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SMART STICK FOR VISUALLY IMPAIRED INDIVIDUALS

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ABSTRACT

Navigating the world without sight presents profound challenges for millions of visually impaired individuals. Echo Guidance includes a pioneering application, addresses these obstacles by facilitating independence and mobility through voice-driven interaction and an IoT smart assistive device for obstacle detection by utilizing Ultrasonic, GPS and GSM modules powered by Arduino. This study explores the design and evaluation of Echo Guidance, highlighting its utilization of advanced algorithms like RGB888 conversion, matrix transformation, and Optical Character Recognition (OCR) for real-time object recognition. The application boasts a voice-centric interface tailored to the needs of the visually impaired, seamlessly integrating day-to-day functionalities such as weather forecasting, reminders, and a calculator accessible through voice commands. Central to Echo Guidance is its innovative object detection and recognition approach, employing the MobileNetObjDetector class powered by TensorFlow Lite for swift and accurate object detection. The OverlayView class visually represents detected objects, enhancing spatial awareness. Additionally, the integration of IoT devices, such as the smart stick with ultrasonic sensors for obstacle detection and head-level obstacle detection, coupled with SOS functionality in case of any emergency using GPS and GSM modules, further enhances Echo Guidance's capabilities. This research underscores Echo Guidance's transformative potential in improving the quality of life for visually impaired individuals, representing a significant advancement in assistive technology. Prioritizing accessibility and user experience, this paper empowers individuals worldwide with newfound independence and confidence in navigating their surroundings.

1.INTRODUCTION

1.1. OBJECTIVE

Visually impaired people are often reluctant to use the resources of the visually impaired because of other factors such as social stigma and discrimination and lack of accessibility. They do find it extremely challenging to glimpse the outer world. On Earth, it is impossible to process real-time data using current equipment.

1.2. PROBLEMSTATEMENT

In today's high-tech environment, the visually impaired need to be self-sufficient. The visually impaired cannot see, depend on others, and cannot use technology. Visually impaired people are at a disadvantage because they do not have access to important information about their surroundings. Therefore, we have

implemented such a voice assistant app project for the visually impaired. Visually impaired people are at a disadvantage because they do not have access to important information about their surroundings. The gaps that we found in other research papers were the currency recognition module. The new type of settings we added in it like autofocus, use flash, and the OCR language.

1.3. OVERVIEW

Echo Guidance emerges as a transformative solution, seeking to redefine the landscape of navigation assistance for the visually impaired through a novel voice-driven interface. This research paper focuses on investigating the efficacy of Echo Guidance in facilitating navigation for individuals with visual impairments, with meticulous attention to its integration with Internet of Things (IoT) technology, utilization of machine learning (ML) algorithms for enhanced object recognition, incorporation of Optical Character Recognition (OCR), and integration of an SOS functionality.

2.LITERATURE REVIEW

- Lilhare et al., [7] limitations in recognizing a diverse range of objects, risks of technological obsolescence, and complexities in feature extraction have been noted, posing significant hurdles in achieving real-time performance and versatility in assistive technologies.
- Despite the advancements like a voice-based access system for visually impaired people [8] where users can open camera with voice command and camera will detect live objects and give result in the form of voice, reliance on traditional camera-based approaches may limit adaptability and realtime performance.
- Moreover, voice-only output may lack detailed information and potentially hindering user comprehension as well as interaction. Furthermore, IoTbased navigation devices, as investigated by Apu et al., [9] have gained attention for their potential to enhance navigation assistance for the visually impaired. These devices integrate sensors and connectivity modules to detect obstacles and provide real-time feedback. However, concerns regarding reliance on technology, effectiveness in complex environments, and maintenance issues have been raised, necessitating further optimization and development in IoTbased solutions.
- The performance of machine learning-based object recognition algorithms, examined by Kaneda and Premachandra [10] has shown promise using both general and omnidirectional camera images. However, research gaps persist, particularly in the utilization of omnidirectional cameras and additionally Potential bias in YOLO algorithm persists and the Scope may not cover diverse scenarios

