Smart Electronic Walking Stick For The Blind People

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Abstract- *The Smart Electronic Stick (Smart E-Stick) is a clever device that blends sophisticated technology to help persons with vision impairments navigate more easily. The stick has an ultrasonic sensor that identifies obstacles as well as light and water sensors that alert the user to potential hazards. The data collected by the sensors is sent to a microprocessor, which analyses the proximity of the obstacle and, if necessary, activates a buzzer. The stick also has haptic vibrations to warn the user of water and pit holes, as well as the ability to detect if the surroundings is bright or dark. The device includes a wireless RF remote control that can activate a buzzer on the stick to assist the blind person in finding the stick if it becomes misplaced. As a result, visually challenged people can use the stick to easily identify obstacles and find their misplaced gadget. On an Android phone, the "Speak for me" app is also used to generate voice messages for the user.*

Keywords- Ultrasonic sensor, Visually impaired, Smart cane for Blind, Microcontroller, GPS, GSM

I. INTRODUCTION

The sense of vision is an essential aspect of human physiology, serving as a key gateway to the world around us. Sadly, blindness is a widespread disability that affects numerous individuals globally. The World Health Organization (WHO) reports that there are 285 million visually impaired people worldwide, with 39 million being blind and 246 million having low vision. It is important to note that approximately 90% of those affected by blindness or visual impairment reside in underdeveloped nations.

The earliest navigational aid for the blind was the walking stick. The bulk of these folks rely on white canes for local navigation and to scan their surroundings for hazards. To allow these people to move freely in an ever-changing environment, a variety of ways and technologies have been developed.

The disadvantage of the standard cane is that it cannot detect obstructions that are outside its line of sight. In other words, in order to detect an obstacle, the user must tap the surface or object. Blind residents in the community rely only on guide dogs, which may cost up to $20,000 and are only usable for five to six years. If the walking stick can deliver vibration and sound warning when an object is within the designated range of distance, visually impaired people will be able to avoid it better.

In this research, a smart cane is presented, capable of identifying obstacles, detecting both water and corners. Additionally, if the user misplaces the cane, they can utilize.a remote switch to locate it. The device is designed to overcome common issues that blind people face while using traditional sticks. When electronics were integrated into the stick, it was transformed into a smart stick with the a forementioned features.

The intelligent cane incorporates an Arduino Pro Mini, a compact device perfectly sized to be mounted on a regular stick. This Arduino is connected to various components including a buzzer, an LDR sensor, an Ultrasonic sensor, and a water detecting sensor.

The stick also has an RF transmitter and receiver that work together to act as a remote for locating the stick if it goes lost. A switch on the remote's built-in RF transmitter activates the buzzer on the stick, allowing a blind person to find it by listening for the buzzer's sound.

The LDR sensor detects bright and dark environments, while the ultrasonic sensor locates obstacles. A water indicator that sounds a warning anytime the user enters any moist places is also built into the stick's base.

This paper aims to develop a working prototype of a system that will vibrate to visually impaired people to alert them to obstacles in their path and help them easily navigate various terrains by recognising pits in the ground and obstructions in their path.

II. LITERATURE SURVEY

This literature introduces a circuitry systembased on sensors, which includes an Ultrasonic Sensor for obstacle detection. A PIC16F690 microcontroller is employed to read these sensors and control a buzzer, an LED, and a motor using PWM. An auditory output is provided through a buzzer alarm . The author proposes a novel concept for a Smart Stick designed specifically for individuals with visual impairments, highlighting its potential as a cost-effective solution accessible to millions of blind individuals worldwide.

This paper presents design of smart blind stick based on an ultrasonic sensor. It works well as a navigational aid for blind people. The smart blind stick emits a buzzer to inform the user when it detects an obstruction in their way. Any obstruction within a 5-35 cm range can be detected by the system in place. An integrated GPS feature will also provide voice directions when impediments are detected in the path .

The proposed solution consisted of a foldable stick with two IR sensors attached to speak a warning message to the blind when impediments are identified. The inclinedsensor. was able to identify low level impediments on the floor and stair case, and horizontal sensor detect high level obstructions. Additionally, utilising ISD1932 flash memory, it can recognise the stair type (upward or downward), and the relevant message is sent back through earphones. The response from the actual test was favourable with accuracy varying from 75% to 90%, all obstacles could be detected .
The hurdles for detection are at least 15 cm tall. From a distance of 70 cm, it can detect stairs and other obstructions. It has a 30 cm range for pothole detection. Its drawbacks include a 30 cm pothole detecting where the range that is too short and also it has the need for user training .

