A Survey on Assistance System for Visually Impaired People for Indoor Navigation

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Abstract: In the past few years, the variety of wearable devices and remote processing systems developed for assisting visually impaired people for indoor navigation as well as for outdoor navigation. The main aim of such assisting wearable devices, smart phone applications and remote processing units is to find out a plausible path in the real-time environment for secure navigation. To sense the surrounding environment by applying techniques of computer vision domain such as visual information processing by using image processing methodology is one of the challenging task. This paper reviews various types of assisting systems developed for vision less people for indoor navigation.

Index Terms: Vision less, Computer Vision Environment, Image Processing, Visual Information, Wearable Device.

I. INTRODUCTION

According to the survey published by World Health Organization (WHO) about the vision less or visual impairments scenario of people all around the world in 2015 suggests that there are around 240 million people suffering from low vision and around 39 million people are completely blind and total affected account due to the low vision is around 940 million.

Visually impaired people have high difficulty in doing their daily routines. Due to low vision or blindness, they suffer by an inferiority complex and also it affects their economic conditions because of less efficiency in doing the work and the cost of the treatment .The major difficulty faced by visually impaired people while navigating or traveling in the unknown surrounding .The main objective while navigation is to find out obstacle free path for the secure navigation. Traditionally with the help of the animal guidance specially with the help of the dog ,the navigation is carried out. The main problem regarding with the help of the dog guidance is that only the obstacles below the knee level get identified. Also, the there is no complete guarantee to reach at destination location with the help of the sensing ability of the dog. The invention of the white cane made the significant impact in the field of the blind navigation because of its low cost and easy use. The white cane gives the ability to navigate the blind person on their own in unknown environment. The main drawback of the white cane that it is unable to find out the obstacles present above the waist size of the person so that it is not also completely secure. Now a day's variety of approaches proposed in the field of computer science for designing of the visual image processing with the help of the image processing methodology and robotic techniques is carried out int real time to travel the plausible path. There are mainly two fields related to the designing of the assistance system are obstacle avoidance and guiding sensed information feedback to the person.

A]Obstacle Detection And Avoidance

There are different types of sensors used for environmental sensing. On the basis of the sensor type, the obstacle avoidance method can be categorized as ultrasonic and infrared sensor-based method, radar and laser scanner-based method, a camera-based method. [1]Ultrasonic sensors are based on the depth and range data. They are simple to use and has a very low cost. The poor angular resolution is one of the disadvantages of this system. Also, the inference problem has occurred when the array of ultrasonic sensors is used. Radar and laser scanner-based method is generally used for robot navigation with high precision and accuracy. But laser scanner is very expensive and because of its high-power consumption and bulkiness, it is unable to place over the wearable device. Now a day's camera-based method frequently used for sensing visual information.[5]RGB-D cameras have been recently and widely used in the designing of the wearable device. RGB-D camera provides both range information and intensity of the object. The RGB-D camera sensor provides information through active sensing and passive sensing regarding with colour, intensity and depth measurement. By using a combination of these, the plausible path by using the concept of the floor segmentation technique can be traversed .Also with these information 3D mapping of the environment is done and the traversable path is analyzed.

B]Guiding Feedback Sensed Information

There is a need for communicating the information sensed by the assistance system to the user. The sensed information is given to the person through three main techniques namely as haptic (vibrations) technique,visual technique and audio technique. In the [5] haptic technique, the vibrations are generated to guide the sensed information through wearable devices. The main drawback of the haptic technique is it is unable to guide the complex information to the person. The second method is an audio method in which the given RGB image is mapped into the acoustic pattern, semantic speeches or predefined set of voices to guide the plausible path. The third is the visual technique in which the LED's brightness used for visualizing the obstacle with it probable distance. Above all the most frequently used technique is the audio technique because it provides the direction of the traversable path and also the overall environmental scenario with semantic speech.

II. LITERATURE REVIEWE

A] The Assistance System Using RGB-D Sensor With Range Expansion

[1]Alarden et al. proposed the new system consisting of the wearable device having the RGB-D camera for both active and passive sensing and headphones for giving the feedbacks about the surrounding environment to the user. The wearable device finds the obstacle-free path by using the floor segmentation technique of the image processing. With the help of the range information, the floor from all other obstacles gets distinguished in the given environment scenario. For actual navigation, this depth information about the floor and obstacle get integrated with the visual information that is getting acquired through passive sensing to find out the obstacle-free path by using 1. Polygonal Floor Segmentation and 2. Pyramidal Filtering

B] The Assistance System Using Windowing-based Mean on Microsoft Kinect Camera

[2]Ali and Mohammad proposed the navigation system, It consists of the wearable device having Depth Microsoft Kinect camera for the active and passive sensing of the surrounding and headphone for the feedback to the user by the assistance device. The input data of 16-bit unsigned integer converted into the 8-bit unsigned integer. For removing the noise, median filter technique and Gaussian low pass filter get used. The actual object detection carried out by using the windowing method in which input array of pixels get divided into the number of different sub- arrays and object get identified with respect to horizontal and vertical partitions. The distance of the detected object with respect to the depth camera get calculated with respect to the brightness of the object.

