Virtual blind Road following based navigation device for blind people

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Abstract: To help the blind people walk to the destination efficiently and safely in indoor environment, a navigation device is presented in this paper. The locating, way-finding, route following and obstacle avoiding modules are the essential components in a navigation system, while it remains a challenging task to consider obstacle avoiding during route following, as the indoor environment is complex, changeable and possibly with dynamic objects. To address this issue, we propose a novel scheme which utilizes a dynamic sub-goal selecting strategy to guide the users to the destination and help them bypass obstacles at the same time. This scheme serves as the key component of a complete navigation system deployed on a pair of wearable optical see-through glasses for the ease of use of blind people’s daily walks. The proposed navigation device has been tested on a collection of individuals and proved to be effective on indoor navigation tasks. The sensors embedded are of low cost, small volume and easy integration, making it possible for the glasses to be widely used as a wearable consumer device.

1. 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, three problems should be considered: Where is the person? The device has to know where the person is located in order to make a correct decision for guiding the person. This refers to be the localization problem. Where does the person want to go? In order to help the visually impaired person reach his destination, the device has to identify the destination. This is known as goal recognition. How does the person get there? This includes way-finding, route following and obstacle detecting.

The existing system uses a GPS based blind navigation technology which cannot be used due to the severely degradation of GPS signal in indoor environment. So to overcome this problem we modify the existing system. The aim is to develop an effective wearable navigation system which can locate the user, follow the virtual-blind-road and avoid obstacles at the same time, in order to provide automatic navigation for the visually impaired people. The main contribution of this paper is the proposal of a novel dynamic sub-goal selecting based virtual-blind-road following scheme which combines the obstacle avoiding algorithm for guiding the blind people to follow the globally shortest virtual-blind-road without collision.

2. DESIGN AND EXPERIMENTAL DETAILS

BLOCK DIAGRAM:

The above block diagram clearly shows that the RFID Tag Reader and Ultrasonic Sensor act as input devices to the Arduino to send data and the LCD, APR9600 and the speaker act as the output devices to perform task specified in the commands of Arduino and thereby generating the suitable output.
Arduino UNO microcontroller board as a platform for open source hardware and software. The Arduino UNO consists of ATmega328p microcontrollers. Arduino hardware is programmed in a wired language (syntax and library), such as C++ with minimal modification and a combined processing environment. It allows communication between computers through programming. It receives the input signal from the sensor, and then generates the output voltage.

ULTRASONIC SENSOR:
Ultrasonic sensors are industrial control devices that use sound waves above 20,000 Hz, beyond the range of human hearing, to measure and calculate distance from the sensor to a specified target object. The sensor has a ceramic transducer that vibrates when electrical energy is applied to it. The vibrations compress and expand air molecules in waves from the sensor face to a target object. A transducer both transmits and receives sound. The ultrasonic sensor will measure distance by emitting a sound wave and then "listening" for a set period of time, allowing for the return echo of the sound wave bouncing off the target, before retransmitting.

RFID Reader:
The reader, or scanner, functions similarly to a barcode scanner; however, while a barcode scanner uses a laser beam to scan the barcode, an RFID scanner uses electromagnetic waves. To transmit these waves, the scanner uses an antenna that transmits a signal, communicating with the tags antenna. The tags antenna receives data from the scanner and transmits its particular chip information to the scanner.
RFID Tag:
RFID tag is a small device which stores and sends data to RFID reader. They are categorized in two types – active tag and passive tag. Active tags are those which contain an internal battery and do not require power from the reader. Typically active tags have a longer distance range than passive tags. Passive tags are smaller and lighter in size than the active tags. They do not contain an internal battery and thus depend on RFID reader for operating power and certainly have a low range limited up to few meters.

Fig:–RFID TAG

APR 9600 VOICE IC:
The APR9600 device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The IC is 28 pin device used to record & playback of maximum of 8 messages. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. the device is ideal for use in portable voice recorders, toys, and many other consumer and industrial applications.

