Image Acquisition, Noise removal, Edge Detection Methods in Image Processing Using Matlab for Prawn Species Identification

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ABSTRACT

Image acquisition is a very essential and primary work for any image classification. A digital image is produced by several image sensors, which besides various types of light-sensitive cameras. Depending on the type of sensor, the resulting image (prawn) data is an ordinary 2D prawn image, or an image sequence. The prawn pixel values typically correspond to light intensity in one or several spectral bands (gray images or color images), but we can also be related to various physical measures of structure, such as depth, absorption or reflectance of sonic or electromagnetic waves, or nuclear magnetic resonance. It has been studied extensively in computer vision and photogrammetric camera lens which may be used to focus light so that objects may be viewed brighter. In this paper we review the techniques proposed in the literature include those using 3D apparatus, 2D objects and lens improvement to increase the size of the prawn so that prawns in the distance can appear larger and clear by presenting various types of cameras and their comparisons. In this paper we also presenting that the image processing techniques such as gray scale conversion, noise removal, sharpening, edge detecting, image segmentation, etc., that are applied for the captured prawn image by using Matlab source code and displaying the results.

Key Words - Digital image, light sensitive, spectral brands, photogrammetric cameras, image processing, gray scale, noise removal, sharpening, segmentation

1. INTRODUCTION

It is very essential need to reduce the time involvement in image processing for the initial work of capturing the images which are very much used to implement the image processing techniques. Now a day's photographic cameras can deliver photographs in various formats, these formats are delivered in a required format simply by applying pre-processing techniques. Photographic cameras are available that can deliver photos without pre-processing hence, without pre-processing techniques it's very difficult to find the actual structure of a prawn. The format of delivering the prawn images without any pre-processing techniques is the Bayer format [9]. In this process we analysis that our camera is connected to a Frame Grabber which retrieves the image, converts it to RGB, changing it to a scale of grays and subsequently carries out the necessary processing by applying image processing techniques. The pre-processing techniques of an image start by image acquisition system.

In image processing image acquisition is defined as the action of retrieving an image from some source as prawns. In image processing image acquisition is the first step in the task implementation because, without an image, no processing is possible. In this paper we have taken the prawn as the source of input that operates within such controlled and measured structure and divisions of that same image [15].

Depending upon the different categories of prawns, a major factor involved in image acquisition of image processing. Sometimes image acquisition is the initial setup and long-term maintenance of the

hardware used to capture the prawns. If the hardware is not properly configured and aligned, then visual artifacts can be produced that can complicate the image processing. Improperly setup hardware also may provide prawn images that are of such low quality that they cannot be salvaged even with extensive processing. All of these elements are vital to certain areas, such as comparative image processing, which looks for specific differences between prawn images [4].

One of the forms of image acquisition in image processing is known as real-time image acquisition. This usually involves retrieving images from a source that is automatically capturing prawn images. One common technology that is used with real-time image processing is known as background image acquisition, which describes both software and hardware that can quickly preserve the images flooding into a system and it specifies the difference between the prawns and backgrounds. The basic two-dimensional image is a monochrome (grayscale) image which has been *digitized.* If we consider an image is a two-dimensional light intensity function $f(x, y)$ where x and y are spatial coordinates and the value of f at any point (x, y) is proportional to the brightness or gray value of the image at that point.

A digitized image is one where Spatial and grayscale values have been made discrete, Intensity measured across a regularly spaced grid in x and y directions, Intensities sampled to 8 bits (256 values). For prawn structure analysis purposes, we can consider a prawn image as a two-dimensional array where x and y index an image point. Each element in the array is called a *pixel* (picture element). *Image processing* is in many cases concerned with taking one array of pixels as input and producing another array of pixels as output which in some way represents an improvement to the original array [12].

As per the definition of we are taking prawn as input and producing same prawn as output simply by making some improvements in the prawn image by using Matlab image processing programs. For example, this processing may remove noise, improve the contrast of the image i.e., sharpening, remove blurring caused by movement of the camera during image acquisition, it may correct for geometrical distortions caused by the lens.

