International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 05 | May - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

BLINDS EYE: Advancing Navigation for the Visually Impaired with Arduino Uno

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Abstract - Blinds Eye Advancing Navigation for the Visually Impaired with Arduino Uno. Navigating their surroundings independently, visually impaired individuals encounter challenges with traditional aids. This advanced blind navigation system, integrating an Arduino Uno for processing, a GPS module for real-time tracking, and a panic button for emergencies, presents a groundbreaking solution. Ultrasonic and IR sensors detect obstacles, issuing audio alerts and adjusting routes. An RF module aids in locating a misplaced smart stick. Overcoming limitations of existing solutions, the system's audio output provides crucial information, ensuring safer and more efficient independent travel for the visually impaired."

Key Words: Arduino Uno, Blind navigation, Visually impaired, GPS module, Ultrasonic sensors, Infrared sensors, RF module, Assistive technology

1.INTRODUCTION

Blindness presents a unique set of challenges to individuals, impacting their ability to navigate and interact with the world around them. While there have been remarkable advancements in assistive technologies aimed at enhancing the independence and mobility of visually impaired individuals, many existing solutions still fall short in providing comprehensive and efficient navigation assistance. Recognizing the need for a more advanced and adaptable system, the "Blinds Eye" project introduces a groundbreaking navigation solution designed specifically for the visually impaired community.

At the heart of the Blinds Eye system lies the Arduino Uno, a versatile microcontroller renowned for its flexibility and ease of use in prototyping electronic devices. Leveraging the processing power of the Arduino Uno, combined with a meticulously crafted array of sensors and modules, this navigation system aims to revolutionize the way visually impaired individuals perceive and interact with their surroundings. One of the key components of the Blinds Eye system is the integration of a GPS module, which provides real-time tracking of the user's location. This allows for precise navigation assistance, enabling users to confidently traverse unfamiliar environments with greater independence. Additionally, the inclusion of ultrasonic and infrared sensors enables the system to detect obstacles in the user's path, issuing audio alerts and dynamically adjusting routes to ensure safe passage.

2.1 LITERATURE SURVEY

[1] This paper presents a novel approach to tackling the navigation difficulties encountered by visually impaired individuals through the development of a multifunctional blind stick. Through innovative design and functionality, this solution aims to enhance the mobility and independence of visually impaired users. By integrating various sensors and technologies, such as ultrasonic sensors and GPS modules, the blind stick offers real-time feedback and assistance in navigating obstacles and unfamiliar environments. The proposed smart blind stick integrates various sensors, including ultrasonic and infrared sensors for obstruction detection, a moisture sensor for identifying wet terrain, and GPS for real-time location tracking. It also incorporates a panic button for sending alert messages, and a remote control for locating the stick. Controlled by an Arduino Uno microcontroller, the system effectively detects obstacles and sends SMS with accurate coordinates to acquaintances during emergencies. The paper discusses the integration of components, presents results from the prototype, and suggests future improvements, highlighting the potential of this multi-functional blind stick to enhance the safety and independence of visually impaired individuals. It references related works in the field, emphasizing the innovation and significance of their solution.

[2] Dynamic and Optimized model for Stairs Detection The paper presents a novel approach to addressing the challenges faced by modern robotic technology in navigating stairs of varying dimensions. The paper introduces a synchronized model utilizing a pair of ultrasonic sensors in a vertical stack-wise arrangement to obstruction sensing and climb stairs. This system aims to enhance the capabilities of robots for search and rescue or surveillance operations. The research includes a comparative study to develop a mathematical algorithm applicable to different types of stairs, and an optional LED light for additional security. The paper highlights the advantages of ultrasonic sensors in various environmental conditions and provides detailed insights into the construction and placement of sensors. Experimental results demonstrate the model's effectiveness in detecting and climbing stairs, thus contributing to the field of robotics and autonomous navigation.

[3] The paper presented at the 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS) introduces a groundbreaking solution designed to empower visually impaired individuals by enhancing their independence and safety. This innovative smart stick integrates ultrasonic sensors for obstacle detection, a camera for object recognition, and a GPS module for accurate location tracking. Through real-

time audio cues and vibration feedback, users can navigate their environment with greater confidence and efficiency. This project builds upon previous research in the field, demonstrating significant technological advancements aimed at addressing the daily obstacles encountered by the visually impaired community, thereby improving accessibility and security in their lives.

