LOW-COST WALKING STICK FOR OBSTACLE AND STAIR DETECTION USING ARDUINO

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ABSTRACT-

The life of any individual depends on five senses, of which the capability of vision is presumably the most important. While moving from one place to another, it is difficult for a blind person to notice the obstacles and stairs. The Smart Blind Stick is a device designed to guide visually impaired people by detecting objects, stairs, etc, and presenting the information to them. In this paper, the system was designed for indoor and outdoor applications to detect obstacles and stairs as well as to identify their nature (ascending or descending). This detects an object or stairs faster and easier, and a guardian or parent can also receive an SMS when the user is in an emergency situation through the Global System for Mobile (GSM) Communication module. As a result, the smart stick may offer a solution for people who are visually impaired to be more independent in their daily lives. The goal of the overall system is to provide a low-cost, effective navigation and handicap discovery aid for the blind that gives them a sense of artificial vision by furnishing information about the environmental script of static and dynamic objects around them so that they can walk independently.

Index terms: Arduino UNO, Ultrasonic sensor, GSM (Global System for Mobile Communication) module, SIM (Subscriber Identity Module) card.

INTRODUCTION

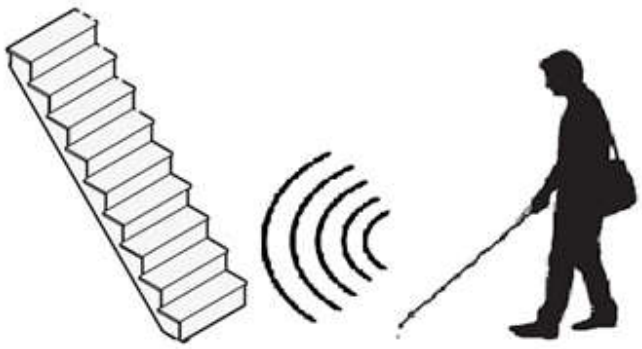

FIGURE 1: Working of Blind stick

Currently,visually impaired people are unable to travel independently due to serious vision impairments.They need help to walk outside in all other daily essential work.It is very challenging and difficult to live as a blind person, as they cannot see anything in front of them and sometimes, they can get hit by objects even humanswhich actually can lead to injury. Visual information is the support for most navigational tasks, so visually impaired people are facing difficulties because of a lack of necessary information about the surrounding environment and atmosphere.We are proposing to make a system that tries to remove the difficulties caused due to blindness and make them self-dependent to do their daily work. Blind people use a stick as a tool for directing them as they move or work which can serve as a support system for them. In this paper, we proposed a solution for blind people by using an ultrasonic sensor in the blind stick. The instrument stands are used to perceive the obstacles and stairs (ascending and descending) in front of blind people. The buzzer which is placed in the smart stick gets activated and produces a sound when any obstacle/stair is detected. This proposed method uses the Arduino UNO as a controller. A GSM module is also used to send an SMS whenever there is an emergency for the user. The blind person can send emergency messages or make an emergency call at risk, to his guardian through the GSM module.

LITERATURE REVIEW

In the year 2020, “Multi-functional blind stick for visually impaired people” is published by IEEE (Institute of Electrical and Electronics Engineers). In the proposed system digital and analog pins of the Arduino are connected to these components via jumper wires. According to the suggested system, it runs on an input voltage between 9V and 12V and has the following properties. Audio and vibration alerts can be issued as needed to warn of impediments of various sizes. Users receive an alarm when they come into contact with moist or wet surfaces. When an emergency occurs, the user can also send their location via SMS to friends, and if lost, it can also be located with an RF remote control.The GPS Module and GSM Module are functional and are able to send messages and give out accurate location of the user. However, the Neo-6M GPS module takes a variable amount of time on startup to get a satellite lock. The soil moisture sensor use is able to effectively determine whether the surface is damp. Finally using the IR and the ultrasonic sensors and are able to detect the obstacles [1].

In the year 2021, “Electronic Embedded System for Stair Recognition Based on Possibilistic Modeling of Ultrasonic Signal”is published by IEEE (Institute of Electrical and Electronics Engineers). In this, anew staircase detection and recognition system using the possibilistic modeling of ultrasonic echois proposed. An ultrasonic sensor LV-MaxSonar-EZ4 provides the distance measurement, and a servo motor is attached to the ultrasonic sensor to stabilize its acquired measurements based on the position information provided by a gyroscope and an accelerometer. For the design corps, two boards were used, which are a Raspberry Pi 3 and an Arduino Nano. Since it consists of a laboratory experimental device, we need to connect it to a computer. That is the purpose of the Raspberry Pi 3 board which provides wireless connectivity. The ultrasonic signal is being processed by a MATLAB script on a laptop. Arduino Nano controls and manages all system components. Firstly, data are collected by the ultrasonic sensor, through wave transmission and reception during a few seconds. While receiving pulse width and analog measure values from the ultrasonic sensor, the Arduino Nano transmits them to the Raspberry Pi card. Through Wi-Fi, the Raspberry Pi 3 connects to a Django page interface to save data. The embedded electronic system is supplied by a rechargeable battery. The stair recognition process is based on the collected data. Such an application requires a real-time system to warn the potential user in time. This vital requirement imposes to work with small ultrasonic signals in order to quickly process them and make the right decision that is being sent to the user [2].

