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NAVCANE-AVOICE BASED NAVIGATION AND LEVELCROSSINGASSISTANCE WITH IOT SYSTEM FOR VISUALLY IMPAIRED

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***Abstract*— Locomotion is inevitable for human beings. The main problem for visually challenged is movement from one place to another,mainly in unknown places,level crossing and identification of their current location. In case of their venture into unfamiliar environment it is a menace for them and for their fellow mates too. Therefore it is essential for the family members, organization of visually challenged to know user's current location. Navcane solves the challengeby detecting both indoor and outdoor obstacles, provide level crossing guidance and detect the current position of the user. Obstacles are detected using Ultrasonic sensors,Global Positioning System(GPS) is used to indicate the current location of the user, level crossing guidance is provided by Reflective InfraRed (RIR) sensor. The current position of visually challenged is uploaded to cloudthrough Wi-Fi module. Navigation information and instructions is intimated to the user of the Navcane by Text to speech converter through Head phone (buzzer or vibratory circuit) controlled by a micro controller.**

***Index Terms*-GPS,RIR,Ultrasonic Sensor, Wi-Fi module**

I. INTRODUCTION

Artificial Vision is the most important part of human physiology as 83% of information human being gets from the environment is via sight. Mobility of visually impaired people is restricted by their incapability to recognize theirsurroundings. Over 39 million people were totally blind out of which 19 million are children (below 15 years).Over 90percent blind children obtain no schooling. Recent survey says, India has became the country with large number of blind people. The population of India has reached 120 crore of those 8.90 crore people are visually impaired. 90% of thosecannot travel independently [6].Mostly visually challenged use *white cane* or *Guided dog* which is not a permanent aid to them. If a guided dog is used the person can go to the places where the dog is trained to move. It is an additional burden for visually challenged to take care of a dog[8]. Advancements in Technology is a scintillation to the visually challenged people.Motion Sensor is used to alert the user of the smart walking stick about the current traffic status and guide the user to cross the asphalt. Ultrasonic sensor is used to detect the obstacle distance,because of its ability to detect all kinds of obstacles irrespective of whether the obstacle is metallic or non-metallic,colored or non-colored,wet or dry. The dust particles in wind,moisture doesn't affect the working of ultrasonic sensor. Global Positioning System(GPS) is used to intimate the user regarding the current position along with time[9]. GPS is not only used to intimate the user but also to his fellowships through Wi-Fi module. The paper is organized as follows: Section II presents System architecture. Obstacle detection is being dealt in Section III. Pedestrian level crossing guidance in Section IV.Position Locator in Section V, intimation to the visually challenged in section VI followed by Results and discussions in Section VII and conclusion in section VIII.

SYSTEM ARCHITECTURE

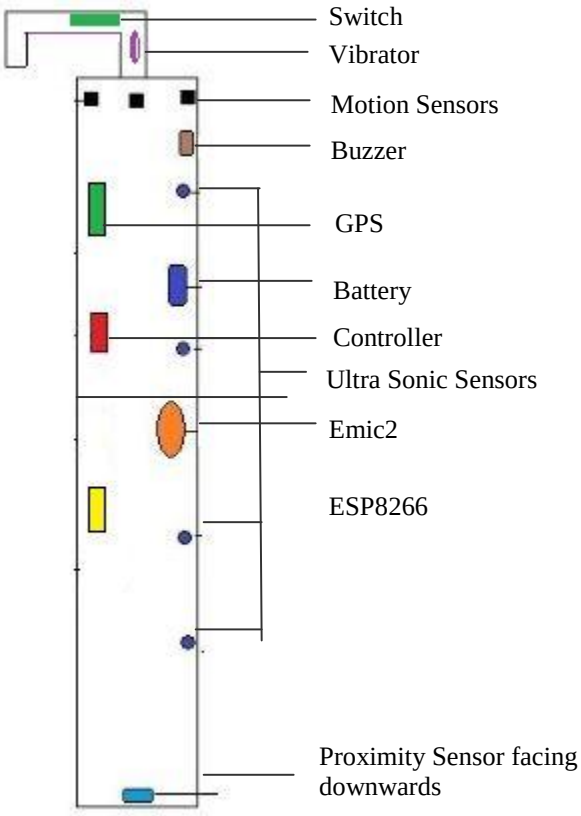

Fig.1. Overall view of stick

II. OBSTACLE DETECTION

A. Working of sensor

Fig.2. Ultrasonic sensor

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contactmeasurement function, the ranging accuracy can reach to 3mm. The module includes ultrasonic transmitters,receiver and control circuit. It operates at a supply of 5 v and 15 mA [1].The IO trigger of the sensor is set high

for at least 10us . The Module automatically sends eight 40 kHz and waits for the pulse signal to be received
back. until the signal is received back it maintains its high level. If the signal is received back it switches to low level. The time of being at high level is called high level time.

