ULTRASONIC BLIND WALKING STICK

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ABSTRACT

Blind stick is an advanced stick designed for visually disabled people for improved navigation. We here, propose an innovative blind stick that allows visually challenged people to navigate with ease using advanced technology. The blind stick is integrated with ultrasonic sensor along with light and water sensing. Our proposed project first uses ultrasonic sensors to detect obstacles ahead using ultrasonic waves. On sensing obstacles, the sensor passes this data to the microcontroller. The microcontroller then processes this data and calculates if the obstacle is close enough. If the obstacle is not that close the circuit does nothing. If the obstacle is close the microcontroller sends a signal to sound a buzzer. It also detects and sounds a different buzzer if it detects water and alerts the blind. One more feature is that it allows the blind to detect if there is light or darkness in the room. A GSM is fixed in the stick which helps a phone to get connected via Bluetooth, which helps in receiving voice commands such as directions. Thus, this system allows for obstacle detection visually disabled people.

Keyword: *Ultrasonic sensor, IR Sensor, Temperature sensor, Water Sensor GSM Module, GPS Module, ATmega328 microcontroller, Buzzer, Vibrator.*

1. INTRODUCTION

Distance measurement of an object in the path of a person, equipment, or a vehicle, stationary or moving is used in a large number of applications such as robotic movement control, vehicle control, blind man's walking stick, medical applications, etc. Measurement using ultrasonic sensors is one of the cheapest among various options. In this application distance measurement of an obstacle by using digital ultrasonic transmitter, receiver module and a microcontroller is presented. The experimental setup and results are described and explained. The techniques of distance measurement using ultrasonic in air include continuous wave and pulse echo technique. In the pulse echo method, a burst of pulses is sent through the transmission medium and is reflected by an object kept at specified distance. The time taken for the pulse to propagate from transmitter to receiver is proportional to the distance of object. For contact less measurement of distance, the device has to rely on the target to reflect the pulse back to itself. The target needs to have a proper orientation that is it needs to be perpendicular to the direction of propagation of the pulses. The amplitude of the received signal gets significantly attenuated and is a function of nature of the medium and the distance between the transmitter and high levels of signal attenuation when used in an air medium, thus limiting its distance target. The pulse echo or time-of-flight method of range measurement is subject to range. A GSM module exposes an interface that allows applications to send and receive messages over the module interface. To perform these tasks, a GSM module must support an "extended AT command set" for sending/receiving voice messages. The ultrasonic range finder presented here is suitable for measuring distance

between 20mm and about 3000mm. It will also turn on motor vibrator and buzzer to give alert sound when obstacle comes in the specific range limit.

2. BACKGROUND LITERATURE

Many ETAs and robot technologies have been applied, to guide the blinds that aimed at improving their mobility in terms of safety, to detect obstacles on the ground, uneven surfaces, holes, steps, and puddles.

A. C-5 Laser Cane: It was introduced in 1973 by Benjamin. It is based on optical triangulation with three laser diodes and three photodiodes as receivers. The Laser Cane can detect obstacles at head-height, drop-offs in front of the user, and obstacles up to a range of 1.5 m or 3.5 m ahead of the user.

B. Sonic Torch: It is a battery operated hand held device basically operates by transmitting the ultrasound in the forward direction and receiving the reflected sound beam from the nearest object.

C. Mowat Sensor: It is a commercially available hand-held ultrasonic-based device that informs the user of the distance to detected objects by means of tactile vibrations. The frequency of the vibration is inversely proportional to the distance between the sensor and the object

D. Sonic Path Finder: It alarms the blind when detecting the obstacle by the acoustic difference. However, it does not provide the accurate path and the position of an obstacle.

E. Meldog: It uses the artificial intelligence, unlike in the sonic pathfinder. It can provide the accurate position of an obstacle using the ultrasound and laser sensors. But, in general, it is relatively large and heavy. Navbelt (1989): It is a portable device equipped with ultrasonic sensors and a computer [6]. It produced a 120o -wide view of the obstacles ahead of the user (similar to a radar screen image). This image was then translated into a series of directional (stereophonic) audio cues through which the user could determine which directions were blocked by obstacles.

3. SYSTEM DESCRIPTION

Fig. 1 shows a blind user walking with an electronic stick. Two ultrasonic sensors are mounted on the stick having range from 20- 350cms (set to different ranges). Two Infrared sensors are also implemented on the lower side of stick for avoiding small obstacles ranging from 2-10cms. A switch that can be operated with the thumb (in worst condition) that allows the blind user to send a general message (I am in trouble, help me) on a saved mobile no. for help. Vibrating sensors along with a buzzer used for beep and vibration if stick is about to hit with any obstacle. Circuit box contain combination of GSM300/900 module and microcontroller circuitry. The co-operation between the Ultrasonic and IR sensors are utilized to create a complementary system that is able to give reliable distance measurement. International Conference on Information Communication & Embedded Systems (ICICES 2014).