2. IMAGE ACQUISITION

Based on the need to reduce the time complexity in image processing, it is necessary to use advanced

camera's to capture the images for improving the time response. In our paper, we presenting real time tracking of capturing different species which are needed for the study of aqua-culture, Nowadays, photographic cameras can deliver photographs in various formats, with different camera calibrations and lens intensities [5]. The need to acquire number of prawn species for our application it is very essential intention to capture different lager number of prawn images at very high transfer rates. Hence in this paper, we also concentrate on different cameras with their intensities for our application approaches.

Figure1: The effect of illuminating a Prawn with different directions (Front, Top, Side)

To capture an image we need some kind of energy source to illuminate the scene. If a prawn image will captured than there is nothing to do about the illumination, hence it is very important to carefully think about how the scene should be lit. In fact, for the field of Machine Vision it is a rule-of-thumb that illumination is 2/3 of the entire system design and only 1/3. The above figure visualize that the same prawn image captured by the camera with different direction of the light source and care must be taken when pointing the illumination directly towards the camera.

Digital Image Acquisition

Traditional photographs, transparencies or negatives can be scanned and cameras can directly record digital images are the two methods for acquiring a digital image. Digital cameras, in their simplest form, use the principle of lens, shutter and film as found in traditional cameras. However instead of silver halide based film, refer to Chemical Image Processing a digital camera uses a CCD or CMOS sensor to record the image. Please refer to the Camera Basics section for more information. The image capture process of a digital camera is almost instantaneous as all the sensors are exposed at the same time also the number of pixels is fixed; therefore the image captured has a fixed resolution [11].

Unlike a digital camera a scanner's image resolution can be controlled by adjusting the movement of the sensor, the main disadvantage is the time taken to record an image, but this is not necessarily an important factor with scanners but would greatly reduce the potential subject matter of a camera. Real-time radiography is generally less sensitive than film radiography. A number of factors contribute to this difference. These factors include (1) the difference in size between the silver halide grains of film and the cesium iodide needles of the RTR scintillation screen, (2) the phosphor bloom of the fluorescent screen, (3) the random pixel noise inherent in image intensifiers, and (4) the pincushion image distortion also inherent in these systems. Real-time radiography systems using an image intensifier tube have poorer resolution (2-4 line pairs per millimeter) [LP/mm] than film (10-20 LP/mm) does. Phosphor bloom, especially in the output conversion phosphor, is the principle cause of diminished resolution and various direction of an images shown in figure (1).

3. CAMERA STANDARDS

Compact cameras, sometimes also called point-and-shoot probably were your first camera. They are very convenient: cheap, small, light and fool proof. As the name suggests, just point it in the general direction of the subject and press the button. The camera does the rest.
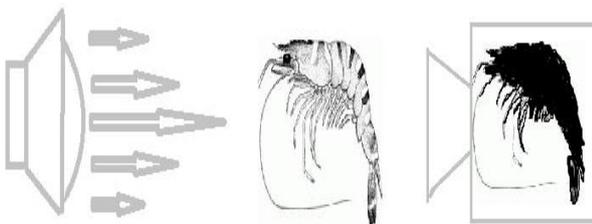

Figure 2: Backlighting. The light source is behind the object of interest, which makes the object stand out as a black shadow.

A camera calibration is the process of finding the internal quantities to the camera that affect the image process. This internal quantity of a camera includes position of image center in the image, focal length, different scaling factors for the rows and column pixels, skew factor, lens distortion. For accurate vision applications, the protocol camera link [1], is best for communication interface, which is the basic technology of the channel link to provide more useful specification for vision applications figure (2). The absolute necessity of a standard camera link is to concentrate on advanced data transmission signals and to increase the camera dissimilarities. One of the major advantages of camera Link interface is reduces both the support time and budges cost.

One of the major important requirements of the camera in the optical system is the lens. Lens is a piece of glass which focuses the incoming light onto the sensor, and by using lens we can increase the size of the object in the image. This process of increasing the size of the object in the image is called optical zoom. All stages of traditional chemical based photography can now be performed by electronic digital processing. Digital imaging includes recording the image, storing the image, manipulating the image and outputting the image. Digital imaging processes and traditional chemical methods are not mutually exclusive, they can be used together in a wide variety of combinations; and the principles of forming the image by light and lens are the same for chemical and digital processes.

