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An Audio Guidance System for Visually Impaired Person

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Abstract

Mobility of visually impaired people is restricted by their incapability to recognize their surroundings. The aim of this paper is to provide a better understanding to the study of the development of navigation aid inside the building for visually impaired people using audio guidance system. This represents a significant step forward in the application of technologies to increase independence and self-reliance for the people with disabilities. It describes the technical and functional architecture of the system for orientation and guidance of a visually impaired person using available modern technology. The Audio guidance is systems that will help visually impaired people to navigate through buildings. This system would detect an object or obstacle and guide the visually impaired person in the desired path through specialized audio rendering. The proposed system in user friendly, innovative and an affordable solution to the guidance for a person with visual disabilities.

1. Introduction

Blindness is a lack of vision. Being blind affects the person in their life. People lose their confidence and become dependent on others. The aim of this project was to guide the impaired people their wished way. It also creates confidence and dependency on them. We want to design and develop an audio guidance system which will be a special device to indicate the right way using smart communication system. The Audio Guidance System for visually impaired one would allow navigation inside of buildings. The audio guidance system hopes to allow challenged people to simply press a button, speak the desired destination, and be guided there with the use of audio instructions. A portable and efficient device is designed which will help the visual impaired person to guide their desired way.

2. Architecture of the System

In this project, we used an Arduino Uno device as processing unit of all the signals we receive from different sensors. The project is designed in such a way that at the very beginning it takes a command from the user so that it can determine its further functions. A microphone is connected to a speech recognition module for receiving any command given by the user. The module then generates a specific code for the command given and delivers to the main processing unit, Arduino Uno. Receiving the code, the Arduino Uno

starts to instruct the user for the specific direction desired through an audio output device which is connected to a text to speech module. This module receives the data to be converted to speech and delivers to the audio output device (earphone). For this step, the Arduino Uno needs to have the specific location data of the user which is supplied to the Arduino Uno by an RFID reader connected to it. RFID reader generates the specific location by calculating the distance from the different "passive read only RFID tags". Sonar sensor is also used to determine any obstruction present to the generated path to be used. If any obstruction if determined, receiving the data and location of the obstacle, the Arduino Uno generates a substitute path which may have no obstruction [1] [2].

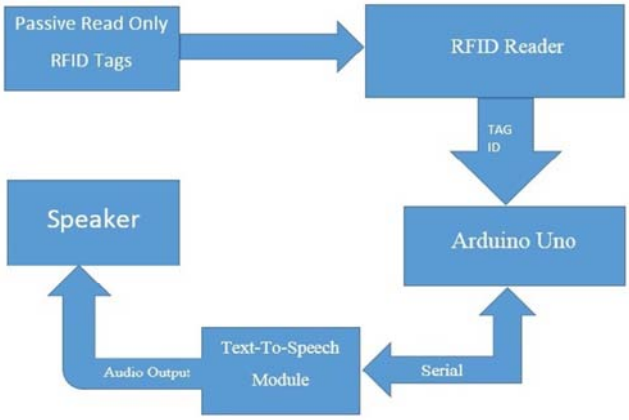

Figure 1. *Block diagram.*

A. RFID

"Radio Frequency Identification" or RFID is a transmitter & receiver type module. RFID includes: 1) Tag chips or integrated circuits, 2) Tag antennas, 3) RFID Reader, 4) Reader antenna An RFID tag is comprised of an integrated circuit (called an IC or chip) attached to an antenna that has been printed, etched, stamped or vapor-deposited onto a mount which is often a paper substrate or Polyethylene Terephthalate (PET).

Figure 2. *RFID Tag [3].*

B. RFID Reader

An RFID reader, also known as an interrogator, is a device that provides the connection between the tag data and the enterprise system software that needs the information. The

reader communicates with tags that are within its field of operation, performing any number of tasks including simple continuous inventorying, filtering (searching for tags that meet certain criteria), writing (or encoding) to select tags, etc. RFID reader and reader antennas both work together to read tags. Reader antennas convert electrical current into electromagnetic waves that are then radiated into space where they can be received by a tag antenna and converted back to electrical current. Just like tag antennas, there is a large variety of reader antennas and optimal antenna selection varies according to the solution's specific application and environment.

