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SMART WALKING CANE FOR VISUALLY IMPAIRED PEDESTRIAN

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ABSTRACT

Persons who are blind and deaf frequently suffering when exercising the most basic things of daily life and that could put lives at risk while traveling, due to the lack of necessary equipment in our country that provides them with assistance to avoid the risk, so came the idea of this research in the design and cane fitted with ultrasonic sensor handheld combines the properties of sound monition and that benefit the blind and vibrating alert feature, which benefit from the experience of deafness. Sensor can detect obstacles within the designed range to avoid the blind person through the issuance of distinctive sound or vibration can be issued by the sense of the deaf by putting his finger on the button at the top of the device vibrate when there is a risk.

KEYWORDS: Walking Cane, Ultrasonic Sensors, Obstacle Detection, Sensor Integration

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I. INTRODUCTION

According to the World Health Organization, there are nearly 285 million people with some form of visual impairment out of which 86% people have low vision and 14% people are blind. Vision is one of the most important sense to humans to survive. Vision helps to connect with the surroundings. People deprived of vision rely on other dependencies like a simple walking cane or other people. In familiar places like the interiors of a house, they memorize the site directions, obstacles on their way and navigate according to them. However, it is not always safe for the blind to rely on their memory to move from one place to another. Especially when they are outdoors. Not all the times blind people are offered help from others and hence there is a need for a device, such as a stick, which can assist the visually impaired people in all forms of life. Transceivers and all the associated components are connected to Ardino Micro controller. Disabled person will be assisted with a vibration in the blind stick when they come in contact with a traffic signal. The button associated with the cane when pressed will displays an additional red light along with the red stop symbol. The blind stick is also provided with battery and is supported with a rechargeable port. Hence they are rechargeable.

II. LITERATURE SURVEY

Assistive technologies for visually impaired individuals have evolved significantly in recent years. One of the most explored solutions is the development of smart walking sticks that use sensors to detect obstacles and provide navigation assistance. The following studies and projects provide insight into previous work in this area.

Ultrasonic Sensor-Based Navigation Aids Several researchers have explored the use of ultrasonic sensors for obstacle detection. These sensors emit high-frequency sound waves and measure the time it takes for the echo to return, allowing accurate distance measurement. In a system was proposed using multiple

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ultrasonic sensors to detect obstacles at various levels (ground, waist, and head height), and alert the user via vibration motors.

Microcontroller-Based Smart Sticks

Projects like the one discussed in [2] used Arduino Uno to interface ultrasonic sensors with buzzers and vibration modules. This setup provided real-time feedback to users about nearby obstacles. The study demonstrated that such systems could significantly reduce collision risks in both indoor and outdoor environments.

Integration with GPS and GSM Modules

Some smart sticks, such as the one described in [3], integrate GPS and GSM modules to enhance safety. The GPS helps track the user's location, while the GSM module can send alerts or location data to caregivers in case of emergencies. While this increases cost and complexity, it adds value in terms of user safety.

Low-Cost and Efficient Designs

Affordability is critical in assistive device design. Research in [4] focused on designing a cost-effective blind stick using a single ultrasonic sensor, a buzzer, and a rechargeable battery. The system was tested in various environments and showed reliable performance in detecting obstacles within a 2-meter range.

AI and Image Processing Enhancements

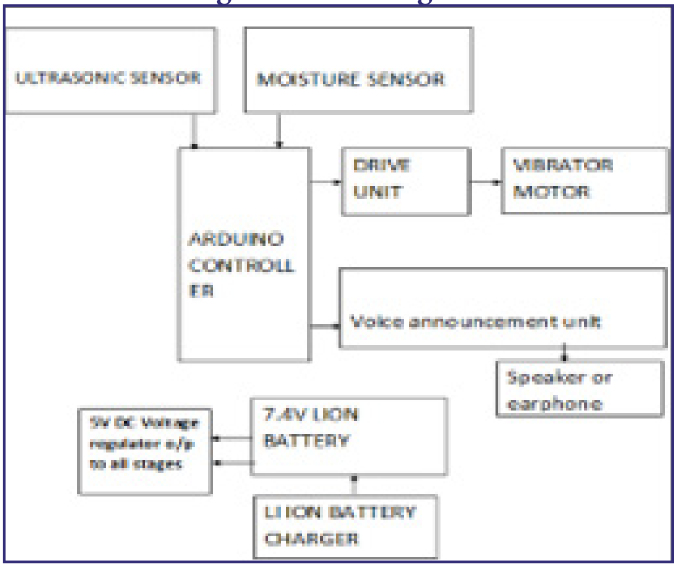
More advanced systems explored in [5] incorporate cameras and AI algorithms for real-time image recognition. These can detect and classify objects, although they require significant processing power and are less feasible in low-cost stick designs

III. OBJECTIVES

- To develop a low-cost assistive device for visually impaired.
- To implement multi-directional obstacle detection using ultrasonic sensors.
- To provide real-time alerts using vibration motors and buzzers.
- To design a portable, lightweight, and durable cane for daily use.
- To reduce accidents by improving the user's awareness of the surroundings.
- To optionally integrate GPS/GSM for advanced safety.

