Barcode Scanner for Visually Impaired

Karan Patel[1*], Ashish Lad[2], Divya Kumawat[3]

[1,2] Student, Department of Computer Engineering, Atharva College of Engineering, Mumbai, Affiliated to University of Mumbai, India.
[3] Asst. Professor, Department of Computer Engineering, Atharva College of Engineering, Mumbai, Affiliated to University of Mumbai, India.

Publication Info

Article history:
Received : 12 February 2020
Accepted : 19 May 2020

Keywords:
Barcode Scanner, One Dimensional (1D), Visually Impaired (VI).

Corresponding author:
Karan Patel
e-mail: *karanpatel344@gmail.com*

Abstract

This paper aims to develop an application that will improve the daily life of a Visually Impaired (VI) shopper or user in general by assisting them with text-to-speech and audio cues. For a visually impaired 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 visually impaired people on both sides of the transaction, as a shopper or as an employee who processes transactions. This application performs barcode detection and for extraction of information related to product.

1. INTRODUCTION

There are 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 greater part of daily responsibilities is a challenge, including independent grocery shopping. Service delays because of rush hour or other myriad of reasons (be it human inefficiency or technological inefficiencies) doesn't make shopping easier.

Most shops and supermarkets use red laser scanners for reading barcodes of product for unique identification of the product and their information. These barcodes are one dimensional with no central database. Different organizations may have the same barcode for internal use within an organization. A VI person can carry a red laser scanner for identifying the product but they usually don't, because these scanners are expensive, big, heavy and not required on a frequent basis. Hence, it is not feasible for them to carry it everywhere. In this project, we aim to build an application which will save a great amount of work, time and stress for the VI person while shopping. This application identifies the packaged products and their information by scanning barcodes through a mobile camera. The mobile camera captures an image of a barcode from a continuous video stream and then the algorithm scans and decodes the barcode present in the image frame. We implement an existing algorithm designed to detect 1D barcodes at a distance, but with the added functionality of assisting the visually impaired, which is missing from the algorithm that we base the project on. In order to make the application beneficial for VI people, the application avoids the need of placing the camera position close to the package, scanning every square inch of the package and holding the package steady for a 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. This will then be fed to the database for comparison. If the product's barcode exists in the system, 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] Whereas their underlying inspiration cropped up in the late 1940s.[3] IBM, 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. Whilst UPC was used for public use, Code 39 was used by the US Army.[5][6]

Wachenfeld et. al. proposed an algorithm which read the barcode with a horizontal scan-line in the middle of the image by covering the barcode, and it captures the frames till the constraints are satisfied. 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 proposed an algorithm that processes several frames of video per second to detect barcodes from a distance of several inches. It presents a 'Bayesian' solution to the problem of real time guidance for the Visually Impaired [8]. Vladimir Kulyukin et. al. propose an algorithm which uses Niblack's binarization filter and support vector machines (SVMs) to detect barcode presence in image regions. The algorithm is implemented on the Google Nexus One smartphone with Android 2.3.3 [9]. The algorithm uses SVMs for detection which is incompatible with our project's implementation methods, as SVMs tend to incline towards ML. Sampada S. Upasani et. al. present an algorithm which 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 use 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. Daniel Kold Hansen has presented a way to locate and decode barcodes in real time with less efforts 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.

3. PROPOSED SYSTEM

The proposed system will work in phases:

In the first phase, we implement the algorithm and test to detect barcodes from a distance that continuously rules out more and more regions of the image using a working webcam; only regions of the image that resemble barcodes are processed intensively.

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

Ultimately the system will be ported to a camera phone and tested.

3.1. Block Diagram of Proposed System:

Figure 1 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. If product information is found in the database, it is announced by "text-to-speech" otherwise the user will be notified of the same.

