5.SOFTWARE IMPLEMENTATION

The software requirement of the system is-

- Keil Microvision 3
- Proload Programming Software
- Embedded C

A complete description is given below:

5.1 Keil Microvision 3

Keil is a cross compiler which is capable of creating executable code for a platform other than the one on which the compiler is run. Cross compiler tools are used to generate executables for embedded systems or multiple platforms. It is used to compile for a platform upon which it is not feasible to do the compiling, like microcontrollers that don't support an operating system.

5.2 Vehicle to Vehicle Communication Code

```
/* 8 Message DISPLAY PROGARM */

#include<stdio.h>

#include<at89x51.h> // header file for atmel 89c51

sfr  port3 = 0xa0;

sfr  port2 = 0xb0;

sfr  port1 = 0x90;

sfr  port0 = 0x80;

sbit  rs = port3 ^ 5;

sbit  rw = port3 ^ 6;

sbit  e = port3 ^ 7;

void display1(); // FUNCTION FOR TRAIN ID 1

void display2(); // FUNCTION FOR TRAIN ID 2

void displayset();

void command() // CONTROL BITS FOR LCD

{
```

```
 rs = 0;
 rw = 0;
  e = 1;
  e = 0;
 }
void datawrt() // CONTROL BITS FOR LCD
{
  rs = 1;
  rw = 0;
   e = 1;
   e = 0;
}
void delay()
{
  unsigned int i;
   for ( i = 0; i < 6000 ; i++ );
}
  void main()
{
   unsigned char temp;
  displayset();
  while(1)
            {
               temp = port2;
                if ( temp == 0xfe )
                display1();
                else if ( temp == 0xfd )
```

```
            display2();
            else if ( temp == 0xfc )
            display3();
            else if ( temp == 0xfb )
           display4();
          else if ( temp == 0xef )
        }
 }
void displayset()
{
    port3 = 0x00;
   port1 = 0x00;
   port1 = 0x38;  // 16X2 LCD DISPLAY
   command();
   delay();
   port1 = 0x0e;  // CURSOR BLINK ON LCD
   command();
   delay();
   port1 = 0x01;  // CLEAR THE SCREEN
   command();
   delay();
   port1 = 0x83;  // STARTING LINE ADDRESS
   command();
   delay();
   port1 = 0x06;  // CURSOR RIGHT SHIFT
   command();
   delay();
```

```
}
  void display1()
{
  displayset();
  port1 = 'H';
  datawrt();
  delay();
  port1 = 'O';
  datawrt();
  delay();
  port1 = ' R';
  datawrt();
  delay();
  port1 = 'N';
  datawrt();
  delay();
  port1 = '';
  datawrt();
  delay();
  port1 = 'D';
  datawrt();
  delay();
  port1 = 'T';
  datawrt();
  delay();
  port1 = 'D’;
  datawrt();
```

```
  delay();
}
 void display2()
{
  displayset();
  port1 = 'P ';
  datawrt();
  delay();
  port1 = 'R ';
  datawrt();
  delay();
  port1 = 'E ';
  datawrt();
  delay();
  port1 = 'S ';
  datawrt();
  delay();
  port1 = 'S ';
  datawrt();
  delay();
  port1 = 'U';
  datawrt();
  delay();
  port1 = 'R';
  datawrt();
  delay();
  port1 = 'E';
```

```
  datawrt();
  delay();
  port1 = ' ';
  datawrt();
  delay();
  port1 = 'D';
  datawrt();
  delay();
  port1 = 'T';
  datawrt();
  delay();
  port1 = 'D';
  datawrt();
  delay();
}
```

5.3 Software Tools Used

The software's which are used to developed this project are

- Keil IDE compiler
- Languages used: Embedded C

➢ Introduction to Keil software

Keil Micro Vision is an integrated development environment used to create software to be run on embedded systems (like a microcontroller). It allows such software to be written both in assembly or C programming languages and for that software to be simulated on a computer before being loaded on to the microcontroller.

➢ What is µVision-3?

µVision 3 is an IDE (Integrated Development Environment) that helps write, compile, and debug embedded programs. It encapsulates the following components:

- A project manager.

- A make facility.
- Tool configuration.
- Editor.

➢ Steps followed in creating an application in µvision3

To create a new project in uVision3:

1. Select Project- New Project.
2. Select a directory and enter the name of the project file.
3. Select Project–Select Device and select a device from Device Database.
4. Create source files to add to the project
5. Select Project-Targets, Groups, and Files. Add/Files, selectSourceGroup1, and add the source files to the project.
6. Select Project-Options and see the tool options. Note that when the target device is selected from the Device Database™ all- special options are set automatically. Default memory model settings are optimal for most applications.
7. Select Project- Rebuild all target files or Build target

To create a new project, simply start Micro Vision and select "Project" =>" New Project" from the pull-down menus. In the file dialog that appears, choose an amend base directory for the project. It is recommended that a directory be created for each project, as several files will be generated. Once the project has been named, the dialog shown in the figure below will appear, prompting the user to select a target device. In this lab, the chip being used is the "P89v51RD2".

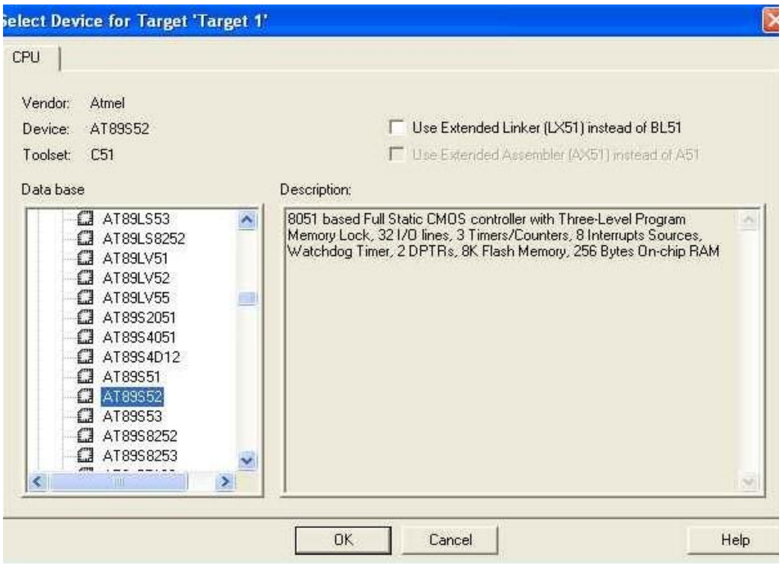

Fig 5.1 Window for choosing the target device

Next, Micro Vision must be instructed to generate a HEX file upon program compilation. A HEX file is a standard file format for storing executable code that is to be loaded onto the microcontroller.

In the “Project Workspace” pane at the left, right–click on “Target1”and select “Options for Target1”. Under the “Output” tab of the resulting options dialog, ensure that both the “Create Executable” and “Create HEX File” options are checked. Then click “OK” as shown in the two figures below.

