IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Smart Application For Visually Impaired

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Abstract: Artificial Intelligence (AI) has the potential to revolutionize assistive technologies for visually impaired individuals by providing more personalized and efficient support. The development of a Smart Personal AI Assistant for visually impaired people represents a significant advancement in accessible technology, aiming to enhance independence and quality of life through intelligent, user-centric design. This paper explores the development and implementation of AI- driven assistance systems tailored specifically for visually impaired users. These systems utilize advanced AI techniques, including machine learning, computer vision, and natural language processing, to deliver enhanced functionalities such as object recognition, navigation guidance, and real-time information retrieval. The system incorporates features such as real-time environmental descriptions and communication assistance, all tailored to the needs of visually impaired users. By integrating AI with voice commands and feedback, the assistance system aims to improve accessibility, autonomy, and overall quality of life for visually impaired individuals. Through user-centered design and iterative testing, the AI assistance system strives to offer a more intuitive, reliable, and effective tool for navigating daily tasks and environments.

Index Terms -Object Detection, Navigation System, Computer vision, Visually Challenged

I. Introduction

The visually impaired people suffer regular and constant challenges in navigation especially when they are alone. They are mostly dependent on someone for even accessing their basic day-to-day needs. So, it's quite a challenging task and the technological solution for them is of utmost importance and much needed. With advancements in artificial intelligence and computer vision, object detection and navigation systems have become essential tools in addressing numerous real-world challenges. The primary need for this project lies in improving efficiency, safety, and accessibility across various domains, such as personal assistance, transportation, surveillance, and automation. One key driver for such systems is enhancing the quality of life for individuals, particularly those with visual impairments. By enabling real-time detection and navigation, these models empower individuals to move independently and safely in unfamiliar environments. Similarly, businesses and industries can benefit from improved automation in warehouses, reducing human effort in inventory management and ensuring smooth operation. To develop a SMART APPLICATION FOR VISUALLY IMPAIRED that is cost effective, efficient and can be easily implemented.The objectives are: • To develop an application that can provide Communication through SMS,Email,Call. • To detect the objects and text in front of them and provide an audio output to the user. • To provide various assistance features for visually challenged such as Read Calculator, Location, Weather, Time and Date, Battery, Message Reader, Object detection,Volume button (Opening app from background) Exit • To provide navigation assistance to the user over voice command.

II. LITERATURE REVIEW

The research paper by Balachandar et al. [1] proposed a system using YOLO V3 and a multi-view object tracking (MVOT) approach, employing multiple cameras to monitor a neighborhood from various angles. The system combines the complementary data from these cameras to create an accurate framework, mapping objects across views using the YOLO V3 algorithm. The detected objects are then converted into voice output, helping visually impaired individuals identify objects in their environment, enhancing their independence, offering significant advantages such as real-time object detection, high accuracy in recognizing multiple objects, and practical utility in aiding navigation and obstacle avoidance. This innovative approach highlights the potential of AI in enhancing accessibility and improving the quality of life for visually impaired users. However, the system's effectiveness may be hindered by hardware requirements, potential issues with false positives or negatives, and limited generalization to diverse real-world environments if the training dataset is not comprehensive. Additionally, the framework's lack of context understanding and dependency on assistive devices could pose challenges in usability and scalability.

The research by Erdaw, Taye, and Lemma [2] presents a real-time obstacle detection and classification system using the YOLO model to assist blind and visually impaired individuals.This paper applies YOLOv2 to detect three object classes—potholes, garbage bins, and poles—and introduces a Short-Term Memory technique to enhance YOLO's detection capabilities in video streaming. This method achieved a mean average precision of 60.17% and a detection speed of 34.6 frames per second. Its advantages include the ability to detect and classify multiple obstacles efficiently in real time, offering practical support for navigation and safety in dynamic environments. The system leverages the strengths of the YOLO model, such as speed and accuracy, to provide immediate feedback, which is crucial for visually impaired users. However, challenges include the reliance on computational resources for real-time performance, potential inaccuracies in detection under complex conditions (e.g., low light or cluttered backgrounds), and the need for user-friendly integration into accessible assistive devices. These limitations highlight the importance of further optimization and user-centric design for broader applicability.