Distance = (high level time × sound velocity)/2
Velocity of sound = 340.29m/s
Distance in cm = distance/58;

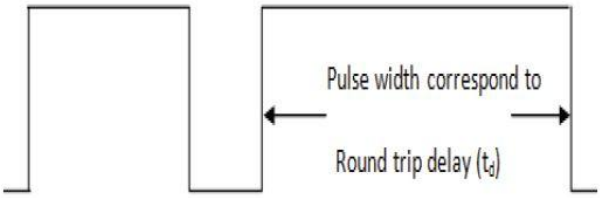

Fig.3. Ultrasonic sensor output wave

B.Assistance in detection of pits and staircase detection

The ultrasonic sensor facing downwards is used to detect a pit and also to assist in climbing down stair case. Four ultrasonic sensors facing straight is used to detect the obstacles ahead of them[10]. The sensors are placed at the height of 10 cm,25 cm,40 cm,75cm from the ground. If a obstacle is detected at a height of 10cm then there is a possibility for it to be a stair case. If all the four sensors from bottom to top of the stick gives a reading in the increasing order then the guidance to the user will be "*Be careful there may be a stair case ahead of you"*[7].

C.Detection and intimation of obstacles

The height of the obstacle can be detected from the position of the sensor in the stick with respect to ground. If there is a obstacle at a height of 13 cm at a distance 17cm from the sensor,then only the sensor placed at 10 cm from the ground will intimate the micro controller that a obstacle is being detected by it. So the information to the user of the stick will be "*There is obstacle of height less than 25 cm at a distance of 17cm before you".*The sensor which is at a height of 25 cm doesn't detect any obstacle ,so the height of the obstacle must be less than 25cm.Consider another case where the obstacle is of height greater than 80 cm at a distance of 35 cm from the stick.In this case all the sensors will detect there is a obstacle before it. So the intimation to the user will be "*There is a obstacle of height greater than 75 cm at a distance 35 cm from you",*since the sensor at height 75 cm has detected the presence of a obstacle there is possibility of obstacle to be of height greater than 75 cm.

Consider another case of wall mounted steel cupboard of width 30cm at a height of 70 cm from ground at a distance of 20 cm from the stick. In this case all the sensors that are placed at heights of 10 cm,25 cm,40 cm will sense the wall as the obstacle but the sensor placed at the height of 75 cm will sense the cupboard as the obstacle so it will intimate the controller that the obstacle is at a distance of 20 cm from it but all the other sensors will inform the microcontroller that the obstacle is at a distance of 50 cm from it since the wall is at 50 cm from the stick. In this case the guidance to the user will be"*There is obstacle of height greater than 75 cmat a distance of 20 cm from you".*

III. PEDESTRIAN LEVEL CROSSING GUIDANCE

A. Motion Sensor assistance in asphalt crossing

Reflective InfraRed(RIR) motion sensor has been used to detect the motion of objects. Infrared rays are emitted.Depending upon the sequential reception of infrared rays in the two sensing elements the motion of object has been detected[4]. One has to cross the road only when the green signal for him is on that is only when the vehicles from his side moves to the opposite side. This idea is used to guide the visually challenged to cross the road using motion sensor.

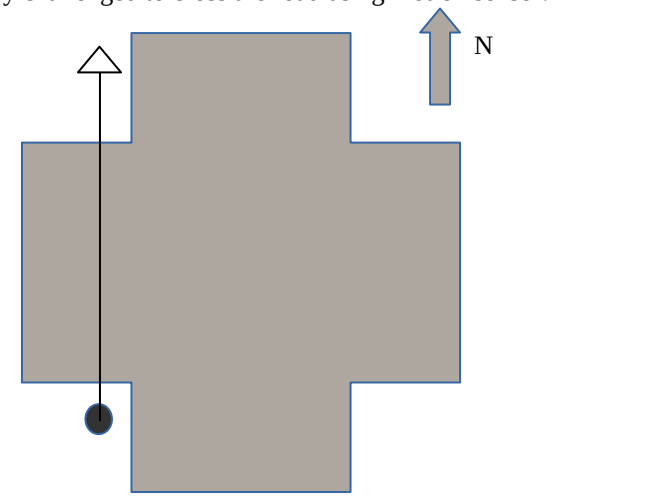

Fig.4. Visualization of level crossing

Consider a visually challenged standing in the south-west of the four road junction as indicated in Fig.4. If he/she wishes to move to his opposite side that is north. The visually challenged has to cross the road only when the vehicles from his side moves to the opposite side.