In our project we have used Text-to-Speech to give voice to our embedded project. Text-to-speech is a process through which text is rendered as digital audio and then converts it to analog audio. It is used to audibly communicate information to the user, when digital audio recordings are inadequate. Text-to-speech (TTS) is a type of speech synthesis application that is used to create a spoken sound version of the text in a computer document, such as a help file or a Web page. TTS can enable the reading of computer display information for the visually challenged person, or may simply be used to augment the reading of a text message [4].

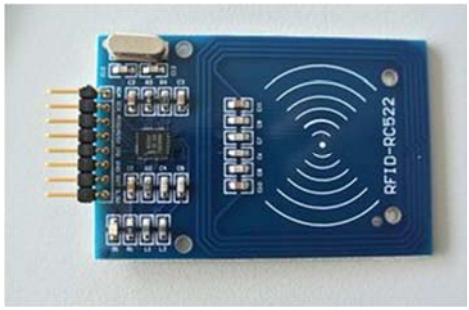

Figure 3. *RFID Reader [3].*

C. Headset

Headset speaker is absolutely perfect for our needs. We will find Headset speaker Systems from many of the top names in the audio industry. Headset speaker Systems allows us to easily connect headphone to our body.

Figure 4. *Headset [5].*

D. Arduino

The Arduino Uno is a microcontroller board based on the

ATmega328. Arduino is an open-source, prototyping platform and its simplicity makes it ideal for hobbyists to use as well as professionals. The Arduino Uno has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with AC-to-DC adapter or battery to get started [6] [7].

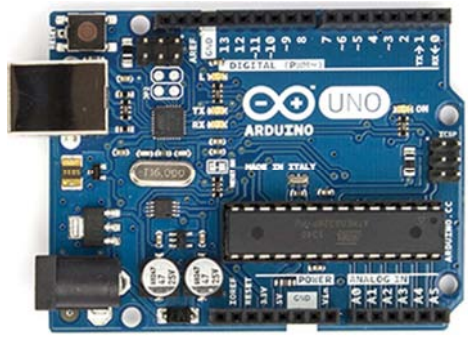

Figure 5. *Arduino Uno [8].*

E. Text-to-speech Module

In this project we have used Text-to-Speech to give voice to our embedded project. Text-to-speech is a process through which text is rendered as digital audio and then converts it to analog audio. It is used to audibly communicate information to the user, when digital audio recordings are inadequate. Text-to-speech (TTS) is a type of speech synthesis application that is used to create a spoken sound version of the text in a computer document, such as a help file or a Web page. TTS can enable the reading of computer display information for the visually challenged person, or may simply be used to augment the reading of a text message [9].

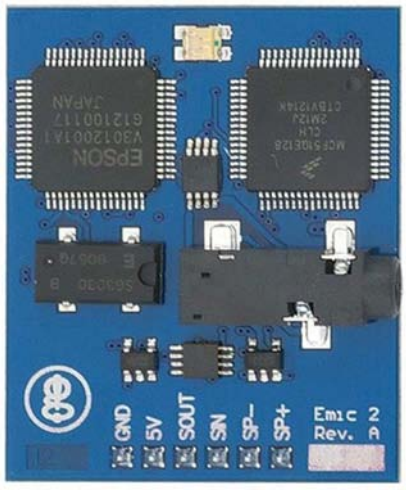

Figure 6. *Text-to-Speech Module [10].*

F. Sonar Sensor

The HC-SR04 Ultrasonic Sensor is a very affordable proximity/distance sensor that has been used mainly for object avoidance in various robotic project. It essentially gives Arduino eyes/special awareness and can prevent robot from crashing or falling off a table. It has also been used in turret application, water level sensing or even as a parking sensor. This sensor was used in our project to prevent collision with any obstacle. Ultrasonic sensor provides an easy method of distance measurement. This sensor is perfect for any number of applications that require to perform measurements between moving or stationary objects. A single I/O pin is used to trigger an ultrasonic burst (well above human hearing) and then "listen" for the echo return pulse. The sensor measures the time required for the echo return, and returns this value to the Arduino as a variable-width pulse via the same I/O pin [11]

Figure 7. *Sonar Sensor [12].*

3. Simulation

We used Proteus 8 to simulate the whole project. Proteus 8 is best simulation software for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers in it. So it is a handy tool to test programs and embedded designs for electronics hobbyist. Simulation can be done via programming of microcontroller in Proteus 8 simulation Software. As we used many modules for our project we had to make all the units to simulate.

