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Smart Walking-tracking Stick for Visually Impaired Peoples

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ABSTRACT: This paper describes the development and application of a smart walking tracking system meant to assist the visually impaired and elderly in overcoming mobility issues. By providing a safe and dependable means of autonomous navigation, the technology intends to improve their quality of life. Carers can also track their loved ones' whereabouts and movements using a remote monitoring device. Wearable devices with a variety of sensors are used in the system to communicate position and movement data to a mobile application. This program provides users with immediate feedback, warns them of potential risks, and guides them through their surroundings. This article discusses the possible advantages of a smart walking tracking system for the elderly and visually handicapped, as well as their carers.

KEYWORDS: Stick, visually impaired people, Arduino uno, Ultrasonic sensor

I. INTRODUCTION

The Smart Walking Tracking System is a technology designed to help the elderly and those with disabilities gain more freedom. By combining sensor technologies, this groundbreaking technology improves how we navigate. The system's core building blocks are ultrasonic sensors. These sensors generate waves that can detect impediments and precisely measure distances in time to secure a way for users. Furthermore, GPS technology enhances the experience by providing users with access to position data, allowing them to comfortably explore new areas without fear of getting lost. Additionally, the device's GSM capabilities allow it to interact with carers or emergency services. This function can help users feel more at peace.

Furthermore, speech recognition technology improves user interaction by allowing spoken commands for communication, which is a critical function for persons with visual impairments. The ability of this technology to precisely identify obstructions in the path is a notable feature that provides consumers more confidence as they traverse terrain. The Smart Walking Tracking System essentially combines voice recognition, GPS technology, sensors, and GSM capabilities into a solution that greatly boosts autonomy for visually impaired people. As technology advances, future inventions might be expected to be more equitable and empowering.

II. LITERATURE REVIEW

This paper's research discusses a brand-new smart stick that allows blind persons to go around on their own. The stick has a siren, a vibrating motor, and other sensors to warn the user of obstructions, potholes, and darkness. It also has a radio-frequency receiver to prevent movement. According to the authors, the stick can improve a user's independence and accuracy while also being more efficient and less expensive than earlier models [1].

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The article discusses how to use an ultrasonic walking stick in conjunction with an Arduino system to navigate and identify obstacles. The stick vibrates to warn the user of impending obstacles, which are detected by an ultrasonic sensor. The report also discusses artificial intelligence and GPS research for blind individuals. The ultrasonic walking stick is a basic, low-cost gadget that can handle future technology [2].

The study focuses on the creation of an intelligent walking stick that will assist blind persons in navigating their surroundings. The walking stick is outfitted with sensors that identify obstructions and notify the user via vibration and audible feedback. The device, which is controlled by a microcontroller, employs GPS navigation to make navigating through unknown locations easier. One of the project's main goals is to provide a feasible, inexpensive solution that improves the independence and mobility of people with vision impairments [3].

Himanshu Sharma et al. created a navigational aid for visually challenged people. The device is a small, portable walking stick with sensors inside that identify obstacles in the immediate vicinity. It provides aural and tactile input to the user. The stick is intended to improve the safety and comfort with which visually impaired people navigate both indoor and outdoor environments. It can be tailored to match the demands of each individual. The project's ultimate goal is to raise their overall standard of living [4].

The literature examination concentrates on a publication by Dr. G. Ramesh and colleagues entitled "Development of e-stick for visually impaired individuals using IoT." This article introduces an electronic cane specifically designed for blind individuals, incorporating sensors and GPS, two technological aspects of the Internet of Things. The coordinating mobile application provides hazard notifications and audio feedback. The research highlights the limitations of traditional canes and asserts that the e-stick has the potential to enhance independence and mobility for individuals who are blind. Furthermore, it emphasizes the possibility of widespread adoption and dissemination, ultimately making a profound impact on the lives of visually impaired individuals [6].

In Ashish Kumar and his team's research article, they propose a distinct smart stick for individuals who are blind or visually challenged. This innovative stick is equipped with various sensors capable of detecting obstructions, potholes, and low-light conditions. Additionally, it incorporates a buzzer and vibrating motor to provide alerts when necessary. To prevent misplacement, a radio-frequency receiver is also included. According to the authors, this advanced smart stick surpasses previous models in terms of both effectiveness and cost-efficiency, thereby enhancing user accuracy and independence. In general, visually impaired individuals can greatly benefit from this state-of-the-art technology in their mobility and overall quality of life [7].

