Height Measuring System On Video Using Otsu Method

C L M Sandy and R Meiyanti
University of Sumatera Utara, Medan, Indonesia
Email: likasandy3@gmail.com and rinimeiyanti522@gmail.com

Abstract. A measurement of height is comparing the value of the magnitude of an object with a standard measuring tool. The problems that exist in the measurement are still the use of a simple apparatus in which one of them is by using a meter. This method requires a relatively long time. To overcome these problems, this research aims to create software with image processing that is used for the measurement of height. And subsequent that image is tested, where the object captured by the video camera can be known so that the height of the object can be measured using the learning method of Otsu. The system was built using Delphi 7 of Vision Lab VCL 4.5 component. To increase the quality of work of the system in future research, the developed system can be combined with other methods.

1. Introduction
Image segmentation based on thresholding is one of the oldest and powerful technique, since the threshold value divides the pixels in such a way that pixels having intensity value less than threshold belongs to one class while pixels whose intensity value is greater than threshold belongs to another class. [1] Measurement is an activity that compares a quantity measured by the measuring instrument used as a unit. In this system of measurement of height, the image processing is able to perform recognition of the object and is capable of processing the measurement of height so that the correct parameter value is obtained. In this system the authors use the method of Otsu, which aims to separate objects from the background that comes naturally. Algorithms have been because, in principle, a video is a row of images that can be moved so as to form a picture of the state or event that is not silent (real time), which is the absolute nature that must be maintained.

2. Theoretical Basis
2.1 Image Processing
The image processing is the manipulation of the image to be, especially with the use of a computer, the images that have better quality. Digital image processing refers to the processing of two-dimensional images using a computer. In a broader context, digital image processing refers to the processing of any two-dimensional data. Digital image is an array containing the values of real or complex which is represented by a specific bit stream.

2.2 Grey-Scale
Gray-scale image is the image using shades of gray which is a combination of black and white. In the image processing, color images are often converted first into gray-scale image. The images received from the video must be converted to the Gray scale image because though the images are in gray matter the Red Green Blue components are not visible in the image. [2] Then, through the gray-scale image processing is carried out, for example, to obtain the texture of objects. To convert the RGB image into a gray-scale image, we use the following formula:

\[
b_{\text{RGB}}(x, y) = 0.11 \times b_{\text{R}}(x, y) + 0.59 \times b_{\text{G}}(x, y) + 0.3 \times b_{\text{B}}(x, y)
\]

where:

- \( b_{\text{R}}(x, y) \) = The value of the intensity of the red color
- \( b_{\text{G}}(x, y) \) = The value of the intensity of the green color

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI. Published under licence by IOP Publishing Ltd.
2.3 Video Image

The image of the video is a collection of images that moved along a specific time duration. The movement the images contained in the video to form a dynamic shift so easily trick the human eye. The movement or rapid change is a challenge for us to implement the right or efficient algorithm in a situation of rapid and dynamic. In recent years, hardware technologies and standards activities have matured to the point that it is becoming feasible to transmit, store, process, and view video signals that are stored in digital formats, and to share video signals between different platforms and application areas. [3] This is a natural evolution, since temporal change, which is usually associated with motion of some type, is often the most important property of a visual signal.

2.4 Otsu

Otsu method is calculating the threshold value T automatically based on the input image. The approach used by the Otsu method is by performing discriminant analysis that is by determining a variable that can distinguish between two or more groups that arise naturally. Otsu's thresholding method involves iterating through all the possible threshold values and calculating a measure of spread for the pixel levels each side of the threshold, i.e. the pixels that either falls in foreground or background. The aim is to find the threshold value where the sum of foreground and background spreads is at its minimum. [4] The threshold operation is regarded as the partitioning of the pixels of an image into two classes C0 and C1 (e.g., objects and background) at grey-level t, i.e., C0 = {0, 1, 2, ..., t} and C1 = {t + 1, t + 2, ..., L-1}. Let σ_w, σ_B, and σ_T be the within-class variance, between-class variance, and the total variance, respectively. [5] Discriminant analysis will maximize these variables in order to separate objects from the background.

