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Assistive Intelligence Sensing Device With Python Intergration

Mrs Keerthana S[1*], Jemimah Margrate S[2], Mariya Suvetha L[3], Oviya M[4]

[1*]*Assistant Professor, B.E-Biomedical Engineering, V.S.B. Engineering College, Karur, Tamilnadu, India.*
[2-4,3]*Ug Scholar, B.E-Biomedical Engineering, V.S.B. Engineering College, Karur, Tamilnadu, India.*

***Corresponding Author:** Mrs Keerthana S*
**Assistant Professor, B.E-Biomedical Engineering, V.S.B. Engineering College, Karur, Tamilnadu, India.*

Abstract

An assistive intelligence sensor device is a comprehensive solution aimed at improving the mobility and independence of people with visual or hearing impairments. It integrates an array of advanced hardware components including Node MCU and Arduino board for data processing, GPS module with antenna for accurate location tracking, emergency key switch for instant warning activation, and time of flight sensor for accurate obstacle detection. A vibrator for haptic feedback, a Wi-Fi module for seamless connectivity and a display for visual feedback. Additionally, the device includes a laptop with a Python-coded program for real-time object detection using a camera, which helps identify and classify objects in the user's environment. Leveraging the Blynk IoT app, the device facilitates instant communication with caregivers or emergency responders, ensuring peace of mind and timely assistance when needed. Also, apart from detecting nearby obstacles and providing haptic feedback, the device uses a GPS module to live track the user's location, ensuring safety and security during outdoor navigation. The integration of intelligent software algorithms further enhances the functionality of the device, enabling it to adapt to various environments and user needs. This manuscript provides a comprehensive overview of the device's design, functionality, and potential applications to improve the quality of life of individuals with disabilities. By integrating state-of-the-art hardware components with intelligent software solutions, the Assistive Intelligence sensor device represents a significant advance in assistive technology, empowering users to navigate their surroundings with confidence and independence.

Keywords: Assistive device, Mobility assistance, Object detection, IoT, Accessibility.

1. INTRODUCTION:

Assistive technology plays an important role in addressing the mobility challenges faced by individuals with visual or hearing impairments, facilitating greater independence and participation in daily activities. In this context, it is crucial to develop innovative solutions tailored to the unique needs of this population. The assistive intelligence sensor device represents a significant advance in assistive technology, designed to improve mobility and independence for individuals with visual or hearing impairments. This paper introduces a

comprehensive solution assistance intelligence sensing device that integrates advanced hardware components and intelligent software algorithms to provide real-time assistance and support. The device uses a variety of sensors to improve user safety and navigation, including a time-of-flight sensor for obstacle detection and a GPS module for location tracking. Furthermore, the device features a high-resolution camera with Python recognition algorithms for object detection, helping users to effectively identify and navigate their surroundings. By leveraging cutting-edge technology and innovative design principles, the Assistive Intelligence Sensing Device aims to address the limitations of existing assistive devices and empower disabled individuals to navigate their environment with confidence and independence. This paper provides an overview of the device's design, functionality, and potential applications, highlighting its importance in the assistive technology field.

2. EASE OF USE:

2.1. INTUITIVE INTERFACE:

The Assistive Intelligent Sensing Device is designed with a user-friendly interface, prioritizing ease of use and accessibility for individuals with visual or auditory impairments. The interface features intuitive navigation menus and clear, easily understandable visual indicators to facilitate interaction with the device. Users are provided with simple, straightforward instructions for operating the device, minimizing the learning curve and ensuring a seamless user experience.

2.2. SEAMLESS INTEGRATION:

The device offers seamless integration with existing assistive technologies and communication platforms, enhancing its usability and functionality. Through compatibility with standard protocols and interfaces, such as WiFi connectivity and IoT applications, the device seamlessly integrates with other devices and services, enabling enhanced communication, data sharing, and remote monitoring capabilities. This integration ensures that users can easily incorporate the device into their daily routines and existing support networks, maximizing its effectiveness in facilitating independent living and mobility.

3. PROBLEM STATEMENT, SCOPE, OBJECTIVE:

3.1. PROBLEM STATEMENT:

Individuals with visual or auditory impairments encounter significant difficulties in navigating their surroundings independently, often relying on assistance from others. Existing assistive technologies may not fully meet their diverse needs, leaving gaps in accessibility and functionality.

