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A Minor Project Report on

SMART ASSIST REAL-TIME OBJECT DETECTION AND VOICE NOTIFICATION FOR THE VISUALLY CHALLENGED PEOPLE

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BONAFIDE CERTIFICATE

Certified that this Report titled **"SMART ASSIST REAL-TIME OBJECT DETECTION AND VOICE NOTIFICATION FOR THE VISUALLY CHALLENGED PEOPLE"** is the Bonafide work of **GOWTHAM R (927622BEE036), HARISH T S(927622BEE039), JEYANTHRAGAV K(927622BEE047),HARISH S(927622BEE303)** who carried out the work during the academic year (2024-2025) under my supervision. Certified further that to the best of my knowledge the work reported here in does not form part of any other project report.

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Submitted for Minor Project IV (18EEP302L) viva-voce Examination held at M Kumarasamy College of Engineering, Karur-639113 on ……...

DECLARATION

We affirm that the Minor Project IV report titled "**SMART ASSIST REAL TIME OBJECT DETECTION AND VOICE NOTIFICATION FOR THE VISUALLY CHALLENGED PEOPLE"** being submitted in partial fulfillment for the award of **Bachelor of Engineering in Electrical and Electronics Engineering** is the original work carried out by us.

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VISION AND MISSION OF THE INSTITUTION

VISION

- ✓ To emerge as a leader among the top institutions in the field of technical education

MISSION

- ✓ Produce smart technocrats with empirical knowledge who can surmount theglobal Challenges.
- ✓ Create a diverse, fully engaged, learner - centric campus environment to provide Quality education to the students.
- ✓ Maintain mutually beneficial partnerships with our alumni, industry and Professional associations.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To produce smart and dynamic professionals with profound theoretical and practical knowledge comparable with the best in the field.

MISSION

- ✓ Produce hi-tech professionals in the field of Electrical and Electronics Engineering by inculcating core knowledge.
- ✓ Produce highly competent professionals with thrust on research.
- ✓ Provide personalized training to the students for enriching their skills.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

- ✓ **PEO1:** Graduates will have flourishing career in the core areas of Electrical Engineering and allied disciplines.
- ✓ **PEO2:** Graduates will pursue higher studies and succeed in academic/research careers.
- ✓ **PEO3:** Graduates will be a successful entrepreneur in creating jobs related to Electrical and Electronics Engineering /allied disciplines.
- ✓ **PEO4:** Graduates will practice ethics and have habit of continuous learning fortheir success in the chosen career.

PROGRAMME OUTCOMES(POs)

After the successful completion of the B.E. Electrical and Electronics Engineering degree program, the students will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of solutions:

Design solutions for Complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES(PSOs)

The following are the Program Specific Outcomes of Engineering Students:

- **PSO1:** Apply the basic concepts of mathematics and science to analyses and design circuits, controls, Electrical machines and drives to solve complex problems.
- **PSO2:** Apply relevant models, resources and emerging tools and techniques to provide solutions to power and energy related issues & challenges.
- **PSO3:** Design, Develop and implement methods and concepts to facilitate solutions for electrical and electronics engineering related real-world problems.

Abstract (Key Words)	Mapping of POs and PSOs
Object Detection Software Using Python, Camera Setup.	PO1, PO2, PO3, PO4, PO5,PO6,PO7,PO8, PO9, PO10, PO11,PO12, PSO1,PSO2,PSO3.

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ABSTRACT

Portable assistive technology systems are developed to enhance the capability of persons with disabilities. One of the most important senses for humans is vision. Vision is the most important sense which helps us in understanding the perception of the surrounding environment. Visually impaired persons face a lot of difficulty in understanding the perception around them, particularly in outdoor environment where objects are continuously changing and moving from one place to another. Object detection solutions would greatly assist visually impaired persons in avoiding from the barriers which they face in their daily routine life. The aim of the object detection system is to provide a simple, user-friendly, handy, economical and efficient solution for the visually impaired persons. Motive of this system is to develop a solution that detects the objects present using camera, as the input device in real time and communicate the same to the user using smartphone through headphones. The system would be developed in hardware as an audio device such as speakers or headphones in providing the information about objects to assist the visually impaired persons. The proposed system helps in identifying and avoiding the objects both in outdoor and indoor environments that affect day to day life activities and occupational performance of the visually impaired persons. The information about the objects in surrounding environment would be very much helpful to the visually impaired persons in their daily life.

