IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

"Implementation of Visually Sensed Obstacles Assistance for Vision Impaired People"

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Abstract: Mobility of visually impaired people is restricted by their incapability to recognize their surroundings. According to the World Health Organization (WHO) in 2012, out of 7 billion global populations there were over 285 million visually impaired people and 39 million were totally blind out of which 19 million are children (below 15 years). This means that someone in our world goes blind in every five seconds and a child in every minute. Over 90 percent blind children obtain no schooling. Recent survey source India is now became the world's large number of blind people. The population of India has reached 120 Cr. of those 8.90 Cr. people are visually impaired. 90%of those cannot travel independently. In this paper, we present a implementation of navigation system of visually impaired people highlighting various technologies with their practical usefulness, design and working challenges and requirements of blind people. The aim of this paper is to provide a better understanding to identify important research directions in this increasingly important social area for future research.

Keywords: Navigation system, visually impaired, obstacle detection, mobility, localization, indoor navigation, outdoor navigation, GPS, IR Sensor, RGB sensor.

I. INTRODUCTION

In order to improve the quality of life for visual impaired orblind people, in this work we focused on developing new technologies to help these persons to access the outdoor environment in particular such as Banks, hospitals, post office, and other public utility. Therefore this work intends to play a special role in this field providing as much information as possible for visually impaired or blind people, which allows them to take a comfortable navigation.
To build a prototype we focused on users and their interests, this work aims to build a system to assist people with disabilities. The system intends to help them in providing the information. In this system we are going to detect an obstacle using ultrasonic sensor. Obstacle detection sensor acts as the heart of the system. Outdoor navigation is becoming a harder task for blind and visually impaired people in the increasingly complex urban world. Advances in technology are causing the blind to fall behind, sometimes even putting their lives at risk. Technology available for navigation of the blind is not sufficiently accessible some devices rely heavily on infrastructural requirements.

Navigation assistance for visually impaired (NAVI) refers to systems that are able to assist or guide people with vision loss, ranging from partially sighted to totally blind, by means of sound commands. Many researchers are working to assist visually impaired people in different ways like voice based assistance, ultrasonic based assistance, camera based assistance and in some advance way researchers are trying to give transplantation of real eyes with robotic eyes which can capable enough to plot the real image over patient retina using some biomedical technologies. In other way creating a fusion of sensing technology and voice based guidance system some of the products were developed which could give better result than individual technology. There are some limitation in system like obstacle detection which could not see the object but detection the object and camera based system can't work properly in different light level so the proposed system is a fusion of color sensing sensor and the obstacle sensor along with the voice based assistance system. The main idea of the proposed system to make person aware of path he is walking and also the obstacle in the path. The proposed system detects and classifies the main structural elements of the scene providing the user with obstacle-free paths in order to navigate safely across unknown scenarios. The proposed system has been tested on a wide variety of scenarios and data sets, giving successful results and showing hat the system is robust and works in challenging indoor environments.

In general, NAVI do not use visual information, and they need complex hardware systems, not only to equip the user but also the building where the navigation has to be accomplished. The system developed by Öktemet al. used wireless communication technology. Another system is, where ultrasonic and GPS sensors are used. Vision sensors play a key role in perception systems because of their low cost and versatility. An example of a system for indoor human localization based on global features that does not need 3-D reconstruction is presented in. However, a disadvantage of monocular systems is that the global scale is not observable from a single image. A way to overcome this problem is by using stereo vision such as in, where a system for NAVI is developed by implementing a stereo vision system to detect

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the obstacles of the scene. The scale can be also obtained by measuring the vertical oscillation in the image during walking to estimate the step frequency, which was empirically related with the speed of the camera.
More recently, range information, which directly provides depth information, has been integrated in these systems. This information has been mainly used to find and identify objects in the scene. One step ahead is to integrate range systems in the navigation task. Some examples are, where the task of NAVI is addressed using a Kinect camera, and, where range information is used to distinguish solid obstacles from wild terrain. Fast corner detector and depth information for path planning tasks is used in, and a system that follows a colored navigation line that is set on the floor and uses radio-frequency identification technology to create map information is presented in. A previous floor plan map of a building is used in to define a semantic plan for a wearable navigation system by means of augmented reality. A main initial stage for any autonomous or semiautonomous navigational system is the recognition of the structure of the environment. Most mobile robots rely on range data for obstacle detection. Popular sensors based on range data are ultrasonic sensors, radar, stereo vision, and laser sensors.

