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Haptic Hat for Visually Impaired

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Abstract: ***The blind and the visually impaired are in a unique position to appreciate and make functional use of haptic devices. Designing devices for the blind is, however, more arduous than many researchers and inventors expect. It is thus important to fully understand the needs and requirements of that community before attempting to create devices for them. It is also important to learn from past research and development in the application of technology for the blind. The ultrasonic haptic vision system enables a person to navigate hallways and around large objects without sight, through the use of an ultrasonic rangefinder that haptically interfaces with the user via tiny vibrating motors mounted on the users head[5]. The idea behind this project was to construct a sixth sensory system that interacts with the body in an intuitive and user friendly fashion and enables the user to navigate without vision. The rangefinder rotated on a motor atop the hat in order to take the sensory data at discrete points around the user. The helmet and required hardware is all battery powered so that it is totally mobile and can be used as intended, so that movement is not restricted by the length of wires.*** **GSM and GPS technology is used for accident detection**

Keywords: Hat, Atmega2560, Atmega328, Ultrasonic Sensor, SIM808

1. Introduction

Haptic Vision is an investigation into the idea that the experience of architecture is lacking because of the bias Western society has placed on **vision**, that the other senses are stifled by this and that it is a result of us living in an occularcentric society. The blind and visually impaired form a heterogeneous group. Blindness and visual impairment vary in etiology, visual acuity and extent of the visual field. The degree of visual impairment varies from no light perception at all to a slight blurring of vision, with every gradation in between. [2]The blind are said to have light perception when they can tell if they are in a dark or bright room. They are capable of projection if they can also locate the source of the light. Similarly the field of view may vary in extent or include blind spots. The term legally blind corresponds to a set of criteria for blindness based on either low acuity or restriction of the visual field . In the United States, legal blindness is defined as having a visual acuity of 20/2001 or less, or having a visual field of 20 degrees or less. The term low vision is used to "describe individuals who have a serious visual impairment, but nevertheless still have some useful vision" 'Blind' is sometimes used in a restrictive sense to refer to people with at most light perception. 'Visually impaired' then refers to all the legally blind. [1]The use of haptics seems to have been well received by the blind despite the many practical advantages of voice synthesis and audio solutions. The basic logical structure of our project involves the sensory input from the ultrasonic rangefinder and its method of acquisition, the DC motor that changes the sensor position to read ranges at different angles, the miniature vibrating motors that provides haptic feedback to the user and the microcontroller which enables the three major components to communicate effectively. The motor atop the hard hat turns the ultrasonic sensor, which reads the distance to the nearest object at different angles and sends this information to the microcontroller which in turn sets the vibrator strength in that direction accordingly, to alert the user to the distance to the nearest object in that direction. The GPS is used to locate the position of the blind .In the case of occurrence of an accident the GSM facility can be used to send a message to a predefined mobile number.

2. Objective and Scope

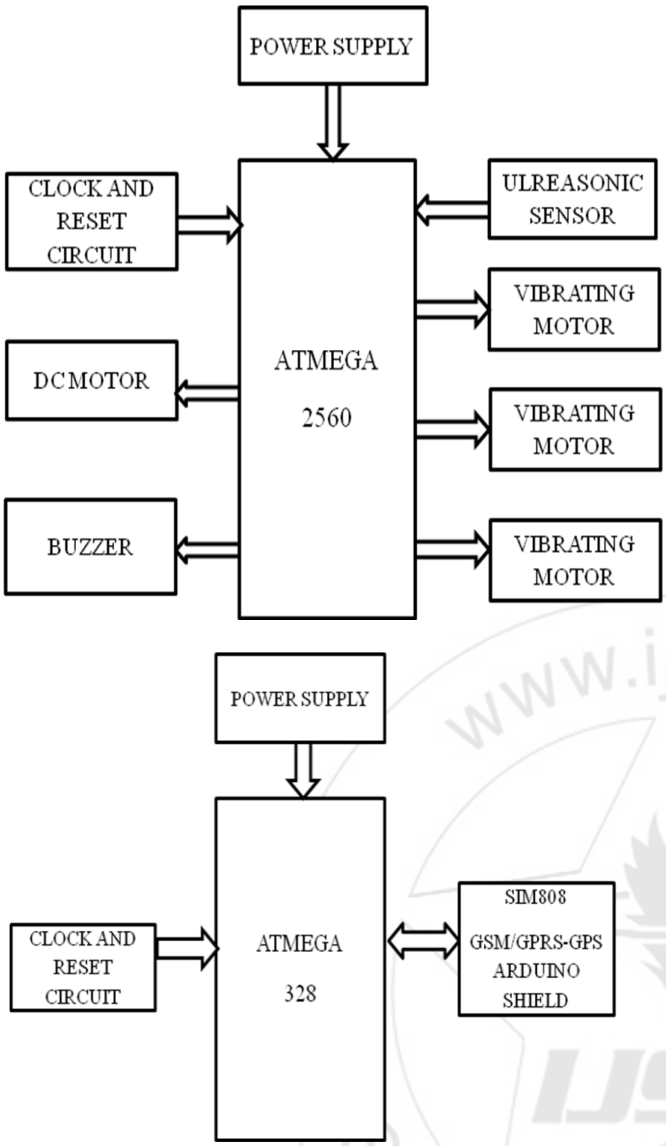
a) Objective

The objective behind this project was to demonstrate an idea by creating a working prototype of a sensory system to enable the sight impaired to navigate through hallways and around large objects. The idea behind this project is to design a product which is very much useful to that person who are visually impaired and who often has to rely on others. It allows the user to walk freely by detecting obstacles

