ULTRASONIC SENSOR BASED RADAR SYSTEM

Project Report submitted in partial fulfilment of the requirement

for the degree of

Bachelor of Technology

in

Electronics and Communication Engineering

Under the Supervision of

Prof. Ghanshyam Singh

By

ANKIT GAUR	**(091015)**
UTKARSH SHARMA	**(091045)**
SHIKHAR TANWAR	**(091059)**

to

Jaypee University of Information and Technology

Waknaghat, Solan – 173234, Himachal Pradesh.

CERTIFICATE

This is to certify that the project report entitled, "**Ultrasonic Sensor Based Radar System**" submitted by **Ankit Gaur, Utkarsh Sharma and Shikhar Tanwar** in partial fulfilment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

This work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Date: 30.05.2017

Place: Waknaghat

Prof. Ghanshyam Singh

(Associate Professor)

Department of Electronics and Communication Engineering

Jaypee University of Information Technology

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Date: 30/5/2013

Ankit Gaur **(091015)**

Utkarsh Sharma **(091045)**

Shikhar Tanwar **(091059)**

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ABSTRACT

Our project aims at detection of objects and finding the distances of these objects using Ultrasonic sensor based radar system. Also, when the distance between the target and the radar reaches a certain pre-defined limit, then the micro controller is programmed so as to stop the motor.

Ultrasonic sensors (also known as **transceivers** when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

Some of the important parameters, when it comes to object detection using ultrasonic sensor based radar system, are accuracy and reliability. Therefore special care must be taken to check the accuracy of these systems.

This technology has many applications in many fields for e.g. in industries (plants etc.), in medicine (probes) etc. But we intend to implement our project as pre-crash safety system for cars, which can be installed in cars and used when the weather conditions are not good (rainy, foggy conditions), and visibility is compromised.

Chapter 1 - INTRODUCTION

1.1 Objective

Ultrasonic sensors are used to detect the presence of targets and to measure the distance to targets in many automated factories and process plants. Sensors with an on or off digital output are available for detecting the presence of objects, Because ultrasonic sensors use sound rather than light for detection, they work in applications where photoelectric sensors may not. Ultrasonic is a great solution for clear object detection and for liquid level measurement, applications that photoelectric struggle with because of target translucence. Target color and/or reflectivity don't affect ultrasonic sensors which can operate reliably in high-glare environments.

1.2 Project description

This system basically detects speed, angle and distance of the specified object in its scope. It involves the basic electronic components and the integrated electronics part. The ultra-sonic acting a main sensor in the system. Ultrasonic gives the signal to MCU which under goes some further processing and give signal to the LCD for the visual purpose. There is buzzer for the audio alarm. This application is based upon the reflection of sound waves. Sound waves are defined as longitudinal pressure waves in the medium in which they are travelling. Subjects whose dimensions are larger than the wavelength of the impinging sound waves reflect them; the reflected waves are called the echo. If the speed of sound in the medium is known and the time taken for the sound waves to travel the distance from the source to the subject and back to the source is measured, the distance from the source to the subject can be computed accurately. This is the measurement principle of this application. According to the distance the controller controlled the devices. The stepper motor interfaced with MCU rotate the ultrasonic sensor to sense the target around it.

1.3 Block Diagram

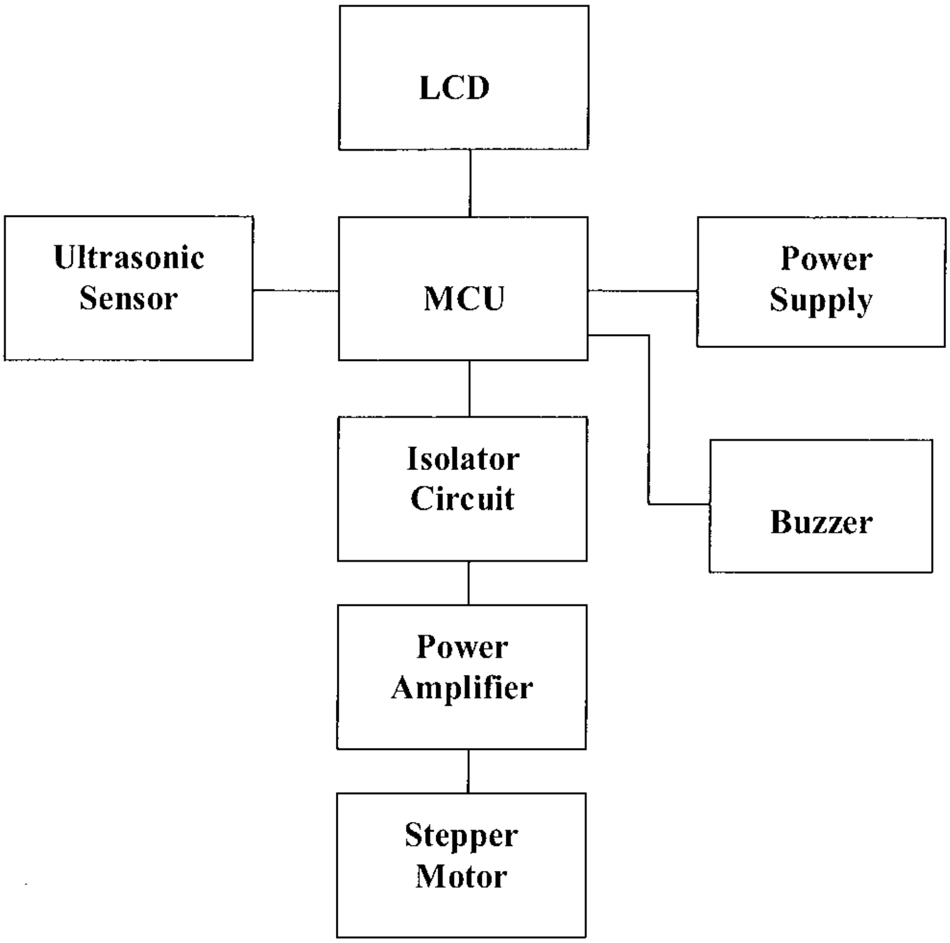


Figure 1. 1 Block diagram of the overall circuit

1.4 Tools/Softwares/Componets Required

- KEIL μ Vision2 Software for programming of Microcontroller.
- I.C Programmer and Software for the burning of the Microcontroller.
- ULTRA SONIC SENSORS.
- Components for designing of the embedded part.
- Soldering kit.
- Measuring Instruments (Multi-meter), etc.

