

**Project Report on**  
**Assistive Collision Avoidance Device For**  
**Visually Impaired Individuals**

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**CERTIFICATE**

*This is to certify that the Major project entitled “Assistive Collision Avoidance Device For Visually Impaired Individuals” being submitted by*

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*in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology in Electronics & Communication Engineering, Guru Nanak Institutions Technical Campus, Hyderabad** to the **J.N.T.U. Hyderabad** during the AY:2014-15 is bonafide work carried out by him under my guidance and supervision. The result provided in this report has not been submitted to any other University or Institution for the award of any degree.*

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## **ABSTRACT**

This work helps the visually challenged people to walk more confidently. The study hypothesizes a smart walking stick that alerts visually impaired people over obstacles in front enabling them in walking confidently with less accidents. It outlines a better navigational tool for the visually impaired.

This device is equipped with a sensor to give information about the obstacles that lie ahead. This system mainly contains ultrasonic ranging module, LCD (for verification & calibration purposes), DC supply, microcontroller, voice output module and speaker/headphones for the purpose of providing vocal feedback about the distance of obstacle to the visually impaired individual.

This is mainly based on ultrasonic sensors which can acquire range data from objects in the environment by estimating the time-of-flight of the signal. The ultrasonic sensors are used to detect whether obstacles are present in front of users. Feedback is presented to users in the form of voice commands. Our system is composed of an ATMEL AT89S52 Microcontroller, an ultrasonic sensor HC-SR04, a voice output module aPR33A3 to provide vocal feedback (to inform about the proximity of the obstacle).

Ultrasonic sensors are cheap (compared to alternatives such as laser range scanners) and are harmless making them ideally suited to this domain. However, they are normally used to detect whether obstacles are located in front of user or not.

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## LIST OF ABBREVIATIONS

ALE	-	Address Latch Enable
IC	-	Integrated Circuit
GPS	-	Global Positioning System
GND	-	Ground
LCD	-	Liquid Crystal Display
MIC	-	Microphone
Obj	-	Object
RST	-	Reset
SPKR	-	Speaker
TRIG	-	Trigger

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## CHAPTER 1: INTRODUCTION

### 1.1 Visual Impairment (Blindness)

Vision is the most important part of human physiology as 83% of information human being gets from the environment is via sight. The 2011 statistics by the World Health Organization (WHO) estimates that there are 285 billion people in world with visual impairment, 39 billion of which are blind and 246 with low vision.

Blindness is the condition of poor visual perception. Various scales have been developed to describe the extent of vision loss and define blindness. Total blindness is the complete lack of form and visual light perception and is clinically recorded as NLP, an abbreviation for "no light perception".

Blindness is frequently used to describe severe visual impairment with some remaining vision. Those described as having only light perception have no more sight than the ability to tell light from dark and the general direction of a light source. The World Health Organization defines low vision as visual acuity of less than 20/60 (6/18), but equal to or better than 20/200 (6/60), or visual field loss to less than 20 degrees, in the better eye with best possible correction. Blindness is defined as visual acuity of less than 20/400 (6/120), or a visual field loss to less than 10 degrees, in the better eye with best possible correction.

### 1.2 Challenges for the visually impaired

People with visual impairment are facing the following challenges in their daily lives

#### 1.2.1 Mobility

Many people with serious visual impairments can travel independently, using a wide range of tools and techniques. Orientation and mobility specialists are professionals who are specifically trained to teach people with visual impairments how to travel safely, confidently, and independently in the home and the community. These professionals can also help visually impaired individual to practice travelling on specific routes which they may use often, such as the route from one's house to a convenience store. Becoming familiar with an environment or route can make it much easier for a visually impaired individual to navigate successfully.

Tools such as the white cane with a red tip - the international symbol of blindness - may also be used to improve mobility. A long cane is used to extend the user's range of touch sensation. It is usually swung in a low sweeping motion, across the intended path of travel, to detect obstacles. However, techniques for cane travel can vary depending on the user and/or the situation. Some visually impaired persons do not carry these kinds of canes, opting instead for the shorter, lighter identification (ID) cane. Still others require a support cane. The choice depends on the individual's vision, motivation, and other factors.

A small number of people employ guide dogs to assist in mobility. These dogs are trained to navigate around various obstacles, and to indicate when it becomes necessary to go up or down a step. However, the helpfulness of guide dogs is limited by the inability of dogs to understand complex directions. The human half of the guide dog team does the directing, based upon skills acquired through previous mobility training. In this sense, the handler might be likened to an aircraft's navigator, who must know how to get from one place to another, and the dog to the pilot, who gets them there safely.

GPS devices can also be used as a mobility aid. Such software can assist visually impaired individual with orientation and navigation, but it is not a replacement for traditional mobility tools such as white canes and guide dogs.

Some visually impaired individuals are skilled at echo locating silent objects simply by producing mouth clicks and listening to the returning echoes. It has been shown that blind echolocation experts use what is normally the "visual" part of their brain to process the echoes. Technology to allow visually impaired individuals to drive motor vehicles is currently being developed.

Government actions are sometimes taken to make public places more accessible to visually impaired individuals. Public transportation is freely available to the visually impaired in many cities. Tactile paving and audible traffic signals can make it easier and safer for visually impaired pedestrians to cross streets. In addition to making rules about who can and cannot use a cane, some governments mandate the right-of-way be given to users of white canes or guide dogs.

### **1.2.2 Reading and magnification**

Most visually impaired people who are not totally blind read print, either of a regular size or enlarged by magnification devices. Many also read large-print, which

is easier for them to read without such devices. A variety of magnifying glasses, some handheld, and some on desktops, can make reading easier for them.

Others read Braille (or the infrequently used Moon type), or rely on talking books and readers or reading machines, which convert printed text to speech or Braille. They use computers with special hardware such as scanners and refreshable Braille displays as well as software written specifically for the blind, such as optical character recognition applications and screen readers.

### **1.2.3 Using Computers**

Access technology such as screen readers, screen magnifiers and refreshable Braille displays enable the blind to use mainstream computer applications and mobile phones. The availability of assistive technology is increasing, accompanied by concerted efforts to ensure the accessibility of information technology to all potential users, including the blind. Later versions of Microsoft Windows include an Accessibility Wizard & Magnifier for those with partial vision, and Microsoft Narrator, a simple screen reader. Linux distributions (as live CDs) for the blind include Oralu and Adriane Knoppix, the latter developed in part by Adriane Knopper who has a visual impairment. Mac OS also comes with a built-in screen reader, called VoiceOver.

## **1.3 Motivation for development of Assistive Collision Avoidance Device**

Of all the challenges cited above the important of all is mobility. Hence the aims of this work are inclined to the article 20 of World Blind Union are as follows.

- Facilitating the personal mobility of persons with disabilities in the manner and at the time of their choice, and at affordable cost.
- Facilitating access by persons with disabilities to quality mobility aids, devices, assistive technologies and forms of live assistance and intermediaries, including by making them available at affordable cost
- Providing training in mobility skills to persons with disabilities and to specialist staff working with persons with disabilities

- Encouraging entities that produce mobility aids, devices and assistive technologies to take into account all aspects of mobility for persons with disabilities.”

## **1.4 Analysis of Mobility aids for visually impaired individuals**

### **1.4.1 Walking Cane**

The oldest mobility aid for persons with visual impairments are the walking cane. A white cane is used by many people who are blind or visually impaired.

#### **Long Cane:**

This "traditional" white cane, also known as a "Hoover" cane, after Dr. Richard Hoover, is designed primarily as a mobility tool used to detect objects in the path of a user. Cane length depends upon the height of a user, and traditionally extends from the floor to the user's sternum. Some organizations favor the use of much longer canes.

#### **Guide Cane:**

This is a shorter cane - generally extending from the floor to the user's waist - with a more limited mobility function. It is used to scan for kerbs and steps. The guide cane can also be used diagonally across the body for protection, warning the user of obstacles immediately ahead.

#### **Identification Cane /Symbol Cane:**

The ID cane is used primarily to alert others as to the bearer's visual impairment. It is often lighter and shorter than the long cane, and has no use as a mobility tool.

#### **Support Cane:**

The white support cane is designed primarily to offer physical stability to a visually impaired user. By virtue of its color, the cane also works as a means of identification. This tool has very limited potential as a mobility device.

### **Kiddie Cane:**

This version works the same as an adult's Long Cane but is designed for use by children.

### **Green Cane:**

Used in some countries to designate that the user has low vision while the white cane designates that a user is blind.



*Figure 1 A visually impaired individual navigating with the help of a cane*

### **1.4.2 Guide Dogs**

The other option that provides the best travel aid for the blind is the guide dogs. Based on the symbiosis between the disabled owner and his dog, the training and the relationship to the animal are the keys to success. The dog is able to detect and analyze complex situations: cross walks, stairs, potential danger, know paths and more.

Although the dogs can be trained to navigate various obstacles, they are partially (red–green) color blind and are not capable of interpreting street signs. The human half of the guide dog team does the directing, based upon skills acquired through previous mobility training. The handler might be likened to an aircraft's navigator, who must know *how* to get from one place to another, and the dog is the pilot, who gets them there safely.

Most of the information is pass through tactile feedback by the handle fixed on the animal. The user is able to feel the attitude of his dog, analyze the situation and also give him appropriate orders. But guide dogs are still far from being affordable, around the price of a nice car, and their average working time is limited, an average of 7 years.



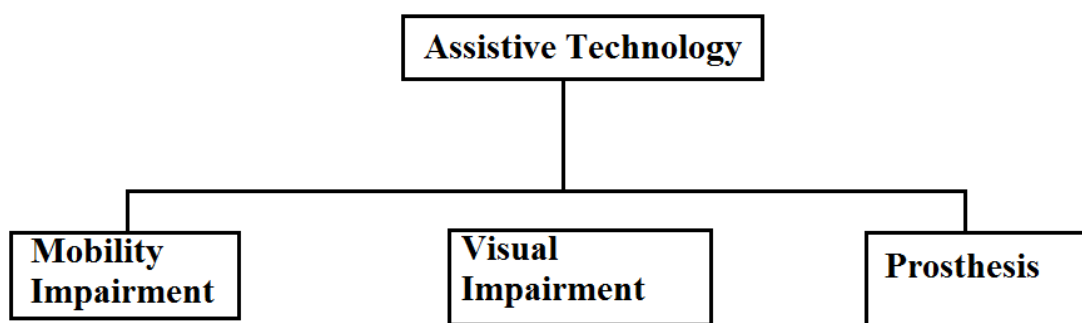
*Figure 2 A visually impaired person taking the help of a guide dog*

### **1.5 Drawbacks and alternative possibilities**

The most important drawbacks of these aids are necessary skills and training phase, range of motion and very little information conveyed. With the rapid advances of modern technology, both in hardware and software front has brought potential to provide intelligent navigation capabilities using Assistive Technology. Although the dogs can be trained to navigate various obstacles, they are partially (red–green) color blind and are not capable of interpreting street signs. The human half of the guide dog team does the directing, based upon skills acquired through previous mobility training.

## 1.6 Assistive Technology

Recently there has been a lot of Electronic Travel Aids (ETA) designed and devised to help the blind navigate independently and safely. Also high-end technological solutions have been introduced recently through “Assistive Technology” to help blind persons navigate independently.



*Figure 3 Types of Assistive technology*

Assistive technology is an umbrella term that includes assistive, adaptive, and rehabilitative devices for people with disabilities and also includes the process used in selecting, locating, and using them.

Assistive technology enables greater enhancement of capabilities by enabling people to perform tasks that were previously problematic to accomplish. Figure 3 summarizes implementation of assistive technologies. Recently a lot of Electronic Travel Aids designed and devised to help the blind navigate independently and safely and also technologically advanced and feasible solutions have been introduced to help blind persons navigate independently.

Many blind guidance systems use ultrasound because of its immunity to the environmental noise. Another reason why ultrasonic is popular is that the technology is relatively inexpensive, and also ultrasound emitters and detectors are small enough to be carried without the need for complex circuit. Also ultrasound emitters and detectors are small enough to be carried without the need for complex circuit.

## **1.7 Aim of the work carried out**

The problem of navigation assistance has been addressed primarily from the angle of human-computer interactions and in the industry, by proposing some commercially viable systems.

The main objective of this project is to provide artificial guidance regarding the obstacles ahead to the visually impaired people with the help of a microcontroller, ultrasonic sensor, and speaker and finally make the instrument available at an affordable price for all the visually impaired people.

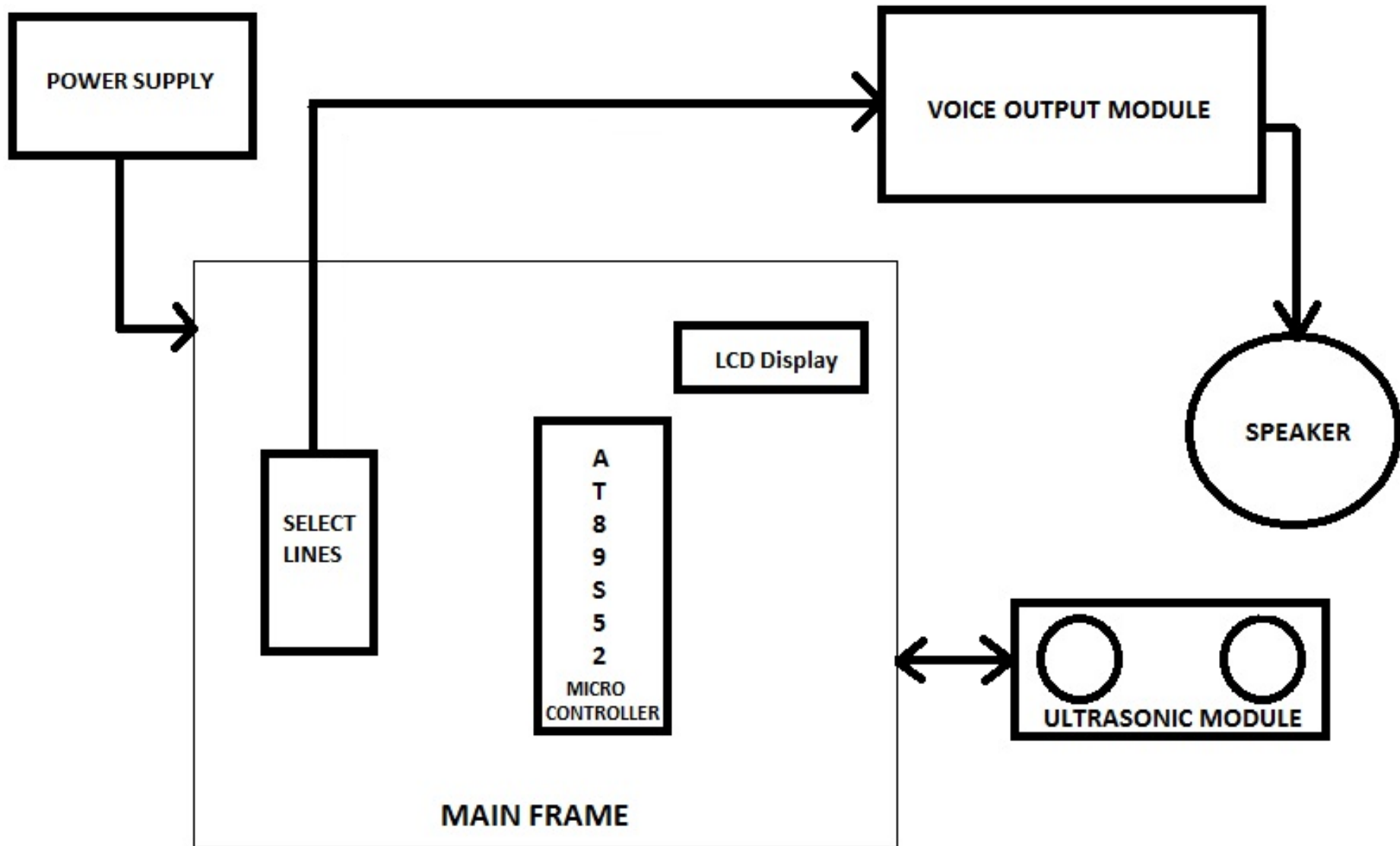
## **1.8 Brief insight into the work carried out**

The work presented in this project is based on the use of new technologies to improve the mobility of visually impaired people. Our work focuses on obstacle detection in order to reduce navigation difficulties for visually impaired people.

