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'A Vocal Eye': A GPS Based Way Finding Voice Navigational System for Visually Impaired People

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Abstract—This article focuses to provide an effective model and a system named 'A Vocal Eye' that can be used to carry out the monitoring system for visually impaired persons which alert them about the existing obstacles and ducts. It also allows visually impaired to hear voice directions to reach their desired endpoint safely by avoiding hurdles and obstacles using ultrasonic sensors. Due to which the acquire range data from objects in the environment and detection of obstacles around.. For solving such issues, a multiple number of microcontroller platform is being implemented (i.e: AVR and Arduino) which directs the command and control throughout monitoring system.. Moreover, brief comparisons of both Microcontrollers are also presented in this paper for appropriate selection.

Index Terms— A Vocal Eye, Ultra sonic sensors, visually impaired, obstacles, Micro controller, AVR and Arduino..

1 Introduction

AN According to Fact Sheet N'282, updated August2014 from the World Health Organization, about 285 million people are visually impaired worldwide: 39 million are blind and 246 million have low vision. Increasing mobility, safety, and independence for the visually impaired is of significant importance. Several mobility aids for the blinds have been existed.

The purpose of this research is to focus on the development of a prototype, a way finding system that uses GPS (the Global Positioning System) and speech recognition for guidance ("as discussed by Fallah [1]"). The availability of 3G-4G make performance of GPS units, coupled with the voice recognition services through the internet, presents an opportunity to provide a low cost solution. The Vocal Eye architecture includes a wireless interface to enable the blind user a little guide of his desired destiny. Speech recognition technology was used as the primary interface. The project implementation is a functional proof of concept prototype which enables users to obtain voice instructions about GPS navigational information of his selected location ("as discussed by Barbeau, S. J [2]"). The prototype system first track the user where he/she is initially located, and provide spoken directions to travel to a remote destination. Its final product is just an open prototype, which can be installed in any wearable position, which we have mentioned below.

Navigation of a visually impaired is achieved in merely two steps. Firstly to sense obstacles or hazardous terrain in the environment of interest (obstacle avoidance), ("as discussed by Alvarez [3]") and the second is path/way finding or navigating to remote locations. Earlier, electronic obstacle avoidance system, like the Laser Cane and ultrasonic-based NavBelt, alert the user of nearby hurdles, (and in some cases can be used to find paths that evade such obstacles ("as discussed by Takizawa [4]").

In spite of such rapid improvement of technology in recent years, the blind community has not privileged as much from such devices. Although things have been tried like: White canes they are dependable and effective at detecting any kind of obstruction creating problem to the person, include abrupt pathway such as "rough surfaces,, stairs, holes and puddles" obstacles ("as discussed by Moulton [5]"). White canes are also relatively cheaper and simpler to use. That's the reason, the paradigm of research more focused on way finding instead of obstacle detection.

GPS way finding systems are chiefly appropriate for outdoor circumstances because the receivers are usually unable to execute well in an indoor environment. Indoor positioning relatively includes sensors using ultra sonic /sonar, digital tags accelerometers etc obstacles ("as discussed by Werb [6]").

Now, there exists some outdoor way finding systems too. GPS systems for the visually impaired include Tormes, GPS, Trekker, Braille Note,and Loadstone GPS.

The Tormesmechanism was developed by the European Space Agency (ESA) in 2004, and it is one of the most reliable system present. It uses a system termed as EGNOS (European Geostationary Navigation Overlay System) which acquire signals from geostationary satellites to confirm that GPS data is right. EGNOS effectively improves the sensitivity and accuracy of GPS from 10m to 2m ("as discussed by Torán [7]").

Tormes combats the " (giant buildings blocking satellite) by a system called SISNet (Signal in Space through Internet), which provides remedial data through the internet when satellites are masked. The Tormes system is, however, rather expensive—it costs for over US$3000, and it is also limitedly available in Spanish ("as discussed by Ford [8]").

The Trekker structure includes talking schemes, talking maps and GPS information—it retails US$895.

