The Method of Recognizing Bank Card Number Based on MATLAB

Di Wang*

College of Information Engineering, Wuhan University of Technology, Wuhan, Hubei 430070, China

*Corresponding author: diwang@whut.edu.cn

Abstract. In this paper, a quick recognition method of bank card number based on MATLAB is designed, which can identify bank card number automatically. Through the gray processing, edge cutting processing, card number positioning processing, template matching card number recognition and other processing of the bank card image, an accurate and clear bank card number is obtained, which has a certain use value in e-commerce and the Internet. It also provides some reference for image processing and character recognition.

1. Background

With the continuous development of communications in the modern information society, Internet + continues to promote social innovation and development, e-commerce is also closely related to people's lives. In 2020, mobile transactions accounted for 69.31%, and "Singles Day" sales reached 372.3 billion. At the same time, online payment plays an irreplaceable role in people's daily life. In mobile payment and other payment business, it is often necessary to input bank card number. Due to the high complexity of bank card number, input forgetting and input errors often occur in the input process. Therefore, the design of bank card number recognition method based on MATLAB is beneficial to people's daily life.

2. Bank card number preprocessing

2.1. Image graying processing

Most of the bank cards obtained in daily shooting are color images. In image processing, the three colors of RGB need to be processed separately, which requires a lot of calculation and takes up a lot of space, so before using various ways to process images, we usually use grayscale processing to convert complex color images into gray images that are convenient for processing. There are four methods for image gray processing, they are component method, weighted average method, average method and maximum method. In the bank card recognition, the card number is usually white or black, and the color of the background is relatively simple. The grayscale image which is easy to identify and deal with can be obtained by setting the appropriate weight. After many experiments, it is found that the graying effect of the image processed by the weighted average method is the best.

The formula of weighted average method for gray treatment is as follows:
\[ f(x, y) = 0.299R(x, y) + 0.587G(x, y) + 0.114B(x, y) \]

Fig. 1 before graying  
Fig. 2 after graying treatment

2.2. **Image binarization processing**

The image obtained from the gray processing of the color image still needs the next binarization processing, and the binarization processing only contains two kinds of pixel values, so the specific threshold should be required before segmentation, because after the graying processing, there is an obvious gray difference between the character number of the card number and the background of the bank card, so we choose the maximum inter-class variance method, referred to as the Otsu method. This method has the remarkable advantage of simple calculation, at the same time, the influence of image brightness on processing is less, and the background and foreground can be separated according to the gray characteristics of the image. At the same time, this method adopts the segmentation with the largest variance between classes, so the correct success rate of segmentation is higher.

After many experiments, the selection of this method can be applied to the segmentation of most bank cards, and the effect is very good.

2.3. **Image denoising processing**

Unnecessary and excessive interference information in image data is called image noise. Generally speaking, there are mainly Gaussian noise and salt and pepper noise in the photos, so the median filtering method is used to reduce the noise. At the same time, after many experiments, this method can remove the noise effectively.

Fig. 3 before noise processing  
Fig. 4 after noise processing

3. **Bank card character processing**

3.1. **Image Edge Detection and Segmentation**

In the processing of image edge detection, the pixel between the foreground and the background is used to jump, the improved Canny operator in MATLAB is used for edge detection, and the multi-stage Canny operator is used, which has the functions of high frequency filtering, noise resistance,
enhanced detection and so on. The Gaussian filter is used to smooth the image so that the pixel value is equal to the center value of the original pixel and the weighted sum of its adjacent pixels, and then the amplitude and direction of the gradient are calculated to suppress the pixels whose gradient is not large enough, leaving only the maximum gradient. Finally, the edge is connected by the double threshold algorithm. Canny operator has a good effect of edge detection. Through many experiments, it is proved that the image can be well processed by using Canny operator, and the complete edge contour can be obtained.

Figure 5 before edge extraction

Figure 6 after edge extraction

3.2. Image character location processing

Choose to use the vertical projection method based on coordinates, through the vertical projection of the bank card image, use the perimeter to check the vertical projection value of each character on the coordinate axis from right to left in turn in the horizontal direction. When the first local minimum point is found, it is considered that this point is the boundary of the rightmost character, so the boundary of each character can be obtained in turn.

Figure 7 character location of bank card number

3.3. Character recognition

The general methods of character recognition are: neural network recognition method, feature statistical matching recognition method, template matching recognition method. The principle of template matching method is to match the extracted single characters waiting for recognition with the template matching library one by one to get the template with the highest degree of matching with this character and get the recognized characters. This method is easily affected by external light, and because it is matched one by one, the matching time will be increased.

The card number of the bank card is only composed of 0-9 Arabic digits, and its font template only needs 10 templates to meet the conditional numbers of 0-9, and its font is neat and standardized, so it does not need to take up a lot of memory computing space, so the template matching recognition method is chosen.

The matching similarity between the template and the subgraph can be expressed by the following formula:

\[ D(i, j) = \sum_{m=1}^{M} \sum_{n=1}^{N} [S_g(m, n) - T(m, n)]^2 \]
By normalizing the above formula, the correlation coefficient of template matching can be obtained:

\[
R(i, j) = \frac{\sum_{m=1}^{M} \sum_{n=1}^{N} S_y(m, n) \times T(m, n)}{\sqrt{\sum_{m=1}^{M} \sum_{n=1}^{N} [S_y(m, n)]^2} \sqrt{\sum_{m=1}^{M} \sum_{n=1}^{N} [T(m, n)]^2}}
\]

When the correlation coefficient \( R(I, j) = 1 \), the template matches the subgraph successfully and matches in turn until the matching target is reached.

Fig. 8 recognition result of template matching

4. Conclusions and prospects
The bank card number recognition method based on MATLAB can effectively and accurately identify the bank card number, which is convenient for people's daily biochemistry. At the same time, this method still has a great research prospect, and the optimization of segmentation recognition can be used as a study of in-depth research.

Optimize the algorithm to improve the recognition speed to achieve good experimental results.

References
[1] Dong Yanhua, Chen Zhonghua, Cai Xixin, et al. Research on bank card number recognition algorithm based on OpenCV [J]. Journal of Jilin Normal University (Natural Science Edition), 2017(3).
[2] Zhang Haining, Li Bin, Chen Chaobo, et al. Research on License Plate Recognition System Based on OpenCV [J]. Industrial Instrumentation and Automation, 2012(06):78-80.
[3] Hu Xiaofeng, Zhao Hui. Visual C++/MATLAB image processing and recognition practical case selection [M]. People's Posts and Telecommunications Press, 2004.
[4] Zhang Lizeng, Cao Xing, Zhao Yaoyao. License plate recognition based on MATLAB [J]. Wireless Internet Technology, 2016(4): 65-68.
[5] Liang Guangming, Sun Jixiang, Ma Qi, etc. Application of Otsu Algorithm in Canny Operator [J]. Journal of National University of Defense Technology, 2003, 25(5): 36-39.
[6] Wang Min, Huang Xinhan, Wei Wu, et al. A license plate character recognition method based on template matching and neural network [J]. Journal of Huazhong University of Science and Technology: Natural Science Edition, 2001(03): 48-50.
[7] Hu Xiaohan, Yang Li. Design and implementation of bank card number recognition system based on deep learning [J]. Information Technology and Informatization, 2020, 000(001):76-78.
[8] Li Le, Deng Shanxi, Ding Xinghao. Image block binarization algorithm based on Otsu method [J]. Microcomputer Information, 2005.