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A REVIEW ON OBSTACLE DETECTION AND VISION

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ABSTRACT

Vision is a beautiful gift to human beings by GOD. Vision allows people to perceive and understand the surrounding world. Till date blind people struggle a lot to live their miserable life. Their problems have made them to lose their hope to live in this competing society. Global estimate of the number of visually impaired people according to World Health Organization survey made in 2010 is 285 million people are visually impaired worldwide. Numerous technical aids that have been developed through recent decades for the orientation and mobility that make the lives of the blind easier. For doing so, sonar input and camera input systems are offered.

KEYWORDS: ultrasonic sensors, infrared sensors, camera, algorithm, image processing, obstacle detection.

INTRODUCTION

Blindness is a state of lacking the visual perception due to physiological or neurological factors. The partial blindness represents the lack of integration in the growth of the optic nerve or visual centre of the eye, and total blindness is the full absence of the visual light perception [1]. Total blindness is the complete lack of form and visual light perception and is clinically recorded as NLP, an abbreviation for "no light perception". Blindness is frequently used to describe severe visual impairment with residual vision. Those described as having only light perception have no more sight than the ability to tell light from dark and the general direction of a light source [2]. Blindness is the inability to see. There are four levels of visual function, according to the International Classification of Diseases -10 (Update and Revision 2006):

i) normal vision
ii) moderate visual impairment
iii) severe visual impairment
iv) blindness

Moderate visual impairment combined with severe visual impairment is grouped under the term "low vision": low vision taken together with blindness represents all visual impairment.

A) Key Facts

i. 285 million people are estimated to be visually impaired worldwide: 39 million are blind and 246 have low vision.
ii. About 90% of the world's visually impaired live in low- income settings.
iii. 82% of people living with blindness are aged 50 and above.
iv. Globally, uncorrected refractive errors are the main cause of moderate and severe visual impairment; cataracts remain the leading cause of blindness in middle- and low-income countries.
v. The number of people visually impaired from infectious diseases has reduced in the last 20 years according to global estimates work.
vi. 80% of all visual impairment can be prevented or cured[3].

Table 1. Global estimate of the number of people visually impaired by age, 2010; for all ages in parenthesis the corresponding prevalence (%).

Ages (in years)	Population (millions)	Blind (millions)	Low Vision (millions)	Visually Impaired (millions)
0-14	1,848.50	1.421	17.518	18.939
15-49	3548.2	5.784	74.463	80.248
50 and older	1,340.80	32.16	154.043	186.203
All ages	6,737.50	39.365 (0.58)	246.024 (3.65)	285.389 (4.24)

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B) Main causes of Blindness in India

The main causes of blindness in india is shown in Fig. 1.1 are as follows: cataract (62.60%), refractive error (19.70%), corneal blindness (0.90%), glaucoma (5.80%), surgical complications (1.20%), posterior capsular opacification (0.90%), posterior segment disorder (4.70%) and others (4.19%). The estimated national prevalence of childhood blindness /low vision is 0.80 per thousand [3].

This study presents some limitaons, the most signific ant are the following: the surveys in the last 10 years have been mostly Rapid Assessments for ages 50 yea rs and older, and naonal studies for all ages with or w ithout WHO Eye Survey Protocol have been few. As a consequence data couldbe limited in representation of countries and of ages. The imputaon of prevalence for missing data can give errors that are difficult to e smate: clearly they could be high in regions with spar se data.

In the Eastern-Mediterranean Region recent data wer e unavaila ble for most of the countries, hence the esmates were in large extent based on surveys from 1993-1998 Dat a from HI countries were also miss-ing or were dated as far back as 15 years.

However it must be noted that in HI countries from available information there was no evidence of major changes in prevalence.

