BEEF CATTLE WEIGHT DETERMINE BY USING DIGITAL IMAGE PROCESSING

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***Abstract* - Based on the livestock size are divided into two parts, where firstly the small one and the other the large one. Whereas the small one consists of poultry, sheep, goats, rabbit, etc. Measuring in the small animal weight could be directly weight, because very easier than the large one. To measure the weight of large animal, especially beef cattle, there are some differences. The body length, chest circumstance, height and width of this animal is could be estimated.**

Any kind of method in measuring the weight of livestock are calculated systematically. However the measurement is not entirely accurate when predicting the weight of beef cattle life. That is why, it is possibly to get a simply method to estimate the weight of beef cattle meat.

The technical information for analyzing of beef cattle weight which call a digital image processing could be used, because it can analyze via photograph system. By using digital image processing with specific algorithms could be recognized certain objects easily. The accurate yield depend on the photograph capability estimation on body length, chest circumstance, height, and the width of beef cattle itself.

Keywords— livestock, beefcattle, weight, digital image processing.

I. INTRODUCTION

Cattle farming has become one of the major commodity in the world and performed with a variety of technologies to achieve the better results. General purpose of cattle farming is to make high profit based on application of good management production principles. One of criteria for a success in beef cattle farming has had healthy with considerable weight.

Currently there are various ways to determine the weight of beefcattle. One of which is done by measuring the chest circumference and body length, and there's also made combine with the height of the beef cattle and in some conditions are doing it based on the chest circumference and body length of the cattle. With a digital image to the beefcattle which processed by any kind specific digital image processing algorithm in every part from cattle's body could be identified, so it could be used to analyze the the beefcattle weight. Beefcattle weight calculation could be done based on two dimensional image by using specific formula which taking into certain scale in actual unit of account.[3]

Besides the whole of cattle body's weight by digital image processing it also can be obtained the weight of cattle per part as we can look at the image below:

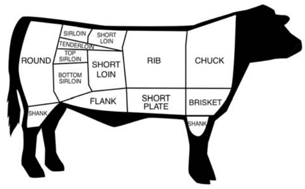


Fig. 1 Types of Beef

The image of the cattle will be segmented based on part as we can look above.[6] After that then made extensive comparison of pixels with a weight per part of beefcattle's body. Based on comparisons could be determined the weight of cattle. Suggested segmentation division:

1. round and rear shank
2. sirloin, short loin, tenderloin, top sirloin, bottom sirloin, flank
3. rib and short plate
4. chunk, brisket and front shank

II. METHODOLOGY

This section describes the methodology of the system. In this research, the weight determining process is done by two method, Localized Region Based Active Contour, and calculation process using Linear Regression.

A. Localized Region Based Active Contour

Image Segmentation is one of image processing methods to extract data from an image or sequence of images. The data that is extracted from an image may include information about the sides, objects, color, light intensity, noise etc.[7]

Active Contour (also known as deformable models or 'snake') is one kind of segmentation method in the field of imaging. The differences between Active Contour and other segmentation models is the process of minimizing curves in the segmentation process. A contour curve is influenced by energy (E_{snake}) which is defined as the sum of the three types of energy as described in the equation below: [2]

$$E_{snake} = E_{internal} + E_{external} + E_{constraint} \quad (1)$$

The process of active contour models is by making an initial contour surrounding the object, then with the energy of an object image ($E_{external}$) will cause the curve shrink and follow the pattern of the object. The curve can be moved closer towards the object and adjust the shape of the object because of the energy on the curve ($E_{internal}$). Active contour models used in this study is not the classical active contour but using active contour without edges.

The most fundamental difference of these two models is the active contour without edges can perform segmentation of objects that do not have the edge, unlike the classic model of the object must have the edge. Besides that, model without edge does not depend on the value of the gradient image as a condition to stop the contour changes. This model uses the average energy in the region and beyond as a condition for segmentation.

Figure 2 Objects covered by the curve cantour

The internal energy contained in snake curve and is responsible for changing the shape of the curve corresponding to the shape of the desired object. To calculate this energy will be used a formula as follows[3]:

$$F(C) = \mu \,.\, length\ (C) + \ v \,.\, area\ (inside\ C) \quad (2)$$

Variable *area*(*insideC*) is used when there is a changes process of curves which only moving inside. In the implementation, the value v=0 is used because we desire that the curve can move out, so there is no need to use $v \,.\, area\ (inside\ C)$. This energy is affected by the mu (μ) variable which regulates the elasticity of the curve shape which in the classical active contour also known as variable alpha (α).

