

Smart Cane Stick with Integrated Sensor

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Abstract—This research proposes a revolutionary smart stick device that aims to increase the mobility and safety of visually impaired people. The recommended system blends the powers of an alarm system and an artificial vision system with state-of-the-art technologies like GPS navigation and a water sensor. People who are blind can now move through unfamiliar environments more effectively. utilizing GPS technology, which provides route guidance and real-time location data through a mobile device interface. As part of the system design, an Arduino UNO R3 microcontroller is interfaced with a range of sensors, including as light, water, and ultrasonic ones, to process input and control output. Through the use of cutting-edge technology, this smart stick system seeks to enhance inclusion and accessibility in the built environment by giving visually impaired persons the confidence to move securely and independently in their surroundings.

Index Terms— IR SENSOR (A215/450), WATER SENSOR, ULTRASONIC SENSOR (HC-SR04), ARDUINO UNO R3.

I. INTRODUCTION

The smart cane stick, which combines cutting-edge technology with inclusive [1] design principles, is a prime example of disruptive innovation in the assistive technology market. A multitude of shields, or add-on boards, are compatible with the Arduino UNO R3, expanding its functionality in various ways. From motor drivers to communication modules and display panels, these shields let users customize their projects to meet unique needs without having to deal with the headaches of complex wiring or soldering. As we explore its numerous functions and transformative impacts, it is a powerful tool designed to enable people who rely on this incredible assistive technology navigate the world with increased autonomy and confidence.



Figure 1. Working Model for the cane stick

A. Ultrasonic Sensor (HC-SR04)

It can measure distance accurately and economically, the HC-SR04 ultrasonic sensor is a popular and widely-used component in the electronics and robotics industries. It works on the same echolocation principle that bats use to navigate in the dark. With remarkable accuracy, the HC-SR04 can determine the distance to objects in the

vicinity by measuring the interval between the transmission and reception of ultrasonic pulses. The HC-SR04 sensor's ease of use and simplicity are two of its main benefits. Users can include it into their projects rapidly with just a few connections to a microcontroller or single-board computer, like an Arduino or Raspberry Pi. It is also appropriate for battery-powered applications because it runs at a low voltage and uses little power.



Figure 2. HC-SR04 Ultrasonic Sensor

B. Water Sensor

A key component in many applications that determines whether water or other conductive liquids are present or absent is the water sensor. It is appropriate for a variety of applications, such as security systems, automated doors and smart home appliances, because it can function well in both indoor and outdoor environments. Moreover, the A215/450 infrared sensor provides microcontroller integration simplicity, facilitating its smooth integration into electronic projects and systems. It works well with battery-powered devices and Internet of Things applications because of its straightforward interface and low power consumption. The A215/450 IR sensor is a useful part of automation and electronics because it provides accurate infrared radiation detection for motion and proximity sensing applications.

II. LITERATURE REVIEW

This study describes the use of Arduino on an ultrasonic blind walking stick. According to WHO estimates, 30 million people are permanently blind and 285 billion people have vision impairments. The ultrasonic sensor is the main feature of this device. The time gap between the sound pulse's propagation and detection can be determined using the gathered data by computing the target's distance. This circuit is powered by a 9-Volt battery through a switch. [1] According to the multiple regression analysis study, age and gender were separate risk factors. The socioeconomic status of the subjects did not appear to be correlated with visual impairment. 5.2% of respondents with unilateral impairment and 1.8% of subjects with bilateral impairment made up the 7.0% of participants with non-correctable visual impairment. [2] A separate risk factor for vision impairment is female sex and advancing age. 75% of participants with presenting visual impairments experience an improvement in VA when proper refractive correction is provided. As the population ages, retinal diseases which are a leading cause of irreversible vision impairment and blindness are projected to become increasingly significant. [3] The system's obstacle and moisture detection sensors are used to gather, process and transmit signals which notifies the user to take immediate action. [4]. The visually impaired person designed, used C to programme, tested, and verified the accuracy of the system. According to a 2011 World Health Organisation survey, approximately 1% of people worldwide are visually impaired. Around 70% of the population have vision impairments, of which approximately 10% are entirely blind (roughly 7 million people) and 90% have limited vision (roughly 63 million people), as per. [5]