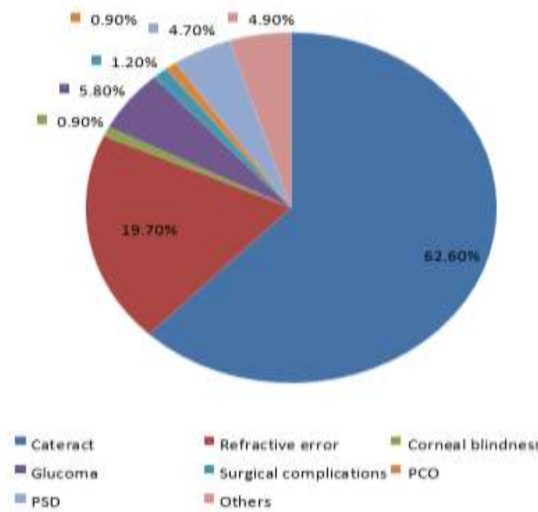

Fig. 1 Main Causes of Blindness in India

Source: Community Eye Health J Indian Supplement 2008, NPCB

India shoulders the largest burden of global blindness, about 3.5 million across the country with 30000 new cases being added each year. One out of every three blind people in the world lives in India - an estimated 15 million blind people live in India [4].

C) The National Sample Survey of India:

The NSSO conducted the 47th round of a nation-wide comprehensive survey of disabled persons during July-December 1991. The survey arrived at an estimate of 16.15 million persons having at least one or the other disability, which constituted 1.9 percent of the total population of 850 million. The survey revealed that population of the visually impaired in India at 850 million level of population is 4 million as per the following distribution [5]:

Table 2. Estimated population of the visually impaired (1991) (Thousands)

Source: Survey of Disabled Persons, NSSO, 1991

Sex	Rural (%)	Urban (%)	Total (%)
Male	1539 (38.42)	308 (7.69)	1847 (46.11)
Female	1796 (44.84)	362 (9.03)	2158 (53.88)
Total	**3335 (83.27)**	**670 (16.72)**	**4005 (100.00)**

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Thus the population of the visually impaired according to above estimate is 0.47 % to population.

MOTIVATION AND SCOPE

Millions of visually impaired people are facing the problems like mobility and orientation in an unknown environment [6]. There is an international symbol tool of blind and visually impaired people just like the white cane with a red tip which is used to enhance the blind movement. This device is light, portable, but range limited to its own size and it is not usable for dynamic obstacles detection neither than obstacles not located on the floor. Another method is the guide dogs which are trained specially to help the blind people on their movement by navigating around the obstacles to alert the person to change his/her way. However, this method has some limitations such as difficulty to understand the complex direction by these dogs, and they are only suitable for about five years. The cost of these trained dogs is very expensive, also it is difficult for many of blind and visually impaired persons to provide the necessary care for another living being. What better can be the use of technology than using it for the visually impaired, who cannot make the use of these otherwise? A Sonar input and Camera input systems should replace a big part of the functionality of a normal visual system: centring automatically on paths, detecting static and moving obstacles on the fly, and guiding to a destiny. The research aims towards solving the major problems of mobility and orientation faced by the blinds. Utilization of technology to improve the mobility will be of tremendous help to visually impaired in acquiring the independence.

REVIEW OF RELATED LITERATURE

Sachin Bharambe et al. in [7], have developed an affordable technology which is cheap and can be a substitute eyes for blind people. As a first step to achieve this goal we decided to make a navigation system for the blind. Our device consists of the following 2 parts: 1) Embedded Device: can be used to detect local obstacles such as walls/cars/etc. using 2 ultrasonic sensors to detect the obstacles and vibrator motors to give tactile feedback to the blind. 2) Android App: will give the navigation directions. These applications can be installed on any android device: cellphone/tablet/etc. It is clear that the investigators have made a complete prototype which is a light weight, comfortable and accurate device which can be used to navigate by blind people. A plane extraction algorithm in open CV within an android application was the next step of this project. This will warn blind person if there is any step or pothole in the path.