Chapter 2 – REGULATED POWER SUPPLY

Power supplies are designed to convert high voltage AC mains to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function.

For example a 5V regulated supply:

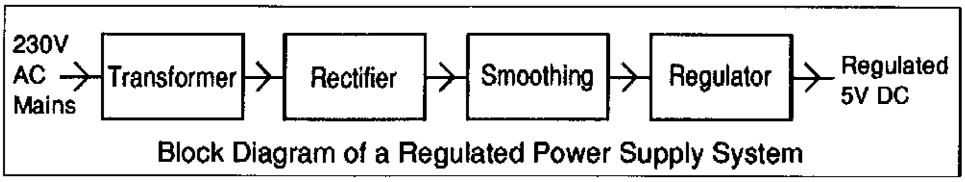


Figure 2. 1 Block diagram of a regulated power supply system

Each of the blocks has its own function as described below :

1. Transformer – steps down high voltage AC mains to low voltage AC.
2. Rectifier – converts AC to DC, but the DC output is varying.
3. Smoothing – smoothes the DC from varying greatly to a small ripple.
4. Regulator – eliminates ripple by setting DC output to a fixed voltage.

2.1 Transformer

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. The two types of transformers

- Step-up transformers (increase voltage),
- Step-down transformers (reduce voltage).

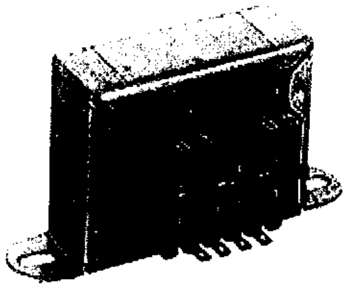


Figure 2. 2 Transformer

Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in UK) 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. The ratio of the number of turns on each coil, called the turn 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.

Turns Ratio

$$N_p/N_s = V_p/V_s$$

And,

Power Out = Power In

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

Where,

Vp = primary (input) voltage

Np = number of turns on primary coil

Ip = primary (input) current

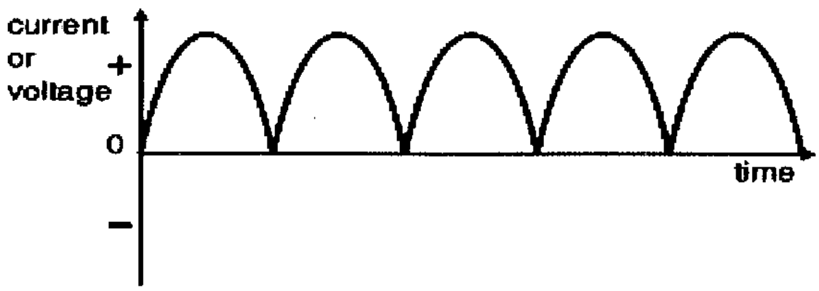
Ns = number of turns on secondary coil

Is = secondary (output) current

Vs = secondary (output) voltage

2.2 Bridge Rectifier

A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses all AC wave (both positive and negative sections). 1.4V is used up in the bridge rectifier because each diode uses 0.7V when conducting and there are always two diodes conducting, as shown in the diagram below. Bridge rectifiers are rated by the maximum current they can pass and the maximum reverse voltage they can withstand (this must be at least three times the supply RMS voltage so the rectifier can withstand the peak voltages). In this alternate pairs of diodes conduct, changing over the connections so the alternating directions of AC are converted to the one direction of DC.



OUTPUT – Full-wave Varying DC

Figure 2. 3 Output of a bridge rectifier

2.2.1 Smoothing

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 the output.

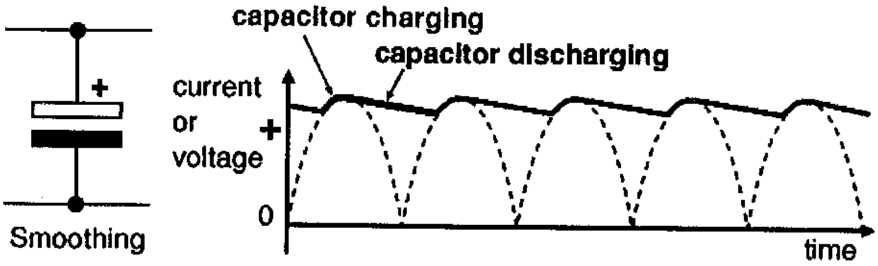


Figure 2. 4 Smoothing circuit and it's output waveform

Note that smoothing significantly increases the average DC voltage to almost the peak value (1.4 × RMS value). For example 6V RMS AC is rectified to full wave DC of about 4.6V RMS (1.4V is lost in the bridge rectifier), with smoothing this increases to almost the peak value giving 1.4 × 4.6 = 6.4V smooth DC.

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 fewer ripples. The capacitor value must be doubled when smoothing half-wave DC.

