Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(3), 670-673 | ISSN:2251-6727

A Smart Walking Stick

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(Received: 16 March 2025 Revised: 20 April 2025 Accepted: 01 May2025)

KEYWORDS

Ultrasonic sensor, Walking Stick, Vibrator Motor, Sensors, Arduino Uno, Microcontroller, Mobility aid, Visually Impaired Person, Alarm system.

ABSTRACT:

Recent advances in technology have enabled elderly citizens to access and utilize a broad variety of services to facilitate their independence. This paper introduces the smart walking stick using ultrasonic sensors and Arduino for the visually impaired. The visually disabled individuals usually rely on the help of other people, trained dogs, or specialized electronic appliances as decision-making support systems. We shall provide an illustration of how to develop and use a model that will assist patients with mild Alzheimer's disease and the elderly. There are many features added into this it a clever stick. Designing smart products that make it possible for elderly individuals to walk freely is the main aim of. We did this by incorporating ultrasonic sensors at certain locations into the can which gave information regarding the environment to the user by triggering the buzzer sound. We suggested low cost and light weight system based on microcontroller which processes the signal and warns the visually challenged individual across any hurdle, water or darkness using beeping signals. Whether at home or outside, there needs to be a proper gadget to help the elderly walk freely and safely. As compared to the commercial walking belts, these walking sticks have been tested to confirm all the factors that are vital for the elderly to reclaim their confidence and enhance their mobility are operating. Our device can detect obstacles within the distance of about 3m from the user.

1. Introduction

The Internet of Things, which allows us to link objects to the Internet, is the foundation of this initiative. An intelligent object is a physical object that possesses the ability to perceive and interact meaningfully with its surroundings, allowing for communication with other objects or with them intermediaries. This pool is intended for seniors who are unable to walk alone owing to medical conditions or Alzheimer's patients. This bar's voice alert feature is yet another fantastic addition. Accidents can be avoided and older users' movements can be monitored thanks to the smart cane's functions. Users can go freely and independently through unfamiliar areas without depending on others when using this smart walking stick.

The kinds of visual impairments, which I have described above can be easily treated at some stage, but in some cases, there is a total loss of vision because of some disease and the individual becomes completely blind which is not reversible in most cases. It is estimated globally that there are about 1.3 billion individuals live with some kind of vision impairments[1].

These individuals are in tremendous difficulty while they interact with other individuals. A majority of such individuals use white canes which assists them to explore the barriers found in their environment and for local wayfinding.

Visually Impaired individuals require an efficient device whereby they are able to travel independently. Today we are able to observe, there are too many approaches, and devices have been crafted, which assist these individuals to travel independently even in a dynamic setting [2].

Ever-evolving technology combined with medicine have created a new branch of science called biotechnology. This area has contributed to the improvement of everyday life but also in the reasonable social integration of people with problems vision, offering them innovative technologies aimed at their independence[3]. It can give the precise location of an obstacle based on the ultrasound and laser sensors. But in practice it is quite large in size and heavy. The above ETAs have some drawbacks. The user has to actively search the surroundings to sense obstacles. This process is laborious and needs the constant movement and awareness of the

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traveller. In these ETAs GPS is not employed. Therefore, no facility to discover the places of the blind individual[4].

In vision aiding white canes and companion dogs were generally employed for offering mobility aid to the visually impaired individuals. But with white cane or guide dogs there are numerous amounts of problems. White cane provides limited preview range where user needs to be extremely careful and stroll. Attendant dog use is also not suited for all visually impaired individuals because they need training and coordination with dogs and also it is not reliable[5]. suggested a multidimensional walking stick for the visually impaired based on ultrasonic sensors.

The visually impaired aid prototype can detect obstacles in all directions of the user. The performance of his suggested stick in detecting obstacles is low, i.e., 1 meter maximum range of detection. The walking stick is unable to decide on the distance of the obstacle to the multidimensional. The prototype of the multidimensional walking stick could sense obstacles in the range of 0m to 1m on the left, right and front of the stick with a suitable vibration warning feedback[6].

2. Objectives

- **Enhance Mobility and Safety**
To assist visually impaired or elderly individuals in navigating their environment safely by detecting obstacles, changes in terrain, and potential hazards using smart sensors.