3.2. Methodology

Methodology defines the sequence of activity followed for a particular work to get completed. Our project methodology is depicted in Figure 2. It includes preprocessing of the

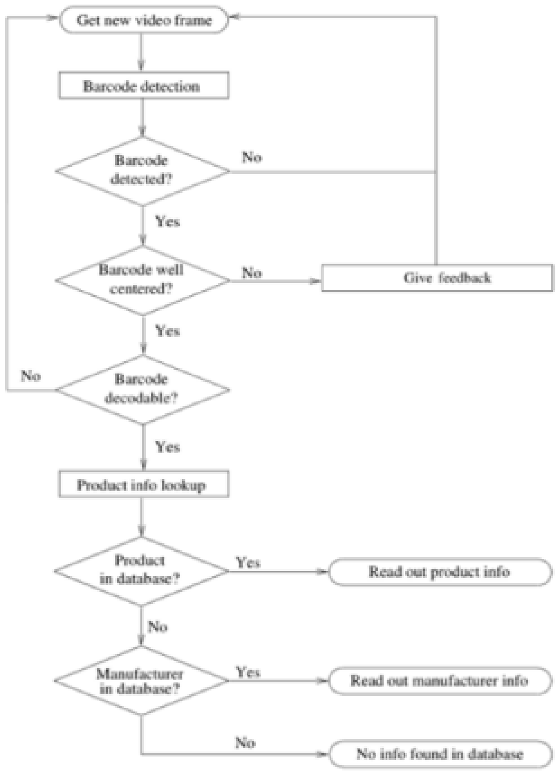

Figure 1

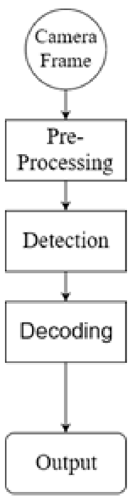

Figure 2

Screenshots:

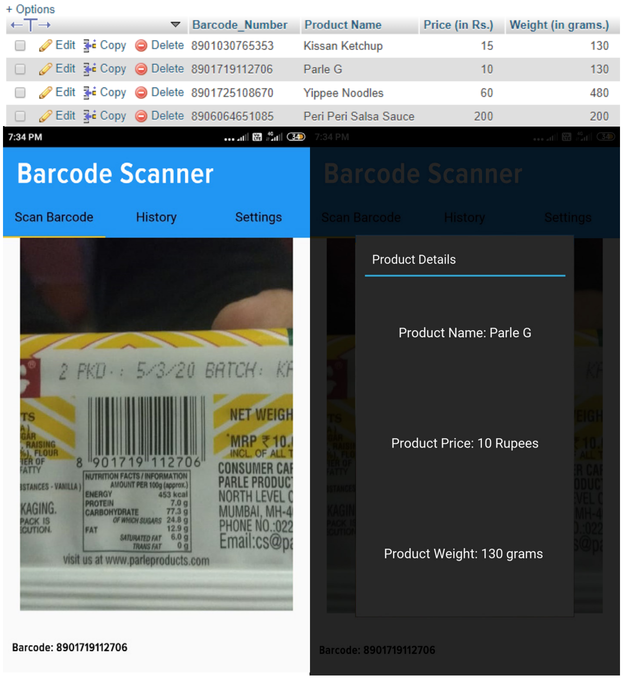

image frame obtained from the camera for estimating edges of the image. Preprocessing of the image is done to reduce blurriness, determine the pixels by contrast sharpening it and removing any false positives out. Preprocessing is followed by detection where barcode is detected and also line edges detected by rough estimate. After detection, decoding is performed where,

a. Lines' width is determined by maximizing pixel count for each line.
b. The lines are swept up and down to determine/estimate the fixed edges.
c. This data is compared to the data in the database to find the output.

At last output is generated as a voice message, If the decoded data exists in database otherwise, user will be notified of non-existence of product in database.

On the user side, the user only has to face the camera towards the product & sweep the product. Once the barcode is in the view, it is scanned, & text-to-speech output is produced, along with a printed output which is stored for future reference. If the barcode is not in the database, the user is notified of the same from text-to-speech.

4. IMPLEMENTATION

The application has used Python language, with zbarcam for barcode detection, buildozer and Python-for-Android to generate the apk, MySQL for database, and various Python & Kivy modules for text-to-speech, frontend, etc. This whole project was made in the Ubuntu Subsystem for Windows 18.04 OS.

4.1. Hardware Requirements:

4.1.1. Minimum Requirements:

This project uses an Android phone and a PC desktop/laptop. It has:

1. Camera: 5MP or above.
2. Inexpensive Webcam/In-built laptop webcam
3. RAM: Minimum 2GB RAM.
4. CPU Speed: 1GHz.
5. CPU/GPU Compatibility: Compatible with Python/MySQL coding.
6. Disk: 20MB of disk space
7. Display Size: 4' or above.

