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Ultrasonic blind stick with GPS and GSM capabilities

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Abstract

The overall objective of this project is to come up with a model that would be of use to the blind members of our society. The research, in simple terms, seek to design an imaginary walking stick that would alert visually impaired persons on nearby obstacles, holes, or water during a walk to help in avoiding any form of unintentional damage. The project brings to life the concept of breaking ground in navigational aids for the blind. A rather plain looking white stick, this is actually very one of a kind, as it is fitted with several sensor that give the user added awareness of the surroundings and raise their level of safety significantly. By its brilliant design and programming, it can provide the GPS sensor with an optimum estimate of the path depending on the place it can access. The user is given the amazing ability to select locations from their list of destination, which were recorded in the database of the system. It uses batteries, stick ultrasonic sensor for GPS and GSM trackers, water sensor, soil moisture sensor, buzzer, push button, vibrator motor and etc. Overall, the device aims to provide a safer and more comfortable way of getting around obstacles in daily life for the visually impaired.

Keywords: *Retinopathy, Obstacle detection, Ultrasonic sensor, stick, impaired persons*

1. INTRODUCTION

Humans are gifted with the sense of sight, an element of great importance in living. Those people who suffer from blindness either total or partial are deprived of this ability, which puts them at a disadvantage in everyday life. Technology is being evolved day by day to facilitate the mobility of such person safely and soundly. Blindness is one of the most common disables are found in people all around the world. They require the help of walking outside and with all the other daily task that are obligatory. We are constructing a system with the aim of removing all the difficulties caused by blindness and enabling them to perform daily activities all alone. A stick can be used as the guide for the blind, who resort to it every now and then while walking or doing some work. The Ultrasonic Blind Stick is an effective electronic guide for the blind. It is based on the creation of a smart stick by which visually impaired people are in a position to be more independent, self-assure, and comfortable in an economical and efficient manner. This system shall cover obstacle detection, water detection, location detection, and emergency messaging. This gadget will be based on a small circuit in the white cane and a still smaller one that acts as a control unit. The microcontroller-based circuit acts as the controlling circuit of the operation of the whole system. Obstacles are detecting through ultrasonic sensors that emit a beep. A water sensor detecting ground water alerts the user. Moreover, the approximate location of the stick is sent to the caregiver or family or friend phone through GPS and GSM connection. The aim of the system is to provide artificial vision to visually im- paired people by providing them with information about the surrounding environment.

2. RELATED WORK

S. Chew et al. use the term "blind spot" in [6] for a competent white stick that joins GPS and social networking technologies to let a user access information provided by other visually im- paired people on the best ways to move through a given public area without running into most obstacles. Although the GPS cannot identify the barriers, the ultrasonic sensor is able to detect obstacles and sound alerts, and it can measure the distances between barriers. Utilizing ultrasonic sensors developed by Osama Bader AL-Barrm, JeenVinouth et al., [2] developed a three directional detection of obstacles system. It is made up of an SMS message system, GPS, the DC vibrating engine, a buzzer, a controller. The technology notifies the user via the motor's vibration and beep upon detecting any impediment. Although it can cover a lot of ground, its accuracy in identifying obstacles could be compromised. Jayant, Pratik, and Mita et al. [7] proposed a smart stick aided mobility system for the visually challenged. It basically makes use of standard ultrasonic sensors along with an ATMEL microprocessor. The system detects obstacles and sounds a buzzer together with vibration once it detects an obstacle. It is run by recharge- able batteries, and most importantly, programmable using an ATMEL AVR microcontroller. Although this robot has a foldable form for port- ability and is capable of detecting an object up to three meters, the one-way detection coverage may compromise its precision in obstacle detection.