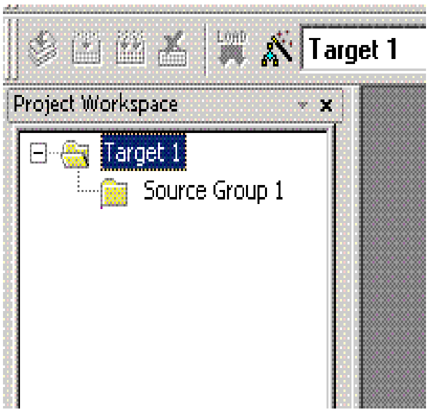

Fig 5.2 Project Workspace Pane

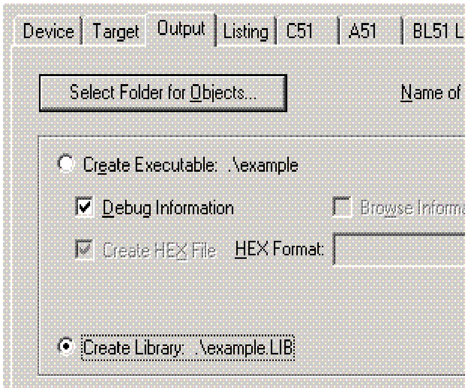

Fig 5.3 Project Options Dialog

Next, a file must be added to the project that will contain the project code. To do this, expand the “Target1” heading, right–click on the “SourceGroup1” folder, and select “Add files…” Create a new blank file (the file name should end in “.asm”), select it, and click “Add.” The new file should now appear in the “Project Workspace” pane under the “Source Group1” folder. Double-click on the newly created file to penitent the editor. All code for this lab will go in this file. To compile the program, first save all source files by clicking on the “Save All” button, and then click on the “Rebuild All Target Files” to compile the program as shown in the figure below. If any errors or warnings occur during compilation, they will be displayed in the output window at the bottom of the screen.

All errors and warnings will reference the line and column number in which they occur along with a description of the problems that they can be easily located. Note that only errors indicate that the compilation failed, warnings do not (though it is generally a good idea to look into the many way).

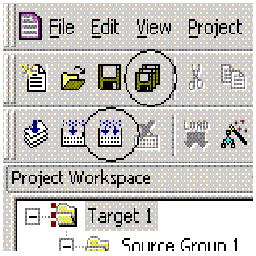

Fig.5.4 “Save all” and “Build All Target Files” buttons

When the program has been successfully compiled, it can be simulated using the integrated debugger in Keil Micro Vision. To start the debugger, select “Debug” =>” Start/Stop Debug Session” from the pull–down menus. At the left side of the debugger window, a table is displayed containing several key parameters about the simulated microcontroller, most notably the elapsed time (circled in the figure below). Just above that, there are several buttons that control code execution. The “Run” button will cause the program to run continuously until a breakpoint is reached, where as the “Step Into” button will execute the next line of code and then pause (the current position in the program is indicated by a yellow arrow to the left of the code).

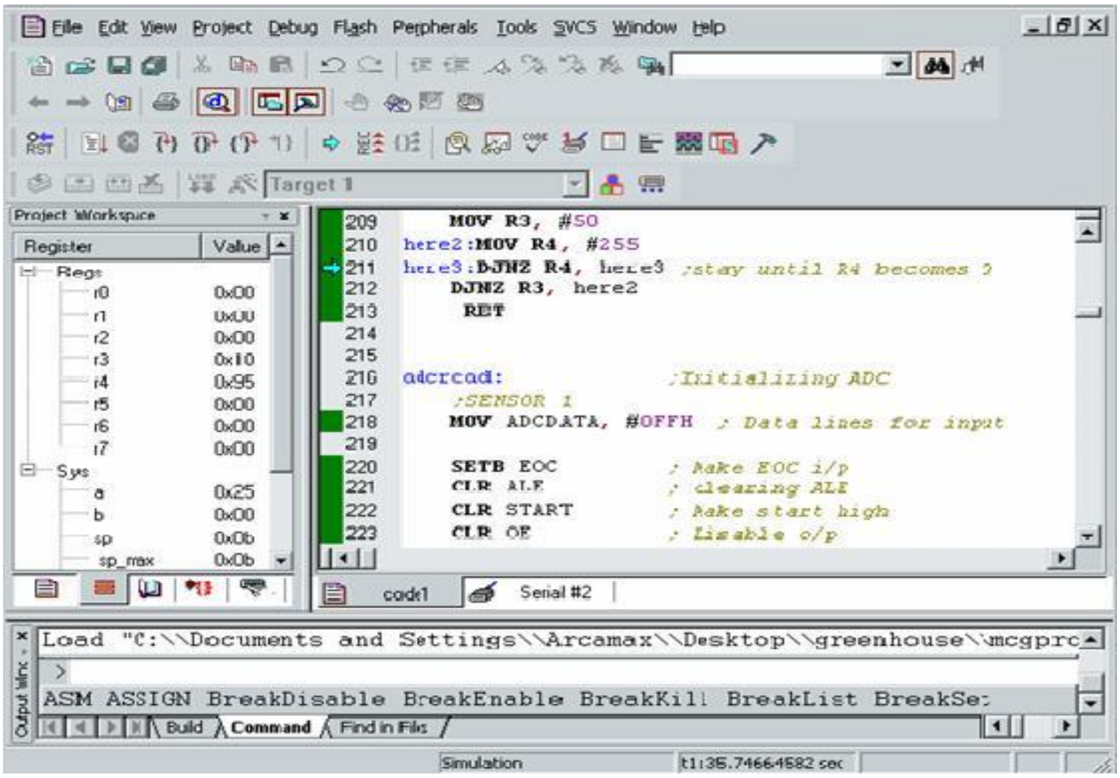

Fig 5.5 µ Vision3 Debugger Window

Break points can be set by double–clicking on the grey bar on the left edge of the window containing the program code. A breakpoint is indicated by a red box next to the line of code.

