International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

Smart Cane 2.0 Walking Stick for Visually Impaired

Azim Uddin Ansari[1], Anjul Gautam[2], Ayush Agarwal[3], Amit Kumar[4], Ms. Ruchi Goel[5]

[1,2,3,4]Student, Dept. of CSE, Krishna Engineering College, Mohan Nagar-201007, Ghaziabad, Uttar Pradesh, India
[5]Professor, Dept. of CSE, Krishna Engineering College, Mohan Nagar-201007, Ghaziabad, Uttar Pradesh, India

---

Abstract - *Human beings have five basic senses: touch, sight, hearing, smell, and taste. When an object comes in contact with any sensing organ an information signal is sent to the brain. The brain processes the signal and helps us to understand and perceive our surroundings. Sight is very important of the five senses. Low vision or blindness has a long-lasting effect on all aspects of an individual's life. They have to rely on others for helping them in their day to day lives like transportation, shopping, academics, and other chores. In this research paper, the existing work in the field of navigation for blind people is discussed based on which a guidance system solution is proposed for people suffering from complete or partial vision loss. The proposed system is based on the concepts of the Internet of Things. It consists of two HC-SR04 ultrasonic sensors for obstacle detection in forward and downward. Alert notifications are provided in three ways which include vibration alerts, beep alerts, and voice-based alerts. The alerts are sent according to distance range between user and obstacle. The system consists of the SD card module for the storage of voice-based alerts. The processing of the system is controlled by the Arduino Uno R3 board microcontroller. The system is embedded in a box with braille instruction for operating the smart cane, and usable on an existing cane. The box makes the system portable and cost-effective.*

Key Words: Smart Cane 2.0, ultrasonic sensors, piezoelectric buzzer, vibration motor, voice alerts, SD card module, braille instructions

1. INTRODUCTION:

A blind or visually impaired person is unable to identify objects in the environment. They rely on others for major tasks like taking public transport, crossing the roads, and on their senses and touch for household chores. Boarding and de-boarding buses or trains is a major issue while commuting between work and home. In urban areas often markets are at a distance from the residential places. They face problems in getting basic daily supplies. In metro railways, they find it difficult to locate the platform or to use stairs or lift.

Smart Cane 2.0 proposes a system based on two Ultrasonic sensors working in the range between 5-400 cm in the forward direction and 2-200 cm in a downward direction. The user will be alerted through a buzzer, vibration pad, and audio signals. The alert notifications are provided as per the specific distance range between the user and the obstacles. The voice signals are provided using audio devices like earphones. The voice alerts are pre-recorded and stored in the system using the SD card module. The system is placed in a box named Smart box which is provided with braille instructions for easy operating of the system. The connecting earphones audio jack is provided in the box. Also, the Smart Box can be used with the existing white canes thus users are not required to buy a new white cane. The system is powered using a Li-ion battery. The main objective of the proposed solution is to provide a cost-effective and efficient idea thus helping the blind people. Furthermore by putting the entire system in a box provides cost efficiency for the buyer and manufacturers.

In the following sections, the existing works are discussed with a comparison and then the proposed solution. The flowchart, and circuit diagram are added for better clarification.

2. LITERATURE SURVEY:

Kumar et al., 2017[1] Proposed a system which consists of Intelligent Voice Stick along with five sensors: ultrasonic, infrared, water, fire and light (LDR). Based on the distance range between the user and the obstacle the system generates a specific output alert signal. It uses voice assistant, vibrator, buzzer and flashlight for providing alerts in day and night time specifically. The entire solution is based on the following methodologies; Small Obstacle Detection for obstacles like pit, staircase or stone are detected by the IR sensor as it is located at the lower side of the stick. Muddy Surface Detection using water sensor which is located at the base of stick to detect wet or muddy patches, Fire Detection by using heat sensor which checks for the heat radiating from the ignited body and direction of the source, and Smart Night Lamp using a LDR sensor which alerts the other people around about the presence of blind person.

Adhe et al., 2016[2] proposed a system based on ultrasonic sensors, water sensor, buzzer, and Bluetooth module. The alert notification is sent if the obstacle lies in the range between 2cm – 200cm. two sonar sensors, a microcontroller, and two vibrators are placed in a wearable jacket. The sensors are fixed on the shoulders to increase the field of sensing and side

determination. The system also comprises dual camera system for stereo vision, worn as glasses and an acoustic sensor system worn on top of a shoe. The system uses wireless RF based remote which activates the buzzer when the blind person presses it to find their stick.