CHAPTER 1

INTRODUCTION

Our prime concept is to simplify the lives of people affected visually by translating the perceptible surroundings around them into audio comments such that they can understand what is going on around them. Visual impairment is a serious cause that segregates people from the basic way of survival in times like these, making them go devoid of various opportunities and general chores that people don't even pay proper heed to. However, with the advent of technology and the technological revolution, the life of visually impaired people can be made comparatively smoother, helping them experience their surroundings in the most optimal process. Thus, for our proposed concept and to reach our required objective, we shall be using the aforementioned domain in ways that shall be explained hereunder. The fourth Industrial revolution that is also known as the technological revolution has almost gasped our industry. The foremost technology that is turning this revolution into reality is Artificial Intelligence, either it is in the form of Machine Learning or Deep Learning. There are many areas in the Machine Learning domain such as Speech Recognition, computer vision, and natural language processing. With the humongous availability of data around the world, it has become comparatively easier to train the algorithm, manipulate it and use it accordingly. In this project, our prime concept is to simplify the lives of people affected visually by translating the perceptible surroundings around them into audio comments such that they can understand what is going on around them. Visual impairment is a serious cause that segregates people from the basic way of survival in times like these, making them go devoid of various opportunities and general chores that people don't even pay proper heed to.

CHAPTER 2

LITERATURE REVIEW

2.1 OBJECT FRAMEWORK USING OPEN CV

Source:

Bumika, Gupta (2017) et al., is a well-known computing technology related to computer vision and image processing.

Inference:

It is used to recognize specific classes (humans, flowers, animals, etc.) in digital images and videos. It focuses on recognizing objects or their instances. There are several well-studied applications of object recognition, such as facial recognition, character recognition, and vehicle computers. Object detection can be used for a variety of purposes, including searching and monitoring. This study introduces some basic concepts used in object detection using the Python 2.7 OpenCV library to improve the efficiency and accuracy of object detection.

2.2 Integration of OpenCV with Python for Real-Time Systems

Source:

Rosebrock, A. (2018). "*Practical Python and OpenCV": An Introductory Computer Vision Book*. PyImage Search.

Inference:

Python's simplicity allows seamless integration with OpenCV for creating user-friendly assistive applications. Key features like the Haar Cascade Classifier and DNN modules facilitate the detection of everyday objects. Python's extensive ecosystem also supports integration with other libraries, such as NumPy for mathematical computations and matplotlib for visualization, enhancing the development process.

2.3 Real-Time Object Recognition for Smart

Assistance Source:

Sandhan, K., et al. (2020). "*Real-Time Assistive System for the Visually Impaired using OpenCV and Raspberry Pi"*. IEEE Conference on Smart Systems.

Inference:

This study focuses on the development of a low-cost Arduino-based system for protecting small-scale transformers. It explains how sensors such as current transformers (CTs) and voltage dividers can be used to detect overload conditions. The system's key advantage is its ability to protect transformers at a fraction of the cost compared to industrial- grade systems. The research also emphasizes the ease of installation and programming, which makes it a viable solution for rural and small industrial applications. The study concludes that the Arduino-based system provides sufficient reliability and efficiency for small to medium transformers.

2.4 Obstacle Detection -OpenCV

Source:

Agarwal, A., et al. (2021). "*Obstacle Detection and Navigation for Blind Users Using OpenCV"*. International Journal of Computer Applications.

Inference:

Combining object recognition with obstacle detection improves navigation for blind users. This research utilizes OpenCV's contour and edge detection methods to identify obstacles and guide users effectively. The dual approach of recognizing objects and detecting obstacles simultaneously enhances safety and allows for a seamless interaction between the user and their environment.

2.5 Speech Feedback Integration

Source:

Rathod, P., & Chavan, S. (2022). "*Text-to-Speech in Real-Time Object Recognition for Blind Assistance"*. Journal of Assistive Technologies.

Inference:

Using Python libraries such as pyttsx3 and gTTS alongside OpenCV enhances interaction by providing real-time speech output, allowing users to understand their surroundings intuitively. This integration also ensures that the system remains adaptable for multiple languages and contexts, thereby broadening its usability for diverse user groups.

CHAPTER 3
EXISTING SYSTEM

Object Detection Through Wearable Devices:

A compact, wearable device mounted on glasses, capable of reading text, recognizing faces, and identifying objects through AI-powered object detection. Smart glasses equipped with object recognition, text-to-speech, and navigation features. The glasses use AI to assist users in real-time.

