ON BOARD VOICE RECOGNITION BASED HOME AUTOMATION

A
Report Submitted
In Partial Fulfillment of the Requirements
For the Degree of

BACHELOR OF TECHNOLOGY

in
Electronics and Communication Department

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May, 2017

CERTIFICATE

It is certified that the work contained in this Project entitled **"On board voice recognition based home automation"** by, Srishti Tiwari(1130434047), Shilpi Gangwar(1130434042), Abhishek Pandey(1120434002), Aman Awasthi(1130434005) from Babu Banarasi Das University has been carried out under my supervision.

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ABSTRACT

Home Automation industry is growing rapidly; this is fuelled by the need to provide supporting systems for the elderly and the disabled, especially those who live alone. Coupled with this, the world population is confirmed to be getting older. Home automation systems must comply with the household standards and convenience of usage. This paper details the overall design of a wireless home automation system (WHAS) which has been built and implemented. The automation centres on recognition of voice commands and uses low-power RF VRM wireless communication modules which are relatively costly. The home automation system is intended to control all lights and electrical appliances in a home or office using voice commands. The system has been tested and verified. The verification tests included voice recognition response test, indoor communication test, and the compression and decompression tests of DPCM (Differential Pulse Code Modulation) speech signals. The tests involved a mix of 35 male and female subjects with different English accents. 35 different voice commands were sent by each person. Thus the test involved sending a total of 1225 commands and 79.8% of these commands were recognised correctly.

The module could recognize your voice. It receives configuration commands or responds through serial port interface. With this module, we can control the car or other electrical devices by voice.

This module can store up to 15 pieces of voice instruction. Those 15 pieces are divided into 3 groups, with 5 in each group. First we should train the module with voice instructions group by group. After that, we should import one group before it could recognize the 5 voice instructions within that group. If we need to implement instructions in other groups, we should import the group first. This module is speaker dependent. If you trained the module, your friend might not be able to make it work.

ACKNOWLEDGEMENT

Whenever a module of work is completed successfully, a source of inspiration and guidance is always there for the student. I, hereby take the opportunity to thank those entire people who helped me in many different ways.

First and foremost, I am grateful to my thesis guide **(Assistant Professor) Mr. Ankit Dalela,** B.B.D. University, for showing faith in my capability and providing able guidance and his generosity and advice extended to me throughout my thesis.

Last, but not least I would like to thank all my faculty and my friends for helping me in all measure of life and for their kind cooperation and moral support.

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CHAPTER-1

INTRODUCTION

In this project it understands whatever commands you set the Say – it module up to use, and speaks to you with various prompts, responses, etc, and of course, it turns stuff on and off. The motivation for this was the number of times that we have gone to bed only to realize that appliances from on to off condition that will be removed. In this project with the help of voice recognition module the user can switch on or off the either ac or dc supply considering the switches.

We have designed an affordable and simple to use system that takes the input from the voice recognition module and uses the microcontroller's intelligence to operate different devices.

We require the intelligence of a microcontroller to control the devices and home appliances. There are various existing technologies available for similar purposes but their cost and complexity is major disadvantage.

Fig. 1.1(a)

Functional block diagram of Voice recognition module based home automation

Caring for and supporting this growing population is a concern for governments and nations around the globe. Home automation is one of the major growing industries that can change the way people live. Some of these home automation systems target those seeking luxury and sophisticated home automation platforms; others target those with special needs like the elderly and the disabled. The aim of the reported Wireless Home Automation System (WHAS) is to provide those with special needs with a system that can respond to voice commands and control the on/off status of electrical devices, such as lamps, fans, television etc, in the home. The system should be reasonably cheap, easy to configure, and easy to run.

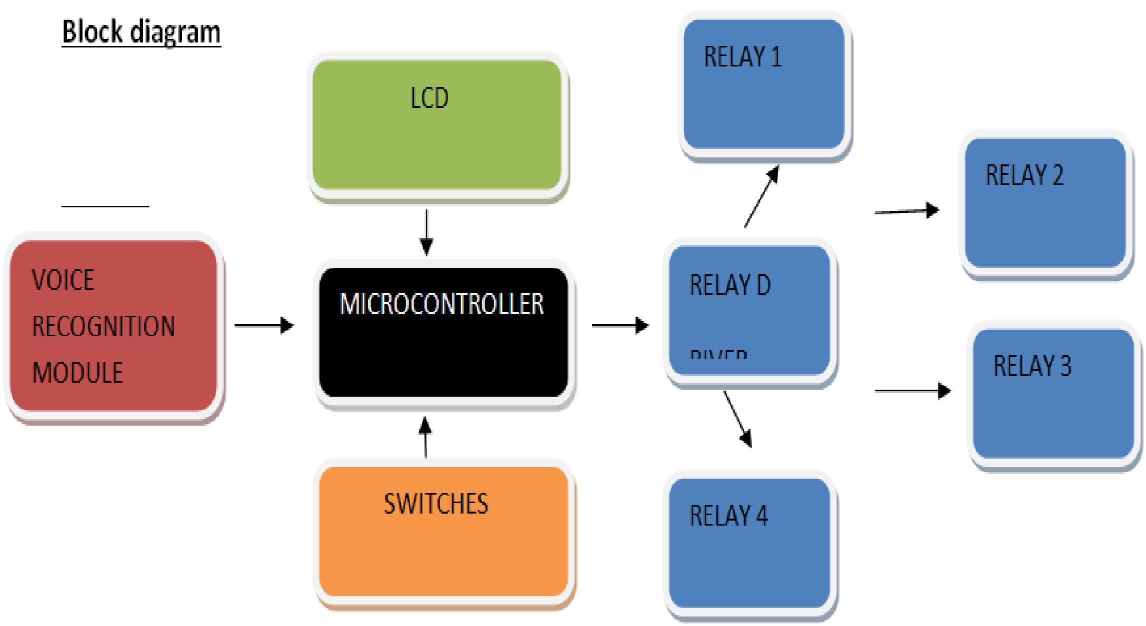


Fig 1.1(b)

Block diagram of voice recognition module based home automation

CHAPTER-2

EQUIPMENTS AND PCB DESGINING

2.1 EQUIPMENTS:

The different major equipments used in system are enlisted below:

a) VOICE RECOGNITION MODULE

b) IC ATMEGA168

c) LCD 16X2

d) ULN2803

e) RELAY

2.1.1 VOICE RECOGNITION HOME AUTOMATION:

INTRODUCTION

The module could recognize your voice. It receives configuration commands or responds through serial port interface. With this module, we can control the car or other electrical devices by voice.

This module can store up to 15 pieces of voice instruction. Those 15 pieces are divided into 3 groups, with 5 in each group. First we should train the module with voice instructions group by group. After that, we should import one group before it could recognize the 5 voice instructions within that group. If we need to implement instructions in other groups, we should import the group first. This module is speaker dependent. If you trained the module, your friend might not be able to make it work.

We've updated this module to V2. We made V2 easy to control. Except only serial input or output of V1, V2 has other useful ways to control and output the result.

You could find a new GOPI row on V2. GCH and GCL are used to import the voice group. And O1~O5 are pins which output the result of voice recognition. For example, if the first voice instruction in the working group is recognized, O1 could output HIGH signal. This output sometimes is very useful, such as while controlling the relay.

The O1~O5 output could be set as many type. You could set it by sending command to it through serial interface. Those setting will be recorded in memory. It will not lose even with power off. You could find the commands in later content.

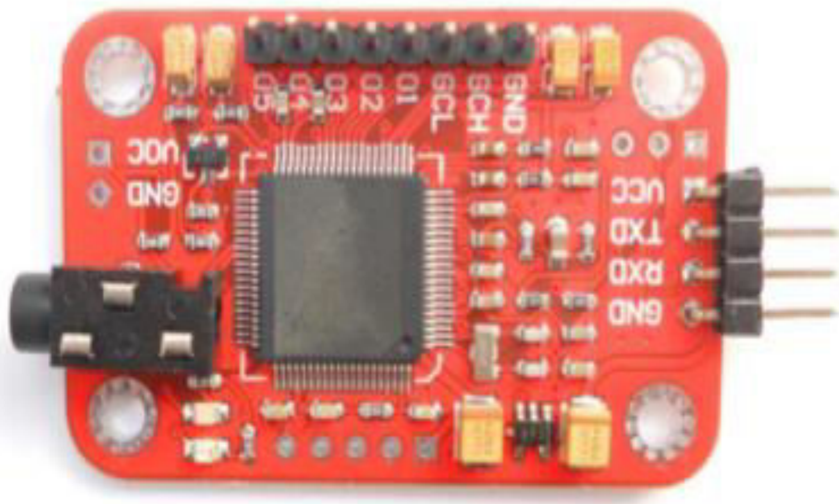


Fig 2.1.1(a)

Voice Recognition Module

Parameters of VRM are-

- Voltage: 4.5-5.5V
- Current: 40mA
- Digital Interface: 5V TTL level UART interface and GPIO
- Analog Interface: 3.5mm mono-channel microphone connector + microphone pin interface
- Size: 30mm x 47.5mm
- Recognition accuracy: 99%(under ideal environment)

Recording stage:

1. Record indication: D1 (RED) flashes 3 times within the 600ms, then off for400ms, and then flashes quickly for 4 times within 600ms. Now the recording indication is over.

2. Begin to speak: D1 (RED) is off for 400ms, and then is on. Voice during the time while D1 (RED) is on will be recorded by this module.

3. Recording a voice instruction successfully for the first time: D1 (RED) off, D2 (ORANGE) on for 300ms.

4. Recording a voice instruction successfully for the first time: D1 (RED) off, D2 (ORANGE) on for 700ms.

5. Recording failure: D2 (ORANGE) flashes 4 times within the 600ms. In cases that voice instructions detected twice don't match, or the sound is too large, or there is no sound, recording will fail. You need to start over the recording process for that instruction.

Waiting mode:

In waiting mode, D2 (ORANGE) is off, and D1 (RED) is on for 80ms every other 200ms, fast flashing. In this mode, it doesn't recognize voice command, only waiting for serial commands.

Recognition stage:

In identification stage, D2 (ORANGE) is off, and D1 (RED) is on for 100ms every other 1500ms, slow flashing. In this stage, this module is processing received voice signal, and if matching, it will send the result immediately via serial port.

Recording Process:

Before using it, we have train it by recording voice instructions. Each voice instruction has the maximum length of 1300ms, which ensures that most words can be recorded. Once you start recording, you can't stop the recording process until you finish all the 5 voice instructions recording of one group. Also, once you start recording, the previous voice instructions in that group will be erased. In training state, this module doesn't reply to any other serial commands.

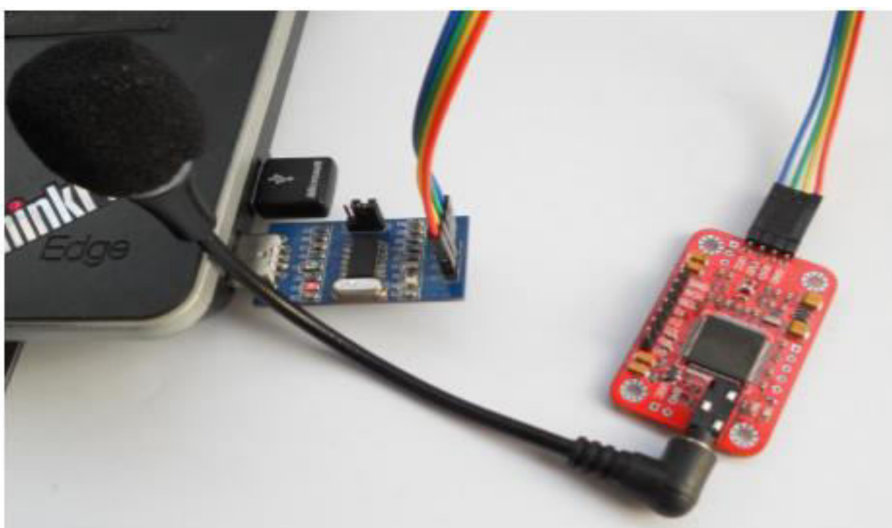


Fig 2.1.1(b) VRM Recording process

Process-

START

No voice // I did not make any sound. So it replied such message

START

Speak now

Again

START

Speak again now

Different // I spoke another words for the second time. So it replied such message

START

Speak now

Again

START

Speak again now

Finish one // recording one instruction successfully

START

Again

START

Finish one

START

Again

START

Finish one

START

Again

START

Finish one

START

Again

START

Finish one

Group1 finished! // recording group 1 successfully

By now, you've finished instruction recording for group 1.

Recognition:

We added another way to import the voice instruction group on V2. For V1, the only way is to send command to it through serial port, for example:

- Send command 0xAA21 to import group 1.
- Send command 0xAA22 to import group 2.
- Send command 0xAA23 to import group 3.

On V2, we added an easy way to import the group:

Look at the following picture, you could control GCH and GCL pins. Those two pins are all 5V TTL.

GCH	GCL	Working state
LOW	LOW	No Change
LOW	HIGH	Import Group2
HIGH	LOW	Import Group1
HIGH	HIGH	Import Group3

Table no. 1.1

Operation table of Voice recognition module

Once the group is important, it will output message through serial port. It could have 15 voice instructions in 3 groups. Each time you need to import the group before it could recognize instructions in that group. That means, this module could recognize 5 voice instructions at the same time. In recognition stage, this module could receive other serial commands. It will not exit the recognition stage until you send 0xAA00, or delete that group, or begin recording instructions.