In the year 2021, “Smart blind stick for the detection and avoidance of obstacle” is published by the international journal of innovations in engineering research and technology. The main objective of this is to help blind people to move more freely by informing the blind person about the circumstances & present condition of the path where he/she is walking using a reliable stick. The stick is used by the blind person to navigate around in an environment by avoiding obstacles. The stick is mounted with a Raspberry Pi setup. Once the obstacle is recognized, audio instruction over earphones is given to the user, and asking him to slow down the two ultrasonic sensors on either side of the stick are triggered on detection of an obstacle. This project is designed to create a system using ultrasonic sensors and providing voice commands through headphones to blind people. It would help a visually impaired person navigate through a public place independently [3].

In the year 2022, “Smart Assistive System for Visually Impaired People Obstruction Avoidance Through Object Detection and Classification” is published by IEEE (Institute of Electrical and Electronics Engineers).The proposed technique makes use of Raspberry Pi 4B, Camera, Ultrasonic Sensor, and Arduino established at the stick of the individual. We take pictures of the scene and afterward pre-process these pictures with the help of Viola-Jones and the TensorFlow Object Detection algorithm. The said techniques are used to detect objects. We also used an ultrasonic sensor mounted on a servomotor to measure the distance between the blind person and obstacles. The presented research utilizes simple calculations for its execution and detects the obstructions with notably high efficiency. The Blind Walking Stick has been eventually made into a prototype that may be used to manually the blind. Its objective is to clear up the troubles confronted with the aid of using blind human beings in their everyday life. Additionally, the system takes safety measures to protect them. The goal of this project is to make it easier for all blind people to walk wherever they want. It was done to make it easier for the blind to travel. It is employed to assist blind persons with disabilities in moving more easily and safely [4].

BLOCK DIAGRAM

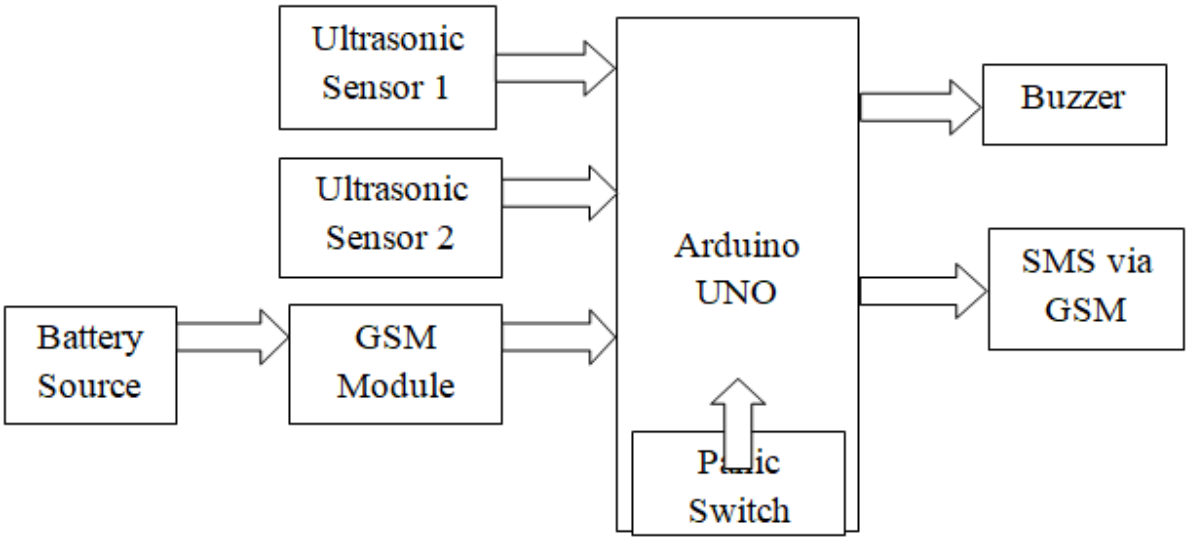

FIGURE 2: Block diagram of the proposed system

Arduino UNO

The Arduino Uno uses the Microchip ATmega328P microcontroller as its core component. It can be interfaced with a variety of expansion boards (shields) and other circuits by means of digital and analog input/output (I/O) pins. It is a physical board that can be programmed (often called a microcontroller) and includes a software interface, called an IDE (Integrated Development Environment), which allows you to upload software code to the board using the USB cable. An external 9-volt battery or a USB cable can power it, but it accepts voltages between 7 and 20 volts.

