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Estimation of milkfish physical weighting as fishery industry support system using image processing technology

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Estimation of milkfish physical weighting as fishery industry support system using image processing technology

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Abstract. The Milkfish prices in many marketplaces influenced by physical weight. The weighting is determined using an analog scale and must be delivered in real time for good marketing for the fishery industry, restaurant and to the final consumer. This paper presents a computer vision system with image processing technology that allows Milkfish scales data to be directly stored in computer databases. The system designed in the form of measuring instruments of physical weight and directly presented on the user's computer. The computer vision approach implemented by determined the measurement pattern to find the parameters (HSVHS) and using contour detection to obtaining object edges as a bounding box. Each bounding box edges measured using pixels scale and formulation using Weight Fish Estimation equation. Accuracy performance of image processing was measured using ROC approach. The results showed the accuracy of weight estimation using 20 fish samples reached by 86.66% and the accuracy of object detection by 95% with error rate measurement by 1 centimeter (cm) from the actual length. This result highly recommended to applied to the fishery field and it can be a tool for fishpond farmers or fishermen to detect fish weight in fish marketing.

1. Intoduction

The physical weight of Milkfish is very important for the determination of prices. Milkfish's weight is determined using analog scales after all the fish crops are collected. The scales will be recorded and used in the marketing process. It certainly requires manpower to always record the data which is subsequently reported in the relevant section. Human limitations that acquired information of technology tools in the field of the fishery can be a constraint [1] Information technology enables the delivery of information in real time and ensures the quality of the information.

Information technology like image processing area is widely used in the field of fisheries. This technology is used in the fishing industry like a vision computer system that automatically measures the length of the fish [2], and it can be used to detect the age of fish using morphological features, and using the growth of body length level [3], and also be used to detect quality of fish [4] detecting the fish's eye to know the freshness of milkfish [5], [6]. This technology could offer a practical way to help provide an alternative solution to know the weight estimate or physical size of the animal body, and animal weight using image processing measurement tools [7], [8]. This research will design image processing technology and applied to determine the weight estimation of milkfish by multiplying the length and the two sides of body width and divided by 800 to obtain the physical weight of the fish. The length of the fish is taken from the tip of the fish's mouth to the tip of the fishtail (total length) while the width of the fish is taken from the top going down to the stomach [9], and get the image as the total length and width using bounding box contour method. The active contours generated by the computer will be used to detect the boundaries of objects in imagery [10]. For example, in Polewali Mandar Regency, South Sulawesi, Indonesia, production of fishpond farmers is Milkfish with 9,325.00 tons. It is possible to increase the living standard of the farmers and increase the export commodity opportunities [11] if technology touch in this case [12]. Fish that have been obtained from the harvest of fish farmers should be directly informed openly and done as soon as possible. This is one way to maintain the quality and increase the price, because information is certainly expected by manufacturers, distributors, real-time stalls in real-time need fresh fish so that the fishery industry needs to use computing technology [13]. This technology will provide an alternative for fish farmers in determining the weight of the fish, do the calculation of the price, and also marketing by technology. This research designs image processing technology as a feature in computer vision that is used to determine the weight estimation of milkfish as support tools for fishery industry in the future.

2. Methodology

2.1. Image Processing Process

Image processing developed and implemented in various fields. As an example, previously done by implementing in the field of transportation [14], [15]. In addition to agriculture [16], as well as in health [17]. Implementation in the fishery field conducted in many researches. However, in the implementation of image processing for Milkfish for weight estimation has not been done, so the opportunity to help the fishing industry for Milkfish marketplace.

This study was carried out by designing an image processing application using C ++ QT and OpenCV Library that consisting of computer vision functions and API (Application Programming Interface) for high-level image processing and low-level as a real-time application optimization [18]. This application was able to estimate physical weight in fish. In this case, used some samples of milkfish

2.1.1. Data Collection. This study using sample 20 Milkfish that will be used later separated into categories based on the actual weight of fish. Category of fish weight was determined based on market conditions in the field. Testing system using sample fish for category 4 with a weight range by 0.22 to 0.26 kilogram (kg).

2.1.2. Image Processing Workflow. Image processing technology in this study to identify the position of the Milkfish in the picture frame (ie its x, y pixel coordinates), the width of the fish (width, height) [1], [10]. Milkfish detection used image processing method to analyzed RGB cell in the image [6]. The detection steps are presented in Figure 1.

