Real-Time Object Recognition with Voice-Guided Navigation for the Visually Impaired

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Abstract—This research introduces a voice-guided navigation system designed to assist visually impaired individuals by providing real-time obstacle detection, spatial orientation, and auditory feedback. Leveraging models like SSD MobileNet V3 for object detection and Faster R-CNN for person counting, the system delivers precise information such as, "A person is 2.8 meters ahead," detailing obstacle type, position (left, right, forward), and distance. Multilingual text-to-speech (TTS) capabilities, powered by pyttsx3 and gTTS, ensure accessibility across diverse languages, while Qwen/Qwen2-1.5B- Instruct enhances natural language interaction for intuitive user experiences. Integrated with OpenCV, TensorFlow, and PyTorch, this robust platform offers real-time guidance, improving mobility, safety, and independence for visually impaired users in various environments.

Index Terms—SSD MobileNet V3, Faster R-CNN (ResNet-50), Computer Vision (OpenCV, TensorFlow & PyTorch), Text-to-Speech (TTS) Technology, Multilingual Support

I. INTRODUCTION

Assistive technologies are very effective in enhancing the mobility and independence of visually impaired individuals, allowing them to navigate with confidence in complex and dynamic environments. Real-time awareness of obstacles, spatial orientation, and contextual understanding is important for safe navigation in unfamiliar places and crowded areas. Based on these requirements, this research proposes an advanced voice-guided navigation system, integrating state-of- the-art object detection, real-time dynamic distance estimation, and multilingual text-to-speech (TTS) technologies. To that end, real-time object detection is supported with deep learning models like SSD MobileNet V3 and Faster R-CNN in the case of accurate identification and person counting. The system improves on natural interaction as well as

precision in communication using Qwen/Qwen2-1.5B-Instruct, which is a large AI model that generates context-aware voice instructions. Clearly audible feedback related to obstacles type, left-right-forward, or distance is conveyed to users-such as "A person is 2.8 meters forward|right|left"-ensuring safe and informative navigation. Built on technologies ranging from OpenCV, TensorFlow, PyTorch, and TTS engines like pyttsx3 and gTTS, the system ensured smooth performance along with scalability. Spatial orientation alert and dynamic distance estimation further help in increasing its utility for use in real world applications. TTS is designed to be multi-linguistic so users from diverse backgrounds can easily operate it.This innovative platform addresses key challenges faced by visually impaired individuals by combining advanced AI technologies with user-friendly functionality. It provides greate autonomy and confidence in everyday life by improving obstacle awareness and supporting independent navigation.

II. RIVEW OF LITERATURE

1. Object Detection Systemfor Visually Impaired Persons Using Smartphone D.Ravi Kuma, Hiren Kumar Thakkar, Suresh Merugu Jan2022 The proposed system employsa cameraas the input device for real-time object detection with voice Lacks advanced person counting for improved spatial awareness. 2 AReal-Time Object Detection Method for Visually Impaired Using Machine Learning Saravanan Alagarsamy, T. Dhiliphan Rajkumar, K. P. L. Syamala Jan 2023 The system employs the YOLO V3 algorithm combined with RCNN for real-time object detection, using convolutional neural networks (CNNs) to recognize diverse objects in the environment. The det Lacks multilingual text-tospeech support, limiting accessibility for diverse linguistic

users. 3 Deep FeatureBased ThreeStage Detection of Banknotes and Coins for Assisting Visually Impaired People Chanhum Park, Se Woon Cho Oct 2020 The proposed system uses a three-stage detection process combining Faster R-CNN for object detection, geometric constraints for Focused solely on currency detection, lacking broader applicability to obstacle detection and navigation. refining detection accuracy. 4 Eye Assistant: Using Mobile Application to Help the Visually Impaired Md. Amanat Khan Shishir, Shahariar Rashid Fahim Dec 2019 The system is implemented as an Android application that performs realtime object and text detection directly on the device using TensorFlow's machine learning API. No advanced person counting or spatial orientation features for crowded environments. 5. 3D Imprinting of the Environment for the Visually Impaired Amogh Adishesha,

Bhagyashree Desai Oct 2015 The system uses a Time of Flight (ToF) camera to capture real-time images of the user's environment. Depth and position of objects are analyzed Does not include realtime voice feedback specifying obstacle type, position, or distance.

III. DESIGN

Fig 1: proposed work

IV. RESULTS

The results demonstrate effective real-time object detection and person counting, leveraging the COCO dataset and pre-trained models like SSD MobileNet V3 and Faster R-CNN. Using averages.txt, the system accurately estimates object dimensions and distances, ensuring precise spatial awareness to assist visually impaired users in dynamic navigation environments.
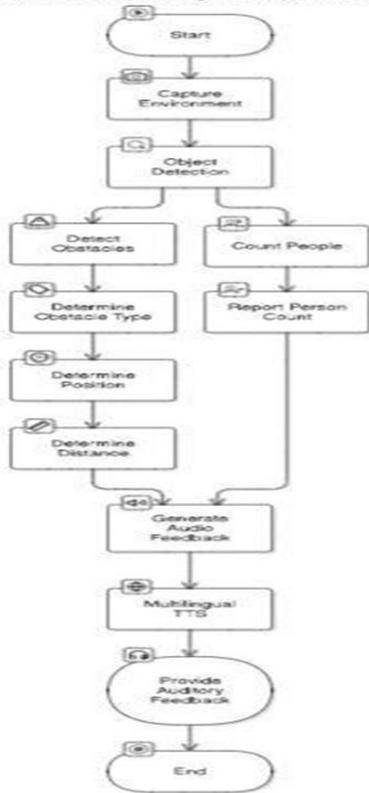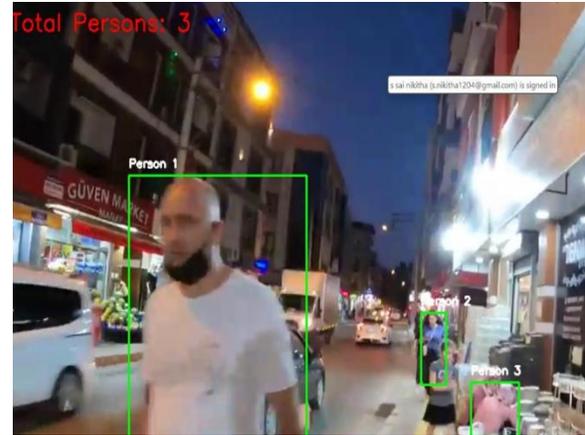

Fig 2: No of Persons detected with audio feedback

Fig 3: Object detection with distance and name and position with audio feedback

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