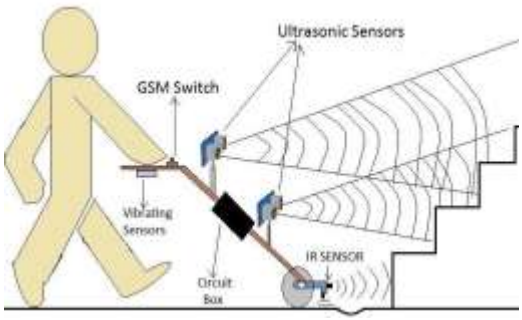

Fig -1: Blind man with electronic stick

The features are:

- Different types of vibrations for different obstacles.
- Automatic (during night time i.e. LDR dependent) high intensity (Red colour) LEDs.
- A small Torch on the top.
- A user controlled horn for traffic.
- More efficient and inexpensive than other devices.
- Easy to access for blinds.
- Code can be upgrade or change easily.

A. Ultrasonic sensor

Fig-2 Ultra Sonic Sensor

Ultrasonic Sensor (transducers) is a type of sensor that uses sound waves to detect an object or target [10].It works on similar principle of radar or sonar which generates high frequency sound waves and evaluates the echo which is received back by the sensor.

B. Infraded Sensor

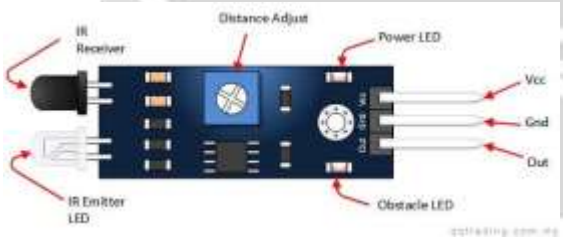

Fig-3 Infraded Sensor

An IR sensor is an electronic device that emits and/or detects infrared radiations in order to sense some aspect of its surroundings [17]. When an object is close to the sensor, the light from the IR transmitter led bounces off the object and received by receiver led.

C. Water Sensor

Fig-4 Water Sensor

A water sensor is an electronic device that is designed to detect the presence of water and provide an alert in time to allow the prevention of water damage. A common design is a small cable or device that lies flat on a floor and relies on the electrical conductivity of water to decrease the resistance across two contacts. The device then sounds an audible alarm together with providing onward signaling in the presence of enough water to bridge the contacts. These are useful in a normally occupied area near any infrastructure that has the potential to leak water, such as HVAC, water pipes, drain pipes, vending machines, dehumidifiers, or water tanks.

D. GSM Module

Fig-5 GSM Module

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator- demodulator) is a critical part here. These modules consists of a GSM module or GPRS modem powered by a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for computer. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities.

E. GPS Module

Fig-6 GPS Module

A **GPS navigation device**, **GPS receiver**, or simply **GPS** is a device that is capable of receiving information from GPS satellites and then to calculate the device's geographical position. Using suitable software, the device may display the position on a map, and it may offer directions.

F. Micro Controller

ATmega328 is a microcontroller, can be also use in Arduino board which is an open- source physical computing platform based on Atmel microcontrollers, and a development environment for writing software for the board. It can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling other physical outputs.

G. Temperature Sensor

A **thermistor** is a temperature-sensing element composed of sintered semiconductor material which exhibits a large change in resistance proportional to a small change in temperature. Thermistors usually have negative temperature coefficients which means the resistance of the thermistor decreases as the temperature increases. Thermistors differ from resistance temperature detectors (RTDs) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a greater precision within a limited temperature range, typically −90°C to 130°C.

A vibrating motor is essentially a motor that is improperly balanced. In other words, there is an off-centered weight attached to the motor's rotational shaft that causes the motor to wobble. The amount of wobble can be changed by the amount of weight that you attach, the weight's distance from the shaft, and the speed at which the motor spins.

Fig-7 Thermistor

H. Buzzer

The Piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used to alert a user of an event corresponding to a switching action, counter signal or sensor input. They are also used in alarm circuits.

The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. It consists of piezo crystals between two conductors. When a potential is applied across these crystals they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range 2 to 4 kHz.

I. **Vibrator**

Fig.8 Vibrator

4. FUNCTIONAL DESCRIPTION

A. Ultrasonic Sensor

We know that sound vibrations cannot penetrate through solids. So what happens is, when a source of sound generates vibrations they travel through air at a speed of 220 meters per second. These vibrations when they meet our ear we describe them as sound. As said earlier these vibrations cannot go through solid, so when they strike with a surface like wall, they are reflected back at the same speed to the source, which is called echo.
Ultrasonic sensor "HC-SR04" provides an output signal proportional to distance based on the echo. The sensor here generates a sound vibration in ultrasonic range upon giving a trigger, after that it waits for the sound vibration to return. Now based on the parameters, sound speed (220m/s) and time taken for the echo to reach the source, it provides output pulse proportional to distance.