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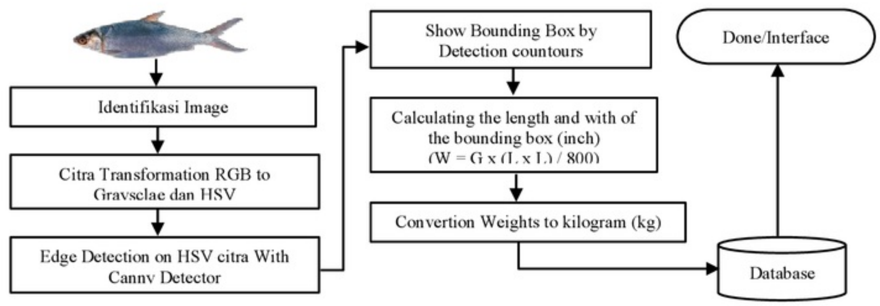

Figure 1. Image processing workflow to identification of the image to estimate the physical weight of milkfish.

- *Calibration measuring Tool*

Image acquisition was done by using a camera on every variation of brightness, time and weather (sunny, cloudy and dusk). The purpose of this approach as to be analysis tool to measure the image processing performance in every variation and then inserted it into the database (SQLite) as a material knowledge system. The image taking was done by first determining the Focal length camera to find out how wide or how narrow the magnification of the object [19], [20]. Container design used to ensure the distance and camera position to the object fixed consistent in all experiment process. The camera was about 44 cm from the container acquisition image that positioned manually. The shooting container was shown in Figure 2 while the Focal length camera involves using (1) [18]. Determination of focal length was the first stage of the workflow of this system.

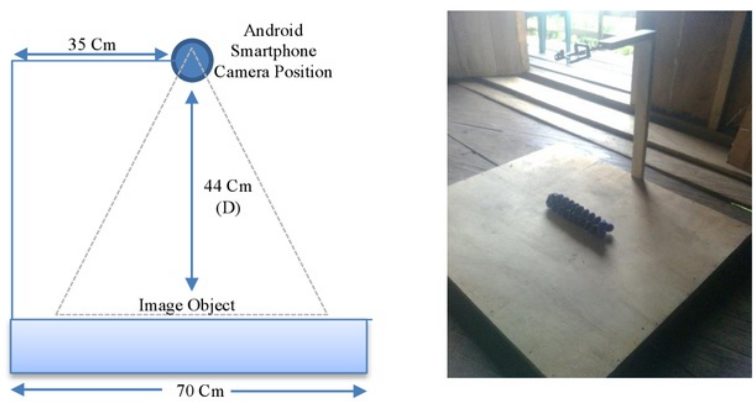

Figure 2. Container Design

$$F = \frac{P \times D}{W} \quad (1)$$

Equation (1) showed variable F for measure focal length camera (pixel), with P for the length of the object in camera (pixel), D for a distance of the object from the camera (cm), and W for the length of the actual object (cm). Based on the visual analysis of each image processing result, there were differences in each image for different levels of brightness and different bounding box patterns formed. Table 1 explained in detail of the results of the detection parameters that obtained at each brightness level.

Table 1. Detection parameter.

Time	Limitation (time)	Paramter (object detection)					
		Min H	Min S	Min V	Max H	Max S	Max V
Dawn	05.00-06.59	Same parameters, but need more lighting					
Morning	07.00-10.00	0	0	56	255	255	255
Noon	10.01-14.59	0	0	42	255	165	255
Afternoon	15.00-17.00	0	0	42	255	165	255
Night	17.01-21.00	Same parameters, but need more lighting					

- *Bounding Box Determination*

Determination of bounding box using counter method to detect edge object [10] to ensure the length of the object in fact, in (2) and (3) used to measure the width of the object actually.

$$W = \frac{P \text{ x } D}{F} \quad (2)$$

$$H = \frac{L \text{ x } D}{F} \quad (3)$$

In (2) and (3), variable W reformulation from (1), but in (3), variable H to measure the width of the actual object in cm unit.