2.1.2 IC ATMEGA 168

INTRODUCTION

The computer on one hand is designed to perform all the general purpose tasks on a single machine like you can use a computer to run a software to perform calculations or you can use a computer to store some multimedia file or to access internet through the browser, whereas the microcontrollers are meant to perform only the specific tasks, for e.g., switching the AC off automatically when room temperature drops to a certain defined limit and again turning it ON when temperature rises above the defined limit.

There are number of popular families of microcontrollers which are used in different applications as per their capability and feasibility to perform the desired task, most common of these are 8051, AVR and PIC microcontrollers. In this we will introduce you with AVR family of microcontrollers.

The Atmel ATmega48/88/168 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega48/88/168 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

The Atmel ATmega48/88/168 provides the following features: 4K/8K/16K bytes of In-System Programmable Flash with Read-While-Write capabilities, 256/512/512 bytes EEPROM, 512/1K/1K bytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption.

The ATmega48, ATmega88 and ATmega168 differ only in memory sizes, boot loader support, and interrupt vector sizes. Table 2-1 summarizes the different memory and interrupts vector sizes for the three devices.

PROCESSOR ARCHITECTURE

AVR follows Harvard Architecture format in which the processor is equipped with separate memories and buses for Program and the Data information. Here while an instruction is being executed, the next instruction is pre-fetched from the program memory.

ALU: The high-performance AVR ALU operates in direct connection with all the 32 general purpose working registers. Within a single clock cycle, arithmetic operations between general purpose registers or between a register and an immediate are executed. The ALU operations are divided into three main categories – arithmetic, logical, and bit-functions. Some implementations of the architecture also provide a powerful multiplier supporting both signed/unsigned multiplication and fractional format.

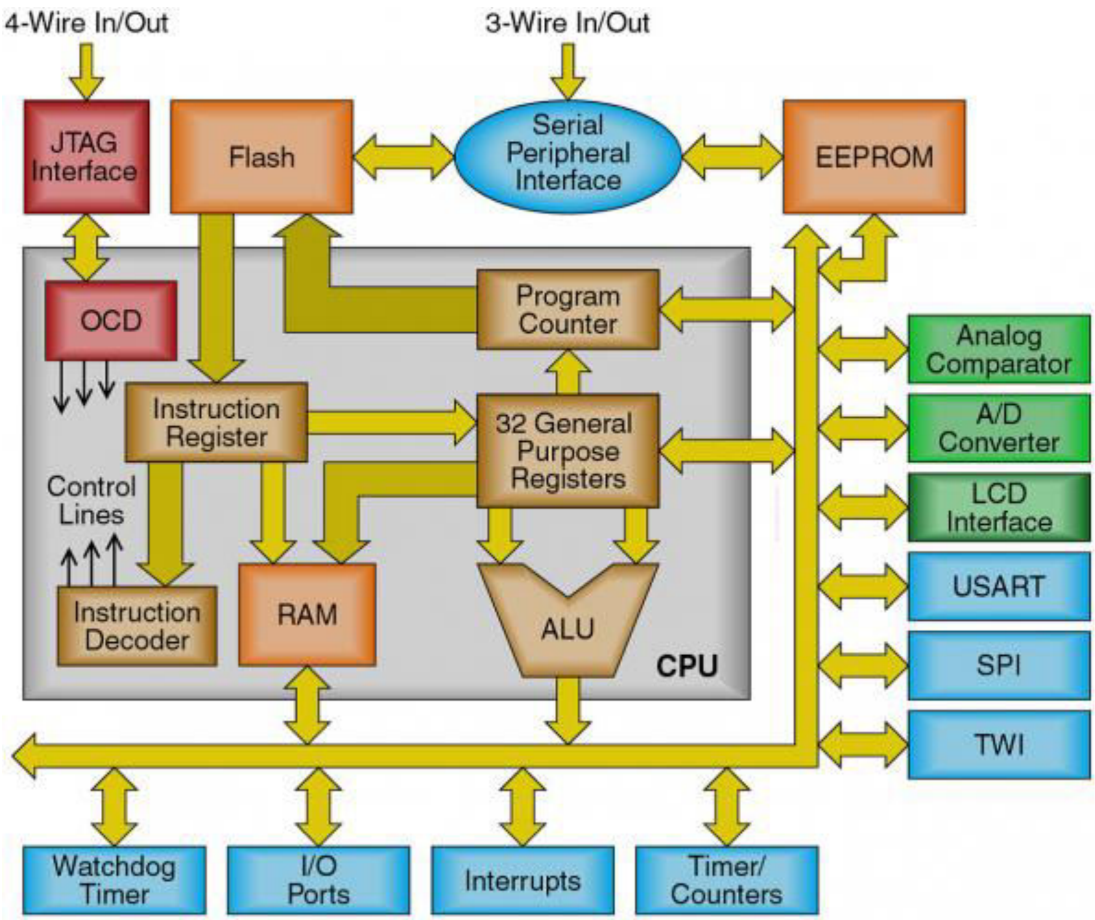


Fig.2.1.2(a)

Internal Architecture of IC Atmega 168

IN-SYSTEM REPROGRAMMABLE FLASH PROGRAM MEMORY: The ATmega48/88/168 contains 4K/8K/16K bytes On-chip In-System Reprogrammable Flash memory for program storage. Since all AVR instructions are 16 or 32 bits wide, the Flash is organized as 2K/4K/8K × 16. For software security, the Flash Program memory space is divided into two sections, Boot Loader Section and Application Program Section in ATmega88 and ATmega168.

EEPROM DATA MEMORY: The Atmel ATmega48 /88/168 contains 256/512/512 bytes of data EEPROM memory. It is organized as a separate data space e, in which single bytes can be read and written. The EEPROM has an endurance of at least 100,000 write/erase cycles. The access between the

EEPROM and the CPU is described in the following, specifying the EEPROM Address Registers, the EEPROM Data Register, and the EEPROM Control Register.

PROGRAM COUNTER: A program counter is a register in a computer processor that contains the address (location) of the instruction being executed at the current time. As each instruction gets fetched, the program counter increases its stored value by 1. After each instruction is fetched, the program counter points to the next instruction in the sequence. When the computer restarts or is reset, the program counter normally reverts to 0. In computing, a program is a specific set of ordered operations for a computer to perform. An instruction is an order given to a computer processor by a program. Within a computer, an address is a specific location in memory or storage. A register is one of a small set of data holding places that the processor uses. Program counter is very important feature in the microcontrollers.

RAM: RAM stands for random access memory. This type of memory storage is temporary and volatile. You might have heard that if your system is working slowly you say that increase the RAM processing will increase. Let us understand in detail. Let us consider two cases to execute a task first the complete task is execute at one place(A), second the task is distributed in parts and the small tasks are executed at different places(A,B C)and finally assembled. It is clear the work will be finished in second case earlier. The A, B, C basically represent different address allocation for temporary processing. This is the case with RAM also if you increase the RAM the address basically increases for temporary processing so that no data has to wait for its turn. On major importance of the RAM is address allocations. However the storage is temporary every time u boot your system the data is lost but when you turn on the system The BIOS fetch number of addresses available in the RAM. This memory supports read as well as write operations both.

INSTRUCTION EXECUTION SECTION (IES): It has the most important unit—instruction register and instruction decoder to control the flow of the instruction during the processing’s.

INPUT/OUTPUT PORTS: To interact with the physical environment there are different input and output ports in every system like in PC we have VGA port to connect the monitor, USB port for flash memory connections and many more ports. Similarly ATMEGA 168 has its input and output ports with different configurations depending on the architecture like only input, only output and bi-directional input output ports. The accessing of this port is referred as input output interface design for microcontrollers. IT has analog input port, analog output port, digital input port ,digital output port, serial communication pins, timer execution pins etc.

ANALOG COMPARATOR & A/D CONVERTERS: The major question is that how a controller manage to detect variation of voltage in-spite it could not understand the voltage but understand only digital sequence

Most of the physical quantities around us are continuous. By continuous we mean that the quantity can take any value between two extreme. For example the atmospheric temperature can take any value (within certain range). If an electrical quantity is made to vary directly in proportion to this value (temperature etc) then what we have is Analogue signal. Now we have we have brought a physical quantity into electrical domain. The electrical quantity in most case is voltage. To bring this quantity into digital domain we have to convert this into digital form. For this a ADC or analog to digital converter is needed. Most modern MCU including AVRs has an ADC on chip. An ADC converts an input voltage into a number. An ADC has a resolution. A 10 Bit ADC has a range of 0-1023. (2^10=1024) The ADC also has a Reference voltage (ARef). When input voltage is GND the output is 0 and when input voltage is equal to ARef the output is 1023. So the input range is 0-ARef and digital output is 0-1023.

- **INBUILT ADC OF AVR**

The ADC is multiplexed with PORTA that means the ADC channels are shared with PORTA. The ADC can be operated in single conversion and free running more. In single conversion mode the ADC does the conversion and then stop. While in free it is continuously converting. It does a conversion and then start next conversion immediately after that.

- **ADC PRE-SCALAR**

The ADC needs a clock pulse to do its conversion. This clock generated by system clock by dividing it to get smaller frequency. The ADC requires a frequency between 50 KHz to 200 KHz. At higher frequency the conversion is fast while a lower frequency the conversion is more accurate. As the system frequency can be set to any value by the user (using internal or externals oscillators) (In board™ a 16MHz crystal is used). So the Pre-scalar is provided to produces acceptable frequency for ADC from any system clock frequency. System clock can be divided by 2, 4,16,32,64,128 by setting the Pre-scalar.

- **ADC CHANNELS**

The ADC in ATmega328 has 6 channels that mean we can take samples from eight different terminals. We can connect up to 8 different sensors and get their values separately.

PIN DESCRIPTION:

VCC: Digital supply voltage.

GND: Ground.

Port B (PB7:0) XTAL1/XTAL2/TOSC1/TOSC2

Port B is an 8-bit bi-directional I/O port with internal pull- up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source Capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit. Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier. If the Internal Calibrated RC Oscillator is used as chip clock source, PB7.6 is used as TOSC2.1 input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

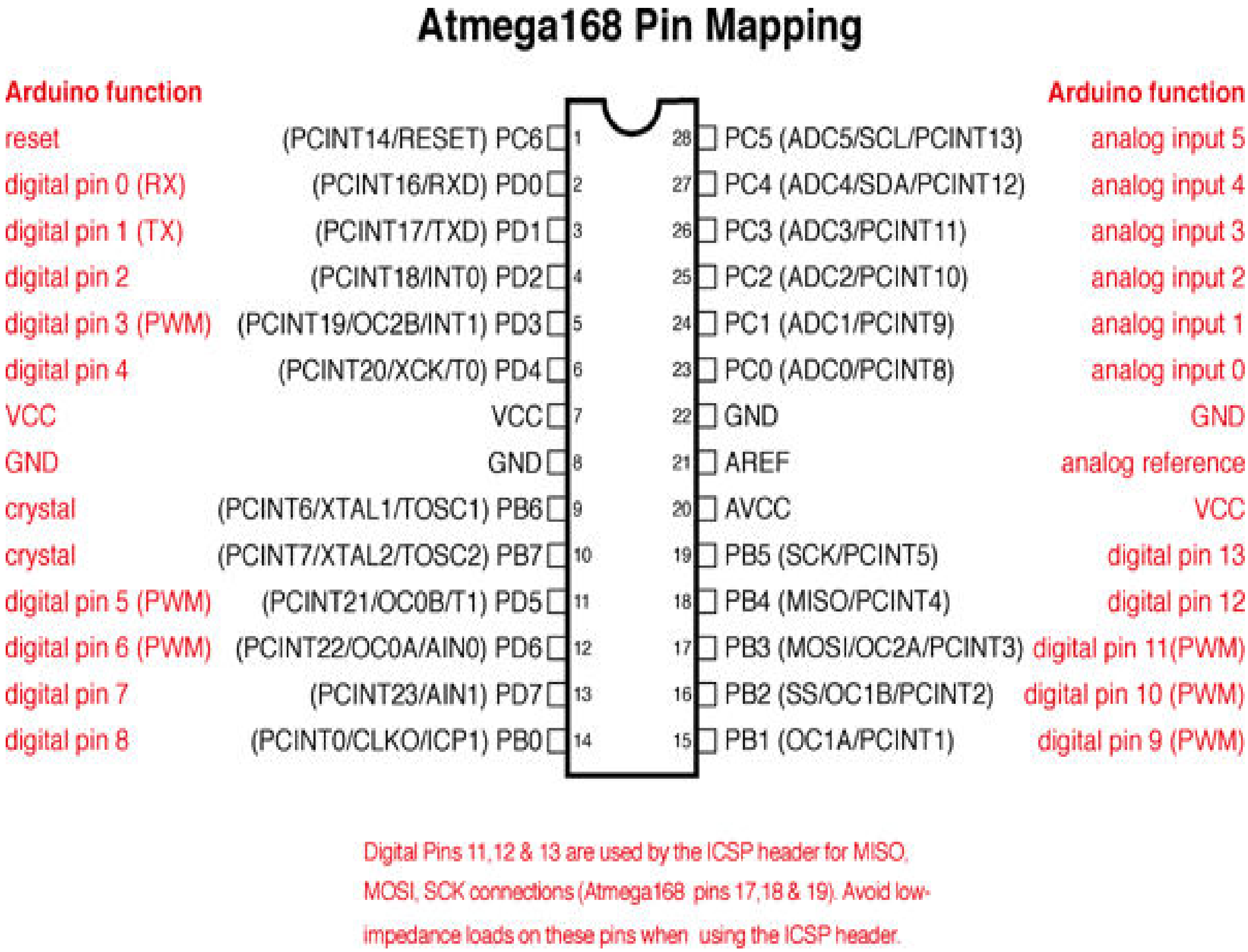


Fig 2.1.2(b)

Pin diagram of IC Atmega 168

Port C (PC5:0)

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC5.0 output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

PC6/RESET:

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C. If the RSTDISBL Fuse is un-programmed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running. Shorter pulses are not guarantee to generate a reset.

