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A REVIEW ON BLIND NAVIGATION SYSTEM

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ABSTRACT

This paper is the review of different navigation systems for the blind and visually impaired people. Navigator would detect an object or obstacle for blind person, guide them and help them travel in familiar and unfamiliar environments independently and safely. The main concept is that the Blind navigation system must take operation when it is needed. There are many navigation systems for visually impaired people but few can provide dynamic interactions and adaptability to changes. The Performance of the designed navigation systems were evaluated by the visually impaired subjects and Testing results suggest that the different blind navigation systems can be used to guide visually impaired subjects to their desired destinations.

Keywords: *Blind, navigation, obstacle, object, sensors, microcontroller, motion detection,* ***processor, sonar sensors.***

I. INTRODUCTION

In the last two decades a variety of useful assistive devices have been proposed, designed and developed in an effort to complementarily assist visually impaired individuals during navigation in their living and working environments. The experiment reported in [1] is concerned with one function of the navigation system: guiding the traveler along a predefined route. They evaluate guidance performance as a function of four different display modes: one involving spatialized sound from a virtual acoustic display, and three involving verbal commands issued by a synthetic speech display. In [2] the alternative 3-D space sensation is studied that is interpreted by our computer vision prototype system and transferred to the user via a vibration array. The obstacles are detected in close proximity and then the information of the captured visual scenes are represented as detectable pattern of vibrations on the human body. In [3], a model of a voice user interface (VUI) for a mobile reading device is presented. Three field studies with blind participants were conducted to develop and refine the model. Research paper [4] uses a precise position measurement system, a wireless connection, a wearable computer, and a vocal communication interface to guide blind users and help them travel in familiar and unfamiliar environments independently and safely. The paper [5] describes ongoing work into a portable mobility aid, worn by the visually impaired. The system uses stereo vision and sonar sensors for obstacle avoidance and recognition of kerbs. Paper [6] explains a wall tracking experiment to collect echo data as a monoaural sensor was moved parallel to a wall which involves an investigation of the components of the echo and the geometry that produced them. Research paper [7] discusses System on embedded based which is blind navigator to detect an object for the blind person and guide them.

II. EXPERIMENTAL VIEW

A. Blind Audio guidance system

Blind Audio guidance system is more beneficial for blind person because it used for both indoor and outdoor & also used with stick or without stick. By use of this system the blind person walk without use of stick. Blind Navigator would detect object and guide blind person use of audio instructions. System will be based on embedded system. The Ultrasonic(US) sensor is used for distance measurement and Infrared(IR) sensor is used to detect an object or obstacle. The APR sound system is use for audio instruction.

In this system, four IR sensors and one US sensor is used. The IR sensors provide detail about objects that will come in route. IR sensors detects the object in left side, right side and the bottom, and audio information is conveyed through the earphone. The US sensor provides the information about the object in straight, whether the object is movable or not and message is conveyed through earphone. US sensor can also give the message that depicts the distance of the object from the user.

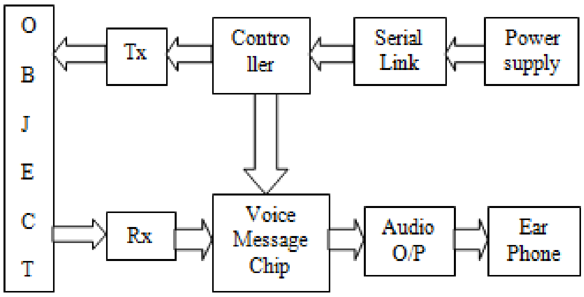

Fig 1. Audio guidance system using US sensor

Here Tx means US Transmitter and Rx means US receiver. The power supply provides constant +5v voltage to controller through the serial link. The controller gives the supply to US sensor. The range of US sensor is 3cm to 3 meter and frequency range is 100 KHz to 50MHz. Ultrasonic transmit the continuously waves which has high frequency. When object comes in the path of signal then it will reradiate by object and received at US receiver which has low frequency as compare to transmitted waves. The Voice massaging chip is single-chip recording divide, volatile storage, and playback Capability 40 to 60 seconds. It is generally use for message storing. It has 1 MB memory for save the messages. It is divided in 8 parts that means save 8 message in chip. Now received signal gives high voltage to the controller and according to which program will execute followed by this the stored message is activated and audio message was conveyed by earphone.

