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A Survey on Guidance System for People with Limited Visionor No Vision

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Abstract: The system developed is a device that helps visually impaired patients to lead an independent life. This system is integrated with voice commands. The input to the system is a real-time scenery and the output is the voice output of the names of the recognized objects. Avoiding obstacles is the main goal of our project so that the life of the visually impaired person can be led safely. The algorithm used is YOLO (You Only Look Once).

The YOLO algorithm uses a single neural network to simultaneously predict bounding boxes and class probabilities for multiple objects within an image. Keywords: YOLO, Object recognition, Voice command integration. The proposed system employs YOLO model trained on large datasets to recognize a wide range of everyday objects, including household items, food products, navigation aids, and more. Upon detecting an object through the camera feed, the system provides audio feedback through speech synthesis, conveying information about the recognized object to the user in a clear and concise manner.

User feedback and iterative improvements are fundamental to the system's development, ensuring its effectiveness and usability for individuals with diverse visual impairments. Moreover, the system's design prioritizes simplicity, portability, and affordability, aiming to make it accessible to a broader population of visually impaired individuals. object recognition system represents a vital step toward empowering the visually impaired community by providing them with a reliable and intuitive tool to better navigate and interact with their environment.

Keywords: YOLO, Object recognition, Voice commands, Real-time

I. INTRODUCTION

For many with visual impairments, navigating the environment poses substantial obstacles, often leading to feelings of isolation and dependency due to limited access to visual information. However, recent technological strides offer a beacon of hope, empowering these individuals by enhancing their independence and communication abilities.

Advanced technologies leveraging computer vision decode and convey crucial information about the surroundings to the visually impaired. Object recognition systems go beyond merely identifying objects; they audibly communicate details like an object's presence, shape, and location, enabling users to interact more confidently with their environment. The integration of currency recognition further amplifies independence by facilitating seamless financial transactions.

Additionally, symbolic communication tools such as Braille writing and gesture detection serve as alternate channels for expression and comprehension. These innovations extend beyond basic object recognition, providing avenues for nuanced interaction and communication, effectively addressing the communication barriers frequently encountered by the visually impaired.

The essence lies in amalgamating these technologies with voice command interfaces, offering real-time auditory feedback. This integration goes beyond passive perception, empowering users to actively engage with their surroundings, fostering autonomy, and reducing dependence on external assistance.

The envisioned outcome isn't just an enhancement in functionality but a profound shift toward a more enriching and self-empowered life for individuals with visual impairments. The relentless pursuit of progress continues to propel the field forward, promising a future where the gap between the unseen and the understood is bridged, creating an era characterized by inclusivity and accessibility for all. This relentless pursuit of progress promises a future where the gap between the unseen and the understood is bridged, creating an era characterized by inclusivity and accessibility for all.

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II. LITERATURE SURVEY

TABLE I. LITERATURE SURVEY

SI NO.	YEAR	TITLE	DESCRIPTION	ADVANTAGES	DISADVANTAGES
1	2023	Object Detection and Recognition System Using Deep Learning Method	Object detection has been studied by many researchers for important applications in the industry like detecting a road object for self-driving cars, medical research for detecting particular diseases, gesture control, etc. Object detection and recognition is incredibly very important with respect to security purposes.	Feature learning on the fly. Efficient way to handle big complicated data. Adaptability and Scalability.	Consumes massive amount of power. Expensive. Lack of transparency.
2.	2023	Object Recognition based on Deep Learning Algorithms using Embedded IoT with Interactive Interface	Compares performance of YOLO and Faster RCNN based on a custom dataset containing different objects and items. The learning part has a raspberry pi device which has a camera module that captures real-time footage, recognizes the object and reads out its name in the language the user is learning.	Cost Saving. Data Monitoring made easier. Better Time Management.	Resources and adaptability is limited. Standardization and support is lacking.
3.	2023	Object Detection and Video Analyzer for the Visually Impaired	A number of changes to different YOLO versions were made in order to develop object recognition model efficiently. The proposed paradigm in this research can aid visually impaired individuals in developing a sense of their environment. It might be difficult to both see and feel what is going on around you if you have vision impairment of any kind. It's challenging to move around and carry out tasks on one's own.	Speed is the key factor to achieve real time implementation and YOLO is known for speed hence the detection speed is higher.	Truly difficult to detect small objects that appear in groups. It does not generalize well on new, unseen data.