Port D (PD7:0):

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

AVCC:

AVCC is the supply voltage pin for the A/D Converter PC3:0, and ADC7:6. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC6.4 use digital supply voltage, VCC.

AREF: AREF is the analog reference pin for the A/D Converter.

2.1.3 LCD 16X2

INTRODUCTION

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.

LCD INTERFACE DIAGRAM

This is the connection diagram of LCD in 4-bit mode, where we only need 6 pins to interface an LCD. D4-D7 is the data pins connection and Enable and Register select are for LCD control pins. We are not using Read/Write (RW) Pin of the LCD, as we are only writing on the LCD so we have made it grounded permanently. If someone wants to use it, then he may connect it on his controller but that will only increase another pin and does not make any big difference. Potentiometer RV1 is used to control the LCD contrast. The unwanted data pins of LCD i.e. D0-D3 are connected to ground.

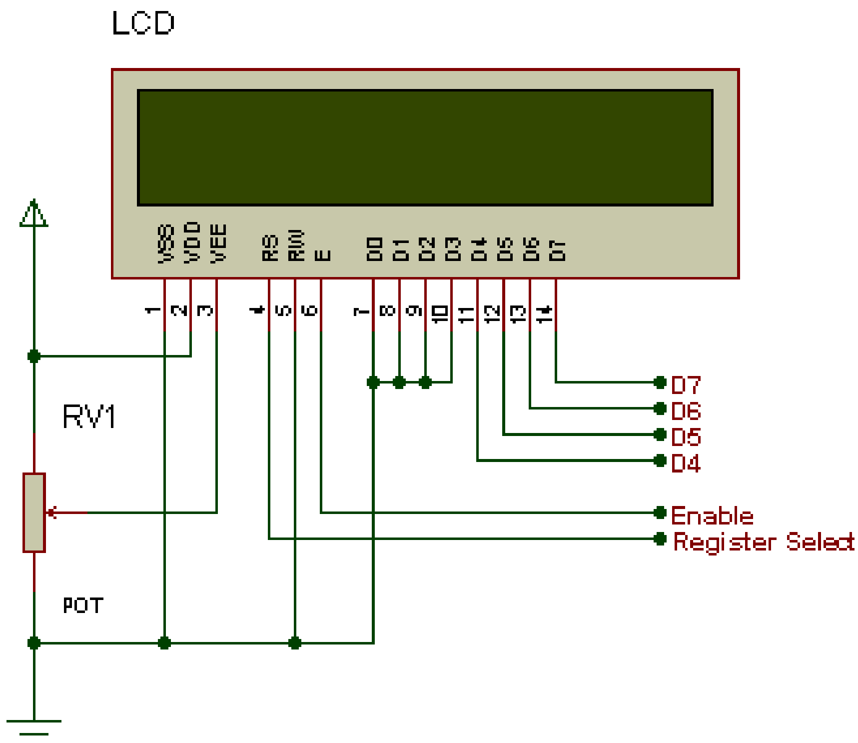


Fig. 2.1.3

Interfacing Diagram of LCD 16x2

2.1.4 ULN 2803

The eight NPN Darlington connected transistors in this family of arrays are ideally suited for interfacing between low logic level digital circuitry (such as TTL, CMOS or PMOS/NMOS) and the higher current/voltage requirements of lamps, relays, printer hammers or other similar loads

for a broad range of computer, industrial, and consumer applications. All devices feature open–collector outputs and freewheeling clamp diodes for transient Suppression. The ULN2803 is designed to be compatible with standard TTL families while the ULN2804 is optimized for 6 to 15 volt high level CMOS or PMOS.

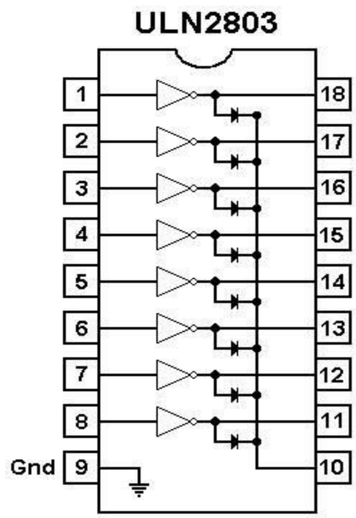


Fig.2.1.4(a)

Internal structure of ULN2803

NEED OF USING THIS IC

The major advantage of using this IC is that it can fulfill the need for high voltage and high current also. This is enabled through a low voltage and low current source to give high voltage and high current output.

PIN 1-8 is the input with low voltage low current and 18-11 corresponding output with high voltage and high current. The high voltage is configured on pin 10 (keeping in mind maximum output voltage of this IC). The current is also increased due to in-built Darlington Pair.

DARLINGTON PAIR

This is two transistors connected together so that the current amplified by the first is amplified further by the second transistor. The overall current gain is equal to the two individual gain multiplied together: Darlington pair current gain, HFE = hfe1* hfe2 (hfe1 and hfe2 are the gains of the individual transistors).

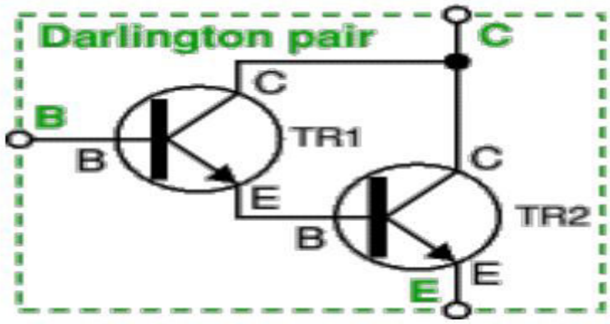


Fig.2.1.4(b)

Darlington pair

This gives the Darlington pair a very high current gain, such as10000, so that only a tiny base current is required to make the pair switch on. A Darlington pair behaves like a single transistor with a very high current gain. It has three leads (B, C and E) which are equivalent to the leads of a standard individual transistor. To turn on there must be 0.7V across both the base-emitter junctions who are connected in series inside the Darlington pair; therefore it requires 1.4V to turn on. Darlington pairs are available as complete packages but you can make up your own from two transistors; TR1 can be a low power type, but normally TR2 will need to be high power. The maximum collector current IC (max) for the pair is the same as IC (max) for TR2.

A Darlington pair is sufficiently sensitive to respond to the small current passed by your skin and it can be used to make a touch-switch as shown in the diagram. For this circuit which just lights an LED the two transistors can be any general purpose low power transistors. The 100kresistor protects the transistors if the contacts are linked with a piece of wire.

2.1.5 RELAY

INTRODUCTION

Relays are electromechanical switches. Relays are used throughout the automobile. Relays which come in assorted sizes, ratings, and applications, are used as remote control switches that are controlled by another switch, such as a horn switch or acomputer as in power train control module. Relays allow a small current flow circuit to control a higher current circuit.

Fig.2.1.5(a)

Relay

RELAY OPERATION

1) **FOR FOUR PIN RELAY**

All relays operate using the same basic principle. The e.g. will use a commonly used 4-pin relay. Relays have two circuits: A control circuit (shown in GREEN) and a load circuit (shown in RED).The control circuit has small control coil while the load circuit has a switch. The coil controls the operation of the switch.

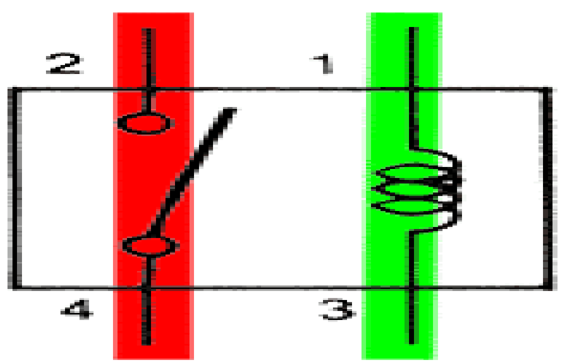


Fig.2.1.5(b)

Load circuit and control circuit of relay

- **RELAY ENERGIZED (ON):** Current flowing through the control circuit coil (pins1 & 3) creates a small magnetic field which causes the switch to close, pins 2 & 4. The switch, which is a part of the load circuit, is used to control an electrical circuit that may connect to it. Current now flows through pins 2 & 4 shown in Red, when the relay in energized.

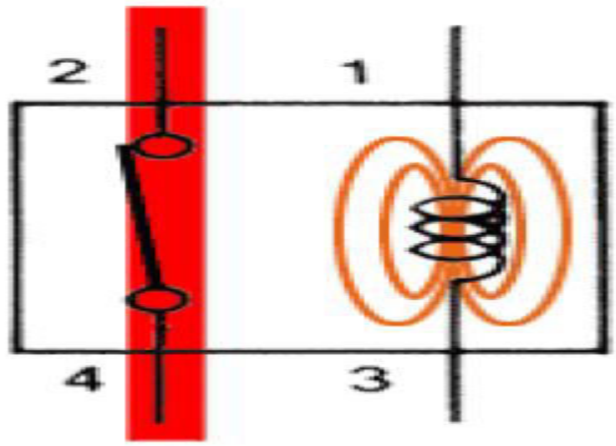


Fig. 2.1.5(c)

Pin 2 and 4 connected due to induced magnetic field

- **RELAY DE-ENERGIZED (OFF):** When current stops flowing through the control circuit, pins 1 & 3, the relay becomes de-energized. Without the magnetic field, the switch opens and current is prevented from flowing through pins 2 & 4. The relay is now off.

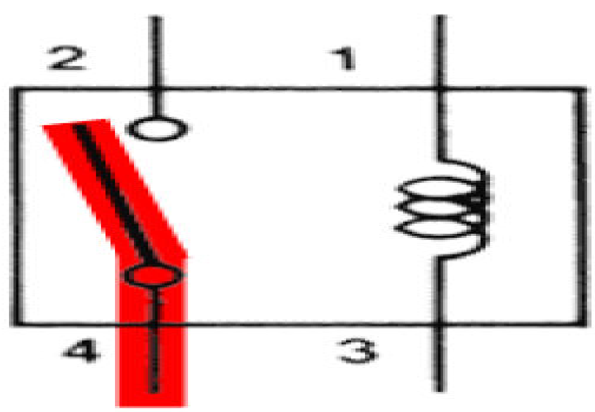


Fig. 2.1.5(d)

Relay showing no connection between pin 2 & 4

2) FOR FIVE PIN RELAY

When no voltage is applied to pin1, there is no current flow through the coil. No current means no magnetic field is developed, and the switch is open. When voltage is supplied to pin 1, current flow close the switch allowing continuity between pins 2 & 4.

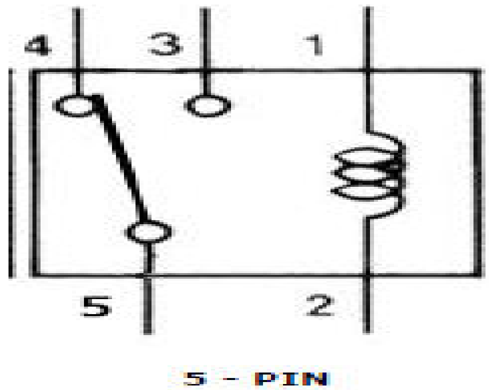


Fig. 2.1.5(e)

Pin relay

Relays are either normally open or normally closed. Notice the position of the switches in the two relays shown below. Normally open relays have a switch that remains open until energized (ON) while normally closed relays are closed until energized. Relays are always shown in the de-energized position (no current flowing through the control circuit - OFF). Normally relays are the most common in vehicles; however either can be use in automotive applications.

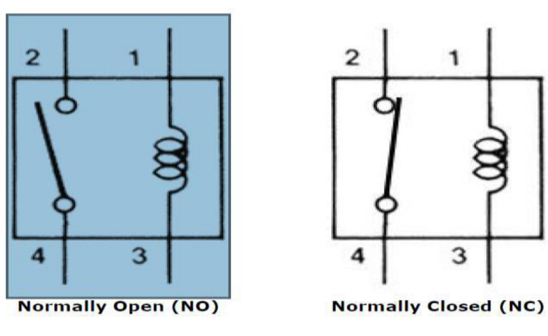


Fig. 2.1.5(f)

Normally open and closed relay

Normally closed relays: The operation of normally closed relay is the same to that of normally open relay, except backwards. In other words, when the relay control coil is NOT energized, the relay switch contacts are closed, completing the circuit through pins 2 & 4. When the control coil is energized, the relay switch contacts opens, which breaks the circuit open and no continuity exist between pins 2 & 4.

