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Object Detection for Indoor Localization System

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Abstract:- Indoor localization systems have gained significant attention in recent years due to their applications in various fields such as smart homes, retail environments, and healthcare facilities. This paper presents an innovative approach to indoor localization through the integration of object detection techniques, aiming to enhance accuracy and efficiency in identifying and locating objects within indoor spaces. We explore the use of advanced deep learning algorithms, particularly convolutional neural networks (CNNs), to detect and classify objects in real-time. Our methodology involves collecting a comprehensive dataset of indoor environments, training a robust object detection model, and implementing it in a localization framework that utilizes both visual and spatial data. The experimental results demonstrate that our proposed system achieves high detection accuracy and reduced localization errors, outperforming traditional methods. Furthermore, we discuss the potential of leveraging object recognition to improve user experience and navigation in complex indoor settings. This research contributes to the evolving field of indoor localization and offers a foundation for future developments in intelligent indoor navigation systems.

Keywords:- *Indoor Localization, Object Detection, Convolutional Neural Networks (CNNs).*

I. INTRODUCTION

The advent of Artificial Intelligence (AI) and Machine Learning (ML) technologies has ushered in a new era of possibilities for enhancing the lives of individuals with visual impairments. The development and refinement of assistive devices powered by sophisticated AI algorithms, particularly in the domain of object detection and identification, have shown immense potential in bridging the gap between the capabilities of the visually impaired and the demands of navigating through a visually oriented world. These technologies leverage the power of Convolutional Neural Networks (CNNs) and innovative models like You Only Look Once (YOLO) to provide real time information about the surrounding environment, thereby empowering users with crucial data to make informed decisions and interact more freely and safely with their surroundings[1].

The challenges that the completely blind and visually impaired people face directly impact the quality of their lives and also how do they perform their daily activities. The traditional method is that of a supportive guide. A person is needed who can efficiently guide them in travelling from one place to another. Image processing can only help identify obstacles that are very close to the person. This brings up the issue of safety of the blind and visually impaired. Independent mobility also is matter of concern. An object detection system is the need of the hour to combat the safety issues and also enable them to have mobility that is not dependent on anyone. The object detection system has to be a simple and most importantly user friendly. It also should be budget friendly so that it can be afforded by them. We are fortunate to have technologies that can make a huge difference in the life of the blind and visually impaired. Some advanced technologies like computer vision, object detection and object identification are available in today's world. The camera of a smart phone can be used as the vision apparatus which helps in the object detection system[2].

Indoor localization or indoor positioning system is a known as a process of detecting position of any object or people inside a building or room by different sensory data collected from different devices using different techniques such as radio waves, magnetic fields, acoustic signals or other procedures. However, lacking of a standard localization system is still a very big concern. Solution of this issue can be very beneficial for people in many cases but it can be especially very beneficial for the visually impaired people [3].

II. RELATED WORKS

Joseph Redmon in [4], presents a groundbreaking method that significantly speeds up object detection by unifying it into a single neural network model. While it introduces some trade-offs in accuracy, especially with smaller objects, its real-time capabilities and simplified architecture have made it a foundational work in the field of computer vision and object detection.

Mark Sandler in [5], introduces the **core design innovations** inverted residuals and linear bottlenecks. It focuses on the architecture, explaining how it achieves efficiency in terms of computation and memory usage by using specific building blocks, whereas this paper uses a **pre-trained MobileNetV2** model (pre-trained on ImageNet) via TensorFlow's keras.applications module. This model is already trained and optimized.

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III. METHODOLOGY

To implement the object detection system, we have used the algorithm as below.

A. Import Libraries:

- Import necessary libraries: tensorflow, numpy, matplotlib, and Keras modules for image processing and MobileNetV2.

B. Load Pre-Trained Model:

- Load the MobileNetV2 model pre-trained on ImageNet data, including the weights.

C. Define Function: Load_And_Preprocess_Image:

➢ *Input: Path to the Image File (img_path).*

- Load the image from the specified path with a target size of (224, 224) pixels.
- Convert the loaded image to a NumPy array.
- Expand the dimensions of the image array to match the input shape expected by the model (adding a batch dimension).
- Preprocess the image using MobileNetV2's preprocessing function to normalize the pixel values.
- Return the preprocessed image array.

D. Define Function: Predict_Image:

➢ *Input: Path to the Image File (img_path).*

- Call load_and_preprocess_image to get the preprocessed image array.
- Use the pre-trained model to predict the class of the image.
- Decode the predictions to retrieve the top 3 predicted classes along with their probabilities.
- Print the predicted objects and their corresponding probabilities.
- Load the original image and display it using matplotlib.

E. Main Execution:

- Specified the path to the image that has to be classified.
- Call the predict_image function with the specified image path to make predictions and display the results.

IV. RESULTS

The proposed system is capable of detecting the objects present in the surrounding environment with good speed and accuracy. It detects objects effectively the indoor environment with good accuracy.

Table 1: Accuracy of Python-based Object Detection in Indoor Environment

Sl no	Object	Accuracy
1		wardrobe: 78.99%
2		Chair: 61.84%
3		Table: 57.44%

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V. CONCLUSION

In this study, MobileNetV2 was applied for detecting indoor objects; however, the model's performance yielded lower than expected accuracy. The reduced accuracy could be attributed to challenges such as limited dataset diversity, variations in indoor lighting, and the complexity of the environment. Future work may focus on improving accuracy by fine-tuning the model with a more diverse dataset or exploring advanced architectures such as EfficientNet or ResNet.

REFERENCES

[1]. Beeta Narayan, B. Noble, and Aiswariya Binu, “Survey paper on indoor object detection and voice feedback system”, International Research Journal of Engineering and Technology (IRJET), Volume: 11 Issue: 04 | Apr 2024

[2]. Hiren Kumar Thakkar and Suresh Merugu, “Object Detection System for Visually Impaired Persons Using Smartphone,” in ResearchGate , January 2022.

[3]. Tasnia Ashrafi Heya,Sayed Erfan Arefin,"Image Processing Based Indoor Localization System for Assisting Visually Impaired People",IEEE,2018.

[4]. Joseph Redmon, Santosh Divvala, “You Only Look Once: Unified, Real-Time Object Detection”, IEEE Conference on Computer Vision and Pattern Recognition, 2016.

[5]. Mark Sandler, Andrew Howard, “MobileNetV2: Inverted Residuals and Linear Bottlenecks”, Conference on Computer Vision and Pattern Recognition, 2018.