Barcode Localization in Image

Pavel Šimurda*
Faculty of Information Technology
Brno University of Technology
Božetěchova 1/2, 612 66 Brno, Czech Republic
xsimur01@stud.fit.vutbr.cz

Abstract
This paper deals with localization of linear barcodes in an image. A new algorithm for detecting and locating barcodes is introduced here. It is based on the usage of the profile of light intensity. Due to this it is possible to work only with certain image information, therefore localization is fast and accurate. The Proposed method can work in real time. In order to test the rate of success of the algorithm, a set of five hundred pictures has been taken. The result of this work is an implementation suitable for barcode readers in digital cameras or cellphones.

Categories and Subject Descriptors
I.4 [**Image Processing and Computer Vision**]: Segmentation; I.5 [**Pattern Recognition**]: Applications

Keywords
Barcode, EAN, detection, localization

1. Introduction
Barcodes are notably widespread in the field of automatic identification in shops, warehouses and package delivery systems etc. Nowadays manual laser scanners are the most commonly used application of a barcode processing. The key problem for human or machine is to search a barcode on the item and, provide a barcode area for a barcode reading system. Which is the most time consuming part of the barcode processing. With an increasing number and quality of digital cameras, image analysis can also be used for decoding a barcode. The entire process of barcode localization, detection and decoding could be automatized. In this case, it is very important to detect and locate areas with the barcode pattern and make these patterns available for barcode reader. The barcode in the image could be rotated in different angles. Also it could be enlightened by a flash or covered by a shadow. Barcodes are often printed on products with marks or texts. Therefore, barcode localization is a very difficult problem. That is the reason why the user must point aimer to the barcode area in most of existing applications in order to read it.

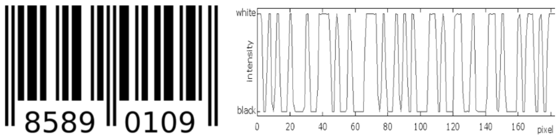

Figure 1: Barcode pattern with intensity profile.

The new method of barcode detection and localization, presented in this paper, is based on the observation of changes in the intensity profile. This approach is suitable for real-time localization because it operates with a small amount of data. In spite of this fact, the method is precise and can handle barcode images of poor quality. A previous version of this algorithm has appeared in [2].

2. Proposed algorithm
There are several techniques to locate the barcode in the image, such as Robust hierarchical feature analysis method [4], which is robust and precise. However it requires high performance. There are also other methods using texture segmentation [3] or texture analysis [1].

The Main goal of the proposed localization method is to find the barcode in real-time, hence only a portion of rows within image are processed. In this approach, changes in the light intensity profile are used to determine where the barcode areas are located. The barcode is a pattern with high density of changes in intensity values as seen in figure 1. There are strong changes of intensity level in three directions and nearly no change in the fourth shown in figure 2.

The Algorithm processes the image by square blocks. In the each block there are four scan lines, between each scan line there is an angle of 45°. These four main orientations are enough to cover all the possible barcode rotations. The values of intensity within these scan lines in the block are extracted. After that, the changes of monotonicity in the intensity signal of extracted values are counted. According to changes in the intensity profile in certain directions it is also possible to specify rotation of the barcode. Evaluation of block told us if this part of image is situated in the barcode area or not.

*Bachelor degree study programme in field Information technology. Supervisor: Assoc. Prof. Adam Herout, Faculty of Information Technology, Brno University of Technology.

Šimurda, P. Barcode localization in image. Information Sciences and Technologies Bulletin of the ACM Slovakia, Special Section on the ACM Student Project of the Year 2011 Competition, Vol. 3, No. 4 (2011) 55-56

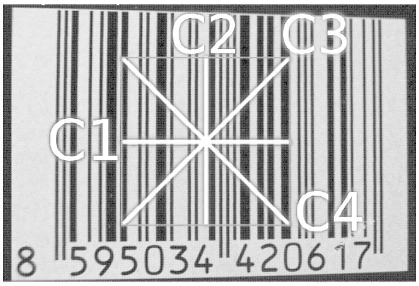

Figure 2: Scanblock containing scan lines

A block can be evaluated as a part of the barcode area, when the count of changes in the given direction meets the conditions from equation 1.

$$C_1 > K_1 \quad \wedge \quad C_3 \leq K_{min} \quad \wedge \quad (C_2 \approx C_4) > K_2 \quad (1)$$

Suppose that C_j, where $j \in \langle 1, 4 \rangle$, is the number of changes in a certain direction. K_1 and K_2 are acceptable thresholds for the certain direction; these depend on the size of the scan-block, because barcodes could vary in size and the scan-block does not have to cover the entire barcode. K_{min} is a minimal threshold, this value has to be close to zero. C_1 is perpendicular direction to C_3 and C_2 is perpendicular to C_4 as shown in figure 2. The rotation of the barcode is determined from the minimal value of C_j.