- **Integrate Real-Time Obstacle Detection**
To incorporate ultrasonic or infrared sensors that can detect obstacles within a defined range and alert the user through vibrations or auditory signals.

- **Improve User Awareness Through Feedback Systems**
To implement haptic feedback or voice alerts that notify the user about their surroundings, including stairs, potholes, or directional guidance.

- **Ensure Ergonomic and User-Friendly Design**
To develop a lightweight, comfortable, and durable walking stick that is easy to use and does not cause fatigue during prolonged use.

- **Support Battery Efficiency and Portability**
To design the device with low power consumption and long battery life, ensuring it is reliable for daily use without frequent charging.

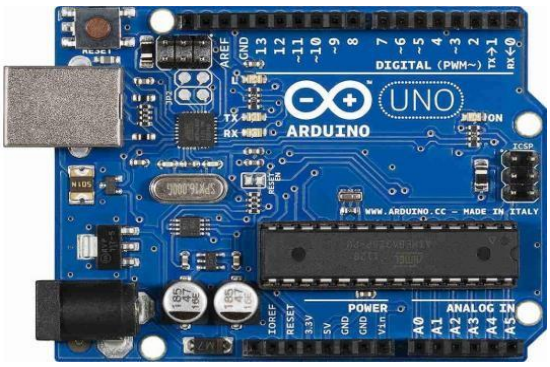
- **Encourage Independent Living**
To empower users with increased confidence and independence in their daily mobility and reduce reliance on external assistance.

3. Methods

This part addresses the theory of part of the components utilized as well as design and implementation of a smart walking stick for the blind. The ultrasonic sensor transmitter produces signals and sends redirect them in a specific direction that will subsequently be reflected back once they are on their way to any obstacle(s), then the receiver of the ultrasonic sensor receives it and forwards it to the microcontroller that will switch ON Buzzer.

1. Introduction to Arduino

This open-source platform is developed using simple-to-use hardware and software components. Arduino consists of physical programmable circuits as well as software Development Environment. You can upload the code or an instruction piece using this IDE to the Arduino circuits. Arduino board can take input from various sensors such as flame sensor, ultrasonic sensors etc. They can also activate motor, LED. The Arduino platform is highly popular for the people who just began learning things pertaining to electronics and pertaining to software and hardware integration. The Arduino platform utilizes a simplified form of C++. Consequently, it is facilitating it easier to learn Arduino programming. You can very well interface other hardware devices such as Wi-Fi modules, GSM modules to Arduino as well to enable internet to the board for online communication with online server and other boards and components, etc.



Arduino UNO Board

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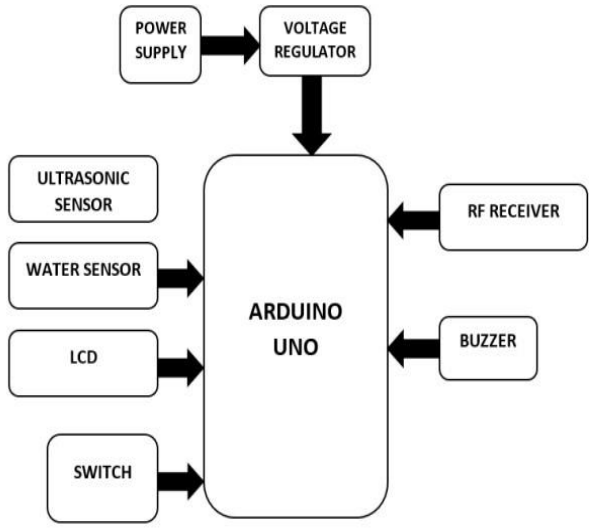


2. Ultrasonic Sensors

To produce, sense and to process ultrasonic signals ultrasonic is the sending of ultrasonic waves of frequency greater than human ear can hear. It can be employed for various applications e.g. ranges calculation. We have utilized Ultrasonic Ranging Module HC - SR04 in our project. You can observe in the below. This ultrasonic sensor contains 4 pins. The pins are VCC for 5v voltage, Trigger, Echo and GND respectively. We have utilized this module to find the distance between the stick and obstacles approaching the ways of a visually impaired person. The module contains transmitter T and Receiver R the T transmits the waves and the R receives the echo sound. Therefore, you can calculate the distance covered by sound easy formula mentioned here.