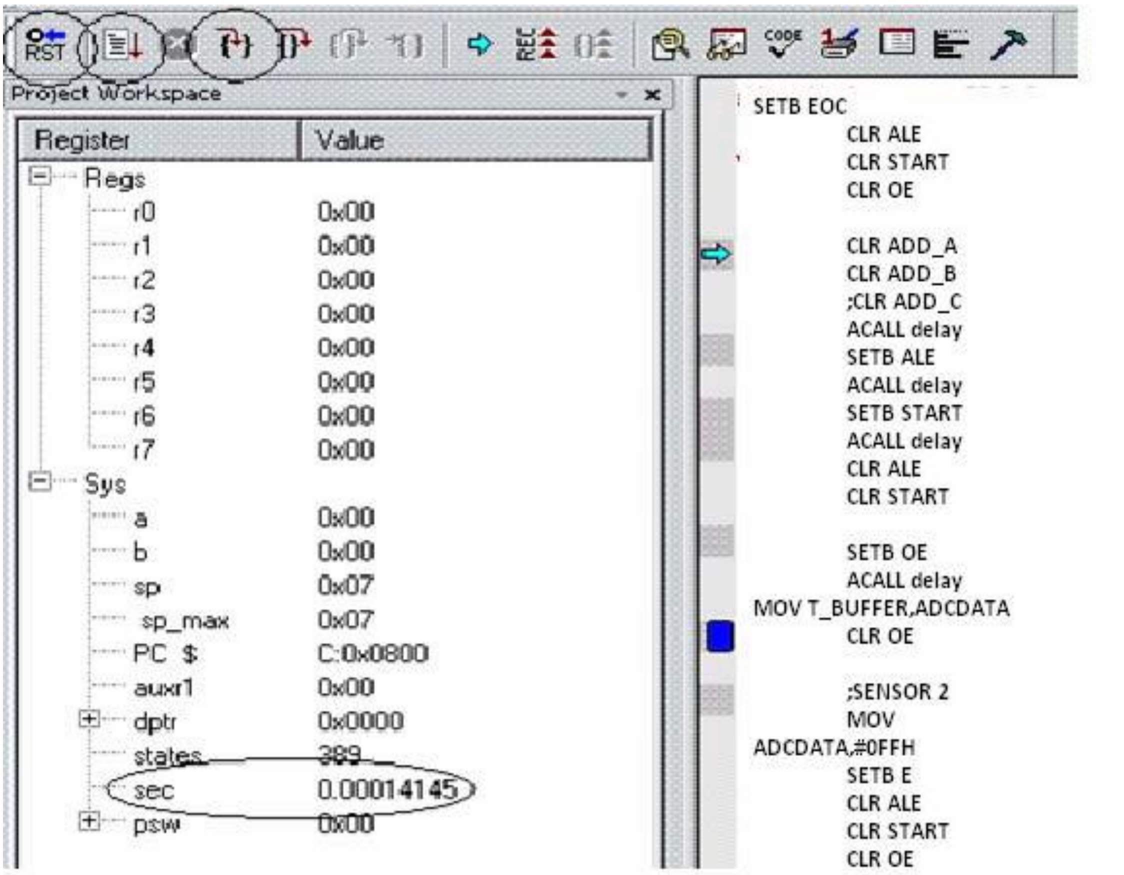

Fig. 5.6 'Reset', 'Run' and 'Step into' options

The current state of the pins on each I/O port on the simulated microcontroller can also be displayed. To view the state of a port, select "Peripherals" => "I/O Ports" => "Port *n*" from the pull–down menus, where *n* is the port number. A checked box in the port window indicates a high (1) pin, and an empty box indicates a low (0) pin. Both the I/O port data and the data at the left side of the screen are updated whenever the program is paused.

The debugger will help eliminate many programming errors, however the simulation is not perfect and code that executes properly in simulation may not always work on the actual microcontroller.

➢ Device database

A unique feature of the Keil µVision3 IDE is the Device Database, which contains information about more than 400 supported microcontrollers. When you create a new µVision3 project and select the target chip from the database, µVision 3 sets all assembler, compiler, linker, and debugger options for you. The only option you must configure is the memory map.

- **Peripheral simulation**

The µVision3 Debugger provides complete simulation for the CPU and on-chip peripherals of most embedded devices. To discover which peripherals of a device are supported, in µVision3 select the Simulated Peripherals item from the Help menu. You may also use the web-based Device Database. We are constantly adding new devices and simulation support for on-chip peripherals so be sure to check Device Data base often.

5.4 Proload Programming Software

'ProLoad' is a software working as a user-friendly interface for programmer boards from Sun rom Technologies. Proload gets its name from "**Pro**gram **Load**er" term, because that is what it is supposed to do. It takes in compiled HEX file and loads it to the hardware. Any compiler can be used with it, Assembly or C, as all of them generate compiled HEX files. ProLoad accepts the Intel HEX format file generated from compiler to be sent to target microcontroller. It auto detects the hardware connected to the serial port. It also auto detects the chip inserted and bytes used. The software is developed in Delhi and requires no over head of any external DLL.

The programmer connects to the computer's serial port (Comm1, 2, 3or 4) with a standard DB9Maleto DB9 Female cable. BaudRate-57600, COM x Automatically selected by window software. No PC Card Required. After making the necessary selections, the 'Auto Program' button is clicked as shown in the figure below which burns the selected hex file on to the microcontroller.

