**ROBOTIC TROLLEY FOR MATERIAL HANDLING**

**A PROJECT REPORT**

*In partial fulfillment for the award of the degree*

*Of*

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**

**ABSTRACT**

The main objective of this project is to fabricate a robotic trolley for material handling in industries. In this project a robotic vehicle is fabricated which runs like a car by carrying tools from place to another. This is done by using a small sensor. The trolley will stop when the trolley is unloaded.

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**CHAPTER 1**

**INTRODUCTION**

**1**

**INTRODUCTION**

Mobile robots have capability to move around in their environment and not fixed to one physical location. In contrast, industrial robots usually consist of a joint arm (multilinked manipulator) and gripper assembly (or end effecter) that is attached to a fixed surface.

Mobile robots are the focus of a great deal of current research and almost every major university has one or more laboratory that focuses on mobile robot research. Mobile robots are also found in industries; military and security environments. They also appear as consumer products, for entertainment or to perform certain tasks like vacuum.

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**CHAPTER 2**

**WORKING PRINCIPLE**

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**WORKING PRINCIPLE**

The sensor is connected at the bed of the vehicle. This is used to check   
the load in bed. The motor is connected with the wheel arrangement with the help of the spur gear.

When the first user keep the tools in this vehicle the trolley moves   
automatically to the second user.

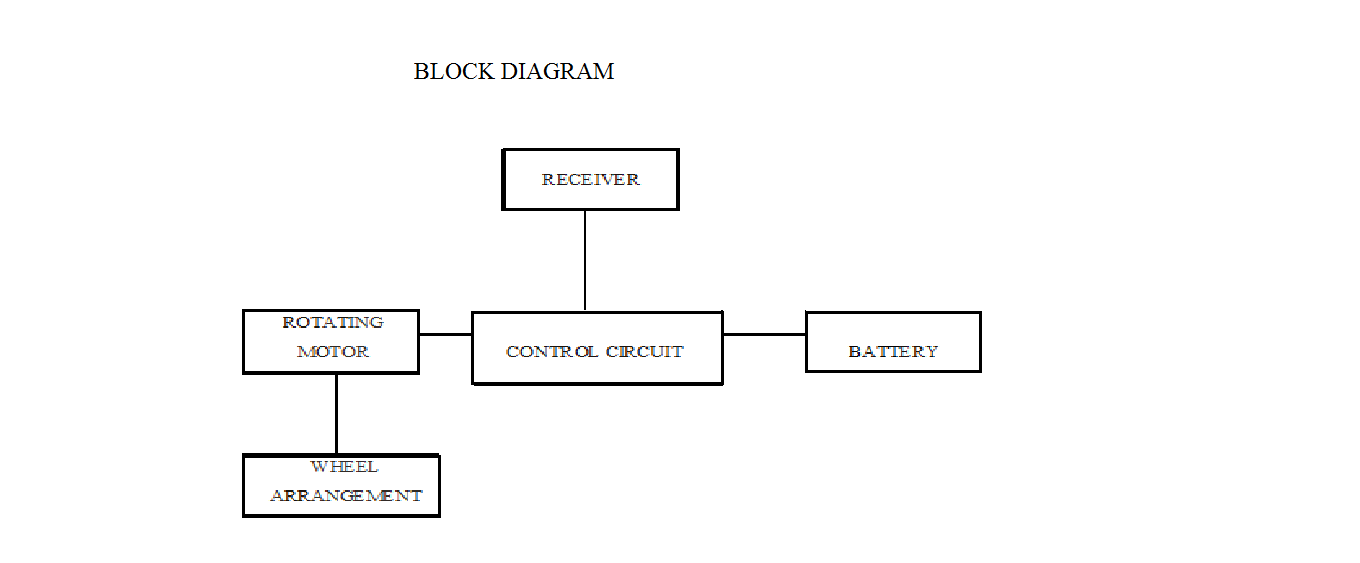
If the second user took the tools from the trolley the trolley stops with the second user. After that when the second user keeps a tool it moves to the next user. It can be used in industries, hospitals etc.

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**CHAPTER 3**

**BLOCK DIAGRAM**

**5**



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**CHAPTER 4**

**FABRICATION OF PARTS**

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**FABRICATION OF PARTS**

**4.1 PMDC MOTOR**

An electric generator is a device that converts mechanical energy to

Electrical energy. The reverse conversion of electrical energy into mechanical energy is done by a motor; motors and generators have many similarities. A generator forces electrons in the windings to flow through the external electrical circuit. It is somewhat analogous to a water pump, which creates a flow of water but does not create the water inside. The source of mechanical energy may be a reciprocating or turbine steam engine, water falling through a turbine or waterwheel, an internal combustion engine, a wind turbine, a hand crank, compressed air or any other source of mechanical energy.



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A dynamo machine consists of a stationary structure, which provides a constant magnetic field and a set of rotating windings which turn within that field. On small machines the constant magnetic field may be provided by one or more permanent magnets; larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called field coils.