[4]A Smart Voice-Enabled Blind Stick with An Emergency Trigger The paper proposed advanced blind navigation system offers a groundbreaking solution for visually impaired individuals, integrating an Arduino Uno microcontroller for central processing, a GPS module for real-time location tracking, and a panic button for emergencies. Ultrasonic and IR sensors detect obstacles and objects, providing immediate audio alerts and route adjustments, while an RF module helps locate a misplaced smart stick. The system's audio output conveys crucial information, promoting safer, more efficient independent travel for the visually impaired. This low-cost, efficient, and lightweight solution addresses the limitations of existing solutions and has the potential for further enhancements like navigation assistance and real-time tracking, making it a comprehensive support system for the visually impaired to navigate their surroundings more independently and safely.

[5] The paper presents a remarkable solution catering to the navigation challenges encountered by visually impaired individuals. The proposed system leverages Google's Cloud Video Intelligence API for real-time video processing, enabling obstacle and object analysis with subsequent feedback through voice messages. This system offers instantaneous navigation support for both indoor and outdoor environments, obviating the necessity for traditional sensors such as ultrasonic or infrared. Additionally, it boasts text recognition capabilities, furnishing an extra layer of information. Noteworthy advantages include cost-effectiveness, reduced memory requirements, and efficient object recognition. Nonetheless, it hinges on a high-speed internet connection, and utilization of Google's API may entail charges. Future improvements might entail integrating solar cells for recharging and linking multiple smart e-sticks for community communication, alongside enhancing voice outputs via caption generation algorithms. In essence, this inventive system harbors the potential to significantly enrich the lives of visually impaired individuals by granting them a semblance of vision and autonomy in traversing their surroundings.

[6] Smart Technologies for Visually Impaired: The paper discusses the development of a smart stick for visually impaired individuals, aimed at enhancing their daily activities and mobility. The project employs artificial intelligence and image processing to detect faces, colors, and various objects in the environment, presenting the information to the user via audio alerts. Unlike conventional approaches that rely solely on sensors, this smart stick utilizes a camera for recognition and utilizes AI algorithms for processing. It also includes a help button that allows the visually impaired person to request assistance or alert their location to friends and family through a SIM card. The paper highlights the importance of supporting blind individuals through modern technology and indicates potential future enhancements, such as cognitive recognition of behaviour and Braille integration. This project offers a promising solution to the challenges faced by the visually impaired, aligning with the advanced blind navigation system's objectives to provide more efficient and safe independent travel for this community.

[7] This paper introduces an extensive solution to aid visually impaired individuals in navigation, integrating diverse technologies to form an advanced blind navigation system. Utilizing an Arduino Uno microcontroller for central processing, a GPS module for real-time location tracking, and ultrasonic and IR sensors for obstacle detection, alongside an RF module for smart stick location retrieval, the system delivers audio output for essential information dissemination, including a panic button for emergency situations. This innovative system targets the improvement of independence and safety for visually impaired individuals, mitigating the shortcomings of current solutions.

[8] Smart Blind Stick In the paper, a groundbreaking smart cane is introduced, designed to address mobility difficulties faced by visually impaired and elderly individuals. This innovative cane incorporates ultrasonic sensors at different heights, an Arduino Uno board for processing, a force sensor to detect pressure changes and potential falls, and wheels for efficient movement. When obstacles are detected, the cane triggers audio and visual alerts, enhancing the user's navigation experience both indoors and outdoors. This smart cane offers a promising solution to promote safer and more confident independent mobility for those with visual impairments and mobility issues, presenting a valuable advancement in assistive technology.

[9] This research paper titled "Enhanced Walking Assistance Device - A Technological Solution for the Visually Impaired," authored by Mohammad Hazzaz Mahmud, Rana Saha, and Sayemul Islam, presents an inventive sensor-based circuitry designed to assist individuals with visual impairments. This system integrates an Ultrasonic Sensor for obstacle detection, paired with a PIC16F690 microcontroller responsible for processing sensor data and controlling various outputs, such as LED indicators, a buzzer, and a motor through PWM signals. Auditory feedback is provided through a buzzer alarm, enhancing the walking experience for visually impaired users.