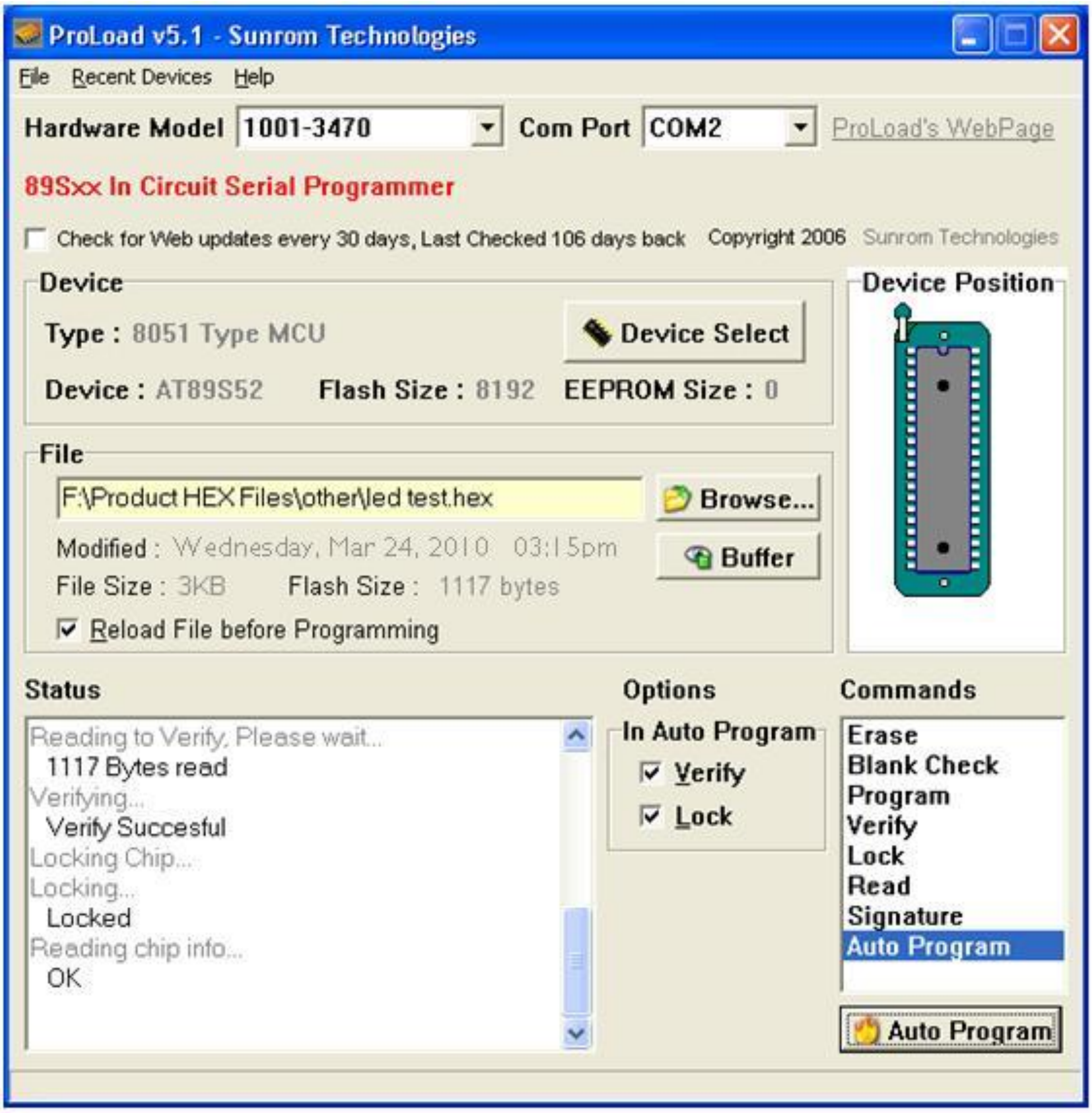

Fig 5.7 Programming window

➢ Topwin

TopWin, a type of software developed for TOP series programmers, adapts to the TOP hardware products of a new generation. TopWin has abandoned its method of one type of software matching for one mode of TOP product by operating different mode of hardware units. TopWin supports automatic identification of hardware mode and function. Once TopWin connects to hardware unit successfully, the name of hardware unit will appear at the bottom of window. The current basic modes that TopWin supported include TOP853, TOP2004, TOP2005 and TOP2048. Product of new mode developed in the future will be supported by new version of TopWin software.

➢ Characteristics:

1. Support 5V device;
2. Adopting USB interface power supply instead of external power supply;
3. Connecting PC through USB universal serial port at a transmission rate of 12MHz/s;
4. Adapting to battery-powered notebook PC as well as desktop PC;
5. Perfect over-current protection to programmer and device against damage;
6. USB loading capacity testing (0 to 10 grade); 40-pin universal locking socket;
7. Operating under WINDOWS98SE/ME/2000/XP;
8. Plastic shell, small size, light weight and low power consumption;
9. Supporting automatic-detection of manufacturer and mode;
10. MCU/MPU timing, programming speed is independent of computer.

➢ Conventional Procedures:

1. Connect to TOPWin correctly; power indicator (red) turns on.
2. Run “TOPWin.exe” and working indicator (green) turns on.
3. Select “File” in the main menu, and upload data to the file buffer.
4. Insert the device into the socket and lock it up, and then be ready for written-in and read-out operation of device.

5.5 Embedded C

The embedded c programming language is used in the microcontrollers. The embedded c language is a general-purpose programming language that provides code efficiency, elements of structured programming and a rich set of operators. Embedded c is not a big language and is not designed for any one particular area of application. It’s generally combined with its absence of restriction, makes embedded c a convenient and effective programming solution for a wide variety of software tasks. Many applications can be solved more easily and efficiently with embedded c than with other more specialized languages. The embedded c language on its own is not capable of performing operations (such as input and output) that would normally require intervention from the operating system. Instead, these capabilities are provided as a part of standard library. Because these functions are separated from the language itself, embedded c is especially suited for producing code that is portable across wide platforms.

6. RESULT

In this chapter, we discuss the various results obtained through this project.

6.1 Horn detected

- In the process of data communication through the visible light on the transmitter side in one vehicle horn is used as switch to transmit signal. The microcontroller receives the signal from the keypad and generates two outputs and gives that signal to the DTMF Encoder. The encoder will generate one tone and one frequency for every pressed key.
- That frequency is amplified by the amplifier circuits and fed into the power LED. At the receiver side light dependent resister will receive the light signal and correspondingly generate an electrical signal proportional to it.
- This electrical signal is processed by a demodulator circuit (DTMF Decoder), and the output of decoder is then fed to a microcontroller and the microcontroller activates the Buzzer for the pressed key in another vehicle and also displays the message “HORN DTD”.

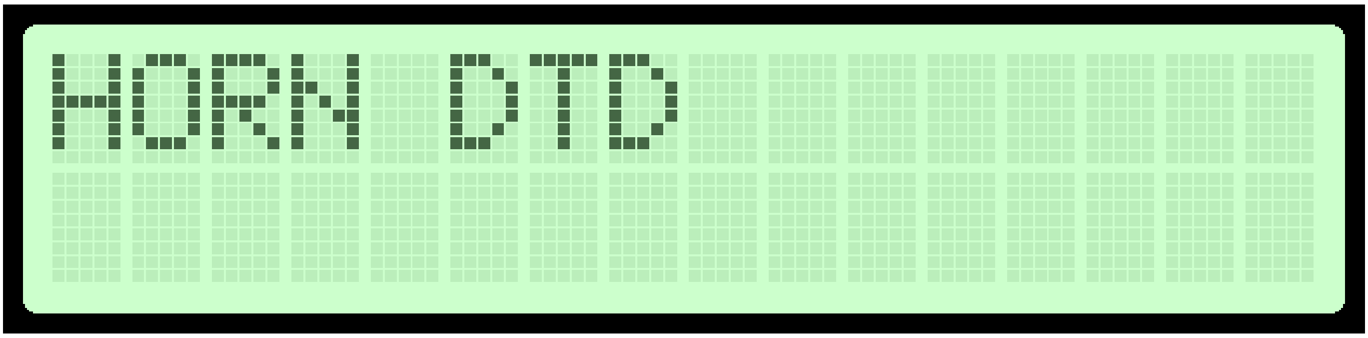

Fig. 6.1 Horn Detected message on LCD

6.2 Pressure detected

- In the process of data communication through the visible light on the transmitter side in one vehicle brake pedal is used as switch to transmit Signal. The microcontroller receives the signal from the keypad and generates two outputs and gives that signal to the DTMF Encoder. The encoder will generate one tone and one frequency for every pressed key.
- That frequency is amplified by the amplifier circuits and fed into the power LED. At the receiver side light dependent resister will receive the light signal and correspondingly generate an electrical signal proportional to it.

- This electrical signal is processed by a demodulator circuit (DTMF Decoder), and the output of decoder is then fed to a microcontroller and the microcontroller activates the Buzzer for the pressed key in another vehicle and vehicle and also displays the message “PRESSURE DTD”.

