Indian Institute of Information Technology, Design and Manufacturing, Kancheepuram

Department of Computer Science and Engineering

RESEARCH INTERNSHIP REPORT on

Smart Visual Cane using Arduino UNO and other sensors

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INDEX

1. INTRODUCTION

NEED FOR THE WORK

Our human body is dependent on five senses that are sight, hearing, taste, smell, and touch. Out of these, one sense organ is our eyes and without eyes, it is tough to live in life. The total population of the world is 7.7 billion and according to the World Health Organization (WHO) survey, approximately 285 million people around the world are visually impaired, among which 39 million are completely blind and 246 million with low vision. Out of this group, 224 million can be cured. A blind person is always at risk of encountering collisions and accidents. It is expected that by the year 2040, blindness will increase three times.

Visually impaired people are facing difficulties during day-to-day activities in terms of traveling and receiving accurate information from their surroundings. Most of the time, visually impaired persons need to rely on others. Blind people cannot walk without the support of a cane. So, the solution is to design smart devices for the visually impaired to make their travel easier. It makes them less dependent.

OBJECTIVE

The main objective of this project is to build a smart visual stick that can detect obstacles, staircase, puddles, high concentration smoke or gas and thus help the visually impaired people to travel in unfamiliar environments.

2. DESCRIPTION

The proposed work can be divided into three distinct sections, namely: the literature review, coding and implementation, and evaluation and testing.

Literature Review:

The initial phase of this project involves conducting a comprehensive review of pertinent research papers and scholarly articles. This literature review aims to acquire valuable insights into recent developments, methodologies, and findings relevant to the project's subject matter. By thoroughly examining the existing knowledge in the field, this process enables understanding of the research landscape, identification of research gaps and the refinement of project objectives.

Coding and Implementation:

Drawing upon the insights gained from the literature review, this phase focuses on the development software, or hardware components necessary for achieving the project's objectives. This may entail programming in a specific language, configuring and integrating hardware devices, and orchestrating various modules to create a functional system. By executing this phase meticulously, the project can materialize its intended solution.

Evaluation and Testing:

This evaluation process aims to assess the solution's effectiveness, reliability, and performance. It involves executing experiments, running simulations, or deploying prototypes to gauge the system's accuracy, robustness, and overall functionality. By subjecting the solution to testing, its capabilities can be validated, and any necessary refinements or optimizations can be identified and addressed.

By organizing the project into these three distinct sections, the internship report can effectively highlight the systematic approach undertaken to accomplish the project goals.

3. EXISTING SYSTEM

According to few research and review papers, the existing systems designed to assist visually impaired individuals, such as the Guide Cane and Smart Vision, employ cutting-edge ultrasonic or laser sensors. These sensors enable the devices to detect obstacles that lie ahead, providing crucial assistance in navigation. In addition to obstacle detection, these systems are equipped with water sensors that detect water leaks or the presence of puddles. Furthermore, they incorporate gas and smoke detection capabilities, enhancing the safety of visually impaired individuals in potentially hazardous environments.

Upon detecting obstacles, water leaks, or hazardous gases or smoke, the system generates audio or vibration signals. These signals are relayed to the visually impaired individual through voice or speaker modules, effectively warning them about the potential dangers, such as holes, puddles, or staircases.

Moreover, the GPS-based visually impaired device incorporates user input interfaces and relies on GPS technology to determine the user's current location. By storing and comparing this location data with the user's designated destination, the system can provide alerts, typically in the form of voice prompts, when the visually impaired person reaches their intended destination.

Additionally, the integration of GSM/GPRS modules within the smart stick offers significant advantages for visually impaired individuals, especially in emergency situations. These modules enable seamless communication capabilities, allowing visually impaired individuals to seek assistance or alert emergency services promptly when needed.