Saurav Mohapatra, Tanish yepuganti karuna, Tripathi, Subham Route, saxena varun among others [9] An extensive report on a new orientation aid for those who are blind is offered throughout this publication regarding the sonar blind wandering staff. The invention constitutes a supersonic trekking staff that makes utilizes supersonic waves' enormous potential of identification of obstacles. It has in- built GPS tracking plus ultrasonic instruments with light as well as water recognition. When a hurdle becomes apparent, the tiny computer gets information regarding it and sounds an alarm if the obstruction ranges are close together. It detects brightness and darkness and provides the blind user with clear notifications. Benjamin et al. [3] have developed a smart stick which incorporates laser sensors to detect obstructions and curbs facing downhill. A micro- phone generates a high-pitched "BEEP" to indicate detection. While this simple and self-explanatory design makes it easy to detect impediments, it provides no cognitive and psychological assistance. Hence, its instruction is limited to beeping alarms.

The active cane was developed by a group at the University of Central Michigan. et al. [5]. It consists of an electronics cane which reads on sends contextual data to blind people through RFID chips placed in storefronts and street signs. To enhance consciousness about the environment, it also has a sensor that uses ultrasound to identify things in the path of a stick tip. A1-Qutayri, M.; Shamsi, M. A.; Jeedella, J. et al., [10] This is achieved through design for the blind, which eliminates the problems with the existing solutions. This allows it to be aware of its exact position, height, and obstacle orientation at any point in time. Embedded inside this magic stick are the roads, buildings, steps, stairs, and possible hazardous obstacles. Functionality and performance have been improved. Borenstein J., Ulrich I., et al., [4] The structural homology of this stick allowed for its light weight and manageability. Ultrasonic sensors are used by this smart blind stick to identify obstacles such as pits and holes. Both vibration and recorded sound messages are received by this user. The user's attention will be maintained by this audio cue. The intensity of the vibrations reveals the proximity of the impediments to the walking path.

Kaustav Sen and Jayoti Das Sen Arnesh et al., [1] This research describes how an artificial vision system is used to help a blind individual detect objects. the location's real-time position computation using the device's GPS. The blind person can perceive all static and dynamic items closer to him with the use of the ultrasonic sensor. Additionally, it has a double feedback system that lets the user hear buzzers and voice guidance. After that, the data is sent to the

Internet of Things device, which is attached to an infrared sensor that detects obstacles. Additionally, this has an emergency button that may be used to send an SMS in an emergency by connecting to the GSM.

A handicapped person's digital strolling staff with a sensor that emits sound has been designed and implemented, according to Pritha Ghosh et al. [8]. The blind user will be alerted by a buzzer on this device, and obstacles in their route will be detected by the HC-SR04 ultrasonic detection module. Furthermore, in the suggested configuration, the microseconds controller that is used is 16F877A. It uses an ARM processor that has more RAM. Because there won't be any GPS detection, this device cannot be utilized indoors. A proximity sensor & the ultrasonic detector are utilized in finding obstacles. The obstacle's location in relation to the blind is determined by the GPS module. Additionally, the blind user can receive directions from the navigation system via voice commands.

3. METHODOLOGY

Arduino uses this data to process commands and do calculations. If an object is discovered to be closer, the user receives the command via their voice or microphone. The voice playback module, which alerts the user to the object, already has the command stored inside. There aretwo units: the transmitter unit, which is worn on the person's hand, and the receiver/transmitter unit, which is housed in the walking stick. Similar to how fire and water sensors are used to detect and alert people to fire and water on the ground, ultrasonic sensors are used to identify obstacles and notify the blind.