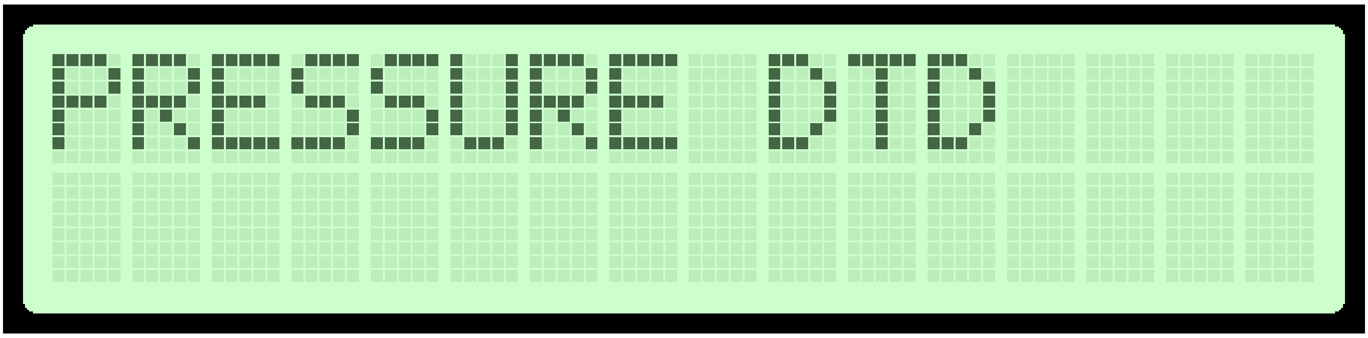

Fig. 6.2 Pressure Detected message on LCD

7. ADVANTAGES, LIMITATIONS AND APPLICATIONS

7.1 Advantages:

1. Harmless for the human body.
2. Data transmission by sockets of existing light fixtures.
3. Alleviation of problems associated with the radio frequency (RF) communication system.
4. Less energy consumption.
5. Increased security.
6. Compact integration of sensors through small dimensions.
7. Huge number of channels available without interfering with other sources.
8. Simple electronics as drive for the LED’s.
9. No influence to other sensitive equipment through radio waves.

7.2 Disadvantages:

1. To transmit the data it should be in the line of sight.
2. Cannot be use during broad day light.

7.3 Applications:

1. This project can be used for all kinds of two-wheeler.
2. Further this project can be used to eliminate key-lock arrangement altogether.
3. This project can also be implemented in a confined area / geological area, so as to restrict the movement of vehicle including two-wheelers.
4. Used near petrol pumps, LPG Storages & Explosive Storage Places to prevent any possible damage as Cell Phone / GSM frequency, which may trigger explosion.
5. In the military Camps, Defense establishments etc. to prevent the information leaking.
6. The cell phone may cause malfunctioning of the Bio-Medical Equipment. So, this project can be used in the hospitals to detect the active mobile device.

8.CONCLUSION

We have presented a VLC system consisting of an li-fi transmitter and receiver that is targeted at v2v applications, and introduced its characteristics and capabilities .in traffic signals, Li-Fi can be used which will communicate with the led lights of the cars and accident numbers can be decreased. Li-Fi is ideal for high density coverage in a confined region .It is believed that the technology can yield a speed more than 10 GBPS .It is the fastest and cheapest wireless communication systems which is suitable for long distance communication Li-Fi will make all lives more technology driven in the near future.

In this project, the concept of Li-Fi had been introduced along with existing techniques and classical trends used for vehicle to vehicle communications. The proposed system has a cost effective solution to reduce accidents. The design guidelines and details of system components were thoroughly explained in this report. The proof of concept has been illustrated by sending data through Li-Fi small-scale prototype model. Finally the result has been measured between the vehicles.

FUTURE SCOPE

The future possibilities are numerous and can be explored further this technology is in manufacturing process to produce every bulb to become a WiFi hotspot to transmit wireless data. In the WI-FI we come to know that the speed and the jamming are really take place which is today's problem because no. of users are increasing. But this traffic problem get reduces to a great number by using LI-Fi technology and this will proceed towards the cleaner, greener, safer and brighter future in this world without radio wave, because radio waves create a harmful effect for living thing, but Li-Fi is the optical wireless communication for data, audio and video streaming in LEDs. In future this system helps the communication much easier than other system. It involves Li-Fi communication, we can use these system in places such as Industries, offices etc.

The project can be extended to communicate Vehicle-to-Infrastructure for smart city. For example, the street lights can be used as transmitter and the vehicle can be used as receiver.

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APPENDIX

I. RESISTORS:

In many electronic circuit applications the resistance forms the basic part of the circuit. The reason for inserting the resistance is to reduce current or to produce the desired voltage drop. These components which offer value of resistance are known as resistors . Resistors may have fixed value i.e., whose value cannot be changed and are known as fixed resistors. Such of those resistors whose value can be changed or varied are known as variable resistors.

There are two types of resistors available. They are :

- Carbon resistors .
- Wire wound resistors .

Carbon resistors are used when the power dissipation is less than 2W because they are smaller and cost less. Wire wound resistors are used where the power dissipation is more than 5W . In electronic equipments carbon resistors are widely used because of their smaller size .

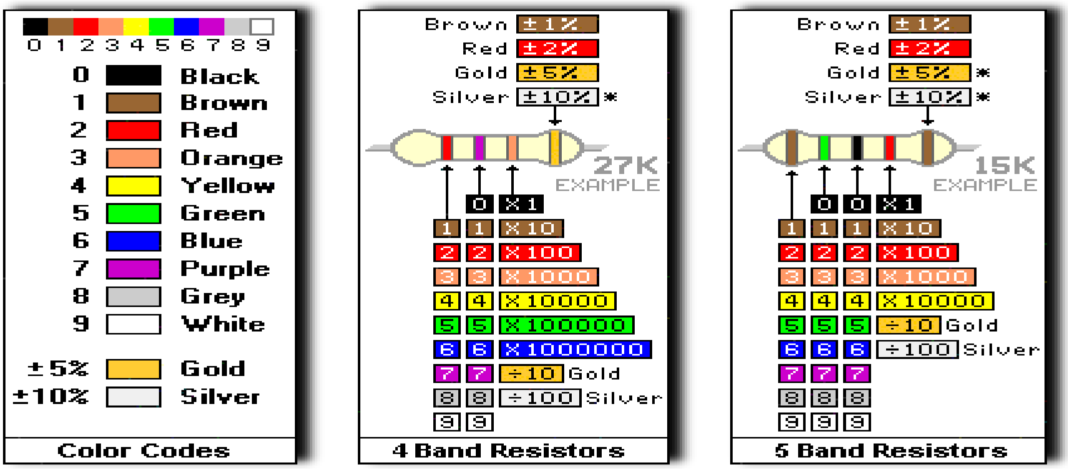
All resistors have three main characteristics:

- Its resistance R in ohms (from 1 ohm to many mega ohms).
- Power rating (from several 0.1W to 10 W).
- Tolerance (in percentage).

➢ RESISTOR COLOR CODING:

The carbon resistors are small in size and are color coded to indicate their resistance value in ohms. Different colors are used to indicate the numeric values. The dark colors represent lower values and the lighter colors represent the higher values. The color code has been standardized by the electronic industries association.