The research by Jakka, Sai, and Jesudoss [3] introduces a Blind Assistance System leveraging SSD algorithm and TensorFlow for object detection and assistance. This system, designed to assist visually impaired people, leverages AI to offer a more accessible solution for navigating daily activities. The main features of the system include object identification, accurate distance calculation, and voice-based feedback via audio commands, making it easier for individuals with visual impairments to interact with their environment and stay connected. The system's advantages include its adaptability for real-time applications, efficient processing capabilities enabled by TensorFlow, and its potential to enhance the mobility and independence of visually impaired users by accurately detecting objects and providing relevant feedback. Additionally, its use of a widely supported framework like TensorFlow allows for scalability and integration into various devices. However, limitations include the potential for inaccuracies in detection under challenging conditions such as poor lighting or overlapping objects, dependency on robust hardware for optimal performance, and the need for seamless integration into assistive devices to ensure usability and practicality for end users.

Kawale et al. [4] developed smart blind sticks that integrate AI with advanced sensor technologies and data processing techniques. These devices provide precise obstacle detection and instantaneous guidance, significantly enhancing the mobility and independence of those with visual impairments. Furthermore, AI-based assistive technologies are transforming the ways visually impaired individuals interact with their environment.The system integrates voice-based feedback and object recognition to enhance mobility and spatial awareness, offering advantages such as real-time assistance, ease of use through voice commands, and improved independence for visually impaired users. By combining navigation and object perception, the system provides a holistic approach to addressing daily challenges. However, its disadvantages may include reliance on precise voice recognition in noisy environments, potential inaccuracies in object detection under complex conditions, and the need for robust hardware to support real-time performance. Additionally, ensuring the system's usability for diverse user needs and environmental contexts may require further optimization and testing.

The research by Litoriya et al. [5] explores the development of a Visual Assistant application for guiding visually impaired individuals, leveraging advancements in Artificial Intelligence, Machine Learning, and computer vision. It highlights the use of state-of-the-art real-time object detection techniques like YOLO and SSD, known for their accuracy and consistency. These methods have simplified the creation and implementation of new models compared to traditional approaches. The study combines these techniques to develop a robust base model, demonstrating superior results compared to existing algorithms and aiming to enhance object tracking and detection for assisting visually impaired users.The combination of these advanced models offers improved performance over traditional algorithms, enhancing the reliability of the visual assistant. However, disadvantages include potential challenges in achieving consistent accuracy under diverse environmental conditions, such as low lighting or occlusion. Additionally, the system's dependence on computational resources and the complexity of integrating it into user-friendly, portable devices may limit its widespread applicability.

The research by Najm, Elferjani, and Alariyib [6] aims to assist visually impaired individuals in navigating safely by using a web camera to detect objects in real-time. The system employs the YOLO model, a CNN-based real-time object detection technique, implemented with Python's OpenCV and Google Text-to-Speech for audible feedback. It identifies objects and determines their screen positions, providing users with location-specific guidance. Evaluation using Mean Average Precision (mAP) demonstrates that the approach achieves superior results compared to previous methods.The advantages of this approach include real-time object recognition and immediate audio-based guidance, which significantly enhances the mobility and independence of visually impaired users. The system's reliance on vocal feedback ensures accessibility without requiring complex interfaces. However, potential disadvantages include challenges in maintaining accuracy in dynamic or noisy environments and the risk of delayed or incorrect feedback due to limitations in object detection algorithms under certain conditions, such as overlapping objects or poor lighting. Additionally, the system's usability may depend on the integration of robust hardware to support seamless operation.