Hui Kong et al. in [8], have presented a novel framework for detecting non flat abandoned objects by matching a reference and a target video sequences. The reference video is taken by a moving camera when there is no suspicious object in the scene. The target video is taken by a camera following the same route and may contain extra objects. The objective is to find these objects. GPS information is used to roughly align the two videos and find the corresponding frame pairs. Based upon the GPS alignment, four simple but effective ideas are proposed to achieve the objective: an intersequence geometric alignment based upon homo graphies, which is computed by a modified RANSAC, to find all possible suspicious areas, an intra sequence geometric alignment to remove false alarms caused by high objects, a local appearance comparison between two aligned intra sequence frames to remove false alarms in flat areas, and a temporal filtering step to confirm the existence of suspicious objects.

Pawel Strumillo in [9], has discussed the problem of outdoor mobility of the visually impaired and reviews key assistive technologies aiding the blind in independent travel. Space perception abilities important for mobility of the visually impaired are discussed first and related definitions and basic concepts such as: cognitive mapping, way finding and navigation are explained. The main mobility barriers the visually impaired encounter in every day life are pointed out. In this respect special attention is given to the information the blind traveller needs to be safer and more skilful in mobility. Also sensory substitution methods and interfaces for nonvisual presentation of the obstacles and communicating navigational data are addressed. Finally, the current projects under way and available technologies aiding the blind in key mobility tasks such as: obstacle avoidance, orientation, navigation and travel in urban environments are reviewed and discussed.

Shaocheng Qu et al. in [10], have presented a small smart car system based on MCV SPCE061A and MCV 89S52. CCD camera was used as its path recognition device to extract path information through image recognition. Based on fuzzy strategy and the least square method, two-dimensional information involving gear angle between the car and the path were measured. Then PD controller was implemented to adaptively control the dc motor, which can guarantee the accurate path trace. Finally, experiment results show that the affectivity of the proposed small smart car.

Velappa Ganapathy et al. in [11], have discussed that robot navigation technique to guide the mobile robot move towards the desired goal where dynamic and unknown environment is involved. Fuzzy Logic (FL) and Artificial Neural Network (ANN) are used to assist autonomous mobile robot move, learn the environment and reach the desired goal. This research study is focused on exploring the four combinations of training algorithms composed of FL and ANN that avoid acute obstacles in the environment. Path remembering algorithm proposed in this paper will assist the mobile robot to come out from acute obstacles. Virtual wall building method also is proposed in order to prevent the mobile robot reentering the same acute obstacle once it has been turned away from the wall. MATLAB simulation is developed to verify and validate the algorithms before they are implemented in real time on Team Amigo BotTM robot. A comparison of all the four combinations of algorithms is done to find the best combination of algorithms to perform the required navigation to avoid acute obstacles.

Przemyslaw Baranski et al. in [12], have explained the concept and reports tests of a remote guidance system for the blind. The system comprises two parts – a remote operator's terminal and a blind person's mobile terminal. The mobile terminal is a small electronic device which consists of a digital camera, GPS receiver and a headset. The two terminals are wirelessly connected via GSM and the Internet. The link transmits video from the blind traveller, GPS data and provides duplex audio communication between the terminals. The GPS location of the blind traveller and real time video captured from the mobile camera are displayed on the remote operator's terminal. The remote operator can navigate the traveller to a destination point and warn him of dangerous obstacles. This paper list the main functional features of the system, its advantages and current shortcomings.

Won Jin Kim et al. in [13], have dealed about multi moving object detection and tracking under moving camera. Moving objects are detected by homography based motion detection. After moving objects are detected, apply online boosting trackers to track moving objects. Because each tracker and detector is measured independently, it is necessary to integrate two systems into one system. Hence, the algorithm detects and tracks multi moving objects without background modeling. It shows experiment results from sequences which are obtained from natural outdoor scene. This have been presented a method for muliple moving object detection and tracking system. The key factors of the algorithem are: (1) homography based motion detection, (2) onlne boosting tracker, and (3) the integration of tracker and detection. The experiments has shown the result of high success rate in outdoor scence.