Evaluation of the image block is very fast, as it is not necessary to operate with all image pixels. The algorithm starts processing with the block of the largest size. Then block size is decreasing, therefore smaller barcode parts are detected. With this approach detection of barcode pattern is the most precise and it covers all possible barcode sizes.

The Last part of the localization algorithm starts when all blocks are evaluated. The Purpose of the localization part is to connect founded blocks and determine all barcode areas in the image. After that on basis of detected barcode rotation the reading line is computed. As a result the algorithm provides coordinates of the barcode area border points and the Read-line where barcode is readable.

Unlike other methods, it is not necessary to process the image more times. To gain an optimal speed of detection the proposed algorithm works with a "mask" to keep information about blocks which have already been detected. The Main benefit of this algorithm is, that it works on simple intensity value extraction. This approach is very fast and it also has correct results.

The algorithm also performs inspection of the located area. This is kind of post-processing eliminates detection errors. The errors are mainly caused because of blurred, enlightened images and very small or unreadable barcodes in the image. Also if there is a text which is situated very close to the barcode area could cause an detection error.

3. Results and testing

The algorithm was tested on set of 545 images of various quality and resolution, to make the tests reliable. The tests were separated into two parts. The first part of the test verifies quality and accuracy of detection by blocks. This was done by the "hit-or-miss" approach. The ratio of correct detected barcode areas to missed areas is 88%. The other testing part checks correctness of the Read-line after the barcode is detected and its rotation is found. In 73% from all images algorithm located barcode area correctly.

Table 1: Results of localization algorithm

Image resolution [px]	speed [ms]	success rate[%]
640x480	8	76
800x600	11	85
1024x768	19	82
1280x1024	32	90
1600x1200	68	85

This result is not very different in efficiency compared to other existing method [4, 5]. The processing speed[1] of this algorithm in 640x480 pixel image is average 8ms. In comparison with other existing methods and applications this speed is almost eight times faster. Tests were successfully made on video input taken from webcam. Therefore this algorithm is suitable for real-time processing. The results of localization algorithm and processing speed is shown in table 1.

4. Conclusion

A new method of detection and localization barcode was described in this article. The algorithm uses intensity profile of scan-lines within image blocks and it can localize several kinds of linear barcodes. The results of all tests shows that the success rate is similar and speed of processing is even better than other conventional methods. Image with resolution lesser than 1280x960 pixels is processed in worst case in 32ms, consequently it can be used in real-time. This algorithm is aimed to increase the speed of processing, therefore it has some problems with blurred images or barcodes overlapped by pattern similar to a barcode. However in final implementation of this algorithm, it suggest it is precise enough to be used as a part of barcode detection and reader application in shops or warehouses.

References

[1] A. K. Jain and Y. Chen. Bar code localization using texture analysis. In *Proceedings of the Second International Conference on Document Analysis and Recognition*, pages 41–44, Japan, 1993.

[2] P. Šimurda. Barcode localization in image. In *Proceedings of the 17th Conference STUDENT EEICT 2011 Volume 1*, pages 169–171, Brno, 2011. FIT VUT.

[3] T. R. Tunistra. Reading barcodes from digital imagery. page 18.

[4] L. Xiangju, F. Guoliang, and W. Yunkuan. A robust barcode reading method based on image analysis of a hierarchical feature classification. In *IEEE/RSJ International Conference on Intelligent Robots and Systems 2006*, pages 3358–3362, Bejing, 2006.

[5] Z. Zhang, J. Wang, S. Han, and M. Yi. Automatic real-time barcode localization in complex scenes. In *Image Processing, 2006 IEEE International Conference*, pages 497–500, Atlanta, 2006.

[1]Tests were made on computer with Intel Core 2 Duo T6600 2.2GHz CPU