A Systematic Review of Wearable Devices for Orientation and Mobility of Adults with Visual Impairment and Blindness

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Abstract: **To walk safely, blind persons require assistance or assistance from others. A smart blind stick might be a useful tool for them to grasp their surroundings and assist them when walking. In this study, we suggest a Smart Stick—a stick with all the sensors and components installed on top of it. This smart stick essentially functions in two ways. Case 1 uses an ultrasonic sensor on the stick to identify obstacles in front of it, whereas Case 2 uses a servo motor to rotate the ultrasonic sensor at an angle to identify obstacles in congested areas. Obstacle detection in both situations triggers a buzzer sound to notify the blind individual. To go from case 1 to case 2, and vice versa, press the switch button. Every barrier in its field of view can be detected by this stick. Additionally, appropriate settings for use are determined. The blind person can walk with confidence and get over his phobia of walking by utilizing this smart stick.**

Keywords— Smart blind Stick, Obstacle Detection, Visually Impaired.

I. INTRODUCTION

The most vital sense organ for every person on the planet is their eyes, which allow them to see nature and their surroundings. The visual system organs that allow us to observe our surroundings and recognize environmental changes are our eyes. But not everyone has the same access to nature as we do. People who are visually handicapped find it challenging to engage with nature. The most important physiological function of the human body is vision. Our eyes are essential to our surrounds because they allow us to communicate with the natural world. Blindness is defined as having a visual acuity of less than 6/60 or the horizontal range of the visual field with both eyes open. Sadly, the World Health Organization estimates that 285 million individuals are partially sighted, with 39 million of them being totally blind.

The percentage of blind individuals over 50 is 82%, which is the upper limit. In addition, 90% of those with vision impairments live in underdeveloped nations. A 2011 WHO survey estimated that around 1% of the world's population—roughly 70 million people—is visually impaired. Of those, 10%—roughly 7 million people—are completely blind, while the remaining 90%—roughly 63 million people—have impairments.

The walking staff was the only navigational aid used by the blind in the past. Among the main disadvantages of utilizing that stick were the training period and the required abilities. Thanks to technological advancements, it is now feasible to create and develop cutting-edge technological solutions that could improve how visually impaired individuals perceive their environment. To create the new stick variants, a great deal of research and development work as well as practical application has gone into the development of these concepts. This essay lists a few of these research works' references:

In this work, a smart stick is developed, with hardware comprising a microprocessor integrated with an Ultrasonic sensor as a proximity sensor, ping sonar sensor, micro pager motor, wet detector, and other accessories. The stick has become more complex and distinctive due to the invention of a new wet sensing circuit by the system.

II. LITERATURE

By monitoring the amount of time it takes for the reflected waves to return to the receiver after being transmitted at a frequency of 40 kHz, ultrasonic sensors can calculate the distance to an item. By sending out ultrasonic sound waves to measure the object's distance, an ultrasonic sensor is used to identify obstacles. After that, these sound waves are transported and transformed into electrical signals. Blind persons who utilize sticks for objection detection employ ultrasonic sensors. The blind person is alerted to obstacles around them by the buzzer on the stick. It assists the blind person in securely navigating through congested settings because it has a 35-cm detection range for obstacles.

By integrating GPS (Global Positioning System) into the stick, blind individuals can get over the constraints of the typical navigation sticks they use. Three ultrasonic sensors are positioned differently to improve the stick's precision. A vibratory motor is installed to improve usability for blind users. It activates with a buzzer when an impediment is detected within the intended range. Infrared sensors are an additional option to ultrasonic sensors. When it comes to precision, infrared sensors outperform ultrasound ones. They have the capacity to identify various barriers at various angles and distances.

Two infrared sensors are installed, one to cover the front range horizontally and the other to detect impediments on the floor by pointing it downward or at an angle. Avoiding the stairs is also made easier with this mounting [5]. There may be instances where the blind person is by themselves while the stick's battery starts to run low. It is possible to stop the battery from draining too much by using piezoelectric charging for the stick. From the produced potential difference, the piezoelectric plates provide electric current [6].