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4.	2022	CNN-Based Object Recognition and Tracking System to Assist Visually Impaired People	This research introduces a groundbreaking smart system tailored for VIPs, providing real-time navigation assistance, privacy-conscious location sharing, and family monitoring through a web-based application. The combination of advanced technologies, including automated voice navigation and deep learning for object detection, positions this system as a significant advancement in addressing the unique challenges faced by visually impaired individuals.	Weights are shared and computation is minimized. Handles large datasets. Feature extraction is automated.	Interpretability challenges. Training takes longer time. Much slower computation.
5	2021	A Systematic Review on Product Recognition for Aiding Visually Impaired People	This paper contributes a systematic review of assistive systems, specifically focusing on the challenging task of object recognition for visually impaired individuals. The evaluation of techniques considers their efficiency and adaptability to hardware constraints, setting the stage for the development of practical, wearable, and IoT- integrated assistive product recognition systems.	Reduced costs. Improved operational efficiency. Resource visibility.	Privacy concern and power dependency.
6	2022	Smart Assistive System for Visually Impaired People Obstruction Avoidance Through Object Detection and Classification	This research addresses the challenges faced by visually impaired individuals through the development of a wearable framework for obstacle detection and scene classification. The integration of Raspberry Pi, a camera, and ultrasonic sensors, along with sophisticated algorithms, offers a low-cost and accessible solution to enhance the daily routines of visually impaired individuals.	Small, low-cost, and versatile computer that can run various operating systems	There's no room for full- size ports
7.	2022	Assistive Devices Analysis for Visually Impaired Persons: A Review on Taxonomy	The paper offers a holistic view of the state-of-the-art assistive devices for VIPs, acknowledging the global prevalence of visual impairments. The focus on categorization, attributes, challenges, and a score-based quantitative analysis contributes to a better understanding of the capabilities and limitations of existing technologies, facilitating informed decisions in choosing assistive devices for visually impaired individuals in various contexts.	Adaptable for different individuals on the basis of the purpose of use.	Not suitable for general purpose

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8.	2018	3-D Object Recognition of a Robotic Navigation Aid for the Visually Impaired	This paper introduces a 3- D object recognition method implemented in a robotic navigation aid, emphasizing real-time detection of indoor structural objects crucial for the navigation of visually impaired individuals. The method's reliance on geometric context, scalability, and parallelism make it a robust and efficient solution, as evidenced by its high success rate in experimental trials.	The entire shape of the object is taken into consideration. Robust.	Lack of depth of complete information. Camera sensors are vulnerable to bad weather conditions.
9.	2019	An Astute Assistive Device for Mobility and Object Recognition for Visually Impaired People	The NavCane emerges as a promising and multifunctional electronic assistive device, offering enhanced capabilities for visually impaired individuals in terms of obstacle detection, pathfinding, and object recognition, ultimately contributing to improved autonomy and safety in daily activities.	Detection of both indoor and outdoor obstacles.	The system might not identify hazards or objects situated above waist or head level.

III. OBJECTIVES

Obstacle avoidance
Real-Time implementation Currency detection
Object recognition

IV. METHODOLGY

YOLO (You Only Look Once) algorithm focuses on object detection rather than traditional feature extraction methods. It divides the input image into a grid and predicts bounding boxes and class probabilities directly using a single neural network. This network simultaneously predicts multiple bounding boxes and their corresponding class probabilities within grid cells. While YOLO doesn't employ explicit feature extraction steps like traditional methods (SIFT, HOG, etc.), it uses convolutional neural networks (CNNs) to automatically learn and extract features from the input image during its processing. The CNN layers in YOLO play a significant role in automatically learning and extracting meaningful features that help in detecting objects within the image. These features are subsequently used to identify and localize objects efficiently like never before. The demonstration is as shown in fig. I.