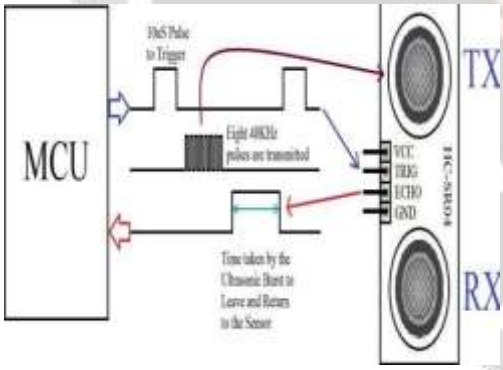

Fig-9 Working **of** Ultrasonic Sensor

IR Sensor

Photo diode is connected in reverse bias, inverting end of LM358 (PIN 2) is connected to the variable resistor, to adjust the sensitivity of the sensor. And non-inverting end (PIN 3) is connected to the junction of photodiode and a resistor. When we turn ON the circuit there is no IR radiation towards photodiode and the Output of the comparator is LOW. When we take some object (not black) in front of IR pair, then IR emitted by IR LED is reflected by the object and absorbed by the photodiode. Now when reflected IR Falls on Photodiode, the voltage across photodiode drops, and the voltage across series resistor R2 increases. When the voltage at Resistor R2 (which is connected to the non-inverting end of comparator) gets higher than the voltage at inverting end, then the output becomes HIGH and LED turns ON. Voltage at inverting end, which is also called **Threshold Voltage**, can

be set by rotating the variable resistor's knob. Higher the voltage at inverting end (-), less sensitive the sensor and Lower the voltage at inverting end (-), more sensitive the sensor.

B. GSM Module

A GSM (Global System for Mobile communication) module is a specialized type of module which accepts a SIM (Subscriber Identity Module) card, and operates over a subscription to a mobile operator. When a GSM module is connected to a microcontroller (ATmega328), this allows the microcontroller to use the GSM module to communicate over the mobile network. A GSM module exposes an interface that allows applications to send and receive messages over the module interface. To perform these tasks, a GSM module must support an "extended AT command set" for sending/receiving SMS messages. The AT commands are sent by the microcontroller tothe module. The module sends back an Information Response i.e. the information requested by the action initiated by the AT command. This is followed by a Result Code. The result code tells about the successful execution of that command. Text message may be sent through the module by interfacing only three signals of the serial interface of module with microcontroller i.e., TXD, RXD and GND. In this scheme RTS and CTS signals of serial port interface of GSM Modem are connected with each other. AT+CMGF = 1, this command configures the GSM module in text mode. AT+CMGS = +917708377615, this
command sends the mobile number of the recipient mobile to the GSM module. GSM configured with microcontroller using two modes- automatic and manual. If the object is too near and system is sending alert sounds and vibrations then automatically it send the message to the stored mobile number. Fig. 8 shows an algorithmic flow chart of GSM module for blind stick.

C. Micro Contoller

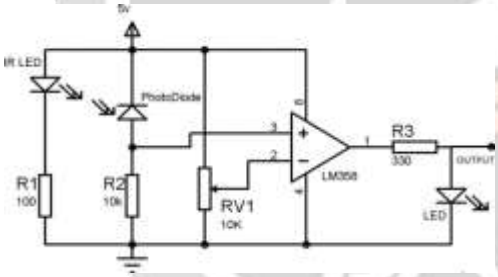

Fig-10 Micro Controller

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more about RISC and CISC Architecture) architecture with 131 powerful instructions.

Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.
ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively.
ATmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD.
ATmega16 has various in-built peripherals like USART, ADC, Analog Comparator, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals. The following table shows the pin description of ATmega16.

5. CONCLUSION

This system can be applied in the straight path, right angle path and the curved path. At least 1m width is required for the proper management of the stick. The broad beam angle ultrasonic sensors enable wide range obstacle information. Major drawback of infrared sensors is their non-linear response i.e. a big change in output voltage

does not always indicate a big change in range. The main functions of this system are the clear path indication and the environment recognition. With the help of electronic walking stick blind, people can improve more than 15-20% travel speed, reduce minor collision, do not lose their way, and increase safety as compare to unaided euipments. Future work includes installtion of GPS system along with additional sensors like accelerometers, PIR motion detector and digital compass which tell the exact location of the user.

6. REFERENCES

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