Nada et al., 2015[3] proposed a system using Microcontroller PIC 16F877A, two IR sensors, and message recording ISD1932. The Microcontroller PIC 16F877A receives values from the IR sensor, calculated results decide the type of obstacle and a specific alert is generated based on the distance between the person and the obstacle. The Message Recording ISD1932 is used to play the appropriate audio as required for the alerting the blind person for the obstacle.

Anwar, 2017[4] proposed a system based on Arduino Uno R3 microcontroller, ultrasonic transducers, IR sensors, water sensors, heat sensors, LDR (Light Dependent Resistor), GPS unit, buzzer, and vibration motor. The system classifies obstacle detection based on the distance range. According to the proposed classifications, more than 4m is the safe zone, between 2m – 4m is the near zone, between 1m – 2m is the close zone and less than 1m is the danger zone in which the system generates alerts using a buzzer and vibration motor. IR sensor in the downward direction for pothole detection, water sensor at the bottom of the stick for detecting water. The heat sensor detects any elevated radiations in the surrounding. LDR sensor generates flashlight alerts for the nearby people in the night time. For navigation system uses GPS.

Shah et al., 2017[5] Proposed a system consisting of four ultrasonic sensors, three are used for front obstacle detection and one for downward obstacles such as potholes. All the sensors are controlled using the Arduino board, which sends a signal to an android app as the calculated data gets more than the threshold value. To calculate the threshold values it first finds the average value by adding past 9 received values from front 3 sensors and present values from it and divide it by 10 and the fluctuation value by finding the difference between max among 10 values and average value and finds threshold value by adding up twice the fluctuation values and average value. The user is provided with object alert from the front, left and right.

Gayathri et al., 2014[6] proposed a smart walking stick using sensors like Ultrasonic sensor, pit sensor, and water sensors for obstacle detection ahead of the person. The Pit sensor which is the IR sensor is used to determine the distance of the dent or any pit from the person. The water sensor is used to sense the presence of water in the person's path. The Vibration motor is used to alert the person. The Keypad is used for setting the destination and the Voice Synthesizer and the speaker alerts the user in case of any deviation from the intended path. The model intends to provide an object detection and assistance using GPS technology.

2.1 Comparison:

All the existing works provides an effective solution to help the blind people. They efficiently tackle various problems faced by the blind people in their daily activities along with some additional features. Using different sensors like ultrasonic, IR, water, fire, light (LDR) provides better obstacle detection in day and night. But it affects the cost of the system majorly. Using Bluetooth module for providing assistance about the location of the stick, and wearable solutions provides a major advantage though with the limitation of an increases hardware and efficiency in certain environmental conditions. The Arduino board microcontroller provides a better control of the entire system without adding much weight to the apparatus. GPS for navigation ensures high level of accuracy in navigation though it depends on the surrounding conditions too. Using ultrasonic sensor provides better performance as they are not affected by the environmental changes unlike IR sensors. The limitations of some of the existing systems are less cost efficient.

According to the Global data on visual impairment report[7] by WHO a major section of the blind people are middle class or poor. The already proposed system requires the user to purchase new sticks which adds to the cost of the system.
The limitations of some of the existing systems are less cost efficient. According to the Global data on visual impairment report[7] by WHO a major section of the blind people are middle class or poor. The already proposed system requires the user to purchase new sticks which adds to the cost. Also the system is limited not too unknown surroundings.

The Smart Cane 2.0 tries to solve high cost and less effectiveness in indoor as well as outdoor surroundings. By incorporating audio devices like earphones for providing the alert the efficiency of the system in outdoors unknown surrounding is increased. The smart box can be attached to the existing white cane thus reducing the required by user to buy a new cane. The braille language guidelines provides better interaction for the user with the smart box.

3. PROPOSED SYSTEM:

The system design for the proposed model has been broken down into two key steps: Detection and Alert Notification. In Detection steps, two ultrasonic sensors are used. One in the forward direction for detecting obstacles ahead of the user like

walls, upcoming traffic. Second in the downward direction for detecting obstacle potholes, small objects, and pebbles. The calculated distance between the user and the obstacle is then provided to alert notification steps. The proposed system comprises of three ways for providing obstacle alert to the user, by using a piezoelectric buzzer, vibration motor, and voice-based alerts using earphones. The voice alert messages are pre-recorded and stored in the SD card module and can be modified easily in the native language of the user and are provided using an audio device like earphones, headphones.