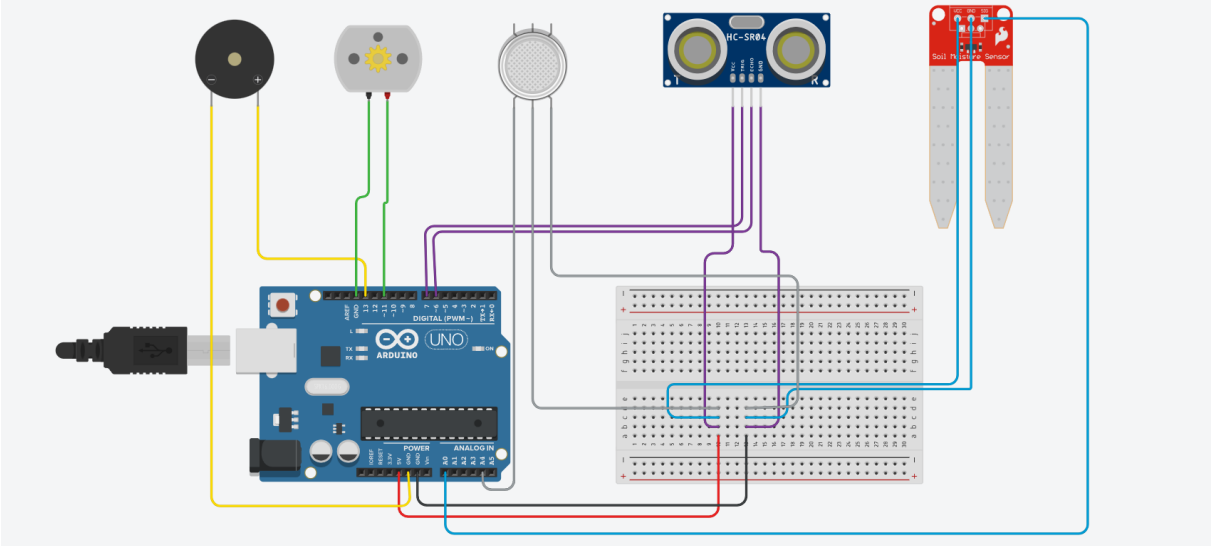
By effectively combining these technologies, the system enhances the independence, safety, and overall well-being of visually impaired individuals.

4. PROPOSED SYSTEM

The proposed system aims to enhance the independence and mobility of visually impaired individuals in unfamiliar environments. It utilizes an ultrasonic sensor to detect obstacles, a water sensor to identify water leaks or puddles, and an MQ2 gas sensor to detect heavy concentrations of gas or smoke. A single buzzer with different frequencies or tunes is incorporated to provide auditory alerts when any of the sensors detect a potential hazard. Additionally, a DC vibrating motor is employed to convey signals to the user through vibrations. By combining these components, the proposed system enables visually impaired individuals to rely less on external assistance and confidently travel in unfamiliar environments. This solution contributes to their overall safety, autonomy, and improved navigation capabilities.

5. CIRCUIT AND COMPONENTS

CIRCUIT



COMPONENTS REQUIRED

Name	Quantity	Component
U1	1	Arduino Uno R3
DIST1	1	Ultrasonic Distance Sensor
GAS1	1	Gas Sensor
SEN1	1	Water Sensor
M3	1	DC Motor
PIEZO1	1	Piezo

6. SYSTEM DESCRIPTION

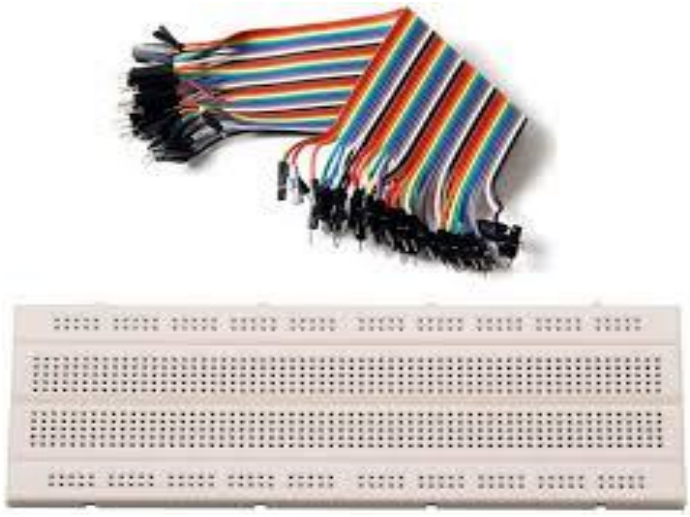
The smart visual stick was improved through the integration of the following additional features:

Arduino UNO

Arduino Uno is a popular microcontroller board widely used in electronics projects and prototyping. It features an ATmega328P microcontroller and offers a user-friendly development environment through the Arduino IDE. With its versatile input and output pins, Arduino Uno allows users to easily connect and control various electronic components. It simplifies the process of integrating hardware and software, making it accessible to both beginners and experienced makers.

Breadboard and Jumper Wires

A breadboard, also known as a prototyping board, is a fundamental tool in electronics prototyping and circuit design. It provides a convenient platform for quickly connecting and testing electronic components without the need for soldering. The board consists of a grid of interconnected holes that allow for easy insertion and removal of components. Jumper wires, on the other hand, are flexible wires with connectors on each end used to establish electrical connections between components on the breadboard. They enable the creation of temporary circuits and facilitate experimentation and rapid prototyping. Together, the breadboard and jumper wires offer a flexible and reusable solution for building and testing electronic circuits, making them essential tools for electronics enthusiasts and professionals alike.



