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International
Journal
Of Modern Engineering Research (IJMER)

Microcontroller Based Obstacle Detection Device Using Voice Signal for the Visually Impaired

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Abstract: *This paper aims in helping the visually impaired people through an electronic aid, which senses any obstacle in the path and alarms the user of the obstacle. The device uses a simple principle of transmitting an ultrasonic signal in the path generated by a wave generator. The signal gets reflected by the obstacle (if any) in the path. The reflected signal is sensed by a sensor and produces a sound signal in the form of voice. This voice signal directs the visually impaired person to identify the obstacles in front of them.*

Keywords: *Navigation, Obstacle detection, Voice signal, visually impaired.*

I. Introduction

The development and application of technology for orientation and mobility has a long history covering the postwar period. Although some early endeavors envisaged systems that might replace the cane or dog guide, more recent efforts have focused on devices and systems designed to supplement and provide a support system for these basic mobility tools. The technological growth in the education of the disabled has two fold objectives namely, Technology for reducing the disabling conditions and Technology for enhancing learning opportunities. While the former deals with the invention of hardware technology the latter pertains to both the hardware and software technologies. Both the approaches become equally important [1]**.**

The most ultrasonic sensorial systems are based on transducers that work as emitters and receivers in the same scanning process. This fact implies that during the emission process the reception stage stays disabled, in order to avoid the emission coupled. This work presents a novel encoding technique, based on Golay complementary pairs, where the dimension of the blind zone is reduced to negligible distances [2].

II. Materials And Methods

Visual impairment is the consequence of a functional loss of vision, rather than the eye disorder itself. Independent travel is a source of anxiety for many blind people and indeed some avoid it altogether. The usage of Light Rapid or Light Rail Transit (LRT) systems by persons with severe visual impairment would resolve many of the difficulties [3]. To remove the anxiety various types of orientation & mobility aids, an Electronic Travel Aid (ETA) which transform visual environmental cues into other sensory modality have been proven to help visually impaired people travel with a greater degree of psychological comfort and independence. In the following we discusses the construction, characteristics of the Microcontroller based Obstacle Detection using voice circuitry for visually impaired.

2.1 Ultrasonic Distance meter

A navigation aid for the blind using echolocation principle and ultrasonic sensors have been developed [4].A commercially available, Ultrasonic Sensor the Sona Switch 1700 (Electronic Design and packing, Livonia, Michigan) was used to expand the environmental detection range of blind individuals [5] .The power supply to this entire circuit is provided by a 12V rechargeable battery to carry out various actions. An ultrasonic distance meter cancels out the effects of temperature and humidity variations by including a measuring unit and a reference unit. This circuit designed as shown in Fig .1 is used to measure the distance of the object with the help of ultrasonic waves. The 12F675 microcontroller is used to generate the 40 KHz frequency signal. This signal is given to level logic converter (MAX232) in order to convert to TTL(Transistor-Transistor Logic) output pulse to +12v and -12v pulse. Then this pulse is transmitted through ultrasonic transmitter.

2.2 Ultrasonic Transmitter

Ultrasonic transmitter produces ultrasonic waves according to its vibration. The 1 level is given to the upper plate and 0 level to the lower plate. The 1 level is nothing but a 40 KHz frequency and 0 level is anything but the delay time. The ultrasonic sensor accepts only 40 KHz frequency as its input. These sensor waves travel

in space, when interruption is made by the obstacle it gets reflected back. The ultrasonic receiver receives the reflected waves [6].

2.3 Ultrasonic Receiver

An ultrasonic wave of 40 KHz frequency is generated by the oscillator .The generated frequency is transmitted through the ultrasonic transmitter sensor which it is subjected back when an obstacle is placed. The reflected back frequency is received in the ultrasonic receiver sensor. Thus with respect to the time the reflection of the noise to the distance that is received. The received output is amplified, which is converted to voltage. This voltage output which is analog is given to ADC which converts the analog to 8 bit Digital output .The 8 bit data is interfaced with microcontroller through its I/O Lines .The data is thus monitored in the Display. The data is nothing but the distance travelled by the ultrasonic sensor. The blind guidance systems use ultrasound because of its immunity to the environmental noise , relatively inexpensive and also ultrasound emitters and detectors are small enough to be carried without the need for complex[7].

