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Mobile Application For Mud Crab Weight Estimation

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***Abstract*—Weight is one of several important parameters in the transactions process of buying and selling of mud crab. It must be known accurately to determine the price of mud crab. All this time, sellers and buyers on the market generally estimate the weight of mud crab just by relying solely on the senses. It does not only potentially cause losses for both sellers and buyers but also has no scientific basis. This research is conducted to assist sellers and buyers in estimating the weight of mud crab by developing a mobile application that uses image processing techniques. This mobile application estimates the weight of mud crab based on the carapace width of mud crab from the image obtained through the camera. This mobile application has been tested on a smartphone device with the operating system Android 4.1.2 Jelly Beans (API level 16). Testing was performed by comparing the estimated weight and carapace width of mud crab obtained through a smartphone device with the actual weight and carapace width of mud crab obtained through direct measurements using Vernier caliper and the scales. The result of this research shows that this mobile application has a good level of accuracy. It can be proving by the mean absolute error rate for the width of mud crab carapace which is only 0.086 cm and mean absolute error rate for the weight of mud crab which is only 2.643 gram. This mobile application is helpful for sellers and buyers to estimate the weight of mud crab.**

Keywords—mud crab, weight estimation, image processing, mobile application

I. INTRODUCTION

Mud crab (Scylla Serrata) have experienced an increase in demand in the past few decades. The increased demand for mud crab because of their high nutritional content. Based on the result of the approximation analysis, this mud crab has a protein content of 47.31% and a fat content of 11.20%. So that this mud crab is one of the commodities that are in great demand by the public.

Weight is one of several important parameters in the transaction process of buying and selling of mud crab. It must be known accurately to determine the price of mud crab. All this time, sellers and buyers on the market generally estimate the weight of mud crab just by relying solely on the senses. It does not only potentially cause losses for both sellers and buyers but also has no scientific basis.

Therefore, a solution is needed for sellers and buyers in estimating the weight of traded mud crab. The solution offered is to use image processing techniques. Image processing can be implemented to overcome the various problem above. Image processing will process the images obtained and take feature values in the image that can be used to estimate the weight of each mud crab. Several previous studies have shown that image processing can be used to estimate the weight of an object, for example such as shrimp[1]–[3], oyster[4], Atlantic salmon[5], Alaskan salmon[6], rainbow trout[7], cattle[8], pigs[9], eggs[10]–[13] and others. As for mud crabs, several previous research tried to find the features of mud crab bodies that have a relationship to the weight of mud crab[14]–[15]. All data used in that mud crab researches obtained through manual measurement. The result of it indicates that the features of the width of mud crab carapace can be used to estimate the weight of the mud crab. It also shows the equation that can be used to estimate the weight of mud crab. It uses the non-linear regression form.

So, in this research, a solution was offered to assist sellers and buyers in estimating the weight of mud crab by developing mobile application that use image processing techniques. Image processing techniques in a mobile application is very important because nowadays smartphones are almost owned by everyone because their features are very useful to support human activities and in addition it can also help human mobility because they take everywhere[16]. So, by implementing this application on a smartphone device, it will definitely help sellers and buyers.

II. MATERIAL AND METHODS

A. The Sample Of Mud Crabs

Fig. 1. The Width Of Mud Crab Carapace

Fig. 1, one hundred twenty mud crabs (Scylla Serrata) used as data in this research. All of the mud crabs obtained in fresh condition and randomly selected to have a variety of different sizes. All mud crab that used as data is washed clean to remove all the mud and sand that is attached. Carapace width of each mud crab was measured manually using a Vernier Caliper (accuracy of 0.001) and the weight of each mud crab was measured directly using a Digital Scales (Max 5 Kg and accuracy of 1 g). The data from that crab then divided into two parts where 100 crab data used as training data and 20 crab data used as test data.

B. Proposed Method

The proposed method for processing mud crab images consists of several main steps. The main steps are explained in the system block in Fig. 2.