Smoothing capacitor for 10% ripple, C = 5 × Io

Vs ×f

Where

C = smoothing capacitance in farads (F)

Io = output current from the supply in amps (A)

Vs = supply voltage in volts (V), this is the peak value of the unsmoothed DC

f = frequency of the AC supply in hertz (Hz), 50Hz in the UK

2.3 Regulator

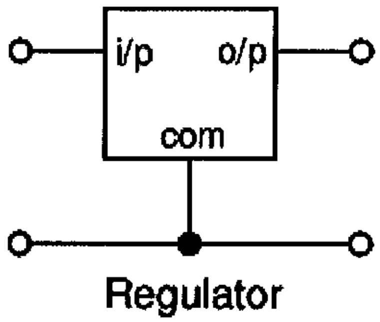


Figure 2. 5 Regulator circuit

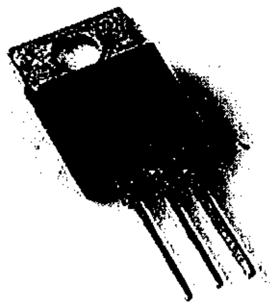


Figure 2. 6 Regulator

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 has 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 heat sink if necessary.

2.4 Working of Power Supply

2.4.1 Transformer

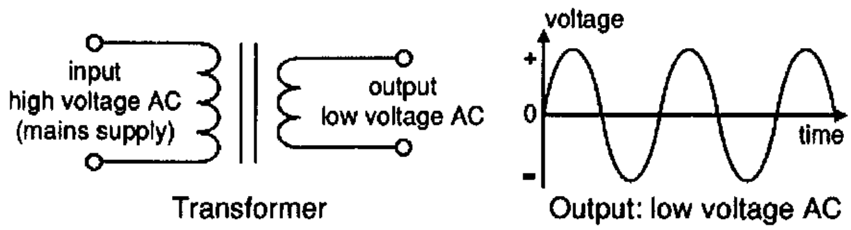


Figure 2. 7 Transformer and it's output

The low voltage AC output is suitable for lamps, heaters and special AC motors. It is not suitable for electronic circuits unless they include a rectifier and a smoothing capacitor.

2.4.2 Transformer + Rectifier

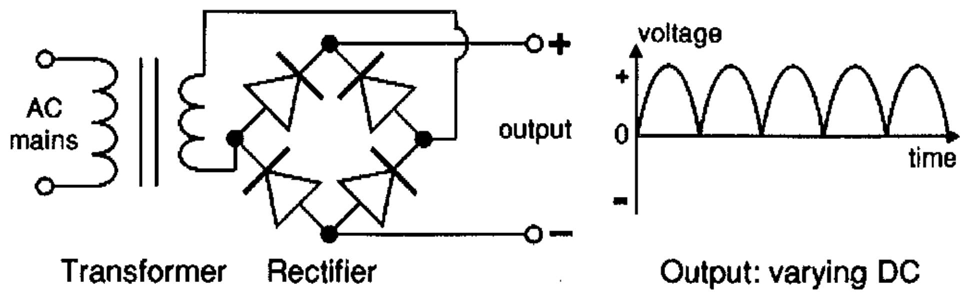


Figure 2. 8 Transformer + rectifier and it's output

The varying DC output is suitable for lamps, heaters and standard motors. It is not suitable for electronic circuits unless they include a smoothing capacitor.

2.4.3 Transformer + Rectifier + Smoothing

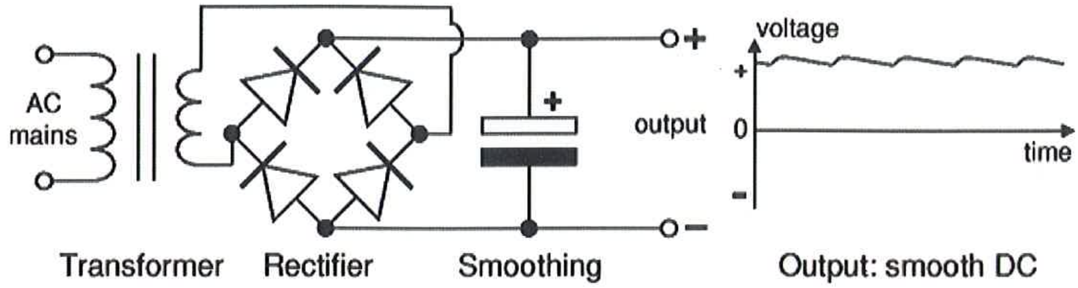


Figure 2. 9 Transformer + rectifier + Smoothing and it's output

The smooth DC output has a small ripple. It is suitable for most electronic circuits.

2.4.4 Transformer + Rectifier + Smoothing + Regulator

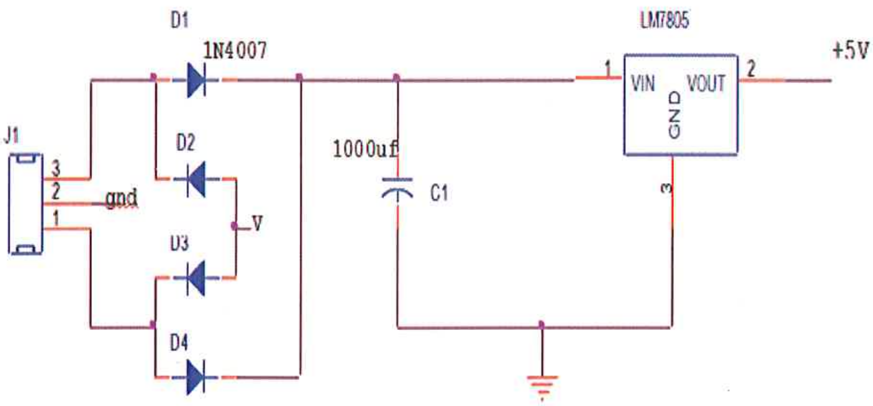


Figure 2. 10 Transformer + rectifier + Smoothing + Regulator

The regulated DC output is very smooth with no ripple. It is suitable for all electronic circuits.