Braille Note GPS is a navigational satellite add-on for owners of the Braille Note family of products—it expense for about US$1500. Loadstone GPS is an open source software, and that enables the users to cooperate with GPS information using syn-

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thetic speech and be capable of used on Symbian S60.
Despite the fact that several systems have been validated from a nominal point of view, few are extensively used amongst the vision disturbed community ("as discussed by Bowling [9]").
In many current systems GPS module combined with comprehensive roadmaps to exhibit information about the locations of nearby locations on streets, points of concern and instructions for wandering to desired destinations.
For a person to follow a particular route, the person must ordinarily have some concept or plan of that track. A blind trekker can find out the route either by being guided by a sighted companion, or by verbal instructions. Once a route has been determined, flourishing travel requires that the individual be able to: i) select the route ii) discover and avoids obstacles and iii) follow the route according to the oral instructions getting from A Vocal Eye. Proposal is about the support for visually impaired through electronic travel aids ("as discussed by Helal [10]"). To successfully follow a route, two key abilities be required. These are "the capability to recognize selection points or verdict points in the environment", and the ability to "interpret, and understand the design of features in the surroundings.
In the year 1991, Golledge et al; were the earliest to put forward the implementation of GPS,GIS, speech, and sonic sensor mechanism for navigation of blinds in an evolution note on the class of GIS.MOBIC, is a GPS based travel aid for the blind and an aged one. It also uses a speech synthesizer tore cite the predestined travel expedition plans ("as discussed by Golledge [11]"). This trial product is implemented on a handheld computer with preloaded digital maps and limited wireless capabilities to get latest information from a remote database.
Further, Golledge et al; deployed similar system by using a portable &wearable computer. Moreover, terrestrial steering support using augmented authenticity is developed for the sighted people.
Metronaut, isa CMU's campus guest assistant that uses a bar code reader to deduce its position, information from a succession of barcode labels positioned at strategic locations of the campus ("as discussed by Meyers [12]").
Parallel kinds of systems are developed by researchers in which existing position of the user is used to overlay textual explanation and appropriate information from their web servers to correspond with the image captured through their head mounted display. Smart Sight, the traveler assistant developed by Yang et al; is a slight variation to this loom. It gives user a multi-modal interface, which includes voice, script and gesture recognition ("as discussed by Amalarethinam [13]").

2. MATERIALS & METHODS

A number of wearable assistive devices have been developed as task-specific solutions for activities such as reading and travel. Given the fact that sight is missing, they try to open new communication channels through hearing and touch. Devices are as diverse as the technology used and the location on the body. Fig. 1] overviews the body areas involved in wearable assistive devices: fingers, hands, wrist, abdomen, chest, feet, tongue, ears, etc. have been studied to transmit visual information to the blind. This chapter intends to review several prototypes so that their potential can be appreciated.

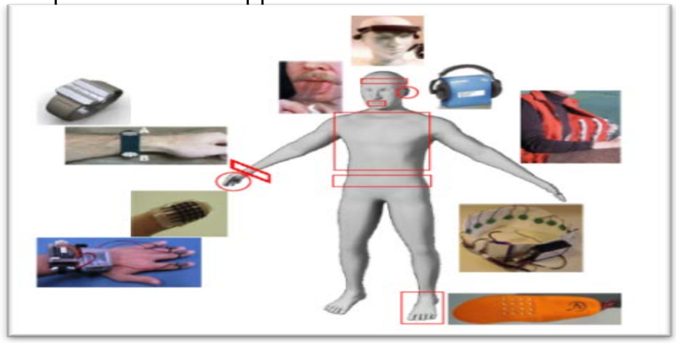

Fig.1: Overview of wearable assistive devices for the blind.

