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APPLYING REAL TIME IMAGE RECOGNITION TECHNOLOGY TO APARTMENT PARKING LOT SECURITY SYSTEM

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Abstract. *This paper proposed an application of image recognition technology in parking lot security management system. It is combined with the license plate recognition system and facial recognition system. The system integrates two functional capabilities, which can effectively control user identity and to enhance parking lot management and security. According to the experimental results, there is good recognition accuracy in this system. It can effectively control the user information. It also reduces the risk and the cost compared to using traditional human security guards. Moreover, this technology can be used in hospital or elder care center also.*
Keywords: Image processing technology, License plate recognition, Face recognition

1. **Introduction.** The security of public space is very important especially in a parking lot of inside apartment because it may cause some serious accidents if we do not pay more attention. It may have robber who comes from the parking lot to break in the apartment. Therefore, the security guard needs to make sure the safety for this apartment. However, the human is easy to make error such as misjudgment and cost of human guard is relatively high also. In order to have safe activity space, an intelligent automatic security management system is investigated in this paper. Using this system, the license plate number of vehicle not on the list of database is not allowed to enter the gate of parking lot. That can enhance the safety.

In this paper, an integration system which includes license plate [1,2] and face recognition [3,4] by using image technology is proposed. These two processes will be done simultaneously and check both image data by system. If information is completely matched, then it will allow the driver to enter the gate. Otherwise, the system will ask more identification data such as ID number. License plate recognition system can be divided into three parts, in which image processing and license location will be done by hardware Field Programmable Gate Array (FPGA), and character recognition was done by LabVIEW. Face recognition system can be divided into three parts: face component analysis, normalization and principal component analysis. This research has some advantages which are automation, fast processing, and enhanced security. It has more information for security system or human guards.

The image processing technology [5,6] which includes the color space conversion, segmentation, and some other image processing technologies is applied in this paper. This technology is convinced to have effective control and good identity confirmation. It can integrate different information effectively and overcome the traditional security problems

also. This paper presents an image recognition technology based on a security management system to have effective control and good identity confirmation. Moreover, this technology can be used in hospital or elder care center also.

2. **License Plate Recognition Algorithm.** After license plate image is captured, the former image processing is conducted to find license plate location, license plate characters segmentation, and license plate character recognition. After morphological process, images will form many different sizes of blocks, and then it will set the initial filter criteria to filter out unlikely license plate blocks. According to the actual experimental analysis, it sets the block filter formula shown as Equations (1) and (2). If the image is actual location of the license plate which meets the above two conditions it will be filtered out. The result of license plate location recognition is shown in Figure 1.

Block Aspect ratio:

$$2 \leq Length/Width \leq 2.2 \tag{1}$$

Block pixels:

$$4400 \leq AreaPixels \leq 4800 \tag{2}$$

After capturing the license plate position, the image noise will be erased using filters. Then, this research uses horizontal positioning projection split upper and lower boundaries of the amendments. And it uses vertical projection of character segmentation to achieve correct position and cut out characters. After cutting through the vertical projection, it gives the license plate characters in each block of the image. This algorithm splits character image block after normalization to image size. The character database for LabVIEW system is shown as Figure 2. And then the character of license plate can be