In, a wearable device is suggested, incorporating a microcontroller board, a solar panel, a range of sensors, mobile communication functionalities, and GPS modules. This system employs a collection of sensors to actively track and log the user's movement, while simultaneously providing real-time notifications to visually impaired individuals regarding any obstacles encountered along their path panel. was able to identify low level impediments on the floor and stair case, and horizontal sensor detect high level obstructions. Additionally, utilising ISD1932 flash memory, it can recognise the stair type (upward or downward), and the relevant message is sent back through earphones. The response from the actual test was favourable with accuracy varying from 75% to 90%, all obstacles could be detected .

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III. PROPOSED SYSTEM

To detect obstacles, an ultrasonic sensor is employed. Before reading the analog voltage at the echo pin, a pulse is sent to the trigger pin to initiate data retrieval from the sensor. The analog voltage is subsequently converted into a digital value through the integrated ADC channel. By performing appropriate calculations, this digital value is then translated

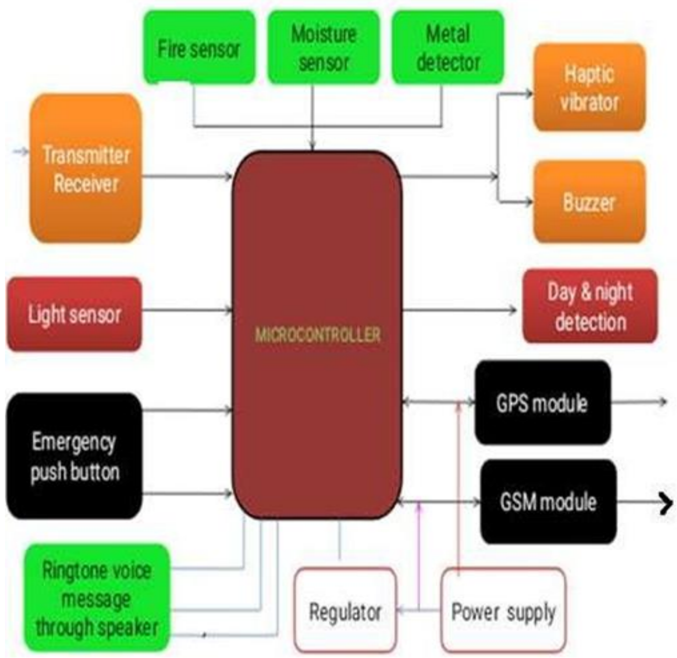


FIG1: Component of smart blind stick

The smart stick's Arduino board controls all of the device's operations as shown in fig.1. The hardware model of Smart E-Stick with Electronic Circuitry and sensors is shown in fig.2.The following four functions are managed by the board:

Fig. 2. Smart E-Stick with Electronic Circuitry and sensors

LDR sensor is utilized to detect light and identify dark areas. By connecting the sensor to a voltage divider circuit, an analog voltage is generated at the corresponding pin of the interfaced controller. This analog voltage is then read and converted into a digital format using the integrated ADC channel. The "analogRead()" function is employed to retrieve the analog voltage from the controller pin

Regarding water detection, the water indication circuit is activated by turning on the base of the switching transistor. When the stick comes into contact with water, a pulse is produced at the base of the transistor, leading to a short- circuiting of the metal strips. Once the transistor is triggered, the Arduino's pin 3 receives a LOW logic signal, resulting in the VCC at the collector pin being connected to ground through the emitter pin.

Stick location detection - In the case that the user loses the stick, they can HIGH the RF encoder's D3 bit by pressing the remote switch. The same logic is transmitted to pin 8 of the Arduino by the RF decoder's D3 bit. When it detects a HIGH logic at the pin, the Arduino delivers a pulse at the buzzer that lasts for a different amount of time depending on how close the remote is to the stick.

IV. HARDWARE IMPLEMENMTATION

A. Ultrasonic Sensor

Fig.3. Detection of low level obstacle in Smart E-Stick

Fig. 3 depicts the Smart E-stick that can identify low-level obstacles. It is made consisting of an ultrasonic sensor that emits sound above 18 kHz at a speed of 344 m/s into the air, and the receiver takes up the sound that is reflected from the object.

