Vol-08 Issue 05, May -2024 ISSN: 2456-9348
Impact Factor: 7.936

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International Journal of Engineering Technology Research & Management

GUIDEME-BLIND ASSISTANCE APP

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ABSTRACT
In our technologically advanced era, addressing the need for independent living for visually impaired individuals has become crucial due to the challenges they face, including social limitations and dependence on manual assistants. The absence of visual information in unfamiliar environments further compounds their difficulties. However recent strides in inclusive technology offer the potential to enhance support for the visually impaired.
This project proposes an innovative solution, leveraging artificial intelligence, machine learning, image and text recognition to aid individuals who are blind or visually impaired. The application mainly focuses on voice-assisted interactions, object recognition, currency identification, navigation and location tracking. The app's capabilities encompass object recognition through voice commands and text analysis for deciphering printed documents, enabling novel needs for visually impaired individuals to engage with their surroundings and harness the benefits of modern technology.
Keywords:
Visually impaired individuals, Object Detection, Machine learning, Artificial Intelligence, Voice-assisted interaction.

INTRODUCTION
"GUIDE-ME" is a mobile application that addresses the needs of visually impaired individuals. The application mainly focuses on voice-assisted interactions, object recognition, currency identification, location tracking and more to enable these individuals to engage with their surroundings and harness the benefit of modern technology [7].
In a world increasingly defined by technological innovation, the "Guide-Me" Blind Assistance App emerges as a beacon of empowerment for individuals facing visual impairments [2]. This transformative project is dedicated to bridging the gap between independence and accessibility, offering a comprehensive suite of features designed to enhance the daily lives of those with limited or no sight. Through cutting-edge technologies and thoughtful design, Guide-Me aspires to be more than an app; it is a companion on the journey toward greater autonomy and inclusivity for the visually impaired [4].
The objectives of our app include enhancing independence, safety and quality of life for individuals with visual impairments.
At the core of the Blind Assistance App's genesis lies a genuine and unwavering commitment to improving the daily experiences of individuals living with visual impairments [6]. The motivation is rooted in a profound understanding of the multifaceted challenges faced by this community and a desire to alleviate these challenges comprehensively. The app seeks to go beyond mere functionality, aspiring to be a catalyst for positive change in the lives of its users.

The challenges faced by individuals with visual impairments extend far beyond the physical realm. From the intricacies of object recognition to the fundamental task of identifying and managing currency, the Blind Assistance App aims to be a holistic solution [3]. More than a tool, it is envisioned as a companion, a facilitator of autonomy, and a conduit for inclusivity. By leveraging cutting-edge technology, the project strives to not only address the disparities in accessibility but to create a transformative tool that enhances the overall quality of life for individuals with visual impairments.

METHODOLOGY

These are the three modules:

- Object Detection
- Currency Recognition
- Location Tracking

The procedures involved in the development of the app are given below:

1. Data Collection
   - Image Data for Object Detection:
     - The COCO dataset (Common Objects in Context dataset) was chosen for training the object detection model due to its huge collection of images including various environments and categories.
     - Extra pictures were collected from online platforms and added to the dataset to make sure we have enough examples of objects which are helpful for blind assistance.
   - Currency Image Data for Recognition:
     - For training the currency recognition model, Custom datasets were compiled which consisted of different denominations of images of existing Indian currency notes.
     - Pictures of the currency notes were captured using smartphone cameras under different lighting conditions and angles to simulate real-world scenarios encountered by visually impaired individuals.
   - GPS Data Collection**:**
     - To train the location tracking model, location data from various geographic locations were collected using GPS-enabled devices.
2. Data Preprocessing
   - Object Detection:
     - Preprocessing procedures consist of resizing images to the input dimensions required by the YOLO model which is typically 416 x 416 pixels, and normalising pixel values to the range [0, 1].
     - To enhance the diversity of the training data, Augmentation methods like flipping, contrast, adjusting the brightness and random rotation were applied.
   - Currency Recognition:
     - We applied the same preprocessing steps in the currency recognition dataset, including resizing images and normalisation.
     - Data augmentation techniques which focus on different lighting conditions and variations in currency note orientation were tailored to currency recognition tasks.
   - Location Tracking:
     - For ensuring accurate location tracking, raw GPS data were preprocessed to remove outliers and noises.
3. Model Training
   - Object Detection Model:
     - The (You Only Look Once) YOLO architecture was selected for its ability to detect multiple objects in an image simultaneously and its real-time performance.
     - Here we chose the v3 model of the YOLO algorithm and trained using the COCO dataset for object detection.