The proposed solution is placed in a box named as Smart Box 2.0. The smart box provides an audio jack for connecting the earphones. The frequency and type of alert signals depend on the distance between the user and the obstacle. The smart box consists of a switch for toggling between the indoor and outdoor modes. Both modes consist of different obstacle range to provide faster and efficient alert notifications. The system is powered using a Li-ion battery making it eco-friendly. There using instruction are provided in Braille language for holding side, indoor and outdoor mode switch, on/off button, and charging port respectively.

Fig 1 represents the flowchart for the process execution of the Smart Cane 2.0

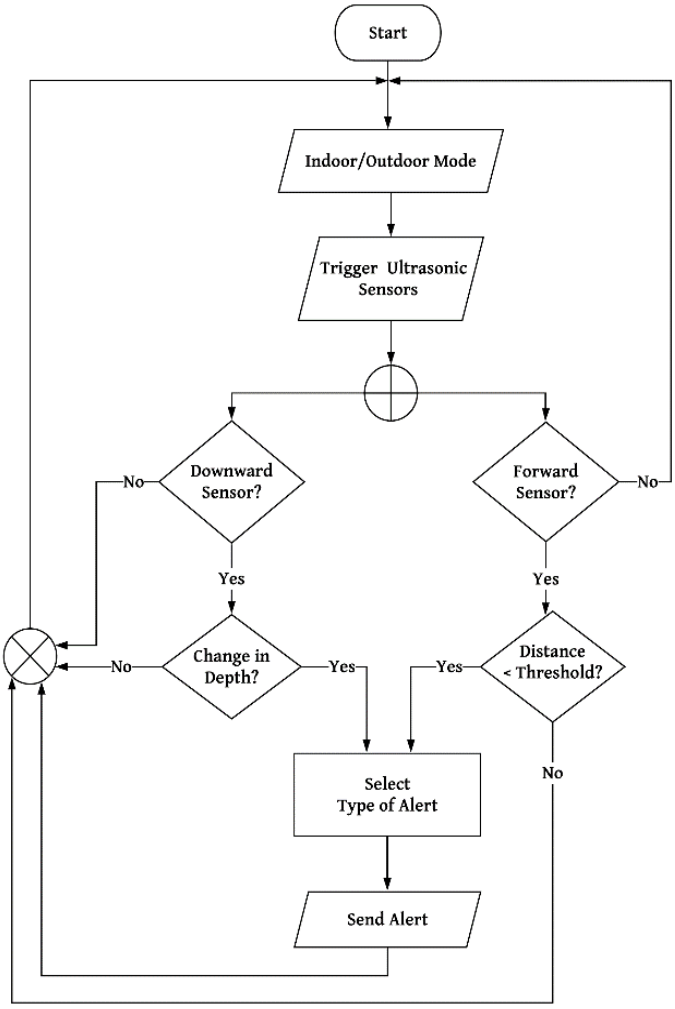

Fig 1. Flow Chart

Fig. 2 represents the circuit diagram of the proposed solution. The components are numbered for better understanding. Serial no. 1 represents the Arduino Uno R3 board[8]. 2a and 2b - the ultrasonic sensors[9] in forward and downward direction respectively. 3 – Vibration motor[10], 4 - Piezoelectric buzzer, 5 – SD card module[11], 6 - LED bulb indicator[12], 7a and 7b – 3.5mm audio jack, 8 – indoor/outdoor mode, 9 – power supply, and 10 – connection wires.

