OBSTACLE AVODING ROBOT

Submitted in partial fulfillment of the Degree of

Bachelor of Technology

under the Supervision of

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WAKNAGHAT

Certificate

This is to certify that project report entitled "**OBSTACLE AVOIDING ROBOT**", submitted by **Harjot Singh , Karan Sethi and Ashish Sharma** in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

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

Date: **Ms. Pragya Gupta**

                                                                          (supervisor)

Acknowledgement

We would like to express our gratitude and appreciation to all those who gave us the possibility to complete this report. A special thanks to our final year project coordinator, Ms.Meenakshi Sood, whose help, stimulating suggestions and encouragement, helped us to coordinate our project especially in writing this report.

Last but not least, many thanks go to the head of the project, Ms. Pragya Gupta who have given her
full effort in guiding the team in achieving the goal as well as her encouragement to maintain our progress in track. We would to appreciate the guidance given by other supervisor as well as the panels especially in our project presentation that has improved our presentation skills by their comment and tips

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Summary

The obstacle detection scheme would be based a sonar sensor, one for forward direction , a microcontroller would take input from the sensor and then compare the inputs to decide where the robot should turn. It would then give input to the two h-bridges which would in turn direct the motors to control the movement of the robot. Apart from that we will use a 5v battery to power the microcontroller and the motors.

In robotics, obstacle avoidance is the task of satisfying some control objective subject to non-intersection or non-collision position constraints. Normally obstacle avoidance is considered to be distinct from path planning in that one is usually implemented as a reactive control law while the other involves the pre-computation of an obstacle-free path which a controller will then guide a robot along.

Signature of Students   Signature of Supervisior

Name:

Date:

1 - INTRODUCTION

1.1 Project overview

The main objective of the project is to develop an "OBSTACLE AVOIDING ROBOT",
using microcontroller AT89C51/2. This Robot will just avoid any obstacle coming in the path
of the robot. To implement this operation, sensors containing pair of IR LED and a Photo
Diode are used. The principal behind the operation is absorption of IR radiations emitted by
the IR LED by the photo diode after the reflection from the obstacle.

The LCD is used to display all the motions of the robot and makes the robot very interactive.
All the four motions of robot are displayed on the LCD such as moving forward, moving
backward, moving left and moving right and stop.

In robotics, obstacle avoidance is the task of satisfying some control objective subject to
non-intersection or non-collision position constraints. In unmanned air vehicles, it is a hot
topic. What is critical about obstacle avoidance concept in this area is the growing need of
usage of unmanned aerial vehicles in urban areas for especially military applications where it
can be very useful in city wars. Normally obstacle avoidance is considered to be distinct
from path planning in that one is usually implemented as a reactive control law while the
other involves the pre-computation of an obstacle-free path which a controller will then guide
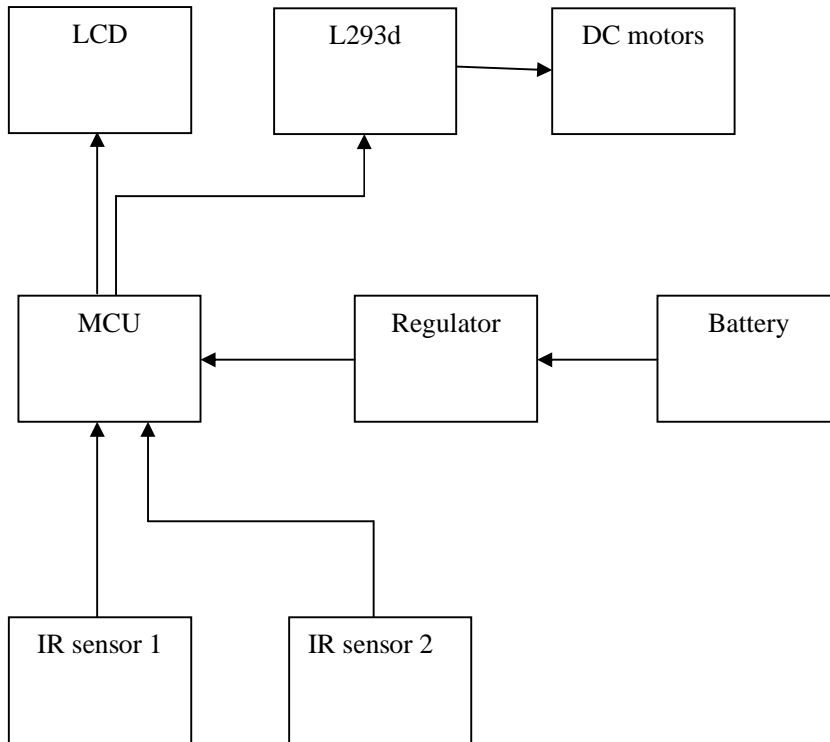a robot along.

1.2 BLOCK DIAGRAM

Fig.-1 Block diagram showing the complete circuit

2 - SYSTEM DESIGN AND WORKING

Hardware Description

2.1 Power Supply -

A POWER SUPPLY is a device which converts, regulates, and transmits the required power to the circuit to be operated.

The input of power supply is 240 volts 50 Hz frequency. The power supply converts the AC into DC and provides one or more DC output voltages. Common voltages are 48,24,15,12,9,5,3.3,2.5,1.8,1.5,1.2 and 1 volts.

Elements of power supply

- ➢ **Transformer:** It is a device used to convert the ac line voltage level from appropriate to the needs of circuit to be operated. At the same time it also provides isolation between the ac line and the circuit to be operated. The output of transformer is ac voltage but of an appropriate magnitude for circuit to powered.
- ➢ **Rectifier:** It is a device which converts ac voltage into pulsating dc. Rectifier uses a unidirectional device called P-N junction diodes. Rectifier can be half wave, Full wave or Bridge rectifier. Out of these three rectifiers we use bridge rectifier because it has maximum efficiency.
- ➢ **Filter**: The output from rectifier section is a pulsating DC. The filter circuit reduces the peak to peak pulses to small ripple voltage. Filter can be capacitor filter, RC filter.
- ➢ **Regulator**: Two common types of circuitry for voltage regulation are discrete transistors and IC's. Discrete-Transistor regulators are of series voltage regulator, current-limiting circuit, and shunt voltage regulator.
- ➢ **Indicator**: Indicators are used to indicate that the power supply is on and working properly. The most commonly used indicators used are led. The led indicator can never be connected directly and it is applied via resistance wire between outputs and led. Indicator is last stage of the power supply and it also shows that the power supply is working correctly.

2.2 TRANSFORMER:

Transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors — the transformer's coils or "windings".

Transformers, the conductors are commonly wound around a single iron-rich core, or around separate but magnetically coupled cores. A varying current in the first or "primary" winding creates a varying magnetic field in the core (or cores) of the transformer. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the "secondary" winding. This effect is called mutual induction. If a load is connected to the secondary circuit, electric charge will flow in the secondary winding of the transformer and transfer energy from the primary circuit to the load connected in the secondary circuit. The secondary induced voltage VS, of an ideal transformer, is scaled from the primary VP by a factor equal to the ratio of the number of turns of wire in their respective windings: By appropriate selection of the numbers of turns, a transformer thus allows an alternating voltage to be stepped up — by making NS more than NP — or stepped down, by making it

The secondary induced voltage V_S, of an ideal transformer, is scaled from the primary V_P by a factor equal to the ratio of the number of turns of wire in their respective windings:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

Transformers are of two types:

1. Step up transformer
2. Step down transformer

In power supply we use step down transformer. We apply 220V AC on the primary of step down transformer. This transformer steps down this voltage to 9V AC. We give this 9 V AC to rectifier circuit, which convert it to 5V DC.

BASIC PARTS OF A TRANSFORMER

In its most basic form a transformer consists of:

A primary coil or winding.

A secondary coil or winding.

A core that supports the coils or windings.

The primary winding is connected to a 60-hertz ac voltage source. The magnetic field (flux) builds up (expands) and collapses (contracts) about the primary winding. The expanding and contracting magnetic field around the primary winding cuts the secondary winding and induces an alternating voltage into the winding. This voltage causes alternating current to flow through the load. The voltage may be stepped up or down depending on the design of the primary and secondary winding.

THE COMPONENTS OF A TRANSFORMER

Two coils of wire (called windings) are wound on some type of core material. In some cases the coils of wire are wound on a cylindrical or rectangular cardboard form. In effect, the core material is air and the transformer is called an AIR-CORE TRANSFORMER. Transformers used at low frequencies, such as 60 hertz and 400 hertz, require a core of low-reluctance magnetic material, usually iron. This type of transformer is called an IRON-CORE TRANSFORMER. Most power transformers are of the iron-core type. The principle parts of a transformer and their functions are:

The CORE, which provides a path for the magnetic lines of flux.

The PRIMARY WINDING, which receives energy from the ac source.

The SECONDARY WINDING, which receives energy from the primary winding and delivers it to the load.

The ENCLOSURE, which protects the above components from dirt, moisture, and mechanical damage.

2.3 RECTIFIER

The main component of rectifier circuit is diode. Thus before explaining rectifier we should know about diodes.
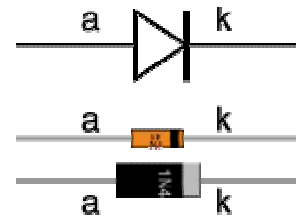
Diodes

Circuit symbol:

Connecting and soldering

Diodes must be connected the correct way round, the diagram may be labeled a or + for anode and k or **-** for cathode (yes, it really is k, not c, for cathode!). The cathode is marked by a line painted on the body. Diodes are labeled with their code in small print; you may need a magnifying glass to read this on small signal diodes!

Small signal diodes can be damaged by heat when soldering, but the risk is small unless you are using a germanium diode (codes beginning OA...) in which case you should use a heat

sink clipped to the lead between the joint and the diode body. A standard crocodile clip can be used as a heat sink.

Rectifier diodes are quite robust and no special precautions are needed for soldering them.