Large power generation dynamos are now rarely seen due to the now   
nearly universal use of alternating current for power distribution and solid   
state electronic AC to DC power conversion. But before the principles of AC   
were discovered, very large direct-current· dynamos were the only means of   
power generation and distribution. Now power generation dynamos are   
mostly a curiosity.

The DC Motor or Direct Current Motor to give it its full title, is the most commonly used actuator for producing continuous movement and whose speed of rotation can easily be controlled, making them ideal for use in applications were speed control, servo type control, and/or positioning is required. A DC motor consists of two parts, a "Stator" which is the stationary part and a "Rotor" which is the rotating part. The result is that there are basically three types of DC Motor available.

Brushed Motor - This type of motor produces a magnetic field in a wound rotor (the part that rotates) by passing an electrical current through a commutator and carbon brush assembly, hence the term "Brushed". The stators (the stationary part) magnetic field is produced by using either a wound stator field winding or by permanent magnets. Generally brushed DC motors are cheap, small and easily controlled.

Brushless Motor - This type of motor produce a magnetic field in the rotor by using permanent magnets attached to it and commutation is achieved electronically. They are generally smaller but more expensive than conventional brushed type DC motors because they use "Hall effect” switches in the stator to produce the required stator field rotational sequence. But they have better torque/speed characteristics, are more efficient and have   
a longer operating life than equivalent brushed types.

Servo Motor - This type of motor is basically a brushed DC motor   
with some form of positional feedback control connected to the rotor shaft.   
They are connected to and controlled by a PWM type controller and are   
mainly used in positional control systems and radio controlled models.

Normal DC motors have almost linear characteristics with their speed   
of rotation being determined by the applied DC voltage and their output   
torque being determined by the current flowing through the motor windings.   
The speed of rotation of any DC motor can be varied from a few revolutions   
per minute (rpm) to many thousands of revolutions per minute making them   
suitable for electronic, automotive or robotic applications. By connecting   
them to gearboxes or gear-trains their output speed can be decreased while at   
the same time increasing the torque output of the motor at a high speed.

A conventional brushed DC Motor consist basically of two parts, the   
stationary body of the motor called the Stator and the inner part which   
rotates producing the movement, called the Rotor or "Armature" for DC machines.

The motors wound stator is an electromagnet which consists of electrical coils connected together in a circular configuration to produce a North-pole then a South-pole then a North-pole etc, type stationary magnetic field system (as opposed to AC machines whose stator field continually rotates with the applied frequency) with the current flowing within these field coils being known as the motor field current.

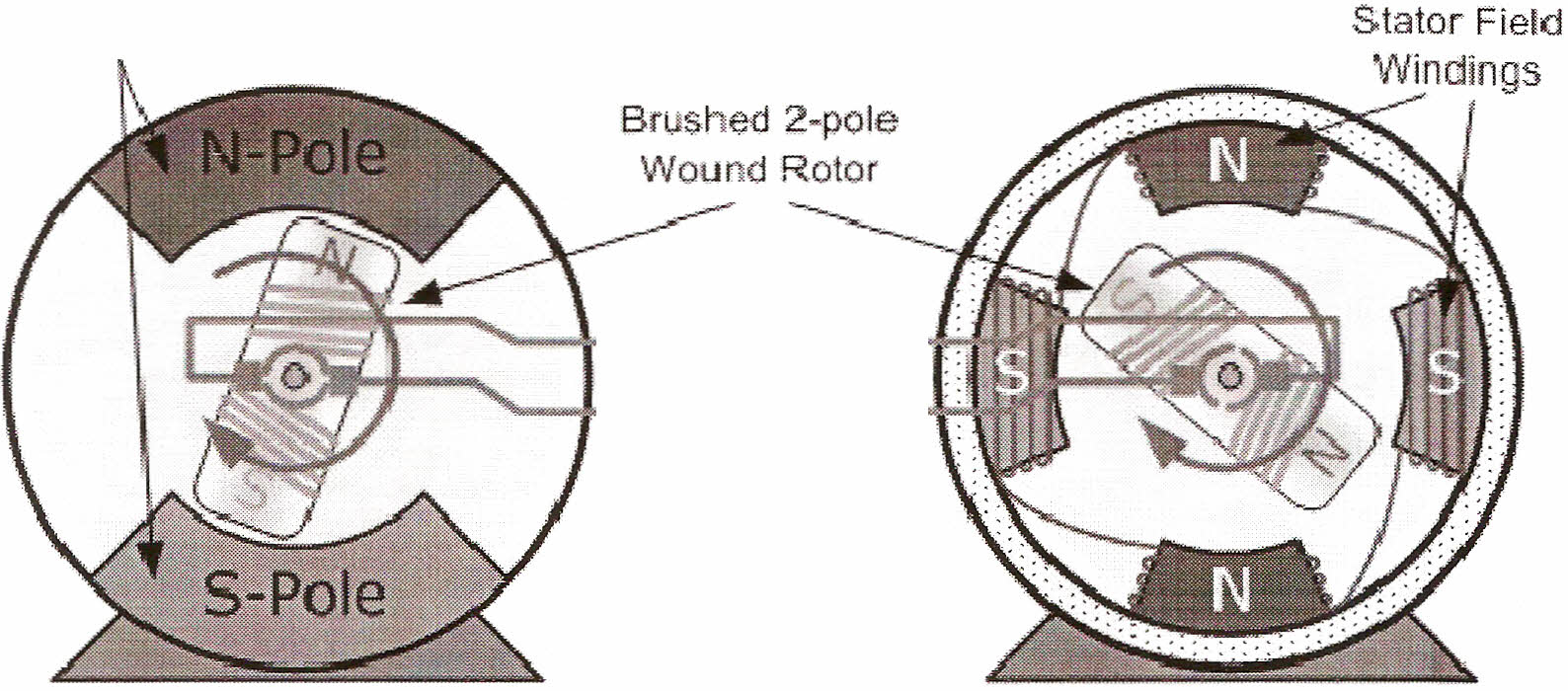
The stators electromagnetic coils can be connected in series, parallel or both together (compound) with the armature. A series wound DC motor has the stator field windings connected in series with the armature while a shunt wound DC motor has the stator field windings connected in parallel with the armature.