Moving through an unknown environment becomes a real challenge when we can't rely on our own eyes. Since dynamic obstacles usually produce noise while moving, visually impaired individual develop their sense of hearing to localize them but when it comes to stationary objects there might be no sound feedback from them thus making them undetectable by the visually impaired individual.

This is mainly based on ultrasound sensors which can acquire range data from objects in the environment by estimating the time-of-flight of the ultrasound signal. Using a sensor coverage area, obstacles can be detected and enable the visually impaired individual to determine which directions should be avoided. The ultrasound sensors are used to detect whether obstacles are present in front of users. Feedback is presented to users in the form of voice commands.

## CHAPTER 2: BLOCK DIAGRAM AND DESCRIPTION



*Figure 4 Block Diagram of Assistive Collision Avoidance Device*

## **Block Diagram of Assistive Collision Avoidance Device**

From the Block Diagram it is clear that there are 6 important aspects in the functional block diagram of the Assistive Collision Avoidance Device. They are as follows.

1. Microcontroller Block
2. Ultrasonic Ranging Module
3. LCD Module
4. Voice Output Module
5. Speaker
6. Power Supply Block

The functionality of each block is discussed in detail and their corresponding inputs and outputs are mentioned in detail in the upcoming sections.

## **2. 1 Microcontroller Block**

### **2.1.1 Inputs and Outputs of microcontroller block**

This block essentially consists of a microcontroller. It receives inputs from Ultrasonic ranging module and selects the appropriate sound track for play back using speaker for spoken feedback purposes and it is also connected to LCD for displaying the distance and calibration of spoken feedback.

It has the following inputs

- 5 Volts power supply from power supply block
- Inputs from Ultrasonic Ranging Module HC - SR04

It has the following outputs

- Display information to 16x2 LCD Module for calibration purposes
- Select lines for selecting appropriate sound track based on inputs from Ultrasonic Ranging Module HC - SR04

### **2.1.2 Description of microcontroller block**

The main frame essentially consists of a microcontroller here it is ATMEL AT89S52 which is burned with a code designed for this purpose and a 16x2 LCD for calibration purposes.

The code is capable of taking inputs of time of travel of the sound wave and calculate the distance based on that time of travel using equations of motion from mechanics in physics and be able to determine the distance of obstacle.

After calculating the distance of the obstacle the microcontroller now displays the same distance on the LCD screen with an accuracy of 1 centimeter. It is also chooses one of the appropriate sound track from pre-recorded audio tracks using the conditions framed in the code dumped inside it.

Example: If the obstacle is 44 centimeters from the Ultrasonic Ranging Module. Output on LCD is “Obj at 044 Cm” Vocal Feedback says “Caution! Object under 50 centimeters”

## **2.2 LCD Block**

### **2.2.1 Inputs and Outputs of LCD Block**

Inputs:

- Power supply

Outputs

- Distance

Power supply of 5V and display information are inputs and display on the LCD is the output.

### **2.2.2 Description of LCD Block**

The LCD Block essentially consists of a LCD here it receives inputs from microcontroller and displays the appropriate output of “distance of obstacle”. This is used for purpose of calibration of spoken feedback according to the distance.

## **2.3 Ultrasonic Ranging Module HC - SR04**

### **2.3.1 Inputs and Outputs of Ultrasonic Ranging Module**

Power supply of 5V and trigger (to start ranging) pulse are the inputs and the output is time of flight (when echo returns) is sent to microcontroller.

### **2.3.2 Description of Ultrasonic Ranging Module**

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, it senses the distance between itself and the obstacle ahead.

The ranging accuracy can reach to 3mm. The module includes ultrasonic transmitters, receiver and control circuit. The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats or dolphins do.

It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. Its operation is not affected by sunlight or black material like Sharp rangefinders. Although acoustically soft materials like cloth can be difficult to detect. It comes complete with ultrasonic transmitter and receiver module.

## **2.4 Voice Output Module**

### **2.4.1 Inputs and Outputs of Voice Output Module**

It has the following inputs

- Selection lines from the main frame block
- Power supply of 5V from the power supply block
- A mic for recording
- A switch to switch between recording and playback modes in the circuit

It has the following outputs

- Sound track playback information to speaker

### **2.4.2 Description Voice Output Module**

It consists of a two modes

#### **a. Recording Mode**

This is used for pre-feeding audio into the memory module present in the Voice Output Module and for later play back purposes

#### **b. Playback Mode**

The appropriate pre-recorded audio is played back by this Voice Output Module as instructed by the microcontroller ATMEL AT89S52.

The main functional component of this block is aPR33A. It 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, e.g. toys, leave messages system, answering machine etc.

Meanwhile, this provides the power-management system. Users can let the chip enter power-down mode when unused. It can effectively reduce electric current consuming to 15uA and increase the using time in any projects powered by batteries.

The appropriate pre-recorded audio is played back by this module as instructed by the microcontroller ATMEL AT89S52.

## **2.5 Speaker**

### **2.5.1 Inputs and Outputs of Speaker**

Input

- Audio track data from voice output module

Output

- Spoken feedback

### **2.5.2 Description of Speaker**

This block is basically used for spoken feedback for the visually impaired individual to alert him regarding the proximity of the obstacle.

The devices which can be used to convey the spoken feedback could be

- Earphones
- Speaker

## **2.6 Power Supply Block**

### **2.6.1 Inputs and Outputs of power supply block**

Inputs:

- Power supply 220V AC

Outputs

- Power supply 5V DC

A series of actions take place inside this block which results in conversion of input 220V AC to 5V DC with the help of a step down 12-0-12 center tapped step down transformer, bridge rectifier DB107, voltage regulator 7805 is a 5V output, three terminal positive voltage regulator IC. A constant voltage of 5V is supplied by this block as the output

### **2.6.2 Description of power supply block**

#### **a. Step Down of Voltage**

Here a center tapped transformer (12-0-12) steps down AC 230V to AC 12V.

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC.

#### **b. Rectification**

The AC voltage is now converted to pulsating DC with the help of Bridge Rectifier DB107. A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as Rectification.

### c. Smoothing

The pulsating DC is smoothened and then given in voltage regulator 7805. Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling

### d. Regulation

The smoothned DC voltage is given as input to voltage regulator 7805 and it finally gives out a 5V DC.. A regulator will maintain the output constant even when there are changes at the input. Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages.

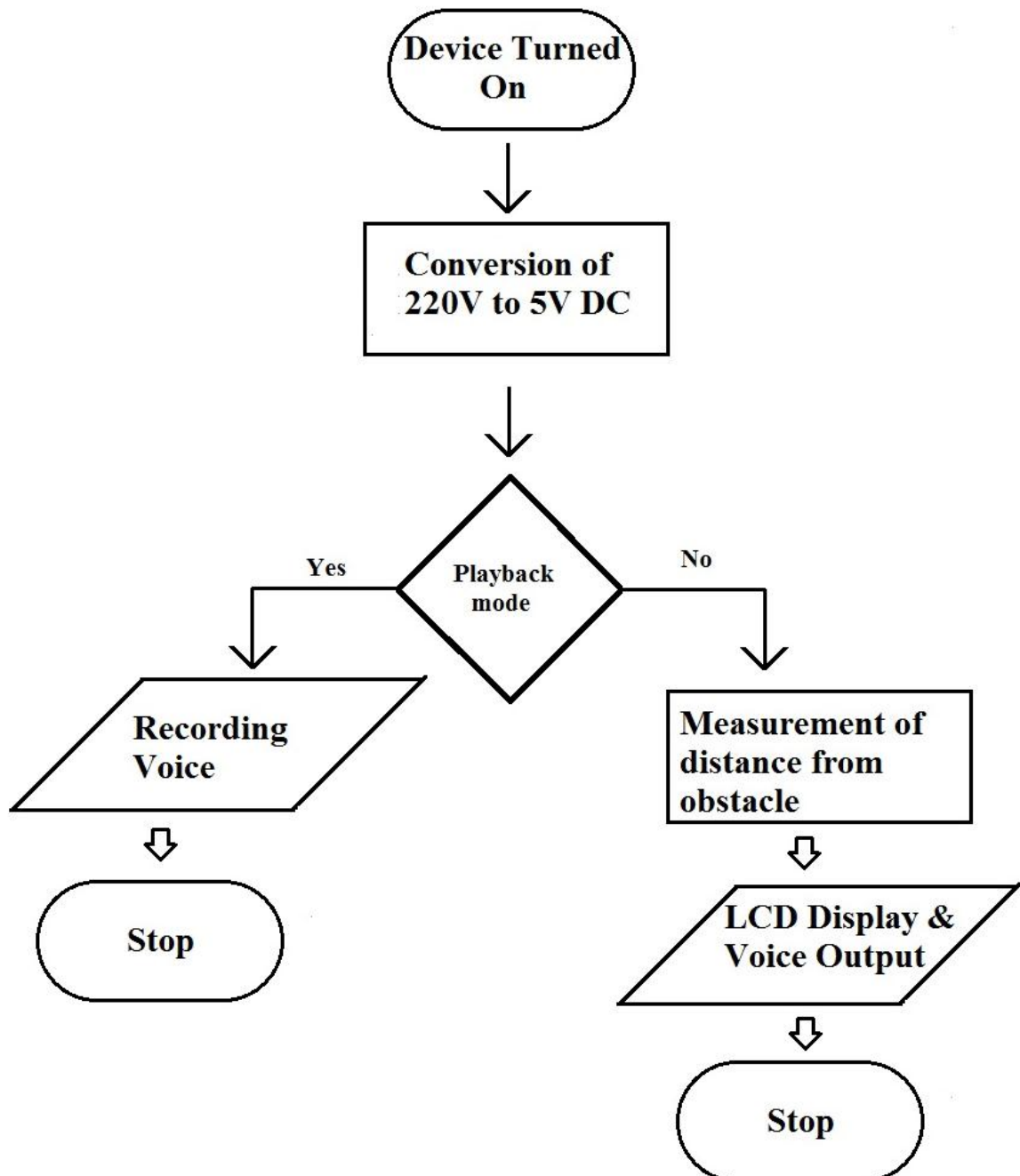
*Figure 5 Table Summarizing inputs and outputs of various blocks*

Block Name	I/O	Inputs or Outputs provided by the block
<b>Microcontroller</b>	<b>Input</b>	1. 5 Volts power supply from power supply block  2. Inputs from Ultrasonic Ranging Module HC - SR04
	<b>Output</b>	1. 16x2 LCD Module for calibration purposes  2. Select lines for selecting appropriate track of audio based on inputs from Ultrasonic Ranging Module HC - SR04
<b>LCD</b>	<b>Input</b>	1. Display data from microcontroller
	<b>Output</b>	1. Display of distance on screen
<b>Ultrasonic Ranging Module</b>	<b>Input</b>	1. Power Supply  2. Trigger Pulse
	<b>Output</b>	1. Time of flight (time to receive echo)

<b>Voice Output Module</b>	<b>Input</b>	1. Selection lines from the main frame block 2. Power supply of 5V from the power supply block 3. A mic for recording 4. A switch to switch between recording and playback modes in the circuit
	<b>Output</b>	1. Audio track playback signal to speaker
<b>Speaker</b>	<b>Input</b>	1. Audio track data from voice output module
	<b>Output</b>	1. Spoken feedback
<b>Power Supply</b>	<b>Input</b>	1. 220 Volts 50 Hertz AC
	<b>Output</b>	1. 5V DC

## 2.7 Flow Chart

A flowchart depicts the above described series of actions.



**Figure 6 Flowchart showing the operation of the Device**

We can see that there are two cases arising near the decision box regarding the mode selection. It could either be playback mode (preferred) or recording mode.

## **2.8 Resolution levels for output of distance**

Put forth the working in measurement and graphical terms we can summarize that the microcontroller in device basically calculates the distance from an obstacle using the inputs from ultrasonic ranging module and displays the exact distance with a resolution up to 1cm accuracy on the 16x2 LCD module and gives out a vocal feedback of the distance of obstacle if any with the resolution up to 50 centimeters accuracy or else says “Obstacle is out of Range” if the obstacle is farther than 350 centimeters.

## CHAPTER 3: Hardware Description & Software Description

### 3.1 List of various components used in each block and their functionality

#### 3.1.1 Main Circuit Block

This block essentially consists of a microcontroller here it receives inputs from Ultrasonic ranging module and selects the appropriate sound track for play back using speaker for spoken feedback purposes and it is also connected to an LCD for displaying the distance and calibration of spoken feedback.

The following table below lists various components used in the above mentioned process.

*Figure 7 Components used in Main Circuit*

S.No.	Name	Quantity
a.	ATMEL AT89S52 Microcontroller	1
b.	Various Resistors	1
c.	3.3 pF Capacitor (ceramic)	2
d.	10 $\mu$ F Capacitor	1
e.	Crystal Oscillator 11.0592 MHz	1
f.	Reset Button	1
g.	Red LED	1
h.	16x2 LCD	1
i.	2 pin connecting wires	3
j.	Ultrasonic Ranging Module, HC-SR04	1

The functionality that is relevant for the functioning of our “Assistive Collision Avoidance Device for Visually Impaired Individuals” of each of the above mentioned component is discussed in brief manner.

#### **a. ATMEL AT89S52 Microcontroller**

##### **Function in the circuit**

This is a very important block and it essentially consists of a microcontroller here it receives inputs from Ultrasonic ranging module and selects the appropriate sound track for play back using speaker for spoken feedback purposes and it is also connected to an LCD for displaying the distance and calibration of spoken feedback.