Testing diodes

You can use a multimeter or a simple tester (battery, resistor and LED) to check that a diode conducts in one direction but not the other. A lamp may be used to test a rectifier diode, but do NOT use a lamp to test a signal diode because the large current passed by the lamp will destroy the diode!

Signal diodes (small current)

Signal diodes are used to process information (electrical signals) in circuits, so they are only required to pass small currents of up to 100mA. General purpose signal diodes such as the 1N4148 are made from silicon and have a forward voltage drop of 0.7V.

Germanium diodes such as the OA90 have a lower forward voltage drop of 0.2V and this makes them suitable to use in radio circuits as detectors which extract the audio signal from the weak radio signal.

For general use, where the size of the forward voltage drop is less important, silicon diodes are better because they are less easily damaged by heat when soldering, they have a lower resistance when conducting, and they have very low leakage currents when a reverse voltage is applied.

Protection diodes for relays

Signal diodes are also used to protect transistors and ICs from the brief high voltage produced when a relay coil is switched off. The diagram shows how a protection diode is connected 'backwards' across the relay coil.

Current flowing through a relay coil creates a magnetic field which collapses suddenly when the current is switched off. The sudden collapse of the magnetic field induces a brief high voltage across the relay coil which is very likely to damage transistors and ICs. The

protection diode allows the induced voltage to drive a brief current through the coil (and diode) so the magnetic field dies away quickly rather than instantly. This prevents the induced voltage becoming high enough to cause damage to transistors and ICs.
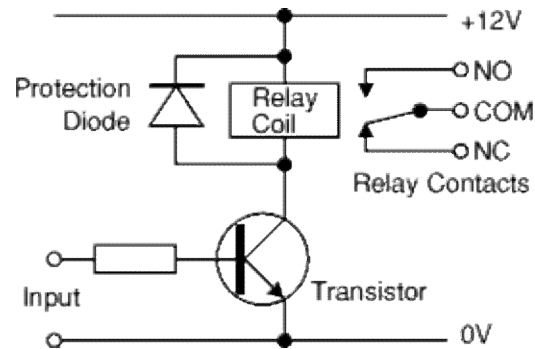

Fig.-2 Protection diode usage

Rectifier diodes (large current)

Rectifier diodes are used in power supplies to convert alternating current (AC) to direct current (DC), a process called rectification. They are also used elsewhere in circuits where a large current must pass through the diode.

All rectifier diodes are made from silicon and therefore have a forward voltage drop of 0.7V. The table shows maximum current and maximum reverse voltage for some popular rectifier diodes. The 1N4001 is suitable for most low voltage circuits with a current of less than 1A.

APPLICATION
•Diodes: Rectification, free-wheeling, etc.
•Zener diode: Voltage control, regulator etc.
•Tunnel diode: Control the current flow, snobbier circuit, etc.

RECTIFIER

Rectification is the conversion of alternating current (AC) to direct current (DC). This involves a device that only allows one-way flow of electrons. This is exactly what a semiconductor diode does.

• A *half-wave* rectifier is a circuit that allows only one half-cycle of the AC voltage waveform to be applied to the load, resulting in one non-alternating polarity across it. The resulting DC delivered to the load "pulsates" significantly.

• A *full-wave* rectifier is a circuit that converts both half-cycles of the AC voltage waveform to an unbroken series of voltage pulses of the same polarity. The resulting DC delivered to the load doesn't "pulsate" as much.

• Polyphase alternating current, when rectified, gives a much "smoother" DC waveform(less *ripple* voltage) than rectified single-phase AC.

HALF WAVE RECTIFIER

The simplest kind of rectifier circuit is the *half-wave* rectifier. It only allows one half of an AC waveform to pass through to the load.

For most power applications, half-wave rectification is insufficient for the task. The harmonic content of the rectifier's output waveform is very large and consequently difficult to filter. Furthermore, the AC power source only supplies power to the load one half every full cycle, meaning that half of its capacity is unused. Half-wave rectification is, however, a very simple way to reduce power to a resistive load.

FULL WAVE RECTIFIER

If we need to rectify AC power to obtain the full use of *both* half-cycles of the sine wave, a different rectifier circuit configuration must be used. Such a circuit is called a full-wave rectifier. One kind of full-wave rectifier, called the center-tap design, uses a transformer with a center-tapped secondary winding and two diodes,

This circuit's operation is easily understood one half-cycle at a time.

Consider the first half cycle, when the source voltage polarity is positive (+) on top and negative (-) on bottom. At this time, only the top diode is conducting; the bottom diode is

blocking current, and the load "sees" the first half of the sine wave, positive on top and negative on bottom. Only the top half of the transformer's secondary winding carries current during this half-cycle. During the next half-cycle, the AC polarity reverses. Now, the other diode and the other half of the transformer's secondary winding carry current while the portions of the circuit formerly carrying current during the last half-cycle sit idle. The load still "sees" half of a sine wave, of the same polarity as before: positive on top and negative on bottom.

One disadvantage of this full-wave rectifier design is the necessity of a transformer with a center-tapped secondary winding. If the circuit in question is one of high power, the size and expense of a suitable transformer is significant. Consequently, the center-tap rectifier design is only seen in low-power applications.

The full-wave center-tapped rectifier polarity at the load may be reversed by changing the direction of the diodes. Furthermore, the reversed diodes can be paralleled with an existing positive-output rectifier. The result is dual-polarity full-wave center-tapped 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 and with single component bridges where the diode bridge is wired internally.

According to the conventional model of current flow originally established by Benjamin Franklin and still followed by most engineers today, current is assumed to flow through electrical Conductors from the positive to the negative pole. In actuality, free electrons in a conductor nearly always flow from the negative to the positive pole. In the vast majority of applications, however, the irrelevant. Therefore, in the discussion below the conventional model is retained.

It is built around a four-diode bridge configuration. For obvious reasons, this design is called a full-wave bridge.

The current flow is through two diodes in series for both polarities. Thus, two diode drops of the source voltage are lost ($0.7 \cdot 2 = 1.4$ V for Si) in the diodes. This is a disadvantage compared with a full-wave center-tap design. This disadvantage is only a problem in very low voltage power supplies. Diodes in a full-wave bridge rectifier circuit can often be frustrating to the new student of electronics.

2.4 The Capacitor Filter

Capacitor passive electronic component consisting of a pair of conductors separated by a dielectric. When a voltage potential difference exists between the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the plates.

An ideal capacitor is characterized by a single constant value, capacitance, which is measured in farads.
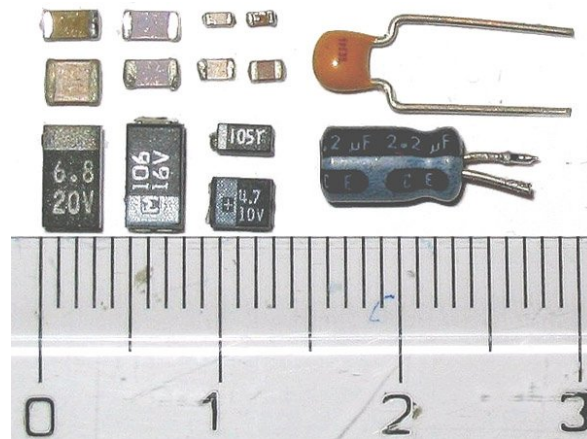
$$C = Q / V$$

Fig 3.Different Capacitors

In a way, a capacitor is a little like a battery. Although they work in completely different ways, capacitors and batteries both store electrical energy. If you have read how Batteries Work, then you knows that a battery has two terminals. Inside the battery, chemical reactions produce electrons on one terminal and absorb electrons at the other terminal.

BASIC

Like a battery, a capacitor has two terminals. Inside the capacitor, the terminals connect to two metal plates separated by a dielectric. The dielectric can be air, paper, plastic or anything else that does not conduct electricity and keeps the plates from touching each other. You can easily make a capacitor from two pieces of aluminum foil and a piece of paper. It won't be a particularly good capacitor in terms of its storage capacity, but it will work. In an electronic circuit, a capacitor is shown like this: When you connect a capacitor to a battery, here's what happens:

•The plate on the capacitor that attaches to the negative terminal of the battery accepts electrons that the battery is producing.

•The plate on the capacitor that attaches to the positive terminal of the battery loses electrons to the battery.

Function

Capacitors store electric charge. They are used with resistors in timing circuit because it takes time for a capacitor to fill with charge. They are used to smooth varying DC supplies by acting as a reservoir of charge. They are also used in filter circuits because capacitors easily pass AC (changing) signals but they block DC (constant) signals.

Capacitance

This is a measure of a capacitor's ability to store charge. A large capacitance means that more charge can be stored. Capacitance is measured in farads, symbol F. However 1F is very large, so prefixes are used to show the smaller values.

Three prefixes (multipliers) are used, μ (micro), n (nano) and p (pico):

- μ means 10^{-6} (millionth), so 1000000μF = 1F
- n means 10^{-9} (thousand-millionth), so 1000nF = 1μF
- p means 10^{-12} (million-millionth), so 1000pF = 1nF

Capacitor values can be very difficult to find because there are many types of capacitor with different labeling systems!

There are many types of capacitor but they can be split into two groups, polarized and un-polarized. Each group has its own circuit symbol.

Polarized capacitors (large values, 1µF +)

Circuit symbol:
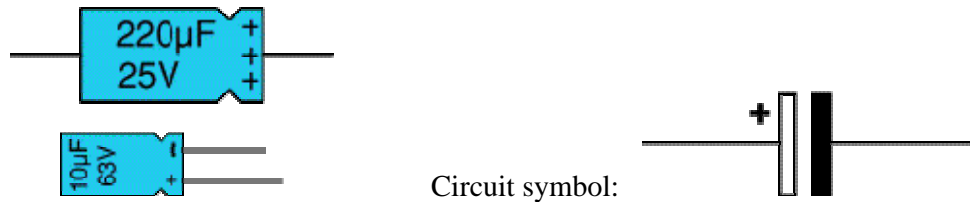
Electrolytic Capacitors

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 (220µF in picture) and radial where both leads are at the same end (10µF in picture). Radial capacitors tend to be a little smaller and they stand upright on the circuit board.

