FAULT DETECTING SYSTEM IN WIND TURBINE

A PROJECT REPORT

Submitted by

ALAGUNACHAMMAI S **Reg. No.:1110107007**

ARUNA B **Reg. No.:1110107011**

INDHUMATHI M **Reg. No.:1110107034**

KANISHKA S **Reg. No.:1110107039**

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

KUMARAGURU COLLEGE OF TECHNOLOGY

COIMBATORE-641049

(An Autonomous Institution Affiliated to Anna University, Chennai)

APRIL 2015

KUMARAGURU COLLEGE OF TECHNOLOGY

COIMBATORE-641049

(An Autonomous Institution Affiliated to Anna University, Chennai)

BONAFIDE CERTIFICATE

Certified that this project report titled **"FAULT DETECTING SYSTEM IN A WIND TURBINE"** is the bonafied work of "**ALAGUNACHAMMAI. S , ARUNA. B, INDHUMATHI. M, KANISHKA. S"** who carried out the project work under my supervision.

SIGNATURE

Ms. K.Kavitha, M.E.(Ph.D),
Assistant Professor/E.C.E
Kumaraguru College of Technology
Coimbatore.

SIGNATURE

Dr. Rajeswari Mariappan M.E., Ph.D.,
HEAD OF THE DEPARTMENT
Electronics & Communication Engineering
Kumaraguru College of Technology
Coimbatore.

The candidates with Register numbers 1110107007,1110107011, 1110107034 and 1110107039 are examined by us in the project viva-voce examination held on …………………….

INTERNAL EXAMINER **EXTERNAL EXAMINER**

ACKNOWLEDGEMENT

First we would like to express our praise and gratitude to the Lord, who has showered his grace and blessing enabling us to complete this project in an excellent manner. He has made all things in beautiful in his time.

We express our sincere thanks to our beloved Joint Correspondent, **Shri. Shankar Vanavarayar** for his kind support and for providing necessary facilities to carry out the project work.

We would like to express our sincere thanks to our beloved Principal **Dr.R.S.Kumar M.E., Ph.D.,** who encouraged us with his valuable thoughts.

We would like to express our sincere thanks and deep sense of gratitude to our HOD, **Dr. Rajeswari Mariappan M.E., Ph.D.,** for her valuable suggestions and encouragement which paved way for the successful completion of the project.

We are greatly privileged to express our deep sense of gratitude to the Project Coordinator **Ms. S. Nagarathinam M.E., (Ph.D)**, Assistant Professor (SRG), for her continuous support throughout the course.

In particular, We wish to thank and express our everlasting gratitude to the Supervisor **Ms. K. Kavitha M.E., (Ph.D)**, Assistant Professor for her expert counselling in each and every steps of project work and we wish to convey our deep sense of gratitude to all teaching and non-teaching staff members of ECE Department for their help and cooperation.

Finally, we thank our parents and our family members for giving us the moral support in all of our activities and our dear friends who helped us to endure our difficult times with their unfailing support and warm wishes.

ABSTRACT

The Wind Turbine blast is identified as a major problem against green energy. It is not only the threatening factor for the people but also causes dangerous hazard for human life. To overcome this problem and to increase the green energy, a simple system is introduced to monitor and prevent the fault occurrence in Small Wind Turbine. Wind turbine is a device that converts kinrtic energy from the wind into electric power. It operates on a simple principle. The energy in the wind turns two or three propeller like blades around a rotor. The rotor is connected to a main shaft, which spins a generator to create electricity.

It collects all the parameters like temperature, vibration and speed from main components of the turbine and sends it to the control room. At Control room through PC (Personal Computer) it is possible to view the current status of the Wind Turbine. The temperature sensor senses the temperature and send the data to control room, at control room through PC it is possible to view the current status of the Wind Turbine. The speed sensor senses the rotational speed from the Generator shaft; the vibration sensor sense the occurrence of higher vibration in any part of the Wind Turbine components. All this parameter data are send to the control room Section .The display unit is placed is in the Wind Turbine section to show the parameters details which acts as the reference for operator in case of checking the working condition, are for any other revamping parts in the Turbine.

The various types of faults occurring in the wind turbine are Gear tooth damages, High speed and low speed shafts faults, etc., The hardware requirements of this device are ARM7/LPC2148, Power supply unit, LCD unit, IR Sensor(IR-333A), Temperature Sensor(LM 35), MEMS sensor (ADXL 335), PWM motor, Relay driver circuit. The software requirements of this device are Keil ide, Flash programmer.

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LIST OF ABBREVATIONS

UART	Universal Asynchronous Receiver/Transmitter
SPI	Serial Peripheral Interface
SSP	System Service processor
GPIO	General Purpose Input/Output
BOD	Brown-Out Detect
RTC	Real-Time Clock
ADCR	ADC control register
ADDR	ADC Data Register
ADGDR	ADC Global Data Register
DTR	Data Terminal Ready
CTS	Clear to send
RTS	Request To Send
RISC	Reduced Instruction Set Computer
EEPROM	Electrically Erasable Programmable Read Only Memory
SRAM	Static Random Access Memory
LED	Light Emitting Diode
LCD	Liquid Crystal Display

RPM	Rotation per Minute
PWM	Pulse-width modulation
MEMS	Micro-Electro-Mechanical Systems
LDR	Light Dependant Resistor

LIST OF FIGURES

1. INTRODUCTION:

Wind energy is conversion of kinetic energy to mechanical energy to electrical energy. It is the known factor that global warming increasing day by day hence it is essential to increase the green energy. In earlier days the wind energy has been used for grinding flours, pumping water and for other purposes. Nowadays the wind energy is utilized very well for power generation since today it is not at all possible to think the world without power. Tamil Nadu is the number one wind power hub of South Asia generates 40% (7158MW) of India's wind power.Recent study is that nowadays the Wind Turbine blast happens commonly The cost of one wind turbine is nearly 1crore including its development and placement cost which leads to not only severe loss but also dangerous hazard to human life.This fault monitoring and preventive system collects the information like temperature, vibration and speed from Wind Turbine main components such as nacelle, gear box and shaft and send it to the control room hence it helps to avoid such dangerous hazards.

2. HARDWARE DESCRIPTION:

2.1. BLOCK DIAGRAM:

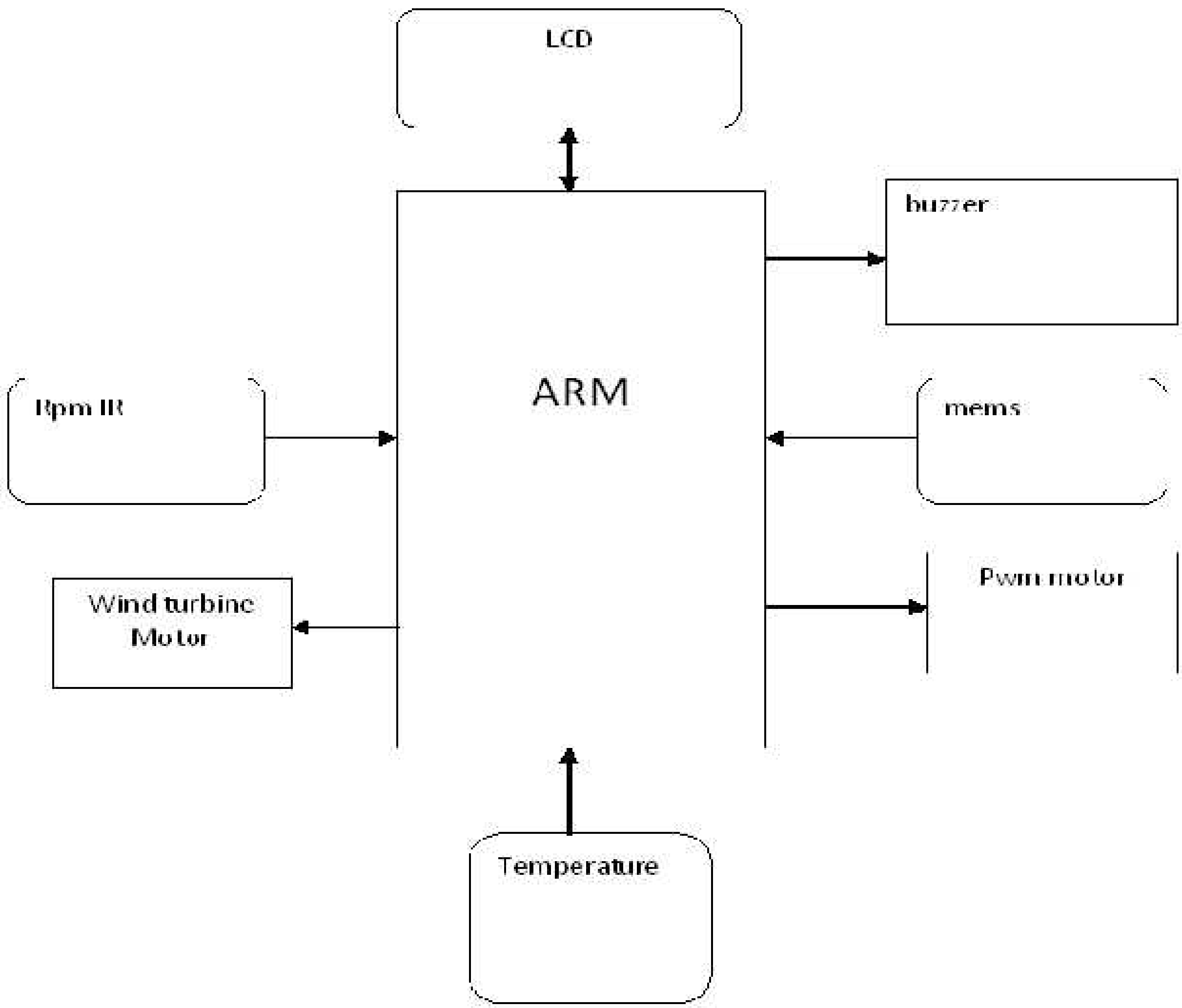


fig.2.1.Block diagram

2. 2. ARM ARCHITECTURE:

The architecture used in smartphones, personal digital assistants and other mobile devices is anything from ARMv5 in obsolete/low-end devices to ARM M-series in current high-end devices. XScale and ARM926 processors are ARMv5TE, and are now more numerous in high-end devices than the StrongARM, ARM9TDMI and ARM7TDMI based ARMv4 processors, but lower-end devices may use older cores with lower licensing costs. ARMv6 processors represented a step up in performance from standard ARMv5 cores, and are used in some cases, but Cortexprocessors (ARMv7) now provide faster and more power-efficient options than all those previous generations. Cortex-A targets applications processors, as needed by smartphones that previously used ARM9 or ARM11. Cortex-R targets real-time applications, and Cortex-M targets microcontrollers. ARM provides a summary of the numerous vendors who implement ARM cores in their design. KEIL also provides a somewhat newer summary of vendors of ARM based processors. ARM further provides a chart [12] displaying an overview of the ARM processor lineup with performance and functionality versus capabilities for the more recent ARM7, ARM9, ARM11, Cortex-M, Cortex-R and Cortex-A device families.

2. 2. 1 ARM 7/LPC2148:

The LPC2148 micro-controllers are based on a 32/16 bit ARM7TDMI-S CPU core. They have real-time emulation and embedded trace support, that combines the micro-controller with embedded high speed flash memory of 512 KB. A 128-bit wide memory interface and an unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode (16bit instruction set)reduces code by more than 30% with minimal performance penalty.

Due to their tiny size and low power consumption, LPC2148 are ideal for applications where miniaturization is a key requirement, such as access control systems and point-of-sale systems. It has serial communications interfaces ranging from a USB 2.0 Full Speed device, multiple UARTS, SPI, SSP to I2Cs. It has on-chip SRAM of 8 KB up to 40 KB. This makes these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power.

The ARM is a 32-bit reduced instruction set computer (RISC) instruction set architecture (ISA) developed by ARM Holdings. It was known as the Advanced RISC Machine, and before that as the Acorn RISC Machine. The ARM architecture is the most widely used 32-bit ISA in terms of numbers produced. They were originally conceived as a processor for desktop personal computers by Acorn Computers, a market now dominated by the x86 family used by IBM PC compatible and AppleMacintosh computers. The relative simplicity of ARM processors made them suitable for low power applications. This has made them dominant in the mobile and embedded electronics market as relatively low cost and small microprocessors and microcontrollers.

ARM processors are developed by ARM and by ARM licensees. Prominent ARM processor families developed by ARM Holdings include the ARM7, ARM9, ARM11 and Cortex. Notable ARM processors developed by licensees include DECStrongARM, Freescalei.MX, Marvell (formerly Intel) XScale, Nintendo, NvidiaTegra, ST-EricssonNomadik, Qualcomm Snapdragon, the Texas InstrumentsOMAP product line, the Samsung Hummingbird and the Apple A4.

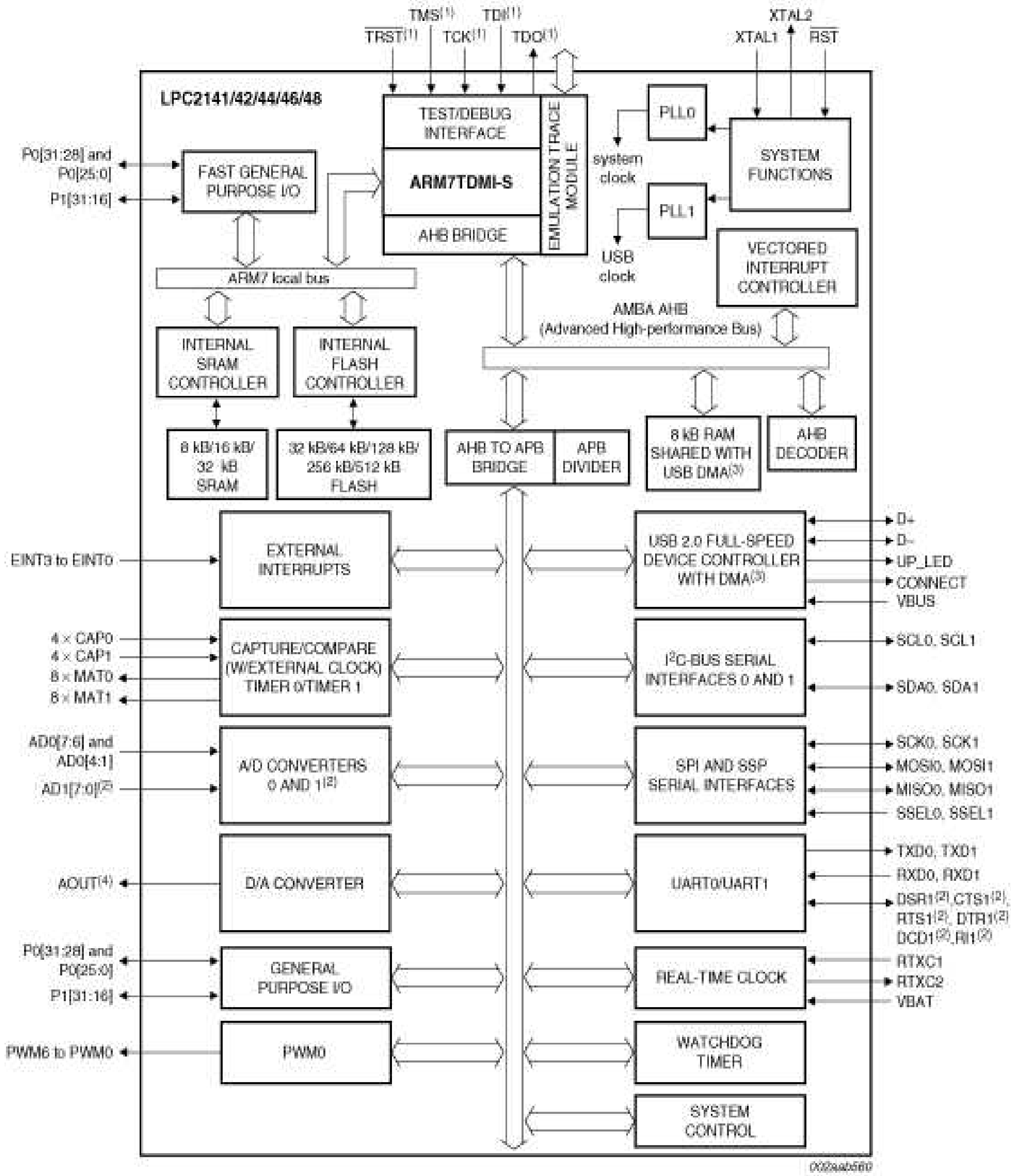


fig.2.2. Architecture diagram of LPC2148

2. 2. 2. RISC features

The ARM architecture includes the following RISC features:

- Load/store architecture.
- No support for misaligned memory accesses (now supported in ARMv6 cores, with some exceptions related to load/store multiple word instructions).
- Uniform 16 × 32-bit register file.
- Fixed instruction width of 32 bits to ease decoding and pipelining, at the cost of decreased code density. Later, "the Thumb instruction set" increased code density.
- Mostly single-cycle execution.

2. 2. 3. Pipelines and other implementation issues

The ARM7 and earlier implementations have a three stage pipeline; the stages being fetch, decode, and execute. Higher performance designs, such as the ARM9, have deeper pipelines: Cortex-A8 has thirteen stages. Additional implementation changes for higher performance include a faster adder, and more extensive branch prediction logic. The difference between the ARM7DI and ARM7DMI cores, for example, was an improved multiplier (hence the added "M").

In ARM 7, a 3 stage pipeline is used. A 3 stage pipeline is the simplest form of pipeline that does not suffer from the problems such as read before write.n a pipeline, when one instruction is executed, second instruction is decoded and third instruction will be fetched.This is executed in a single cycle.