Electronic photography has been in existence since the 1930's, the first television transmission being made by the BBC on the 2nd November 1936 from Alexandra Palace. The cameras the BBC used were based on imaging tubes using thermal valve principles. Imaging tubes were the standard television capture device until the 1970's when Charged Coupled Devices (CCDs) were first introduced. Although the CCDs designed for television cameras produce excellent video pictures their use for still images were greatly limited by the small amount of image information they could record. During the 1980's higher definition CCDs were developed for use in digital cameras. By the late 1990's CMOS (Complementary Metal Oxide Semiconductor) technology was also being used to make image sensors for cameras. A digital image is made up from a great number of pixels, each pixel having a specific numeric tonal value. Image contrast is determined by the number of tonal values available and image resolution is determined by the number of pixels available.

Digital Single Lens Reflex cameras (DSLRs) are the "serious" camera of choice these days. Though this comes at the price of a serious increase in weight and bulk (and, well, price), they are also much more inflexible on everything that matters. In particular, they have interchangeable lenses which allow you to

always have the best lens for the occasion. Even APS-C (DX) cameras have big enough sensors to allow shallow depth of field and good low light/dynamic range quality. The diagrammatic view of Digital Single Lens Reflex camera is shown in the below figure (3). There is an optical viewfinder, which allows framing in the worst light conditions and is generally more responsive than any electronic screen.

Figure 3: A DSLR camera sample view

The annoyances of compact cameras are also gone: shutter lag is virtually unknown, autofocus generally very fast (though this depends on the lens) and even entry-level cameras provide full manual control along with their scene modes. There are several different sensor sizes, commonly called "cropped sensor", "APS-C" or "DX" for the smaller versions, and "full frame" or "FX" for the bigger ones, which correspond exactly to the size of 35mm film. High end cameras tend to use FX for a variety of reasons, mostly having to do with image quality in difficult light conditions. Concretely, the main difference has to do with the crop factor, which we will cover in tomorrow's lesson.

In short, a DSLR will be better than a compact in every respect. There are DSLRs at all price points, from the entry level to full featured pro beasts. In 2014, entry level models would be the Canon T5i and Nikon D3200, while more advanced models are the Canon 7D and the Nikon D7100. Hence in our application we selected DSLR camera for capturing Prawn images to display accurate and noise less images.

4. IMAGE PROCESSING TECHNIQUES:

Image processing is a physical process used to convert an image signal into a physical image. The image signal can be either digital or analog. The actual output itself can be an actual physical image or the characteristics of an image. The most common type of image processing is photography. In this process, an image is captured using a camera to create a digital or analog image. In order to produce a physical picture, the image is processed using the appropriate technology based on the input source type. In digital photography, the image is stored as a computer file. This file is translated using photographic software to generate an actual image. The colors, shading, and nuances are all captured at the time the photograph is taken the software translates this information into an image shown in the below figure(4).
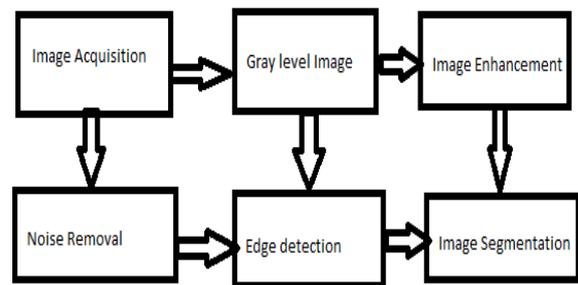

Figure 4: Basic image processing techniques

4.1 Gray scale image:

In this we concentrate more on gray scale because it is usually the preferred format for image processing results also shown in below figure. Even in cases requiring color, an RGB color image can be decomposed and handled as three separate grayscale images. Indexed images must be converted to grayscale or RGB for most operations.