The rotor or armature of a DC machine consists of current carrying conductors connected together at one end to electrically isolated copper segments called the commutator. The commutator allows an electrical connection to be made via carbon brushes (hence the name "Brushed" motor) to an external power supply as the armature rotates. The magnetic field setup by the rotor tries to align itself with the stationary stator field causing the rotor to rotate on its axis, but cannot align itself due to commutation delays.

The rotational speed of the motor is dependent on the strength of the rotors magnetic field and the more voltage that is applied to the motor the faster the rotor will rotate. By varying this applied DC voltage the rotational speed of the motor can also be varied.

**Conventional (Brushed) DC Motor**

Permanent magnet



2pole Permanent 4-Pole Wound   
 Field Motor Magnet Motor

Permanent magnet (PMDC) brushed motors are generally much smaller and cheaper than their equivalent wound stator type DC motor cousins as they have no field winding. In permanent magnet DC (PMDC) motors these field coils are replaced with strong rare earth (i.e. Samarium Cobolt, or Neodymium Iron Boron) type magnets which have very high magnetic energy fields. This gives them a much better linear speed/torque characteristic than the equivalent wound motors because of the permanent and sometimes very strong magnetic field, making them more suitable for use in models, robotics and servos.

Although DC brushed motors are very efficient and cheap, problems   
associated with the brushed DC motor is that sparking occurs under heavy   
load conditions between the two surfaces of the commutator and carbon   
brushes resulting in self generating heat, short life span and electrical noise   
due to sparking, which can damage any semiconductor switching device   
such as a 110SFET or transistor. To overcome these disadvantages,   
Brushless DC Motors were developed.

The brushless DC motor (BDCM) is very similar to a permanent   
magnet DC motor, but does not have any brushes to replace or wear out due   
to commutator sparking. Therefore, little heat is generated in the rotor   
increasing the motors life. The design of the brushless motor eliminates the need for brushes by using a more complex drive circuit was the rotor   
magnetic field is a permanent magnet which is always in synchronization   
with the stator field allows for a more precise speed and torque control. Then   
the construction of a brushless DC motor is very similar to the AC motor   
making it a true synchronous motor but one disadvantage is that it is more   
expensive than an equivalent "brushed" motor design.

The control of the brushless DC motors is very different from the   
normal brushed DC motor, in that it this type of motor incorporates some   
means to detect the rotors angular position (or magnetic poles) required to   
produce the feedback signals required to control the semiconductor   
switching devices. The most common position/pole sensor is the Hall   
element, but some motors use optical sensors. Using the Hall sensors   
signals, the polarity of the electromagnets is switched by the motor control   
drive circuitry. Then the motor can be easily synchronized to a digital clock   
signal, providing precise speed control. Brushless DC motors can be   
constructed to have, an external permanent magnet rotor and an internal   
electromagnet stator or an internal permanent magnet rotor and an external   
electromagnet stator.

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**4.1.1 TORQUE CAPABILITIES OF MOTORS**

When optimally designed for a given active current (i.e., torque current), voltage, pole-pair number, excitation frequency (i.e., synchronous speed), and core flux density, all categories of electric motors or generators will exhibit virtually the same maximum continuous shaft torque (i.e., operating torque) within a given physical size of electromagnetic core. Some applications require bursts of torque beyond the maximum operating torque, such as short bursts of torque to accelerate an electric vehicle from standstill. Always limited by magnetic core saturation or safe operating temperature rise and voltage, the capacity for torque bursts beyond the maximum operating torque differs significantly between categories of electric motors or generators.

Electric machines without a transformer circuit topology, such as Field-Wound (i.e., electromagnet) or Permanent Magnet (PM) Synchronous electric machines cannot realize bursts of torque higher than the maximum designed torque without saturating the magnetic core and rendering any increase in current as useless. Furthermore, the permanent magnet assembly of PM synchronous electric machines can be irreparably damaged, if bursts of torque exceeding the maximum operating torque rating are attempted.