Smartphone-Based Applications:

A free AI-powered app designed to help visually impaired individuals by detecting objects, reading text, and identifying people through smartphone cameras. Though not fully AI-based, this app connects blind users with volunteers or agents who assist them in identifying objects or reading text using the smartphone's camera. A similar app to Seeing AI, Google Lookout detects objects, reads text, and provides navigation help through the phone's camera.

AI-Powered Object Detection Models:

YOLO (You Only Look Once):

Frequently used in real-time object detection systems, YOLO is a deep learning-based algorithm capable of identifying objects quickly and accurately in images and videos. It is the backbone for many custom systems developed for blind assistance.

SSD (Single Shot MultiBox Detector):

Another deep-learning-based object detection algorithm used in custom projects for blind users. It's fast and often used in embedded systems.

CHAPTER 4

PROPOSED METHODOLOGY

4.1 FLOW CHART OF OBJECT DETECTION FOR VISUALLAY CHALLENGED PEOPLE

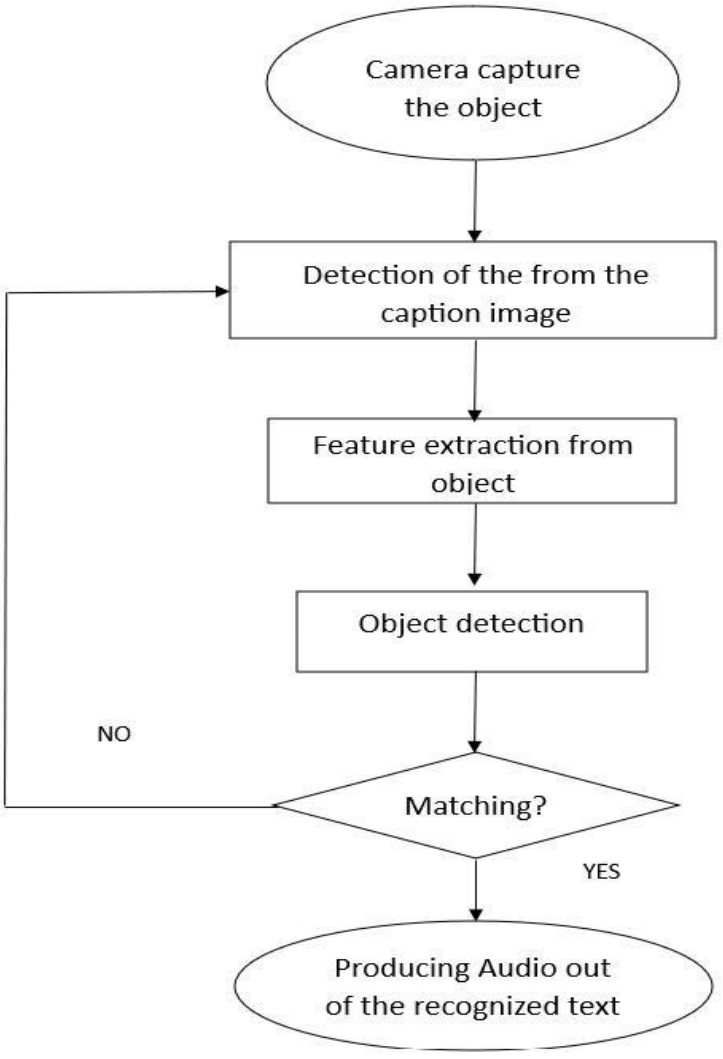

Fig No 4.1 Flow Chart of Object Detection for Visually challenged people

4.2 DESCRIPTION

This project aims to develop an assistive object detection system for visually impaired individuals using OpenCV, Python, and machine learning techniques. The system leverages computer vision to identify and analyses objects in real time, providing immediate feedback through audio output to enhance user awareness and mobility. Utilizing pre-trained machine learning models, such as YOLO or SSD, the system processes visual data captured through a camera to detect obstacles, recognize objects, and determine their relative positions. Developed in Python, the system integrates OpenCV for image processing, object tracking, and feature extraction, ensuring efficient and reliable performance. The audio feedback system, implemented using text-to-speech libraries, allows users to receive clear descriptions of their surroundings. To ensure seamless operation, the system employs optimized code and lightweight machine learning models for fast and efficient processing, even on resource-constrained devices. It can be equipped with additional features such as object distance estimation to give users a sense of spatial depth. The modular design allows easy integration with advanced technologies like LIDAR for enhanced obstacle detection or AR glasses for visual alerts, broadening its utility. Security measures, such as encrypted data transfer and user authentication, ensure privacy and safe usage in connected environments. The system is designed to adapt to varying light and weather conditions, enabling consistent performance across diverse scenarios. By incorporating multilingual support, it becomes accessible to a global audience, further enhancing its impact. With future advancements, this project could explore integration with wearable sensors for gesture control or integration with IoT systems for home automation, providing a holistic assistive solution for visually impaired individuals.