Input Division into Grid:
The input image is divided into a grid of cells. YOLO takes the entire image and splits it into a predefined number of cells. Each cell is responsible for detecting objects within its boundaries.

Bounding Box Prediction:
Each grid cell predicts bounding boxes. These boxes define objects' boundaries and include coordinates (x, y, width, height) alongside confidence scores and class probabilities.

Class Prediction:
YOLO predicts class probabilities for each bounding box, assigning labels/categories to detected objects (e.g., person, car, dog) to determine what object the bounding box encapsulates.

Non-Maximum Suppression (NMS):
To eliminate redundant or overlapping bounding boxes, NMS is applied. It retains the most confident predictions, filtering out duplicates.

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Post-Processing:
The final output comprises bounding boxes, class labels, and confidence scores for detected objects.

These steps enable YOLO to efficiently and accurately detect multiple objects within an image in real-time, all processed within a single neural network. Variants like YOLOv3, YOLOv4, etc., introduce improvements to enhance accuracy, speed, and robustness in object detection tasks.

Why the opted method is better than the traditional one?

Traditional Classification:
Traditional Classification focuses on classifying the entire image, not localizing objects within it. They predict a single label for the entire image without specifying where objects are located.

The algorithms may be slower as they need to scan the entire image several times at different scales for multi-scale object detection.

Traditional algorithms classify an entire image, which means they might struggle with detecting and localizing multiple objects simultaneously.

YOLO Classification:
Performs object localization and classification simultaneously. It divides an image into a grid, predicts bounding boxes, and assigns class probabilities within these grid cells, providing precise object locations.

Known for its speed, YOLO processes images in real-time due to its single-pass architecture, making it suitable for applications requiring quick object detection.

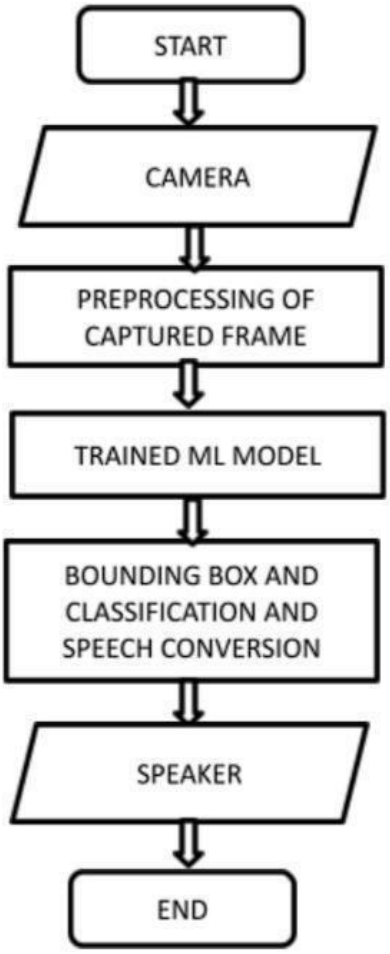

FIG I. WORK FLOW OF YOLO

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V. APPLICATION REQUIREMENTS

1. Tensor flow

TensorFlow is an open-source machine learning framework developed by Google. It's designed to build, train, and deploy machine learning models, primarily focusing on neural networks. TensorFlow serves as a powerful tool for implementing machine learning models, especially neural networks, and has contributed significantly to the widespread adoption of deep learning in both research and practical applications.

