Smart Stick For Visually Impaired On Streets Using Arduino UNO

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ABSTRACT

A smart stick concept is devised to provide a smart electronic aid for blind people. Blind and visually impaired find difficulties in detecting obstacles during walking in the street. The system is intended to provide artificial vision and object detection, real time assistance via making use of Arduino UNO and is to provide a sound based assistance to blind people. The existing devices for the visually impaired only focus on travelling from one location to another. The device is aimed to help visually impaired with the same maneuver as that of sighted people involves providing a smart electronic aid for blind people to provide artificial vision and object detection, real assistance by using Arduino Uno. An Arduino is used to advise the blind people about the barrier or obstacles and sends alarms using a buzzer. The aim of the overall system is to provide a low cost and efficient navigation, moisture detection and obstacle detection aid for blind which gives a sense of artificial sight by providing information about the environmental scenario of static and dynamic objectsround them, so that they can walk independently in the street.

Keywords— Buzzer, Smart Stick, Smart sensors, Streets, Arduino UNO.

1. INTRODUCTION

Many people with serious visual impairments can travel independently, using a wide range of tools and techniques. Orientation and mobility specialists are professionals who are specifically trained to teach people with visual impairments how to travel safely, confidently, and independently in the home and the community[1]. These professionals can also help blind people to practice travelling on specific routes which they may use often, such as the route from one's house to a convenience store. Becoming familiar with an environment or route can make it much easier for a blind person to navigate successfully.

Eye sight plays a major role in collecting most of the information from the real world and that information will be processed by brain, visually impaired people suffer inconveniences in their daily life and social life[2]. Blindness or visual impairment is condition that affects many people around the world. This condition leads to the loss of the valuable senses of vision. Worldwide there are millions of people who are visually impaired, where many of them are blind. The need for assistive devices was and will be continuous. There is a wide range of navigation systems and tools existing for visually impaired individuals. [3]The blind person truly requires an identifying object.

Blindness is the absence of vision. It also refers to a deficiency of optic that cannot be reformed with any other easy ways. Among the significant types of incapacity, visual hindrance is perhaps the most severe disability and influences numerous individuals around the globe.[4] Additionally, as indicated by the World Health Organization (WHO), about 2.2 billion individuals are outwardly weakened worldwide. The mini project marks out related issues and proposes a brilliant and impaired solution that makes a weakened individual's life more straight forward and considerably more effortless. Comparing with other fundamental devices, "SmartStick" is more intelligent and successful, as those

weak and individuals need the help of an intelligent stick constantly[5].The device will provide them a keen and mechanical arrangement to be confident while moving. The primary aim is to offer and guarantee a strain-free living as like as normal humanbeings. If he faces obstacles,[6] then he will be guided through alarms. Many individuals who will utilize this visually impaired stick will live a joyful and productive life.

Smart walking stick is specially designed to detect obstacles which may help the blind to navigate care-free. [7]The audio messages will keep the user alert and considerably reduce accidents[8]. This system presents a concept to provide a smart electronic aid for blind people, both in public and private space the proposed system contains the ultrasonic sensor, water sensor, Arduino UNO and buzzer[9]. When any objects or obstacles come in range of an ultrasonic sensor and it make buzzer sound[10].

2. OBJECTIVES OF THE STUDY

- The main objective of our project is to provide a sound based assistance to blind people.
- Our project focuses on designing a device for blind people that help them to travel independently and also it must be comfortable to use.
- The proposed device is used for guiding individuals who are blind or partially sighted.
- The device is used to help blind people to move with the same ease and confidence as sighted people.

3. REVIEW OF THE RELATED WORK

Based on the literature survey this project has been carried out and has been observed thatdesigning of this Smart Stick there will be a centralized system for the user that will reduce the economic impact of automation on them. Based on survey some reviews are mentioned below in the Table 1.

