CASE STUDY APPLYING THE MACHINE VISION FOR FACE DETECTION AND RECOGNITION SYSTEM

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ABSTRACT

Nowadays, several places want high security systems.The security systems that have been used extensively are the finger print and identification systems. These systems are easy to use, and easy to transfer data to computer. However, these systems are often found errors such the loss of identification cards, instability of the finger print system. The finger print can change or several users who work for maintenance have grimy finger. Identification system can be used by others users or workers. Thus, a design program for face detection and recognition system becomes very important in security systems. The face is detected to find face region and elements for defining face pattern. Then the detected face is compared with the face pattern for recognition. The machine vision is used to design a program which is used in the pattern matching function. However, the source code of several programs is difficult to understand and develop. Thus LabVIEW NI Vision that is graphical language and it is easy to understand and develop. Moreover, LabVIEW NI Vision can process faster than MATLAB. Thus LabVIEW NI Vision is selected for the design and development of this study. In the process, there are several factors that are out of control. Those factors are not selected to increase the effectiveness of the system. The face image that is removed ears and hair is analyzed through the developed program. Finally, the result of applying the machine vision for face detection and recognition system show 100 percentages accuracy. The program is created to detection correctly that can be acceptable.

1. INTRODUCTION

The present security systems are used for verifying people in several places. They are also need for multiple tasks. The security systems that have been used extensively are the finger print and identification systems. These two systems are that they can transfer data to computer and they are easy to use. However, the error detection and unstable are still occurred in the system. Other security systems are iris scanning and the vessel scanning. The both systems have higher costs because they require special camera and they are new technology. These problems cannot be accepted for security system (Pramod, et al., 2013). Thus, the design of computer program for facial detection and recognition system is very important. Each human face has approximately 80 nodal points which are important points for detection. For example, distance between the eyes, width of the nose, depth of the eye sockets, the shape of the cheekbones, and the length of the jaw line. These nodal points are calculated by creating a numerical code, called a face print (Manpreet, et al., 2014). Facial 2D images were kept in the database to compare with scanning face. To be precise and true, the image was obtained from a face that was viewing almost straight at the camera for avoiding orientation problem, expression of face, problem of pose, occlusion and illumination (Umar, et al., 2014). However, several programs are used for designing but the popular program is MATLAB. The source code of this program is difficult to understand and develop. Thus, LabVIEW NI Vision that used picture language and is easy to understand and develop is selected for the design and development of the program in this study. In addition, this program has high accuracy is mainly used in food industrial (S. Nashat, et al., 2013), (Davies, E.R, 2013). In the processing step, there are several factors that are out of control as shown in Figure 1 a machine readable travel documents (MRTD) system based on a number of evaluation factors (Hietmeyer, R., 2000). Those factors are not selected to increase the effectiveness of the system.

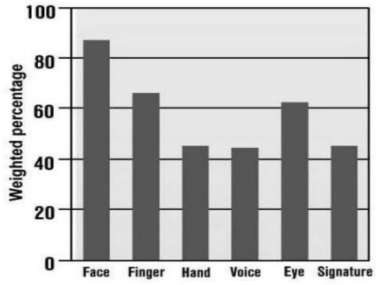

Figure 1. Facial features scored the highest compatibility.

In this study, LabVIEW NI Vision will be used to develop the computer program for facial detection and recognition system, the program can real-time scan, detect and recognize all of the users for the security system in the workplace. Moreover, the factors that are important for facial detection and recognition system are also studied.

2. EXPERIMENT

2.1 Experimental Apparatus

1. LabVIEW NI Vision

LabVIEW NI Vision will be used to develop the computer program for facial detection and recognition system due to graphical language of the program that is easier than other programs. Pattern matching that is the main feature is used in this study.

2. Camera

The scanning image is scanned from 1.0 megapixels camera and processed by LabVIEW NI Vision.

2.2 Technique

2.2.1 Data acquisition

The data acquisition procedure starts with 10 users are photographed and 5 images of each face is cropped to 200pixels*250pixels. Ears and hairs area are removed to eliminate the hairstyle problem as shown in Figure 2. These images are prepared to compare with the scanning image. Thus 50 images of 10 users are collected in a folder of database. The folder of database is split into 10 folders. Each folder is the folder of 5 face images of each user as shown in Figure 3.