Larisa Dunai et al. in [14], have discussed about a new prototype used as a travel aid for blind people. The system consists of two stereo cameras and a portable computer for processing the environmental information. The aim of the system is to detect the static and dynamic objects from the surrounding environment and transform them into acoustical signals. Through stereophonic headphones, the user perceives the acoustic image of the environment, the volume of the objects, moving object direction and trajectory, its distance relative to the user and the free paths in a range of 5m to 15m. The acoustic signals represent short train of delta sounds externalized with non-individual Head- Related Transfer Functions generated in an anechoic chamber. Experimental results show that users were able to control and navigate with the system safety both in familiar and unfamiliar environments.

M. Bujacz et al. in [15], have discussed about initial research on the system for remote guidance of the blind. The concept is based on the idea that a blind pedestrian can be aided by spoken instructions from an operator who receives a video stream from a camera carried by the visually impaired user. An early prototype utilizing two laptop PCs and a wireless internet connection is used in orientation and mobility trials, which aim to measure the potential usefulness of the system and discover possible problems with user operator communication or device design. Test results show a quantitative performance increase when traveling with a remote guide: 15-50% speed increase and nearly halved times of navigational tasks; however, the main success is the engendered feeling of safety when assisted and the enthusiasm with which the concept was welcomed by blind trial participants.

Hao Sun et al. in [16], have discussed about an approach for detecting and tracking independently moving objects from a mobile platform using un calibrated stereo cameras. Firstly, scale invariant feature transform (SIFT) features are detected and a novel multi view matching method is proposed for simultaneous stereo matching and motion tracking of

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the detected features. A multi view geometric constraint, derived from the relative camera positions in pairs of consecutive stereo views, is then derived for independent motion detection. Finally, a dimensional variable particle filter is introduced for joint detection and tracking of multiple independently moving objects. Experimental results on real world stereo sequences demonstrate the effectiveness and robustness of our method.

David T. Batarseh et al.in [17], have developed a mobile ultrasonic ranging system for the blind. In this project, a commercially available ultrasonic sensor, the Sona Switch TM 1700 (Electronic Design and Packing, Livonia, Michigan) was used to expand the environmental detection range of blind individuals. This sensor has a dc voltage output proportional to distance measured and an internal solid state switch. The dc voltage changes inversely with respect to changes in object distance. By using a monolithic voltage to frequency (V/F) converter, the dc voltage from the sensor is converted into an ac frequency that produces an audible frequency of chirps in two small headphones. The larger the dc voltage input into the V/F converter, the higher the frequency of chirps output. The result is a system that produces a varying frequency of chirps that is inversely proportional to the distance measured. The sensor is mounted on a light weight helmet allowing the user to obtain a reading in whichever direction their head points. The power source and corresponding circuitry are each encased in a plastic experimenter’s box and attached to the user’s belt.

Paweł Strumiłło et al. in [18], have discussed about an auditory space perception system is postulated that comprises of a 3D scene reconstruction (stereoscopy) and segmentation, object sonification and presentation of sounds with the use of HRTFs (Head Related Transfer Functions). Short review of electronic auditory display devices is given first. The concept of the wearable electronic travel aid (ETA) for the blind, that is currently under development at the Technical University of Lodz, is outlined. A PC based model of the wearable ETA system and the conducted pilot study is summarised. System modules, i.e., 3D scene rendering, object (obstacle) selection, and generation of sound icons are briefly characterised. The importance of Bregman’s theory of sound streams is indicated. Finally, the need for use of HRTFs for generating aspatialized auditory scene is explained.