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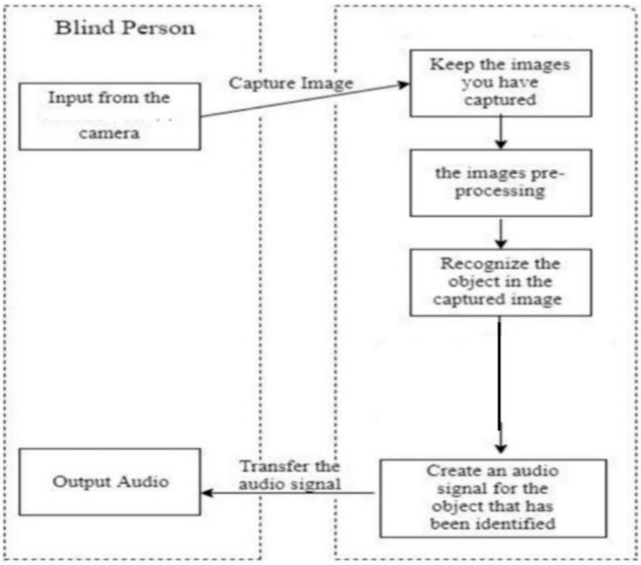

Figure 1: Architecture of Object Detection Module

- Currency Recognition Model:
  § Using the custom-made currency image dataset, a separate YOLO-based model was trained specifically for currency recognition tasks.

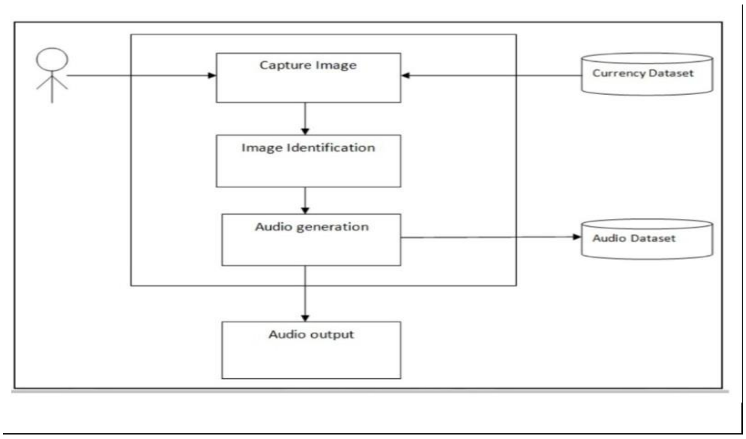

Figure 2: Architecture of Currency Detection Module

- Location Tracking Model:
  § Utilise the device's built-in GPS capabilities for enabling users to access location-based information on the go and to provide real-time location updates to the user interface.
  § Here the module wants to predict the user's current location based on latitude and longitude coordinates.

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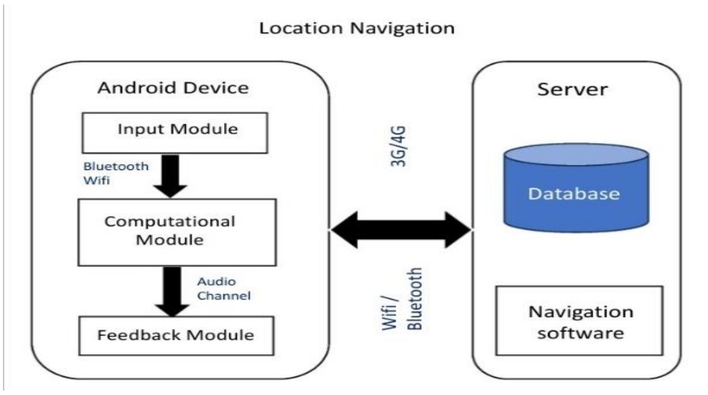
Figure 3: Architecture of Location Detection Module