The ARM7TDMI implementation uses a Three-stage pipeline design. These three stages are

- Instruction Fetch (F)
- Instruction Decode (D)
- Execute (E)

2. 2. 4. Features of ARM LPC2148

- 16/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 8 to 40 KB of on-chip static RAM and 32 to 512 KB of on-chip flash program memory 128 bit wide interface/accelerator enables high speed 60 MHz operation.
- In-System/In-Application Programming (ISP/IAP) via on-chip boot-loader software.
- EmbeddedICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip RealMonitor software and high speed tracing of instruction execution.
- USB 2.0 Full Speed compliant Device Controller with 2 KB of endpoint RAM. In addition, the LPC2146/8 provides 8 KB of on-chip RAM accessible to USB by DMA.
- One or two (LPC2141/2 vs. LPC2144/6/8) 10-bit A/D converters provide a total of 6/14 analog inputs, with conversion times as low as 2.44 μs per channel.
- Single 10-bit D/A converter provide variable analog output.
- Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.
- Low power real-time clock with independent power and dedicated 32 kHz clock input

- Multiple serial interfaces including two UARTs (16C550), two Fast I2C-bus (400 Kbit/s), SPI and SSP with buffering and variable data length capabilities.
- Vectored interrupt controller with configurable priorities and vector addresses.
- Up to nine edge or level sensitive external interrupt pins available.
- 60 MHz maximum CPU clock available from programmable on-chip PLL with settling time of 100 μs.
- On-chip integrated oscillator operates with an external crystal in range from 1 MHz to 30 MHz and with an external oscillator up to 50 MHz.
- Power saving modes include Idle and Power-down.
- Individual enable/disable of peripheral functions as well as peripheral clock scaling for additional power optimization.
- Processor wake-up from Power-down mode via external interrupt, USB, Brown-Out Detect (BOD) or Real-Time Clock (RTC).
- Single power supply chip with Power-On Reset (POR) and BOD circuits:– CPU operating voltage range of 3.0 V to 3.6 V (3.3 V ± 10 %) with 5 V tolerant I/O pads.

2. 2. 5. LPC2148 PIN DIAGRAM

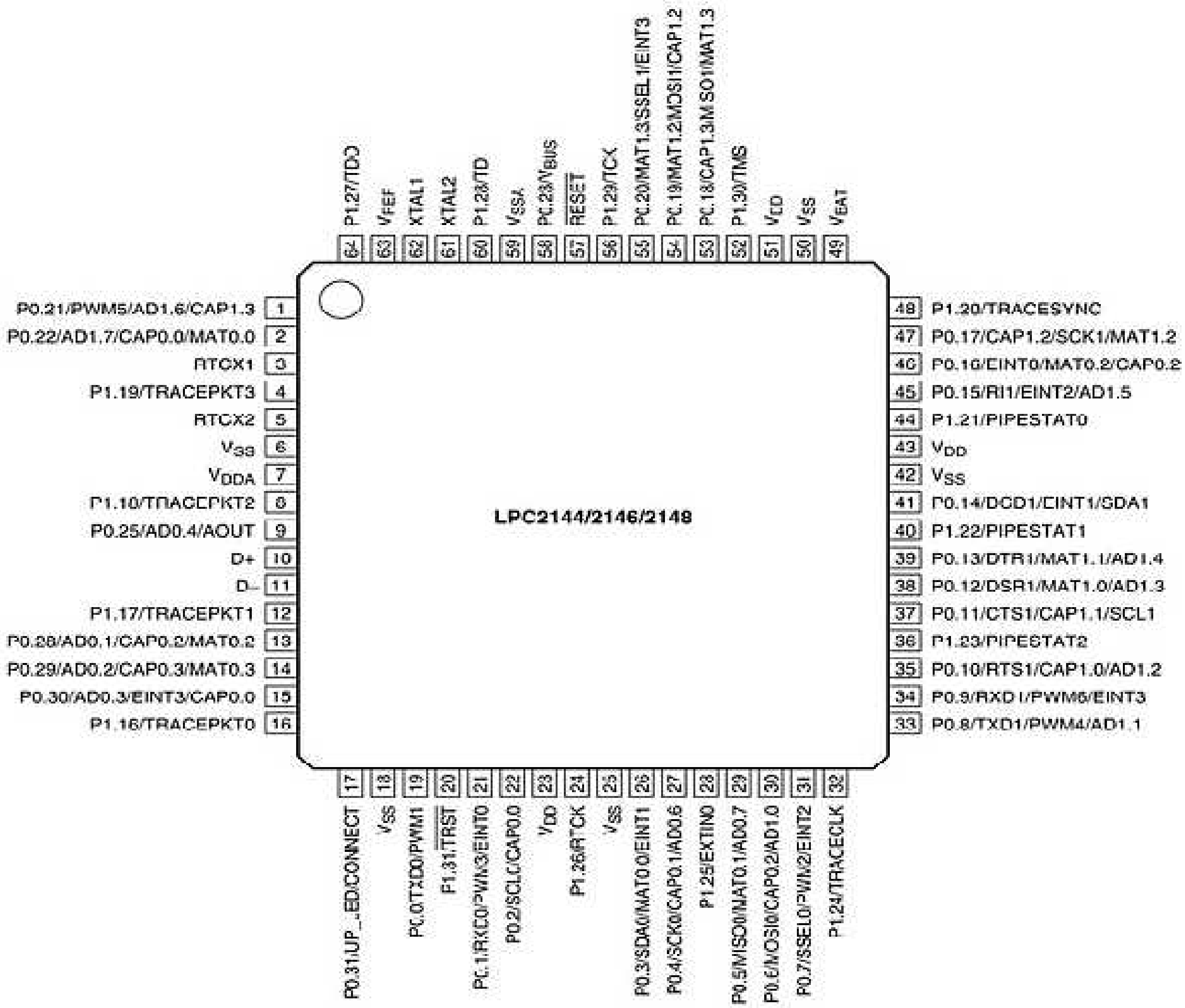


fig.2.3.LPC2148 pin diagram

2. 2.6. The Advantages of THUMB

THUMB instructions operate with the standard ARM register configuration, allowing excellent interoperability between ARM and THUMB states. Each 16-bit THUMB instruction has a corresponding 32-bit ARM instruction with the same effect on the processor model.

The major advantage of a 32-bit (ARM) architecture over a 16-bit architecture is its ability to manipulate 32-bit integers with single instructions, and to address a large address space efficiently. When processing 32-bit data, a 16-bit architecture will take at least two instructions to perform the same task as a single ARM instruction.

2. 2.7. Memory map concepts and operating modes

The basic concept on the LPC2141/2/4/6/8 is that each memory area has a "natural" location in the memory map. This is the address range for which code residing in that area is written. The bulk of each memory space remains permanently fixed in the same location, eliminating the need to have portions of the code designed to run in different address ranges.

Because of the location of the interrupt vectors on the ARM7 processor (at addresses 0x0000 0000 through 0x0000 001C,) a small portion of the Boot Block and SRAM spaces need to be re-mapped in order to allow alternative uses of interrupts in the different operating modes Re-mapping of the interrupts is accomplished via the Memory Mapping Control feature.

2. 3. Memory format

The processor views memory as a linear collection of bytes numbered in ascending order from zero. For example, bytes 0-3 in memory hold the first stored word,and bytes 4-7 hold the second stored word.There are two types of format

2. 3.1. Big- Endian format

In byte-invariant big-endian format, the processor stores the most significant byte of a word at the lowest-numbered byte, and the least significant byte at the highest-numbered byte. Therefore, byte 0 of the memory system connects to data.

2. 3.2. Little Endian Format

In little-endian format, the lowest-numbered byte in a word is the least significant byte of the word and the highest-numbered byte is the most significant. Therefore, byte 0 of the memory system connects to data lines.

2.4.GPIO

General Purpose Input/Output (GPIO) is an interface available on some devices. A microprocessor, microcontroller or interface device may have one or more GPIO connections to interface with external devices and peripherals. These can act as input, to read digital signals from other parts of a circuit, or output, to control or signal to other devices. GPIOs are often arranged into groups, typically of 8 pins - a GPIO port - that usually have individual GPIOs configurable either as input or outputs. In some cases, GPIOs may be configurable to produce CPU interrupts and be able to use Direct Memory Access to move large quantities of data efficiently into or out of the device.

GPIO peripherals vary quite widely. In some cases, they are very simple, a group of pins that can be switched as a group to either input or output. In others, each pin can be setup flexibly to accept or source different logic voltages, with configurable drive strengths and pull up/downs. The input and output voltages are typically, though not universally limited to the supply voltage of the device with the GPIOs on, and may be damaged by greater voltages.

The GPIO peripheral provides dedicated general-purpose pins that can be configured as either inputs or outputs.When configured as an output, you can write to an internal register to control the state driven on the output pin. When configured as an input, you can detect the state of the input by reading the state of an internal register.