Additionally, the blind stick is compatible with a number of IOT (Internet of Things) modules and services. When using the stick, a blind person can use voice or text messaging to stay in touch with friends and family. In an emergency or other situation, the blind person can notify their family members by sending alert messages. The Arduino Uno microcontroller powers this model. To find the stick and detect obstacles, it features an RF module, an IR sensor, and an ultrasonic sensor. Additionally, a vibrational sensor and a panic button for emergencies are positioned on the same stick [7].

The addition of the SOS navigation system improves the stick's dependability and safety. This enables the blind man to receive support from his or her well-wishers via a video call using an Android application. In an emergency, the blind person can activate the SOS function by pushing the designated button on the stick [8]. Both an infrared sensor and an ultrasonic sensor can be installed on the stick to improve efficiency even more in their respective functions. with addition to obstacle detection, this aids with level detection [9]. As a step toward even more technological innovation, the stick has a real-time audio voice help system attached. The blind person will be guided by this voice help independently of family members. In addition to voice help and GPS, navigation algorithms can be used to provide blind people with a map guide when they are in unfamiliar or new locations [10].

To increase the stick's compatibility, additional sensors such an RF module and a water sensor can be added [11]. An autonomous path finding system replaces the walking stick. The assistor system aids the visually impaired individual in navigating the path. The assistor can navigate on its own thanks to its camera and other obstacle-avoiding sensors. Without using a stick, the blind man has merely followed the procedure [12]. Since the Raspberry Pi is about thirty times faster than the Arduino, it can be used to boost the stick system's feedback. It is also more advanced than Arduino because it can provide connection to the internet [13].

Additionally, an angle sensor and ultrasonic sensor are added on the stepper motor to improve the stick's comfort and user-friendliness. The bottom of the stick has wheels connected so that the user can slide it wherever they're needed. The stick's height can be changed to suit the user's comfort level [14].

We introduce an appropriate detection feedback mechanism that determines the obstacle's correct height and length. Under the right circumstances, LED light can also be employed to provide feedback to the user. As a result, this stick is tailored for a variety of terrain.

Figure 1 illustrates how the blind man's stick operates. The stick features a button switch fixed to it that allows the user to alternate between the two modes of operation. The user can switch to mode 2 whenever they are in a congested area so they can see impediments from the side as well. The user only needs to flip off the switch's main switch in order to turn off the stick.

III. METHODOLOGY

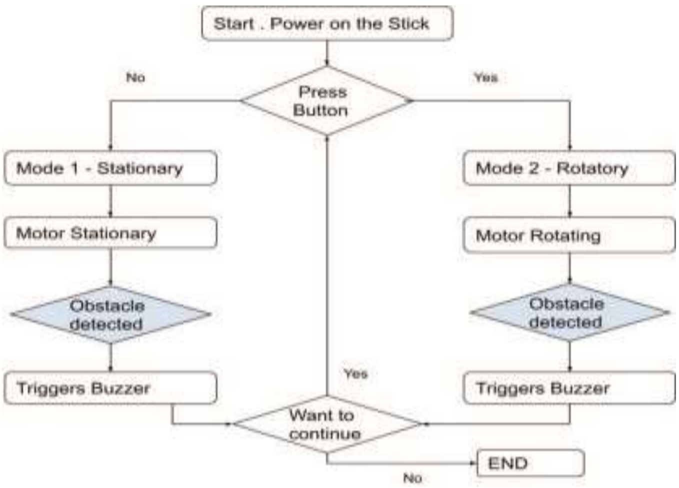

Fig. 1. of Stick Flowchart

IV. PROPOSED STICK

The microprocessor in the stick is an Arduino Mega 2560. An external power source in the form of a 3.2V battery powers it. One method of detecting objects is via an ultrasound sensor. There is a transmitter and a receiver for the HC-SR04 Ultrasonic Distance Sensor. The electrical signals are converted to ultrasonic waves by the transmitter, which is trig pin controlled. These waves are reflected after colliding with the obstruction along the path. The receiver, which is managed by an echo pin, transforms the reflected photons back into electrical impulses.