At first, we simulated the RFID unit. For this we designed RFID reader and tags in Proteus 8. The reader reads the tags identification and sends the given information to the Arduino. We had to simulate it using RX and TX library. The simulation was easy and the output was as expected.

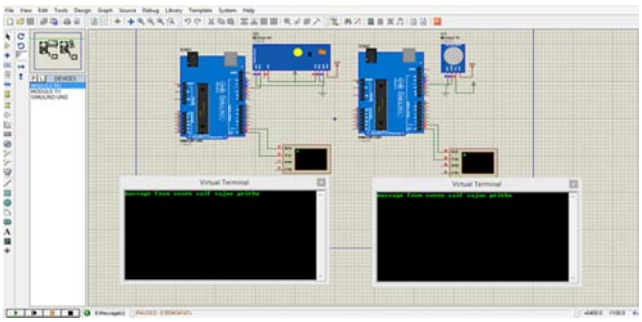

Figure 8. *Simulation of RFID.*

We simulated the full system of our hardware work. As

The Arduino select the RFID tags. It selects only those tags which are need to be active to show the right direction called by the user. The RFID reader reads & identify the tags & guides through audio signal using Text-to-Speech.

The whole circuit was simulated very easily. As all the component was modules we had to make it for simulating it. We also had to use many software to train different modules and for coding.

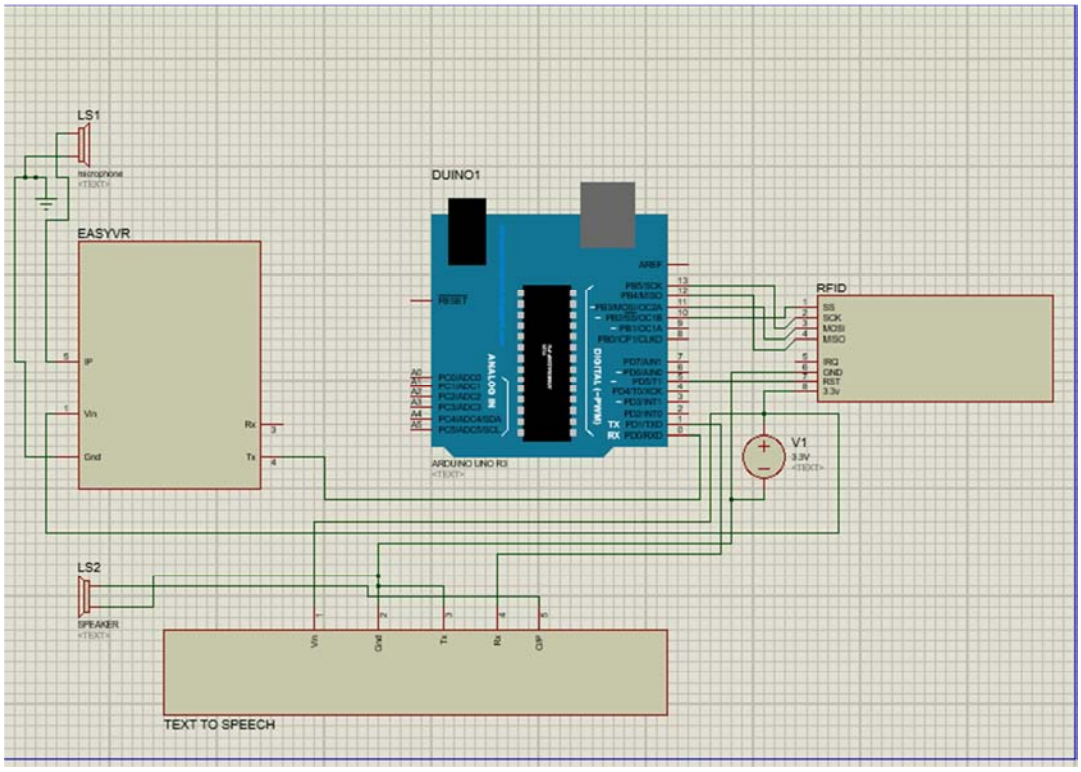

Figure 9. *Full Simulation.*

Appropriate codes were written for different modules to work and uploaded and then applied to give the expected output.