2. Pandas

Pandas is a popular open-source Python library used for data manipulation and analysis. It offers powerful and flexible tools for working with structured data, primarily in the form of tables (similar to spreadsheets or SQL tables). Pandas is widely used in data analysis, data preprocessing, feature engineering, and exploratory data analysis (EDA) tasks in various domains such as data science, finance, research, and more. Its intuitive and powerful tools make it a go-to library for handling structured data in Python.

3. Numpy

NumPy is widely used in scientific computing, data analysis, machine learning, and other requiring numerical operations and handling multi-dimensional data structures. Efficient array processing capabilities and extensive functionalities make it a crucial component in the Python ecosystem for numerical computations. It becomes more useful adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these array.

4. Keras

Open sources software for artificial neural networks and machine learning. It is the interface for the Tensorflow library. It is user friendly, Modular and extensible. It Supports other common utilities like dropout, batch normalization, and Pooling.

5. Sklearn

Sklearn is a free software library for the python programming language. The main process of this library is clustering, regression and classification. For doing this process some of the algorithms like SVM(Support Vector machine), gradient boosting, K-means and DBSCAN. And designed to interoperate using the numpy and pandas libraries.

6. Matplotlib

Matplotlib is a plotting library for plotting graphs like bar graphs, pie chart, etc. it is used for embedding plots into applications using general purpose GUI toolkits like Tkinter, wxPython, Qt, or GTK. It provides the object oriented API. We can make use of Matplotlib.

7. Sci-kit

Scikit-learn, commonly referred to as sklearn, is an open-source machine learning library for Python. It provides a wide range of tools for various machine learning tasks, including classification, regression, clustering, dimensionality reduction, model selection, and preprocessing. Scikit is widely used in academia and industry for tasks ranging from exploratory data analysis and feature engineering to building and deploying machine learning models due to its ease of use, robustness, and extensive functionalities.

8. SimpleITK

SimpleITK is a simplified interface to the Insight Segmentation and Registration Toolkit (ITK) for medical image analysis. It's a Python wrapper around the powerful ITK library, providing an easier and more user-friendly interface for working with medical imaging data.

9. OpenCV

Open Source Computer Vision Library, is a popular open-source computer vision and machine learning software library. It offers a wide range of tools and functionalities for real-time computer vision tasks, image and video processing, and machine learning.

VI. RESULTS

The accuracy of currency detection results depends on the quality of the training data, the performance of the detection model, and factors such as image quality, variations in currency appearance, and lighting conditions. These results are crucial in applications such as currency recognition systems in ATMs, automated cash handling machines, or in financial applications where quick and accurate currency identification is required. Object detection for visually impaired

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individuals aims to provide information about the surrounding environment through auditory or tactile feedback. The results of object detection in this context typically involve:

Object Identification: Recognizing and identifying various objects or obstacles present in the surroundings. This includes detecting common objects like chairs, tables, doors, stairs, pedestrians, etc.

Location and Distance: Determining the location and approximate distance of detected objects concerning the user. This information helps in spatial awareness and navigation.

Feedback Output: Conveying information about the detected objects to the visually impaired person through auditory cues (such as spoken descriptions or beeps with varying frequencies indicating object proximity) or tactile feedback (like vibrations or textures on wearable devices).

Real-time Updates: Continuous updates on the environment, detecting and notifying the user of new objects or changes in the surroundings as they move.

User Interface: Providing a user-friendly interface that allows for easy interaction and interpretation of the information received from the object detection system.

The goal is to create an assistive technology that enhances the independence and safety of visually impaired individuals by providing them with real-time information about their surroundings, aiding in navigation and everyday tasks. The effectiveness of such systems lies in their accuracy, reliability, and the ability to deliver timely and easily interpretable information to the user.

VII. CONCLUSION

- From the developed system it is strongly concluded that the visually impaired person is now able to lead an independent life.
- They can also do their roles and duties as every other normal person without dependency. They can now be more cautious while doing their day-to-day activities.
- The objects surrounding them will be detected and the same is being output through voice commands.

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