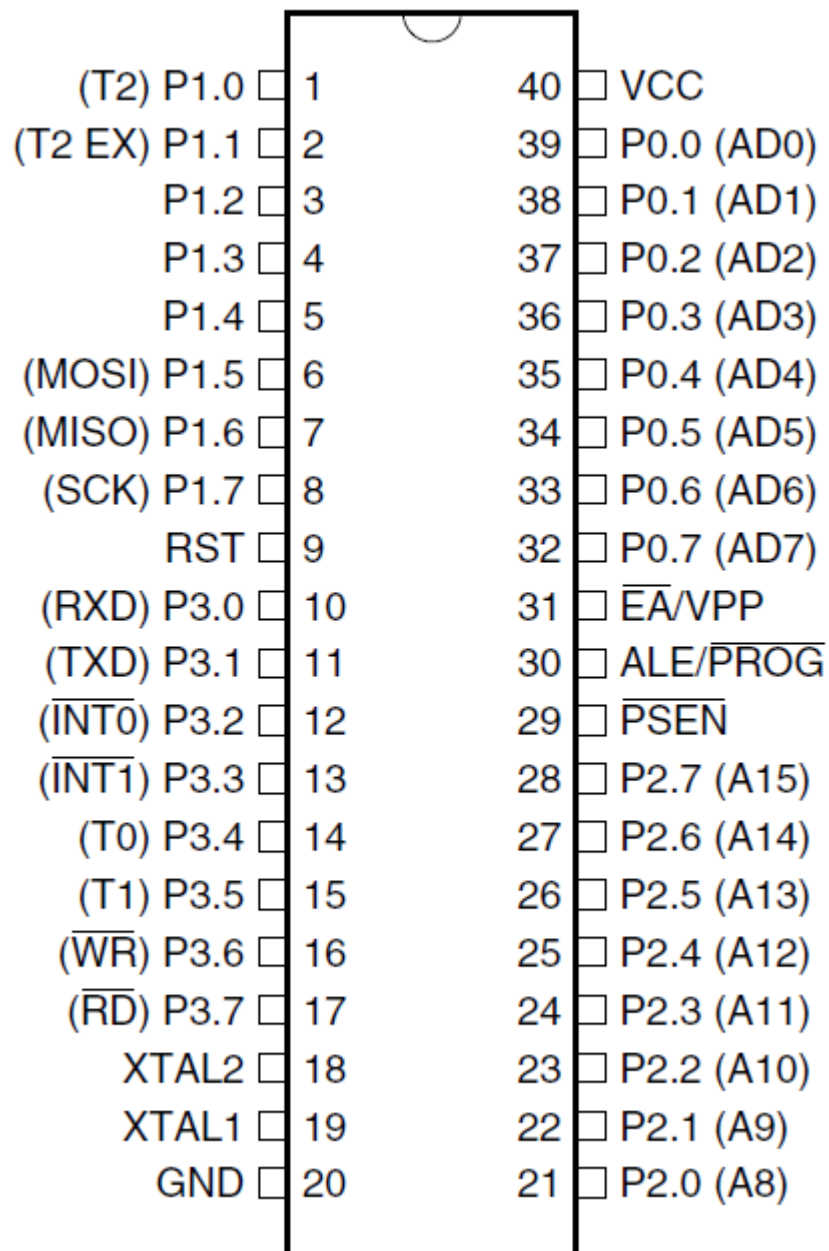
##### **Description**

AT89S52 microcontroller is a great family supports Intel MCS-51 . Atmel AT89S52 is created by, indicated by the initials "AT". This microcontroller has a low consumption, but 8-bit CMOS gives high performance with an internal flash memory 8K Bytes. This is done using the technology and high density non-volatile memory belonging to the Atmel 80C51 and is compatible with the standard. Flash memory chip enable internal or scheduled to be reprogrammed by a non-volatile memory. By combining an 8-bit CPU with Flash programmable memory per core monolithic Atmel microcontroller AT89S52 is very strong which has high flexibility and is therefore the perfect solution for many embedded applications.

The main features of the microcontroller are:

- Compatibility with MCS 51 family
- 8-bit CPU at a frequency of up to 33MHz
- RAM: 256 Bytes
- Flash memory: 8K Bytes
- 32 lines of programming for input / output general
- 8 Interrupt sources organized in two levels of priorities
- 3 timers / counters of 16 bits
- Watchdog Timer
- two data pointers
- One serial port (full duplex UART)

- ISP Programming Interface 8K Bytes
- supports up to 10 000 rewrites
- contains oscillator
- short-term programming

**Various Pins used in this device**

**Figure 8 Pin Diagram of AT89S52**

AT89S52 is a 40-pin microcontroller, the significance of which is set out below. Incidentally mentioned pin number considering that pin 1 is in the top left and top right pin 40.

**Vcc (40)** supply voltage

**GND (20)** earth

**Port 0 (39-32):** Port 0 is a bidirectional port input / output 8 bits. As output port, each pin is assigned eight TTL inputs. When Port 0 pins are enrolled logical value 1, they can be used as high impedance inputs. Port 0 can also be configured as the least significant address or data during access to external program and data memory. Port 0 is also the recipient during programming Flash code and gives bits resulting from the testing program. Closing transistor is required during program verification.

**Port 1 (1-8):** Port 1 is also a bidirectional port input / output with internal pull-up (transistor is automatically closed). Buffers output port can support one four TTL inputs. When port 1 is written to logic value 1, ie the transistor is closed, we can use the port for reading, otherwise, if the transistor is to use port opened for writing. Port 1 also receives the least significant address bits during Flash programming and verification. In addition, pins 0 and 1 of port 1 can be configured as timers and counters it, and pins 5, 6, 7 are used for programming interface.

**Port 2 (21-28):** Portal 2 is also a bidirectional port input / 8-bit iețire with internal pull-up. With the same operation mode as the port 1, as compared with the existing transistor. Portal 2 is the one that gives the most significant bits of the address in extracting the external memory and external memory during data access using 16-bit addresses. In this mode of operation, the Port 2 uses strong internal pull up the issue logic 1 value. While access to external data memory that utilizes 8-bit addresses, port 2 is used for special function registers. Port 2 also receives the most significant address bits and some control signals during Flash programming and verification.

**Port 3 (10-17):** Port 3 is also a bidirectional port input / output 8-bit with internal pull-up, behave as port 1 and port 2. 3 receives control signals for programming and verify Flash memory. Other special functions that you can perform port 3 are:

- pin 0 is an alternative function, input the serial port (RXD);
- pin 1 is used as output to the serial port (TXD);
- pins 2 and 3 are used for external interrupt (INT0 # # INT1);
- pins 4 and 5 may be used interchangeably as the timers (T0 and T1);
- pin 6 is used as the external signal to the memory write (#WR);
- Terminal 7 is used as the external signal read from memory (#RD).
- 

**RST (9):** RST serves to reset the entry. A high value on this pin between two machine cycles while the oscillator is running, resets the device. This pin operates high for 98 oscillator periods after the watchdog of the stops. To disable this feature using bit special function registers DISRTO in exactly the address 8EH. The default state of bit DISRTO, RESET feature is active HIGH.

**ALE / PROG # (30)** comes from the acronym of Address Latch Enable, and this is the one command buffer that stores the least significant address. When programming the Flash memory programming this pin serves as the input pulses: #PROG (Pulse Input Program). For normal operation, ALE issue at a time constant equal to 1/6 of the frequency oscillator and can be used for external timer or clock post. For desired function that executes ALE can be disabled by setting bit special register at 8EH logic value 0. With this bit set, ALE is active only for MOVX and MOVC instructions. Disable bit ALE has no effect on the microcontroller if external execution mode.

**PSEN (29):** acronym PSEN Program Store Enable is and represents the control signal for external program memory. When AT89S52 running external program memory code, #PSEN is activated 2 times for each machine cycle, except when #PSEN signal activation is omitted during access to external data memory.

**EA / VPP (31):** EA acronym stands for External Access Enable. #EA Must be connected to the GRD in order to enable the extraction of code from external program memory from address 0000H to address internal program executions FFFFH. #EA must be tied to VCC.

**XTAL1 (19):** XTAL1 is used as input to the inverting oscillator as a clock input amplified and operational circuit.

**XTAL2 (18):** XTAL2 is amplified oscillator output inverter.

The AT89S52 has 4 different ports, each one having 8 Input/output lines providing a total of 32 I/O lines. Those ports can be used to output DATA and orders do other devices, or to read the state of a sensor, or a switch. Most of the ports of the 89S52 have 'dual function' meaning that they can be used for two different functions.

The first one is to perform input/output operations and the second one is used to implement special features of the microcontroller like counting external pulses, interrupting the execution of the program according to external events, performing serial data transfer or connecting the chip to a computer to update the software. Each port has 8 pins, and will be treated from the software point of view as an 8-bit variable called 'register', each bit being connected to a different Input/output pin.

#### **b-d. Various Resistors and Capacitors**

Various resistors and capacitors where ever necessary have been used.

#### **e. Crystal Oscillator 11.0592 MHz**

##### **Function in the circuit**

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

### **Description:**

It provide clock pulses of 11.0592 MHz frequency. It can be used as UART clock ( $6 \times 1.8432$  MHz). It allows integer division to common baud rates ( $96 \times 115200$  baud or  $96 \times 96 \times 1,200$  baud). It is a common clock for Intel 8051 microprocessor. It uses mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency.

This frequency is commonly used to keep track of time, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators. The crystal oscillator circuit sustains oscillation by taking a voltage signal from the quartz resonator, amplifying it, and feeding it back to the resonator. The rate of expansion and contraction of the quartz is the resonant frequency, and is determined by the cut and size of the crystal.

When the energy of the generated output frequencies matches the losses in the circuit, an oscillation can be sustained. One of the most important traits of the crystal oscillator is that it exhibits very low phase noise. In the crystal oscillator, the crystal mostly vibrates in one axis, therefore only one phase is dominant. This property of low phase noise makes them particularly useful in telecommunications where stable signals are needed, and in scientific equipment where very precise time references are needed. The result is that a quartz crystal behaves like a circuit composed of an inductor, capacitor and resistor, with a precise resonant frequency

### **f. Reset Button**

#### **Function in the circuit**

Incase the device dosent respond or gets stuck, the reset button is used to reset the microcontroller.

## **Description**

A push-button (also spelled pushbutton) or simply button is simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, though even many un-biased buttons (due to their physical nature) require a spring to return to their un-pushed state.

### **g. Red LED**

#### **Function in the circuit**

It is used in the circuit for indication that the circuit is receiving power.

### **h. 16x2 LCD**

#### **Function in the circuit**

The LCD Block essentially consists of a LCD here it receives inputs from microcontroller and displays the appropriate output of “distance of obstacle”. This is used for purpose of calibration of spoken feedback according to the distance.

## **Description**

This is a basic 16 character by 2 line display. Black text on Green background. LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

**Figure 9 Pin description of 16 x 2 LCD**

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	V <sub>cc</sub>
3	Contrast adjustment; through a variable resistor	V <sub>EE</sub>
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7

15	Backlight V <sub>CC</sub> (5V)	Led+
16	Backlight Ground (0V)	Led-

#### i. connecting wires

##### Function in the circuit

- They are mainly used for the following purposes
- Delivering Power to various blocks.
- Conveying data from Ultrasonic Ranging module to microcontroller
- Conveying data from microcontroller to LCD for display.
- Conveying data from microcontroller to voice output module.
- Conveying data from voice output module to speaker.

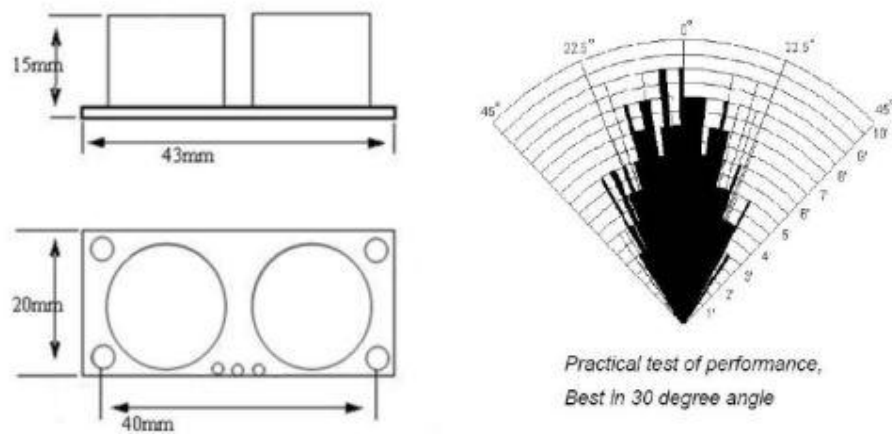
#### j. Ultra Sonic Ranging Module, HC-SR04

##### Function in the circuit

Ultrasonic ranging module is an important component in our device. The HC - SR04 provides 2cm - 400cm non-contact measurement function, it senses the distance between itself and the obstacle ahead.

##### Description

Ultrasonic sensors work on a principle similar to sonar which evaluate distance of a target by interpreting the echoes from ultrasonic sound waves. This ultrasonic module measures the distance accurately which provides 0cm - 400cm with a gross error of 3cm. Its compact size, higher range and easy usability make it a handy sensor for distance measurement and mapping.



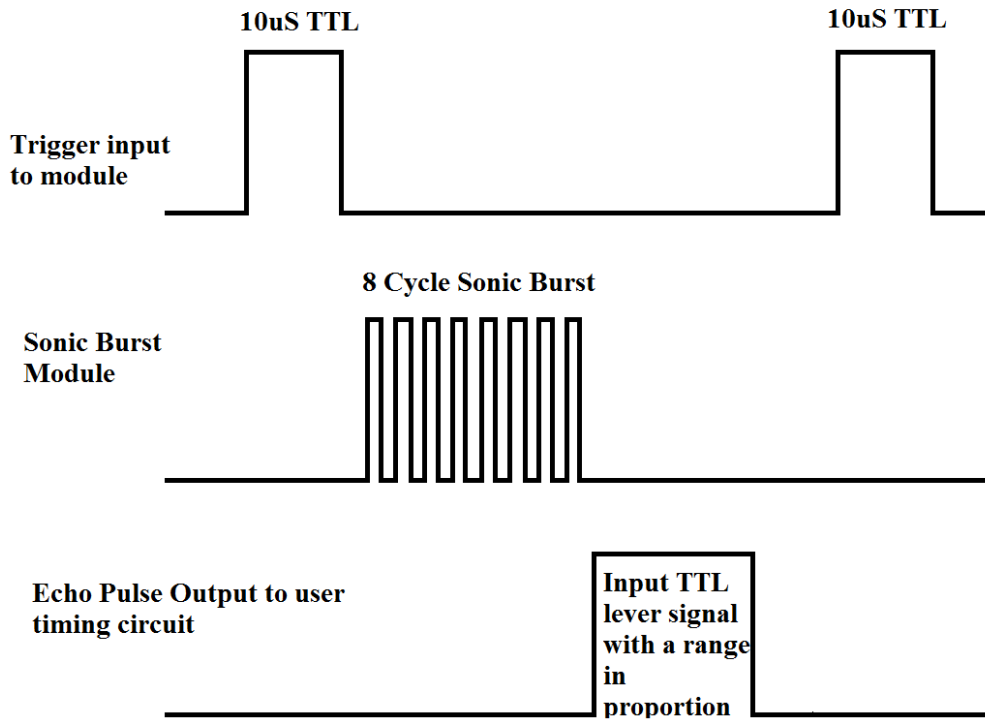
**Figure 10 Variation of performance of the Ultrasonic Ranging Module with angle**

The module can easily be interfaced to micro controllers where the triggering and measurement can be done using two pin. The sensor transmits an ultrasonic wave and produces an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated. Features non-contact measurement with blinding from 0-1cm.

### Working

The working of the distance measurement can be understood from the timing diagram. The Timing diagram is shown in figure.