In the study conducted by Shubham Bele and his team, multiple sensors including two ultrasonic sensors, two infrared sensors, a rain sensor, and other sensors were utilized. Additionally, the stick incorporates a GSM module, an Arduino Uno microcontroller, and a vibrating sensor. The primary functions of the stick entail identifying the environment and detecting obstacles. Noteworthy advantages of the proposed system consist of providing position monitoring to enhance safety, facilitating navigation both indoors and outdoors, and recognizing obstacles using speech and vibration output. However, it should be noted that the system necessitates regular battery charging and may cease to function if left uncharged [8].

Shravan Mohite and his colleagues discuss the development of a "Smart Walking Stick." The stick is made up of ultrasonic sensors, a vibrator motor, a water sensor, a light (LDR) sensor, and an Arduino Uno R3 CPU. The Arduino Uno R3 evaluates sensor signals and transmits alerts via buzzers, vibrators, and voice alarms. Blind persons can also utilize GPS navigation on a mobile device to navigate strange and unusual circumstances. Prior research has concentrated on constrained functionality, indoor navigation, and obstacle detection [9].

A smart walking stick is currently being developed by Shravan Mohite and his colleagues. The stick is composed of several components, including ultrasonic sensors, a vibrator motor, a water sensor, an LDR sensor, and an Arduino Uno R3 CPU, which processes sensor signals and generates alarms via buzzers, vibrators, and voice alerts. The blind are

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also led to strange and unfamiliar locales by using GPS navigation on a mobile smartphone. Prior efforts concentrated on limited functionality, obstacle detection, or indoor navigation [10].

According to Gia Hoang Phan's research, a smart stick with low costs and power requirements could be a viable alternative. The stick's creation uses strong, lightweight materials, making it suited for both men and women. The stick has ultrasonic sensors that detect obstructions as well as a GSM module. The results show how successful the stick is at detecting obstructions, with error rates in distance measurements of less than 1%. Furthermore, the voltage readings on the stick correspond well with distance measurements, indicating accurate operation [11].

III. METHODOLOGY

The primary goal of the intelligent blind cane is to provide visually impaired individuals with improved path awareness and GPS-based location tracking. This is achieved through the incorporation of several infrared (IR) sensors. The cane employs these sensors to detect obstacles, aiding the user in navigation. The various components required for this system are interconnected as per specific needs.

1) Obstacle Detection:

The intelligent cane, designed for the visually impaired community, utilizes IR sensors to identify the presence of obstacles. Each IR sensor consists of a transmitter and a receiver. The transmitter emits IR light to detect obstacles in its path. When these obstacles reflect the IR light, the receiver captures the signals and transmits them to our system. This information helps us determine the proximity and distance of objects in front of the user, relative to the cane they hold in their hands.

2) Voice Recognition:

This cane represents an innovative solution for both visually impaired and elderly individuals, incorporating GPS tracking and voice recognition systems. In this project, whenever an object is detected by the sensor in front of the cane, it sends a signal to the microcontroller. The microcontroller then generates voice output through a speaker. Additionally, our project's voice recognition system module is depicted in Figure 1 for further reference.

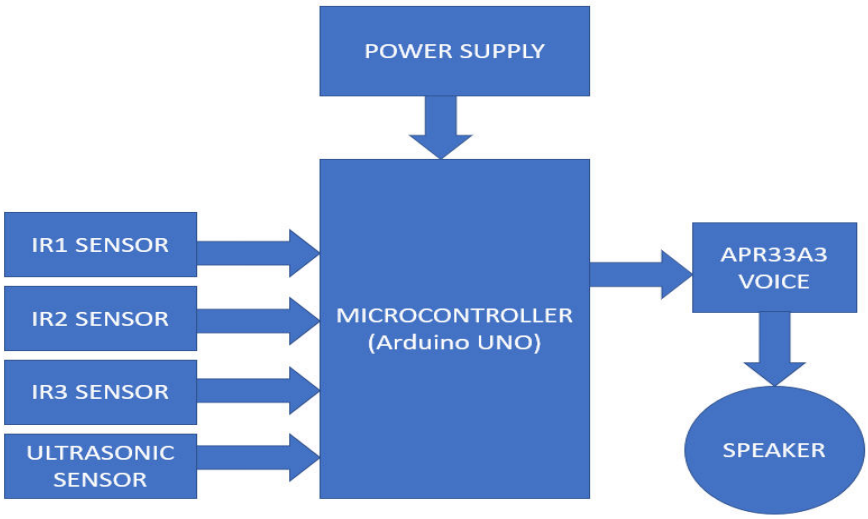

Fig .1

3) **GPS tracking**

With the addition of Node-MCU to the system, the system gains cutting-edge capability that can assist the blind. Because of the embedded Wi-Fi module and little coding, the gadget can connect to the internet swiftly and

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effortlessly. Furthermore, the stick includes an SMS system that allows blind people to send text messages to pre-saved phone numbers. The data is digitized and compressed before being sent down a channel with two other streams of user data, each in its time slot, via the GSM module. After receiving serial data from radiation monitoring equipment like survey meters or area monitors, this module may deliver text SMS data to a host server. We also describe the GPS tracking mechanism in Figure 2.