Chapter 3 - MICROCONTROLLER 8051 FAMILY

In our day to day life the role of micro-controllers has been immense. They are used in a variety of applications ranging from home appliances, FAX machines, Video games, Camera, Exercise equipment, Cellular phones musical Instruments to Computers, engine control, aeronautics, security systems and the list goes on.

3.1 Microcontroller versus Microprocessors

What is the difference between a microprocessor and microcontroller? The microprocessors (such as 8086, 80286, 68000 etc.) contain no RAM, no ROM and no I/O ports on the chip itself. For this reason they are referred as general- purpose microprocessors. A system designer using general-purpose microprocessor must add external RAM, ROM, I/O ports and timers to make them functional. Although the addition of external RAM, ROM, and I/O ports make the system bulkier and much more expensive, they have the advantage of versatility such that the designer can decide on the amount of RAM, ROM and I/o ports needed to fit the task at hand. This is the not the case with microcontrollers. A microcontroller has a CPU (a microprocessor) in addition to the fixed amount of RAM, ROM, I/O ports, and timers are all embedded together on the chip: therefore, the designer cannot add any external memory, I/O, or timer to it. The fixed amount of on chip RAM, ROM, and number of I/O ports in microcontrollers make them ideal for many applications in which cost and space are critical. In many applications, for example a TV remote control, there is no need for the computing power of a 486 or even a 8086 microprocessor. In many applications, the space it takes, the power it consumes, and the price per unit are much more critical considerations than the computing power. These applications most often require some I/O operations to read signals and turn on and off certain bits. It is interesting to know that some microcontroller's manufactures have gone as far as integrating an ADC and other peripherals into the microcontrollers.

3.2 Microcontrollers for Embedded Systems

In the literature discussing microprocessors, we often see a term embedded system. Microprocessors and microcontrollers are widely used in embedded system products. An embedded product uses a microprocessor (or microcontroller) to do one task and one task only. A printer is an example of embedded system since the processor inside it performs one task only: namely, get data and print it. Contrasting this with a IBM PC which can be used for a number of applications such as word processor, print server, network server, video game player, or internet terminal. Software for a variety of applications can be loaded and run. Of course the reason a PC can perform myriad tasks is that it has RAM memory and an operating system that loads the application software into RAM and lets the CPU run it. In an embedded system, there is only one application software that is burned into ROM. A PC contains or is connected to various embedded products such as the keyboard, printer, modem, disk controller, sound card, CD-ROM drive, mouse and so on. Each one of these peripherals has a microcontroller inside it that performs only one task. For example, inside every mouse there is a microcontroller to perform the task of finding the mouse position and sending it to the PC.

Although microcontrollers are the preferred choice for many embedded systems, there are times that a microcontroller is inadequate for the task. For this reason, in many years the manufacturers for general-purpose microprocessors have targeted their microprocessor for the high end of the embedded market.

3.3 A brief history of 8051 Family

In 1981, Intel Corporation introduced an 8-bit microcontroller called the 8051. This microcontroller had 128 bytes of RAM, 4K bytes of on-chip ROM, two timers, one serial port, and four ports (8-bit) all on a single chip. The 8051 is an 8- bit processor, meaning the CPU can work on only 8- bit pieces to be processed by the CPU. The 8051 has a total of four I/O ports, each 8- bit wide. Although 8051 can have a maximum of 64K bytes of on-chip ROM, many manufacturers put only4K bytes on the chip.

The 8051 became widely popular after Intel allowed other manufacturers to make any flavor of the 8051 they please with the condition that they remain code compatible with the 8051. This has led to many versions of the 8051 with different speeds and amount of on-chip ROM marketed by more than half a dozen manufacturers. It is important to know that although there are different flavors of the 8051, they are all compatible with the original 8051 as far as the instructions are concerned. This means that if you write your program for one, it will run on any one of them regardless of the manufacturer. The major 8051 manufacturers are Intel, Atmel, Dallas Semiconductors, Philips Corporation, Infineon.

8051 microcontroller

The 8051 is the original member of the 8051 family. Intel refers to it as MCS-51.

Other members of the 8051 family

There are two other members in the 8051 family of microcontrollers. They are the 8052 and the 8031.

Comparison of 8051 Family Members

Feature	8051	8052	8031
ROM (On Chip)	4K	8K	0K
RAM (Bytes)	128	256	128
Timers	2	3	2
I/O Pins	32	32	32

Table 1

AT89C51 from ATMEL Corporation:

This popular 8051 chip has on-chip ROM in the form of flash memory. This is ideal for fast development since flash memory can be erased in seconds compared to twenty minutes or more needed for the earlier versions of the 8051. To use the AT89C51 to develop a microcontroller-based system requires a ROM burner that supports flash memory: However, a ROM eraser is not needed. Notice that in flash memory you must erase the entire contents of ROM in order to program it again. The PROM burner does this erasing of flash itself and this is why a separate burner is not needed. To eliminate the need for a PROM burner Atmel is working on a version of the AT89C51 that can be programmed by the serial COM port of the PC.