- A short 10uS pulse is supplied to the trigger input to start the ranging,
- 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
- The range can be calculated through the time interval between sending trigger signal and receiving echo signal. Formula:  $\mu\text{S} / 58 = \text{centimeters}$  or  $\mu\text{S} / 148 = \text{inch}$  or: the range = high level time \* velocity (340M/S) / 2
- Its better to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.



*Figure 11 Timing diagram of Ultrasonic Ranging Module*

### 3.1.2 Voice Output Module

It consists of a two modes

#### a. Recording Mode

This is used for pre-feeding audio into the memory module present in the audio circuit and for later play back purposes

#### b. Playback Mode

The appropriate pre-recorded audio is played back by this module as instructed by the microcontroller ATMEL AT89S52.

Figure 12 Components used in Voice Output Module

S.No.	Name	Quantity
a.	APLUS aPR33A3	1
b.	Resistor 4.2K $\Omega$ (R1)	1
c.	Resistor 7K $\Omega$	2

d.	Resistor 1K $\Omega$ (R3,R7 )	1
e.	Resistor 5.6K $\Omega$ (R4)	1
f.	Resistor 56K $\Omega$ (R6)	1
g.	Resistor 100K $\Omega$	1
h.	0.1 $\mu$ F ceramic capacitor	5
i.	1 $\mu$ F capacitor	2
j.	100 $\mu$ F capacitor	1
k.	Switch	1
l.	Mic	1
m.	Speaker	1

The functionality that is relevant for the functioning of our “Assistive Collision Avoidance Device for Visually Impaired Individuals” of each of the above mentioned component is discussed in brief manner.

#### **a. APLUS aPR33A3**

##### **Function in the circuit**

It is the heart of the voice output module. It has the following responsibilities

- Recording the sound from the microphone
- Playing back the appropriate stored sound as instructed by the microprocessor

##### **Description**

The aPR33A series are powerful audio processor along with high performance audio analog-to-digital converters (ADCs) and digital-to-analog converters (DACs). The aPR33A series are a fully integrated solution offering high performance and unparalleled integration with analog input, digital processing and analog output functionality.

The aPR33A series incorporates all the functionality required to perform demanding audio/voice applications. High quality audio/voice systems with lower bill-of-material costs can be implemented with the aPR33A series because of its integrated analog data converters and full suite of quality-enhancing features such as sample-rate convertor.

The aPR33A series C2.0 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, e.g. toys, leave messages system, answering machine etc. Meanwhile, this mode provides the power-management system. Users can let the chip enter power-down mode when unused. It can effectively reduce electric current consuming to 15uA and increase the using time in any projects powered by batteries.

#### **b-j. Various Resistors and Capacitors**

Various resistors and capacitors where ever necessary have been used.

#### **k. Switch**

##### **Function in the circuit**

It is used in the circuit for indication that the circuit is receiving power.

#### **l. Microphone**

##### **Function in the circuit**

It is used for recording the audio track into the the Voice Output Module for voice feedback to Visually Impaired Individual.

##### **Description**

A microphone, colloquially mic is an accoustic-to-electric transducer or sensor that converts sound in air into an electric signal.

### **m. Speaker**

#### **Function in the circuit**

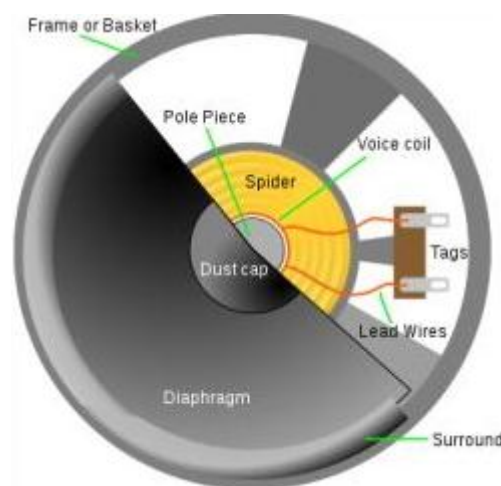
Plays the audio track as as instructed by Voice Output Module for voice feedback to Visually Impaired Individual

#### **Description**

A loudspeaker (or loud-speaker or speaker) is an electroacoustic transducer, a device which converts an electrical audio signal into a corresponding sound.

A speaker may have more than one driver units. As air is produced when the cone moves, a rear vent is made in some speakers for the air to move out. A dust cap is also made in the cone so as to prevent air from getting in through the front. The dust cap can also be kept as the vent. A rubber, foam, or sometimes cloth surround at the outer edge of the cone allows for flexible movement.

Depending on the movement of current through the voice coil, the north and South Pole of the magnetic field will be at one end of the voice coil or the other. Since the permanent magnet also has magnetic poles, its magnetic fields will push the coil outwards if all the magnetic fields are lined up together. If the magnetic fields are lined oppositely, the coil will be pushed outwards. Thus the voice coil will be pushed outwards and inwards according to the music. This push-pull of cone will increase-decrease air pressure in eardrum creating music.



***Figure 13 Cross Section of Speaker***

### 3.1.3 Power Supply Block

The prime function is conversion of input voltage of 220V AC to 5V DC with the help of a step down 12-0-12 center tapped step down transformer, bridge rectifier DB107, voltage regulator. L7805CV is a 5V output, three terminal positive voltage regulator IC. A constant voltage of 5V is supplied by this block as the output.

The following table below lists various components used in the above mentioned process.

**Figure 14 Components used in conversion of 220V AC to 5V DC**

S.No.	Name	Quantity
a.	Center tapped step down transformer	1
b.	DB 107 Bridge Rectifier	1
c.	1000 $\mu$ F Capacitor	1
d.	L7805CV Voltage Regulator	2
e.	Red LED	1

The functionality that is relevant for the functioning of our “Assistive Collision Avoidance Device for Visually Impaired Individuals” of each of the above mentioned component is discussed in brief manner.

#### **a. Center tapped step down transformer**

##### **Function in the circuit**

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC.

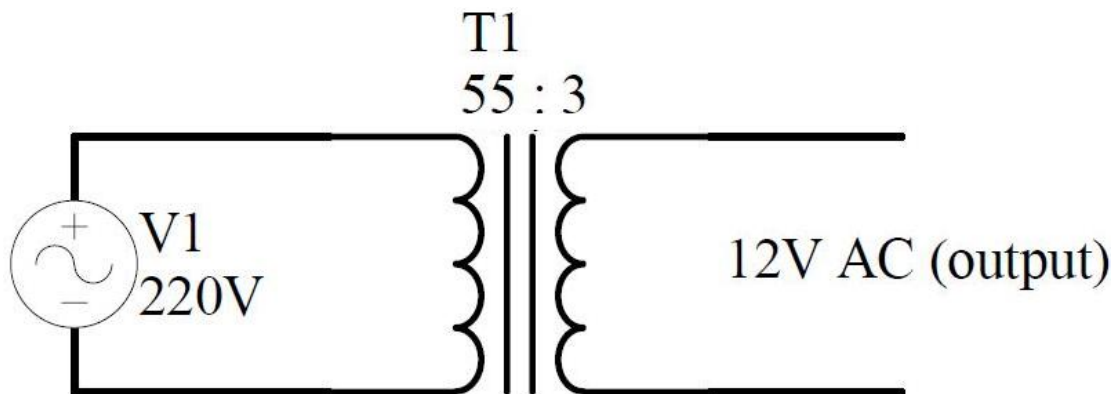
##### **Description**

Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage to a safer low voltage.

The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils, instead they are linked by an

alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core.

Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up.



**Figure 15 Step-down Transformer 220V to 12V**

The ratio of the number of turns on each coil, called the turns ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

$$\text{turns ratio} = \frac{V_p}{V_s} = \frac{N_p}{N_s} \quad \text{and} \quad \text{power out} = \text{power in}$$

$$V_s \times I_s = V_p \times I_p$$

$V_p$  = primary (input) voltage       $V_s$  = secondary (output) voltage

$N_p$  = number of turns on primary coil       $N_s$  = number of turns on secondary coil

$I_p$  = primary (input) current       $I_s$  = secondary (output) current

In a basic power supply the input power transformer has its primary winding connected to the mains (line) supply. A secondary winding, electro-magnetically coupled but electrically isolated from the primary is used to obtain an AC voltage of suitable amplitude, and after further processing by the PSU, to drive the electronics circuit it is to supply.

The transformer stage must be able to supply the current needed. If too small a transformer is used, it is likely that the power supply's ability to maintain full output

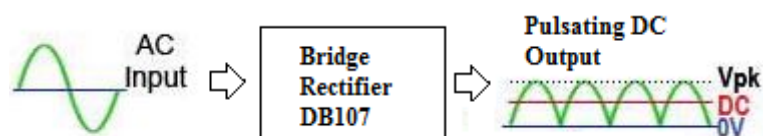
voltage at full output current will be impaired. With too small a transformer, the losses will increase dramatically as full load is placed on the transformer.

As the transformer is likely to be the most costly item in the power supply unit, careful consideration must be given to balancing cost with likely current requirement. There may also be a need for safety devices such as thermal fuses to disconnect the transformer if overheating occurs, and electrical isolation between primary and secondary windings, for electrical safety.

### b. DB 107 Bridge Rectifier

#### Function in the circuit

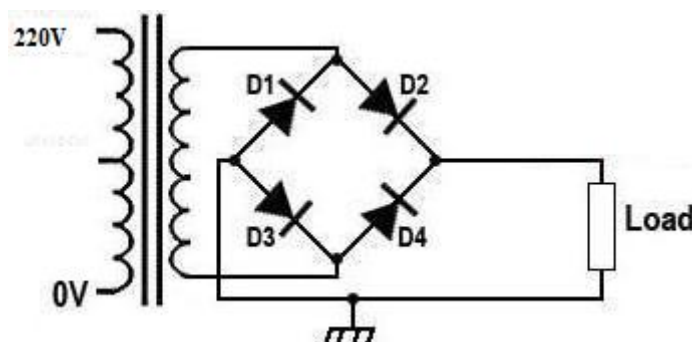
The AC voltage of 12V from transformer is now converted into a pulsating DC with the help of **Bridge Rectifier DB107**.



*Figure 16 Waveform of AC to pulsating DC conversion*

#### Description

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as Rectification.



*Figure 17 Bridge Rectifier*

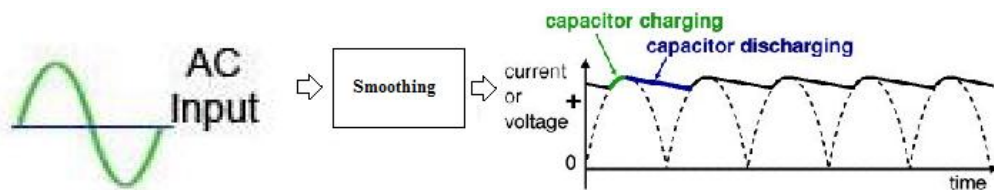
A bridge rectifier is an arrangement of four or more diodes in a bridge circuit configuration which provides the same output polarity for either input polarity. It is

used for converting an alternating current (AC) input into a direct current (DC) output. A bridge rectifier provides full-wave rectification from a two-wire AC input, therefore resulting in lower weight and cost when compared to a rectifier with a 3-wire input from a transformer with a center-tapped secondary winding.

### c. 1000 $\mu$ F Capacitor

#### Function in the circuit

The pulsating DC given out by bridge rectifier DB107 is smoothened.



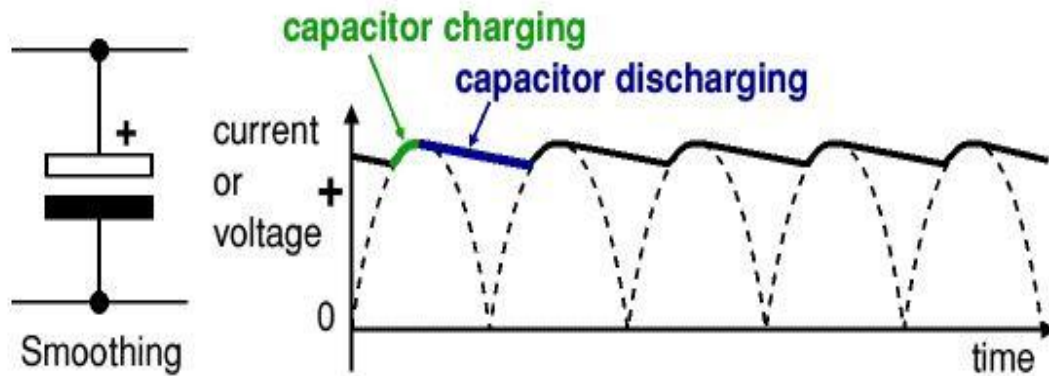
*Figure 18 Smoothing of pulsating DC*

#### Description

A Smoothing capacitor is a capacitor that acts to smooth or even out fluctuations in a signal. The most common and used application for smoothing capacitors is after a power supply voltage or a rectifier. Power supply voltage can sometimes supply erratic and unsmooth voltages that fluctuate greatly.

When a steady DC signal is needed and is necessary, a smoothing capacitor is the right component needed in order to smooth out the fluctuating signal to make it more steady.

Usually when choosing a smoothing capacitor, an electrolytic capacitor is used from anywhere from 10 $\mu$ F to a few thousand  $\mu$ F. The greater the amplitude of the fluctuations and the greater the waveform, the larger capacitor will be necessary. Thus, if smoothing a 30mV waveform, a 10 $\mu$ F capacitor may suffice to smooth out the signal. However, if dealing with a much greater signal, A much larger capacitor will be required, say, maybe 3300 $\mu$ F in order to smooth it out to a near DC level.



**Figure 19** Smoothing Filter

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the unsmoothed varying DC (dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to output.

Smoothing is not perfect due to the capacitor voltage falling a little as it discharges, giving a small ripple voltage. For many circuits a ripple which is 10% of the supply voltage is satisfactory and the equation below gives the required value for the smoothing capacitor. A larger capacitor will give less ripple. The capacitor value must be doubled when smoothing half-wave DC.

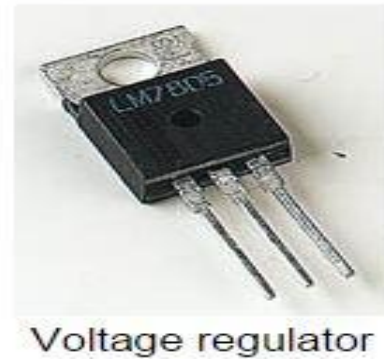
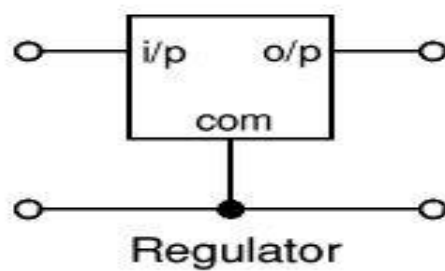
#### **d. L7805CV Voltage Regulator**

##### **Function in the circuit**

A regulator will maintain the output constant even when changes at the input or any other changes occur.