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.

Tantalum Bead Capacitors

Tantalum bead capacitors are polarized and have low voltage ratings like electrolytic capacitors. They are expensive but very small, so they are used where a large capacitance is needed in a small size.

Modern tantalum bead capacitors are printed with their capacitance, voltage and polarity in full. However older ones use a color-code system which has two stripes (for the two digits) and a spot of color for the number of zeros to give the value in µF. The standard color code is

used, but for the spot, grey is used to mean × 0.01 and white means × 0.1 so that values of less than 10μF can be shown. A third color stripe near the leads shows the voltage (yellow 6.3V, black 10V, green 16V, blue 20V, grey 25V, white 30V, pink 35V). The positive (+) lead is to the right when the spot is facing you: 'when the spot is in sight, the positive is to the right'.
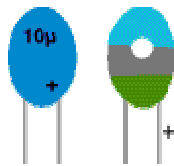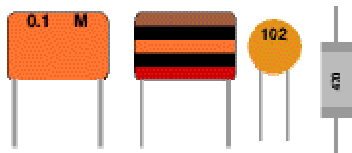

For example: blue, grey, black spot   means 68μF
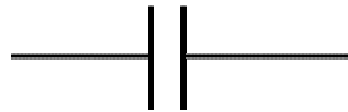For example: blue, grey, white spot   means 6.8μF
For example: blue, grey, grey spot   means 0.68μF

Un-polarized capacitors (small values, up to 1μF)

                    Circuit symbol:

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!

Many small value capacitors have their value printed but without a multiplier, so you need to use experience to work out what the multiplier should be!
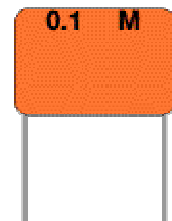
For example 0.1 means 0.1μF = 100nF.

2.5 REGULATOR IC (78XX)

It is a three pin IC used as a voltage regulator. It converts unregulated DC current into regulated DC current. Normally we get fixed output by connecting the voltage regulator at the output of the filtered DC (see in above diagram). It can also be used in circuits to get a low DC voltage from a high DC voltage (for example we use 7805 to get 5V from 12V). There are two types of voltage regulators 1. Fixed voltage regulators (78xx, 79xx) 2. Variable voltage regulators (LM317)

In fixed voltage regulators there is another classification 1. +ve voltage regulators 2. -ve voltage regulators POSITIVE VOLTAGE REGULATORS this include 78xx voltage regulators. The most commonly used ones are 7805 and 7812. 7805 gives fixed 5V DC voltage if input voltage is in (7.5V, 20V).
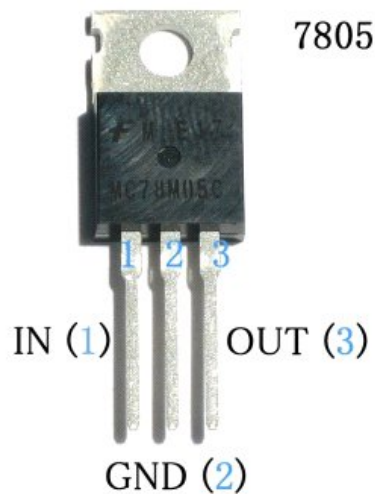
Fig.- 4 Regulator

2.6 LED

Light Emitting Diodes
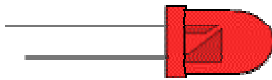
Circuit symbol:-

Function

LEDs emit light when an electric current passes through them.

Connecting and soldering

LEDs must be connected the correct way round, the diagram may be labeled a or + for anode and k or **-** for cathode (yes, it really is k, not c, for cathode!). The cathode is the short lead and there may be a slight flat on the body of round LEDs. If you can see inside the LED the cathode is the larger electrode (but this is not an official identification method).
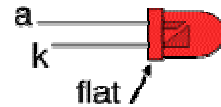
LEDs can be damaged by heat when soldering, but the risk is small unless you are very slow. No special precautions are needed for soldering most LEDs.

Testing an LED

Never connect an LED directly to a battery or power supply! It will be destroyed almost instantly because too much current will pass through and burn it out.
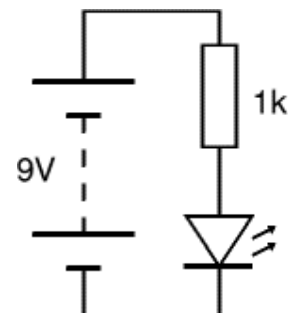
LEDs must have a resistor in series to limit the current to a safe value, for quick testing purposes a 1kΩ resistor is suitable for most LEDs if your supply voltage is 12V or less. Remember to connect the LED the correct way round!

For an accurate value please see calculating an LED resistor value below.

The power supply circuit comprises of four basic parts:

TRANSFORMER	→	BRIDGE RECTIFIER	→	SHUNT CAPACITOR	→	VOLTAGE REGULATOR	→	INDICATOR
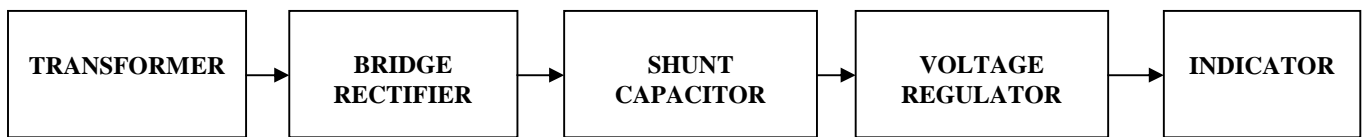
Fig.-5 Power Supply Circuit

The transformer steps down the 220 V a/c. into 12 V a/c. The transformer work on the principle of magnetic induction, where two coils: primary and secondary are wound around an iron core. The two coils are physically insulated from each other in such a way that passing a/c. current through the primary coil creates a changing voltage in the primary coil and a changing magnetic field in the core. This in turn induces a varying a/c. voltage in the secondary coil.

The a/c. voltage is then fed to the bridge rectifier. The rectifier circuit is used in most electronic power supplies is the single-phase bridge rectifier with capacitor filtering, usually followed by a linear voltage regulator. A rectifier circuit is necessary to convert a signal having zero average value into a non-zero average value. A rectifier transforms alternating current into direct current by limiting or regulating the direction of flow of current. The output resulting from a rectifier is a pulsating D.C. voltage. This voltage is not appropriate for the components that are going to work through it.

Fig.-6 Circuit Testing Led

The ripple of the D.C. voltage is smoothened using a filter capacitor of 1000 micro-Farad 25V. The filter capacitor stores electrical charge. If it is large enough the capacitor will store charg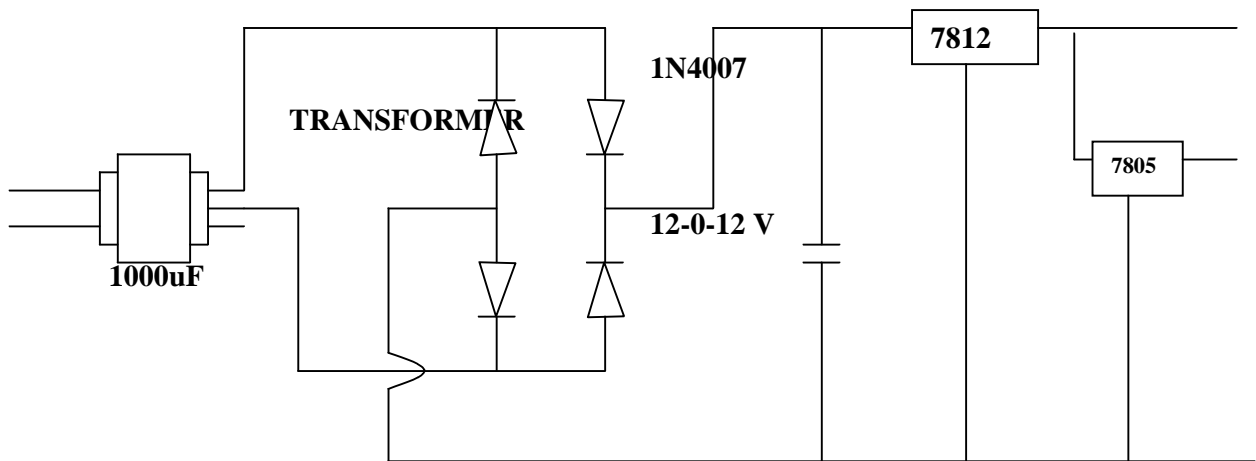e as the voltage rises and give up the charge as the voltage falls. This has the effect of smoothing out the waveform and provides steadier voltage output. A filter capacitor is connected at the rectifier output and the d.c voltage is obtained across the capacitor. When this capacitor is used in this project, it should be twice the supply voltage. When the filter is used, the RC charge time of the filter capacitor must be short and the RC discharge time must be long to eliminate ripple action. In other words the capacitor must charge up fast, preferably with no discharge.

When the rectifier output voltage is increasing, the capacitor charges to the peak voltage Vm. Just past the positive peak, the rectifier output voltage starts to fall but at this point the capacitor has +Vm voltage across it. Since the source voltage becomes slightly less than Vm, the capacitor will try to send current back through the diode of rectifier. This reverse biases the diode. The diode disconnects or separates the source the source form load. The capacitor starts to discharge through load. This prevents the load voltage from falling to zero. The capacitor continues to discharge until source voltage becomes more than capacitor voltage. The diode again starts conducting and the capacitor is again charged to peak value Vm. When capacitor is charging the rectifier supplies the charging through capacitor branch as well as load current, the capacitor sends currents through the load. The rate at which capacitor

discharge depends upon time constant RC. The longer the time constant, the steadier is the output voltage. An increase in load current i.e. decrease in resistance makes time constant of discharge path smaller. The ripple increase and d.c. output voltage V dc decreases. Maximum capacity cannot exceed a certain limit because the larger the capacitance the greater is the current required to charge the capacitor.