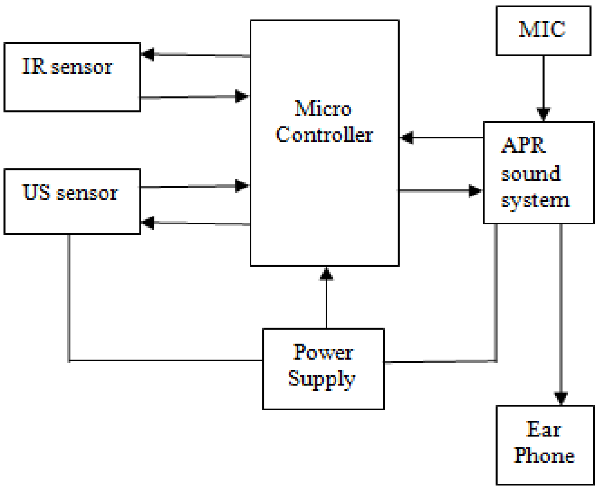

Fig 2. Block diagram of blind navigation system

Here the microcontroller is connected with IR sensor, US sensor, APR sound system, Power supply or Battery and Ear phone. Initially the high supply voltage is provided to IR sensor circuits which generate oscillation frequency of 30 KHz continuously. This frequency is transmitted by IR LED & when obstacle comes in the path of this sensor this frequency will reradiate by obstacle & received by photodiode which gives

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corresponding low output to the controller according to which the corresponding program will execute and corresponding signal is given to APR circuit followed by this the stored message is activated and audio message was conveyed by earphone. Similarly US sensor having 5 v supply for transmitting signal and receiver initially having low voltage and when obstacle comes in the path of signal then it will radiate by obstacle and received at receiver which gives high voltage to the controller and according to which program will execute followed by this the stored message is activated and audio message was conveyed by earphone. MIC is used for the recording the message in chip.

B. An Integrated Indoor/Outdoor Blind Navigation System

Drishti is made up of COTS(Commercial-Off-The-Shelf) hardware and software. Our prototype weighs approximately 8 lbs. Drishti outdoor version uses DGPS to locate the visually impaired user in the outdoor environment and provides him/her with dynamic route and reroute service. This system is an integrated indoor and outdoor navigation system using which the user can travel in any place without changing services. He or she can go from an outdoor environment to an indoor environment or vice versa by speaking a simple command. This work gives the user extensive convenience and independence.

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Fig 3. Using Drishti in outdoor environment

Fig 4. Using Drishti in indoor environment

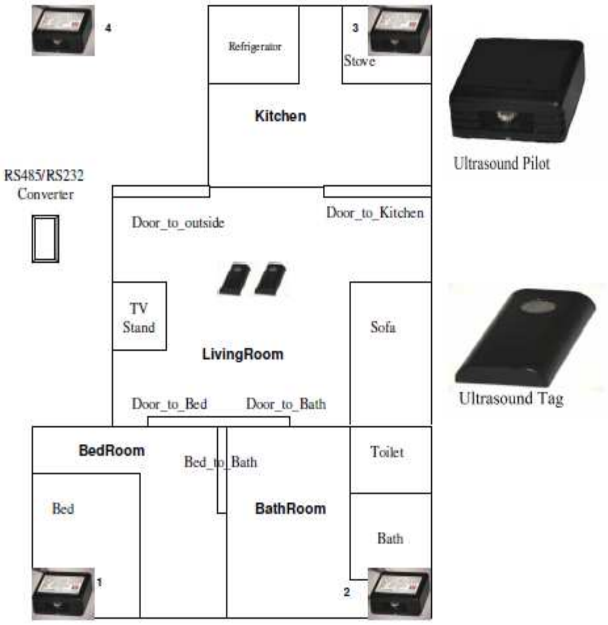

Fig 5. Ultrasound location system coverage of the Smart House

Hardware components in the Drishti , integrated system conisists of:

- Wearable computer
- Differential GPS server
- Wireless network
- Ultrasound positioning and location algorithms

Ultrasound positioning system harnesses ultrasound for high resolution high seperatability positioning. The best resolution can be within 0.3 mm. It can consist of an indefinite number of pilots and beacons to form a large system with the customized software. The two beacons are attached to the shoulders of the user using Velcro, as shown in Fig4, to easily receive the ultrasound signals sent from the pilots and to provide not only position but also orientation. Fig5 shows how the ultrasound positioning device covers the “smart house”. In this system 4 pilots are used that are mounted on the four corners of the “smart house” ceiling to provide full coverage of the house. The beacons on the user’s shoulders can always receive ultrasound signals from at least two pilots at different positions. The flight time difference of the ultrasound signals is used to calculate the distance between the beacons and the two closest pilots.

