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Ultrasonic Blind Walking Stick With Voice Playback

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Abstract : The paper describes ultrasonic blind walking stick with voice playback. Traditionally visually impaired people used a stick to find out if any obstacles are present in front of them. But this stick is inefficient in various aspects and the person using it has to face several problems. The objective of this project is to provide the visually impaired a better navigational tool. The ultrasonic blind walking stick is way more advanced than the traditional walking stick as the use of sensors makes object detection easier. The voice playback assists the blind person to take appropriate steps to reach the desired destination. Along with the obstacles, pit can also be detected by using sensor on the stick. The vibrator connected to the stick is used for the indication of pit or down slope or steps.

Key Words: **PIC16f877a, ultrasonic, walking stick, voice playback**.

1.INTRODUCTION

The project aims on providing an alternative to the traditional walking stick. The developed stick targets at providing accurate detection of objects and guiding the person accordingly. PIC microcontroller is small and low cost single chip computer that can do calculations automatically at high speed with great accuracy.
When we combine this power with a pair of ultrasonic wave transmitter and receiver, we can use PIC's accurate time measurement feature to measure the time it takes for the sound waves to reach an obstacle and bounce back to the receiver. By quick and fast calculations we can immediately find out the distance. And if the object is very close then the user can be alerted with a voice playback and vibration on the stick. MP3 audio module is used for voice playback.
Our project focuses on obstacle detection, pit detection and finding location in order to reduce navigation difficulties for visually impaired people.

2. LITERATURE SURVEY

There are different methods that can be used to implement ultrasonic blind walking stick . By doing survey, different methods that were found out are as follows:

- Voice operated outdoor navigation system for visually impaired persons done by Osama Bader AL-Barrm International Journal of Latest Trends in Engineering and Technology [1]. Uses a stick equipped with ultra-sonic sensors, GPS and audio output system. The stick contains GPS along with a SD memory card which used to store different locations .The user can use voice commands to input the desired loaction. This system will also provide the speed and the remaining distance to reach the distention. When the ultra-sonic sensors detect any obstacle directly the voice system will activate the caution voice. This system can be classified as a low cost system affordable by the user. In addition to that, it can provide a voice guide for the user with greatest possible accuracy. The system uses the ARM processor which has more memory space, so that the operating speed is high. However, this system cannot operate indoors because there will be no signal for the GPS system. The accuracy of the GPS signal need to be improved because it only can be controlled within 5 meters radios. Finally, the blind person needs to be trained on the system so that he or she can use it effectively
- Another study done by (Jayant, Pratik and Mita, 2012) [2] proposed a smart cane assisted mobility for the visually impaired. The system is based on normal ultrasonic sensors and ATMEL microcontroller. It operates with two rechargeable battery (7.4v) it can be recharged using USB cable or AC adaptor. The control unit is programmed using ATMEL AVR microcontroller ATMEGA328P microcontroller. Once any obstacles are detected vibration and buzzer will start in order to warn the user. This system is a non-complex system to use. It has the ability to cover a distance up to 3 meters and has the rechargeable feature of the battery. Also, this system can be folded in small piece so that

the user can carry it easily. However, this system has only one direction detection coverage and it is inaccurate in detecting the obstacles.

- The Nottingham Obstacle Detector (NOD) is a hand held device subsumed with ultrasound. The device provides feedback as a unique note on the musical scale which is audible, and depicts the distance of the obstacle[3].

All the studies which had been reviewed show that, there are a number of techniques for making a smart stick for blind people. However, the study conclusion shows that, using the ultrasonic sensors would be an efficient solution to detect the obstacles. The ultrasonic sensors work efficiently in an angle of 45 degrees. Thus the obstacleswhich are in front can be detected easily as the range of the ultrasonic sensors is 2cm to 4m. Now the advancement in this project is that for left and right obstacle detection IR sensors are used which have a very small range and thus would work for obstacles which are very close. Use of 3 ultrasonic sensors would create calculation errors thus the use of IR sensors is preferred. And with the MP3 audio module voice playback is possible which gives the commands to the user if any obstacle is detected.