4.3 PROJECT OUTCOME

This project is developed and structured using various python libraries for working with various domains of Machine Learning, such as speech recognition, computer vision, natural language processing. The whole project is made in Jupyter Notebook, which is a very usable platform for projects like such. The project can be implemented after the successful implementation of OpenCV 3.4+. Since OpenCV 4 is still in beta right now and the official release has not been initiated yet, it is safer to use the version 3 of the OpenCV library. Apart from that, we need to install the YOLOv3 training dataset and MS COCO dataset to start our project implementation. The system we proposed here is used for blind for their guidance for location through a voice based guidelines. A variety of object detection techniques is used using the YOLOv3 algorithm which shall be explained further and the detected output is translated to audio for audio feedback. Implementing the same on a video based input meets the objective output that we have set to plan out. The need for identifying objects in the surroundings among blind people and a broader look at the advanced technology available in today's world is the reason to develop this project. Object recognition is one of the fundamental tasks in computer vision. It is the process of finding or identifying instances of objects (for example faces, dogs or buildings) in digital images or videos. Globally, the causes of vision impairment are cataract, uncorrected refractive errors, trachoma, diabetic retinopathy, corneal opacity, age related muscular degeneration and eye injuries. It limits visually impaired people to navigate and perform everyday tasks. The objective of the project is to design and implement a system that captures the user's environment through a camera module. The images that are captured are transformed to Raspberry pi and it is analyzed using Haar Cascade and SSD Model. Then the recognized objects are given to the user via audio through a speaker or bluetooth headset. The image data is transferred to data server for further use.

The model is conducted initially through OpenCV. Using OpenCV, the surrounding around the user can be evaluated. Upon receiving this input the algorithm is triggered and the input gets divided into frames and subsequent functions of the algorithm proceeds to detect objects around the user and thereby recognize those objects in real time along with audio feedback of the name of the objects.

