International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Intelligent Assistive Cane for Visually Impaired

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Abstract: ***The creation of an Intelligent Assistive Cane to improve the safety and mobility of people with vision impairments is presented in this paper. To provide real-time obstacle identification and navigation guidance, the cane combines a number of state-of-the-art technologies, such as ultrasonic sensors, a buzzer, voice aid, and a vibration motor. To identify impediments within a certain range, ultrasonic sensors are positioned strategically on the cane. The buzzer emits an audible alert upon detection, and the vibration motor provides haptic feedback to direct the user toward safe routes. Voice help also provides spoken directions and alerts, enabling the user to confidently traverse their environment.By combining these technologies, the cane can recognize impediments like walls, poles, and stairs with accuracy and send out signals in a timely manner. For those who are visually challenged, this creative method greatly lowers the chance of accidents and enhances their general quality of life.***

Keywords: ***obstacle detection, assistive technology, microcontroller , ultrasonic sensor***

1. INTRODUCTION

The ability of a person with visual impairment to independently navigate their environment is greatly impacted. Although conventional assistive canes offer fundamental assistance, they frequently lack the advanced technology necessary to recognize and notify users of problems instantly. This paper describes the creation of an Intelligent Assistive Cane, a cutting-edge gadget intended to improve the mobility and security of people with visual impairments, in order to overcome this constraint. To give consumers complete support, the Intelligent Assistive Cane integrates a variety of technology. To identify impediments within a certain range, ultrasonic sensors are positioned strategically on the cane. The cane activates a multi-modal alert system that includes a vibration motor, verbal assistance, and a buzzer when it detects an obstruction.The user is alerted to the approaching impediment by the buzzer's auditory warning. Concurrently, the voice aid system gives spoken directions, directing the user to a secure route or warning them of possible dangers. The vibration motor provides tactile input to improve situational awareness by directing the user and warning them of obstacles' location and closeness. There are numerous significant benefits to integrating these technologies. First of all, the cane can recognize things at different distances

and angles thanks to the ultrasonic sensors' accurate and dependable obstacle recognition. Second, regardless of the user's preference for either tactile or aural alerts, the multi-modal alert system guarantees that users receive timely and efficient notifications.The cane provides information and assistance by integrating tactile, visual, and aural cues, enabling users to confidently navigate complicated settings and make well-informed decisions. Through increased mobility, safety, and freedom, the Intelligent Assistive Cane has the potential to greatly improve the quality of life for those with vision impairments. Through the provision of timely notifications, instructive assistance, and real-time obstacle detection, the cane enables users to confidently traverse their environment and actively engage in society.

2. LITERATURE REVIEW

- **Smart Cane: Assistive Cane for Visually Impaired People by Mohd Helmy Abd Wahab, Amirul A. Talib, Herdawatie A. Kadir, Ayob Johari, A. Noraziah, Roslina M. Sidek, and Ariffin A. Mutalib. [1]** According to the study's hypothesis, visually impaired people may walk more safely if they have a smart cane that warns them of impending hazards. The paper's goal is to discuss the creation of a cane called the Smart Cane that can interact with users via vibration and voice alarm. Physical installation and coding are part of the development process. The smart cane has undergone a number of tests, and the outcomes are described. The PIC microcontroller's source code is developed using the MPLAB program.The hardware consists of a water detector, a microprocessor (single chip), and ultrasonic sensors, which produce high frequency sound waves and measure the echo that the sensor receives.

- **The IoT-enabled intelligent stick for visually impaired people to recognize obstacles was developed by Muhammad Siddique Farooq, Imran Shafi, Harris Khan, Isabel De La Torre Díez, Jose Breñosa, Julio César Martínez Espinosa, and Imran Ashraf. [2]** In order to help visually impaired persons traverse the outdoors, this article introduces an Internet of Things (IoT)-enabled smart stick that can identify and alert users to potential hazards. The suggested design makes use of a high definition video camera with object recognition built in, ultrasonic sensors for obstacle detection, and a water sensor to identify puddles and other wet surfaces in the user's route. After correctly detecting and recognizing objects, the user is also given voice input through earphones regarding various obstacles and objects.There are two modes on the proposed smart stick: the first uses ultrasonic sensors to detect obstacles and provides feedback via vibration

motors about their direction; the second mode detects and recognizes obstacles and provides voice feedback. The environment and individual preferences determine which mode is used. Additionally, the user's latitude and longitude are recorded and uploaded to the IoT platform for efficient tracking through GPS and GSM modules, allowing the user or stick's real-time location to be tracked on the IoT dashboard.By creating a request signal in the form of an SMS with a Google Maps link created with latitude and longitude coordinates and transmitted over an IoT-enabled environment, a panic button is also offered for emergency assistance.