2.2 PCB DESIGNING

A printed circuit board, or PCB, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate. It is also referred to as printed wiring board (PWB) or etched wiring board. Printed circuit boards are used in virtually all but the simplest commercially produced electronic devices.

A PCB populated with electronic components is called a printed circuit assembly (PCA), printed circuit board assembly or PCB Assembly (PCBA). In informal use the term "PCB" is used both for bare and assembled boards, the context clarifying the meaning.

Alternatives to PCBs include wire wrap and point-to-point construction. PCBs must initially be designed and laid out, but become cheaper, faster to make, and potentially more reliable for high-volume production since production and soldering of PCBs can be automated. Much of the electronics industry's PCB design, assembly, and quality control needs are set by standards published by the IPC organization.

PCBs are inexpensive, and can be highly reliable. They require much more layout effort and higher initial cost than either wire-wrapped or point-to-point constructed circuits, but are much cheaper and faster for high-volume production. Much of the electronics industry's PCB design, assembly, and quality control needs are set by standards that are published by the IPC organization.

Printed Circuit Boards are primarily an insulating material used as base, into which conductive strips are printed. The base material is generally fiber glass, and the conductive connections are generally copper and are made through an etching process. The main PCB board is called the motherboard; the smaller attachment PCB boards are called daughter boards or daughter cards.

2.2.1 LAYOUT OF THE PROJECT PCB

A PCB layout is required to place components on the PCB so that the component area can be minimized and the components can be placed in an efficient manner. The components can be placed in two ways, either manually or by software. The manual procedure is quiet cumbersome and is very inefficient. The other method is by the use of computer software. This method is advantageous as it saves time and valuable copper area. There are various software's available for this purpose like-

- Express PCB
- Pad2pad
- Protel PCB
- PCB design etc.

Many of them are loaded with auto routing and auto placement facility. The software that we have used here is **EXPRESS PCB.** This software has a good interface, easy editing options and a wide range of components.

EXPRESS P.C.B.

Express PCB is a very easy to use Windows application for laying out printed circuit boards. There are two parts to Express PCB, Express SCH for drawing schematics and Express PCB for designing circuit boards. We downloaded the software from the website **www.expresspcb.com.**

There are lots of functions available in the software. This software is free of cost and it is very easy to use. The different layers of the PCB can be viewed by just a click of a button on the interface. And we easily get its print on paper which is utilized for further processing. We can design single sided PCB as well as Double Sided PCB with this Software.

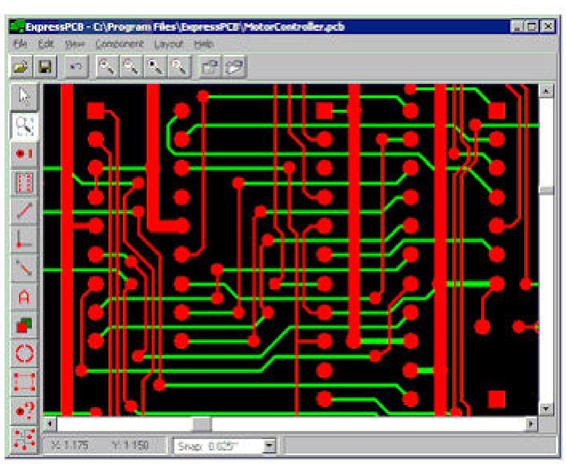


Fig. 2.2.1(a) Software PCB designing

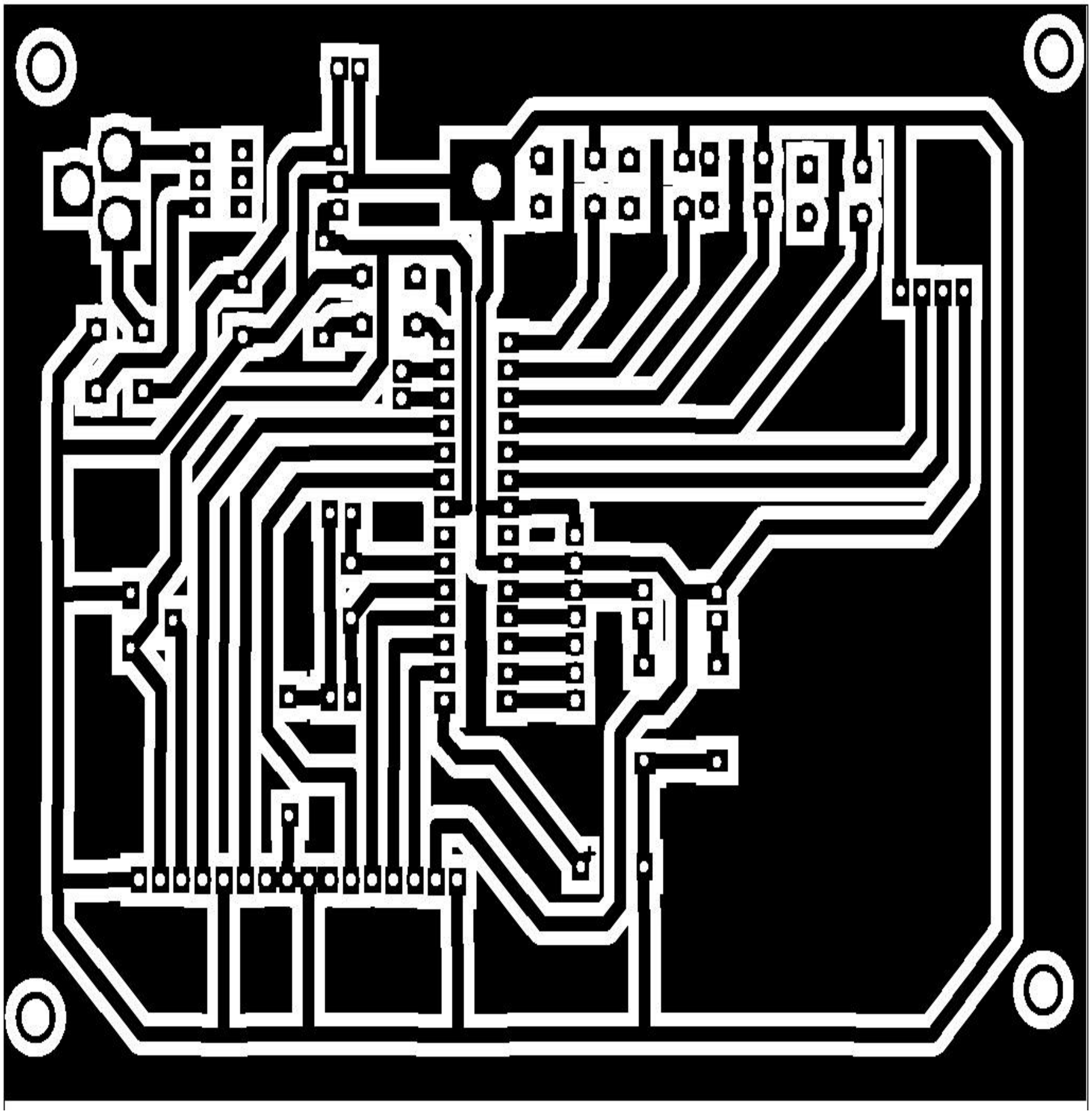


Fig. 2.2.1(b)

Top view of PCB

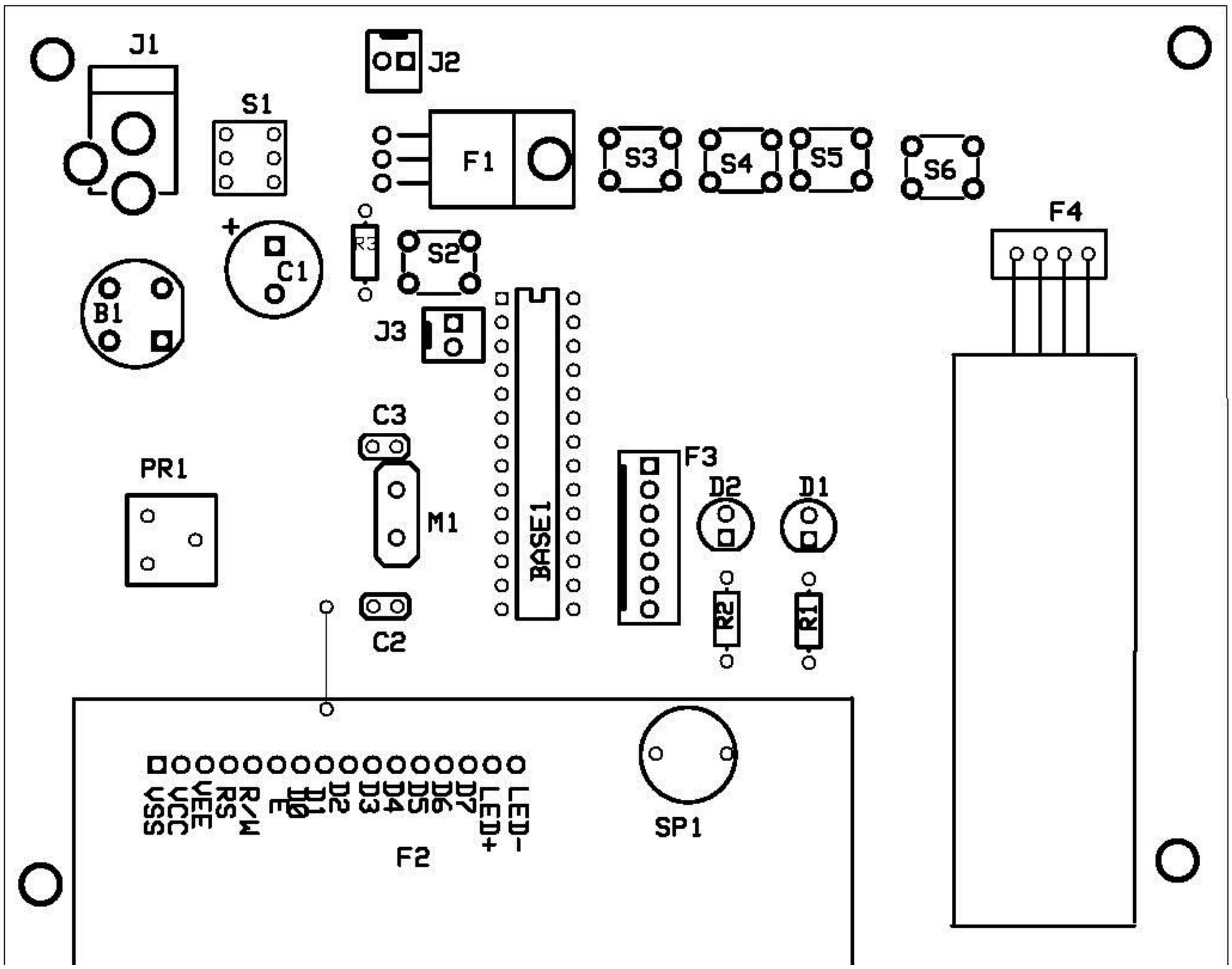


Fig. 2.2.1(c)

Bottom view of PCB

2.2.2 PCB DESINGING AND FABRICATION

PCB Designing includes the following steps:-

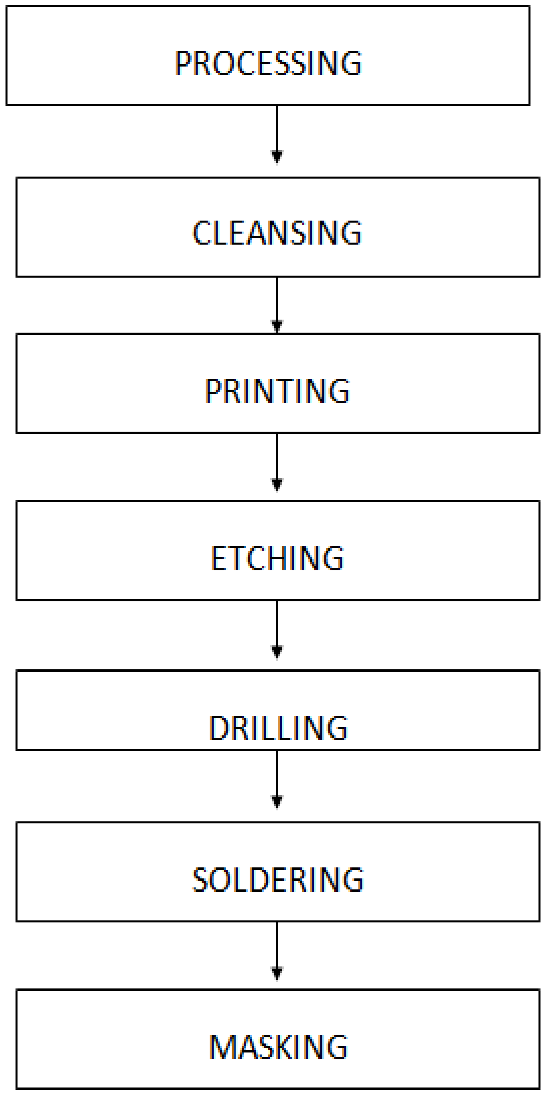


Fig. 2.2.2(a)

Block diagram of PCB designing

2.2.2.1 PROCESSING

The layout of a PCB has to incorporate all the information on the board before one can go on to the artwork preparation. This means that a concept that clearly defines all the details of the circuit and partly also of the final equipment, is a prerequisite before the actual layout can start. The detail circuit diagram is very important for the layout designer and he must also be familiar with the design concept and with the philosophy behind the equipment. The General Considerations are-

a-) LAYOUT SCALE:- Depending on the accuracy required, artwork should be produced at a 1:1 or 2:1 or even 4:1 scale. The layout is best prepared on the same scale as the artwork. This prevents all the problems which might be caused by redrawing of layout to the artwork scale.

b-) GRID SYSTEM OR GRAPH PAPER: - It is commonly accepted practice to use these for designing.

c-) BOARD TYPES:-There are two side of a PCB board – Component side & Solder side. Depending on these board are classified as-

- **SINGLE-SIDED BOARDS**: - These are used where costs have to be kept at a minimum & a particular Circuit can be accommodated on such board. To jump over conductor tracks, components have to be utilized. If this is not feasible, jumper wires are used. (Jumper wires should be less otherwise double-sided PCB should be considered.
- **DOUBLE-SIDED BOARDS**: - These are made with or without plated through holes. Plated through holes are fairly expensive.