FIGURE 1. Result of license plate location

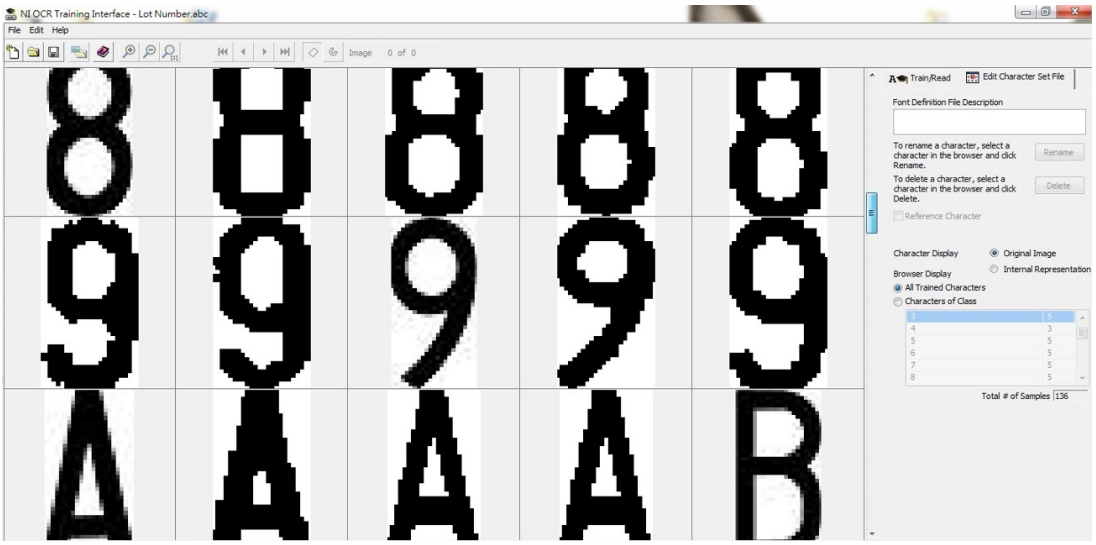


FIGURE 2. Character database for LabVIEW system

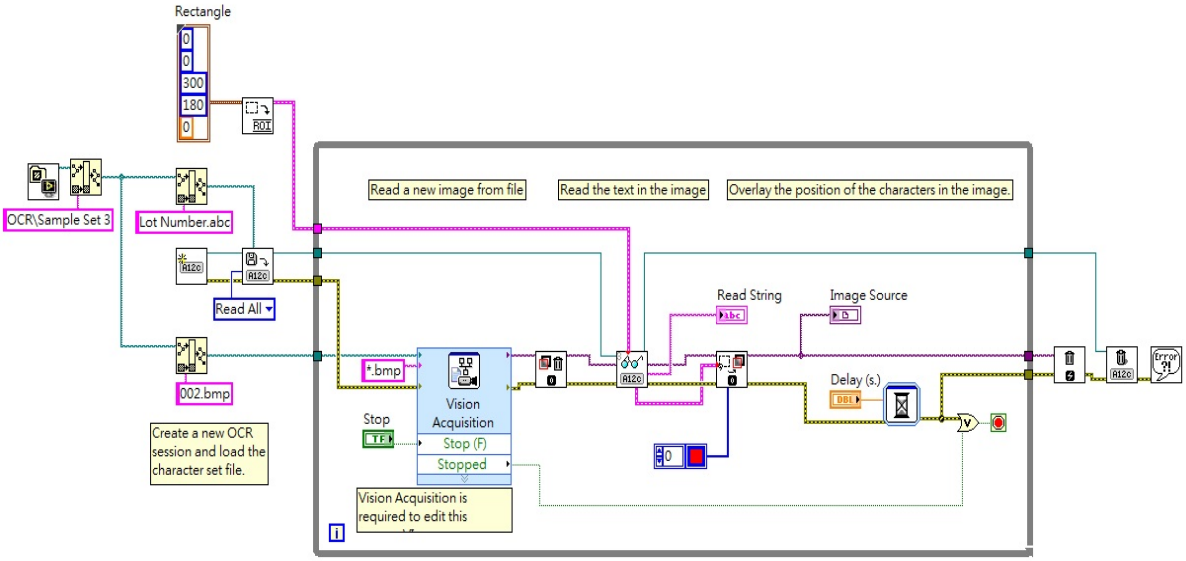


FIGURE 3. Character recognizing algorithm

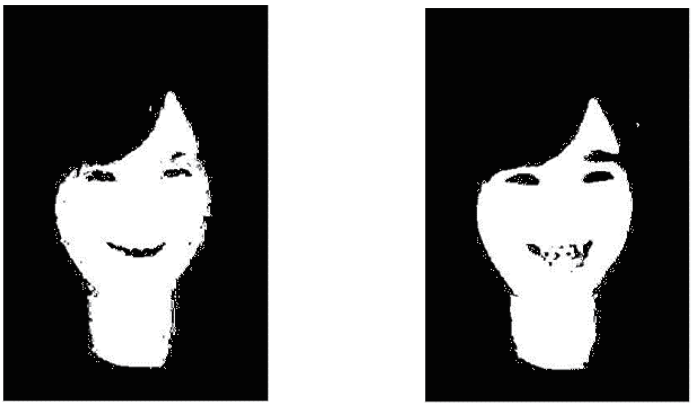
(a) RGB image (b) L*a*b* image

FIGURE 4. RGB image and L*a*b* image

recognized by using LabVIEW system. The character of license plate can be recognized by using the LabVIEW algorithm which is shown in Figure 3.

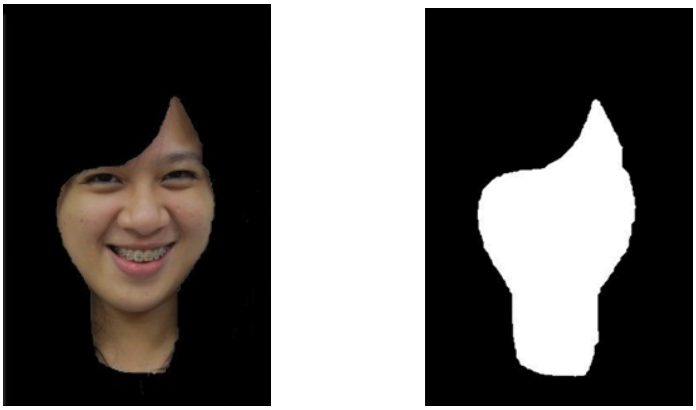
3. **Face Recognition Algorithm.** In order to enhance the security of the system, a face recognition algorithm is applied. After the face images are captured, the system uses color space conversion and analyzes the region of face. The Otsu's method is used to make image segmentation have more precise position of human face. The face recognition is based on the identification of the principal component analysis framework to establish facial feature space. Finally, the system uses Euclidean distance to determine the size of the human face identity. In this paper, the L*a*b* color space conversion is chosen to do human face detection component analysis. L* represents the luminance component, a* represents the red/green color component, and b* represents the yellow/blue component. The color place conversion result is shown in Figure 4.

In this paper, the Otsu's image area segmentation method is used. By Otsu's image region segmentation method we can automatically analyze the optimal segmentation threshold of human face images. The face segmentation histogram analysis results are shown in Figure 5, which are the components of the color space by a* and b* conversion. Based on the image results, the Otsu's image region segmentation method can effectively



a* component b* component

FIGURE 5. Face segmentation histogram analysis results



(a) Original image (b) After morphology

FIGURE 6. Experimental results after morphology

separate the face component. In order to have more clear face region, the process of morphology should be done. The experimental result after morphology is shown in Figure 6.

After normalizing the human face image size, this paper analyzes through the main ingredient to complete face recognition algorithm. It is widely used in two-dimensional face recognition. After conversion you can use less data to replace the original data, so the advantage of its method can reduce the dimension of image data and can quickly analyze the results. Finally, the algorithm uses the Euclidean distance to find the closest results from training sample library. The difference between the images of human face is projected onto the feature space and to find the weight vector in space. Based on the computation results of Euclidean distance shown as Equation (3), the system will find the same person's face image between the two vectors has the smallest value.

$$D(x, y) = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + \cdots + (x_n - y_n)^2} \tag{3}$$

4. **Experimental Results.** This paper proposed an integration image recognition technology for a parking lot security management system. It is combined with the license plate recognition algorithm and facial recognition system. After conducting the license plate image processing, the LabVIEW system is adopted to recognize the character of license plate. The experimental results are shown in Figure 7.