- **Zariman, A., and F.A. Ghani, 2019. IoT-based smart cane [3]**

This study presents a walking stick model for those with vision impairments that is based on the Internet of Things. To aid in navigation and obstacle detection, the cane is outfitted with a GPS module, GPS antenna, Arduino, ultrasonic sensor, and buzzer. The user may steer clear of obstacles within this range thanks to the customizable obstacle detection range of 1 to 3 meters. The user's location is determined in part via the GPS module and antenna. The buzzer alerts the user with two different sounds: an interrupted sound to indicate an obstruction and a continuous sound when the destination is reached. This dual-sound method improves mobility and safety by enabling the user to distinguish between approaching impediments and the arrival at the destination. Using a conventional white cane is made simple by the system's lightweight and compact design.

- **In April 2024, Muktha, D.S., Niveditha, G., Pinto, N.A., and Sinha, S. Improving Mobility: A Smart Cane for the Visually Impaired with Voice-Assisted Guidance and an Integrated Navigation System. [4]**

This study describes the design of a "Smart Cane" that uses voice-guided navigation and object recognition to increase the mobility and safety of visually impaired users. The cane warns the user of possible difficulties by using a bidirectional vibration motor to provide haptic feedback and ultrasonic sensors to identify items in the immediate vicinity. A microcontroller controls the system and maximizes power consumption to prolong battery life. Easy-to-use controls, an ergonomic design, and integrated navigation capabilities driven by an online Map API are further benefits. In both indoor and outdoor environments, this package of features provides dependable, easily accessible direction.

3. METHODOLOGY

The hardware and software are the two components that make up the proposed project's methodology. The software component uses

Arduino, an open-source electronics platform, to design a creative solution, while the hardware component builds an actual cane using microcontrollers and an ultrasonic sensor. Make that people with different degrees of vision impairment can easily learn and use the interface. We assess the cane's precision, dependability, and utility by fusing hardware elements with Arduino's programming capabilities.

Hardware Components :

1. Nano-Arduino Board

This little, multipurpose microcontroller is perfect for portable applications. It manages the output device control and sensor data processing. This smart cane's brain is the Nano Arduino board. It is a compact, potent microcontroller that interprets data from sensors, including ultrasonic ones. The Arduino sends out vibration or sound signals when it detects an obstruction.

2. Ultrasonic Sensor

One essential part that allows the cane to identify obstructions in its path is the ultrasonic sensor. It can determine the distance to the obstacle by sending out high-frequency sound waves and timing how long it takes for the echoes to return. The proper warnings are then triggered using this information.

3. Buzzer

The buzzer is in charge of emitting sound notifications to notify the user to any dangers. To signal various dangers, it can produce a range of noises, including beeps and tones. To make the sound easily audible to the user, the frequency and intensity can be changed.

4. Vibration Motor

The user receives haptic input from the vibration motor, which uses tactile sensations to warn them of obstacles. It can vibrate in a variety of patterns and intensities to communicate particular

information, such the direction and closeness of an obstruction. These haptic feedback systems are especially helpful for people who might have trouble hearing or comprehending audio signals.