Parvadhavardhni, Santoshi, and Posonia [7] proposed a system that integrates TensorFlow (YOLO), OpenCV, Noir camera, ultrasonic sensors, and Raspberry Pi to enable real-time object detection and provide audio feedback to visually impaired users, assisting them in navigating their environment safely and independently. It addresses challenges faced by visually impaired individuals, such as limited independence and safety concerns due to conditions like macular degeneration or glaucoma. The combination of these technologies allows for accurate detection and real-time environmental feedback, improving users' confidence, independence, and overall quality of life. The system enhances navigation and provides valuable assistance for visually impaired individuals.The system's advantages include the integration of affordable hardware (Raspberry Pi) with the advanced YOLO model for real-time, accurate object detection, making it a cost-effective solution for aiding visually impaired individuals. The real-time audio feedback enhances user independence and safety while navigating different environments. However, the system's disadvantages include potential challenges with detection accuracy in cluttered or low-light environments, as well as the reliance on the computational power of the Raspberry Pi, which may limit real-time performance under complex conditions. Additionally, the system's effectiveness may depend on proper calibration and integration of hardware components for optimal operation.

C. Sagana et al., [8], introduces an innovative system designed to aid visually impaired individuals through object recognition technology. The paper likely delves into the application of computer vision methodologies and machine learning algorithms to detect and classify objects in real-time. It is anticipated to discuss the system architecture, including the integration of image processing techniques and model training approaches. Furthermore, insights into the dataset used for model training, evaluation metrics employed, and performance analysis are expected. This study is valuable for understanding the technical intricacies and challenges associated with developing assistive technologies tailored for the visually impaired. The system's advantages include its ability to identify objects in real-time, providing auditory feedback to help users navigate and interact with their environment independently. This enhances safety and mobility for visually impaired individuals by recognizing potential obstacles and assisting in daily activities. However, the system's disadvantages include challenges in ensuring high accuracy under diverse environmental conditions, such as low lighting or cluttered spaces, which may affect the reliability of object detection. Additionally, the system's performance might be constrained by the computational resources available, making it less effective on low-cost or portable devices.

The research by Singh et al. [9] presents a live object recognition system designed to aid blind or partially sighted individuals, addressing the limitations of existing assistive technologies like Screen Reading software and Braille devices, which fall short in situations requiring the recognition of people or objects. The system aims to provide visually impaired users with a "second set of eyes," allowing them to navigate their environment independently without the need for a guardian. The goal is to enhance the quality of life for those with total or partial blindness by creating a more inclusive environment through assistive technology that supports their daily activities and fosters greater independence.The system's advantages include its ability to provide personalized, real-time assistance, such as object recognition, navigation guidance, and contextual feedback, enhancing the user's safety and confidence. The integration of AI allows for continuous learning and adaptation to the user's environment. However, the system's disadvantages include the potential for inaccuracies in object detection or navigation, particularly in complex or dynamic environments. Additionally, the effectiveness of the system may be limited by the need for high computational power, making it less feasible for low-cost devices, and its reliance on voice commands could be problematic in noisy environments.

Vijiyakumar et al.[10] stated a model that navigates blind people that guide them about objects as provides the distance of the object and it also provides the audio feedback to insist them with object information and they have used single shot detection (SSD) algorithm to detect an object and find distance mono depth algorithm. The system's advantages include real-time object detection, providing immediate feedback to the user, and the SSD algorithm's efficiency in detecting multiple objects simultaneously, making it suitable for dynamic environments. This enhances the safety and mobility of visually impaired individuals by helping them identify obstacles and navigate more independently. However, the disadvantages of the system include potential limitations in detecting objects accurately in cluttered or poorly lit environments, as well as the dependency on the computational power required for real-time processing, which may limit its application on resource-constrained devices. Additionally, the system may require further optimization to handle diverse environments effectively.

III. Problem Statement

Visually challenged individuals face significant barriers in navigating their surroundings, accessing real-time information, and performing essential daily tasks independently. Conventional assistive tools like white canes or physical guides offer limited contextual awareness and do not provide digital access to services such as banking, weather updates, or object recognition.

There is a pressing need for a **comprehensive, voice-interactive Android application** that empowers visually impaired users by integrating **navigation assistance, object detection, time and weather updates, calculator functionality, and secure banking features**—all within a single, accessible interface. Such an application should be designed to provide real-time feedback, minimize dependency on external help, and enhance the autonomy and confidence of visually challenged individuals in their day-to-day lives.