The replayed sound exhibits high quality with a low noise level. Sampling rate for a 60 second recording period is 4.2 kHz that gives a sound record/replay bandwidth of 20Hz to 2.1 kHz. However, by changing an oscillation resistor, a sampling rate as high as 8.0 kHz can be achieved. This shortens the total length of sound recording to 32 seconds.

Total sound recording time can be varied from 32 seconds to 60 seconds by changing the value of a single resistor. The IC can operate in one of two modes: serial mode and parallel mode. In serial access mode, sound can be recorded in 256 sections. In parallel access mode, sound can be recorded in 2, 4 or 8 sections. The IC can be controlled simply using push button keys. It is also possible to control the IC using external digital circuitry such as micro-controllers and computers.

This APR9600 voice IC has 28 pin DIP package works in supply voltage between 4.5V & 6.5V. During recording and replaying, current consumption is 25 mA. In idle mode, the current drops to 1 mA. The APR9600 experimental board is an assembled PCB board consisting of an APR9600 IC, an electrets microphone, support components and necessary switches to allow users to explore all functions of the APR9600 chip. The oscillation resistor is chosen so that the total recording period is 60 seconds with a sampling rate of 4.2 kHz. The board measures 80mm by 55mm.

Fig:–APR9600 Experimental board

SPEAKER:
A loudspeaker corresponding sound. The most widely used type of speaker in the 2010s is the dynamic speaker, invented in 1924 by Edward W. Kellogg and Chester W. Rice. The dynamic speaker operates on the same basic principle dynamic microphone, but
in reverse, to produce sound from an electrical signal. When an alternating current electrical audio signal is applied to its voice coil, a coil of wire suspended in a circular gap between the poles of a permanent magnet, the coil is forced to move rapidly back and forth due to Faraday's law of induction, which causes a diaphragm (usually conically shaped) attached to the coil to move back and forth, pushing on the air to create sound waves. Besides this most common method, there are several alternative technologies that can be used to convert an electrical signal into sound. The sound source (e.g., a sound recording or a microphone) must be amplified or strengthened with an audio power amplifier before the signal is sent to the speaker, or loudspeaker or speaker is an electroacoustic transducer, a converts an electrical audio signal into a audio signal.

Fig:-speaker

RTL schematic diagram:

The above figure shows the Schematic diagram of entire circuit. The 12V battery is connected to the Arduino through a bridge rectifier and a voltage regulator to decrease voltage to 5V. The LCD connected to Arduino displays the comments and object information. The ultrasonic sensor is used to detect the obstacle on the way and send information to controller. The RFID Tag Reader connected to Arduino is used to identify the obstacle and inform it to user. The APR9600 act as an output device which records and stores the voice messages of the objects which are replayed when the same object is detected. The MIC is used to record the voice messages which is connected to APR9600 and the messages are replayed using the speaker connected to it.
3. Results:

![Virtual Blind Road Following Based Navigation Device for Blind People](image)

The above figure shows the entire connection of the virtual blind road following based navigation device for blind people. The voltage regulator along with the bridge rectifier is used to reduce the voltage of the battery. The ultrasonic sensor and the RFID tag reader are used to detect the obstacle and the APR9600 is used to inform about the obstacle to the user.
The above figure represents the detection of the obstacle using the ultrasonic sensor and display it to be wall in the LCD display. The APR9600 replay/recorder informs the user as obstacle detected through the speaker.

**Conclusion:**
The project proposed the design and architecture of a new concept of navigation device for visually challenged. The main advantage of the system is that it can be operated easily and is cost efficient and is available to millions of people around the world. The system is a combination of various working units make it a real-time system that monitors the surroundings of the user and provide information about the objects around him.

It can be further improved by embedding certain number of ultrasonic sensors and RFID tag reader thereby by increasing the accuracy of the device and use it for multiple applications by using different sensors. The device can be further enhanced by using VLSI technology to design the PCB unit which makes the deice more compact.

It is more effective if the ultrasonic sensors are placed at different positions on the body. The device can be upgraded to be worn as a belt which makes it easy to be carried. The sensor can be used to provide the distance of the object from the user and make it easy for the user to identify its position.

**References:**