ISSN: 2277-3754
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 1, Issue 3, March 2012

Iris Recognition Using Stationary Wavelet Transform and Artificial Neural Network

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Abstract*— This paper focuses on the recognition of the iris of eye for the security purpose. The objective of this study is to develop the image processing algorithm using stationary wavelet transform to get the normalized cropping images which would be suitable inputs processing and detection. Testing is done using a real-time visual recognition system. The Matlab software version 7.6 is used to integrate all algorithms. The implementation also consists of a prototype that emulates the hardware response. Consisting of a control system this hardware provides data through the microcontroller based system to the Matlab code which then activates the camera for image processing. It also activates the buzzer for unrecognised image. The result shows that the system can detect iris accurately and give response accordingly as required for the application.

***Keywords*— Pattern recognition, Iris, Stationary Wavelet Transform, Artificial Neural Network, Microcontroller.**

I. INTRODUCTION

Biometrics is the science and technology of machines that can detect difference between human biological structures. The machine is made by high resolution web camera to extract information from an image in order to solve some task. As a scientific discipline biometrics is concerned with the theory behind artificial systems that extract information from images. Each of the application areas described above employ a range of computer vision tasks; with more or less well defined measurement or processing problems, which can be solved using a variety of methods. Some examples of typical computer vision tasks are presented below. Recognition is the classical problem in computer vision, image processing, and machine vision. It is related to the determination of whether or not the image data contains some specific object, feature, or activity. This task can normally be solved robustly and without effort by a human, but is still not satisfactorily solved in computer vision for the general case, involving arbitrary objects in arbitrary situations. The existing methods for dealing with this problem can at best solve it only for specific objects, such as simple geometric objects, human faces, printed or handwritten characters, or vehicles, and in specific situations, typically described in terms of well-defined illumination, background, and pose of the object relative to the camera ([1]–[6], [8], [11]).

The bolt and nut is a sample of a fastener which is a hardware device that mechanically joins or affixes two or more objects together. Fasteners can also be used to close a container such as a bag, a box, or an envelope; or they may involve keeping together the sides of detects the human biological structural differences. Stationary wavelet transform is a technique that will be suitably used for the application purpose for energy matching of iris getting from web camera. MATLAB is the abbreviation of matrix laboratory, which has several hundred built-in functions packages and thirty kinds of tool kits.

In this paper, we use the MATLAB and implement the stationary wavelet transform for image processing and detection. The optimization algorithm has less iteration than implementation with Artificial Neural Network process for the same task and other improved algorithms while the convergence rate is faster and the precision is higher [7].

Curve figures in terms of perimeter radius are used as feature extraction ([6], [10], [12]) for recognizing objects. This method is more suitable for real time recognition systems compared with previous research [5], because we can get better iteration time and accuracy. This paper is organized as follows; software implementation is proposed in the section 2. Methodology and hardware details are presented in section 3. The result and discussion are presented in section 4. Finally, section 5 presents the conclusion on the findings.

II. SOFTWARE FRAMEWORK DEVELOPMENT

A software framework for image processing in defect detection of real-time visual inspection system has been developed using stationary wavelet transform technique and is the Real-Time Intelligent Visual Inspection. The framework will start at image acquisition and will go through a series of processes before the results can be output. Fig.1 shows the developed IVIS software.

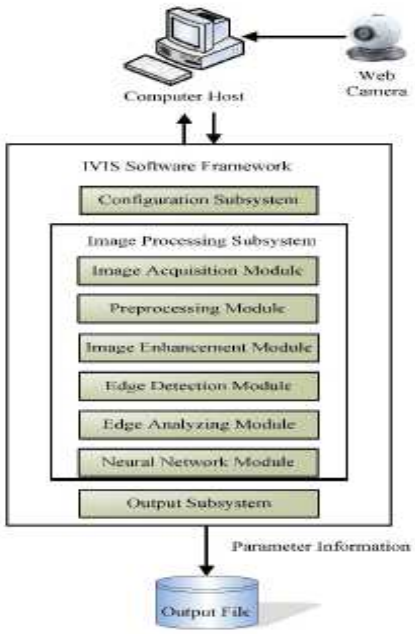

Fig.1. Software Framework

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The process start with image acquisition where image will be capture, follow by pre-processing of the images captured to reduce noises in the image. Images are then enhanced to ease the analyzing process. After the images have been enhanced, the edge inside the images was then determined. Lastly according to the parameter of edges, the status of a bottle in the bottling process can be determined by using neural network and action can be taken to follow up this result [15].

A. Configuration subsystem

Video configuration module used for configure the information e.g. to choose proper webcam device, image brightness, image colour, etc. This module also use for configure the information such as image size and image resolution. In this case, image size is fixed i.e. 352 x 280 pixels, and the image input format is in gray scale.

B. Image processing subsystem

Image processing sub-system consists of some modules as shown in figure 1.

i). Image acquisition module

When come into development of a vision system, image acquisition is the first and most important step to be taking care of. Any deficiency of the initial image can cause a major problem while processing and analyzing the image.

Hardware equipment carries a very important role to acquire image with sufficient contrast and sharp focusing. However in this paper, we will stress on the software framework in this section, and an ordinary high-end webcam have been used as an image acquisition device.