2.2.2.2 CLEANING

The cleaning of the copper surface prior to resist application is an essential step for any type of PCB process using etches or plating resist.After scrubbing with the abrasive, a water rinse will remove most of the remaining slurry.

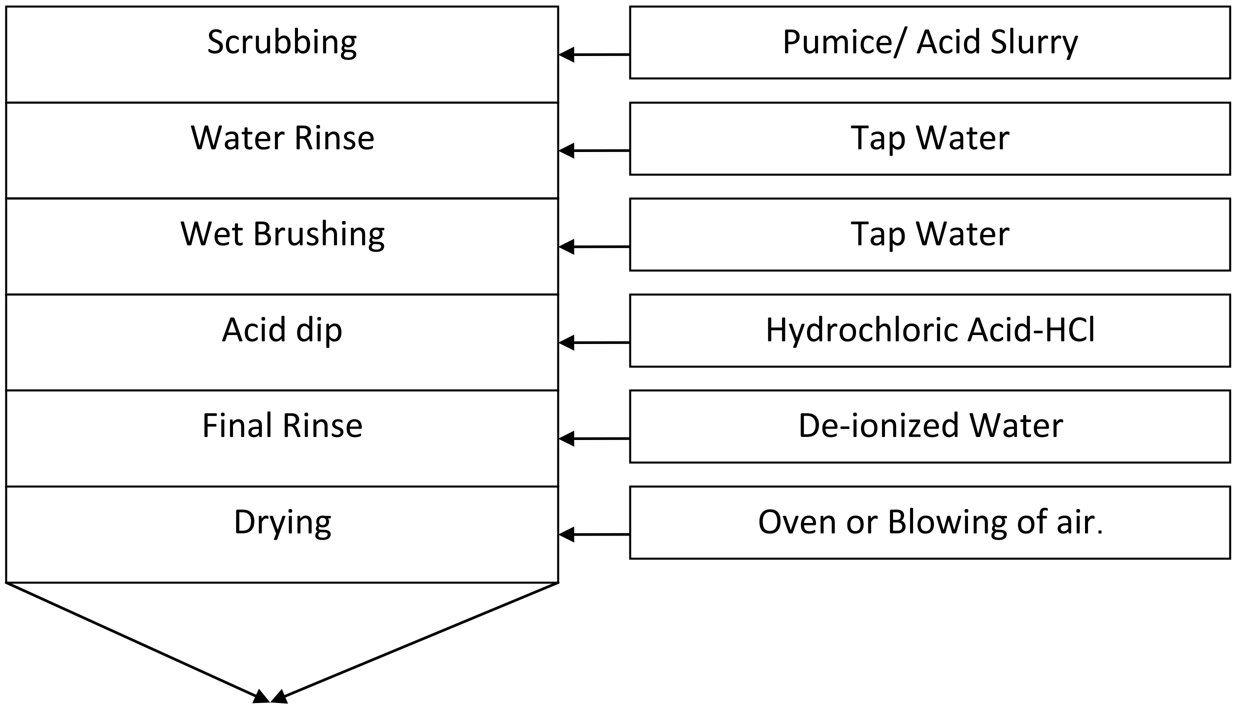


Table no.2.1

PCB cleaning process

2.2.2.3 ETCHING

It is of utmost importance to choose a suitable Etchant Systems. There are many factors to be considered:-

- Etching speed
- Copper solving capacity
- Etchant price
- Pollution character

We have uses $FeCl_3$ (Conc. 120 g/liter 0.1 M) for etching.

2.2.2.4 DRILLING

The importance of hole drilling into PCB's has further gone with electronic component miniaturization and its need for smaller holes diameters (diameters less than half the board thickness) and higher package density.

The following hole diameter tolerances have been generally accepted wherever no other specifications are mentioned.

Hole Diameter (D) <= 1mm ⟶ + / - 0.05 mm

Hole Diameter (D) > 3 mm ⟶ + / – 0.1 mm

2.2.2.5 SOLDERING

Flux should be removed after Soldering. It is done through washing by 0.5—1 % HCl followed by Neutralization in dilute alkali to remove corrosive flux.Non-corrosive is removed by Iso-Propanal.

2.2.2.6 MASKING

It is done for the protection of conductor track from Oxidation.

Masking is an important process in IC fabrication process that is used at every step whether it is doping, oxidation ,metallization and passivization.

CHAPTER 3

COMPONENTS

3.1 VOLTAGE REGULATOR

INTRODUCTION

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

Fig. 3.1(a)

IC7805

Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. The maximum current they can pass also rates them. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current (over load protection) and over-heating (thermal protection). Many of fixed voltage regulator ICs has 3 leads. They include a hole for attaching a heat sink if necessary.

3 TERMINAL 1A POSITIVE VOLTAGE REGULATOR

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

The KA78XX/KA78XXA series of three-terminal positive regulator are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

The 78xx (sometimes LM78xx) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the xx is replaced with two digits, indicating the output voltage (for example, the 7805 has a 5 volt output, while the 7812 produces 12 volts). The 78xx line is positive voltage regulators: they produce a voltage that is positive relative to a common ground. There is a related line of 79xx devices which are complementary negative voltage regulators. 78xx and 79xx ICs can be used in combination to provide positive and negative supply voltages in the same circuit.

PIN ARCHITECTURE

7805, It is a voltage regulator the 78 indicates a positive regulator the 05 indicates the voltage output. At 1 amp if adequate heats sink is provided. Never fear it has thermal protection to shut it down only if the internal heating exceeds the safety zone. It will not destroy itself by removing or reducing the load it will come- back alive after cooling.

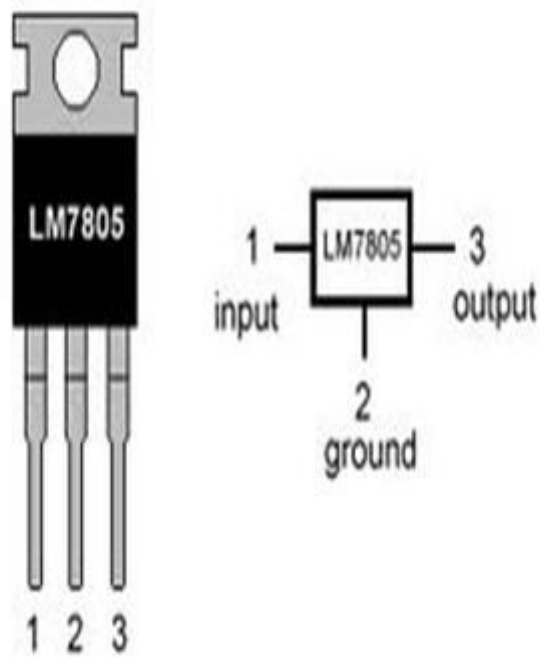


Fig. 3.1(b)

Pin Diagram of IC 7805

3.2 BRIDGE RECTIFIER

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.

The simple process of rectification produces a type of DC characterized by pulsating voltages and currents (although still unidirectional).

HALF WAVE RECTIFIER: In half wave rectification of a single-phase supply, either the positive or negative half of the AC wave is passed, while the other half is blocked. Because only one half of the input waveform reaches the output, mean voltage is lower. Half-wave rectification requires a single diode in a single-phase supply, or three in a three-phase supply. Rectifiers yield a unidirectional but pulsating direct current; half-wave rectifiers produce far more ripple than full-wave rectifiers, and much more filtering is needed to eliminate harmonics of the AC frequency from the output.

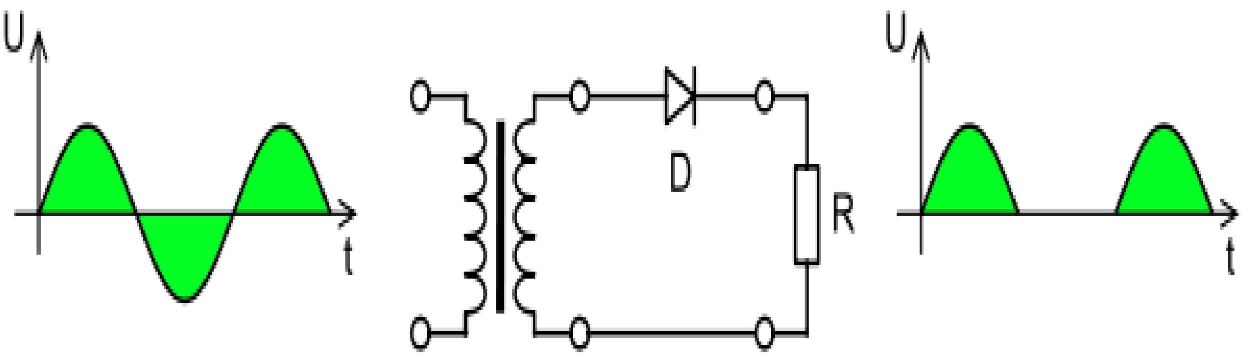


Fig. 3.2(a) Input - output diagram of half wave rectifier

FULL WAVE RECTIFIER: A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output. Full-wave rectification converts both polarities of the input waveform to DC (direct current), and yields a higher mean output voltage. Two diodes and a center tapped transformer, or four diodes in a bridge configuration and any AC source (including a transformer without center tap), are needed. Single semiconductor diodes, double diodes with common cathode or common anode, and four-diode bridges, are manufactured as single components.

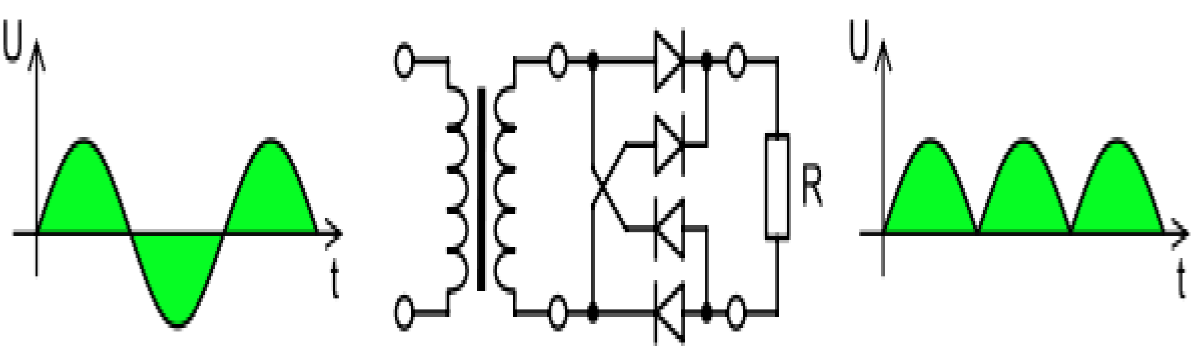


Fig. 3.2(b) Input – output diagram of full wave rectifier

BRIDGE RECTIFIER: A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

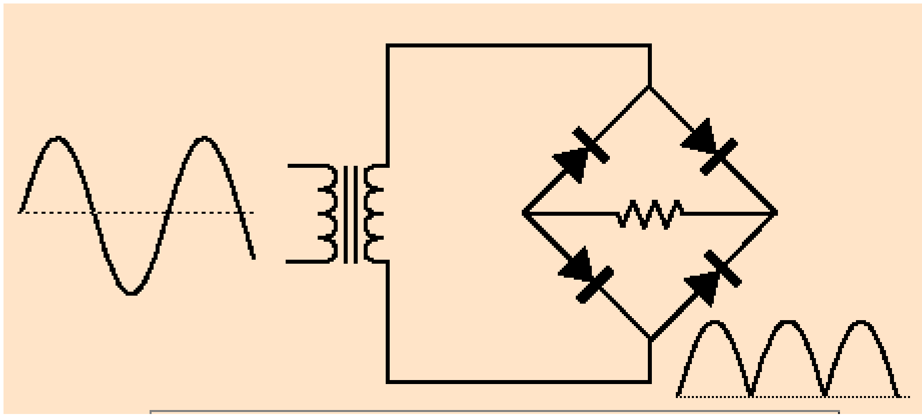


Fig. 3.2(c)

Bridge rectifier

CURRENT FLOW IN BRIDGE RECTIFIER

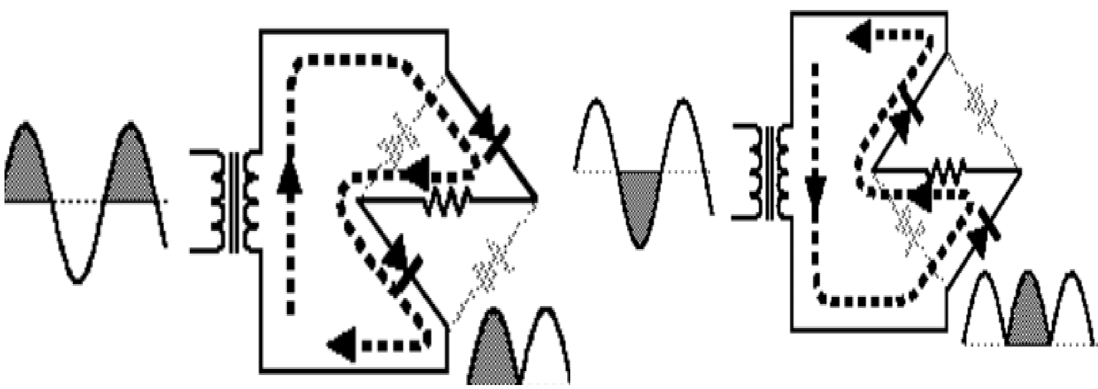


Fig. 3.2(d)

Current flow in bridge rectifier

For both and negative swings of the transformer, there is a forward path through the diode bridge.Both conduction paths cause current to flow in the same direction through the load resistor.