Piotr Skulimowski et al. in [19], have discussed that communication demonstrates an application dedicated to the blind and visually impaired users of mobile phones. Unlike other supporting tools (like screen readers), the proposed solution comprises of a set of programs designed in cooperation with the target users and suited to their specific needs. Some novel phone functions were implemented in the latest version of the application that is dedicated for the phones running on Symbian OS 9+. One functionality deals with employing the digital phone camera for detecting colour of an object focused in the camera lens. The other one is to serve as a navigation tool for the blind. By combining specially pre-processed digital maps of the terrain and GPS read outs, the new module is aimed at aiding the blind in travelling in the urban environment.

G.Gayathri et al. in [20] have discussed about a simple walking stick equipped with sensors to give information about the environment. GPS technology is integrated with pre-programmed locations to determine the optimal route to be taken. The user can choose the location from the set of destinations stored in the memory and will lead in the correct direction of the stick. In this system, ultrasonic sensor, pit sensor, water sensor, GPS receiver, level converter, driver, vibrator, voice synthesizer, keypad, speaker or headphone, PIC controller and battery are used. The overall aim of the device is to provide a convenient and safe method for the blind to overcome their difficulties in daily life.

Dr. Boyina.S.Rao et al. in [21] have presented the method utilizes the Global Positioning System (GPS) and it also incorporates object avoidance technologies. The system applies a zigbee protocol to provide the continuous tracking of the visually impaired person. It also consists of additional components like ATMEGA microcontroller, ultrasonic sensor and microphone to provide more refined location and orientation information. The visually impaired person issues the command and receives the direction response using audio signals. The latitude and longitude values are received continuously from the GPS receiver and then transferred to the PC using the zigbee transceivers, using these values the localization of the visually impaired person is attained using Google map.

Saneesh. C. T et al. in [22] have discussed how to travel safely, confidently, and independently in the home and the community. Use of cane has many disadvantages such as limited perception and lack of depth assessment. In this paper, we have proposed a system that overcomes the difficulties faced by the cane by using ultrasonic sensor, GPS and GSM.

B.Amutha and M. Ponnavaikko in [23] have discussed an algorithm for accurate location information is being incorporated in the human walking model and in the blind human walking model. We want to implement an accurate location tracking mechanism using Zigbee along with GPS, we have incorporated Markov chain algorithm for establishing accuracy.

Naseer Muhammad and Engr.Qazi Waqar Al in [24] have proposed a new thought developing an intelligent stick equipped with GPS navigation system, which detect the obstacles in path and gives information about their location using GPS coordinates. The combination of ultrasonic sensors and GPS will detect the obstacles and determine the position and will gives information about location through Bluetooth.

K.Chandana and G.R. Hemantha in [25] have presented the device relies on providing navigation using GPS receiver with user required location names announcement and user relatives or a remote operator can provide real time assistance by monitoring the video transmitted by a RF camera. The RF camera at the user side acts as a transmission section continuously transmits video streams to RF receiver, acts as a receiving section. The RF receiver with antenna receives the video streams and displays it on the computer monitor using XGA TV box. The receiving video on the computer also contains the audio of the user. By hearing the audio of the user in the video, user relatives or a remote operator provides immediate assistance by identifying the user current staying locations and surroundings during the emergency conditions such as need of any medical help or in unsafe situations.

M. Naveen Kumar and K. Usha in [26] have discussed a system intended to provide overall measures –object detection and real- time assistance via Global Positioning System(GPS).The system consist of ultrasonic sensor, GPS Module, GSM Module and vibratory circuit(speakers or head phones). This project aims at the development of an Electronic Travelling Aid (ETA) kit to help the blind people to find obstacle free path. This ETA is fixed to the stick of the blind people. When the object is detected near to the blinds stick it alerts them with the help of vibratory circuit (speakers or head phones). The location of the blind is found using Global System for Mobile communications (GSM) and Global Position System (GPS).