##### **Description**

The smoothed DC voltage is given as input to voltage regulator 7805 and it finally gives out a 5V DC



**Figure 20 Voltage Regulator**

This is the last block in a regulated DC power supply. The output voltage or current will change or fluctuate when there is change in the input from ac mains or due to change in load current at the output of the regulated power supply or due to other factors like temperature changes. This problem can be eliminated by using a regulator. A regulator will maintain the output constant even when changes at the input or any other changes occur. Transistor series regulator, Fixed and variable IC regulators or a zener diode operated in the zener region can be used depending on their applications. IC's like 78XX and 79XX are used to obtain fixed values of voltages at the output. With IC's like LM 317 and 723 etc the output voltage can be adjusted to a required constant value. Figure below shows the LM317 voltage regulator. The output voltage can be adjusted with adjusting the values of resistances  $R_1$  and  $R_2$ . Usually coupling capacitors of values about  $0.01\mu\text{F}$  to  $10\mu\text{F}$  needs to be connected at the output and input to address input noise and output transients.

Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current ('overload protection') and overheating ('thermal protection').

Many of the fixed voltage regulator ICs have 3 leads and look like power transistors, such as the 7805 +5V 1A regulator shown on the right. They include a hole for attaching a heatsink if necessary.

#### **e. Red LED**

##### **Function in the circuit**

It is used in the circuit for indication that the circuit is receiving power.

### **3.2 Software Packages**

The software packages that are required for the following purposes

- a. The software is required for the purpose of writing the program and verifying it for errors and then generating the .hex file.
- b. It is also required for burning the .hex file into microcontroller.

The two important software packages utilized are

- a. Keil  $\mu$ Vision 5
- b. Flash Magic

#### **3.2.1 Keil $\mu$ Vision 5 (For creating the program and then creating a .hex file)**

##### **Purpose**

Creating the program and verifying it for errors and then generating the .hex file.

##### **Description**

The  $\mu$ Vision IDE from Keil combines project management, make facilities, source code editing, program debugging, and complete simulation in one powerful environment.

The  $\mu$ Vision development platform is easy-to-use and helping you quickly create embedded programs that work. The  $\mu$ Vision editor and debugger are integrated in a single application that provides a seamless embedded project development environment.

The  $\mu$ Vision IDE is the easiest way for most developers to create embedded applications using the Keil development tools.

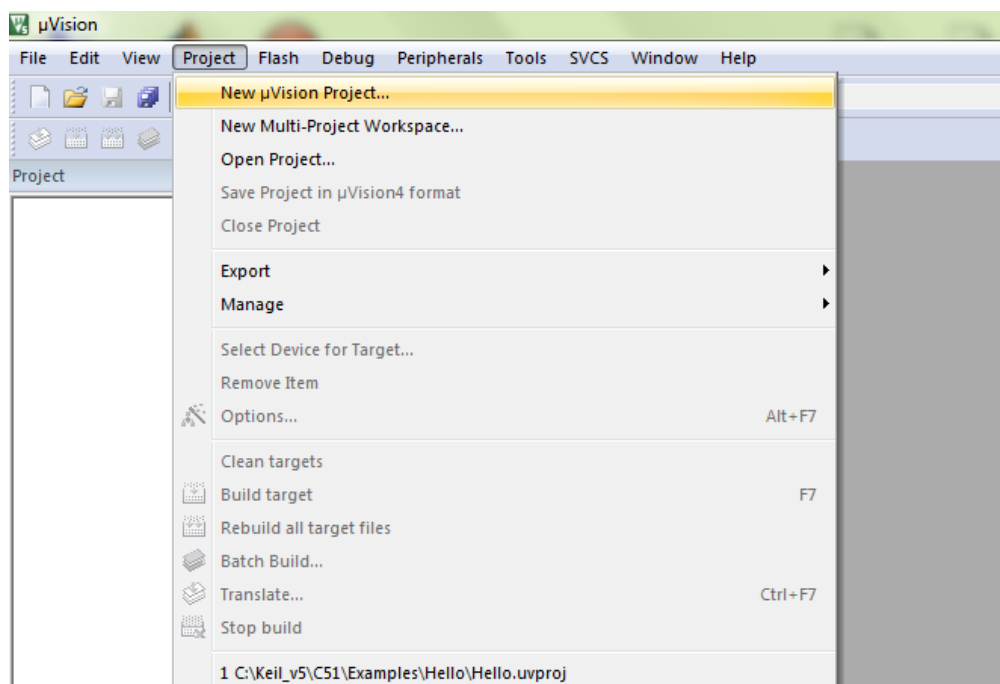
## Procedure

1. Click on Keil  $\mu$ Vision 5 icon on desktop. Then an initialization window appears



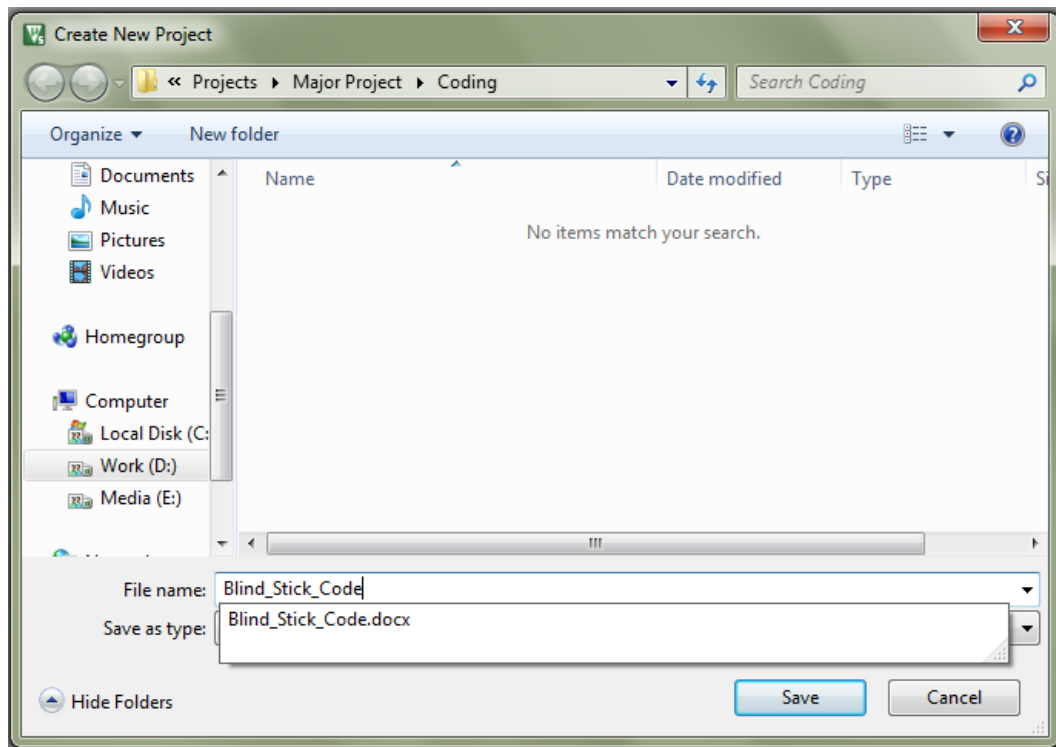
*Figure 21 Keil  $\mu$ Vision 5 initialization window*

2. Now go to project tab and click on new  $\mu$ Vision Project.



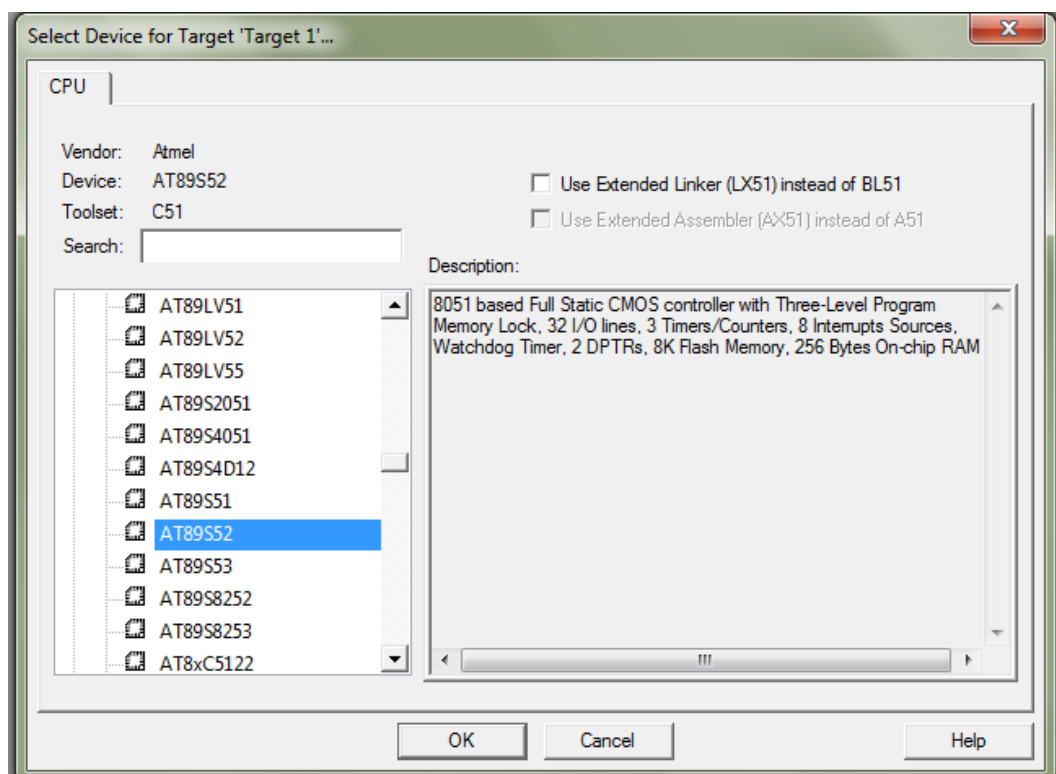
*Figure 22 Creating a  $\mu$ Vision Project*

3. Enter the name of file and click on save



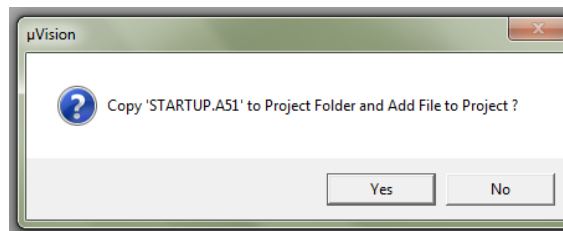
**Figure 23 Creating a new µVision Project (save window)**

4. Select the target device as ATMEL AT89S52 and click OK



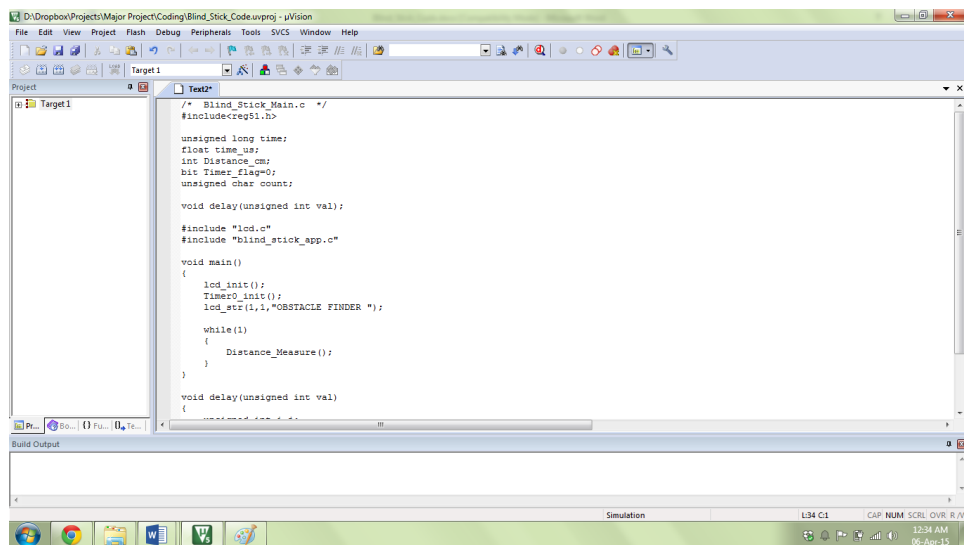
**Figure 24 Selecting target device**

5. Select No for the next prompt that appears.



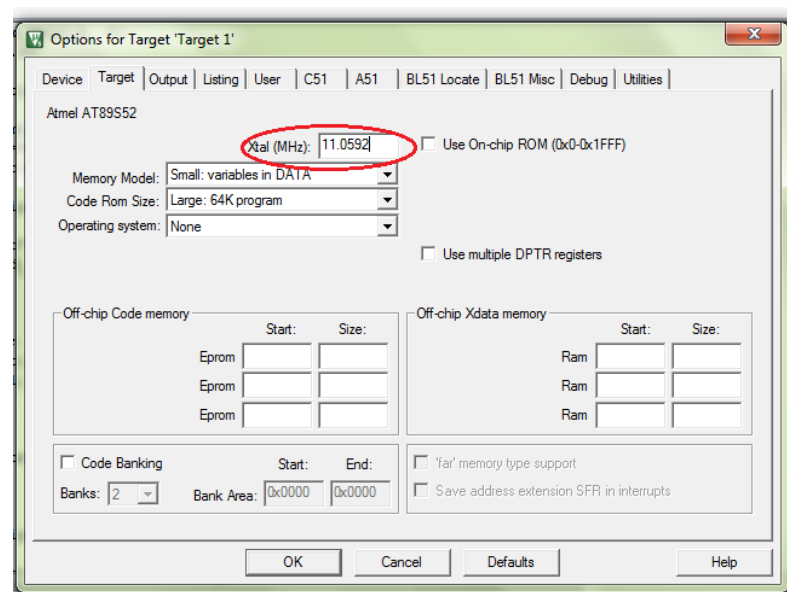
**Figure 25 µVision Prompt**

6. Open new text windows enter the program and save it.



**Figure 26 Text entry window of µVision Project**

7. Now set the frequency for crystal oscillator as 11.0592 MHz.

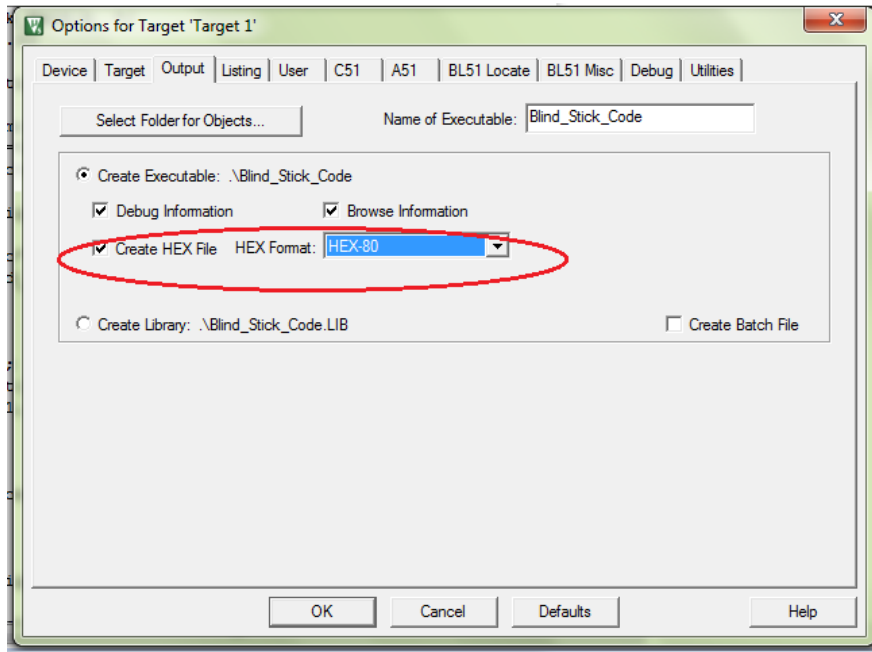


**Figure 27 Selecting frequency of crystal oscillator as 11.0592MHz**

8. Build Project.

9. Compiling the program leads to the step of build project

10. Simulate Program and download to the board.



*Figure 28 Creating a .hex file*

### 3.2.2 Flash Magic

#### Purpose

Burning the program into the microcontroller.