The voltage regulator regulates the supply if the supply if the line voltage increases or decreases. The series 78xx regulators provide fixed regulated voltages from 5 to 24 volts. An unregulated input voltage is applied at the IC Input pin i.e. pin 1 which is filtered by capacitor. The out terminal of the IC i.e. pin 3 provides a regular output. The third terminal is connected to ground. While the input voltage may vary over some permissible voltage range, and the output voltage remains constant within specified voltage variation limit. The 78xx IC's are positive voltage regulators whereas 79xx IC's are negative voltage regulators.

These voltage regulators are integrated circuits designed as fixed voltage regulators for a wide variety of applications. These regulators employ current limiting, thermal shutdown and safe area compensation. With adequate heat sinking they can deliver output currents in excess of 1 A. These regulators have internal thermal overload protection. It uses output transistor safe area compensation and the output voltage offered is in 2% and 4% tolerance.

2.7 Motors

Michael Faraday invented the electric motor, which is used to convert electrical energy to mechanical energy, in 1821. Electric current supplied from the power lines can only be used directly in heating, lighting and other applications. To use this power to run devices like pumps, automobiles, domestic appliances and machine tools, the electrical energy must be converted to mechanical energy, which rotates shafts and gear trains.

Electric motors are available in three basic types of horsepower (hp) ratings: small, medium and large. Small motors are made to produce fractional hp of 1/20 to 1 hp. Medium motors are available in the range of 1 to 100 hp and large motors are available in ratings of 100 to

50,000 hp. Power can also be expressed in kilowatts (1 kW = 1.33 hp; 1 hp = 746 W). Standard frequencies at which motors operate are 50 or 60 Hertz.

Working

The electric motor is based on the principle of electromagnetism and uses the Lorentz law. When current flows through a wire it produces a magnetic field. The right hand rule is used to describe the magnetic field. The right-hand rule is used to find the direction of the force. When the thumb points in the direction of the current and the fingers point in the direction of the external magnetic field, then the force experienced by the conductor is in the outward direction from the palm.

An electric motor has a rotating part called the rotor and a stationary part called the stator. Electromagnets called poles are wound on the frame called the armature. When current is passed, the rotor rotates due to the torque generated by the wires and the magnetic field. The rotation is transferred to a shaft which transfers its rotation energy to any device that is attached to it.

Types of Electric Motors

Major types of electric motors are DC motors (direct current), AC motors (alternating current) and Universal motors that can operate on either AC or DC current. Each category is an industry by itself and has many different sub-types.

Universal Motors

These motors can use both DC and AC current and are commonly used in vacuum cleaners, food mixers, blenders, small power tools and hair dryers and other appliances that operate at high speed but are not used continuously. They are a variant of the wound DC motor and special care is taken to cover the impedance and reluctance of AC motors. Thyristors or stepped speed control circuits are used for continuous speed control.

DC Motors :DC motors provide momentary power bursts of up to five times the rated torque. The speed can be brought down to zero smoothly and immediately raised in the opposite direction without any power interruption.

DC motors have an electromagnet with two poles, which serve as a rotating armature. A commutator or rotary switch is used to reverse the current direction twice in each cycle. This causes the poles of the electromagnet to push and pull against the external permanent magnets. When the poles of the armature pass through the poles of the permanent magnet, the commutator reverses the polarity of the armature. The inertia maintains the current direction at the instance when polarity is switched.

Major types of DC motors are:

- Brushless DC Motors: These motors are used to drive CD-ROM spindles, fans, office products like Xerox machines, lasers and also in expensive aircraft models. They have a permanent external rotor magnet; three phase driving coils and Hall Effect devices that sense rotor position. They are more efficient than AC motors, do not produce excessive heat and last longer since there is no commutator.
- Limited-Angle Torque Motors: These are special type of brushless DC motors and the torque is produced within 180 degrees of rotation. They are used in: direct laser mirrors, servo valves, open shutters used in heat-seeking sensors, position missile guidance radar antennas and power systems where the degree of rotation is small. The rotor carries field magnets and the stator carries the armature winding.
- PM DC Motors: These are small motors that produce about 50% greater torque than other comparably sized motors. Magnets are made of Samarium-cobalt and the torque ripple is greatly reduced.
- Coreless DC Motors: In these motors, there is no iron core, thus giving a low mass and higher acceleration and deceleration. The stator is made of a cylindrical permanent magnet that is placed in a housing made of mild steel. Rotors are wound in a honeycombed pattern to increase the torque. The commutator is made of gold, platinum and other precious metals. They are used to drive Capstan in magnetic tape drives and in high-performance servo-controlled systems.
- Linear DC Motors: These are used in Maglev super fast trains and produce a linear force and no a torque. It has a stator and a slider. The stator has a laminated steel frame with conductors wound in transverse slots. The slider has sets of magnets, commutator, a bearing surface and it makes a path of magnetic flux between the magnets.

AC Motors

The AC motor allows long-range distribution of alternating current. This motor played a very important role in the rapid growth of industrialization. An AC motor has two main parts, a fixed external stator and an internal rotor. The stator has coils through which AC current flows and it produces a rotating magnetic field. The rotor is attached to the output shaft and gets a torque by the rotating magnetic field. Based on the type of rotor, there are two major types of motors, synchronous motors and induction motors. The synchronous motor rotates at the frequency of the input current or its fractions. The induction motor can turn at lower speeds than the input frequency and is also called a squirrel cage motor. A common differentiator is the phase of the motor. Single-phase motors use a single discrete waveform while two and three phase motors use two and three discrete polyphase waveforms that are spaced 180 and 120 degrees apart.

- Single-phase AC induction motors: In this type of motor, only one discrete waveform is used. It has a rotating magnetic field to create the starting torque. These are used in devices like fans, washing machines, clothes dryer and other small household appliances. Important types are shaded pole motors and split phase induction motors.
- Three-phase AC induction motors: These are used in high power applications. The phase difference between the three discrete waveforms of the input polyphase creates a rotating magnetic field. They are the workhorses of the industry and are used in heavy-duty electrical networks, locomotives and other applications. Using the principles of electromagnetic induction, current is induced in the conductors of the rotor by a rotating magnetic field. This creates a counterbalance field that makes the rotor turn in the direction of the magnetic field. The rotor rotates at a slower rate than the magnetic field. These motors will work even if one phase is disconnected.
- Single-phase AC synchronous motors: These motors rotate in a synchronous manner with the main current frequency. They have magnetized rotors and do not need an induced current. This prevents backward slippage against the main frequency which makes them very accurate. They are used in audio turntables, mechanical clocks, tape drives, telescope drive systems, strip chart recorders and other applications.
- Three-phase AC synchronous motors: These motors provide high and accurate performance and are used in traction motor applications and in TGV locomotives.

Connections to the rotor coils are given on slip rings and a separate field current is given. This produces a continuous magnetic field that causes the rotor to rotate synchronously with the rotating magnetic field. These motors can also be used as alternators. To reduce starting problems, the motors are driven by transistorized variable frequency drives or with squirrel cage winding with a common rotor.

Stepper motors:

The design is similar to three-phase AC synchronous motors and is a hybrid of a DC motor with solenoid. They have an internal rotor with permanent magnets that is controlled by external magnets which are operated electronically. The motor does not rotate continuously but steps from one position to another when the windings are activated and deactivated in a sequence. This allows them to turn forwards or backwards. They are used in sophisticated positioning drives and in servo controlled systems.

Definite and Special-Purpose Motors: These are used for special applications like powering instruments, gear motors, toothless motors, etc. They can be customized for a specific use and cost less than the standard motors with the same power rating.
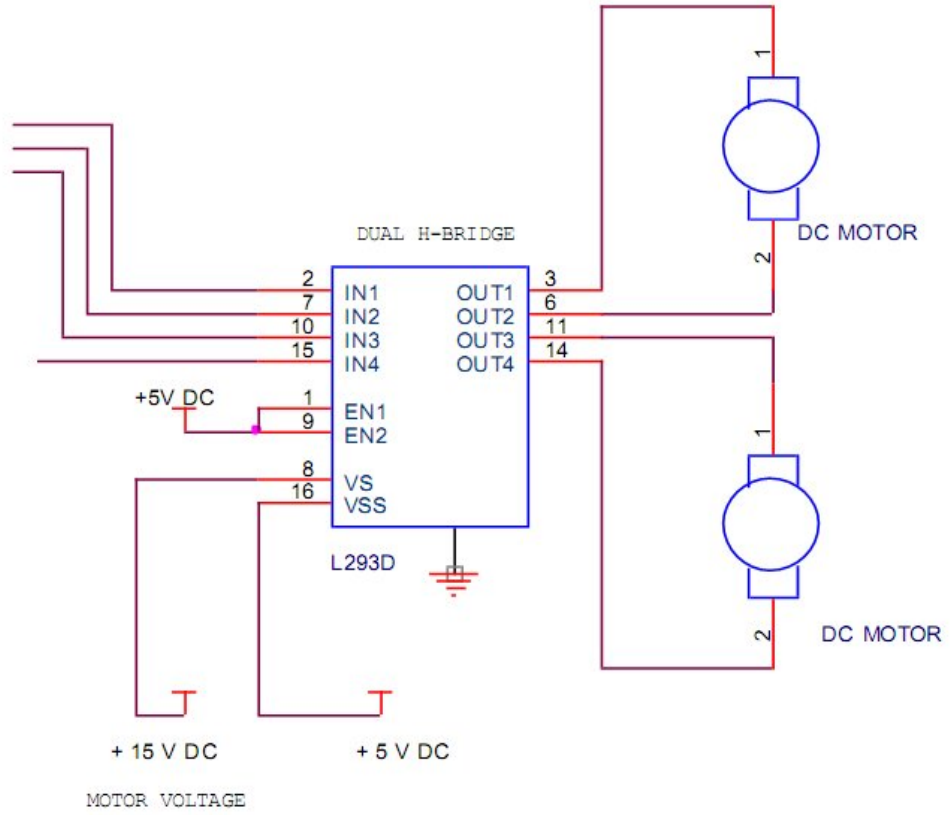
Fig.-7 SCHEMATIC OF L293D WITH DC MOTOR

3. MICRONTROLLER:

3.1 BRIEF INTRODUCTION TO 8051 MICROCONTROLLER:

A microcontroller is a single chip that contains the processor (the CPU), non-volatile memory for the program (ROM or flash), volatile memory for input and output (RAM), a clock and an I/O control unit. Also called a "computer on a chip," billions of microcontroller units (MCUs) are embedded each year in a myriad of products from toys to appliances to automobiles. For example, a single vehicle can use 70 or more microcontrollers. The following picture describes a general block diagram of microcontroller.