In the software point of view, Matlab has been chosen as the development tools. Using the tools mentioned, there are several ways to acquire a video stream from a webcam. The most common ways are DirectX, QuickCAM or VFW (Video for Windows). A real-time series of image can be acquired using the tools mentioned. Each individual image was stored and further analyzing can be carried on thereafter.

ii) Pre-processing module

After the image has been captured from the first stage, each image will go through the pre-processing stage to eliminate noise inside the image, to enhance the result of the output.

Imaging sensor including camera-like devices, rarely have evenly illuminated image. Even in the absence of vignetting (this causes off-axis rays to be lost by collision with the lens mount at large apertures - typically f/2 or greater) image brightness falls off rapidly away from the axis of the imaging lens [16].

iii) Image enhancement module

After the noises have been removed at the pre-processing stage, the image is then processed to maximize the contrast to give optimum output for processing the edges. In our case, since the colour of our target unit is in bright colour, whereas the background in dark colour, therefore to maximize the contrast of the image.

The first part of the algorithm is used to maximize the contrast of two regions and the edge in the image. If the pixel value in a pixel is more than a threshold value, certain value of brightness (enhance-brightness) is adds to the pixel.

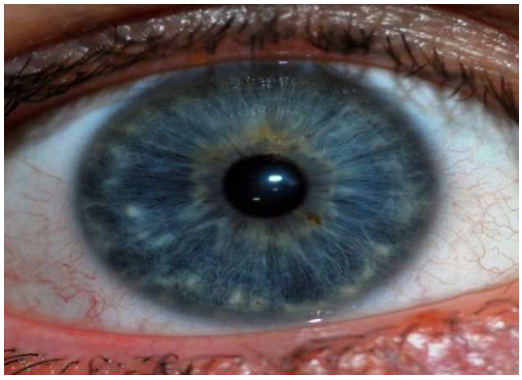

Fig. 2 Image iris 1

Whereas when it is less than the threshold value, certain value of darkness value (enhance-darkness) is subtracted from the pixel. Since the value of a pixel is range from 0 to 255, therefore, the second part of the algorithm is used to ensure the pixel value after calculation is within the range. Figure 2 and 3 shows an image result from the enhancement process.

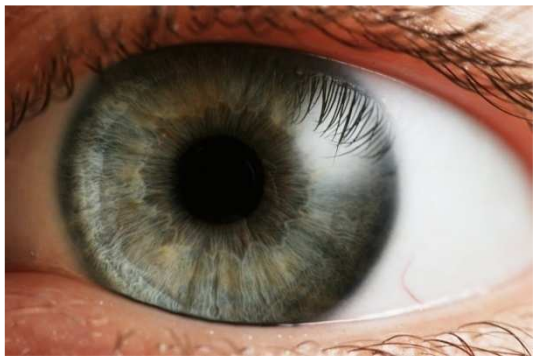

Fig. 3 Image iris 2

III. METHODOLOGY

Hardware Framework

The framework starts when camera sensor detects the presence of iris image. This signal is provided to the microcontroller unit that tells Matlab program that iris image present in front of the webcam. With a response time of less than 250 ms, the sensor via the controller system initiates the web camera to capture the object. The captured image then will be processed by computer using image processing and stationary wavelet transform and trained artificial neural network, finally sending the output signal to the microcontroller ATMega32. As an actuator, the microcontroller which is connected to a personal computer via serial port RS232, orders the Smart Peripheral Controller (SPC) to activate the buzzer or not Fig. 1.

The hardware system provides a communication between the prototype setup and the Matlab code. The microcontroller is programmed using C language and controls the input and output of the system.

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IV. Result & Discussion

After the image processing sequences, we have a final result for each iris image shown in Fig. 2 and Fig. 3.The results of stationary wavelet transform of testing can be seen in the Fig. 4 and Fig. 5. By using the heuristic method for two types of iris, we can decide that for an output value of less than 0.05 to almost zero is defined as a iris in database, whereas the output value of greater or equal to 0.05 to almost one is defined as a image not in database and buzzer gets on, this is decided by artificial neural network.

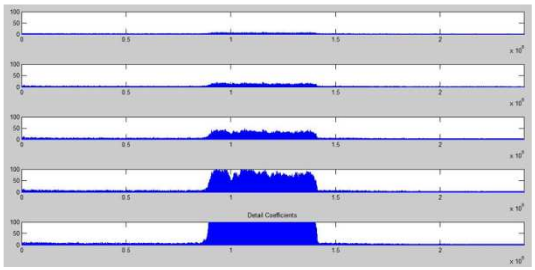

Fig.4 Wavelet transform iris image 1

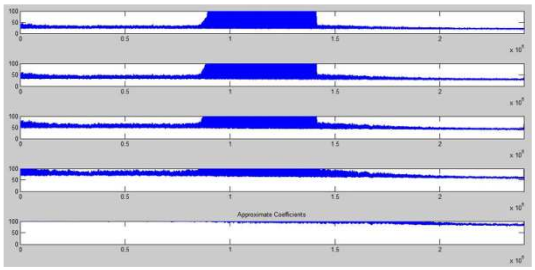

Fig.5 Wavelet transform graph for image2

V. Conclusions

This experiment shows satisfactory results as compared to other iris recognition techniques while maintaining same threshold error and a good processing speed-up in terms of success rate. The success rate is more than 95%, for high resolution images. The success rate can be improved up to 98% if we had used an additional different image enhancement technique at the pre processing. The distance factor is also affecting the result so lens quality of camera sensor is required of very good quality. For our result 3meter maximum is require above that distance efficiency start reducing.

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