Figure 2. The face image of user that is cropped to 200pixels*250pixels.

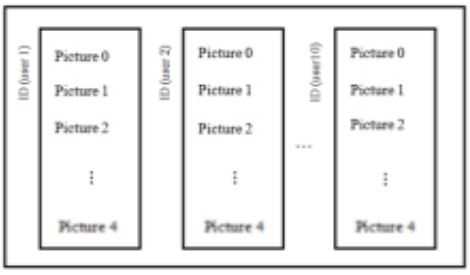

Figure 3. Database of each user.

2.2.2 Scanning Process

The scanning process starts when ID is keyed and start button is pushed. The images in database and the scanning images are changed from color image to gray scale image for decreasing the images size and detected the edge of images for preparing the comparison. Next, program is designed to photograph the user. Then, the image is scanned. The image is changed to gray scale image. Next the gray scale image is detected the edge. That is same as image in database. Then the detected edge image is compared with images in database. Finally, the text file is recorded when comparison is successful for recording ID date and time as shown in Figure 4.

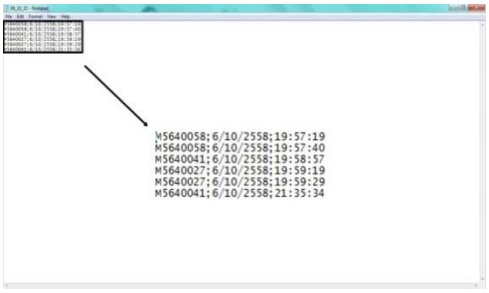

Figure 4. Text file to record user ID, date and time.

2.2.3 Pattern matching

Pattern matching will process by comparing 2 images. The first image is the image in the database or pattern image and another image is the scanning image. In the comparison process, first, the program will change the color image from camera to gray-scale image for decreasing image resolution. Then the program can detect the border of image from camera and compare to the images in database.

2.2.4 User Interface (UI)

The user interface or UI is interfaced to key user ID and display result for user. The interface includes the blank block for user ID input and the start button. Name of folder is similar to user ID. The address of folder or database and comparing images show in concatenated string block. The pattern show the picture 4 or the last picture of user in database and image out is image scanned by camera or webcam for comparing with the image in database. This UI has two LED, green LED and red LED. The green LED shows when image pattern match with image out on the other hand, the red LED show when image pattern does not match with image out. And the last important on UI is match score that is a score of similar between image pattern and image out. The most value of match score is 1,000 but in this case 600 or 60 percentages. As shown in Figure 5.

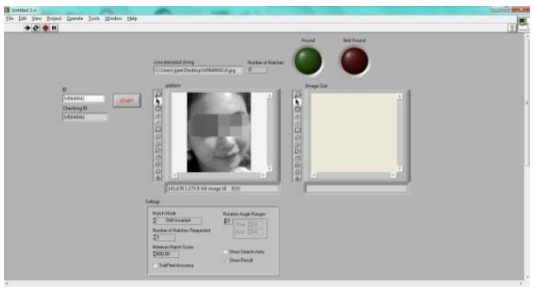

Figure 5. User Interface

3. ANALYSIS

3.1 Governing Equations

3.1.1 Mathematical interpretation of a digital image

An image is treated as a matrix of mxn elements. Each element of the digitized image (pixel) has a value that corresponds to the brightness of the point in the captured scene. An image whose resolution in intensity is of 8 bits, can take values from 0 to 255. In the case of black and white images, it can take 0 and 1 values. In general, an image is represented in a bidimensional matrix as shown in (1).

$$I = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Since most of the devices acquire the images with a depth of 8 bits, the typical range of levels of gray for an image is from 0 to 255 so that the matrix elements of the image is represented by $x_{ij} \in [0 \dots 255]$.At this point, it is convenient to say that even if the images are acquired at RGB format, it is frequently transformed in a gray scale matrix. To achieve the transformation from RGB type to gray, Grassman level (Wyszecki & Stiles, 1982)is employed:

$$I_{gray} = I_R(0.299) + I_G(0.587) + I_B(0.114) \quad (2)$$

3.1.2 The threshold function

This function generates a binary output image from a gray scale input image; the transition level is given by the threshold value t and p value of pixels, this function is defined as:

$$q = \begin{cases} 0 \; if \; p \le t \\ 255 \; if \; p > t \end{cases} \quad (3)$$