#### Description

Flash Magic is Windows software from the Embedded Systems Academy that allows easy access to all the ISP features provided by the devices.

These features include:

- Erasing the Flash memory (individual blocks or the whole device)
- Programming the Flash memory
- Modifying the Boot Vector and Status Byte
- Reading Flash memory

- Performing a blank check on a section of Flash memory
- Reading the signature bytes
- Reading and writing the security bits
- Direct load of a new baud rate (high speed communications)
- Sending commands to place device in Bootloader mode

Flash Magic provides a clear and simple user interface to these features and more as described in the following sections. Under Windows, only one application may have access the COM Port at any one time, preventing other applications from using the COM Port. Flash Magic only obtains access to the selected COM Port when ISP operations are being performed.

This means that other applications that need to use the COM Port, such as debugging tools, may be used while Flash Magic is loaded. The  $\mu$ Vision IDE is the easiest way for most developers to create embedded applications using the Keil development tools.

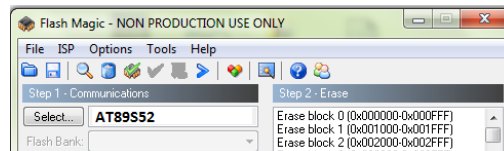
### **Burning the Program into ATMEL AT89S52 Microcontroller**

1. The .hex file is obtained using procedure in previous section.
2. Open Flash Magic from the Start menu



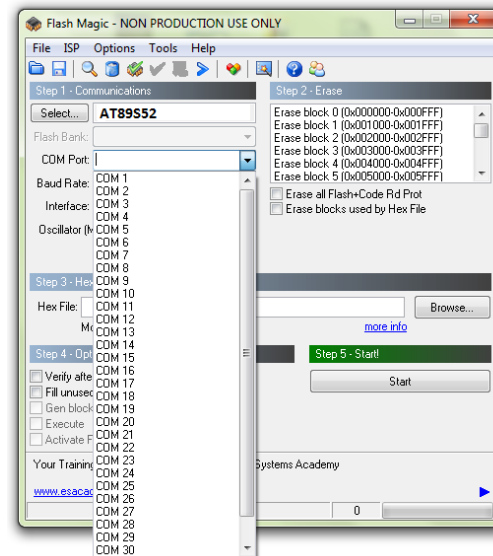
*Figure 29 Flash Magic initialization window*

3. Select the target device as ATMEL AT89S52



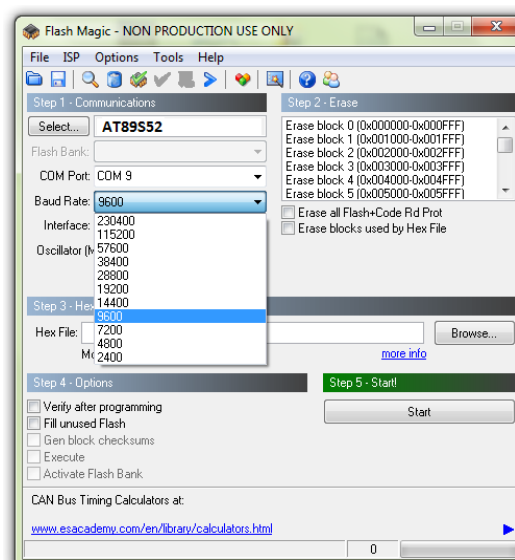
**Figure 30 Target device selection**

4. Select the appropriate COM port (Communication Port)



**Figure 31 COM Port rate selection drop down list**

5. Go to device manager and the COM Port can be easily identified.
6. Select Baud rate as 9600



**Figure 32 Baud rate selection drop down list**

7. Tick the appropriate settings

## 8. Select the HEX file

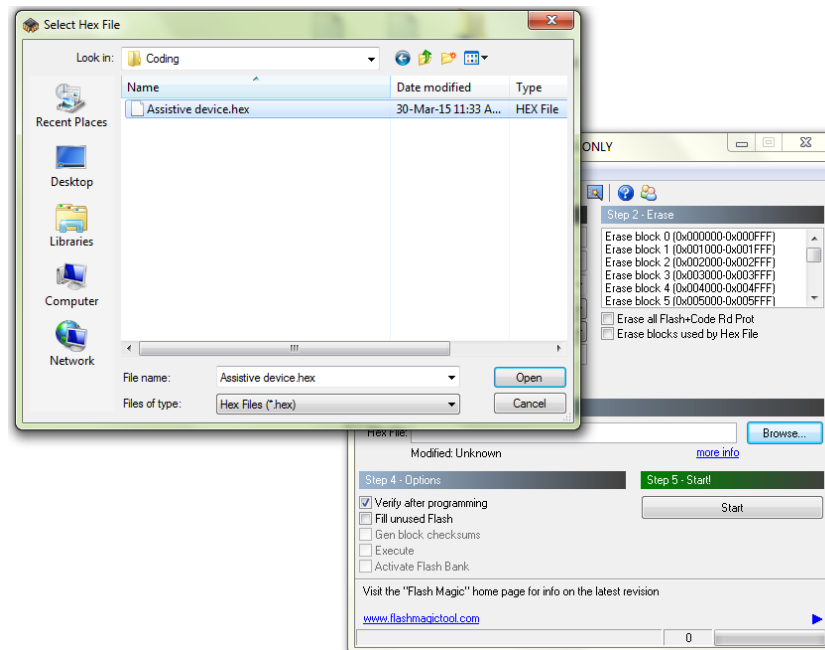


Figure 33 .hex file browsing

## 9. Click on Start to burn the program into ATMEL AT89S52 Microcontroller.

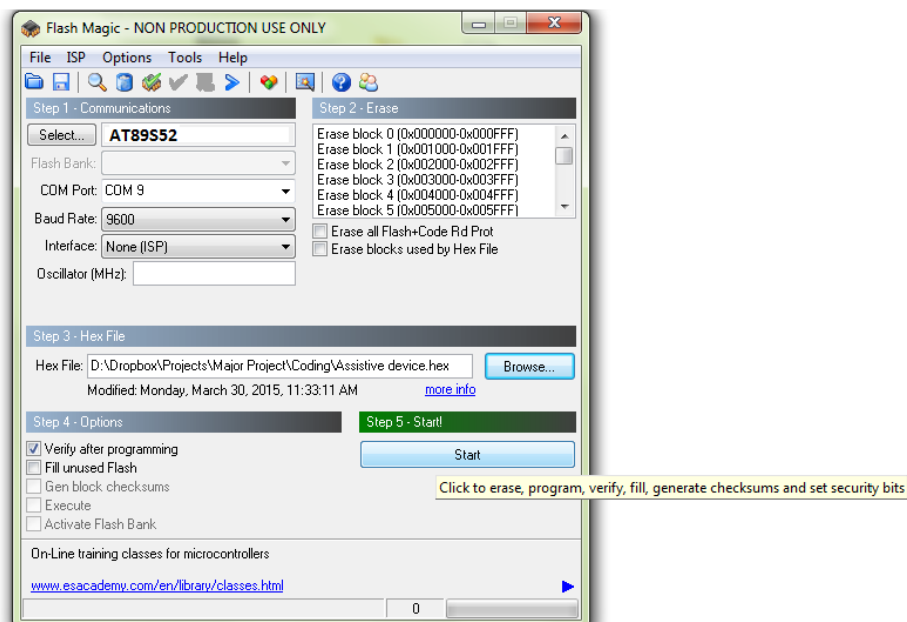


Figure 34 Initialization of burn process

## 10. The hex file is successfully burned into microcontroller.

### 3.3 Programming

#### 3.3.1 Assistive Device Main Program

**Aim:** To integrate distance measurement program and LCD interfacing program.

**Description:**

- This is the main program that brings together all other programs such as lcd.c and distance\_senor\_app.c programs.
- Only this program contains the void main ()

**Program:**

```
/* Assistive_Device_Main.c */
#include<reg51.h>

unsigned long time;
float time_us;
int Distance_cm;
bit Timer_flag=0;
unsigned char count;

void delay(unsigned int val);

#include "lcd.c"
#include " distance_sensor_app.c "

void main()
{
    lcd_init();
    Timer0_init();
    lcd_str(1,1,"OBSTACLE FINDER ");

    while(1)
    {
        Distance_Measure();
```

```
    }  
}  
  
void delay(unsigned int val)  
{  
    unsigned int i,j;  
    for(i=0;i<val;i++)  
        for(j=0;j<1275;j++);  
}
```

**Output:**

The distance computed is displayed on 16x2 LCD

### 3.3.2 Distance Measurement Program

**Aim:** To calculate distance using the inputs and select the particular pre-recorded audio track on the Voice Output Module for vocal feedback.

**Description:**

- This distance\_senor\_app.c program contains many sub-programs such as Voice\_alert, Distance\_measure, Find\_Distance, pulse, Pulse\_delay, Timer0\_init() for the purpose of measuring distance and voice alert.

**Program:**

```
/* distance_sensor_app.c      */
sbit echo=P2^1;
sbit pulser=P2^0;//trigger

sbit DIS_BLW_50CMS=P3^0;
sbit DIS_BLW_100CMS=P3^1;
sbit DIS_BLW_150CMS=P3^2;
sbit DIS_BLW_200CMS=P3^3;
sbit DIS_BLW_250CMS=P3^4;
sbit DIS_BLW_300CMS=P3^5;
sbit DIS_BLW_350CMS=P3^6;
sbit DIS_ABV_350CMS=P3^7;

bit f;
char flag;

Timer0_init();
Pulse_Delay(unsigned int);
Pulse();
Find_Distance();
Distance_Measure();
Voice_Alert();

Timer0_init()
```

```
{  
    TMOD=0X11;  
    TH0=0X00;  
    TL0=0X00;  
    IE=0X82;  
}
```

Timer0()interrupt 1

```
{  
    TR0=0;  
    TF0=0;  
    TH0=0X00;  
    TL0=0X00;  
    count=count+1;  
    if(count>2)  
    {  
        Timer_flag=1;  
    }  
}
```

Distance\_Measure()

```
{  
    Pulse();  
    while(echo!=1);  
    TR0=1;  
    while(echo!=0&&Timer_flag!=1);  
    {  
        if(Timer_flag==1)  
        {  
            TR0=0;  
            TF0=0;  
            TH0=0X00;  
            TL0=0X00;  
        }  
    }  
}
```

```
        Timer_flag=0;
    }
    if(Timer_flag==0)
    {
        Find_Distance();
        echo=1;
    }
}

Find_Distance()
{
    TR0=0;
    time=(TH0*256)+TL0;
    time_us=(time*1.0856);
    Distance_cm=time_us/58;
    if(Distance_cm<=351&&Distance_cm>1 && flag!=8)
    {
        flag=8;
        if(f==0)
            lcd_str(1,1,"Obj at      ");
        lcd_chr(1,8,(Distance_cm/100)+48);
        lcd_data(((Distance_cm%100)/10)+48);
        lcd_data((Distance_cm%10)+48);
        if(f==0)
            lcd_str(0,0,"Cm");
        Voice_Alert();
        TH0=0X00;
        TL0=0X00;
        f=1;
    }
    else
    {
```

```
        flag=0;
        TH0=0X00;
        TL0=0X00;
        f=0;
        lcd_str(1,1,"Obj Out of Range");
        DIS_ABV_350CMS=0;
        delay(50);
        DIS_ABV_350CMS=1;
        delay(400);
    }
}

Pulse()
{
    pulser=1;
    Pulse_Delay(10);
    pulser=0;
}

Pulse_Delay(unsigned int k)
{
    int j;
    for (j=0;j<=k;j++);
}

Voice_Alert()
{
    if(Distance_cm>=0&&Distance_cm<50 && flag!=1)
    {
        flag=1;
        DIS_BLW_50CMS=0;
        delay(50);
    }
}
```

```
        DIS_BLW_50CMS=1;
        delay(400);
    }
    if(Distance_cm>=50&&Distance_cm<100 && flag!=2)
    {
        flag=2;
        DIS_BLW_100CMS=0;
        delay(50);
        DIS_BLW_100CMS=1;
        delay(400);
    }

    if(Distance_cm>=100&&Distance_cm<150 && flag!=3)
    {
        flag=3;
        DIS_BLW_150CMS=0;
        delay(50);
        DIS_BLW_150CMS=1;
        delay(400);
    }

    if(Distance_cm>=150&&Distance_cm<200 && flag!=4)
    {
        flag=4;
        DIS_BLW_200CMS=0;
        delay(50);
        DIS_BLW_200CMS=1;
        delay(400);
    }

    if(Distance_cm>=200&&Distance_cm<250 && flag!=5)
    {
        flag=5;
```

```
        DIS_BLW_250CMS=0;
        delay(50);
        DIS_BLW_250CMS=1;
        delay(400);
    }

    if(Distance_cm>=250&&Distance_cm<300 && flag!=6)
    {
        flag=6;
        DIS_BLW_300CMS=0;
        delay(50);
        DIS_BLW_300CMS=1;
        delay(400);
    }

    if(Distance_cm>=300&&Distance_cm<350 && flag!=7)
    {
        flag=7;
        DIS_BLW_350CMS=0;
        delay(50);
        DIS_BLW_350CMS=1;
        delay(400);
    }
}
```

**Output:**

1. Distance value
2. Selection of a respective pre-recorded audio track (Spoken Feedback)

### 3.3.3 LCD Interfacing Program

**Aim:** To write basic instructions necessary for interfacing LCD to ATMEL AT89S52 microcontroller.

**Description:** This program contains subprograms such as void lcd\_init(); void lcd\_cmd(char ch), void lcd\_data(char ch), void lcd\_chr(char l,char p,char ch), void lcd\_str(char l,char p,char \*str) which are required for the functioning of LCD.