2.4 MAX232 (Logic Level Converter)

MAX232 is the voltage level converter. It converts voltage level from CMOS (microcontroller output is CMOS) to TTL (PC output is TTL) and vice versa, but it drives voltage level from one to another voltage, hence it is also called as voltage driver IC. MAX232 has wide applications in Battery-Powered systems, Modems, Computers etc.

2.5 12F675

12F675 is a PIC micro controller that has one analog comparator. The PIC12F675 has four analog inputs, multiplexed into one sample and hold circuit. The output of the sample and hold is connected to the input of the converter. The converter generates a binary result and stores the result in the 10-bit register.

2.6 Data EEPROM Memory

EEPROM stands for Electrically Erasable Programmable Read-Only Memory and is a type of non-volatile memory used in computers and other electronic devices to store small amounts of data that must be saved when power is removed. The PIC12F675 device has 128 Bytes of data EEPROM with an addressing range from 0h to 7h. The EEPROM data memory allows byte read and write.

2.7 APR9600

The APR9600 is a low cost, high performance sound record/replay IC ,incorporating flash analogue storage technique. The device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The IC is non –volatile, recorded sound retained even after the power supply is removed from the module. The voice circuitry designed to record the voice signal. During sound recording, sound is picked up by the microphone. A microphone pre- amplifier amplifies the voltage signal from the microphone. The constructed obstacle device sense the obstacles at every five inches and simultaneously voice signal will be produced.

2.8 Microcontroller

The heart of the micro controller is the CPU core. AT89C51 is the 40 pins, 8 bit Micro controller manufactured by Atmel group. It is the flash type reprogrammable memory. Advantage of this flash memory is we can erase the program within few minutes. It has 4kb on chip ROM and 128 bytes internal RAM and 32 I/O pin as arranged as port 0 to port 3 each has 8 bit bin. It is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash Programmable and Erasable Read Only Memory (PEROM). The pin diagram of AT89C51 is shown in Fig.2.

2.9 SMCL - LCD

AT89C51 is the 40 pin, 8 bit Microcontroller manufactured by Atmel group. It is the flash type reprogrammable memory. Advantage of this flash memory is we can erase the program within few minutes. It has 4kb on chip ROM and 128 bytes internal RAM and 32 I/O pin as arranged as port 0 to port 3 each has 8 bit bin .Port 0 contain 8 data line(D_O-D_7) as well as low order address line(A_O-A_7). Port contain higher order address line (A_8-A_{15}). Port 3 contains special purpose register such as serial input receiver register SBUF, interrupt INT0,INT1 and Timers T_0 , T_1 many of the pins have multi functions which can be used as general purpose I/P pins (or) Special purpose function can be decided by the programmer itself. The pin diagram of SMCL-LCD is shown in Fig.3.

2.9.1 Crystal

The heart of the micro controller is the circuitries which generate the clock pulse. Then micro controller provides the two pins XTAL 1, XTAL 2 to correct the external crystal resonator along with capacitor. The crystal frequency is the basic clock frequency of the microcontroller.

2.9.2 Reset

The memory location for 89C51 is 0000H to 0FFFH. Whenever switch on the supply the memory location starts from 0000H.The 89C51 micro controller provide 9th pin for Reset Function .Here the reset circuitry consists of 10Mf capacitor in series with 10K resister. When switch on the supply the capacitor is changed and discharged gives high low pulse to the 9th pin through the 7414 inverter. Here we interface LCD display to microcontroller via port 0 and port 2. LCD control lines are connected in port 2 and Data lines are connected in port 0.

2.9.3 LCD

Liquid Crystal Display has 16 pins in which first three and the 15th pins are used for power supply. 4th pin is RS (Register Selection) if it is low data and if it is high command will be displayed. 5th pin is R/W if it is low it performs write operation. 6th pin act as enable and remaining pins are data lines.
Microcontroller based obstacle detection device for Visually Impaired is shown in the Fig.4.

