# Astute Support System with Voice Feedback for Visually Impaired and Blind Assistance *

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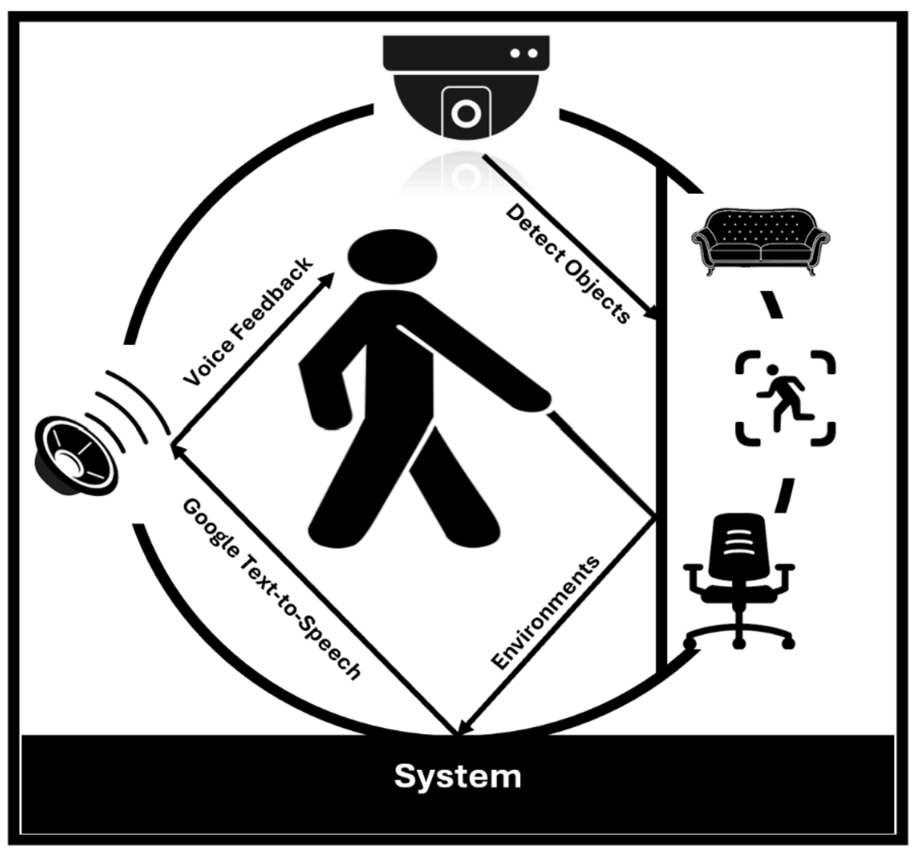
## Purpose and Aims:

- **Purpose:**

Develop an assistive vision system to help visually impaired individuals identify and recognize objects in real time.

- **Aims:**

1. Implement a compact, real-time object detection model to achieve high detection accuracy.
2. Incorporate voice feedback (via Google Text-to-Speech) to provide immediate verbal identification.
3. Deliver a system that is user-friendly, affordable, and deployable on low-resource devices.