Equation 1: Distance = (time taken*0.034)/2 can be used to determine the obstacle's distance from the stick (1) With the use of a buzzer, obstacle detection is demonstrated by a sound signal.

The blind man is able to walk in congested areas because to the servo motor, which rotates ultrasonic sensors. The servo motor has an ultrasonic sensor installed so that the area on either side of the stick is within 60 degrees of each other.

There are two cases: -

Mode 1: The ultrasonic sensor is steady and will detect the obstruction in the direct line of sight because the push button is off and the servomotor is not operating. To check for obstructions in this situation, the individual must physically move the stick.

Mode 2: The ultrasonic sensor's servo motor, which is connected to it, is turned on and helps the sensor rotate 60 degrees on either side of the stick in order to identify obstacles. This rotating feature is specifically designed to make it easier for blind people to navigate busy spaces.

When the stick is in rotating mode, the vibrator is fixed to it so that the blind guy may detect motion from the ultrasonic sensor.

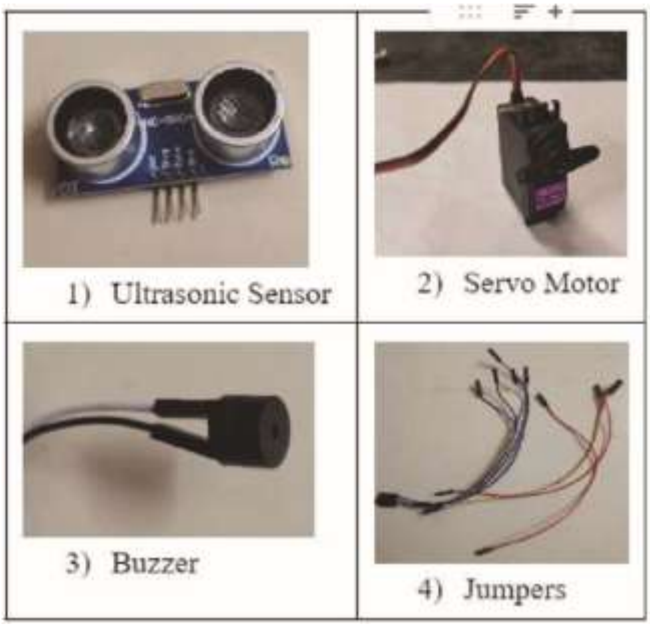

Fig. 2. Hardware used

1) Ultrasound Sensor: This device locates obstructions in the way.

Specifications:

i) Voltage: - 5V

ii) Measurement Range:-0.02m to 4m

iii) Number of Pins:- 4 (Vcc, Trig, Echo, GND)

iv) Current:- 15mA

2) Servo Motor: This drives the ultrasonic sensor's rotation. It produces torque and velocity when current and voltage are supplied, which aids in rotation.

3) Vibrator: This device produces vibration from electrical signals. used to indicate to a blind person where the ultrasonic sensor on a servo motor is located.

4) Jumpers: These are used to connect the circuit's hardware parts together.

5) Buzzer: The buzzer produces sound waves by converting electrical signals. In a great deal of circuits, it serves as an output device.

V. RESULT

Fig. 3. Hardware used

The blind stick's basic prototype is depicted in Figure 3. The servo motor's mounting of the ultrasonic sensor enables it to move at various angles. The blind man can perceive the ultrasonic sensor's position with the aid of the vibrator. Through jumpers, the Arduino Mega 2560 controls this ultrasonic sensor.

✓ S. Raj, S. Divya,M. Praveen Shai,A. Jawahar Akash and V. Nisha, "Smart Assistance Navigational System for Visually Impaired Individuals," 2019 IEEE International

TABLE I. OBJECT DETECTION USING BLIND MAN'S STICK

Object	Distance	Action
Wall	20 cm	Detected
Pole	25 cm	Detected
Person	16 cm	Detected

Fig. 4. Object Detection

From Table 1, it becomes clear that the blind man's stick is able to detect obstacles in its vicinity with an average distance from the user as 22 cm. The stick also shows obstacle detection accuracy of 20 cm in the rotating mode of operation.

