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Intelligent Reading Assistant for the Visually Impaired

Reuben Reji[1], Rammohan Damodar[2], Rohit Pillai[3], Saurabh Nair[4], Manjusha Deshmukh[5]
[1,2,3,4]*Student, Department of Computer Engineering, Pillai College of Engineering, Mumbai, India*
[5]*Professor, Department of Computer Engineering, Pillai College of Engineering, Mumbai, India*

***Abstract*: There are about 39 million blind people and 285 million visually impaired people worldwide. Disability of visual text reading has a huge impact on the quality of life for visually disabled people. Although there have been several devices designed for visually disabled to sense object using an alternating sense such as sound and touch, the development of text reading device is still at an early stage. Existing system for text recognition are typically limited either by explicitly relying on specific shapes or color masks or by requiring user assistance or may be of high cost. This project works on three aspects to help the visually impaired. The first one is the text reader using Optical Character Recognition(OCR) which will also read out the text to the user. The second is the Object Recognition System using the YOLO (You Only Look Once) module which will help the user to identify the object in front of him/her. The third one is the barcode Scanner which will help the user to read the barcode printed on the product to recognize the product. This can help the visually impaired person in his/her shopping trip to recognize the product he/she wants to purchase. The hardware by which we are going to present our concept is a mobile phone using an android application.**

***Keywords*: Object Recognition System. You Only Look Once, Barcode Scanner, Optical Character Recognition, Convolutional neural network.**

1. Introduction

Existing system for an assistant system for the visually impaired are typically limited. A personal reading assistant to assist visually impaired people is still at an early stage of development. Optical Character Recognition has been used since a long time to detect text. Optical character recognition (also optical character reader, OCR) is the mechanical or electronic conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo (for example the text on signs and billboards in a landscape photo) or from subtitle text superimposed on an image. You Only Look Once(YOLO)-Unified, Real-Time Object Detection: only look once (YOLO) is a state-of-the-art, real-time object detection system. It can be used to detect object in real time. The Live bar code Scanner can be used to recognize the product held by the user. The output for all the modules will be in the form of audio. Integration of all these functions will be done through an android application.

2. Literature survey

Optical character recognition-An overview and an insight: Deepa Berchmans, S. S Kumar describe a prototype system, where OCR can be used in internet connected mobile device applications that extract text captured using the device's camera. These devices that do not have OCR functionality built into the operating system will typically use an OCR API to extract the text from the image file captured and provided by the device. The OCR API returns the extracted text, along with information about the location of the detected text in the original image back to the device app for further processing (such as text-to-speech) or display [1].

Optical character recognition for model-based object recognition applications: The 3D model contains detailed information about the object, including the shape of its structure, the spatial relationship between its parts and its appearance. This 3D model provides prior knowledge to the problem being solved [2].

HC2D barcode reader using embedded camera in Android phone: The HC2D barcode is a highest capacity of 2D barcode while it occupies a small area. The size of the HC2D barcode is suitable for displaying on print media such as paper and poster. But, for reading the HC2D barcode, the bit representation of the barcode is obtained by scanning the image of the barcode with scanner machine only [3].

Reading Assistant for the Visually Impaired: The project has a small inbuilt camera that scans the text printed on a paper, converts it to audio format using a synthesized voice for reading out the scanned text quickly translating books, documents and other materials for daily living, especially away from home or office [4].

A barcode-scanner aid for visually-impaired people: Visually-impaired people are surrounded by information that are crucial for them in the day to day activities but still out of reach like product packaging information, price, etc. This implementation aids the individual by making this information accessible. [5]

You Only Look Once: Unified, Real-Time Object Detection: You Only Look Once is a new approach to object detection. In YOLO, A single neural network predicts bounding boxes and class probabilities directly from full images in one evaluation. Since the whole detection pipeline is a single network, it can be

optimized end-to-end directly on detection performance.[6]

Design of an Optical Character Recognition System for Camera-based Handheld Devices: This paper presents a complete Optical Character Recognition (OCR) system for camera captured image/graphics embedded textual documents for handheld devices. At first, text regions are extracted and skew corrected. Then, these regions are binarized and segmented into lines and characters [7].

Mobile Reading Assistant for Blind People: The main aim of this system is to build an automatic text reading assistant using existing hardware associated with innovative algorithms. A personal digital assistant (PDA) was chosen because it combines small-size, computational resources and low cost price. Three key technologies are necessary: text detection, optical character recognition and speech synthesis. Here a visually impaired person can use his or her Smartphone to get a reading assistance [8].

3. Proposed work

Controlling the computer mouse using the eyes movement requires a fast and effective algorithm, that's brought us to decrease the running time of the tool to the minimum by dividing the operation into few steps and using a tracking algorithm in order to avoid unnecessary calculations.

A. System architecture

The system architecture is given in Figure 1. Each block is described in this Section. Our proposed system is integrated into an Android Application which will have the following blocks.