External energy contained in the image will be processed. Suppose variables in C is a snake curve then the variable c_1 and c_2 represent the average value of the image (μ_0) from the inside and the outside of the curve. Assume again that image (μ_0) is divided into two areas, namely μ_0^i (the object to be segmented) and μ_0^o (background objects), then assume also that the object pattern is c. The formula to calculate the external energy is:[2]

$$F_1(C) + F_2(C) = \int_{inside\ (C)} |\mu_0 - C_1|^2\, dxdy + \int_{outside\ (C)} |\mu_0 - C_1|^2\, dxdy \quad (3)$$

C curve will change its form of either a larger or smaller size to see the value of the internal energy and the energy of the object to be segmented (c). Snake curve will move to follow the following requirements[2]

$$\inf_C \left\{ F_1(C) + F_2(C) \right\} \approx 0 \approx F_1(C) + F_2(C) \quad (4)$$

It can be concluded that the segmentation will be completed when F1 (C) ≈ 0 and F2 (C) ≈ 0, ie when the curve C is exactly stay at the area to be segmented. The process of change of the curve will stop when the energy value of C = Ć. From both of the energy formula above, it can be concluded that the total energy used to minimize the shape of the curve is[2]

$$F(C, c_1, c_2) = \mu \,.\, length\ (C) + \ v \,.\, area\ (inside\ C) + \int_{inside\ (C)} |\mu_0 - C_1|^2\, dxdy + \int_{outside\ (C)} |\mu_0 - C_1|^2\, dxdy \quad (5)$$

B. Linier Regresion

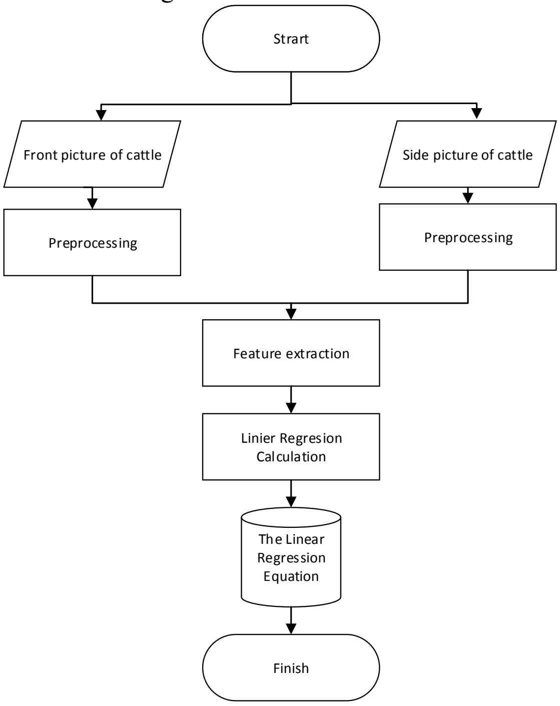
Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. One variable is considered to be an explanatory variable, and the other is considered to be a dependent variable. For example, a modeler might want to relate the weights of individuals to their heights using a linear regression model. [5]

Before attempting to fit a linear model to observed data, a modeler should first determine whether or not there is a relationship between the variables of interest. This does not necessarily imply that one variable causes the other (for example, higher SAT scores do not cause higher college grades), but that there is some significant association between the two variables. A scatterplot can be a helpful tool in determining the strength of the relationship between two variables. If there appears to be no association between the proposed explanatory and dependent variables (i.e., the scatterplot does not indicate any increasing or decreasing trends), then fitting a linear regression model to the data probably will not provide a useful model. A valuable numerical measure of association between two variables is the correlation coefficient, which is a value between -1 and 1 indicating the strength of the association of the observed data for the two variables.

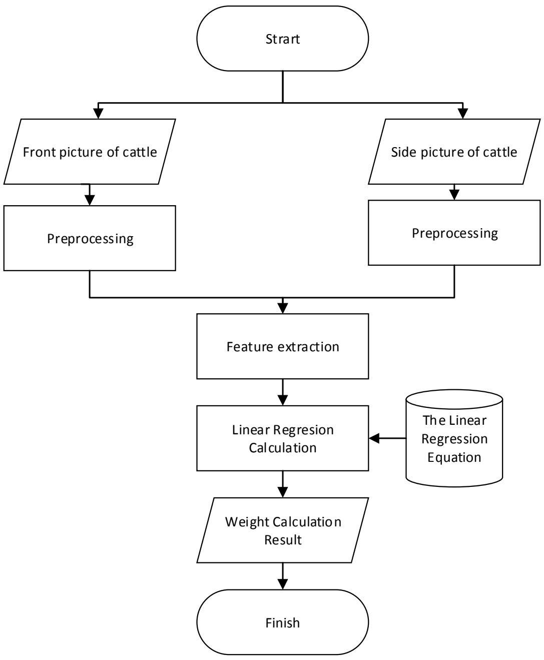
A linear regression line has an equation of the form Y = a + bX, where X is the explanatory variable and Y is the dependent variable. The slope of the line is b, and a is the intercept (the value of y when x = 0).