Harsha Gawari and Prof. Meeta Bakuli in [27] designed a system uses GPS and voice recognition along with obstacle avoidance for the purpose of guiding visually impaired. The visually impaired person issues the command and receives the direction response using audio signals. The latitude and longitude values are received continuously from the GPS receiver. The directions are given to the user with the help of audio signals. An obstacle detector is used to help the user to avoid obstacles by sending an audio message.GPS receivers use NMEA standard. With the advancement in voice recognition it becomes easier to issue commands regarding directions to the visually impaired.

Megha Agarwal and Dr.S.R.N.Reddy in [28] have presented a low frequency RFID based Object Identification System (RFASSIST) that has been produced to help blind people toidentify various objects. RFASSIST uses an 8-bit PIC Microcontroller to interface RFID Reader Module. RFID reader tracks an object carrying passive RFID tag in an indoor environment. Microcontroller processes signals received from RFID reader. To provide assistance to the blind, the framework combines RFID based object identification with audio messages. It also displays the object’s name on LCD. This project stores the date and time of identification of object on PC using RS232 serial communication. The data was successfully stored in computer’s memory which can be later used as a data base in certain application

A.Dhanshri1and K. R. Kashwan in [29] have presented an effort to report a comprehensive method to design, characterize and test electronics system based on image matching, radar and ultrasound sensor principles for the aid of blind persons. The simulation results showed good accuracy for identifying objects. Simulations were carried out in MATLAB and images of test objects were acquired by using NI-LabVIEW platform. The main objectives were to acquire an image of obstacle, identify it, measure a distance from current location and finally convert text into synthesized voice. Finding is expected to be supportive to the vision affected people.

Prashant Bhardwaj and Jaspal Singh in [30] have proposed system which detects the obstacle via an infrared based detecting system and sends back vibro-tactile or sound (buzzer) feedback to inform the user about its position. The most common method of obstacle detection, used by blind people is the walking stick. The limitation of walking stick is that, it does not provide protection near to head area. A sensor module is fixed on a light weight cap allowing

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the user to obtain the information about obstacles and also about correct path on which the user should move.

Kiran G Vetteth et al. in [31] have presented the device uses a digital camera to capture the image frames directly in front of the user, and the processor implements image processing to determine the obstacle and a set of vibrational motors warns the user. The system also provides audio response. The sonar sensors detect obstacles in the user's immediate vicinity. Upon detection, the vibrational motors caution him/her regarding the presence of obstacles. Image processing is used to provide the lateral distance between the obstacle and the user, so as to provide distance perception.

Rodrigo C. Belleza et al. in [32] have presented a prototype that utilizes the Microsoft Kinect for Windows and Arduino microcontroller board. The prototype facilitates advanced gesture recognition, voice recognition, obstacle detection and indoor environment navigation. Open Computer Vision (OpenCV) performs image analysis, and gesture tracking to transform Kinect data to the desired output. A computer vision technology device provides greater accessibility for those with vision impairments.

Nitish Sukhija et al. in [33] have discussed a Smart stick for blind man, a machine that can follow a path. The path can be visible like a black line on a white surface (or vice-versa) or it can be invisible like a magnetic field. Sensing a line and manoeuvring the robot to stay on course, while constantly correcting wrong moves using feedback mechanism forms a simple yet effective closed loop system. As a programmer you get an opportunity to 'teach' the robot how to follow the line thus giving it a human-like property of responding to stimuli.

Abhishek Choubey and Dattatray Patil in [34] have proposed the simple and economical system which is low cost implementation of embedded system with RFID, its sensor and cognition device. It is proposed that the RFID tag should be embedded in walking ways in a fixed manner with unique identifiers. When blind person moves around the sensor placed in stick energies the embedded tags and reads the tag ID. The cognitive algorithm in cognition device decodes the address of information message associated with it regarding the place. It will further play an audio file which will tell the person about the locality and the moving person get the guidance about local place and his desired movement.

Arjun Sharma et al. in [35] have discussed the embedded system dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. The blind navigator is mainly used Ultrasonic sensor (US sensor) and Infrared sensor (IR sensor). A microcontroller (or MCU) is a computer-on-a-chip used to control electronic devices. A typical microcontroller contains all the memory and interfaces needed for a simple application. The APR sound system is use for audio instruction.