Electric machines with a transformer circuit topology, such as Induction (i.e., asynchronous) electric machines, Induction Doubly-Fed electric machines, and Induction or Synchronous Wound-Rotor Doubly-Fed (WRDF) electric machines, exhibit very high bursts of torque because the active current (i.e., Magneto-Motive-Force or the product of current and winding-turns) induced on either side of the transformer oppose each other and as a result, the active current contributes nothing to the transformer coupled magnetic core flux density, which would otherwise lead to core saturation.

Electric machines that rely on Induction or Asynchronous principles short-circuit one port of the transformer circuit and as a result, the reactive impedance of the transformer circuit becomes dominant as slip increases, which limits the magnitude of active (i.e., real) current. Still, bursts of torque that are two to three times higher than the maximum design torque are realizable.

The Synchronous WRDF electric machine is the only electric machine with a truly dual ported transformer circuit topology (i.e., both ports independently excited with no short-circuited port). The dual ported transformer circuit topology is known to be unstable and requires a multiphase slip-ring-brush assembly to propagate limited power to the rotor winding set. If a precision means were available to instantaneously control torque angle and slip for synchronous operation during motoring or generating while simultaneously providing brushless power to the rotor winding set the active current of the Synchronous WRDF electric machine would be independent of the reactive impedance of the transformer circuit and bursts of torque significantly higher than the maximum operating torque and far beyond the practical capability of any other type of electric machine would be realizable. Torque bursts greater than eight times operating torque have been calculated.

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# 4.2 RECHARGEABLE BATTERY

A rechargeable battery (also known as a storage battery) is a group of one or more [secondary cells](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrochemical_cell). Rechargeable batteries use [electrochemical](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrochemistry) [reactions](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Chemical_reaction) that are electrically reversible. Rechargeable batteries come in many different sizes and use different combinations of chemicals. Commonly used secondary cell ("rechargeable battery") chemistries are [lead acid](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Lead-acid_battery), [nickel cadmium](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Nickel-cadmium_battery) (NiCd), [nickel metal hydride](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Nickel-metal_hydride_battery) (NiMH), [lithium ion](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Lithium_ion_battery) (Li-ion), and [lithium ion polymer](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Lithium_ion_polymer_battery) (Li-ion polymer).

Rechargeable batteries can offer economic and environmental benefits compared to disposable batteries. Some rechargeable battery types are available in the same [sizes](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/List_of_battery_sizes) as disposable types. While the rechargeable cells have a higher initial cost, rechargeable batteries can be recharged many times. Proper selection of a rechargeable battery system can reduce toxic materials sent to landfills compared to an equivalent series of disposable batteries. For example, battery manufacturers of NiMH rechargeable batteries claim a [service life](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Service_life) of 100-1000 charge cycles for their batteries.

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## 4.2.1 USAGE AND APPLICATIONS

Rechargeable batteries currently are used for applications such as automobile starters, portable consumer devices, light vehicles (such as [motorized wheelchairs](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Wheelchair), [golf carts](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Golf_carts), [electric bicycles](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electric_bicycles), and electric [forklifts](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Forklifts)), tools, and [uninterruptible power supplies](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Uninterruptible_power_supply). Emerging applications in [hybrid electric vehicles](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Hybrid_electric_vehicle) and [electric vehicles](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Battery_electric_vehicle) are driving the technology to reduce cost, reduce weight, and increase lifetime.

Unlike non-rechargeable batteries ([primary cells](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Primary_cell)), rechargeable batteries have to be charged before use. The need to charge rechargeable batteries before use deterred potential buyers who needed to use the batteries immediately. However, new [low self discharge batteries](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Low_self-discharge_NiMH_battery) allow users to purchase rechargeable battery that already hold about 70% of the rated capacity, allowing consumers to use the batteries immediately and recharge later.

[Grid energy storage](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Grid_energy_storage) applications use industrial rechargeable batteries for load leveling, where they store electric energy for use during peak load periods, and for [renewable energy](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Renewable_energy) uses, such as storing power generated from [photovoltaic arrays](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Photovoltaic_array) during the day to be used at night. By charging batteries during periods of low demand and returning energy to the grid during periods of high electrical demand, load-leveling helps eliminate the need for expensive [peaking power plants](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Peaking_power_plant) and helps [amortize](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Amortization_(business)) the cost of generators over more hours of operation.

The [National Electrical Manufacturers Association](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/National_Electrical_Manufacturers_Association) has estimated that U.S. demand for rechargeable is growing twice as fast as demand for non rechargeable.

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## 4.2.2 CHARGING AND DISCHARGING

During charging, the positive active material is [oxidized](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Oxidized), producing [electrons](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electron), and the negative material is [reduced](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Redox), consuming electrons. These electrons constitute the [current](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electric_current) flow in the external [circuit](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrical_network). The [electrolyte](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrolyte) may serve as a simple buffer for [ion](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Ion) flow between the [electrodes](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrode), as in [lithium-ion](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Lithium-ion_battery) and [nickel-cadmium](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Nickel-cadmium_battery) cells, or it may be an active participant in the [electrochemical](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrochemical) reaction, as in [lead-acid](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Lead-acid_battery) cells.