Ultrasonic sensor

Ultrasonic sensors measure distances between themselves and objects using ultrasonic sound waves. Ultrasonic sensors measure proximity by sending and receiving ultrasonic pulses sent from a transducer. Sound waves that travel at high frequencies are reflected by surfaces to produce a unique echo pattern. A sound wave is sent out by an ultrasonic sensor at a frequency that is higher than that of human hearing. To receive and send ultrasonic sounds, the sensor's transducer acts as a microphone. Time lapses between the sending and receiving of ultrasonic pulses determine the distance between a sensor and a target. In order to detect obstacles or objects, an ultrasonic pulse is sent out at 40kHz and bounced back if there is an obstacle in the way.

GSM Module

Wireless data links to a network can be provided by GSM modems or GSM modules, which use GSM mobile telephone technology. Communication with mobile networks is done by GSM modems, which are used in mobile telephones and other equipment. SIM cards allow their devices to be identified by the network.A GSM modem that can accept SIM cards from any network operator will function just like a mobile phone, displaying a unique phone number for each GSM network operator. Short Messaging Service (SMS) is designed for wireless radiation monitoring with a Global System for Mobile Communication (GSM) module. As a result of this module, data received from radiation monitoring devices, such as survey meters or area monitors, can be sent to a host server in the form of text SMS.

BUZZER

Beepers and buzzers are audio signaling devices that can be mechanical, electromechanical, or piezoelectric in design. Buzzers are small yet efficient components we can use to add sound features to our projects/systems. The 2-pin structure makes it easy to mount on breadboards, Perf Boards, and even PCBs, making it a widely used component in electronic applications. This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V.

BATTERY

Typically, electric batteries consist of electrochemical cells connected to external connections for the purpose of powering electrical devices. Positive terminals of a battery are cathodes, while negative terminals are anodes. Electrons flow from the negative terminal to the positive terminal through an external electric circuit. The free-energy difference generated by the redox reaction between the reactants and products of a battery is then delivered to the external circuit as electrical energy when the battery is connected to an external electric load.

IMPLEMENTATION

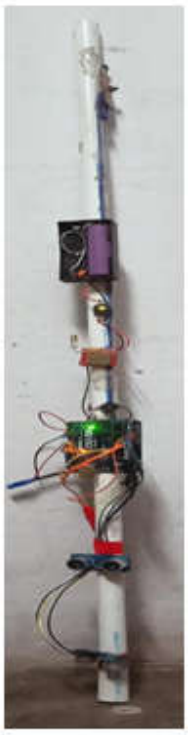

FIGURE 3: Prototype of the blind stick

The work behind this blind stick is that it is used for special purposes as a sensing device for blind people. The circuit provides a 5V power supply for the circuit and maintains its output of the power supply at a constant level. It is used widely to detect objects and stairs using ultrasonic sensors. The proposed project first uses ultrasonic sensors to detect obstacles/stairs ahead using ultrasonic waves.If the obstacle/stair is not that close the circuit does nothing.If the obstacle/stair is close enoughthe Arduino UNO sends a warning in the form of a sound.To determine the distance of an object/stair, calculate the distance between sending the signal and receiving back the signal.GSM module is used by the blind person to contact mobile numbers stored in the SIM card in case of any emergency. As any unforeseen condition occurs the emergency button can be pressed, which is connected to the top of the Stick.The blind person can send emergency messages or make an emergency call at risk, to his guardian through the GSM module.

