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A COMPREHENSIVE SURVEY ON SMART STICK FOR VISUALLY IMPAIRED PEOPLE

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ABSTRACT

This paper describes a smart cane with an alarm to help visually impaired individual when they move in unease paths. A growing number of people are experiencing challenges and problems in their daily lives as a result of their visual impairment. In unstructured circumstances, walking with ease and confidence is considered one of their challenges. In order to address this problem, a novel electronic stick with RF remote transmitter and receiver that uses an ultrasonic sensor and buzzer has been designed. If there are any impediments or items in front of the visually impaired person's walking route, an ultrasonic sensor is capable of detecting them. The distance between the visually impaired person and a barrier is calculated using an ultrasonic sensor. There is an alert if the estimated distance falls inside the provided range. The use of an RF remote allows visually impaired people to locate their electronic stick. Many experiments have been carried out in a variety of locations by a larger number of people in order to examine and ensure the correctness of an electronic stick, and the results have been satisfactory.

I. INTRODUCTION

People who are visually impaired are unable to see items with their own eyes. According to statistics, around 290 million individuals are blind. According to [1, 2], 40 million of them are completely blind, while 250 million have very poor vision. The World Health Organization (WHO) has also said in [2] that roughly 85 percent of total blind people live in poor countries such as India. According to reports, India is home to roughly one-third of the world's visually impaired individuals [2, 3] and also estimates that by 2020, the number of visually impaired persons will have doubled. WHO tries to prevent blindness by providing a variety of tactics and initiatives and also plans to take actions in many poor countries. WHO has begun a global strategy for universal eye health for the years 2014-2019, as described in [4]. Many eye health groups also take action on a regular basis to help their own people safeguard their eyes and recover from blindness. In India, there are around 15 million visually impaired persons. Despite the fact that India need 40 thousand optometrists, it only has 8 thousand, accounting for roughly 23% of the total required. Every year, India requires 2.5lakh eye donations, but only receives about 25,000. In India, there are approximately 110 eye banks, however this number is insufficient.

There are a variety of causes for blindness, but the most common is refractive error, which affects a large number of people. As a result, people's blindness problems are greatly reduced through the use of electronic devices that produce excellent results. The major component that visually impaired people utilise when walking in unstructured or uncomfortable environments/paths is the stick. Initially, the stick was made of wood or plastic to assist visually impaired persons when walking outside. Because technology is continuously advancing, the stick now includes an electronic component to assist the blind person with more accuracy. The term "smart stick" refers to a stick that contains electronic components.

Many studies on smart sticks have been conducted, as stated in [5-7, 8, 10, 11]. The term "white cane" refers to a cane that is completely white in colour and is used to describe exclusively visually impaired persons [5]. Because technology is rapidly advancing, the cane now has multiple sensors to deliver precise results and to measure distance between the visually impaired and an object. Ultrasonic, infrared (IR), and light dependent resistor (LDR) sensors are among the sensors found in many smart sticks [6-12]. Ultrasonic sensors are the most popular among these sensors and are also included in many smart canes because to their accuracy, ease of use, and low cost. It determines the distance between visually impaired people and a potential hazard. Other than ultrasonic sensors and a variety of other sensors, smart canes can use a variety of technologies to provide extremely accurate results for visually impaired persons. When walking out, the smart cane's Bluetooth integration greatly aids visually challenged people. Also, a global positioning system (GPS) is utilised in smart

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canes to tell where the visually impaired person is and to notify family members of the blind person's current location when they are outside. IIT Delhi recently undertook and completed an experiment using Ultrasonic sensors in a smart cane [12]. This smart cane provides a number of benefits as well as some drawbacks. This stick can detect the distance between an obstacle and a visually impaired person, as well as provide alerts to visually impaired persons. In extremely noisy surroundings, hearing vibration is quite difficult. There is no help for visually impaired people who misplace their stick or unintentionally drop their smart cane. The above mentioned experiment has certain drawbacks as well.

