Barcode Scanner for Visually Impaired: A Review

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Abstract

This paper has the goal of creating an application that will improve the daily life of visually impaired shoppers or users in general by assisting them with text-to-speech and audio cues. For a visually impaired (VI) person, shopping itself is a monumental task. They also face social scrutiny from the masses that may not understand their plights and consider them an inconvenience. This may lead to a negative impact on a visually impaired person. This application can also be used by shops/companies for assisting a visually impaired employee working at the transaction counter doing check-out of products. So, this application is beneficial for the visually impaired person on both sides of the transaction, as a shopper or as an employee who processes the transaction. This application has a framework for barcode detection and extraction of information related to the product.

1. INTRODUCTION

Bar-coding is used in labeled and packaged goods for unique identification of the product and their information. Barcodes have no central database. Different organizations may have the same barcode for internal use within the organization. It is One Dimensional (1D) in nature, and generally read by a "red laser scanner" in shops and supermarkets. Carrying a red laser scanner is not feasible for everyone as they are expensive, big, and heavy and not being used frequently. Apart from this, there is always an increasing interest in having a portable scanner/reader, because of progressing technology.

There exist over 285 million visually impaired (VI) people worldwide, of which 39 million are completely blind, and around 246 million have low vision, according to the WHO.[1] For them, a major part of daily responsibilities is a challenge, including independent grocery shopping. Service delays because of rush hour or other myriads of reasons (be human inefficiency or technological inefficiencies) and makes their shopping experience uneasy.

1.1. Need and Motivation

Visually Impaired (VI) who lives alone faces problems in knowing the contents of packaged products, at home and also at stores. This project aims at assisting them, helping them identify packaged products and related information by scanning only barcodes.

This application will save a great amount of work, time and stress of VI that exists because of their disability and make their lives easier.

1.2. Basic Concept

Our project will focus on the scanning, & decoding of barcode signals, just like a red laser scanner. Barcodes are One Dimensional (1D) waveforms (time series) representing line symbols. There are various separate algorithms for reading 1D barcodes from images and automatically detecting barcode patterns from images, but there are no algorithms explicitly designed for remote detection of 1D barcodes from some distance.

This aspect is required to speed up the search process otherwise a visually impaired person (VI) would be forced to hold the camera close to the package and scan every square inch of its surface painstakingly, keeping it steady for every few seconds.

2. REVIEW OF LITERATURE

Our proposed system will develop an application that will record and analyze frames of camera roll captured by it. Then these frames will be fed to the database for comparison. If the product's barcode exists in the system, the user will be notified otherwise an 'error-report' response will be generated

Barcodes themselves were developed as early as in the 1970s, spearheaded by IBM [2]. But its underlying inspiration cropped up in the late 1940s [3]. IBM and Computer Identics Corporation were some of the proponents of this revolution [2][4]. "UPC" and "Code 39" are some of the oldest barcodes made available. UPC was used for public use while Code 39 was used by the US Army.[5][6] Many researchers have worked in this direction.

Wachenfeld et. Al. have suggested an algorithm that reads the barcode in the center of the image using a horizontal scan line by covering the barcode and capturing the frames until the constraints are met. They also developed a barcode image database, covering common irregularities such as inhomogeneous lighting, reflections, or blurriness induced by camera motion results from experiments with more than 1,000 images from this database are presented using their own algorithm put in place by MATLAB, as well as experiments on the go. The proposed algorithm claims to display essentially 100% accuracy in real-life circumstances and yields very good resolution output reliant on their database, ranging from 90.5% (640 to 480) to 99.2% (2592 to 1944). This algorithm has formed the basis for the barcode segment line scanning method on mobile phone cameras.[7] This algorithm is based on Symbian C++ and outdated by 12 years meaning it cannot use the improved and newly developed technologies of the past decade.

Ender Tekin and James M. Coughlan have formulated an algorithm that processes multiple frames of video per second to detect barcodes from a range. It offers a 'Bayesian' solution to the Visually Impaired's dilemma of real-time guidance.[8]

Kulyukin, Vladimir et. al. have proposed an algorithm that uses the binarization filter of Niblack and SVMs to indicate the presence of barcode in regions of an image. Their proposed algorithm has been implemented with Android 2.3.3 on the Google Nexus One smartphone.[9] The algorithm uses SVMs for detection which is incompatible with the implementation methods of our project, since SVMs seem to incline to ML.