2. 4.1. Purpose of the Peripheral

Most system on a chip (SoC) devices require some general-purpose input/output (GPIO) functionality in order to interact with other components in the system using low-speed interface pins. The control and use of the GPIO capability on this device is grouped together in the GPIO peripheral and is described in the following sections.

Interrupt latency

It is the amount of time between the assertion of an interrupt signal and the start of the associated interrupt service routine. Factors that affect interrupt latency include the length of time that interrupts are disabled during normal program execution, processor speed, and preemption of the processor by higher priority interrupts.

Interrupt service routine

A small piece of software executed in response to a particular interrupt. Abbreviated ISR. [more]

Interrupt type

A unique number associated with each interrupt. The interrupt type is typically the processor's index into the interrupt vector.

Interrupt vector

The address of an interrupt service routine.This term is sometimes used incorrectly to refer to either the interrupt type or the address of the interrupt vector.

External Interrupt

External interrupts are a mechanism for I/O devices that communicate infrequently with the CPU to get the attention of the CPU. Rather than have the CPU constantly check to see if the I/O device needs attention (this is polling), the device interrupts the CPU.

There's a protocol between device and CPU that allows the device to indicate what kind of service it wants from the CPU. Usually, this is done using an interrupt number. The CPU then locates an interrupt handler based on this number, runs the code for the handler, and tells the device it's done.

Dealing with I/O devices can slow down the CPU a lot because devices are often as slow as hard drives, in response time. However, such interrupts are infrequent, so the CPU only has to manage the interrupts when needed.

At this point, you should know what an external interrupt is, and be able to summarize the protocol between the CPU and the interrupting device.

Vector interrupts

This is the fastest system. The onus is placed on the requesting device to request the interrupt, and identify itself. The identity could be a branching address for the desired interrupt-handling routine.

If the device just supplies an identification number, this can be used in conjunction with a lookup table to determine the address of the required service routine. Response time is best when the device requesting service also supplies a branching address.

Priority Interrupt Controller Chips (PIC's) are hardware chips designed to make the task of a device presenting its own address to the CPU simple. The PIC also assesses the priority of the devices connected to it. Modern PIC's can also be programmed to prevent the generation of interrupts which are lower than a desired level.

The decoded location is connected to the output of a priority encoder. The input of the priority encoder is connected to each device. When a device requests service, the priority encoder presents a special code combination (unique for each device) to the decoded memory location. The port thus holds the value or address associated with the highest device requesting service.

The priority encoder arranges all devices in a list, devices given a lower priority are serviced when no other higher priority devices need servicing. This simplifies the software required to determine the device, resulting in an increase in speed.

2.5.ADC Converter

ARM7 LPC2148 has 14 channel 10 bit ADC. It give the digital outputs with 10bit resolution.The ADC channels are classified into two types ADC0 and ADC1. ADC0 has six channels (ADC0.0 – ADC0.5) and ADC1 has 8 channels (ADC1.0 to 1.7).

The ADC control register (ADCR) and ADC Data Register(ADDR) and ADGDR (ADC Global Data Register) are used to develop the code in ARM7 2148.in the ADGDR the digital output is stored.

2.6 Additional features

- Power-down mode.
- Measurement range 0 V to VREF (typically 3 V; not to exceed VDDA voltage level).
- 10 bit conversion time ≥ 2.44 μs.
- Burst conversion mode for single or multiple inputs.
- Optional conversion on transition on input pin or Timer Match signal.
- Global Start command for both converters is also available in LPC214x series
- UART : ARM7 2148 have 2 UART channels UART0 and UART1.P0.0 and P0.1 are used for UART0 Tx and Rx pins. And P0.8 and P0.9 is used for UART1.

2.7 POWER SUPPLY UNIT

2.7.1.CIRCUIT DIAGRAM

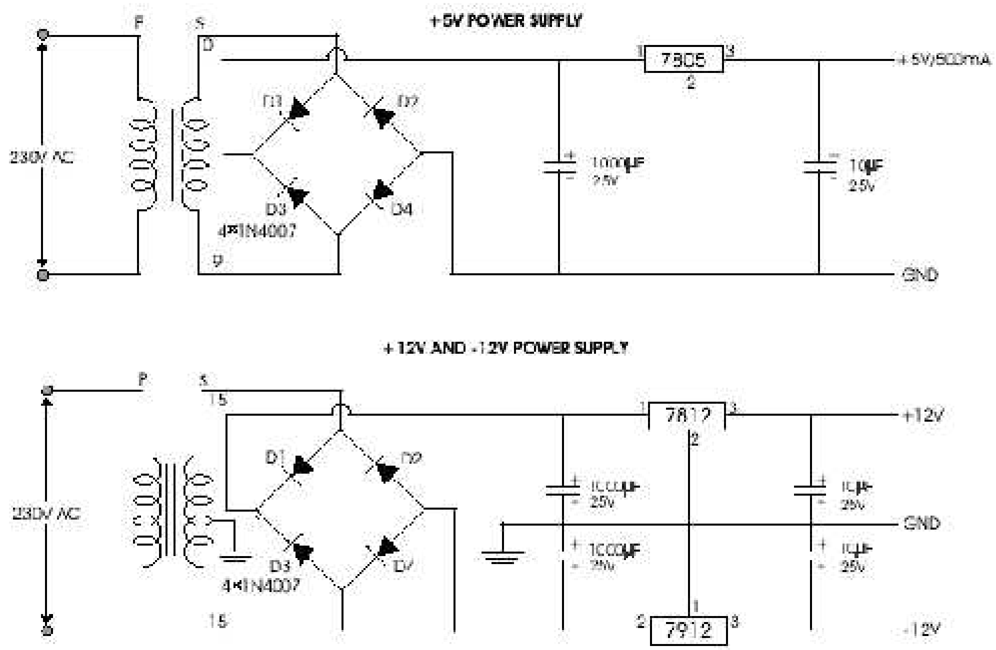


Fig.2.4. Circuit Diagram of Power Supply

2.7.2.WORKING PRINCIPLE

The AC voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired DC output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage vriation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes.

Block Diagram

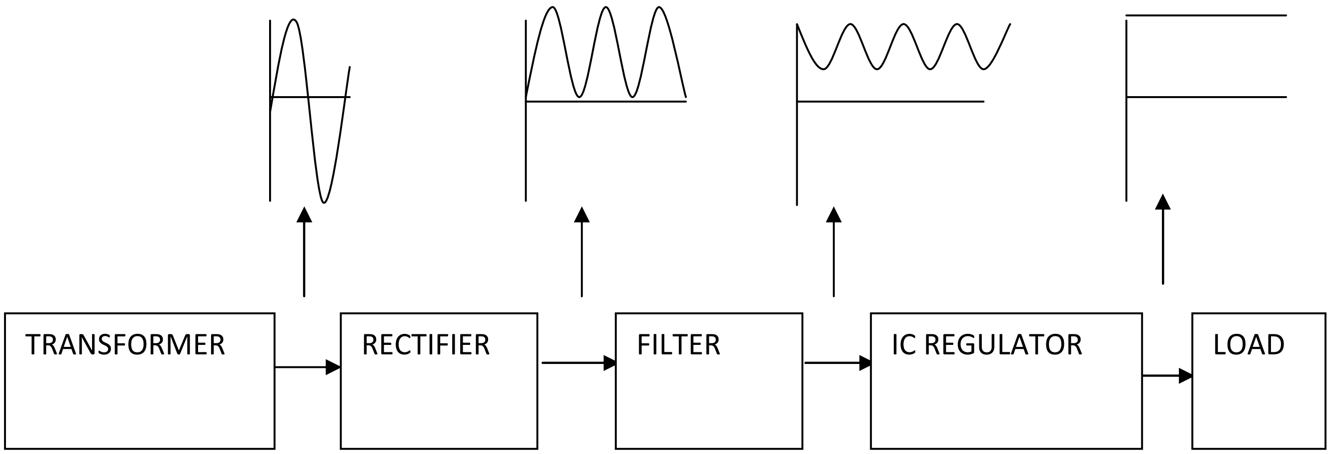


Fig.2.5. Block diagram of power supply

TRANSFORMER

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

BRIDGE RECTIFIER

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.

One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing 2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction.

In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

This may be shown by assigning values to some of the components shown in views A and B. assume that the same transformer is used in both circuits. The peak voltage developed between points X and Y is 1000 volts in both circuits. In the conventional full-wave circuit shown—in view A, the peak voltage from the center tap to either X or Y is 500 volts.

Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts.

The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

IC VOLTAGE REGULATORS

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milliamperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

2.8 LCD DISPLAY

fig.2.6.2x16 lcd display

LCD DISPLAY UNIT

A liquid crystal display (LCD) is an electro-optical amplitude modulator realized as a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power.

Each pixel of an LCD typically consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axes of transmission of which are (in most of the cases) perpendicular to each other. With no liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer.