3. PROBLEM FORMULATION

At present, there are many developed systems that provide voice navigational systems for visually impaired .But all navigational techniques involve locating the navigator's position compared to known locations or patterns. In modern era of research, navigation can be implemented for many purposes even though it helps out to know the location of any particular destination, so this system can be used for blind peoples as an aid for them to locate their destination. As Electronic integrated bridge concepts are driving future navigation system planning. Integrated systems take inputs from various ship sensors, electronically display positioning information and provide control signals required to maintain a preset course.
The walking aid is supposed to be an external prosthesis that would help its recipient – a blind user – be aware of the obstacles surrounding him. The resulting device should do all of this without impairing one's daily life. We want it to be helpful to the user but not at any expense. Of course, it is not going to be the most perfect solution but it needs to tackle the basic problem without creating new ones. Most of my project duration had me studying the implications of using different forms of sensing and alerting and long term physical and psychological effects on the user. I'm happy to say we've succeeded in making a device that aids without adversity.
Of course, since it is an undergrad project, we had to study the present day condition of the problem we wish to tackle. We looked up existing solutions to the plight of the blind and found a lot of them. To name a few,
Seeing Aid :– A pair of glasses that use mounted infrared LEDs for obstacle detection. User is notified using different tones.
Laser Cane :– A cane that uses three lasers for detection. Sound and vibrations (front beam only) are used to convey information.
Mowat Sensor: – A handheld device that emits and receives ultrasound. User is alerted using vibrations by varying intensity.
Nottingham Obstacle Detector: – A sonar handheld, that varies frequency of vibrations to alert the user.
And there were a lot more devices that use a combination of their sensing and alerting mechanisms. Our device inescapably

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does the same, yet the end result is nowhere quite as similar to any of these solutions as they are to one another.

4. CHALLENGES & RESEARCH ISSUES

All Of all sensations professed through our senses, those received through vision have by far the greatest impact on opinion. Vision combined with the other senses, mainly hearing, allow us to have a world global opinion and to perform actions upon it. For the blind, the lack of vision is a major obstacle in daily living: information access, flexibility, way finding, communication with the environment and with other people, among others, are challenging problems.

In fact, school and working-age sightless have very high analphabet and unemployment rates. For example, in the US, the sightless unemployment rate is around 75% while only 10% of the blind children take education in Braille. Despite efforts, a true is that most schools and employers cannot accommodate sightless people. In significance, the person who is sightless and his/her family face important socioeconomic constraints.

The matter of the sightless becomes a very thoughtful problem in terms of health and social security. Costly-in home expenditures, nursing home care and welfare expenditures on unemployment and health services have to be fascinated by the state. A state action to allow the sightless/visually impaired to live self-governing and creative lives has been to teach them new ways to achieve routine daily tasks. A great variety of specialists is involved: special education teachers, Braille teachers, psychologists, orientation and mobility specialists, low-vision specialists and vision rehabilitation therapists to name a few.

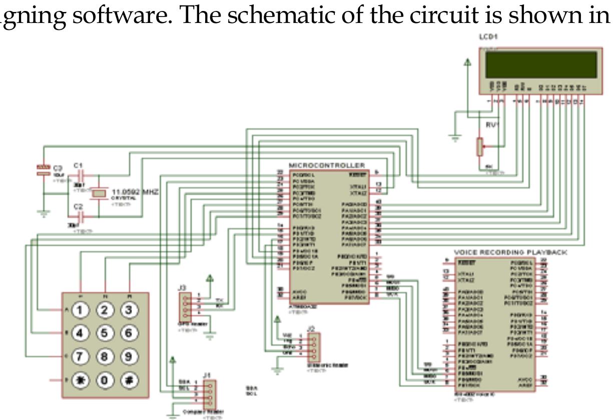
Evidently, this involves a very high cost that has to be absorbed by the state. Moreover, the availability of funding and qualified personnel is insufficient to cover the actual population's demand.