Thresholding technique segment scalar images by generating a binary partitioning of the image intensities. A thresholding technique tries to find an intensity value, called the threshold, which separates the desired classes. The segmentation is then obtained by grouping all pixels with intensity greater than the threshold into one class, and all other pixels into another class. [6]

The probability for pixel i given by:

\[ p_i = \frac{n_i}{N} \]  

where:
\( n_i \) = the number of pixels by the number of grayish \( i \)
\( N \) = the sum of all pixels in the image
\( P_i \) = result

In Otsu method, the threshold that minimizes intra-class variance is determined, which is defined as the weighted sum of the variance of two classes:

\[ \sigma_w^2(t) = w_1(t)\sigma_1^2(t) + w_2(t)\sigma_2^2(t) \]  

(2)

The weights \( w_i \) is the probability of two classes separated by a threshold t and \( \sigma_i^2 \) variations of these classes.

Otsu shows that minimizes intra-class variance is the same as maximizing inter-class variance.

\[ \sigma_b^2(t) = \sigma^2 - \sigma_w^2(t) = w_1(t)w_2(t)[\mu_1(t) - \mu_2(t)]^2 \]

(3)

stated in class probabilities \( w_i \) and class mean \( \mu_i \). Probability class \( w_i(t) \) is calculated from the histogram as follows:

\[ w_i(t) = \sum p(i) \]  

(4)
while the average class $\mu_1(t)$ is:

$$\mu_1(t) = \frac{\sum_0^t p(i) x(i)}{w_1}$$  \hspace{1cm} (5)

Where $x(i)$ is the value in the middle $i$ histogram. Similarly, to calculate $w_2(t)$ and $\mu_2$ on the right side of the histogram larger than $t$. Probability of class and class facility can be calculated iteratively. This idea resulted in an effective algorithm.

The optimum threshold value can be obtained in two ways. The first way is carried out by minimizing WCV. The second way is implemented by maximizing the BCV.

3. The Scheme of System
The scheme of the height measurement system developed in this study is illustrated in Figure 3.1.

![Figure 3.1.](source)

**Figure 3.1.** The scheme of height measurement system in video

3.1 Grey-Scale
Flowchart for gray-scale processes are developed based on Figure 3.2:

![Flowchart](source)
3.2 Otsu
Flowchart for the process of Otsu in the system is developed based on Figure 3.3:

![Flowchart](image)

4. User Interfaces
4.1 View of the Main Form
Before the operation, the program will display a page like this:
4.2 View of the Otsu form
Once executed, the program will display a page like this

4.3 The test results
This form is intended for testing of Measurement of Height, here is a view of test results:

5.1 Conclusions
From the results of research and discussion undertaken conclusions can be drawn as follows:
1. Excellence of method of Otsu is to maximize the compatibility of a threshold so that the object can be separated from the background. All this is achieved by selecting the threshold value which gives the best class division for all the existing pixels in the image.
2. To get the end result is precise and accurate, then the condition or environment of the image catcher must be considered. The conditions referred to, among other things, are light, place, distance, and the position of the object of image.

3. Fairly evenly distributed light makes Otsu method is good enough to use. Light in the image is not always smooth, the meaning is that the existing light, has a different intensity depending on the spread of light, if the light is fairly evenly distributed then the intensity is not too bright and not too dark so the test in the system can work well.

4. Height measurement system is not able to work well if the region, in which the object to be measured, contains many other objects, because the measuring ruler can be moved to the place of other objects. To simplify and prevent this, you can choose the right place while doing the test so that the system can work well.

References

[1] Muzamil B 2014 Digital Image Processing International Journal of Scientific & Technology Research vol 3 Issue 1 ISSN 2277-8616

[2] Asole N 2012 Brain Tumor Detection Using Digital Image Processing Based On Soft Computing Journal of Signal and Image Processing ISSN: 0976-8882 & E-Issn: 0976-8890 vol 3 Issue 3 pp 102-105

[3] Prasad B 2012 An Efficient Medical Image Segmentation Using Conventional OTSU Method International Journal Of Advanced Science And Technology vol 38

[4] Choudhary K and Pote T 2012 Enhanced Identification of Malarial Infected Objects using Otsu Algorithm from Thin Smear Digital Images International Journal of Latest Research in Science and Technology ISSN (Online):2278-5299 vol 1 Issue 2 Page No 159-163 July-August ISSN (Online):2278-5299

[5] Bovik Al Handbook of Image Am Video Processing Austin, 2000 Isbn 0-12-119790-5