Table 1: List of the papers reviewed

SL NO.	AUTHOR & YEAR	TITLE	CONTRIBUTIONS
1.	IEEE 2017	Ultrasonic Based SmartBlind Stick	In the 7th annual conference and workshop, a novel low cost, durable and accurate smart stick to find out obstacles of any height by giving a vibration to the blind person, a real-time application. Limitation:The range of sensing obstacles is very less and nomoisture detector is used.
2.	A.S Romadhon and A.K Husein (2020)	Smart Stick for Blind using Arduino	A.S Romadhon and A.K Husein propose a system that is equipped with an ultrasonic sensor, a water sensor, and a pulse heart sensor that will be mounted on a white cane to determine changes in the surroundings. Limitation: Too many sensors used which makes the stick more bulkyand complex and is costly.
3.	Prof. Shashikant Sahare (2021)	Smart Stick for VisuallyImpaired	Shashikant Sahare designed a smart stick using Raspberry pi microcontroller for the blind forconfident movement in their surroundings, by giving a beep sound signal in case of obstacles. Limitation: Minimal number of sensors used, obstacles detectedis of low range

4. PROPOSED PRODUCT DESIGN

This idea is used to save economic cost and make a centralized system when implementing obstacle sensing stick. In this, users should be able to handle and operate the stick and thereby obtain all essential information about any obstacle by combining the use of the hardware and software. They will have the ability to detect any obstacle or moisture/waterlog via the website.
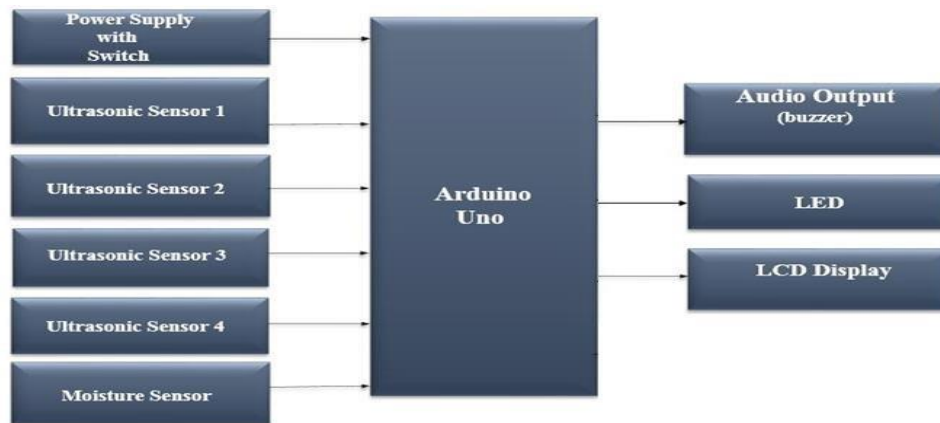

Fig 1 Hardware Implementation of Smart Stick

Fig.1 shows the hardware representation of the smart stick. By using this idea, a lot of effort has been applied for consumers by making the system centralized. The proposed system uses a web application for all the devices instead of individual remotes. This project is especially designed for blind people where automation implementation is necessary with keeping cost cutting in mind. The system is multipurpose, extendable and totally variable to user needs.Hardware Implementation of the Smart Stick shows the sensors and different components connected to the Arduino UNO. This block diagram shows the input that we are taking through the sensors and passing along the path. Also, the outputs that will be controlled via the threshold distance are also shown in this block diagram.Software Implementation of the Smart Stick shows how the software and hardware components are integrated together into a single package.

5. METHODOLOGY

Stage 1: It consists of a Power Supply Unit (PSU) which supplies the needed power to the Arduino, Ultrasonic Sensors, Moisture Sensor, LED, LCD, and Buzzer.

Stage 2: The Arduino is connected to the Power Supply Unit, Ultrasonic sensors, Moisture sensor, LED, LCD, Buzzer, and Vibration motor.

Stage 3: The Ultrasonic Sensors used to detect any obstacle present around the blind person within the threshold distance and initiate the Arduino to activate the alarm to send a short duration beep sound through the buzzer and the vibration motor to cause short duration vibrations in the stick, meanwhile the LED starts blinking and the LCD displays relevant information as per the code.

For obstacle at front, above the knee level, preset limit = 60cmFor obstacle at front, below the knee level, preset limit = 60cmFor obstacle at right, preset limit = 40cm

For obstacle at left, preset limit = 40cm

Stage 4: In case of any waterlog/puddle present on the way of the blind person, the moisture sensor detects the moisture and initiates the Arduino to activate the alarm to send a long duration beep sound through the buzzer and the vibration motor to cause long duration vibration in the stick, meanwhile the LED starts blinking and the LCD displays relevant information as per the code.

