# Detecting and Decoding Barcodes in Images

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## Introduction

o For the past several decades, handheld laser scanners allow workers in stores to read barcodes

o It would be desirable to allow consumers to read barcodes via camera phone to quickly find product descriptions, reviews, and pricing information

Fig 1. A cell phone is used to scan a barcode. This technology may become ubiquitous if algorithms to localize and decode barcodes can be made more robust.

o Current methods are not robust due to dim, unfocused, noisy, or low-resolution image data.

oThis research focuses on making more efficient and robust algorithms to localize and then decode barcodes within images.

Fig 2. Although the barcode in the image above is blurry and the scene is cluttered, the barcode can be successfully localized and decoded using methods developed at UC Santa Cruz.

## Barcode Localization

o Once an image is obtained, the first step is to localize the barcode, or to find its location within the image. Many methods to do this have been developed. This section summarizes one such method.

oSince a typical barcode consists of vertical bars, we may locate the barcode by looking for an extended region with high horizontal gradients and low vertical gradients. Thus, for an image $I(x, y)$, applying the operation

$$\left|\frac{\partial}{\partial x} I(x,y)\right| - \left|\frac{\partial}{\partial y} I(x,y)\right| \qquad (1)$$

and then low-pass filtering the result leads us to the bar code. This is shown pictorially below

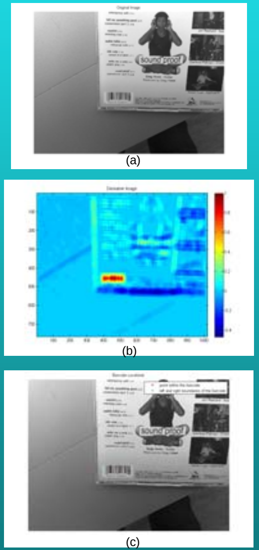

Fig 3. (a) The original image (b) Equation 1 is applied to the image, and the result is low-pass filtered . The red region, which is of the highest intensity, corresponds to the barcode. (c) The barcode is localized using image b). Left and right barcode boundaries are determined.

## Barcode Decoding

o After the barcode is localized using one of the methods in the previous section, it must be decoded in order to obtain the product's information. This section discusses one method I implemented to accomplish this.

o Using the left and right bounds of the barcode found during localization, a "scan line", *s(t)*, and smoothed derivative, *f(t)*, are obtained. This is shown below:

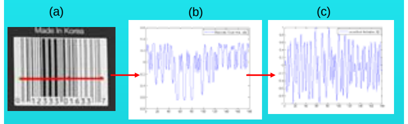

Fig 4. (a) The barcode (b) A scan-line from the barcode, *s(t)* (c) The smoothed derivative of *s(t)*, called *f(t)*

o Next, peaks in *f(t)* are found. The peaks in *f(t)* correspond to inflection points in *s(t)*:

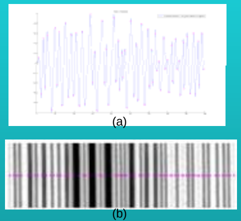

Fig 5. (a) The derivative of the scan-line, *f(t)*, with peaks identified (b) The edges of the bars, which correspond to the peaks of (a)

o Some peaks in the signal correspond to noise, while others represent the bars we are looking for. To identify the true bars, a statistical model called an HMM is used. The results are shown below:

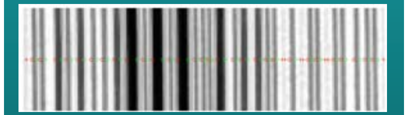

Fig 5. Final Result. The left side of each bar is marked with a red circle, the right side with a red circle, and noise is marked with red crosses

## Conclusions

o By applying the localization methods and then the decoding methods, blurry and unclear barcodes may be properly interpreted.

o Future work may involve developing additional localization and decoding methods, and improving upon methods which already exist.

## Sources

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Kresic-Juric, S. "Applications of hidden Markov models in bar code decoding." Pattern Recognition Letters 27(2006): 1665-1672. Print.