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IV. Research Methodology

The research methodology involves identifying the key challenges faced by visually impaired individuals in performing everyday activities such as navigation, object recognition, accessing weather and time information, basic calculations, and secure financial transactions. This was achieved through literature review, user interviews, and analysis of existing assistive technologies.The development of the Android application for visually challenged individuals began with identifying key challenges through user interviews and literature review. Requirements were gathered by analyzing existing assistive technologies and accessibility standards. Suitable technologies were selected, including TensorFlow Lite for object detection, Google Maps API for navigation, and Android's Text-to-Speech and Speech-to-Text APIs for voice interaction, with Java as the development language. A modular, voice-based system design was created to ensure usability and scalability. The application was implemented by integrating essential features such as navigation, object detection, voice calculator, weather/time updates, and secure banking. Comprehensive testing—including unit, usability, and performance testing—was conducted, followed by iterative refinements based on user feedback to enhance accessibility, responsiveness, and overall user experience.

A. Proposed System

The proposed system is an android application which helps the blind people to lead a comfortable and normal life like others. Blind assistance is an application which clearly focuses on voice assistant and image recognition features. The application is also able to assist the users using voice command to recognize objects in the day-to-day life, do text analysis to recognize the text in the hard copy document. It will be an efficient way in which visually challenged people can also link with the world with the help of technology and employ the potentials of the technology. Blind people can't tell the exact time. They always need an assistant or helper to go out. But, If they visit a place more than once, they can go there without any helper or assistant and if it is a new place, they need an assistant to visit there. Only hearing voices or noise, they can differentiate among humans, vehicles and other animals. Mostly, blind people cannot pass roads without any help. In communication, they can recognize only their known voices. A novel method is proposed when the image is captured using a camera and the captured image is scanned from left to right to detect an obstacle and produce sound. Sound is produced by analyzing an image in which the top image is converted into a high frequency and the lower part into a subtitle sound. And the height depends on the brightness of the image as well. The application generates information according to the classification of the objects in the frame. These instructions will be sent to the text to speech system and then communicated to the user using audio. This application contain many features to improve the daily activities of the user.

The major features provided by the application:

1. OCR Reader
2. Object Detection
3. Navigation
4. Time and Date
5. Weather
6. Calculator
7. Message Reader
8. Location
9. Battery Percentage
10. Money Transfer

The system is designed to reduce computational load and dependency on large datasets, making it suitable for low-resource clinical settings. Performance is evaluated using key metrics such as accuracy, sensitivity, and specificity, ensuring the system is both reliable and efficient for real-world medical applications.

B. *Architecture / Implementation*

Architecture explains the project flow. The below figure explains the complete project flow. SSD Algorithm is used for object detection feature, whereas google map API is used for navigation assistance.Android apk is generated once the application is executed.

