WALK-AID: Arduino Based Smart Stick for the Blind

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ABSTRACT — The concept of the Walk-Aid is an approach that focuses on helping a partially or completely blind person who faces difficulty in doing day-to-day tasks. The idea is to provide them with a sensing stick that can give them a sort of feedback about the environment around them. This feedback could be any of those remaining 4 senses that the blind person could be sound in. We would be using sound feedback to alert/warn the user that something is ahead in the path and they should get out of the way. The main heart core of the approach would be an ultrasonic sensor, which would be driving that feedback mechanism followed by an Arduino Uno for working as a central processor along with batteries for power. Further, this mechanism would be implemented and showcased on anything which a person uses daily such as belts, gloves, masks, sticks, etc. We have used a stick in this project.

Keywords: Arduino Uno, ultrasonic sensor

I. INTRODUCTION

For blind people, the walking stick is one of the more important parts of their life. This walking stick has been used by the blind for navigation since the old times. The plan is to make this stick more helpful for the blind, by incorporating an obstacle detection system, which will further enhance the safety of the blind. Hence the name Walk-Aid.

There are countless visually impaired individuals in the general public, who are experiencing practicing the fundamental things of day-to-day existence and that could seriously jeopardize lives while voyaging.[1]There is a need these days to give security and well-being to an overwhelming number of individuals.

There have not been many gadgets grown such a long way to help visually impaired individuals.The visually impaired stick is incorporated with an ultrasonic sensor alongside a signal gadget and vibration sensor.

[2]While managing impediments like entryways, posts, shrubs, and different things, a blind individual can't make a remedial move.Moreover, blind individuals have more noteworthy limits in regular daily existence since they should depend on others to finish their everyday errands. In the earlier 10 years, visionless people moved about utilizing customary sticks, which gave them huge troubles in exploring ordinarily. That is the reason, to forestall it, they need a savvy framework to direct them through these issues with a third eye.

The proposed project first uses an ultrasonic sensor to identify snags without contacting it utilizing ultrasonic waves. On detecting snags the sensor passes this information/8 to the microcontroller. The microcontroller then processes this information and computes assuming the impediment is sufficiently close. If the hindrance is far the circuit sits idle however If the obstruction is close the microcontroller conveys a message to sound a signal and vibrate the stick utilizing a vibration actuator.

[3]The system consists of an array of five ultrasonic sensors paired with an AT89S52 microcontroller, to process navigation paths around obstacles in the path of a blind person. The system can also be customized with audio messages to help with the navigation, stored on an on-board flash memory. The ultrasonic sensors are implemented on a pair of spectacles and a waist belt, which together form the necessary sensors in order to calculate the correct path for the blind, with detection possible up to a distance of 500 cm.

For the testing purpose, certain tests were conducted on different individuals and it was found that it took 15 to 16 hours for the user to completely comprehend the functioning of the device. Moreover, the wearable device was also taken into use by keeping a set of obstructions and the hit rate was found to be very low, indicating successful obstacle detection.

[4]There is a vast population of people who are both blind and deaf and certainly couldn't take the benefit of GPS(Global Positioning System) and voice assistance which brings the approach of using vibration feedback systems to user-friendly devices. A simple vibrating motor operating at a frequency of 250-400 Hz which is also found in many day-to-day devices such as smartphones could be used to guide the deaf in a real-time scenario. The range could be 150-200 cm for the obstruction to be detected.

[5]A more robust and practical approach is the development of a smart chair with all the bells and whistles of a walking stick. In addition to this, now a person can also sit in a chair. This idea also brings in the use of navigation, as the person now is sitting in a movable machine. Directional navigation technology could be implemented with the use of GPS which could be used to take the user to their destination. It is a good solution, especially for the elderly, or people with walking disabilities in addition to blindness.To accomplish this, the walker processes information gained from onboard laser scanners to distinguish positive and negative impediments and imparts with the client through vibration input on the handles and the belt tied to the user.

The prototype was tried and tested in different conditions out of which the situations where the reaction time was required to be rigorous were important. The device was also simulated in artificially made human-like situations and also tested on different subjects. The success rate was around 90% with all the tests combined.

II. Hardware Components:

A. Walking stick

For implanting the other hardware components on a medium we need a stick that is reliable, lightweight, waterproof, and durable.

B. Arduino Uno

An Arduino Uno is a microcontroller development board that allows the user to code and implement software known as Arduino IDE. For physical computing, there are many additional microcontrollers and microcontroller platforms to choose from. A similar capability is available in Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many more programs. All of these tools condense the complicated elements of microcontroller programming into an easy-to-use package. Arduino also makes dealing with microcontrollers easier.

In Fig. 1, the Arduino Uno which was used in the hardware is demonstrated.

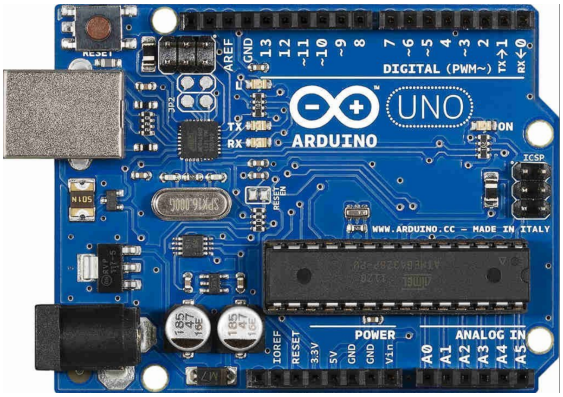

FIG 1: Arduino Uno Board

C. Piezo buzzer

The piezo buzzer makes sound by using the piezoelectric phenomenon in reverse. The essential idea is the creation of pressure fluctuation or strain by applying an electric voltage across a piezoelectric material. These buzzers can be used to notify a user of an event triggered by a switch, counter signal, or sensor input. They're also found in alarm systems.