3.2 AT89S52:

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller, which provides a highly flexible and cost-effective solution to many, embedded control applications. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM con-tents but freezes the oscillator, disabling all other chip functions until the next interrupt. The hardware is driven by a set of program instructions, or software. Once familiar with hardware and software, the user can then apply the microcontroller to the problems easily. The pin diagram of the 8051 shows all of the input/output pins unique to microcontrollers: The following are some of the capabilities of 8051 microcontroller.

1. Internal ROM and RAM

2. I/O ports with programmable pins

3. Timers and counters

4. Serial data communication

The 8051 architecture consists of these specific features:

- ➢ 16 bit PC &data pointer (DPTR)
- ➢ 8 bit program status word (PSW)
- ➢ 8 bit stack pointer (SP)
- ➢ Internal ROM 4k
- ➢ Internal RAM of 128 bytes.
- ➢ 4 register banks, each containing 8 registers
- ➢ 80 bits of general purpose data memory
- ➢ 32 input/output pins arranged as four 8 bit ports: P0-P3
- ➢ Two 16 bit timer/counters: T0-T1
- ➢ Two external and three internal interrupt sources Oscillator and clock circuits.

Circumstances that we find ourselves in today in the field of microcontrollers had their beginnings in the development of technology of integrated circuits. This development has made it possible to store hundreds of thousands of transistors into one chip. That was a prerequisite for production of microprocessors, and the first computers were made by adding external peripherals such as memory, input-output lines, timers and other. Further increasing of the volume of the package resulted in creation of integrated circuits. These integrated circuits contained both processor and peripherals. That is how the first chip containing a microcomputer, or what would later be known as a microcontroller came about.

Definition of a Microcontroller

Microcontroller, as the name suggests, are small controllers. They are like single chip computers that are often embedded into other systems to function as processing/controlling unit. For example, the remote control you are using probably has microcontrollers inside that do decoding and other controlling functions. They are also used in automobiles, washing machines, microwave ovens, toys ... etc, where automation is needed.

The key features of microcontrollers include:

1. High Integration of Functionality

2. Microcontrollers sometimes are called single-chip computers because they have on-chip memory and I/O circuitry .

3. Field Programmability, Flexibility.

4. Microcontrollers often use EEPROM or EPROM as their storage device to allow field programmability so they are flexible to use.
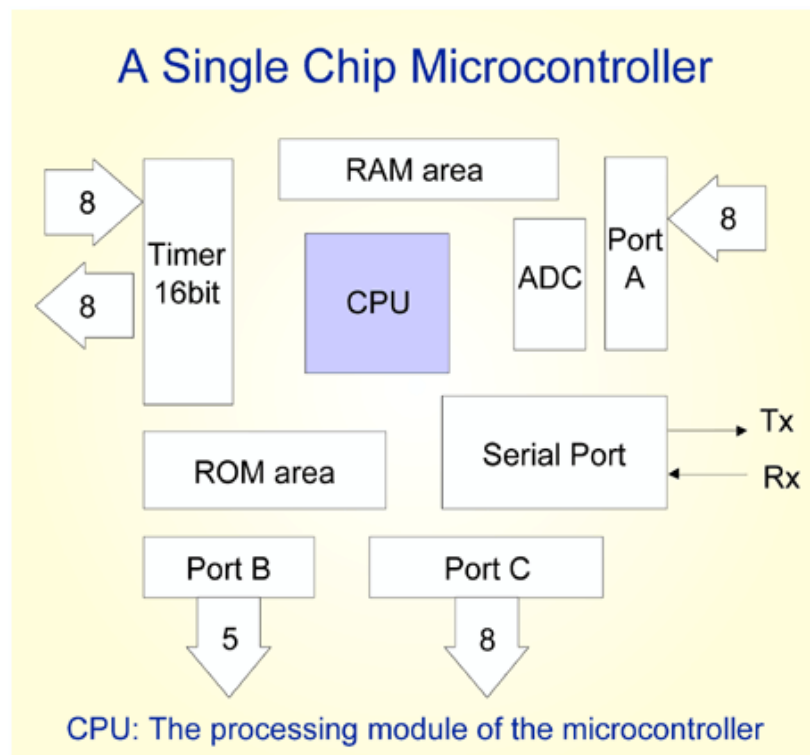
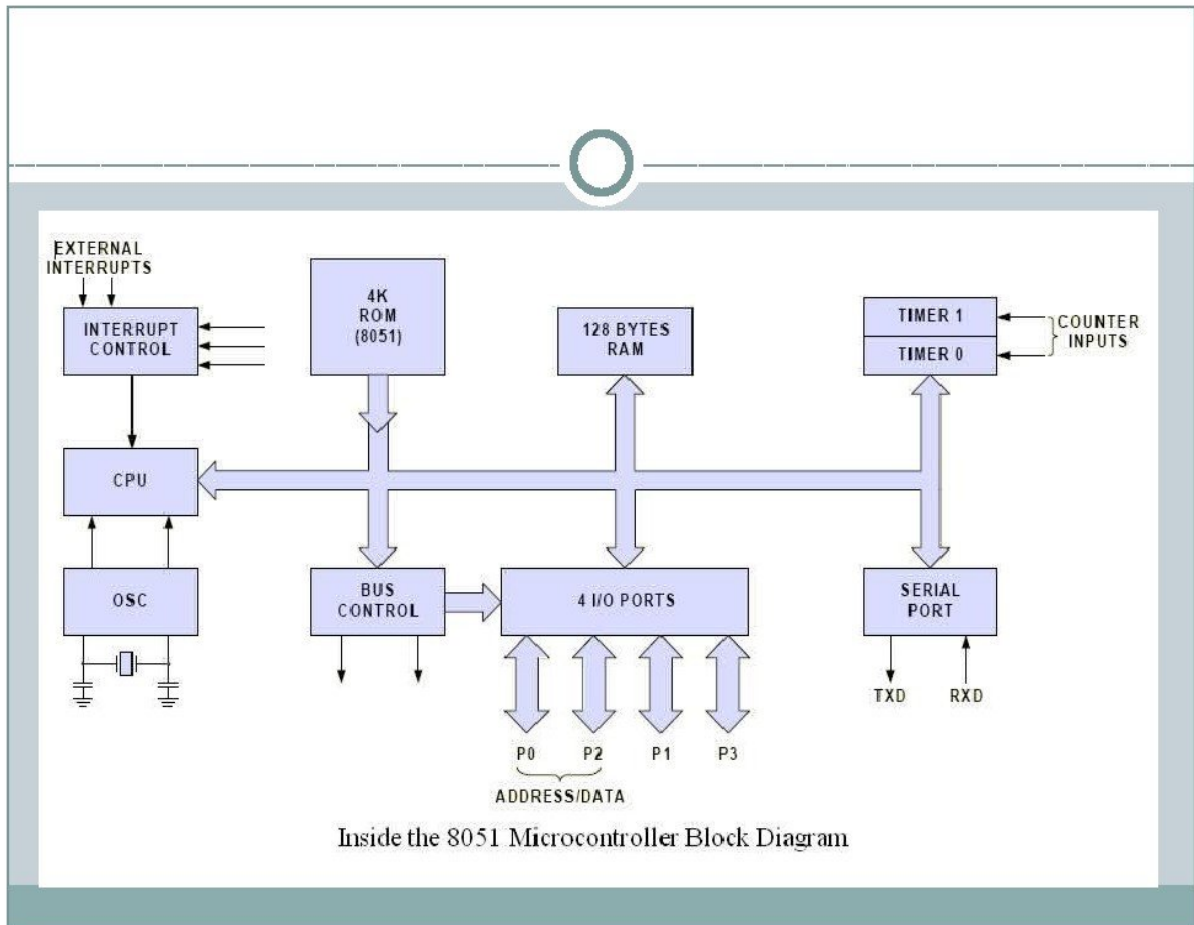**Showing a typical microcontroller device and its different subunits**

Fig.-8 8051 Block Diagram

3.3 MICROCONTROLLERS VERSUS MICROPROCESSORS

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

MICROCONTROLLERS FOR EMBEDDED SYSTEMS

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

has a microcontroller inside it that performs only one task. For example, inside every mouse there is a microcontroller to perform the task of finding the mouse position and sending it to the PC.

3.4 INTRODUCTION TO 8051

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

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

3.5 AT89C51

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

3.6 FEATURES OF AT89C51

- 4K on-chip ROM

- 128 bytes internal RAM (8-bit)

- 32 I/O pins

- Two 16-bit timers

- Six Interrupts

- Serial programming facility

- 40 pin Dual-in-line Package

3.7 PIN diagram
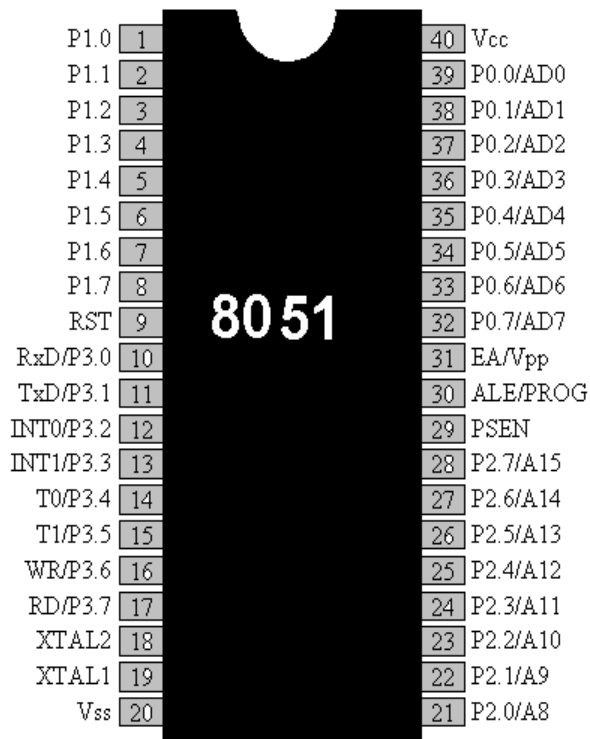
3.8 PIN DESCRIPTION

The 89C51 have a total of 40 pins that are dedicated for various functions such as I/O, RD, WR, address and interrupts. Out of 40 pins, a total of 32 pins are set aside for the four ports P0, P1, P2, and P3, where each port takes 8 pins. The rest of the pins are designated as Vcc, GND, XTAL1, XTAL, RST, EA, and PSEN. All these pins except PSEN and ALE are used by all members of the 8051 and 8031 families. In other words, they must be connected in order for the system to work, regardless of whether the microcontroller is of the 8051 or the 8031 family. The other two pins, PSEN and ALE are used mainly in 8031 based systems.