4. Implementation

After simulating the circuits, the circuits were implemented in real life. At first the RFID Reading unit had been made. Then the Text-to-speech unit has been built sequentially. The implementation of all the units is described below:

The RFID Reader was used to read the RFID tags. We connected the reader with the shield board. Pin 1 of RFID reader was connected to a 3.3v power source. Pin 2 was connected to the pin 5 of shield. We grounded pin 3. Pin 4 was kept open. Then Pin 5, pin 6, pin 7 and pin 8 was connected consecutively with the pin 12, pin 11, pin 13 and pin 10 of the shield.

The Text-to-speech (TTS) module was used to give output speech. This module converts the given text to an audio signal. Pin 1 and Pin 2 of the TTS were kept open. Pin 3 and pin 4 of TTS was connected to Pin 3 and 2of shield. Pin 5 was connected to a power source of 5v and the pin 6 was grounded. An obstacle detector called Ultrasonic Sensor was used to detect obstacle in front of the impaired person. A Buzzer was also used with the sensor.

Figure 10. *Practical Implementation.*

5. Final Circuit

This is the combination of the entire upper given units. The visually impaired person will command his desired destination to the speech recognition module for which the RFID reader will ask RFID tags to be read. The RFID tags will hold some information which will be converted to audio

signal by TTS module to guide the visually impaired person to the desired destination.

At the end we can say that the system is a very efficient system. The total system are based on C based compiler. We used Arduino Uno R3 which use ATMEGA32 microcontroller.

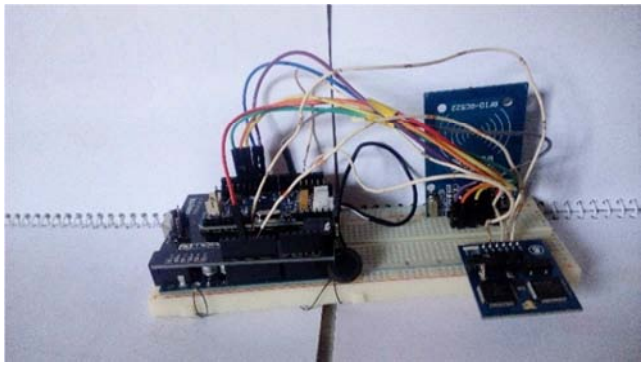

Figure 11. *Full circuit.*

6. Results

The simulation was successfully simulated as it was expected. And in real life, the practical implementation was executed very perfectly. With the help of stick a visually impaired person can walk inside indoor without any inconvenience.

7. Discussions

This project is covered for the sake of visually impaired people. By using this audio guidance system we can easily detect any object or, obstacle in a surrounding, which will help the blind to get direction, supervise his movement throughout the premises. These systems will allow helpless blind people to develop much better representation of the environment by providing the auditory guidance through a headpiece. Visually impaired people are advised by auditory signals and announcements providing short and simple messages that are easy to follow. The walking instructors provided comments regarding the placement of loudspeakers to enhance auditory localization. As we know visual impairment causes people difficulties with normal daily activities such as walking, reading, driving, and socializing. So, thinking over their daily life sufferings we initiated this project. Actually modern technology and smart world gifted us numerous invaluable things, but some sort of issues is still unrecoverable. Just this spirit of motivation keeps our intension alive, and rejoices us to go ahead. Initially we made a theoretical procedure to continue. Here, in this project, we used an Arduino Uno device as processing unit of all the signals we receive from different sensors. The project is designed in such a way that at the very beginning it takes a command from the user so that it can determine its further functions. A microphone is connected to a speech recognition module for receiving any command given by the user. The module then generates a specific code for the command given and delivers to the main processing unit, Arduino Uno. Receiving the code, the Arduino Uno starts to instruct the user for the specific direction desired through an audio output device which is connected to a text to speech module. This module receives the data to be converted to speech and delivers to the audio output device (earphone). For this step, the arduinoUNO needs to have the specific location data of the user which is supplied to the Arduino Uno by an RFID reader connected to it. RFID reader generates the specific location by calculating the distance from the different ‘’passive read only RFID tags’’. Sonar sensor is also used to determine any obstruction present to the generated path to be used. If any obstruction if determined, receiving the data and location of the obstacle, the Arduino Uno generates a substitute path which may have no obstruction.