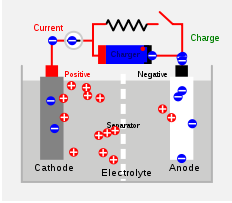
[](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/File:Secondary_Cell_Diagram.svg)

Diagram of the charging of a secondary cell battery.

The energy used to charge rechargeable batteries mostly comes from AC current ([mains electricity](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Mains_electricity)) using an adapter unit. Most [battery chargers](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Battery_charger) can take several hours to charge a battery. Most batteries can be charged in far less time than the most common simple battery chargers are capable of. [Duracell](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Duracell) and [Rayovac](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Rayovac) now sell chargers that can charge [AA](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/AA_battery)- and [AAA](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/AAA_battery)-size NiMH batteries in just 15 minutes; Energizer sells chargers that can additionally charge C/D-size and 9 V NiMH batteries. However, high rates of charging (eg. 15 minute charger, 1 hour chargers) will cause long term damage to NiMH and most other rechargeable batteries.

Battery is susceptible to damage due to [reverse charging](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Rechargeable_battery) if they are fully discharged. Fully integrated [battery chargers](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Battery_charger) that optimize the charging current are available.

Also, attempting to recharge non-rechargeable batteries has a small chance of causing a [battery explosion](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Battery_explosion).

[Flow batteries](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Flow_battery), which are not commonly used by consumers, are recharged by replacing the electrolyte liquid.

Battery manufacturers' technical notes often refer to VPC. This is [volts](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Volt) per [cell](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrochemical_cell), and refers to the individual secondary cells that make up the battery. For example, to charge a 12 V battery (containing 6 cells of 2 V each) at 2.3 VPC requires a voltage of 13.8 V across the battery's terminals.

Most NiMH AA or AAA batteries rate their cells at 1.2 V. However, this is not a problem in most devices because alkaline batteries drop in voltage as the energy is depleted. Most devices are designed to continue to operate at a reduced voltage of between 0.9 and 1.1 V

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### 4.2.3 REVERSE CHARGING

Reverse charging, which damages batteries, is when a rechargeable battery is recharged with its [polarity](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrical_polarity) reversed. Reverse charging can occur under a number of circumstances, the three most common being:

* When a battery is incorrectly inserted into a [charger](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Battery_charger).
* When an automotive type battery charger is connected in reverse to the battery terminals. This usually occurs when a completely discharged battery is being charged, otherwise sparking will occur.
* When a series string is deeply discharged.

When one cell completely discharges ahead of the rest, the stronger cells will apply a reverse current to the discharged cell. This is commonly referred to as "cell reversal". Cell reversal significantly shortens the life of the affected cell and therefore shortens the overall life of the battery. In some extreme cases, the reversed cell can begin to emit smoke or catch fire. Some Ni-Cad type cells exhibit a "memory" effect. Some Ni-Cad type cells that are not fully charged and discharged periodically can lose their ability to retain a full charge, i.e. exhibit reduced capacity. Cycling a multi cell battery into deep discharge to overcome this memory effect can cause cell reversal and do more harm than good. In critical applications using Ni-Cad batteries, such as in aircraft, each cell is individually discharged by connecting a load clip across the terminals of each cell, thereby avoiding cell reversal, then charging the cells in series.

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### DEPTH OF DISCHARGE

|  |  |
| --- | --- |
|  |  |

Depth of discharge (DOD) is normally stated as a percentage of the nominal ampere-hour capacity; 0% DOD means no discharge. Since the usable capacity of a battery system depends on the rate of discharge and the allowable voltage at the end of discharge, the depth of discharge must be qualified to show the way it is to be measured. Due to variations during manufacture and aging, the DOD for complete discharge can change over time / discharge cycles. Generally a rechargeable battery system will tolerate more charge/discharge cycles if the DOD is lower on each cycle.

## ACTIVE COMPONENTS

Active components in a secondary cell are the chemicals that make up the positive and negative active materials, and the [electrolyte](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrolyte). The positive and negative are made up of different materials, with the positive exhibiting a [reduction](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Redox) potential and the negative having an [oxidation](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Oxidation) potential. The sum of these potentials is the standard cell potential or [voltage](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Voltage).

In [primary cells](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Primary_cell) the positive and negative electrodes are known as the [cathode](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Cathode) and [anode](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Anode), respectively. Although this convention is sometimes carried through to rechargeable systems — especially with [lithium-ion](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Lithium-ion_battery) cells, because of their origins in primary lithium cells — this practice can lead to confusion. In rechargeable cells the positive electrode is the cathode on discharge and the anode on charge, and vice versa for the negative electrode.