II. RECENT RESEARCH

Table 1.0 describes the recent available researches in mentioned field

S. No.	Title and Limitations
1.	**White Cane** Its detection range is limited up to 1-2 feet only.
2.	**Roshni** This system is used for indoor navigation because it requires detailed interior map of the building.
3.	**RFID based map reading system** It system changes the interference in heavy traffic and its initial development cost is quite high.
4.	**Voice operated outdoor navigation system** This system fails to give obstacle detection and warning alert.
5.	**Camera based image processing system** This system requires complex camera and it requires lot prossing power.
6.	**Navigation system for blind pedestrian** This system is used for indoor environment and does not need any power supply and tags are not easy to adjust for an outdoor, insensitive environment.
7.	**Global positioning system** GPS and wireless technology is limited for civil purpose (few meters) because of its low real time responsiveness and lack of accuracy.
8.	**IR sensor and magnetic compass on handheld device** This system is limited for indoor navigation because it requires location and orientation of user.
9.	**Talking assistance type location finding system** Infrared sensor is unable to work under strong sunlight; similarly, ultrasonic sensors get effected by loud environmental noises such as hissing sound produced by air houses.
10.	**Drishti** There are only two beacons attached to the user's shoulder, it is impossible to get the height information of the user. The algorithm we used to calculate the location is for two-dimension using the average height of a person, which results in bigger error if the user sits or lies down. Because the signal may be reflected or blocked by furniture and walls, there are some "dead spots" that have bad data reads.
11.	**Wearable obstacle avoidance system** Complex computation for VOICE-"seeing with sound".
12.	**Ultrasonic sensor** Ultrasound is that, walls may reflect or block ultrasound signals, which result in less accurate localization
13.	**Indoor navigation system** This is limited for indoor environment.
14.	**Blind audio guidance system** Issue of this system is the difficulty to know one's location globally.
15.	**Vibration and voice operated navigation system** Needs some surface for producing distance output; sound waves get absorbed in some surfaces like sponge, cloth, skin, and so forth.

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III.PROPOSED SYSTEM

Traditionally white cane is the most popular, simplest tool for detecting obstacles due to its low cost,portability. It enables user to effectively scan the area in front and detect obstacles on the ground likeholes, steps, walls, uneven surfaces, downstairs etc .but it can only be used to detect obstacles up to knee-level. In another approach a system called "Roshni" determines the user's position in the building,navigation via audio messages by pressing keys on the mobile unit. It uses sonar technology to identifythe position of user by mounting ultrasonic modules on ceiling at regular intervals. GPS based techniqueis "Drishti" which can switch the system from an indoor to an outdoor environment and vice versa with asimple vocal command. To provide complete navigation system, authors extend indoor version of Drishtito the outdoor versions for blind pedestrians by adding only two ultrasonic transceivers that are smallerthan a credit card and are tagged to the user's shoulder.
A wearable obstacle avoidance electronics devicedesigned to serve the navigation system of visually impaired person. System consist of implementation ofthe vOIce-"seeing with sound" system which contains glasses with attached camera, portable computerand ear speakers. System emphasizes its characteristics like free hands, free ears, wearable and east tooperate.

After analysing these implementations it concludes that GPS based systems are not reliable as GPShas it's own error terms of few meters and for blind person this distance matters lot on other hand allsonar or infrared based system has limitation of detecting object color hence the proposed system ismainly aiming at novel approach towards designing and developing a shoes and portable audio playing device in order to assist blind person to move on different surface and in different path.