Stage 5: Thus any obstacle around at a distance less than that of the preset limit (threshold distance) along with any waterlog/puddle present on the way of the blind person is detected and is guided through different tones of beep sound and vibrations accordingly.

6. HARDWARE IMPLEMENTATION

The hardware components required are Arduino UNO, Ultrasonic Sensor, IR Sensor, Moisture Sensor, LCD, LED and Buzzer
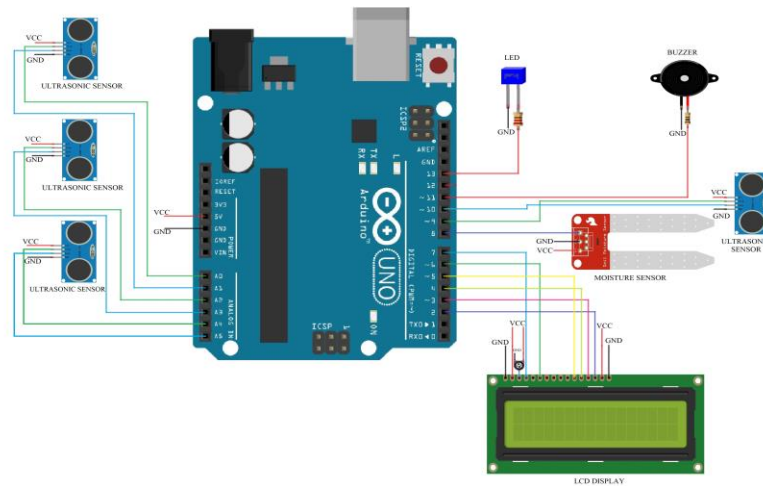

Fig. 3 Hardware Circuit Setup

A: Arduino UNO: Arduino UNO R3 is a microcontroller board based on ATmega328p. It has 20 pins out of which16 digital input and output pins and 6 analog input pins, 16MHZ Quartz crystal, power jack, ICSP header and reset button. Compare to PIC microcontroller, it is very easy to perform withArduino since it is user friendly. The Operation Voltage is 5V, you can directly connect it to computer with USB cable, power it with AC-DC adapter or battery. The Arduino can communicate with a wide range of outputs, including sensors, LEDs, motors, and displays, by responding to sensors and inputs. Figure 4.1 shows an Arduino UNO unit. **Arduino Uno** is a popular microcontroller development board based on 8-bit ATmega328P microcontroller. Along with ATmega328P MCU IC, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller.

B: Ultrasonic Sensor[14]: The ultrasonic sensor module will read the distance between the sensor and the obstacles.The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object. This sensor reads from 2cm to 400cm (0.8inch to 157inch) with an accuracy of 0.3cm (0.1inches). It will send that data to the Arduino microcontroller which will according to the programming will detect the position of the obstacles in the front, left, right of the blind user and according to the set range it will calculate the distance and alert the user it hasto move in the necessary direction or not if obstacle detect in the front of the blind user then [15]microcontroller(Arduino) will receive the signal's according to the programming and buzzer will start alert alarming or alert sound

C: Moisture Sensor: This is simple and small portable water level/water droplet identification, detection sensor. The moisture sensor module will read the water level/water, and it will send that data to theArduino microcontroller which will according to the programming will detect the water in thefront of the blind user and alerts the user to move in the necessary direction. If water is detected in the front of the blind user, then microcontroller (Arduino)[11,12] will receive the signals according to the programming and buzzer will start alert alarming or alert sound

D:Buzzer: An Arduino buzzer is also called a piezo buzzer. It is basically a tiny speaker that you can connect directly to a Microcontroller (Arduino) . You can make it sound a tone at a frequency you set. It's works as an alarm unit when sensors (ultrasonic sensor, moisture sensor) detect any obstacles in front of the blind user and through this alarming unit or buzzer blind user get alertwhen buzzer starts sounding after sensors detecting any hurdle in front of the user.

E: LCD Display: (Liquid Crystal Display) Is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. Liquid-crystal display other electronically modulated optical device that uses the light- modulating properties of liquid crystals combined with polarizers. Liquid crystals do not emit. Connect the VSS to the GND and VDD to the 5V. To use the LCD backlight, connect the backlight Anode to the 5V and connect the backlight cathode to the GND through a 220Ω resistor[13].