3.2. SCOPE FOR STUDY:

This study aims to address the mobility challenges faced by individuals with disabilities through the development and evaluation of the Assistive Intelligent Sensing Device. The scope encompasses the design, implementation, and testing of both hardware and software components. Additionally, the study will explore usability aspects, including interface design and integration with existing assistive technologies.

3.3. AIM AND OBJECTIVE OF STUDY:

The aim of this study is to develop and evaluate the effectiveness of the Assistive Intelligent Sensing Device in enhancing the mobility and independence of individuals with visual or auditory impairments.

3.3.1. OBJECTIVE OF THE STUDY:

1. To design and implement the hardware components of the Assistive Intelligent Sensing Device, including sensors, microcontrollers, and communication modules.
2. To develop and integrate intelligent software algorithms for object detection, obstacle avoidance, and real-time feedback.
3. To conduct comprehensive testing and evaluation of the device's functionality in simulated environments.
4. To assess the performance and reliability of the device through technical testing and validation procedures.
5. To optimize the design and functionality of the device based on testing feedback and iterative improvements.

4. LITERATURE SURVEY:

1. Bhumika Gupta (2017) et a;. proposed object detection is a well-known computer technology connected with computer vision and image processing that focuses on detecting objects or its instances of a certain class (such as humans, flowers, animals) in digital images and videos. There are various applications of object detection that have been well researched including face detection, character recognition, and vehicle calculator. Object detection can be used for various purposes including retrieval and surveillance. In this study, various basic concepts used in object detection while making use of OpenCV library of python 2.7, improving the efficiency and accuracy of object detection are presented.
2. Kartik Umesh Sharma (2017) et al, proposed an object detection system finds objects of the real world present either in a digital image or a video, where the object can belong to any class of objects namely humans, cars, etc. In order to detect an object in an image or a video the system needs to have a few components in order to complete the task of detecting an object, they are a model database, a feature detector, a hypothesiser and a hypothesiser verifier. This paper presents a review of the various techniques that are used to detect an object, localise an object, categorise an object, extract features, appearance information, and many more, in images and videos. The comments are drawn based on the studied literature and key issues are also identified relevant to the object detection. Information about the source codes and online datasets is provided to facilitate the new researcher in object detection area. An idea about the possible solution for the multi class object detection is also presented. This paper is suitable for the researchers who are the beginners in this domain.
3. Mukesh Tiwari (2017) et al. presented object detection and tracking is one of the critical areas of research due to routine change in motion of object and variation in scene size, occlusions, appearance variations, and ego-motion and illumination changes. Specifically, feature selection is the vital role in object tracking. It is related to many real time applications like vehicle perception, video surveillance and so on. In order to overcome the issue of detection, tracking related to object movement and appearance. Most of the algorithm focuses on the tracking algorithm to smoothen the video sequence. On the other hand, few methods use the prior available information about object shape, color, texture and so on. Tracking algorithm which combines above stated parameters of objects is discussed and analyzed in this research. The goal of this paper is to analyze and review the previous approach towards object tracking and detection using video sequences through different phases. Also, identify the gap and suggest a new approach to improve the tracking of object over video frame.
4. Aishwarya Sarkale (2018) et al. proposed humans have a great capability to distinguish objects by their vision. But, for machines object detection is an issue. Thus, Neural Networks have been introduced in the field of computer science. Neural Networks are also called as 'Artificial Neural Networks'. Artificial Neural Networks are computational models of the brain which helps in object detection and recognition. This paper describes and demonstrates the different types of Neural Networks such as ANN, KNN, FASTER R-CNN, 3D-CNN, RNN etc. with their accuracies. From the study of various research papers, the accuracies of different Neural Networks are discussed and compared and it can be concluded that in the given test cases, the ANN gives the best accuracy for the object detection.
5. Karanbir Chahal (2018) et al. proposed Object detection is the identification of an object in the image along with its localization and classification. It has wide spread applications and is a critical component for vision based software systems. This paper seeks to perform a rigorous survey of modern object detection algorithms that use deep learning. As part of the survey, the topics explored include various algorithms, quality metrics, speed/size trade offs and training methodologies. This paper focuses on the two types of object detection algorithms- the SSD class of single step detectors and the Faster R-CNN class of two step detectors. Techniques to construct detectors that are portable and fast on low powered devices are also addressed by exploring new light weight convolutional base architectures. Ultimately, a rigorous review of the strengths and weaknesses of each detector leads us to the present state of the art.
6. Richard Socher (2018) et al. proposed recent advances in 3D sensing technologies make it possible to easily record color and depth images which together can improve object recognition. Most current methods rely on very welldesigned features for this new 3D modality. We introduce a model based on a combination of convolutional and recursive neural networks (CNN and RNN) for learning features and classifying RGB-D images. The CNN layer learns low-level translationally invariant features which are then given as inputs to multiple, fixed-tree RNNs in order to compose higher order features. RNN scan be seen as combining convolution and pooling into one efficient, hierarchical operation. Our main result is that even RNNs with random weights compose powerful features. Our model obtains state of the art performance on a standard