VI. CONCLUSION

This article developed a clever blind stick that allows the blind man to avoid roadblocks. The blind guy is informed of impending obstacles by the buzzer on the stick, which is equipped with an ultrasonic sensor. Additionally, the blind individual would be able to identify impediments from the sides as well as the front as part of the second implementation phase. This was accomplished by mounting an ultrasonic sensor such that it could detect impediments from the user's sides on a servo motor.

The paper-implanted stick was able to identify impediments in the blind man's immediate vicinity. However, the stick can be upgraded with other sensors, like an IR sensor or TF Mini, to further enhance the obstacle sensing distance. Additionally, the stick can be equipped with a number of additional features to make it more user-friendly, like a GPS module that allows family members of the blind person to track them in case they get lost or that allows the user to guide the blind person to their destination by pre-selecting it.

REFERENCES

✓ Naiwrita Dey,Ankita Paul,Pritha Ghosh,Chandrama Mukherjee,Rahul De,Sohini Dey, "Ultrasonic Sensor Based Smart Blind Stick" IEEE International Conference on Current Trends toward Converging Technologies, March, 2018.

✓ Md S.Arefi and T. Mollick, "Design of an Ultrasonic Distance Meter", International journal of scientific and engineering research Vol. 4, Issue3, March, 2013.

✓ A. Agarwal, D. Kumar and A. Bhardwaj, ― Ultrasonic Stick for Blind,ђ International journal of engineering and computer science, ISSN:2319-7242 Vol. 4, Issue 4, April 2015, pp. 11375-11378.

✓ Ayat A. Nada, Mahmoud A. Fakhr, Ahmed F. Seddik ― Assistive infrared sensor based smart stick for blind people, IEEE Information Conference (SAI) , July 2015, INSPEC accession number 15420043.

✓ D. K. Soni, N. Sharma, I. Kaushik and B. Bhushan, "Producing Energy Using Blind Man Stick," 2020 IEEE 9th International Conference on Communication Systems and Network Technologies (CSNT), 2020, pp. 173-178, doi: 10.1109/CSNT48778.2020.9115766.

Conference on Intelligent Techniques in Control Optimization and Signal Processing (INCOS), 2019, INCOS45849.2019.8951333.

- ✓ V. Kunta, C. Tuniki and U. Sairam, “Multi-Functional Blind Stick for Visually Impaired People”, 2020 5th International Conference on Communication and Electronics Systems, ICCES 48766.2020.9137870.
- ✓ S. Mohapatra, S. Rout, V. Tripati, T. Saxena and Y. Karuna, "Smart Walking Stick for Blind integrated with SOS Navigation System", 2018 2nd International Conference on Trends in Electronics and Informatics (ICOEI), 2018, ICOEI.2018.8553935.
- ✓ R. K. Patnaik,K. B. Swain, R. Rajeswari, S. Pal, C. Dash and A. Mishra, "Arduino based automated STICK GUIDE for a visually impaired person," 2017 IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM), 2017, ICSTM.2017.8089194.
- ✓ S.Koley and R. Mishra, — Voice Operated Outdoor Navigation System for Visually Impaired Persons, International journal of engineering trends and technology, Vol.3,Issue 2, 2012.
- ✓ M. P. Agarwal and A. R. Gupta, "Smart Stick for the Blind and Visually Impaired People," 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT), 2018, ICICCT.2018.8473344.
- ✓ A. Krishnan,G. Deepakraj, N. Nishanth and K. M. Anandkumar, "Autonomous walking stick for the blind using echolocation and image processing," 2016 2nd International Conference on Contemporary Computing and Informatics (IC3I), IC3I.2016.7917927.
- ✓ T. S. Aravinth, "Wifi and Bluetooth based Smart Stick for Guiding Blind People," 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS), 2020, ICISS 49785.2020.9316084.
- ✓ Y. Liu, Z. Gao, Z. Shao and G. Liu, "Intelligent ultrasonic detection of walking sticks for the blind," 2017 9th International Conference on Electronics, Computers and Artificial Intelligence (ECAI), 2017, pp.