C. Wall Tracking With a CTFM Ultrasonic Sensor

The research reported in this paper examines the way blind people navigate using an ultrasonic sensor mobility aid and determines what information is in the Continuous Transmitted Frequency Modulated (CTFM) echo of a wall that the blind people can perceive and use to track the wall. For a blind person, sensing a wall involves panning the sensor in the direction required to get the desired information and separating wanted echoes from unwanted ones. In order to do this, we set up an experiment to track a wall with a CTFM ultrasonic sensor.

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Fig 6. ultrasonic mobility aid

The observations from that experiment enabled us to develop a model of the wall echo. The results of this research imply that blind people may be more interested in finding areas of free space where there is no echo. Blind people seem to prefer to listen to low amplitude echoes and use them to track the wall. The echo acoustic cues vary in frequency according to how far the sensor is from the object, thus indicating distance. The user listens to these sounds through earphones and by detecting the differences between sound signals can identify the different objects. To recognize objects we need to extract features from the echo. In this system a single monaural sensor, multiple echo components, sensor motion and an echo model to detect the features. The echo received by a sensor from a wall when the sensor axis is aimed at an angle of 40° to the wall. We found that the echo contains three types of components: an orthogonal echo component, a surface echo component and an object corner echo component. We demonstrate that these echo types can be recognized and tracked as the sensor moves along a wall. We developed a suite of software to analyze and extract features from the sensor echo. These features then become the data that we use for wall tracking. The software tools we use are a peak detector and a trough detector.

D. Robotic Sensing for the Guidance of the Visually Impaired

The project prototype, as shown in Figure 7, comprises system electronics in a backpack and sensors which are mounted either on the backpack or on the user's body. Three sonar sensors are fixed to the user's belt and one is mounted at chest height. These sensors are driven and interpreted by a Motorola HC11 microcontroller. Two calibrated grayscale cameras are mounted on rigid arms, which extend over the user's shoulders from the backpack. The camera orientation can be adjusted over a small range for alignment. The vision part of the project at present uses an image capture and process board based on the TI C40 processor.

Fig 7. Project prototype

Ground-Plane Obstacle Detection (GPOD) algorithm, which uses disparity between stereo image pairs to detect potential obstacles. Obstacle detection is complicated by the significant sensor movements that arise from the user's walking action. An estimate of motion is required for three reasons: To estimate ground position when it cannot be seen, To removal the complex gait motion from the perceived motion of world entities, to allow tracking, an aid to image feature matching through time. Experimental analysis of walking gait shows that the components of motion are approximately sinusoidal in form. Each component is therefore modeled by a single sine wave with fundamental signal parameters of amplitude, frequency, phase, and a fixed offset from zero, which are assumed to be constant over short periods of time, and must be estimated as the user walks. A change in the type of motion is detected by a pattern detector and a tracking action chosen accordingly. If, for example, the change in the motion falls below a threshold value, it is assumed that the person has stopped walking and the current position is then used as an estimate of future position

Dynamic Ground Plane Recalibration (DGPR) is for wheeled mobile robots moving over flat ground, there is no change in position of the ground plane relative to the cameras, and the cyclopean ground-plane disparity function is therefore fixed. However, the sensor movements that were modeled in the previous section make it impossible to use a one-time, fixed ground plane calibration in this application. Dynamic recalibration of the ground plane is important: to prevent human movement affecting obstacle detection and to obtain a better estimate of the ground plane for slopes, hills or non-flat ground.