Sushant Mahalle and Himanshu lokhande in [36] have discussed a system uses AT89S52/LPC2148 microcontroller based embedded system to process real time data collected using ultrasonic sensor network. Based on direction and distance of detected obstacle ,relevant pre-recorded speech message stored in Voice and play back circuit. Such speech messages are conveyed to the subject using speaker on voice and playback circuit.

M. Mathankumar and T. Kavitha in [37] have presented the system uses PIC microcontroller and RFID technology. The blind people are provided with low power RFID reader when they step into the supermarket. In the supermarket, products are segregated and placed in the shelves. Each shelf is integrated with a passive RFID tag along with unique ID which describes the category of the product and its specification. The passive tag information is read by the RFID reader and sent to microcontroller. The read tag ID is matched with recorded audio file in the APR9600 IC and played through the speaker which is embedded with the RFID reader. As the recorded audio file is unique to each product and clearly specifies about the product, they can decide about acquiring the item by listening to the audio.

V. Ramya et al. in [38] have discussed the advancement in modern day with electronic sensors, touch sensing and microcontroller technology, the proposed system aids the visually impaired in navigation via audible messages and haptic feedback, helping them localize where they are and to improve their mobility. This system supports the visually impaired to enter notes and control device operation via touch keypad. The device also provides user information in audio format, including navigation direction, ambient light and temperature condition.

B.P. Santosh Kumar et al. in [39] have discussed about an instrument, which is the outcome of robotics and bioengineering, and it is called "Guided Microcontroller". It is a robotics-based obstacle-avoidance system for the blind and visually impaired.

A device, called Guided Microcontroller, uses the mobile robotics technology is a wheeled device pushed ahead of the user via an attached cane. When the Guided Microcontroller detects an obstacle, it steers around it. The user immediately feels this steering action and can follow the device's new path easily without any conscious effort.

Osama Bader AL-Barrm and Jeen Vinouth in [40] have designed a portable stick that detects the obstacles in the path of the blind using ultrasonic sensors. It consists of these sensors to scan three different directions, a microcontroller, buzzer and DC vibration motor. The buzzer and vibration motor is activated when any obstacle is detected. In addition, the stick is equipped with GPS and SMS message system. GPS system provide the information regarding the location of the blind person using the stick to his family members. SMS system is used by the blind to send SMS message to the saved numbers in the microcontroller in case of emergency.

Akella.S.Narasimha Raju et al. in [41] have presented a Guide Cane used for the purpose of blind navigation system. Obstacle sensor senses the object in front of the blind and informs him. Direction to the blind people are given through RF communication from the survived data base in this way Electronic Travel Aid (ETA) is developed for blind person.

V. DhilipKanna, et al [42] have addressed a virtual eye for blinds which communicates to the surroundings through a camera. The LADAR (Laser Detection and Ranging) is used for locating objects distance from visually impaired. PID (Passive Infrared Detector) is used for motion detection. It measures IR light radiation from objects in its field of view. Virtual object detector (VOD) is used for recognizing the object viewed by camera using online database. Location identification is done by GPS. They have experimented on FPGA with Zigbee transmitter. The entire computation is main processing unit is done within few ms. System can be used in noisy environment. But it only works for still images. Image transmission delay using ZIGBEE is not specified.

CONCLUSION

In general the research work carried out so far can be classified on the basis of

1. Ultrasonic Sensors used for detection of static and dynamic obstacle detection
2. Static and moving camera
3. Number of cameras used
4. Type of hardware used
5. Type of image transmission
6. Algorithm used detection of static and dynamic obstacle detection
7. Measures used for performance evaluation

There is a need to focus the research on static and moving obstacle detection using camera. The objective of research should be to develop specific algorithm to serve the need of visually impaired.

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