To assess the proximity of an object, an ultrasonic sensor emits and receives ultrasonic pulses. Boundaries reflect these high-frequency sound waves, resulting in distinct echo patterns. The information captured by the ultrasonic sensor is transmitted to an Arduino UNO, which utilizes it to calculate the distance between the user and any detected object. In order to obtain data from the sensor, a pulse must first be sent to the trigger pin of the ultrasonic sensor before the analog voltage at the echo pin can be read.

Algorithms are used to translate time into a distance measurement as shown in fig. 4. Table I shows the ultrasonic sensor's performance along with the speed of the transmitted and reflected light as well as its equivalent distance. If the ultrasonic sensor recognizes distance less than 10 cm, a HIGH pulse is connected to the buzzer. The pulse never stops until the user gets away from the obstruction.

$$speed = 340\ m/s = 0.034\ cm/\mu s$$

$$time = distance/speed$$

$$time = \frac{10}{0.034}\mu s = 294\ \mu s$$

$$distance = \frac{speed * time}{2}$$

$$distance = \frac{0.034 * 294}{2}$$

Fig.4. Ultrasonic sensor and relation between and distance

S.No	Time(µS)	Distance(CM) Measured	Actual Distance(CM)
1	30	0.51	0.53
2	48	0.8	0.81
3	81	1.38	1.37
4	294	4.99	5
5	350	6	6.2
6	420	7.14	7.2
7	496	8.43	8.5
8	590	10	10.1
9	756	12.85	12.7
10	1020	17.34	17.2
11	1430	24	23.8
12	1670	28.39	27
13	2500	42.5	44
14	2920	49.6	51
15	3241	55	56

A. Remote Circuit to find lost Smart E-Stick

Fig.5. Detection of lost lost Smart E-Stick using Remote Circuit

In case their stick goes missing, the visually impaired can use a wireless remote circuit, as shown in fig. 5, to help them find it. A buzzer sound is produced when a signal from the distant circuit is received, amplified, and transmitted.

If the user misplaces the stick, pressing the remote switch results in the RF encoder's D3 bit transitioning to a HIGH state.The same logic is transmitted to Arduino pin 8 using the D3 bit of the RF decoder. Depending on how close the stick is when HIGH logic is detected, the Arduino delivers a pulse to the buzzer.

B.Moisture sensor and LDR

The voice alert is generated when water is identified by moisture sensor. The switching transistor's base is activated by the water indicator circuit. The metal strips are short-circuited when the stick steps in water because the water causes a pulse to be generated at the transistor's base. As the transistor is triggered, providing a LOW logic to Arduino's pin 3, it establishes a connection between the VCC at the collector pin and the ground through the emitter pin. This connection leads to haptic vibration alerts

The LDR sensor performs the light detection, which is utilized to find dark areas. The sensor outputs an analogue voltage at the interfaced controller pin when it is coupled to a voltage divider circuit. The integrated ADC channel is used to read and digitize the analogue voltage. To read analogue voltage at the controller pin, use the analogRead() function.

Accelerometer: By monitoring variations in acceleration, an accelerometer can be used to find vibrations. It can detect vibrations coming from a variety of directions and offer information that may be analysed to determine the vibrations' pattern and intensity.

Using a piezoelectric sensor, mechanical vibrations can be turned into electrical impulses. The sensor produces a voltage proportionate to the vibration's intensity when it is subjected to a vibration. Vibrations in the surroundings can be recorded and measured using this kind of sensor.

A tactile transducer is a vibration tool that has the ability to both generate and detect vibrations. In addition to detecting and analysing vibrations from the environment, it can be used to provide vibrations to a visually impaired user.

The vibration sensor selected would rely on a number of variables, including the system's integration needs, intended sensitivity, frequency range, and range of frequencie.