The color bands are printed at one end of the resistors and are read from the left to right. The first color band closed to the edge indicates the first digit in the value of resistance .The second band gives the second digit. The third band gives the number of zero’s after two digits . The resulting number is the resistance in ohms . A fourth band indicates the tolerance i.e., to indicate how accurate the resistance value is , the bands are shown in the figure 1.



➢ PRESET:

There are two general categories of variable resistors:

- ❖ General purpose resistors.
- ❖ Precision resistors.

The general purpose type can again be wire wound type and carbon type .These follows either linear or logarithmic law. The precision type are always wire wound and follow a linear law .The variable resistors can be broadly classified as potentiometer , rheostats , presets and decade resistance boxes.

The general purpose wire wound potentiometers are available in 1, 2, 3 and 4 watts. The usual tolerances ratings 10 % and 20% are available. The widely used potentiometers are of the standard diameters 19mm, 31mm, and 44mm. The temperature coefficient depends on the wire used and on the resistors values. The resolution of these wire wound resistors is proper than carbon resistors because the wiper has to move from one winding to the other, where as in carbon potentiometers it is continuous. These resistors are highly linear, the linearity falling with 1%.

II. CAPACITORS:

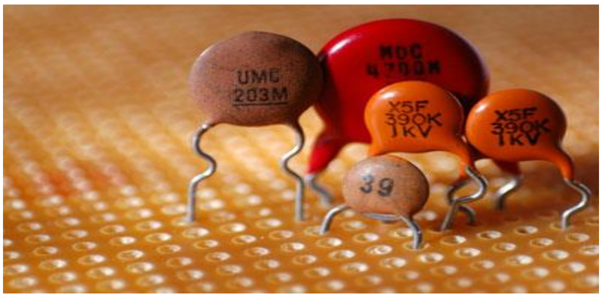
Devices which can store electronic charge are called capacitors. Capacitance can be understood as the ability of a dielectric to store electric charges. Its unit is Farad, named after the Michael Faraday. The capacitors are named according to the dielectric used. Most common ones are air, paper, and mica, ceramic and electrolytic capacitors.

Physically a capacitor has conducting plates separated by an insulator or the dielectric. The plates of the capacitor have opposite charge, this gives rise to an electric field .In capacitor the electric field is concentrated in the dielectric between the plates.

Like resistors, capacitors are also crucial to the correct working of nearly every electronic circuit and provide us with a means of storing electrical energy in the form of an electric field. Capacitors have numerous applications including storage capacitors in power supplies, coupling of A.C. signals between the stages of an amplifier, and decoupling power supply rails so that, As far as A.C. signal components are concerned, the supply rails are indistinguishable from zero volts.

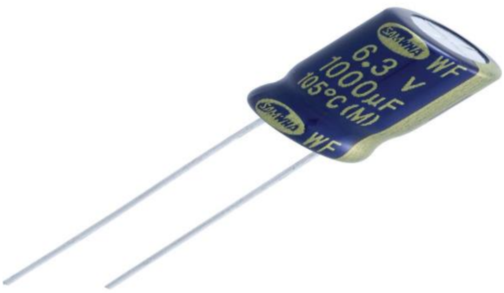
➢ TYPES OF CAPACITORS:

❖ DISC CAPACITORS :



In the disk form, silver is fired on to both sides of the ceramic to form the conductor plates. The sheets are then baked and cut to the appropriate shape and size & attached by pressure contact and soldering . These have high capacitance per unit volume and are very economical. The disks are lacquered or encapsulated in plastic or Phenolic molding. Round disk are used at high voltages the capacitance of values upto 0.01F can be obtained. They have tolerance of +20% or –20%. In general these capacitors have voltage ratings up to 750 V D.C.

❖ ELECTROLYTIC CAPACITORS :



These capacitors derive the name from electrolyte which is used as a medium to produce high dielectric constants. These capacitors have low value for large capacitances at low working voltages.

There are two types of Electrolytic capacitors:

- Aluminum Electrolytic capacitors.
- Tantalum electrolytic capacitors.

Electrolytic capacitors are used in circuits that have combination of D.C. voltage and A.C. The D.C. voltage maintains the polarity . They are used as ‘ripple filter ‘ where large capacitance are required at low cost in small space . They are also used as ‘biased capacitors ‘ and ‘decoupling capacitors ‘ and even as ‘coupling capacitors ‘ in R- C amplifier.

COLOR CODING :

Mica and tubular ceramic capacitors are color coded to indicate a capacitance value . As coding is necessary only for very small sizes, color coded capacitors value is also in the pF. The colors are the same as for the resistor coding from black for ‘0’ upto white for ‘9’. Mica capacitors use ‘six dot code system’.

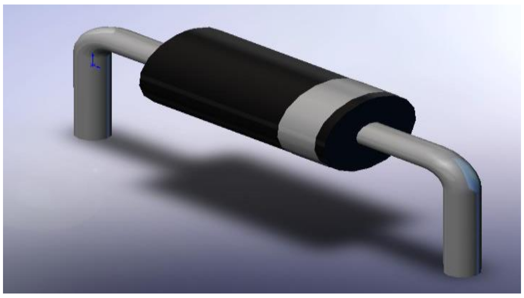
SIX DOT CODE :

Here the top row is read from the left to right and the bottom from right to left .The dot indicates the following:

(1) . White . (2). Digit . (3). Digit. (4) . Multiplier. (5) . Tolerance . (6) . Class.

White for the first dot indicates the coding. The capacitance value is read from the next three dots . If the first dot is silver it indicates paper capacitor. The white colored band indicates the left and specifies the temperature coefficient . The next three colors indicate the value of capacitance . For example Brown, Black, Brown = 100 pF.

III. DIODES:

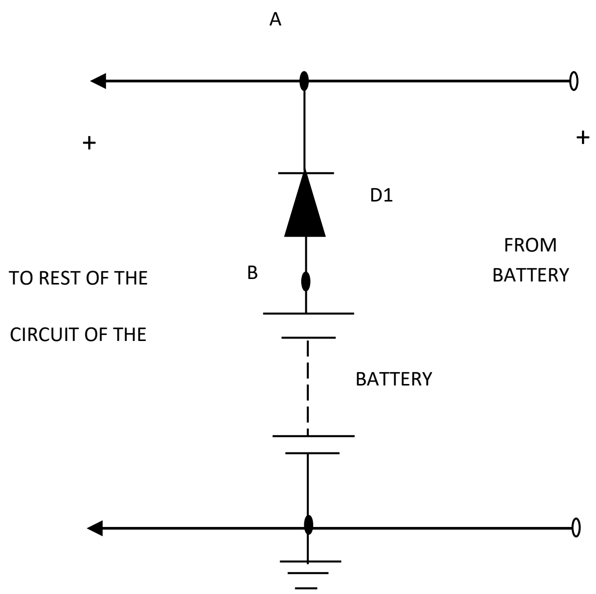


To ensure unidirectional flow of liquid we use mechanical valves in its path. By properly arranging these valves in a system we get useful devices such as pumps and locomotives. In the field of electronics too we have a valve called semiconductor diode (a counterpart of thermionic valve) for controlling the flow of electric current in one direction. But we use these diodes in circuits for limited purposes like converting AC to DC, by passing EMF etc. a diode allows current to pass through it provided it is forward biased and the biasing voltage is more than potential barrier (forward voltage drop) of the diode.