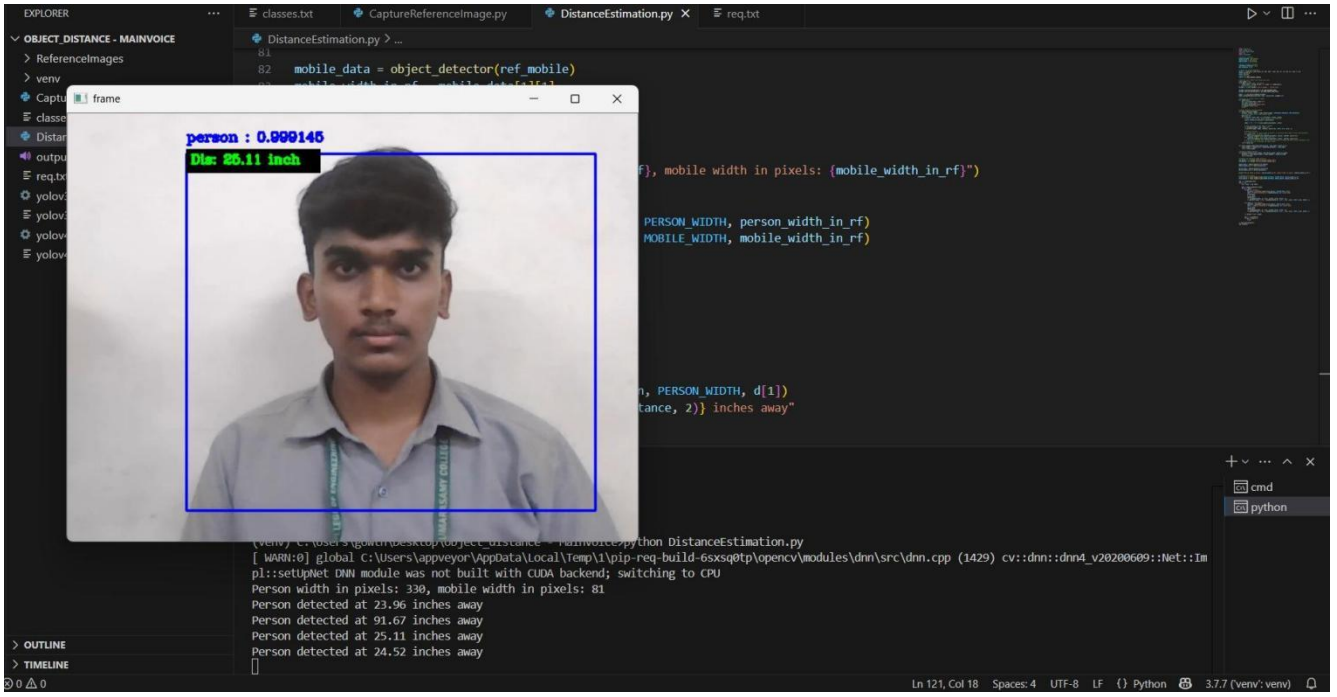

Fig No 4.2 Outcome of Object Detection for Visually challenged people

The proposed system aims to utilize Python and relevant libraries such as OpenCV and TensorFlow for object detection and distance finding. This system can be utilized for various applications such as surveillance, robotics, social distancing monitoring, etc.

KEY COMPONENTS:

Object Detection Model:

Utilize pre-trained deep learning models like YOLO (You Only Look Once), SSD (Single Shot MultiBox Detector), or Faster R-CNN for object detection. These models are available in libraries like TensorFlow and OpenCV. Fine-tune the pre-trained models if necessary to suit the specific requirements of the application.

Camera setup:

Utilize cameras (webcams, IP cameras, or surveillance cameras) for capturing the live video feed. Ensure the cameras are positioned strategically to cover the target area effectively.

Distance estimation:

Implement algorithms to estimate the distance between detected objects and the camera. This can be done using techniques like triangulation, depth estimation from stereo images, or perspective transformation. Calibrate the camera if necessary to improve the accuracy of distance estimation.

CHAPTER 5

5.1 CONCLUSION:

In this project, we have developed a functional prototype capable of detecting and recognizing objects in the surrounding environment and providing real-time audio feedback with minimal user effort, aimed specifically at assisting individuals with visual impairments. Visual disability poses significant challenges in daily life, from navigating safely to performing routine tasks independently, and while we may not be able to restore vision, this project demonstrates how technology can be used to partially substitute it through intelligent assistance. By integrating object detection, machine learning, sensor technology, and voice output, the system acts as an aid that helps visually impaired users interpret their surroundings more effectively. The project reflects the practical application of interdisciplinary knowledge, involving continuous learning and innovation, and the resulting prototype stands as a proof of concept that such assistive systems are both feasible and impactful. Though there are numerous enhancements envisioned for the future—such as navigation support, obstacle avoidance, and voice command features—the current model lays a strong and scalable foundation for further development. More than just a technical solution, this project represents a step toward inclusive innovation, driven by empathy and a desire to improve the quality of life for those affected by visual impairment. The system was tested under various lighting and object conditions to ensure reliability and consistency, and the audio feedback is designed to be immediate and clear, enhancing the user's situational awareness. Considerations for power efficiency and portability have also been incorporated to make the device practical for everyday use. This work highlights the transformative potential of combining AI and embedded systems to build affordable, real-time assistive technologies. With further refinement and user-centered improvements, the prototype can evolve into a robust product capable of making a meaningful difference in the lives of visually impaired individuals, ultimately contributing to a more inclusive and accessible world.

5.2 FUTURE SCOPE:

1. Enhanced Real-Time Detection

Future advancements in edge computing and optimized neural networks could enable faster real-time object detection, making navigation seamless for users.

2. Integration with Wearable Devices

Combining object detection technology with smart glasses or other wearable devices could provide more practical, hands-free solutions.

3. Multi-Language Accessibility

Expanding language support in object detection systems would benefit a global audience of visually impaired users.

4. Contextual Understanding

Incorporating context-aware AI could help interpret complex scenes, such as crowded environments or dynamic traffic situations.

5. Improved Power Efficiency

Developing energy-efficient algorithms would allow portable devices to operate longer, especially crucial for assistive technologies.

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