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Object Detection and Localization for Visually Impaired

Anil Kumar R[1], Sahana D[2].

[1]Assistant Professor, Department of Electronics and Communication Engineering, S J C Institute of Technology Chickballapur, India, anilkumar.sjcit1@gmail.com

[2]UG Student, Department of Electronics and Communication Engineering S J C Institute of Technology Chickballapur, India, Sahana31d@gmail.com

ABSTRACT –

Nowadays, a significant number of individuals are affected by both temporary and permanent disabilities, with blindness being one of them. The World Health Organization (WHO) reports that there are nearly 390 million fully blind individuals and another 2850 million who are visually impaired. Various supporting and guiding systems have been established and are continuously being developed to enhance the daily lives of people with disabilities as they navigate from one location to another. Our proposed approach aims to introduce an auto assistance system specifically designed for individuals with visual impairments. This system can be particularly beneficial for those who are unable to see objects due to their disability. In order to assist blind individuals, several methods have been explored, with ongoing research in this area. Previous models faced challenges in object detection, prompting us to propose a new method that utilizes CNNs (Convolutional Neural Networks) to support individuals who are blind or visually impaired.

Keywords—visually impaired, CNNs, deep learning

I. INTRODUCTION

Visually impaired individuals (VIPs) often face obstacles when it comes to carrying out their daily routines. These challenges include locating objects, navigating their surroundings, and completing tasks such as identifying money or reading text. However, advancements in assistive technology have provided solutions to empower VIPs and help them overcome these difficulties. Various methods, platforms, tools, and software have been developed over time to enable VIPs to accomplish tasks that were once inaccessible to them.

Electronic devices containing cameras, sensors, and microprocessors are frequently utilized as remedies. These gadgets offer user interaction via touch or sound. Despite the assertions of precision from various object detection and recognition systems, they frequently fall short in delivering the required information and functionalities for monitoring VIPs and guaranteeing their security. Nevertheless, gaining knowledge about the objects in their environment can be advantageous even for visually impaired individuals. Additionally, a monitoring system is crucial for the families of VIPs to keep track of their locations.

In order to meet these criteria, the research suggests an intelligent system that conducts instant object localization and identification. Once an object is detected by the system, the user will promptly receive audio feedback. If the user recognizes a known object, like a book, they will hear the corresponding word. Furthermore, the system consistently stores the user's location and a snapshot of the latest scene on a server. Family members can utilize an app to monitor the user's whereabouts using this data.

The Mobile-Net structure is employed for object detection and recognition because of its minimal computational requirements and suitability for low-power gadgets. Considering the restricted capabilities of wearable technology and the necessity for precise object identification, utilizing sophisticated and state-of-the-art object recognition techniques may not be practical as the main approaches.

II. LITERATURE SURVEY

Sony Tirkey, Anmol Ratan Tirkey and Cazal Tirkey [1], The purpose of this research is to develop an automated assistance system for individuals with visual impairments. By utilizing CNNs (Convolutional Neural Networks), a widely used technique in deep learning models, the system achieves a detection accuracy exceeding 95% for objects captured by the camera. The identified objects are then relayed through verbal messages, making it a significant prototype for assisting the visually impaired.

Ajinkya Badave, Rathin Jagtap, Rizina Kaovasia and Shivani Rahatwad [2], The study presents an android-based system that leverages the smart phone camera to capture images and inform the user about the detected object, its distance, and direction through audio instructions delivered via speakers or headphones. This system is designed to enhance users' awareness of their surroundings and enable them to navigate independently.

Anitha J, Subalaxmi A, and Vijayalakshmi G [3] developed a system with the aim of reducing the need for specialized and wearable gadgets among visually impaired individuals. This system offers an Android smartphone application that assists in object recognition and navigation. The real-time object classification is achieved through the utilization of the R-CNN algorithm. The video captured by the phone's camera is processed using image processing algorithms. Following the scanning and segmentation of objects, the Fast R-CNN algorithm is used to detect multiple regions. Finally, the Google API is employed for text-to-speech conversion to communicate the information to the user.