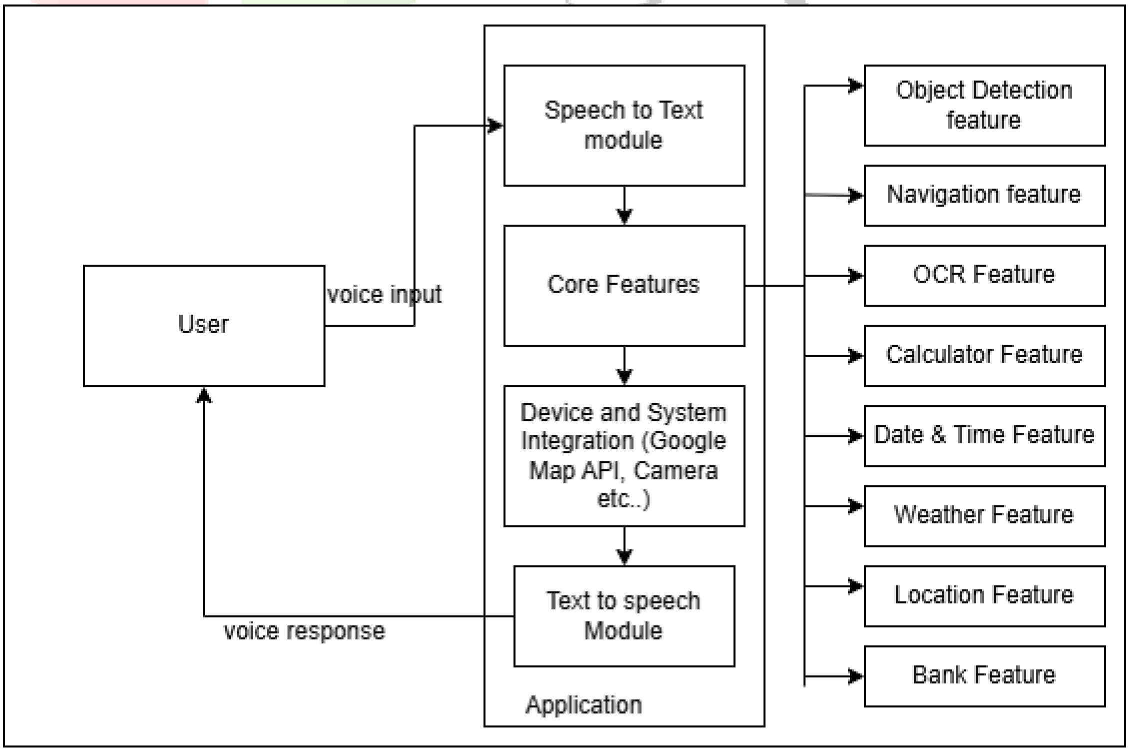

Figure 1: System Architecture

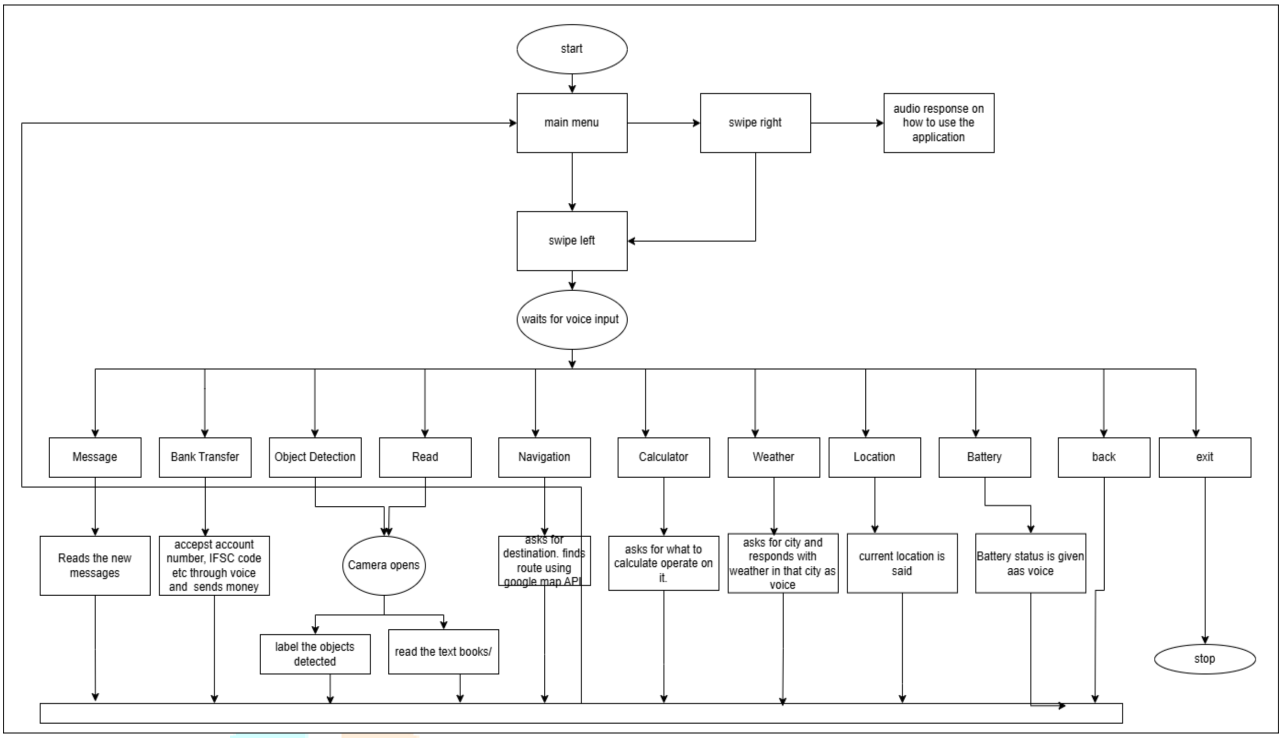

Figure 2: Work flow of the application

V. Results And Discussion

The application "BLIND ASSISTANCE" is an android application used to provide assistance to visually impaired people. A blind assistance application aims to provide support and enhance the daily lives of individuals with visual impairments. The application can convert written text into spoken words, allowing blind users to listen to various types of content such as documents, emails, webpages, or messages. TTS functionality ensures accessibility to textual information. It support voice commands to perform various actions and navigate through the app's interface. This enables users to interact with the application hands-free and execute tasks efficiently. In this project, computer vision and image processing algorithms are being utilized, and objects in the user's surroundings can be identified and described by the application. By using the device's camera, the application can provide audio feedback about objects, reading product labels, or recognizing landmarks.This application include GPS and mapping functionalities to assist blind users in navigating their surroundings. It can provide audio directions, turn-by-turn instructions, and real-time location updates to help users reach their desired destinations safely

VI. Conclusion And Future

The smart application for visually impaired people is to help those people who are blind or visually impaired using Artificial Intelligence, Machine Learning, Image and Text Recognition. The idea is manifested through a mobile application that clearly focuses on voice assistant, object detection,text reading, navigation etc. The application is also able to assist the users using voice command to recognize objects in day-to-day life and do text analysis to recognize the text in the hard copy document. It will be an efficient way in which visually challenged people can also link with the world with the help of technology and employ the potentials of the technology. The proposed system uses Artificial Intelligence to assist the visually impaired people which is all based on voice command. It also does image recognition of the photographs clicked or uses a camera to recognize the