Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 10, October-2019

Low Cost Modular Visual Aid for Blind using Ultrasonic Waves

S. D. Nehal Raj
Electronics and Communication Engineering
BMS College of Engineering
Bangalore, Karnataka

***Abstract*— Vision is one of the most important sense of humans. We perceive, receive and analyse our surrounding with the help of input from our vision. Vision accounts to 70 to 80 percent of our daily interaction [1]. Globally, it is estimated that approximately 1.3 billion people live with some form of vision impairment.[2]. Currently available aid for visual impairment is either pre-dated like walking stick or aids which are complex and too expensive to use. This project exploits the echoing and ranging capacity of ultrasonic waves to construct a simple inexpensive and modular torch like device which can also be fitted on any cane if one wants to. Ultrasonic Ranging Module HC - SR04 is used with Atmega 32A microcontroller to detect and calculate the distance between object and the person, then using voice recorder module output is given in audio form to blind people to help them navigate.**

Keywords*— *Ultrasonic Ranging Module HC - SR04,ATmega 32A, APR33A3 Voice recorder , Modular design,visual impairment, GPS and GSM module;

I. INTRODUCTION

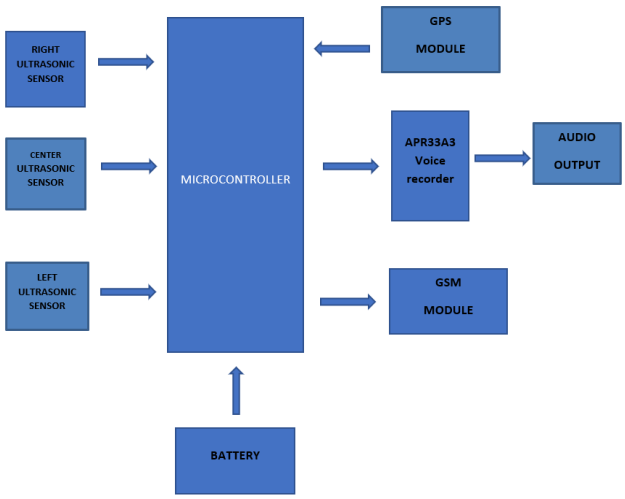
The number of people with visual impairment is increasing with time, this increases toll on economy as well as visually impaired people has to depend on others for at least some of their needs. Currently visually challenged people use walking stick or dogs to guide them which although provides some level of freedom are not reliable and cannot detect all level of obstacles. The more complex and costlier solution include converting images from camera to electrical signal and using them to provide detectable output. So, the goal of this project is to provide some degree of locomotive freedom for the blind in a cheap and portable way with easily available modules. This project also trends on modular feature of the project so that it can be easily upgradeable and repairable. [3]
The proposed design uses Atmega32 microcontroller with the help of ultrasonic sensor to detect the obstacle Infront of them. Atmega32's four port design enables our design to be flexible and cheap enough to add GPS and GSM module along with voice recorder IC to make it easier and safer to use. GPS would enable the model to detect the position of the person using it and in case of emergency with the help of GSM module deliver the location coordinates and preprogrammed safety message to programmed number.

II. LITERATURE SURVEY

Our objective is to design a modular, portable and cheap visual aid module which can used has a wrist band or on head or fitted on a cane if needed. To get information of the obstacle present we can use sensors. Sensors can be further classified as active and passive sensors. Passive sensors just receive the incoming signal coming from the present energy sources like PIR sensor which detect incoming IR signal from energy sources. Active sensors emit and detect distorted reflected signals to estimate the size and distance of the obstacle. I went with the active ultrasonic sensors because its more accurate and has long range. Ultrasonic sensor was chosen instead of infrared or lasers because it has wide bandwidth, not affected by atmosphere and lower cost than the other two.[4]
The sensor input is then given has input to Atmega 32A microcontroller which calculates the distance between obstacle and person. The microcontroller then gives output to speaker. GSM and GPS module is added to the module to provide location and send emergency message.

III. SYSTEM DESIGN AND OVERVIEW

The model aims to develop a modular visual aid so that it can be easily upgraded or repaired and can be fitted into a cane or cap if needed. The whole system works on 12 v power supply and uses LM7805 voltage regulator to convert it into 5 v.