- *Estimation of Milkfish Weight*

The process for detecting Milkfish weight consists of identification of fish positions in picture frames (ie x, y pixel coordinates), fish area (width, height) [9]. Position detection using image processing method to find RGB in the image [6]. Meanwhile, to detect the weight on the fish was done based on the width and length of the bounding box with the following steps:

a. Take a picture with the camera.
b. Transforms RGB image into grayscale image.
c. Apply short edge on the grayscale image using canny method and Contours and Threshold feature from Image Processing theory.
d. Contour elimination that has a small area because it was only considered as noise.
e. Look for bounding box for each contour.
f. Calculates the length and width of the bounding box as a result of the detection of the length and width of the fish.
g. The length and width of the bounding box were converted into inch units.
h. Calculate the weight of fish using (4).
i. Fish batches obtained from the measurements in pounds (lbs), it needs to be converted into kilograms (kg) before being displayed to the program user interface that shows in Figure 4 and Figure 5.

$$W = \frac{L \text{ x } G^2}{800} \quad (4)$$

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Where, Weight (W) is Fish weight in pounds (lbs), Length (L) is the length of fish in inches, Girth (G) is fish body width in inches and value 800 is Standard Shape factor for Milkfish. Simulation to measure the Weight is shown in Figure 3.

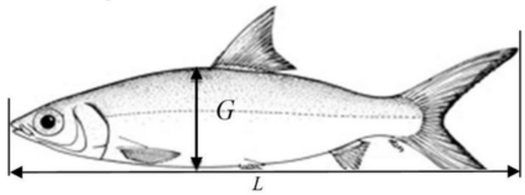

Figure 3. Measurement model of milkfish weight estimation [11].

- *Measurenment of Accuracy*

The accuracy of weight determination was done to ensure the results obtained were appropriate or near to the actual weight size. For accuracy reason, calculation using (5) while to know the level of tolerance error was used (6) and the weighting estimation accuracy was used (7).

$$Accuracy\ IMP = \frac{TP+TN}{TP+FP+FN+TN} \quad (5)$$

Equation (5) was described in Table 2 which shows the actual value matrix and Receiver Operating Character (ROC) predicted results [21].

Table 2. ROC matrix.

Detection	Actual	
	Object	Not object
Detected	True positive (TP)	False negative (FN)
Not detected	False negative (FN)	True negative (TN)

Equation (6) used to calculate the error tolerance, where Tolerance Err to measure Error Tolerance, with Mean (Abs (Error)) for average of absolute value error and Mean (PA) for average of the actual test score, while (7) was used to calculate the accuracy of the weight estimation of the fish by considering the value of the error correlation, where accuracy to measure accuracy estimation of Milkfish weight, Tolerance Err derived from (5), and Mean (PA) was an average of the actual test score.

$$Tolerance\ Err = \sum_{i=0}^{n} \frac{Mean(Abs(Error))}{Mean\ (P.A)} \quad (6)$$

$$Accuracy = \left(1 - \left(\frac{Tolerance\ Err}{Mean\ (P.A)}\right)\right) * 100 \quad (7)$$

3. Result

An image processing technology in computer vision has managed to detect the weight of fish. For validation of the overall test results, used the ROC method to calculate the accuracy, precision, and recall of designed program performance. Calculation of the accuracy using (5).

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The process on a vision computer through an interface would display an image acquisition and image processing results in the length of Milkfish, width and weighting value. Figure 4 and Figure 5 was the result of computer vision experiment for fish weight estimation.

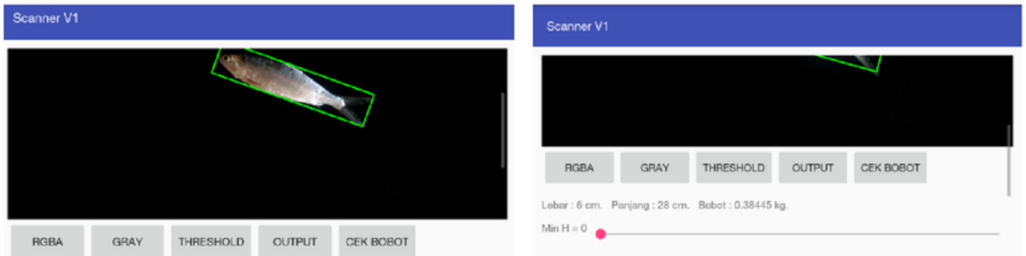

Figure 4. The first experiment calculation of milkfish weight estimation.