Khairnar DP, Karad RB, Kapse A et al [4], The aim of the proposed systems is to develop an Android application that provides crucial details about the environment and objects to people with visual impairments. This system is designed to decrease the dependence on conventional specialized gadgets and wearable technology. The study also explores object detection and the significance of ORB in comparison to SIFTS and SURFS in different situations. The camera records videos, which are subsequently divided into frames. Image edge detection is performed by matching keys in the database, and then a synthesizer converts text to speech to give instructions to the user.

The study by Chen LB, Su JP, Chen MC, et al [5] introduces an innovative approach to aid visually impaired/blind individuals. The system comprises smart glasses, an intelligent walking stick, a mobile app, and an online information platform. Through the use of smart glasses and the intelligent walking stick, visually impaired/blind individuals can identify obstacles in their environment. If a fall occurs, important details like GPS location and fall detection will be saved and shared on the online platform. The mobile app proposed enables users to retrieve and review this data.

III. METHODOLOGY

Our proposed framework is centered around the Raspberry Pi. To ensure a strong audio output, we have decided to incorporate a speaker. Additionally, the Raspberry Pi is fully compatible with high-quality headphones that provide improved bass. Our strategy involves implementing the Raspberry Pi (3 B+) methodology.

In order to provide clients with flexibility, we have chosen to use a power bank as the power source for the Raspberry Pi. This choice is influenced by the popularity of the Raspberry Pi, a highly favored single-board computer. The Raspberry Pi's Open CV software streamlines the process of carrying out necessary calculations and operations for image processing. Our Raspberry Pi comes with a 32 GB class 10 SD card. Moreover, we have opted to utilize a USB camera instead of the Raspberry Pi camera due to its sturdy wiring and maintenance difficulties. In our configuration, we demonstrate a YOLO algorithm based on the Raspberry Pi. A speaker is connected to one of the Raspberry Pi's USB ports to serve as a basic audio output device. For the sake of portability, we are using the 5-volt power bank as the power supply.

IV. IMPLEMENTATION

When the Raspberry Pi (Rpi) is powered on, it will start running its internal code or process. This code will continue to run until the Raspberry Pi is turned off. Before accessing the content record that contains information about lesson titles, YOLO weights, and arrangement records, the Rpi will import all the necessary libraries such as Open CV, Pyttsx3, Time, and Num Py. Once this is done, the code will activate the appropriate camera.

The camera will then begin recording real-time outlines at a rate of one frame per second (fps). The code will analyze each incoming image/frame and adjust the width and height to an acceptable level. After that, the modified form of the image will be connected to the protest location algorithm using YOLO as an example. Before sending this modified image to the YOLO weights and YOLO setup records, a 'BLOB from image' will be created.

The Open CV function 'blob From Image' is used to obtain and modify expectations from image categorization. The code performs a forward pass of the YOLO object detector to provide us with bounding boxes, course ids, and related lesson probabilities. In addition to its speed, YOLO also offers three methods to enhance its execution.