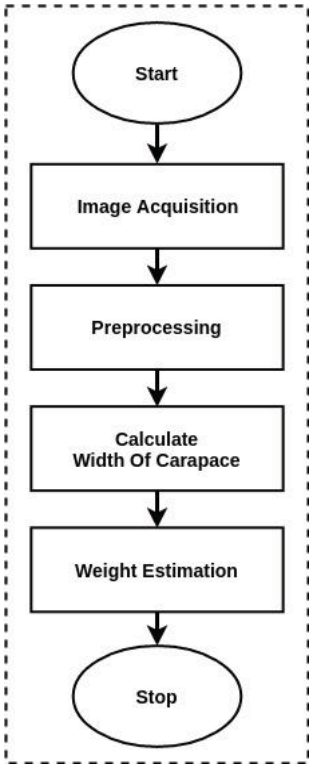


Fig. 2. Proposed Method System Block

- Step 1. Image Acquisition

The image acquisition process is carried out using a camera on a smartphone device. The image acquisition distance between mud crabs and the camera is around 23 cm. To make it easier for users to estimate the distance of image acquisition, in the middle of the camera screen is placed a circle and then metal coin must be placed at the top of mud crab. Metal coin on mud crab image take must be directly inside the circle on the camera screen so the user can estimate the image acquisition distance. Image obtained from the camera are all in the form of RGB images.

- Step 2. Preprocessing

RGB images obtained from the camera then go through the preprocessing stages. The preprocessing stages are the image normalization and histogram equalization. The image normalization process aims to change the image size obtained from the camera to the desired size for processing that is a 320X240 pixels. The histogram equalization is done to increase the contrast in the image.

- Step 3. Calculate Width of Carapace

One of the important steps in working using image processing to measure value is the calibration stage[1213]. Determined the number of pixels that correspond to the object's diameter in horizontal and vertical direction. Identifying two coefficients of K_x and K_y (cm/pix). Providing a centimeter match to the value of one pixel in the direction X and Y, (1).

$$K_x = \frac{D}{P_x} \; ; \; K_y = \frac{D}{P_y} \tag{1}$$

Where D is the diameter of objects in cm; P_x and P_y are the numbers of a pixel in the X and Y directions that are appropriate for the object's diameter. Coefficients K_x and K_y can be used to measure the actual distance on image in cm. For example, the distance between point A (X_A, Y_A) and B (X_B, Y_B) can be obtained using the Euclidian distance (2).

$$L = \sqrt{[(X_A - X_B) * K_x]^2 + [(Y_A - Y_B) * K_y]^2} \tag{2}$$

So that the user only puts two markers manually on the mud crab image processed. Both markers indicate the width of the mud crab carapace in the image. Sot that by knowing the coordinates of the two markers and using the equations described above, the original width of the mud crab carapace can be obtained using image processing.

- Step 4. Weight Estimation

The carapace width of the mud crab obtained from the previous stage is then used to estimate the weight of the mud crab using the non-linear regression (3).

$$W = aL^b \tag{3}$$

Where W is the weight of the crab; L is the width of the carapace; the values of *a* and *b* are constant.

C. Research Design

Mobile application development is carried out on smartphone Samsung Galaxy Core Duos GT-I8262 with processor Snapdragon MSM8225 S4 Play Dual Core 1.2 GHz, Cortex A5 GPU Adreno 203, 1 GB RAM, 8 GB internal memory, 5 MP camera and Android operating system 4.1.2 Jelly Beans (API level 16). In Addition, this research also carried out testing process by comparing the width of mud crab carapace and the weight of mud crabs obtained through the result of the estimation from the smartphone device with the actual carapace width of mud crab obtained through the measurement results directly using Vernier caliper and the actual weight of mud crab obtained through the measurement result directly using the digital scales. The result of the test is then analyzed to determine the level of accuracy of the proposed method. The following is the equation used to calculate the mean absolute error rate, (4).

$$MAE = \frac{\sum_{i=0}^{n} |f_i - y_i|}{n} \tag{4}$$

Where n is the amount of test data; f_i is the result of the mobile application estimation; y_i is the result of the direct measurement.

III. Results and Discussion

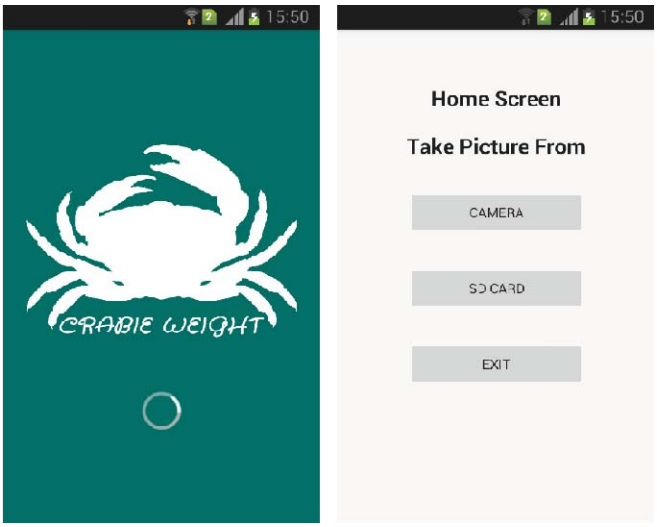
A. Mobile Application Implementation

The method training process is carried out using 100 training data that have prepared in advance to (3). The result

is that the value of *a* is 0.2505 and *b* is 2.8824. Both values are then applied as a constant value in (3) to estimate the weight of mud crab in the mobile application developed in this research. The following is the mobile application interface developed:

- Splash and Home Screen

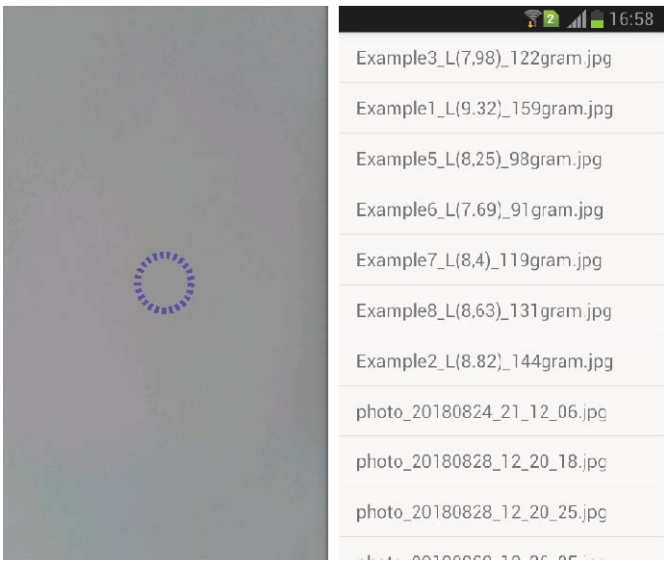
The home screen is the page that first appears when the application opened after the application's splash screen is displayed. Fig. 3 (a, b) shows the appearance of the splash screen and the home screen of the application.



(a) (b)

Fig. 3. a. Splash Screen. b. Home Screen.

This screen has the three main buttons used to start the application, namely the Camera, SD Card, and Exit buttons. The camera button is used to call the smart phone's default camera for direct image acquisition. The SD Card button is used to take pictures from internal storage memory if the image has prepared in advance. The exit button will show an alert dialog then the user will choose to want to exit from the application or not. The processed image displayed on the image analysis screen, Fig. 4 (a, b).



(a) (b)

Fig. 4. a. Camera Screen. b. Files Screen.

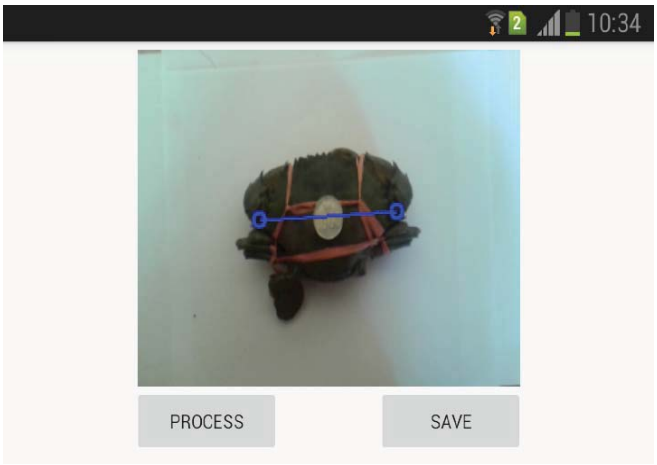
- Camera and Files Screen

In the middle of the camera screen, there is a small circle. A metal coin must be place above the mud crab carapace and the metal coin must be positioned just inside the circle in the middle of the camera screen. So that, the users can estimate the distance of image acquisition. To carry out the image acquisition process. Users only need to touch the smartphone screen. As for the file list screen, all image files contained in the work folder will display. Users need to select the image file for processing.

- Image Analysis Screen

The image analysis screen consists of one image viewer and two buttons. The first button is a process that functions to move to the results screen if the displayed image has gone through an analysis process. That is marking the width of the mud crab's carapace so that when moving to the result screen the carapace width variable has known and then enters the carapace width calculating formula and the mud crab weight estimating formula. The second button is the save button which serves to store images displayed on the smartphone's internal storage memory.

After the acquisition image is displayed as shown in Fig.5, the user then direct two markers to mark the width of the mud crab carapace. Two markers placed on the left and right sides of the mud crab carapace. They will produce a blue line that extends between them as a carapace width place-mark from the mud crab, Fig. 5 (a, b).



(a) (b)

Fig. 5. a. Results Screen b. Documentation.