Vcc

Pin 40 provides supply voltage to the chip. The voltage source is +5 V.

GND

Pin 20 is the ground.

XTAL1 and XTAL2

The 8051 have an on-chip oscillator but requires external clock to run it. Most often a quartz crystal oscillator is connected to input XTAL1 (pin 19) and XTAL2 (pin 18). The quartz crystal oscillator connected to XTAL1 and XTAL2 also needs two capacitors of 30 pF value. One side of each capacitor is connected to the ground.

It must be noted that there are various speeds of the 8051 family. Speed refers to the maximum oscillator frequency connected to the XTAL. For example, a 12 MHz chip must be connected to a crystal with 12 MHz frequency or less. Likewise, a 20 MHz microcontroller requires a crystal frequency of no more than 20 MHz When the 8051 is connected to a crystal oscillator and is powered up, we can observe the frequency on the XTAL2 pin using oscilloscope.

RST

Pin 9 is the reset pin. It is an input and is active high (normally low). Upon applying a high pulse to this pin, the microcontroller will reset and terminate all activities. This is often referred to as a power –on reset. Activating a power-on reset will cause all values in the registers to be lost. Notice that the value of Program Counter is 0000 upon reset, forcing the CPU to fetch the first code from ROM memory location 0000. This means that we must place

the first line of source code in ROM location 0000 that is where the CPU wakes up and expects to find the first instruction. In order to RESET input to be effective, it must have a minimum duration of 2 machine cycles. In other words, the high pulse must be high for a minimum of 2 machine cycles before it is allowed to go low.

EA

All the 8051 family members come with on-chip ROM to store programs. In such cases, the EA pin is connected to the Vcc. For family members such as 8031 and 8032 in which there is no on-chip ROM, code is stored on an external ROM and is fetched by the 8031/32. Therefore for the 8031 the EA pin must be connected to ground to indicate that the code is stored externally. EA, which stands for "external access," is pin number 31 in the DIP packages. It is input pin and must be connected to either Vcc or GND. In other words, it cannot be left unconnected.

PSEN

This is an output pin. PSEN stands for "program store enable." It is the read strobe to external program memory. When the microcontroller is executing from external memory, PSEN is activated twice each machine cycle.

ALE

ALE (Address latch enable) is an output pin and is active high. When connecting a microcontroller to external memory, port 0 provides both address and data. In other words the microcontroller multiplexes address and data through port 0 to save pins. The ALE pin is used for de-multiplexing the address and data by connecting to the G pin of the 74LS373 chip.

I/O port pins and their functions

The four ports P0, P1, P2, and P3 each use 8 pins, making them 8-bit ports. All the ports upon RESET are configured as output, ready to be used as output ports. To use any of these as input port, it must be programmed.

Port 0

Port 0 occupies a total of 8 pins (pins 32 to 39). It can be used for input or output. To use the pins of port 0 as both input and output ports, each pin must be connected externally to a 10K-ohm pull-up resistor. This is due to fact that port 0 is an open drain, unlike P1, P2 and P3. With external pull-up resistors connected upon reset, port 0 is configured as output port.

In order to make port 0 an input, the port must be programmed by writing 1 to all the bits of it. Port 0 is also designated as AD0-AD7, allowing it to be used for both data and address. When connecting a microcontroller to an external memory, port 0 provides both address and data. The microcontroller multiplexes address and data through port 0 to save pins. ALE indicates if P0 has address or data. When ALE=0, it provides data D0-D7, but when ALE=1 it has address A0-A7. Therefore, ALE is used for de-multiplexing address and data with the help of latch 74LS373.

Port 1

Port 1 occupies a total of 8 pins (pins 1 to 8). It can be used as input or output. In contrast to port 0, this port does not require pull-up resistors since it has already pull-up resistors internally. Upon reset, port 1 is configures as an output port. Similar to port 0, port 1 can be used as an input port by writing 1 to all its bits.

Port 2

Port 2 occupies a total of 8 pins (pins 21 to 28). It can be used as input or output. Just like P1, port 2 does not need any pull-up resistors since it has pull-up resistors internally. Upon reset port 2 is configured as output port. To make port 2 inputs, it must be programmed as such by writing 1s to it.

Port 3

Port 3 occupies a total of 8 pins (pins 10 to 17). It can be used as input or output. P3 does not need any pull-up resistors, the same as P1 and P2 did not. Although port 3 is configured as output port upon reset, this is not the way it is most commonly used. Port 3 has an additional function of providing some extremely important signals such as interrupts. Some of the alternate functions of P3 are listed below:

P3.0   RXD (Serial input)

P3.1   TXD (Serial output)

P3.2   INT0 (External interrupt 0)

P3.3   INT1 (External interrupt 1)

P3.4   T0 (Timer 0 external input)

P3.5   T1 (Timer 1 external input)

P3.6   WR (External memory write strobe)

P3.7   RD (External memory read strobe)

INSIDE THE 89C51

Registers

In the CPU, registers are used to store information temporarily. That information could be a byte of data to be processed, or an address pointing to the data to be fetched. In the 8051 there us only one data type: 8 bits. With an 8- bit data type, any data larger than 8 bits has to be broken into 8-bit chunks before it is processed.

A
B
R0
R1
R2
R3
R4
R5
R6
R7

DPTR

PC
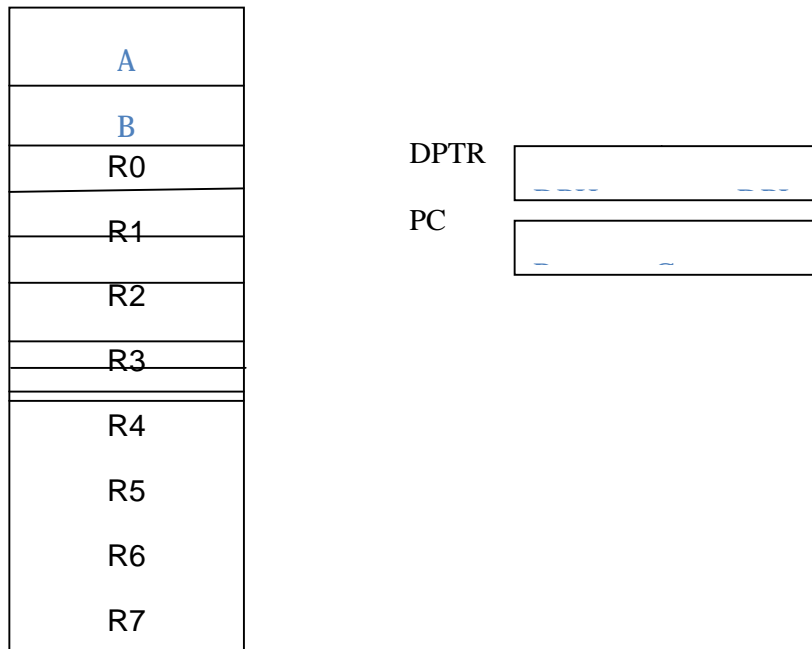
Some 8051 8-bit registers

The most commonly used registers of the 8051 are A(accumulator), B, R0, R1, R2, R3, R4, R5, R6, R7, DPTR (data pointer) and PC (program counter). All the above registers are 8-bit registers except DPTR and the program counter. The accumulator A is used for all arithmetic and logic instructions.

Program Counter and Data Pointer

The program counter is a 16- bit register and it points to the address of the next instruction to be executed. As the CPU fetches op-code from the program ROM, the

35

program counter is incremented to point to the next instruction. Since the PC is 16 bit wide, it can access program addresses 0000 to FFFFH, a total of 64K bytes of code. However, not all the members of the 8051 have the entire 64K bytes of on-chip ROM installed.

The DPTR register is made up of two 8-bit registers, DPH and DPL, which are used to furnish memory addresses for internal and external data access. The DPTR is under the control of program instructions and can be specified by its name, DPTR. DPTR does not have a single internal address; DPH and DPL are assigned an address each.

Flag bits and the PSW Register

Like any other microprocessor, the 8051 have a flag register to indicate arithmetic conditions such as the carry bit. The flag register in the 8051 is called the program status word (PSW) register.