**Program:**

```
/* lcd.c */  
  
#define LCD_DATA P1  
  
#define lcd_clr          lcd_cmd(0x01)  
  
sbit RS = P2^6;  
sbit EN = P2^7;  
  
void lcd_init();  
void lcd_cmd(char ch);  
void lcd_data(char ch);  
void lcd_chr(char l,char p,char ch);  
void lcd_str(char l,char p,char *str);  
  
void lcd_init()  
{  
    lcd_cmd(0x38);  
    lcd_cmd(0x0C);  
    lcd_cmd(0x01);  
    lcd_cmd(0x80);  
}  
  
void lcd_cmd(char ch)  
{  
    LCD_DATA = ch;
```

```
        RS = 0;
        EN = 1;
        delay(2);
        EN=0;
    }

void lcd_data(char ch)
{
    LCD_DATA = ch;
    RS = 1;
    EN = 1;
    delay(2);
    EN=0;
}

void lcd_chr(char l,char p,char ch)
{
    if(l==1)
        lcd_cmd(0x7F+p);
    else if(l==2)
        lcd_cmd(0xBF+p);
    lcd_data(ch);
}

void lcd_str(char l,char p,char *str)
{
    if(l==1)
        lcd_cmd(0x7F+p);
    else if(l==2)
        lcd_cmd(0xBF+p);
    while(*str!='\0')
    {
        lcd_data(*str);
    }
}
```

```
        str++;  
    }  
}
```

**Output:**

LCD is interfaced

## CHAPTER 4: CIRCUIT DIAGRAM & DESCRIPTION

### 4.1 Main Circuit

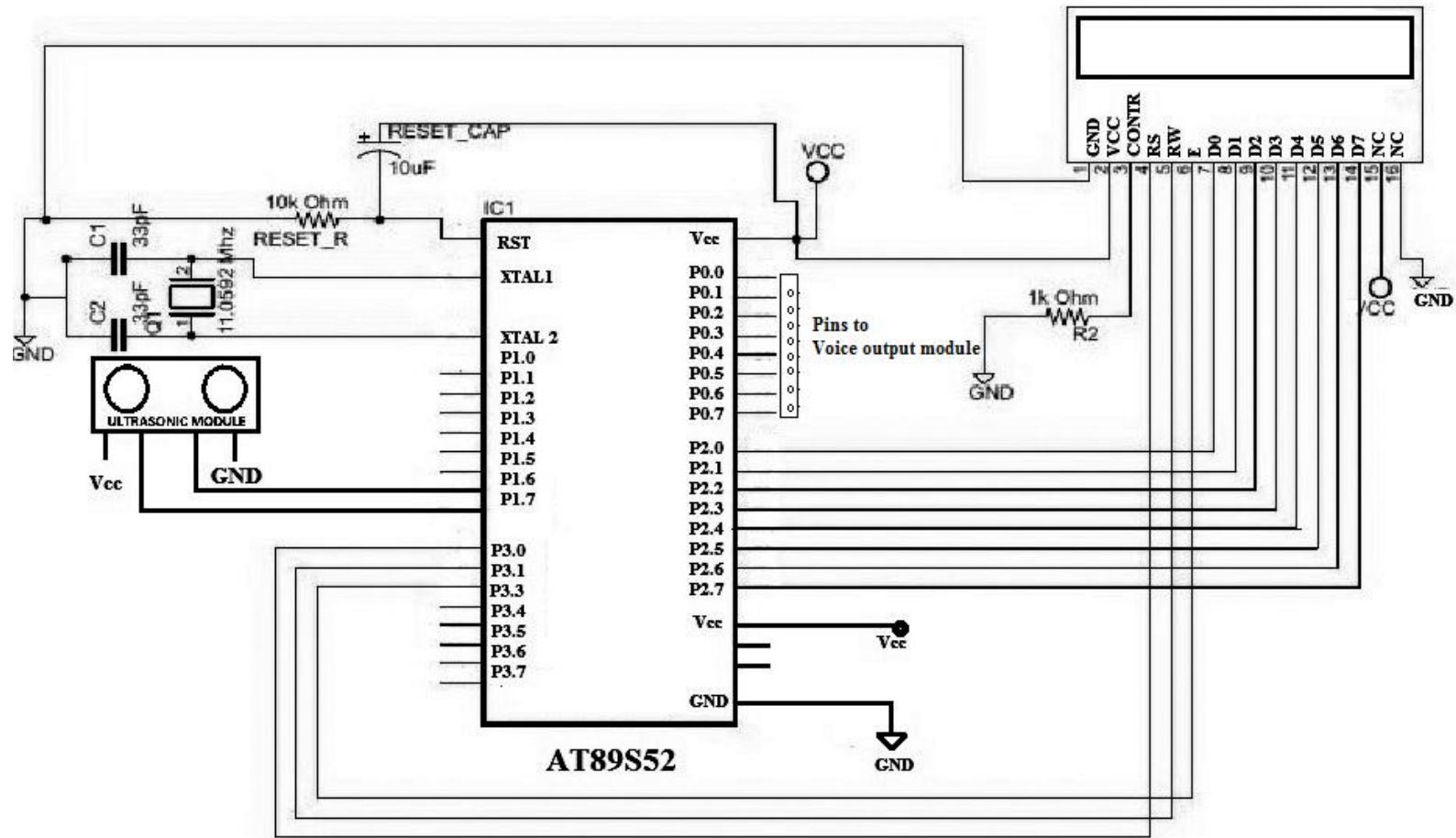


Figure 35 Main Circuit Diagram

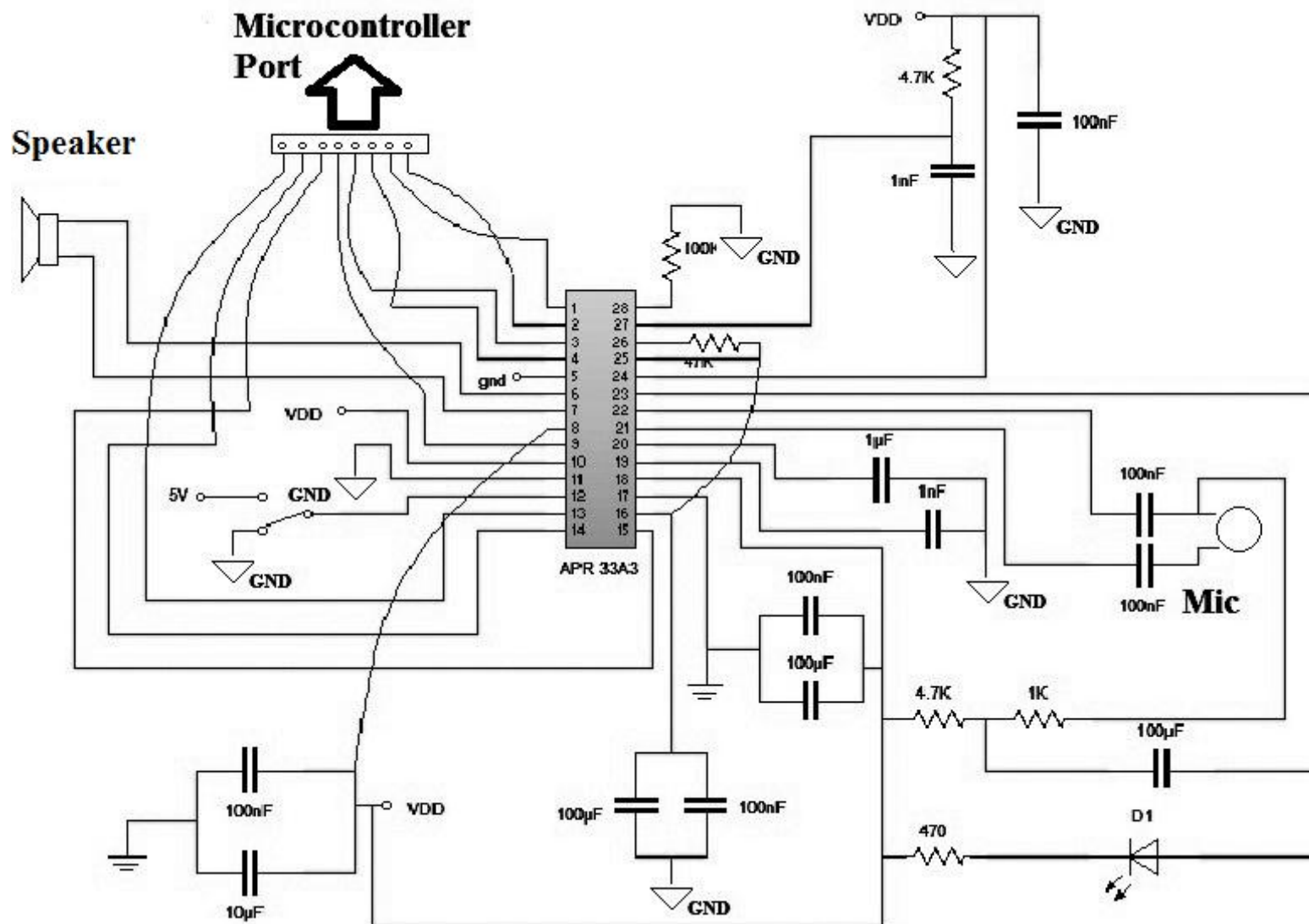


Figure 36 Various connections in aPR33A3 Voice Output Module

The first circuit shown is the main circuit and the second circuit is the Voice output module and it is connected to main circuit

The main circuit connections are as here under

1. Pin 1 of the LCD is grounded

1. Here

P3.0=RS

P3.1=R/W

p3.2=Enable is taken

2. Port 2 is used as data port.

P2.0=DB0

P2.1=DB1

.

.

P2.7=DB7

3. Power on reset circuit is provided by using 10k ohm and 10uF resistor on RST pin.

4. 11.0592 MHz crystal is used along with two 33pF capacitors which are grounded.

### **Voice Output Module**

The important connections are

1. A mic for recording purpose is connected to pin 19 and 20 through capacitors

2. A speaker for playback purpose is connected across pin 6 and 7

3. A switch for selecting recording or playback mode is provided at pin 12

4. Pins 1,2,3,4,9,13,14 and 15 are connected to the port of microcontroller ATMEL AT89S52.

## **Operation of Voice Output Module**

### **Record Message**

During the /REC pin drove to VIL, chip in the record mode. When the message pin (M0, M1, M2 ... M7) drove to VIL in record mode, the chip will playback “beep” tone and message record starting. The message record will continue until message pin released or full of this message, and the chip will playback “beep” tone 2 times to indicate the message record finished. If the message already exist and user record again, the old one’s message will be replaced.

After reset, /REC and M0 to M7 pin will be pull-up to VDD by internal resistor.

### **Playback Message**

During the /REC pin drove to VIH, chip in the playback mode. When the message pin (M0, M1, M2 ... M7) drove from VIH to VIL in playback mode, the message playback starting. The message playback will continue until message pin drove from VIH to VIL again or end of this message.

After reset, /REC and M0 to M7 pin will be pull-up to VDD by internal resistor.

### **Voice Input**

The aPR33A series supported single channel voice input by microphone or line-in. The following fig. showed circuit for different input methods: microphone, line-in and mixture of both.

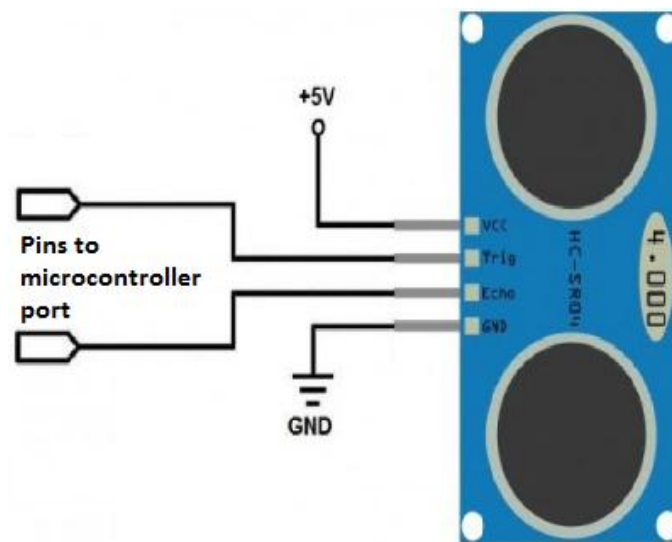
### **Busy**

The MICG pin will be drove to low during the message record or playback, and drove to high during idle or standby, user can detect MICG status to know chip is busy or not.

### **Reset**

aPR33A series can enter standby mode when RSTB pin drive to low. During chip in the standby mode, the current consumption is reduced to ISB and any operation will be stopped, user also can not execute any new operate in this mode. The standby mode will continue until RSTB pin goes to high, chip will be started to initial, and playback “beep” tone to indicate enter idle mode. User can get less current consumption by control RSTB pin specially in some application which concern standby current.

#### 4.2 Ultrasonic Ranging Module Connections



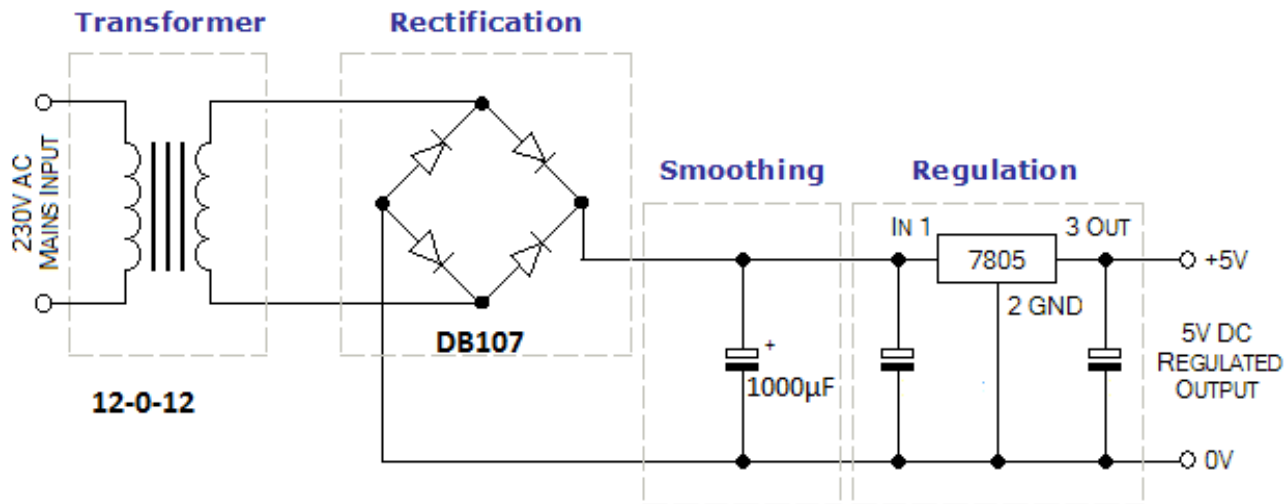
Pin No.	Pin	Connection
1	5V	Supply
2	Trigger	Pulse Input
3	Echo	Pulse Output
4	GND	0V

*Figure 37 Connections of Ultrasonic Ranging Sensor*

##### Connections in the device

1. Supply voltage of 5V and 0V is connected to VCC and GND pins respectively.
2. The TRIG and ECHO pins are connected to AT8952 microcontroller port

### 4.3 Conversion of 220V AC to 5V DC



*Figure 38 Conversion circuit for 220V AC to 5V DC*

There are 4 important components for converting 230V AC to 5V DC power supply

#### Transformer

Here a center tapped transformer (12-0-12) steps down AC 230V to AC 12V.

#### Rectifier

The AC voltage is now converted to pulsating DC with the help of bridge rectifier DB107.

#### Smoothing Capacitor

The pulsating DC is smoothed and then given to voltage regulator 7805.

#### Regulation

The smoothed DC voltage is given as input to voltage regulator 7805 and it finally gives out a 5V DC.

#### **4.4 Working modes of the device**

There is a switch provided on the Voice Output Module which is used for selection of

- a. Playback mode
- b. Recording mode

These modes correspond to the mode switch used to select the mode of the voice output module. The use of each of these two modes is described as here under.