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### 4.2.4 COMMON RECHARGEABLE BATTERY TYPES

[**Nickel-cadmium battery**](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Nickel-cadmium_battery) **(NiCd)**

Created by Waldemar Jungner of Sweden in 1899 which was based on [Thomas Edison](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Thomas_Edison)'s first [alkaline battery](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Alkaline_battery). Using [nickel oxide hydroxide](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Nickel_oxide_hydroxide) and metallic [cadmium](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Cadmium) as [electrodes](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrode). Cadmium is a toxic element, and was banned for most uses by the European Union in 2004. Nickel-cadmium batteries have been almost completely superseded by nickel-metal hydride batteries.

[**Nickel-metal hydride battery**](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Nickel-metal_hydride_battery) **(NiMH)**

First developed around 1980's. The battery has a hydrogen-absorbing [alloy](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Alloy) for the negative [electrode](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrode) instead of [cadmium](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Cadmium).

[**Lithium-ion battery**](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Lithium-ion_battery)

The technology behind lithium-ion battery has not yet fully reached maturity. However, the batteries are the type of choice in many consumer electronics and have one of the best [energy-to-mass ratios](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Energy_density) and a very slow [loss of charge](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Loss_of_charge) when not in use. The popularity of lithium-ion batteries has spread as their technology continues to improve.

[**Lithium sulfur battery**](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Lithium_sulfur_battery)

A new battery chemistry developed by [Sion Power](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/w/index.php?title=Sion_Power&action=edit&redlink=1) since 1994. Claims superior energy to weight than current lithium technologies on the market. Also lower material cost may help this product reach the mass market. Not to be confused with [lithium sulfur dioxide (Li-SO2)](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Lithium_battery) batteries which explode when recharged.

[**Thin film battery**](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Thin_film_rechargeable_lithium_battery) **(TFB)**

An emerging refinement of the lithium ion technology by Excellatron. The developers claim a very large increase in recharge cycles, around 40,000 cycles. Higher charge and discharge rates. At least 5C charge rate. Sustained 60C discharge, and 1000C peak discharge rate. And also a significant increase in specific energy, and energy density.

Also Infinite Power Solutions makes thin film batteries (TFB) for micro-electronics applications that are flexible, rechargeable, solid-state lithium batteries.

**Smart battery**

A smart battery has the voltage monitoring circuit built inside. [Smart Battery System](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Smart_Battery_System) Carbon foam-based lead acid battery. Firefly Energy has developed a carbon foam-based lead acid battery with a reported energy density of 30-40% more than their original 38 Wh/kg, with long life and very high power density.

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## RECENT DEVELOPMENTS

In 2007, assistant professor [Yi Cui](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Yi_Cui) and colleagues at [Stanford University](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Stanford_University)'s Department of Materials Science and Engineering discovered that using [silicon](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Silicon) [nanowires](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Nanowire) as the anode increases the volumetric charge density of the anode by up to a factor of 10. See also ‘[Nanowire’ battery](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Nanowire_battery).

Another development is the invention of flexible batteries, which can be made paper-thin. Ceramatec, a research and development subcompany of CoorsTek, is testing a battery which contains a chunk of solid sodium metal mated to a sulfur compound by an extraordinary, paper-thin ceramic membrane. The membrane conducts [ions](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Ions) back and forth to generate a current. The company claims that it can cram about 40 kilowatt hours of energy into a package about the size of a refrigerator, and operate below 90 degrees Celsius. The company also claims that their battery will allow for 3,650 discharge/recharge cycles (or roughly 1 per day for one decade.)

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## ALTERNATIVES

Several alternatives to rechargeable batteries exist or are under development. For uses like portable [radios](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Clockwork_radio) and [flashlights](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Flashlight), rechargeable batteries may be replaced by clockwork mechanisms or [dynamos](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Electrical_generator) which are cranked by the user to provide power. For transportation, [uninterruptible power supply](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Uninterruptible_power_supply) systems and laboratories, [flywheel energy storage](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Flywheel_energy_storage) systems store energy in a spinning rotor for reconversion to electric power when needed; such systems may be used to provide large pulses of power that would otherwise be objectionable on a common electrical grid.

A future development could be [ultracapacitors](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Ultracapacitor) for transportation, using a large capacitor to store energy instead of the rechargeable battery banks used in [hybrid vehicles](mhtml:file://E:\anoop\Battery\Rechargeable%20battery%20-%20Wikipedia,%20the%20free%20encyclopedia.mht!/wiki/Hybrid_vehicles). One drawback to capacitors compared with batteries is that the terminal voltage drops rapidly; a capacitor that has 25% of its initial energy left in it will have one-half of its initial voltage. Battery systems tend to have a terminal voltage that does not decline rapidly until nearly exhausted. This characteristic complicates the design of power electronics for use with ultracapacitors. However, there are potential benefits in cycle efficiency, lifetime, and weight compared with rechargeable systems.

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**4.3 PCB DESIGN**

The PCB design starts right from the selection of the laminates .The two main types of base laminate are epoxy glass and phenolic paper laminates are generally used for simple circuits. Though it is very cheap and can easily be drilled, phenolic paper has poor electrical characteristics and it absorbs more moisture than epoxy glass. Epoxy glass has higher mechanical strength.