F: Light-emitting diode: (LED) is a semiconductor device that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.

7. SOFTWARE REQUIREMENTS

The Arduino integrated development environment is a cross-platform application (for Microsoft Windows, macros, and Linux) that is written in the Java programming language. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic function for starting the sketch and the main program loop, that are compiled and linked with a program stub main () into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.
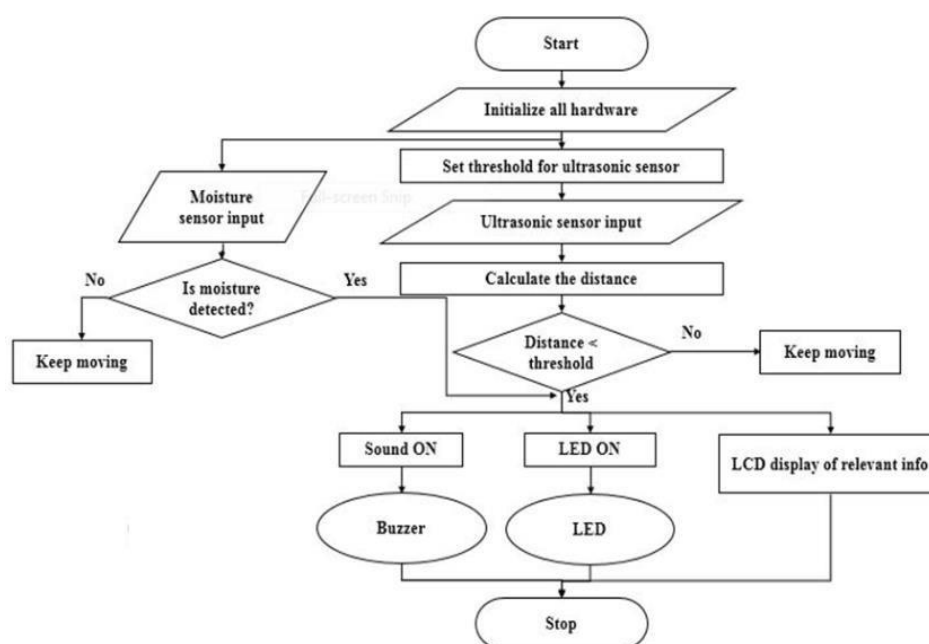

Fig 4: Flow chart of the system

8. SYSTEM DEVELOPMENT

All the sensors are connected to the Arduino UNO board I/O pins. The connections are made by studying the architecture of the Arduino UNO. All the other pins are connected to the I/O pins and initialized accordingly. Some requires an Input-Pull-Up or Input-Pull-Down, those resistors are internally present in Arduino UNO and can be initialized in software. The Fig.3 shows the arrangement of hardware model, the sensors involved in the project that is ultrasonic sensor and moisture sensor external power-supply and cannot be driven through the onboard power supply unit present. All the power-supply is provided via 5V wall adapters through USB type B or a battery.

CASE 1: When there is no obstacle within the pre-set limit (threshold distance) ahead of theblind person
CASE 2: When the obstacle is at a distance less than the pre-set limit (threshold distance) infront of the user, above the knee level
CASE 3: When the obstacle is at a distance less than the preset limit (threshold distance) infront of the user, below the knee.
CASE 4: When the obstacle is within the preset limit (threshold distance) at the right of the blind person.
CASE 5: When the obstacle is within the pre-set limit (threshold distance) at the left of the blind person.
CASE 6: When there is any puddle/waterlog present on the path of the blind
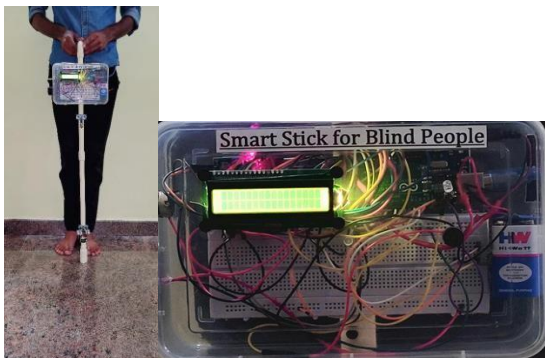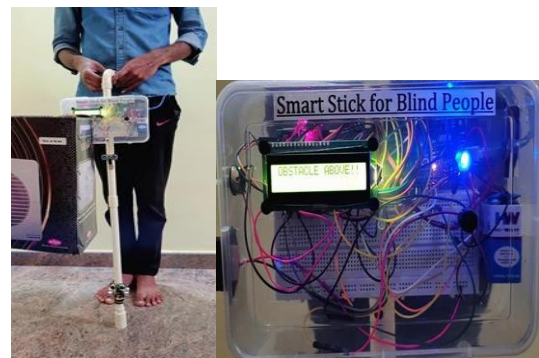