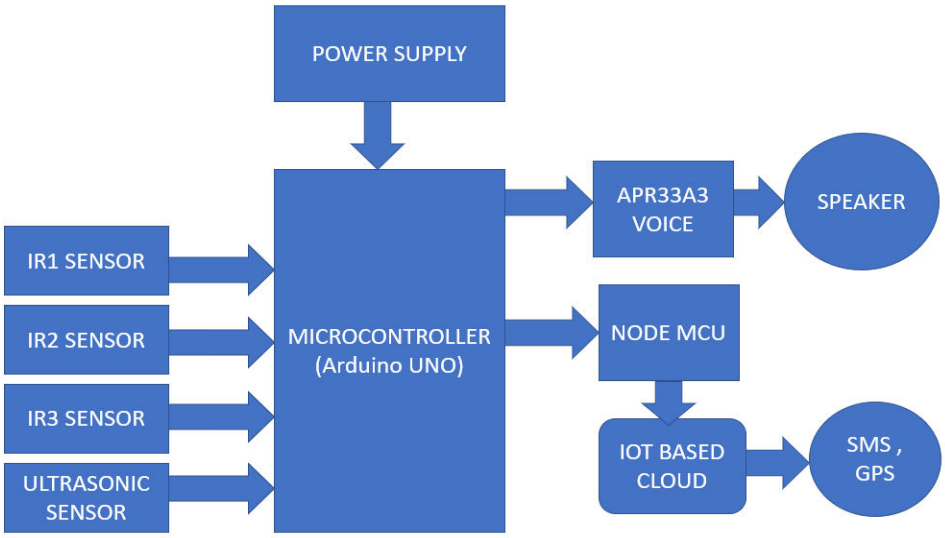

Fig .2.

The transmission of a message through the GSM module involves several distinct phases. Firstly, the module needs to undergo initialization and configuration, which includes setting up essential applications such as SIM card information and network requirements. Once this initialization process is completed, the module establishes communication with the GSM network by registering on an available network.

Subsequently, the message composition phase begins. This involves specifying the recipient's phone number and composing the message's content. Once the message is ready for transmission, the GSM module employs its communication protocols to transmit it to the GSM network. Within the Global System for Mobile Communications (GSM), the message is analyzed and routed to the appropriate destination based on the recipient's phone number.

Finally, the message is retrieved by the device used by the sender. It is crucial to note that the specifics of this process may vary depending on the particular GSM module and the communication protocols it supports. Nonetheless, these outlined stages provide a general overview of the procedure by which a GSM module sends a text message.

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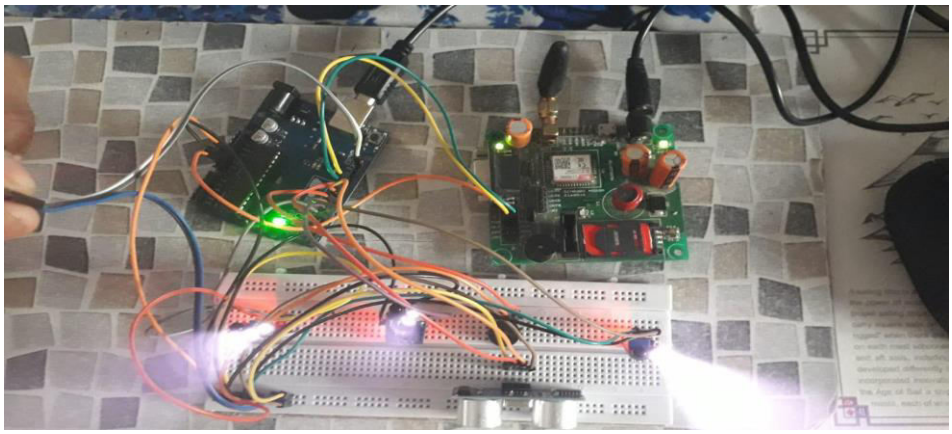
IV. RESULT



The smart stick for blind people has been built with cutting-edge capabilities to increase the safety and freedom of those who are blind or visually impaired. Because of its integrated sensors, microcontrollers, and GPS technology, the device identifies obstructions, provides haptic or aural feedback, and facilitates navigation.

Obstacle detection: Using infrared (IR) and ultrasonic sensors, the smart stick recognizes barriers in the user's route.

Auditory feedback: The device's feedback mechanism, a buzzer, allows users to detect obstructions in their environment and perceive their surroundings.