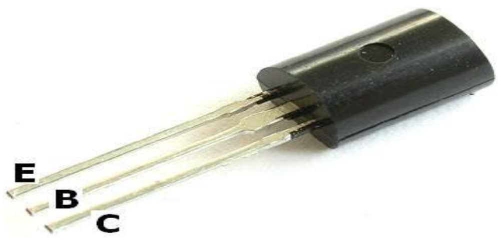
➢ AUTOMATIC SWITCHOVER TO BATTERY:

An uninterrupted power supply (UPS) is necessary for a main operated clock. This facility is very useful in transistors and two in ones for recording or listening to news programs. A relay can do this job with a battery backup. But the relay takes several milliseconds before it makes contact. Moreover, it is costly and occupies space.

The same task can be achieved with a single diode. Just connect a germanium diode DR50 (D1) as shown in fig 1.when the power is available form the eliminator or the external power source, the gadget will use the power from it. As points A and B are at same potential, the external power is remove, point B will be at higher potential that point A i.e. D1 is forward biased and current flows from the battery. In no case the voltage of the eliminator or the external power source should be less than the voltage of the battery. Otherwise, the current will flow from the battery during mains operation also and the battery will be drained quickly.



IV. TRANSISTOR:



The transistor an entirely new type of electronic device is capable of achieving amplification of weak signals in a fashion comparable and often superior to that realized by vacuum tubes. Transistors are far smaller than vacuum tube, have no filaments and hence need no heating power and may be operates in any position. They are mechanically strong, hence practically unlimited life and can do some jobs better than vacuum tubes.

Invented in 1948 by J. Bardeen and W.H.Brattain of Bell Telephone Laboratories, a transistor has now become the heart of most electronic appliance. Though transistor is only slightly more the 45 years old, yet it is fast replacing vacuum tubes in almost all applications.

A transistor consists of two pn junction formed by sand witching either p-type or n-type semiconductor between a pair of opposite type. Accordingly, there are two types of transistors namely:

- ❖ n-p-n transistor
- ❖ p-n-p transistor

An n-p-n is composed of two n-type semiconductors separated a by thin section of p-type. However, a p-n-p is formed by two p-section separated by a thin section of n-type.

- ❖ These are two pn junctions. Therefore, a transistor may be regarded as a combination of two diodes connected back to back.
- ❖ There are 3 terminals, taken from each type of semiconductor.
- ❖ The middle section is very thin layer. This is the most important factor in the functioning of a transistor.

Origin of the name "transistor ": When new devices are invented, scientists often try to device a name that will appropriately describe the device. A transistor has two pn junctions. As the discussed later one junction is forward biased and the other is reversed biased. The forward biased junction has low resistance path whereas the reverse biased junction has low resistance path whereas the reverse biased junction has a high resistance path. The weak signal is introduced in the low resistance circuit and output is taken from the high resistance circuit. Therefore, a transistor transfers a signal from a low resistance to high resistance. The prefix 'tans' means the signal transfer property of the device while 'istor' classifies it as a solid element in the same general family with resistors.

➢ NAMING THE TRANSISTOR TERMINALS:

A transistor (pnp or npn) has three sections of doped semiconductors. The section on one side is the emitter and the section on the opposite side is the collector. The middle section is called the base and forms two junctions between the emitter and collector.

- Emitter: - The section on one side that supplies charge carriers (electrons or holes) is called the emitter. The emitter is always forward biased w.r.t base so that it can supply a large number of majority carriers.
- Collector: - The section on the other side that collects the charge is called the collector. The collector is always reversing biased. Its function is to remove charges from its junction with the base.
- Base: - The middle section, which forms to pn junctions between the emitter and collector, is called base. The base emitter junction is forward biased, allowing low resistance for the emitter circuit. The base-collector junction is reversed biased and provides high resistance in the collector circuit.

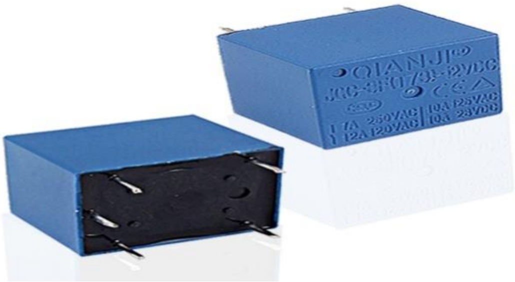
CHARACTERISTICS OF TRANSISTORS

Whenever we have to decide about the applications of a transistor certain question arises. Some of these are – how much amplification gets from it? What is the highest frequency upto which it can be used? How much power output could we get from it? And what should be the values of different components used in the circuits? The answers to these entire questions lie in the electrical properties of the transistor. These properties depend on the size, manufacturing techniques and materials used in the manufacturer of transistor and are know as characteristics. Transistor manufacturers give these characteristics in the data sheets published by them.

- Current gain factor 'alpha' (α)
- Current gain factor 'beta' (β)
- Input resistance (Rin)
- Output resistance (Rout)
- Cut-off frequency (F α and Fβ)
- Leakage current (I 'co)
- Maximum permissible limits:

1. Maximum collector voltage (V_{ceo})
2. Maximum emitter current (IC Max)
3. Maximum Power dissipation (P max)

V. RELAY:



A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly drive an electric motor is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

➢ BASIC DESIGN AND OPERATION:

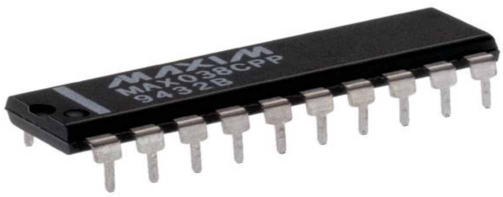
A simple electromagnetic relay consists of a coil of wire surrounding a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts (there are two in the relay pictured). The armature is hinged to the yoke and mechanically linked to one or more sets of moving contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit board (PCB) via the yoke, which is soldered to the PCB.

When an electric current is passed through the coil it generates a magnetic field that attracts the armature, and the consequent movement of the movable contact(s) either makes or breaks (depending upon construction) a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low-voltage application this reduces noise; in a high voltage or current application it reduces arcing.