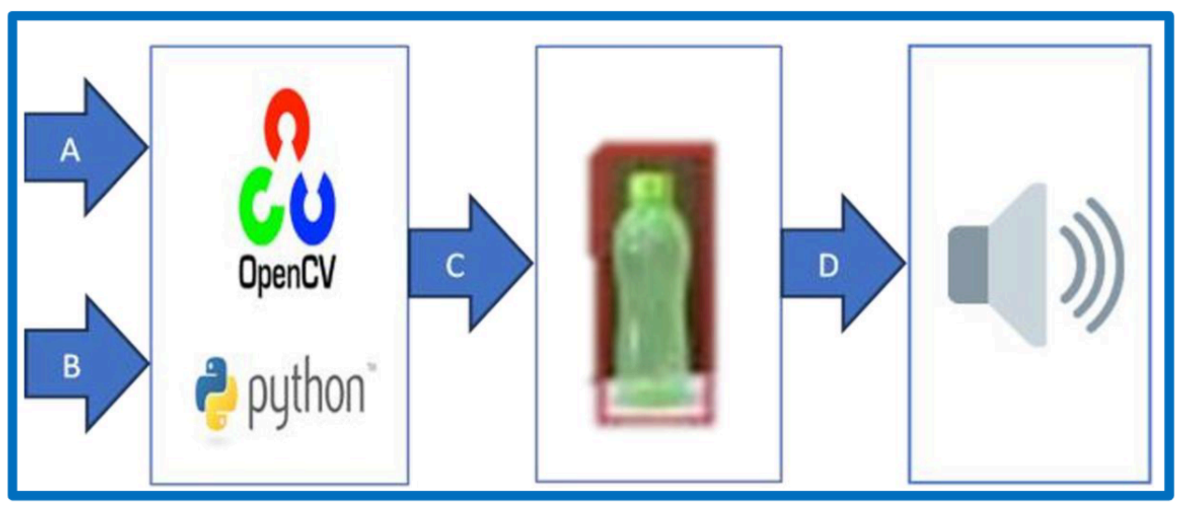



## Background Information:

- Around 2.2 billion people worldwide have near vision impairments, presenting daily challenges in recognizing objects. Traditional aid tools like white canes and guide dogs do not fully support real-time object identification.
- Computer-vision-based solutions, utilizing affordable hardware and machine learning, are gaining popularity for visually impaired and blind individuals, but many face challenges like low detection accuracy and computational resources.
- A novel assistive system, utilizing YOLO-based methods for real-time object detection and recognition, combined with text-to-speech output, is proposed to address issues and ensure reliable detection results.

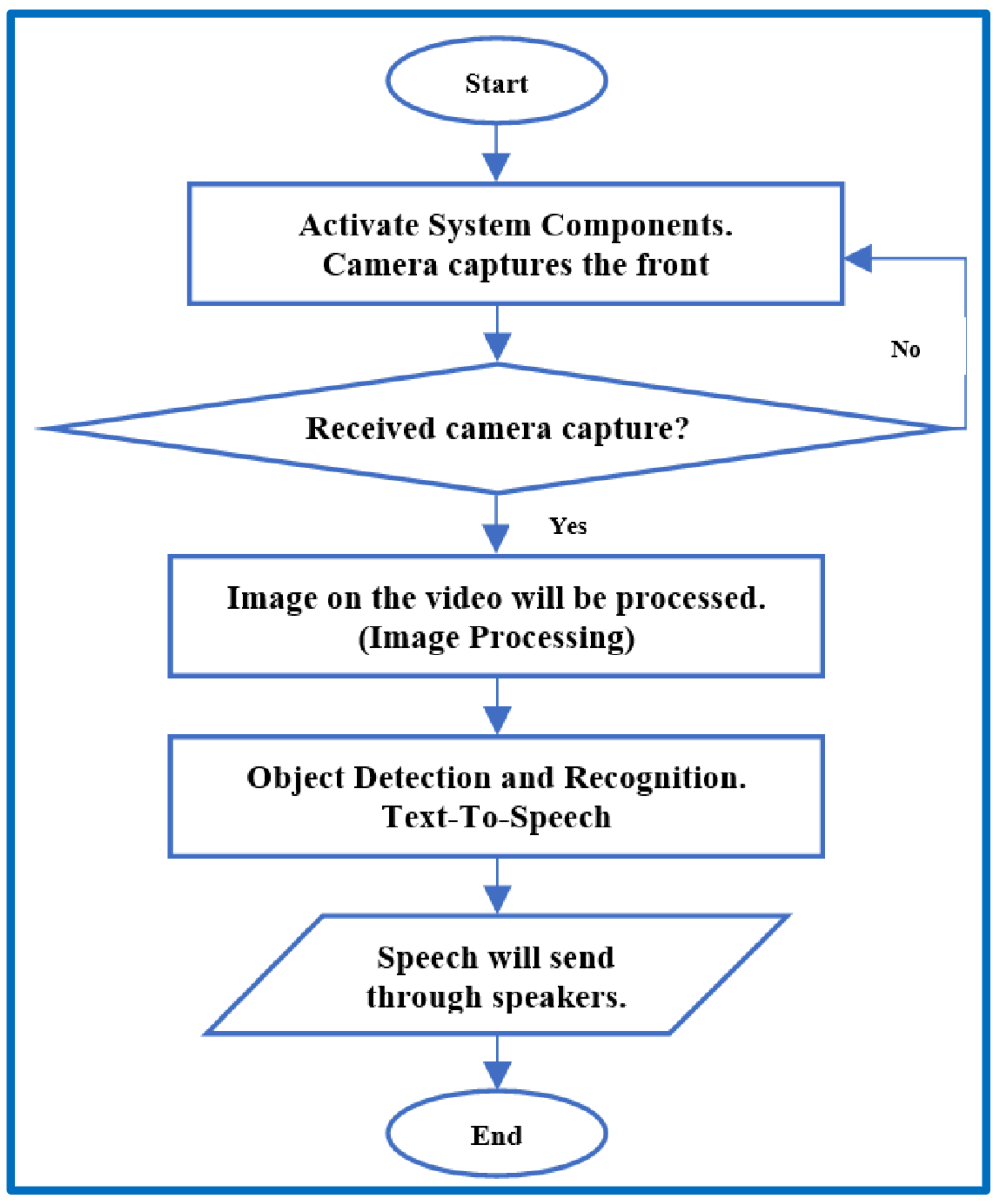
## Method Framework:

**Hardware and Software:**




**(A)** Capturing the real-time video and sending data to the system.
**(B)** Video frame, activate cv2 environment, and run the python to activate the system.
**(C)** The object in the video will be detected through real-time object recognition using YOLO and send voice.
**(D)** Using gTTs will generate speech and will send to users through speakers.

**System Flow:**
The system uses real-time video input, YOLO for object detection and recognition, and voice feedback for text labels above a confidence threshold, with the user hearing the object name in real time.




## Analysis:

**Accuracy and IoU Comparison:**
The Intersection over Union (IoU) values and enhanced IoU metrics for various object classes exceeded 0.90, indicating robust bounding-box accuracy.

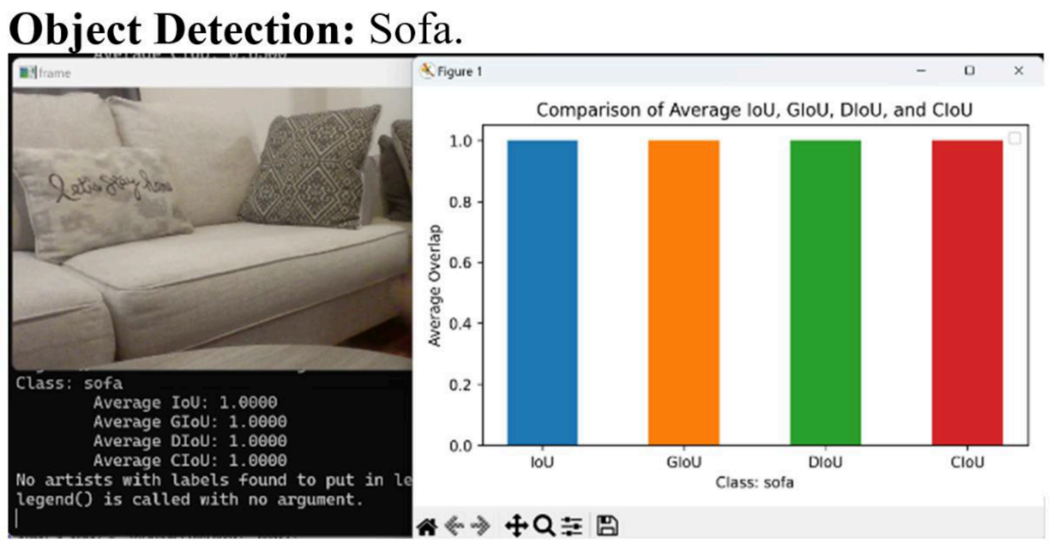
**System Performance Highlights:**

- Average IoU across multiple common objects: ~90%.
- Real-time inference (~30–60 FPS, depending on hardware).
- Audio feedback improves user experience.

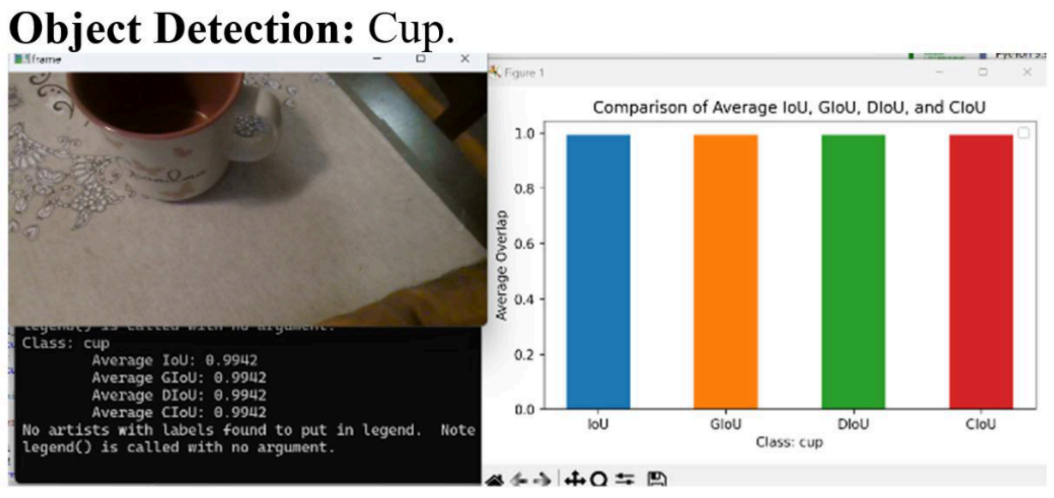
## Outcomes:

The system achieved high accuracy in one tour while using the system for object detection in real-time. Most results are more 90%, indicate reliability detection.

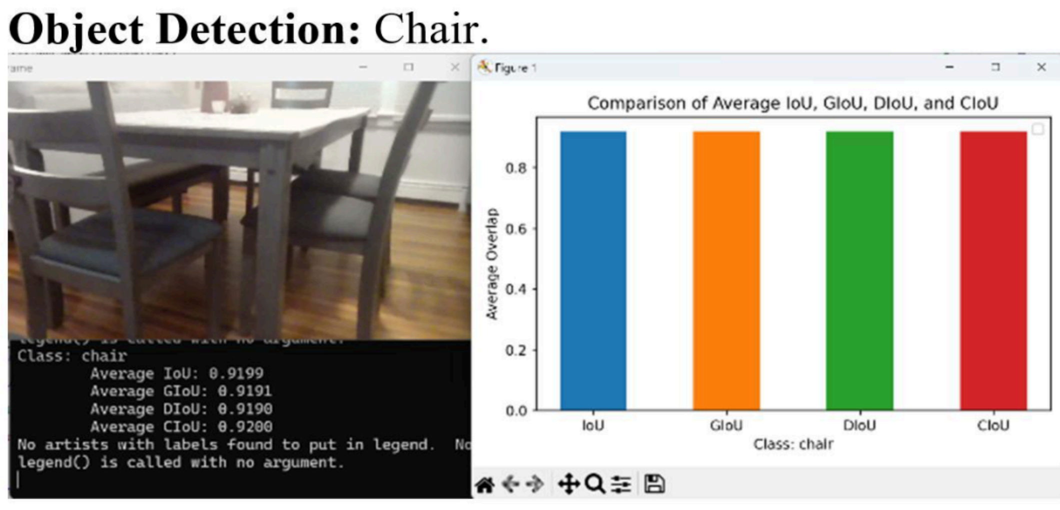
**Object Detection:** Sofa.




**Object Detection:** Cup.




**Object Detection:** Chair.




## Discussion, Conclusion, Implications and Limitations:

- **Discussion:**

The proposed assistive system leverages a compact yet powerful YOLO model, achieving high accuracy while remaining computationally efficient. Voice feedback allows immediate identification of objects for the visually impaired.

- **Conclusion:**

– The system's high accuracy results demonstrate reliable object detection.
– Real-time voice prompts significantly improve usability for VIB individuals.

- **Broader Impacts:**

– Could be integrated into wearable devices like smart glasses.
– May enhance mobility, safety, and independence for individuals with visual impairments.

- **Limitations & Future Work:**

– Currently relies on a pre-trained model with 80 class names; specialized classes may require custom training.
– Additional sensor inputs such as LiDAR or ultrasonic sensors could further improve hazard detection.
– Future research could incorporate advanced AI features like personal object recognition and indoor navigation assistance.

## References:

1. Tan, M., Pang, R., & Le, Q. V. (2020). EfficientDet: Scalable and efficient object detection. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition.*
2. World Health Organization. *Blindness and vision impairment*. WHO. https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment
3. Khan, M. A., Paul, P., Rashid, M., Hossain, M., & Ahad, M. A. R. (2020). An AI-based visual aid with integrated reading assistant for the completely blind. IEEE.
***4. Kariri, A., & Elleithy, K. (2024, November). Astute Support System for Visually Impaired and Blind with Highest Intersection over Union for Object Detection and Recognition with Voice Feedback. In 2024 IEEE Long Island Systems, Applications and Technology Conference (LISAT) (pp. 1-7). IEEE.**