The primary challenge faced by visually impaired individuals is finding their way around. People with good vision are needed to help these people. 10% of visually impaired people, according to the WHO, have no functional vision at all, making it impossible for them to get around safely and independently. Our method involved adding some electronics parts and sensors to the cane, these kinds of problems are what electronic assistive devices are meant to fix. The presence of impediments on the road is detected using the ultrasonic sensors, water sensor, buzzer, and RF transmitter/receiver. Any obstruction within the 2 to 450 cm range can be detected using an ultrasonic sensor. As a result, it will notify the user anytime there is an obstruction within this range. [6,7]

Legally blind is defined as having a field of vision of 10° or less and the inability to see at a distance of 6 metres. 95% of those who are legally blind are not completely blind. [8] The walking stick made up of a circuit board with a PIC microcontroller, an LED for indication, a micro-pager motor for input, and sensors positioned at the stick's appropriate locations for input. The sensors' placement is predetermined by practical applications.

Because of its dependability, microcontrollers are used throughout the project's design [9]. Benefits in both the public and private spheres are the goals of the system. It is made up of a straightforward walking stick with ultrasonic sensors that sense water, pits, and objects to provide environmental information. Pre-programmed places are combined with GPS technology to calculate the best path to take. From the list of locations kept in the memory, the user can select the place. [10]

Visual impairment people struggle with navigation on a daily basis to go from one point to another quickly and safely. They frequently rely on outside help, which might come from people, trained dogs, or specialised technology gadgets that serve as decision-making support systems. The range of motion, minimal information transmitted, required abilities and training period are the main disadvantages of these aids. The system's general goals include object detection and artificial vision, as well as real-time support through the use of the global positioning system (GPS). The ultrasonic sensor, pit sensor, water sensor, GPS receiver, GSM module, voice synthesiser, microcontroller, and speaker are all used in this system. [11]. The system additionally makes use of a water sensor to identify any water in the user's path. A buzzer notifies the user of any obstructions discovered. [12]

III. PROPOSED SYSTEM

The suggested smart stick system combines RFID, GPS, light, water, ultrasonic, and matching actuators with a microprocessor to produce a sophisticated assistive technology for the blind. The system uses ultrasonic technology to identify objects in the user's path and a water sensor to identify potentially dangerous wet surfaces. The RFID module allows interaction with identified points of interest, while the light sensor guarantees responsiveness to changing lighting conditions. Through a mobile device interface, integrated GPS navigation offers real-time location data and route direction. When combined, these elements offer a complete solution that promotes inclusivity in the everyday lives of visually impaired people by improving their mobility, safety, and independence.

This visually challenged stick works by being designed to be used as a detecting tool for individuals who have visual impairments. The circuit maintains a steady force supply yield while supplying the circuit with a 5V force source. Using ultrasonic sensors to detect objects is a common practice. If an object is present, the Arduino UNO gets data from the ultrasonic sensor that determines how far away it is from the user. To find an object's distance, calculate the time it takes to send a message and receive a sign back.

Time is equal to Speed * Distance.

The sign is moving at a pace of 341 meters per second. It calculates the time difference between sending and receiving the message.

$\text{Distance} = \text{Speed} \times \text{Time}$

It is positioned to the left and right of the stick in order to be detected. It can sense conflicts that are closer because of its restricted reach. Arduino uses this data to calculate the order conditions and perform measurements. The command is sent to the user through the speaker or microphone if an item is found to be closer. These developments will benefit the designer even more, if these qualities weren't sufficient to justify more study in this field. This task is application-based since it provides a bewildered person with an application. It may also be modified to be more capable of making decisions using different kinds of sensors, so it can be utilized for a range of applications. The objective is to tackle the issues that visually impaired individuals face on a daily basis. Additionally, the system puts protections in place to ensure their security.