A. Atmega 32A MICROCONTROLLER

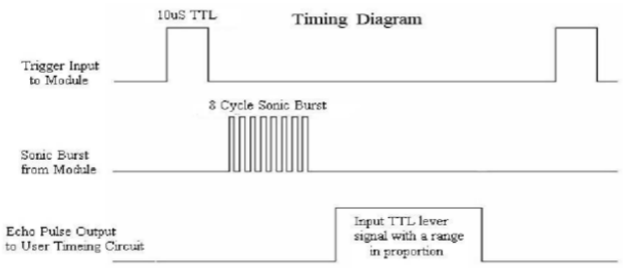
The proposed design uses Atmega 32A microcontroller. It has 32Kbytes of In-System Self-programmable Flash program memory and data retention capacity of 20 years at 85°C/100 years at 25°C. he ATmega32A is a 40 pins device with 32 KB Flash, 2 KB SRAM and 1 KB EEPROM. By executing instructions in a single clock cycle, the devices achieve CPU throughput approaching one million instructions per second (MIPS) per megahertz, allowing the system designer to optimize power consumption versus processing speed.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 10, October-2019

Atmega 32A was chosen because AVR family has GCC based IDE that is completely free. This 8-bit CPU is 4 times faster than the 8 bits PIC and 12 times faster than 8051. It's easier to code and not that power demanding as compared to ARM.so it will run much longer for battery-based operation.
Microcontroller first triggers the ultrasonic sensors trigger pin for at least 10us. After triggering it waits for rising edge output of echo pin of sensor. Once echo goes high, we get an external interrupt and we are going to start a counter (enabling a counter) in the ISR (Interrupt Service Routine) which is executed right after an interrupt triggered. When echo pin goes low interrupt is again generated disabling the counter. This timer count is used to calculate the distance between the obstacle and the person.

B. ULTRASONIC RANGING MODULE HC-SR04

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules include ultrasonic transmitters, receiver and control circuit. The basic principle of work:
(1) Using IO trigger for at least 10us high level signal.
(2) The Module automatically sends eight 40 kHz pulse and detect whether there is a pulse signal back.
(3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning. Test distance = (high level time×velocity of sound (340M/S) / 2 [4]
The Timing diagram is shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8-cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion. You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch; or: the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.



My model design plans to use 3 ultrasonic sensors for 270 degree filed of view. All the three sensors work parlelly on the same principle the microcontroller triggers them using their respective pins, then calculates the time-based o echo signal length.[5][6]

C. APR33A3 VOICE-RECORDER

APR33a3 Voice play back provides high quality recording and playback with 11 minutes audio at 8 KHz sampling rate with 16-bit resolution. The aPR33A series C2.x is specially designed for simple key trigger, user can record and playback the message averagely for 1, 2, 4 or 8 voice message(s) by switch, it is suitable in simple interface or need to limit the length of single message.[7]
In this project the recorder is used in 8 voice mode to record 6 messages (object .5m center, object .5m right, object .5m left, object 1m center, object 1 m right, object 1m left) 2 for each ultrasonic sensor, the other 2 message slot have been left for future upgradability.

D. GSM MODULE

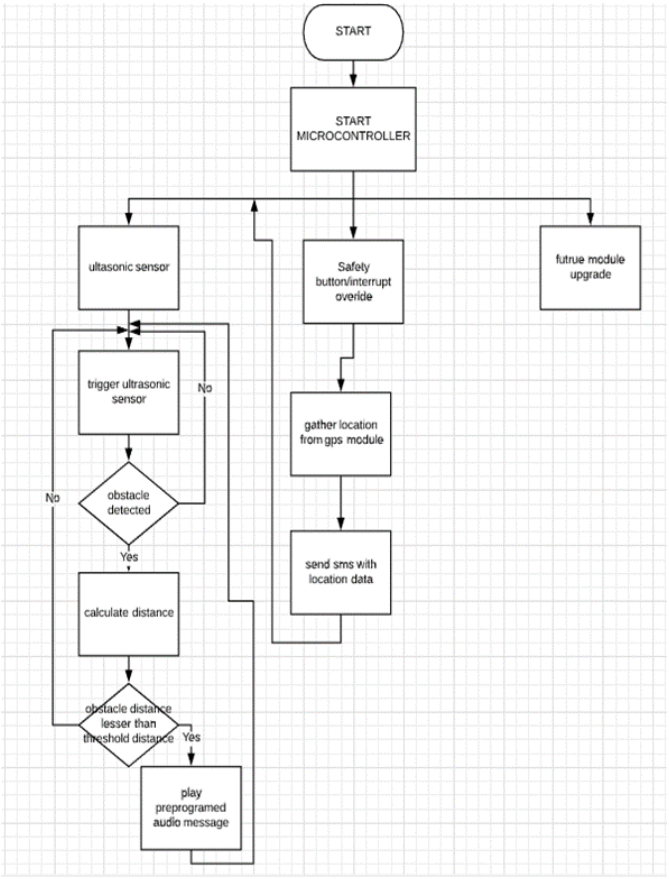
GSM (Global System for Mobile communication) module can be used with Atmega 32A, so that in case of emergency a blind person can send emergency message to already preprogramed number. SIM 900A s compatible with our project. SIM900A Modem can work with any GSM network operator SIM card just like a mobile phone with its own unique phone number.SIM900A GSM/GPRS modem is plug and play modem with RS232 serial communication supported. Hence Advantage of using this modem will be that its RS232 port can be used to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed. SIM900 modem supports features like voice call, SMS, Data/Fax, GPRS etc.[8]