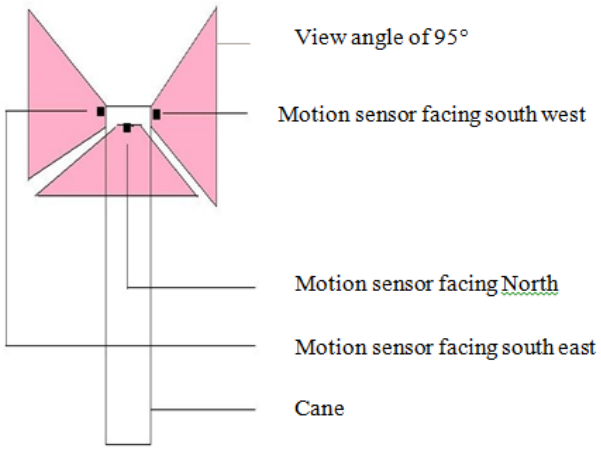

Fig.5. Position of motion sensor in stick

The motion sensor has a view angle of 95 °.So three motion sensors each positioned at right, left and front side of the stick has been placed so it totally covers an angle of 285°. If the user holds the stick facing north then the sensors faces south-east, south-west, north directions respectively. As the user has to hold the stick the remaining angle is concealed by the user. In the above mentioned case as the vehicles from south moves towards north the sensor facing south west direction will detect the motion and informs the micro controller which in turn informs the visually challenged as "It is safe to *cross the*

road".

Another possibility is that,since it is four road junction the vehicle may also move from south to south west direction. In such a case it becomes a menace for the visually challenged. So the right time for the visually challenged to cross the road is only when the sensor facing south-west detects the motion and not by the sensor facing north. If sensor facing north detects motion then the guidance to the visually challenged will be,"*Not safe to cross the road"*.

IV. Position Locator

A. *Internet Of Things (IOT)*

It is of ultimate importance to know about the current position of a person. A well eye sighted person can know about his current location by looking to the environment around him but what about visually challenged. In order to solve this challenge Global Positioning System (GPS) is used.The current position along with current time can be found using GPS.The data provided by GPS is processed by and informed to the user of the stick using Text to speech converter module,which intimates the user regarding his current position[5].

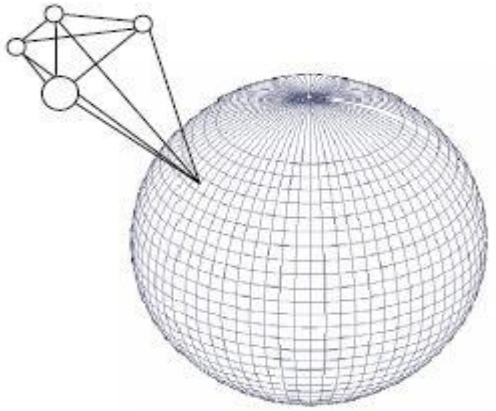

Fig.6.GPS collecting Information from four satellites

The current location of visually challenged is not only important for him/her but also to their fellowships. They should be aware of the visually challenged person's current location because there is a possibility that a visually challenged ventures into a unknown environment. Its the responsibility of the fellowships to find the visually challenged if they are lost. So it is essential to keep track of their path. Therefore Wi-Fi module is used to upload the current position of the user of the stick to a particular web page. The fellow mates, organization for blind people can access the web page with the login ID provided to them. Separate ID will be provided for each user of the stick. So at any time the fellowships can track the position of the visually challenged.

V. Intimation to the Visually Challenged

A. *Text to speech*

The guidance to the user is done using Text to speech convertermodule along with head phone[3][11]. The module can convey information in English and Spanish. It has a inbuilt headphone socket. So information can be provided to the user via headphone.

B. *Buzzer*

Buzzer is used to convey the information to the persons for those who can't understand English. Buzzer intimates the location of obstacles at different distances by beeping at different time intervals for different distances[2].

c. *Vibratory circuit*

A vibratory circuit is used if the user is unable to hear the buzzer sound because of the ambient noise.Different intensities of vibration indicates different distances [12].

VI. Results and Discussions

The prototype of Nav-cane has been implemented and the results aretabulated and charted. Buzzer is used to intimate the user with its beep sound differing by intervals between the beep sound.The following Graph shows variations in intervals of beep sound for different distance of obstacles.

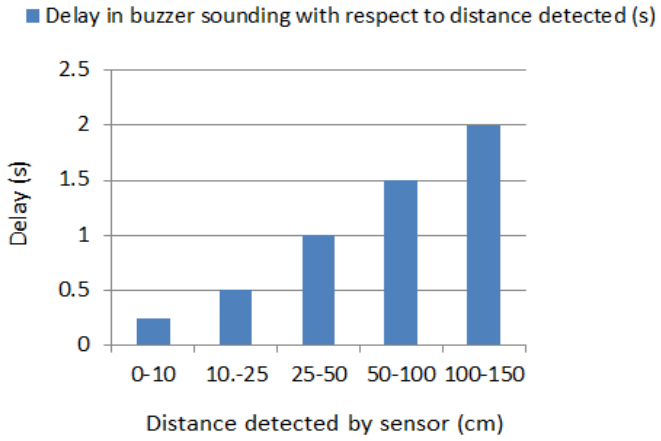

Fig .7. Variation Of Intervals in beep sounds

Five ultrasonic sensors are used for detecting obstacles where one ultrasonic sensor is used for depth measurement (mentioned as 1in the Table I) and other four ultrasonic sensors (mentioned as 2,3,4 and 5 in the Table I are used formeasuring obstacles at different heights in the increasing order).Sensor 1 is given higher priority since it detects sudden fall in height of the walking surface.