Sampada S. Upasani et. al. have presented an algorithm that detects the barcode using MATLAB to test the algorithm. It works on a similar premise of edge detection and removal of the rest of the image except the boundary of the barcode itself. They had used a webcam camera for barcode detection and have developed their own simple database for the same.[10] It can be considered to be a sort of a practical solution to the algorithm developed by Tekin et. al. even though there is a difference in their fields of usage and intent.[8][10] The methodology of our project is similar to this project, with the exceptions being the end product & hence the diverging approaches. Their end product creates an Excel sheet of the final bill based on the calculation of multiple barcodes thus eliminating the chances of human error, which is hence, completely different than our aim. They also execute their algorithm in MATLAB, thus diverging more.

Daniel Kold Hansen has presented a way to locate and decode barcodes in real-time with less effort from a user. Their work can be extended by applying modules of deep learning if needed [11]. Their approach of the YOLO (You Only Look Once) algorithm mainly focuses on the decoding, whereas our project implements different methodologies in addition to text-to-speech & so on, to help the visually impaired. The figure (1) given below explains how their YOLO algorithm works:

Input is taken, then fed into the algorithm, from which the detected area is cropped. After that, angle prediction is done if barcode strip is sloped/inclined, based on which rotation is done & finally the barcode is decoded. They used the Muenster Barode DB for testing purposes and their detector is effective with the test results on given DB. In addition, they have identified 1D and QR barcodes with the same network, and able to add additional types of barcodes easily. They have also developed a network that could predict the angle of barcode rotation. The angle prediction network is a regression network built on the architecture Darknet19, which has been taught and verified for both 1D and QR barcodes. The test of how the angle prediction would assist barcode decoding also showed that the predictions on all tests' saw an increase in the decoding success rate. They also used ZXing, the 1D barcode decoding from which helped speed up the process.

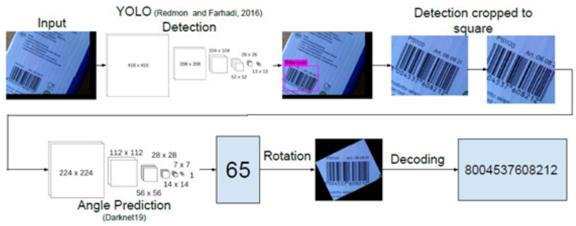

Figure (1): Overview of YOLO algorithm system [11]

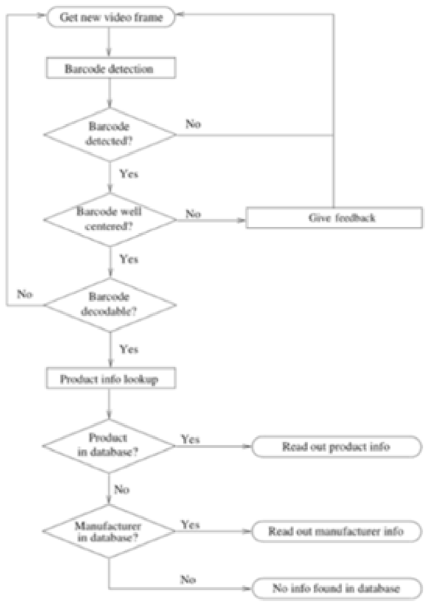

Figure 2: Block Diagram of the Proposed System

3. PROPOSED SYSTEM FOR PROJECT

The proposed system will work in phases:

In the first phase, we implement the algorithm and check to detect barcode from a distance that continually excludes more and more regions of the image via a working webcam; only regions of the image that resemble barcode are thoroughly processed.

In the second phase, we modify this working algorithm, adding functionalities that will aid the visually impaired.

The system will finally be ported to a smartphone and examined.

Block Diagram of Proposed System:

Figure (2) shows the block diagram of the proposed system where initially the application captures a frame by using a mobile phone camera. The captured frame is then scanned. If the barcode is detected and it is well centered then only the barcode is decoded otherwise the application discards the current frame and captures the next frame. The above-given process is repeated until a decodable barcode frame is scanned and accepted. Users will be notified if a barcode's edge is detected but not decodable yet.

Once the frame is decodable, the product information will be looked up to. If the product information is found in the database, it is announced by "text-to-speech" otherwise the user will be notified of the same.

4. CONCLUSION

The application proposed in this paper aims at scanning and reading barcodes, primarily intended for use by users who are visually impaired. A primary characteristic of the application would be the barcode detection capability, rapidly scan it, and audibly let users know, with help of text-to-speech aid, the details of the product thus making the process fluent for users. This application will be tested with a blindfolded subject, and will be verified for text-to-speech results i.e. accuracy based on a set of initial scans. Sincethe technology constantly changes,our system can be further extended byusing better hardware capable of capturing video frames of high quality. Furthermore, this system can be incorporated in a variety of professional environments for assisting visually impaired employees/ users; depending on the use, the implementation can be modified for the purpose of it.

5. APPENDIX

- WHO: World Health Organization.
- SVM: Support Vector Machine.

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