When the coil is energized with direct current, a diode is often placed across the coil to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a voltage spike dangerous to semiconductor circuit components. Some automotive relays include a diode inside the relay case. Alternatively, a contact protection network consisting of a capacitor and resistor in series (snubber circuit) may absorb the surge. If the coil is designed to be energized with alternating current (AC), a small copper "shading ring" can be crimped to the end of the solenoid, creating a small out-of-phase current which increases the minimum pull on the armature during the AC cycle.[1]

A solid-state relay uses a thyristor or other solid-state switching device, activated by the control signal, to switch the controlled load, instead of a solenoid. An optocoupler (a light-emitting diode (LED) coupled with a photo transistor) can be used to isolate control and controlled circuits.

➢ Introduction to Integrated Circuits:



All modern digital systems rely on the use of integrated circuits in which hundreds of thousands of components are fabricated on a single chip of silicon. A relative measure of the number of individual semiconductor devices within the chip is given by referring to its 'scale of integration'. The following terminology is commonly applied.

Scale of integration	Abbreviation	Number of logic gates
Small	SSI	1 to 10
Medium	MSI	10 to 100
Large	LSI	100 to 1000
Very large	VLSI	1000 to 10,000
Super large	SLSI	10,000 to 100,000

- **Encapsulation:**

The most common package used to encapsulate an integrated circuit, and that with which most reader will be familiar, is the plastic dual-in-line (DIL) type. These are available with a differing number of pins depending upon the complexity of the integrated circuit in question and, in particular, the need to provide external connections to the device. Conventional logic gates, for example, are often supplied in 14-pin or 16-pin DIL packages, whilst microprocessors (and their more complex support devices) often require 40-pins or more.

- **Identification:**

When delving into an unfamiliar piece of equipment, one of the most common problems is that of identifying the integrated circuit devices. To aid us in this task, manufacturers provide some coding on the upper surface of each chip. Such a coding generally includes the type number of the chip (including some of the generic coding), the manufacturer's name (usually in the form of prefix letters), and the classification of the device (in the form of a prefix, infix or suffix).

In many cases the coding is further extended to indicate such things as encapsulation, date of manufacture, and any special characteristics of the device. Unfortunately, all of this potentially useful information often leads to some considerable confusion due to inconsistencies in marking from one manufacturer to the next!

➢ Logic Families:

The integrated circuit device on which modern digital circuitry depends belongs to one or other of several ‘logic families’. The term simply describes the type of semiconductor technology employed in the fabrication of the integrated circuit. This technology is instrumental in determining the characteristics of a particular device. This, however, is quite different from its characteristics, and encompasses such important criteria as supply voltage, power dissipation, switching speed and immunity to noise.

The most popular logic families, at least as far as the more basic general purpose devices are concerned, are complementary metal oxide semiconductor (CMOS) and transistor transistor logic (TTL). TTL also has a number of sub-families including the popular low power Schottky (LS-TTL) variants.

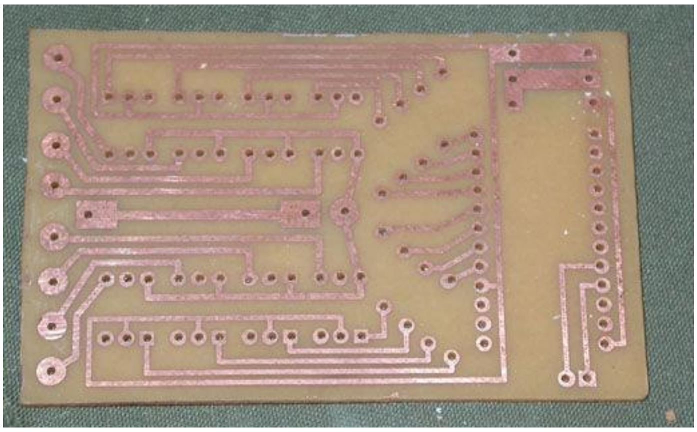
The most common range of conventional TTL logic devices is known as the ‘74’ series. These devices are, not surprisingly, distinguished by the prefix number 74 in their coding. Thus, devices coded with the numbers 7400, 7408, 7432 and 74121 are all members of this family which is often referred to as ‘Standard TTL’. Low power Schottky variants of these devices are distinguished by an LS infix. The coding would then be 74LS00, 74LS08, 74LS32 and 74LS121.

Popular CMOS devices from part of the ‘4000’ series and are coded with an initial prefix of 4. Thus 4001, 4174, 4501 and 4574 are all CMOS devices. CMOS devices are sometimes also given a suffix letter; A to denote the ‘original’ (now obsolete) unbuffered series, and B to denote the improved (buffered) series. A UB suffix denotes an unbuffered B-series device.

Infix letters	Meaning
C	CMOS version of a corresponding TTL device
F	‘Fast’ – a high speed version of the device
H	High speed version

VI. PCB DESIGNING & SOLDERING TECHNIQUES

PCB DESIGNING:



1. Design your circuit board. Use PCB computer-aided design (CAD) software to draw your circuit board. You can also use a perforated board that has pre-drilled holes in it to help you see how your circuit board's components would be placed and work in reality.
2. Buy a plain board that is coated with a fine layer of copper on one side from a retailer.
3. Scrub the board with a scouring pad and water to make sure the copper is clean. Let the board dry.
4. Print your circuit board's design onto the dull side of a sheet of blue transfer paper. Make sure the design is oriented correctly for transfer.
5. Place the blue transfer paper on the board with the circuit board's printed design against the copper.
6. Lay a sheet of ordinary white paper over the blue paper. Following the transfer paper's instructions, iron over the white and blue paper to transfer the design onto the copper board. Iron every design detail that appears near an edge or corner of the board with the tip of the iron.
7. Let the board and blue paper cool. Peel the blue paper slowly away from the board to see the transferred design.
8. Examine the transfer paper to check for any black toner from the printed design that failed to transfer to the copper board. Make sure the board's design is oriented correctly.
9. Replace any missing toner on the board with ink from a black permanent marker. Allow the ink to dry for a few hours.
10. Remove exposed parts of the copper from the board using ferric chloride in a process called etching.
11. Put on old clothes, gloves and safety goggles.

12. Warm the ferric chloride stored in a non-corrosive jar and sealed with a non-corrosive lid, in a bucket of warm water. Do not heat it above 115 F (46 C) to prevent toxic fumes from being released.
13. Pour only enough ferric chloride to fill a plastic tray that has plastic risers in it to rest the circuit board on. Be sure to do this in a well-ventilated space.
14. Use plastic tongs to lay the circuit board face down on the risers in the tray. Allow 5 to 20 minutes, depending on the size of your circuit board, for the exposed copper to drop off the board as it etches away. Use the plastic tongs to agitate the board and tray to allow for faster etching if necessary.
15. Wash all the etching equipment and the circuit board thoroughly with plenty of running water.
16. Drill 0.03-inch (0.8 mm) lead component holes into your circuit board with high-speed steel or carbide drill bits. Wear safety goggles and a protective mask to protect your eyes and lungs while you drill.
17. Scrub the board clean with a scouring pad and running water. Add your board's electrical components and solder them into place.