3.EXISTING SYSTEM

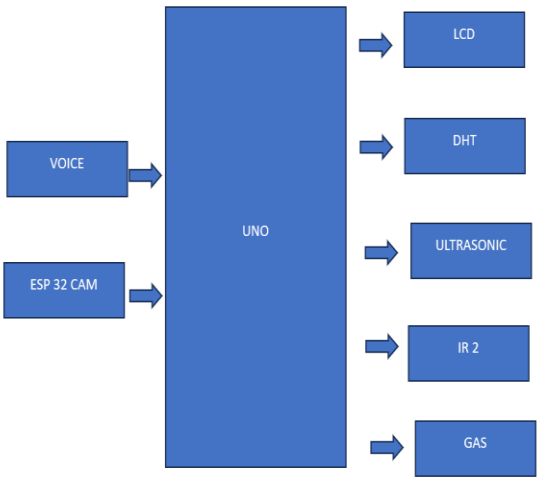
- A smart guiding glass for blind individuals in an indoor setting was suggested by Jinqiang Bai et al. To determine the depth and distance from the barrier, it uses an ultrasonic sensor and depth camera. The depth data and obstacle distance are used by an internal CPU to provide an AR depiction to the AR glasses and audio feedback through earphones. Its flaw is that it is only appropriate for indoor settings.

- An RGB-D sensor-based navigation aid for the blind was proposed by Aladrén et al. This system uses a combination of colour and range information to identify objects and alerts users to their presence through audible signals. Its key benefit is that, in comparison to other sensors, it is a more affordable choice and can identify objects with more accuracy. Its shortcomings include its restricted range and inability to operate in the presence of transparent things.
- Wan-Jung Chang et al. suggested an AI-based solution for blind persons to assist pedestrians at zebra crossings. This method recommends a system of assistance based on. Blind people can utilise artificial intelligence (AI) tools to help them cross zebras. According to test results, this method is extremely accurate, with an accuracy rate of 90%.This system's primary flaw is that it can only be used for one thing

3.1. PROPOSED SYSTEM

The architecture of the Echo Guidance system comprises a mobile app [19]tailored for visually impaired users, seamlessly integrated with an IoT Smart Stick. The mobile app incorporates modules for OCR, object detection, utility features, location services, and user interaction, providing comprehensive navigation assistance and accessibility features. Through OCR integration, printed text is converted to speech, enhancing accessibility. Object detection algorithms and machine learning enable real-time detection of obstacles, while utility features like weather forecasting and a calculator further enrich the user experience. Integration with the IoT Smart Stick, equipped with Arduino microcontrollers, ultrasonic sensors, GPS, and GSM modules, enhances navigation with obstacle detection, precise geolocation, and emergency communication capabilities. Together, this architecture empowers visually impaired individuals to navigate with confidence, promoting independence and inclusivity in everyday life.

3.2. BLOCKDIAGRAM



BLOCK DIAGRAM DESCRIPTION

REGULATED POWER SUPPLY:

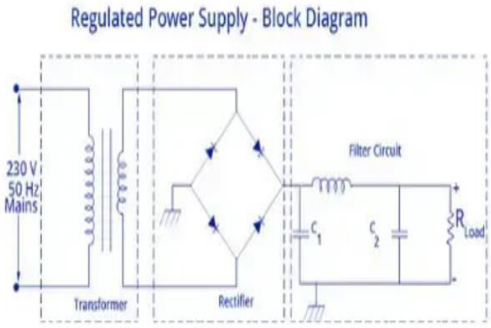


Fig: Regulated Power Supply Diagram

A regulated power supply provides a stable DC output by transforming variable AC input.

Component Overview: The essential components of a regulated power supply consist of a transformer, rectifier, filter, and regulator, each vital for ensuring a stable DC output.

The rectification process involves diodes transforming alternating current (AC) into direct current (DC), sometimes using full-wave rectification to optimize efficiency.

Filter Function: Filters, including capacitor and LC kinds, mitigate ripple and stabilize the DC output voltage.