IV. MODULES DESCRIPTION

A. Ultrasonic Sensor

An essential part of the smart stick system, the ultrasonic sensor is used to identify objects and barriers in the immediate area. It creates high-frequency sound waves and timers how long it takes for them to return after colliding with an object. The sensor can calculate the distance to adjacent objects by analysing the reflected waves.

B. Water Sensor

The water sensor is essential for identifying damp surfaces and potentially dangerous situations including spills, puddles, and slick spots. When it comes into touch with water, it detects changes in conductivity or resistance. The water sensor helps the user navigate safely and prevent accidents caused by hazardous or slick circumstances by quickly detecting the presence of moisture.

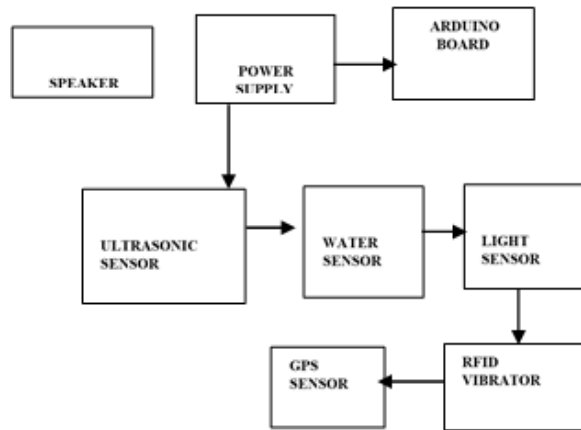


Figure 3. Block Diagram

C. Light Sensor (LDR)

In the Light Dependent Resistor (LDR), the light sensor is used to measure changes in the amount of light in the surrounding area. It responds to variations in light intensity by altering its resistance. The light sensor in the smart stick system allows adaptive behaviour, which can include changing the LEDs' brightness or turning on specific features depending on the amount of light in the area.

D. Rfid Module

The RFID module, also known as the radio-frequency identification module, enables communication with RFID tags or labels that are affixed to objects or landmarks. It is made up of an antenna and reader that can wirelessly connect to RFID tags that are within range

E. GPS (Global Positioning System) Sensor

By obtaining signals from satellites orbiting the Earth, the GPS sensor allows for exact location monitoring and navigation. Regardless of the weather or geographical barriers, it provides precise positioning information by computing the user's precise coordinates, velocity, and time. Through a connected mobile device interface, the GPS sensor, which is integrated with the smart stick system, provides real-time navigation help, route planning, and location-based services. This improves the mobility and quality of life of visually impaired people by enabling them to confidently and independently explore unfamiliar situations.



Figure 4. Working Smart Cane Stick

V. CONCLUSION

All things considered, the invention of the smart stick system represents a significant advancement in the field of assistive technology for the blind and visually impaired folks. The device offers a complete solution to increase mobility and safety by combining RFID, GPS, light, water, ultrasonic, and intelligent actuators with a CPU and

intelligent actuators. The Smart Stick's features, which include real-time GPS navigation, interaction with tagged areas of interest, lighting adaption, obstacle recognition, and wet surface identification, give visually impaired persons a sense of confidence and independence when exploring their surroundings.

FUTURE ENHANCEMENT

Subsequent investigations into assistive technology for the visually impaired may focus on several facets to enhance the functionality and efficiency of smart stick gadgets. First off, the device's overall weight and size may decrease as a result of sensor module refinement and miniaturisation, improving portability and user comfort. There is also space to explore alternative interaction and feedback modalities such as haptic interfaces or auditory cues to provide consumers with clear and unobtrusive recommendations.

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