Section 2 contains a proposed system that eliminates the limitations of the previous trials and incorporates additional benefits into the smart cane for visually impaired people. Real-time tests in unfavourable pathways make up Section 3. The suggested experiment's conclusion is presented in Section 4.

II. METHODOLOGY

Smart cane, a system that provides buzzer alerts to visually impaired persons, has been developed in this suggested system, and its benefits are as follows:

- With this suggested Stick, visually impaired people can compute the distance between an obstacle and themselves.
- The stick may also identify an object/obstacle from a distance of up to 20 metres
- When the computed distance falls within the fixed range, the signal is sent to the 433MHz microcontroller.
- This stick can warn visually impaired people by using a buzzer to give them a warning.
- Using an RF transmitter and remote, the proposed system also overcomes the limitations of the above-mentioned experiment.
- A light dependent resistor (LDR) is also used in this proposed system to assess the light intensity around the blind individual.
- This proposed stick is less expensive and extremely precise.

Microcontroller, Buzzer, Ultrasonic sensors, RF transmitter and receiver, and LDR are all included in the suggested stick. Figure 1 depicts the flow chart for this suggested stick. When visually challenged people are walking through unstructured roads, this designed stick is utilised to identify any items in front of them.

If the smart cane identifies any items in front of the visually impaired individual, it alerts them with a beeping sound produced by a buzzer. When a person gets close to an object, the frequency of the sound increases. That is, when the distance is short, the beeping sound is louder, and when the distance is long, the beeping sound is quieter. Following that, there are brief descriptions of both hardware and software components.

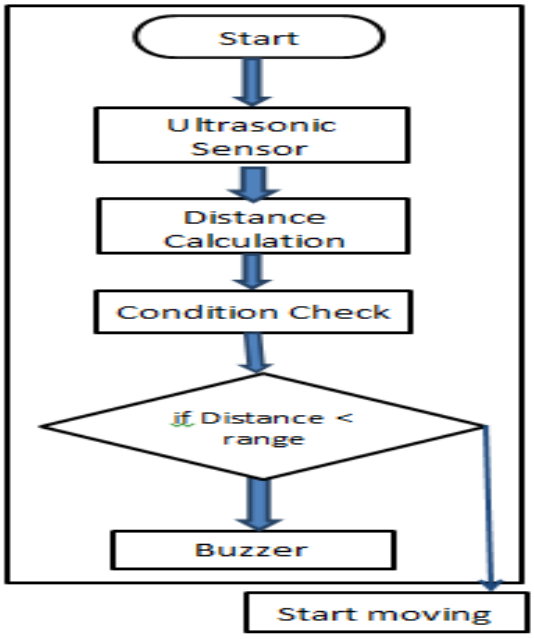

Figure 1: Flow chart of the proposed system

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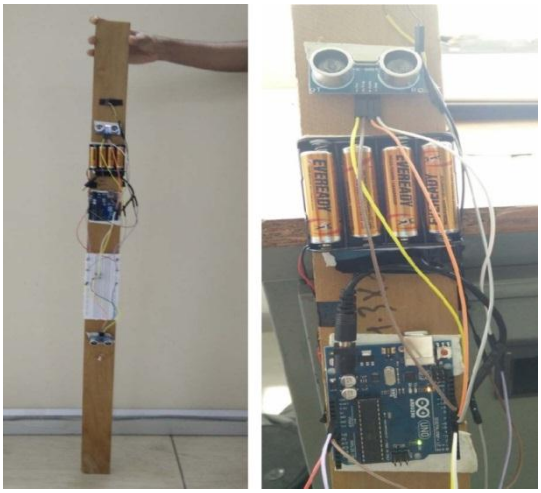
A. Hardware components:

1) Microcontroller

The main component, the Arduino UNO R3, is utilized for electronics and coding. This is most likely referred to as the smart cane's main control unit, as seen in Fig. 3. This ATmega328 Arduino controller is quite durable, and users can simply play with it, demonstrating its ease of use. It contains 14 digital input or output pins, six of which can be utilized as PWM outputs. It also has 6 analogue pins and a quartz crystal with a frequency of 16MHz. 2KB SRAM memory and 1KB EEPROM memory are the memory components of the Arduino Uno. There's also 32KB of flash memory on board. It comprises of a power socket that is connected to a USB port. This serves as a power source, and it does so through the USB where it can be programmed and functioned accordingly.



