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# LOW COST SMART GLASSES FOR VISUALLY IMPAIRED USING RASPBERRY PI

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*Abstract:* **Blindness is the inability to perceive light, leading individuals to rely on guiding tools and human assistance. This study introduces a prototype of smart glasses designed to help blind users by detecting objects and text signs, providing audio feedback. The device uses a Raspberry Pi as the microprocessor and a camera for detection. Object detection is powered by the YOLO algorithm, while Optical Character Recognition(OCR) identifies both handwritten and printed text. MATLAB is employed for OCR tasks, which include image capturing, text extraction, and text-to-speech conversion. The prototype can detect up to 15 objects and operates effectively under varying light conditions. The system can use voice responds to visually impaired people about the objects in front of them by uploading the photos to our backend object detection system through the camera function of smart glasses and then download the text descriptions of the result and then use the text-to-speech function . The average processing time for the prototype is about 1.9 seconds while walking quickly and 1.7 seconds at a slower pace.**

*Keywords:* **blindness, smartglasses, guidingtool, YOLO, OCR, Raspberry pobject detection, text detection, text-to speech conversion**

## I. INTRODUCTION

Humans can identify objects from light thanks to their eyes, and the brain processes the information it receives. A person who has no idea of Light is regarded as complete blindness or vision impairment. People with vision impairments, particularly those who are blind, rely on their other senses. Furthermore, some of people compensate for their vision impairment by using trained animals, guidance aids, or human support. A low-cost smart glass that can recognize objects and even text signs that affect blind people is what the researchers hope to create.A variety of new gadgets and technical developments, such as smart sticks and smart glasses, were introduced, providing a navigation tool for people with visual impairments. The goal of this project is to develop a low-cost smart eyeglass prototype that will assist the blind. The Since the prototype is designed to detect objects in the living and garage areas, the number of objects it can detect is restricted to 15. The prototype is limited to recognizing text signs in English. Other signs like logos, symbols, and figures are not recognized by it. It is restricted to signs with sharp edges, particularly those that are square, rectangular, and red-bordered. Furthermore, it won't take into account different kinds of visually impaired people. The prototype is exclusively intended for blind individuals. It is unable to provide precise wearer directions to the object it has detected.

## II. PROPOSED ALGORITHM

Creating low-cost smart glasses for visually impaired users using a Raspberry Pi involves several key components and principles. For object detection, the prototype utilizes the YOLOv3 algorithm. This algorithm divides an image into grid cells, with each cell predicting five bounding boxes that enclose detected objects.The object detection process consists of four main parts:

1. Data Collection: This involves gathering images of objects found in living spaces or other areas to create a dataset. In this project, a total of 5,673 images will be collected and labelled with annotations for the objects of interest. These images will then undergo data preparation.
2. Data Preparation: Relevant images are gathered, and the annotations are corrected and updated as needed. This includes resizing images and adjusting colour to ensure accuracy. Bounding boxes are drawn around objects of interest, and each box is assigned a corresponding class label. A thorough review of annotations ensures that the boxes closely fit the objects without including excessive background.
3. Model Training: YOLOv3 is the chosen algorithm for this phase. The process includes data preparation, configuration, training, and evaluation, with each step being crucial for building a robust object detection system. Data augmentation techniques will be applied to increase the diversity of the dataset during training. During configuration, hyper parameters such as learning rate, batch size, number of epochs, and optimization algorithms will be set.
4. Inference: This phase involves applying the trained model to make predictions. It requires setting up the YOLOv3 architecture along with the custom weights used during training.

For text detection, Optical Character Recognition (OCR) and Open CV will be employed to identify both handwritten and digital text. This process includes three steps:

1. Image Acquisition: The initial step involves capturing text signs live using the Raspberry Pi Camera Module v2, which features a 5 MP camera with a resolution of 2592 x 1944 pixels.
2. Pre-processing: This step includes converting images from colour to grayscale, edge detection, noise removal, warping, cropping, and thresholding. Binarization converts the captured images into grayscale, which simplifies recognition processes. Many Open CV functions require input images to be in grayscale format, allowing the program to better recognize the red border format of the text.

- Edge detection is a crucial pre-processing step in various image processing and computer vision tasks, including text detection. Canny edge detection is applied to grayscale images to enhance the identification of contours.
- Warping and cropping are important image processing techniques used to manipulate images for different applications, such as preparing data for machine learning, improving visual appearance, or correcting perspective distortions.
- Thresholding is used to create binary images from grayscale images. By converting an image to a binary format, thresholding facilitates segmentation based on intensity levels, making the image easier to analyze and process.
- Image-to-text conversion involves using OCR or OpenCV techniques to extract text from images. This process includes several steps, ranging from image preprocessing to the actual text extraction.