The important properties that have to be considered for selecting the PCB substrate are the dielectric strength, insulation resistance, water absorption property, coeff. of thermal expansion, shear strength, hardness, dimensional stability etc.

**4.3.1 PCB Fabrication**

The fabrication of a PCB includes four steps.

1. Preparing the PCB pattern.
2. Transferring the pattern onto the PCB.
3. Developing the PCB.
4. Finishing (i.e.) drilling, cutting, smoothing, turning etc.

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Pattern designing is the primary step in fabricating a PCB. In this step, all interconnection between the components in the given circuit are converted into PCB tracks. Several factors such as positioning the diameter of holes, the area that each component would occupy, the type of end terminal should be considered.

**Transferring the PCB Pattern**

The copper side of the PCB should be thoroughly cleaned with the help of alcoholic spirit or petrol. It must be completely free from dust and other contaminants.

The mirror image of the pattern must be carbon copied and to the laminate the complete pattern may now be made each resistant with the help of paint and thin brush.

##### Developing

In this developing all excessive copper is removed from the board and only the printed pattern is left behind. About 100ml of tap water should be heated to 75 ° C and 30.5 grams of FeCl3 added to it, the mixture should be thoroughly stirred and a few drops of HCl may be added to speed up the process.

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The board with its copper side facing upward should be placed in a flat bottomed plastic tray and the aqueous solution of FeCl2 poured in the etching process would take 40 to 60 min to complete.

After etching the board it should be washed under running water and then held against light .the printed pattern should be clearly visible. The paint should be removed with the help of thinner.

**Finishing Touches**

After the etching is completed, hole of suitable diameter should be drilled, then the PCB may be tin plated using an ordinary 35 Watts soldering rod along with the solder core ,the copper side may be given a coat of varnish to prevent oxidation.

**Drilling**

Drills for PCB use usually come with either a set of collects of various sizes or a 3-Jaw chuck. For accuracy however 3-jaw chunks aren’t brilliant and small drill below 1 mm from grooves in the jaws preventing good grips.

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**Soldering**

Begin the construction by soldering the resistors followed by the capacitors and the LEDs diodes and IC sockets. Don’t try soldering an IC directly unless you trust your skill in soldering. All components should be soldered as shown in the figure. Now connect the switch and then solder/screw if on the PCB using multiple washers or spaces. Soldering it directly will only reduce its height above other components and hamper in its easy fixation in the cabinet. Now connect the battery lead.

**Assembling**

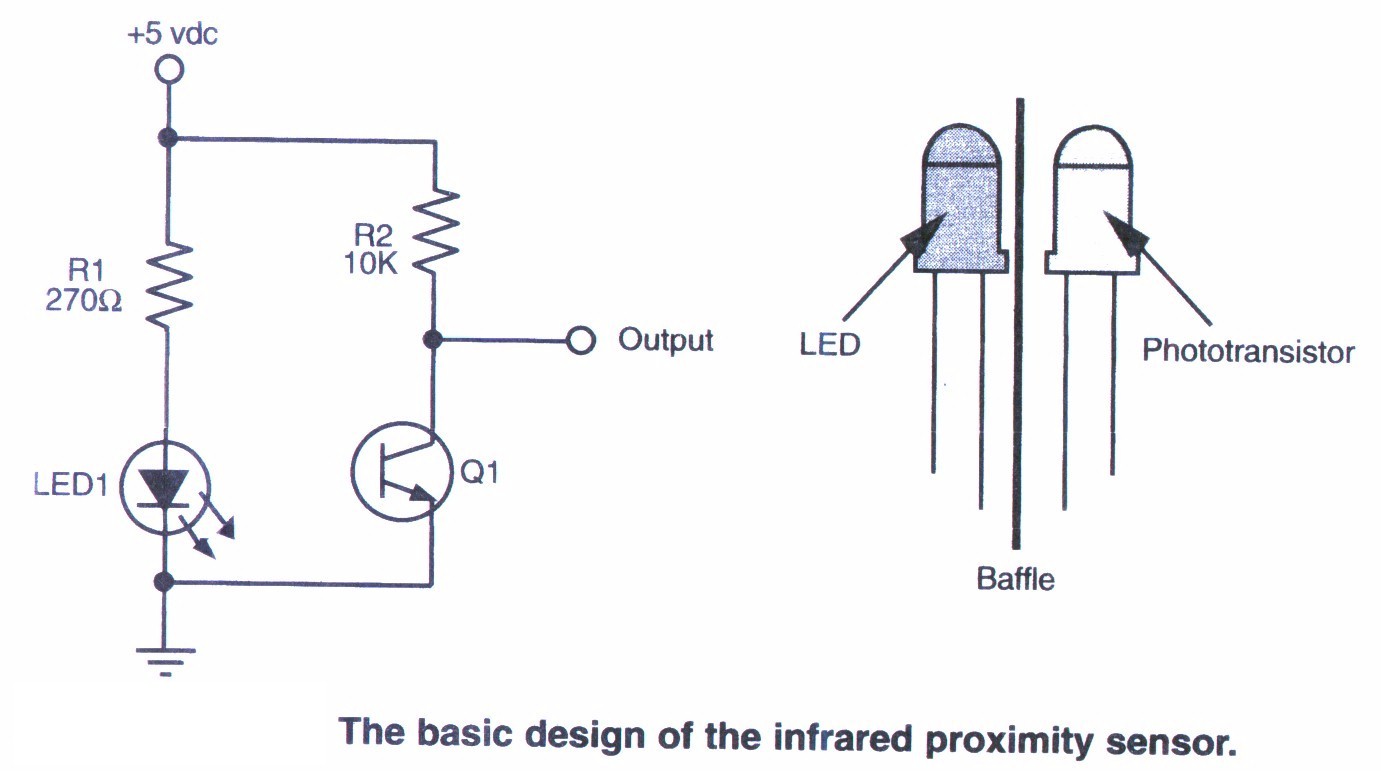
The circuit can be enclosed in any kind of cabinet. Before fitting the PCB suitable holes must be drilled in the cabinet for the switch, LED and buzzer. Note that a rotary switch can be used instead of a slide type.