8. Conclusion

We presented a navigation aid which helps blind people to navigate safely. By using this audio guidance system we can easily overcome any obstacle in the surrounding, which will help the blind to get direction and supervise his movement throughout the premises. These systems will allow helpless blind people to develop much better representation of the environment by providing the auditory guidance through a headpiece. Visually impaired people are advised by audible instructions and announcements providing short and simple messages that are easy to follow. We hope that this aid will be an effective, low-cost solution for reducing navigation problems for blind users. We choose this smart communication system only because of this faster and instantaneous communication. It is nothing but a life saving device.

References

[1] Thomas, Bruce, Victor Demczuk, Wayne Piekarski, David Hepworth, and Bernard Gunther. "A wearable computer system with augmented reality to support terrestrial navigation." In *Wearable Computers, 1998. Digest of Papers. Second International Symposium on*, pp. 168-171. IEEE, 1998.

[2] Al-Fahoum, Amjed S., Heba B. Al-Hmoud, and Ausaila A. Al-Fraihat. 'A Smart Infrared Microcontroller-Based Blind Guidance System'. *Active and Passive Electronic Components* 2013(2013): 1-7. Web. 01 Nov. 2015.

[3] (2015)Robotshop.com, 'Seeedstudio 125KHz RFID Tags (3x Key Fob + 2x Cards)', 2015. [Online]. Available: http://www.robotshop.com/en/seeedstudio-125khz-rfid-tags.html.

[4] (2015)Raspberrypi.org, 'Raspberry Pi • View topic - Using Multiple RFID Reader with a Single Pi', 2015. [Online]. Available: https://www.raspberrypi.org/forums/viewtopic.php?f=37&t=90872.

[5] Guitarcenter.com,. 'Headset Microphone Wireless Systems| Guitar Center'. N. p., 2015. Web. 30 Nov. 2015.

[6] Arduino.cc, 'Arduino - Windows', 2015. [Online]. Available: https://www.arduino.cc/en/Guide/Windows. [Accessed: 12- Nov- 2015].

[7] A. R3, S. V3.2, S. V3.2, A. 5V/16MHz, S. Arduino and S. OpenLog, 'Arduino Uno - R3 - DEV-11021 – SparkFun Electronics', Sparkfun.com, 2015. [Online]. Available: https://www.sparkfun.com/products/11021. [Accessed: 30- Nov- 2015].

[8] 5V/16MHz, S. Arduino and S. OpenLog, 'Arduino Uno - R3 - DEV-11021 - SparkFun Electronics', Sparkfun.com, 2015. [Online]. Available: https://www.sparkfun.com/products/11021.

[9] T. 2, B. Straight, E. Shield, F. Headers, S. TPA2005D1, S. ohm) and T. Speaker, 'Text-to-Speech Module - Emic 2 - DEV-11711 - SparkFun Electronics', Sparkfun.com, 2015. [Online]. Available: https://www.sparkfun.com/products/11711. [Accessed: 30- Nov- 2015].

[10] (2015)T. 2, B. Straight, E. Shield, F. Headers, S. TPA2005D1, S. ohm) and T. Speaker, 'Text-to-Speech Module - Emic 2 - DEV-11711 - SparkFun Electronics', Sparkfun.com, 2015. [Online]. Available: https://www.sparkfun.com/products/11711.

[11] (2015) Parallax.com, 'PING' Ultrasonic Distance Sensor | 28015 | Parallax Inc', 2015. [Online]. Available: https://www.parallax.com/product/28015

[12] (2015) I. Shoditeli, I. Shoditeli and V. profile, 'Ultrasonic: Sensor Ultrasonic', Ultrasonicochen.blogspot.com,Available:http://ultrasonicochen.blogspot.com/2015/03/sensor- ultrasonic.html.