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Virtual Blind Navigation Device with Interactive Assistance

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ABSTRACT: A smart device with several features in order to help the blind person to walk efficiently and safely on the indoor and outdoor environment. The blind persons are not able to find the locations and obstacles, to this issue navigation system with a smart device. This includes a location finding guide, obstacles detecting sensors, with an E-speaker based on the IoT. Raspberry pi3 controller is used for information transferring and storage purpose. To capture the things and to detect the way IP webcam server is linked with the mobile camera. Ultrasonic sensor is used for detecting the obstacles on the indoor and outdoor environment. These are the key component on the smart device that a blind person would easily carry with them. This smart stick is based on the IoT with an internal structural design with it.

KEYWORDS: Ultrasonic sensor, GSM Module, Raspberry Pi controller.

I. INTRODUCTION

The visually impaired people usually have difficulties in walking in an unfamiliar and complex place independently. To provide them an automatic navigation device with effective guidance on their move, to find where they located and to make a correct decision for guiding the person, and to help the visually impaired person to reach his destination, this device has been introduced [1]. This is known as goal recognition. This includes way-finding, route following, and obstacle detecting [9]. Way finding is to plan a shortest path from the starting position to the destination, route following is to make sure the blind person follow the planned path and obstacle detecting is to help him avoid obstacles. The visually disabled people have difficulties in walking and they are not able to detect anything and find their way independently. In order to provide a helpful automation navigation system, a smart device with an advanced system using IoT is installed [8]. The device has known to find the location with the help of the IP webcam server, this device helps them to find their way through the google assistant, this includes way finding, route following features.
To find the obstacles ultrasonic sensor is used that helps to detect any obstacles and to avoid obstacles in their way [3]. There are many navigation systems so far proposed to solve the above problems faced by the visually impaired people, as they are of high cost or globally for the shortest path, although some electronic travel aids were designed [11], in this detecting and avoiding the obstacles are ignored. To overcome the existing system of the blind navigation by producing even better helpful device for the visually impaired people, is to add the additional features to the navigation system that can be easily carry as a smart device [4]. The navigation system for the indoor and outdoor environment is based on the visual localization through the server linked with the mobile camera and the way-finding, route following and obstacles can be detected [9]. This is less weight and of low cost that can be affordable to blind persons. GPS-based blind navigation can be used in indoor and outdoor environment for location finding, along with the Google assistance.

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II. KEY FEATURES OF THE SYSTEM

The main key features of proposed security system are Indoor and Outdoor localization ,
There are many wireless localization systems that utilize UWB (Ultra Wide Band) radar, and RFID (Radio Frequency Identification). UWB radar has been a particularly attractive technology for indoor localization because it is not susceptible to interference from other signals (due to its drastically different signal type and radio spectrum), and the UWB signal (especially the low frequencies included in the broad range of the UWB spectrum) can penetrate a variety of materials, including walls [1]. UWB radar achieves very high localization accuracy, which can be up to 10 cm [4]. The slow progress in the UWB standard development has limited the use of UWB in consumer products and portable user devices. RFID based systems can be used for localization and object tracking as they have a reasonable range, low cost and can be easily embedded in the tracking objects[7]. However, the limited range makes them unsuitable for high precision indoor localization.
It is favourable for localization of sensors in WSN (Wireless Sensor Network), but it is not suitable for indoor localization as it cannot provide the distance between the user and the labelled sensor [12]. Most of the existing bluetooth based localization systems relay on RSSI (Received Signal Strength Indicator), however, they are prone to multipath fading and environmental noise, lower localization accuracy due to its signal band which is the same with other signals. Thus, only bluetooth based localization system has very large uncertainty in localization. Most of portable consumer devices (e.g. smart phones, laptops) are Wi-Fi enabled [6], for indoor and outdoor localization. However, existing Wi-Fi networks are normally deployed for communication rather than localization purposes. Therefore their localization accuracy still needs improvement, by connecting web camera server with the Wi-Fi network.