C. Calculation Process

In this research, the calculation process is done by Regression Linier. The steps of calculation process are shown in fig.3 below:



(a)



(b)

Fig 3 Flowchart of calculation process : (a)Training Process (b)Testing Process

Pre-processing process is the first process in system design. This process is purposed to prepare image before acquiring its feature. The steps of pre-processing process are described below:

- Image will be scaled into 0.5 of its original image.
- After that, the image formatted in .jpeg in the form of digital data 8 bits at each base color RGB (Red, Green, Blue) will be converted into the YCbCr color space.[1]
- The next step is edge detection to mark the part that becomes the image detail so cattle image can separate with the background.[5]
- The next step is remove small objects from binary image.[4]
- The next step is computes the Euclidean distance transform of the binary image BW.[4]
- The next step is labeling the image and choose the biggest part.[4]
- The next step is performs morphological closing on the grayscale or binary image.[4]
- The next step is fills holes in the binary image. A hole is a set of background pixels that cannot be reached by filling in the background from the edge of the image.[4]
- The next step is Localized Region Based Active Contour to seperate the background that is still incorporated.
- The last step in pre-processing is save the data result.

Fig 4 Scaling to 0.5 of the original image

Fig 5 Convert RGB to YCbCr color space

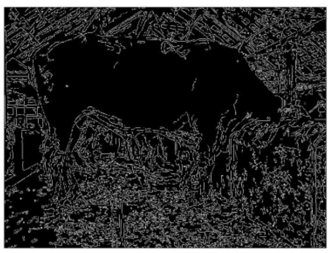


Fig 6 Edge Detection Result

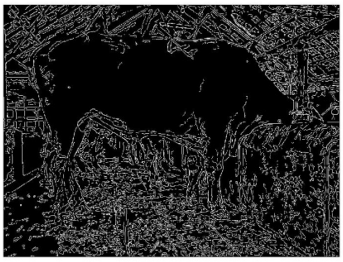


Fig 7 Remove small objects from binary image (bwareaopen)

Fig 8 Computes the Euclidean distance transform of the binary image (bwdist)

Fig 9 Labeling the image and choose the biggest part

Fig 10 Performs morphological closing on the grayscale or binary image (imclose)

Fig 11 Fills holes in the binary image (imfill)

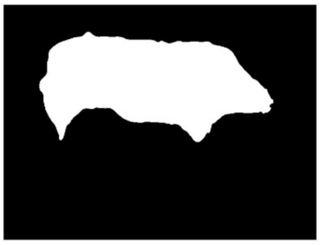


Fig 12 Localized Region Based Active Contour

Feature extraction is a feature-taking process which describes the characteristic of the image. Feature resulted from feature extraction process is used to compare between one character to another character.

From the side picture of cattle, after passing through the image preprocessing by image morphological Operation and Image segmentation by the background then the cattle will segmented by the types of meat.

From all of the segmentation, each part will be calculated by the amount of pixels. The number of pixels of each of these segmentation would become the feature which then will be calculated to determine the carcass weight of cattle.

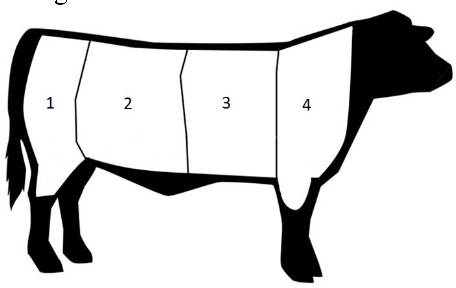


Fig 13 Segmented Feature Extraction of side picture

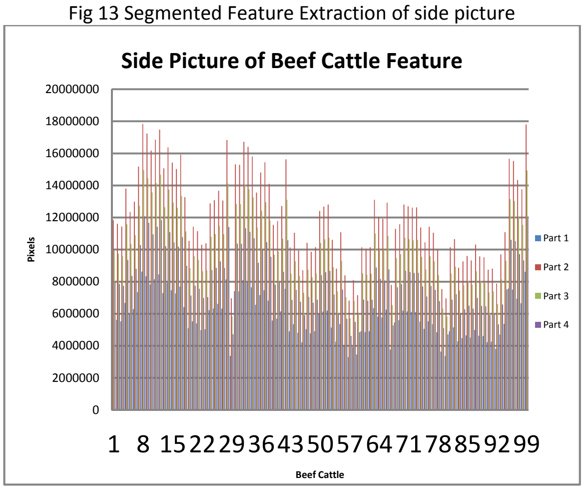


Fig14 Side Picture of Cattle Feature (pixels)

Data of side picture of cattle feature consist of 4 part. Part 1 consists of the round and the rear shank. Size of part 1 compared to the overall area is 16.12%. Part 2 consists of the sirloin, the short loin, the tenderloin, the top sirloin, the bottom sirloin, and the flank.. Size of part 2 compared to the overall area is

33.33%. Part 3 consists of the rib and the short plate. Size of part 3 compared to the overall area is 27.96%. Part 4 consists of the chunk, the brisket and the front shank. Size of part 4 compared to the overall area is 22.58%.