RGB-D object data set while being more accurate and faster during training and testing than comparable architectures such as two-layer CNNs.

7. Yordanka Karayaneva (2018) et al. presented schools in many parts of the world use robots as social peers in order to interact with children and young students for a rich experience. Such use has shown significant enhancement of children's learning. This project uses the humanoid robot NAO which provides object recognition of colours, shapes, typed words, and handwritten digits and operators. The recognition of typed words provides performance of the corresponding movements in the sign language. Five classifiers including neural networks are used for the handwritten recognition of digits and operators. The accuracy of the object recognition algorithms are within the range of 82%-92% when tested on images captured by the robot including the movements which represent words in the sign language. The five classifiers for handwritten recognition produce highly accurate results which are within the range of 87%-98%. This project will serve as a promising provision for an affective touch for children and young students.
8. Abdul Muhsin M (2019) et al. proposed everybody deserve to live independently, especially those who disabled, with the last decades, technology gives attention to disabled to make them control their life as possible. In this work, assistive system for blind is suggested, to let him knows what is around him, by using YOLO for detecting objects within images and video streams quickly based on deep neural network to make accurate detection, and OpenCV under Python using Raspberry Pi3. The obtained results indicated the success of the proposed model in giving blind users the capability to move around in unfamiliar indoor outdoor environment, through a user friendly device by person and object identification model.
9. Geethapriya. S (2019) et al. proposed the Objective is to detect of objects using You Only Look Once (YOLO) approach. This method has several advantages as compared to other object detection algorithms. In other algorithms like Convolutional Neural Network, Fast Convolutional Neural Network the algorithm will not look at the image completely but in YOLO the algorithm looks the image completely by predicting the bounding boxes using convolutional network and the class probabilities for these boxes and detects the image faster as compared to other algorithms.
10. R. Sujeetha (2019) et al. proposed object detection and tracking could be a immense, vivacious however inconclusive and trending area of computer vision. Due to its immense use in official surveillances, tracking modules applied in security and lots of others applications have made researchers to devise a lot of optimized and specialized methods. However, problems are faced in implementing object detection and tracking in real-time; like tracking in real time and giving appropriate optimized results, over dynamic computation to find the efficient performance with respect to time factor, or multiple objects tracking create this task more difficult. Though, several techniques are devised but still lies a lot of scope of improvement, however during this literature review we've seen some illustrious and multiple ways of object detection and tracking. In this method we will be using Tensor Flow and Open CV library and CNN algorithm will be used and we will be labelling the detected layers with accuracy being checked at the same time .For validation purpose live input video will be taken for the same where objects will be getting detected and it can be simulated same for real-time through external hardware added. In the end we see the proper optimized and efficient algorithm for object tracking and detection.
11. Marion Hersh, "Wearable Travel Aids for Blind and Partially Sighted People:(1)Obstacle Detection Devices and Environmental Information Extraction-Initial focus on devices like laser canes, smart canes, and ultra-canes using infrared, ultrasonic, and/or laser sensors.(2)Navigation and Way finding Devices-Development of GPS systems and environmental information beacons for location and facility information.(3)Apps on Smart Mobile Devices and Vision Sensors-Evolution to purely software-driven solutions using existing mobile devices and the integration of vision sensors for advanced navigation. This brief survey highlights the progression from hardware-focused devices to software-driven solutions, including the challenges of designing apps for compatibility with audio and tactile output for effective use by the visually impaired.