[10] The article entitled "Electronic Navigation Aid System for the Blind Based on ARM7 Architecture" authored by V. S. M. Madhulika S, M. S. Madhan Mohan, CH. Sridevi, and T. V. Janardhana Rao presents the development of an Electronic Travel Aid ETA kit designed to support visually impaired individuals in navigating obstacle-free routes. This ETA system is affixed to the user's cane and incorporates an GSM module GPS module ultrasonic sensor, and vibratory circuit speakers or headphones. These components work collaboratively to alert users of nearby obstacles, facilitating navigation and monitoring.

2.2 METHODOLOGY

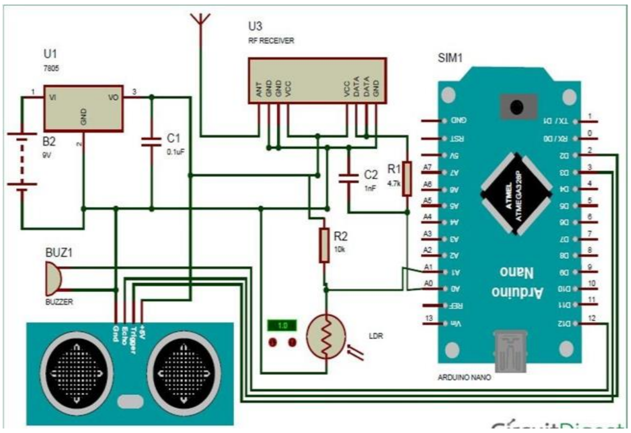

Fig -1: circuit diagram

The Arduino Smart Blind Stick Project comprises two distinct circuits: one mounted on the blind person's stick and another, a small remote RF transmitter circuit, used to locate the main circuit. The primary board's schematic entails employing an Arduino Nano to manage all sensors, although an Arduino Uno can serve the same purpose through identical pinouts and programming. A 9V battery powers the entire board, regulated to +5V via a 7805 Voltage regulator. The Ultrasonic sensor operates at 5V, with its trigger and Echo pins linked to Arduino Nano pins 3 and 2, respectively. A Light Dependent Resistor (LDR) interfaces with a 10K resistor to form a potential divider, with the voltage difference measured by Arduino ADC pin A1. Another ADC pin, A0, captures the signal from the RF receiver. A buzzer, connected to pin 12, serves as the board's output, facilitating safe navigation for the visually impaired through real-time sensor feedback and Arduino Nano-controlled alerts.

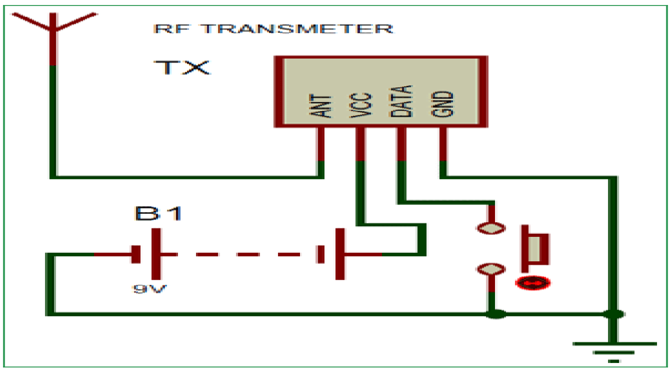

Fig -2 RF remote circuit

In the RF remote circuit, a clever workaround is employed to simplify the functionality. Typically, using a 433 MHz RF module requires an Encoder and Decoder or two MCUs to function, such as the HT12D and HT12E decoder and encoder ICs used in previous Receiver circuit and RF Transmitter. However this application, only the receiver needs to detect if the transmitter is sending signals. Thus, the data pin of the transmitter is connected to either Ground or Vcc of the supply. The data pin of the receiver part is then passed through an RC filter before being connected to the Arduino. When the button on the transmitter is pressed, the receiver outputs a constant ADC value repeatedly. This repetitive output is not observed when the button is not pressed. Consequently, the Arduino program is designed to detect repeated values, indicating that the button has been pressed. This clever approach enables a visually impaired individual to track their stick effectively.