5. RESULTS & DISCUSSIONS

The findings from the proposed projects are discussed in a categorical manner like:

5.1 SIMULATION & MODELLING

We have performed the simulation of the circuit on Proteus designing software. The schematic of the circuit is shown in fig

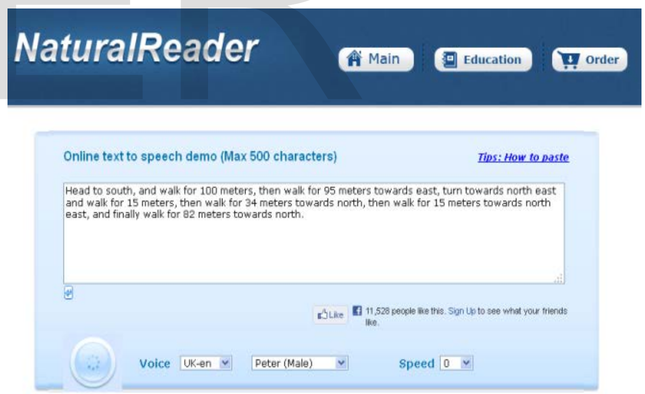


For speech assisted navigation, many researchers have used text to speech conversion. In such cases researchers are converting text into English language only. Vocal Eye follows similar criteria for this.

5.2 TEXT TO SPEECH CONVERTER FOR AUDIO RECORDING

A text to speech converter (TTS) is a sort of speech synthesis software that allows text in English and certain other languages to be transformed into spoken audio or speech. In other words, it converts normal language text into sound version of the text. The purpose of text to speech is to convey textual information to visually impaired person. This system is usually used with voice recognition programs. Depending on the application software being used, user can also manipulate the speed, tone & pitch of their audio playback.

Step 1 - Text to be con-



Step 2 -Text beingconvert-

Step 3 - Voice available for

5.3 HARDWARE IMPLEMENTATION

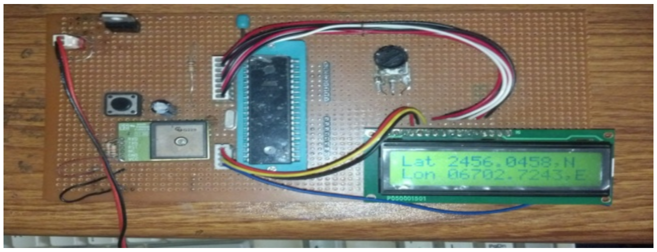
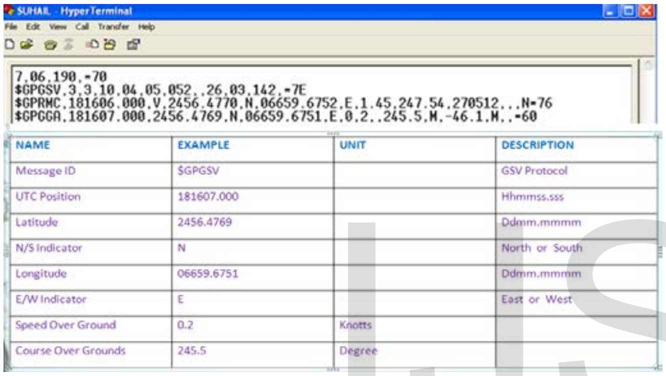


Fig 5.1

The working of proposed system is such it first identify users initial position, a format is such:

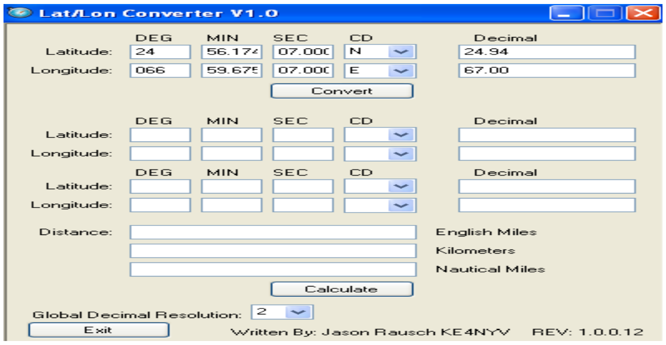
5.4 GPS DATA FORMAT



NAME	EXAMPLE	UNIT	DESCRIPTION
Message ID	$GPGSV		GSV Protocol
UTC Position	181607.000		Hhmmss.sss
Latitude	2456.4769		Ddmm.mmmm
N/S Indicator	N		North or South
Longitude	06659.6751		Ddmm.mmmm
E/W Indicator	E		East or West
Speed Over Ground	0.2	Knotts	
Course Over Grounds	245.5	Degree	

