ECHO GUIDANCE: SMART ASSISTIVE STICK USING IOT

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Abstract

Visually impaired people find it difficult to identify objects in front of them while walking down the street, which makes it risky. The smart stick comes as a way to define the world around them. In this paper, we propose a solution, presented in a smart stick with an infrared sensor to detect staircases and a pair of ultrasonic sensors in order to detect any other obstacles in front of the user, within four meters. Furthermore, another sensor is placed at the bottom of the stick to prevent puddles. Speech warning message is triggered upon identification of any obstacle. About 39 million people are permanently blind and about 285 billion are visually impaired. Blind person, who doesn't walk alone, struggles to do his own job. There's always fear of getting injured and getting into an accident. How can we solve those problems? Indeed, this paper has provided a solution which can relieve the blind from this problem. Which is "Blind Stand with voice control to guide blind people" This is essentially a device consisting of Arduino UNO, Ultrasonic Sensor and Voice Module that informs and notifies the blind person of the hazards This will help a blind person to walk comfortably and keep themselves safe from danger.

Keywords: Arduino, Wi-Fi Module ESP8266, Ultrasonic Sensor & Buzzer

I.INTRODUCTION

Blind stick is an innovative stick designed for visually disabled people for improved navigation. We here propose an advanced blind stick that allows visually challenged people to navigate with ease using advanced technology. The blind stick is integrated with ultrasonic sensor along with light and water sensing. Our proposed project first uses ultrasonic sensors to detect obstacles ahead using ultrasonic waves. The main motivation behind this project is to help blind people. As we all know that blind people are facing so many problems nowadays like moving from one place to another place. Blind and visually impaired people find it difficult to travel in unfamiliar places because they do not receive enough information about their location with respect to traffic and obstacles on the way which can be easily seen by people without visual impairment. And blind people always depend on others to move one place and to deal with their needs and all. Blind people or low vision people often have a difficult time self-navigating outside well-known environments. In fact, physical movement is one of the biggest challenges for blind people, explains World Access for the Blind. Traveling or simply walking down a crowded street may pose great difficulty. Because of this, many people with low vision will bring a sighted friend or family member to help navigate unknown environments. As well, blind people must learn every detail about the home environment. Large obstacles such as tables and chairs must remain in one location to prevent injury. If a blind person lives with others, each member of the household must diligently keep walkways clear and all items in designated locations.

II. LITERATURE SURVEY

1.Smart Walking Stick for Visually Impaired People Using Ultrasonic Sensors and GPS Module Authors: S. Sharma, A. Gupta, et al.

This paper presents the development of a smart walking stick equipped with ultrasonic sensors and a GPS module to assist visually impaired individuals. The ultrasonic sensors are used to detect obstacles within a certain range and alert the user through a buzzer. The GPS module provides real-time tracking to ensure safety and location awareness. The system is cost-effective and offers basic mobility assistance but lacks remote monitoring features and web integration.

2. Design and Implementation of a GPS-Based Blind Navigation System Using Arduino Authors: M. Singh, R. Verma, et al.

The researchers proposed a GPS and GSM-based navigation system built on Arduino to help blind users travel independently. The device provides voice feedback using pre-recorded instructions and sends location details via SMS in case of emergencies. While the system offers real-time location support and emergency communication, it lacks integration with IoT platforms and has limited processing capabilities compared to Raspberry Pi. Copyright to IJARSCT DOI: 10.48175/568 956 www.ijarsct.co.in I JARSCT International Journal of Advanced Research in Science, Communication and Technology International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal ISSN: 2581-9429

3. IoT-Based Smart Cane for Blind People Authors: P. Kumar, D. Patel, et al.

This work utilizes IoT technologies like Wi-Fi and cloud storage to develop a smart cane that logs the user's path and alerts them of nearby obstacles. The system includes ultrasonic sensors, a esp32 microcontroller, and Blynk IoT platform for data visualization. A key advantage is the ability to monitor movement history remotely. However, the device does not offer advanced emergency support or GPS accuracy as seen in more comprehensive systems.

4. Assistive Technology for the Visually Impaired Using Machine Learning Authors: L. Brown, H. Zhang, et al.

This paper focuses on enhancing blind assistance with AI-based object detection using cameras and machine learning algorithms. Although the primary aim is different from ultrasonic navigation, it contributes a unique approach to detecting and recognizing objects in the environment. This technology is computationally intensive and requires more robust hardware, making it suitable for future enhancements but less feasible for basic, portable applications.