2.3 EXISTING SYSTEM

Before the Growth of BLINDS EYE, navigation for the visually impaired relied heavily on traditional methods such as canes, guide dogs, and assistance from others. While these methods are effective to a certain extent, they often come with limitations and dependencies that hinder the independence and mobility of individuals with visual impairments. BLINDS EYE seeks to revolutionize navigation for the visually impaired by leveraging the power of technology, specifically Arduino Uno microcontroller boards. By incorporating ultrasonic sensors, audible feedback mechanisms, and innovative software algorithms, BLINDS EYE aims to provide a more reliable, intuitive, and independent navigation solution for the visually impaired.

2.4 DRAWBACKS

The BLINDS EYE system, although promising for aiding visually impaired individuals in navigation, encounters several notable limitations. Firstly, its dependency on battery power necessitates regular charging, which may inconvenience users and lead to interruptions in functionality. Moreover, when the battery is depleted, the device becomes non-operational, rendering it ineffective until recharged. Secondly, the system requires users to undergo training to use it effectively, potentially serving as a barrier to adoption for some individuals. Additionally, the device lacks object recognition capabilities, only identifying obstacles without distinguishing between individuals or other objects. This limitation restricts its utility in environments with various obstacles. Furthermore, the system does not offer protection from obstacles at face level or above the head, diminishing its effectiveness in crowded or diverse settings. Addressing these limitations is crucial for enhancing the practicality and usability of the BLINDS EYE system as a navigation aid for the visually impaired.

2.5 WORKING

The proposed advanced blind stick integrates cutting-edge technology to significantly enhance navigation for visually impaired individuals. Incorporating ultrasonic sensors, light and water sensing capabilities, and an Arduino Uno microcontroller, this innovative device provides real-time feedback and alerts to users, improving their safety and independence. Utilizing ultrasonic waves, the stick detects obstacles ahead, relaying this data to Arduino Uno for processing. When an obstacle is detected within close proximity, the Arduino Uno triggers voice warnings, alerting the user to potential hazards. Additionally, the stick features a water sensor that identifies wet surfaces, emitting a distinct buzzer sound to notify the user of slippery conditions. Moreover, the stick incorporates a vibration function to signal nearby obstacles, enhancing the user's spatial awareness. Furthermore, the device includes a light sensor, enabling users to discern between light and darkness in their surroundings. Notably, to assist users in locating their stick, a wireless RF-based remote is integrated, allowing users to trigger a buzzer sound on the stick with a simple button press. This comprehensive system leverages state-of-the-art technology to address the diverse challenges faced by visually impaired individuals, empowering them to navigate with confidence and ease in various environments.

2.6 RESULTS

Fig -3 result1

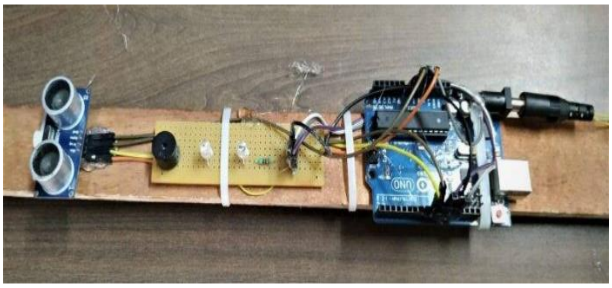

Fig -4 result2

3. CONCLUSIONS

This paper introduces a novel solution aimed at assisting visually impaired individuals with navigation challenges through the development of a smart blind stick. By effectively leveraging ultrasonic sensors, this device can detect obstacles within a range of 30cm. Upon obstacle detection, the integrated buzzer alerts the user, gradually increasing in intensity as the obstacle approaches. Looking ahead, future iterations of this project aim to enhance its functionality by incorporating additional features tailored to further improve the life of blind people individuals within the community. Planned upgrades include replacing the Arduino with a Raspberry Pi for improved efficiency, integrating GPS functionality for location tracking, and incorporating IoT devices to facilitate enhanced mobility for the blind. These advancements hold the promise of significantly enhancing the efficacy and usability of the smart blind stick, thereby offering greater independence and accessibility to blind persons individuals.

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