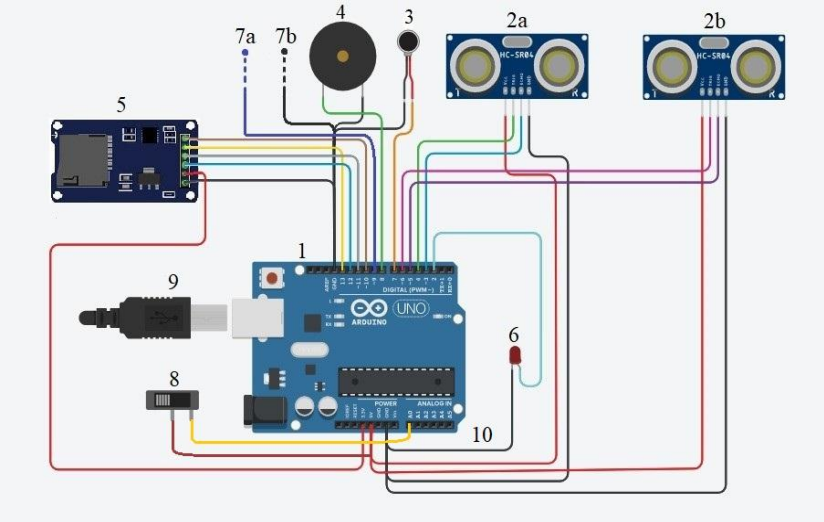

Fig. 2 Circuit Diagram

4. CONCLUSION

The Smart Box is provided with instruction in Braille which makes user friendly. The user can use the smart box with their existing white cane. Two ultrasonic sensors are used, increasing the effectiveness of the system. The alerts are provided using a speaker, piezoelectric buzzer, and voice-based alert using audio-based alerts. The three-way alert notification makes the system efficient and effective in public transport, metro rail, and unknown surroundings. The indoor and outdoor switch allows easy switching between modes for better results. The estimated weight of the box is calculated to be between 270 -280 gm taking into consideration the weight of every component according to the standards mentioned in the official documentation. The main objective of the proposed system is to cost-effective and user friendly. The main advantage of the proposed solution is that the smart box provides portability, easy charging and user friendly controls of the system.

5. FUTURE WORKS:

Future research work should include providing complete map-based navigation in the outdoor mode. The machine learning model should be implemented in recording and analyzing the coordinate data of the daily commune path thus improving navigation and response efficiency of the system. In case of any indoor and outdoor emergency, the system should be able to send an SOS message to the ambulance and the emergency contact. Future work should involve more focus on improving the accuracy and effectiveness of the present system.

REFERENCES

[1] M. Kumar, F. Kabir, and S. Roy, "Low Cost Smart Stick for Blind and Partially Sighted People," Int. J. Adv. Eng. Manag., 2017, doi:10.24999/ijoaem/02030018.

[2]S. Adhe et al., "Ultrasonic Smart Stick for Visually Impaired People," IOSR J. Comput. Eng., 2016, doi: 10.1371/journal.pone.0015995.

[3]A. A. Nada, M. A. Fakhr, and A. F. Seddik, "Assistive infrared sensor based smart stick for blind people," in Proceedings of the 2015 Science and Information Conference, SAI 2015, 2015, doi: 10.1109/SAI.2015.7237289.

[4] A. Anwar, "A Smart Stick for Assisting Blind People," IOSR J. Comput. Eng., 2017, doi: 10.9790/0661-1903028690.

[5]H. R. Shah, D. B. Uchil, S. S. Rane, P. Shete, and B. E. Student, "Smart Stick for Blind using Arduino, Ultrasonic Sensor and Android," Int. J. Eng. Sci. Comput., vol. 7, no. 4, p. 10929, 2017, [Online]. Available: http://ijesc.org/.

[6] G. Gayathri, M. Vishnupriya, R. Nandhini, and M. Banupriya, "Smart walking stick for visually impaired," IJECS, 2014.

[7] World Health Organisation, "Global Data on Visual Impairment 2010," Glob. Data Vis. Impair. 2010, p. 17, 2010, [Online]. Available: http://www.who.int/blindness/GLOBALDATAFINALfor web.pdf.

[8] M. Banzi, Getting Started with Arduino, 2nd Edition - O'Reilly Media. 2011.

[9] C. Scott, "HC-SR04 Ultrasonic Sensor," Arduino Basics, 2012. .

[10] V. M. Type and K. Features, "Pico Vibe ™ Model : 310-101," vol. 44, no. 0, pp. 1–5, 2015.

[11] DATASHEET SD CARD, "Micro SD Card Micro SDHC Mini TF Card Adapter Reader Module for Arduino," Data Sheet, 2013.

[12] K. Streubel, "Light-emitting diodes (LEDs)," in Handbook of Optoelectronics, Second Edition: Concepts, Devices, and Techniques, 2017.