Switch on the circuit to be desired range. It will automatically start its timing cycles. To be sure that it is working properly watch the LED flash. The components are selected to trigger the alarm a few minutes before the set limit.

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**4.4 IR SENSORS**

Infrared (IR) light is [electromagnetic radiation](http://en.wikipedia.org/wiki/Electromagnetic_radiation) with a [wavelength](http://en.wikipedia.org/wiki/Wavelength) longer than that of [visible light](http://en.wikipedia.org/wiki/Visible_light), measured from the nominal edge of visible [red](http://en.wikipedia.org/wiki/Red) light at 0.7 [micrometers](http://en.wikipedia.org/wiki/Micrometre), and extending conventionally to 300 [micrometers](http://en.wikipedia.org/wiki/Micrometre). These wavelengths correspond to a [frequency range](http://en.wikipedia.org/wiki/Frequency_range) of approximately 430 to 1[THz](http://en.wikipedia.org/wiki/THz),[[1]](http://en.wikipedia.org/wiki/Infrared#cite_note-0) and include most of the [thermal radiation](http://en.wikipedia.org/wiki/Thermal_radiation) emitted by objects near room temperature. Microscopically, IR light is typically emitted or absorbed by molecules when they change their [rotational-vibration](http://en.wikipedia.org/wiki/Infrared_spectroscopy) movements.



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One is an infrared FM transmitter in which audio information is used to modulate the chopping frequency (30 to 250 KHz) of an infrared beam emitted by a set of LEDs.

The transmitter is capable of driving up to 50 to 60 LEDs depending on configuration (Total of 250-300 mA maximum, typically 8 sets of seven series connected IR LEDs) See our article on Infrared Illuminators for more information. This FM method is far superior to ordinary AM methods where the IR beam is amplitude modulated; being less susceptible to stray "noise" from 60 Hz AC operated lamps. The transmitter and receiver can be operated from 12 volt supplies so that eight AA cells can be used as a simple power source, since only 50 ma is needed. The transmitter kit contains two IR LEDs, which is sufficient for many applications

The receiver unit consists of a IR sensitive photodiode detector and a special FM receiver with a nominal frequency range of 30 to 250 kHz, having a sensitivity of around one microvolt. A phase locked loop (PLL) detector recovers the audio and feeds it to an audio power amplifier with up to 500 milliwatts of audio output. Audio quality is excellent. Range is up to 100 feet without optics, a few hundred feet with simple lenses and with suitable optics such as parabolic mirrors and telescopes, ranges up to a few miles are possible.

It contains PC boards and all parts that are needed to complete one transmitter and one receiver. Two may be used if two channels are needed for stereo. Applications include wireless audio links, private listening devices for TV and radio, IR communications links, fiber optic and infrared experiments, and other experiments with infrared and optics. Since no radio signals are involved, no FCC licensing is necessary.

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**CHAPTER 5**

**VIEW THROUGH CAMERA**

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Photo

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**CHAPTER 6**

**ADVANTAGES**

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**ADVANTAGES**

* + Less manpower is needed
  + Implementation is easy
  + Fabrication coast is less
  + User friendly

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**CHAPTER 7**

**APPLICATION**

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**APPLICATION**

* + It can be used in industries
  + It can be used in libraries

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**CHAPTER 8**

**CONCLUSION**

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**CONCLUSION**

We have designed and fabricated a robotic trolley for material handling in industries. With the help this trolley one can move tools from one place to another or from one user to another. This is done with the help of a sensor and a motor.

We have carried much confidence in doing this project successfully. We have learn about analysis of a problem, how to solve it, design of the trolley, design of parts ,fabrication of parts, material purchase, assembling of parts and successful testing robotic trolley.

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**CHAPTER 9**

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