3. SYSTEM DESIGN AND IMPLEMENTATION

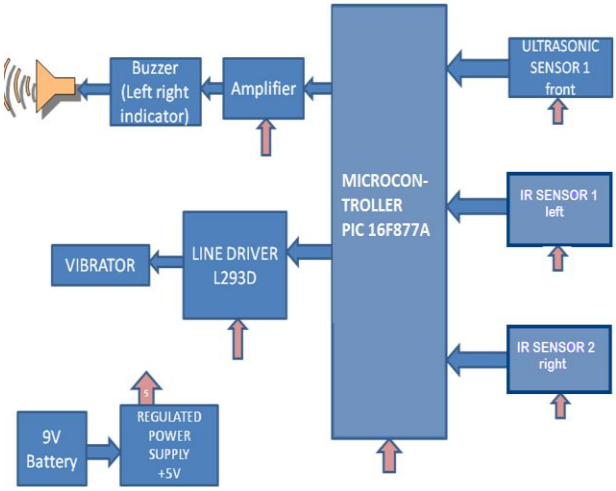

Fig -1: block diagram

The major components of the system as seen in the block diagram are as follows:

- PIC16F877A microcontroller
- DC Motor with driver(L293D)
- Ultrasonic Ranging Module (HC - SR04)
- IR sensor
- Voltage regulator
- MP3 audio module

3.1. PIC16F877A

The PIC microcontroller PIC16f877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy.

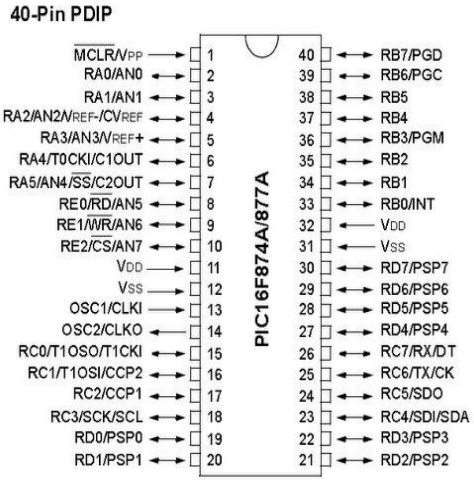

Fig -2: PIN configuration

3.2 L293D

The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin each for motor. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor.

- Pin 2 =Logic 1 and Pin 7= Logic 0 (clockwise direction)
- Pin 2 = Logic 0 and Pin 7 = Logic 1 (Anticlockwise Direction)
- Pin 2 = Logic 0 and Pin 7 = Logic 0 (idle) [No rotation]
- Pin 2 = Logic 1 and Pin 7 = Logic 1 (idle) [no rotation]

In this project motor driver is used to operate the vibrator which helps the stick vibrate when a pit is detected.

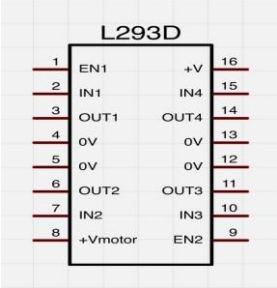

Fig-3: PIN configuration of L293D

3.3 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 includes 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 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.

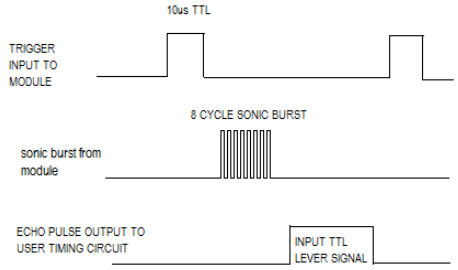

Fig-4: Timing Diagram

You only need to supply a short 10uS pulse for triggering 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. We 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.

3.4 IR sensor

The basic concept of an Infrared Sensor which is used as Obstacle detector is to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver.
There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED's of specific wavelength can be used as infrared sources.