(a) (b)

Figure 2a: shows external view of cane used.

Figure 2b: shows close look of the cane used.

2) Sensors used

Ultrasonic and LDR sensors were employed in this experiment. The HC-SR04, also known as standard sensor, is an ultrasonic sensor used in this model. It recognises an object and determines the distance between the visually impaired person and the object.

An ultrasonic sensor can detect an object from a distance of 20cm to 400cm, and many advanced ultrasonic sensors can detect objects up to 20 metres. As a result, ultrasonic sensors provide precise findings.

An ultrasonic sensor has a frequency range of 20 kHz. When it detects an obstacle in the blind person's route, it calculates the distance, and if the estimated distance is less than the set threshold, signals are sent to the microcontroller, which produces the beeping sound. LDR is used to determine whether or not a blind person is alone in a dark room, as well as whether or not it is a day.

3) RF Transmitter and Receiver

The 433MHz RF transmitter and receiver employed here has a frequency range of 3KHz to 300GHz. It is mostly used to locate a blind person's smart cane when he or she drops it while going out. It's simply referred to as an RF remote. When a blind person presses the RF transmitter, the signal is sent across the air to the receiver, which is built into the smart stick. After that, it begins to beep. That person will be able to find the stick on his own this manner.

B. Software component

Arduino IDE 1.6.8 software is used to perform programming operation. Since it is robust any user can use it and perform code in it. USB is used for programming part and dumping that coding into the Arduino uno.

III. RESULTS AND DISCUSSION

Ultrasonic sensors are used in real-time trials to test the proposed systems. Using the Arduino IDE to dump the desired code. Testing using the ultrasonic sensor is now possible. We must first use ultrasonic to determine the

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estimated value, and then use some standards to determine the measured values. Then, using tabular form, we must compare the two and identify the error. The comparison is shown in the following Table.1 between ultrasonic sensor's observed and computed value.

Table 1: Depicts comparison of measured and calculated values.

Distance (cm)	Analog value calculated (mV)	Analog value measured (mV)	error
5	25	23.8	1.2
10	50	48.1	1.9
15	75	72.3	2.7
20	100	96.3	3.7
30	150	145.8	4.2
40	200	194.3	5.7
50	250	243.6	6.4
75	375	367.0	8.0
100	500	489.8	10.2
150	750	735.3	14.7
200	1000	981.1	18.9
300	1500	1468.2	31.8

To test the ability of the smart cane, a greater number of trials were conducted in many different paths by a greater number of people. Based on the results of this test, we can conclude that the smart cane provides great precision and alerts visually impaired persons when an object is in front of them. The following are some of the test photocopies:

(a)

(b)

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(c)

Figure 3: (a) There is no item in front of a Person (b) An item is in the way of that person and it warns by alarming. (c) After hearing alarm sound that individual avoids messing.

(a) (b)

(c)

Figure 4: It is observed with different people in different locations. (a) Distance between an item and an individual is more enough (b) when target is closer and it starts alarming (c) After indicating, individual avoids collision.

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These tests show that this stick may deliver excellent results and is suited for a wide range of users on a variety of difficult paths. This smart cane produces precise results while also being less expensive.

IV. CONCLUSION

This technology demonstrates that the smart cane's mobility and precision for visually impaired people has improved. The project's major goal is to enable visually impaired to identify objects in front of them, allowing them to walk with ease and confidence on difficult roads while also ensuring their safety.

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