E. GPS MODULE

GPS can be used so that in case of emergency the person can send his or her location with the help of gsm module.
Global Positioning System (GPS) makes use of signals sent by satellites in space and ground stations on Earth to accurately determine their position on Earth. Radio Frequency signals sent from satellites and ground stations are received by the GPS. GPS makes use of these signals to determine its exact position. The GPS itself does not need to transmit any information. The signals received from the satellites and ground stations contain time stamps of the time when the signals were transmitted. By calculating the time difference between the time, the signal was transmitted and the time the signal was received, and using the speed of the signal, the distance between the satellites and the GPS can be determined using a simple formula for distance using speed and time. Using information from 3 or more satellites, the exact position of the GPS can be triangulated. [9]
The working principle of the project can be characterised as below
1) The power supply activates the circuit and microcontroller is initialized. Interrupt is generated to activate the ultrasonic sensors.
2) The ultrasonic sensor continuously checks the obstacle. The sensor transmitter transmits the frequency, which reflects from the obstacle. Sensor receiver receives the reflected frequency and gives it to microcontroller.
3) If the obstacle detected is within the specified programmed distance the microcontroller processes it and gives signal to APR33A3 Voice recorder.
4) Its outputs sound and start to inform the person that the obstacle is detected through headphone.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 10, October-2019

5)If emergency button is pushed the GSM module gets the location coordinates from the GPS module and it sends message to already programmed number with his or her location.



IV . RESULT

The proposed project was built and test. The result was in par with the proposed system design. The user could walk without any help comfortable after some practice and avoid all collision. The project was compact enough to be fitted into a cap or cane or on wrist as a band and modular enough so that it can be easily upgraded and repaired. It was fast, efficient, compact and affordable enough so that everyone can use it.

V. CONCLUSION

Visually impaired people usually use walking stick or rely on other people for support or have to spend hefty amount on complex guidance systems. This project will help them become more independent without spending much money. My project provides foundation for more upgradable visual aids. This project provides a compact, low-cost, portable and low power consumption device for visually challenged person with low response time. The system can be improved further in future by adding wireless connectivity.

VI. FUTURE SCOPE

The system can be supplemented with PIR, humidity and fire sensor to give better detection. It can be further enhanced by using VLSI technology to design the PCB unit. This makes the system further more compact. A wall following function can also be added so that the user can walk straight along a corridor in an indoor environment.

REFERENCES

[1] Bourne RRA, Flaxman SR, Braithwaite T, Cicinelli MV, Das A, Jonas JB, et al.; Vision Loss Expert Group. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. Lancet Glob Health. 2017 Sep;5(9):e888–97.

[2] Fricke, TR, Tahhan N, Resnikoff S, Papas E, Burnett A, Suit MH, Naduvilath T, Naidoo K, Global Prevalence of Presbyopia and Vision Impairment from Uncorrected Presbyopia: Systematic Review, Meta-analysis, and Modelling, Ophthalmology. 2018 May 9

[3] Sunita and Jennie Sharf. “The people sensor: a mobility aid for the visually impaired.” *Digest of Papers. Second International Symposium on Wearable Computers (Cat. No.98EX215)* (1998): 166-167.”
Abdul Sfiiyan Manaf, Ebin Joseph, Shibil P M, Akmal Ahmed, 2019, Effective Fast Response Smart Stick for Blind People, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) RTESIT – 2019 (VOLUME 7 – ISSUE 08)

[4] https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf

[5] Wang W. C.. Intelligent Ultrasonic distance Measurement Based on ARM[J]. Instrument Rechnique and Sensor, 2010, (7):34-36

[6] Tohru Ifukube, Tadayuki sasaki and Chen Perg, (1991). “A blind mobility aid modeled after echolocation of bats”. IEEE transactions on biomedical engineering. pp: 461-465

[7] https://www.mycomkits.com/reference/aPR33Ax_C2.1_Datasheet_2130219.pdf

[8] https://www.electronicwings.com/sensors-modules/sim900a-gsmgprs-module

[9] https://www.electronicwings.com/avr-atmega/gps-module-interfacing-with-atmega1632