- Design and developing a shoe having multiple depth, obstacle detection and RGB sensor.
- Design a control board to detect multiple level of obstacle and the ground object.
- Develop sound recording and playing module for voice assistance

IV.RESEARCH METHODOLOGY

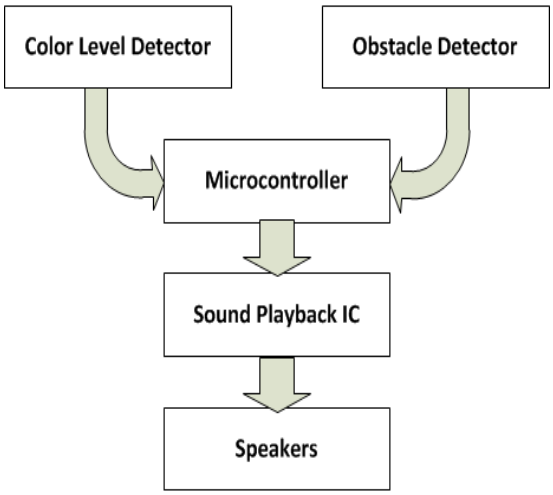

Fig 1.0 Over all execution

Flow chart and its explanation
In the proposed system, IR sensor as an obstacledetector and RGB sensor as a color level detector both working as input device. This sensed input data is collected by microprocessor and according to developed algorithm (in embedded C) it gives comments to vibration assist and voice assist to alert blind pedestrian. Test tosound conversion Ie has maximum 8 different messagesstorage capacity. Ie in its record mode records differentpossible alert messages while developing and according toimmediate environment it plays appropriate message toguide user through headphones/ speakers. RGB sensor makes it possible to assist user about flour on which he/she is walking. This will be definitely useful for visually impaired person. If user listens that he/she iswalking on grass he/she will feels save to move. But if user listens that he/she is on road then user will be more alert and conscious at his/her every step.

Most of other navigation system for blind fails to detect obstacles at head levels as protruding window panes, a moving vehicle, raised platforms, and horizontal bars etc. Proposed system solves this problem by adding one more IR sensor at cap of user which will be useful for detecting head level obstacles easily. As visually impaired personsare more

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efficient in sensing vibrations, they can easilydifferentiate level of intensities of vibration which willuseful in giving warning signals. If the level of intensity ismore users will understand that detected obstacle is close, its intensity is less if detected obstacle is at a safe distance.

Proposed system has capacity to alert user at differentterrain like grass, road, footpath, zebra crossing, upstairs and downstairs etc by giving specific message though headphones.

Figure 2 (a) (b) show the overall proposed architecture of the system. Where shoes will be having a three side with IR based obstacle detection sensor which will guide user with the obstacle and play sound and RGB color sensor for detecting surface where user is walking. These surface then further classified as per earth, foot path, zebra crossing, grass, etc.