Regulatory Mechanism: Regulators modulate and stabilize output voltage to safeguard against input fluctuations or load variations, crucial for a dependable power supply.

MICRO CONTROLLER

ARDUINO

The Arduino is a series of microcontroller boards designed to facilitate electrical design, prototyping, and experimentation for artists, hackers, amateurs, and even professionals. Individuals use it as the cognitive component for their robots, to create innovative digital musical instruments, or to develop a system that enables houseplants to notify you via Twitter when they want water. Arduino boards, namely the basic Arduino Uno, are constructed around an ATmega microcontroller, which functions as a comprehensive computing unit including a CPU, RAM, Flash memory, and input/output ports, all integrated into a single chip. In contrast to a Raspberry Pi, it is designed to connect various sensors, LEDs, tiny motors, speakers, servos, and similar components directly to these pins, which may read or output digital or analog voltages ranging from 0 to 5 volts. The Arduino interfaces with your computer by USB, allowing you to program it in a straightforward language (C/C++, akin to Java) using the complimentary Arduino IDE by uploading your developed code to the board. Once programmed, the Arduino may operate via a USB connection to your computer or independently without it—requiring just a power source, devoid of a keyboard or display

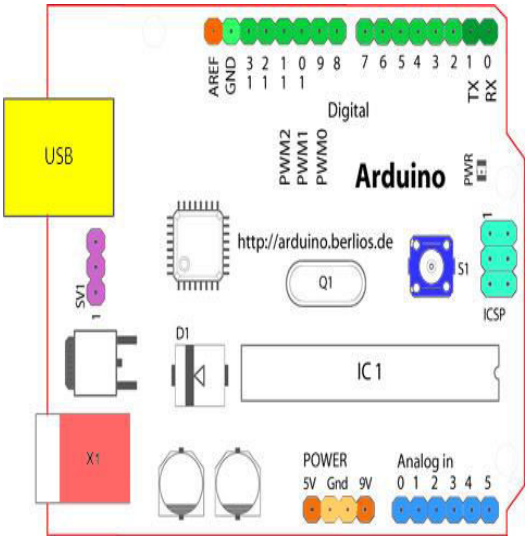


Fig: Structure of Arduino Board

ESP32

The ESP32 is a single 2.4 GHz Wi-Fi and Bluetooth combination chip designed using TSMC's ultra-low-power 40 nm technology. It is engineered to optimize power and RF performance, demonstrating resilience, adaptability, and dependability across diverse applications and power conditions. The ESP32 chip family comprises the ESP32-D0WD-V3, ESP32-D0WDQ6-V3, ESP32-D0WD, ESP32-D0WDQ6, ESP32-D2WD, ESP32-S0WD, and ESP32-U4WDH, with the ESP32-D0WD-V3, ESP32-D0WDQ6-V3, and ESP32-U4WDH being derived from the ECO V3 wafer.

ESP32 INTEGRATED CAMERA MODULE

Summary

- The ESP32-CAM is a compact, low-power camera module using the ESP32 architecture. It includes an OV2640 camera and has an integrated TF card slot.
- The ESP32-CAM is extensively applicable in intelligent IoT applications, including wireless video surveillance, WiFi image transmission, and QR code recognition.

Characteristics

- Onboard ESP32-S module, facilitates WiFi and Bluetooth connectivity.
- OV2640 camera equipped with flash
- Equipped with an onboard TF card slot, compatible with TF cards up to 4GB for data storage.
- Facilitates WiFi video surveillance and WiFi image transmission
- Facilitates several sleep states, with deep sleep current as low as 6mA.
- The control interface is available via a pin header, facilitating straightforward integration and embedding into consumer goods.

SENSOR

A sensor is a device that identifies and reacts to certain stimuli from the physical world. The input may consist of light, heat, motion, moisture, pressure, or several other environmental phenomena. The output is often a signal that is either translated to a human-readable format at the sensor site or transferred electronically via a network for interpretation or further processing.

