Young Shrimp Detection by Using Modified Directional Wavelet Coefficients

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Abstract

Nowadays, young shrimps in any farm are counted manually for sales by using ladle tools. It takes time and there is a lot of estimation and errors. In this paper, we present a digital image processing method to detect young shrimps in order to count a number of young shrimps automatically. Basic wavelet transform based method is proposed. Coefficients of wavelet transform are modified with mophological technique in vertical, horizontal, and diagonal subbands, and inverse transform is then taken to get an output young shrimp image. Torso of any young shrimps are identified. The experimental results show that the proposed is more effective than the conventional method.

Keywords : Young Shrimp Detection, Wavelet Transform

1. Introduction

Shrimp farm is an economic cultivation and it is most consumed world wide. The process to nurse young shrimps is very sensitive and takes a high cost. Therefore, it is very important that a new technology should be applied and developed to help agriculturists to save the cost. At present, a manual method to count number of youung shrimp for sales is to use ladles as shown in Fig. 1. The agriculturists will estimate the amount of young shrimps depend on the ladle sizes. This estimation method gives a lot of errors and takes long time in the process that may cause the young shrimps dead. It needs a new method that does not touch the young shrimp and has more effective in counting a number of them.

(a) (b)

Figure 1 (a) The ladle tools and (b) the manual method to estimate number of young shrimps.

In the previous related works for objection separation or object-based classification, some papers have been proposed. The method is to classify automatically the extract interested objects [1]. Two classes can be separated by compairing the similarity in order to pull out the interested objects. There are methods of object-based classification with a new algorithm to count automatically the amount of fission track [2], [3], but this method can be used with a smooth background without noise. A method for counting objects by using active search of multicolored objects is proposed [4]. This method is based on color similarity of the object models. However, it is complex and takes a long processing time. Skeleton technique-based methods for counting a number of objects are proposed [5], [6]. Their principle is to make definitions in order to compare the results of the skeleton technique. But this method is not suitable in a case of object overlapping without circular blobs. For the young shrimps image that comes with noises or disturbance from any factors, such as light source, food scraps, or shrimps' torso overlapping, the object When we review in the previous works, these make it hard to indentify and count each young shrimp. In this paper, we propose a novel mothod to detect young shrimps in order to count a number of them by using midified coefficients of wavelet transform.

2. Methods

Fig. 2 shows block diagram of the proposed method to detect and count young shrimps. The details of each process is described as follows.

2.1 *Original Young Shrimp Image and Gray-Scale Conversion*

Before we capture a young shrimp image, they will be ladled and released in a water container. Young shrims will be catched with the ladle tool in size A, as shown in Fig. 1(a). The tool is capable approximately for 2,500 young shrimps. They are then put into a 30×40×5 cm container.Young shrimp image is captured from digital camera with a size of 3,456×3,204 pixels, 30 pixels/mm

resolution, and 24-bit-color bitmap format. Each young shrimp is approximately 2 mm long. The image is then converted to 8-bit gray scale image.

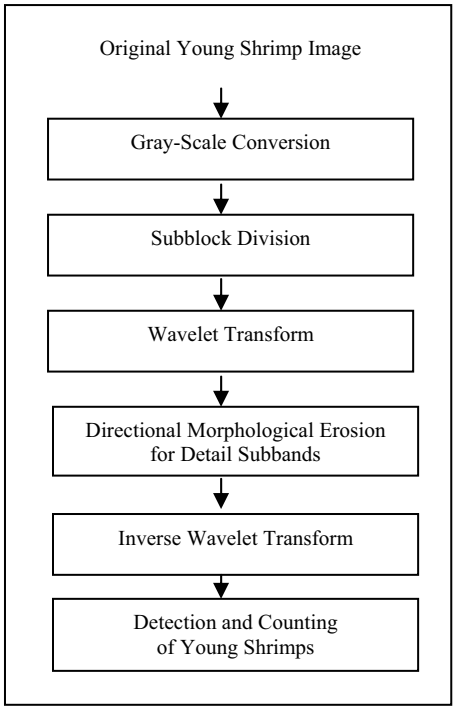
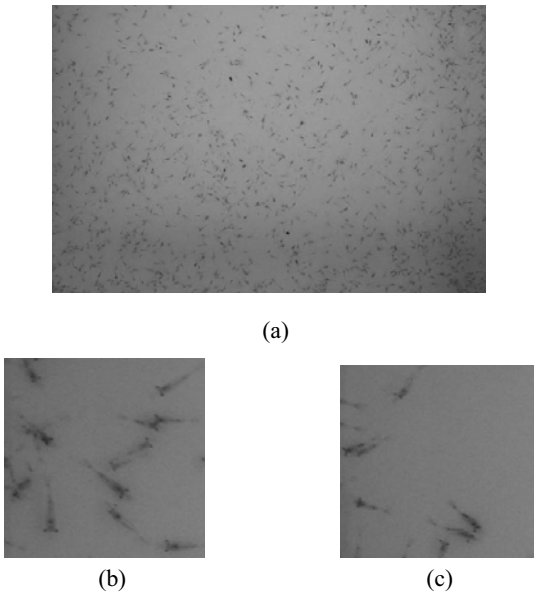


Figure 2 The proposed method.