4.2. Software Requirements:

4.2.1. Minimum Requirements:

1. OS: Android Ice-cream Sandwich i.e. 7.0, (API Level 24).
2. Python: 3.6 or above
3. Kivy: 1.10.1
4. zbarcam 2019.1020
5. MySQL 5.7
6. Windows 7 or above
7. Ubuntu Subsystem for Windows 18.04
8. phpMyAdmin 4.9.5

4.2.2. Front End

The front end is made using KivyMD, which is a collection of Material Design compliant widgets for use with Kivy, the Python based framework on which this project is made on.

4.2.3. Dataset Used

Dataset for the project is generated manually. MySQL is used for database management system. phpMyAdmin is used for administration of the DBMS (though it's not mandatory to use it).

5. CONCLUSION

The application presented in this paper aims to scan and read barcodes, intended for use especially by visually impaired users. A key feature of the application is the ability to detect barcodes, 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. Testing this application with a blindfolded subject, it is noted that it provides, with text-to-speech, an accuracy of 90-95% based on 15 initial scans. The system can be further extended by using better hardware, since technology is constantly developing, such that video frames captured are extremely 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.

6. APPENDIX

1. WHO: World Health Organization.
2. SVM: Support Vector Machine.

7. ACKNOWLEDGEMENT

We owe sincere thanks to our college Atharva College of Engineering for giving us a platform to prepare a project on the topic "Barcode Scanner for Visually Impaired" and we would like to thank our Principal Dr. Shrikant Kallurkar for inciting in us the need for this research and giving us the opportunity and time to conduct and present a research on the topic. We are sincerely grateful for having Asst. Prof. Divya Kumawat as our guide and Prof. Suvarna Pansambal, Head of "Computer Engineering" Department, and our project coordinators, Prof Mamta Meena, and Prof. Shweta Sharma, during our research which would have seemed difficult without their motivation, constant support and valuable suggestions. Moreover, the completion of this research would have been impossible without the cooperation, suggestions and help of our friends and family.

8. REFERENCES

[1] Pascolini, D., & Mariotti, S. P. (2012). Global estimates of visual impairment: 2010. British Journal of Ophthalmology, 96(5), 614-618.

[2] Bill Selmeier. (2009). Spreading the Barcode. pg. 26, 214,236, 238, 244, 245, 236, 238, 244, 245.

[3] Fishman, C., & Overholt, A. (2001). Agenda items: The killer app, bar none. Fast Company, 47, 147-151.

[4] Seideman, T. (1993). „Barcodes Sweep the World “. Wonders of modern technology.

[5] Nelson, B. (1997). Punched cards to bar codes: A 200 year journey. Helmers Publishing Company.

[6] AdamsCommunications.onanonlineblognamed. (2011).A Short History of Bar Code on the website BarCode 1.

[7] Wachenfeld, S., Terlunen, S., & Jiang, X. (2008, December). Robust recognition of 1-d barcodes using camera phones. In 2008 19th International Conference on Pattern Recognition (pp. 1-4). IEEE.

[8] Tekin, E., & Coughlan, J. M. (2009, December). An algorithm enabling blind users to find and read barcodes. In 2009 Workshop on Applications of Computer Vision (WACV) (pp. 1-8). IEEE.

[9] Kulyukin, V., Kutiyanawala, A., & Zaman, T. (2012). Eyes-free barcode detection on smartphones with Niblack's binarization and support vector machines. In Proceedings of the International Conference on Image Processing, Computer Vision, and Pattern Recognition (IPCV) (p. 1). The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp).

[10] Upasani, S. S., Khandate, A. N., Nikhare, A. U., Mange, R. A., & Tornekar, R. (2016). Robust algorithm for developing barcode recognition system using web-cam. International Journal of Scientific & Engineering Research, 7(4), 82-86.

[11] Hansen, D. K., Nasrollahi, K., Rasmussen, C. B., & Moeslund, T. B. (2017). Real-time barcode detection and classification using deep learning. In International Joint Conference on Computational Intelligence (pp. 321-327). SCITEPRESS Digital Library.

