Barcode Image Denoise - RL Approach

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1 Overview

Barcodes are digital signs made of adjacent and alternating black and white smaller rectangles. Despite the great progress made in deep learning, decoding them in high-resolution images has proven to be a difficult task. Over the years, barcodes have increasingly become part of human interaction in many fields. In administration, they are used to encode, save, and retrieve various users' information; in businesses such as grocery stores, they are used to track sales and inventories and in hospitals, they are used to track and retrieve patients' data. More interestingly, in warehouses, their detection will facilitate the automation process involved in manipulating different packages. In this project, we will deal with denoising, rectifying and decoding of barcodes that have already been segmented from an image. By rectifying we mean detecting the angle associated with rotated barcodes. We are investigating denoising deep neural networks for noise removal, and Hough transform for determining the rotation angle of the barcode images. We plan to test our approach on a database of synthetically generated images.

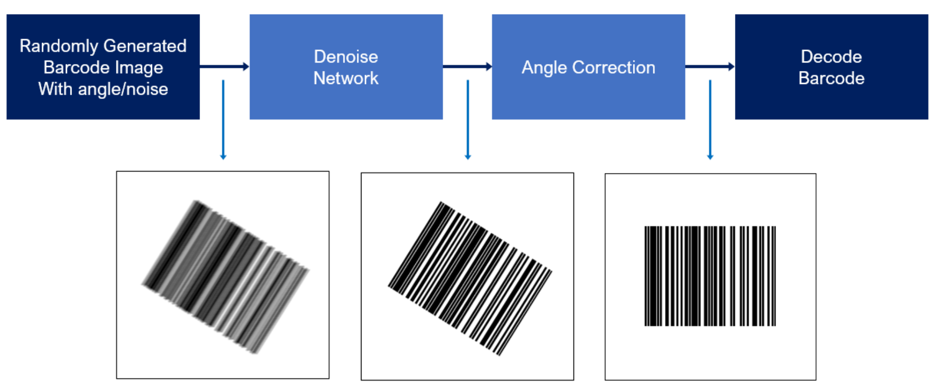


Figure 1: Project pipeline.

2 Approach

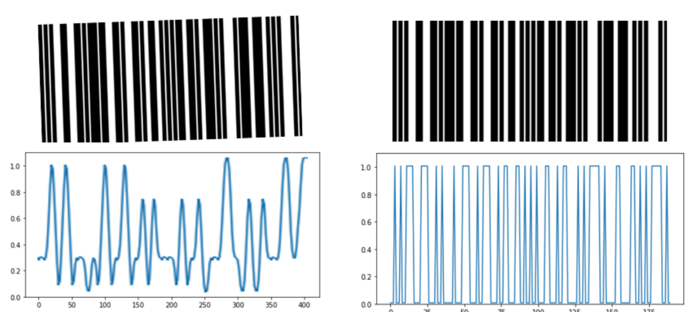
Our proposed method consists of three stages: barcode denoising stage, angle correction stage, and the barcode decoding stage.

2.1 Denoise Network

Most of the conventional denoising approaches focus on assuming the corrupted noise to be additive white Gaussian noise(AWGN). However, the realistic noise in real-world noisy images is much more complex than AWGN. As a result, many state-of-the-art denoising methods in the literature [1], [2] [3] [4] [5] which have shown significant performance at the nonrealistic images become much less effective when applied to real-world noisy images. Over the past few years, the deep learning-based method has become one of the main avenues when it comes to denoising techniques. In that sense, we will be exploring image enhancement techniques with the deep neural network-based high-dimensional filtering with a deep neural network.

2.2 Angle Correction

First, we proposed a method to detect the angle of a given barcode, according to the Hough transform [6]. Based on the Hough transform, we are able to detect a set of line segments or collinear points on the barcode to determine the main angle of the barcode. This main angle represents the principal direction of line segments in image, which also is the rotation angle of the barcode. After rotating the barcode with the main angle, we need to check the flatness of the rotated barcodes whether the rotated barcode still has a small error or not. So, we proposed a method to correct the main angle by projecting the barcode horizontally. If the rotated barcode is flat, the projected data are clear with 0s and 1s shown in Fig 2 (b). By correcting the horizontal projection of the barcode, we can correct the main angle detected on the Hough transform.



(a) Rotated Barcode with Error (b) Corrected Barcode

Figure 2: Projection of the 1D barcode

2.3 Decode Barcode

For this stage, due to minimizing the whole processing speed, we use a conventional barcode decoding application. Zebra crossing is also known as ZXing [7] and ZBar [8] are both open-source, multi-format 1D/2D barcode image processing library.

3 Results

We generated images containing barcodes so that the barcodes have randomly generated angles based on the 1-D barcode, Code 39, Code 93, Code 128, UPC, EAN among others. We detect the angle of the barcode to rotate it back to have a flat shape similar to the original. For angle correction, by checking the flatness of the result, we corrected lines of the barcode to make them orthogonal to the horizontal lines. Then we decode the barcode using a conventional decoding library. For the final result, we compare the detection rate between the final outputs and the intermediate outputs which is obtained using angle detection only. Table 1 shows the average error rate of the detected barcodes based on intermediate outputs and final outputs. Test #1, #2, and #3 differs in the fact that we are using in each of them, random samples of barcode images at different angles. The fact that the final percentages of test #1 and test #2 are zeros suggests that our approach is working well on angle correction. But we observe that test #3 gives the highest final output which means there still needs some more improvement for our approach. Overall the average row in table 1 reveals that output using angle correction is better as expected which means that our approach is working.

Error Rate	Intermediate	Final
Test # 1	8.50 %	0.00 %
Test # 2	9.67 %	0.00 %
Test # 3	11.08 %	0.20 %
Average	9.75 %	0.07 %

Table 1: Detection Error Rate of proposed method.

References

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