2. 2 *Subblock Division*



(a)

(b) (c)

Figure 3 (a) Original gray-scale image (3,456×3,204 pixels), (b) and (c) young shrimp subblocks (256×256 pixels).

In this step, the image is separated into many 256×256 pixels subblocks to avoid the light source effect that is not smooth all over the image. There are approximately 7-10 young shrimps in each subblock image. These subblocks will be transformed by wavelet decomposition in the next step. Fig. 3 shows examples of young shrimp subblock images.

2.3 *Wavelet Transform*

Operation of wavelet transform (WT) for each subblock image to get their coefficients is shown in Fig. 4. The method is to wavelet-decompose the original input image into four subband images, where f(x,y) is original subblock input image.

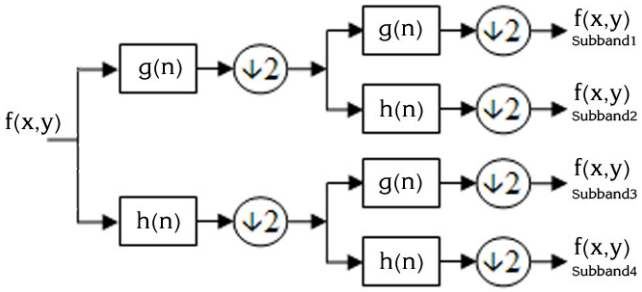
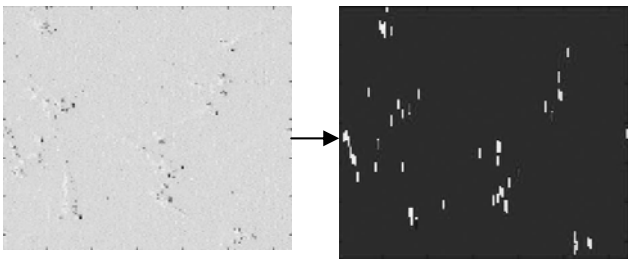


Figure 4 Block diagram of wavelet decomposition.

After the transformation, wavelet coefficients in each subband will contain in each image that is down-resized by a half. Subband1 is an approximation or background of the input image, while subband2, subband3, and subband4 are called vertical, horizontal, and diagonal details.

2.4 *Directional Morphological Erosion for Detail Subbands*

This process is to modify wavelet coefficients in each subband by using mathematical morphology. Erosion with the structuring element in any directions is used to shrink the detail coefficients in subband2, subband3, and subband4, respectively. Fig. 5 shows example of the modification. The input is the vertical coefficients transformed by wavelet decomposition. We use linear structuring element with 5 pixels length, in the directions of 0° (horizontal), 90° (vertical), and 135° (diagonal), as shown in Fig. 6.



(a) (b)

Figure 5 (a) Original coefficient (vertical) and (b) morphologically-eroded coefficients.

Next, to get a new coefficients, we cut out of the background in any subbands. For exanple, to find average coefficients in subband2 (LH), it is in (1) and (2). LH_{avg} is

average coefficients of LH, and LH(x,y) is any local value in each pixel in the subband.

$$LH_{avg} = \frac{LH_{max} + LH_{min}}{2} \quad (1)$$

$$\text{if } LH(x,y) > LH_{avg} \text{ then } LH(x,y) = 0 \quad (2)$$

0	0	0	0	0
0	0	0	0	0
1	1	1	1	1
0	0	0	0	0
0	0	0	0	0

(a)

0	0	1	0	0
0	0	1	0	0
0	0	1	0	0
0	0	1	0	0
0	0	1	0	0

(b)

1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

(c)

Figure 6 Linears structuring element (a) horizontal, (b) vertical, and (c) diagonal.

2.5 *Inverse Wavelet Transform*

In this step, inverse wavelet transform operation is performed for each new cofficients, by using only LH, HL, and HH modified subbands, while original LL is kept and used without any modifications. This process is to assemble black the coefficients into the original image. Fig. 7 shows block diagram of the inverse transform.

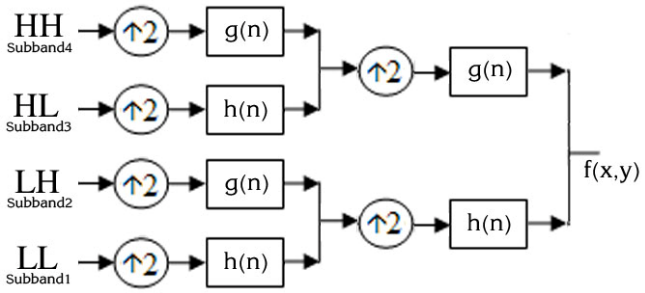


Figure 7 Block diagram of inverse wavelet decomposition.