Table I Results of Navigation assistance using Text to speech converter

S.No	Sensors	Readings(cm)	Intimation
1	1 2 3 4 5	7 18 52 35 90	Obstacle at 18 cm at height less than 25cm
2	1 2 3 4 5	16 - - - -	A pit of height 16cm is ahead of you.
3	1 2 3 4 5	9 68 75 80 20	Obstacle at 20cm at height greater than 75cm
4	1 2 3	24 - -	A pit of height greater than 20cm is ahead of

	4 5	- -	you
5	1 2 3 4 5	9 43 61 38 66	Obstacle at 38cm at height less than 75 cm

Fig.8.Aworking model of Navcane

VII. CONCLUSION

Although certain limitations like the inability to detect the obstacles hanging at a height of 150 cm from the ground exists, this model proves to be a great scintillation to the lamented visually challenged people.Its low cost of Rs.9000,weight around 2 Kg proves to be a great luminance to the visually challenged with its augmented features compared to already existing white cane and guided dog.

VIII. ACKNOWLEDGEMENT

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REFERENCE

[1] S.Shoval, J.Borenstein and Y.Koren, "The NavBelt-a computerized travel aid for the blind based on mobile robotics technology" *IEEE Trans. on Biomedical Engineering*, vol. 45, pp. 1-3, Nov 1998.

[2] J.Borenstein, "The Guidance Cane-applying mobile robot technologies to assist the visually impaired,"*IEEE Trans. Systems,Man and Cybernetics, Part A:Systems and Humans*, vol. 31, no. 2, pp. 2-4, Mar 2001.

[3] M.Naveen Kumar and K.Usha, "Voice based Guidance and location indication system for blind using GSM,GPS and Optical Device Indicator," *IJETT*, vol. 4, pp. 1-3, July 2013.

[4] C.Vigneshwari, V.Vimala and G.Sumithra, "Sensor based Assistance System for Visually Impaired," *IJETT*, vol. 4, pp. 2-4, Oct 2013.

[5] K.Yelamarthi, Haas.D, Neilson.D and Mothersell.S, "RFID and GPS integrated navigation system for the visually impaired," *IEEE Trans on Circuits and Systems(MWCAS)*, pp. 1149-1152, Aug 2010.

[6] Who.int, "WHO | Visual impairment and blindness", 2016. [Online]. Available: http://www.who.int/mediacentre/factsheets/fs282/en/. [Accessed: 17- Jan- 2016].

[7] Google Books, "Patent US5392034 - Vehicle classification system using profile" ,2016. [Online]. Available: https://www.google.com.ar/patents/US5392034.[Accessed:19- Jan- 2016].

[8] T.Miura, Y.Ebihara, M.Sakajiriand T.Ifukube, "Utilization of auditory perceptions of sounds and silent objects for orientation and mobility by visually-impaired people,"*IEEE Trans. Systems,Man and Cybernetics, Part A:Systems and Humans*, , pp.1080-1082, Oct 20011.

[9] K.Soeda, S.Aoki, K.Yanashima,and K.Magatani, "Development of the visually impaired person guidance system using GPS,"*Engineering in Medicine and Biology Society, 2004. IEMBS '04. 26th Annual International Conference of the IEEE.*, vol. 2, pp. 4870-4873, Sept 2004.

[10] K.Magatani, and K.Yanashima, "The development of the navigation system for visually impaired persons,"*Engineering in Medicine and Biology Society, 2001. Proceedings of the 23rd Annual International Conference of the IEEE*., vol. 2, pp. 1481-1483,2001.

[11] L.Kuei-Chen, W.Ching-Hung, T.Shau-Yin and T.Yin-Te, "Voice Helper: A Mobile Assistive System for Visually Impaired Persons",*(CIT/IUCC/DASC/PICOM), 2015 IEEE International Conference*, pp. 1400-1402, Oct 2015.

[12] Lu Wang, Na Li, Dejing Ni and JuanWu "Navigation system for the visually impaired individuals with the kinect and vibrotactile belt",*Robotics and Biomimetics (ROBIO), 2014 IEEE International Conference*, 1874 - 1876, Dec 2014.