# BARCODE LOCALIZATION IN IMAGE

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**Abstract**: The main purpose of this work is to find and implement the most suitable algorithm for locating barcodes in an image. This paper describes an approach 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 result of this work is the implementation suitable for barcode readers in digital cameras or cellphones.

**Keywords**: barcode, localization

## 1 INTRODUCTION

The barcode localization is a difficult problem. The barcode in the image could be rotated in different angles. It could also be enlightened by a flash or covered by a shadow. Barcodes are often printed on products with marks or texts, which increases the difficulty of barcode localization. On the other hand, barcode is a pattern of parallel lines that looks easily recognisable. In general, the image processing and pattern recognition is complex because a huge amount of data is processed. To gain an optimal speed of localization it is important to operate with as small amount of data as possible.

There are two most used methods of barcode localization, which are based on texture segmentation [4] or partial line scanning [1]. The former method is robust and precise but it requires high performance. The latter method scans only certain lines in the image; it seems to be faster and more practical. In both approaches, the image is often preprocessed in order to eliminate shadows and excessive light.

There are other algorithms that use morphological operations [2] or using frequency domains (Fourier, Discrete Cosine Transforms) [3]. But they have one serious disadvantage: the whole image has to be processed more than once. That is the reason why they are not suitable for real-time localization.

## 2 PROPOSED ALGORITHM

I have focused on methods based on line scanning instead of texture segmentation methods. This approach does not process the entire image but only its parts shown in Fig. 1(a). The proposed algo-

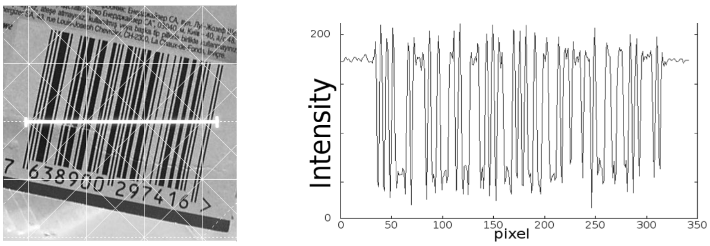



**Figure 1:** (a) Grid of scan lines (b) Intensity profile of the scan line

rithm uses the profile of light intensity (Fig. 1(b)), because the barcode is a pattern with high density of changes in intensity values.

At the beginning, the image is divided into scan-blocks with four scanning directions, which match scan-lines. Scan-lines include an angle 45°, that is because we have to cover all the possible barcode rotations. Values of intensity within these lines in the image are extracted. After that, the changes of monotonicity in the intensity signal are counted.

Suppose that $C$ is the number of changes in $j$ direction (Fig. 2b). $M_i$ represents the $ith$ local extremum from the signal of the intensity profile. The difference between two neighboring local extrema has to be greater than threshold $T$.

$$C_j = \sum_{i=0}^{n-1} \begin{cases} 1 & (M_i - M_{i+1}) > T \\ 0 & otherwise \end{cases} \tag{1}$$

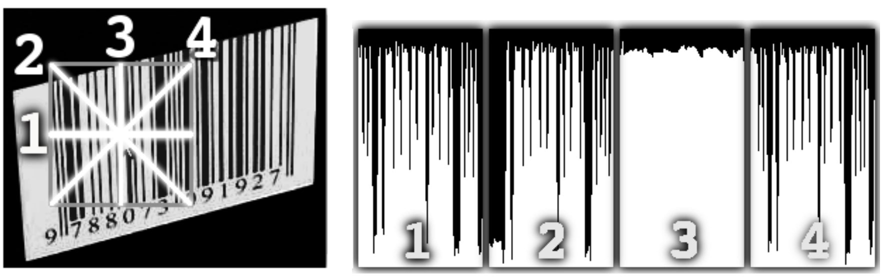
$$C_1 > K_1 \quad \wedge \quad C_3 <= K_{min} \quad \wedge \quad (C_2 = C_4) > K_2 \tag{2}$$

The barcode area must meet conditions from eq. 2, where $K_1$ and $K_2$ are acceptable thresholds for certain direction; these depend on the size of the scan-block, because barcodes could vary in size and the scan-block do not have to cover entire barcode. $K_{min}$ is a minimal treshold, 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 $C_j$.

A very difficult problem is to represent the located area of the barcode. It is easy to mark parts of lines in the image that match the barcode. But it is more complicated to determine a continuous area, where the barcode is situated. The problem was solved by several modifications of the proposed algorithm. The biggest change consists of replacing scan-lines with scan-blocks as is shown in Figure 2a. The scan-block is a composition of four scan-lines at angle 45°, the whole image is devided into these blocks. After evaluation of lines within a scan-block it could be marked as containing the barcode. From related scan-blocks it is possible to determine coordinates of the barcode area. For better barcode recognition, other criteria such as color balance and dispersion of intensity were added. The Last step of the process is to connect blocks containing the same directions into barcode areas.

## 3 RESULTS AND TESTING

I have made an interactive application to watch the signal of light intensity. That helped me determine where the barcode could be. Also it is very useful for understanding the data content. With this application, I have found that there are strong changes of intensity level in three directions and nearly no change in the fourth as is shown in Figure 2b. This pattern matches a barcode in a certain direction.




**(a)** scan-block area **(b)** appropriate intensity profiles

**Figure 2:** Visual output from interactive scanner application

Figure 3 shows the recognised barcodes, the resolution of the image and time how long the localization took. Tests were made on a desktop computer with 1.2GHz CPU. Photos and barcodes in them had to vary in quality to make the tests representative.


**Figure 3:** Results of localization

This method has problems with text that is similar to barcode intensity profile. This could be solved by omitting areas which are very small because it would not be a readable barcode but in the worst case only its part. Other possible method is comparing two neighbouring blocks, if these blocks have similar intensities in the same direction, but this is very time-consuming. Or the “Hit-or-miss” approach could be applied. This means the located area is passed to the barcode reader application, if barcode reader could not read a barcode the localization was incorrect.

## 4 CONCLUSION

To achieve considerable speed of localization, working with the profile of intensity level is effective. Unlike other methods, it is not necessary to scan the image more times. Therefore it has less performance requirements, so the image can be processed in real-time. The proposed method performs an image segmentation for the partial line-scanning. For each block, appropriate scan-lines are selected and then the algorithm for barcode recognition is performed. The result of this work is an algorithm, that could be a part of a barcode detection and reader application.

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