5. MATERIALS AND METHODS:

5.1. MATERIALS STUDIED:

Materials examined in this research include hardware components and software used in the development of an assisted intelligence sensing device. Hardware components include Node MCU, Arduino board, GPS module with antenna, emergency key switch, and time of flight (ToF) sensor, vibrator, WiFi module, display and camera with embedded Python authentication algorithms.

5.2. INSTRUMENTS USED:

The tools used in this study include soldering equipment for connecting hardware components, a laptop with relevant software for programming and testing, and a high-resolution camera integrated into the device for object and obstacle detection equipped with Python recognition algorithms.

5.3. EXPERIMENTAL DETAILS:

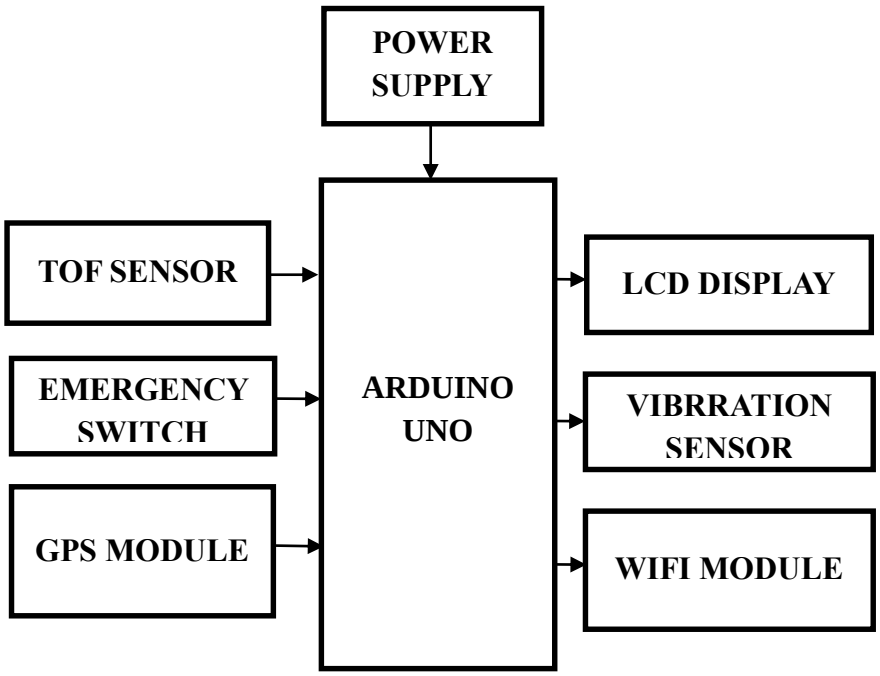
The development process of an assistive intelligence sensing device includes hardware selection, software development, integration and testing. Hardware components are selected based on compatibility, functionality and energy efficiency. An Arduino board was programmed to process sensor data and control device functions, while Python recognition algorithms were used to detect objects and obstacles using the camera.

The camera captured images of the user's surroundings, which were then processed using Python recognition algorithms to detect and identify objects and obstacles. The Anaconda and Spider applications were used to convert visual data into auditory feedback, verbalizing the names of recognized objects to the user. Rigorous testing has been conducted to verify the performance, reliability and usability of the device in various environments and scenarios. This includes object accuracy and obstacle detection using a camera, distance measurement with ToF sensors, live location tracking with GPS, and evaluating the functionality of a security keyboard and Arduino Uno integration.