The second feature is the Chest Circumference. Chest Circumference obtained from the front-view photo. The blue line from the bottom picture will become feature to determine the weight of the cattle.

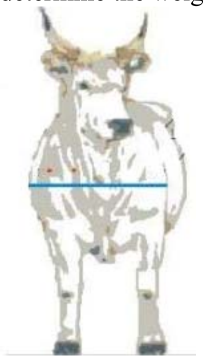


Fig 15 front picture of cattle

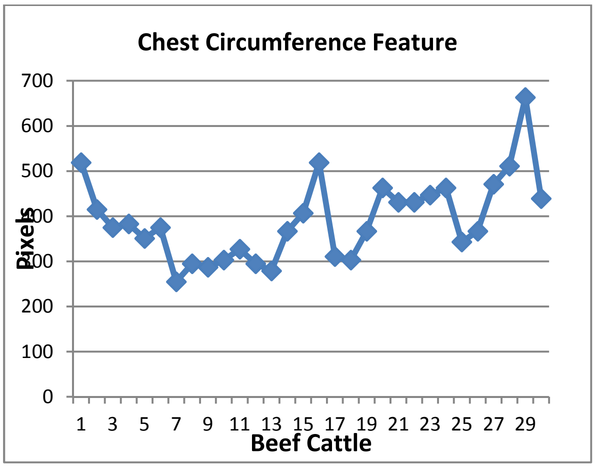


Fig 16 Chest Circumference Feature

Data of chest circumference feature will be used to calculate the weight of carcass beef cattle. This data will be used for all parts. To calculate the weight of part 1, the part 1 of side picture of cattle feature will be regressed with these data. To calculate the weight of part 2, the part 2 of side picture of cattle feature will be regressed with these data. To calculate the weight of part 3, the part 3 of side picture of cattle feature will be regressed with these data. To calculate the weight of part 4, the part 4 of side picture of cattle feature will be regressed with these data.

III. RESULT & DISCUSSION

Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. One variable is considered to be an explanatory variable, and the other is considered to be a dependent variable. For example, a modeler might want to relate the weights of individuals to their heights using a linear regression model.

This method is used to calculate the weight of beef cattle based on the number of pixels of each segment and also elliptical circumference. Each of these segments will be calculated how much it weighed using linear regression.

	Part1 Coefficient	*Part 2 Coefficient*	*Part 3 Coefficient*	*Part 4 Coefficient*	*Without Segmentation Coefficient*
Intercept	1.53E+01	1.54E+01	9.52E+00	8.96E+00	4.91E+01
X Variable 1	1.30E-06	6.34E-07	4.68E-07	5.46E-07	6.76E-07
X Variable 2	1.04E-01	1.05E-01	6.50E-02	6.11E-02	3.35E-01

After doing training process, the next process is processing test. This testing is used to know the performance system. The performance system will be measured by parameters below:

$$\%_{error} = \left|\frac{W_{experimental} - W_{theoritical}}{W_{theoritical}}\right| .100 \quad (6)$$

Experimental is number of calculation from this research. And than theritical is number of real weghit. System accuracy is an accuracy measurement in recognizing the given input in order to get the proper result. System accuracy is shown by the equation:

$$Accuracy = 1 - \%_{error} \quad (7)$$

	Error	Accuracy
Part 1	26.78638	73.21362
Part 2	26.78638	73.21362
Part 3	26.78638	73.21362
Part 4	26.78638	73.21362
Without Segmentation	26.78638	73.21362

The more backward anatomy have greater bone area, the greater the bone area have more meat will be propped. as the rear of the body has a duty to support a larger body, therefore, must be large. The anatomical shape of small and big animals have the same characteristics so it has the same accuracy. This system accuracy is 73.21362%.

IV. CONCLUSION

From the research that has been done, it can be concluded as follows:

1. The side picture of cattle and Chest Circumference feature was appropriate to calculate the weight of cattle.
2. Linear regression was appropriate to calculate the weight of cattle with the accuracy of the system 73.21362% and the computation time 187.281s.
3. The accuracy between segmented object and without segmentation is the same because the anatomical shape of small and big animals have the same characteristics.

From the research that has been done, things that can be suggested are:

1. Image segementation to seperate the background for the next time should be more sensitive.

2. The size of pixels should be bigger to get the more sensitive system.
3. Try to build a more complex system to calculate the weight of beef cattle by using sensor.

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