In the above figure one set of diode is forward biased the other set is reverse biased.

3.3 CRYSTAL OSCILLATOR

A crystal oscillator is an electronic circuit that uses the 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 (as in quartz wristwatches), 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 designed around them were called "crystal oscillators".

A crystal oscillator is an electronic circuit that produces electrical oscillations at a particular designed frequency determined by the physical characteristics of one or more crystals, generally of quartz, positioned in the circuit feedback loop. A piezoelectric effect causes a crystal such as quartz to vibrate and resonate at a particular frequency. The quartz crystal naturally oscillates at a particular frequency, its fundamental frequency that can be hundreds of megahertz. The crystal oscillator is generally used in various forms such as a frequency generator, a frequency modulator and a frequency converter. The crystal oscillator utilizes crystal having excellent piezoelectric characteristics, in which crystal functions as a stable mechanical vibrator. There are many types of crystal oscillators. One of them is a crystal oscillator employing an inverting amplifier including a CMOS (complementary metal oxide semiconductor) circuit, and used, for example, as a reference signal source of a PLL (phase-pocked poop) circuit of a mobile phone. Crystal oscillator circuits using crystal have a number of advantages in actual application since crystals show high frequency stability and stable temperature characteristic as well as excellent processing ability. Temperature-compensated crystal oscillators, in which variation in oscillation frequency that arises from the frequency-temperature characteristic of the quartz-crystal unit is compensated, find particularly wide use in devices such as wireless phones used in a mobile environment. A surface mounting crystal oscillator is used mainly as a frequency reference source particularly for a variety of portable electronic devices such as portable telephones because of its compact size and light weight.

CRYSTAL OSCILLATORS USED IN MICROCONTROLLERS

A microcontroller is disclosed that includes a crystal oscillator circuit that is programmable to provide multiple different levels of start-up current. In the present embodiment, the crystal oscillator circuit includes logic devices for receiving programming indicating one of a plurality of different start-up current levels and a resistor chain. The logic devices are coupled to the resistor chain for controlling the resistance of the oscillator circuit such that, upon receiving programming indicating a particular start-up current level, the crystal oscillator circuit generates a corresponding start-up current. In addition, the crystal oscillator circuit includes provision for selecting one of a plurality of different levels of capacitance. Furthermore, the crystal oscillator circuit includes a gate pass that includes circuitry for assuring predetermined start-up conditions are met. A feedback loop that includes an amplifier provides for steady-state operations that have low power consumption.

Fig. 3.3

Crystal oscillator

3.4 DIODE

A device having two terminals and has a low resistance to electrical current in one direction and a high resistance in the other direction. Diode is a two-element device which passes a signal in one direction only. They are used most commonly to convert AC to DC, because they pass the positive part of the wave, and block the negative part of the AC signal, or, if they are reversed, they pass only the negative part and not the positive part.

RECTIFICATION DIODE (1N4007)

The stripe stamped on one end of the diode shows indicates the polarity of the diode. The stripe shows the cathode side. These diodes are made to handle relatively high currents. The device on top can handle as high as 6A, and the one below it can safely handle up to 1A.However, it is best used at about 70% of its rating because this current value is a maximum rating. This diode is used for switching, because it can switch on and off at very high speed. However, the maximum current it can handle is 120 mA. This makes it well suited to use within digital circuits. The maximum reverse voltage (reverse bias) this diode can handle is 30V.

The voltage regulation diode is used with a rating of 6V. When this type of diode is reverse biased, it will resist changes in voltage. If the input voltage is increased, the output voltage will not change. (Or any change will be an insignificant amount.) While the output voltage does not increase with an increase in input voltage, the output current will.

This requires some thought for a protection circuit so that too much current does not flow. The rated current limit for the device is 30 mA. Generally, a 3-terminal voltage regulator is used for the stabilization of a power supply. Therefore, this diode is typically used to protect the circuit from momentary voltage spikes. 3 terminal regulators use voltage regulation diodes inside.

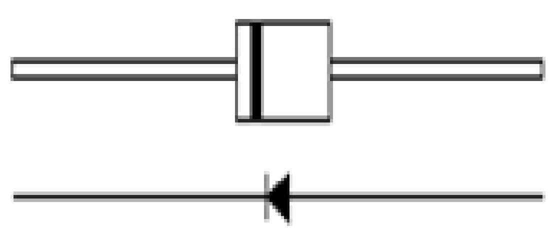


Fig. 3.4 Diode

3.5 RESISTOR

There is always some resistance in every circuit.

• A circuit is always made up of some wire, so there will be some resistance there.

• Even the battery has parts that offer resistance to the flow of electrons.

• The only circuits that come near to zero resistance are superconductors.

• This resistance that is from the parts of the circuit itself (especially the battery) is called internal resistance.

• The squiggly line just before the positive terminal of the battery is to show the internal resistance of the circuit.

• A resistor is a device found in circuits that has a certain amount of resistance.

• The most common reason to add resistance to a circuit by using a resistor is that we need to be able to adjust the current flowing through a particular part of the circuit.

• If voltage is constant, then we can change the resistor to change the current. I=V R If "V" is constant and we change "R", "I" will be different.

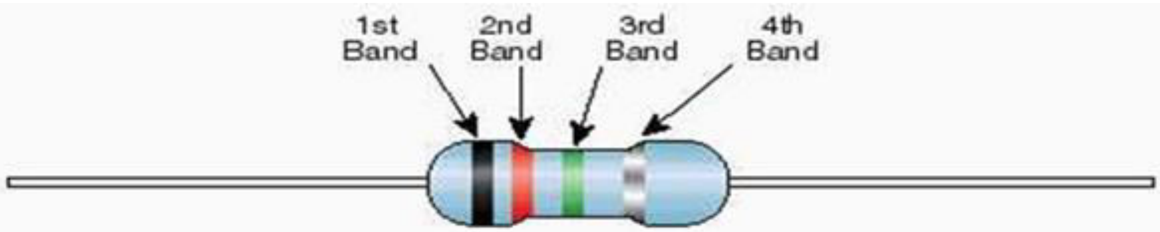
- **VARIABLE RESISTORS**
- **ADJUSTABLE RESISTORS**

A resistor may have one or more fixed tapping points so that the resistance can be changed by moving the connecting wires to different terminals. Some wire wound power resistors have a tapping point that can slide along the resistance element, allowing a larger or smaller part of the resistance to be used.

Where continuous adjustment of the resistance value during operation of equipment is required, the sliding resistance tap can be connected to a knob accessible to an operator. Such a device is called a rheostat and has two terminals.

POTENTIOMETERS

A common element in electronic devices is a three-terminal resistor with a continuously adjustable tapping point controlled by rotation of a shaft or knob. These variable resistors are known as potentiometers when all three terminals are present, since they act as a continuously adjustable voltage divider. A common example is a volume control for a radio receiver.



Color	1st Band (1st figure)	2nd Band (2nd figure)	3rd Band (multiplier)	4th Band (tolerance)
Black	0	0	10^0	
Brown	1	1	10^1	
Red	2	2	10^2	±2%
Orange	3	3	10^3	
Yellow	4	4	10^4	
Green	5	5	10^5	
Blue	6	6	10^6	
Violet	7	7	10^7	
Gray	8	8	10^8	
White	9	9	10^9	
Gold			10^{-1}	±5%
Silver			10^{-2}	±10%

Fig. 3.5

Color code of resistor

3.6 CAPACITOR

INTRODUCTION

The function of capacitors is to store electricity, or electrical energy. The capacitor also functions as filter, passing AC, and blocking DC. The capacitor is constructed with two electrode plates separated by insulator. They are also used in timing circuits because it takes time for a capacitor to fill with charge. They can be used to smooth varying DC supplies by acting as reservoir of charge.

When DC voltage is applied to the capacitor, an electric charge is stored on each electrode. While the capacitor is charging up, current flows. The current will stop flowing when the capacitor has fully charged.

Commercial capacitors are generally classified according to the dielectric. The most used are mica, paper, electrolytic and ceramic capacitors. Electrolytic capacitors use a molecular thin oxide film as the dielectric resulting in large capacitance values. There is no required polarity, since either side can be the most positive plate, except for electrolytic capacitors. These are marked to indicate which side must be positive to maintain the internal electrolytic action that produces the dielectric required to form the capacitance. It should be noted that the polarity of the charging source determines the polarity of the changing source determines the polarity of the capacitor voltage.

- ✓ **TYPES OF CAPACITOR**
- ➢ **POLARIZED CAPACITORS:**

These are the capacitors having polarity. Basically these are of larger values than 1uf.Electrolytic capacitors are polarized and they must be connected the correct way round, at least one of their leads will be marked + or -. They are not damaged by heat when soldering.

There are two designs of electrolytic capacitors; axial where the leads are attached to each end and radial where both leads are at the same end . Radial capacitors tend to stand upright on the circuit board.

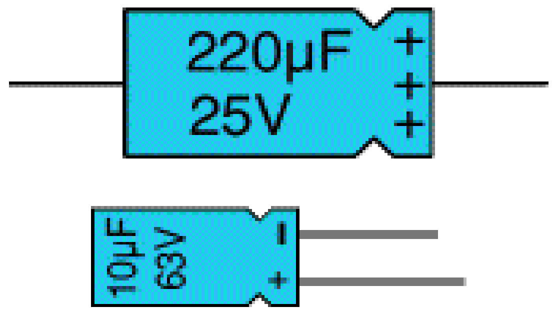


Fig. 3.6(a)

Polarized Capacitor

It is easy to find the value of electrolytic capacitors because they are clearly printed with their capacitance and voltage rating. The voltage rating can be quite low (6V for example) and it should always be checked when selecting an electrolytic capacitor. If the project parts list does not specify a voltage, choose a capacitor with a rating which is greater than the project's power supply voltage. 25V is a sensible minimum for most battery circuits.

- **UN-POLARIZED CAPACITORS:**

Small value capacitors are un-polarized and may be connected either way round. They are not damaged by heat when soldering, except for one unusual type (polystyrene). They have high voltage ratings of at least 50V, usually 250V or so. It can be difficult to find the values of these small capacitors because there are many types of them and several different labeling systems.

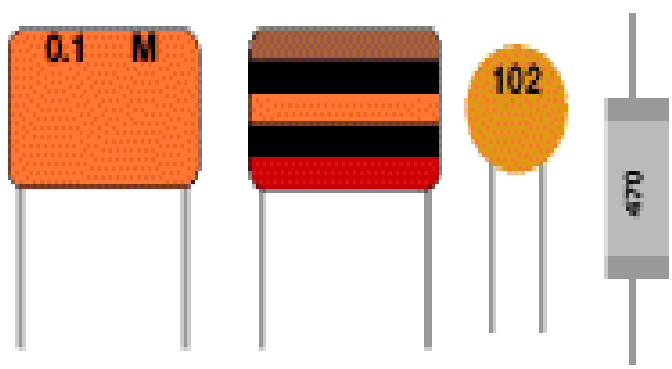


Fig. 3.6(b)

Unpolarized capacitors

3.7 ACCESSORIES

ADAPTERS

The adapters are the device that has inbuilt circuitry for converting the 230V AC in to desired DC like +5V adapter, +12V adapter, +9V adapter and many more. This consists of inbuilt circuit for HIGH AC to low voltage DC conversion.

Fig. 3.7(a) Adaptor

DIP BASES

The case outlines of the plastic and ceramic Dual In-line Packages (DIPs) are nearly identical. The lead configuration consists of two rows of leads, both with 100 mil pitch. The plastic DIP is shown in Figure. If the DIP base is of 18 pin then 9 lines will be in one side and 9 on other side. The IC bases of have round cut from the left of which the pin 1 of base is considered similar is the case with integrated chips.