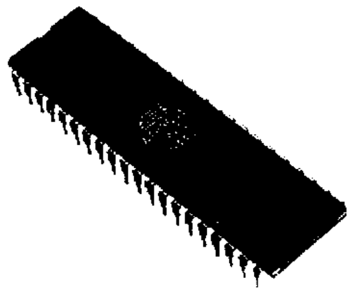


Figure 3. 1 Atmel Microcontroller AT89C51

Hardware features

- 40 pin IC
- 4 Kbytes of Flash
- 128 Bytes of RAM
- 32 I/O lines
- Two16-Bit Timer/Counters
- Two-Level Interrupt Architecture
- Full Duplex Serial Port
- On Chip Oscillator and Clock Circuitry

3.4 Code for Microcontroller

```
#define buzz P20
#define mot P21
#include<lcdrout.h>
sbit TRIG = P3^3;
#include<newultrasonic.h>


void main (void)
{
unsigned int d,thr;
lcd_initialize();
lcd_cmd1(0x80);
M1=M2=M3=M4=1;
lcd_puts("UltraSonic Based");
lcd_cmd1(0xc0);
lcd_puts("    RoboCar     ");
secdelay(3);

lcd_cmd1(0x01);
lcd_cmd1(0x80);
lcd_puts("Distance:");
lcd_cmd1(0x8c);
lcd_puts("cm");
init_ultrasonic();


while (1)
        {
```

```
d=distance();
ms_delay(30);
lcd_cmd1(0x89);
displaypval(d);

if (d<=50)
{
mot=1;
buzz=0;
ms_delay(d*5);
buzz=1;
ms_delay(d*5);
buzz=0;
ms_delay(d*5);
buzz=1;
ms_delay(d*5);
buzz=0;
ms_delay(d*5);
buzz=1;
ms_delay(d*5);


}
else

{
mot=0;
}
}}
```

Chapter 4 - DISPLAY UNIT (LIQUID CRYSTAL DISPLAY)

Liquid crystal displays (LCD) are widely used in recent years as compares to LEDs. This is due to the declining prices of LCD, the ability to display numbers, characters and graphics, incorporation of a refreshing controller into the LCD, their by relieving the CPU of the task of refreshing the LCD and also the ease of programming for characters and graphics. HD 44780 based LCDs are most commonly used.

The LCD, which is used as a display in the system, is LMB162A. The main features of this LCD are: 16 X 2 display, intelligent LCD, used for alphanumeric characters & based on ASCII codes. This LCD contains 16 pins, in which 8 pins are used as 8-bit data I/O, which are extended ASCII. Three pins are used as control lines these are Read/Write pin, Enable pin and Register select pin. Two pins are used for Backlight and LCD voltage, another two pins are for Backlight & LCD ground and one pin is used for contrast change.

4.1 LCD pin description

Pin	Symbol	I/O	Description
1	VSS	-	Ground
2	VCC	-	+5V power supply
3	VEE	-	Power supply to control contrast
4	RS	I	RS=0 to select command register, RS=1 to select data register.
5	R/W	I	R/W=0 for write, R/W=1 for read

6	E	I/O	Enable
7	DB0	I/O	The 8 bit data bus
8	DB1	I/O	The 8 bit data bus
9	DB2	I/O	The 8 bit data bus
10	DB3	I/O	The 8 bit data bus
11	DB4	I/O	The 8 bit data bus
12	DB5	I/O	The 8 bit data bus
13	DB6	I/O	The 8 bit data bus
14	DB7	I/O	The 8 bit data bus

Table 2

The LCD discuss in this section has the most common connector used for the Hitachi 44780 based LCD is 14 pins in a row and modes of operation and how to program and interface with microcontroller is describes in this section

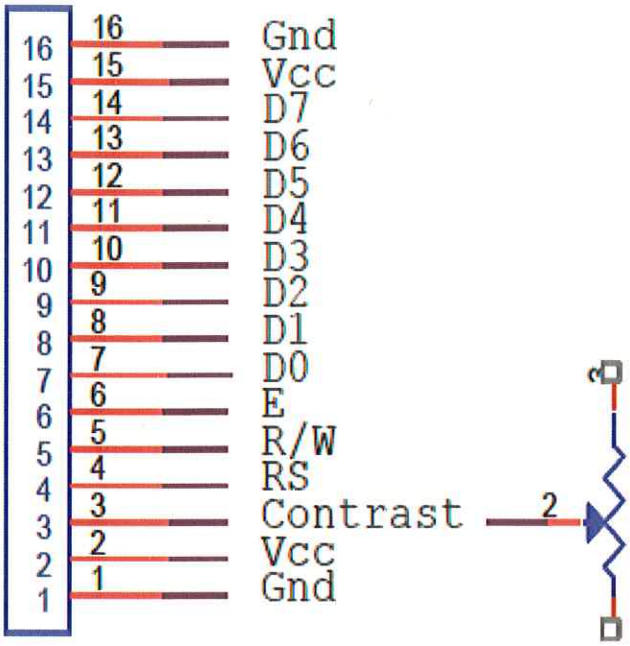


Figure 4. 1 Pin diagram of an LCD

The voltage V_{CC} and V_{SS} provided by +5V and ground respectively while V_{EE} is used for controlling LCD contrast. Variable voltage between Ground and V_{cc} is used to specify the contrast (or "darkness") of the characters on the LCD screen.

RS (register select)

There are two important registers inside the LCD. The RS pin is used for their selection as follows. If RS=0, the instruction command code register is selected, then allowing to user to send a command such as clear display, cursor at home etc.. If RS=1, the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W (read/write)

The R/W (read/write) input allowing the user to write information from it. R/W=1, when it read and R/W=0, when it writing.

EN (enable)

The enable pin is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high power, a high-to-low pulse must be applied to this pin in order to for the LCD to latch in the data presented at the data pins.