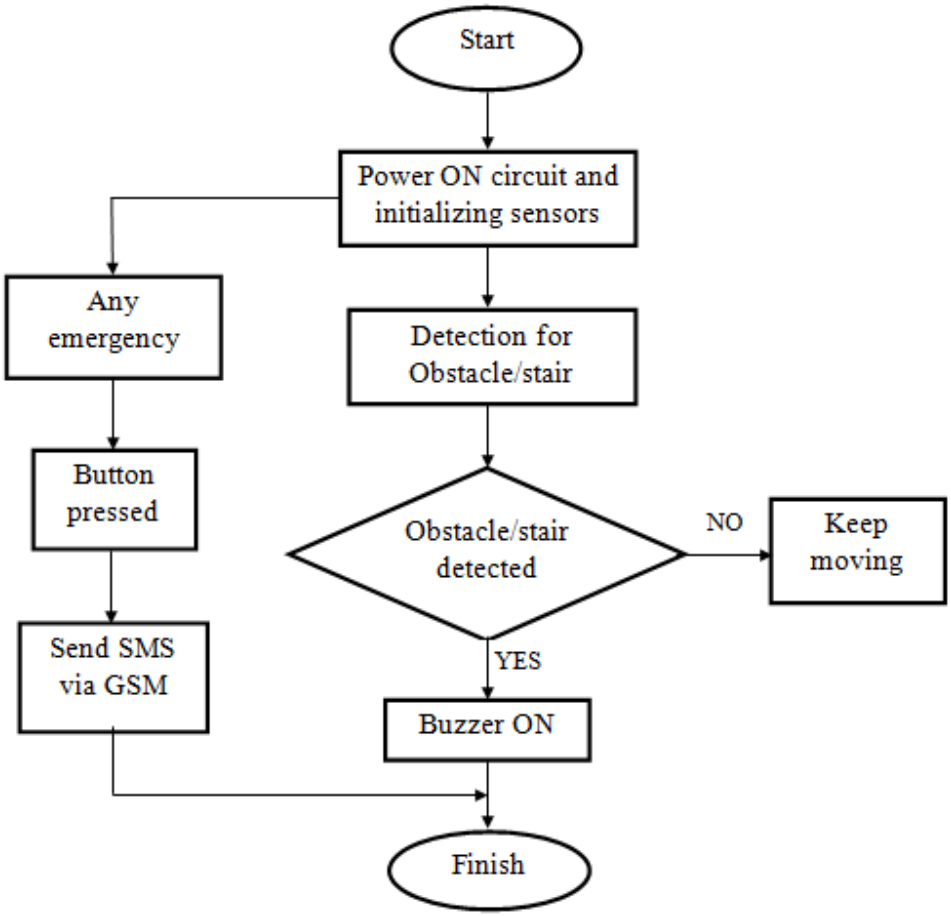

FIGURE 3: Flow chart of the proposed system

SOFTWARE REQUIREMENTS

ARDUINO IDE SOFTWARE

This is an official software developed by Arduino. cc called the "Integrated Development Environment" or IDE. It contains a text editor for writing code, a message area, a console for typing commands, and a toolbar with buttons for common functions. Basically, it is used to edit, compile, and upload the Arduino code. This open-source software is compatible with almost all Arduino modules and is readily available to download and use. It is easy to install and compile code while on the go.In order to upload programs and communicate with the Arduino hardware, it connects to the Arduino hardware.

RESULTS

By using the proposed system, the obstacles and stairs are detected. In order to evaluate the proposed method's performance, experiments were conducted. Here we are present a traveling aid that will make everyday life easier for the visually impaired. It has already been mentioned that sensor circuits provide information about the environment. The GSM module sends a message to the parent or guardian when the person is in an emergency.

FIGURE 4: Obstacle detection

FIGURE 5: Upstair detection

FIGURE 6: Down stair detection

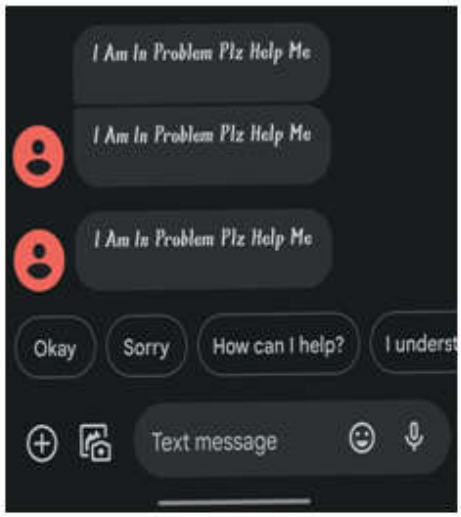

FIGURE 7: Message sent to the parent/guardian

CONCLUSION

This paper presents an electronic subsystem for obstacle and stair detection and recognition. This system will assist visually impaired people by avoiding obstacles/stairs in their way, to lead a life like other normal people in the world. The prototype of Smart Stick for Blind is able to detect obstacles and stairs in front of the user. Guardian or parent can also receive an SMS when the user is in an emergency situation through the Global System for Mobile (GSM) Communication module. And, it is therefore capable of guiding a visually impaired person in navigating his environment. This reduces human effort and gives a better understanding of the surroundings and it provides an opportunity for visually impaired people to move from one place to another without being assisted by others. Therefore, the smart stick is user-friendly, has quick response, has very low power consumption, is lighter weight and it is easy to hold by the user.

FUTURE SCOPE

Though the prototype model worked very effectively with remarkable outputs, the real-life situation is going to be way more challenging and demanding. A few of the challenges of the stick can be enabled with a voice module and GPS module which can help the blind with better navigation. Through the voice module, the person will be aware of the current position and distance from the destination which will be informed to users through voice instructions given. And the GPS module helps the user to send the location to the parent or guardian. As the smart stick functionality expands, it will enable visually impaired persons to navigate independently in an efficient manner and ensure a higher level of safety.

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