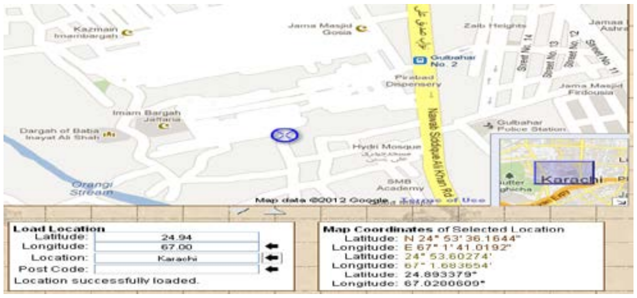
Through GPS coordinates of longitude and latitude initial position be determined.

5.5 FINDING POSITION FROM LONGITUDE AND LATITUDE



The location on Google map appeared.

5.6 RESULT OF ABOVE DATA



Now it acquire from the user its target location, our aim is to take this information verbally, as the user is blind. But at this stage this information is provided through a dial keypad consisting of digits 0-9.

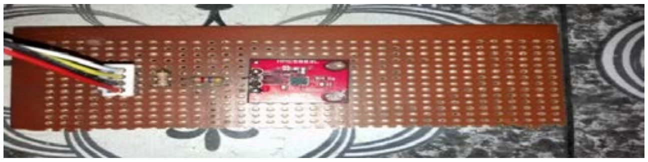


Fig 5.2

Currently we have worked on 4 Karachi based locations; feed on the digits 1 to 4 user can select any one by pressing a desired digit. When a button is press voice information about the location is conveyed, through this information blind can easily reached to their desired destination.

6. HARDWARE COMPONENTS

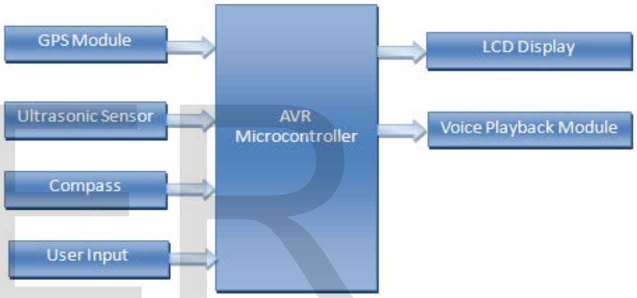


Fig.6.1: Block diagram of hardware components

6.1 ULTRASONIC SENSOR

Ultrasonic sensors having two modules one is transmitter and second is receiver. A transmitter send the sound wave which has particular frequency and receiver attach the sound which transmitted by transmitter. By using time gap of transmitting and receiving sound we can calculate distance of the object.

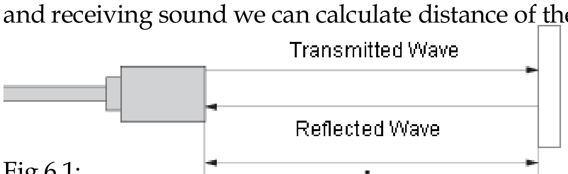


Fig.6.1:

6.2 ISD 4002 VOICE RECORDING/PLAYBACK IC

The ISD4002 Chip Coder series provides high-quality 3-volt single-chip Record/Playback solutions for 2 to 4 minute messaging applications ideally for cellular phones and other portable products. The CMOS-based devices include an on-chip oscillator, anti-aliasing filter, smoothing filter, auto mute feature, audio amplifier and high density multilevel Flash memory array.

6.3 SELECTION OF ISD 4002

ISD 4002 is a multiple-message record/playback device. This single chip can record up to 2 to 4 minute worth of voice messages. Microphone inputs and speaker outputs are all handled

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by the ISD 4002.