GPS technology is built into the smart stick. If the stick falls, the GPS will assist in locating and recovering it. Users can also use global positioning data to find themselves and receive step-by-step directions to their desired locations.

V. DISCUSSION

The smart cane, designed for individuals with visual impairments, serves as a valuable tool to assist them in their daily activities. This device operates by detecting obstacles and offering feedback through sensors and microcontrollers, which can be either haptic or auditory. Additionally, it incorporates GPS technology to facilitate navigation and destination tracking. This portable and user-friendly smart cane represents an innovative solution that has the potential to significantly enhance the daily lives of visually impaired individuals.

One of its key advantages lies in its ability to improve safety, particularly in crowded environments, by identifying potential hazards. Nevertheless, it's important to acknowledge potential limitations, such as the susceptibility of the device to environmental factors that may affect its sensors and microcontrollers. Furthermore, it may not be suitable for individuals with more complex or severe needs.

In summary, the smart cane holds great promise for improving the quality of life for those with visual impairments, yet additional research is necessary to comprehensively assess its efficacy and limitations.

VI. LIMITATIONS

Although the Smart Walking-Tracking Stick (SW-TS) offers valuable assistance to visually impaired and elderly individuals, it does come with certain limitations that should be considered:

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1. Dependency on Advanced Technologies: The SW-TS relies heavily on advanced technologies like GPS, sensors, and connectivity for its functionality. In areas with poor network coverage or weak GPS signals, the device may not perform optimally or may fail altogether.

2. Battery Life Concerns: The device's battery life is critical. If the battery unexpectedly runs out, it could leave visually impaired or elderly users without the assistance they rely on.

3. Complexity for Some Users: Certain users, particularly those less familiar with technology, may find it challenging to use and adapt to the SW-TS interface and its various functionalities. Designers should consider the diverse needs and abilities of the target user demographic when creating such assistive devices.

4. Accuracy of Obstacle Detection: While the device aids in obstacle detection, its accuracy may not be 100%. False positives or negatives in obstacle detection could potentially lead to accidents or hinder smooth navigation.

5. Impact of Adverse Weather Conditions: Adverse weather conditions or challenging terrains may affect the device's performance. For instance, heavy rain or snow could interfere with sensors or impair visibility, limiting the device's effectiveness.

6. Maintenance and Updates: Like any electronic device, the SW-TS requires regular maintenance and updates to ensure proper functionality. Elderly or visually impaired users might encounter difficulties when attempting to perform these tasks independently.

VII. CONCLUSION

The Smart Stick project for individuals with visual impairments represents an innovative tool aimed at improving safety and mobility. Its core purpose is to offer an alternative to traditional white canes, empowering visually impaired individuals to navigate their surroundings with increased autonomy. The smart stick incorporates a range of sensors, including ultrasonic and infrared sensors, to effectively detect obstacles in the user's path. Moreover, it harnesses Bluetooth and GPS technology to furnish users with location and directional guidance.

In terms of its design, the smart stick prioritizes user-friendliness, boasting a lightweight and robust construction. It features a comfortable grip and straightforward controls to ensure effortless usage. Furthermore, the device's versatility shines through as it can be personalized and adjusted to accommodate individual preferences and requirements, making it adaptable to a diverse range of users.

VIII. FUTURE SCOPE

As technology continues its rapid advancement, the future of Smart Walking-Tracking Stick (SW-TS) devices holds the promise of becoming increasingly sophisticated and feature-rich. Anticipated developments in these devices include:

1. Enhanced Sensor Technology: Future SW-TS devices are likely to incorporate improved sensors, including advanced cameras, more precise GPS systems, and sophisticated artificial intelligence algorithms. These enhancements will enable even more effective assistance for visually impaired individuals in navigating their surroundings.

2. Integration with Smart Devices: SW-TS devices may seamlessly integrate with other smart devices such as smartphones, smartwatches, or home automation systems. This integration could significantly augment the stick's functionality, providing users with enhanced access to information, navigation aids, and communication tools.

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3. Real-Time Mapping and Navigation: Future SW-TS devices could offer real-time mapping and navigation assistance, including voice-guided directions and proximity alerts for obstacles and potential hazards. This would greatly improve users' ability to navigate unfamiliar environments.

5. Customization: Manufacturers may focus on creating SW-TS products that are highly customizable, allowing users to tailor the device to their individual preferences and specific needs. Customization options might include adjustable height, various grip choices, and personalized voice commands.

6. Expanded Functionalities: Future SW-TS devices may extend their functionalities beyond navigation. They could include built-in features for reading support, object recognition, or even language translation capabilities, providing users with more comprehensive assistance in their daily lives.

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