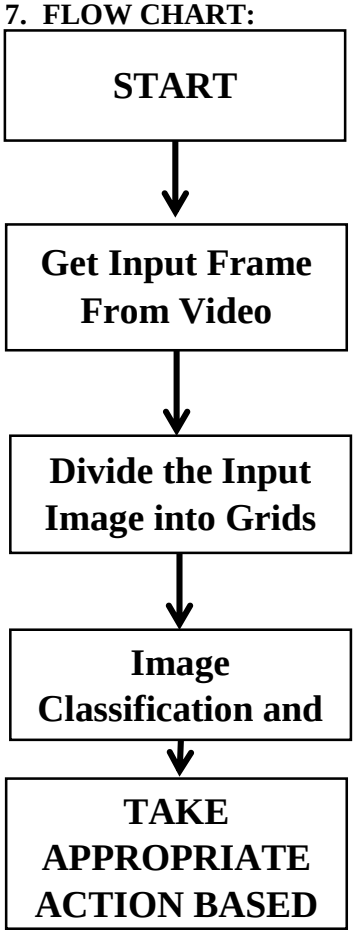
5.4. ETHICAL CONSIDERATIONS:

No animal or human studies were conducted in this research. Therefore, institutional animal ethics committee approval or human ethics committee approval was not required. In addition, because the study did not involve human participants, written consent was not required from humans or patients.

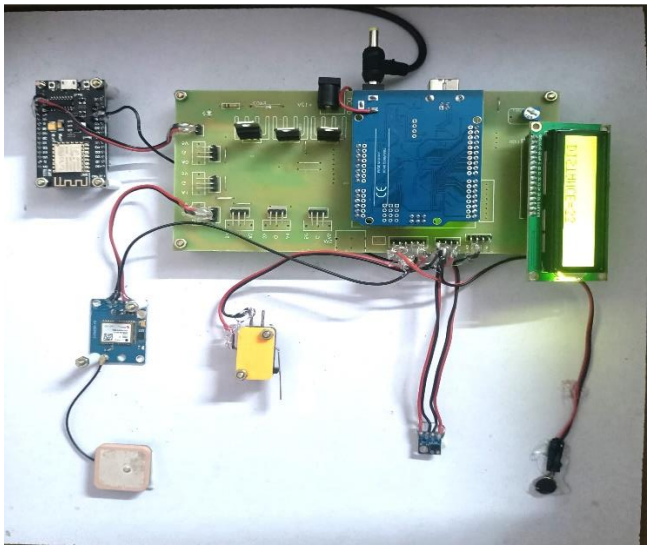
6. BLOCK DIAGRAM:



7. FLOW CHART:



8. SYSTEM SPECIFICATION:

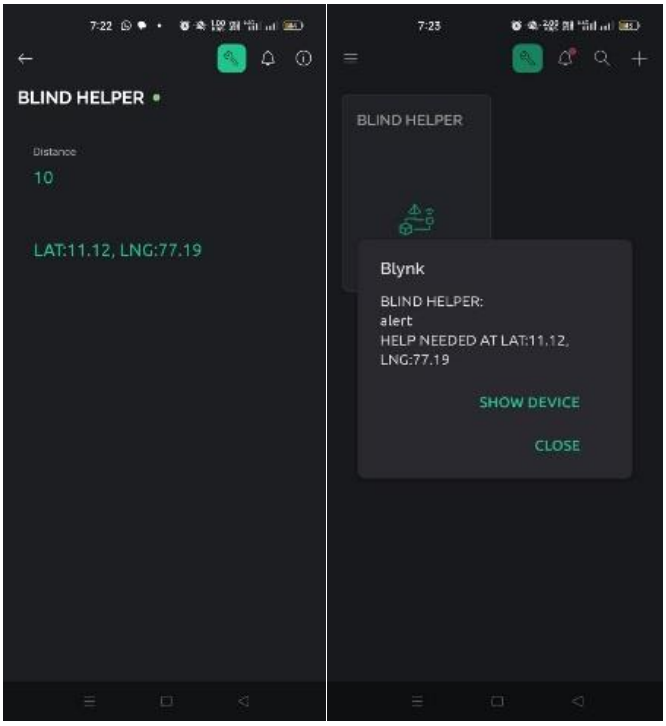


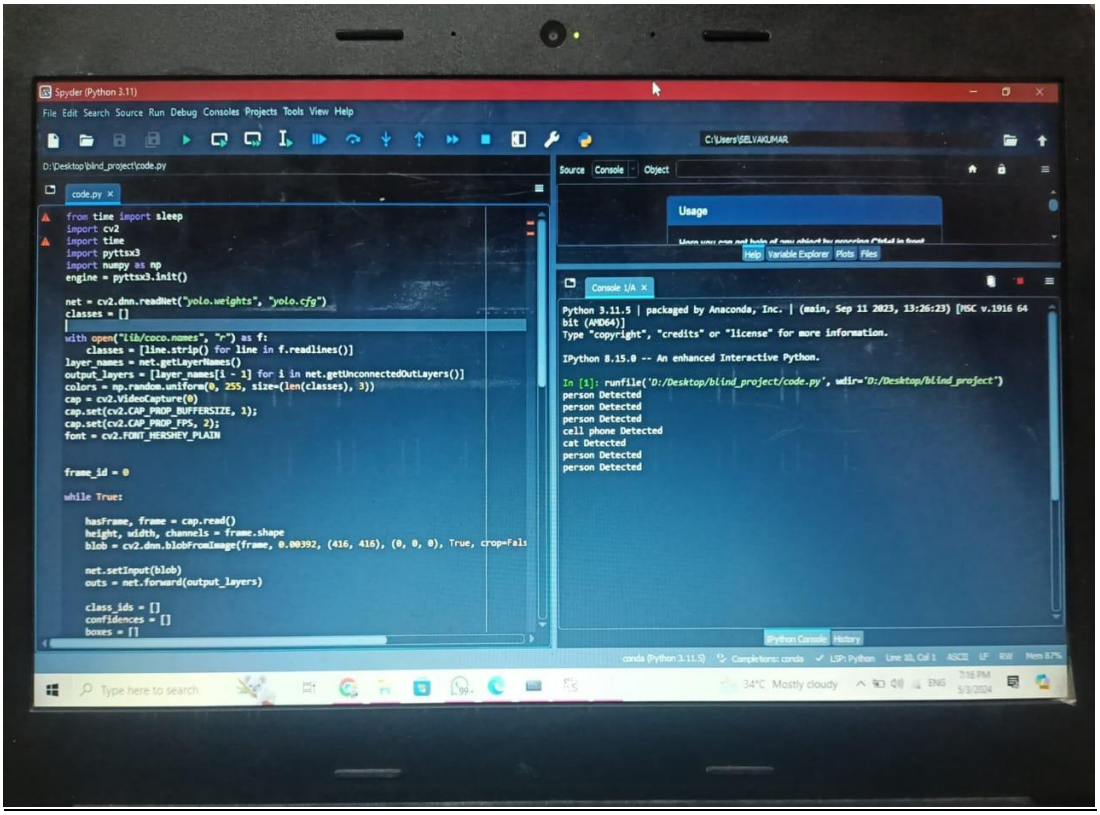
8.1. HARDWARE SPECIFICATION:

1. Node MCU
2. Arduino board
3. GPS module with antenna
4. Time of Flight sensor
5. WiFi module
6. Emergency key switch
7. Vibrator
8. Display
9. High-resolution camera

These components are carefully selected for their compatibility, functionality, and performance to ensure the optimal operation of the device.

8.2. SOFTWARE SPECIFICATION:





1. Python programming language
2. Anaconda and Spyder applications for object recognition
3. Blynk IoT application for communication and alert system
4. Python recognition algorithms for real-time object detection

These software components are integrated to facilitate data processing, object recognition, communication, and overall functionality of the device.

9. HARDWARE SPECIFICATION:

1. **Node MCU:** A microcontroller unit that provides processing power and connectivity for the device's operation.
2. **Arduino board:** A programmable circuit board used for controlling and interfacing with various hardware components.
3. **GPS module with antenna:** A module that receives signals from global positioning satellites to determine the device's precise location.
4. **Time of Flight sensor:** A sensor that measures the time taken for a signal to travel to an object and back, used for accurate distance measurement.
5. **WiFi module:** A component that enables wireless communication and connectivity to networks for data exchange.
6. **Emergency key switch:** A switch that, when activated, triggers immediate alerts or actions in emergency situations.
7. **Vibrator:** A component that provides haptic feedback to the user, indicating alerts or notifications.
8. **Display:** A visual interface that presents information and feedback to the user, enhancing user interaction and understanding.
9. **High-resolution camera:** A camera with enhanced image quality and resolution, used for object recognition and visual feedback.