Based on the experiment, 156 license plates are adopted and there are 148 plates correct. The accuracy of recognition is about 95%. Moreover, in order to enhance the security of

FIGURE 7. Experimental results of license recognition

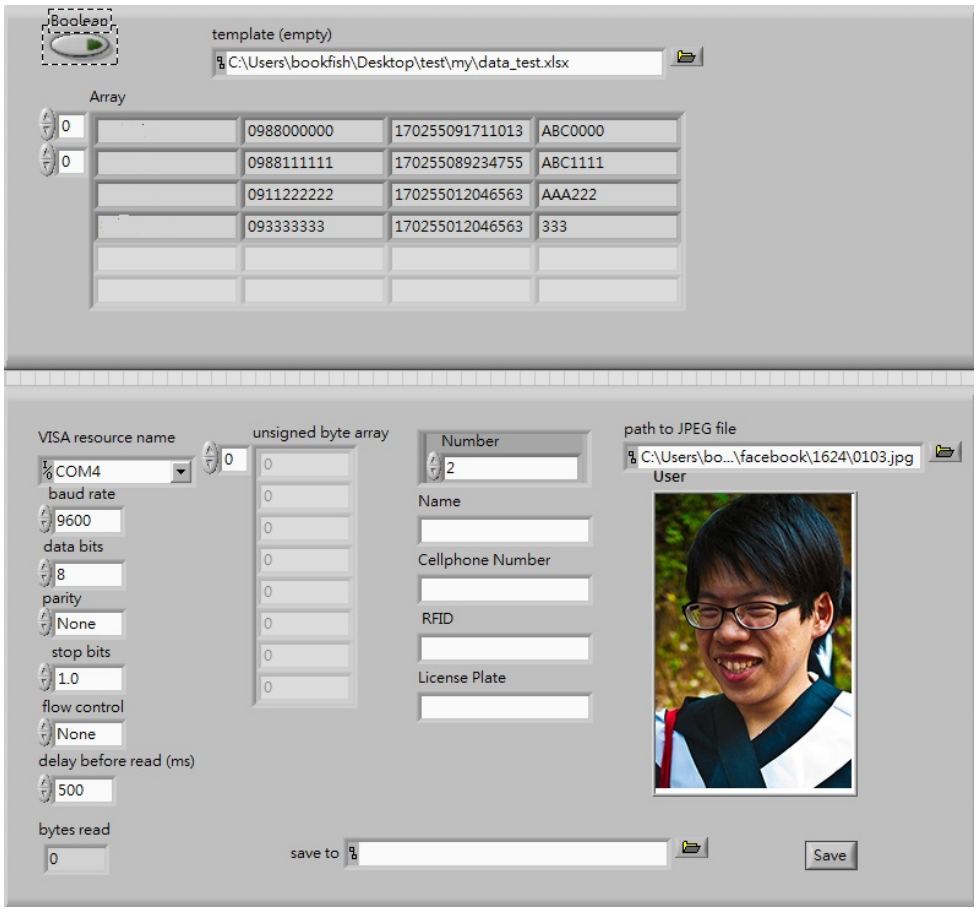


FIGURE 8. Integration interface of system

TABLE 1. Accuracy of face recognition

	5 persons	10 persons	15 persons	20 persons
3 samples	98%	90%	88%	87%
4 samples	100%	91%	90%	89%
5 samples	100%	95%	96%	92%

the management system, the face recognition algorithm is also applied. According to the experimental results, the face recognition rate is shown in Table 1.

The interface of integration system proposed in this paper is shown in Figure 8.

5. **Conclusion.** This study presents an intelligent security management system which integrates license plate recognition algorithm and face recognition algorithm to make the security monitor automatically. Moreover, the system will transmit identification results to the management interface using LabVIEW and display related information in monitor. Based on experimental results, the proposed system is convinced that it is an efficient and accurate security management system. Moreover, the system will combine the RFID and big data computation technology to enhance the capability of system in the future.

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