D0-D7 (data lines)

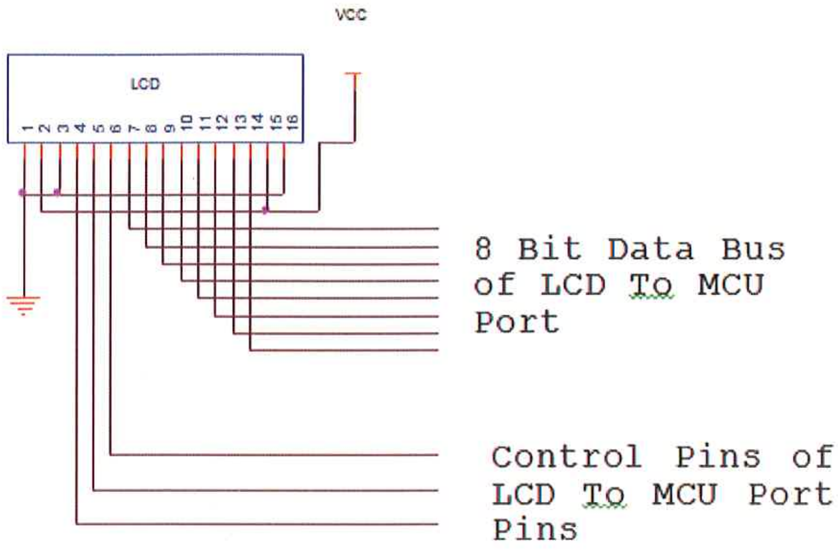
The 8-bit data pins, D0-D7, are used to send information to the LCD or read the contents of the LCD's internal registers. To displays the letters and numbers, we send ASCII codes for the letters A-Z, a-z, and numbers 0-9 to these pins while making RS =1. There are also command codes that can be sent to clear the display or force the cursor to the home position or blink the cursor.

We also use RS =0 to check the busy flag bit to see if the LCD is ready to receive the information. The busy flag is D7 and can be read when R/W =1 and RS =0, as follows: if R/W =1 and RS =0, when D7 =1(busy flag =1), the LCD is busy taking care of internal operations and will not accept any information. When D7 =0, the LCD is ready to receive new information.

4.2 Interfacing of micro controller with LCD display

In most applications, the "R/W" line is grounded. This simplifies the application because when data is read back, the microcontroller I/O pins have to be alternated between input and output modes.

In this case, "R/W" to ground and just wait the maximum amount of time for each instruction (4.1ms for clearing the display or moving the cursor/display to the "home position", 160µs for all other commands) and also the application software is simpler, it also frees up a microcontroller pin for other uses. Different LCD execute instructions at different rates and to avoid problems later on (such as if the LCD is changed to a slower unit). Before sending commands or data to the LCD module, the Module must be initialized. Once the initialization is complete, the LCD can be written to with data or instructions as required. Each character to display is written like the control bytes, except that the "RS" line is set. During initialization, by setting the "S/C" bit during the "Move Cursor/Shift Display" command, after each character is sent to the LCD, the cursor built into the LCD will increment to the next position (either right or left). Normally, the "S/C" bit is set (equal to "1")



Interfacing of Microcontroller with LCD

Figure 4. 2 Microcontroller interfacing with LCD

4.3 LCD Command Code

Code (HEX)	Command to LCD Instruction Register
1	Clear the display screen
2	Return home
4	Decrement cursor(shift cursor to left)
6	Increment cursor(shift cursor to right)
7	Shift display right

8	Shift display left
9	Display off, cursor off
A	Display off, cursor on
C	Display on, cursor off
E	Display on, cursor blinking
F	Display on, cursor blinking
10	Shift cursor position to left
14	Shift cursor position to right
18	Shift the entire display to left
1C	Shift the entire display to right
80	Force cursor to the beginning of 1st line
C0	Force cursor to the beginning of 2nd line
38	2 line and 5×7 matrix

Table 3

Chapter 5 - BUZZER FOR BEEP SOURCE

A **buzzer** or **beeper** is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

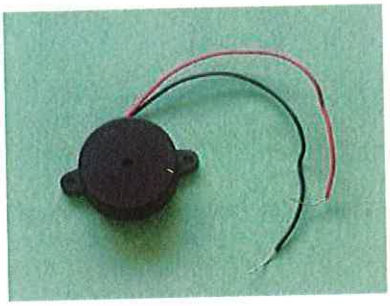


Figure 5. 1 Buzzer

5.1 Mechanical Buzzer

A joy buzzer is an example of a purely mechanical buzzer.

A joy buzzer (also called a hand buzzer) is a practical joke device that consists of a coiled spring inside a disc worn in the palm of the hand. When the wearer shakes hands with another person, a button on the disc releases the spring, which rapidly unwinds creating a vibration that feels somewhat like an electric shock to someone not expecting it.

5.2 Electromechanical Buzzer

Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

An electric bell is a mechanical bell that functions by means of an electromagnet. When an electric current is applied, it produces a repetitive buzzing or clanging sound. Electric bells have been widely used at railroad crossings, in telephones, fire and burglar alarms, as school bells, doorbells, and alarms in industrial plants, but they are now being widely replaced with electronic sounders.

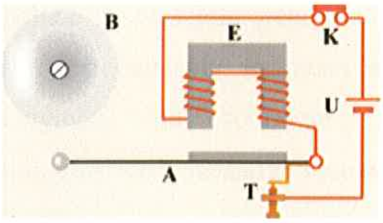


Figure 5. 2 Electromechanical buzzer

An electric buzzer uses a similar mechanism to an interrupter bell, but without the resonant bell. They are quieter than bells, but adequate for a warning tone over a small distance, such as across a desktop.

With the development of low cost electronics from the 1970s onwards, most buzzers have now been replaced by electronic 'sounders'. These replace the electromechanical striker of a bell with an electronic oscillator and a loudspeaker, often a piezo transducer.

5.3 Piezoelectric buzzer

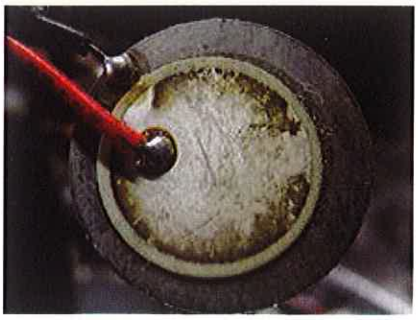


Figure 5. 3 Piezoelectric buzzer

A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier.

Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep. Oscillation is the repetitive variation, typically in time, of some measure about a central value (often a point of equilibrium) or between two or more different states. Familiar examples include a swinging pendulum and AC power. The term vibration is sometimes used more narrowly to mean a mechanical oscillation but sometimes is used to be synonymous with "oscillation". Oscillations occur not only in physical systems but also in biological systems and in human society.

A piezoelectric audio amplifier (PAA) is a single integrated circuit or a PCB developed to amplify small audio signals to drive piezoelectric audio loudspeaker elements. A piezo audio amplifier can amplify a small signal sine wave of 1 volt peak-to-peak to a signal of about 30 or 60 Volts.

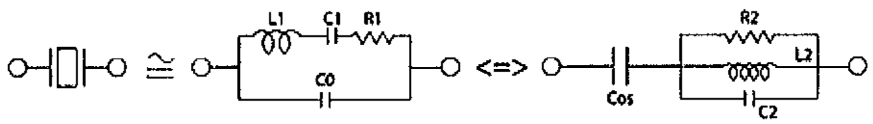


Figure 5. 4 Piezoelectric audio amplifier

Uses

- Annunciate panels
- Electronic metronomes
- Game shows
- Microwave ovens and other household appliances
- Sporting events such as basketball games
- Electrical alarms
- Buzzers

5.3 Interfacing Circuit to MCU

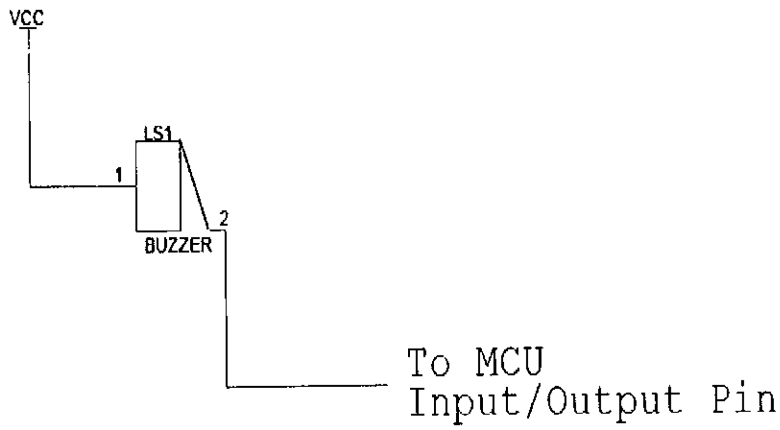


Figure 5. 5 Buzzer and MCU interfacing

Chapter 6 – ULTRASONIC SENSOR TRANSCEIVER

Ultrasonic is a term meaning the application of ultrasound. It is often used in industry as a shorthand term for any equipment employing ultrasonic principles. **Ultrasound** is a cyclic sound pressure wave with a frequency greater than the upper limit of human hearing. Ultrasound is thus not separated from "normal" (audible) sound based on differences in physical properties, only the fact that humans cannot hear it. Although this limit varies from person to person, it is approximately 20 kilohertz (20,000 hertz) in healthy, young adults. The production of ultrasound is used in many different fields, typically to penetrate a medium and measure the reflection signature or supply focused energy. The reflection signature can reveal details about the inner structure of the medium, a property also used by animals such as bats for hunting. The most well-known application of ultrasound is its use in sonography to produce pictures of foetuses in the human womb. There are a vast number of other applications as well.

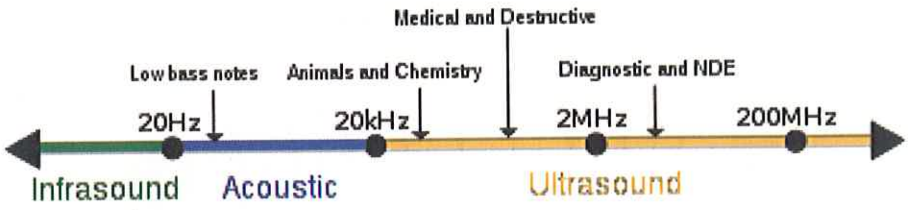


Figure 6. 1 Approximate frequency ranges corresponding to ultrasound, with rough guide of some applications

6.1 Ability to hear ultrasound

The upper frequency limit in humans (approximately 20 KHZ) is due to limitations of the middle ear, which acts as a low-pass filter. Ultrasonic hearing can occur if ultrasound is fed directly into the skull bone and reaches the cochlea through bone conduction without passing through the middle ear.

It is a fact in psychoacoustics that children can hear some high-pitched sounds that older adults cannot hear, because in humans the upper limit pitch of hearing tends to become lower with age. A cell phone company has used this to create ring signals supposedly only able to be heard by younger humans; but many older people can hear it, which may be due to the considerable variation of age- related deterioration in the upper hearing threshold.

Many animals—such as dogs, cats, dolphins, bats, and mice—have an upper frequency limit that is higher than that of the human ear and thus can hear ultrasound. This is why a dog whistle can be heard by a dog.

See also The Mosquito (an electronic device used to deter loitering by young people).

6.2 Ultrasonic Range Finder

A common use of ultrasound is in range finding; this use is also called SONAR, (sound navigation and ranging). This works similarly to RADAR (radio detection and ranging): An ultrasonic pulse is generated in a particular direction. If there is an object in the path of this pulse, part or all of the pulse will be reflected back to the transmitter as an echo and can be detected through the receiver path. By measuring the difference in time between the pulse being transmitted and the echo being received, it is possible to determine how far away the object is.