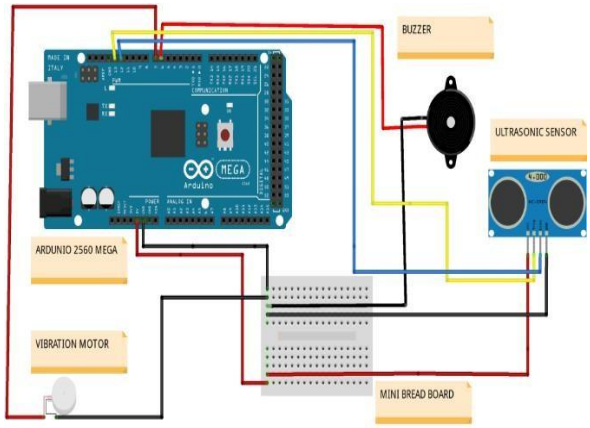
5. Voice Assistance

The user can receive verbal instructions and guidance using voice aid technology. It can provide general information about the surroundings, indicate the existence of barriers, or provide alternate routes. A speech module or a smartphone app connection can be used to incorporate voice assistance.

Software Components

- Sensor Data Acquisition: This process entails continuously reading and gathering information from ultrasonic sensors as well as other possible sensors. After processing this data, pertinent information such as the distance to obstacles and their orientation is extracted, allowing the cane to give the user precise and timely feedback.
- Obstacle Detection: Determines obstructions within a specific range by analyzing sensor data.
- Alert Generation: To notify the user of any obstructions or dangers identified by the cane's sensors, the Intelligent Assistive Cane uses a variety of alerts, including voice prompts, vibrations, and audio alarms.

CIRCUIT DIAGRAM



4. RESULT ANALYSIS

An ultrasonic distance sensor is implemented by the Arduino code to determine the separation between the sensor and an item. When the object is within 30 centimeters, the recorded distance is

then used to activate a vibration motor and a buzzer. The trigger, echo, buzzer, and vibration motor pin numbers are defined first in the code. These pins are set up as input or output, and serial connection is started in the setup() method. The main logic is included in the loop() function. It begins by briefly raising the trigger pin to produce a transient ultrasonic pulse. The reflected pulse is then recorded by the echo pin, and the pulseIn() function is used to determine how long the pulse lasted.Using the known speed of sound, this duration is translated into distance in centimeters. For the sake of monitoring and troubleshooting, the computed distance is printed onto the serial monitor. The vibration motor and buzzer are turned on to warn the user if the distance is less than 30 centimeters. They are switched off otherwise. To ensure precise readings, a 100 millisecond lag is added between measurements.

Distance(cm)	Buzzer	Vibration
>30	Off	Off
<=30	On	On

5. CONCULSION

In this article, we presented a novel intelligent assistive cane that enables people with vision impairments to go around with safety and self-assurance. This smart cane is a useful tool for increasing mobility since it uses cutting-edge technology to identify obstacles in the user's path and notify them via sounds, voice commands, and vibrations.Our strategy consists of a number of crucial components that cooperate to provide users with efficient service. To start, the cane has ultrasonic sensors that can detect impediments at various distances. By identifying potential obstacles in their path, these sensors are essential for assisting users in understanding their surroundings. The cane's alert system kicks in to deliver timely notifications based on the user's needs when a barrier is recognized.To make sure users get the information in the way that suits them most, this system employs vibrations, spoken instructions, and sound alarms. We assist consumers in making smarter decisions while navigating their environment by integrating these various warning types.Our evaluation's findings demonstrate that the Intelligent Assistive Cane significantly raises users' environmental awareness. They feel safer and more self-sufficient when they are moving around thanks to this increased awareness. But we also discovered several difficulties, such how effectively the cane functions in various environments and its capacity to identify impediments in congested areas. These problems show that more advancements are required. There are numerous methods to improve the cane going forward. To make sure it functions consistently in a range of scenarios, we might concentrate on enhancing its obstacle detection. Computer vision is one example of a new technology that could further increase users' awareness. Additionally, the cane might be more efficient and user-friendly if it were tailored to each person's tastes. To sum up, the Intelligent

Assistive Cane represents a significant advancement in assistive technology for those who are blind or visually impaired. This study demonstrates how contemporary technology may support visually impaired people in leading more autonomous and self-assured lives by fusing intelligent detecting features with clear alarms. In the end, this cane promotes users' independence and capacity to interact with the world around them in addition to assisting them in navigating their environment, thereby fostering a more welcoming society for all.

6. REFERENCES

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