IR SENSOR

The infrared segment of the electromagnetic spectrum is categorized into three regions: near infrared, mid infrared, and far infrared.

What is an IR Sensor?

An IR sensor is an electrical device that produces light to detect objects in its environment. An IR sensor can measure an object's temperature and detect motion. Typically, all things emit a type of heat radiation within the infrared spectrum. These forms of radiation are imperceptible to the human eye; nevertheless, infrared sensors can detect them.

Fig: IR Sensor Board

What is HC-SR04 Ultrasonic Sensor:

The HC-SR04 ultrasonic sensor comprises a transmitter and a receiver. This sensor is used to ascertain the distance to the target. The duration required for wave transmission and reception will determine the distance between the sensor and an item. This sensor employs sound waves using non-contact technology. This sensor measures the needed distance to the target without causing harm and delivers precise information. The sensor's range extends from 2 centimeters to 400 centimeters. The HC-SR04 is an ultrasonic sensor that use

sonar technology to determine the distance to an item from the sensor. It offers an exceptional range of non-contact detection with high precision and consistent results. It has two modules: an ultrasonic transmitter and a receiver. This sensor is used in diverse applications such as directional and speed measurement, security alarms, medical devices, sonar, humidification, wireless charging, non-destructive testing, and ultrasonography

Fig: HCSR04-ultrasonic-sensor

ESP8266 WI-FI MODULE:

In 2014, an ESP8266 Wi-Fi module was introduced and developed by third-party manufacturers like AI thinkers, which is mainly utilized for IoT-based embedded applications development. It is capable of handling various functions of the Wi-Fi network from another application processor.

It is a SOC (System On-chip) integrated with a TCP/IP protocol stack, which can provide microcontroller access to any type of Wi-Fi network. This article deals with the pin configuration, specifications, circuit diagram, applications, and alternatives of the ESP8266 Wi-Fi module.

What is the ESP8266 Wi-Fi Module?

An ESP8266 Wi-Fi module is a SOC microchip mainly used for the development of end-point IoT (Internet of things) applications. It is referred to as a standalone wireless transceiver, available at a very low price. It is used to enable the internet connection to various applications of embedded systems.

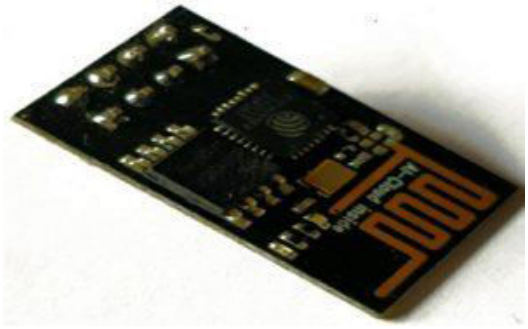


Fig ESP8266 Wi-Fi Module

CONCLUSION

In conclusion, the findings of this paper shed light on the transformative potential of Echo Guidance in redefining navigation assistance for individuals with visual impairments. Through a comprehensive investigation and meticulous evaluation, the study has revealed the diverse capabilities of Echo Guidance. The integration of Echo Guidance with an IoT device, equipped with ultrasonic sensors, GPS, and GSM modules, represents a significant leap forward in navigation aid technology. The real-time feedback provided by the IoT component enhances spatial awareness and safety, enabling users to navigate independently in various environments. Furthermore, the incorporation of ML algorithms, particularly those based on the MobileNet architecture, empowers Echo Guidance to deliver precise object recognition capabilities. By translating visual data into intuitive auditory cues, users can navigate with confidence, surmounting obstacles with ease. Additionally, the integration of OCR capabilities promotes greater

accessibility for users with visual impairments. The inclusion of an SOS functionality adds an extra layer of security, ensuring swift assistance during emergencies. In essence, Echo Guidance represents a paradigm shift in assistive technology, embodying a holistic approach to addressing the diverse needs of individuals with visual impairments. By emphasizing user-centric design principles and rigorous evaluation, Echo Guidance is poised to empower users to navigate their environments with newfound independence and safety.

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