HC-SR04 Ultrasonic Sensor Module

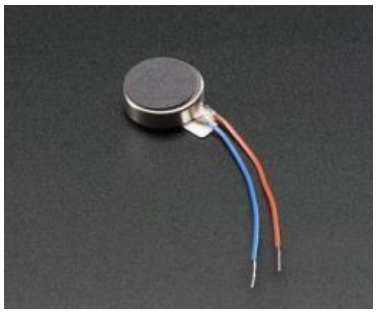
3. Small Passive Buzzer

This is a buzzer module is an electronic integrated traducer structure. This requires only DC power source and is very commonly used in computers, printers, alarms and toys etc. There are three pins of which S can be connected to output digital pin and – pin of the module to the GND of the Arduino.

KY-006 Small Passive Buzzer

4. Vibrating Vibration Motor

This Coin is vibration Motor which is otherwise referred to as flat vibration motor or pancake vibration motor. It is a kind of ERM Motors. It resembles a coin due to its thickness. This vibrator is positioned inside shell, which assists in minimizing the thickness. The shell also has strong closure. The vibrator motor is used in providing users with alert and haptic feedback.



Vibrating Vibration Motor

5. Water and mud detection

In learning to feel the water or mud, the moisture sensor is mounted at the end of the stick. When the sensor identifies water level, it warns the user through tactile and audio feedback. Soil moisture sensors calculated the volumetric water content indirectly by employing some other characteristic of the soil, like electrical resistance, dielectric constant, or neutron interaction, as a surrogate for the moisture content. The relationship between the measured property and soil moisture should be calibrated and can differ based on environmental conditions like soil type, temperature, or electric conductivity.

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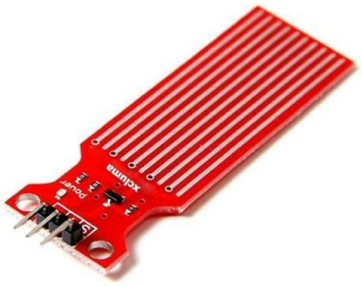

Water and mud detection

4. Results and Discussion

The design of the electrical circuit was initially pieced together using a breadboard.

Once found whole on the breadboard, it was eventually ported onto a Vero board. The Vero board was segmented such that there exists a power supply unit, display, transmitter, receiver and microcontroller section. Prior to soldering the elements on the Vero board, the Vero board strip lines were scrubbed using a razor blade to get rid of grease, oxidation, oil and dust. The resistors, capacitors, diodes and connecting terminals were properly connected using soldering iron and soldering flux on the Vero board in order not to damage integrated circuit IC sockets that were used. During soldering of components on the Vero board, caution was exercised to reduce damage to components caused by excessive heat from soldering iron. Further, proper caution was exercised to prevent short-circuit between nearby copper strips on the Vero board during soldering. To prevent potential short circuits, discontinuity of copper strips was established when required, this is achieved by cutting the copper strips wherever required.

Testing of the Ultrasonic Sensor

1. The circuit was connected on a bread-board.

2. An object was positioned (fixed at a distance) and the device was taken up to 1m away from the object.

3. Gradually the distance between the device and object was varied until the distance at which the output voltage was logic high.

4. Step 3 and 4 were repeated for different objects of varying size. Simulation Several simulations were carried out to ascertain the efficiency of our proposed technique. Testing of the Ultrasonic and Moisture Sensor

Test and reliability check was conducted using each components of the smart stick to validate their efficiency and know if they are working according to specification before soldering.

1. Ultrasonic Sensor: The ultrasonic sensor was tested and the result as presented in Table 1 shows that the system worked according to specification at a distance not too far from the user. The buzzer came ON indicating the presence of obstacle on the way of the user.

Water Detection Sensor: A bread-board was used for connecting the circuit. A vessel containing water was placed on the table. The moisture sensor was immersed into the water contained and a beep sound was heard which is different from the beep from the obstacle detection.

2. Water Detection Sensor: A bread-board was used for connecting the circuit. A vessel containing water was placed on the table. The moisture sensor was immersed into the water contained and a beep sound was heard which is different from the beep from the obstacle detection.

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