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IGuide an Electronic Aid for Visually Impaired

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Abstract

IGuide is a travel aid to help visually impaired to provide obstacle free path, wet floor detection and live location of the user. A few specialists created electronic 'travel helps' to help and improve speed and versatility of an individual who is outwardly hindered. IGuide is one of the electronic 'travel helps' that gives client wellbeing and organized data through material and sound criticism instruments. The objective of the IGuide system is to offer simplified information of the surrounding environment to the user and to deduce prioritized information without causing information overloading. The device comprises of a low power embedded system with ultrasonic sensors, APR module, Wi-Fi module vibration motors, and a battery. Furthermore, we are including a Wi-Fi module which helps in providing live location of the user in case of emergency. Evaluation of the IGuide on people with visual impairments has shown effectiveness and usefulness irrespective of the number of years of blindness.

Keywords: *Assistive technology, Blindpeople, electronic travel aid, man machine systems, navigation, obstacle detection, rehabilitation, visually impaired people, wearable system*

INTRODUCTION

Visual perception plays an extremely significant job in getting information about the surrounding scene. Mapping of any scene and exploring can be a simple task for anybody, however it is a knownactuality that it isn't that basic for visually impaired individual. As indicated by the World Health Organization, in 2013, there were around 285 million partial/total blind individuals out of which 39 million were totally blind [1]. Movability helps to improve the personal satisfaction of the visually impaired individuals by giving them self-confidence. The amount of outwardly weakened people has been foreseen to twofold by 2021. Throughout the years, white sticks have been utilized by the visually impaired/outwardly debilitated for giving help. Visually impaired individuals have been utilizing white-sticks to travel autonomously for a long time.

Figure 1: *Expected output of IGuide.*

Each visually impaired individual has various purposes behind utilizing sticks. Some of them utilize guided canines yet they require broad preparing, while others utilized a stick to caution individuals that they were descending the road. A portion of the white stick clients will pick straight sticks over different sticks, as it is progressively solid, while others incline toward foldable sticks that can be collapsed and makes it convenient for putting away purposes.

However, both white canes as well as guided dogs have few short comes which are listed below:

- Cane can be more cumbersome and it can get stuck in cracks and pit holes and there are chances of getting a poke in the stomach
- Canes are not suitable for all kind of floors, i.e., it cannot be used in snow regions or wet floors.
- A guided dog requires extensive training and is also expensive.

Figure 2: *Blind person with cane stick and guided dog.*

Numerous electronic travel aids (ETA) have been developed throughout the years for helping their portability challenges. These ETAs are accessible in various structures, for example, handheld gadgets, sensor sticks, and wearable frameworks. However, acknowledgement of these aids is very less among the visually impaired people. The reason for this is not that visually impaired people are resistive to recent technologically developed systems. Instead there is always a scope for further research to expand the usage of ETAs [3].

Echolocation framework for the visually impaired (ESB) is one of the travel aids that utilized customary eyeglass. The VOICE, NAVI were also ETAs which made use of a camera embedded on an eyeglass. However, these ETAs made the overall system bulky and also failed to detect wet floors. K Sonar cane was an ETA that used sensors on the cane. However, it required extensive training.

In order to overcome the limitations of the existing ETAs, we have come up with a new ETAcalled IGuide. IGuide is a wearable device in the form of a boot which consists of ultrasonic sensors to detect floor level and knee level obstacles, a moisture sensor to detect wet floor and a

Wi-Fi module to detect the live location of the user in case of emergency. In this way, IGuide can be used to replace all other existing travel aids.

RELATED WORK

Echolocation system makes use of a phase beam which forms an approach to visualize the surrounding environment which was used by the blind. It utilizes sound to give feedback to the users. Two ultrasonic sensors are utilized on customary eyeglasses and sound input is given to the clients through earphones. It is compact and identifies head-level obstacles. In any case, it doesn't detect floor-level hindrances and wet floors [4].

The VOICE, 2000 [5] utilizes sound to give feedback to users on recognition of hurdles. It is a video guided assistive framework that makes an interpretation of visual data into various sound examples. A computerized camera had been appended to the customary eyeglasses and a sound input was given to clients by means of headphones. It requires incredible endeavours to prepare the clients because of complex sound examples. But it neglects to distinguish wet floors and floor-level obstructions.

The NavBelt, [6] depends on mobile robotics technology which was developed to help people who suffer from visual impairments. It is basically a versatile gadget which comprises of ultrasonic sensors and a PC. However, this guide is restricted in identifying floor-level snags.