To understand grayscale better, here we are using image representations in Matlab: A grayscale image m pixels tall and n pixels wide is represented as a matrix of double datatype of size $m{\times}n$. Element values (such as $img(m,n)$) denote the pixel grayscale intensities in [0,1] with 0=black and 1=white. A first-order global characteristic of an image is its gray level histogram. The gray level histogram of an image is a chart, listing all of the gray levels (Shown in figure 5.1) that are used in the image on the horizontal axis and indicating the number of pixels having each level on the vertical axis. The gray level histogram of the image is shown as right inset. Gray level images usually consist of 256 levels of gray, so, the horizontal axis of the histogram runs from 0 to 255. The vertical axis varies in scale depending on the number of pixels in the image and the distribution of the gray level values. A set of techniques, called gray level histogram modifications, is used to improve the visual appearance of an image

4.2 Smoothing of noisy images:

Noise is the random variation in the pixel content caused by the acquisition, digitization and transmission process. An example of a original image is shown in Figure 7. As seen from the image, pixels which are affected by noise often appear markedly different from their neighbor pixels in Figure 7b. Noise cannot be eliminated altogether; it can be reduced by a process called smoothing. The simplest way of noise reduction is to analyze a few nearest neighbor pixels of each pixel in the image and to see if the difference between the gray value of the pixel and the gray values of its nearest neighbors is essential [3]. Often smoothing by averaging is applied. Here each pixel is replaced by the average of its neighbor pixels. Another effective way of noise reduction is median filtering when each pixel is replaced by the median of its neighbor pixels. The image, shown in Figure 7c is obtained by the median filtering of the image.

Digital images are prone to a variety of types of noise. Noise is the result of errors in the image acquisition process that result in pixel values that do not reflect the true intensities of the real scene. There are several ways that noise can be introduced into an image, depending on how the image is created. If the Prawn image is scanned from a photograph made on film, the film grain is a source of noise [14]. Noise can also be the result of damage to the film, or be introduced by the scanner itself. If the Prawn image is acquired directly in a digital format, the mechanism for gathering the data (such as a CCD detector) can introduce noise. Electronic transmission of image data can introduce noise.

Median filtering is similar to using an averaging filter, in that each output pixel is set to an average of the pixel values in the neighborhood of the corresponding input pixel. However, with median filtering, the value of an output pixel is determined by the median of the neighborhood pixels, rather than the mean. The median is much less sensitive than the mean to extreme values (called outliers). Median filtering is therefore better able to remove these outliers without reducing the sharpness of the image. The medfilt2 function implements median filtering.

4.3 Sharpening

Similarly to smoothing there is a class of spatial filters called high-pass filters, which are often applied for image sharpening. Their application is also based on the discrete convolution of the original image with a special mask [2]. To produce a sharpening effect the following filters can be used:

$$\begin{pmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{pmatrix}, \begin{pmatrix} -1 & -1 & -1 \\ -1 & 9 & -1 \\ -1 & -1 & -1 \end{pmatrix}, \begin{pmatrix} 1 & -2 & 1 \\ -2 & 5 & -2 \\ 1 & -2 & 1 \end{pmatrix}$$

An example of an image where a sharpening may be necessary is shown in Figure 6 The resulted image with enhanced edges. Another way of making an image sharper is to apply edge detection filters such as the Laplace, Roberts, Sobel filters, and to add the found edges to the original image.

4.4 Edge detection

Edge detection is one of the important pre-processing steps in image analysis. Edges characterize boundaries and edge detection is one of the most difficult tasks in image processing hence it is a problem of fundamental importance in image processing. Edges in images are areas with strong intensity contrasts and a jump in intensity from one pixel to the next can create major variation in the picture quality [6]. Edge detection of an image significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. Conventionally, mathematical morphology edge detection methods use single and symmetrical structure elements. But they are difficult to detect complex edge feature, because they are only sensitive to image edge which has the same direction of structure elements. Edge detection techniques transform images to edge images benefiting from the changes of gray tones in the image.

The most frequently used edge detection is Roberts edge detection, Prewit edge detection, Sobel edge detection and Canny edge detection methods [10]. In this paper, we are concentrating on sobel and canny edge detection methods which are suitable for our application because this edge method are give clear and perfect edges of the Prawn which are shown in the results part.