B. Way-Finding and Route Following
The sparse map built by the Google assistance is used for providing the global path. An algorithm was adopted as the way-finding [10]. After the globally shortest path from the starting position to the destination was found, the route following algorithm will provide accurate guidance information to ensure that the user can follow the globally shortest path and avoid obstacles. The route following algorithm in takes the globally shortest path and an advanced knowledge of indoor environment as inputs, and outputs a control strategy that makes the user's trajectory remain close to the globally shortest path [5]. It selects some special nodes (e.g. entrance node, room node and intersection node, etc.) as sub-goals to guide the user.
A path deviation detecting method which is based on measuring the similarity between the current frame and the training frame of the pre-defined path [10].The dynamic obstacles and changes of the environment were not considered. Hence, it is not able to help the blind avoid dynamic obstacles but to overcome the above problems, a dynamic sub-goal based route following algorithm was proposed in this system. The sub-goal is selected dynamically, which includes but is not limited to the special node as mentioned. The above route following algorithm combining the obstacle detecting method which takes the dynamic obstacles and changes of environment into account, and the globally shortest path, output the optimal walkable direction to ensure the user follow the globally shortest path closely at the same time we avoid the obstacles [3].
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III. SYSTEM SETUP

. In this scheme, the architecture of the navigation system is illustrated in Fig.1, which includes visual way finding, obstacle detection and route following module. The rendering module converts the guiding information produced by the navigation system into audio voice that can be heard through earphones.The route following module takes the current pose of the blind using the IP web camera server, and the obstacle distance measured by the ultrasonic wave as inputs and uses a dynamic sub-goal selecting method to produce the guiding information [10]. This allows the user to follow the globally shortest path as closely as possible and avoid obstacles at the same time. Fusing the IP web camera and the ultrasonic rangefinder for obstacle detection can ensure adequate safety of the visually impaired individual.
The Ultra sonic sensor sends the wave to the Raspberry Pi [11]. The Raspberry Pi3 Controller, used to done the Graphical accelaraization, Encoder and the Decoder applications should be done within the controller. There should be so many applications and the systems working inside the Raspberry Pi. In this process the captured images should be converted in to the text documents then text will be converted in to the audio format using some application

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A. BLOCK DIAGRAM

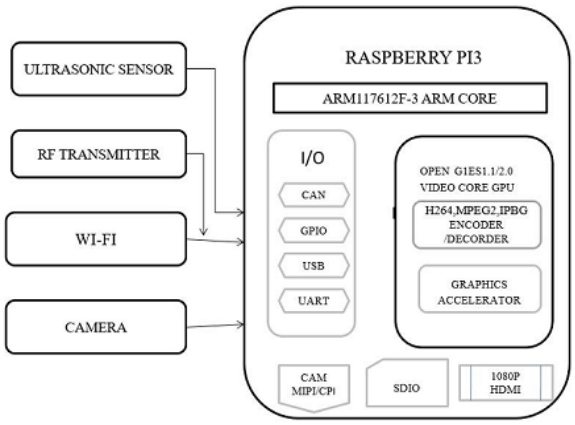

Fig 1 Block Diagram

The block diagram consists of Raspberry pi3 controller that acts as the mini computer, consists of both input and output pins. The ultrasonic sensor is fused with it for obstacle detection, RF transmitter is used for find the device if it missed , by transmitting the radio frequency signal , Wi-Fi is used for web cam server connections. Secured digital input output is used for securing the data stored.

V. MODULES WITH WORKING PRINCIPLES

A. Ultrasonic Sensor

The architecture of this sensor is shown in the fig.2. It measures distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic sensor measures distance to the target by measuring the time between the emission and reception. Ultrasonic sensor is used to detect any obstacle from the receiver side.

Fig.2 Ultrasonic sensor

B. Raspberry Pi3

The Raspberry Pi3 model is a small credit card size computer. A keyboard, mouse, display, power supply, micro SD card with installed Linux Distribution and have a fully-fledged computer that can run applications from word processers and spreadsheets to games. This device is like a small computer. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. Raspberry Pi 3 has 1 GB of RAM. It can be boot from the USB or from the flash drives. Raspberry Pi3 also supports wireless internet out of the box, with built-in Wi-Fi and Bluetooth. By attaching hardware like LEDs, sensors and motors to these pins you are able to interact with this hardware.

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Fig .3 Raspberry Pi3

C.GSM Module

GSM (Global System for Mobile communication) is a digital mobile network that is widely used by mobile phone users. GSM uses a variation of time division multiple access and is the most widely used for the three digital wireless telephony technologies. It is the part of the evolution of wireless mobile telecommunication that includes High-Speed Circuit-Switched Data, Universal Mobile Telecommunications Service

Fig .4 GSM Module

D.IP Webcam

IP Webcam is an Android app that lets you transform your phone into a network camera which will let you remotely view videos that are captured real-time. You can view the video via a browser or stream it over your phone.