objects and describes them in audio to have light and friendly discussion. The main goal of the project is to build an application that helps blind people to lead a better life.The navigation feature helps the visually impaired user to navigate freely with the voice assistance whereas the object detection feature helps to identify nearby objects. It also include text reading and the user can communicate with anyone freely through calls or messages. Hopefully this application helps blind people

As a future enhancement, instead of using an android application, an IOT device can be implemented for the sole purpose of assisting the visually impaired. This will further reduce the cost and open more possibilities such as adding of other sensors to provide additional data such as distance and provide more precision and accuracy. It will also make the device more energy efficient as it won't be required to run heavy services in the background that are used in android to overcome restriction such as running of background service, energy usage etc

VII. ACKNOWLEDGMENT

I wish to convey my sincere appreciation to all those who have supported and guided me in completing this research paper. I am particularly grateful to my mentor and faculty members for their unwavering encouragement, valuable insights, and expert advice, which played a pivotal role in directing this study. I also extend my thanks to my classmates and the technical team for their practical support during the development and testing stages of the proposed system, as their teamwork was crucial in overcoming significant challenges and ensuring timely completion. In particular, I extend my appreciation to the developers and maintainers of frameworks and tools such as TensorFlow, Keras, NumPy, and Matplotlib, which served as the backbone for developing this project.

I also acknowledge the open datasets shared by researchers and institutions, without which this project would not have been possible.

Lastly, I owe a deep sense of gratitude to my family and friends for their constant patience, encouragement, and emotional support throughout this endeavour. Their faith in my abilities inspired me with the determination and confidence needed to successfully bring this project to completion.

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