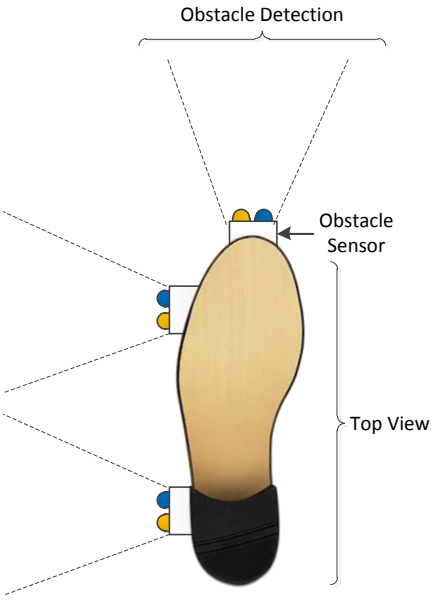

Figure 2 (a) Top view shoe with IR sensor

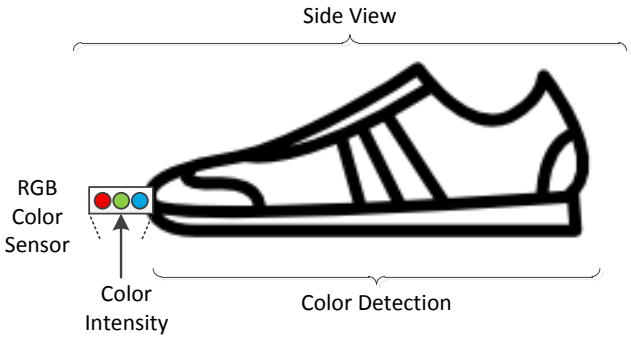

Figure 2(b) Side view showing RGB sensor

Sound Recorder IC:
APR 9301 is a single chip Voice recorder and Playback device for 20 to 30 seconds voice recording and play back. It is an ideal IC for automatic answering machine, door phones etc. This IC has data storage capacity and requires no software and microcontroller. It provides high quality voice recording and play back up to 30 seconds.
The IC requires minimum components to create a voice recorder. The IC has non-volatile flash memory technology with 100K recording cycles and 100 year message retention capacity. The IC utilizes the Invox proprietary analog / multi-level flash non-volatile memory cells that can store more than 256 voltage levels. It requires a single 5 volt supply and operates in 25 mA current.

Detecting Obstacle with IR (Infrared) Sensor:
The basic concept of IR(infrared) obstacle detection is to transmit the IR signal(radiation) in a direction and a signal is received at the IR receiver when the IR radiation bounces back from a surface of the object.

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Here in the figure the object can be anything which has certain shape and size, the IR LED transmits the IR signal on to the object and the signal is reflected back from the surface of the object. The reflected signals are received by an IR receiver. The IR receiver can be a photodiode / phototransistor or a readymade module which decodes the signal. In order to implement the IR obstacle detection, we need to understand that how to transmit IR signal using commercially available electronic components.same way we also need to understand the IR receiver.

Color Sensor:
Main role of the color sensor in the project is to identify the color of the surface where person is walking and try to find out the location where user is walking. Suppose you have a sensor that can see many different colors, such as a photo resistor. How would you use this sensor to detect red apples vs. green apples? Well, consider brightness comparisons. Red apples reflect red light but absorb green light. Green apples reflect green light but absorb red light.

If you shine a red light (such as from a red **LED**) on both apples, the red apple will reflect much more light than the green apple. As such, the apple that appears the brightest to your sensor will be the red apple. If you shine green light from a green LED on both apples, the green apple will appear the brightest.

Figure 3.hardware implementation

Figure 3. Describes the hardware implementation where obstacle sensor on all the direction and RGB sensor on downward direction can be seen. Obstacle sensor detects obstacle from left, right front direction on other hand one more obstacle sensor will detects the depth in ground to avoid accidental fall from stairs or hole in path.

Table 2: voice feedback at different situations

Direction of obstacle respect to the position of user	Announcement in the headphone
RIGHT FRONT	RIGHT OBSTACLE
LEFT	LEFT SIDE OBSTACLE
RIGHT	RIGHT SIDE OBSTACLE

Table 3. Voice feedback at different terrains

Color Detected	Announcement in the headphone
GREEN	HE IS MOVING ON GRASS OR CARPET
BLACK	HE IS WALKING ON ROAD
WHITE	HE IS ON ZEBRA CROSSING OR INDOOR STILE

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V. CONCLUSION

Proposed system provides a broad overview of state of the art techniques used for navigation system for visually impaired people. It concludes that navigation system have not achieved large scale exploitation mainly due to unaffordable cost, accuracy, usability. Future navigation system needs to first and foremost lower the installation expenditure by minimizing the infrastructure disputes that is required for localizing the consumer. Usability needs to be improved by minimizing the amount of sensors users have to carry and providing usable directions in a robust modality of feedback. System need to take into account the user's special requirements, minimize cognitive load, cost effective, user friendliness and minimize any interference from the environment.

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BIOGRAPHY

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