The program status word (PSW) register is an 8-bit register. It is also referred as the flag register. Although the PSW register is 8-bit wide, only 6 bits of it are used by the microcontroller. The two unused bits are user definable flags. Four of the flags are conditional flags, meaning they indicate some conditions that resulted after an instruction was executed. These four are CY (carry), AC (auxiliary carry), P (parity), and OV (overflow). The bits of the PSW register are shown below:

CY	AC	F0	RS1	RS0	OV	--	P

CY   PSW.7   Carry flag

AC   PSW.6   Auxiliary carry flag

--   PSW.5   Available to the user for general purpose

RS1   PSW.6   Register bank selector bit 1

RS0   PSW.3   Register bank selector bit 0

OV   PSW.2   Overflow flag

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F0   PSW.1   User definable bit

P   PSW.0   Parity flag

CY, the carry flag

This flag is set whenever there is a carry out from the d7 bit. This flag bit is affected after an 8-bit addition or subtraction. It can also be set to 1 or 0 directly by an instruction such as "SETB C" and "CLR C" where "SETB C" stands for set bit carry and "CLR C" for clear carry.
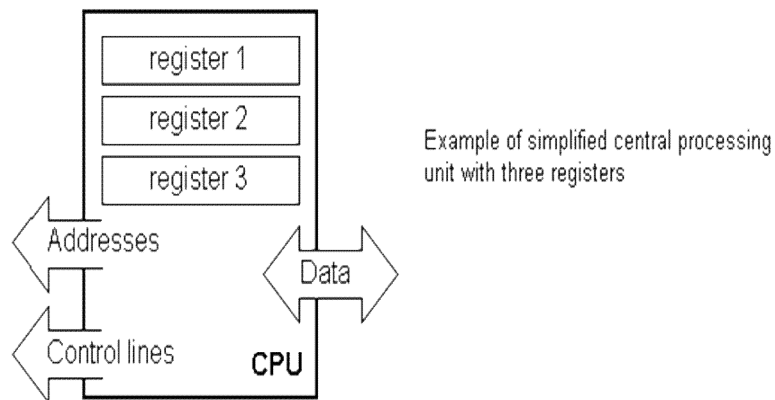

Fig.-9 Simplified central Processing Unit With Three Registers

4. IR SENSOR

4.1 IR SENSOR AS A REFLECTOR:

Infrared (IR) light or the infrared part of the spectrum is electromagnetic radiation with wavelength between 700 to 3000 nanometers (nm). As human can see only waves between 400 to 700 nanometers, infrared light is invisible to the human eye.

Sensors for surveillance cameras, however, may detect wavelength up to 1100 nm. This provides an additional source of light for cameras. As this part of the spectrum will be considered as red by sensors, IR is filtered out under color mode, when there is more than enough light. This ensures that the color is accurate and not distorted to red. When it is dark and the camera struggles to see with every last bit of light, models equipped with removable IR-Cut filter will move the filter aside to let in IR light, and shift to black and white mode to avoid the color shift.

In such cases, it is possible to shine an additional source of IR onto the scene by IR LEDs. This additional IR light is visible to the surveillance camera but not to the human eye. This provides a much brighter image in the dark without alerting to subjects that they can be easily seen.

4.2 WORKING OF IR SENSOR

The basic principle of IR sensor is based on an IR emitter and an IR receiver. IR emitter will emit infrared continuously when power is supplied to it. On the other hand, the IR receiver will be connected and perform the task of a voltage divider. IR receiver can be imagined as a transistor with its base current determined by the intensity of IR light received. The lower the intensity of IR light cause higher resistance between collector-emitter terminals of transistor, and limiting current from collector to emitter. This change of resistance will further change the voltage at the output of voltage divider. In others word, the greater the intensity of IR light hitting IR receiver, the lower the resistance of IR receiver and hence the output voltage of voltage divider will decreased. Usually the IR emitter and IR receiver will be mounted side by side, pointing to a reflective surface. The further distance away between emitter and receiver decrease the amount of infrared light hitting the receiver if the distance between the sensor and a reflective surface is fixed. Since the output voltage from voltage divider varies

with the intensity of IR light, and microcontroller is not used in this project, a comparator (LM324) is used to show the changes.

LM324

A LM324 consists of 4 comparators in a chip. It issued to compare voltage pairs. Each comparator has VRef+ and VRef-. Depending on the applications, user may either connect a fixed reference voltage to VRef+ or VRef-..In this example, the output voltage from voltage divider (IR Receiver) is connected to VRef- and a preset (variable resistor) is being used to generate voltage for VRef+. VRef+ is considered as the threshold voltage for comparator output to change. If VRef- is greater than VRef+, Vout will be low (0V) and vice versa. Hence, the voltage generated by comparator output of LM324 can provide digital logic to microcontroller and in this project it is being use to drive LED.

White or reflective surface   Black or non-reflective surface
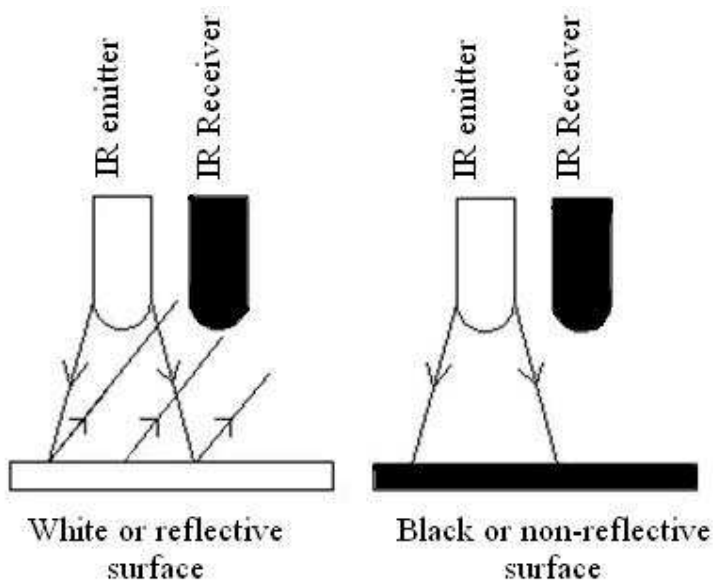
4.3 CIRCUIT DIAGRAM:
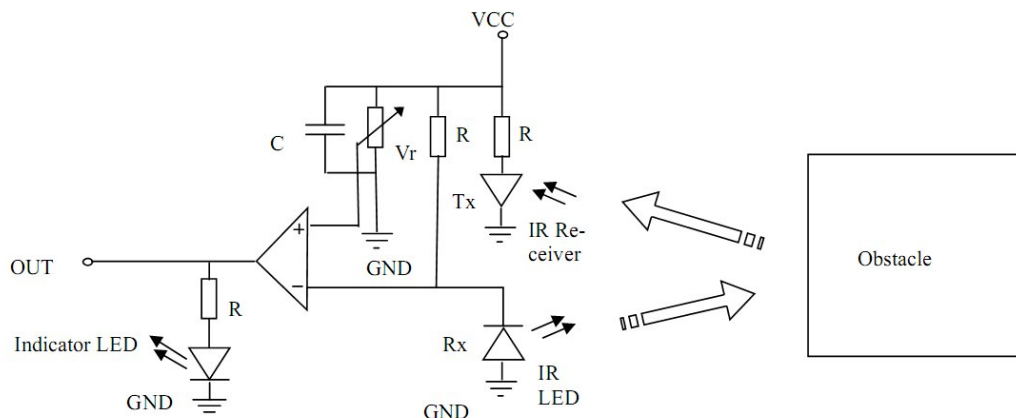
The sensitivity of the IR Sensor is tuned using the potentiometer. The potentiometer is tune able in both the directions. Initially tune the potentiometer in clockwise direction such that the Indicator LED starts glowing. Once that is achieved, turn the potentiometer just enough in anti-clockwise direction to turn off the Indicator LED. At this point the sensitivity of the receiver is maximum. Thus, its sensing distance is maximum at this point. If the sensing distance(i.e., Sensitivity) of the receiver is needed to be reduced, then one can tune the potentiometer in the anti-clockwise direction from this point. Further, if the orientation of both TX and Rx LED's is parallel to each other, such that both are facing outwards, then their sensitivity is maximum. For example, if the potentiometer is tuned inside room/building for maximum sensitivity and then taken out in open sunlight, it will require retuning, since sun's rays also contain Infrared (IR) frequencies, thus acting as a IR source (transmitter). This will disturb the receiver's sensing capacity. Hence it needs to be returned to work perfectly in the new surroundings. The output of IR receiver goes low when it receives IR signal. Hence the output pin is normally low because, though the IR LED is continuously transmitting, due to no obstacle, nothing is reflected back to the IR receiver. The indication LED is off. When an obstacle is encountered, the output of IR receiver goes low; IR signal is reflected from the obstacle surface. This drives the output of the comparator low. This output is connected to the cathode of the LED, which then turns ON.

Application Ideas

• Obstacle detection

• Shaft encoder

• Fixed frequency detection

5. Liquid Crystal Display

5.1 Liquid Crystal Display

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

The liquid - crystal display (LCD) consist of a liquid crystal material (normally organic for LCD's) that will flow like a liquid but whose molecular structure has some properties normally associated with solids.

- ➢ The LCD does not generate its own light but depends on an external or internal source.
- ➢ Under dark conditions, it would be necessary for the unit to have its own internal light source either behind or to the side of the LCD.
- ➢ During the day, or in the lighted areas, a reflector can be put behind the LCD to reflect the light back through the display for maximum intensity. The LCD has the distinct advantage of having the lower power requirement than the LED. It is typical in the order of microwatts for the display, as compared to the same order of mill watts for LEDs. LCD is limited to a temperature range of about 0° to 60° C. Lifetime is an area of concern because LCDs can chemically degrade. LCDs can add a lot to out applications in terms of providing a useful interface for the user, debugging an application or just giving it a "professional" look. The most common type of LCD controller is the Hitachi 44780 which provides a relatively simple interface between a processor and an LCD. Besides this there are several other reasons for LCDs replacing LEDs(seven segment LEDs or other multisegment LEDs).This is due the following reasons :-
- ➢ The declining prices of LCDs.
- ➢ The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.

➢ In corporation of a refreshing controller into the LCD , thereby relieving the CPU of the task of refreshing the LCD in contrast, the LED must be refreshed by the CPU (or in some other way) to keep displaying the data.

➢ Ease of programming for characters and graphics.