4. User Interface Design
    - § The user interface was carefully crafted to make it easy to use and accessible, with simple options to select modules and built-in voice feedback features designed for users with visual impairments.
    - § Focusing on simplicity, clarity, and inclusivity, make individuals with visual impairments confident enough to navigate the app independently, ensuring effortless access to the assistance they require for their daily activities with ease and convenience.
    - § Every factor of the interface was thoughtfully designed to ensure easy interaction and navigation of the user.
5. Integration of Modules
    - § We've made sure that users can easily switch between different features without any interruptions, ensuring a smooth experience throughout the app.
    - § Additionally, we've looked into how different parts of the app can work together to make things even better for users.
    - § The app is structured with a modular architecture, facilitating effortless integration of future functionalities. Concurrently, user feedback mechanisms are employed to collect valuable insights, encouraging a culture of continuous refinement and improvement.
6. System Evaluation
    - § To make sure our models worked well in different situations, we tested them on different sets of data. This helped us see if they could do more than just what they learned during training and if they could handle real-life situations. We looked at how accurate they were and how well they performed in practical scenarios. This process of testing gave us confidence that our models were reliable and could be trusted to help users effectively.

Requirements

YOLO divides an input image into an $S \times S$ grid. If the center of an object falls into a grid cell, that grid cell is responsible for detecting that object. Each grid cell predicts B bounding boxes and confidence scores for those boxes. These confidence scores reflect how confident the model is that the box contains an object and how accurate it thinks the predicted box is.

YOLO predicts multiple bounding boxes per grid cell. At training time, we only want one bounding box predictor to be responsible for each object. YOLO assigns one predictor to be "responsible" for predicting an object based on which prediction has the highest current IOU with the ground truth. This leads to specialization between the bounding box predictors. Each predictor gets better at forecasting certain sizes, aspect ratios, or classes of objects, improving the overall recall score.

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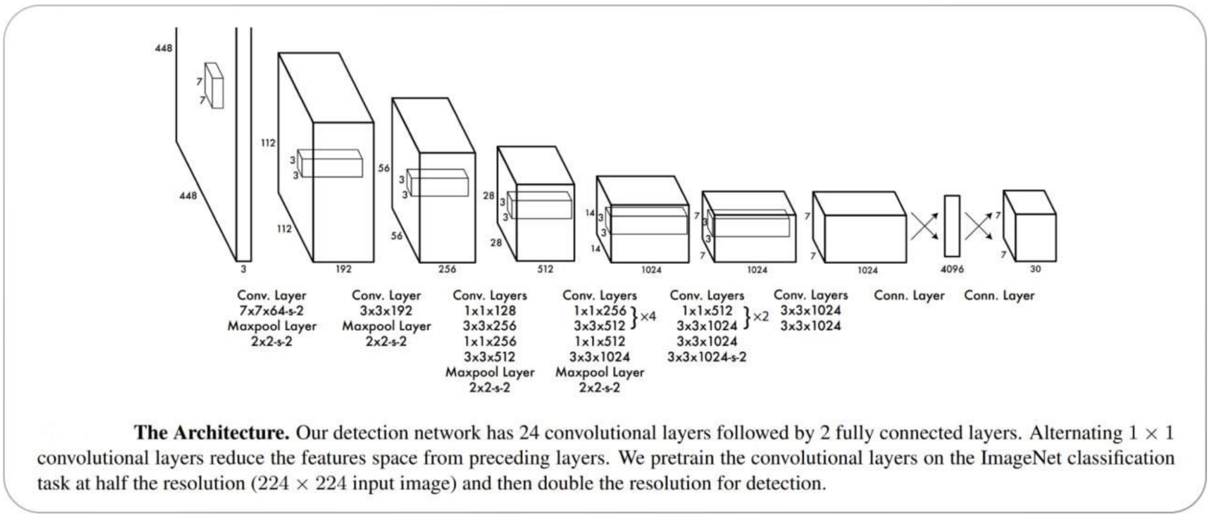

Figure 4: Working of YOLO Algorithm

RESULTS AND ANALYSIS

The blind assistance app exhibited strong performance across its modules, achieving high accuracy rates in object detection, currency recognition, and location tracking. User feedback underscored the app's intuitive interface and its significant impact on enhancing users' independence and confidence in daily navigation tasks. While the app's performance met expectations, opportunities for optimization were identified, particularly in improving object detection speed and expanding currency recognition capabilities. Overall, the app's successful validation demonstrates its effectiveness in providing valuable assistance to individuals with visual impairments, reaffirming its potential as a reliable tool for enhancing accessibility and mobility.