The surfaces of the electrodes that are in contact with the liquid crystal material are treated so as to align the liquid crystal molecules in a particular direction. This treatment typically consists of a thin polymer layer that is unidirectional rubbed using, for example, a cloth. The direction of the liquid crystal alignment is then defined by the direction of rubbing. Electrodes are made of a transparent conductor called Indium Tin Oxide (ITO). Before applying an electric field, the orientation of the liquid crystal molecules is determined by the alignment at the surfaces. In a twisted nematic device, the surface alignment directions at the two electrodes are perpendicular to each other, and so the molecules arrange themselves in a helical structure, or twist. Because the liquid crystal material is birefringent, light passing through one polarizing filter is rotated by the liquid crystal helix as it passes through the liquid crystal layer, allowing it to pass through the second polarized filter. Half of the incident light is absorbed by the first polarizing filter, but otherwise the entire assembly is reasonably transparent.

The optical effect of a twisted nematic device in the voltage-on state is far less dependent on variations in the device thickness than that in the voltage-off state. Because of this, these devices are usually operated between crossed polarizers such that they appear bright with no voltage (the eye is much more sensitive to variations in the dark state than the bright state). These devices can also be operated between parallel polarizers, in which case the bright and dark states are reversed. The voltage-off dark state in this configuration appears blotchy, however, because of small variations of thickness across the device.

2.8.1 LCD pin descriptions:

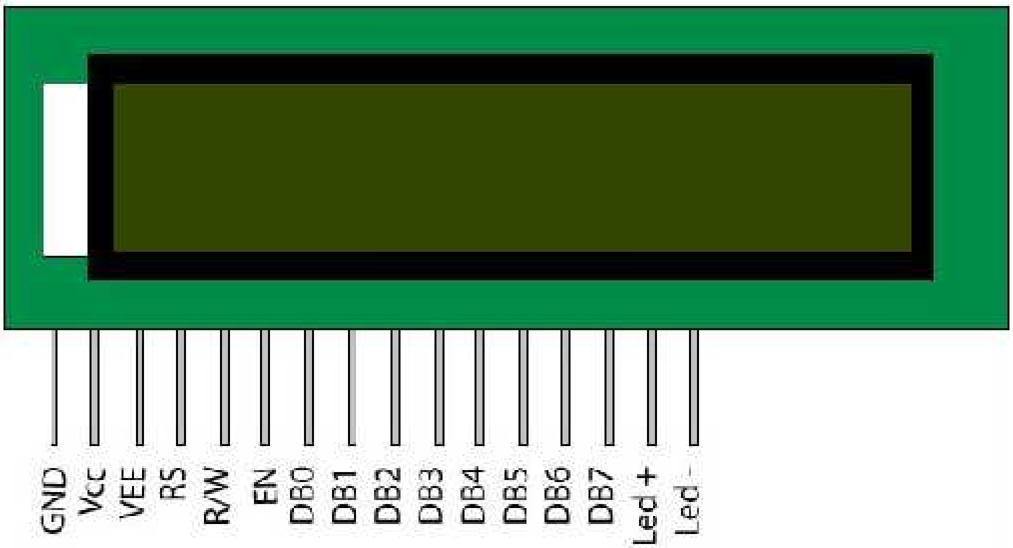


Fig.2.7. LCD pin diagram.

The LCD discussed in this section has 14 pins. The function of each pin is given in the table below.

V_{CC}, VSS, and V_{EE}:

While V_{CC} and $_{VSS}$ provide +5V and ground, respectively, V_{EE} is used for controlling LCD contrast.

RS, Register Select:

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

R/W, Read/Write:

R/W input allows the user to write information to the LCD or read information from it. R/W=1 when reading; R/W=0 when writing.

E, Enable:

The enable pin is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high-to-low pulse must be applied to this pin in order for the LCD to latch in the data present at the data pins. This pulse must be a minimum of 450ns wide.

D0-D7:

The 8-bit data pins, D0-D7, are used to send information to the LCD or read the contents of the LCD's internal registers.

To display letters and numbers, we send ASCII codes for the letters A-Z, a-z, and numbers 0-9 to these pins while making RS=1.

There are also instruction command codes that can be sent to the LCD to clear the display or force the cursor to the home position or blink the cursor. Table lists the instruction command codes.

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

Note: It is recommended to check the busy flag before writing any data to the LCD.

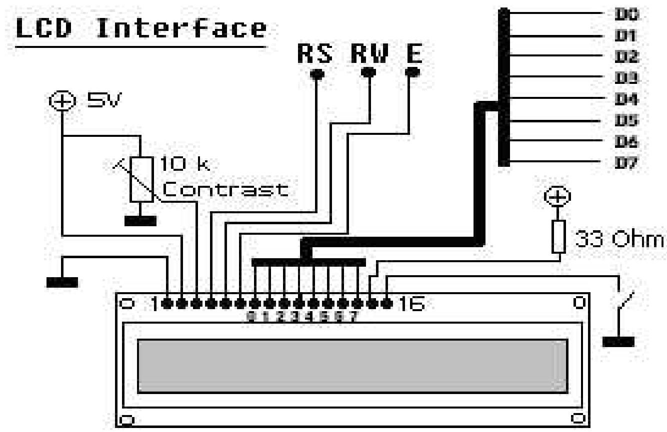


Fig. 2.8. LCD Connections

2.1.Table LCD PIN DETAILS

Pin No	Name	Function	USE
1	Vss	Ground	
2	Vdd	+ve Supply	5v Volts Regulated DC
3	Vee	Contrast	This is used to set the contrast1
4	RS	Register Set	Register select signal 0:Instruction register (when writing) Busy flag & address counter (When reading) 1:Data register (when writing & reading)

5	R/W	Read / Write	Read/write select signal “0” for writing , “1” for reading
6	E	Enable	Operation (data read/write) enable signal
7	D0	Data Bit 0	
8	D1	Data Bit 1	
9	D2	Data Bit 2	
10	D3	Data Bit 3	
11	D4	Data Bit 4	
12	D5	Data Bit 5	
13	D6	Data Bit 6	
14	D7	Data Bit 7	
15	A	+4.2 for Back light	Positive supply for back light if available
16	K	Power supply Back light (0V)	

2.9 TEMPERATURE SENSOR

The silicon bandgap temperature **sensor** is an extremely common form of temperature sensor (thermometer) used in electronic equipment. Its main advantage is that it can be included in a silicon integrated circuit at very low cost. The principle of the sensor is that the forward voltage of a silicon diode is temperature-dependent, according to the following equation:

$$V_{BE} = V_{G0}\left(1 - \frac{T}{T_0}\right) + V_{BE0}\left(\frac{T}{T_0}\right) + \left(\frac{nKT}{q}\right)\ln\left(\frac{T_0}{T}\right) + \left(\frac{KT}{q}\right)\ln\left(\frac{I_C}{I_{C0}}\right)$$

where

T = temperature in kelvins

T_0= reference temperature

V_{G0} = bandgap voltage at absolute zero

V_{BE0} = bandgap voltage at temperature T_0 and current I_{C0}

K = Boltzmann's constant

q = charge on an electron

n = a device-dependent constant

By comparing the bandgap voltages at two different currents, I_{C1} and I_{C2}, many of the variables in the above equation can be eliminated, resulting in the relationship:

$$\Delta V_{BE} = \frac{KT}{q} \cdot \ln\left(\frac{I_{C1}}{I_{C2}}\right)$$

An electronic circuit, such as the Brokaw bandgap reference, that measures ΔV_{BE} can therefore be used to calculate the temperature of the diode. The result remains valid up to about 200 °C to 250 °C, when leakage currents become large enough to corrupt the measurement. Above these temperatures, materials such as silicon carbide can be used instead of silicon.

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

Fig.2.9. LM35

2.9.1.FEATURES

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guaranteeable (at +25°C)
- .Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1⁄4°C typical
- Low impedance output, 0.1 for 1 mA load

2.10.IR SENSOR

The sensor will be basically a light detecting sensor. We here are using the property of absorption. We all know that black surface tends to absorb all the light that falls on it. So, we place a LED(Light Emitting Diode) along with a LDR(Light Dependant Resistor) as our sensor. Suppose that our sensor is hovering upon white surface. White surface reflects more than black. Therefore, more light would be reflected on LDR and thus, its resistance would change and we can predict accordingly that the sensor will be upon white surface. When it will be hovering upon black surface, less amount of light will be reflected and so we can predict that it is over the black surface.