6.3.1 AVAILABLE OPERATION MODE:

There are two types of Mode which are following

1. Record Mode
2. Playback Mode

6.4 GLOBAL POSITIONING SYSTEM

Global Positioning System (GPS) satellites broadcast signals from space which are used by GPS receivers, to provide three-dimensional location (latitude, longitude, and altitude) and precise time. Reliable positioning, navigation, and timing services are provided by the GPS receivers to users all around the world continuously in all weather, day or night, anywhere on or near the Earth. The GPS receiver used in this project is GR87.Its main features are

- On chip 1Mb SRAM
- Low power consumption
- Multi path mitigation hardware
- Reacquisition time 0.1 seconds

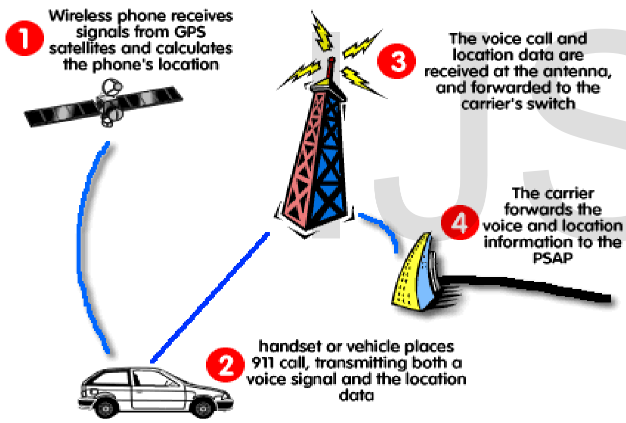

Fig 6.1

6.4.1 ACCURACY OF GPS:

There are four basic levels of accuracy - or types of solutions - we can obtain with our real-time GPS mining system:

1. Autonomous Accuracy
2. Differential GPS (DGPS) Accuracy
3. Real-Time Kinematic Float (RTK Float) Accuracy
4. Real-Time Kinematic Fixed (RTK Fixed) Accuracy

6.5 HM2007:

HM2007 is a single chip CMOS voice recognition LSI circuit with the on chip analog front end, Voice analysis, recognition process and the system control functions. The speech recognition system is a completely assembled and easy to use programmable speech recognition circuit. It has 8 bit data out which can be interfaced with any microcontroller for further development.

6.6 KEYPAD:

The keypad is used for set the GPS coordinated and select the destination options that will select by visually impaired person.

6.7 LIQUID CRYSTAL DISPLAY

LCD is use for show the GPS ordinates and keypad instruction and the data that given by visually impaired person.

6.8 SPEAKER

The speaker is used for guiding the visually impaired person to navigate by prerecording voice using recording IC.

6.9 MAX 232

RS-232 is a serial binary data interconnection between Data terminal equipment (DTE) and Data Circuit-terminating Equipment (DCE)). It is a level converter IC which is used to communication between computer and microcontroller using serial port.

6.10 POWER SUPPLY

Power supply is the main part of this project. Because all circuitry run on low DC voltage. But we have high AC voltage source so then we have to use transformer, bridge rectifier, filtering capacitors and regulator ICs.

7.0 PRELIMINARY RESULTS

7.1 TEXT TO SPEECH CONVERTER FOR AUDIO RECORDING

A text to speech converter (TTS) is a sort of speech synthesis software that allows text in English and certain other languages to be transformed into spoken audio or speech. In other words, it converts normal language text into sound version of the text. The purpose of text to speech is to convey textual information to visually impaired person. This system is usually used with voice recognition programs. Depending on the application software being used, user can also manipulate the speed, tone & pitch of their audio playback.

TABLE 1

COMPARISON OF ARDUINO VS AVR MICROCONTROLLER

AVR MICROCONTROLLER	ARDUINO
A microcontroller is an IC that contain a CPU as well as some amount or RAM, ROM and other peripherals. Microcontrollers can function without external memory or storage. Normally, microcontrollers are either programmed before being soldered to a PCB or are programmable using In-System-Programming (ISP or ICSP) connectors via a special "programmer" device attached to a personal computer. Typical microcontrollers are much simpler and slower than typical microprocessors but I believe the distinction is mostly one of scale and application AVR is just an integrated circuit microchip, made by Atmel. It looks something like this 	Arduino is a combination of both chip and breadboard. The Arduino is an AVR processor running special code that lets you use the Arduino environment to program and upload code easily. All you need is a USB cable to program and communicate with it. An Arduino is a PCB containing an Atmel AVR microcontroller and usually providing a set of connectors in a standard pattern. The microcontroller is typically preprogrammed with a "bootloader" program that allows a program (called a "sketch") to be loaded into the microcontroller over a TTY serial connection (or virtual serial over USB connection) from a PC. It looks something like this: 

