Decoding 1-D Barcode from Degraded Images Using a Neural Network

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Abstract. Today we know that billions of products carry the 1-D bar codes, and with the increasing availability of camera phones, many applications that take advantage of immediate identification of the barcode are possible. The existing open-source libraries for 1-D barcodes recognition are not able to recognize the codes from images acquired using simple devices without autofocus or macro function. In this article we present an improvement of an existing algorithm for recognizing 1-D barcodes using camera phones with and without autofocus. The multilayer feedforward neural network based on backpropagation algorithm is used for image restoration in order to improve the selected algorithm. Performances of the proposed algorithm were compared with those obtained from available open-source libraries. The results show that our method makes possible the decoding of barcodes from images captured by mobile phones without autofocus.

Keywords: Barcode recognition, Image restoration, Neural networks.

1 Introduction

In recent years the growth of the mobile devices market has forced manufacturers to create ever more sophisticated devices. The increasing availability of camera phones, i.e. mobile phones with an integrated digital camera, has paved the way for a new generation of applications, offering to the end users an enhanced level of interactivity unthinkable a few years ago. Many applications become possible, e.g. an instant barcode-based identification of products for the online retrieval of product information. Such applications allow for example, the display of warnings for people with allergies, results of product tests or price comparisons in shopping situations [1]. In Figure 1 an illustration of a typical application that make use of a barcode identification.

There are many different barcode types that exist for many different purposes. We can split these into 1D and 2D barcodes. 1D barcodes are what most people think barcodes are: columns of varying width lines that are imprinted on the back of products. Within the 1D barcode we have EAN-13/UPC-A, Code 128, Code 39, EAN-8 etc. and today we know that billions of products carry EAN-13 bar codes. The two most important parameters influencing recognition accuracy on a mobile camera phone are focus and image resolution, with the former remaining the principal problem; instead low camera resolutions such as 640x480 pixels are not critical [2]. Figure 2 shows an example that highlights the difference between a barcode acquired with a device having autofocus (AF) and without AF. It is evident that images like that in Figure 2(b) present
Fig. 1. Graphical illustration of the process of a typical application that make use of a barcode identification

a high level of degradation that makes the decoding process very difficult or even worst, impossible.

Searching the Internet for camera phones with/without AF, we can estimate that about 90% of camera phones is without autofocus. There are several libraries to decode 1-D barcode but if we analyze the most widespread of these available with an open-source license, all of them show serious difficulties in recognizing barcodes from images captured by devices without autofocus (see some results in Table 1).

Many studies have been made to develop applications for mobile devices capable to decode 1-D barcodes [1, 3]. Many studies have aimed to look for efficient and operative algorithms able to recognize a high percentage of codes in a limited time. Others have studied restoration techniques to improve the quality of codes acquired with sensors without autofocus or macro function, and the accuracy of the subsequent decoding [4].

There are several libraries available to decode the multitude of barcode standards. Only a few of these libraries are open-source. One prominent open-source library is the ZXing project. It has the capability to read not just 1D barcodes but also 2D barcodes. Although this library is widely used and has a great support by the community, it has the common weakness to expect a camera with autofocus and a relatively high resolution in order to work properly. For this reason we decided to work on ZXing library to make it a viable solution when working with devices without autofocus.

In particular, in this work we experiment with a novel restoration technique based on neural networks, in order to improve the quality of the images and therefore the recognition accuracy of 1D barcodes. Image restoration is a process that attempts to reconstruct an image that has been degraded by blur and additive noise [5, 6]. The image restoration is called blind image restoration when the degradation function is unknown. In the present work we perform blind image restoration using a back-propagation neural network and we show how the proposed restoration technique can increase the performance of the selected open-source tool in order to use it with all types of camera phones.

1 Based on data from http://www.shoppydoo.com
2 http://code.google.com/p/zxing/ a Java multi-format 1D/2D barcode image processing library.