In an image, an edge is a curve that follows a path of rapid change in image intensity. Edges are often associated with the boundaries of objects in a scene. Edge detection is used to identify the edges in an image.The most powerful edge-detection method that edge provides is the Canny method Shown in figure 8. The Canny method differs from the other edge-detection methods in that it uses two different thresholds (to detect strong and weak edges), and

includes the weak edges in the output only if they are connected to strong edges [7]. This method is therefore less likely than the others to be fooled by noise, and more likely to detect true weak edges.

4.5 Image segmentation

Segmentation is one of the key problems in image processing. A popular method used for image segmentation is thresholding. After thresholding a binary image is formed where all object pixels have one gray level and all background pixels have another - generally the object pixels are 'black' and the background is 'white' [13]. Thresholding can be defined as mapping of the gray scale into the binary set $\{0,1\}$:

$$S(x,y)=\begin{cases} 0, if\ g(x,y) < T(x,y) \\ 1, if\ g(x,y) \geq T(x,y) \end{cases}$$

Where S(x, y) is the value of the segmented image, g(x, y) is the gray level of the pixel (x, y) and T(x, y) is the threshold value at the coordinates (x, y). It can be selected, for instance, on the basis of the gray level histogram. When the histogram has two pronounced maxima, which reflect gray levels of object(s) and background, it is possible to select a single threshold for the entire image. A method which is based on this idea and uses a correlation criterion to select the best threshold is described below. Sometimes gray level histograms have only one maximum. This can be caused, e.g., by inhomogeneous illumination of various regions of the image [8]. In such case it is impossible to select a single thresholding value for the entire image and a local binarization technique (described below) must be applied. General methods to solve the problem of binarization of in homogeneously illuminated images, however, are not available. Segmentation of images involves sometimes not only the discrimination between objects and the background, but also separation between different regions. One method for such separation is known as watershed segmentation the basic principles of which are Global thresholding using a correlation criterion, Local binarization using discrete convolution, and Segmentation based on watershed transform these segmentations are used in our future work.

5. EXPERIMENT RESULTS

This section presents the relative performance of various image processing techniques such as gray scale conversion, smoothing of noise images, sharpening, edge detection using sobel and canny methods by using Matlab source codes. We are performing these techniques for the captured Prawn image. By using the resultant Prawn image of various images processing technique we are trying to find the difference between the prawn each other and specifying the category of Prawn. Hence the resultant prawn images of gray scale, sharpening, edge detection of sobel and canny methods are shown in the below figures.

5.1 Gray scale image: A grayscale image is also called gray-scale or gray-level) is a data matrix whose values represent intensities within some range. MATLAB supplies a grayscale Prawn image as a individual matrix, with each element of the matrix corresponding to one Prawn image pixel. By convention, this documentation uses the variable name I to refer to grayscale Prawn images. The result of converting the original image to gray scale Prawn image is shown in below figure
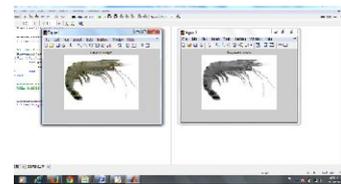

Figure 5: Gray scale image

5.2 Image Sharpening: To sharpen a Prawn color image, you need to make the luma intensity transitions are more accurate for sharpen the given Prawn color image. For this analysis we are converting an R'G'B' image into the Y'CbCr color space and apply a highpass filter to the luma portion of the Prawn image only. Then, you transform the image back to the R'G'B' color space to view the results. To blur an image, you apply a lowpass filter to the luma portion of the image which is shown in the below figure.
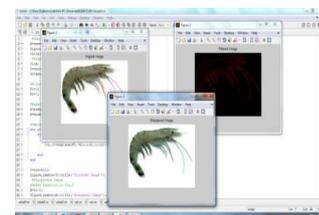

Figure 6: Image Sharpening

5.3 Noise Removal: Removing of noise in the captured Prawn image is the essential and primary work of our application. It can be done by implementing Median filtering by using Mat lab shown in the below figure (7). Wiener2 works best when the noise is constant-power ("white") additive noise, such as Gaussian noise. The example below

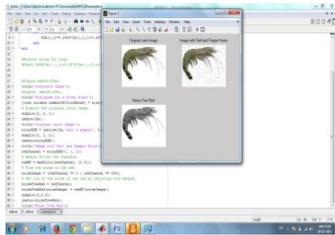applies wiener2 to an image of Saturn that has had Gaussian noise added