5. Real-Time Smart Navigation System for Visually Impaired Individuals Authors: T. Desai, N. Joshi, et al.

The authors implemented a comprehensive navigation aid using Raspberry Pi, GPS, and cloud communication. The system alerts the user via vibration motors and provides caregivers with real-time location updates through a web interface. This work closely aligns with the objectives of the current project and supports the need for integrated monitoring, real-time feedback, and caregiver connectivity. It lays a foundation for further customization and scalability in IoT-based assistive solutions.

III.EXISTING SYSTEM

Current assistive technologies for visually impaired individuals often rely on simple cane-based systems or expensive, complex devices that require extensive training. These systems typically lack real-time feedback, navigation assistance, and obstacle detection capabilities, making it difficult for users to navigate safely and efficiently. Some existing systems also require manual input or rely on GPS signals alone, which can be unreliable in indoor or urban environments.

PROBLEM STATEMENT:

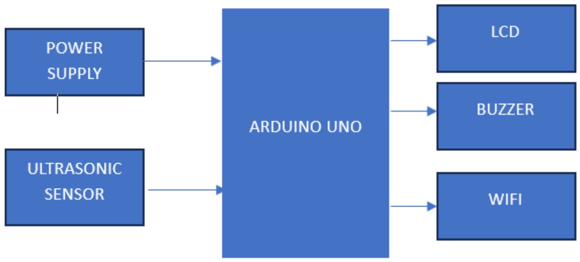
Visually impaired individuals face significant challenges in navigating their environment safely due to limited access to real-time obstacle detection and location awareness. Traditional mobility aids lack advanced features like GPS tracking and emergency communication, limiting their effectiveness in modern urban settings. This project aims to address these limitations through a smart, IoT-enabled assistive device.

IV.PROPOSED SYSTEM

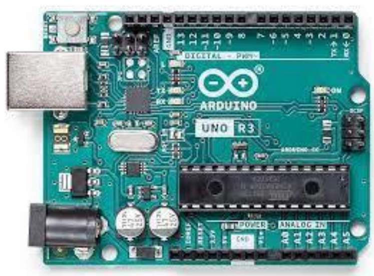
The system consists of ultrasonic sensors, GPS module, and the feedback is received through audio. Voice output works through TTS (text to speech). The proposed system detects an object around them and sends feedback in the form of speech that is warning messages via earphone and also provides navigation to specific location through GPS. The aim of the overall system is to provide a low cost, efficient navigation and obstacle detection aid for blind which gives a sense of artificial vision by providing information about the environmental scenario of static and dynamic object around them, so that they can walk independently.

This smart stick is an electronic walking guide which has four ultrasonic sensors. Out of these four sensors 3 sensors are used for obstacle detection which is placed on the side of the stick. The other sensor is responsible for pothole detection which is placed below the smart stick. These ultrasonic sensors range from 2-250cms. A camera is used for object identification and text identification. A toggle switch is kept which is operated by the user to enable the different features of the smart stick; finally, the output of the stick is through an earpiece.

V.BLOCK DIAGRAM



ARDUINO UNO



The **Arduino Uno R3** is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

ESP8266 WI-FI MODULE

This is the heart of the project. Since the project is based on WIFI control of appliances, the module forms the important component of the project. The ESP8266 Arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability, and the amazing thing is that this little board has a MCU (Micro Controller Unit) integrated which gives the possibility to control I/O digital pins via simple and almost pseudo-code like programming language. This device is produced by Shanghai-based Chinese manufacturer, Es press if Systems.

ULTRASONIC SENSOR

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The following guide is universally since it has to be followed irrespective of the type of computational device used.

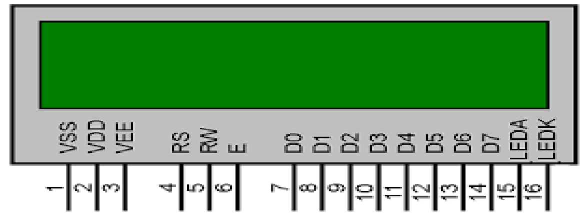
BUZZER

A buzzer or beeper is an audio signalling device used for various purposes such as alarms, timers, and user input confirmation. There are two main types: electromechanical and electronic.