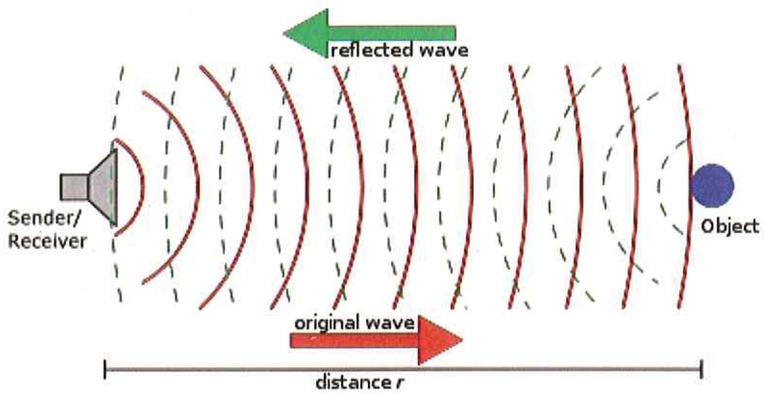


Figure 6. 2 Principle of active sonar

The measured travel time of SONAR pulses in water is strongly dependent on the temperature and the salinity of the water. Ultrasonic ranging is also applied for measurement in air and for short distances. Such method is capable for easily and rapidly measuring the layout of rooms.

Although range finding underwater is performed at both sub-audible and audible frequencies for great distances (1 to several kilometers), ultrasonic range finding is used when distances are shorter and the accuracy of the distance measurement is desired to be finer. Ultrasonic measurements may be limited through barrier layers with large salinity, temperature or vortex differentials. Ranging in water varies from about hundreds to thousands of meters, but can be performed with centimeters to meters accuracy

6.3 Ultrasonic Distance Sensor

Its compact size, higher range and easy usability make it a handy sensor for distance measurement and mapping.

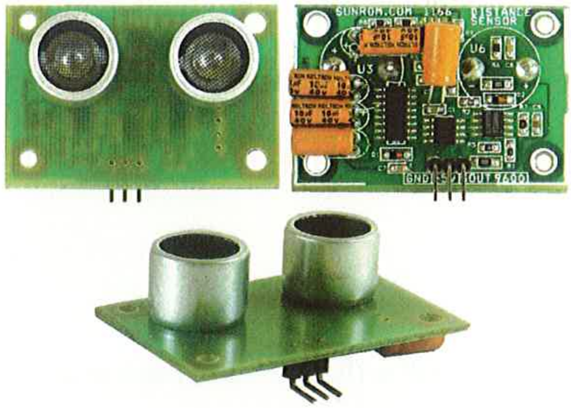


Figure 6. 3 Ultrasonic distance sensors

6.4 Features

- Minimum range 10 centimetres
- Maximum range 400 centimetres (4 Meters)
- Accuracy of +-1 cm
- Resolution 0.1 cm
- 5V DC Supply voltage
- Compact sized SMD design
- Modulated at 40 kHz
- Serial data of 9600 bps TTL level output for easy interface with any microcontroller.

Specification

Parameter Value Unit

Supply Voltage 5 V

Supply Current 15 mA

Output Data speed 9600 Bps

Output Data Format 8-N-1 8 data bytes, no parity, 1 stop bit

Pin Details

1 2 3

Figure 6. 4 Pin details

Pin Value

1 – GND Supply Ground.

2 - +5V Supply +5V

3 – Serial Out 9600 Serial output data (TTL 5V level) at 9600 baud rate

Chapter 7 - FUTURE IMPLEMENTATION

To make a short range radar which can be implemented in cars for safe driving during extreme weather conditions like rainfall, fog and snow where visibility is compromised and is the reason for majority of accidents.

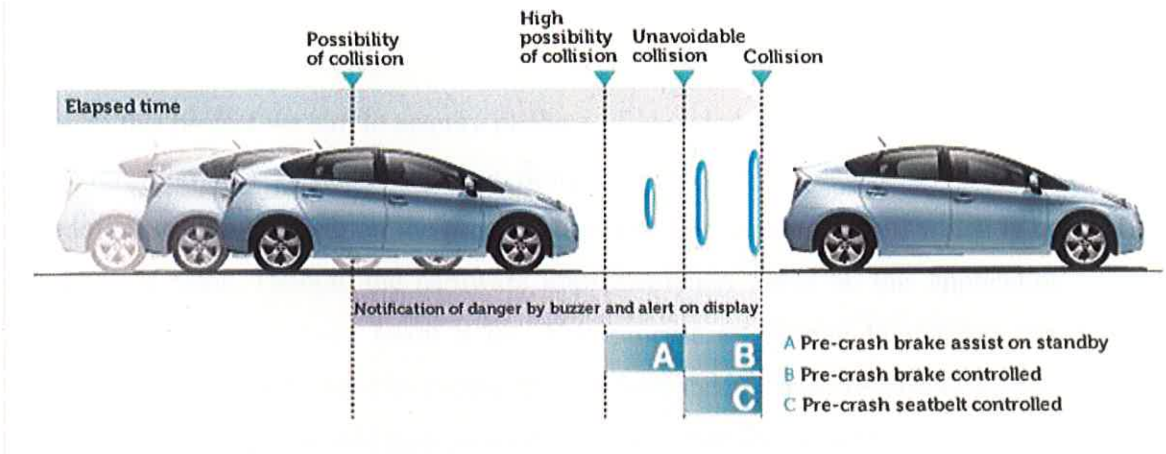


Figure 7.1 Available Concept

Notification of danger by buzzer and alert on display

CONCLUSION

It is quite evident, that this project has many practical applications in AV (Audio-Video) alarm based systems for

- Homes
- Shops
- Military purpose
- Object detection

Through this project we aim to acquire plethora of knowledge in the field of electronics and communication and at the same time design a good object detection system. In this expedition, we are working on the project ultrasonic transceiver system, which is basically one kind of radar. Though, the hardware implementation based on this application is on small scale basis, we have learnt a lot. This process of gaining knowledge has many problems but we look forward to eventually deal with them. Thus the journey of facing and overcoming difficulties would train us for the future higher end projects.

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