Pair of Ultrasonic Sensors

To enhance obstacle detection capabilities, a pair of ultrasonic sensors were integrated into the system. These sensors detect obstacles in front of the visually impaired user within a range of 200 cm ahead, covering the height range from ground level to the head level of the stick. By providing real-time obstacle information, these sensors assist users in navigating safely through their surroundings.

Water Sensor

The inclusion of a water sensor enables the detection of various water-related incidents such as leaks, spills, floods, puddles, and rain. This feature serves as a crucial safety mechanism, alerting visually impaired users to potentially hazardous wet surfaces or water accmulation in their vicinity. By providing timely information, the water sensor enhances the user's awareness and minimizes the risk of accidents.

MQ2 Gas Sensor

Incorporating an MQ2 gas sensor enhances the smart visual stick's functionality by detecting high concentrations of gas or smoke in the surrounding environment. This feature acts as an early warning system, alerting visually impaired users to potential hazards or the need for immediate action, thereby ensuring their safety and well-being.

Buzzer - Multiple Tone Generator

A buzzer with multiple tone generation capabilities was integrated into the system. By programming the microcontroller or Arduino, specific frequencies or sequences of tones can be played, allowing for different sounds to be associated with different situations. This audio feedback feature enables visually impaired users to interpret their environment effectively and respond accordingly.

DC vibrating motor

A DC vibrating motor is a compact electromagnetic device used to generate vibrations or oscillations in various applications. It consists of a permanent magnet and an electromagnet that create a magnetic field. When electric current flows through the electromagnet, it interacts with the permanent magnet, causing the motor to vibrate. DC vibrating motors are valued for their simplicity, small size, and efficient operation. It acts as a vibrating alert system for visually impaired people

7. IMPLEMENTATION

The implementation phase involved meticulous integration of the ultrasonic sensors, water sensor, gas sensors, buzzer, and DC vibrating motor onto the existing white stick. The components were connected to a breadboard, and an Arduino UNO microcontroller board was utilized for seamless communication and control.

Arduino C++ programming was conducted to establish effective coordination among the integrated components.

- The ultrasonic sensors were carefully positioned on the stick to enable accurate obstacle detection within the desired range. Precise calibration was performed to ensure reliable detection from ground level to head level height.

- The water sensor was integrated to detect water-related incidents such as leaks, spills, and puddles.

- The gas sensors were incorporated to detect high concentrations of gas or smoke in the surrounding environment.

- The buzzer, acting as a sound generator, was connected to emit specific frequencies or sequences of tones for different situations.

- Simultaneously, the DC vibrating motor was integrated to provide tactile feedback without producing any sound.

8. PROTOTYPE WORKING MODEL

(REAL PICTURE OF MY MODEL)

9. TESTING

Comprehensive testing was undertaken to validate the accuracy of detection and appropriate feedback provided by the modified system. Different scenarios were simulated to assess the performance of the integrated components. The ultrasonic sensors were tested to ensure precise obstacle detection within the designated range. The water sensor was evaluated for its ability to promptly detect water incidents. The gas sensors were assessed to ensure reliable detection of high gas concentrations or smoke. The buzzer's tone generation capabilities were tested to ensure appropriate sounds were emitted for different situations. Additionally, the DC vibrating motor was evaluated to confirm its reliable operation in providing tactile feedback.

Throughout the testing phase, data collection and analysis were performed to measure the system's performance against predetermined benchmarks. This analysis helped identify any necessary refinements or optimizations to improve the system's functionality. The successful completion of the tests showcases the effectiveness and reliability of the modified system in accurately detecting obstacles, water incidents, gas concentrations, and providing appropriate feedback to visually impaired individuals.

10.RESULTS AND CONCLUSION

The enhanced smart visual stick successfully incorporated the a forementioned modifications, significantly improving its functionality and usability for visually impaired individuals. By integrating ultrasonic sensors, a water sensor, and an MQ2 gas sensor, the system provides valuable real-time information about obstacles, water-related incidents, and gas concentrations. Moreover, the inclusion of a buzzer and a DC vibrating motor enables effective communication and feedback, ensuring the safety and convenience of visually impaired users.

These modifications exemplify the continuous advancements in assistive technologies, demonstrating their potential to enhance the independence and mobility of visually impaired people.