Figure 7: Noise Removal

5.4 Edge Detection: The most powerful edge-detection method that edge provides is the Canny method. The Canny method differs from the other edge-detection methods in that it uses two different thresholds (to detect strong and weak edges), and includes the weak edges in the output only if they are connected to strong edges. This method is therefore less likely than the others to be fooled by noise, and more likely to detect true weak edges. We also show the output of Sobel edge detection method in the below figure and its comparisons for the same image.
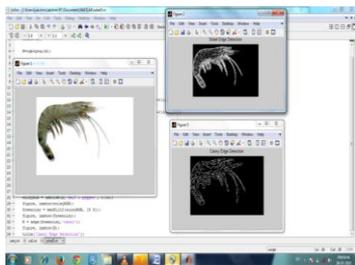

Figure 8: Sobel and Canny Edge Detection

6. Conclusion

The image acquisition is a fundamental part of the image processing research because of its subsequent processes depends on it. To achieve this, departing from signals of camera link protocol, is very much important care on capturing of Prawn images. In analysis for this purpose of capturing different Prawns with clear and accurate Prawn structure we suggesting DSLR Cameras for our applications. This captured prawns are than used for implementing various image processing techniques like converting original image into gray scale converting, image sharpening , image noise removal, and identifying the Prawn image edges by applying canny and sobel edge detection their result in Matlab are also shown. In our future work, we are extending the same process of image processing techniques by applying image segmentation in which the given Prawn image is dividing into different division or blocks or segments for identifying the difference of one Prawn with other Prawns.

REFERENCES

1. Specifications of camera link, interface standard for digital camera and frame grabbers, Camera Link, October 2000.

2. N. S. Jayant, "Average and median-based smoothing techniques for improving digital speech processing", ZEEE Trans. Acoust., Speech Signal Processing, vol. ASSP-23, pp.552-557, Dec .1975.

3. F. Luisier, T. Blu and M. Unser, "Image Denosing in Mixed Poission-gaussian Noise", IEEE Transactions on Image Processing, vol. 4, (1999) July.33.

4. Ajay Kumar Nain, Surbhi Singhania, Shailender Gupta and Bharat Bhushan , "A . Comparative Study of Mixed Noise Removal Techniques" International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.7 -2014

5. SukHwan Lim and Abbas EI Gamal, "Integration of Image Capture and Processing – Beyond Single Chip Digital Camera", Proceedings of SPIVE , 2001

6. Rohan Kandwal, Ashok Kumar, Sajay Bhargava, "Review: Existing Image Segmentation Techniques", IJARCSSE,April – 2014, pp. 153-156

7. Ahmed R. Khalifa, "Evaluating the Effectiveness Of Region Growing And Edge Detection Segmentation Algorithms. -2010

8. A. M. Khan, Ravi. S, "Image Segmentation Methods: A Comparative Study", International Journal of Soft Computing and Engineering ISSN: 2231-2307, Volume-3, Issue-4, September 2013.

9. N, Senrhilkumaran and R. Rajesh, "Edge Detection Techniques for Image Segmentation – A Survey of soft Computing Approaches", International Journal of Recent Trends in Engineering, Vol.1, No.2, May 2009.

10. Ravi S and A M Khan, "Operators Used in Edge Detection: A Case Study", International Journal of Applied Engineering, ISSN 0973-4562 vol. 7 No 11, 2012.

11. S. Nagabhushana, "Computer Vision and Image Processing", New Age International Publishers, 2005.

12. R.C. Gonzalez and R.E. Woods, "Digital Image Processing", third edition, PHI publication, 2008.

13. Yong Yang, "Image Segmentation By Fuzzy C-Means Clustering Algorithm with A Novel Penalty Term", Computing And Informatics, Vol. 26, 17-31, 2007.

14. Yu-Hsiang Wang, "Tutorial: Image Segmentation", Natioanl Taiwan University, Taipei,ROC,

15. Fu., K.S., Mui, J.K., 1981. A Survey on image segmentation. Pattern Recognition13 (1), 3-16.