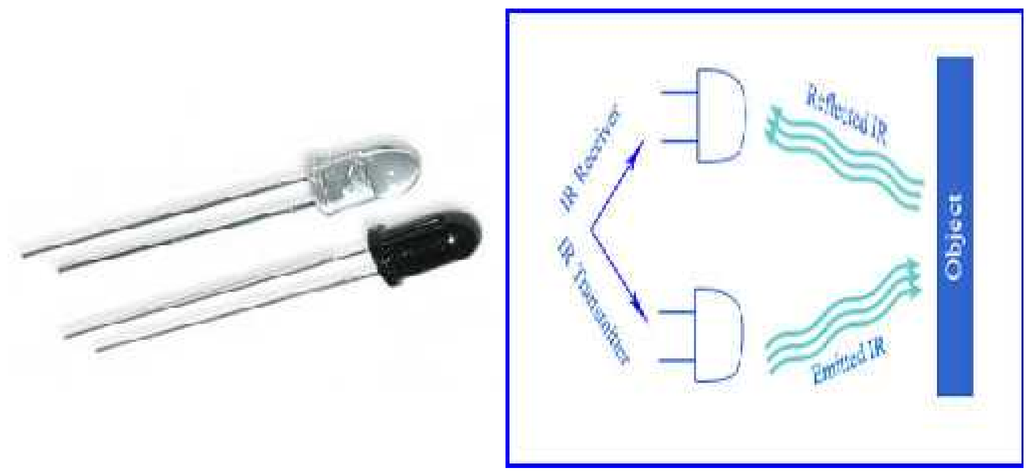


Fig.2.10.IR-333A

2.10.1. WORKING

The basic idea is to make use of IR LEDs to send the infrared waves to the object. Another IR diode of the same type is to be used to detect the reflected wave from the object.

When IR receiver is subjected to infrared light, a voltage difference is produced across the leads. Less voltage which is produced can be hardly detected and hence operational amplifiers (Op-amps) are used to detect the low voltages accurately. Measuring the distance of the object from the receiver sensor: The electrical property of IR sensor components can be used to measure the distance of an object. The fact when IR receiver is subjected to light, a potential difference is produced across the leads.

2.10.2. FEATURES

- High reliability
- High radiant intensity
- Peak wavelength λp=940nm
- 2.54mm Lead spacing
- Low forward voltage
- Pb free

2.11.MEMS SENSOR:

fig.2.11.ADXL335

The ADXL335 is a complete 3-axis acceleration measurement system. The ADXL335 has a measurement range of ±3 *g* mini-mum. It contains a polysilicon surface-micromachined sensor and signal conditioning circuitry to implement an open-loop acceleration measurement architecture. The output signals are analog voltages that are proportional to acceleration. The accelerometer can measure the static acceleration of gravity in tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.

2.11.1.WORKING:

Polysilicon springs suspend the MEMS structure above the substrate such that the body of the sensor (also known as the proof mass) can move in the X and Y axes. Acceleration causes deflection of the proof mass from its centre position. Around the four sides of the square proof mass are 32 sets of radial fingers. These fingers are positioned between plates that are fixed to the substrate. Each finger and pair of fixed plates make up a differential capacitor, and the deflection of the proof mass is determined by measuring the differential capacitance. This sensing method has the ability of sensing both dynamic acceleration (i.e. shock or vibration) and static acceleration (i.e. inclination or gravity).

The differential capacitance is measured using synchronous modulation/demodulation techniques. After amplification, the X and Y axis acceleration signals each go through a 32KOhm resistor to an output pin (Cx and Cy) and a duty cycle modulator .The user may limit the bandwidth, and thereby lower the noise floor, by adding a capacitor at the Cx and Cy pin. The output signals are voltage proportional to acceleration and pulse-width-modulation (PWM) proportional to acceleration.

2.11.2.FEATURES:

- 3-axis sensing
- Small, low profile package
- 4 mm × 4 mm × 1.45 mm LFCSP
- Low power : 350 µA (typical)
- Single-supply operation: 1.8 V to 3.6 V
- 10,000 *g* shock survival
- Excellent temperature stability

2.12.PULSE-WIDTH MODULATION MOTOR

Pulse-width modulation is an effective method for adjusting the amount of power delivered to an electrical load. A simple circuit containing an inverter chip, diodes, trimpot, and capacitor creates the variable duty-cycle PWM. A resistor and transistor switch heavier loads than the 74AC14 chip can drive by itself.

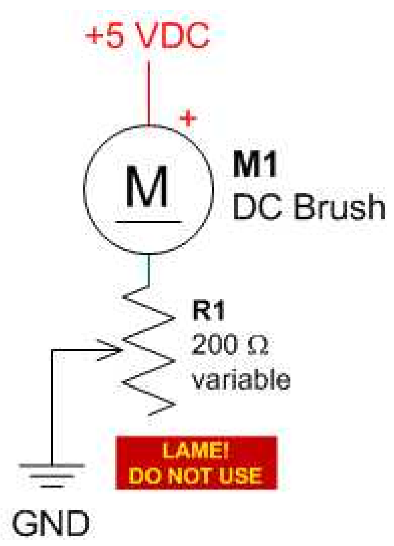


Fig.2.12.PWM motor

A motor needs a lot more power at startup that it does when running. The 112 ohm resistance is far too large for the motor to start turning at power up. Motors also draw a lot more power when a robot goes uphill or pushes something.

There is another reason why a resistor is not a good choice for controlling the power delivered to a large load. As the power requirements increase, it will quickly exceed the power rating on a resistor or potentiometer. The electronic component will get very hot and then will likely fail permanently.

Furthermore, a resistor wastes excess power as heat. In a battery powered robot, we'd prefer to not waste energy. A microcontroller-based PWM solution uses fewer components and has the flexibility of varying the duty cycle and frequency on-the-fly through software. This can be an advantage in a mini sumo battle, where searching might be performed at a slower motor speed, but the duty cycle needs to be increased to 100% "on" for pushing an opponent. PWM is more energy efficient than providing a constant current to the motor.

2.12.1.Pulse Width Modulated Waveform

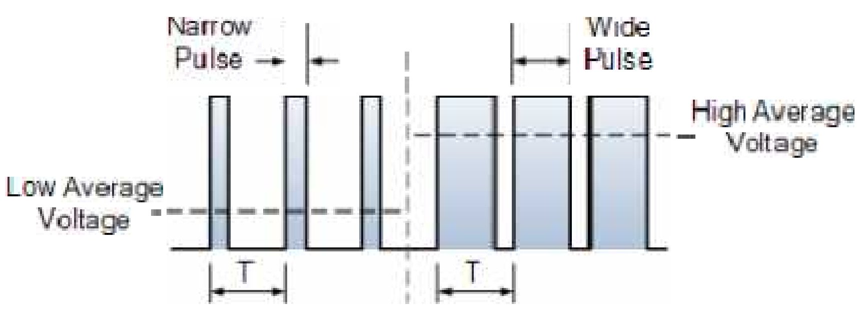
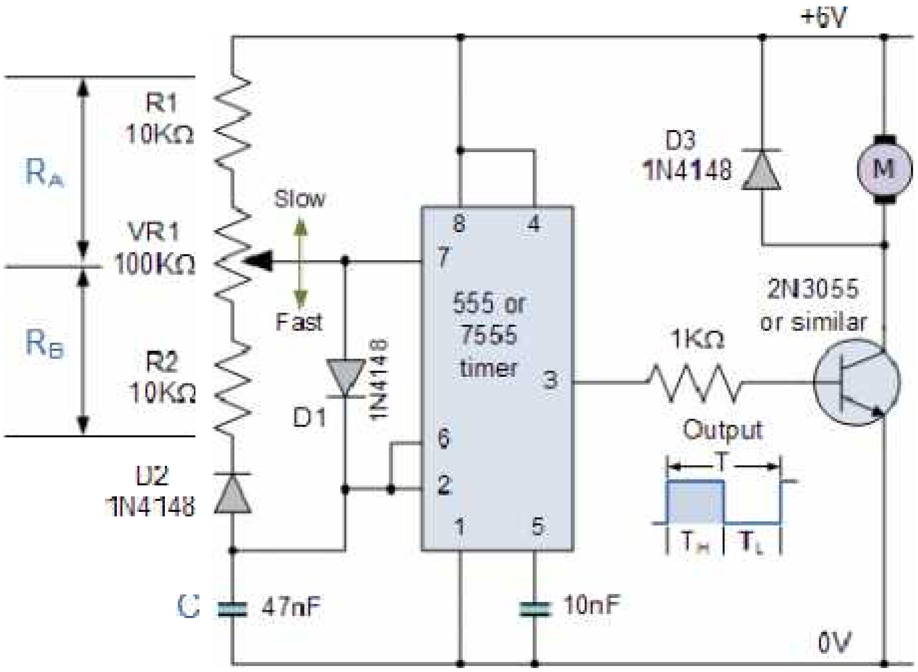


fig.2.13.PWM waveform

The use of pulse width modulation to control a small motor has the advantage in that the power loss in the switching transistor is small because the transistor is either fully “ON” or fully “OFF”. As a result the switching transistor has a much reduced power dissipation giving it a linear type of control which results in better speed stability.

Also the amplitude of the motor voltage remains constant so the motor is always at full strength. The result is that the motor can be rotated much more slowly without it stalling. So how can we produce a pulse width modulation signal to control the motor. Easy, use an Astable 555 Oscillator circuit as shown below.