5.2 LCD Pin Description

The LCD discuss in this section has the most common connector used for the Hitachi 44780 based LCD is 14 pins in a row and modes of operation and how to program and interface with microcontroller is describes in this section.
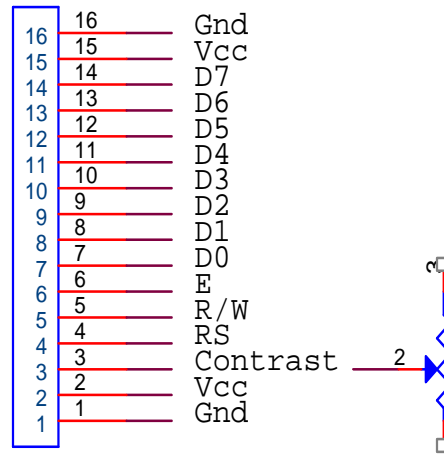
LCD Pin Description Diagram
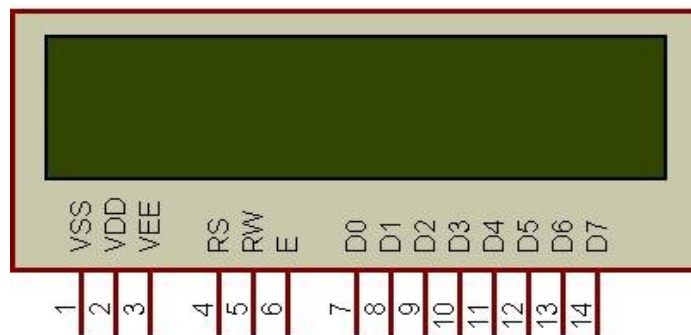
<u>V_{CC}, V_{SS}, V_{EE}</u>

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

<u>RS (register select)</u>

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

<u>R/W (read/write)</u>

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

<u>EN (enable)</u>

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

<u>D0-D7 (data lines)</u>

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

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

5.3 WORKING

The interface used by LCD is a parallel bus, allowing simple and fast reading/writing of data to and from the LCD. This waveform will write an ASCII Byte out to the LCD's screen. The ASCII code to be displayed is eight bits long and is sent to the LCD either four or eight bits at a time. If four bit mode is used, two "nibbles" of data (Sent high four bits and then low four bits with an "Enable" Clock pulse with each nibble) are sent to make up a full eight bit transfer.

The "Enable" Clock is used to initiate the data transfer within the LCD. Sending parallel data as either four or eight bits are the two primary modes of operation. While there are secondary considerations and modes, deciding how to send the data to the LCD is most critical decision to be made for an LCD interface application. Eight bit mode is best used when speed is required in an application and at least ten I/O pins are available. Four bit mode requires a minimum of six bits. To wire a microcontroller to an LCD in four bit mode, just the top four bits (DB4-7) are written to.

The "RS" bit is used to select whether data or an instruction is being transferred between the microcontroller and the LCD. If the Bit is set, then the byte at the current LCD "Cursor" Position can be read or written. When the Bit is reset, either an instruction is being sent to the LCD or the execution status of the last instruction is read back (whether or not it has completed). Reading Data back is best used in applications which required data to be moved back and forth on the LCD (such as in applications which scroll data between lines).In our Project we have permanently grounded R/W pin which means we are not retrieving any data from LCD.

The LCD can be thought of as a "Teletype" display because in normal operation, after a character has been sent to the LCD, the internal "Cursor" is moved one character to the right. The "Clear Display" and "Return Cursor and LCD to Home Position" instructions are used to reset the Cursor's position to the top right character on the display. To move the Cursor, the "Move Cursor to Display" instruction is used. For this instruction, bit 7 of the instruction byte is set with the remaining seven bits used as the address of the character on the LCD the cursor is to move to. These seven bits provide 128 addresses, which matches the maximum number

of LCD character addresses available. Eight programmable characters are available and use codes 0x000 to 0x007. They are programmed by pointing the LCD's "Cursor" to the Character Generator RAM The last aspect of the LCD to discuss is how to specify a contrast voltage to the Display. I typically use a potentiometer wired as a voltage divider. This will provide an easily variable voltage between Ground and Vcc, which will be used to specify the contrast (or "darkness") of the characters on the LCD screen. You may find that different LCDs work differently with lower voltages providing darker characters.

5.4 DIFFERENT TYPES OF LCDs:

There are different type of LCDs available in the market such as:

- ➢ 16*2 Green
- ➢ 16*2 Jumbo
- ➢ 16*4 Green
- ➢ 20*4 Blue

6. Software Description

6.1 KEIL

Keil development tools for the 8051 microcontroller family support every level of developer from the professional applications engineer to the student just learning about embedded software development. The industry-standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, and Single-board Computers support ALL 8051-compatible derivatives and help you get your projects completed on schedule.

The following table shows the Keil C51 Product Line (across the top) and the Components that are included (along the left side). You may use this information to find the development tool kit that best fits your needs.

6.2 Software Development Cycle

When you use the Keil µVision, the project development cycle is roughly the same as it is for any other software development project.

1. Create a project, select the target chip from the device database, and configure the tool settings.

2. Create source files in C or assembly.

3. Build your application with the project manager.

4. Correct errors in source files.

5. Test the linked application.
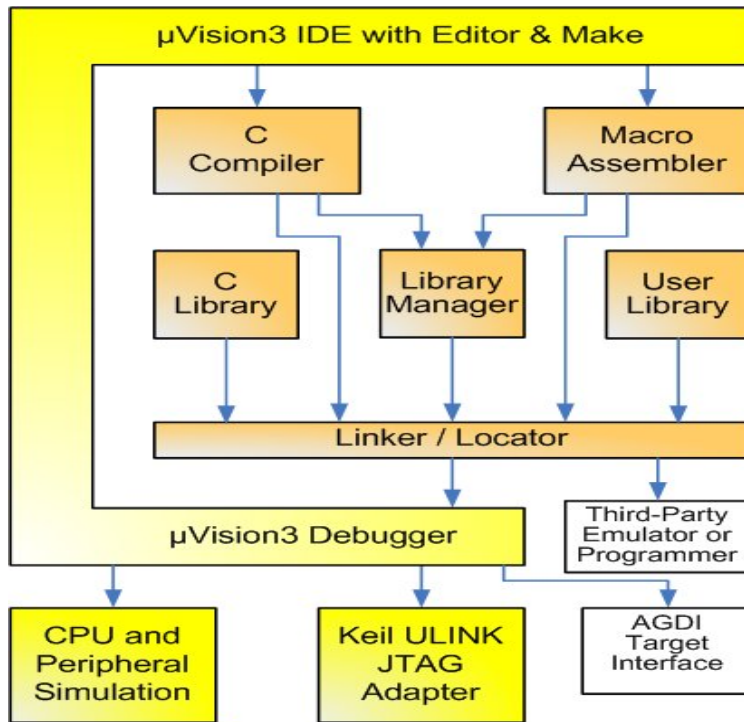
The following block diagram illustrates the complete µVision/ARM software development cycle. Each component is described below.

6.3 µVision IDE

The µVision IDE combines project management, a rich-featured editor with interactive error correction, option setup, make facility, and on-line help. Use µVision to create your source files and organize them into a project that defines your target application. µVision automatically compiles, assembles, and links your embedded application and provides a single focal point for your development efforts.

6.4 C51 Compiler & A51 Macro Assembler

Source files are created by the µVision IDE and are passed to the C51 Compiler or A51 Macro Assembler. The compiler and assembler process source files and create relocatable object files.

The Keil C51 Compiler is a full ANSI implementation of the C programming language that supports all standard features of the C language. In addition, numerous features for direct support of the 8051 architecture have been added.

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The Keil A51 macro assembler supports the complete instruction set of the 8051 and all derivatives.

6.5 LIB51 Library Manager

The LIB51 library manager allows you to create object library from the object files created by the compiler and assembler. Libraries are specially formatted, ordered program collections of object modules that may be used by the linker at a later time. When the linker processes a library, only those object modules in the library that are necessary to create the program are used.

6.6 BL51 Linker/Locator

The BL51 Linker/Locator creates an absolute ELF/DWARF file using the object modules extracted from libraries and those created by the compiler and assembler. An absolute object file or module contains no relocatable code or data. All code and data reside at fixed memory locations. The absolute ELF/DWARF file may be used:

- To program an Flash ROM or other memory devices,

- With the µVision Debugger for simulation and target debugging,

- With an in-circuit emulator for the program testing.

6.7 µVision Debugger

The µVision symbolic, source-level debugger is ideally suited for fast, reliable program debugging. The debugger includes a high-speed simulator that let you simulate an entire 8051 system including on-chip peripherals and external hardware. The attributes of the chip you use are automatically configured when you select the device from the Device Database.

The µVision Debugger provides several ways for you to test your programs on real target hardware.

- Install the MON51 Target monitor on your target system and download your program using the Monitor-51 interface built-in to the µVision Debugger.

- Use the Advanced GDI interface to attach use the µVision Debugger front end with your target system.

Requesting Assistance

At Keil Software, we are dedicated to provide you with the best embedded development tools and documentation available. If you have suggestions or comments regarding any of the on-line manuals accompanying this product, please contact us. If you think you have discovered a problem with the software, do the following before calling technical support.

1. Read the sections in this manual that pertains to the job or task you are trying to accomplish.

2. Isolate the problem to determine if it is a problem with the assembler, compiler, linker, debugger, or another development tool.

3. Further isolate software problems by reducing your code to a few lines.

If you are still experiencing problems after following these steps, report them to our technical support group. Please include your product serial number and version number. We prefer that you send the problem via email. If you contact us by fax, be sure to include your name and telephone numbers (voice and fax) where we can reach you.

Try to be as detailed as possible when describing the problem you are having. The more descriptive your example, the faster we can find a solution. If you have a single-page code example demonstrating the problem, please email it to us. If possible, make sure that your problem can be duplicated with the µVision Simulator. Please try to avoid sending complete applications or long listings as this slows down our response to you. Kiel software converts the C-codes into the Intel Hex code.

7. CHALLENGES

a> Providing proper power to different circuit

b> Availablity of burner

c> Testing for different purposes

8. APPLICATIONS

a> Can be used in Mines

b> Can be used for avoiding concealed paths

c>This design can be handful for making vacuum cleaner

9. REFERENCES:-

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