Fig. 3.7(b) Dip bases

Basically IC is sensitive to short circuit or voltage so in place of that we first install the bases of the IC with same number of pins and before placing the IC's we check all voltage points of the IC then mount the IC once proper configuration is assured. The DIP base depends on number of pins of the IC and ranges from 4pin configuration to 40 pin configuration. They are available in different pin configuration and size depending on IC need.

POWER JACK

Power Jack is basically a connector to connect the adapter output to the board directly. It has the proper connection designed to connect with the adapter as well as out connection to connect to the board. It has three terminals output 1 Vcc, 2 GND and 3 No connection.

Fig. 3.7(c) Power jack

SWITCHES

In electrical engineering, a switch is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another.

The most familiar form of switch is a manually operated electromechanical device with one or more sets of electrical contacts, which are connected to external circuits. Each set of contacts can be in one of two states: either "closed" meaning the contacts are touching and electricity can flow between them, or "open", meaning the contacts are separated and the switch is non-conducting. The mechanism actuating the transition between these two states (open or closed) can be either a "toggle" (flip switch for continuous "on" or "off") or "momentary" (push-for "on" or push-for "off") type.

A switch may be directly manipulated by a human as a control signal to a system, such as a computer keyboard button, or to control power flow in a circuit, such as a light switch. Automatically operated switches can be used to control the motions of machines, for example, to indicate that a garage door has reached its full open position or that a machine tool is in a position to accept another work piece. Switches may be operated by process variables such as pressure, temperature, flow, current, voltage, and force, acting as sensors in a process and used to automatically control a system. For example, a thermostat is a temperature-operated switch used to control a heating process. A switch that is operated by another electrical circuit is called a relay. Large switches may be remotely operated by a motor drive mechanism. Some switches are used to isolate electric power from a system, providing a visible point of isolation that can be padlocked if necessary to prevent accidental operation of a machine during maintenance, or to prevent electric shock.

An ideal switch would have no voltage drop when closed, and would have no limits on voltage or current rating. It would have zero rise time and fall time during state changes, and would change state without "bouncing" between on and off positions.

Practical switches fall short of this ideal; they have resistance, limits on the current and voltage they can handle, finite switching time, etc. The ideal switch is often used in circuit analysis as it greatly simplifies the system of equations to be solved, however this can lead to a less accurate solution. Theoretical treatment of the effects of non-ideal properties is required in the design of large networks of switches, as for example used in telephone exchanges.

There are varying types of switches:

MICRO-SWITCH: This is small switch for interconnection. It has 4 terminals with 2 in pair already connected .when you press the switch all four get connected.

POWER SWITCH: This is 6 terminal switches for bidirectional connectivity on press.

TOGGLE SWITCH: A toggle switch is a class of electrical switches that are manually actuated by a mechanical lever, handle, or rocking mechanism. This is a two state switch that is not connected, and connected. It remains in the state till not forced again to change the state.

DPDT SWITCH: A DPDT switch is a class of electrical switches that are manually actuated by a mechanical rocking mechanism. This is a three state switch that is not connected, connected to one and connected to second. It remains in the state till forced in that particular state else goesto normal state.

DIP SWITCHES: These are combination of multiple small switches in one package to put on/off multiple channels in circuitry. A DIP switch is a manual electric switch that is packaged with others in a group in a standard dual in-line package (DIP). The term may refer to each individual switch, or to the unit as a whole. This type of switch is designed to be used on a printed circuit board along with other electronic components and is commonly used to customize the behavior of an electronic device for specific situations.DIP switches are an alternative to jumper blocks. Their main advantages are that they are quicker to change and there are no parts to lose. These are available in different configuration for example 8 pin configurations, 16 pin configuration and many more.

CONNECTORS

Connectors are wire connection and interface to connect two different points. It has different configuration like 2- pin connector, 3 -pin connector, 4- pin connector and many more.

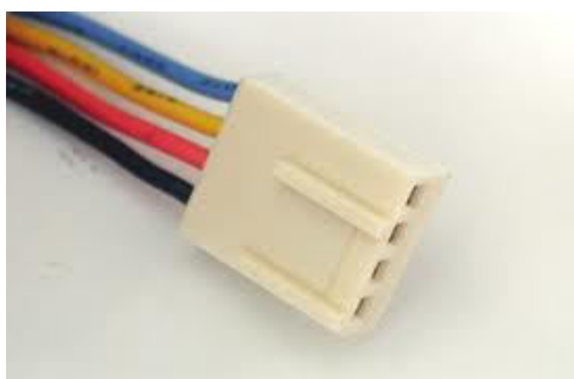


Fig. 3.7(d) Connector

BERGE STRIP

Berge strip is also type of connector. It is of two types male or female. This is also used for making electrical connections to mount some components. The come in different packages and dimensions.

Depending upon the need they can be purchased. These are used for mounting certain modules, LCD etc.

MALE CONNECTOR: These have metallic rods for the connection

Fig. 3.7(e) Male connector

FEMALE CONNECTOR: These have holes.

Fig. 3.7(f) Female connector

DC CONNECTORS

A DC connector (or DC plug, for one common type of connector) is an electrical connector for supplying direct current (DC) power.

Compared to domestic AC power plugs and sockets, DC connectors have many more standard types that are not interchangeable. The dimensions and arrangement of DC connectors can be chosen to prevent accidental interconnection of incompatible sources and loads. Types vary from small coaxial connectors used to power portable electronic devices from AC adapters, to connectors used for automotive accessories and for battery packs in portable equipment.

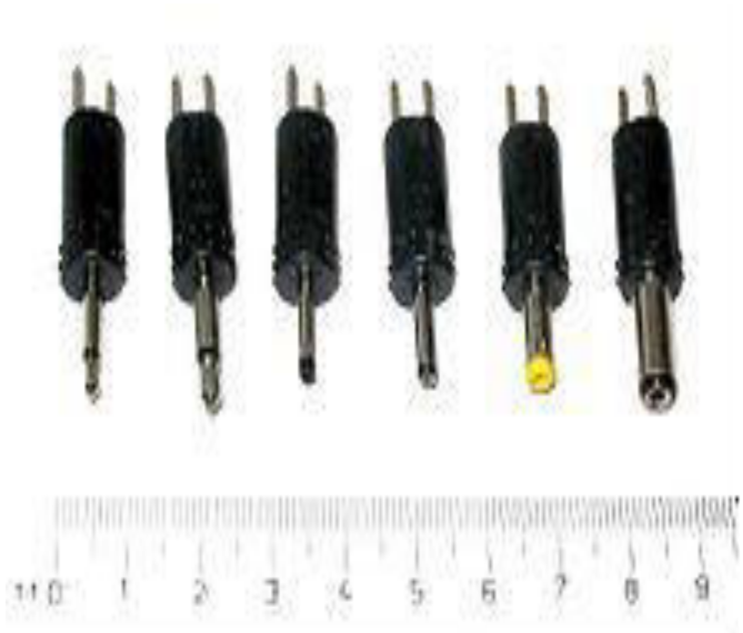


Fig. 3.7(g) DC connector

3.8 LED'S

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Appearing as practical electronic components early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

Fig. 3.8(a)

LED’S

When a light-emitting diode is forward-biased (switched on), electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. A LED is often small in area (less than 1 mm2), and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output.

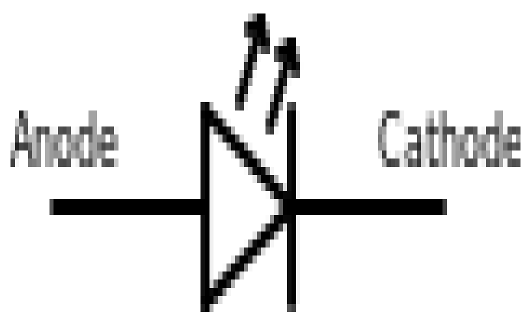


Fig. 3.8(b)

Anode and Cathode pole of LED

Light-emitting diodes are used in applications as diverse as aviation lighting, automotive lighting, advertising, general lighting, and traffic signals. LED’s have allowed new text, video displays, and sensors to be developed, while their high switching rates are also useful in advanced communications technology. Infrared LEDs are also used in the remote control units of many commercial products including televisions, DVD players and other domestic appliances.

CHAPTER 4

WORKING OPERATION AND PROGRAMMIMG CODES

1.1 WORKING

In this project it understands whatever commands you set the Say – it module up to use, and speaks to you with various prompts, responses, etc, and of course, it turns stuff on and off. The motivation for this was the number of times that we have gone to bed only to realize that appliances from on to off condition that will be removed. In this project with the help of voice recognition module the user can switch on or off the either ac or dc supply considering the switches.

POWER SUPPLY: The input is 230V AC which is step down using the transformer (12-0-12) .The 12V ac input is fed to the bridge diode to gives 12V pulsating DC. This DC voltage is filtered through the capacitor to remove the ripples. The filtered DC is fed to 7805 regulator to fetch +5v regulated output. This regulated voltage is given to all the components to function properly.

SERIAL COMMANDS

This module can be configured by sending commands via serial port. Configuration will be not erased after powered off. Its interface is 5V TTL. The serial data format: 8 data bits, no parity, 1 stop bit. The default baud rate is 9600 and baud rate can be changed.

The actual processor used to implement a microcontroller can vary widely. In many products, such as microwave ovens, the demand on the CPU is fairly low and price is an important consideration. In these cases, manufacturers turn to dedicated microcontroller chips – devices that were originally designed to below-cost, small, low-power, embedded CPUs. The Intel 8051 is good examples of such chip. A typical low-end microcontroller chip might have 1000 bytes of ROM and 20 bytes of RAM on the chip, along with eight I/O pins.

Micro-controllers may not implement an external address or data bus as they integrate RAM and non-volatile memory on the same chip as the CPU. Using fewer pins, the chip can be placed in a much smaller, cheaper package.

Integrating the memory and other peripherals on a single chip and testing them as a unit increases the cost of that chip, but often results in decreased net cost of the embedded system as a whole. Even if the cost of a CPU that has integrated peripherals is slightly more than the cost of a CPU and external peripherals, having fewer chips typically allows a smaller and cheaper circuit board, and reduces the labor required to assemble and test the circuit board.

BLOCK DIAGRAM:

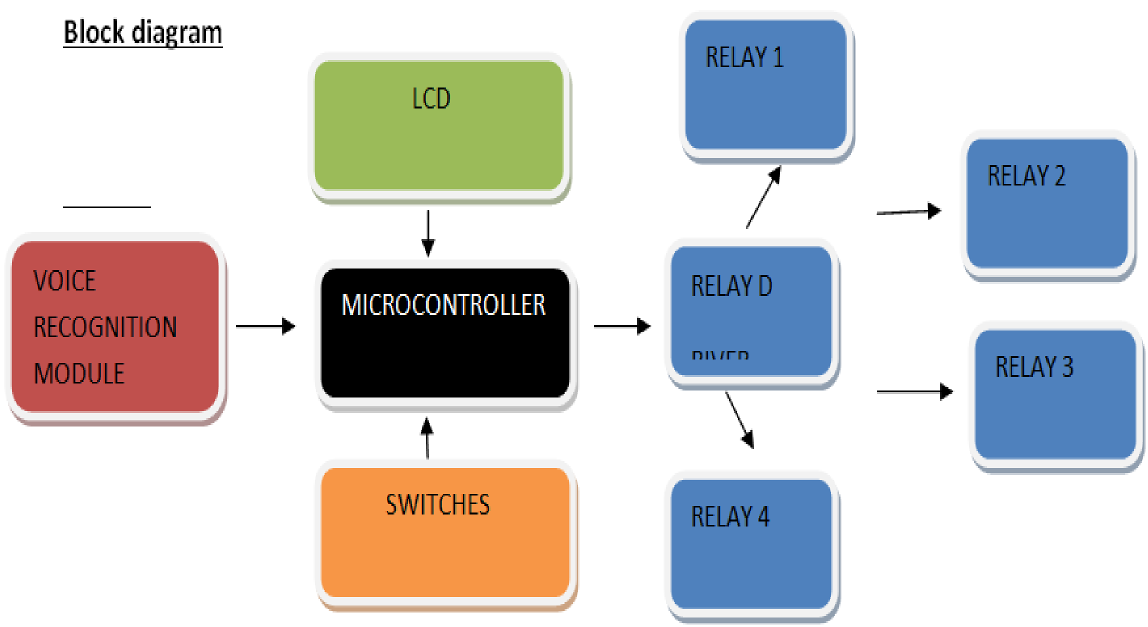


Fig. 4.1

Block diagram of voice recognition module based home automation

4.2 CIRCUIT DIAGRAM:

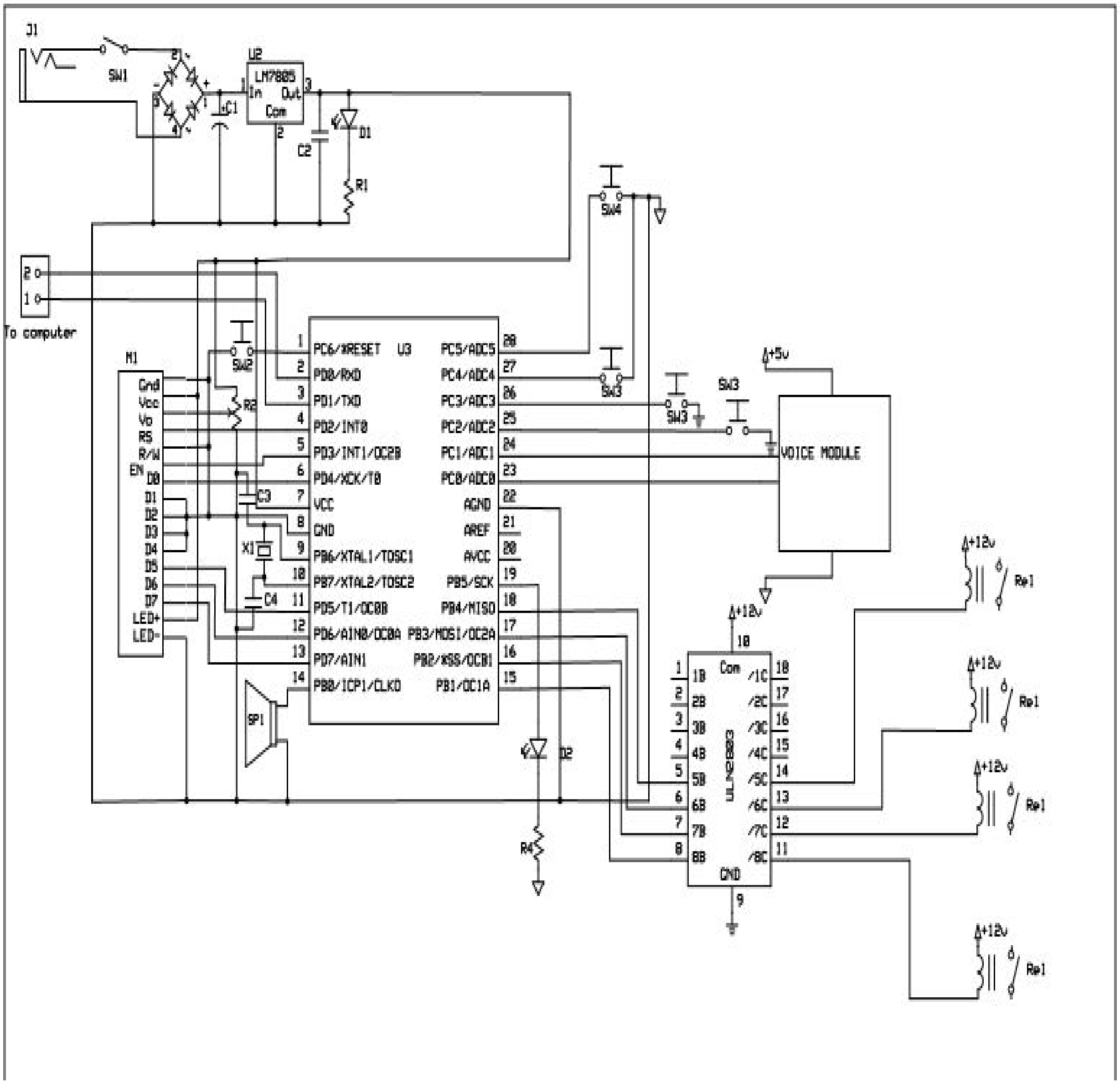


Fig. 4.2

Circuit diagram of Voice recognition module based home automation

CHAPTER 5

ADVANTAGES AND DISADVANTAGES

This project is made with best of capabilities and dedication. Details were taken care of in preparing it. The problems encountered in various steps were taken into account and eliminated to much extent so that they may not harm the project functioning. Also certain areas were thought of before hand and worked upon, so as to prevent them from becoming a limitation for the project. But, as it is that every system is not perfect in all the aspects. They have some associated limitations. Here are presented the advantages, in general and comparative of the counterparts, and disadvantages of the project.

5.1 ADVANTAGES

1.) Flexibility & Convenience

2.) Security

3.) Cost Saving

4.) Remote Control

5.) Easy to use

6.) Helps disabled people

7.) Can communicate with the home appliances from anywhere in home by voice control.

8.) Integrates all the electrical appliances so that can be controlled together when needed.

9.) Comfortable living

10.) Prevents wasting of electricity

5.2 DISADVANTAGES

1.) Every human bring has differences such as their voice, mouth and speaking style so sometimes there is conversation disturbance.

2.) Background noise difficulty.

CHAPTER 6

APPLICATIONS

1.) Turning lights down / off at night.
2.) Turning lights or radio on / off when someone approaches the house, simulating occupancy.
3.) Operating television, hot water heater, kettle, toaster etc. ready for your use.
4.) Optimizing use of low cost electricity.
5.) Voice recognition security system.
6.) Controlling all home appliances.
7.) This is very useful for blind people's.

CHAPTER-7

CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

A home automation system based on voice recognition was built and implemented. The system is targetted at elderly and disabled people. The prototype developed can control electrical devices in a home or office. The system implements Automatic Speech Recognition engines through Microsoft speech APIs. The system implements the wireless network using ZigBee RF modules for their efficiency and low power consumption. Multimedia streaming through the network was impleneted with the help of the Differential Pulse Code Modulation (DPCM) compression algorithms that allows to compress the speech data to half of its orignal data size. The preliminary test results are promising.

The test subjects were a mix of male and female and 35 different voice commands were sent by each person. Thus the test involved sending a total of 1225 commands. 79.8% of these commands were recognised correctly. When a command is not recognised correctly, the software ignores the command and does not transmit any signals to the device control modules. The accuracy of the recognition can be affected by background noise, speed of the speaker, and the clearity of the spoken accent. These factors need to be studied further in more details by conducting more tests. The system was tested in an apartment and performed well up to 40m. With a clear line-ofsight transmission (such as in a wide open gymnasium) the reception was accurate up to 80m. Additional tests are being planned involving a bigger variety of commands.

7.2 FUTURE SCOPE

• Adding confirmation commands to the voice recognition system.

• Integrating variable control functions to improve the system versatility such as providing control

commands other than ON/OFF commands. For example “Increase Temperature”, “Dim Lights” etc

• Integration of GSM or mobile server to operate from a distance.

• Design and integration of an online home control panel.

REFERENCES

- http://www.EngineersGarage.com
- http://www.Slideshare.com
- http://www.ElectronicsForYou.com
- Wikipedia- Electronic pages

APPENDIX

PROGRAMMIMG CODES

```
#define recordSwitch1 16 // switch connection 1 #define
recordSwitch2 17

#define importPin 18 #define
stopListening 19

#define m1 9 // devices connected here #define
m2 10

#define m3 11
#define m4 12

NewSoftSerial vrm(14,15); // voice recognition module connected over here LiquidCrystal
lcd(2,3,4,5,6,7); // lcd connected over here

LED led1(13); // led connected over here

void setup()

{

   led1.blink(1000); // blink led for 1 sec tone(8,3000,1000); // tone of
   3000Hz for 1 sec duration

   vrm.begin(9600); // baud rate for communication between vrm and microcontroller delay(100);//
   wait for the system to be stablized

   Serial.begin(9600);

   delay(100);// wait for 1 sec here

   lcd.begin(16,2); // dimension of the LCD lcd.print("Wait...");// initial
   message displayed on lcd delay(1000);

   check();
```

```
    pinMode(importPin,INPUT); // pin mode defined
    digitalWrite(importPin,HIGH);
    pinMode(recordSwitch1,INPUT);
    digitalWrite(recordSwitch1,HIGH);
    pinMode(recordSwitch2,INPUT);
    digitalWrite(recordSwitch2,HIGH);
    pinMode(stopListening,INPUT);
    digitalWrite(stopListening,HIGH);


    pinMode(m1,OUTPUT);

    pinMode(m2,OUTPUT);

    pinMode(m3,OUTPUT);

    pinMode(m4,OUTPUT);


}


void loop()

{

    disp();


    if(digitalRead(importPin)==LOW) // start voice commands by importing segement 1 of the module
by default

    {

        compactMode(); // set the module in compact form.


        import1(); // delay(1000);
        tone(8,3000,500);// indicate

        while(digitalRead(importPin)==LOW);

    }


    if(digitalRead(stopListening)==LOW)

    {
```

```
    deleteGroup();
    lcd.clear();
    lcd.print("Not Active");
    tone(8,3000,1000);// indicate
    while(digitalRead(stopListening)==LOW);                    // hold here
}
if(digitalRead(recordSwitch1)==LOW)          // switch for recording in segment 1
{
    tone(8,3000,200);
    lcd.clear(); lcd.print("Are u sure");
    lcd.setCursor(0,1); lcd.print("reset to exit");
    while(digitalRead(recordSwitch1)==LOW);
    delay(1000);
    while(digitalRead(recordSwitch1)==HIGH);//
    record1();
    delay(1000);
    while(digitalRead(recordSwitch1)==LOW);
}
if(digitalRead(recordSwitch2)==LOW) // switch for recording in segment 2
{
    tone(8,3000,200);
    lcd.clear(); lcd.print("Are u sure");
    lcd.setCursor(0,1); lcd.print("reset to exit");
    while(digitalRead(recordSwitch2)==LOW);
    delay(1000);
    while(digitalRead(recordSwitch2)==HIGH);//
```

```
    record2();
    delay(1000);
    while(digitalRead(recordSwitch2)==LOW);
}

if(vrm.available()) // for any response from module
{
    tone(8,3000,200); char
    ch=vrm.read(); Serial.print(ch);
    switch(ch)
```

```
{

case 0x11:
   digitalWrite(m1,HIGH);
   break;


case 0x12:
   digitalWrite(m2,HIGH);
   break;


case 0x13:
   digitalWrite(m3,HIGH);
   break;


case 0x14:
   digitalWrite(m4,HIGH);
   break;


case 0x15:
   import2();
   break;
   case 0x21: digitalWrite(m1,LOW); break;


   case 0x22: digitalWrite(m2,LOW); break;


   case 0x23: digitalWrite(m3,LOW); break;


   case 0x24: digitalWrite(m4,LOW); break;


   case 0x25: import1(); break;


   }

}
```

```
}
int check()
{
   lcd.clear(); lcd.print("Searchig Module");
   lcd.setCursor(0,1); compactMode();
   delay(100);
   vrm.print(0XAA,BYTE);
   vrm.print(0X00,BYTE);
   delay(100);
   delay(10);
   while(1)
   {
      if(vrm.available())
      {
         byte ch=vrm.read(); Serial.println(ch);
         if(ch==204) // see the data sheet
         {
            lcd.print("Found");
            delay(1000);
            tone(8,3000,500); return 1;
         }
      }
      else
{
         vrm.print(0XAA,BYTE);
```

```
            vrm.print(0X00,BYTE);
            tone(8,3000,50);
            delay(1000);
        }
    }
}
int record1()
{
    lcd.clear(); lcd.print("Recording 1");

    commonMode();
    vrm.flush();

    delay(1000);
```

```
    vrm.print(0XAA,BYTE);

    vrm.print(0X11,BYTE);


    delay(100);

    while(1)

    {

       if(vrm.available())

       {

          char ch=vrm.read();
          Serial.print(ch);

if(ch==char(10))

          {

             delay(500);

             lcd.clear();

          }

          else lcd.print(ch);

          if(ch=='!')

          {

             lcd.clear();

             lcd.print("Group 1 finished");
             tone(8,3000,500);



             return 1;

          }

       }
```

```
    }
}

int record2()
{
    commonMode();
    vrm.flush();
    delay(1000);
    vrm.print(0XAA,BYTE);
    vrm.print(0X12,BYTE);
    delay(100);
    while(1)
    {
        if(vrm.available())
        {

            char ch=vrm.read();
            Serial.print(ch);


            if(ch==char(10))
            {
                delay(500);
```

```
            lcd.clear();
        }
        else lcd.print(ch);

        if(ch=='!')
        {
            lcd.clear();
            lcd.print("Group 2 finished");
            tone(8,3000,500);
            return 1;
        }
      }
    }
}
```

```
void commonMode()

{

    vrm.print(0XAA,BYTE);

    vrm.print(0X36,BYTE);

    delay(100);


}


void compactMode()

{

    vrm.print(0XAA,BYTE);

    vrm.print(0X37,BYTE);

    delay(100);

}


void import1()

{

    led1.on();

    vrm.print(0XAA,BYTE);

    vrm.print(0X21,BYTE);

    lcd.clear();


    lcd.print("Group 1 Imported");
    tone(8,3000,50);

    delay(100);

    tone(8,3000,50);

    delay(100);
```

```
}

void import2()
{
   led1.off();
   vrm.print(0XAA,BYTE);
   vrm.print(0X22,BYTE);
   lcd.clear();

   lcd.print("Group 2 Imported");
   tone(8,3000,50);
   delay(100);
   tone(8,3000,50);
   delay(100);

}

void deleteGroup()
{
   vrm.print(0XAA,BYTE);
   vrm.print(0X00,BYTE);
   delay(100);
}

void disp()

{
   lcd.setCursor(0,0);
   lcd.print("D0 D1 D2    D3      ");
```

```
    lcd.setCursor(0,1);

    lcd.print(digitalRead(m1),DEC);
    lcd.print(" ");

    lcd.print(digitalRead(m2),DEC);
    lcd.print(" ");

    lcd.print(digitalRead(m3),DEC);
    lcd.print(" ");

    lcd.print(digitalRead(m4),DEC);
    lcd.print(" ");

}
```