IV. METHODOLOGY

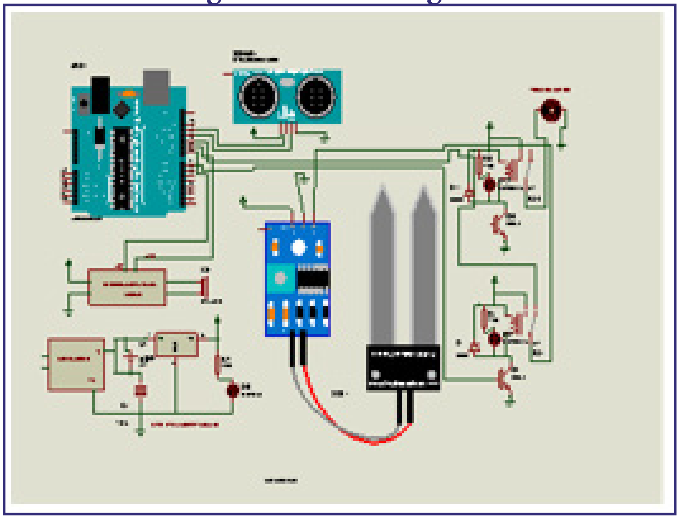
Fig. 1 : Block Diagram



The methodology adopted for developing the Smart Walking Cane focuses on creating a reliable, low-cost, and user-friendly assistive device capable of detecting obstacles and providing timely feedback to visually impaired individuals. The development process follows a systematic approach involving requirement analysis, system design, hardware implementation, software programming, integration, and testing. The first phase involves a detailed requirement analysis to understand the challenges faced by visually impaired individuals during navigation. Key requirements identified include multidirectional obstacle detection, fast response time, minimal user training, low power consumption, and portability. Based on these requirements, ultrasonic sensors were chosen due to their accuracy, affordability, and suitability for real-time distance measurement. Other essential components such as a microcontroller, vibration motor, and buzzer were selected to ensure effective user feedback. In the system design phase, both hardware and software architectures were planned. The hardware structure includes ultrasonic sensors placed at strategic positions on the cane to detect obstacles from different directions. A microcontroller, such as Arduino or ESP32, acts as the central processing unit to handle sensor readings and trigger responses. The design also includes a vibration motor mounted on the cane's handle to provide haptic feedback and a buzzer to offer an additional auditory alert in high-risk situations. A rechargeable battery supplies power to the entire system, while a switch allows users to easily turn the device on and off. The hardware implementation stage involves assembling all components and integrating them into the cane structure. Ultrasonic sensors are connected to the microcontroller through trigger and echo pins, while the vibration motor and buzzer are wired to designated output pins. Careful wiring, soldering, and insulation ensure system durability and safety.

V. CIRCUIT DIAGRAM

Fig. 2 : Circuit Diagram



The blind cane project is design with Arduino Uno microcontroller ultrasonic sensor vibration motor and voice Processing Unit. The ultrasonic sensor connected to the Arduino oh no pin number 8 and 9 as Trigger and Eco pins and ultrasonic sensor is connected to the blind cane as soon as the object detected the Eco of pulses generated from the sensor is connected to Arduino pin no 8 and according to the program the distance calculates and alert using voice processor APR A303 module and generate the sound using speaker to alert the blind person. The Arduino pin 4 is connected to the voice processor input signal which now generate the prerecorded voice through speaker.

To generate the alarm sound using buzzer we are using a electromagnetic relay which is designed with relay and transistor BC548 the as soon as the nearby object detected through ultrasonic sensor the controller now activates the electromagnetic relays which is connected with BC 548 transistor and electromagnetic relay coil connected with LED indication and the freewheeling diode IN4007 which prevents any reverse feedback as soon as the relays gets ON. The buzzer which now starts to generate the alarm sound and alert the blind person. In the similar way it is possible to generate a vibration through vibration motor to alert blind person apart from audio visual indication to generate vibration to alert immediately and with another electromagnetic relay circuit we connect a vibration motor which generate vibrations.

For the blind person safety to detect any kind of wet soil we are using soil moisture are wet detection sensor which is connected to the Arduino UNO ,as soon as the blind stick is inserted into the soil the moisture sensor which is connected at the tip of the blind stick detect this wetness and immediately alert using buzzer , Audio ,Voice and vibration ,the soil sensor which is connected to analogue pin A0 of Arduino controller.

Microcontroller, sensors, voice processor required a 5-volt power supply that is possible to generate from 7.4v DC battery to 5 volt using 7805 regulator and the regulator output now is a 5 volt which is going to connect for microcontroller and other sensors. The battery we are using lithium Ion which is 7.4v and possible to charge using charge controller unit.

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz

Fig. 3 : Setup of The System

VI. FUTURE SCOPE

By implementing GSM and GPS technology any health issues or problems for the blind person information will be send to relative or police control room.

VII. CONCLUSION

The blind stick proposed in this paper can aid the visually impaired user by helping him/her navigate through different terrains and obstacles. The stick is also able to inform the user's location to their caretakers in case of an emergency or distress. Also, the stick has the capability to be located using a RF remote control. This can be further enhanced by adding small scale and high performing sensors thus improving the design and reducing the space being occupied on the stick.

Few improvements can be made to the sensor angle placement to make them adjust according to the angle of the stick w.r.t to the ground so that they always point straight instead of mounting them at a static angle.

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