C. GPS and GSM

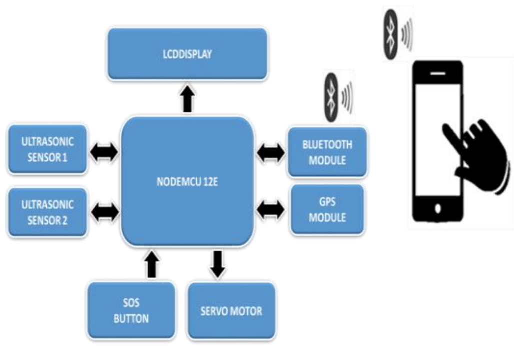
Fig.6. GPS and GSM system

GPS and GSM system, depicted in the fig. 6. has been used to locate the user for safety reasons. GPS device will assist them in tracking their location if they press the emergency push button when they are disoriented. If a blind person needs assistance, they can press the emergency button that is installed on the stick, and within two minutes, the GSM will communicate the person's location and other relevant information to the pre-defined contact numbers.

D. Feedback from users

Smart canes with obstacle detection sensors provide reliable feedback about nearby objects, helping individuals to detect obstacles in their path and avoid potential accidents. Users appreciate the accuracy of these sensors in identifying obstacles.Smart canes equipped with obstacle detection sensors and haptic feedback systems, have significantly improved safety and confidence for blind users. smart canes offer adjustable features, such as cane length and handle grip, allowing users to customize the cane to their individual needs and preferences. Users value smart canes with long-lasting battery life, ensuring reliable usage throughout the day without frequent recharging.

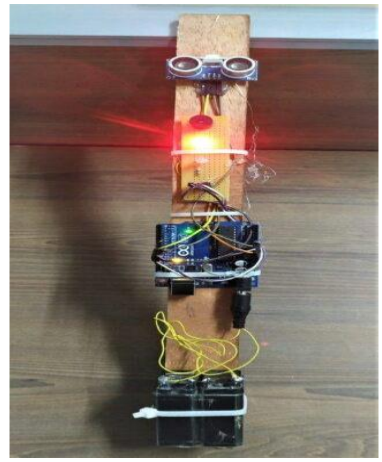
SYSTEM ARCHITECTURE



RESULT SNAPSHOTS

MOBILE APPLICATION BLUETOOTH CONNECTION

SMART BLIND STICK



V. CONCLUSION

For the many millions of visually impaired people across the world, the Smart E-Stick is a very affordable choice. A real-time system that records the user's location and provides dual feedback is created in the recommended E-stick by combining many functional components, improving the security and safety of navigation. GPS can be used by blind people to determine source and destination route information. GPS can help determine the quickest and most efficient path using Google/Bing maps based on current locations. It could be improved even more to have greater decision-making capabilities by using a range of sensors.

REFERENCES

[1] Mahmud, M. H., Saha, R., & Islam, S. Smart walking stick-an electronic approach to assist visually disabled persons. *International Journal of Scientific & Engineering Research* (2013).

[2] Nahar, V. V., Nikam, J. L., & Deore, P. K. Smart blind walking stick. *International Journal of Modern Trends in Engineering and Research*. (2016).

[3] I. Ulrich, and J. Borenstein, "The guide cane-Applying mobile robot technologies to assist the visually impaired," IEEE Transaction on Systems, Man, and Cybernetics-Part A: Systems and Humans, vol. 31.

[4] Dey, N., Paul, A., Ghosh, P., Mukherjee, C., De, R., & Dey, S.. Ultrasonic sensor based smart blind stick. In *2018 international conference on current trends towards converging technologies (ICCTCT)* IEEE (2018, March).

[5] Therib, M. A. Smart blinding stick with holes, obstacles and ponds detector based on microcontroller. *J. Babylon Univ. Eng. Sci*(2017).

[6] Nada, A. A., Fakhr, M. A., & Seddik, A. F. Assistive infrared sensor based smart stick for blind people. In *2015 science and information conference* IEEE. (2015, July).

[7] Sharma, H., Tripathi, M., Kumar, A., & Gaur, M. S. Embedded assistive stick for visually impaired persons. In

2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT) IEEE (2018, July)..

[8] M. Nie, J. Ren, Z. Li et al., "SoundView: an auditory guidance system based on environment understanding for the visually impaired people,"in *Proceedings of the 31st Annual International Conference of the IEEE Engineering in Medicine and Biology Society: Engineering the Future of Biomedicine (EMBC '09)*, IEEE, September 2009.

[9] A. Ramadhan, "Wearable smart system for visually impaired people," Sensors, vol. 18, 2018.