##### **a. Playback mode:**

This mode can be accessed by setting the switch in playback position.

This mode recalls or plays the pre-recorded audio track on the speaker

This also requires a selection regarding which audio track to play out of multiple saved tracks in its memory. (This is done by microcontroller)

##### **b. Recording mode**

This mode can be accessed by setting the switch in record position.

This mode records the audio track using the inputs from microphone

This also requires a selection regarding which memory is to be fed with which message so as to match the program dumped in microcontroller.

##### **The following messages are currently recorded**

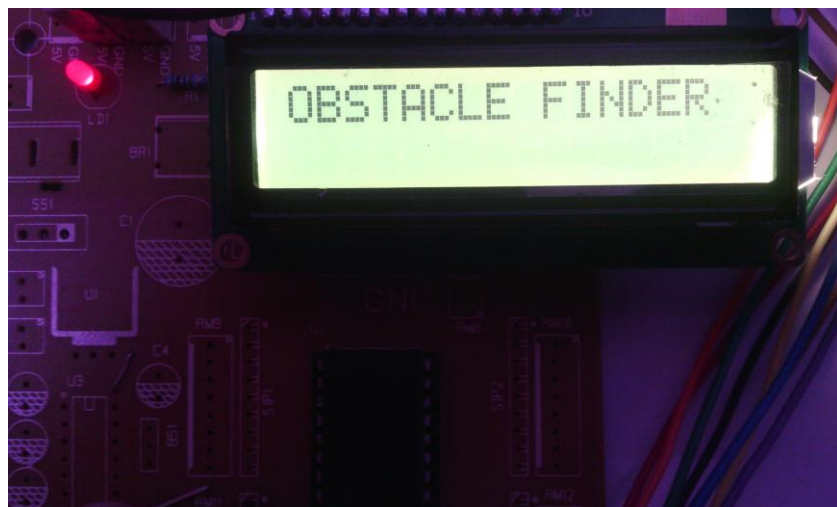
- a. A caution message saying “Caution! Object is under 50 centimeters”.
- b. A caution message saying “Caution! Object is under 100 centimeters”.
- c. A message saying “object is under 150 centimeters.
- d. A message saying “object is under 200 centimeters.
- e. A message saying “object is under 250 centimeters.
- f. A message saying “object is under 300 centimeters.
- g. A message saying “object is under 350 centimeters.
- h. A message saying “obstacle is out of range”.

## 4.5 Operation of Device

### 4.5.1 Playback mode (This is the default mode in which the device operates)

The following points exhaustively convey the working methodology of the device

- a. The device is powered on with the help of AC 220V 50 Hertz supply voltage
- b. The voltage is stepped down to 12 V AC and given as input to bridge rectifier
- c. The bridge rectifier converts AC voltage to DC
- d. The rectified voltage is now given into the voltage regulator to give a constant power supply of 5V DC.
- e. This power is used to power the following modules
  - Microcontroller ATMEL AT89S52
  - 16x2 LCD
  - Voice output module
- f. Now all the devices are powered on and the same is indicated by the LEDs present on each block.
- g. The same is indicated by LCD which turns on and displays “OBSTACLE FINDER” as a verification message to show that it is functional.



*Figure 39 LCD initialization display*

- h. Now Ultrasonic ranging module HC - SR04 functionality starts and it functions as here under
  - Using IO trigger for at least 10us high level signal,

- The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
- 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 $\times$ velocity of sound (340M/S) / 2

i. Using this time for receiving the transmitted ultra-sonic signal the Microcontroller ATMEL AT89S52 computes the distance and sends it to LCD and Voice Output Module.

- Microcontroller ATMEL AT89S52 displays the distance of on the 16x2 LCD module.
- Microcontroller ATMEL AT89S52 selects an appropriate pre-recorded audio track for spoken feedback on the voice output module for the visually impaired.

j. The Voice Output Module which consists of pre-recorded audio tracks now plays an appropriate audio track according to the Microcontroller ATMEL AT89S52 selection.

#### **4.5.2 Recording mode of operation of Device**

There is a switch provided on the Voice Output Module which is used for selection of playback mode or recording mode.

When switch is flipped to recording mode

- Any memory location which is occupied by a sound track can be erased.
- New audio track can be recorded with help of mic present on the Voice Output Module.

## CHAPTER 5: RESULTS AND ANALYSIS

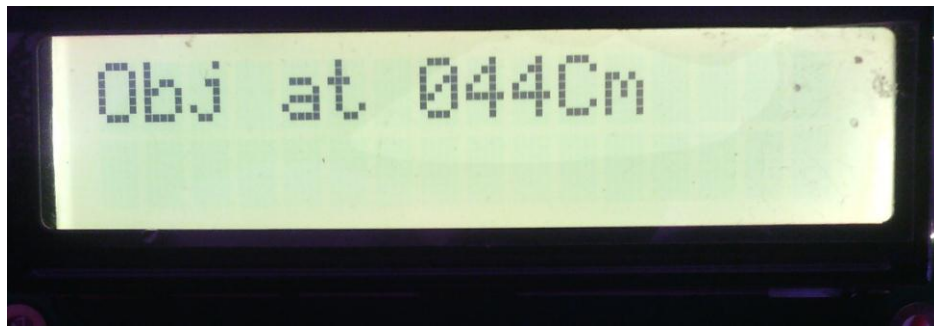
There are various results under various test cases, here few test cases are considered to depict all the possible results.

### 5.1 Obstacle is under 50 centimeters

**Condition:** The distance of the obstacle is 44 centimeters from the Ultrasonic Ranging Module.

#### Output on LCD

Obj at 044 Cm



*Figure 40 LCD output for Obstacle at 44 centimeters*

#### Vocal Feedback

“Caution! Object under 50 centimeters”

### 5.2 Obstacle is under 100 centimeters

**Condition:** The distance of the obstacle is 83 centimeters from the Ultrasonic Ranging Module.

#### Output on LCD

Obj at 083Cm



*Figure 41 LCD output for Obstacle at 83 centimeters*

### Vocal Feedback

“Caution! Object under 100 centimeters”

### 5.3 Obstacle is under 150 centimeters

**Condition:** The distance of the obstacle is 129 centimeters from the Ultrasonic Ranging Module.

### Output on LCD

Obj at 129 Cm



*Figure 42 LCD output for Obstacle at 129 centimeters*

### Vocal Feedback

“Object under 150 centimeters”

### 5.4 Obstacle is under 200 centimeters

**Condition:** The distance of the obstacle is 181 centimeters from the Ultrasonic Ranging Module.

### Output on LCD

Obj at 181 Cm



*Figure 43 LCD output for Obstacle at 181 centimeters*

### **Vocal Feedback**

“Object under 200 centimeters”

### **5.5 Obstacle is under 250 centimeters**

**Condition:** The distance of the obstacle is 218 centimeters from the Ultrasonic Ranging Module.

### **Output on LCD**

Obj at 218Cm



*Figure 44 LCD output for Obstacle at 218 centimeters*

### **Vocal Feedback**

“Object under 250 centimeters”

### **5.6 Obstacle is under 300 centimeters**

**Condition:** The distance of the obstacle is 284 centimeters from the Ultrasonic Ranging Module.

### **Output on LCD**

Obj at 284 Cm



*Figure 45 LCD output for Obstacle at 284 centimeters*

### **Vocal Feedback**

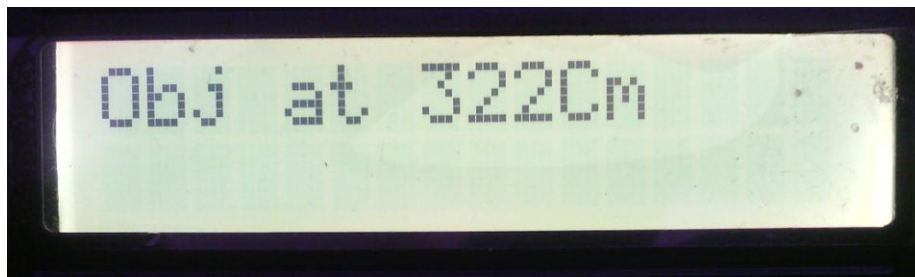
“Object under 300 centimeters”

### **5.7 Obstacle is under 350 centimeters**

**Condition:** The distance of the obstacle is 322 centimeters from the Ultrasonic Ranging Module.

### **Output on LCD**

Obj at 322Cm



*Figure 46 LCD output for Obstacle at 322 centimeters*

### **Vocal Feedback**

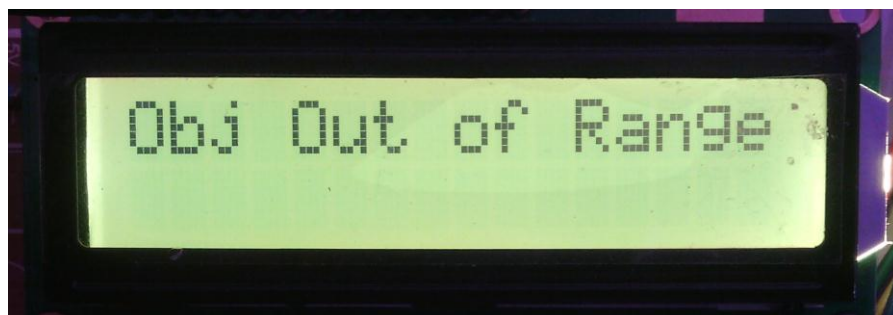
“Object under 350 centimeters”

### **5.8 Obstacle is out of range (Case 1)**

**Condition:** The distance of the obstacle is 353 centimeters from the ultrasonic ranging module

### **Output on LCD**

Obj Out of Range



*Figure 47 LCD output for Obstacle at 353 centimeters*

### **Vocal Feedback**

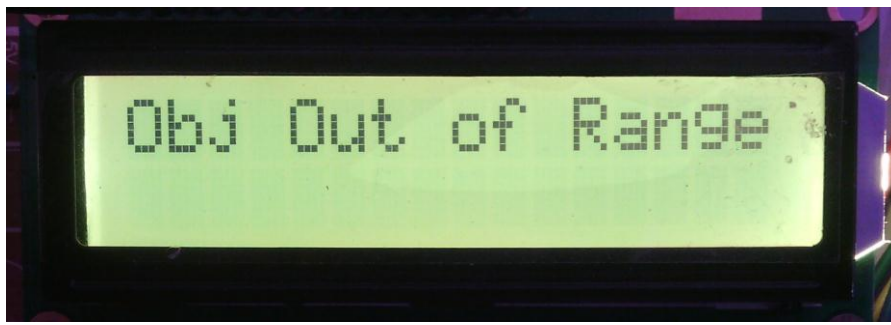
“Obstacle is out of range”

### **5.9 Obstacle is out of range (Case 2)**

**Condition:** The distance of the obstacle is 500 centimeters from the ultrasonic ranging

### **Output on LCD**

Obj Out of Range



*Figure 48 LCD output for Obstacle at 500 centimeters*

### **Vocal Feedback**

“Obstacle is out of range”

***SUMMARY OF RESULTS***

Distance	LCD Display	Vocal Feedback
44 Centimeters	Obj at 44 Cm	“Caution! Object under 50 centimeters”
83 Centimeters	Obj at 83 Cm	“Caution! Object under 100 centimeters”
129 Centimeters	Obj at 129 Cm	“Object under 150 centimeters”
181 Centimeters	Obj at 181 Cm	“Object under 200 centimeters”
218 Centimeters	Obj at 218 Cm	“Object under 250 centimeters”
284 Centimeters	Obj at 284 Cm	“Object under 300 centimeters”
322 Centimeters	Obj at 322 Cm	“Object under 350 centimeters”
353 Centimeters	Obj Out of Range	“Obstacle is out of range”
500 Centimeters	Obj Out of Range	“Obstacle is out of range”

***Figure 49 Summary of various test conditions and results***

## **CHAPTER 6: MERITS AND APPLICATIONS**

### **6.1 MERITS**

Assistive Collision Avoidance Device for the Visually Impaired is a hands-free and a hassle-free pedestrian navigation system. It integrates several technologies including wearable computers, sound navigation and ranging.

This device focuses on bringing about an approach which would make a visually impaired person to walk through busy roads and help identify obstacles without any trouble.

The system also provides audio response. The sonar sensors detect obstacles in the user's immediate vicinity. Upon detection, the vocal feedback caution him/her regarding the presence of obstacles.

Being a real time system, it accounts for real time changes by processing on current frames and is reactive by providing instant responses.

This is the best type of cane for visually impaired individuals learning to travel for children and adults. Provides the most information/feedback of upcoming surface to a visually impaired traveler.

### **6.2 Other Applications**

1. The same technology can be used to prevent collision between containers during their placement in cargo ships.
2. They can also be used in smart breaking systems and reverse parking alarms and also to alert about proximity of an obstacle.
3. It can be used in lift cabins to prevent collision with walls or the bottom edge of the floor during an emergency.
4. It can be used to carefully stack various fragile items in warehouse.

## CHAPTER 7: CONCLUSION AND FUTURE SCOPE

### 7.1 Conclusion

A system has been implemented that allows visually impaired users to detect and avoid obstacles as they walk around. With the proposed architecture, if constructed with at most accuracy, the blind people will be able to move from one place to another without others help. If such a system is developed, it will act as a basic platform for the generation of more such devices for the visually impaired in the future which will be cost effective.

Each part of the system is also mounted on hard circuit board. It will be interesting to weave directly the wires inside the textile fiber and to use semi rigid support for the mounting of the electronic components.

Another solution to improve the wearable aspect could be to design the system as a set of independent modules that can be fixed on the cloth and communicating via wireless connection. In order to accomplish a perfectly wearable system the miniaturization should be improved on the sensors. Those could never be, in a close future, perfectly wearable but could approximate the size of a standard button or clipper present on the most common vest. This device has permit to reach a step forward the integration of visually impaired people or a precious help when the vision is reduced by harsh environment.

## 7.2 FUTURE SCOPE

It is our belief that recent advances in technologies could help and facilitate in the day-to-day operations of visually impaired people. It is believed that with the endless applications of Computer Vision, using the robust, platform independent OpenCV libraries, systems can be created which can compensate the visual awareness of a visually impaired person.

In future work incorporation of GPS facility to the system is intended to provide step by step voice directions to the blind users to their destinations, while avoiding obstacles based on the current system.

Although mainly used in identifying one's location, GPS (Global Positioning System) devices also help blind persons in traveling independently. Blind persons can use portable GPS systems to determine and verify the correct travel route. They can use these devices whether they are walking or riding a vehicle.

GPS devices for the blind include screen readers so the user can hear the information. Other GPS devices are connected to a Braille display so the user can read the information displayed in Braille. Blind persons should use a particular mobility device in addition to the GPS system.

By providing user input to the system, the system can be made more robust and user friendly. For instance the incorporation of speech processing or tactile switches will give the user control over system.

The exploration of the use of sensors to update pedestrian traffic levels to constantly monitor and update our database directly is being planned.

Some future enhancements that could be made are like increasing the range of the ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles.

## CHAPTER 8: PUBLICATION

Project work entitled “**Assistive Collision Avoidance Device For Visually Impaired Individuals**” has been submitted to the journal “Lab Experiments” and has been accepted for publication in March 2015 issue (In press).

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