Irrespective of the voltage fluctuation provided to the buzzer, it delivers the same loud sound. It is made up of piezo crystals sandwiched between two conductors. When a potential is placed across these crystals, one conductor is pushed while the other is pulled. A sound wave is produced as a result of this push and pull motion. The majority of buzzers have a range of 2–4 kHz.

Figure 2. shows the respective piezo buzzer which we have used during the implementation of the hardware

FIG.2: Piezo Buzzer

D. Ultrasonic sensor

An ultrasonic sensor is an electronic device that deploys ultrasonic sound waves to detect the distance between a target item and translates the reflected sound into an electrical signal. A transducer is used to emit and receive ultrasonic pulses, which then pass on information about an object's presence. It's worth noting that ultrasonic waves move quicker than audible sound waves.

In this project, an ultrasonic sensor is used as a feedback sensor where the Arduino board gives commands and the component is displayed in Fig 3.

Fig 3:Arduino ultrasonic HC-SR04

III. Working

The mechanism has been implemented on the side of a stick. A blind person holding this device can simply press a button to turn it on. After the device is turned on, the ultrasonic sensor will take real-time data and will pass on this information to the Arduino Uno. This Arduino Uno will then pass on this information to a buzzer which will create a beeping sound on the successful detection of an obstacle. The components driving the whole process are, namely, the Arduino Uno, buzzer, jumper wires, and a DC battery for power.

The whole process has been summarized by the following block diagram from Fig 4.

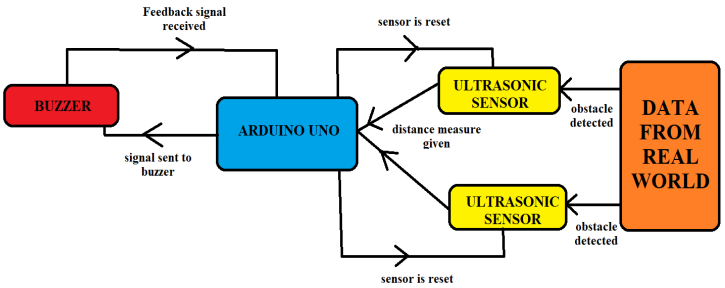

FIG 4. Block Diagram of the process

IV. Methodology

Walk-Aid works on the echolocation idea, and that implies it distinguishes surfaces and articles by utilizing an ultrasonic sensor. This permits it to work in good ways, without the further need for actual contact that exemplary strolling stalks require.

At the point when an obstruction is effectively distinguished, Walk-Aid can give criticism to the client, informing them of the approaching hindrance and helping them in keeping away from it.

When the person is holding the stick and starts to walk the ultrasonic sensor constantly sends a transmitting wave

which is later received by the receiver when the wave strikes the object to which the distance can be calculated using

Distance (d) = (Duration/2) / 29.1

We divide by the factor 29.1 because of the speed of sound (which is 1 / speed of sound) in air. So we are saying that for every 29.1 ms sound travels 1 cm approximately.The duration is divided by the factor of 2 because the sensor gives to and fro the time of the wave, so double the distance that is required.

From this calculation, the Arduino Uno computes at what distance the buzzer should sound. When the distance is less than 0.5m then the buzzer rings so that the blind person can change the path. If the change of path also has an obstruction in the way then the buzzer keeps ringing till there is no obstruction in the way of the person.

V. Project Demonstration

The Walk-Aid was held at a normal walking level, imitating that of a blind person, and obstacle detection was observed and measured for various objects. It was observed that upon the detection of subsequent obstacles, the feedback was being received in the form of a buzzing sound played by the buzzer.

Below Figure 5 are the pictures of the working prototype.

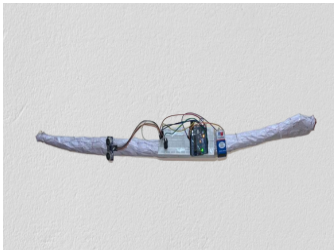

Fig 5: Prototype of the walking stick

VI. Outcomes and Observations

We have implemented and tested our hardware model in different scenarios, and real-life situations. During this time the paper was written and had rigorous trials and testing.

We initialized the range of the ultrasonic sensor to 0.5 meters so that if any object is in the range of the stick, the buzzer can produce the sound. In table 1 the observations were made when a certain type of obstacle is in front of the stick.

S.No	Type of obstacle	Distance under which detected x(m)	Feedback /Buzzer activated	Distance difference 0.5-x (m)
1	Door	0.45	YES	0.05
2	Rock	0.48	YES	0.02
3	Car	0.39	YES	0.11
4	Man	0.41	YES	0.09
5	Pole	0.45	YES	0.05

Table 1:Observation of the walking stick

NOTE: Car and Human were moving when the distance was being recorded

VII. Conclusion

Walk-Aid allows the person who is having a visual impairment to move around without the need for the assistance of another person. The walking stick needs to be placed in a torrid area.There is a need for the improvement of the voice command to identify the object and inform the user of what type of object is forthcoming.

VIII. Acknowledgement

We would like to thank our teacher and guide Professor Malaya Kumar Hota, who gave us his valuable suggestions and ideas when we were in need of them. He encouraged us to work on this project. We are also grateful to our Institute for allowing us to work and providing us with the necessary resources for the project. We would also like to thank all of them who helped us to complete this project. We are immensely grateful to all involved in this project as without their inspiration and valuable suggestion it would not have been possible to develop the project within the prescribed time.

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