C] Novel Indoor Navigation System

[3]The novel indoor assistance system proposed that, the institute or the house with IP cameras installed over ceilings of the room for detecting the motion of the visually impaired system. The Computer vision based real-time image processing algorithm get implemented over the remote processing unit with the help image processing library called OpenCV. A user will communicate with the remote processing unit via a smart mobile application interface through voice commands by mentioning the interested destination location inside the institute or home. The destination location information of user's interested navigation path gets convert into text and communication with remote processing unit get established through Wi-Fi or Blue tooth. The information about navigation direction to the user get conveyed through audible feedback via smart phone application in a real-time environment.

D] The Low-cost Helmet-Mounted Camera

[4] Suman Deb et al. proposed the wearable device which is helmet as an assistance system for indoor and outdoor navigation. For the real-time path traversing, the camera is mounted over the helmet. The proposed system creates the map of the surrounding area and whether given environmental scenario is traversable or not get decided .The preprocessing of the RGB image is done for noise filtration for that RGB color space is converted into HSL image. The pyramidal segmentation is carried out by two approaches namely Gaussian pyramid and Laplacian pyramid. Then edge detection is carried out for extracting actual information about path and obstacles only by horizontal, vertical and diagonal edges. The template matching is done by using the safe window method.

E] Smart Guiding Glasses

[5]Jinqiang Bai et al. proposed the smart guiding glasses for visually impaired people for the indoor environment. To develop the "ETA" (Electronic Travel Aids) for Visually Impaired people based on the "Multisensor fusion based algorithm" is the main of the proposed system. The combination of ultrasonic sensors and the depth camera provides better assistance than particular use of either of them.

F] Assistance System for Describing Indoor Scenes for Visually Blind People

[6]The main aim of the proposed system is to develop effective Image processing technique for the real-time navigation system for the visually impaired people. There are multiple objects present in the surrounding environment. To identify important objects and obstacles according to blind person perspective is important task so that proposed methodology provides coarse image description by using the concept of the "Compressive Sensing" and "Multi-labeling of the Image ". Authors claim that this system provides better object detection for depth images having multiple objects in the surrounding environment.

G] Improved Object Detection System for NAVI To Sensed Information Feedback

[7]R. Nagarajan et al. proposed the new approach for multiple objects detection in real-time image processing. To provide preferences to the objects by Neural Network and Closed Boundary technique is the main aim of the proposed technique. The proposed system reduces the ambiguity in case of multiple objects present in the surrounding.

H] Learning Platform for Visually Impaired Children

[8]B. K. Balasuriya et al. Proposed the application for visually impaired children between the age 6-14 for identifying the 3D object in an indoor environment as well as in outdoor location without any third party help. It consists of 3 modules namely outdoor object recognition model, indoor object recognition model and dialogue generator module for surroundings environment description. These modules are based on feature extraction through RGB image by using Convolutional Neural Network. The sign conventions recognition and object recognition are important features of this application.





III . COMPARISON OF THE REVIEWED SYSTEMS

1.System	2.Collision Avoidance & Object Detection (Yes/No)	3.Guiding Feedback Method& Device&	4. Feature	
		Sensors Used		
1.The assistance system using RGB-D Sensor with range expansion	1.Yes 2.Yes	1.Audio 2.Wearable Device ,RGB-D Camera	[1]Floor Segmentation with 99% accuracy	
2.The assistance system using windowing-based mean on Microsoft Kinect camera	1.Yes 2.Yes	1.Audio 2.Wearable Device, Kinect Camera	[2]Object Recognition by using windowing method in the range of 4m by using OpenCV	
3.Novel indoor navigation system	1.Yes 2.No	1.Audio 2.Remote Processing Unit, Camera, Wifi, Blue tooth	[3]Traversing of path by using computer vision algorithm implemented by using OpenCV with less complexity	
4.The low-cost helmet-mounted camera	1.Yes 2.Yes	1.Audio 2.Helmet, RGB camera	[4] Robust with image noise, quality, camera vibrations working on 25fps	

1.System	2.Collision Avoidance & Object Detection (Yes/No)	3.Guiding Feedback Method& Device& Sensors Used	4. Feature
5.Smart Guiding Glasses	1.Yes 2.Yes	1.Audio 2.Wearable Device,ultrasonic sensors,RGB-D camera	[5]Multi sensor fusion based algorithm by using floor segmentation
6.Assistance System for Describing Indoor Scenes for Visually Blind People	1.Yes 2.Yes	Wearable Device RGB Camera	[6] Multi labeling of the Image
7.Improved Object Detection System for NAVI	1.Yes 2.Yes	1.Audio 2.Wearable device,RGB Camera	[7]Find out important objects from multiple objects by CNN

IV. Conclusion

In this study, we have examined various designing approaches for building assistance system for visually impaired people. There are mainly two modules in designing of any assistance system as traversing the path by avoiding collisions and sensing the surrounding environment. The survey focuses on the study of various kinds of sensors and computer vision based image processing techniques used for the indoor navigation. Each sensor and techniques have its advantages as well as a drawbacks. However, amongst the analyzed sensors RGB-D sensor has the least amount of drawbacks and because of its active and passive sensing capabilities, the image processing techniques can be implemented with high performance. Because of these advantages, it is widely used in designing of assistance system. The complex information is easy to analyze in audio-based feedback method so that audio-based guidance is widely used for giving feedback about surrounding visual information. OpenCV library widely uses for image processing techniques.

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