Step number	1	2	3	4
Total no. of obstacles in region	6	6	6	8
No. of obstacles detected by GPOD	4	0	0	0
No. of obstacles detected by DPGR	4	4	4	5

Table 1: Comparison between GPOD and DGPR results

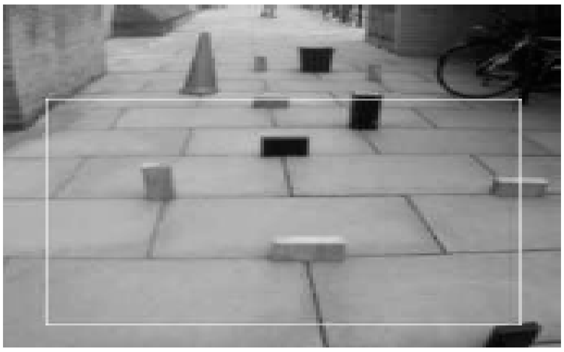

Fig 8a. The original image.

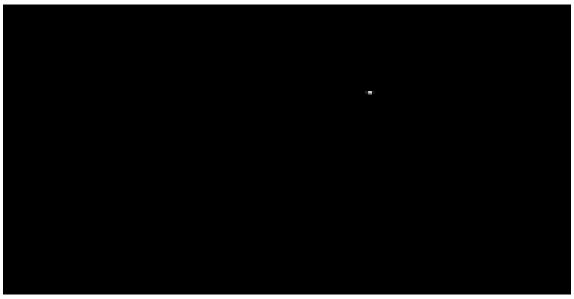

Fig 8b. Result from Ground Plane Obstacle Detection.

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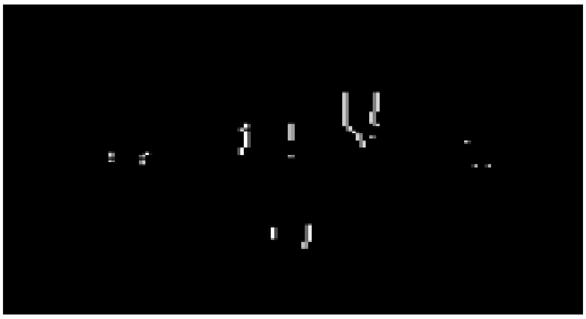

Fig 8c. Result from RANSAC Dynamic Ground Plane Recalibration.

A comparison between GPOD and DGPR in terms of the number of obstacles detected in the first 4 images is shown in Table 1. In these tests, the between-image movements were measured approximately by hand. From the second image onwards, the basic GPOD algorithm fails to detect any obstacles, but the DGPR algorithm is unaffected by the movements.

Fig 9. Testing the user interface with the sonar sensors.

Figure 9 shows the user interface with the sonar sensors. Three sonar sensors were mounted on the user's belt, one aiming directly in front of the user, and the others pointing at about 15 degrees to each side. This configuration was found to provide adequate coverage of the 'danger area' in front of the user, and to prevent obstacles falling between the beams of neighboring sensors. A small vibrating motor was mounted close to each sensor. Each motor was activated when the corresponding sensor detected an obstacle at a range less than a threshold selected by the user. A fourth sensor and motor were mounted at chest height. The users have to rotate their bodies to scan from side to side to find a clear path, instead of stepping sideways into unknown territory.

IV. APPLICATION

The navigation systems detects the obstacles and guides the blind and visually impaired people by helping them travel in familiar and unfamiliar environment , independently and safely.

V. RESULT

Blind audio guidance system is used to transform visual information to auditory information. Drishti provides a hands-free travel and living convenience to the blind and visually impaired user. It provides the dynamic interaction, the adaptability to changes. The limitation of this system is that the error in calculation of the distance when the subject sits and also the working range of this system depends on the coverage of the wireless network.CTFM ultrasonic sensor, results indicate that more useful information is contained in echo components and they also demonstrate that accurate wall following is possible.

The results of the types of navigation systems is tabulated as follows.

NAVIGATION SYSTEM	RESULT
Blind audio guidance system	Visual information is transformed into auditory information.
Drishti	Provides hands free travel convenience to the blind both indoor and outdoor.
CTFM Ultrasonic Sensor	Helps in detecting the multiple objects from echoes.
Robotic Sensing	Guides to avoid obstacles and raised edges of the road.

Table 2: Results

VI.CONCLUSION

Blind navigation system uses sensors to detect the objects or obstacle in the path and helps the blind in navigating through the city without the aid of any assistance. These systems will allow blind travelers to develop much better representations of the environment by either providing the auditory guidance or Mechanical guidance.

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