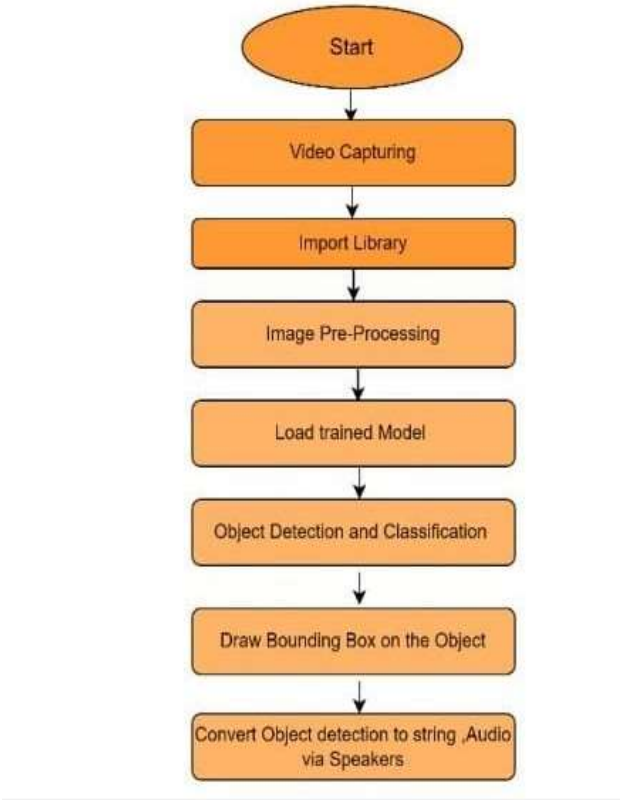

Fig 1: Flow Chart of the System

V. APPLICATIONS

- Object detection algorithms possess the ability to identify obstacles, pedestrians, traffic signs, and a range of other objects in the environment. This advanced technology plays a crucial role in helping visually impaired individuals navigate safely through streets, sidewalks, and indoor spaces.
- Object detection holds great potential in assisting individuals with visual impairments in recognizing items showcased on store shelves, understanding labels, and distinguishing between different products.
- By integrating object detection algorithms with optical character recognition (OCR) technology, individuals with visual impairments can receive assistance in interpreting text present in their surroundings, such as signs, menus, and documents.

VI. ADVANTAGES

- Improved Navigation: Object detection technology has the potential to greatly enhance the navigation experience for visually impaired individuals. By accurately detecting and identifying obstacles, pedestrians, and other objects in their path, it enables them to navigate their surroundings more safely. Furthermore, the ability to localize these objects provides precise information on their location relative to the user, further improving their navigation capabilities.
- Enhanced Safety: One of the key benefits of object detection systems is their ability to detect potential hazards in real-time. This includes identifying moving vehicles, drop-offs, and obstacles on the ground. By promptly alerting the user to these hazards, object detection systems can help prevent accidents and injuries, thereby enhancing overall safety.
- Increased Independence: Object detection technology empowers visually impaired individuals to become more independent in various tasks. Whether it's shopping, traveling, or exploring new environments, they can rely on the information provided by the object detection system to gain a better understanding of their surroundings. This reduces their dependence on assistance from others, allowing them to navigate and engage with the world around them with greater confidence and autonomy.

VII. RESULTS

The main aim of the proposed system is to assist individuals who have visual impairments by giving them a perception of their surroundings. This allows them to navigate and avoid obstacles or barriers while moving from one place to another. The system has successfully accomplished its objective of

providing a straightforward, user-friendly, and convenient solution. It is capable of quickly and accurately detecting objects in both indoor and outdoor settings. Additionally, the system effectively identifies multiple objects in the surrounding area and conveys this information to the user through audio output using headphones or speakers. Thorough testing has been conducted on the system's ability to detect objects in indoor and outdoor environments, as well as objects situated more than 10 meters away from the camera.

VIII. FUTURE SCOPE

There is significant room for progress in this project. By integrating sensors into the system, we can accurately measure the temperature of an object, helping us ascertain its warmth or coolness. This function would provide a safety measure for the user. Furthermore, the project could be extended to include a GPS function for better navigation. Moreover, the system could be applied in robotics to imitate human movements and conduct. Additionally, it could be improved to function in outdoor settings, allowing it to not just detect objects but also recognize and maneuver around barriers.

The system can also be used in robotics which can act and behave the same like human and also can be further extended for the outdoor environment purpose in which it can not only detect objects but also detect any obstacles that come in their way

IX. CONCLUSION

Recently, there have been significant advancements in assistive technologies designed to assist individuals with visual impairments in detecting objects and navigating their surroundings. However, many of these solutions are expensive, complicated to use, and require specialized training. Our primary goal is to provide visually impaired individuals with an affordable, user-friendly, and portable assistive device that enables them to gain a better understanding of their environment and move independently. By utilizing real-time video streaming from a smart phone camera and employing object detection algorithms, our device can audibly communicate object labels to the user through speakers or headphones. This audio feedback greatly aids users in their daily activities and improves their overall quality of life.

X. REFERENCES

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[4] Anitha J, Subalaxmi A, and Vijayalakshmi G published a paper in 2019 on real-time object detection for visually challenged individuals. The study was featured in the International Journal of Innovation in Technology and Exploration Engineering.

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