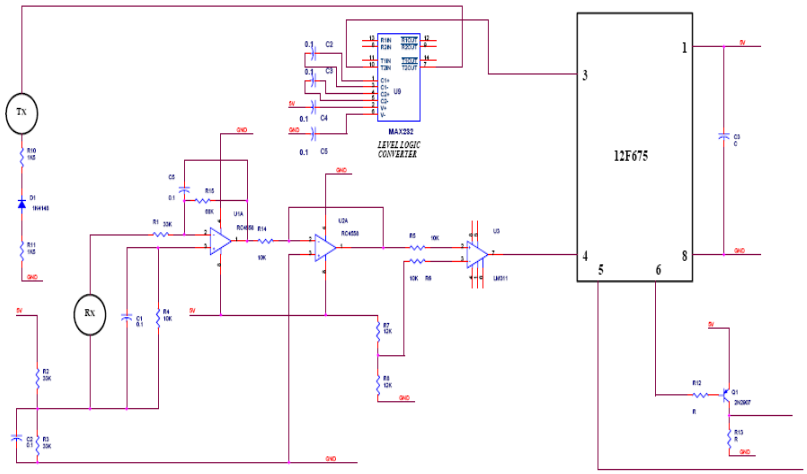

Fig .1 Ultrasonic Distance Measurement

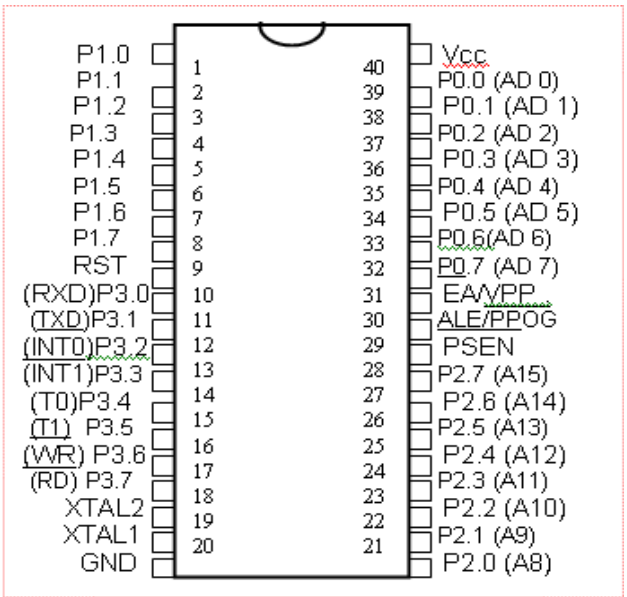

Fig. 2 Pin diagram of AT89C51-Microcontroller

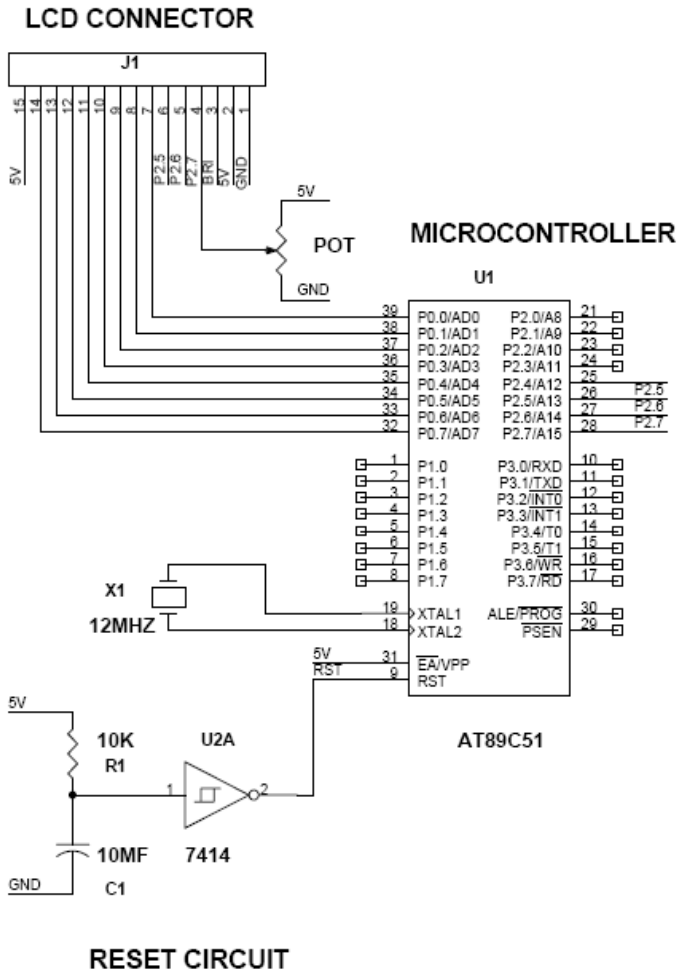

Fig. 3 SMCL-LCD

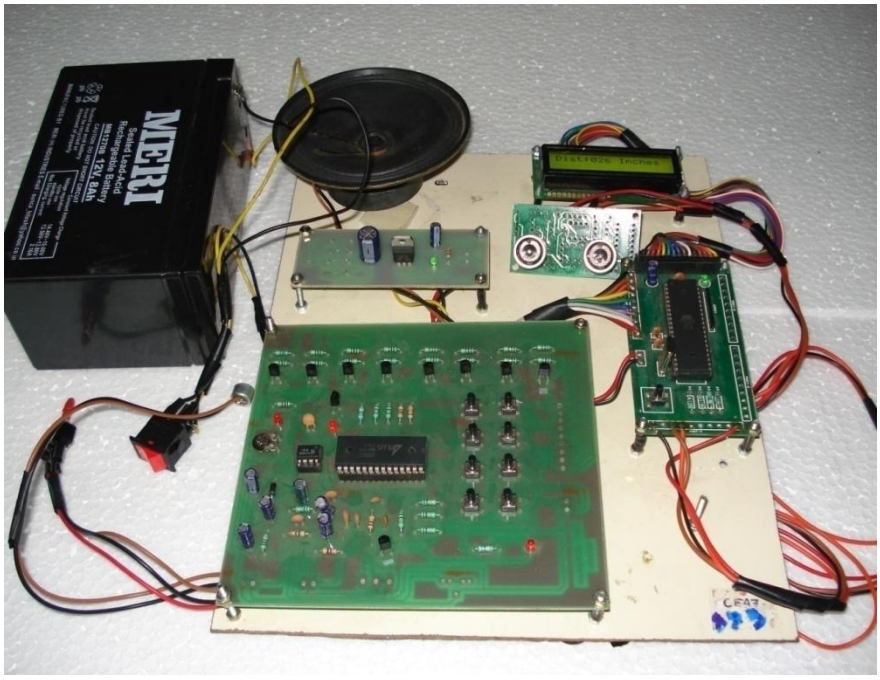

Fig. 4 Microcontroller based obstacle detection device for Visually Impaired

III. Result and Discussion

To help the visually impaired sense obstacles in the linear path, obstacle detection device using ultrasonic transmitter has been designed. An ultrasonic wave of 40 KHz frequency generated by the oscillator is transmitted through the ultrasonic transmitter which when hits the obstacle reflects back the frequency wave and it is received in the ultrasonic receiver sensor. The received output is amplified and converted as analog voltage. An analog to digital converter converts the analog output to a digital output and is shown in the LCD display. The output seen in the display gives the distance of obstacle in inches and simultaneously sound signal in the form of voice is produced starting from five inches to the maximum of forty inches. This voice signal helps the visually impaired to identify the obstacle in their linear path.

Sound intensity of the voice signal generated by APR9600 was measured using sound level intensity meter (LUTRON, make).The measured sound intensity (dB) for various distance of obstacles, is found to be slightly varying and the sound intensity output lies between 90 and 100 dB. This output intensity is higher than the noise level of normal environment and hence the voice signal will caution the blind in all places except in heavy traffic congested roads and industries with noisy machineries.

IV. Conclusion

Visually impaired persons encounter serious difficulties in conducting an independent life, which are inherent to the nature of their impairment. In particular, orientation and navigation in unknown environment seems impossible without an external help. The constructed obstacle detection device for the visually impaired using voice signal found to be highly useful and comfortable for totally blind as they cannot move here and there without the aid of a cane or assistance. The most popular method of obstacle detection is the transmission of ultrasonic waves and the decoding of received reflections to sense the presence of an obstacle in the travel path. Thus the navigational devices are referred as clear path indicators. The constructed obstacle detection device is a light weight system and can be easily worn by visually impaired person.

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