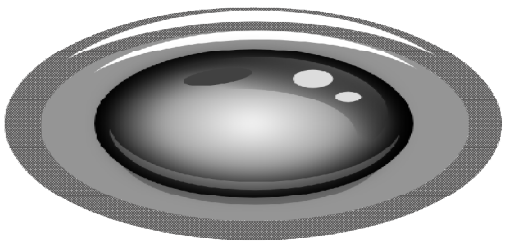

Fig.5 IP Webcam Android App

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An Internet Protocol camera, or IP camera, is a type of digital video camera that receives control data and sends image data via the Internet. They are commonly used forsurveillance. Unlike analogclosed-circuit television (CCTV) **cameras**, they require no local recording device, but only a local area network.

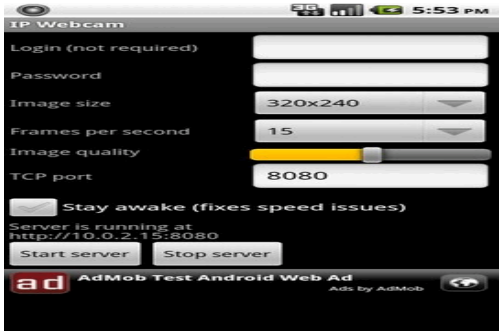

Fig.6 IP Webcam server

VI. RESULT AND CONCLUSION

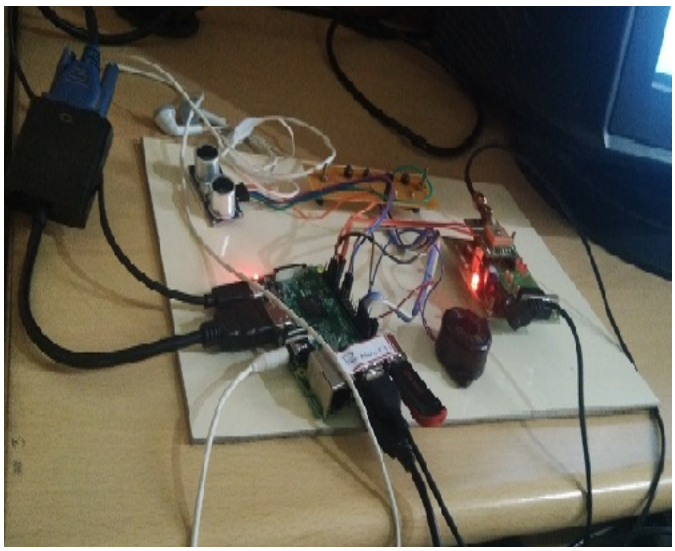

Fig 7 Implemented Prototype

In the fig.7, the implemented prototype for the visually impaired groups to help them reach the destination safely and efficiently is illustrated. A smart device, with several features is introduced here, in order to help the blind person to walk very easily. The proposed navigation device consists of an IP web camera and an ultrasonic rangefinder, an embedded monitor, and an earphone.

The IP web camera used for monitoring virtual-blind-road and locating the user precisely with visual algorithm [7]. It consists of an ultrasonic sensor to measure the distance of an obstacle in front of the users. Fusing the IP web camera and the ultrasonic rangefinder for obstacle detection can ensure adequate safety of the visually impaired individual. All the algorithms such as visual, obstacle detecting, way-finding, route following, speech synthesis, etc. are performed on the controller. The earphone is used for playing the guiding sound to the totally blind individuals when they are in a noisy indoor environment. The SD card is used to store the data fetched by the camera. Raspberry Pi3 controller is the minicomputer programmed by python and connected with ear phones. Four buttons are in built for sending mail to the neighbour seeking help, and to location finding with GPS system. This includes way-finding, route following along with obstacle detecting. Way finding is to plan a shortest path from the starting position to the destination, route

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following is to make sure the blind person follow the planned path. The ultrasonic sensor shown in Fig.2, fitted at the bottom of the device for detecting the obstacles in front of the person. On the top Raspberry pi3 controller is placed with the mobile display for monitoring the path along with the Earphones. GPS used for sharing and locating the persons.

VI.CONCLUSION

In order to solve the common aiming problem for blind users, we have proposed a region of interest method to detect the object, while the blind user simply shakes the object for a couple of seconds. This method can effectively distinguish the object of interest from background or other objects in the camera view. To extract text regions from complex backgrounds, we have proposed an edge based text region extraction. The corresponding feature maps estimate the global structural feature of text at every pixel. The localized text regions are transformed into audio output for blind users by using text to speech synthesizer. The sensors embedded on the device have the characteristics of low cost, small size and easy integration. Thus, it has great potential in consumer market, especially electronic travel aids market.

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