- Results Screen

On this screen, the coordinates of the two markers points obtained from the previous screen and the coefficients of K_x and K_y are used as inputs in (2) to calculate the original width of the mud crab's carapace. Then the width of the mud crab carapace along with the two constants, *a* and *b* which have also obtained previously, are used as inputs in (3) to estimate the weight of the mud crab. The estimation results from the width of the mud crab carapace and the mud crab weight then displayed on this screen, Fig. 6 (a, b).

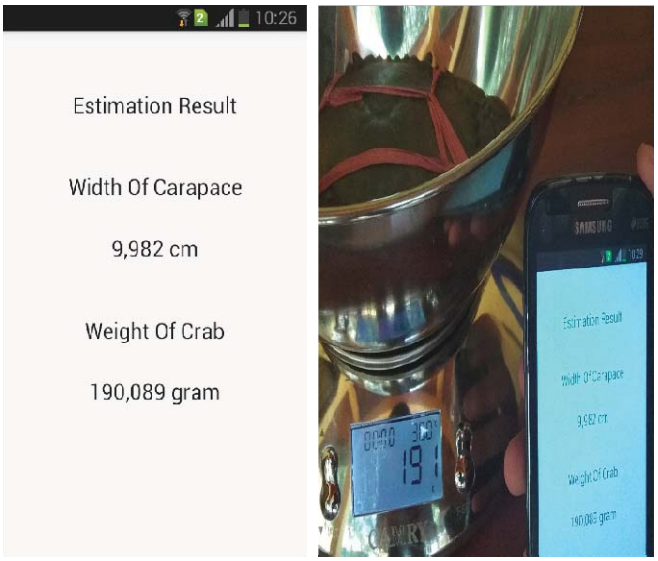


Fig. 6. a. Results Screen. b. Documentations

B. Test Result

The test was carried out using 20 images of mud crabs that had prepared in advance as test data. The test results can see in Table I. The test results show that the width of mud crab carapace can be used to estimate the weight of mud crab. In addition, from Table I. It can also be seen that the method proposed in this research has a good level of accuracy in estimating the weight of mud crabs. It can be evidenced by the mean absolute error value to estimate the width of mud crab carapace is 0.086 cm while the weight of mud crab is 2.643 gram. However, this application has the disadvantage that sometimes there are several mud crabs that have the same carapace width but the weight is very different. Accuracy in this application can be improved by increasing the number and variety of training data used. So, the method used in this application can estimate the weight of mud crab based on the average weight of a number of mud crab used as training data that have the same carapace width.

TABLE I. TEST RESULT

Data	Width of Carapace (cm)			Mud Crab Weight (gram)		
	Manual	*System*	*Error*	*Manual*	*System*	*Error*
Crab 1	6.726	6.723	0.003	61.0	60.864	0.136
Crab 2	8.210	8.296	0.086	115.0	111.508	3.492
Crab 3	10.160	9.982	0.178	191.0	190.089	0.911
Crab 4	9.760	9.871	0.111	183.0	184.088	1.088
Crab 5	8.570	8.550	0.020	118.0	121.654	3.654
Crab 6	10.360	10.447	0.087	210.0	216.768	6.768
Crab 7	8.330	8.430	0.100	110.0	116.806	6.806
Crab 8	7.990	7.977	0.013	94.0	99.608	5.608
Crab 9	9.690	9.577	0.113	164.0	168.692	4.692
Crab 10	7.150	7.259	0.109	73.0	75.878	2.878
Crab 11	8.560	8.691	0.131	125.0	127.524	2.524
Crab 12	8.420	8.559	0.139	120.0	122.037	2.037
Crab 13	7.618	7.808	0.190	94.0	93.662	0.338
Crab 14	8.270	8.225	0.015	109.0	109.935	0.935
Crab 15	7.770	7.897	0.127	95.0	96.746	1.746
Crab 16	6.950	7.035	0.085	67.0	69.332	2.332
Crab 17	7.500	7.513	0.013	85.0	83.818	1.182
Crab 18	8.200	8.257	0.057	109.0	110.015	1.015
Crab 19	7.450	7.433	0.017	84.0	81.264	2.736
Crab 20	11.140	11.274	0.134	268.0	269.983	1.983

IV. CONCLUSION

Researchers successfully developed a mobile application that uses image processing techniques to estimate the weight of mud crab. The application runs on a smartphone device, and it has a good level of accuracy. It can prove by mean absolute error rate to estimate the width of mud crab carapace which is only 0.086 cm and the mean absolute error rate to estimate the weight of mud crab which is only 2.643 gram. So that, this application is very suitable to be used to estimate the weight of mud crab, Table I.

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