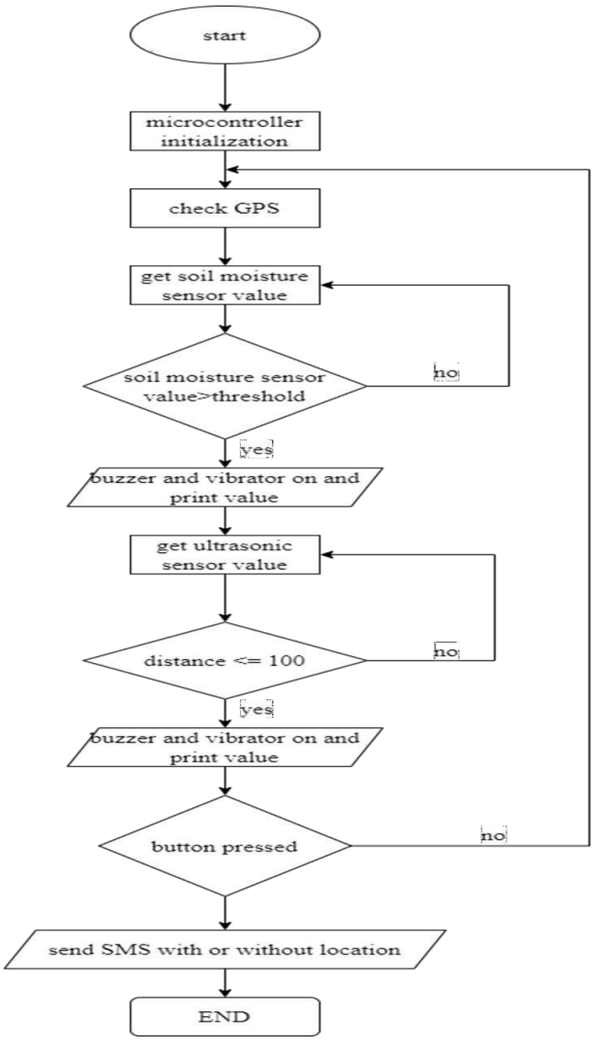

Fig 1. Block Diagram

Apart from regulating the buzzer, the microcontroller employs a sensor to ascertain the separation between the barriers. In addition, an Arduino or similar microcontroller will be used to provide sensor inputs, actuator control for vibrating motors or speakers, and GPS data. The buzzer and vibrator are also connected in parallel to produce a vibrating effect. The microcontroller then evaluates the data to determine if the separations between the barriers are appropriate. It buzzes differently when there are nearby impediments. Insulate a dependable power source that will enable ongoing operation, like rechargeable batteries. The GPS module is used to track the present location of the blind person. The blind individual can program phone numbers into the little computer to be called in case

of an emergency or other issue by using a GSM module.

Making sound waves and measuring how long it takes for them to return after striking a surface is one method of estimating distance. Length d is obtained by summing the sound speed, velocity h, and echo return time t.

$$D = v.\, t/2 \qquad \ldots\ldots(1)$$

Where:

D is the object's distance from you. Around 343 m/s, or X, is the vibration's speed at a common temperature. An ultrasonic pulse has a round-trip duration of t.

The length and longitude for the current position are provided by the GPS. The length from both places with the latitude and longitude can be computed using the Haversine formula. The above equation, however, is a simplification and presupposes that the Earth is a perfect sphere, which is untrue.

$$a = sin^2(\Delta\emptyset\Delta\lambda)+\cos(\emptyset_1)\cos(\emptyset 2)sin^2(\text{—}) \ldots (2)$$

$$c = 2arctan2(\sqrt{a},\sqrt{1-a}) \ldots\ldots(3)$$

$$d = R.c \quad \ldots\ldots\ldots(4)$$

where the two spots' poles in radians are: ϕ1, ϕ2.

The two points' longitudes, measured in radians, are λ1, λ2, λ 1, and λ 2.

$$\Delta\varphi = \phi 2 - \phi 1$$

The Earth's radius, expressed as $\Delta\lambda = \lambda 2 - \lambda 1$ R, has a mean radius of 6,371 km. Distance d between the two places is exactly as indicated.

3.1 HARDWARE SPECIFICATION

Some of the elements wanted for developing a vibrating blind sticks include an Arduino Uno controlling board, a sound sensor, a soil moisture sensor, a buzzer, a vibrator motor, a push button, a breadboard, jumper wires, a battery pack, a GPS device, and a GSM module.

3.2 HARDWARE DESCRIPTION

3.2.1 Arduino uno

The development board Arduino Uno's simple Internet relationship, interchangeable chips, and array of I/O possibilities render it an incredibly user-friendly microcontroller, even for novices. Since then, many varieties have been created; the "uno" version from the first Uno device is one of the most well-known that has endured.