2.13.RELAY DRIVER CIRCUIT:

- A Relay driver circuit is a circuit which can drive or operate a relay so that it can function appropriately ina circuit.
- The driven relay can then operate as a switch in the circuit which can open or close according to the needs of the circuit and its operation.

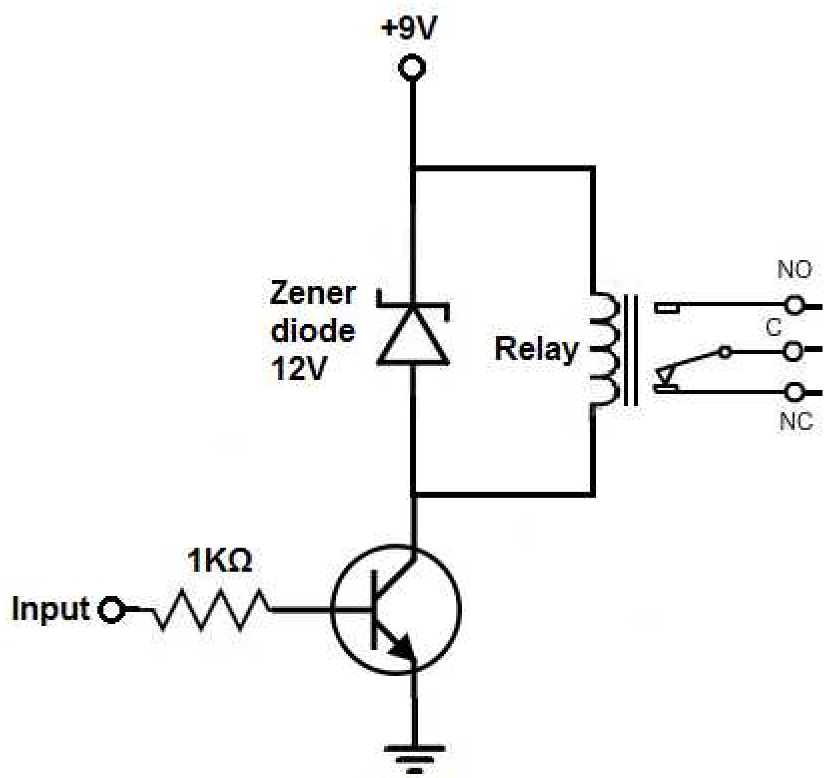


Fig.2.14.Relay driver circuit

Here a transistor is used to drive the relay,we can use considerably less power to get the relay driven.Because transistor is an amplifier,base lead enough current to cause a larger current to flow from the emitter of the transistor to the collector.Once the base receives sufficient power the transistor will conduct from emitter to collector and power the relay.

With no voltage or input current applied through the transistor's base lead.The transistor's emitter-to-collector channel is open,hence blocking current flow through the relay spoil.However,if sufficint voltage at the input current are applied to the base lead,the transistor's emitter-to-collector channel will open, allowing current to flow through the relay's coil.

The benefit of this circuit is smaller and arbitary current can be used to power the circuit and the relay.

3.SOFTWARE DESCRIPTION:

3.1.Embedded C

The C for microcontrollers and the standard C syntax and semantics are slightly different. The former is aimed at the general purpose programming paradigm whereas the latter is for a specific target microcontroller such as 8051 or PIC. The underlying fact is that everything will be ultimately mapped into the microcontroller machine code. If a certain feature such as indirect access to I/O registers is inhibited in the target microcontroller, the compiler will also restrict the same at higher level. Similarly some C operators which are meant for general purpose computing are also not available with the C for microcontrollers. Even the operators and constructs which may lead to memory inefficiency are not available in C programming meant for microcontrollers.

Be aware that the target code should fit in the limited on-chip memory of the processor. Even the I/O functions available in standard C such as printf() or scanf() are either not made available in C compilers for microcontrollers or advised not to use them. These functions eat up lot of memory space and are not time-efficient owing to the dragging of supporting functions like floating point routines and lot of delimiters. Another striking difference in case of embedded systems programs is that they do nothave the umbrella or support of the operating system.

The programmer has to be accustomed with the absence of system calls which makes life easy in traditional C.

3.1.1.ADVANTAGES:

- It is small and simpler to learn, understand, program and debug.
- Compared to assembly language, C code written is more reliable and scalable, more portable between different platform.
- C compilers are available for almost all embedded devices in use today, and there is a large pool of experienced C programmers.
- Unlike assembly, C has advantage of processor-independence and is not specific to any particular microprocessor/microcontroller or any system. This makes it convenient for a user to develop programs that can run on most of the systems.
- As C combines functionality of assembly language and features of high level languages, C is treated as a 'middle-level computer language' or 'high level assembly language'.
- It is fairly efficient.
- It supports access to I/O and provides ease of management of large embedded projects.
- Java is also used in many embedded systems but Java programs require the Java Virtual Machine (JVM), which consumes a lot of resources. Hence it is not used for smaller embedded devices.

3.2.SERIAL COMMUNICATION

3.2.1.INTRODUCTION

Serial communication is basically the transmission or reception of data one bit at a time. Today's computers generally address data in bytes or some multiple thereof. A byte contains 8 bits. A bit is basically either a logical 1 or zero. Every character on this page is actually expressed internally as one byte. The serial port is used to convert each byte to a stream of ones and zeroes as well as to convert a stream of ones and zeroes to bytes. The serial port contains a electronic chip called a Universal Asynchronous Receiver/Transmitter (UART) that actually does the conversion.

The serial port has many pins. We will discuss the transmit and receive pin first. Electrically speaking, whenever the serial port sends a logical one (1) a negative voltage is effected on the transmit pin. Whenever the serial port sends a logical zero (0) a positive voltage is affected. When no data is being sent, the serial port's transmit pin's voltage is negative (1) and is said to be in a MARK state. Note that the serial port can also be forced to keep the transmit pin at a positive voltage (0) and is said to be the SPACEor BREAK state. (The terms MARK and SPACE are also used to simply denote a negative voltage (1) or a positive voltage (0) at the transmit pin respectively).

When transmitting a byte, the UART (serial port) first sends a STARTBIT which is a positive voltage (0), followed by the data (general 8 bits, but could be 5, 6, 7, or 8 bits) followed by one or two STOP Bits which is a negative(1) voltage. The sequence is repeated for each byte sent. Figure 1 shows a diagram of what a byte transmission would look like.

At this point you may want to know what the duration of a bit is. In other words, how long does the signal stay in a particular state to define a bit. The answer is simple. It is dependent on the baud rate. The baud rate is the number of times the signal can switch states in one second. Therefore, if the line is operating at 9600 baud, the line can switch states 9,600 times per second.

When transmitting a character there are other characteristics other than the baud rate that must be known or that must be setup. These characteristics define the entire interpretation of the data stream.The first characteristic is the length of the byte that will be transmitted. This length in general can be anywhere from 5 to 8 bits.

The second characteristic is parity. The parity characteristic can be even, odd, mark, space, or none. If even parity, then the last data bit transmitted will be a logical 1 if the data transmitted had an even amount of 0 bits. If odd parity, then the last data bit transmitted will be a logical 1 if the data transmitted had an odd amount of 0 bits. If MARK parity, then the last transmitted data bit will always be a logical 1. If SPACE parity, then the last transmitted data bit will always be a logical 0. If no parity then there is no parity bit transmitted.

The third characteristic is the amount of stop bits. This value in general is 1 or 2. Assume we want to send the letter 'A' over the serial port. The binary representation of the letter 'A' is 01000001. Remembering that bits are transmitted from least significant bit (LSB) to most significant bit (MSB), the bit stream transmitted would be as follows for the line characteristics 8 bits, no parity, 1 stop bit and 9600 baud.

LSB (0 1 0 0 0 0 0 1 0 1) MSB

The above represents (Start Bit) (Data Bits) (Stop Bit). To calculate the actual byte transfer rate simply divide the baud rate by the number of bits that must be transferred for each byte of data. In the case of the above example, each character requires 10 bits to be transmitted for each character. As such, at 9600 baud, up to 960 bytes can be transferred in one second.

The above discussion was concerned with the "electrical/logical" characteristics of the data stream. We will expand the discussion to line protocol. Serial communication can be half duplex or full duplex. Full duplex communication means that a device can receive and transmit data at the same time. Half duplex means that the device cannot send and receive at the same time. It can do them both, but not at the same time. Half duplex communication is all but outdated except for a very small focused set of applications.

Half duplex serial communication needs at a minimum two wires, signal ground and the data line. Full duplex serial communication needs at a minimum three wires, signal ground, transmit data line, and receive data line. The RS232 specification governs the physical and electrical characteristics of serial communications. This specification defines several additional signals that are asserted (set to logical 1) for information and control beyond the data signal

These signals are the Carrier Detect Signal (CD), asserted by modems to signal a successful connection to another modem, Ring Indicator (RI), asserted by modems to signal the phone ringing, Data Set Ready (DSR), asserted by modems to show their presence, Clear To Send (CTS), asserted by modems if they can receive data, Data Terminal Ready (DTR), asserted by terminals to show their presence, Request To Send (RTS), asserted by terminals if they can receive data. The section RS232 Cabling describes these signals and how they are connected.