Table 1: Comparison of microcontroller

	8051	PIC	AVR
SPEED	Slow	Moderate	Fast
MEMORY	Small	Large	Large
ARCHITECTURE	CISC	RISC	RISC
ADC	Not Present	Inbuilt	Inbuilt
Timers	Inbuilt	Inbuilt	Inbuilt
PWM Channels	Not Present	Inbuilt	Inbuilt

9. CONCLUSION

It is concluded that in proposed 'A Vocal Eye' system, AVR microcontroller failed to respond precisely in the occurrence of multiple delays while parallel processing. So, as a result the preferable solution came across which responds more accurately is Arduino board to provide blinds a secure path.

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REFERENCES

[1] Fallah, N., Apostolopoulos, I., Bekris, K., &Folmer, E. (2013). Indoor human navigation systems: A survey. Interacting with Computers, 25(1), 21-33.

[2] Barbeau, S. J., Nevine, L. G., &Winters, P. L. (2010). Integration of GPS-enabled Mobile Phones and AVL–Personalized Real-time Transit Navigation Information on Your Phone 2.Transportation, 38(39), 40.

[3] Alvarez, J. C., Gonzalez, R. C., Alvarez, D., Shkel, A., &Lumelsky, V. (2004).Accounting for limited sensing in real-time obstacle avoidance for mobile robots.In Robotics and Automation, 2004.Proceedings.ICRA'04.2004 IEEE International Conference on (Vol. 5, pp. 4356-4361).IEEE.

[4] Takizawa, H., Yamaguchi, S., Aoyagi, M., Ezaki, N., & Mizuno, S. (2012, December). Kinect cane: an assistive system for the visually impaired based on three-dimensional object recognition. In System Integration (SII), 2012 IEEE/SICE International Symposium on (pp. 740-745).IEEE.

[5] Moulton, B., Pradhan, G., Chaczko, Z., Moulton, B., Pradhan, G., &Chaczko, Z. (2009). Voice Operated Guidance Systems for Vision Impaired People-Investigating a User-Centered Open Source Model. JDCTA, 3(4), 60-68.

[6] Werb, J., &Lanzl, C. (1998).Designing a positioning system for finding things and people indoors. Spectrum, IEEE, 35(9), 71-78.

[7] Torán, F., & Ventura-Traveset, J. (2006). The ESA SISNeT Project: Current Status and Future Plans. In European Navigation Conference. Manchester.

[8] Ford, L. R. (1985). Urban morphology and preservation in Spain. Geographical Review, 265-299.
Bowling, A. (2004).Measuring health.McGraw-Hill Education (UK).

[9] Bowling, A. (2004). Measuring health. McGraw-Hill Education (UK).

[10] Helal, A. S., Moore, S. E., &Ramachandran, B.

ISSN 2229-5518
(2001).Drishti: An integrated navigation system for visually impaired and disabled. In Wearable Computers, 2001.Proceedings. Fifth International Symposium on (pp. 149-156). IEEE.

[11] Golledge, R. G., Klatzky, R. L., Loomis, J. M., Speigle, J., &Tietz, J. (1998). A geographical information system for a GPS based personal guidance system. International Journal of Geographical Information Science, 12(7), 727-749.

[12] Meyers, N. M., &Nulty, D. D. (2009).How to use (five) curriculum design principles to align authentic learning environments, assessment, students' approaches to thinking and learning outcomes. Assessment & Evaluation in Higher Education, 34(5), 565-577.

[13] Amalarethinam, D. G., & Ali, H. K. (2011). An Overview of Pervasive Navigation Systems. International Journal of Research and Reviews in Computer Science, 1(2), 6-14.