Navigation assistance for visually impaired (NAVI) 2007 [7], is a gadget which was created for incomplete visual deficiency individuals with the assistance of sound directions through sound mechanism. In this gadget, an RGB-D camera is utilized rather than different sensors which are suitable for both range and visual data. However, the camera made the general framework massive and did not identify damp floors. K sonar cane 2008 [8], provided the users with audio feedback on detection of obstacles. It embedded the system on a white cane. The systemconsists of ultrasonic sensors which help in detection of distance and this distance is further converted into audio feedback. It uses variable frequency sound patterns in order to convert the distance of obstacles. However, the user must provide continuous and cognizant efforts to drive the system. Moreover, it doesn't have any provision for detection of wet floor and head level obstacles.

METHODOLOGY

The working of IGuide is explained in this section. IGuide is an electronic device to provide aid to visually impaired people in obstacle free path-finding. Fig. 2 represents the block diagram of IGuide. The IGuide comprises of ultrasonic sensors, vibration motors, moisture sensor, a step-down button, microcontroller circuits, Wi-Fi module, emergency button and a battery for power supply [4]. Basically, there are three ultrasonic sensors in each shoe/boot. The first ultrasonic sensor is used to detect floor level obstacle, the second ultrasonic sensor is used to detect knee level obstacle and the third ultrasonic sensor is used to detect obstacle toward right/left. Furthermore, a moisture sensor is used to detect wet floor. When an obstacle is detected by any one of these sensors, an audio feedback is given to the user by an APR module using speaker and also a tactile feedback is given using a vibration motor. Further, a Wi-Fi module is integrated in the circuit. When the user is in danger

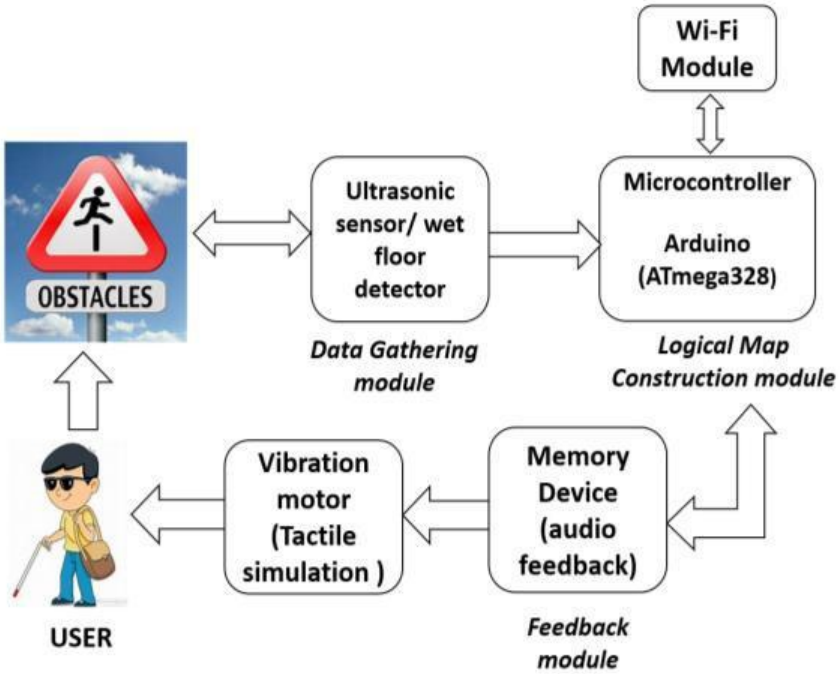

Figure 3: *Block diagram of IGuide.*

or incase of any emergency, he can press the emergency button which will send the live location of the blind person to his/her guardian.

A microcontroller circuit is used for monitoring the inputs from the sensors and controlling the outputs. A power supply is used to power all the components on the boot and a step-down button is used to detect the down state of the foot [4].

Implementation

The IGuide is made up of three modules namely, Data gathering module (DGM), logical map construction module (LMCM), and feedback module (FBM).

- DGM: Ultrasonic sensors and wet floor detectors are included in this module, which are used to collect information from the surrounding environment and the acquired data is sent to the LMCM module.
- LMCM: A customized microcontroller circuit for processing the input received from the DGM is used in this module and it constructs a logical map of the surrounding. The logical map consists of data about the obstacles detected by the IGuide. Based on the current position and direction of movement of the user this module gathers priority information which is sent to the feedback module.
- FBM: This module gives feedback to the user with the help of vibration motor which provides tactile simulation and auditory simulation is provided with the help of an APR module [4].