-Text-to-speech (TTS) conversion transforms text into audio output using synthesized speech. This process involves natural language processing to comprehend the text and generate a voice output that sounds human-like, typically delivered through headphones.

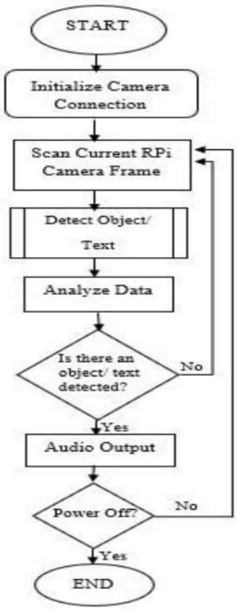


**Fig. 1.**Flowchart

III. EXPERIMENT AND RESULT

The real-time object detection system successfully identified objects across 30-40 predefined classes. Each detected object was accurately enclosed in red bounding boxes, demonstrating the model's capability to effectively localize and classify items within diverse environments. The system achieved an average performance rate of 80%, which indicates a solid level of accuracy in recognizing and distinguishing between various objects in real-time scenarios such as suitable for applications in security, autonomous vehicles, and industrial automation. Future enhancements could focus on improving the model's performance through data augmentation, hyper parameter tuning, or leveraging more advanced architectures, as well as expanding the class range for broader applicability. Overall, this project showcases the potential of real-time object detection technology in practical applications.

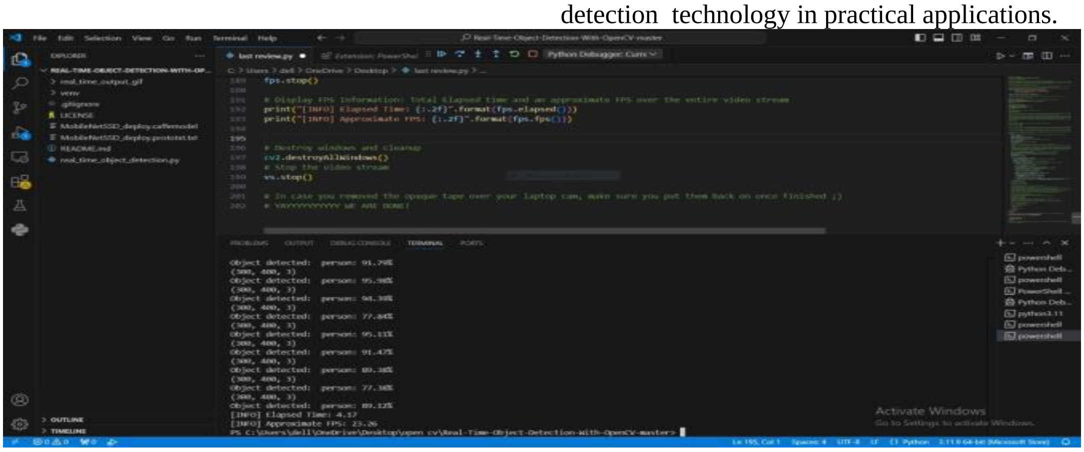

Fig 2.object detection output


The above figure shows the results of real-time object detection ,using inbuild camera and obtained clear and precised results with a precision of 80%.This could be effectively implemented on the smart glasses for real-time object detection.

## IV. CONCLUSION

This paper presents a real-time object detection system designed to enhance independence and safety for visually impaired individuals. Using the YOLOv3 algorithm, the system offers a fast, accurate solution for detecting various objects and conveying their location through audio feedback. The solution, which works on both smartphones and web applications, overcomes limitations in existing assistive tools by providing precise, immediate object recognition without needing additional, costly equipment.

Testing showed that the system could accurately identify over 75% of objects in diverse environments, providing critical information to visually impaired users for navigation and daily activities. With processing times under 2000 milliseconds, users receive real-time audio notifications, improving responsiveness and confidence in new settings. Future enhancements could include expanding object classes, improving accuracy in challenging conditions, and adding directional guidance. This project demonstrates how advanced technology, accessible through standard mobile devices, can significantly improve the quality of life for visually impaired individuals by promoting autonomy, reducing dependency, and enhancing their overall safety and engagement in society.

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