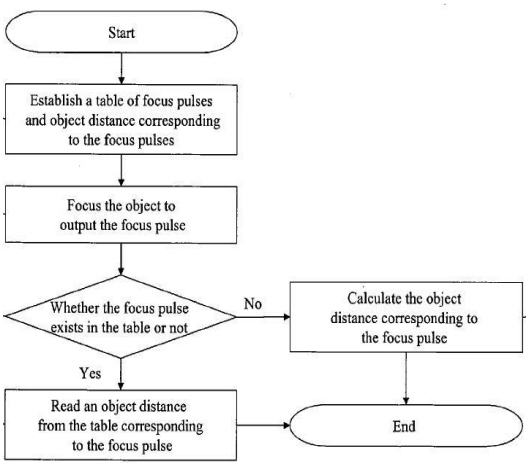

Figure 4. Calculating object distance [8]

B. Measuring Image Height

The image viewing program displays the image file in frame. The user should select a target for being measured to get number of pixel. The Image height will be obtained when number of pixel multiply with pixel size is built-in parameter value of the image capture device.

C. Calculate the Fish Length

The actual of fish length is based on basics of optical System. Light rays refract when they pass through the lens and concentrate on the surface (refer Fig. 5). This effect is used in our eyes and similar devices as cameras, microscopes, telescopes, etc [11].

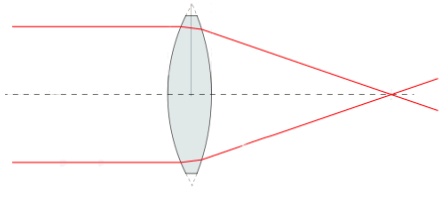

Figure 5. Light rays refract

In cameras, there are a group of lenses (instead of one) that work together to make more control on light and to get a better quality image (refer Fig. 6).

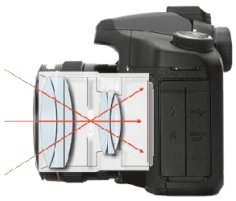

Figure 6. Group of Lenses in Camera

But the rules are the same for a single lens or a group of lenses. There are four variables that are important:

The size of the object (Y1) (1)

The distance of the object from the lens (X1) (2)

The size of the image on the sensor or the film (Y2) (3)

The distance between the sensor and the lens (X2)

$$a1 = a2 \Rightarrow tag\ a1 = tag\ a2 \quad (4)$$

Tangent is an opposite side or adjacent

$$Tag\ a1 = Y1/X1 \quad (5)$$

$$Tag\ a2 = Y2/X2 \quad (6)$$

Tag a1 = tag a2 ==> Y1/X1 = Y2/X2 ==> we can inverse both sides of the equation

$$\boldsymbol{X1/Y1 = X2/Y2} \quad (7)$$

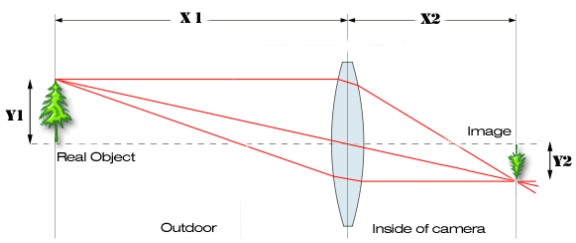

Figure 7. A simple imaging system

Notice that there are two right angles in Fig. 7 which is clearly shown in Fig. 8. Thus, triangles rules can be applied in this case.

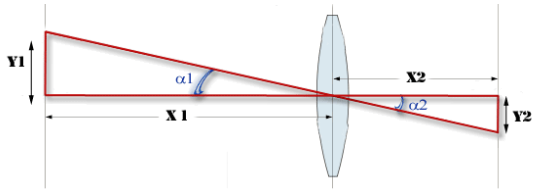

Figure 8. Geometry concept

The variable name of Y1 is the size of an object. In this case is the actual fish length. This length will be obtained there variables. There are Y2, X2 and X1. The Y2 refers to the size of the image on the sensor or the film. This means Y2 is the fish image. X2 refers to the size of the focal length. Focal length value will be obtained in EXIF information. The value of X2 can be set when the image is taken.

IV. Result

A. Image Collection

In this testing we choose fish type of "Sela" species in different sizes. We took picture with different types of camera, illumination and camera position. Fig. 9 show the screen shot of used System for measuring "Sela" species.