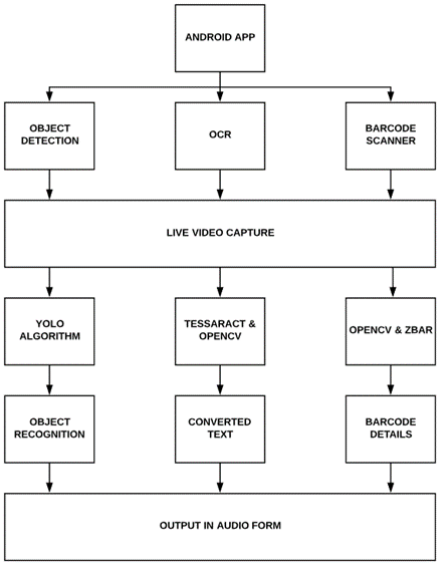

Fig. 1. Proposed system architecture

- Block 1 Description(OCR): At first we aim to implement character recognition through live video so that the blind person does not have to take a picture and when the camera is hovered over the text live recognition of the text is done. This recognized text can be then converted to speech or audio so that the blind person can interpret what is written. This implementation of OCR is done with help of Tesseract and OpenCV for printed text as well as handwritten.
- Block 2 Description (Object Detection): This is a feature that will help the blind person to detect the object with the help of camera module. YOLO or You Only Look Once is an object detection algorithm much different from the region based algorithms. In YOLO a single convolution network predicts the bounding boxes and the class probabilities for these boxes. We take an image and split it into an SxS grid, within each of the grid we take m bounding boxes. For each of the bounding box, the network outputs a class probability and offset values for the bounding box. The bounding boxes having the class probability above a threshold value is selected and used to locate the object within the image. YOLO is orders of magnitude faster (45 frames per second) than other object detection algorithms. The main goal of Fast-RCNN is to improve these two algorithms by extracting the features and making an end-to-end classification with a single Algorithm. It is easier to train, faster at test time (the classification phase is almost real-time) and it is more accurate. With Fast-RCNN, real-time Object Detection is possible if the region proposals are already pre-computed. main point of Faster-RCNN: making the region proposals algorithm as a part of the neural network. It merges Fast-RCNN with a Region Proposal Network producing better object detection results and in real-time (hence the name :)) for the first time. Moreover, the results are not dependent on the accuracy of an external region proposals algorithm anymore. The main task is to help the blind person recognize what object is in front of him or her with help of fast R-CNN and YOLO Algorithm Models.
- Block 3 Description (Live Barcode Scanner): This feature will help the blind person to scan barcode with help of live video capture and then once the barcode is scanned the person will be able to recognize what is the item that he or she is holding and other details of it which will be given in the form of audio. OpenCV can do is
- Output Block Description: After the text or handwritten text is detected or an object is detected or the barcode is scanned by the mobile camera then the output will be in the form of audio. It will be read aloud to the user using the Talkback function of the android phones.

Table 1
Performance analysis

Modules	Performance	Drawbacks
OCR	Very Good	Handwritten not Detected
Object Detection	Moderate	Average Accuracy
Barcode Scanning	Good	Limited products

Table 2
Accuracy analysis

Modules	Percentage accuracy
OCR	75-85 %
Object Detection(tensor flow Model)	65-75%
Barcode Scanning	75-80%

B. *Experimental results*

Fig. 2. Object Detection Results

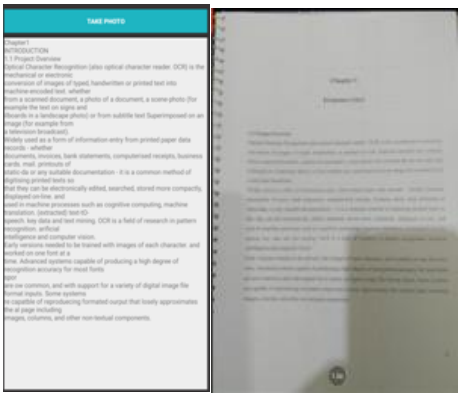

Fig. 3. OCR Results

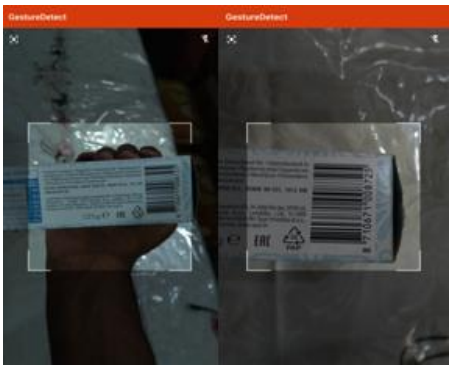

Fig. 4. Barcode scanner result

4. Requirement analysis

The implementation detail is given in this section.

A. *Software requirements*

- *Python* - python is an interpreter, object oriented high level programming language. It emphasizes code readability and reduces code maintenance making it suitable for Rapid *Application Development. Android Studio*- For creating project interface in form of an app.
- *Tesseract*- Library used for character recognition of printed text.
- *OpenCV* - Library with collection of algorithm which can be used for applications like barcode, detect and recognize faces, identify objects.
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B. *Hardware requirements*

Android Handset - For running application program.

C. *Dataset and parameters*

A labeled dataset containing around 20000 pictures for common objects found inside a home. Includes more than 20,000 digital images from three different indoor object categories, including doors, stairs, and hospital signs etc.

5. Conclusion

This presented the implementation of intelligent reading assistant for the visually impaired.

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