Power Consumption Analysis

- No-load condition: When the step-down button of the IGuide is not turned on, all the elements of IGuide will be switched OFF except the microcontroller. Therefore only microcontroller will consume the current
- Full-load condition: When the step-down button is pressed, and the IGuide is on a wet floor and has obstacles on all three directions, then all the

components ofIGuide are turned on and maximum current is consumed.
- Average-load condition: All the sensors get activated when the step-down button is depressed. Hence, power is consumed by all the sensors and microcontroller. Furthermore, when an obstacle is spotted, the audio module and respective vibrator motors get activated consuming current. [4]

Hardware Requirements

The hardware components used in IGuide system are listed in this section. The sensors used are ultrasonic sensor and moisture sensor.

The ultrasonic sensor is used to measure the distance of an object using ultrasonic sound waves. Its measurement range is between 3cm to 3m range.

The moisture sensor is used to detect the water. The working voltage of moisture sensor is 5V and working current is <20 mA.

A vibration motor is a device which generates vibrations via an electric motor.

The microcontroller that is used in the IGuide system is Arduino Uno which is based on the Microchip ATmega328P.

Voice recording is done in APR33A3 module to give audio feedback to the user. The operating voltage range of this module is between 3V~6.5V DC and voice recording can be done for about 11 minutes.

Software Requirements

Arduino integrated development environment (IDE) is official software which is used for programing, compiling and uploading the code in the Arduino device.

RESUTS AND DISUSSION

When the user is approximately 25cm away from the obstacle, he/she gets an audio as well as a tactile feedback with the help of the sensors which are embedded on the boot. The user also gets prioritized information about thesurrounding which helps in creating a logical map of the surrounding. This system aids in getting prioritized information about the wet floor with the help of a moisture sensor. The IGuide system is as shown in the Fig. 4 given below:

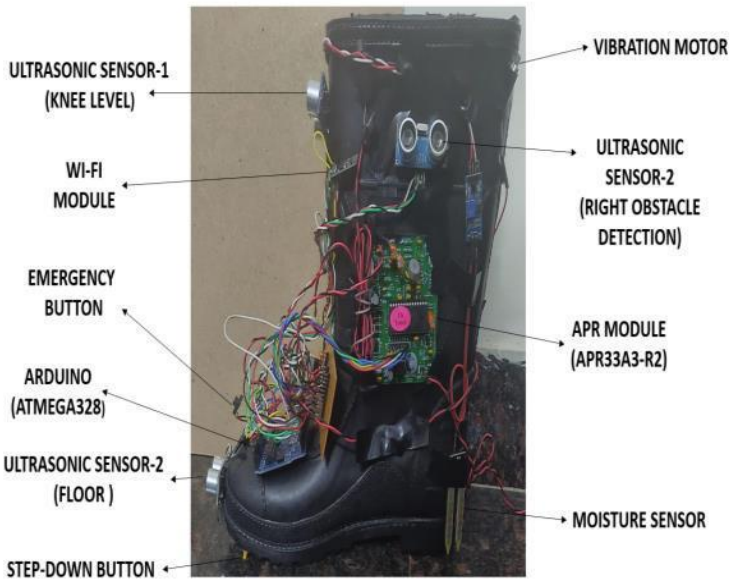

Figure 4: *End product of IGUIDE.*

The IGuide helps in detecting floor level and knee level obstacles, wet floors and it also helps in detecting the live location of the user using Wi-Fi module.

The IGuide provides feedback to the user by using a speaker. Incase of wireless communication, awireless headphone can be used for communication.

CONCLUSION

This study introduced a novel arrangement, IGuide, for visually impaired individuals. The IGuide gives answers for five crucial inadequacies of the existing ETAs.

1. It distinguishes wet surfaces to abstain from slipping accidents.
2. It distinguishes floor-level and knee-level hindrances.
3. It helps in detecting live location of the user incases of emergency.
4. It creates a simplified logical map of thesurrounding and gives prioritizedinformation to the user.
5. It is less expensive and light in weight.

Because of the above mentioned benefits, the IGuide system is easy to access by the users. Further, the proposed framework can be updated utilizing artificial intelligence methods that would monitor the health condition of the subject. The future IGuide systems can be used to detect human object interactions in the form of touch and motion which can utilize ultra-high frequency RFID tags and RFID readers.

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