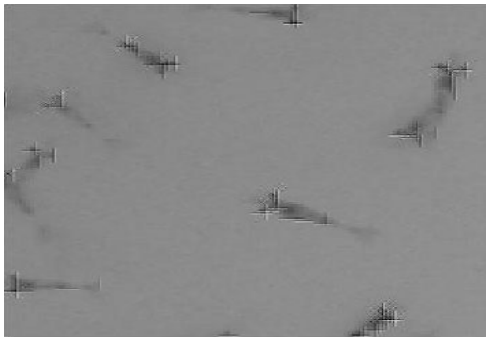
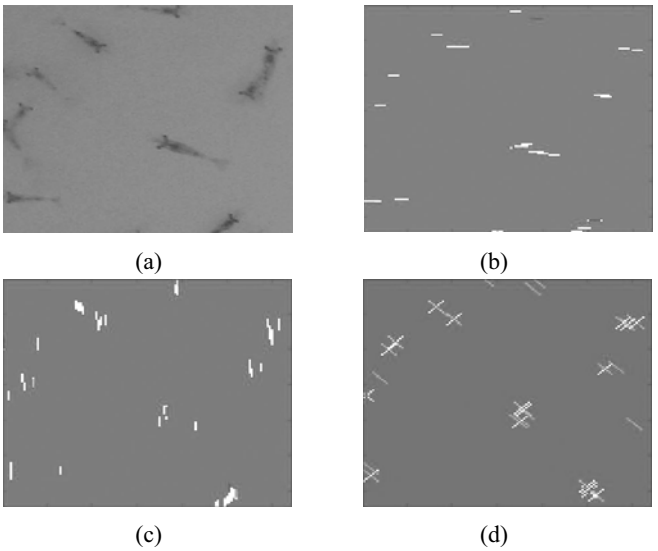


Figure 8 Inverse transform result.

2.6 *Detection and Counting of Young Shrimp*s

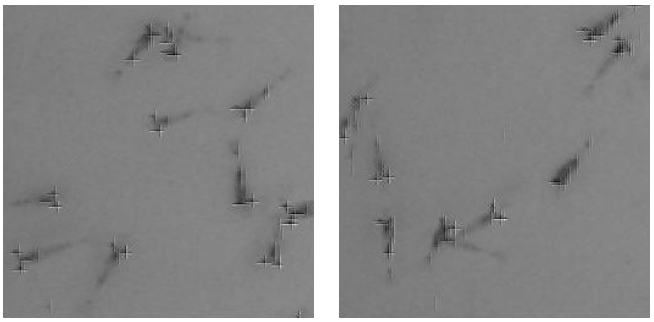
The results of the detection by using modified wavelet coefficients of wavelet is shown in Fig. 8. This method has an efficiency under the condition that the image of young shrimps must not be ambiguous extremely and the young shrimp's torso intensity must not be brighter than or equal the background image.

In Fig. 9, you can see that the young shrimps are clearly easy to be detected by considering the position of the coefficients in Fig. 9(b), Fig. 9(c), and Fig. 9(d). We define the specific condition of this mothod to detect and count young shrimps in each subband image. The young shrimp will be identified when it consists of grounps of the coefficients combined in any directions. For example, in figure 8, it consists of 10 grounps of the modified detail coefficients, therefore the detected young shrimps are counted to 10 shrimps. However this simple counting mothod still does not work in some much-overlapping cases.



(a) (b) (c) (d)

Figure 9 (a) Original image, (b), (c), and (d) are coefficients in any direction, HL, LH, and HH, respectively.



(a) (b)

Figure 10 Detection and counting results (a) correct and (b) incorrect

Fig. 10 shows exampels of the output results to compare that, in Fig. 10(a), the young shrimps can be detected and counted to 11 shrimps, that is a correct result. However, in Fig. 10(b), the method can detect and count just 9 shrimp. That is incorrect, because young shrimps are overlapped by another one.

3. Conclusions

To count an amount of young shrimps for sales in any shirmp farm, the manual ladel tools is used to approximately count. This makes much errors and also takes a long time. This paper proposes a novel idea and a method to detect and count young shrimps based on digital image processing techniques. Modification of wavelet transform coefficients is proposed.

Hoever, the the definition to determine the young shrimps by counting local groups of coefficients is not suitable in some much-overlapping cases. For example, this problem is showm in Fig. 11.

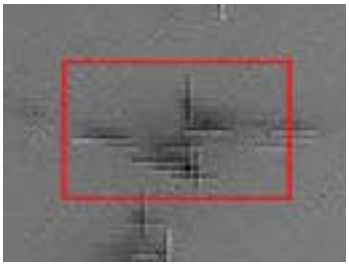


Figure 11 Overlapping of young shrimps.

In Fig. 11, there are exactly two young shrimps that overpped to each other. They are too close and their torso lay down in the same direction. Counting based on a local group of the coefficients is just one group. This problem should be solved in the future works. The efficient of the proposed method is evaluated and it reveals the accuracy of 80.61% compared with the manual count.

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