Electromechanical buzzers are based on an electromechanical system similar to an electric bell but without the metal gong. They typically involve a relay connected to interrupt its own actuating current, producing a buzzing sound. These buzzers were often mounted on walls or ceilings to amplify the sound.

Electronic buzzers utilize a piezoelectric element driven by an oscillating electronic circuit or audio signal source. They produce sounds like clicks, rings, or beeps to indicate actions such as button presses. Electronic buzzers are widely used in modern applications due to their versatility and reliability.

LCD



It is called Liquid Crystal Display. We are going to use 16x2 characters LCD. This will be connected to microcontroller. The job of LCD will be to display all the system generated messages coming from the controller. LCD will provide interactive user interface. This unit requires +5VDC for its proper operation. This module is used for display the present status of the system.

VI.RESULTS

likely designed for an obstacle detection or path guidance system. Here’s a detailed breakdown of the visible components and what the system might be doing:

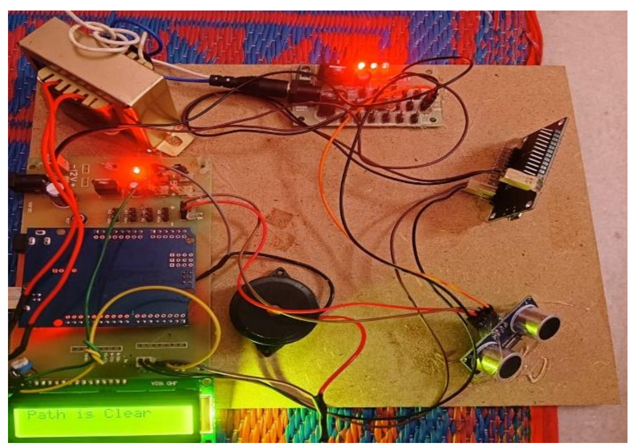


Fig 1 Smart Assistive Stick Using Machine Learning And IOT

Working principle:

The ultrasonic sensor emits a sound wave and listens for its echo to detect whether the path ahead is clear or blocked. The microcontroller processes this data and updates the LCD display accordingly. If an obstacle is detected, the message on the LCD would likely change and might trigger the buzzer for an audio alert. Additional LEDs provide quick visual status indicators.

"Blind stick" or smart walking stick. At the core of this setup is a microcontroller, likely an Arduino, which manages the operation of the entire device. Connected to this board is an LCD display that provides real-time status updates; in the image, it reads "BLIND STICK," indicating the system is powered on and operational. The project is likely equipped with sensors, such as ultrasound or infrared, to detect obstacles in the user's path. When an obstacle is detected, the system can alert the user through audio signals, like a buzzer or speaker, also visible in the image.

VII.CONCLUSION

The Echo Guidance system integrates voice-activated technology with a Smart Assistive Stick, leveraging Machine Learning and IoT to enhance mobility and independence for visually impaired individuals. This innovative solution provides real-time obstacle detection, voice navigation, and environmental awareness, ensuring a safer and more efficient way to navigate surroundings. With adaptive learning capabilities, the system continuously improves its guidance accuracy based on user behaviour and environmental patterns. Overall, this project represents a significant step towards empowering the blind community with smart, reliable, and user-friendly assistive technology.

VIII.FUTURE SCOPE

Adding sensors like LiDAR, infrared cameras, and accelerometers to improve obstacle detection accuracy and environmental situational awareness. Implementing machine learning algorithms to tailor navigation assistance based on individual user behaviour, preferences, and frequently visited locations. Extending capabilities to indoor environments using technologies like Bluetooth beacons or Ultra-Wideband (UWB) to overcome GPS limitations indoors. Incorporating voice command features and natural language processing for hands-free operation and interactive user feedback. Using refined vibration or tactile feedback methods to provide intuitive and unobtrusive alerts tailored to different types of obstacles or navigation cues. Leveraging cloud computing for real-time data updates, storage, and analytics to continuously improve system performance and user experience. Allowing users to share real-time hazard information within a community network to enhance collective safety. Developing a lighter, more compact hardware design with longer battery life to facilitate all-day use. Connecting the assistive stick to smartwatches or other wearables to offer seamless notifications and control options. Adding automatic alert systems to notify caregivers or emergency services in case of falls or critical incidents.

These advancements would make the Echo Guidance system more comprehensive, adaptive, and indispensable as an assistive technology for visually impaired individuals.

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