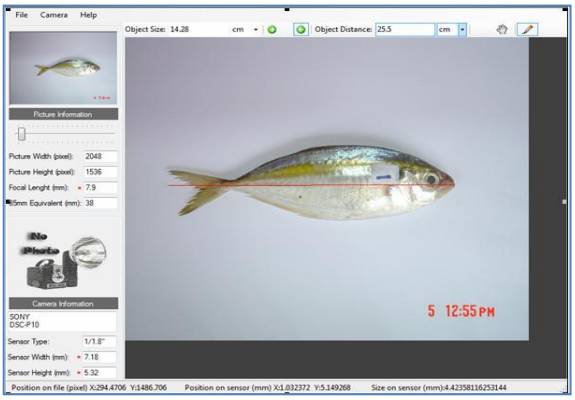

Figure 9. Interface of system

B. Critical Analysis

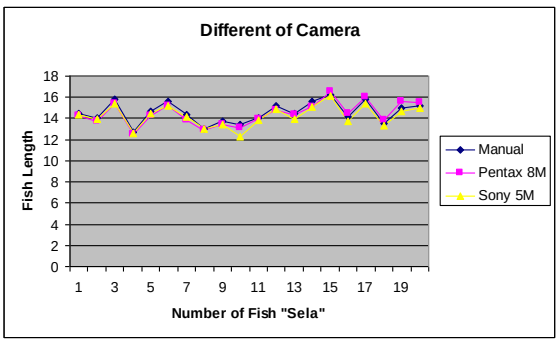

Figure 10. The comparison with different types of camera

In the Fig. 10, shows the measurements result which compare between manual and camera method (Pentax and Sony). From the result we can see, the result from

Pentax (8.0 M pixel) approximation with manual method with error 0.74%. Meanwhile the result from Sony (5.0 M pixel) camera had 2.19% error.

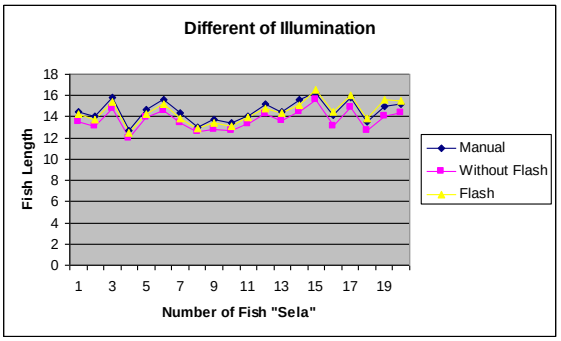

Figure 11. The comparison with different of illumination

In this case, the manual method acts as true value. Fig. 11 shows the comparison result within flash and without flash in Pentex camera. The result with flash is 0.74% error and without flash is 6.03% error.

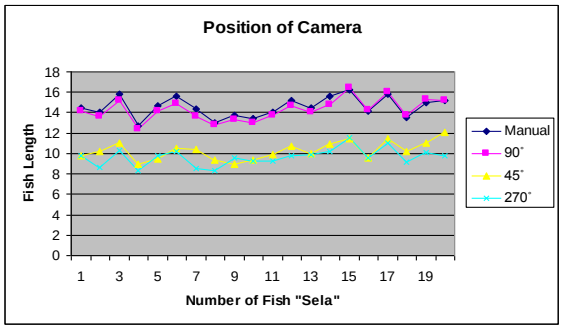

Figure 12. The comparison with position of camera

Fig. 12 shows the comparison result between different positions of camera. In this research, we used three differential positions with 45 and 270 degree. So from the result we can see approximation true value only when the position of camera in 90 degree.

V. Discussion and Conclusion

We can conclude that accuracy of Hsiu's method give a good result 0.78% when we use Pentax Optio E40 with 8M pixel. This result totally give a big range when we applied the flash and without flash on the camera. In our research, we test our result with different of camera position. So, the results gave more accurate when the position of camera is 90˚. This study showed that Hsiu's method can be used in measure length of fish but still need improvement. We have same clue that believed able to enhance Hsiu's method. We will present this clue in the future. In our suggestion, we will improve Hsiu's method focus on how to detect head and tail fish using image processing to generate object size of image automatically.

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