b) Scope

The sensor embedded in the hat senses the pressure applied on it due to the accident, which is further connected to the GSM module i.e. the cell phone. An alarm will be turned on immediately after the accident takes place & if it is not turned off within 15 seconds, it will send a message to the friends/relatives & nearest ambulance with details of the location where accident took place. The future scope is to include a microphone & speaker arrangement in the helmet which has a wireless connection with the Smartphone to attend/ reject calls[3] . GPRS along with ioT can be used to store the details regarding the navigation of blind. With the use of a voice module along with the GPS system helps to provide route for blind.

3. Block Diagram



1. ATMEGA 2560

The high-performance, low-power Microchip 8-bit AVR RISC-based microcontroller combines 256KB ISP flash memory, 8KB SRAM, 4KB EEPROM, 86 general purpose I/O lines, 32 general purpose working registers, real time counter, six flexible timer/counters with compare modes, PWM, 4 USARTs, byte oriented 2-wire serial interface, 16-channel 10-bit A/D converter, and a JTAG interface for on-chip. By executing powerful instructions in a single clock cycle, the device achieves a throughput approaching 1 MIPS per MHz, balancing power consumption and processing speed. debugging. The device achieves a throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.

2. ATMEGA 328

The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz .

3. Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The Arduino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically. The board can operate on an external supply from 6 to 20 volts.

4. Ultrasonic Sensors

Ultrasonic sensors are in air, non-contact object detection and ranging sensors that detect objects within an area .use high frequency sound to detect and localize objects in a variety of environments. The sensor minimum reported distance is 6-inches (15.2 cm). Here the LV-MaxSonar-EZ1 sensor is used. However, the LV-MaxSonar-EZ1 will range and report targets to the front sensor face. Large targets closer than 6-inches will typically range as 6-inches.The benefits include low cost ,reliable and stable range data. It is a very low power ranger, excellent for multiple sensor or battery-based systems.

5. Vibrating Motor

For controlling the intensity of vibration of the motors at different angles, depending on the value of the range at that particular angle.

6. DC geared Motor

A servo motor is a rotary actuator that allows for precise control of angular position. The servo motor is actually an assembly of four things: a normal DC motor, a gear reduction unit, a position-sensing, and a control circuit. The function of the servo is to receive a control signal that represents a desired output position of the servo shaft, and apply power to its DC motor until its shaft turns to that position. It uses the position-sensing device to determine the rotational position of the shaft.

7.Buzzer

Buzzer helps the user to make sound when he needs to communicate with other. The operating power of a buzzer is 3-6V/25 mA. It has extremely compact and ultrathin construction. The buzzer converts the electrical signal it receives into a vibration, which creates a buzzing sound. The higher the signal it receives, the more intense the vibration, and the louder the sound is.

8.SIM808GSM/GPRS-GPS arduino shield

SIM808 module is a complete Quad-Band GSM/GPRS module which combines GPS technology for satellite navigation. The compact design which integrated GPRS and GPS in a SMT package will significantly save both time and costs for customers to develop GPS enabled applications. Featuring an industry-standard interface and GPS function, it allows variable assets to be tracked seamlessly at any location and anytime with signal coverage.

4. Working

Ultrasonic sensor which is mounted on hat of the blind person it start radiating ultrasonic waves in front direction of the helmet. When the wave is incident on the object, it reflects back from object. This signal is received by ultrasonic sensor and this signal is applied to the Microcontroller. Here the ultrasonic sensor position is varied using a dc motor. Microcontroller process on the received signal and take a control action according to it. That is microcontroller measure the distance of the object from blind person and this signal are transmitted to the vibrating motor. The intensity of vibration of the motor is changed depending on the distance of the obstacle from the blind. If the object is very close a buzzer indication is provided. Microcontroller sends control signal to the vibrating motors according to the direction of object (Left or Right) and the corresponding motor gets vibrate. A GPS module is attached which helps to find the location of the blind. A GSM module connected to the system sends a message to a predefined mobile number in case of an accident.

5. Advantages & Applications

The system is efficient. Moving objects can be detected and measured. The position of the blind is easily detected using this system. To indicate the blind person if any object is present. It can be used to avail help if any accident occurs to the blind person

6. Result

7. Conclusion

Haptics has a great potential for helping people with special needs, and making the use of computing devices more natural and concrete for all people. The final design met and exceeded all of the expectations that were laid out before starting to construction of this project. The whole goal was to be able to navigate a hallway successfully without running into any walls while blindfolded as a demonstration that this idea was intuitive and feasible. Usability is the high point of this project. This design was intended for use by anyone barring safety concerns because of the rotating sensor on the top. This project was designed primarily for the vision impaired. We wanted to create a project specifically for people with special needs. The intention of this project was to be usable by anyone with minimal training if at all. The user should be able to intuitively feel objects around them by just putting the hat on, and letting the haptic interface do the rest.

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