Fig 5: Case 1 No obstacle ahead of the blind person

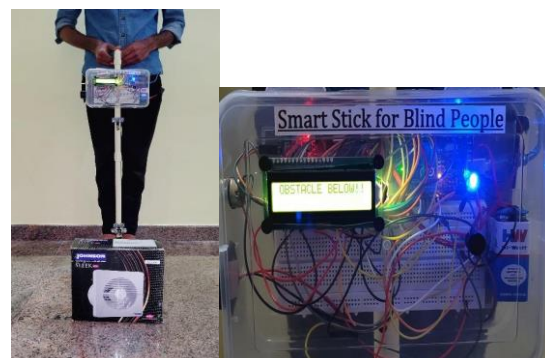Fig 6: Case 2 Obstacle is at front, above the knee level
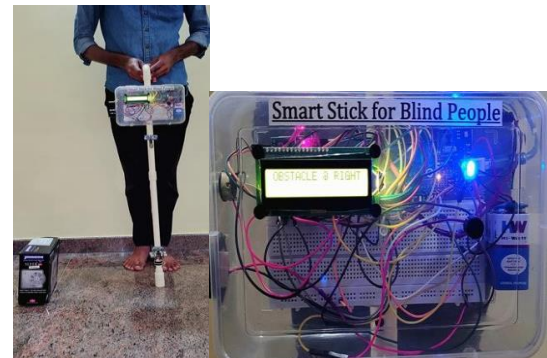

Fig.7: Case 3 Obstacle is at front / below
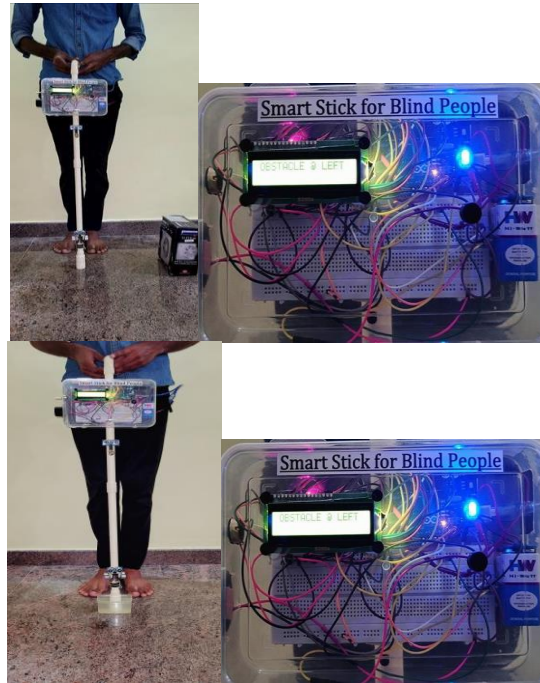

Fig 8: Case 4 Obstacle is at right

Fig 9: Case 5 Obstacle is at left
Fig 10: Case 6 Presence of water/puddle

9. FUTURE SCOPE

In future some of the modification can be made in this mini project which makes it more useful,reliable and give it more applications in real life situations such as-

• The system can be modified by initiating with the addition of Bluetooth module for proper ON and OFF functioning.

• Integration of GPS module for detecting location of user, in case of emergency.

• Having a separate back-up power system.

CONCLUSION

The project proposed is the design and architecture of a new concept of Smart ElectronicGuiding Stick for blind people on the streets. The blind stick proposed in this paper can aid the visually impaired user by helping him/her navigate through different terrains and obstacles. The advantage of the system lies in the fact that it can prove to be very low cost solution to millions of blind person worldwide. The proposed combination of various working units makes a real-time system that monitorsposition of the user and. It aims to solve the problems faced by the blind people in their daily life. The system also takes measures to ensure their safety.

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