3.5 Voltage regulator

All the components in the circuit of blind walking stick require a voltage of 5v. Now if a higher voltage is given to the circuit which leads to higher current, the components might get damaged due to overvoltage. To avoid this we use voltage regulator.
The blind walking stick uses LM805 voltage regulator as the requirement of the circuit is 5V DC supply. The 7805 voltage regulator has a 5-volt output. LM7805 is a positive voltage regulator. It produces a voltage that is positive relative to a common ground. This devices supports an input voltage anywhere from around 2.5 volts over the intended output voltage up to a maximum of 30 volts, and typically provide 1 or 1.5 amperes of current.

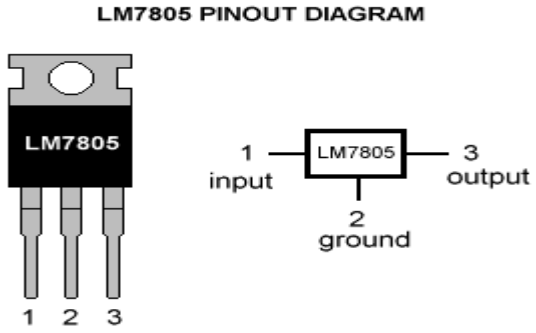

Fig-5: Voltage Regulator

3.6 MP3 audio module

This embedded MP3 module is an universal and compact circuit (37 mm x 27 mm) for playing MP3 audio files. The MP3 module can be used in embedded systems. The MP3 files (up 65,536) are stored in a micro SDcard. Controlling the module could be done either by buttons and digital inputs or via TTL serial interfaces.
FN-M16P is a small and low price MP3 module with an simplified output directly to the speaker. The module can be used as a standalone module with attached battery, speaker and push buttons or used in combination with an Arduino UNO or any other with RX/TX capabilities.

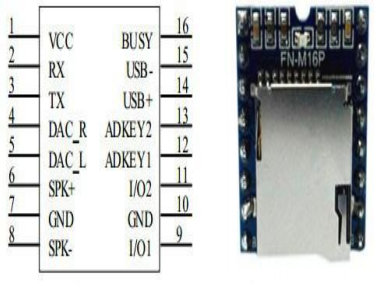

Fig-5: Pin configuration of MP3 module

4. SYSTEM WORKING

When the switch is turned ON the begins to run and the PIC checks the PIN status. The sensors then start functioning and the data collected by them. The ultrasonic sensor is used for detecting objects/obstacles which are in front whereas the two IR sensors are used to detect the obstacles on the sides. After the collection of data the calculations are done according to the formula : uS / 58 = centimeters or uS / 148 =inch. Once the distance of the obstacle is calculated then the conditions are checked.

Conditions:

(1)An obstacle in the range of 90-140 centimeters.
(2)An obstacle in the range of 60-90 centimeters.
(3)An obstacle in the range of 30-60 centimeters.
  (a)There is an obstacle in the front and the left and right side is free.
  (b)There is an obstacle in the front and the left side and the right side is free.
  (c)There is an obstacle in the front and the right side and the left side is free.
  (d)There are obstacles on all the three sides i.e. front, left and right.
(4)An obstacle is in the range of 30-60 centimeters.
(5) An obstacle is within the range of 30 centimeters.
(6)If there is a pit ahead.

5. FUTURE SCOPE

A global positioning method will used to find the position of' the user using the global positioning system (GPS) and guidance to their destination will be given to the user by voice navigation.Awallfollowing function can also be added so that the user can walk straight along a corridor in an indoor environment. Some more applications like vehicle detection, slippery floor, on-coming vehicle detection and fire or smoke alarm can also be included.

6. CONCLUSION

The main purpose of this project is to produce a prototype that can detect objects or obstacles in front of users and feeds warning back, in the forms of voice messages and vibration, to users..If constructed with at most accuracy, the blind people will able to move from one place to another without others help. The developed prototype gives good results in detecting obstacles paced at distance in front of the user and also the obstacles which are on the sides. The end product of project that meets all the goals . However there are still some considerable adjustments that can be made. With more time and resources we would like to create a custom walking stick for the blind.

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