10. SOFTWARE SPECIFICATION:

1. **Python programming language:** A high-level programming language used for developing software applications, known for its simplicity and readability.
2. **Anaconda and Spyder applications for object recognition:** Integrated development environments (IDEs) used for developing and executing Python code for object recognition tasks.
3. **Blynk IoT application for communication and alert system:** A mobile application that facilitates communication between the device and external services, enabling real-time alerts and notifications.
4. **Python recognition algorithms for real-time object detection:** Algorithms developed in Python for analysing visual data captured by the camera and detecting objects in real-time.

11. RESULTS AND DISCUSSION:

The assistive intelligent sensing device demonstrated promising performance during rigorous testing procedures. The security keyboard activation successfully initiated alerts, proving its effectiveness in emergency situations. In addition, the Arduino Uno coordinates processing data seamlessly, which contributes to the functional efficiency of the device. The microprocessor function is optimized, improving data processing capabilities while maintaining energy efficiency. Also, Python recognition algorithms use the camera to reliably recognize objects and facilitate object identification. Real-time object recognition provided immediate detection and notification, improving the usability and security features of the device. The haptic feedback mechanism served as an effective warning system, providing timely notifications and improving situational awareness. Also, the emergency alert system ensured immediate assistance in emergency situations and facilitated quick activation and communication with potential caregivers. These results underscore the potential impact of an assistive intelligence sensor device in improving the mobility and independence of individuals with visual or hearing impairments.

Functionality	**Result**
Object Detection	Successful detection of obstacles
Distance Measurement	Accurate measurement of distances
Live Location Tracking	Precise tracking of user's location
Safety Keypad Activation	Successful triggering of alerts
Arduino Uno Integration	Seamless integration for data processing
Microprocessor Functionality	Optimal performance and efficiency
Safety Keypad Activation	Successful triggering of alerts

Arduino Uno Integration	Seamless integration for data processing
Microprocessor Functionality	Optimal performance and efficiency
Python Recognition Algorithms	Reliable object recognition using camera
Real-time Object Identification	Instantaneous detection and notification
Haptic Feedback Mechanism	Effective alert system for user notification
Emergency Alert System	Swift activation and communication with caregivers

BENEFITS:

1. **Enhanced Safety:** The device provides real-time feedback on obstacles and hazards in the user's environment, significantly reducing the risk of accidents and injuries.
2. **Increased Independence:** By enabling individuals with visual or auditory impairments to navigate their surroundings more independently, the device promotes greater autonomy and self-reliance.
3. **Improved Quality of Life:** With features such as object detection, distance measurement, and location tracking, the device enhances the overall quality of life for users by facilitating easier and safer mobility.
4. **Peace of Mind for Caregivers:** Caregivers and family members can remotely monitor the user's location and receive alerts in case of emergencies, providing them with peace of mind and reassurance.
5. **Promotion of Social Inclusion:** By addressing the mobility challenges faced by individuals with disabilities, the device promotes social inclusion and equal participation in community activities and events.

12.CONCLUSION:

The Assistive Intelligence Sensing Device represents an exciting advancement in the field of assistive technology, providing a comprehensive solution to the mobility challenges faced by individuals with visual or hearing impairments. Through the integration of advanced hardware components and intelligent software algorithms, the device provides real-time help and support, helping users navigate their environment with confidence and independence. The successful implementation of an assistive intelligence sensing device underlines its potential to significantly improve the quality of life of persons with disabilities. Leveraging state-of-the-art technology and innovative design principles, the device offers various features including obstacle detection, location tracking, object recognition and emergency warning systems to improve user safety and navigation. Moving forward, continued research and development efforts are needed to further improve the functionality and accessibility of assistive intelligence sensing devices. In addition, collaboration with stakeholders, including people with disabilities, caregivers, and health professionals, is essential to ensure that the device meets the diverse needs of its users and is responsive to evolving challenges and opportunities in the assistive technology field.

In conclusion, assistive intelligence sensing devices represent a significant step forward in improving the mobility and independence of individuals with visual or hearing impairments. The device holds great promise in improving the overall well-being and quality of life of individuals with disabilities by providing innovative solutions to address the unique challenges faced by this population.

13.ACKNOWLEDGMENT

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