The above paragraph alluded to hardware flow control. Hardware flow control is a method that two connected devices use to tell each other electronically when to send or when not to send data. A modem in general drops (logical 0) its CTS line when it can no longer receive characters. It re-asserts it when it can receive again. A terminal does the same thing instead with the RTS signal. Another method of hardware flow control in practice is to perform the same procedure in the previous paragraph except that the DSR and DTR signal.

Note that hardware flow control requires the use of additional wires. The benefit to this however is crisp and reliable flow control. Another method of flow control used is known as software flow control. This method requires a simple 3 wire serial communication link, transmit data, receive data, and signal ground. If using this method, when a device can no longer receive, it will transmit a character that the two devices agreed on. This character is known as the XOFF character. This character is generally a hexadecimal 13. When a device can receive again it transmits an XON character that both devices agreed to. This character is generally a hexadecimal 11.

3.2.2.RS232

When we look at the connector pin out of the RS232 port, we see two pins which are certainly used for flow control. These two pins are **RTS**, request to send and **CTS**, clear to send. With **DTE/DCE** communication (i.e. a computer communicating with a modem device) **RTS** is an output on the **DTE** and input on the **DCE. CTS** are the answering signal coming from the **DCE.**

Before sending a character, the **DTE** asks permission by setting its **RTS** output. No information will be sent until the **DCE** grants permission by using the **CTS** line.

If the **DCE** cannot handle new requests, the **CTS** signal will go low. A simple but useful mechanism allows flow control in one direction. The assumption is that the **DTE** can always handle incoming information faster than the **DCE** can send it. In the past, this was true. Modem speeds of 300 baud were common and 1200 baud was seen as a high speed connection.

For further control of the information flow, both devices have the ability to signal their status to the other side. For this purpose, the **DTR** data terminal ready and **DSR** data set ready signals are present. The **DTE** uses the **DTR** signal to signal that it is ready to accept information, whereas the **DCE** uses the **DSR** signal for the same purpose. Using these signals involves not a small protocol of requesting and answering as with the **RTS/CTS** handshaking. These signals are in one direction only.

The last flow control signal present in **DTE/DCE** communication is the **CD** carrier detect. It is not used directly for flow control, but mainly an indication of the ability of the modem device to communicate with its counter part. This signal indicates the existence of a communication link between two modem devices.

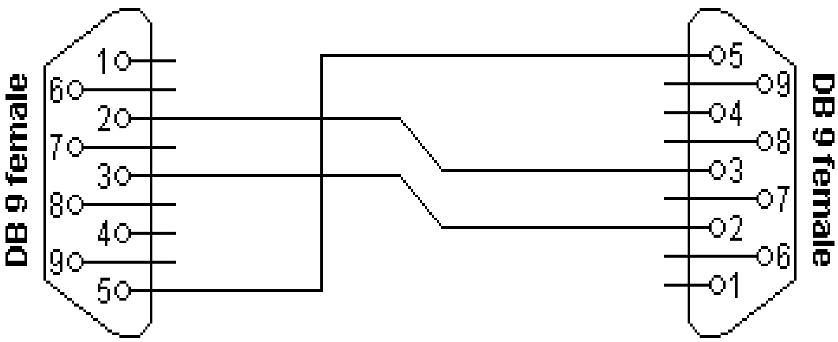


Fig.3.1.communication link between 2 modem devices

Connector 1	Connector 2	Function
2	3	Rx ← TX
3	2	TX → Rx
5	5	Signal ground

Table.3.1.Function of the communication link between 2 devices

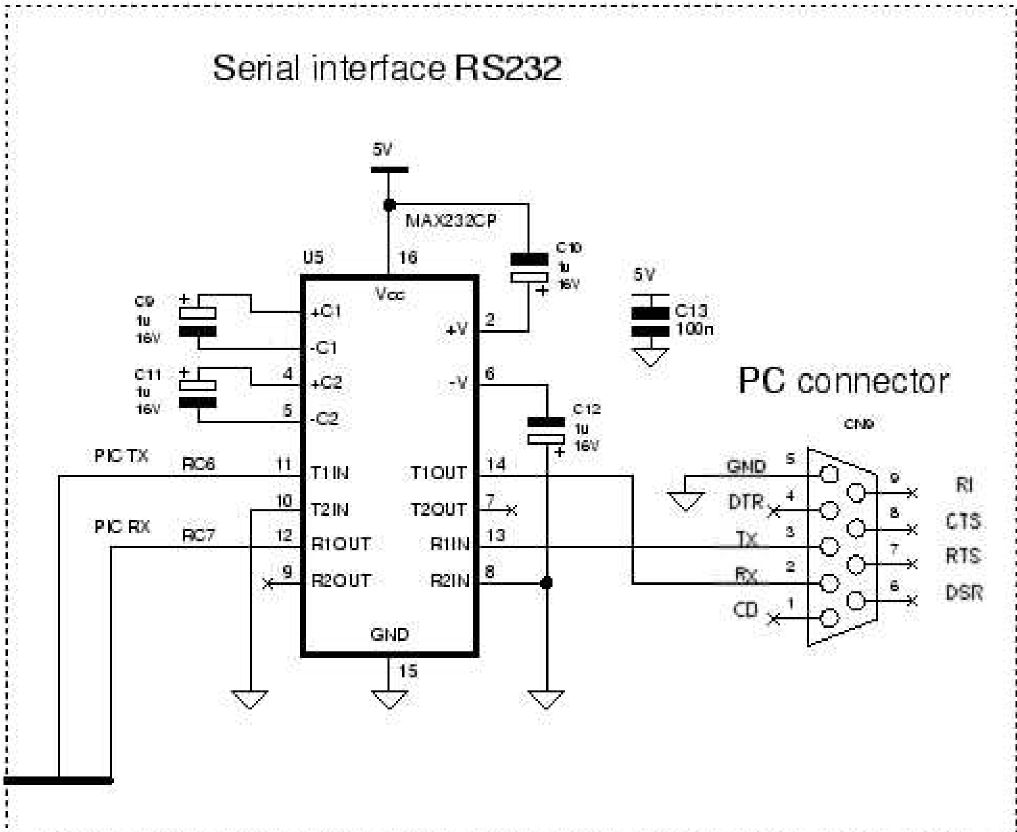


Fig.3.2. serial interface connection of RS232.

3.3.KEIL IDE

Keil Software is the leading vendor for 8/16-bit development tools (ranked at first position in the 2004 Embedded Market Study of the Embedded Systems and EE Times magazine). Keil Software is represented world-wide in more than 40 countries. Since the market introduction in 1988, the Keil C51 Compiler is the de facto industry standard and supports more than 500 current 8051 device variants. Now, Keil Software offers development tools for ARM.

Keil Software makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, and evaluation boards for the 8051, 251, ARM, and XC16x/C16x/ST10 microcontroller families.

Keil Software is pleased to announce simulation support for the Atmel AT91 ARM family of microcontrollers. The Keil µVision Debugger simulates the complete ARM instruction-set as well as the on-chip peripherals for each device in the AT91 ARM/Thumb microcontroller family. The integrated simulator provides complete peripheral simulation. Other new features in the µVision Debugger include:

- An integrated Software Logic Analyzer that measures I/O signals as well as program variables and helps developers create complex signal processing algorithms.
- An Execution Profiler that measures time spent in each function, source line, and assembler instruction. Now developers can find exactly where programs spend the most time.

"Using nothing more than the provided simulation support and debug scripts, developers can create a high-fidelity simulation of their actual target hardware and environment. No extra hardware or test equipment is required. The Logic Analyzer and Execution Profiler will help developers when it comes time to develop and tune signaling algorithms." said Jon Ward, President of Keil Software USA, Inc.

3.4.FLASH PROGRAMMER

FLASH PROGRAMMERis a software that is used to dump the hex file into the pic controller.

- Straightforward and intuitive user interface
- Five simple steps to erasing and programming a device and setting any options desired

- Programs Intel Hex Files
- Automatic verifying after programming
- Fills unused Flash to increase firmware security
- Ability to automatically program checksums.
- Using the supplied checksum calculation routine your firmware can easily verify the integrity of a Flash block, ensuring no unauthorized or corrupted code can ever be executed
- Program security bits
- Check which Flash blocks are blank or in use with the ability to easily erase all blocks in use
- Read the device signature
- Read any section of Flash and save as an Intel Hex File

4.CONCLUSION

This system enables the monitoring and prevention of higher vibration , rise in temperature ,higher speed of the wind turbine using the developed methodology to avoid blasting hazard.This is simple, reliable, convenient, time saving and high security system for wind turbine. In future this system can be expanded by using CAN bus to control and more number of turbines.