3.2 Numerical Method

3.2.1 Digital image in RGB to grayscale

In the example presented in Figure 4 shows how to acquire a digital image in RGB and grayscale format using the IMAQ toolbox. In this case, there are two important blocks: the first one is the IMAQ Create block located in Vision and Motion/Vision Utilities/Image Management, this block creates a new image with a specified image type (RGB, Grayscale, HSL, etc.), the second block is the IMAQ Read Image which is located in Vision and Motion/Vision Utilities/Files/, the function of this block is to open an image file which is specified previously in the file path of the block and put all the information of this opened image in the new image created by IMAQ Create. In other words, in the example presented in Figure 6 (a) the file picture4.png is opened by the IMAQ Read Image and the image is saved in a new image called image color that corresponds to a RGB (U32) image type. It is very simple to modify the image type of the system, in Figure 6 (b) the image type is changed to Grayscale (U8) and the image is placed in image gray.

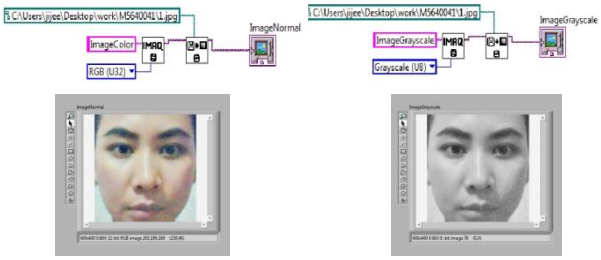

Figure 6. RGB (left or picture A) and Grayscale Image Acquisition (right or picture B).

3.2.2 The threshold function

Figure 7 (b) shows the result of applying the threshold function to image in Figure 7 (a) with a t value of 100. From equation (3), if value of pixel (p) is greater than threshold value (t), these pixels are 255 or white pixe,l when value of pixel is less than or equal to threshold value, these pixels are 0 or black pixel. Thus, this result of threshold method is black and white image.

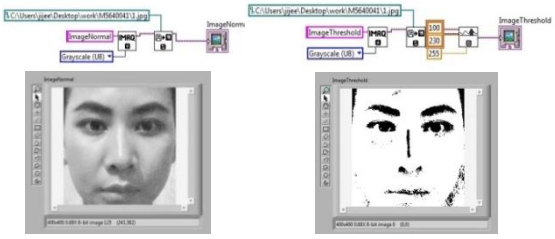

Figure 7.Grayscale (left or picture A) and threshold image(right or picture B).

RESULT AND DISCUSSION

The ten users are scanned by the computer program. In this case LabVIEW NI vision is selected for design the face detection and recognition system. The process of facial detection and recognition system is successful. The result is shown to user is red and green LED. In correct case, the green LED is shown on the user interface. On the other hand, red LED is shown instead in the

wrong case as shown in Figure 8. In the Figure 8 is shown about images in database that similar to scanning image such as in this case, "2.jpg" is shown the red circle area. The file name of third picture is "2" in database match with the scanning image.However, this program can scan all of user correctly 100 percentages that use match score is 600 from 1,000 or 60 percentages and the focal length is 30-50 cm.

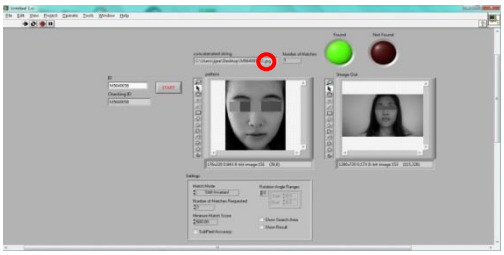

Figure 8. The user interface

CONCLUSION

The computer program is designed for security system. Thus, the system must be stable, easy to use, easy to develop and can be used in real situation. And this program can use in the real situation. It can scan, detect and recognize the face image. This program can scan all of user correctly 100 percentages and match score 60 percentages that can acceptable. However, the factors cannot increase the effectiveness are not selected. The factors are selected such as light control, focal length and match score. This program is the case study, but it can use in the real situation. The effectiveness will increase if this program is developed.

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NOMENCLATURE

I	: input image
mxn	: elements matrix of digital image
p	: value pixel of original image
q	: value pixel new image
t	: threshold value

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