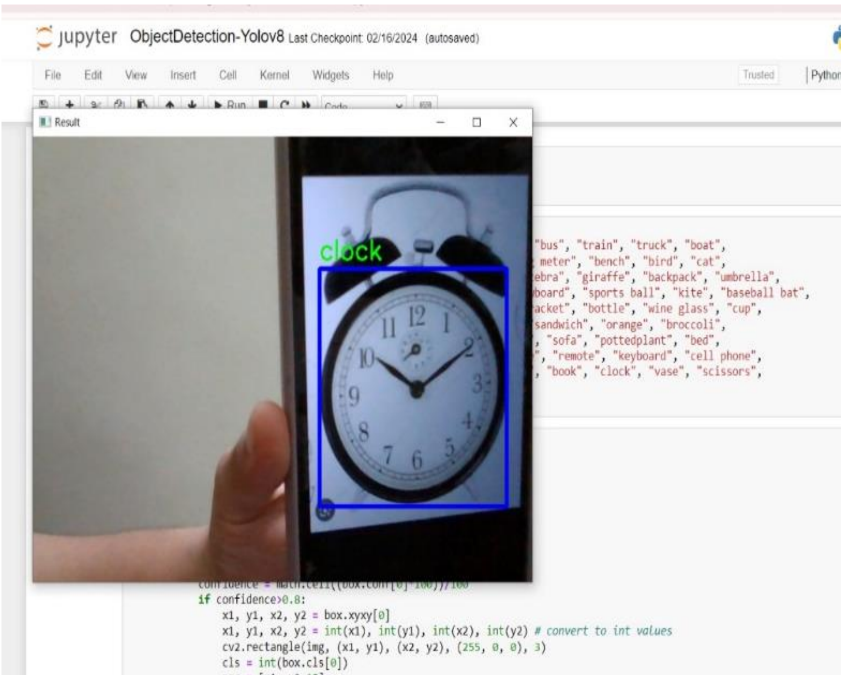

Figure 5: Outcome of Object Detection

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Figure 6: Outcome of Currency Detection

Figure 7: Location Detection Output

It should be noted that the detection results shown in figures 5, 6, and 7 are read out loud since the application targets visually impaired people. Thus, it uses the built-in voice engine incorporated in the mobile phone to read results out loud.

Furthermore, the application was tested by 10 people with visible impairments. Each person had to answer the set of questions listed in Table I. For each question, the person had to provide an integer number between 1 and 5, with 1 meaning "poor performance" and 5 meaning "excellent performance". In addition, the questionnaire allowed each person to provide comments on the application. It can be seen from Table I that the results are good in general and the application is well-accepted.

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TABLE I. QUESTIONNAIRE RESULTS

	Average	Median	Min	Max
Familiarity of the interface	4.4	4.5	3	5
How easy is the application as a whole	4.1	4	3	5
How good is the performance	3.7	4	3	4
How is its responsiveness	4	4	3	5
Clarity of the prompt messages	3.9	4	3	5

CONCLUSION

This project signifies a pivotal milestone in addressing the pressing challenges faced by visually impaired individuals. By using cutting-edge technologies, our solution pioneers a path towards greater independence and accessibility. The application's focus on voice-assisted interactions, object recognition, currency identification, navigation, and location tracking represent a comprehensive suite of tools tailored to empower the visually impaired community[5]. Through these functionalities, we aim to mitigate the barriers that impede their daily activities and hinder their integration into various environments. This project reaffirms the potential of inclusive technology in reshaping the lives of individuals with visual impairments[1]. The seamless integration of technologies not only facilitates interaction with the surroundings but also fosters a sense of autonomy and confidence in navigating an ever-evolving world[9]. Moving forward, continued advancements and refinements in technology offer the promise of further enhancing the functionalities and usability of such solutions. As we stride into the future, it is imperative to continue our dedication to inclusivity, leveraging innovation to bridge the gap between limitations and possibilities for the visually impaired[8].

Ultimately, this project stands as a testament to the transformative impact technology can have in promoting equality, independence, and enriched experiences for individuals with visual impairments. It is a steadfast commitment towards a more inclusive society, where everyone can harness the benefits of modern technology, irrespective of their abilities.

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