Fig. 2 Arduino uno

3.2.2 Ultrasonic Sensor

A supersonic speed monitor was a gadget that measures length via supersonic waves. Doppler effect theory underpins the workings of an ultrasonic sensor. This is made composed of an antenna and a supersonic transmitter. The transmitter only transmits the signal in one direction. The sent signal is reflected back by the obstruction and reaches the recipient.

Therefore, the distance between the extraordinarily fast gadget and the obstruction is determined by the entire time required to broadcast and receive the message twice.

Fig.3 Ultrasonic sensor

3.2.4 Water Sensor

A technology wet detect serves to figure out the existence of liquid within the blind path and instantly alert the blind party in order to prevent the blind from falling.

Fig. 4 Water sensor

3.2.5 Buzzer

The user receives auditory signals using a piezo buzzer. When water or an obstruction is detected, the Arduino beeps.

Fig.5 Buzzer

3.2.6 Vibrator Motor

It resembles a direct current motor, tiny to the touch yet lacking a core. Its primary usage is to alert the user to incoming calls silently and without vibration. Numerous gadgets, including cell phones, pagers, and handsets, use it. This motor's tiny size and light weight are attributed to its magnetic properties. A tiny vibrating motor gives the user haptic sensation in this way. The Arduino triggers it in the same manner as the buzzer.

Fig.6 Vibrator motor

3.2.7 Push Button

It represents a basic shift mechanism which can be utilized to control a device or procedure. The majority of buttons are composed of a hard substance, typically plastic or metal. In an emergency, it is utilized to turn on the warning system. Its pressing initiates a procedure that gathers the geographical coordinates and sends these towards the intended spot.

Fig.7 Push button

3.2.8 NEO-6M GPS Module

In order to share actual time fashion connecting data, the GPS transmitters use radio waves into space. By providing combined length and latitude, it can be used to deliver location assured SMS messages in an emergency.

Fig.8 GPS module

3.2.9 SIM900/SIM800 GSM Module

By the help among this component, an Arduino circuit can send texts via the cellphone network of things. Using the push button in a crisis, this feature is useful for communicating the user's location.

Fig.9 GSM module

3.3 SOFTWARE SPECIFICATION

3.3.1 Arduino IDE

The Arduino IDE makes text, assembling, & publishing coding on Arduino boards extremely easy with its pre-built libraries, ease of use, and support for C and C+. It may be accessed on Linux, Mac OS, and Microsoft. The app is highly convenient to use at every stage of teaching and learning because of its abundance of ex-ample texts and ease of accessibility.

Fig.10 Arduino IDE

3.3.2 TinyGPS++Library

This framework makes use of for interacting via a GPS module and offers fundamental capabilities to handle GPS data and collecting coordinates.

3.3.3 Software Serial Library

Software serial libraries a number for uno is a digitizing pin are now able to interact over serial enabling the simultaneous operation of several tools including gps receivers and gsm modules.

4.RESULT

It is able to detect obstacles and provides much easier and safer accommodation for the blinded people to pass through obstacles in their everyday lives. We derive data from the stick's sensors and process it in that way. In case of urgency, we will pass further in the same way while processing the data through this system and share the location of the person with the guardian in the process. It is for this reason that our system works in a very orderly way to protect the visually impaired persons.

5.CONCLUSION

This blind stick, which combines tracking via GPS with sonic technologies, is a huge assistance to the visually impaired. This improves obstacle detection while also enforcing confidence and autonomy in mobility around outside locations. With a 90% success rate, the ultra- sonic sensors that identify obstacles in one's close vicinity and the GPS tracking that pro- vides broader spatial awareness can let users move around more safely and easily. Further- more, users may go farther thanks to the integration of GPS, which makes it easy to plan routes, mark locations, and even provide assistance in unfamiliar areas. Integrating a GPS and an ultrasonic detector into a blindstick would be a significant step in improving the mobility and freedom of those who are blind.

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