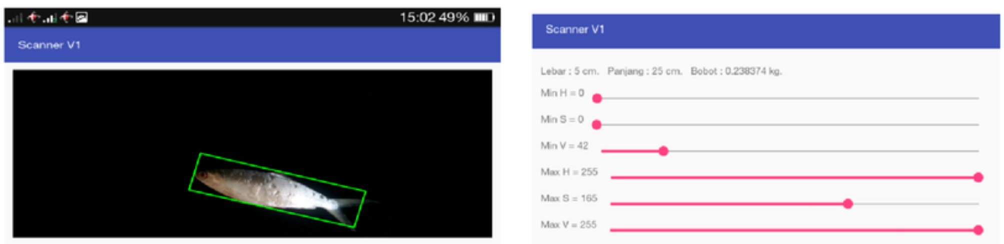

Figure 5. The second experiment calculation of milkfish weight estimation.

The bounding box showed the value of width and length of the Milkfish, then calculate the value to estimate of weight using equation (4). In the first experiment (Figure 4) at 15:02 PM with cloudy weather conditions were normal lighting, first Milkfish with the actual weight 3.8 ounces or 0.38 kg with a length of 28 cm or 10.28 inches and has width 6 cm or 2.34 inches, this experiment detects Milkfish with 100% accuracy between system estimation and actual weight of Milkfish. Figure 5 showed the second experiment with different Milkfish, where size was 2 ounces or 0.2 kg weight, 25 cm or 9.75 inches length and 5 cm wide or 1.95 inches. As a result, the program detects fish with 100% accuracy, the weight of the program was same as the actual fish weight of 0.23 Kg or 0.2 Kg. Best parameters that findings in all testing procedure was value min H = 0; min S = 0; min V = 42; max H = 255; max S = 165; max V = 255 consistently for 20 samples of Milkfish.

Detail of the test results in this paper is shown in Table 3, where the number of successfully detected samples reached 19 (TP) or 95%, while the wrong number of detection reached 1 (FP) and True Negative and False Negative reached 0 (zero). The average error detection was profound difference rate by 1 cm from the actual length.

Table 3. Test result of true positive.

Data	Actual (Kg.)	Estimated (Kg.)	Difference Err.	Abs. Err.
1	0.21	0.2	0.01	0.01
2	0.21	0.21	0	0
3	0.21	0.22	-0.01	0.01
4	0.21	0.22	-0.01	0.01

5	0.23	0.22	0.01	0.01
6	0.22	0.22	0	0
7	0.22	0.22	0	0
8	0.22	0.22	0	0
9	0.21	0.22	-0.01	0.01
10	0.22	0.21	0.01	0.01
11	0.2	0.2	0	0
12	0.22	0.22	0	0
13	0.24	0.23	0.01	0.01
14	0.24	0.23	0.01	0.01
15	0.22	0.2	0.02	0.02
16	0.19	0.2	-0.01	0.01
17	0.22	0.22	0	0
18	0.22	0.23	-0.01	0.01
19	0.23	0.23	0	0
Average	0.21	0.21	0.001	0.006

Based on Table 3, error tolerance and system accuracy for Milkfish's physical weighting estimation measured using (6) and (7). Test results showed that the tolerance error by 0.028 kg with a system accuracy rate 86.66%. This accuracy leads to enough to represent the better result of estimation system for local need and it has a chance to improve for fishing industry implementation because the accuracy of the computer vision for Milkfish's physical weighting estimation will certainly affect the calculation of the selling price.

This paper has presented image processing technology in computer vision system to estimate milkfish's physical weighting. This study got the problem with suddenly lighting change, so it was calibrated again to measuring the object. The instrumentation process must be matched in each temperature and lighting condition because the measurement pattern found different levels of brightness and different bounding box patterns occur, so the system detects the object by searching RGB color difference. This condition makes the system required a large identification method to be able to detect the real object. Although this research has collected a variety of measuring results to be used as knowledge materials system, but that the system can be used in any condition with maximum results

4. Conclusion

Image processing technology in computer vision system to estimate milkfish's physical weighting leads to high accuracy by 86.66% with performance True Positive object detection by 95%. The contour method that produces the bounding box has detected the edge of the object and successful to shown the length and width of the Milkfish with 100% accuracy level. This is proven by comparing the measurement result of the system with the result of manual scale measurement. This result will certainly affect the calculation of the selling price. This study represents the approach to improve and develop an application to combine with supply chain management in fishery industry support system, and it can be a tool for farmers of fishpond or fishers in fish marketing system in the future.

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